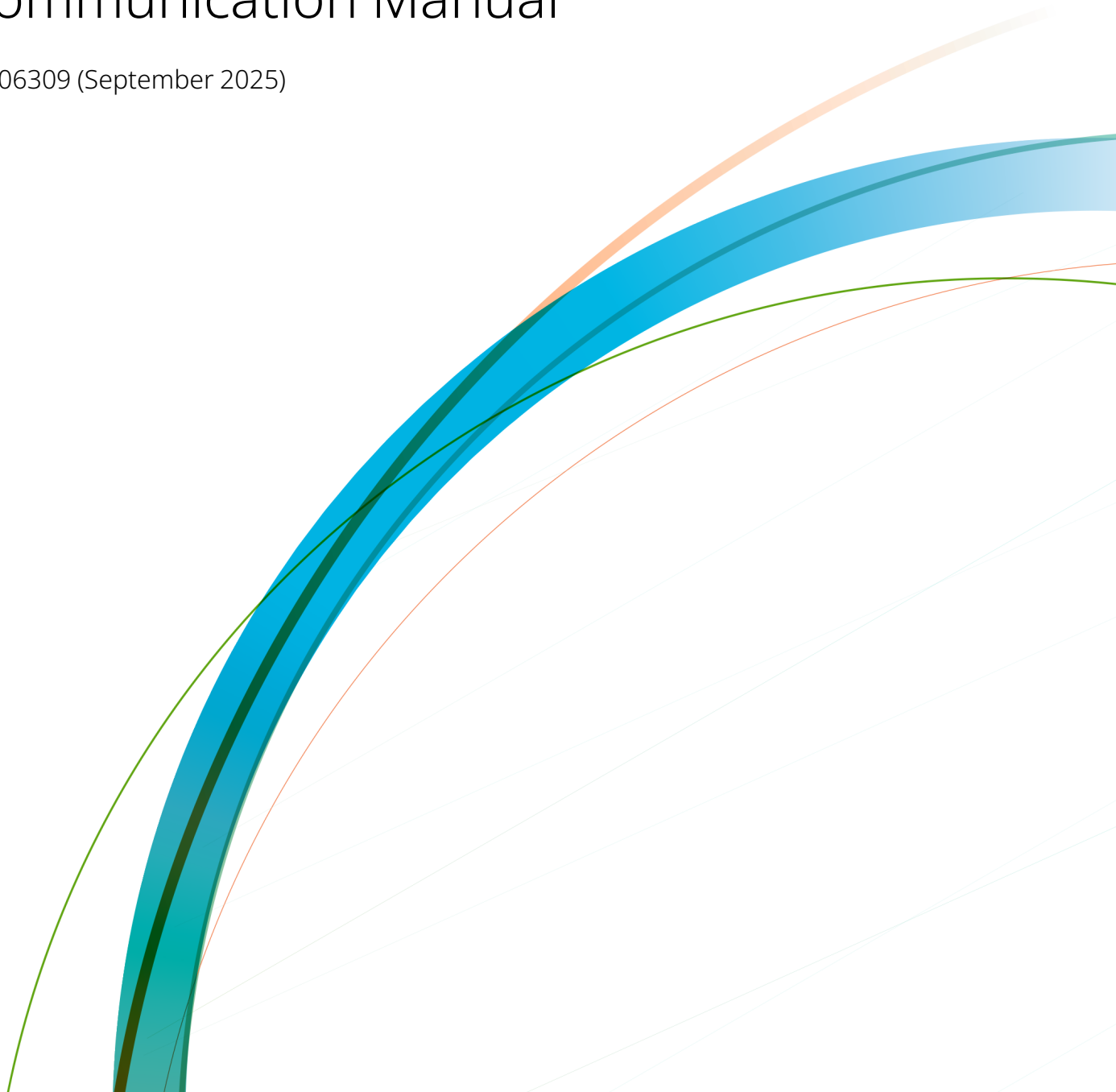
GUIDANT

Fusion4

Communication Manual

MN06309 (September 2025)



Important

All information and technical specifications in this document have been carefully checked and compiled by the author; however, we cannot completely exclude the possibility of errors. Guidant Measurement is always grateful to be informed of any errors; contact us at TechnicalCommunications@GuidantMeasurement.com.

Caution

The default or operating values used in this document and in the configuration parameters of the product described in this document are for factory testing only and should not be construed as default or operating values for your system. Each system is unique and each configuration parameter must be reviewed and programmed for that specific system application.

Disclaimer

Guidant hereby disclaims all responsibility for damages, including but not included to consequential damages arising out of or related to the inputting of incorrect or improper program or default values entered in connection with the product described in this document.

Technical Support

Field Service Response Center

24/7 Technical Support/Schedule a Technician: +1 844.203.4014
System installation supervision, startup, and commissioning services are available.

Customer Support

Erie Customer Service

Guidant Measurement
1602 Wagner Avenue
Erie, PA 16510 USA
+1 814.898.5000
MS.ResponseCenter@GuidantMeasurement.com

Ellerbek Customer Service

Guidant Measurement
Smith Meter GmbH
Regentstrasse 1 25474 Ellerbek, Germany
P.O. Box 1164 25470 Ellerbek, Germany
+49 4101 304-0
ResponseCenter.MS@GuidantMeasurement.com

Guidant Knowledge Base

KB.GuidantMeasurement.com

Contents

1 General 1
1.1 Introduction 1
1.2 Target audience 1
2 Safety 2
2.1 Safety Conventions 2
2.1.1 Warnings 2
2.1.2 Cautions 2
2.2 Liability 2
3 Fusion4 System Overview 4
3.1 Fusion4 Portal 5
3.1.1 Description 5
3.1.2 Principle of operation 5
3.1.3 Communications 6
3.2 Fusion4 Single-Stream Controller for Additive Injection 7
3.2.1 General 7
3.2.2 Principle of operation 7
3.2.3 Communications 8
3.3 Fusion4 Single Stream Controller for Blending 9
3.3.1 General 9
3.3.2 Principle of operation 9
3.3.3 Communications 9

3.4 Fusion4 Multi-Stream Controller for Additive Injection 10
3.4.1 General 10
3.4.2 Principle of operation 11
3.4.3 Communications 11
3.5 Fusion4 Multi-Stream Controller for Loading 13
3.5.1 General 13
3.5.2 Communications 13

4 RS-485 Communications 15

4.1 Characteristics 16
4.2 Cable specifications 16

5 Smith Meter AccuLoad Protocol 17

5.1 Fusion4 SSC-A, Fusion4 SSC-B and Fusion4 MSC-A 17
5.1.1 Description 17
5.1.1.1 Text field format 18
5.1.1.2 Broadcast commands 19
5.1.1.3 Command Identifier Prefixes 19
5.1.1.3.1 RV - Read Value 19
5.1.1.3.2 WV - Write Value 20
5.1.1.3.3 EX - Execute Task 20
5.1.1.4 Error Codes 21
5.1.1.5 Examples 22
5.1.2 Fusion4 SSC-A 23
5.1.3 Fusion4 SSC-B 27
5.1.4 Fusion4 MSC-A 34
5.2 Fusion4 MSC-L 38
5.2.1 Description 38
5.2.1.1 Communications for Terminal Mode of Operation 39
5.2.1.2 Communications for Minicomputer Mode of Operation 40
5.2.2 Configuring AccuLoad Emulation functionality on the Fusion4 MSC-L 40

5.2.3 Fusion4 MSC-L Product Numbering 41
5.2.4 Commands 42
5.2.4.1 AB - Allocate Blend Recipes 42
5.2.4.1.1 AB - Allocate Blend Recipes Command: Character 1 43
5.2.4.1.2 AB - Allocate Blend Recipes Command: Character 2 43
5.2.4.1.3 AB - Allocate Blend Recipes Command: Character 3 44
5.2.4.1.4 AB - Allocate Blend Recipes Command: Character 4 45
5.2.4.1.5 AB - Allocate Blend Recipes Command: Character 5 46
5.2.4.1.6 AB - Allocate Blend Recipes Command: Character 6 46
5.2.4.1.7 AB - Allocate Blend Recipes: Character 7 47
5.2.4.1.8 AB - Allocate Blend Recipes: Character 8 48
5.2.4.1.9 Allocate Blend Recipes: Character 9 49
5.2.4.1.10 AB - Allocate Blend Recipes: Character 11 50
5.2.4.1.11 AB - Allocate Blend Recipes: Character 12 51
5.2.4.1.12 AB - Allocate Blend Recipes: Character 13 51
5.2.4.2 AR - Alarm Reset 52
5.2.4.2.1 System Alarms That Can Be Reset Through Communications 54
5.2.4.2.2 Injector Alarms That Can Be Reset Through Communications 54
5.2.4.2.3 Arm Alarms That Can Be Reset Through Communications 55
5.2.4.2.4 Meter Alarms That Can Be Reset Through Communications 56
5.2.4.2.5 Product Alarms That Can Be Reset Through Communications 56
5.2.4.3 AV - Request Additive Volumes by Batch 57
5.2.4.4 BA - Bay Assignment 60
5.2.4.5 DY - Request Dynamic Display Values 60
5.2.4.5.1 DY_SYXX - System Dynamic Display Values 62
5.2.4.5.2 DY_INXX - Injector Dynamic Display Values 64
5.2.4.5.3 DY_PNXX - Product Dynamic Display Values 66
5.2.4.5.4 DY_DDXX - Recipe Dynamic Display Values 68
5.2.4.5.5 DY_BNXX - Batch Dynamic Display Values 68
5.2.4.6 Command Code EA - Enquire Alarms 71
5.2.4.6.1 Response to EA_SY command: Characters A1 and A2 72

5.2.4.6.2 Response to EA_SY command: Character A3 72
5.2.4.6.3 Response to EA_SY command: Character A4 73
5.2.4.6.4 Response to EA_SY command: Character A5 74
5.2.4.6.5 Response to EA_SY command: Character A6 75
5.2.4.6.6 Response to EA_SY command: Characters A7 to A9 76
5.2.4.6.7 Response to EA_SY command: Character A10 76
5.2.4.6.8 Response to EA_Px command: Character A1 77
5.2.4.6.9 Response to EA_Px command: Character A2 78
5.2.4.6.10 Response to EA_Px command: Character A3 79
5.2.4.6.11 Response to EA_Px command: Character A4 80
5.2.4.6.12 Response to EA_AR command: Character A1 81
5.2.4.6.13 Response to EA_AR command: Character A2 82
5.2.4.6.14 Response to EA_AR command: Character A3 83
5.2.4.6.15 Response to EA_IN command: Characters A1 to A12 84
5.2.4.6.16 Response to EA_IN command: Character A13 84
5.2.4.6.17 Response to EA_IN command: Character A14 85
5.2.4.6.18 Response to EA_IN command: Character A15 86
5.2.4.6.19 Response to EA_IN command: Character A16 87
5.2.4.6.20 Response to EA_IN command: Character A17 87
5.2.4.6.21 Response to EA_IN command: Character A18 88
5.2.4.6.22 Response to EA_IN command: Characters A19 to A24 89
5.2.4.6.23 Response to EA_IN command: Character A25 89
5.2.4.6.24 Response to EA_IN command: Character A26 90
5.2.4.6.25 Response to EA_IN command: Character A27 91
5.2.4.6.26 Response to EA_IN command: Character A28 91
5.2.4.6.27 Response to EA_IN command: Character A29 92
5.2.4.6.28 Response to EA_IN command: Character A30 93
5.2.4.6.29 Response to EA_IN command: Characters A31 to A42 94
5.2.4.6.30 Response to EA_IN command: Character A43 94
5.2.4.6.31 Response to EA_IN command: Character A44 95
5.2.4.6.32 Response to EA_IN command: Character A45 96

5.2.4.6.33 Response to EA_IN command: Character A46 97
5.2.4.6.34 Response to EA_IN command: Character A47 97
5.2.4.6.35 Response to EA_IN command: Character A48 98
5.2.4.6.36 Response to EA_IN command: Characters A49 to A66 99
5.2.4.6.37 Response to EA_IN command: Character A67 99
5.2.4.6.38 Response to EA_IN command: Character A68 100
5.2.4.6.39 Response to EA_IN command: Character A69 101
5.2.4.6.40 Response to EA_IN command: Character A70 102
5.2.4.6.41 Response to EA_IN command: Character A71 to A77 103
5.2.4.6.42 Response to EA_Mx command: Character A1 103
5.2.4.6.43 Response to EA_Mx command: Character A2 104
5.2.4.6.44 Response to EA_Mx command: Characters A3 and A4 104
5.2.4.6.45 Response to EA_RR command: Character A1 105
5.2.4.7 EB - End Batch 105
5.2.4.8 EQ - Enquire Status 106
5.2.4.8.1 Response to EQ command: Character A1 107
5.2.4.8.2 Response to EQ command: Character A2 107
5.2.4.8.3 Response to EQ command: Character A3 108
5.2.4.8.4 Response to EQ command: Character A4 109
5.2.4.8.5 Response to EQ command: Character A5 110
5.2.4.8.6 Response to EQ command: Character A6 111
5.2.4.8.7 Response to EQ command: Character A7 112
5.2.4.8.8 Response to EQ command: Character A8 113
5.2.4.8.9 Response to EQ command: Characters A9 to A16 114
5.2.4.9 ET - End Transaction 114
5.2.4.10 GD - Get Date and Time 114
5.2.4.11 LD - Request Load Average Density 115
5.2.4.12 LP - Request Load Average Pressure 117
5.2.4.13 LT - Request Load Average Temperature 118
5.2.4.14 MP - Minimum Preset 120
5.2.4.15 RB - Request Batch Totals 121

5.2.4.15.1 Additive selection code: Character A1 124
5.2.4.15.2 Additive selection code: Character A2 125
5.2.4.15.3 Additive selection code: Character A3 126
5.2.4.15.4 Additive selection code: Character A4 127
5.2.4.15.5 Additive selection code: Character A5 128
5.2.4.15.6 Additive selection code: Character A6 128
5.2.4.16 RE - Reset Status Conditions 129
5.2.4.16.1 Valid status codes for RE - Reset Status Conditions command 130
5.2.4.17 RK - Read Keyboard 130
5.2.4.18 RR - Request Recipe 132
5.2.4.19 SA - Remote Start 132
5.2.4.20 SB - Set Batch 133
5.2.4.21 SD - Set Date and Time 134
5.2.4.22 SF - Authorize and Set Batch without override 135
5.2.4.23 SP - Remote Stop 136
5.2.4.24 ST - Remote Stop on Arm 136
5.2.4.25 TN - Show Transaction Stop Date and Time 137
5.2.4.26 VT - Request Meter Totalizer Data 138
5.2.4.27 WA - Write Second Line of Message to Appear on Display 141
5.2.4.28 WB - Write Third Line of Message to Appear on Display 142
5.2.4.29 WC - Write Fourth Line of Message to Appear on Display 144
5.2.4.30 WD - Write to Display 146
5.2.4.31 WX - Write to the Display in Security Mode 148

6 Brooks Petrocount Protocol 151

6.1 Description 151
6.1.1 Text Field Format 152
6.1.2 Broadcast Commands 152
6.1.3 Command Identifier Prefixes 153
6.1.3.1 R - Read Value 153
6.1.3.2 W - Write a Value with Return Data Acknowledge 153

6.1.3.3 A - Write a Value with ACK Acknowledge 154
6.1.3.4 B - Write a Value with No Response 154
6.1.3.5 X - Execute a Task in the Fusion4 Controller 155
6.1.4 Error Messages 155
6.1.5 Examples 156
6.2 Fusion4 SSC-A 158
6.3 Fusion4 SSC-B 161

7 Modbus Protocols 170

7.1 General 170
7.1.1 Modbus RTU 170
7.1.1.1 Unicast mode 171
7.1.1.2 Broadcast mode 171
7.1.1.3 Message format 171
7.1.1.3.1 Function code 03 (0x03): Read Holding Registers 173
7.1.1.3.2 Function code 06 (0x06): Write Single Holding Register 175
7.1.1.3.3 Function code 16 (0x10): Write Multiple Registers 176
7.1.1.4 Exception Responses 177
7.1.1.5 Executing a Task 180
7.1.2 Modbus Legacy 181
7.1.2.1 Read and Write Commands 181
7.1.2.1.1 Read a Parameter (Command Code - 03h) 181
7.1.2.1.2 Write a Parameter (Command Code - 10h) 182
7.1.2.2 Executing a Task 182
7.1.2.2.1 Execute a Task via Modus Function Code 10h 183
7.1.2.2.2 Execute a Task via Modbus Function Code 06h 183
7.2 Modbus Legacy Protocol 185
7.2.1 Fusion4 SSC-A 185
7.2.1.1 Definition of Fusion4 SSC-A Volume Parameters 189
7.2.2 Fusion4 SSC-B 191
7.2.2.1 Definition of Fusion4 SSC-B Volume Parameters 198

7.2.3 Fusion4 MSC-A 199
7.2.3.1 Definition of Fusion4 MSC-A Volume Parameters 204
7.3 Modbus RTU Protocol 205
7.3.1 Fusion4 SSC-A 205
7.3.1.1 Fusion4 SSC-A Modbus RTU Block 209
7.3.2 Fusion4 SSC-B 212
7.3.2.1 Fusion4 SSC-B Modbus RTU Block 221
7.3.3 Fusion4 MSC-A 225
7.3.3.1 Fusion4 MSC-A Modbus RTU | TCP/IP Block 230
7.3.4 Modbus RTU | TCP/IP register maps for Fusion4 MSC-L 233
7.3.4.1 Fusion4 MSC-L Device Modbus register map 235
7.3.4.1.1 Fusion4 MSC-L Device Modbus register map - Arm Card submap 252
7.3.4.1.2 Fusion4 MSC-L Device Modbus register map: I/O Card submap 256
7.3.4.1.3 Fusion4 MSC-L Device Modbus register map: Bay submap 260
7.3.4.1.4 Fusion4 MSC-L Device Modbus register map: Batch/Arm submap 263
7.3.4.2 Fusion4 MSC-L Arm Modbus register map 264
7.3.4.2.1 Fusion4 MSC-L Arm Modbus register map - Product submap 269
7.3.4.2.2 Fusion4 MSC-L Arm Modbus register map - Additive submap 281
7.3.4.2.3 Fusion4 MSC-L Arm Modbus register map - External Additive submap 286
7.3.4.3 Fusion4 MSC-L Device Modbus register map – Optimized map 289
7.3.5 Fusion4 MSC-L Universal Data Interface 300
7.3.5.1 UDI Read/Write Procedures 300
7.3.5.1.1 UDI Read Procedure (All or Indexed) 300
7.3.5.1.2 UDI Write Procedure (All or Indexed) 301
7.3.5.2 UDI State 303
7.3.5.3 Examples 304
7.3.5.3.1 Example 1: Show prompt data 304
7.3.5.3.2 Get last user response for bay 1 304
7.3.5.3.3 Set Recipe 1 for Arm 1 304
7.3.5.3.4 Set batch details for bay 1 304
7.3.5.3.5 Get last batch record for arm 3 305

7.4 MSC-L Modbus Application Interface 306
7.4.1 Function Details 306
7.4.1.1 F4 Portal Scan Registers 306
7.4.1.1.1 F4 Portal Scan Registers [Index 0] – Alarm Status Interface 309
7.4.1.1.2 F4 Portal Scan Registers [Index 1] – Alarm Log Interface 310
7.4.1.1.3 F4 Portal Scan Registers [Index 2] – Transaction Interface 311
7.4.1.1.4 F4 Portal Scan Registers [Index 3] – Preset Loader Interface 312
7.4.1.1.5 F4 Portal Scan Registers [Index 4] – Last Transaction ID Bay 1 315
7.4.1.1.6 F4 Portal Scan Registers [Index 5] – Last Transaction ID Bay 2 315
7.4.1.1.7 F4 Portal Scan Registers [Index 6] – Loading Arm State 315
7.4.1.1.8 F4 Portal Scan Registers [Index 7] – Alarm Log Index 316
7.4.1.1.9 F4 Portal Scan Registers [Index 8] – Event Log Index 316
7.4.1.1.10 F4 Portal Scan Registers [Index 9] – Calibration Log Index 316
7.4.1.1.11 F4 Portal Scan Registers [Index 10] – Batch State 316
7.4.1.1.12 F4 Portal Scan Registers [Index 11] – Batch Evaluation State 317
7.4.1.1.13 F4 Portal Scan Registers [Index 12] – Number of Batches 317
7.4.1.1.14 F4 Portal Scan Registers [Index 13] – Display State 318
7.4.1.1.15 F4 Portal Scan Registers [Index 14] – Last Transaction Parked 319
7.4.1.1.16 F4 Portal Scan Registers [Index 15] – Transaction State 320
7.4.1.2 Arm State Details 320
7.4.1.3 Last User Response 323
7.4.1.4 Last User Answer 325
7.4.1.5 Show Prompt 326
7.4.1.6 Show Internal Prompt 337
7.4.1.7 Show TAS Prompt 337
7.4.1.8 Bay 1 Batch Details 340
7.4.1.9 Bay 2 Batch Details 342
7.4.1.10 Transaction Workflow Mode 342
7.4.1.11 Restore TAS Control 343
7.4.1.12 Close Screen 345
7.4.1.13 Arm Command 345

7.4.1.14 Bay Command 347
7.4.1.15 Plan Init Start Batch V2 348
7.4.1.16 Batch Static Info 348
7.4.1.17 Dynamic Batch Info 349
7.4.1.18 Permissives Connected 349
7.4.1.19 Generic Record 349
7.4.1.20 Arm Current State 350
7.4.1.21 Authorization Interface 352
7.4.1.21.1 Authorization Database Update 352
7.4.1.21.2 Login Remotely Authorized User 353
7.4.1.22 Read and Update Date and Time 355
7.4.2 Remote Loading Use Case 356
7.4.2.1 Prerequisites 356
7.4.2.2 Workflow Sequence 356
7.4.2.2.1 Read F4 Portal Scan Register 356
7.4.2.2.2 Restore TAS Control 358
7.4.2.2.3 Attach Permissive 359
7.4.2.2.4 Clear Screen 361
7.4.2.2.5 Read Access Card 361
7.4.2.2.6 Display Message 365
7.4.2.2.7 Remote Authorized 369
7.4.2.2.8 Write Truck Number 369
7.4.2.2.9 Plan Init Start batch 372
7.4.2.2.10 Read Batch Static Info 377
7.4.2.2.11 Read Batch Dynamic Info 378
7.4.2.2.12 Remote stop/pause loading arm 378
7.4.2.2.13 End Transaction 380
7.4.3 Retrieve Transaction Record 381
7.4.3.1 Retrieve MSC-L Standard Transaction Record 382
7.4.3.1.1 Check Unprocessed Transactions Available 382
7.4.3.1.2 Read Unprocessed Transaction 383

7.4.3.1.3 Transaction record details 385
7.4.3.1.4 Batch record 388
7.4.3.1.5 Product stream record 391
7.4.3.1.6 Enumerations used 397
7.4.3.1.7 Mark Transaction as Processed 399
7.4.3.2 1010 Emulation Transaction and Batch Record 400
7.4.4 Retrieve Stored Records 406
7.4.4.1 Reading transaction Record 407
7.4.4.2 Reading Batch Record 408
7.4.4.3 Reading Alarm logs 409
7.4.5 Alarm Interface 412
7.4.5.1 Alarm Table construction: 413
7.4.5.2 Active Alarms 415
7.4.5.3 Detecting Alarm Status Change 416
7.4.5.4 Acknowledge alarm and reset alarm 416
7.4.5.5 Active alarm bitmask 416
7.4.5.6 Active Alarms Reset: 428
7.4.6 Instantaneous Values 433
7.4.6.1 Instantaneous Values Configuration State 433
7.4.6.2 Instantaneous Process Variables 434
7.4.6.3 Stream Dynamic Info 439
7.4.7 Digital IO State 439
7.4.7.1 Arm Board Digital IO State 439
7.4.7.2 In-Out Board Digital IO State 440
7.4.8 Update Authorization Database 445
7.4.8.1 User Database 445
7.4.8.2 Object Database 446

8 Serial Line Internet Protocol (SLIP+) 448

8.1 Description 448
8.1.1 Address Byte 448

8.1.2 Control Byte 449
8.1.3 Information Field 449
8.1.4 Longitudinal Redundancy Checksum Byte 450
8.2 Fusion4 MSC-A 451
8.2.1 Commands 451
8.2.1.1 Query Commands 451
8.2.1.2 Commands for Changing Values 452
8.3 Fusion4 MSC-L 453
8.3.1 1010CB 454
8.3.2 1010CJ 454
8.3.3 1010BJ 454
8.3.3.1 AA - Alter Arm Name 458
8.3.3.2 AI - Additive Injectors 459
8.3.3.3 AN - Accumulated Net Totals 460
8.3.3.4 AN - Net Accumulated Totals 461
8.3.3.5 AP - Additive Parameters 462
8.3.3.6 AR - Additive Recipes 465
8.3.3.7 AS - Arm Settings 470
8.3.3.8 AT - Accumulated Totals 472
8.3.3.9 AV - Application Version 473
8.3.3.10 BT - Batch Totals 474
8.3.3.11 CA - Control Arm 476
8.3.3.12 CC - Clear Power Cycle 477
8.3.3.13 CM - Clear Message 478
8.3.3.14 CP - Set or Clear PIN Numbers 478
8.3.3.15 DM - Display Message 479
8.3.3.16 DN - Set Arm Density 481
8.3.3.17 DP - Display Prompt 482
8.3.3.18 ENQ - Operational State Enquiry 485
8.3.3.18.1 Command Fields 488
8.3.3.18.2 System Status Byte 489

8.3.3.18.3 Arm Status Byte (applies to all arm status bytes) 489
8.3.3.18.4 Operator Answer 490
8.3.3.19 FR - Flow Rates 490
8.3.3.20 GA - Get Answer 491
8.3.3.21 GD - Get Date and Time 493
8.3.3.22 GH - Get Hidden 494
8.3.3.23 GT - Gross Totals 496
8.3.3.24 IA - Injector Accumulative Totals 497
8.3.3.25 IT - Instantaneous Temperatures 498
8.3.3.26 LT - Last Load Temperatures 499
8.3.3.27 MI - Message Initial 500
8.3.3.28 MR - Manager Reset 501
8.3.3.29 NT - Net Totals 502
8.3.3.30 OP - Option Settings 503
8.3.3.31 PD - Power Cycle Date and Time 505
8.3.3.32 PR - Presets 505
8.3.3.33 RA - Remote Authorise 506
8.3.3.34 RC - Compartment Response 507
8.3.3.35 RD - Reset Date and Time 509
8.3.3.36 RL - Load Number Response 510
8.3.3.37 SA - Send Answer 511
8.3.3.38 SM - Stop Arm 511
8.3.3.39 SO - System Options 512
8.3.3.40 ST - Send Transaction 514
8.3.3.41 SV - Software Version 517
8.3.3.42 SY - Send Entry (Batch) 517
8.3.3.43 TC - Transaction Complete 520
8.3.3.44 TT - Terminate Transaction 520
8.3.3.45 VA - Valve Settings and Calibration 521
8.3.3.46 Error Status Code 523
8.3.4 1010RD 523

8.3.4.1 AS - Arm Settings 524
8.3.4.2 AT - Accumulated Totals 528
8.3.4.3 CM - Clear Message 529
8.3.4.4 DM - Display Message 529
8.3.4.5 DN - Send Density 530
8.3.4.6 ENQ - Operational State Enquiry 531
8.3.4.7 FR - Flow Rate 534
8.3.4.8 GT - Gross Total 534
8.3.4.9 IT - Instantaneous Temperature 535
8.3.4.10 MO - Set Option Parameters 536
8.3.4.11 OP - Returns Settings of Options 538
8.3.4.12 PA - Set Arm Parameters 540
8.3.4.13 PR - Preset 540
8.3.4.14 RD - Reset Date and Time 541
8.3.4.15 RL – Load number response 542
8.3.4.16 SA - Send Answer 542
8.3.4.17 SO - System Options 543
8.3.4.18 ST - Send Transaction 544
8.3.4.19 SY - Send Entry 546
8.3.4.20 VA - Valve Settings 548
8.3.4.21 VE - Set valve parameters 550
8.4 Byte Testing 552
8.4.1 Description 552
8.4.2 3.2 Byte Testing 552

9 FlexConn Protocol 556

10 RS-485 Wiring for Fusion4 SSC-A/SSC-B 557

10.1 Introduction 557
10.2 Fusion4 SSC-A and SSC-B Serial Connectivity 558
10.2.1 CAN-ADD-BLEND Board 558

10.2.1.1 2- Wire Half-Duplex RS-485 Connection 558
10.2.1.2 4-Wire Full-Duplex RS-485 Connection 559
10.2.1.3 4-Wire Full-Duplex RS-422 Connection 561
10.2.2 CAN-OPTION-SSC Board 562
10.3 Connecting Fusion4 SSC-A/SSC-B to MSC-L 563
10.4 Connecting Fusion4 SSC-A/SSC-B to 1010 B-Series 563
10.5 Connecting Fusion4 SSC-A/SSC-B to 1010 C-Series 565
10.6 Connecting Fusion4 SSC-A/SSC-B to Portal 566
10.6.1 RS-232 to RS-422/485 Converter 567
10.6.2 RS-485 Serial Connection 568
10.6.3 Serial Device Server 568
10.7 Connecting Fusion4 SSC-A/SSC-B to Experion 569

11 RS-485 Wiring for Fusion4 MSC-A/MSC-L 570

11.1 Fusion4 MSC-A / Fusion4 MSC-L Serial Connectivity 570
11.1.1 CAN-ARM-MSC-1 Board 571
11.1.2 CAN-ARM-MSC-2 Board 572
11.1.3 CAN-HMI-MSC Board 573
11.1.3.1 CAN-HMI-MSC Board: Connector CN-150 573
11.1.3.2 CAN-HMI-MSC Board: Connector CN-151 574
11.1.3.2.1 4-Wire Full-Duplex RS-485 Connection 575
11.1.3.2.2 4-Wire Full-Duplex RS-422 Connection 576
11.1.4 Connecting Fusion4 MSC-A to Fusion4 MSC-L 577
11.1.5 Connecting Fusion4 MSC-A to 1010 B-series load computer 578
11.1.6 Connecting Fusion4 MSC-A to 1010 C-series load computer 580
11.1.7 Connecting Fusion4 MSC-A / Fusion4 MSC-L to Fusion4 Portal 581
11.1.7.1 RS-232 to RS-422/485 converter 582
11.1.7.2 RS-485 serial connection 582
11.1.7.3 Serial device server 584
11.1.8 Connecting Fusion4 MSC-A to Experion® 585
11.1.9 Connecting Fusion4 MSC-L to Terminal Manager 585

12 Ethernet Communications 586
12.1 Modbus TCP/IP Protocol 586
12.1.1 Protocol Description 587
12.1.1.1 Modbus On TCP/IP Application Data Unit 587
12.1.1.2 MBAP Header description 588
12.1.1.3 Modbus Functions Codes Description 589
12.2 Fusion4 MSC-A / MSC-L 589
12.2.1 Connecting Fusion4 MSC-A / MSC-L to Ethernet Network 589
12.2.2 CAN-ARM-MSC-1 Board 590
12.2.3 CAN-ARM-MSC-2 Board 591
12.2.4 CAN-HMI-MSC Board: 592
12.2.5 Connecting Fusion4 MSC-A to MSC-L over Ethernet 593
12.2.6 Connecting Fusion4 MSC-A / MSC-L to Fusion4 Portal over Ethernet 593
12.2.7 Connecting Fusion4 MSC-A / MSC-L to Experion over Ethernet 594
12.2.8 Connecting Fusion4 MSC-L to Terminal manager over Ethernet 594

13 Portal OPC 595
13.1 Introduction 595
13.1.1 Available licenses for OPC Clients 596
13.1.2 DCOM Configuration 597
13.1.2.1 Windows Fire Wall Setting 597
13.1.2.2 User Accounts 597
13.1.2.3 DCOM Machine Default Settings 597
13.1.3 Prerequisites for OPC Client Machine 604
13.1.3.1 OPC Core Components 604
13.1.3.2 Check Logon Permission between Client and Server 605
13.1.4 Prerequisites for Visual Basic OPC Client Machine 605
13.1.5 TAS/OPC acquiring Information from Fusion4 OPC Server 605
13.1.5.1 Setting Type of TAS Status for Site 605
13.1.5.2 COM Port Settings and Refresh Rate 607
13.1.6 OPC Value, Quality and Timestamp Properties 607

13.1.7 Subscription 608
13.1.8 Sales Codes 617
13.1.9 Engineering Units 619
13.2 Communication 621
13.2.1 Checking TAS Status 621
13.2.2 Checking Device Communications Status 622
13.2.2.1 Stopping and Restarting Scanning on Device 623
13.2.3 Checking Health of Fusion4 OPC Server 623
13.2.4 Handshaking between Client and Fusion4 OPC Server 623
13.3 Loading Workflow Support for TAS System 624
13.3.1 About Loading Workflow Support 624
13.3.2 Example of Workflow 624
13.3.3 Loading States - ENQ 626
13.3.4 Remote Authorisation State - RA 628
13.3.5 Remote Load Authorisation State - RL 630
13.3.6 Allocate Recipe State - AR 632
13.3.6.1 Option 1 632
13.3.6.2 Option 2 633
13.3.6.3 Option 3 634
13.3.7 Remote Compartment Authorisation State - RC 636
13.3.8 Batch Loading State - IV 637
13.3.9 Batch Loading Completed - BT 640
13.3.10 Authorizing Transaction Complete from TAS/ OPC client 645
13.3.10.1 Settling Transaction- TS 646
13.4 TAS/OPC Client Commands 647
13.4.1 Internal Additive Injectors - AD 647
13.4.1.1 Option 1 647
13.4.1.2 Option 2 650
13.4.1.3 Option 3 652
13.4.2 External Additive Injectors - AI 653
13.4.2.1 Type and Number of Injection Points 654

13.4.2.2 Specific External Additive Injector Settings 654
13.4.3 Arm Status - AM 655
13.4.4 Arm Settings - AS 656
13.4.4.1 Option 1 657
13.4.4.2 Option 2 658
13.4.5 Application Version - AV 660
13.4.6 Blend/Additive Recipes - BR 661
13.4.6.1 Option 1 - Uploading Additive/Blend Recipe to Computer 661
13.4.6.2 Option 2 - Downloading Additive/Blend Recipe to Device 663
13.4.7 Clear Power Cycle - CC 665
13.4.8 Clear General Purpose Input Latches - CL 666
13.4.9 Communication Settings - CO 668
13.4.9.1 Option 1 - Retrieving the General Communications Settings 669
13.4.9.2 Option 2 - Communication Port Settings 670
13.4.10 Correction Settings - CS 672
13.4.10.1 Option 1 673
13.4.10.1.1 Commodity Types 674
13.4.10.1.2 Density Correction 674
13.4.10.1.3 Volume Correction 675
13.4.10.2 Option 2 675
13.4.10.3 Option 3 676
13.4.10.4 Option 4 677
13.4.10.5 Option 5 678
13.4.11 Set Meter Density - DN 679
13.4.12 Get Date and Time - GD 680
13.4.13 General Purpose Inputs - GI 681
13.4.14 General Purpose Outputs - GO 683
13.4.15 Injector Accumulative Total - IA 687
13.4.15.1 Option 1 688
13.4.15.2 Option 2 688
13.4.16 General Purpose Input Status - IS 689

13.4.17 Loading Arm Information - LA 702
13.4.18 Alter Meter Name - MN 703
13.4.19 Manager Reset - MR 704
13.4.20 Flow Meter Settings - MS 704
13.4.21 Preset - PR 707
13.4.21.1 Option 1 - Minimum Preset for All Loading Arms 707
13.4.21.2 Option 2 - Minimum Preset for Flow Meter 708
13.4.22 Reset Date and Time - RD 709
13.4.23 Set RIT Lamps - SL 710
13.4.24 Stop Arm - SM 711
13.4.25 System Options - SO 712
13.4.26 Send Transaction - ST 713
13.4.27 Software Version - SV 715
13.4.28 Send Batch - SY 716
13.4.28.1 Option 1 716
13.4.28.2 Option 2 718
13.4.28.3 Option 3 720
13.4.28.4 Option 4 722
13.4.29 Type of Loading Arm - TA 723
13.4.30 Blend Target and Ratio - TB 724
13.4.31 Actual and Current Target Flow - TF 725
13.4.31.1 Actual and Current Target Flow for All Loading Arms 725
13.4.31.2 Actual and Current Target Flow for Particular Flow Meter 726
13.4.32 Type of Instrument - TI 727
13.4.33 Terminate Transaction - TT 728
13.4.34 Volume Correction Factor - VC 729
13.4.35 Displaying Messages and Getting Answers 730
13.4.35.1 Justify Character Options 730
13.4.35.2 Message Options 731
13.4.35.3 Display Message - DM 731
13.4.35.4 Display Prompt - DP 733

13.4.35.5 Get Answer GA 734
13.4.35.6 Get Hidden - GH 735
13.4.35.7 Get Touch Key - GK 737
13.4.35.8 Get NexWatch Card - GN 738
13.4.35.9 Get RF ID - GR 740
13.4.35.10 Clear Message - CM 741
13.4.35.11 Answer Available - AA 741
13.5 Alarms 742
13.5.1 Types of Alarms 742
13.5.1.1 Fetching Alarms on Demand 742
13.5.1.2 System Alarms 743
13.5.1.3 Flow Meter Alarms 747
13.5.1.4 Loading Arm Alarms 749
13.5.1.5 Additive Injection Alarms 751
13.5.1.6 Recipe Alarms 753
13.5.2 Resetting Alarms 754
13.5.2.1 Resetting All Alarms 754
13.5.2.2 Resetting System Alarms 755
13.5.2.3 Resetting Flow Meter Alarms 755
13.5.2.4 Resetting Loading Arm Alarms 756
13.5.2.5 Resetting Additive Injection Alarms 756
13.5.2.6 Resetting Recipe Alarms 757
13.5.2.7 Resetting Individual Alarms 757
13.6 Diagnostics 758
13.6.1 Application Log Events 758
13.6.2 Audit Log Events 759

Appendix A: Fusion4 MSC-L Modbus UDI Items A-1

Appendix B: Description of Parameters B-1

B.1 Fusion4 controllers for additive injection B-1

B.2 Fusion4 controllers for blending B-8
B.3 Fusion4 controllers for loading B-24
B.3.1 Device-based protocol parameters B-24
B.3.2 Arm-based protocol parameters B-34

Appendix C: Modbus Enumerations and Structures C-1

C.1 Controllers for Additive Injection C-1
C.1.1 Task Register C-1
C.1.2 Alarm Action C-2
C.1.3 Permissive State C-3
C.1.4 Pacing Source C-3
C.1.5 Factored Pulse Output C-5
C.1.6 Permissive Function C-5
C.1.7 Additive Stream State C-7
C.1.8 Active Alarms (individual bits in 16-bits data) C-8
C.2 Controllers for Blending C-8
C.2.1 Task Register C-8
C.2.2 Alarm Action C-10
C.2.3 Blend Point Relative to Wild Stream C-11
C.2.4 Permissive State C-11
C.2.5 Factored Pulse Output C-11
C.2.6 Reset Blend Deviation Counter at Transaction Start C-12
C.2.7 Pre-Shutdown Control C-12
C.2.8 Clean Start Control C-13
C.2.9 Permissive Function (Modbus RTU | TCP/IP) C-13
C.2.10 Permissive Function (Modbus Legacy) C-14
C.2.11 Volume Correction Table C-14
C.2.12 Commodity Group C-15
C.2.13 VCF Options C-15
C.2.14 Glass Hydrometer Used C-16
C.2.15 Reference Temperature Units C-17

C.2.16 Reference Pressure Units C-17
C.2.17 Blend Stream State C-18
C.2.18 Active Alarms (individual bits in 16-bits data) C-18
C.3 Fusion4 controllers for loading C-19
C.3.1 Enumerations C-19
C.3.1.1 Alarm Action C-19
C.3.1.2 Permissive State C-20
C.3.1.3 Flow Phase C-20
C.3.1.4 Loading Type C-21
C.3.1.5 Boolean C-22
C.3.1.6 Enable/Disable C-22
C.3.1.7 Permissive Function C-22
C.3.1.8 Factored Pulse Output C-23
C.3.1.9 Actuator Type C-23
C.3.1.10 VCF Commodity Group C-24
C.3.1.11 VCF Compensation Options C-24
C.3.1.12 VCF Table Options C-25
C.3.1.13 VCF Density Reading Correction C-25
C.3.1.14 VCF Thermal Correction (Meter) C-25
C.3.1.15 VCF Mixture Calculation Option C-26
C.3.1.16 Input Control Mode C-26
C.3.1.17 Additive Alarms C-28
C.3.1.18 Digital State C-29
C.3.1.19 Additive Control State C-29
C.3.1.20 Fusion4 TAS Prompt C-30
C.3.1.21 Units: Pressure C-38
C.3.1.22 Units: Volume C-39
C.3.1.23 Units: Density C-39
C.3.1.24 Units: Temperature C-39
C.3.1.25 Units: Mass C-40
C.3.1.26 Units: Injection Volume C-40

C.3.1.27 Bay Type C-40
C.3.1.28 Arm Side Status C-40
C.3.1.29 Loading Bay C-41
C.3.1.30 Permissive Type C-41
C.3.1.31 UDI State C-42
C.3.1.32 UDI Command C-43
C.3.1.33 UDI Error Code C-43
C.3.1.34 Batch State C-44
C.3.1.35 Bay Command C-44
C.3.1.36 Workflow Option Type C-45
C.3.1.37 Fusion4 Record Type C-46
C.3.1.38 Record Req State C-46
C.3.1.39 Unprocessed Transactions Available C-46
C.3.1.40 User Prompt State C-47
C.3.1.41 Load Arm C-47
C.3.1.42 Arm Command C-48
C.3.1.43 MSCL Auth Db C-48
C.3.1.44 F4 Screen Icon C-49
C.3.1.45 Product Symbol C-49
C.3.1.46 F4 Prompt Input C-51
C.3.1.47 Controller State C-52
C.3.1.48 Batch Evaluation State C-53
C.3.1.49 Product Stream Alarms C-53
C.3.1.50 Device Alarms C-55
C.3.1.51 Bay Alarms C-56
C.3.1.52 Arm Alarms C-57
C.3.1.53 IO Card Digital IO States C-59
C.3.1.54 ARM Card Digital IO States C-60
C.3.1.55 ARM Current State C-61
C.3.1.56 Communication Mode C-62
C.3.1.57 Destination Record Type C-62

C.3.1.58 Preset Type C-62
C.3.1.59 Temperature Dimension C-62
C.3.1.60 Pressure Dimension C-63
C.3.1.61 Density Dimension C-63
C.3.1.62 Thermal Coeff Dimension C-63
C.3.1.63 Alarm Log Record Status C-64
C.3.1.64 Unprocessed Alarm Record Available C-64
C.3.1.65 Transaction Workflow Mode C-64
C.3.1.66 Batch Start Option C-64
C.3.1.67 Permissive State (External Additive 1 -12) C-65
C.3.1.68 Permissive State (External Additive 13 - 24) C-65
C.3.1.69 Permissive State (External Additive 1 - 6) C-66
C.3.1.70 Permissive State (External Additive 7 - 12) C-67
C.3.1.71 Permissive State (Internal Additive 1 -12) C-68
C.3.1.72 Permissive State (Internal Additive 13 - 24) C-68
C.3.1.73 Language C-69
C.3.1.74 User Attributes C-70
C.3.1.75 Object Attributes C-70
C.3.1.76 Device Type C-71
C.3.1.77 Device Type C-71
C.3.1.78 Sensor Category C-72
C.3.1.79 Sensor Health C-72
C.3.1.80 Status Code C-73
C.3.1.81 Alarm Severity C-73
C.3.2 Structures C-74
C.3.2.1 Bay Command C-74
C.3.2.2 Transaction Authorization Details C-74
C.3.2.3 Transaction Authorization Details Unicode C-75
C.3.2.4 Authorization Object C-75
C.3.2.5 User Response C-75
C.3.2.6 Batch Details C-76

C.3.2.7 Authorization Data C-76
C.3.2.8 Plan Init Start Batch C-77
C.3.2.9 Internal Prompt Data C-77
C.3.2.10 Compartment Response C-78
C.3.2.11 Record Request C-78
C.3.2.11.1 Read response data C-78
C.3.2.11.2 Write request data C-79
C.3.2.12 Arm Command C-80
C.3.2.13 Delete Auth Object Request C-80
C.3.2.14 Load Recipe C-81
C.3.2.15 Arm State Details C-82
C.3.2.16 Show Prompt Data C-83
C.3.2.17 Stream Address C-84
C.3.2.17.1 Device Address Flag (1 Bit, Bit 23) C-84
C.3.2.17.2 Device Number (11 Bits, Bits 23-12) C-84
C.3.2.17.3 Board Number (3 Bits, Bits 10-8) C-85
C.3.2.17.4 Function Number (4 Bits, Bits 7-4) C-85
C.3.2.18 Index Number (4 Bits, Bits 3-0) C-85
C.3.2.19 Batch Details V2 ..... C-85
C.3.2.20 Plan Init Start Batch V2 ..... C-86
C.3.2.21 1010 Transaction Record C-86
C.3.2.22 1010 Batch Record C-89
C.3.2.23 Generic Record Info Request C-92
C.3.2.24 Generic Record Data Field C-92
C.3.2.25 Load Batch Static Info C-93
C.3.2.26 Finished Product Stream Sub-record C-93
C.3.2.27 Main and Blend Product Stream Sub-record C-94
C.3.2.28 Additive Product Stream Sub-record C-95
C.3.2.29 Stream Dynamic Info C-96
C.3.2.30 RTC Date C-96
C.3.2.31 RTC Time C-96

C.3.2.32 Sensor Value C-97
C.3.2.33 Density Reference C-97
C.3.2.34 Pressure Reference C-98
C.3.2.35 Temperature Reference C-98
C.3.2.36 Thermal Coeff Reference C-99
C.3.2.37 Alarm State Text C-99
C.3.2.38 Remotely Authorized User Data C-99
C.3.2.39 Authorization Data C-100
C.3.2.40 Sensor Value Health C-100
C.3.2.41 Load Batch Dynamic Info C-100

1 General

1.1 Introduction

The Fusion4 Communication Manual provides users with the information needed to automate the control and data retrieval process from Guidant microprocessor-based controllers and Fusion4 Portal.

This manual describes the machine-to-machine messages needed for electronic controller operation using a number of protocols. By providing the protocols as defined in this manual, users can choose the protocol that best suits their needs.

This manual applies to Fusion4 Portal and all Fusion4 controllers. The list of controllers includes:

- Fusion4 SSC-A (Single-Stream Controller for Additive Injection)
- Fusion4 SSC-B (Single-Stream Controller for Blending)
- Fusion4 MSC-A (Multi-Stream Controller for Additive Injection)
- Fusion4 MSC-L (Multi-Stream Controller for Loading)

1.2 Target audience

This manual is intended for:

- Administrators who are assigned to install Fusion4 controllers and/or Fusion4 Portal
- Administrators, engineers, system integrators and supervisors who are assigned to configure and maintain Fusion4 controllers and/or Fusion4 Portal
- System integrators who are assigned to integrate the Terminal Automation System (TAS) with Fusion4 controllers and/or Fusion4 Portal
- Operators who are assigned to operate Fusion4 controllers and/or Fusion4 Portal

2 Safety

2.1 Safety Conventions

2.1.1 Warnings

The following warning formatting used in the manual recommends your attention to prevent personal injuries or dangerous situations.

> WARNING: General warning. It is always explained by text.

2.1.2 Cautions

The following caution formatting and symbols used in the manual recommends your attention to prevent damages to the equipment.

> CAUTION: General caution information.

> CAUTION:  Electrostatic discharge (ESD) sensitive device.

2.2 Liability

Guidantdisclaims any responsibility for personal injury or damage to the equipment caused by the following:

- Deviation from any of the prescribed procedures.
- Execution of activities that are not prescribed.
- Neglecting the safety regulations for handling tools and use of electricity.

The contents, descriptions, and specifications in this manual are subject to change without notice. Guidant accepts no responsibility for any errors that may appear in this manual.

> WARNING: Only certified technicians are authorized to make changes to the F4 system. All modifications must be in accordance with the guidelines as set forth by Guidant. Modifications not authorized by Guidant invalidates the approval certificates.

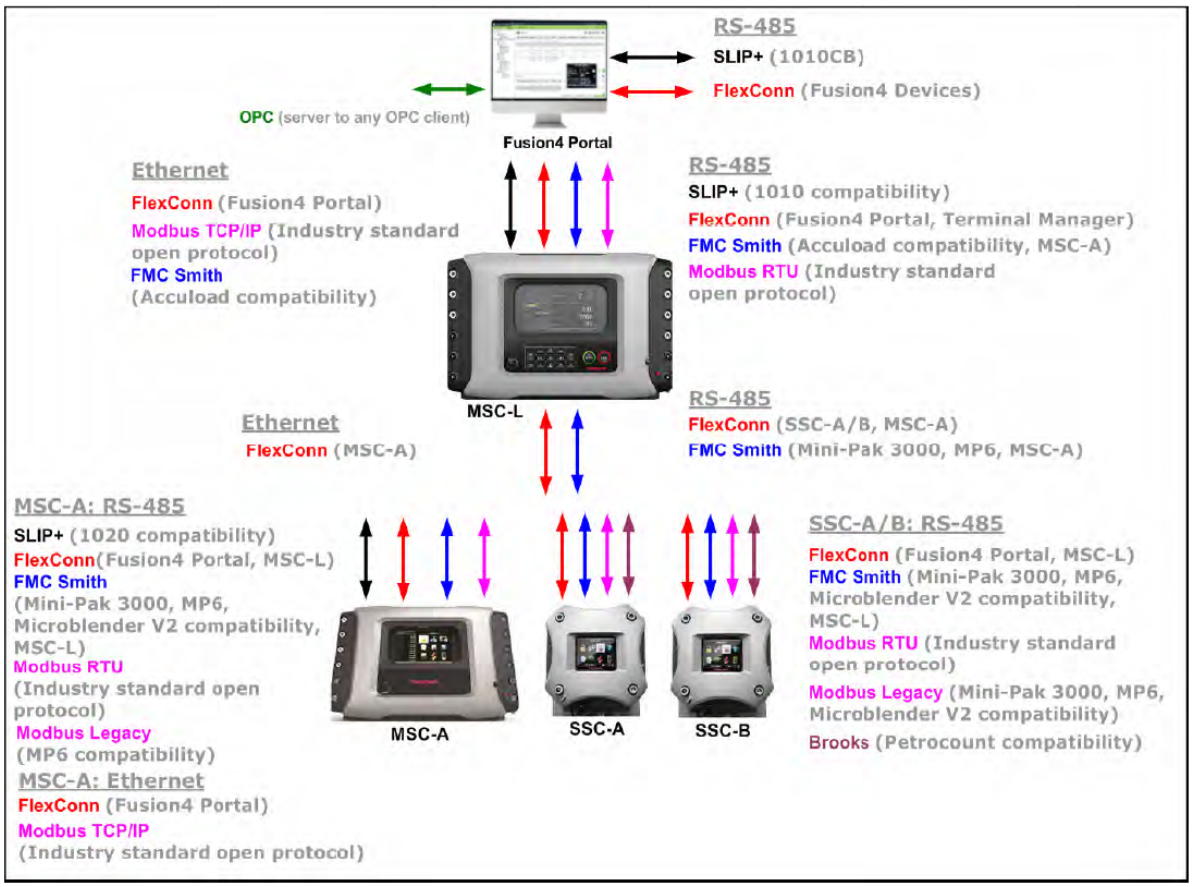
3 Fusion4 System Overview

Guidant's Fusion4 loading automation system manages and controls the loading and unloading of petrochemicals in a safe, secure and well-documented manner. Key elements in the Fusion4 system are:

- Fusion4 Portal, see section 3.1
- Fusion4 controllers for loading, see section 3.5
- Fusion4 controllers for additive injection, see section 3.2 and section 3.4
- Fusion4 controllers for blending, see section 3.3

The following figure shows an overview of the Fusion4 system.

Figure 3-1: Fusion4 system overview



3.1 Fusion4 Portal

3.1.1 Description

Fusion4 Portal is a Windows PC software suite designed to interface with a portfolio of hazardous area control devices. Its main functions are:

- Retrieving data from the connected devices to print a Bill of Lading (BoL) after product has been delivered to a truck or train etc.
- Configuring, commissioning and diagnosing of controllers
- OPC interfacing
- Monitoring of field devices for the control room
- Printing transactions

Fusion4 Portal can scan and print transaction data of 1 up to 250 streams spread across up to 50 devices, including:

- 1010CB preset controllers
- Fusion4 SSC-As (Single-Stream Controllers for Additive Injection)
- Fusion4 SSC-Bs (Single-Stream Controllers for Blending)
- Fusion4 MSC-Ls (Multi-Stream Controllers for Loading)
- Fusion4 MSC-As (Multi-Stream Controllers for Additive Injection)

3.1.2 Principle of operation

The basic principle of operation is achieved by Fusion4 Portal continuously communicating with the connected devices. As soon as a device has new transaction data available Fusion4 Portal will retrieve this data. When transaction data from a connected device like a Fusion4 SSC-A or Fusion4 MSC-A is received and the print transaction function of the device is enabled, a transaction summary will be printed. When transaction data from a connected device like an Fusion4 SSC-B, Fusion4 MSC-L or 1010CB is received and the print transaction function of the device is enabled, the data, including the applicable engineering units, is

immediately printed resulting in a Bill of Lading (BoL). The BoL is printed for custody transfer when a product from storage tanks has been transferred to other parties. Fusion4 Portal is certified for printing W&M compliant BOLs for Contrec 1010CB and Fusion4 SSC-B. For this reason, Fusion4 Portal is certified for printing W&M compliant BoLs for 1010CB and SSC-B. The transaction data, including the applicable engineering units, is stored immediately after receipt on the hard disk.

3.1.3 Communications

Communication with the devices is realized by using hard-wired, serial EIA RS-422/485 communications ports, which are connected to the devices via serial communication lines.

> NOTE: Optionally, the Fusion4 Portal server may be connected to the devices through a Terminal Server.

Fusion4 Portal includes several different communications protocols. These include:

- FlexConn (see CHAPTER 9)
- SLIP+ (see CHAPTER 8)

For more information refer to:

- Fusion4 Portal Installation & Operation Manual (MN06306)
- Fusion4 SSC-A Installation & Operation Manual (MN06302)
- Fusion4 SSC-B Installation & Operation Manual (MN06304)
- Fusion4 MSC-A Installation & Operation Manual (MN06305)
- Fusion4 MSC-L Installation & Operation Manual (MN06301)

3.2 Fusion4 Single-Stream Controller for Additive Injection

3.2.1 General

The Fusion4 Single Stream Controller for Additive Injection (Fusion4 SSC-A) is designed to control one single additive stream. It can operate within any product transfer application, such as road tanker loading, rail off-loading or pipeline transfer, where chemical additive needs to be injected to process stream.

3.2.2 Principle of operation

The basic principle of operation is achieved by the Fusion4 SSC-A monitoring the flow of the wild stream, and using this flow rate to accurately pace the flow of additive stream to a defined recipe (additive volume) in SSC-A.

The pacing of the additive stream is realized through accurate, rapid injections of very small volumes of additive into the process, as per configured pacing volume.

The Fusion4 SSC-A is a cycle-based injector, meaning that the additive is not dispensed continuously. An internal recipe controls the ratio of additive being injected to the process stream. In a typical application, the process flow rate is monitored by the controller. As chemical additive is called for, the controller opens a solenoid control valve and injects a small quantity of additive into the process stream. When the required quantity is reached, the controller closes the valve and waits until the next injection is required. The injection cycle repeats in this manner, keeping the additive 'in pace' with the process flow. The reason for cyclical injection technology is uniform mixing of product and additive.

The injection control of the Fusion4 SSC-A can be achieved in different pacing modes:

- Self-paced mode: The Fusion4 SSC-A autonomously injects on a time and fluid volume basis (configurable).
- Smart mode: An external trigger source (Pulse Input, Digital Input, Analogue Input, or Comms) makes the Fusion4 SSC-A inject a configurable additive

volume.

- Slave mode: In this case additive injection is fully controlled by an external device.

3.2.3 Communications

Full control and full access to all setup entities of the Fusion4 SSC-A can be realized by using a hard-wired, serial EIA RS-485 communications port, which is connected to a client system via a data communications line. This client system can be a PC service program, a load computer, a SCADA system, DCS, or any other type of Terminal Automation System.

The Fusion4 SSC-A includes several different communications protocols. These include:

- FlexConn (see CHAPTER 9)
- FMC Smith AccuLoad (see CHAPTER 5)
- Brooks PetroCount (see CHAPTER 6)
- Modbus Legacy and Modbus RTU (see CHAPTER 7)

The Fusion4 SSC-A supports two serial communication ports.

- The CAN-ADD-BLEND board houses a 2- or 4-wire isolated RS-485 communication port.
- The CAN-OPTION-SSC board houses a 2-wire isolated RS-485 communication port.

Alarms are reported through the protocols of the RS-485 communications interface. Alarms may also be cleared using the RS-485 communications interface.

> NOTE: Refer to the Fusion4 SSC-A Installation & Operation Manual (MN06302) for more information.

3.3 Fusion4 Single Stream Controller for Blending

3.3.1 General

The Fusion4 Single Stream Controller for Blending (Fusion4 SSC-B) is a hazardous area, intelligent blend controller, utilizing state-of-the-art microprocessor technology for high-accuracy blending applications.

The MID-compliant Fusion4 SSC-B is designed to control one single blend stream. It can operate within any product transfer application, such as road tanker loading, rail off-loading or pipeline transfer, where multiple products need to be accurately combined.

3.3.2 Principle of operation

The basic principle of operation is achieved by the Fusion4 SSC-B monitoring the flow of the wild stream, and using this flow rate to accurately pace the flow of the blend stream to a predetermined target blend percentage or ratio.

The pacing of the blend stream is achieved through digitally controlled solenoid valves that modulate the position of a variable control valve within the blend stream.

The Fusion4 SSC-B is capable of achieving highly accurate linear control across the complete blend range; allowing for blend ratios from 0% to 100% (practical blend rates are around 5% to 40%) on standard load rack applications.

Temperature and pressure measurements are used to convert the observed blend volume to reference conditions, in order to have very accurate blend transaction data that can be used for W&M-compliant custody transfer.

3.3.3 Communications

Full control and full access to all setup entities of the Fusion4 SSC-B can be realized by using a hard-wired, serial EIA RS-485 communications port, which is connected to a client system via a data communications line. This client system can be a PC

service program, a load computer, a SCADA system, DCS, or any other type of Terminal Automation System.

The Fusion4 SSC-B includes several different communications protocols. These include:

- FlexConn (see CHAPTER 9)
- FMC Smith AccuLoad (see CHAPTER 5)
- Brooks PetroCount (see CHAPTER 6)
- Modbus Legacy and Modbus RTU (see CHAPTER 7)

The Fusion4 SSC-B supports two serial communication ports.

- The CAN-ADD-BLEND board houses a 2- or 4-wire isolated RS-485 communication port.
- The CAN-OPTION-SSC board houses a 2-wire isolated RS-485 communication port.

Alarms are reported through the protocols of the RS-485 communications interface. Alarms may also be cleared using the RS-485 communications interface.

> NOTE: Refer to the Fusion4 SSC-B Installation & Operation Manual (MN06304) for more information.

3.4 Fusion4 Multi-Stream Controller for Additive Injection

3.4.1 General

The Fusion4 Multi-Stream Controller for Additive Injection (Fusion4 MSC-A) is designed to control up to twenty four additive streams. It can operate within any product transfer application, such as road tanker loading, rail off-loading or pipeline transfer, where chemical additive needs to be injected to process stream.

3.4.2 Principle of operation

The basic principle of operation is achieved by the Fusion4 MSC-A monitoring the flow of the wild stream, and using this flow rate to accurately pace the flow of additive stream to a defined recipe (additive volume) in MSC-A.

The pacing of the additive stream is realized through accurate, rapid injections of very small volumes of additive into the process, as per configured pacing volume.

The Fusion4 MSC-A is a cycle-based injector, meaning that the additive does not dispense continuously. An internal recipe controls the ratio of additive being injected to the process stream. In a typical application, the process flow rate is monitored by the controller. As chemical additive is called for, the controller opens a solenoid control valve and injects a small quantity of additive into the process stream. When the required quantity is reached, the controller closes the valve and waits until the next injection is required. The injection cycle repeats in this manner, keeping the additive 'in pace' with the process flow. The reason for cyclical injection technology is uniform mixing of product and additive.

The injection control of the Fusion4 MSC-A can be achieved in different pacing modes:

- Self-paced mode: The Fusion4 MSC-A autonomously injects on a time and fluid volume basis (configurable).
- Smart mode: An external trigger source (Pulse Input, Digital Input, Analogue Input, or Comms) makes the Fusion4 MSC-A inject a configurable additive volume.
- Slave mode: In this case additive injection is fully controlled by an external device.

3.4.3 Communications

Full control and full access to all setup entities of the Fusion4 MSC-A can be realized by using:

- Hard-wired, serial EIA RS-485 communications port, which is connected to a client system via a data communications line
- Ethernet

This client system can be a PC service program, a load computer, a SCADA system, DCS, or any other type of Terminal Automation System.

The Fusion4 MSC-A includes several different communications protocols. These include:

RS-485

- SLIP+, see CHAPTER 8
- FlexConn, CHAPTER 9
- FMC Smith AccuLoad (see CHAPTER 5)
- Modbus Legacy and Modbus RTU | TCP/IP (see CHAPTER 7)

Ethernet

- FlexConn (see CHAPTER 9)
- Modbus TCP/IP (see CHAPTER 12)

The Fusion4 MSC-A supports the following serial communication ports:

- The CAN-ARM-MSC-1 board houses one isolated terminal connector with two 2-wire half-duplex RS-485 communication ports.
- The CAN-ARM-MSC-2 board houses one isolated terminal connector with two 2-wire half-duplex RS-485 communication ports.
- The CAN-HMI-MSC board houses one isolated terminal connector with two 2-wire half-duplex RS-485 communication ports and one 4-wire full-duplex RS-485 terminal connector.

Alarms are reported through the protocols of the RS-485 communications interface. Alarms may also be cleared using the RS-485 communications interface.

> NOTE: Refer to the Fusion4 MSC-A Installation & Operation Manual (MN06305) for more information.

3.5 Fusion4 Multi-Stream Controller for Loading

3.5.1 General

The Fusion4 Multi-Stream Controller for Loading (Fusion4 MSC-L) is a Load Computer, Batch Controller Unit (BCU) or a Preset, and is typically installed on a loading, at a terminal, in the petro chemical industry. The Fusion4 MSC-L is designed to accurately transfer products from the storage area into another containment vessel. Apart, from loading a single product, the MSC-L also provides necessary functionality for blending products, additive injections and for loading the final products accurately, as required in the global oil storage and distribution industry.

The MSC-L controls the following:

- Loading - Transferring the base or the stock oil, or the petroleum derivative from a storage tank to a vehicle, for example, road trucks, rail cars, or barges.
- Additive injection - Improving and differentiating the base or stock oil, or petroleum derivatives by changing the physical properties and specifications of the oil product (fuel) during loading/transferring.
- Blending - Combining two or more fluid products to a predetermined specification during loading.

3.5.2 Communications

Full control and full access to all setup entities of the Fusion4 MSC-L can be realized by using:

- Hard-wired, serial EIA RS-485 communications port, which is connected to a client system via a data communications line
- Ethernet

This client system can be a PC service program, a SCADA system, DCS, or any other type of Terminal Automation System.

The Fusion4 MSC-L includes several different communications protocols. These include:

RS-485

- FMC Smith AccuLoad, see CHAPTER 5
- Modbus RTU, see CHAPTER 7
- FlexConn, see CHAPTER 9

Ethernet

- FlexConn, see CHAPTER 9
- Modbus TCP/IP, see CHAPTER 12

The Fusion4 MSC-L supports the following serial communication ports:

- The CAN-ARM-MSC board houses one isolated terminal connector with two 2-wire half-duplex RS-485 communication ports.
- The CAN-HMI-MSC board houses one isolated terminal connector with two 2-wire half-duplex RS-485 communication ports and one 4-wire full-duplex RS-485 terminal connector.

Alarms are reported through the protocols of the RS-485 communications interface. Alarms may also be cleared using the RS-485 communications interface.

> NOTE: Refer to the Fusion4 MSC-L Installation & Operation Manual (MN06301) for more information.

4 RS-485 Communications

The Fusion4 controllers (Fusion4 SSC-A, Fusion4 SSC-B, Fusion4 MSC-A and Fusion4 MSC-L) use the EIA-485 standard for communications. A converter is required to enable communications with peripheral devices such as modems or personal computers that use the EIA-232 interface standard.

Proper system wiring is critical to the reliable operation of serial communication interfaces. Improper wiring can cause high data error rates and reduce data throughput. Although exact wiring requirements vary depending on the type of interface used, each of the following is important to the overall success of a communications system:

- Cable lengths and types
- Shielding
- Twisted Pair Wiring

RS-485 interfaces are typically used in multi-drop configurations. When installing a two-wire cable for use with a Fusion4 controller, receive and transmit share the same conductor pair (half-duplex). The wires must be a twisted pair. Wiring for RS-485 must be designed as a daisy chain. Cable stubs are permitted so long as they are 4.5 m (15 feet) or less in length. Conductor pairs must be terminated with a termination resistor at the most distant end, to ensure proper line impedance for maximum signal reception. Without termination resistors, reflections of fast driver edges can cause multiple data edges that can cause data corruption. Termination resistors also reduce electrical noise sensitivity due to the lower impedance. The value of each termination resistor should be equal to the cable characteristic impedance (typically, 120 ohms for twisted pairs).

Using the recommended cable (Belden Cable 9841 for two-wire), an RS-485 interface may support maximum 32 server devices onto one client (host) over a maximum wire length of 1000 m (3281 feet). The host (client) initiates the communication by addressing one of the servers in its query. Only the addressed server will respond.

4.1 Characteristics

The table below displays the characteristics of an RS-485 interface used for communications.

Table 4-1: Characteristics of RS-485 Interface

Item	Min.	Typical	Max.	Unit
Terminator resistor RT	118	120	122	Ω
Driver common mode voltage	-1	-	+3	V
Driver output voltage, Open circuit	1.5 -1.5	-	6 -6	V
Driver output voltage, Loaded	1.5 -1.5	-	3.6 -3.6	V
Driver output short circuit current	-	-	±200	mA
Receiver common mode voltage	-7	-	+12	V
Receiver sensitivity	-	-	±200	mV
Receiver input resistance	12	-	-	kΩ
Data transmission rate	-	-	500	kbps
Number of connected devices	-	-	32	-

4.2 Cable specifications

The following table displays the specifications of a cable used in RS-485 interfaces.

Table 4-2: Cable specifications for RS-485 interfaces

Item	Min.	Typical	Max.	Unit
Cable length	-	-	1000 [3281]	m [ft]
Cable characteristic impedance	-	120		Ω
Cable DC resistance	-	-	100	Ω
Cable capacitance	-	-	55.77 [17]	pF/m [pF/ft]

5 Smith Meter AccuLoad Protocol

5.1 Fusion4 SSC-A, Fusion4 SSC-B and Fusion4 MSC-A

5.1.1 Description

The Smith Meter AccuLoad protocol is closely related to the protocol defined by Smith Meter Inc. for use with their AccuLoad Electronic Preset Controller. In the AccuLoad protocol, there are two different message formats, depending on whether the message originated from the client or from a controller.

- The message format for a command instruction from the client to a controller is:

STX	A1A2A3	text	ETX	LRC

Term	Description	Hex value
STX	Start of Text Character	02_{HEX}
$A_1A_2A_3$	3-digit address of the Fusion4 controller	
text	ASCII string containing the command instruction	
ETX	End of Text Character	03_{HEX}
LRC	Longitudinal Redundancy Check	

NOTE: This protocol is also used by MSC-L when it is the client and a Fusion4 SSC-A, Fusion4 SSC-B or Fusion4 MSC-A is a server device communicating with each other over RS485 using FMC Smith protocol for external additive injection.

- The message format for a response/acknowledgment from a controller to the client is:

NUL	STX	A1A2A3	text	ETX	LRC	PAD

Term	Description	Hex value
NUL	Null Character	00_{HEX}
STX	Start of Text Character	02_{HEX}
$A_1A_2A_3$	3-digit address of the Fusion4 controller	
text	ASCII string containing the response acknowledgment	
ETX	End of Text Character	03_{HEX}
LRC	Longitudinal Redundancy Check	
PAD	Pad Character	$7F_{HEX}$

The longest packet string transmitted or received by the controller can be no longer than 255 characters in length. The command to or the response from the controller is contained in the text field. The format for this field is defined in the descriptions of the allowed commands and responses below.

5.1.1.1 Text field format

The structure of the text field is very specific for each command. The formats for the text field apply whether the string is a request from the client or a response from the controller. The format of the data associated with a given parameter code is specific and cannot be varied. Only one command may be transmitted to the controller in a given text field.

The Parameter and Task Code formats are described in detail in the Installation & Operation Manual of the specific Fusion4 controller. All leading and trailing zeros on numbers must be transmitted. Even though the alphanumeric data strings are of variable length, they cannot be longer than the maximum length specified. The controller determines the end of the string when either a semi-colon or an ETX is encountered.

When a protocol string is received by the controller, it is first checked for transmission errors by using the LRC. The LRC is a 7-bit exclusive-OR of the characters in the protocol string following the STX character up to and including the ETX character. If the LRC of the received string does not match the received LRC

value, an error has occurred in transmission and the Fusion4 controller will ignore the string.

5.1.1.2 Broadcast commands

A Fusion4 controller is capable of receiving a 'broadcast' command from the client unit using the AccuLoad protocol. A broadcast command is a command that is directed to all the controllers on the communications bus, simultaneously. In the controller, the addresses 998, 999, and 000 are reserved for use as the Broadcast Address. Any command message that is addressed to a controller's Broadcast Address, is recognized by that unit and processed. However, unlike a command to a controller's primary address, a broadcast command generates no response from the controller. Clearing alarms and setting the time/date are examples of the use of broadcast commands. Only write commands or task commands may be broadcast since a read command by definition requires a response and responses to broadcast commands are not allowed.

5.1.1.3 Command Identifier Prefixes

In the table below the command identifier prefixes that are available in the FMC Smith AccuLoad protocol are listed.

Table 5-1: Smith Meter AccuLoad protocol: Command identifier prefixes

Identifier	Description
RV	Read a value from the Fusion4 controller
WV	Write a value to the Fusion4 controller
EX	Execute a task function in the Fusion4 controller

5.1.1.3.1 RV - Read Value

This command instructs the controller to read a memory location.

- Request

RV_XXX		
XXX	=	Parameter register code
_	=	Denotes a space

- Response

RV_XXX_ A_0.... A_n		Command completed successfully
XXX	=	Parameter register code
A_0..... A_n	=	Value of the parameter register requested. It is an ASCII character string whose format is defined in the specific controller manual.
_	=	Denotes a space
or		
NOXX		Execution of the command failed
XX	=	Two-digit error code as defined in section 5.1.1.4.

5.1.1.3.2 WV - Write Value

This command instructs the controller to program a memory location.

- Request

WV_XXX_A_0 A_n	
XXX = Parameter register code to be written to A_0....A_n = Data to be written to the parameter register XXX. The data string must conform exactly to the format for that code as defined in the specific controller manual. _ = Denotes a space	

- Response

OK	Value was programmed successfully
or	
NOXX	Execution of the command failed
XX = Two-digit error code as defined in section 5.1.1.4.	

5.1.1.3.3 EX - Execute Task

This command instructs the controller to execute a task function.

- Request

EX_XXX	
XXX = Task code as defined in the specific controller manual _ = Denotes a space	

- Response

OK	Task was completed successfully
or	
NOXX	Execution of the command failed
XX = Two-digit error code as defined in section 5.1.1.4.	

5.1.1.4 Error Codes

The controller is capable of returning several error messages to the client unit if it is unable to successfully carry out a command. These error messages are in the form of 'NOXX' where 'XX' is a two-digit number representing the error that occurred.

The individual errors that the controller is capable of responding to are listed in the following table.

Table 5-2: Smith Meter AccuLoad protocol: Error codes

Error No.	Description	Explanation
00	Illegal Command	Command code is not recognized.
01	Transaction in Progress	Controller is permitted. No measurement parameters can be changed.
02	Illegal Value	Value is out of range
03	Syntax Error in Value	Value string is not in the correct format.
04	Illegal Text String Format	Construction of the text field is incorrect.
05	Unit in Critical Alarm	Alarm must be cleared before the command can be completed.
06	Option Not Installed	Command code is not supported in this version of the controller.

Error No.	Description	Explanation
07	No Transaction in Progress	Transaction must be in progress to execute the command code.
08	Transmission Error (LRC failed)	Error occurred in the protocol string during transmission.
09	In Local Programming Mode	Controller is being programmed with the hand held controller.
10	Commands out of Sequence	Another command code must be performed before the current one can be.
11	Write Attempt to a Read Only Value	Tried to store a value to a read only parameter register.
12	Access Denied to Security Code	Future Use
13	No Records Found	This error results when trying to read or clear records from the Transaction or Security Log and no records are present.

5.1.1.5 Examples

Example 1. The client requests the Active Alarm Status (802) of the controller with address 123. The controller has no active alarms.

- Request

STX	123	RV 802	ETX	LRC

- Response

NUL	STX	123	RV 802 0000	ETX	LRC	PAD

Example 2. The client sets the Additive K-Factor to 6300.000 on the controller with address 313.

- Request

STX	313	WV 001 6300.000	ETX	LRC

- Response

NUL	STX	313	OK	ETX	LRC	PAD

Example 3. The client sets the time on all the controllers on the communication loop at the same time (broadcast command). The time is 02:34:13 PM. Number 999 is the broadcast address for the system.

- Request

STX	999	WV 111 14:34:13	ETX	LRC

- Response

  None

5.1.2 Fusion4 SSC-A



The following table lists the AccuLoad protocol parameters for the Fusion4 SSC-A (Single Stream Controller for Additive Injection).

Table 5-3: AccuLoad protocol parameters for Fusion4 SSC-A

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream K-factor	001	floating point	R	nnnnn.nnn		
Additive K-factor	002	floating point	R	nnnnn.nnn		
Injection volume	010	floating point	R/W	nnnn.n		
Volume per injection cycle	020	floating point	R/W	nnnn.n		

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Solenoid dwell time	030	integer	R	nnnnn		
Minimum product volume for transaction	040	floating point	R/W	nnn		
Factored pulse output resolution	050	enumeration, see C.1.5	R	n	2...5	
Number of clean start cycles	060	integer	R/W	nn		
Flush volume	061	floating point	R/W	nnn		
High flow threshold value	063	floating point	R/W	nnnnn		
Low flow threshold value	064	floating point	R/W	nnnnn		
Transaction closing time	065	integer	R/W	nnn		
Pacing source	080	enumeration, see C.1.4	R	n	0...2	
Permissive function	081	enumeration, see C.1.6	R/W	n	0...2	
Injection offset	090	integer	R/W	nnn		
Unit address	100	integer	R	nnn		
Broadcast address	101	integer	R	nnn		
Number of solenoid retries	131	integer	R	n		
DI hysteresis time	132	integer	R	nnnn		
Feedback pulse duration	133	integer	R	nnnn		
Pump run timeout	134	integer	R/W	nnn		
No additive alarm action	310	enumeration, see C.1.2	R	n	0...2	

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
No additive timeout period	311	integer	R	n		
Additive volume deviation alarm action	320	enumeration, see C.1.2	R	n	0...2	
Additive volume deviation allowed	322	integer	R/W	nnn		
Additive deviation basis	323	integer	R	nn	5...20	
Leaking solenoid alarm action	340	enumeration, see C.1.2	R	n	0...2	
Leaking solenoid volume limit	341	floating point	R	nnn		
Leaking solenoid timeout period	342	integer	R	nn		
No activity timeout alarm action	370	enumeration, see C.1.2	R	n	0...2	
No activity timeout period	371	integer	R	nnn		
Active alarms	802	bit mask, see section C.1.8	R	hhhh		
Permissive state	804	enumeration, see C.1.3	R	n	0...2	
Solenoid close delay	805	integer	R	nnnn		
Additive stream flow rate	809	floating point	R	nnnnn		
Accumulative wild stream gross observed volume	810	floating point	R	nnnnnnn		

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Accumulative total additive stream gross observed volume	850	floating point	R	nnnnn.nnn		
Accumulative transactional additive stream gross observed volume	860	floating point	R	nnnnn.nnn		
Accumulative leaking solenoid gross observed volume	870	floating point	R	nnnnn.nnn		
Accumulative calibration gross observed volume	880	floating point	R	nnnnn.nnn		
Load stream flow rate	881	floating point	R	nnnnn.nnn		
Additive stream flow rate	882	floating point	R	nnnnn.nnn		
Transaction PPM	883	floating point	R	nnnnn		
Task register	888	integer, see C.1.1	W	hhhh		
Firmware version number	890	string	R	aaaaaa		
Product ID	892	string	R	aaaaaaaaa		
Device serial number	893	string	R	ssssssss		

5.1.3 Fusion4 SSC-B



The following table lists the FMC Smith AccuLoad protocol parameters for the Fusion4 SSC-B (Single Stream Controller for Blending).

Table 5-4: AccuLoad protocol parameters for Fusion4 SSC-B

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream K-factor	001	floating point	R	nnnnn.nnn		100
Blend stream K-factor	002	floating point	R	nnnnn.nnn		750
Target blend percentage rate A	010	floating point	R/W	nnn.nn		0
Target blend percentage rate B	011	floating point	R/W	nnn.nn		0
Target blend percentage rate C	012	floating point	R/W	nnn.nn		0
Target blend percentage rate D	013	floating point	R/W	nnn.nn		0
Target blend percentage rate E	014	floating point	R/W	nnn.nn		0
Dead band control window limit	020	floating point	R/W	nnnn.nn	0.01...10000	0.1

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Inner control window limit	021	floating point	R	nnnn.nn	0.01...10000	1
Middle control window limit	022	floating point	R	nnnn.nn	0.01...10000	10
Outer control window limit	023	floating point	R	nnnn.nn	0.01...10000	100
Solenoid active dwell	030	integer	R	nnnn	50...1000	100
Solenoid rest dwell	031	integer	R	nnnn	50...1000	100
Permissive function	040	enumeration, see C.2.10	R	n	0...1	1
Blend stream pulse timeout	041	integer	R	nn	1...90	2
Wild stream pulse timeout	042	integer	R	nnn	1...999	5
Deviation count smoothing value	044	integer	R	nn	0...12	10
Reset blend deviation counter at transaction start	045	enumeration, see C.2.6	R	n	0...1	0
Multifunction DC output #1	049	enumeration, see C.2.5	R	n	2...5	2
Multi function DC output #2	050	enumeration, see C.2.5	R	n	2...5	2
Preset gross observed volume	060	floating point	R/W	nnnnnn	0...999999	0

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Flush volume	061	floating point	R/W	nnn	0...999	0
Pre-shutdown control	062	enumeration	R	n	0...2	0
Pre-shutdown volume	063	floating point	R/W	nnnn	0...9999	0
Clean start control	070	enumeration, see C.2.8	R	n	0...1	0
Blend point relative to wild stream meter	080	enumeration, see C.2.3	R	n	0...1	0
Gross standard volume calculation interval	082	floating point	R	nnnn.nn		
Temperature compensation used	083	boolean	R	n		
Unit address	100	integer	R	nnn		
Broadcast address	101	integer	R	nnn		
DI hysteresis time	132	integer	R	nnnn		
Calibration high flow rate	200	floating point	R	nnnn	1...9999	60
Calibration low flow rate	201	floating point	R	nnn	1...100	15
Calibration inner control window limit	210	integer	R	nnn	1...100	10

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Calibration outer flow rate control window	211	integer	R	nnnn	1...9999	25
Calibration start low flow volume	220	floating point	R	nnnn	1...9999	25
Calibration end low flow volume	221	floating point	R	nnnn	1...9999	25
Calibration final shut down volume	230	floating point	R	nnn	0...999	20
Flow calculation smoothing value	240	integer	R	nn	1...99	10
Control failure alarm action	310	enumeration, see C.2.2	R	n	0...2	2
Control failure alarm timeout	311	integer	R	nn	1...30	10
Blend percentage deviation alarm action	320	enumeration, see C.2.2	R	n	0...2	2
Blend low percentage allowed	321	integer	R/W	nn	1...99	95
Blend high percentage allowed	322	integer	R/W	nnn	101...999	105

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Minimum wild stream volume for alarm	323	floating point	R/W	nnn	1...999	5
Leaking blend valve alarm action	340	enumeration, see C.2.2	R	n	0...2	2
Leaking blend valve volume limit	341	floating point	R	nnnn	1...9999	100
Wild stream closing volume alarm action	350	enumeration, see C.2.2	R	n	0...2	2
Wild stream closing volume	351	floating point	R	nnnn	1...9999	150
Blend stream closing timeout alarm action	360	enumeration, see C.2.2	R	n	0...2	2
Blend stream closing timeout	361	integer	R	nnn	1...240	60
No activity alarm action	370	enumeration, see C.2.2	R	n	0...2	2
No activity timeout	371	integer	R	nn	1...65535	30
Flush volume alarm action	380	enumeration, see C.2.2	R	n	0...2	2
Flush volume deviation	381	integer	R/W	nnn	1...100	25

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Active alarms	802	integer, see C.2.18	R	hhhh	0...65535	0
Permissive state	804	enumeration, see C.2.4	R	n	0...1	0
Accumulative wild stream gross observed volume	810	floating point	R	nnnnnnnn	0...99999999	0
Accumulative blend stream gross observed volume	820	floating point	R	nnnnnnnn	0...99999999	0
Accumulative blend stream gross standard volume	825	floating point	R	nnnnnnnn	0...99999999	0
Transactional wild stream gross observed volume	830	floating point	R	nnnnnn.nn	0...999999.99	0
Transactional blend stream gross observed volume	840	floating point	R	nnnnnn.nn	0...999999.99	0

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Transactional blend stream gross standard volume	845	floating point	R	nnnnnn.nn	0...999999.99	0
Transactional blend percentage (normal mode)	850	floating point	R	nnn.nn	0...100.00	0
Accumulative blend volume (emulation mode only)	850	floating point	R	nnnnnnnn	0	0
Transaction deviation count	860	floating point	R	nnnnn		0
Transaction current average temperature	865	floating point	R	nnn.n	-999.9...999.9	0
Instantaneous temperature	866	floating point	R	nnn.n	-999.9...999.9	0
Accumulative leaking blend stream gross observed volume	870	floating point	R	nnnnnnnn	0...99999999	0
Accumulative calibration gross observed volume	880	floating point	R	nnnnnnnn	0...99999999	0

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream flow rate	881	floating point	R	nnnn		
Blend stream flow rate	882	floating point	R	nnnn		
Transactional blend percentage	883	floating point	R	nnnn		
Task register	888	enumeration, see C.2.1	W		1...802	
Firmware version number	890	string	R	aaaaaa		
Product ID	892	string	R	aaaaaaaaa		
Device serial number	893	string	R	aaaaaaaa		

5.1.4 Fusion4 MSC-A



The following table lists the AccuLoad protocol parameters for the Fusion4 MSC-A (Multi-Stream Controller for Additive Injection).

Table 5-5: AccuLoad protocol parameters for Fusion4 MSC-A

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream K-factor	001	floating point	R	nnnnn.nnn		
Additive K-factor	002	floating point	R	nnnnn.nnn		
Injection volume	010	floating point	R/W	nnnn.n		

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Volume per injection cycle	020	floating point	R/W	nnnn.n		
Solenoid dwell time	030	integer	R	nnnnn		
Minimum product volume for transaction	040	floating point	R/W	nnn		
Factored pulse output resolution	050	enumeration, see C.1.5	R	n	2...5	
Number of clean start cycles	060	integer	R/W	nn		
Flush volume	061	floating point	R/W	nnn		
High flow threshold value	063	floating point	R/W	nnnnn		
Low flow threshold value	064	floating point	R/W	nnnnn		
Transaction closing time	065	integer	R/W	nnn		
Pacing source	080	enumeration, see C.1.4	R	n	0...2	
Permissive function	081	enumeration, see C.1.6	R/W	n	0...2	
Injection offset	090	integer	R/W	nnn		
Unit address	100	integer	R	nnn		
Number of solenoid retries	131	integer	R	n		
Feedback pulse duration	133	integer	R	nnnn		
Pump run timeout	134	integer	R/W	nnnn		
No additive alarm action	310	enumeration, see C.1.2	R	n	0...2	

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
No additive flow timeout period	311	integer	R	n		
Additive volume deviation alarm action	320	enumeration, see C.1.2	R	n	0...2	
Additive volume deviation allowed	322	integer	R/W	nnn		
Additive deviation basis	323	integer	R	nn		
Leaking solenoid alarm action	340	enumeration, see C.1.2	R	n	0...2	
Leaking solenoid volume limit	341	floating point	R	nnn		
Leaking solenoid timeout period	342	integer	R	nn		
No activity timeout alarm action	370	enumeration, see C.1.2	R	n	0...2	
No activity timeout period	371	integer	R	nnn		
Slow flow volume alarm action	380	enumeration, see C.1.2	R	n		
Active alarms	802		R	hhh		
Permissive state	804	enumeration, see C.1.3	R	n	0...2	
Solenoid close delay	805	integer	R	nnnn		
Alarm and permissive state (injectors 1 - 6) #	806		R			
Alarm and permissive state (injectors 7 - 12) #	807		R			

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Additive stream flow rate	809	floating point	R	nnnnn		
Accumulative wild stream gross observed volume	810	floating point	R	nnnnnnn		
Alarm and permissive state (injectors 13 - 18) #	811		R			
Alarm and permissive state (injectors 19 - 24) #	812		R			
Accumulative total additive stream gross observed volume	850	floating point	R	nnnnn.nnn		
Accumulative transactional additive stream gross observed volume	860	floating point	R	nnnnn.nnn		
Accumulative leaking solenoid gross observed volume	870	floating point	R	nnnnn.nnn		
Accumulative calibration gross observed volume	880	floating point	R	nnnnn.nnn		
Load stream flow rate	881	floating point	R	nnnnn.nnn		
Additive stream flow rate	882	floating point	R	nnnnn.nnn		

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Transaction PPM	883	floating point	R	nnnnn		
Task register	888	integer, see C.1.1	W	hhhh		
Software version #	890	string	R	aaaaaa		
Product ID #	892	string	R	aaaaaaaaa		
Device serial number #	893	string	R	aaaaaaaa		

NOTE: The # denotes global parameters affecting all injector channels.

5.2 Fusion4 MSC-L



5.2.1 Description

The AccuLoad Emulation functionality in the Fusion4 MSC-L allows the Fusion4 MSC-L to interact with a TAS in the same way as AccuLoad III interacts. Due to some inherent differences between the devices, the functionality of Standby mode and Remote mode is not implemented for Accuload Emulation. Therefore, all supported commands currently work irrespective of the mode of the Fusion4 MSC-L.

The Fusion4 MSC-L supports two protocols for AccuLoad Emulation mode.

- Communications for Terminal Mode of Operation, see section 5.2.1.1
- Communications for Minicomputer Mode of Operation, see section 5.2.1.2

5.2.1.1 Communications for Terminal Mode of Operation

In Communications for Terminal Mode of Operation there are two different message formats:

The message format for a command instruction to AccuLoad III is:

*	A1A2	text	CR	LF

Term	Description	Hex value
*	Start of the message	$2A_{HEX}$
A_1A_2	2-digit Fusion4 MSC-L address (01...99)	
text	ASCII string containing the command instruction	
CR	Carriage Return	$0D_{HEX}$
LF	Line Feed	$0A_{HEX}$

NOTES:

1. The CR-LF characters define the end of the message.
2. No error checking other than parity on each character is performed.

The message format for a response/acknowledgment from the Fusion4 MSC-L is:

*	A1A2	text	CR	LF

Term	Description	Hex value
*	Start of the message	$2A_{HEX}$
A_1A_2	2-digit Fusion4 MSC-L address (01...99)	
text	ASCII string containing the response/acknowledgment	
CR	Carriage Return	$0D_{HEX}$
LF	Line Feed	$0A_{HEX}$

NOTES:

1. The CR-LF characters define the end of the message.
2. No error checking other than parity on each character is performed.

5.2.1.2 Communications for Minicomputer Mode of Operation

In Communications for Minicomputer Mode of Operation there are two different message formats:

The message format for a command instruction:

STX	A1A2	text	ETX	LRC

Term	Description	Hex value
STX	Start of Text	02_{HEX}
A_1A_2	2-digit Fusion4 MSC-L address (01...99)	
text	ASCII string containing the command instruction	
ETX	End of Text	03_{HEX}
LRC	Longitudinal Redundancy Check	$0A_{HEX}$

The message format for a response/acknowledgment from the Fusion4 MSC-L is:

NL	STX	A1A2	text	ETX	LRC	PAD

Term	Description	Hex value
NL	Null character	00_{HEX}
STX	Start of Text	02_{HEX}
A_1A_2	2-digit Fusion4 MSC-L address (01...99)	
text	ASCII string containing the response/acknowledgment	
ETX	End of Text	03_{HEX}
LCR	Longitudinal Redundancy Check	
PAD	Pad character	$7F_{HEX}$

5.2.2 Configuring AccuLoad Emulation functionality on the Fusion4 MSC-L

Configure the following from the HMI:

1. Install the AccuLoad Emulation Workflow from the installation package.
2. Set the communication protocol of the selected COM port to Terminal host or Minicomputer host. Set the baud rate, parity, etc. the same as the host side.
3. Set the arm address for each arm from the arm identification menu. This address needs to be the same as the one set on the host side.
4. From the device configuration menu, set the emulation type as AccuLoad.
5. From the Workflow Settings menu, set the workflow mode as 'Remote only' and also set the correct timeout. When a command is not set within this timeout, the Fusion4 MSC-L will go to Standby mode and only the RE_SA command (see section 5.2.4.16) will get it back in Remote mode.

> NOTE: In Standby mode it is currently not possible to perform transactions locally.

5.2.3 Fusion4 MSC-L Product Numbering

There are many commands in AccuLoad that fetch data by sending a product number as a part of the command. In AccuLoad it is possible to assign up to six products to an arm and then these can be addressed as product 1 through 6 in a command. However, in Fusion4 MSC-L streams are assigned to an arm. To match this with the AccuLoad method, the products are numbered as follows.

Consider that for an arm in Fusion4 MSC-L, streams 2, 4, 6, 8 and 10 are assigned to this arm through the arm configuration. These will be then internally numbered as product 1 through 5 for Emulation, i.e.:

- Product 1 = Stream 2
- Product 2 = Stream 4
- Product 3 = Stream 6
- Product 4 = Stream 8
- Product 5 = Stream 10
- Product 6 = Not used on this arm

5.2.4 Commands

5.2.4.1 AB - Allocate Blend Recipes

This command allocates the blend recipes that will be allowable for selection. This allocation is a subset of those enabled in Program mode.

- Command

AB_C1C2C3...C13	
Where C1C2C3...C13 is the three- to thirteen-character bit map. See section 5.2.4.1.1 up to and including section 5.2.4.1.13 for more information.	

- Response

OK	Good Response. Recipes were allocated
or	
NOXX	Recipes were not allocated.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks:

1. AccuLoad III has a total of 50 recipes on device level, whereas the Fusion4 MSC-L has 50 recipes per arm. Therefore, when the recipe numbers are sent for a particular arm, these recipes need to be configured on that arm in the Fusion4 MSC-L.
2. A one allocates the corresponding recipe number for selection. Allocation is cancelled when Transaction done status is being set.
3. Allocation is also cancelled if, when in Remote Control mode, a power-fail restart occurs between batches.
4. This command does not require all characters. A minimum of three char- acters is accepted. For those characters omitted, the corresponding recipes are not allocated.
5. This command will automatically exit from Program mode when initiated

Constraints: Recipe allocation remains in effect for the current transaction only.

Special Case: None

5.2.4.1.1 AB - Allocate Blend Recipes Command: Character 1

The following table describes character 1 of the AB command.

Table 5-6: AB command: Character 1

Character		Recipe Request			
Char	Hex	Recipe 4	Recipe 3	Recipe 2	Recipe 1
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.2 AB - Allocate Blend Recipes Command: Character 2

The following table describes character 2 of the AB command.

Table 5-7: AB command: Character 2

Character		Recipe Request			
Char	Hex	Recipe 8	Recipe 7	Recipe 6	Recipe 5
0	30				
1	31				X
2	32			X	

Character		Recipe Request			
Char	Hex	Recipe 8	Recipe 7	Recipe 6	Recipe 5
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.3 AB - Allocate Blend Recipes Command: Character 3

The following table describes character 3 of the AB command.

Table 5-8: AB command: Character 3

Character		Recipe Request			
Char	Hex	Recipe 12	Recipe 11	Recipe 10	Recipe 9
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X

Character		Recipe Request			
Char	Hex	Recipe 12	Recipe 11	Recipe 10	Recipe 9
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.4 AB - Allocate Blend Recipes Command: Character 4

The following table describes character 4 of the AB command.

Table 5-9: AB command: Character 4

Character		Recipe Request			
Char	Hex	Recipe 16	Recipe 15	Recipe 14	Recipe 13
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.5 AB - Allocate Blend Recipes Command: Character 5

The following table describes character 5 of the AB command.

Table 5-10: AB command: Character 5

Character		Recipe Request			
Char	Hex	Recipe 20	Recipe 19	Recipe 18	Recipe 17
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.6 AB - Allocate Blend Recipes Command: Character 6

The following describes character 6 of the AB command.

Table 5-11: AB command: Character 6

Character		Recipe Request			
Char	Hex	Recipe 24	Recipe 23	Recipe 22	Recipe 21
0	30				
1	31				X
2	32			X	

Character		Recipe Request			
Char	Hex	Recipe 24	Recipe 23	Recipe 22	Recipe 21
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.7 AB - Allocate Blend Recipes: Character 7

The following table describes character 7 of the AB command.

Table 5-12: AB command: Character 7

Character		Recipe Request			
Char	Hex	Recipe 28	Recipe 27	Recipe 26	Recipe 25
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X

Character		Recipe Request			
Char	Hex	Recipe 28	Recipe 27	Recipe 26	Recipe 25
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.8 AB - Allocate Blend Recipes: Character 8

The following table describes character 8 of the AB command.

AB command: Character 8

Characters		Recipe Request			
Char	Hex	Recipe 32	Recipe 31	Recipe 30	Recipe 29
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.9 Allocate Blend Recipes: Character 9

The following table describes character 9 of the AB command.

Figure 5-1: AB command: Character 9

Characters		Recipe Request			
Char	Hex	Recipe 36	Recipe 35	Recipe 34	Recipe 33
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

AB - Allocate Blend Recipes: Character 10

The following table describes character 10 of the AB command.

Table 5-13: AB command: Character 10

Characters		Recipe Request			
Char	Hex	Recipe 40	Recipe 39	Recipe 38	Recipe 37
0	30				
1	31				X
2	32			X	
3	33			X	X

Characters		Recipe Request			
Char	Hex	Recipe 40	Recipe 39	Recipe 38	Recipe 37
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.10 AB - Allocate Blend Recipes: Character 11

The following table describes character 11 of the AB command.

Figure 5-2: AB command: Character 11

Characters		Recipe Request			
Char	Hex	Recipe 44	Recipe 43	Recipe 42	Recipe 41
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	

Characters		Recipe Request			
Char	Hex	Recipe 44	Recipe 43	Recipe 42	Recipe 41
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.11 AB - Allocate Blend Recipes: Character 12

The following table describes character 12 of the AB command.

Table 5-14: AB command: Character 12

Character		Recipe Request			
Char	Hex	Recipe 48	Recipe 47	Recipe 46	Recipe 45
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.1.12 AB - Allocate Blend Recipes: Character 13

The following table describes character 13 of the AB command.

Figure 5-3: AB command: Character 13

Character		Recipe Request			
Char	Hex	Reserved	Reserved	Recipe 50	Recipe 49
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.2 AR - Alarm Reset

This command resets one of the alarms currently registered at the Fusion4 MSC-L.

- Command

AR AR_XX_DD AR_XX_IN_YY	Reset all alarms in all tables. Reset specific alarm for a specified directory. Reset specific alarm for the specified injector.

XX = Two-character alarm code. See section 5.2.4.2.1 up to and including section 5.2.4.2.5 for more information.

DD = Directory, where:

- SY = System
- P1 = Product 1
- P2 = Product 2
- P3 = Product 3
- P4 = Product 4
- P5 = Product 5
- P6 = Product 6
- AR = Arm
- M1 = Meter 1
- M2 = Meter 2 (Ratio, hybrid blending configuration only)
- M3 = Meter 3 (Ratio, hybrid blending configuration only)
- M4 = Meter 4 (Ratio, hybrid blending configuration only)
- M5 = Meter 5 (Ratio, hybrid blending configuration only)
- M6 = Meter 6 (Ratio, hybrid blending configuration only)
- IN = Additive injector
- RR = Recipe (01 - 50)

YY = Injector (01...24)

- Response

OK	Good response
or	
NOXX	The alarm was not reset
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The two-character alarm code must be one of those alarms that is allowed to be reset through the communication channel.

Constraints: The alarm code must be able to be reset through communications. If it is allowed, it must be pending or a ”NO” will be returned.

Special Case: A special code, ”AA”, may be used to reset all resettable alarms that are pending in the directory specified.

5.2.4.2.1 System Alarms That Can Be Reset Through Communications

The following table gives an overview of the System alarms that can be reset through communications.

Table 5-15: System Alarms

Code	Condition
CM	Communications Alarm - Communications failure on one of the communications channels.
PA	Power-fail Alarm - The unit either had a power failure or a hardware reset occurred.
U1	User Alarm #1
U2	User Alarm #2
U3	User Alarm #3
U4	User Alarm #4
U5	User Alarm #5
U6	User Alarm #6

5.2.4.2.2 Injector Alarms That Can Be Reset Through Communications

The following table gives an overview of the Injector alarms that can be through communications.

Table 5-16: Injector Alarms

Code	Condition
KA	Low Additive Error - Indicates that not enough additive was injected during one cycle or an average of several cycles.
NA	No Additive Pulses Error - Indicates that the additive flow meter's pulses were not detected.
GA	General Additive Error - Indicates that there is an additive injector error.
AH	Additive High Temperature Alarm - Used only for flow controlled additive types. Temperature probe or transducer is out of range with high alarm setting.
AL	Additive Low Temperature Alarm - Used only for flow controlled additive types. Temperature probe or transducer is out of range with low alarm setting.
AT	Additive Temperature Probe - Used only for flow controlled additive types. Short or open condition in temperature probe.
PS	Pulse Security - Used only with the security option. Indicated that an excessive number of out- of-sequence errors in the A-B pulse stream have been detected on one of the flow controlled additive meters.
XA	Indicates a collision in the incoming pulse stream. (The signals on A and A-bar or B and B-bar are the same).
CT	Indicates that the additive total received from the smart additive system may be erroneous.

5.2.4.2.3 Arm Alarms That Can Be Reset Through Communications

The following table gives an overview of the Arm alarms that can be through communications.

Table 5-17: Arm Alarms

Code	Condition
CA	Additive Clean Line - The additive clean line volume delivered has under-run the additive clean line volume programmed.
CL	Clean Line - The clean line volume delivered has under-run the clean line volume programmed by at least the amount of clean line alarm limit.

Code	Condition
HF	High Flow - Flow rate has exceeded limit set by Excess High Flow program parameter for more than 4 seconds.
OA	Overrun - Volume delivered has exceeded the preset amount by at least the number of units set in the Overrun Limit program code.

5.2.4.2.4 Meter Alarms That Can Be Reset Through Communications

The following table gives an overview of the Meter alarms that can be through communications.

Table 5-18: Meter Alarms

Code	Condition
DR	Density Transducer - Density transducer failure or out-of-range condition.
LA	Leakage Alarm - Indicates that leakage between transactions has exceeded the programmed "leakage alarm limit" (system 202).
PR	Pressure Transducer - Pressure transducer failure or out-of-range condition.
TP	Temperature Probe - Short or open condition in the temperature probe circuit.
VF	Valve Fault - Indicates that the meter was still registering flow when the valve fault timer expired after the Fusion4 MSC-L commanded the valve to close.
XA	Indicates a collision in the incoming pulse stream. (The signals on A and A-bar or B and B-bar are the same).

5.2.4.2.5 Product Alarms That Can Be Reset Through Communications

The following table gives an overview of the Product alarms that can be reset through communications.

Table 5-19: Product Alarms

Code	Condition
BH	Blend High Alarm - An overflow on this product has caused a blend tolerance to be exceeded.
BL	Blend Low Alarm - An underflow on this product has caused the blend tolerance to be exceeded.

Code	Condition
BV	Block Valve Alarm - The valve did not close within 10 seconds after receiving the signal to close.
HD	High Density - Density transducer is out of range of the high alarm setting.
HF	High Flow Alarm - Flow rate has exceeded limit set by Excess High Flow program code for more than 4 seconds.
HP	High Pressure - Pressure transducer is out of range of the high alarm setting.
HT	High Temperature - Temperature probe or transducer is out of range of the high alarm setting.
LD	Low Density - Density transducer is out of range of the low alarm setting.
LF	Low Flow Alarm - Flow rate was at or below the minimum flow rate established by Low Flow Limit program code for longer than 8 seconds.
LP	Low Pressure - Pressure transducer is out of range of the low alarm setting.
LT	Low Temperature - Temperature probe or transducer is out of range of the low alarm setting.
OA	Overrun Alarm - Volume delivered has exceeded the preset amount by at least the number of units set in the overrun limit program code.
UF	Unauthorized Flow - The Fusion4 MSC-L has detected unauthorized flow.

5.2.4.3 AV - Request Additive Volumes by Batch

This command retrieves additive batch volumes from the Fusion4 MSC-L.

- Command

Current Transaction AV_XX AV_XX_Z AV_XX_YY AV_XX_YY_Z Local Storage Transaction AV_XX_YY_NNN AV_XX_YY_Z_NNN		Total additive of batch in progress (delivery type for flow controlled additive) Total additive, by volume type, of batch in progress if that type is available Total additive of a specified batch Total additive of specified batch, specified volume type if volume was stored Total additive of a specified batch in an historic transaction Total additive, volume type, of specified batch in an historic transaction for flow controlled additives
XX	=	Additive number (01...24)
YY	=	Batch number requested
Z	=	G (GV Total)
	=	N (GST Total)
	=	M (Mass Total)
NNN	=	Number of transactions back into local storage to retrieve the data

- Response

Current transaction AV_XX_YY_VVVV.VV AV_XX_Z_VVVV.VV AV_XX_YY_Z_VVVV.VV Local Storage Transaction AV_XX_YY_VVVV.VV_NNN AV_XX_YY_Z_VVVV.VV_NNN		Good response. For AV_XX and AV_XX_YY Good response for AV_XX_Z Good response for AV_XX_YY_Z Good response for AV_XX_YY_NN Good response for AV_XX_YY_Z_NNN
XX	=	Additive number (01…24)
YY	=	Batch number requested
Z	=	R for Raw or Indicated (IV) Total
	=	G for Gross (GV) Total
	=	N for Gross at Standard Temperature (GST) Total
	=	M for Mass Total
VVVV.VV		Total Additive Batch Volume
NNN		Number of transactions back into local storage to retrieve the data
or		
NOXX		Additive batch volumes have not been retrieved.
XX	=	Two-digit error code as defined in section 5.1.1.4.

Remarks: If bays are configured, the AV for the current batch returns the current batch on the arm addressed (or NO39 if no batch is in progress for the arm). For an AV command for a completed batch, the batch argument specified in the batch is the bay-based transaction, and hence may return a batch completed on an arm that is not the arm being addressed.

Constraints:

1. The commands AV_XX_Z, AV_XX_YY_Z_NNN, and AV_XX_YY_Z will work only when "Z" is "G for Gross (GV) Total".
2. Volume units are assumed as the type programmed into the Fusion4 MSC-L. Volume types are available for flow controlled additives only.

Special Case: None

5.2.4.4 BA - Bay Assignment

This command retrieves the position of each arm in the bay.

- Command

BA	

- Response

BA_A1A2A3A4A5A6	Good response. The position of each arm in the bay was retrieved.
An n is a character representing the position of arm n: • A = Bay A • B = Loading bay B • ? = In transit	
or	
NOXX	The position of each arm in the bay was not retrieved.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: None

Constraints: None

Special Case: None

5.2.4.5 DY - Request Dynamic Display Values

This command retrieves a current dynamic display value from the Fusion4 MSC-L.

- Command

DY_ddxx	
dd = Dynamic display type: • SY = System • P1 = Product #1 • P2 = Product #2 • P3 = Product #3 • P4 = Product #4 • P5 = Product #5 • P6 = Product #6 • Bz = batch, where "z" is 1...9 for batches 1...9, and "A" for batch 10 • CB = current batch xx = Variable number to access. See section 5.2.4.5.1 up to and including section 5.2.4.5.5 for more information.	

- Response

DY_V..V_D..D	Good response
V..V = Value of the variable D..D = Description of the variable (may contain spaces)	
NOXX	Requested display was not returned.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks:

1. No response exceeds 31 characters.
2. For bay configurations, the following information applies:
   - All additives on the bay can be accessed via any valid arm address located on the bay.
   - Batch values are for the bay-based batch.

- Not all transaction "DY" values are available when bays are configured, i.e., average temperature, pressure, meter factor, etc.

Constraints:

1. NO06 will be returned if the requested batch has not been delivered (Bz qualifier).
2. NO05 will be returned if there is no transaction in progress and no trans- action has ever been done (TR qualifier).
3. NO30 will be returned if a product or recipe is requested which is not currently allocated to the arm to which the command was directed.
4. NO31 will be returned if the command format does not match the current configuration for the arm.

Special Case: None

5.2.4.5.1 DY_SYXX - System Dynamic Display Values

The following table gives an overview of the System dynamic display values.

Table 5-20: System dynamic display values

Index Number (XX)	Description	Response
00	Current Flow Rate Units/Min, Arm 1	DY Flow (Arm 1)XXXXX.X Gal/Min
01	Current Flow Rate Units/Min, Arm 2	DY Flow (Arm 2)XXXXX.X Gal/Min
02	Current Flow Rate Units/Min, Arm 3	DY Flow (Arm 3)XXXXX.X Gal/Min
03	Current Flow Rate Units/Min, Arm 4	DY Flow (Arm 4)XXXXX.X Gal/Min
04	Current Flow Rate Units/Min, Arm 5	DY Flow (Arm 5)XXXXX.X Gal/Min
05	Current Flow Rate Units/Min, Arm 6	DY Flow (Arm 6)XXXXX.X Gal/Min

Index Number (XX)	Description	Response
06	Current Flow Rate Units/Hr, Arm 1	DY Flow (Arm 1)XXXXXXX.X Gal/Hr
07	Current Flow Rate Units/Hr, Arm 2	DY Flow (Arm 2)XXXXXXX.X Gal/Hr
08	Current Flow Rate Units/Hr, Arm 3	DY Flow (Arm 3)XXXXXXX.X Gal/Hr
09	Current Flow Rate Units/Hr, Arm 4	DY Flow (Arm 4)XXXXXXX.X Gal/Hr
10	Current Flow Rate Units/Hr, Arm 5	DY Flow (Arm 5)XXXXXXX.X Gal/Hr
11	Current Flow Rate Units/Hr, Arm 6	DY Flow (Arm 6)XXXXXXX.X Gal/Hr
12	Current Recipe Name, Arm 1	DY Recipe (Arm 1) XXXXXXXXX
13	Current Recipe Name, Arm 2	DY Recipe (Arm 2) XXXXXXXXX
14	Current Recipe Name, Arm 3	DY Recipe (Arm 3) XXXXXXXXX
15	Current Recipe Name, Arm 4	DY Recipe (Arm 4) XXXXXXXXX
16	Current Recipe Name, Arm 5	DY Recipe (Arm 5) XXXXXXXXX
17	Current Recipe Name, Arm 6	DY Recipe (Arm 6) XXXXXXXXX
18	Current Preset, Arm 1	DY Preset (Arm 1) XXXXXX Gal
19	Current Preset, Arm 2	DY Preset (Arm 2) XXXXXX Gal
20	Current Preset, Arm 3	DY Preset (Arm 3) XXXXXX Gal
21	Current Preset, Arm 4	DY Preset (Arm 4) XXXXXX Gal
22	Current Preset, Arm 5	DY Preset (Arm 5) XXXXXX Gal
23	Current Preset, Arm 6	DY Preset (Arm 6) XXXXXX Gal
24	Current Delivered Volume, Arm 1	DY Deliv. (Arm 1) XXXXXXX.XX Gal
25	Current Delivered Volume, Arm 2	DY Deliv. (Arm 2) XXXXXXX.XX Gal
26	Current Delivered Volume, Arm 3	DY Deliv. (Arm 3) XXXXXXX.XX Gal

Index Number (XX)	Description	Response
27	Current Delivered Volume, Arm 4	DY Deliv. (Arm 4) XXXXXXX.XX Gal
28	Current Delivered Volume, Arm 5	DY Deliv. (Arm 5) XXXXXXX.XX Gal
29	Current Delivered Volume, Arm 6	DY Deliv. (Arm 6) XXXXXXX.XX Gal
30	Current Remaining Volume, Arm 1	DY Remain. (Arm 1) XXXXXXX.XX Gal
31	Current Remaining Volume, Arm 2	DY Remain. (Arm 2) XXXXXXX.XX Gal
32	Current Remaining Volume, Arm 3	DY Remain. (Arm 3) XXXXXXX.XX Gal
33	Current Remaining Volume, Arm 4	DY Remain. (Arm 4) XXXXXXX.XX Gal
34	Current Remaining Volume, Arm 5	DY Remain. (Arm 5) XXXXXXX.XX Gal
35	Current Remaining Volume, Arm 6	DY Remain. (Arm 6) XXXXXXX.XX Gal
36	Time of Last Power Fail	DY HH:MM:SS AM MM-DD-YY

5.2.4.5.2 DY_INXX - Injector Dynamic Display Values

The following table gives an overview of the Injector dynamic display values.

Table 5-21: Injector dynamic display values

Index Number (XX)	Description	Response
00	Injector 1 Current Pulse Rate	DY Inj 1 Cal XXXX.XX
01	Injector 2 Current Pulse Rate	DY Inj 2 Cal XXXX.XX
02	Injector 3 Current Pulse Rate	DY Inj 3 Cal XXXX.XX
03	Injector 4 Current Pulse Rate	DY Inj 4 Cal XXXX.XX
04	Injector 5 Current Pulse Rate	DY Inj 5 Cal XXXX.XX
05	Injector 6 Current Pulse Rate	DY Inj 6 Cal XXXX.XX

Index Number (XX)	Description	Response
06	Injector 7 Current Pulse Rate	DY Inj 7 Cal XXXX.XX
07	Injector 8 Current Pulse Rate	DY Inj 8 Cal XXXX.XX
08	Injector 9 Current Pulse Rate	DY Inj 9 Cal XXXX.XX
09	Injector 10 Current Pulse Rate	DY Inj 10 Cal XXXX.XX
10	Injector 11 Current Pulse Rate	DY Inj 11 Cal XXXX.XX
11	Injector 12 Current Pulse Rate	DY Inj 12 Cal XXXX.XX
12	Injector 13 Current Pulse Rate	DY Inj 13 Cal XXXX.XX
13	Injector 14 Current Pulse Rate	DY Inj 14 Cal XXXX.XX
14	Injector 15 Current Pulse Rate	DY Inj 15 Cal XXXX.XX
15	Injector 16 Current Pulse Rate	DY Inj 16 Cal XXXX.XX
16	Injector 17 Current Pulse Rate	DY Inj 17 Cal XXXX.XX
17	Injector 18 Current Pulse Rate	DY Inj 18 Cal XXXX.XX
18	Injector 19 Current Pulse Rate	DY Inj 19 Cal XXXX.XX
19	Injector 20 Current Pulse Rate	DY Inj 20 Cal XXXX.XX
20	Injector 21 Current Pulse Rate	DY Inj 21 Cal XXXX.XX
21	Injector 22 Current Pulse Rate	DY Inj 22 Cal XXXX.XX
22	Injector 23 Current Pulse Rate	DY Inj 23 Cal XXXX.XX
23	Injector 24 Current Pulse Rate	DY Inj 24 Cal XXXX.XX
24	Injector 1 Programmed Pulse Rate	DY Inj 1 Prg XXXX.XX
25	Injector 2 Programmed Pulse Rate	DY Inj 2 Prg XXXX.XX
26	Injector 3 Programmed Pulse Rate	DY Inj 3 Prg XXXX.XX
27	Injector 4 Programmed Pulse Rate	DY Inj 4 Prg XXXX.XX
28	Injector 5 Programmed Pulse Rate	DY Inj 5 Prg XXXX.XX
29	Injector 6 Programmed Pulse Rate	DY Inj 6 Prg XXXX.XX
30	Injector 7 Programmed Pulse Rate	DY Inj 7 Prg XXXX.XX
31	Injector 8 Programmed Pulse Rate	DY Inj 8 Prg XXXX.XX
32	Injector 9 Programmed Pulse Rate	DY Inj 9 Prg XXXX.XX
33	Injector 10 Programmed Pulse Rate	DY Inj 10 Prg XXXX.XX
34	Injector 11 Programmed Pulse Rate	DY Inj 11 Prg XXXX.XX
35	Injector 12 Programmed Pulse Rate	DY Inj 12 Prg XXXX.XX

Index Number (XX)	Description	Response
36	Injector 13 Programmed Pulse Rate	DY Inj 13 Prg XXXX.XX
37	Injector 14 Programmed Pulse Rate	DY Inj 14 Prg XXXX.XX
38	Injector 15 Programmed Pulse Rate	DY Inj 15 Prg XXXX.XX
39	Injector 16 Programmed Pulse Rate	DY Inj 16 Prg XXXX.XX
40	Injector 17 Programmed Pulse Rate	DY Inj 17 Prg XXXX.XX
41	Injector 18 Programmed Pulse Rate	DY Inj 18 Prg XXXX.XX
42	Injector 19 Programmed Pulse Rate	DY Inj 19 Prg XXXX.XX
43	Injector 20 Programmed Pulse Rate	DY Inj 20 Prg XXXX.XX
44	Injector 21 Programmed Pulse Rate	DY Inj 21 Prg XXXX.XX
45	Injector 22 Programmed Pulse Rate	DY Inj 22 Prg XXXX.XX
46	Injector 23 Programmed Pulse Rate	DY Inj 23 Prg XXXX.XX
47	Injector 24 Programmed Pulse Rate	DY Inj 24 Prg XXXX.XX

5.2.4.5.3 DY_PNXX - Product Dynamic Display Values

The following table gives an overview of the Product dynamic display values.

Table 5-22: Product dynamic display values

Index Number (XX)	Description	Response
00	Current Flow Rate, Units/Minute	DY Flow XXXXX.X Gal/Min
01	Current Flow Rate, Units/Hour	DY Flow XXXXXXX.X Gal/Hr
02	Batch Average Temperature	DY Temperature SXXXX.X F
03	Batch Average Density	DY Density XXXX.X Kg/M3
04#	Batch Average API	DY API SXXX.X
05#	Batch Average Reference Density	DY Ref Dens XXXX.X Lb/F3
06#	Batch Average Relative Density	DY Rel Dens X.XXXX
07	Batch Average Pressure	DY Pressure XXXX.X PSI

Index Number (XX)	Description	Response
08#	Batch Average Vapor Pressure	DY Avg Vapor Press XXXX.X PSI
09#	Batch Average Meter Factor	DY Cur Meter Factor X.XXXXX
10#	Batch Average CTL	DY Batch Avg CTL X.XXXXX
11#	Batch Average CPL	DY Batch Avg CPL X.XXXXX
12	Current Temperature	DY Current Temp SXXXX.X F
13	Current Density	DY Current Density SXXXX.X Kg/M3
14#	Current Meter Factor	DY Current Meter Fact. X.XXXXX
15#	Current Valve Requested Position	DY Valve Requested Closed
16#	Current Percentage of Batch	DY Current % XXX %
17	Desired Percentage of Batch	DY Desired % XXX %
18#	Current Batch Raw Volume	DY Raw Batch XXXXXXX.XX Gal
19	Current Batch Gross Volume	DY Gross Batch XXXXXXX.XX Gal
20	Current Batch GST Volume	DY GST Batch XXXXXXX.XX Gal
21	Current Batch GSV Volume	DY GSV Batch XXXXXXX.XX Gal
22	Current Batch Mass Total	DY Mass Batch XXXXXXX.XX Lbs
23#	Transaction Raw Volume	DY Raw Trans XXXXXXX.XX Gal
24#	Transaction Gross Volume	DY Gross Trans XXXXXXX.XX Gal

Index Number (XX)	Description	Response
25#	Transaction GST Volume	DY GST Trans XXXXXXX.XX Gal
26#	Transaction GSV Volume	DY GSV Trans XXXXXXX.XX Gal
27#	Transaction Mass Total	DY Mass Trans XXXXXXX.XX Lbs
28	Batch Current Density	DY Cur: Dens XXXX.X Lb/F3

NOTE: For P1...P6 (= Product 1 to Product 6) the variables marked with # will respond NOXX as these are not accessible/not used on the Fusion4 MSC-L.

5.2.4.5.4 DY_DDXX - Recipe Dynamic Display Values

The following table gives an overview of the Recipe dynamic display values.

Table 5-23: Recipe dynamic display values

Index Number (XX)	Description	Response
00	Recipe Name and Number	DY Recipe XX = XXXXXXXXX
01	Transaction Raw Volume	DY R#XX Raw Trans XXXXXXX Gal
02	Transaction Gross Volume	DY R#XX Gross Trans XXXXXXX Gal
03	Transaction GST Volume	DY R#XX GST Trans XXXXXXX Gal
04	Transaction GSV Volume	DY R#XX GSV Trans XXXXXXX Gal
05	Transaction Mass Total	DY R#XX Mass Trans XXXXXXX Gal

5.2.4.5.5 DY_BNXX - Batch Dynamic Display Values

The following table gives an overview of the Batch dynamic display values.

Table 5-24: Batch dynamic display values

Index Number (XX)	Description	Response
00	Recipe Name and Number	DY Recipe XX = XXXXXXXXX
01#	Indicated (Raw) Batch Volume	DY Raw Batch XXXXXXX.XX Gal
02	Gross Batch Volume	DY Gross Batch XXXXXXX.XX Gal

Index Number (XX)	Description	Response
03#	GST Batch Volume	DY GST Batch XXXXXXX.XX Gal
04	GSV Batch Volume	DY GSV Batch XXXXXXX.XX Gal
05	Mass Batch Total	DY Mass Batch XXXXXXX.XX Gal
06	Batch Average Temperature	DY Batch Avg Temp SXXXX.X F
07	Batch Average Density	DY Batch Avg Dens XXXX.X Lb/F3
08	Batch Average Pressure	DY Batch Avg Pres XXXX.X PSI
09#	Batch Average Meter Factor	DY Batch Avg Mtr Factor X.XXXXX
10#	Batch Average CTL	DY Batch Avg CTL X.XXXXX
11#	Batch Average CPL	DY Batch Avg CPL X.XXXXX
12	Additive #1 Batch Volume	DY Add 1 Batch XXXXXXXX.XXX
13	Additive #2 Batch Volume	DY Add 2 Batch XXXXXXXX.XXX
14	Additive #3 Batch Volume	DY Add 3 Batch XXXXXXXX.XXX
15	Additive #4 Batch Volume	DY Add 4 Batch XXXXXXXX.XXX
16	Additive #5 Batch Volume	DY Add 5 Batch XXXXXXXX.XXX
17	Additive #6 Batch Volume	DY Add 6 Batch XXXXXXXX.XXX
18	Additive #7 Batch Volume	DY Add 7 Batch XXXXXXXX.XXX
19	Additive #8 Batch Volume	DY Add 8 Batch XXXXXXXX.XXX

Index Number (XX)	Description	Response
20	Additive #9 Batch Volume	DY Add 9 Batch XXXXXXXX.XXX
21	Additive #10 Batch Volume	DY Add 10 Batch XXXXXXXX.XXX
22	Additive #11 Batch Volume	DY Add 11 Batch XXXXXXXX.XXX
23	Additive #12 Batch Volume	DY Add 12 Batch XXXXXXXX.XXX
24#	Additive #13 Batch Volume	DY Add 13 Batch XXXXXXXX.XXX
25#	Additive #14 Batch Volume	DY Add 14 Batch XXXXXXXX.XXX
26#	Additive #15 Batch Volume	DY Add 15 Batch XXXXXXXX.XXX
27#	Additive #16 Batch Volume	DY Add 16 Batch XXXXXXXX.XXX
28#	Additive #17 Batch Volume	DY Add 17 Batch XXXXXXXX.XXX
29#	Additive #18 Batch Volume	DY Add 18 Batch XXXXXXXX.XXX
30#	Additive #19 Batch Volume	DY Add 19 Batch XXXXXXXX.XXX
31#	Additive #20 Batch Volume	DY Add 20 Batch XXXXXXXX.XXX
32#	Additive #21 Batch Volume	DY Add 21 Batch XXXXXXXX.XXX
33#	Additive #22 Batch Volume	DY Add 22 Batch XXXXXXXX.XXX
34#	Additive #23 Batch Volume	DY Add 23 Batch XXXXXXXX.XXX
35#	Additive #24 Batch Volume	DY Add 24 Batch XXXXXXXX.XXX

Index Number (XX)	Description	Response

NOTE: For Bz (= Batch, were z is 1 to 9 for batches 1 to 9, and A for batch 10), and CB (= Current batch) the variables marked with # will respond NOXX as these are not used/accessible on the Fusion4 MSC-L.

5.2.4.6 Command Code EA - Enquire Alarms

This command requests the alarm status from the Fusion4 MSC-L (short form).

- Command

EA_DD	Request alarm status of directory.

DD = Directory specification:

- SY = System
- P1 = Product #1
- P2 = Product #2
- P3 = Product #3
- P4 = Product #4
- P5 = Product #5
- P6 = Product #6
- AR = Arm
- IN = Injector
- M1 = Meter
- M2 = Meter 2 (ratio, hybrid blending configuration only)
- M3 = Meter 3 (ratio, hybrid blending configuration only)
- M4 = Meter 4 (ratio, hybrid blending configuration only)
- M5 = Meter 5 (ratio, hybrid blending configuration only)
- M6 = Meter 6 (ratio, hybrid blending configuration only)
- RR = Recipe

- Response

EA_SY_ A1A2A3A4A5A6A8A9A10 EA_Px_A1A2A3A4 EA_AR_ A1A2A3	Good Response. Ten characters for System. Good Response. Four characters for Products. Good Response. Three characters for Arm.
EA_IN_A1A2A3 ... A77	Good Response. Seventy-seven characters for Additive Injectors.
EA_Mx_A1A2A3 EA_RR_A1	Good Response. Three characters for Meter. Good Response. One character for Recipe.
or	
NOXX	Requested display not returned
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: Allow for additional characters to be added to the end when alarms are added in the future.

Constraints:

1. NO30 will be returned if the meter, product or additive specified is not currently configured to the arm which the request was sent.
2. NO31 will be returned if the command format does not match the current configuration for the arm.

Special Case: None

5.2.4.6.1 Response to EA_SY command: Characters A1 and A2

The system alarm requests associated with characters A1 and A2 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.2 Response to EA_SY command: Character A3

The following table describes character A3 in the response to an EA_SY command.

Table 5-25: Response to EA_SY command: Character A3

Character		System Alarm Requests			
Char	Hex	Communication (CM)	Power Failure (PA)	Passcode Reset (DA)	BSE Failure (DA)
0	30				
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		X		
5	35		X		N/A
6	36		X	N/A	
7	37		X	N/A	N/A
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A
<	3C	X	X		
=	3D	X	X		N/A
>	3E	X	X	N/A	
?	3F	X	X	N/A	N/A

NOTE: The system alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.3 Response to EA_SY command: Character A4

The following table describes character A4 in the response to an EA_SY command.

Table 5-26: Response to EA_SY command: Character A4

Character		System Alarm Requests			
Char	Hex	User Alarm 1 (U1)	PTB Printer (PP)	Shared Printer (SP)	CIVACON Comm Failure (CV)
0	30				
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		N/A		
5	35		N/A		N/A
6	36		N/A	N/A	
7	37		N/A	N/A	N/A
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A
<	3C	X	N/A		
=	3D	X	N/A		N/A
>	3E	X	N/A	N/A	
?	3F	X	N/A	N/A	N/A

NOTE: The system alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.4 Response to EA_SY command: Character A5

The following table describes character A5 in the response to an EA_SY command.

Table 5-27: Response to EA_SY: Character A5

Character		System Alarm Requests			
Char	Hex	User Alarm 5 (U5)	User Alarm 4 (U4)	User Alarm 3 (U3)	User Alarm 2 (U2)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.5 Response to EA_SY command: Character A6

The following table describes character A6 in the response to an EA_SY command.

Table 5-28: Response to EA_SY command: Character A6

Character		System Alarm Requests			
Char	Hex	User Alarm 9 (U9)	User Alarm 8 (U8)	User Alarm 7 (U7)	User Alarm 6 (U6)
0	30				
1	31				X
2	32			N/A	
3	33			N/A	X

Character		System Alarm Requests			
Char	Hex	User Alarm 9 (U9)	User Alarm 8 (U8)	User Alarm 7 (U7)	User Alarm 6 (U6)
4	34		N/A		
5	35		N/A		X
6	36		N/A	N/A	
7	37		N/A	N/A	X
8	38	N/A			
9	39	N/A			X
:	3A	N/A		N/A	
;	3B	N/A		N/A	X
<	3C	N/A	N/A		
=	3D	N/A	N/A		X
>	3E	N/A	N/A	N/A	
?	3F	N/A	N/A	N/A	X

NOTE: The system alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.6 Response to EA_SY command: Characters A7 to A9

The system alarm requests associated with characters A7 to A9 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.7 Response to EA_SY command: Character A10

The following table describes character A10 in the response to an EA_SY command.

Table 5-29: Response to EA_SY command: Character A10

Character		System Alarm Requests			
Char	Hex	Reserved	Reserved	ComFlash (CF)	Data Retention (DA)
0	30				

Character		System Alarm Requests			
Char	Hex	Reserved	Reserved	ComFlash (CF)	Data Retention (DA)
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		X		
5	35		X		N/A
6	36		X	N/A	
7	37		X	N/A	N/A
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A
<	3C	X	X		
=	3D	X	X		N/A
>	3E	X	X	N/A	
?	3F	X	X	N/A	N/A

NOTE: The system alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.8 Response to EA_Px command: Character A1

The following table describes character A1 in the response to an EA_Px command.

Table 5-30: Response to EA_Px command: Character A1

Character		Product Alarm Requests			
Char	Hex	High Flow (HF)	High Density (HD)	Back Pressure (BP)	Product Program Error (DA)
0	30				

Character		Product Alarm Requests			
Char	Hex	High Flow (HF)	High Density (HD)	Back Pressure (BP)	Product Program Error (DA)
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		X		
5	35		X		N/A
6	36		X	N/A	
7	37		X	N/A	N/A
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A
<	3C	X	X		
=	3D	X	X		N/A
>	3E	X	X	N/A	
?	3F	X	X	N/A	N/A

NOTE: The product alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.9 Response to EA_Px command: Character A2

The following table describes character A2 in the response to an EA_Px command.

Table 5-31: Response to EA_Px command: Character A2

Character		Product Alarm Requests			
Char	Hex	Low Flow (LF)	Low Density (LD)	High Temp Alarm (HT)	High Pressure (HP)
0	30				
1	31				X

Character		Product Alarm Requests			
Char	Hex	Low Flow (LF)	Low Density (LD)	High Temp Alarm (HT)	High Pressure (HP)
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.10 Response to EA_Px command: Character A3

The following table describes character A3 in the response to an EA_Px command.

Table 5-32: Response to EA_Px command: Character A3

Character		Product Alarm Requests			
Char	Hex	Overrun (OA)	Zero Flow (ZF)	Low Temperature (LT)	Low Pressure (LP)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		N/A		
5	35		N/A		X

Character		Product Alarm Requests			
Char	Hex	Overrun (OA)	Zero Flow (ZF)	Low Temperature (LT)	Low Pressure (LP)
6	36		N/A	X	
7	37		N/A	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	N/A		
=	3D	X	N/A		X
>	3E	X	N/A	X	
?	3F	X	N/A	X	X

NOTE: The product alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.11 Response to EA_Px command: Character A4

The following table describes character A4 in the response to an EA_Px command.

Table 5-33: Response to EA_Px command: Character A4

Character		Product Alarm Requests			
Char	Hex	Product Stop (PA)	Blend Low (BL)	Blend High (BH)	Block Valve (BV)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	

Character		Product Alarm Requests			
Char	Hex	Product Stop (PA)	Blend Low (BL)	Blend High (BH)	Block Valve (BV)
7	37		X	X	X
8	38	N/A			
9	39	N/A			X
:	3A	N/A		X	
;	3B	N/A		X	X
<	3C	N/A	X		
=	3D	N/A	X		X
>	3E	N/A	X	X	
?	3F	N/A	X	X	X

NOTE: The product alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.12 Response to EA_AR command: Character A1

The following table describes character A1 in the response to an EA_AR command.

Table 5-34: Response to EA_AR command: Character A1

Character		Arm Alarm Requests			
Char	Hex	Ticket (TK)	Overrun (OA)	Zero Flow (ZF)	Arm Program Error (DA)
0	30				
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		X		
5	35		X		N/A
6	36		X	N/A	
7	37		X	N/A	N/A

Character		Arm Alarm Requests			
Char	Hex	Ticket (TK)	Overrun (OA)	Zero Flow (ZF)	Arm Program Error (DA)
8	38	N/A			
9	39	N/A			N/A
:	3A	N/A		N/A	
;	3B	N/A		N/A	N/A
<	3C	N/A	X		
=	3D	N/A	X		N/A
>	3E	N/A	X	N/A	
?	3F	N/A	X	N/A	N/A

NOTE: The arm alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.13 Response to EA_AR command: Character A2

The following table describes character A2 in the response to an EA_AR command.

Table 5-35: Response to EA_AR command: Character A2

Character		Arm Alarm Requests			
Char	Hex	Storage Full (SF)	Arm Recipe Program Error (DA)	Additive Clean Line (CA)	Clean Line (CL)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		N/A		
5	35		N/A		X
6	36		N/A	X	
7	37		N/A	X	X

Character		Arm Alarm Requests			
Char	Hex	Storage Full (SF)	Arm Recipe Program Error (DA)	Additive Clean Line (CA)	Clean Line (CL)
8	38	N/A			
9	39	N/A			X
:	3A	N/A		X	
;	3B	N/A		X	X
<	3C	N/A	N/A		
=	3D	N/A	N/A		X
>	3E	N/A	N/A	X	
?	3F	N/A	N/A	X	X

NOTE: The arm alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.14 Response to EA_AR command: Character A3

The following table describes character A3 in the response to an EA_AR command.

Table 5-36: Response to EA_AR command: Character A3

Character		Arm Alarm Requests			
Char	Hex	Reserved	Reserved	Card Removed (CD)	DE Head Alarm (DE)
0	30				
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		X		
5	35		X		N/A
6	36		X	N/A	
7	37		X	N/A	N/A

Character		Arm Alarm Requests			
Char	Hex	Reserved	Reserved	Card Removed (CD)	DE Head Alarm (DE)
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A
<	3C	X	X		
=	3D	X	X		N/A
>	3E	X	X	N/A	
?	3F	X	X	N/A	N/A

NOTE: The arm alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.15 Response to EA_IN command: Characters A1 to A12

The injector alarm requests associated with characters A1 to A12 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.16 Response to EA_IN command: Character A13

The following table describes character A13 in the response to an EA_IN command.

Table 5-37: Response to EA_IN command: Character A13

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Low Add Error (KA)	Injector 3 Low Add Error (KA)	Injector 2 Low Add Error (KA)	Injector 1 Low Add Error (KA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Low Add Error (KA)	Injector 3 Low Add Error (KA)	Injector 2 Low Add Error (KA)	Injector 1 Low Add Error (KA)
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.17 Response to EA_IN command: Character A14

The following table describes character A14 in the response to an EA_IN command.

Table 5-38: Response to EA_IN command: Character A14

Character		Injector Alarm Requests			
Char	Hex	Injector 8 Low Add Error (KA)	Injector 7 Low Add Error (KA)	Injector 6 Low Add Error (KA)	Injector 5 Low Add Error (KA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X

Character		Injector Alarm Requests			
Char	Hex	Injector 8 Low Add Error (KA)	Injector 7 Low Add Error (KA)	Injector 6 Low Add Error (KA)	Injector 5 Low Add Error (KA)
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.18 Response to EA_IN command: Character A15

The following table describes character A15 in the response to an EA_IN command.

Table 5-39: Response to EA_IN command: Character A15

Character		Injector Alarm Requests			
Char	Hex	Injector 12 Low Add Error (KA)	Injector 11 Low Add Error (KA)	Injector 10 Low Add Error (KA)	Injector 9 Low Add Error (KA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.19 Response to EA_IN command: Character A16

The following table describes character A16 in the response to an EA_IN command.

Table 5-40: Response to EA_IN command: Character A16

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Low Add Error (KA)	Injector 3 Low Add Error (KA)	Injector 2 Low Add Error (KA)	Injector 1 Low Add Error (KA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.20 Response to EA_IN command: Character A17

The following table describes character A17 in the response to an EA_IN command.

Table 5-41: Response to EA_IN command: Character A17

Character		Injector Alarm Requests			
Char	Hex	Injector 20 Low Add Error (KA)	Injector 19 Low Add Error (KA)	Injector 18 Low Add Error (KA)	Injector 17 Low Add Error (KA)
0	30				
1	31				X

Character		Injector Alarm Requests			
Char	Hex	Injector 20 Low Add Error (KA)	Injector 19 Low Add Error (KA)	Injector 18 Low Add Error (KA)	Injector 17 Low Add Error (KA)
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.21 Response to EA_IN command: Character A18

The following table describes character A18 in the response to an EA_IN command.

Figure 5-4: EA_IN command: Character A18

Character		Injector Alarm Requests			
Char	Hex	Injector 24 Low Add Error (KA)	Injector 23 Low Add Error (KA)	Injector 22 Low Add Error (KA)	Injector 21 Low Add Error (KA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	

Character		Injector Alarm Requests			
Char	Hex	Injector 24 Low Add Error (KA)	Injector 23 Low Add Error (KA)	Injector 22 Low Add Error (KA)	Injector 21 Low Add Error (KA)
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.22 Response to EA_IN command: Characters A19 to A24

The injector alarm requests associated with characters A19 to A24 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.23 Response to EA_IN command: Character A25

The following table describes character A25 in the response to an EA_IN command.

Figure 5-5: Response to EA_IN command: Character A25

Character		Injector Alarm Requests			
Char	Hex	Injector 4 No Pulses (NA)	Injector 3 No Pulses (NA)	Injector 2 No Pulses (NA)	Injector 1 No Pulses (NA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X

Character		Injector Alarm Requests			
Char	Hex	Injector 4 No Pulses (NA)	Injector 3 No Pulses (NA)	Injector 2 No Pulses (NA)	Injector 1 No Pulses (NA)
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.24 Response to EA_IN command: Character A26

The following table describes character A26 in the response to an EA_IN command.

Table 5-42: Response to EA_IN command: Character A26

Character		Injector Alarm Requests			
Char	Hex	Injector 8 No Pulses (NA)	Injector 7 No Pulses (NA)	Injector 6 No Pulses (NA)	Injector 5 No Pulses (NA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		

Character		Injector Alarm Requests			
Char	Hex	Injector 8 No Pulses (NA)	Injector 7 No Pulses (NA)	Injector 6 No Pulses (NA)	Injector 5 No Pulses (NA)
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.25 Response to EA_IN command: Character A27

The following table describes character A27 in the response to an EA_IN command.

Table 5-43: Response to EA_IN command: Character A27

Character		Injector Alarm Requests			
Char	Hex	Injector 12 No Pulses (NA)	Injector 11 No Pulses (NA)	Injector 10 No Pulses (NA)	Injector 9 No Pulses (NA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.26 Response to EA_IN command: Character A28

The following table describes character A28 in the response to an EA_IN command.

Table 5-44: Response to EA_IN command: Character A28

Character		Injector Alarm Requests			
Char	Hex	Injector 16 No Pulses (NA)	Injector 15 No Pulses (NA)	Injector 14 No Pulses (NA)	Injector 13 No Pulses (NA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.27 Response to EA_IN command: Character A29

The following table describes character A29 in the response to an EA_IN command.

Table 5-45: Response to EA_IN command: Character A29

Character		Injector Alarm Requests			
Char	Hex	Injector 20 No Pulses (NA)	Injector 19 No Pulses (NA)	Injector 18 No Pulses (NA)	Injector 17 No Pulses (NA)
0	30				
1	31				X
2	32			X	
3	33			X	X

Character		Injector Alarm Requests			
Char	Hex	Injector 20 No Pulses (NA)	Injector 19 No Pulses (NA)	Injector 18 No Pulses (NA)	Injector 17 No Pulses (NA)
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.28 Response to EA_IN command: Character A30

The following table describes character A30 in the response to an EA_IN command.

Table 5-46: Response to EA_IN command: Character A30

Character		Injector Alarm Requests			
Char	Hex	Injector 24 No Pulses (NA)	Injector 23 No Pulses (NA)	Injector 22 No Pulses (NA)	Injector 21 No Pulses (NA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			

Character		Injector Alarm Requests			
Char	Hex	Injector 24 No Pulses (NA)	Injector 23 No Pulses (NA)	Injector 22 No Pulses (NA)	Injector 21 No Pulses (NA)
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.29 Response to EA_IN command: Characters A31 to A42

The injector alarm requests associated with characters A31 to A42 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.30 Response to EA_IN command: Character A43

The following table describes character A43 in the response to an EA_IN command.

Table 5-47: Response to EA_IN command: Character A43

Character		Injector Alarm Requests			
Char	Hex	Injector 4 General Additive Error (GA)	Injector 3 General Additive Error (GA)	Injector 2 General Additive Error (GA)	Injector 1 General Additive Error (GA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			

Character		Injector Alarm Requests			
Char	Hex	Injector 4 General Additive Error (GA)	Injector 3 General Additive Error (GA)	Injector 2 General Additive Error (GA)	Injector 1 General Additive Error (GA)
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.31 Response to EA_IN command: Character A44

The following table describes character A44 in the response to an EA_IN command.

Table 5-48: Response to EA_IN command: Character A44

Character		Injector Alarm Requests			
Char	Hex	Injector 8 General Additive Error (GA)	Injector 7 General Additive Error (GA)	Injector 6 General Additive Error (GA)	Injector 5 General Additive Error (GA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		

Character		Injector Alarm Requests			
Char	Hex	Injector 8 General Additive Error (GA)	Injector 7 General Additive Error (GA)	Injector 6 General Additive Error (GA)	Injector 5 General Additive Error (GA)
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.32 Response to EA_IN command: Character A45

The following table describes character A45 in the response to an EA_IN command.

Table 5-49: Response to EA_IN command: Character A45

Character		Injector Alarm Requests			
Char	Hex	Injector 12 General Additive Error (GA)	Injector 11 General Additive Error (GA)	Injector 10 General Additive Error (GA)	Injector 9 General Additive Error (GA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.33 Response to EA_IN command: Character A46

The following table describes character A46 in the response to an EA_IN command.

Table 5-50: EA_IN command: Character A46

Character		Injector Alarm Requests			
Char	Hex	Injector 16 General Additive Error (GA)	Injector 15 General Additive Error (GA)	Injector 14 General Additive Error (GA)	Injector 13 General Additive Error (GA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.34 Response to EA_IN command: Character A47

The following table describes character A47 in the response to an EA_IN command.

Table 5-51: Response to EA_IN command: Character A47

Character		Injector Alarm Requests			
Char	Hex	Injector 20 General Additive Error (GA)	Injector 19 General Additive Error (GA)	Injector 18 General Additive Error (GA)	Injector 19 General Additive Error (GA)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.35 Response to EA_IN command: Character A48

The following table describes character A48 in the response to an EA_IN command.

Table 5-52: Response to EA_IN command: Character A48

Character		Injector Alarm Requests			
Char	Hex	Injector 24 General Additive Error (GA)	Injector 23 General Additive Error (GA)	Injector 22 General Additive Error (GA)	Injector 21 General Additive Error (GA)
0	30				
1	31				X
2	32			X	

Character		Injector Alarm Requests			
Char	Hex	Injector 24 General Additive Error (GA)	Injector 23 General Additive Error (GA)	Injector 22 General Additive Error (GA)	Injector 21 General Additive Error (GA)
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.36 Response to EA_IN command: Characters A49 to A66

The injector alarm requests associated with characters A49 to A66 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.37 Response to EA_IN command: Character A67

The following table describes character A67 in the response to an EA_IN command.

Table 5-53: Response to EA_IN command: Character A67

Character		Injector Alarm Requests			
Char	Hex	Injector 4 High Temp (AH)	Injector 3 High Temp (AH)	Injector 2 High Temp (AH)	Injector 1 High Temp (AH)
0	30				
1	31				X
2	32			X	

Character		Injector Alarm Requests			
Char	Hex	Injector 4 High Temp (AH)	Injector 3 High Temp (AH)	Injector 2 High Temp (AH)	Injector 1 High Temp (AH)
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.38 Response to EA_IN command: Character A68

The following table describes character A68 in the response to an EA_IN command.

Table 5-54: Response to EA_IN command: Character A68

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Low Temp (AL)	Injector 3 Low Temp (AL)	Injector 2 Low Temp (AL)	Injector 1 Low Temp (AL)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Low Temp (AL)	Injector 3 Low Temp (AL)	Injector 2 Low Temp (AL)	Injector 1 Low Temp (AL)
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.39 Response to EA_IN command: Character A69

The following table describes character A69 in the response to an EA_IN command.

Table 5-55: Response to EA_IN command: Character A69

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Temp. Probe (AT)	Injector 3 Temp. Probe (AT)	Injector 2 Temp. Probe (AT)	Injector 1 Temp. Probe (AT)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Temp. Probe (AT)	Injector 3 Temp. Probe (AT)	Injector 2 Temp. Probe (AT)	Injector 1 Temp. Probe (AT)
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.40 Response to EA_IN command: Character A70

The following table describes character A70 in the response to an EA_IN command.

Table 5-56: Response EA_IN command: Character A70

Character		Injector Alarm Requests			
Char	Hex	Injector 4 Pulse Security (PS)	Injector 3 Pulse Security (PS)	Injector 2 Pulse Security (PS)	Injector 1 Pulse Security (PS)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.6.41 Response to EA_IN command: Character A71 to A77

The injector alarm requests associated with characters A71 to A77 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.42 Response to EA_Mx command: Character A1

The following table describes character A1 in the response to an EA_Mx command.

Table 5-57: Response to EA_Mx command: Character A1

Character		Meter Alarm Requests			
Char	Hex	Valve Fault (VF)	Pulse Security (PS)	Transmitter Integrity (XA)	Meter Program Error (DA)
0	30				
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		N/A		
5	35		N/A		N/A
6	36		N/A	N/A	
7	37		N/A	N/A	N/A
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A
<	3C	X	N/A		
=	3D	X	N/A		N/A
>	3E	X	N/A	N/A	
?	3F	X	N/A	N/A	N/A

NOTE: The meter alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.43 Response to EA_Mx command: Character A2

The following table describes character A2 in the response to an EA_Mx command.

Table 5-58: Response to EA_Mx command: Character A2

Character		Meter Alarm Requests			
Char	Hex	Turbine Meter (TM)	Density Trans. (DR)	Pressure Trans. (PR)	Temperature Probe (TP)
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	N/A			
9	39	N/A			X
:	3A	N/A		X	
;	3B	N/A		X	X
<	3C	N/A	X		
=	3D	N/A	X		X
>	3E	N/A	X	X	
?	3F	N/A	X	X	X

NOTE: The meter alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.44 Response to EA_Mx command: Characters A3 and A4

The meter alarm requests associated with characters A3 and A4 are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.6.45 Response to EA_RR command: Character A1

The following table describes character A1 in the response to an EA_RR command.

Table 5-59: Response to EA_RR command: Character A1

Character		Recipe Alarm Requests			
Char	Hex	Reserved	Reserved	Reserved	Program Error (DA)#
0	30				
1	31				N/A
2	32			X	
3	33			X	N/A
4	34		X		
5	35		X		N/A
6	36		X	X	
7	37		X	X	N/A
8	38	X			
9	39	X			N/A
:	3A	X		X	
;	3B	X		X	N/A
<	3C	X	X		
=	3D	X	X		N/A
>	3E	X	X	X	
?	3F	X	X	X	N/A

NOTE: The meter alarm requests highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.7 EB - End Batch

This command cancels the remaining batch volume.

- Command

EB	Cancel remaining batch volume.

- Response

OK	Good response. Batch flagged as complete if batch is in progress. Batch authorization is removed.
or	
NOXX	Remaining batch volume was not canceled.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: AccuLoad Emulation Workflow needs to be installed on the HMI. See section 5.2.2 for more information.

Constraints: NO01 will be returned if the other side is in the program mode locally or via communications.

Special Case: Valve will be commanded to close if it has not already been commanded to do so.

5.2.4.8 EQ - Enquire Status

This command retrieves the operational status of the Fusion4 MSC-L. Data is returned in a bit-mapped format.

Command

EQ	Retrieve operational status of Fusion4 MSC-L.

- Response

AAAAAAAAAAAAAAAA	Good response: 16 Characters. For descriptions of each of the characters, see section 5.2.4.8.1 up to and including section 5.2.4.8.9.
Where each A =	Quasi hex value; ”0 1 2 3 4 5 6 7 8 9 : ; < > ?”.
or	
NOXX	Operational status of Fusion4 MSC-L was not retrieved.
XX =	Two-digit error code as defined in section 5.1.1.4.

Remarks: Allow for additional characters to be added on the end for future status indicators. For bay configurations - SA and SF - refer to the bay. Other flags continue to be specific to the arm.

Constraints: None

Special Case: See notes under tables.

5.2.4.8.1 Response to EQ command: Character A1

The conditions associated with character A1 in the response to the EQ command are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.8.2 Response to EQ command: Character A2

The following table describes character A2 in the response to the EQ command.

Table 5-60: Response to EQ command: Character A2

Character		Condition			
Char	Hex	Transaction in Progress	Transaction Done	Batch Done	Keypad Data Pending
0	30				
1	31				N/A
2	32			X	
3	33			X	N/A
4	34		X		
5	35		X		N/A
6	36		X	X	
7	37		X	X	N/A
8	38	X			
9	39	X			N/A
:	3A	X		X	
;	3B	X		X	N/A
<	3C	X	X		
=	3D	X	X		N/A
>	3E	X	X	X	
?	3F	X	X	X	N/A

Character		Condition			
Char	Hex	Transaction in Progress	Transaction Done	Batch Done	Keypad Data Pending

NOTE: The condition highlighted in red is not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

NOTE: X shows an asserted condition. 'Alarm Conditions' are not conditions that will result in an Fusion4 MSC-L alarm being generated; they are combinations of status conditions that should be unable to occur at the same time.

5.2.4.8.3 Response to EQ command: Character A3

The following table describes character A3 in the response to the EQ command.

Table 5-61: Response to EQ command: Character A3

Character		Condition			
Char	Hex	Alarm On	Standby Transactions Exist	Storage Full	In Standby Mode
0	30				
1	31				N/A
2	32			N/A	
3	33			N/A	N/A
4	34		N/A		
5	35		N/A		N/A
6	36		N/A	N/A	
7	37		N/A	N/A	N/A
8	38	X			
9	39	X			N/A
:	3A	X		N/A	
;	3B	X		N/A	N/A

Character		Condition			
Char	Hex	Alarm On	Standby Transactions Exist	Storage Full	In Standby Mode
<	3C	X	N/A		
=	3D	X	N/A		N/A
>	3E	X	N/A	N/A	
?	3F	X	N/A	N/A	N/A

NOTE: The conditions highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

NOTE: X shows an asserted condition. Some alarm conditions cannot reset through the communication channel. (See AR - Alarm Reset command, section 5.2.4.2).

NOTE: The "(not used)" positions in this table reflect the attempt to remain mostly compatible with AccuLoad II. Many of these values were used for standby mode operations; they shall be reported as "off" in the AccuLoad III-X.

5.2.4.8.4 Response to EQ command: Character A4

The following table describes character A4 in the response to the EQ command.

Table 5-62: Response to EQ command: Character A4

Character		Condition			
Char	Hex	Program Value Changed	Delay Prompt in Effect	Display Message Time-out	Power-fail Occurred
0	30				
1	31				X
2	32			N/A	
3	33			N/A	X
4	34		N/A		

Character		Condition			
Char	Hex	Program Value Changed	Delay Prompt in Effect	Display Message Time-out	Power-fail Occurred
5	35		N/A		X
6	36		N/A	N/A	
7	37		N/A	N/A	X
8	38	N/A			
9	39	N/A			X
:	3A	N/A		N/A	
;	3B	N/A		N/A	X
<	3C	N/A	N/A		
=	3D	N/A	N/A		X
>	3E	N/A	N/A	N/A	
?	3F	N/A	N/A	N/A	X

NOTE: The conditions highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

NOTE: X shows an asserted condition.

5.2.4.8.5 Response to EQ command: Character A5

The following table describes character A5 in the response to the EQ command.

Table 5-63: Response to EQ command: Character A5

Character		Condition			
Char	Hex	Checking Entries	Input 1	Input 2	Input 3
0	30				
1	31				X
2	32			X	
3	33			X	X

Character		Condition			
Char	Hex	Checking Entries	Input 1	Input 2	Input 3
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	N/A			
9	39	N/A			X
:	3A	N/A		X	
;	3B	N/A		X	X
<	3C	N/A	X		
=	3D	N/A	X		X
>	3E	N/A	X	X	
?	3F	N/A	X	X	X

NOTE: The conditions highlighted in red are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

NOTE: X shows an asserted condition (= AC input at contact).

5.2.4.8.6 Response to EQ command: Character A6

The following table describes character A6 in the response to the EQ command.

Table 5-64: Response to EQ command: Character A6

Character		Condition			
Char	Hex	Input 4	Input 5	Input 6	Input 7
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		

Character		Condition			
Char	Hex	Input 4	Input 5	Input 6	Input 7
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

NOTE: X shows an asserted condition (= AC input at contact).

5.2.4.8.7 Response to EQ command: Character A7

The following table describes character A7 in the response to the EQ command.

Table 5-65: Response to EQ command: Character A7

Character		Condition			
Char	Hex	Input 8	Input 9	Input 10	Input 11
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X

Character		Condition			
Char	Hex	Input 8	Input 9	Input 10	Input 11
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

NOTE: X shows an asserted condition (= AC input at contact).

5.2.4.8.8 Response to EQ command: Character A8

The following table describes character A8 in the response to the EQ command.

Table 5-66: Response to EQ command: Character A8

Character		Condition			
Char	Hex	Input 12	Input 13	Input 14	Input 15
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
:	3A	X		X	
;	3B	X		X	X
<	3C	X	X		
=	3D	X	X		X
>	3E	X	X	X	
?	3F	X	X	X	X

5.2.4.8.9 Response to EQ command: Characters A9 to A16

The conditions associated with characters A9 to A16 in the response to the EQ command are not supported by the Fusion4 MSC-L due to differences in architecture between the Fusion4 MSC-L and the AccuLoad III.

5.2.4.9 ET - End Transaction

This command removes authorization and flags the transaction as complete.

- Command

ET	

- Response

OK	Good Response. If transaction is in progress, transaction is flagged as complete. Authorization is removed.
or	
NOXX	Transaction was not ended.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks:

1. AccuLoad Emulation work flow needs to be installed on the HMI.
2. If bays are configured, this command will end the transaction for the entire bay.

Constraints: None

Special Case: None

5.2.4.10 GD - Get Date and Time

This command retrieves the current date and time from the Fusion4 MSC-L.

- Command

GD	Retrieve current date and time from Fusion4 MSC-L.

- Response

GD_DDDDDDDD_HHNN_X		Good Response
DDDDDDDD	=	MMDDYYYY (Standard time)
	=	DDMMYYYY (Military time)
HH	=	Hours
NN	=	Minutes
X	=	A (Standard time - A.M.)
	=	P (Standard time - P.M.)
	=	M (Military time)
or		
NOXX		Current date and time were not retrieved from Fusion4 MSC-L.
XX	=	Two-digit error code as defined in section 5.1.1.4.

Remarks: None

Constraints: None

Special Case: None

5.2.4.11 LD - Request Load Average Density

This command requests the batch average density from the Fusion4 MSC-L.

- Command

Current Transaction	Request current batch average density of the specified product.
LD_Px LD_YY_Px	Request batch average density for the specified batch and the specified product.
Local Storage Transaction	
LD_YY_Px_NNN	Request batch average density for a specified product of a stored transaction
Px = Product 1, 2, 3, 4, 5 or 6	
YY = Batch number requested (01...10)	
NNN = Number of transactions back into local storage to retrieve data	

- Response

Current Transaction LD_YY_Px_VVV.V Local Storage Transaction LD_YY_Px_VVV.V_NNN		Good response for commands LD_Px and LD_YY_Px Good response for command LD_YY_Px_NNN
YY	=	Batch number (01...10)
Px	=	Product 1, 2, 3, 4, 5 or 6
VVVV.V	=	Average value (where most significant digit can be "-" minus
		sign)
NNN	=	Number of transactions back into local storage to retrieve data
or		
NOXX		The batch average density was not read.
XX	=	Two-digit error code as defined in section 5.1.1.4.

Remarks:

1. Appropriate NOXX codes will be returned in case the product is not assigned to the arm or if the product is not used in the batch. See section 5.2.3 for more information about product numbering.
2. Response field padded with leading spaces. If value is negative, minus sign will immediately precede most significant digit.

Constraints:

1. Density units are as programmed in the Fusion4 MSC-L.
2. NO06 will be returned for a product request if the product requested was not delivered in the transaction.
3. NO30 will be returned if the product specified is not currently configured to the arm to which the command was directed.

4. NO31 will be returned if product load averages are requested for an arm currently configured for straight product delivery.
5. NO39 (No current batch on this arm) will be returned if transaction is in progress on bay but there is no active batch on the addressed arm. 'YY' specifies the bay-based batch number.

Special Case: None

5.2.4.12 LP - Request Load Average Pressure

This command requests the batch average pressure from the Fusion4 MSC-L.

- Command

Current Transaction LP_Px LP_YY_Px Local Storage Transaction LP_YY_Px_NNN	Request the current batch average pressure of the specified product. Request the current batch average pressure for the specified batch and the specified product. Request the batch average pressure for a specified product of a stored transaction.
Px = Product 1, 2, 3, 4, 5 or 6 YY = Batch number requested (01...10) NNN = Number of transactions back into local storage to retrieve data	

- Response

Current Transaction LP_YY_Px_VVV.V Local Storage Transaction LP_YY_Px_VVV.V_NNN		Good response for commands LP_Px and LP_YY_Px Good response for command LP_YY_Px_NNN
YY	=	Batch number requested (01...10)
Px	=	Product 1, 2, 3, 4, 5 or 6

Current Transaction LP_YY_Px_VVV.V Local Storage Transaction LP_YY_Px_VVV.V_NNN		Good response for commands LP_Px and LP_YY_Px Good response for command LP_YY_Px_NNN
VVVV.V	=	Average value
NNN	=	Number of transactions back into local storage to retrieve data
or		
NOXX		The batch average pressure was not read.
XX	=	Two-digit error code as defined in section 5.1.1.4.

Remarks: Appropriate NOXX codes will be returned in case the product is not assigned to the arm or if the product is not used in the batch. See section 5.2.3 for more information about product numbering.

Constraints:

1. Pressure units are as programmed for the Fusion4 MSC-L.
2. NO06 will be returned for a product request if the product requested was not delivered in the transaction.
3. NO30 will be returned if the product specified is not currently configured to the arm to which the command was directed.
4. NO31 will be returned if product load averages are requested for a arm currently configured for straight product delivery.
5. NO39 (No current batch on this arm) will be returned if transaction is in progress on bay but there is no active batch on the addressed arm. "YY" specifies the bay-based batch number.

Special Case: None

5.2.4.13 LT - Request Load Average Temperature

This command requests the value of the batch average temperature from the Fusion4 MSC-L.

- Command

Current Transaction LT_Px LT_YY_Px Local Storage Transaction LT_YY_Px_NNN	Request the batch average temperature of the specified product. Request the batch average temperature for the specified batch and the specified product. Request the batch average temperature for a specified product of a stored transaction.
R = Current batch Px = Product 1, 2, 3, 4, 5 or 6 YY = Batch number requested (01...10) NNN = Number of transactions back into local storage to retrieve data	

- Response

Current Transaction LT_YY_Px_SVVV.V Local Storage Transaction LT_YY_Px_SVVV.V_NNN	Good response for commands LT_Px and LT_XX_Px Good response for command LT_YY_Px_NNN
YY = Batch number requested (01...10) Px = Product 1, 2, 3, 4, 5 or 6 S = Sign (+ or -) VVVV.V = Average value NNN = Number of transactions back into local storage to retrieve data	
or	
NOXX	The batch average temperature was not read.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: Appropriate NOXX codes will be returned in case the product is not assigned to the arm or if the product is not used in the batch. See section 5.2.3 for more information about product numbering.

Constraints:

1. Temperature units are as programmed for the Fusion4 MSC-L. Negative temperature is possible.
2. NO06 will be returned for a product request if the product requested was not delivered in the transaction.
3. NO30 will be returned if the product specified is not currently configured to the arm to which the command was directed.
4. NO31 will be returned if product load averages are requested for an arm currently configured for straight product delivery.
5. NO39 (No current batch on this arm) will be returned if transaction is in progress on bay but there is no active batch on the addressed arm. 'YY' specifies the bay-based batch number.

Special Case: None

5.2.4.14 MP - Minimum Preset

This command requests the minimum preset allowed for the recipe specified.

- Command

MP_RR	Request the minimum preset allowed for the recipe specified.
RR = Recipe number (01...50)	

- Response

MP_RR_VVVVV	Good response
RR = Recipe number (01...50) VVVVV = Minimum preset	
or	
NOXX	Minimum preset was not returned.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: None

Constraints: NO30 will be returned if the recipe specified is not currently configured arm (or bay, if bays are configured) to which the command was directed.

Special Case: None

5.2.4.15 RB - Request Batch Totals

This command retrieves batch data from the Fusion4 MSC-L.

- Command

Current Transaction	Current batch volume, delivery volume type
RB	Current batch, specified product (ratio, sequential, hybrid)
RB_Px	Completed batch volume, delivery volume type
RB_YY	Completed batch volume, specified volume type
RB_YY_X	Product volume of batch, delivery volume type
RB_YY_Px	Product volume of batch, specified volume type
RB_YY_X_Px	
Local Storage Transaction	Historic transaction requests
	Returns the product volume type
RB_YY_NNN	Returns the batch in the volume type requested if that volume type was stored
RB_YY_Px_NNN	
RB_YY_X_NNN	Returns the product in the volume type requested if that volume type was stored
RB_YY_Z_Px_NNN	
X	= R for raw total (Indicated Volume - IV)
	= G for gross volume (GV)
	= N for @ standard temperature volume (GST)
	= P for net pressure & temperature volume (GSV)
	= M for mass total
	= Product 1, 2, 3, 4, 5 or 6
Px YY NNN	= Batch Number (01...10)
	= Number of transactions back into local storage to retrieve data

- Response

Current Transaction RB_YY_X_A1A2A3A4A5A6_RR_VVVVVV RB_YY_X_A1A2A3A4A5A6_Px_VVVVVV Local Storage Transaction RB_YY_X_A1A2A3A4A5A6_RR_VVVVVV_NNN RB_YY_X_A1A2A3A4A5A6_Px_VVVVVV_NNN	For commands RB, RB_YY and RB_YY_X For commands RB_YY_Px, RB_YY_Px_X and RB_Px For commands RB_XX_NNN and RB_XX_X_NNN For commands RB_XX_Px_NNN and RB_XX_Px_X_NNN
YY = Batch number requested or current batch X = R for raw total = G for gross total = N for gross at standard temperature total = P for net temperature & pressure = M for mass totals A1A2A3A4A5A6 = Additive selection code, see section 5.2.4.15.1 up to and including section 5.2.4.15.6 Px = Product 1, 2, 3, 4, 5 or 6 RR = Recipe number 01...50 VVVVVV = Batch volume NNN = Number of transactions back into local storage to retrieve data	
or	
NOXX	The batch data was not retrieved
XX	Two-digit error code as defined in section 5.1.1.4.

Remarks:

1. For a command requesting a specific volume type only the following types will be responded to: G for gross volume (GV), P for net pressure & temperature volume (GSV) and MM for mass total.
2. Appropriate NOXX codes will be returned in case the product is not assigned to the arm or if the product is not used in the batch.
3. For the commands with completed batch volume, batch data from another arm may be responded rather than the addressed arm number, if that batch was not run on the addressed arm.
4. The batch is not considered complete until the start key is pressed for the next batch, or the transaction is ended. RB_YY will always fail on the current batch even after BD status is reported in Command EQ or RS.
5. If bays are configured, the returned value is the bay-based batch total.

Constraints:

1. Batch volume units are assumed as the type programmed into the Fusion4 MSC-L.
2. NO03 will be returned for a product request if the product requested was not delivered in the batch.
3. NO30 will be returned if the product specified is not currently configured to the arm to which the command was directed.
4. NO31 will be returned if the product batch totals are requested for an arm currently configured for straight product delivery.

Special Case: None

5.2.4.15.1 Additive selection code: Character A1

The following table gives a description of character A1 of the additive selection code.

Table 5-67: Additive selection code: Character A1

Character Sent (A2)		Add 4	Add 3	Add 2	Add 1
Char	Hex				
0	30				

Character Sent (A2)		Add 4	Add 3	Add 2	Add 1
Char	Hex				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.15.2 Additive selection code: Character A2

The following table gives a description of character A2 of the additive selection code.

Table 5-68: Additive selection code: Character A2

Character Sent (A2)		Add 8	Add 7	Add 6	Add 5
Char	Hex				
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	

Character Sent (A2)		Add 8	Add 7	Add 6	Add 5
Char	Hex				
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.15.3 Additive selection code: Character A3

The following table gives a description of character A3 of the additive selection code.

Table 5-69: Additive selection code: Character A3

Character Sent (A2)		Add 12	Add 11	Add 10	Add 9
Char	Hex				
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		

Character Sent (A2)		Add 12	Add 11	Add 10	Add 9
Char	Hex				
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.15.4 Additive selection code: Character A4

The following table gives a description of character A4 of the additive selection code.

Table 5-70: Additive selection code: Character A4

Character Sent (A2)		Add 16	Add 15	Add 14	Add 13
Char	Hex				
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.15.5 Additive selection code: Character A5

The following table gives a description of character A5 of the additive selection code.

Table 5-71: Additive selection code: Character A5

Character Sent (A2)		Add 20	Add 19	Add 18	Add 17
Char	Hex				
0	30				
1	31				X
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.15.6 Additive selection code: Character A6

The following table gives a description of character A6 of the additive selection code.

Table 5-72: Additive selection code: Character A6

Character Sent (A2)		Add 24	Add 23	Add 22	Add 21
Char	Hex				
0	30				
1	31				X

Character Sent (A2)		Add 24	Add 23	Add 22	Add 21
Char	Hex				
2	32			X	
3	33			X	X
4	34		X		
5	35		X		X
6	36		X	X	
7	37		X	X	X
8	38	X			
9	39	X			X
A	41	X		X	
B	42	X		X	X
C	43	X	X		
D	44	X	X		X
E	45	X	X	X	
F	46	X	X	X	X

5.2.4.16 RE - Reset Status Conditions

This command resets or acknowledges pending status conditions of the Fusion4 MSC-L.

- Command

RE_XX	Reset or acknowledge status condition.
XX = Two-character code. See section 5.2.4.16.1 for more information.	

- Response

OK	Good response. The status condition has been reset. The status condition will no longer appear in response to status requests (EQ command).
or	
NOXX	The status condition has not been reset.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: For bay configurations, the RE TD command clears the transaction done flag for the bay. RE BD still affects only the arm addressed.

Constraints: None

Special Case: BD and TD statuses are also reset on authorize commands.

5.2.4.16.1 Valid status codes for RE - Reset Status Conditions command

Code	Condition
BD	Batch Done Status
SA	Standby Mode
TD	Transaction done status (also resets BD)

> NOTE: If the status code is already reset, a NO06 will be returned.

5.2.4.17 RK - Read Keyboard

This command instructs the Fusion4 MSC-L to transmit any pending data entered at the keypad to the requesting device.

- Command

RK	

- Response

RK_NNNN N	Good response
NNNN N is a string of 1 to 25 characters, where the final character is a non-numeric terminating key represented as indicated below: Numeric keypad data zero through nine will be represented by their ASCII character equivalents. The following is accepted as terminating key only and will be represented as follows: • Enter key (“ENTER”) = “E“ The Clear key (“CLEAR”) has a function and therefore will not be represented on the display. If pressed, the last character entered will be cleared and another character may be entered in its place. If pressed a second time, the entire field will be cleared and the entry will have to be repeated.	
or	
NOXX	Pending data was not available.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The response string NNNN...N will contain leading zeros to the length of response specified in the prompt that was issued. If the expected input length for a prompt is four digits and only two digits are entered, two leading zeros and the two digits input at the keypad will be displayed in the response to the “RK” command. If the prompt was issued with the option for variable input field length (adding 40 to expected data length), leading zeros are still returned.

Constraints: Once a terminating key is pressed at the keypad the message ”PLEASE WAIT” will be displayed. Keypad data is not cleared from the Fusion4 MSC-L until a ”WX”, ”WD”, or ”DA” command has been issued. After data pending, the keypad is locked until a ”WX” or ”WD” command has been issued for prompt or a ”DA” command removes Minicomp host control. If none of these occur within three minutes, Fusion4 MSC-L will time-out and release the keypad and display from Minicomp host control.

Special Case: None

5.2.4.18 RR - Request Recipe

This command requests the current recipe number from the Fusion4 MSC-L.

- Command

RR	

- Response

RR_NN		Good response
NN	=	Recipe number (01...50)
or		
NOXX		Recipe number was not returned.
XX	=	Two-digit error code as defined in section 5.1.1.4.

Remarks: The recipe number returned by the RR command will remain in effect until another recipe is selected, either by allocating a single recipe (AB command) or by selection at the Fusion4 MSC-L keypad. Neither batch done nor trans- action done clears the recipe number from the RR response.

Constraints:

1. NO05 will be returned if no transaction has ever been completed.
2. NO39 will be returned if bays are configured and an RR command is sent to an arm with no batch in progress, when a bay transaction is in progress.

Special Case: None

5.2.4.19 SA - Remote Start

This command remotely starts the Fusion4 MSC-L as though the ”START” key was pressed.

- Command

SA	

- Response

OK	Good response. Fusion4 MSC-L is released for flow to begin.
or	
NOXX	Fusion4 MSC-L was not released for remote start.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: AccuLoad Emulation Workflow needs to be installed. See section 5.2.2 for more information.

Constraints:

1. NO05 will be returned if no transaction has ever been completed.
2. NO01 will be returned if another arm is in Program mode locally or via communications.

Special Case: None

5.2.4.20 SB - Set Batch

This command authorizes a batch and presets batch volumes for a transaction.

- Command

SB_VVVVV	
VVVVV = Volume to preset	

- Response

OK	Good response. Batch volume has been accepted.
or	
NOXX	Batch volume has not been set.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks:

1. The AccuLoad Emulation Workflow needs to be installed. See section 5.2.2 for more information.
2. See also remarks for AB - Allocate Blend Recipes command.

3. Batch volume must not exceed programmed maximum batch size and must not be below the programmed minimum batch size.
4. Units value must correspond to what is programmed into Fusion4 MSC-L for units of measurement.

Constraints: None

Special Case: An authorization command with batch size of 0 allows the driver to select batch size. Driver may clear any preset batch size and enter a new batch volume providing that it is less than the preset batch size. A batch amount of zero while in the Auto Preset mode will result in the maximum batch amount being displayed; a non-zero set batch amount will override the maximum batch amount as the auto preset amount and cannot be overridden by the driver while in the Auto Preset Mode.

5.2.4.21 SD - Set Date and Time

This command sets the date and time in the Fusion4 MSC-L.

- Command

SD_DDDDDDDD_HHNN_X	
DDDDDDDD = MMDDYYYY (Standard Time)	
= DDMMYYYY (Military Time)	
MM = Month	
DD = Day	
YYYY = Year	
HH = Hours	
NN = Minutes	
X = A (Standard time - A.M.)	
= P (Standard time - P.M.)	
= M (Military time)	

- Response

OK	Good response. Time and date value accepted and seconds reset to zero.
or	
NOXX	Time and date were not accepted.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: None

Constraints: Time value must be within the range programmed into the Fusion4 MSC-L, i.e. 0000...2359 for Military, 0000...1259 for Standard, month must be within the range of 1...12; day must be in the range valid for the month chosen.

Special Case: Leading spaces may be used in place of leading zeros for month, day, year, hours, and minutes. However, this is not recommended.

5.2.4.22 SF - Authorize and Set Batch without override

This command allows an automation system to authorize a batch in remote control with a predefined batch volume that cannot be overridden by the driver.

- Command

SF_VVVVV	
VVVVV = Volume to preset	

- Response

OK	Good response. Batch volume has been accepted.
or	
NOXX	The batch volume was not set.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks:

1. The AccuLoad Emulation Workflow needs to be installed. See section 5.2.2 for more information.
2. See also remarks for AB - Allocate Blend Recipes command.

Constraints: Batch volume must not exceed programmed maximum batch size and must not be below the programmed minimum batch size. Units value must correspond to what is programmed into Fusion4 MSC-L for units of meas- urement.

Special Case: None

5.2.4.23 SP - Remote Stop

This command instructs the Fusion4 MSC-L to stop, halting product delivery on all arms.

- Command

SP	
A1A2A3A4A5A6 = Additive selection code, see section 5.2.4.15.1 up to and including section 5.2.4.15.6 VVVVVV = Volume to preset	

- Response

OK	Good response
or	
NOXX	The Fusion4 MSC-L was not stopped. NO36 will be returned if the Fusion4 MSC-L is being used with a card reader and the card data is invalid or has expired.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The AccuLoad Emulation Workflow needs to be installed. See section 5.2.2 for more information.

Constraints: Valve and pump are shut down whether flow is present or not. If a batch is in progress, the ”START” key or the SA” - Remote Start command must be used to continue the batch.

Special Case: None

5.2.4.24 ST - Remote Stop on Arm

This command instructs the Fusion4 MSC-L to stop flow on an individual arm, halting product delivery on that arm only. Any other arms with flow in progress are

not affected.

- Command

ST	

- Response

OK	Good Response
or	
NOXX	The flow to the arm was not stopped.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The AccuLoad Emulation Workflow needs to be installed. See section 5.2.2 for more information

Constraints: Valve and pump are shut down whether flow is present or not. If a batch is in progress, the ”START” key or the ”SA” - Remote Start command must be used to continue the batch.

Special Case: None

5.2.4.25 TN - Show Transaction Stop Date and Time

This command retrieves the transaction stop date and time and internal transaction number.

- Command

Current Transaction TN Local Storage Transaction TN_NNN	
NNN = Number of transactions back into local storage to retrieve data.	

- Response

Current Transaction TN_IIII_DDDDDDDD_AAAA_X Local Storage Transaction TN_IIII_DDDDDDDD_AAAA_X		Good response Good response
IIII	=	Internal Transaction Number
DDDDDDDD	=	Transaction Stop Date
	=	(MMDDYYYY for Standard Time)
	=	(DDMMYYYY for Military Time)
AAAA	=	Transaction Stop Time (HHMM)
X	=	A (Standard Time - A.M.)
	=	P (Standard Time - P.M.)
	=	M (Military Time)
or		
NOXX		The transaction stop date and time were not retrieved.
XX	=	Two-digit error code as defined in section 5.1.1.4.

Remarks: None

Constraints: None

Special Case: None

5.2.4.26 VT - Request Meter Totalizer Data

This command requests a totalizer value from the Fusion4 MSC-L.

- Command

VT_Z_Px VT_Aaa	Product non-resettable totals. Valid for sequential and ratio blending configurations. Additive non-resettable totals
Z = G for gross volume (GV) = P for gross at standard temperature and pressure volume (GSV) = M for mass totals Px = Product 1, 2, 3, 4, 5 or 6 Aaa = A01 (Additive 1) = A02 (Additive 2) = ... = ... = A24 (Additive 24)	

If the AccuLoad is programmed for 'dynamic leakage update' (System 336), the non-resettable totals will be updated with leakage volume while the AccuLoad is idle. The VT_Z_Px command will return the current value of the non-resettable totals which will include any leakage that has occurred since the end of the last transaction.

If the AccuLoad is programmed for 'update non-resettables with leakage at transaction start' (System 336), the non- resettable totals will remain static while the AccuLoad is idle (i.e. leakage will not be added until start of next transaction). The 'VT_Z_Px' command will return the value of the non-resettable totals captured at the end of the last transaction.

As always, if a transaction is in progress, the VT_Z_Px command will return the current value of the dynamically updated non-resettable totals.

- Response

VT_Z_Px_VVVVVVV VT_Aaa_VVVVVVV	Good Response. Product Totals, blending configuration. Good Response. Additive Totals
Z = G for gross volume (GV) = P for net volume temperature and pressure (GSV) = M for mass totals Px = Product 1, 2, 3, 4, 5 or 6 Aaa = A01 (Additive 1) = A02 (Additive 2) = ... = ... = A24 (Additive 24) VVVVVVVV = 9-digit totalizer volume	
or	
NOXX	Totals were not retrieved.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks:

1. Appropriate NOXX codes will be returned in case the product or the additive is not assigned to the arm.
2. Products, recipes and additives must be allocated to the arm addressed.

Constraints:

1. NO30 will be returned if the additive component, or recipe requested is not currently configured to the arm to which the request was directed.
2. NO31 will be returned if the arm is not configured for “Straight with VRS”.

Special Case: None

5.2.4.27 WA - Write Second Line of Message to Appear on Display

This command instructs the Fusion4 MSC-L to display the second line of a message, up to 30 characters in length. The message is displayed on the line below the message specified with a WD or WX command. The format is identical to these commands; however the timeout value is ignored. The delimiter character is not ignored; the last command set determines the expected input form.

- Command

WA_NNN_X...Xd99	
X...X = An alphanumeric character string of up to 30 characters. See also Remarks. NNN = Timeout value in seconds. An entry of 000 will cause the timeout value to default to what was entered for the first display message or if a non-zero entry is used, it will override the previous value entered. d = A required delimiter used to signify the input field. There are three different delimiters each indicating a unique handling of the input process. They are as follows: & = Input data is entered directly with no initiator required; any function key except the "CLEAR" or the "STOP" may be used to terminate the input sequence. NOTE: The above delimiters are acceptable as part of the alphanumeric message. 99 = The input field length. This may be encoded to allow a variable length input field up to the length specified here. The range of the input length is 00 to 20. To encode the option of the variable length input, add 40 to the desired input field length. EXAMPLE: To request an input field length of 5, enter "05". To also include the option, enter "45". If the option is not included the operator will have to put in 5 digits and then press the terminating key, any more than 5 digits and the message "Error Press Clear" will appear on the Fusion4 MSC-L display. If the option is included, the terminating key can be pressed at any time sending data to the Host.	

- Response

OK	Good Response. Message has been accepted for alphanumeric display (left justified).
or	
NOXX	Message was not accepted.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The following characters can be displayed on the Fusion4 MSC-L display (X...X part of command).

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9

+ ! ” # $ % & ’ ( ) - . / : ; < = > @ [\ ^ _ ' {|} ° ? * space

The prompt will wrap to the second line of the display where necessary.

Constraints:

1. The WD or WX command must be issued first. The input field length must be zero if one was previously defined in the first message issued. If it is not, a NO06 will be returned.
2. NO01 will be returned if another arm is in the program mode locally or via communications.

Special Case: None

5.2.4.28 WB - Write Third Line of Message to Appear on Display

This command allows writing a 30-character message, which is displayed two lines below the message specified with a WD or WX command. The format is identical to these commands; however, the timeout value is ignored. The delimiter character is not ignored. The last command set determines the expected input form.

The commands that write to lines other than the first (WA, WB, WC) must be preceded by one of the prompt commands that write to the first line (WD, WX).

- Command

WB_NNN_X...Xd99	

X...X = An alphanumeric character string of up to 30 characters. See also Remarks.

NNN = Prompt timeout value (001-999)

d = A required delimiter used to signify the input field. There are three different delimiters each indicating a unique handling of the input process. They are as follows:

& = Input data is entered directly with no initiator required; any function key except the "CLEAR" or the "STOP" may be used to terminate the input sequence.

> NOTE: The above delimiters are acceptable as part of the alphanumeric message.

99 = The input field length. This may be encoded to allow a variable length input field up to the length specified here. The range of the input length is 00 to 20. To encode the option of the variable length input, add 40 to the desired input field length.

EXAMPLE: To request an input field length of 5, enter "05". To also include the option, enter "45". If the option is not included the operator will have to put in 5 digits and then press the terminating key, any more than 5 digits and the message "Error Press Clear" will appear on the Fusion4 MSC-L display. If the option is included, the terminating key can be pressed at any time sending data to the Host.

- Response

OK	Good Response. Message has been accepted for alphanumeric display (left justified).
or	
NOXX	Message was not accepted.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The following characters can be displayed on the Fusion4 MSC-L display (X...X part of command).

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9

+ ! ” # $ % & ’ ( ) - . / : ; < = > @ [\ ^ _ ' {|} ° ? * space

The prompt will wrap to the second line of the display where necessary.

Constraints:

1. The WD or WX commandmust be issued first. The input field length must be zero if one was previously defined in the first message issued. If it is not, a NO06 will be returned.
2. NO01 will be returned if another arm is in the program mode locally or via communications.

Special Case: None

5.2.4.29 WC - Write Fourth Line of Message to Appear on Display

This commands allows writing a 30-character message which is displayed three lines below the message specified with a WD or WX command. The format is identical to these commands; however, the timeout value is ignored. The delimiter character is not ignored. The last command set determines the expected input form.

The commands that write to lines other than the first (WA, WB, WC) must be preceded by one of the prompt commands that write to the first line (WD, WX).

- Command

WC_NNN_X...Xd99	

X...X = An alphanumeric character string of up to 30 characters. See also Remarks.

NNN = Prompt timeout value (001-999)

d = A required delimiter used to signify the input field. There are three different delimiters each indicating a unique handling of the input process. They are as follows:

& = Input data is entered directly with no initiator required; any function key except the "CLEAR" or the "STOP" may be used to terminate the input sequence.

> NOTE: The above delimiters are acceptable as part of the alphanumeric message.

99 = The input field length. This may be encoded to allow a variable length input field up to the length specified here. The range of the input length is 00 to 20. To encode the option of the variable length input, add 40 to the desired input field length.

EXAMPLE: To request an input field length of 5, enter "05". To also include the option, enter "45". If the option is not included the operator will have to put in 5 digits and then press the terminating key, any more than 5 digits and the message "Error Press Clear" will appear on the Fusion4 MSC-L display. If the option is included, the terminating key can be pressed at any time sending data to the Host.

- Response

OK	Good Response. Message has been accepted for alphanumeric display (left justified).
or	
NOXX	Message was not accepted.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The following characters can be displayed on the Fusion4 MSC-L display (X...X part of command).

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9

+ ! " # $ % & ' ( ) - . / : ; < = > @ [\ ^ _ ' {|} ° ? * space

The prompt will wrap to the second line of the display where necessary.

Constraints:

1. The WD or WX command must be issued first. The input field length must be zero if one was previously defined in the first message issued. If it is not, a NO06 will be returned.
2. NO01 will be returned if another arm is in the program mode locally or via communications.

Special Case: None

5.2.4.30 WD - Write to Display

This command instructs the Fusion4 MSC-L to display a 30-character message. The time displayed and length of response are also specified in the command. Data will be echoed to the screen upon input by the operator. This command may be used alone or it may be used in conjunction with any combination of the WA, WB or WC commands.

- Command

WD_NNN_X...Xd99	
X...X = An alphanumeric character string of up to 30 characters (see Remarks). NNN = Time-out value in seconds. An entry of 000 will cause the time-out value to default to what was entered for the first display message or if a non-zero entry is used, it will override the previous value entered. d = A required delimiter used to signify the input field. There are three different delimiters each indicating a unique handling of the input process. They are as follows: & = Input data is entered directly with no initiator required; any function key except the "CLEAR" or the "STOP" may be used to terminate the input sequence. NOTE: The above delimiters are acceptable as part of the alphanumeric message. 99 = The input field length. This may be encoded to allow a variable length input field up to the length specified here. The range of the input length is 00 to 20. To encode the option of the variable length input, add 40 to the desired input field length. EXAMPLE: To request an input field length of 5, enter "05." To also include the option, enter "45." If the option is not included the operator will have to put in 5 digits and then press the terminating key, any more than 5 digits and the message "Error Press Clear" will appear on the Fusion4 MSC-L display. If the option is included, the terminating key can be pressed at any time sending data to the Host.	

- Response

OK	Good Response. Message has been accepted for alphanumeric display (left justified).
or	
NOXX	Message was not accepted.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The following characters can be displayed on the Fusion4 MSC-L display (X...X part of command).

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9

+ ! " # $ % & ' ( ) - . / : ; < = > @ [\ ^ _ ' {|} ° ? * space

The prompt will wrap to the second line of the display where necessary.

Constraints: NO01 will be returned if another arm is in the program mode locally or via communications.

Special Case: Keypad data pending flag and data are cleared.

5.2.4.31 WX - Write to the Display in Security Mode

This command sends a message to the Fusion4 MSC-L and enables the keypad for input in an Echo 'X' or Security mode. The time displayed and length of response are also specified in the command. Data will be echoed to the screen upon input by the operator. This command may be used alone or it may be used in conjunction with any combination of the WA, WB or WC commands.

- Command

WX_NNN_X...Xd99	
X...X = An alphanumeric character string of up to 30 characters (see Remarks). NNN = Time-out value in seconds. An entry of 000 will cause the time-out value to default to what was entered for the first display message or if a non-zero entry is used, it will override the previous value entered. d = A required delimiter used to signify the input field. There are three different delimiters each indicating a unique handling of the input process. They are as follows: & = Input data is entered directly with no initiator required; any function key except the "CLEAR" or the "STOP" may be used to terminate the input sequence. NOTE: The above delimiters are acceptable as part of the alphanumeric message. 99 = The input field length. This may be encoded to allow a variable length input field up to the length specified here. The range of the input length is 00 to 20. To encode the option of the variable length input, add 40 to the desired input field length. EXAMPLE: To request an input field length of 5, enter "05." To also include the option, enter "45." If the option is not included the operator will have to put in 5 digits and then press the terminating key, any more than 5 digits and the message "Error Press Clear" will appear on the Fusion4 MSC-L display. If the option is included, the terminating key can be pressed at any time sending data to the Host.	

- Response

OK	Good Response. Message has been accepted for alphanumeric display (left justified). Keypad enabled for input in Echo 'X' mode.
or	
NOXX	Message was not accepted.
XX = Two-digit error code as defined in section 5.1.1.4.	

Remarks: The following characters can be displayed on the Fusion4 MSC-L display (X...X part of command).

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 0 1 2 3 4 5 6 7 8 9

+ ! " # $ % & ' ( ) - . / : ; < = > @ [\ ^ _ ' {|} ° ? * space

The prompt will wrap to the second line of the display where necessary.

Constraints: NO01 will be returned if another arm is in the program mode locally or via communications.

Special Case: The TO status bit will be cleared on acceptance of a WD or WX command.

Also, keypad data pending flag and data are cleared.

6 Brooks Petrocount Protocol

6.1 Description

The Brooks Petrocount protocol is provided to allow users with Brooks Instruments PetroCount IMS presets to easily communicate with the Fusion4 controller.

Existing software communications drivers used to communicate with the Brooks units can be used to communicate with the Fusion4 controller. All that needs to be taken into account is the parameter code table for the controller.

In the Brooks Petrocount protocol, the message format is the same, regardless of whether the transmission originated from the client or from the controller.

The format for a command message in the Brooks Petrocount protocol is:

SOH	$D_1D_2D_3$	$S_1S_2S_3$	STX	text	ETX	BCC1	BCC2

Term	Description	Hex value
SOH	Start of header	01_{HEX}
$D_1D_2D_3$	3-digit address of the destination controller	
$S_1S_2S_3$	3-digit address of the source controller	
STX	Start of text character	02_{HEX}
text	ASCII string containing the instruction / response	
ETX	End of text character	03_{HEX}
BCC1	MSB (most significant bit) of the binary checksum of the string	
BCC2	LSB (least significant bit) of the binary checksum of the string	

The longest packet string transmitted or received by the controller can be no longer than 255 characters in length. The command to or the response from the controller is contained in the text field. The format for this field is defined in the descriptions of the allowed commands and responses below.

6.1.1 Text Field Format

The structure of the text field is very specific. This applies to the field whether the string is a request from the client or a response from the controller. The format of the data associated with a given parameter code is also specific and cannot be varied. The Parameter and Task Codes are described in detail in the specific controller manuals.

The data contained in the text field has a specific format depending on which parameter code it is associated with. All data within the text field must be formatted exactly as described in the controller manual. All leading and trailing zeros on numbers must be transmitted. Even though the alphanumeric data strings are variable length, they cannot be longer than the maximum length specified. The controller determines the end of the string when a semi-colon or an ETX is encountered.

When a protocol string is received by the controller, it is first checked for transmission errors by using the binary check characters (BCC). The BCC is an 8-bit binary sum of the characters in the protocol string from the SOH character to the ETX character, inclusive. BCC1 and BCC2 are the ASCII hexadecimal representation of the BCC, with BCC1 being the most significant four bits. If the BCC of the received string does not match the received BCC, an error has occurred in transmission and the controller will ignore the string.

6.1.2 Broadcast Commands

The Fusion4 controller is capable of receiving a 'broadcast' command from the client unit using the Brooks Petrocount protocol. A broadcast command is a command that is directed to all the controllers on the communications bus simultaneously. In the controller, the addresses 998, 999, and 000 are reserved for use as the broadcast address. Any command message that is addressed to the broadcast address of a controller is recognized by that controller and processed.

However, unlike a command to the primary address of a controller, there is no response from the controller to a broadcast command. Clearing alarms and setting the time/date are examples of the use of broadcast commands. Only write commands or task commands may be broadcast since a read command by

definition requires a response and responses to broadcast commands are not allowed.

6.1.3 Command Identifier Prefixes

The following table lists the command identifier prefixes that are available in the Brooks Petrocount protocol.

Table 6-1: Brooks Petrocount Protocol: Command Identifier Prefixes

Identifier	Description
R	Read a data register in the controller
W	Write to a data register with data return
A	Write to a data register with return acknowledge
B	Write to a data register with no response
X	Execute a task in the controller

6.1.3.1 R - Read Value

This command instructs the controller to transmit the contents of a register back to the client.

- Request

'RPPP'	
PPP	Parameter register code defined in the specific controller manual.

- Response

'PPP=A_0 A_n'	Command completed successfully
PPP	Parameter register code.
A_0 A_n	Value of the parameter register requested. It is an ASCII character string whose format is defined in the specific controller manual.
'NAK'	Response failed; NAK control character (15 hex)

6.1.3.2 W - Write a Value with Return Data Acknowledge

This command instructs the controller to program a parameter register and acknowledge the command with return data.

- Request

'WPPP=A$_0$ A$_n$'	
PPP	Parameter register code defined in the specific controller manual.
A$_0$ A$_n$	Value of the parameter register requested. It is an ASCII character string whose format is defined in the specific controller manual.

- Response

'WPPP=A$_0$ A$_n$'	Command completed successfully
PPP	parameter register code.
A$_0$ A$_n$	Value of the parameter register requested. It is an ASCII character string whose format is defined in the specific controller manual.

6.1.3.3 A - Write a Value with ACK Acknowledge

This command instructs the Fusion4 controller to program a parameter register and acknowledge the command with an ACK control character.

- Request

'APPP=A$_0$ A$_n$'	
PPP	Parameter register code as defined in the specific Fusion4 controller manual.
A$_0$ A$_n$	Value of the parameter register requested. It is an ASCII character string whose format is defined in the specific Fusion4 controller manual.

- Response

'ACK'	Successful; ACK control character (06 hex)
'NAK'	Response failed; NAK control character (15 hex)

6.1.3.4 B - Write a Value with No Response

This command instructs the Fusion4 controller to program a parameter register and to not respond. Only command type that can be used with the Broadcast

Command.

- Request

'BPPP=A$_0$ A$_n$'	
PPP	Parameter register code as defined in the specific Fusion4 controller manual.
A_0 A_n	Value of the parameter register requested. It is an ASCII character string whose format is defined in the specific Fusion4 controller manual.

- Response

None	

6.1.3.5 X - Execute a Task in the Fusion4 Controller

This command instructs the Fusion4 controller to execute a task.

- Request

'XPPP'	
PPP	number of the task to execute as defined in the specific Fusion4 controller manual.

- Response

'XPPP=Y'	Successful
PPP	Number of the task that was executed.
'NAK'	Response failed; NAK control character (15 hex)

6.1.4 Error Messages

When an error is detected in the text field by the Fusion4 controller, it will respond with a NAK character. Reasons that can cause a command to fail and a NAK to be sent back to the client are listed in the table below.

The client has no way of knowing which condition caused the error. However, once the client's software is installed and debugged, most of these conditions will not present a problem.

Table 6-2: Brooks Petrocount Protocol: Error Messages

Error message	Explanation
Illegal Command	Command code is not recognized.
Illegal Value	Value is out of range.
Syntax Error In Value	Value string is not in the correct format.
Illegal Text String Format	Construction of the text field is incorrect.
Unit In Critical Alarm	Alarm must be cleared before the command can be completed.
Option Not Installed	Command code is not supported in this version of the controller.
Transaction In Progress	Controller is permitted. Certain parameters can not be changed.
No Transaction in Progress	Transaction must be in progress to execute the code.
Transmission Error (BCC failed)	Error occurred in the protocol string during trans-mission.
In Local Programming Mode	Controller is being programmed with the hand- held controller.
Commands Out Of Sequence	Another command code must execute before the current one can.
Write Attempt to a Read Only Value	Tried to store a value to a read only parameter register.

6.1.5 Examples

Example 1. The client requests the Active Alarm Status (802) of controller with address 123. The controller has no active alarms. The client's address is 689.

- Request

SOH	123	689	STX	R802	ETX	BCC1	BCC2

- Response

SOH	689	123	STX	802=0000	ETX	BCC1	BCC2

Example 2. The client sets the Additive K-Factor to 6300.000 on controller with address 313. It wants a data response from the controller.

- Request

SOH	313	689	STX	W001=6300.000	ETX	BCC1	BCC2

- Response

SOH	689	313	STX	W001=6300.000	ETX	BCC1	BCC2

Example 3. The client sets the User #3 Password to 5434 in the controller with address 246. It wants an acknowledge response from the controller.

- Request

SOH	246	689	STX	A720=5434	ETX	BCC1	BCC2

- Response

SOH	689	246	STX	ACK	ETX	BCC1	BCC2

Example 4. The client sets the time on all controllers on the communication loop at the same time (broadcast command). The time is 02:34:13 PM. Number 999 is the broadcast address for the system.

- Request

SOH	999	689	STX	B111=14:34:13	ETX	BCC1	BCC2

- Response None.

Example 5. The client sets the factored pulse output resolution (050) to 1/100th of a unit volume. The controller's address is 423, and the client wants a response with data.

- Request

SOH	423	689	STX	W050=2	ETX	BCC1	BCC2

- Response

SOH	689	423	STX	W050=2	ETX	BCC1	BCC2

6.2 Fusion4 SSC-A



The following table lists the Brooks Petrocount protocol parameters for the Fusion4 SSC-A (single stream controller for additive injection). See section B.1 for a description of the parameters.

Table 6-3: Brooks Petrocount protocol Parameters for Fusion4 SSC-A

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream K-factor	001	floating point	R	nnnnn.nnn		
Additive K-factor	002	floating point	R	nnnnn.nnn		
Injection volume	010	floating point	R/W	nnnn.n		
Volume per injection cycle	020	floating point	R/W	nnnn.n		
Solenoid dwell time	030	integer	R	nnnnn		
Minimum product volume for transaction	040	floating point	R/W	nnn		
Factored pulse output resolution	050	enumeration, see C.1.5	R	n	2...5	
Number of clean start cycles	060	integer	R/W	nn		
Flush volume	061	floating point	R/W	nnn		
High flow threshold value	063	floating point	R/W	nnnnn		

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Low flow threshold value	064	floating point	R/W	nnnnn		
Transaction closing time	065	integer	R/W	nnn		
Pacing source	080	enumeration, see C.1.4	R	n	0...2	
Permissive function	081	enumeration, see C.1.6	R/W	n	0...2	
Injection offset	090	integer	R/W	nnn		
Unit address	100	integer	R	nnn		
Broadcast address	101	integer	R	nnn		
Number of solenoid retries	131	integer	R	n		
DI hysteresis time	132	integer	R	nnnn		
Feedback pulse duration	133	integer	R	nnnn		
Pump run timeout	134	integer	R/W	nnn		
No additive alarm action	310	enumeration, see C.1.2	R	n	0...2	
No additive timeout period	311	integer	R	n		
Additive volume deviation alarm action	320	enumeration, see C.1.2	R	n	0...2	
Additive volume deviation allowed	322	integer	R/W	nnn		
Additive deviation basis	323	integer	R	nn	5...20	
Leaking solenoid alarm action	340	enumeration, see C.1.2	R	n	0...2	

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Leaking solenoid volume limit	341	floating point	R	nnn		
Leaking solenoid timeout period	342	integer	R	nn		
No activity timeout alarm action	370	enumeration, see C.1.2	R	n	0...2	
No activity timeout period	371	integer	R	nnn		
Active alarms	802	bitmask, see C.1.8	R	hhhh		
Permissive state	804	enumeration, see C.1.3	R	n	0...1	
Solenoid close delay	805	integer	R	nnnn		
Additive stream flow rate	809	floating point	R	nnnnn		
Accumulative wild stream gross observed volume	810	floating point	R	nnnnnnn		
Accumulative total additive stream gross observed volume	850	floating point	R	nnnnnnn		
Accumulative transac- tional additive stream gross observed volume	860	floating point	R	nnnnnnn		
Accumulative leaking solenoid gross observed volume	870	floating point	R	nnnnnnn		

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Accumulative calibration gross observed volume	880	floating point	R	nnnnnnn		
Load stream flow rate	881	floating point	R	nnnnn.nnn		
Additive stream flow rate	882	floating point	R	nnnnn.nnn		
Transaction PPM	883	floating point	R	nnnnn		
Task register	888	integer, see C.1.1	W	hhhh		
Firmware version number	890	string	R	aaaaaa		
Product ID	892	string	R	aaaaaaaaa		
Device serial number	893	string	R	ssssssss		

6.3 Fusion4 SSC-B



The following table lists the parameters of the Brooks Petrocount protocol for the Fusion4 SSC-B (single stream controller for blending). See section B.1 for a description of the parameters.

Table 6-4: Brooks Petrocount protocol parameters for Fusion4 SSC-B

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream K-factor	001	floating point	R	nnnnn.nnn		100
Blend stream K-factor	002	floating point	R	nnnnn.nnn		750
Target blend percentage rate A	010	floating point	R/W	nnn.nn		0
Target blend percentage rate B	011	floating point	R/W	nnn.nn		0
Target blend percentage rate C	012	floating point	R/W	nnn.nn		0
Target blend percentage rate D	013	floating point	R/W	nnn.nn		0
Target blend percentage rate E	014	floating point	R/W	nnn.nn		0
Dead band control window limit	020	floating point	R/W	nnnn.nn	0.01...10000	0.1
Inner control window limit	021	floating point	R	nnnn.nn	0.01...10000	1
Middle control window limit	022	floating point	R	nnnn.nn	0.01...10000	10
Outer control window limit	023	floating point	R	nnnn.nn	0.01...10000	100
Solenoid active dwell	030	integer	R	nnnn	50...1000	100

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Solenoid rest dwell	031	integer	R	nnnn	50...1000	100
Permissive function	040	enumeration, see C.2.10	R	n	0...1	1
Blend stream pulse timeout	041	integer	R	nn	1...90	2
Wild stream pulse timeout	042	integer	R	nnn	1...999	5
Deviation count smoothing value	044	integer	R	nn	0...12	10
Reset blend deviation counter at transaction start	045	enumeration (see section, see C.2.6	R	n	0...1	0
Multifunction DC output #1	049	enumeration, see C.2.5	R	n	2...5	2
Multi function DC output #2	050	enumeration, see C.2.5	R	n	2...5	2
Preset gross observed volume	060	floating point	R/W	nnnnnn	0...999999	0
Flush volume	061	floating point	R/W	nnn	0...999	0
Pre-shutdown control	062	enumeration	R	n	0...2	0
Pre-shutdown volume	063	floating point	R/W	nnnn	0...9999	0
Clean start control	070	enumeration, see C.2.8	R	n	0...1	0

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Blend point relative to wild stream meter	080	enumeration, see C.2.3	R	n	0...1	0
Gross standard volume calculation interval	082	floating point	R	nnnn.nn		
Temperature compensation used	083	boolean	R	n		
Unit address	100	integer	R	nnn		
Broadcast address	101	integer	R	nnn		
DI hysteresis time	132	integer	R	nnnn		
Calibration high flow rate	200	floating point	R	nnnn	1...9999	60
Calibration low flow rate	201	floating point	R	nnn	1...100	15
Calibration inner control window limit	210	integer	R	nnn	1...100	10
Calibration outer flow rate control window	211	integer	R	nnnn	1...9999	25
Calibration start low flow volume	220	floating point	R	nnnn	1...9999	25
Calibration end low flow volume	221	floating point	R	nnnn	1...9999	25

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Calibration final shut down volume	230	floating point	R	nnn	0...999	20
Flow calculation smoothing value	240	integer	R	nn	1...99	10
Control failure alarm action	310	enumeration, see C.2.2	R	n	0...2	2
Control failure alarm timeout	311	integer	R	nn	1...30	10
Blend percentage deviation alarm action	320	enumeration, see C.2.2	R	n	0...2	2
Blend low percentage allowed	321	integer	R/W	nn	1...99	95
Blend high percentage allowed	322	integer	R/W	nnn	101...999	105
Minimum wild stream volume for alarm	323	floating point	R/W	nnn	1...999	5
Leaking blend valve alarm action	340	enumeration, see C.2.2	R	n	0...2	2
Leaking blend valve volume limit	341	floating point	R	nnnn	1...9999	100

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Wild stream closing volume alarm action	350	enumeration, see C.2.2	R	n	0...2	2
Wild stream closing volume	351	floating point	R	nnnn	1...9999	150
Blend stream closing timeout alarm action	360	enumeration, see C.2.2	R	n	0...2	2
Blend stream closing timeout	361	integer	R	nnn	1...240	60
No activity alarm action	370	enumeration, see C.2.2	R	n	0...2	2
No activity timeout	371	integer	R	nn	1...65535	30
Flush volume alarm action	380	enumeration, see C.2.2	R	n	0...2	2
Flush volume deviation	381	integer	R/W	nnn	1...100	25
Active alarms	802	integer, see C.2.18	R	hhhh	0...65535	0
Permissive state	804	enumeration, see C.2.4	R	n	0...1	0
Accumulative wild stream gross observed volume	810	floating point	R	nnnnnnnn	0...99999999	0

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Accumulative blend stream gross observed volume	820	floating point	R	nnnnnnnn	0...99999999	0
Accumulative blend stream gross standard volume	825	floating point	R	nnnnnnnn	0...99999999	0
Transactional wild stream gross observed volume	830	floating point	R	nnnnnn.nn	0...999999.99	0
Transactional blend stream gross observed volume	840	floating point	R	nnnnnn.nn	0...999999.99	0
Transactional blend stream gross standard volume	845	floating point	R	nnnnnn.nn	0...999999.99	0
Transactional blend percentage (normal mode)	850	floating point	R	nnn.nn	0...100.00	0

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Accumulative blend volume (emulation mode only)	850	floating point	R	nnnnnnnn	0	0
Transaction deviation count	860	floating point	R	nnnnn		0
Transaction current average temperature	865	floating point	R	nnn.n	-999.9...999.9	0
Instantaneous temperature	866	floating point	R	nnn.n	-999.9...999.9	0
Accumulative leaking blend stream gross observed volume	870	floating point	R	nnnnnnnn	0...99999999	0
Accumulative calibration gross observed volume	880	floating point	R	nnnnnnnn	0...99999999	0
Wild stream flow rate	881	floating point	R	nnnn		
Blend stream flow rate	882	floating point	R	nnnn		
Transactional blend percentage	883	floating point	R	nnnn		
Task register	888	enumeration, see C.2.1	W		1...802	

Parameter Name	Parameter Number	Parameter Format	Access	Format	Range	Default
Firmware version number	890	string	R	aaaaaa		
Product ID	892	string	R	aaaaaaaaa		
Device serial number	893	string	R	aaaaaaaa		

7 Modbus Protocols

7.1 General

Modbus is a widely recognized protocol in industrial Modbus RTU | TCP/IP register maps for Fusion4 MSC-L applications. It is an open protocol supported by the Modbus Organization (www.modbus.org), which provides technical specifications.

With regard to the Fusion4 controllers, three variations of the Modbus protocol implementation can be distinguished:

- Modbus RTU is the standard Modbus protocol over serial communication line with RTU (Remote Terminal Unit) framing. It has its own data map. See section 7.1.1.
- Modbus Legacy uses Modbus RTU framing but handles data/ messages in a non-standard way. It has its own data map to provide backward compatibility where older instruments were used. See section 7.1.2.
- Modbus TCP/IP is the standard Modbus TCP/IP protocol. Data mapping and command interpretation are the same as per Modbus RTU.

7.1.1 Modbus RTU

Modbus RTU is an application layer messaging protocol that provides client/server communications between devices connected on different types of buses or networks.

Modbus RTU is a request/reply protocol and offers services specified by function codes. Modbus function codes are elements of Modbus request/reply protocol data units (PDUs).

Modbus RTU over serial line is a client-server protocol. Only one client (at the same time) is connected to the bus, and one or several (247 maximum number) servers nodes are also connected to the same serial bus. A Modbus communication is always initiated by the client. The server nodes will never transmit data without receiving a request from the client node. The server nodes will never communicate

with each other. The client node initiates only one Modbus transaction at the same time.

The client node issues a Modbus request to the server nodes in two modes:

7.1.1.1 Unicast mode

In this mode, the client node addresses an individual server node. After receiving and processing the request, the server returns a message (response) to the client. Each server must have a unique address (from 1 to 247) so that it can be addressed independently from other nodes.

7.1.1.2 Broadcast mode

In this mode, the client can send a request to all servers. No response is returned to broadcast requests sent by the client. Broadcast requests are necessarily writing commands. All servers must accept the broadcast request for writing function. The address 0 is reserved to identify a broadcast exchange.

At the physical level Modbus RTU over serial line may use different physical interfaces with Fusion4 devices providing the most common TIA/EIA-485 (RS-485) interface.

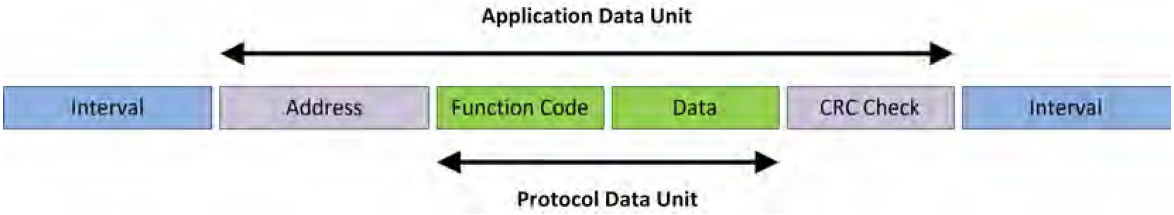
7.1.1.3 Message format

In RTU mode, a message starts with a silent interval of at least 3.5 character times. Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval. The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs between two characters, the message frame is declared incomplete and will be discarded by the receiver.

Modbus RTU defines a simple protocol data unit (PDU) independent of the underlying communication layers. The mapping of the Modbus protocol on specific buses or network can introduce some additional fields on the application data unit. (ADU).

> NOTE: By default, the numerical data values within messages are placed in big endian format, i.e. higher order byte first, but Fusion4 devices allow an option for reversed byte order (little endian format) for greater flexibility when working

vith different clients. The examples in this chapter are based on the default big endian format for numerical data values within messages.



Term	Description
Address	The Address field only contains the address of the server. • The address of the server is programmable in the range from 1 to 247. • 0 = Broadcast, no response required from server. • The range 248 to 255 is reserved. • When the server returns its response, it places its own address in the response address field to let the client know which server is responding,
Function	The function code indicates to the server device what kind of action to perform: • 03 = Read holding register(s), see section 7.1.1.1.1 • 06 = Write single holding register, see section 7.1.1.1.2 • 16 = Write multiple holding registers, see section 7.1.1.1.3
Data	The data field contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

Term	Description
CRC Check	The error–checking field is based on a Cyclical Redundancy Checking (CRC) method performed on the message contents. The CRC field checks the contents of the entire message. It is applied regardless of any parity checking method used for the individual characters of the message. The CRC field is appended to the message as the last field in the message. When this is done, the low–order byte of the field is appended first, followed by the high–order byte. The CRC high– order byte is the last byte to be sent in the message. The CRC value is calculated by the sending device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

When a client sends a query to a server, it expects a normal response. One of four possible events can occur from the query of a client.

- If the server receives the query without a communication error and can handle the query normally, it returns a normal response (See details below).
- If the server does not receive the query due to a communication error, no response is returned. The client has to process a time-out condition for the query.
- If the server receives the query, but detects a communication error (parity or CRC), no response is returned. The client has to process a time-out condition for the query.
- If the server receives the query without a communication error, but cannot handle it (e.g. if the request is to read a non-existent register), the server will return an exception informing the client of the nature of the error. See section 7.1.1.2.

7.1.1.3.1 Function code 03 (0x03): Read Holding Registers

Function code 03 (0x03) is used to read the contents of a contiguous block of holding registers in a server. The request PDU specifies the starting address and

the number of holding registers. In the PDU, holding registers are addressed starting at zero. Therefore, holding registers numbered 1-16 are addressed as 0-15.

The holding register data in the response message are packed as two bytes per holding register, with the binary contents right justified within each byte (the default byte order is big endian).

Request

Function code	1 byte	0x03
Starting address	2 bytes	0x0000 to 0xFFFF
Quantity of registers	2 bytes	1 to 125 (0x7D)

Response

Function code	1 byte	0x03
Byte count	1 byte	2 x N*
Register value	N* x 2 bytes	

*N = Quantity of registers

Example

Below is an example of a request to read holding registers 108 to 110.

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	03	Function	03
Starting address Hi	00	Byte count	06
Starting address Lo	6B	Register value Hi (108)	02
Quantity of registers Hi	00	Register value Lo (108)	2B
Quantity of registers Lo	03	Register value Hi (109)	00
		Register value Lo (109)	00
		Register value Hi (110)	00
		Register value Lo (110)	64

The contents of holding registers 108 to 110 are shown as the two-byte value of 02 2B hex (555 decimal), 00 00 hex (0 decimal) and 00 64 hex (100 decimal) respectively.

7.1.1.3.2 Function code 06 (0x06): Write Single Holding Register

Function code 06 (0x06) is used to write a single holding register in a server. The request PDU specifies the address of the holding register to be written. In the PDU, holding registers are addressed starting at zero. Therefore, holding register numbered 1 is addressed as 0.

The normal response is an echo of the request, returned after the holding register contents have been written.

Request

Function code	1 Byte	0x06
Register address	2 Bytes	0x0000 to 0xFFFF
Register value	2 Bytes	0x0000 to 0xFFFF

Response

Function code	1 Byte	0x06
Register address	2 Bytes	0x0000 to 0xFFFF
Register value	2 Bytes	0x0000 to 0xFFFF

Error

Error code	1 Byte	0x86
Exception code	1 Byte	01 or 02 or 03 or 04 or 05 or 06

Example

Below is an example of a request to write holding register 2 to 00 03 hex.

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	06	Function	06
Register address Hi	00	Register address Hi	00
Register address Lo	01	Register address Lo	01

Request		Response	
Register value Hi	00	Register value Hi	00
Register value Lo	03	Register value Lo	03

7.1.1.3.3 Function code 16 (0x10): Write Multiple Registers

Function code 16 (0x10) is used to write a block of contiguous registers (1 to 123 registers) in a server. The requested written values are specified in the Request data field. Data is packed as two bytes per register. The normal response returns the function code, starting address, and quantity of holding registers written.

> NOTE: Fusion4 implementation of this function allows only one mapped parameter to be written per request (a parameter can occupy one or more registers).

Request

Function code	1 Byte	
Starting address	2 Bytes	0x0000 to 0xFFFF
Quantity of registers	2 Bytes	0x0001 to 0x007B
Byte count	1 Byte	2 x N*
Registers value	N* x 2 Bytes	Value

*N = Quantity of registers

Response

Function code	1 Byte	0x10
Starting address	2 Bytes	0x0000 to 0xFFFF
Quantity of registers	2 Bytes	1 to 123 (007B)

Error

Error code	1 Byte	0x90
Exception code	1 Byte	01, 02, 03, 04, 05 or 06

Example

Below is an example of a request to write two holding registers starting at 2 to 00 0A hex and 01 02 hex.

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	10	Function	10
Starting address Hi	00	Starting address Hi	00
Starting address Lo	01	Starting address Lo	01
Quantity of registers Hi	00	Quantity of registers Hi	00
Quantity of registers Lo	02	Quantity of registers Lo	02
Byte count	04		
Registers value Hi	00		
Registers value Lo	0A		
Registers value Hi	01		
Registers value Lo	02		

7.1.1.4 Exception Responses

When a client device sends a request to a server device it expects a normal response. One of four possible events can occur from the client's query:

- If the server device receives the request without a communication error, and can handle the query normally, it returns a normal response.
- If the server device does not receive the request due to a communication error, no response is returned. The client program will eventually process a timeout condition for the request.
- If the server device receives the request, but detects a communication error (parity, CRC, ...), no response is returned. The client program will eventually process a timeout condition for the request.
- If the server device receives the request without a communication error, but cannot handle it (for example, if the request is to read a non-existent output or register), the server device will return an exception response informing the client of the nature of the error.

The exception response message has two fields that differentiate it from a normal response:

- Function Code Field: In a normal response, the server device echoes the function code of the original request in the function code field of the response. All function codes have a most-significant bit (MSB) of 0 (their values are all below 80 hexadecimal). In an exception response, the server sets the MSB of the function code to

  1. This makes the function code value in an exception response exactly 80 hexadecimal higher than the value would be for a normal response.

     With the function code's MSB set, the client's application program can recognize the exception response and can examine the data field for the exception code.

- Data Field: In a normal response, the server may return data or statistics in the data field (any information that was requested in the request). In an exception response, the server returns an exception code in the data field. This defines the server condition that caused the exception.

Example of a client request and server exception response.

Request		Response	
Field Name	(Hex)	Field Name	(Hex)
Function	03	Function	83
Starting address Hi	00	Exception code	02
Starting address Lo	6B		
Quantity of registers Hi	00		
Quantity of registers Lo	03		

In this example, the client addresses a request to a server device. The function code (03) is for a Read Holding Registers operation. It requests to read the contents of holding registers 108 (006B hex) to 110.

If the output address is non-existent in the server device, the server will return the exception response with the exception code shown (02). This specifies an illegal data address for the server.

The following table lists the exception codes.

Table 7-1: Modbus Exception Codes

Code	Name	Description
01	Illegal function	The function code received in the query is not an allowable action for the server (or server). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or server) is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values.
02	Illegal data address	The data address received in the query is not an allowable address for the server (or server). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is sub- mitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on regis- ters 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 “Illegal Data Address” since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.
03	Illegal data value	A value contained in the query data field is not an allowable value for server (or server). This indicates a fault in the structure of the remainder of a com- plex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS pro- tocol is unaware of the significance of any particular value of any particular register.
04	server device failure	An unrecoverable error occurred while the server was attempting to perform the requested action.

Code	Name	Description
05	Acknowledge	Specialized use in conjunction with programming commands. The server (or server) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the client (or client). The client (or client) can next issue a Poll Program Complete message to determine if pro- cessing is completed.
06	server device busy	Specialized use in conjunction with programming commands. The server (or server) is engaged in processing a long-duration program command. The client (or client) should retransmit the message later when the server (or server) is free.

7.1.1.5 Executing a Task

Fusion4 devices allow to execute tasks by writing specific values into Parameter # 2000. This parameter can be used as a task register by a client using Modbus RTU protocol. By setting a bit in a single word written to the Parameter # 2000 register, various tasks can be executed (See Appendix A for possible task values).

Example

Execute Task “Enable Permissive” in unit address 123 (write value 0002h into register # 2000 using Modbus Function code 10h).

Request 7Bh	10h	07h	D0h	00h	01h	02h	00h	02h	CRC-H 59	CRC-L A3

Term	Description
7B	Address of the controller
10	Write command
07 D0	Parameter (2000)
00 01	# of words to write (in this case = 1 word)
02	# of bytes to write (in this case = 2 bytes)

Term	Description
00 02	Data to write
59 A3	CRC

Response 7Bh	10h	07h	D0h	00h	01h	CRC-H	CRC-L

7.1.2 Modbus Legacy

The Modbus Legacy protocol is a modified subset of Modbus Protocol, where commands adhere to the message framing defined by Modbus RTU (See section 7.1.1), but are not necessarily used for the same purpose.

For example, function code 06h is defined by Modbus to 'Preset a Single Register', while Modbus Legacy protocol use this function code to 'Execute a Task'.

This version of protocol is provided for backward compatibility where older instruments (such as MiniPak 3000) were used and it has its own data map. Several points should be noted when using Modbus Legacy protocol:

- The location of the decimal point is fixed for each parameter. The location of the decimal point is governed by the parameter scaling factor. The scaling factor is the integer number by which the parameter value should be divided to get the real value of the parameter.
- String data is transmitted in the order in which they would be 'read' (i.e. from left to right). For example, 'Premium' is transmitted with the 'P' first and the 'm' last. String data is 'null' terminated within the data field. See example 2 below.
- All numbers in this section are decimal (base 10), unless otherwise specified. All hexadecimal numbers are followed by 'h'.

7.1.2.1 Read and Write Commands

7.1.2.1.1 Read a Parameter (Command Code - 03h)

This function code is modified to allow only one mapped parameter to be read per request.

Examples

Example 1. client wants to read parameter 001 in unit address 145. Parameter 001 has a value of 0345.243.

Request 91h	03h	00h	01h	00h	02h	CRC-H	CRC-L

Response 91h	03h	04h	00h	05h	44h	9Bh	CRC-H	CRC-L

Example 2. client wants to read parameter 110 in unit address 145. Parameter 110 has a value of '06/22/95'.

Request 91h	03h	00h	6Eh	00h	05h	CRC-H	CRC-L

Response 91h	03h	0Ah	30h	36h	2Fh	32h	32h	2Fh	39h	35h	00h	00h	CRC-L	CRC-R

7.1.2.1.2 Write a Parameter (Command Code - 10h)

This function code is modified to allow only one mapped parameter to be altered per request.

Example

client wants to set Parameter # 132 to 750 in unit address 145.

Request 91h	10h	00h	84h	00h	01h	02h	02h	EEh	CRC-H	CRC-L

Response 91h	10h	00h	84h	00h	01h	CRC-H	CRC-L

7.1.2.2 Executing a Task

Two methods exist for executing a Task when utilizing Modbus Legacy protocol. Both methods allow only one task to be executed per request.

- One method (preferred) uses Modbus Function code 10h where writing various values into a specific register (Parameter # 888) would initiate different tasks. See section 7.1.2.2.1.
- The other method is provided for compatibility with previous implementations and utilizes Modbus Function code 06h which is not used in the same manner as defined by Modbus. The task execution is determined by Parameter number and the two 'data bytes' are ignored by the server device. They can be set to any

value and will be echoed back to the client unit in the response packet. See section 7.1.2.2.2.

7.1.2.2.1 Execute a Task via Modus Function Code 10h

This method allows to execute tasks by writing specific values into Parameter # 888 via Modbus Function code 10h. This parameter can be used as a task register by a client using Modbus Legacy protocol. By setting a bit in a single word written to the Parameter # 888 register, various tasks can be executed (See Appendix A for possible task values).

Example

Execute Task "Enable Permissive" in unit address 123 (write value 0002h into Parameter # 888 using Modbus Function code 10h).

Request 7Bh	10h	03h	78h	00h	01h	02h	00h	02h	CRC-H 05	CRC-L 8B

Term	Description
7B	Address of the controller
10	Write command
03 78	Parameter (888)
00 01	# of words to write (in this case = 1 word)
02	# of bytes to write (in this case = 2 bytes)
00 02	Data to write
05 8B	CRC

Response 7Bh	10h	03h	78h	00h	01h	CRC-H	CRC-L

7.1.2.2.2 Execute a Task via Modbus Function Code 06h

This method allows to execute tasks by writing into specific Parameters (registers) via Modbus Function code 06h (data value is ignored). By setting a specific Parameter number, various tasks can be executed (See Appendix A for possible tasks and associated Parameter numbers).

Example

Execute task "Clear Additive Totals" in unit address 192 (write arbitrary value 0000h into Parameter # 802 using Modbus Function code 06h).

Request C0h	06h	03h	22h	00h	00h	CRC-H	CRC-L

Response C0h	06h	03h	22h	00h	00h	CRC-H	CRC-L

7.2 Modbus Legacy Protocol

7.2.1 Fusion4 SSC-A



The following table provides the Modbus Legacy register map for the Fusion4 SSC-A (single stream controller for additive Injection). See section B.1 for a description of the parameters.

Table 7-2: Modbus Legacy register map for Fusion4 SSC-A

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard/ Modicon)		Registers	Type				
Wild stream K-factor	001	0001	002	40002	2	uint32	R	1000		
Additive K-factor	002	0002	003	40003	2	uint32	R	1000		
Injection volume	010	000A	011	40011	2	uint32	R/W	1000		
Volume per injection cycle	020	0014	021	40021	2	uint32	R/W	10		
Solenoid dwell time	030	001E	031	40031	1	uint16	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard/ Modicon)		Registers	Type				
Minimum transaction volume	040	0028	041	40041	2	uint32	R/W	1		
Factored pulse output resolution	050	0032	051	40051	1	uint16 (enum)	R	1	See C.1.5	
Number of clean start cycles	060	003C	061	40061	1	uint16	R/W	1		
Flush volume	061	003D	062	40062	2	uint32	R/W	1		
High flow threshold value	063	003F	064	40064	2	uint32	R/W	1		
Low flow threshold value	064	0040	065	40065	2	uint32	R/W	1		
Transaction closing time	065	0041	066	40066	1	uint16	R/W	1		
Pacing source	080	0050	081	40081	1	uint16 (enum)	R	1	See C.1.4	
Permissive function	081	0051	082	40082	1	uint16 (enum)	R/W	1	See C.1.6	
Injection offset	090	005A	091	40091	1	uint16	R/W	1		
Unit address	100	0064	101	40101	1	uint16	R	1		
Broadcast address	101	0065	102	40102	1	uint16	R	1		
Number of solenoid retries	131	0083	132	40132	1	uint16	R	1		
DI hysteresis time	132	0084	133	40133	1	uint16	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard/ Modicon)		Registers	Type				
Feedback pulse duration	133	0085	134	40134	1	uint16	R	1		
Pump run timeout	134	0086	135	40135	1	uint16	R/W	1		
No additive alarm action	310	0136	311	40311	1	uint16 (enum)	R	1	See C.1.2	
No additive timeout period	311	0137	312	40312	1	uint16	R	1		
Additive volume deviation alarm action	320	0140	321	40321	1	uint16 (enum)	R	1	See C.1.2	
Additive volume deviation allowed	322	0142	323	40323	1	uint16	R/W	1		
Leaking solenoid alarm action	340	0154	341	40341	1	uint16 (enum)	R	1	See C.1.2	
Leaking solenoid volume limit	341	0155	342	40342	1	uint16	R	1		
Leaking solenoid timeout period	342	0156	343	40343	1	uint16	R	1		
No activity timeout alarm action	370	0172	371	40371	1	uint16 (enum)	R	1	See C.1.2	
No activity timeout period	371	0173	372	40372	1	uint16	R	1	1...65535	
Active alarms	802	0322	803	40803	1	uint16 (enum)	R	1	See C.1.8	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard/ Modicon)		Registers	Type				
Permissive state	804	0324	805	40805	1	uint16 (enum)	R	1	See C.1.3	
Solenoid close delay	805	0325	806	40806	1	uint16	R	1		
Additive stream flow rate	809	0329	810	40810	2	uint32	R	1		
Accumulative wild stream gross observed volume	810	032A	811	40811	2	uint32	R	1		
Accumulative total additive stream gross observed volume	850	0352	851	40851	2	uint32	R	1000		
Accumulative transactional additive stream gross observed volume	860	035C	861	40861	2	uint32	R	1000		
Accumulative leaking sole-noid gross observed volume	870	0366	871	40871	2	uint32	R	1000		
Accumulative calibration gross observed volume	880	0370	881	40881	2	uint32	R	1000		
Load stream flow rate	881	0371	882	40882	2	uint32	R	1		
Additive stream flow rate	882	0372	883	40883	2	uint32	R	1		
Transaction PPM	883	0373	884	40884	2	uint32	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard/ Modicon)		Registers	Type				
Transactional load stream gross observed volume	885	0375	886	40886	2	uint32	R	1		
Task register	888	0378	889	40889	1	uint16 (enum)	W	1	See C.1.1	
Firmware ver- sion number	890	037A	891	40891	3	string	R	1		
Product ID	892	037C	893	40893	5	string	R	1		
Device serial number	893	037D	894	40894	4	string	R	1		

7.2.1.1 Definition of Fusion4 SSC-A Volume Parameters

The following table provides a definition of the Fusion4 SSC-A volume parameters.

Table 7-3: Definition of Fusion4 SSC-A volume parameters

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. additive volume	Acc. calibration volume	Acc. leaking volume
810	Accumulative wild stream gross observed volume	x			
850	Accumulative total additive stream gross observed volume		x	x	x
860	Accumulative transactional additive stream gross observed volume		x		

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. additive volume	Acc. calibration volume	Acc. leaking volume
870	Accumulative leaking solenoid gross observed volume				x
880	Accumulative calibration gross observed volume			x	

7.2.2 Fusion4 SSC-B



The following table provides the Modbus Legacy register map for the Fusion4 SSC-B (single stream controller for blending). See section B.2 for a description of the parameters.

Table 7-4: Modbus Legacy register map for Fusion4 SSC-B

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Wild stream K-factor	001	0001	002	40002	2	uint32	R	1000	0.001... 99999.999	100
Blend stream K-factor	002	0002	003	40003	2	uint32	R	1000	0.001... 99999.999	50
Target blend percentage rate A	010	000A	011	40011	2	uint32	R/W	100	0...100	0
Target blend percentage rate B	011	000B	012	40012	2	uint32	R/W	100	0...100	0

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Target blend percentage rate C	012	000C	013	40013	2	uint32	R/W	100	0...100	0
Target blend percentage rate D	013	000D	014	40014	2	uint32	R/W	100	0...100	0
Target blend percentage rate E	014	000E	015	40015	2	uint32	R/W	100	0...100	0
Dead band control window limit	020	0014	021	40021	2	uint32	R/W	100	0.01... 10000	0.1
Inner control window limit	021	0015	022	40022	2	uint32	R	100	0.01... 10000	1
Middle control window limit	022	0016	023	40023	2	uint32	R	100	0.01... 10000	10
Outer control window limit	023	0017	024	40024	2	uint32	R	100	0.01... 10000	100
Solenoid active dwell	030	001E	031	40031	1	uint16	R	1	50...1000	10
Solenoid rest dwell	031	001F	032	40032	1	uint16	R	1	50...1000	10
Permissive Function	040	0028	041	40041	1	uint16 (enum)	R	1	See C.2.10	0

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Blend stream pulse timeout	041	0029	042	40042	1	uint16	R	1		
Wild stream pulse timeout	042	002A	043	40043	1	uint16	R	1		
Deviation count smoothing value	044	002C	045	40045	1	uint16	R	1		
Reset blend deviation counter at transaction start	045	002D	046	40046	1	uint16 (enum)	R	1	See C.2.6	
Multifunction DC output #1	049	0031	050	40050	1	uint16 (enum)	R	1	See C.2.5	
Multifunction DC output #2	050	0032	051	40051	1	uint16 (enum)	R	1	See C.2.5	
Preset gross observed volume	060	003C	061	40061	2	uint32	R/W	1		
Flush volume	061	003D	062	40062	2	uint32	R/W	1		
Pre-shutdown control	062	003E	063	40063	1	uint16 (enum)	R	1	See C.2.7	
Pre-shutdown volume	063	003F	064	40064	2	uint32	R/W	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Clean start control	070	0046	071	40071	1	uint16 (enum)	R	1	See C.2.8	
Blend point relative to wild stream meter	080	0050	081	40081	1	uint16 (enum)	R	1	See C.2.3	
Gross standard volume calculation interval	082	0052	083	40083	2	uint32	R	100		
Temperature compensation used	083	0053	084	40084	1	uint16 (bool)	R	1		
Unit address	100	0064	101	40101	1	uint16	R	1		
Broadcast address	101	0065	102	40102	1	uint16	R	1		
DI hysteresis time	132	0084	133	40133	1	uint16	R	1		
Calibration high flow rate	200	00C8	201	40201	2	uint32	R	1		
Calibration low flow rate	201	00C9	202	40202	2	uint32	R	1		
Calibration inner control window limit	210	00D2	211	40211	1	uint16	R	1		
Calibration outer flow rate control window	211	00D3	212	40212	1	uint16	R	1		
Calibration start low flow volume	220	00DC	221	40221	2	uint32	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Calibration end low flow volume	221	00DD	222	40222	2	uint32	R	1		
Calibration final shut down volume	230	00E6	231	40231	2	uint32	R	1		
Flow calculation smoothing value	240	00F0	241	40241	1	uint16	R	1		
Control failure alarm action	310	0136	311	40311	1	uint16 (enum)	R	1	See C.2.2	
Control failure alarm timeout	311	0137	312	40312	1	uint16	R	1		
Blend percentage deviation alarm action	320	0140	321	40321	1	uint16 (enum)	R	1	See C.2.2	
Blend low percentage allowed	321	0141	322	40322	1	uint16	R/W	1		
Blend high percentage allowed	322	0142	323	40323	1	uint16	R/W	1		
Leaking blend valve alarm action	340	0154	341	40341	1	uint16 (enum)	R	1	See C.2.2	
Leaking blend valve volume limit	341	0155	342	40342	2	uint16	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Wild stream closing volume alarm action	350	015E	351	40351	1	uint16 (enum)	R	1	See C.2.2	
Wild stream closing volume	351	015F	352	40352	2	uint32	R	1		
Blend stream closing timeout alarm action	360	0168	361	40361	1	uint16 (enum)	R	1	See C.2.2	
Blend stream closing timeout	361	0169	362	40362	1	uint16	R	1		
No activity alarm action	370	0172	371	40371	1	uint16 (enum)	R	1	See C.2.2	
No activity timeout period	371	0173	372	40372	1	uint16	R	1	1...65535	30
Flush volume alarm action	380	017C	381	40381	1	uint16 (enum)	R	1	See C.2.2	
Flush volume deviation	381	017D	382	40382	1	uint16	R/W	1		
Active alarms	802	0322	803	40803	1	uint16 (enum)	R	1		
Permissive state	804	0324	805	40805	1	uint16 (enum)	R	1	See C.2.4	
Accumulative wild stream gross observed volume	810	032A	811	40811	2	uint32	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Accumulative blend stream gross observed volume	820	0334	821	40821	2	uint32	R	1		
Transactional wild stream gross observed volume	830	033E	831	40831	2	uint32	R	100		
Transactional blend percentage	850	0352	851	40851	2	uint32	R	1000 / 100		
Transaction deviation count	860	035C	861	40861	2	uint32	R	1		
Transactional current average temperature	865	0361	866	40866	2	uint32	R	10		
Instantaneous temperature	866	0362	867	40867	2	uint32	R	10		
Accumulative leaking blend stream gross observed volume	870	0366	871	40871	2	uint32	R	1		
Accumulative calibration gross observed volume	880	0370	881	40881	2	uint32	R	1		
Wild stream flow rate	881	0371	882	40882	2	uint32	R	1		
Blend stream flow rate	882	0372	883	40883	2	uint32	R	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address (Parameter Equivalent)		Number (Standard / Modicon)		Registers	Type				
Transactional blend percentage	883	0373	884	40884	2	uint32	R	1		
Transactional load stream gross observed volume	885	0375	886	40886	2	uint32	R	1		
Task register	888	0378	889	40889	1	uint16 (enum)	W	1	See C.2.1	
Firmware version number	890	037A	891	40891	3	string	R	1		
Product ID	892	037C	893	40893	3	string	R	1		
Device serial number	893	037D	894	40894	5	string	R	1		

7.2.2.1 Definition of Fusion4 SSC-B Volume Parameters

The following table provides a definition of the Fusion4 SSC-B volume parameters.

Table 7-5: Definition of Fusion4 SSC-B volume parameters

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. blend volume	Acc. calibration volume	Acc. leaking volume
810	Accumulative wild stream gross observed volume	x			

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. blend volume	Acc. calibration volume	Acc. leaking volume
820	Accumulative blend stream gross observed volume		x		
825	Accumulative blend stream gross standard volume		x		
870	Accumulative leaking blend stream gross observed volume				x
880	Accumulative calibration gross observed volume			x	

7.2.3 Fusion4 MSC-A



The following table provides the Modbus Legacy register map for the Fusion4 MSC-A (multi-stream controller for additive Injection). See section B.1 for a description of the parameters.

Table 7-6: Modbus Legacy register map for Fusion4 MSC-A

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address Parameter / Equivalent		Number (Standard / Modicon)		Registers	Type				
Wild stream K-factor	001	0001	002	40002	2	uint32	R/W	1000		
Additive K-factor	002	0002	003	40003	2	uint32	R/W	1000		
Injection volume	010	000A	011	40011	2	uint32	R/W	10		
Volume per injection cycle	020	0014	021	40021	2	uint32	R/W	10		
Solenoid dwell time	030	001E	031	40031	1	uint16	R/W	1		
Minimum product volume for transaction	040	0028	041	40041	2	uint32	R/W	1		
Factored pulse output resolution	050	0032	051	40051	1	uint16 (enum)	R/W		See C.1.5	
Number of clean start cycles	060	003C	061	40061	1	uint16	R/W	1		
Flush volume	061	003D	062	40062	2	uint32	R/W	1		
High flow threshold value	063	003F	064	40064	2	uint32	R/W	1		
Low flow threshold value	064	0040	065	40065	2	uint32	R/W	1		
Transaction closing time	065	0041	066	40066	1	uint16	R/W	1		
Pacing source	080	0050	081	40081	1	uint16 (enum)	R/W		See C.1.4	
Permissive function	081	0051	082	40082	1	uint16 (enum)	R		See C.1.6	
Injection offset	090	005A	091	40091	1	uint16	R/W	1		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address Parameter / Equivalent		Number (Standard / Modicon)		Registers	Type				
Unit address	100	0064	101	40101	1	uint16	R	1		
Number of solenoid retries	131	0083	132	40132	1	uint16	R/W	1		
Feedback pulse duration	133	0085	134	40134	1	uint16	R/W	1		
Pump run timeout	134	0086	135	40135	1	uint16	R/W	1		
No additive alarm action	310	0136	311	40311	1	uint16 (enum)	R/W		See C.1.2	
No additive flow timeout period	311	0137	312	40312	1	uint16	R/W	1		
Additive volume deviation alarm action	320	0140	321	40321	1	uint16 (enum)	R/W		See C.1.2	
Additive volume deviation allowed	322	0142	323	40323	1	uint16	R/W	1		
Additive deviation basis	323	0143	324	40324	1	uint16	R/W	1		
Leaking solenoid alarm action	340	0154	341	40341	1	uint16 (enum)	R/W		See C.1.2	
Leaking solenoid volume limit	341	0155	342	40342	1	uint16	R/W	1		
Leaking solenoid timeout period	342	0156	343	40343	1	uint16	R/W	1		
No activity timeout alarm action	370	0172	371	40371	1	uint16 (enum)	R/W		See C.1.2	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address Parameter / Equivalent		Number (Standard / Modicon)		Registers	Type				
No activity timeout period	371	0173	372	40372	1	uint16	R/W	1		
Slow flow volume alarm action	380	017C	381	40381	1	uint16 (enum)	R/W		See C.1.2	
Active alarms	802	0322	803	40803	1	uint16 (enum)	R	1	See C.1.8	
Permissive state	804	0324	805	40805	1	uint16 (enum)	R		See C.1.3	
Solenoid close delay	805	0325	806	40806	1	uint16	R	1		
Alarm and permissive state (injectors 1 - 6) #	806	0326	807	40807	1	uint16 (bits)	R			
Alarm and permissive state (injectors 7 - 12) #	807	0327	808	40808	1	uint16 (bits)	R			
Additive stream flow rate	809	0329	810	40810	2	uint32	R	1		
Accumulative wild stream gross observed volume	810	032A	811	40811	2	uint32	R	1		
Alarm and permissive state (injectors 13 -18) #	811	032B	812	40812	1	uint16 (bits)	R			
Alarm and permissive state (injectors 19 -24) #	812	032C	813	40813	1	uint16 (bits)	R			

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address Parameter / Equivalent		Number (Standard / Modicon)		Registers	Type				
Accumulative total additive stream gross observed volume	850	0352	851	40851	2	uint32	R	1000		
Accumulative transactional additive stream gross observed volume	860	035C	861	40861	2	uint32	R	1000		
Accumulative leaking solenoid gross observed volume	870	0366	871	40871	2	uint32	R	1000		
Accumulative calibration gross observed volume	880	0370	881	40881	2	uint32	R	1000		
Load stream flow rate	881	0371	882	40882	2	uint32	R	1		
Additive stream flow rate	882	0372	883	40883	2	uint32	R	1		
Transaction PPM	883	0373	884	40884	2	uint32	R	1		
Transactional load stream gross observed volume	885	0375	886	40886	2	uint32	R	1		
Task register	888	0378	889	40889	1	uint16 (enum)	W/R		See C.1.1	
Software version #	890	037A	891	40891	3	string	R			
Product ID #	892	037C	893	40893	5	string	R			

Parameter Name	Starting Holding Register				Data Size / Type		Access	Scaling Factor	Range	Default
	Address Parameter / Equivalent		Number (Standard / Modicon)		Registers	Type				
Device serial number #	893	037D	894	40894	4	string	R			

NOTE: Parameters marked with # are global parameters.

7.2.3.1 Definition of Fusion4 MSC-A Volume Parameters

The following provides a definition of the Fusion4 MSC-A volume parameters.

Table 7-7: Definition of Fusion4 MSC-A volume parameters

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. additive volume	Acc. calibration volume	Acc. leaking volume
810	Accumulative wild stream gross observed volume	ü			
850	Accumulative total additive stream gross observed volume		ü	ü	ü
860	Accumulative transactional additive stream gross observed volume		ü		
870	Accumulative leaking solenoid gross observed volume				ü
880	Accumulative calibration gross observed volume			ü	

7.3 Modbus RTU Protocol

7.3.1 Fusion4 SSC-A



The following table provides the Modbus RTU register map for the Fusion4 SSC-A (single stream controller for additive injection). See section B.1 for a description of the parameters.

> NOTE: In previous releases of the Fusion4 SSC-A the Modbus RTU protocol is known as the Full Modbus protocol.

Table 7-8: Modbus RTU register map for Fusion4 SSC-A

Param. Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Adress (Decimal/Hex)		Number (Standard/Modicon)		Registers	Type			
Accumulative total additive stream gross observed volume	000	0000	001	40001	4	float64	R		

Param. Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Adress (Decimal/Hex)		Number (Standard/Modicon)		Registers	Type			
Accumulative transactional additive stream gross observed volume	004	0004	005	40005	4	float64	R		
Accumulative wild stream gross observed volume	016	0010	017	40017	4	float64	R		
Wild stream K-factor	100	0064	101	40101	2	float32	R		100,0
Additive K-factor	102	0066	103	40103	2	float32	R		750,0
Leaking solenoid volume limit	104	0068	105	40105	2	float32	R	0.0... 999.99	0,1
Solenoid dwell time	200	00C8	201	40201	1	uint16	R	0... 32767	0
Factored pulse output resolution	201	00C9	202	40202	1	uint 16 (enum)	R	See C.1.5	2
Pacing source	202	00CA	203	40203	1	uint16 (enum)	R	See C.1.4	
Unit address	203	00CB	204	40204	1	uint16	R	1...997	123
Broadcast address	204	00CC	205	40205	1	uint16	R		998
DI hysteresis time	205	00CD	206	40206	1	uint16	R	0...1000	250
Feedback pulse duration	206	00CE	207	40207	1	uint16	R	0...1000	500

Param. Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Adress (Decimal/Hex)		Number (Standard/Modicon)		Registers	Type			
Reserved	207	00CF	208	40208	1				
No additive alarm action	208	00D0	209	40209	1	uint16 (enum)	R	See C.1.2	
Additive volume deviation alarm action	209	00D1	210	40210	1	uint16 (enum)	R	See C.1.2	
Leaking solenoid alarm action	210	00D2	211	40211	1	uint16 (enum)	R	See C.1.2	
No activity timeout alarm action	211	00D3	212	40212	1	uint16 (enum)	R	See C.1.2	
Permissive state	212	00D4	213	40213	1	uint16 (enum)	R	See C.1.3	
Solenoid close delay	213	00D5	214	40214	1	uint16	R	500... 10000	500
Active alarms	214	00D6	215	40215	1	uint16	R		
Permissive function	215	00D7	216	40216	1	uint16 (enum)	R	See C.1.6	
Reserved	300	012C	301	40301	1				
Number of solenoid retries	301	012D	302	40302	1	uint16	R	0...2	2
No additive flow timeout period	302	012E	303	40303	1	uint16	R	1...9	2

Param. Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Adress (Decimal/Hex)		Number (Standard/Modicon)		Registers	Type			
Leaking solenoid timeout period	303	012F	304	40304	1	uint16	R	1...99	60
No activity timeout period	304	0130	305	40305	1	uint16	R	1... 65535	60
Injection volume	400	0190	401	40401	2	float32	R/W	0.10... 9900.00	20.00
Volume per injection cycle	402	0192	403	40403	2	float32	R/W	0.001... 9999.9	40.00
Minimum product volume for transaction	404	0194	405	40405	2	float32	R/W	1.00... 999.00	10,00
Clean start gross observed volume	406	0196	407	40407	2	float32	R/W	0.00... 999.00	0.00
High flow threshold value	408	0198	409	40409	2	float32	R/W	0.0... 30000.0	1000.0
Low flow threshold value	410	019A	411	40411	2	float32	R/W	0.0... 30000.0	1000.0
Number of clean start cycles	600	0258	601	40601	1	uint16	R/W	1...99	10

Param. Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Adress (Decimal/Hex)		Number (Standard/Modicon)		Registers	Type			
Injection offset	601	0259	602	40602	1	uint16	R/W	0...100	0
Pump start timeout	602	025A	603	40603	1	uint16	R/W	1...255	10
Additive vol- ume deviation allowed	603	025B	604	40604	1	uint16	R/W	1...100	10
Transaction closing time	604	025C	605	40605	1	uint16	R/W	5...255	30
See section 7.3.1.1 for parameters with holding register 40801 through 41826.									
Task register	2000	07D0	2001	42001	1	uint 16 (enum)	W	See C.1.1	
See section 7.3.1.1 for parameters with holding register 42801 through 42826.									

7.3.1.1 Fusion4 SSC-A Modbus RTU Block

The folowing table provides the Modbus RTU register map for holding registers 40801 through 40840, 41801 through 41826, and 42801 through 42826 for the Fusion4 SSC-A. See section B.1 for a description of the parameters.

> NOTE: In the table below, the following scaling factors apply to 32-bit integer type parameters:

Flow rate	*1000
Percentage	*100
Temperature	*100
Other	No scaling

Table 7-9: Modbus RTU register map for Fusion4 SSC-A (continued)

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type	
Additive stream state (See also section C.1.7)	800	0320	801	40801	1	uint16	R
	1800	0708	1801	41801	1	uint16	
	2800	0AF0	2801	42801	1	uint16	
Active alarms (See also section C.1.8)	801	0321	802	40802	1	uint16	R
	1801	0709	1802	41802	1	uint16	
	2801	0AF1	2802	42802	1	uint16	
Accumulative total load stream gross observed volume	802	0322	803	40803	4	float64	R
	1802	070A	1803	41803	2	float32	
	2802	0AF2	2803	42803	2	int32	
Accumulative total additive stream gross observed volume	806	0326	807	40807	4	float64	R
	1804	070C	1805	41805	2	float32	
	2804	0AF4	2805	42805	2	int32	
Transactional load stream gross observed volume	810	032A	811	40811	4	float64	R
	1806	070E	1807	41807	2	float32	
	2806	0AF6	2807	42807	2	int32	
Transactional additive stream gross observed volume	814	032E	815	40815	4	float64	R
	1808	0710	1809	41809	2	float32	
	2808	0AF8	2809	42809	2	int32	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type	
Product stream flow rate	818	0332	819	40819	4	float64	R
	1810	0712	1811	41811	2	float32	
	2810	0AFA	2811	42811	2	int32	
Additive stream flow rate	822	0336	823	40823	4	float64	R
	1812	0714	1813	41813	2	float32	
	2812	0AFC	2813	42813	2	int32	
Transaction PPM	826	033A	827	40827	4	float64	R
	1814	0716	1815	41815	2	float32	
	2814	AFE	2815	42815	2	int32	
Software version	830	33E	831	40831	4	char[8]	R
	1816	718	1817	41817	4	char[8]	
	2816	0B00	2817	42817	4	char[8]	
Product ID	834	0342	835	40835	5	char [10]	R
	1820	071C	1821	41821	5	char [10]	
	2820	0B04	2821	42821	5	char [10]	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type	
Device serial number	839	0347	840	40840	4	char[8]	R
	1825	0721	1826	41826	4	char[8]	
	2825	0B09	2826	42826	4	char[8]	
Accumulative leaking solenoid volume	844	034C	847	40845	4	float64	R
	1831	0727	1832	41832	2	float32	
	2831	0B0F	2832	42832	2	int32	
Calibration Accumulative Volume	848	0350	851	40849	4	float64	R
	1833	0729	1834	41834	2	float32	
	2833	0B11	2834	42834	2	int32	

7.3.2 Fusion4 SSC-B



The following table provides the Modbus RTU register map for the Fusion4 SSC-B (single stream controller for blending). See section B.2 for a description of the parameters.

> NOTE: In previous releases of the Fusion4 SSC-B the Modbus RTU protocol is known as Full Modbus protocol.

Table 7-10: Modbus RTU register map for Fusion4 SSC-B

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Flush volume	000	0000	001	40001	4	float64	R/W	0.00... 999.0	0.0
Reference temperature	004	0004	005	40005	4	float64	R/W		
Reference pressure	008	0008	009	40009	4	float64	R/W		
Blend product observed density	012	000C	013	40013	4	float64	R/W		0.0
Blend product observed temperature	016	0010	017	40017	4	float64	R/W		0.0
Blend product observed pressure	020	0014	021	40021	4	float64	R/W		0.0
Blend product expansion coeff	024	0018	025	40025	4	float64	R/W		0.0
VCF calculation interval volume	028	001C	029	40029	4	float64	R/W	1.0... 1000.0	100.0
Recipe 1 target blend percentage	100	0064	101	40101	2	float32	R/W	0...100	0.0
Recipe 2 target blend percentage	102	0066	103	40103	2	float32	R/W	0...100	0.0
Recipe 3 target blend percentage	104	0068	105	40105	2	float32	R/W	0...100	0.0
Recipe 4 target blend percentage	106	006A	107	40107	2	float32	R/W	0...100	0.0
Recipe 5 target blend percentage	108	006C	109	40109	2	float32	R/W	0...100	0.0

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Dead band control window limit	110	006E	111	40111	2	float32	R/W	0.01... 10000.00	0.1
Preset gross observed volume	112	0070	113	40113	2	float32	R/W	0.0... 999999.0	0.0
Pre-shutdown closure volume	114	0072	115	40115	2	float32	R/W	0.0... 9999.0	0.0
Minimum wild stream flow for alarm	116	0074	117	40117	2	float32	R/W	1.0... 999.0	5.0
Blend high percentage allowed	200	00C8	201	40201	1	uint16	R/W	101...999	105
Volume correction table	201	00C9	202	40202	1	uint16 (enum)	R/W	See C.2.11	
Commodity group	202	00CA	203	40203	1	uint16 (enum)	R/W	See C.2.12	
VCF options	203	00CB	204	40204	1	uint16 (enum)	R/W	See C.2.13	
Glass hydrometer used	204	00CC	205	40205	1	uint16 (enum)	R/W	See C.2.14	0

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Reference temperature units	205	00CD	206	40206	1	uint16 (enum)	R/W	See C.2.15	
Reference pressure units	206	00CE	207	40207	1	uint16 (enum)	R/W	See C.2.16	
Blend low percentage allowed	300	012C	301	40301	1	uint16	R/W	1...99	95
Flush volume deviation	301	012D	302	40302	1	uint16	R/W	1...100	25
Temperature compensation used	302	012E	303	40303	1	uint16	R/W	0...1	
Pressure compensation used	303	012F	304	40304	1	uint16	R/W	0...1	
VCF calculation interval min	304	0130	305	40305	1	uint16	R/W	1...60	1
VCF calculation interval max	305	0131	306	40306	1	uint16	R/W	1...60	3
Reserved	400	0190	401	40401	4				
Calibration low flow volume	404	0194	405	40405	4	float64	R		
Calibration end flow volume	408	0198	409	40409	4	float64	R		
Calibration final shutdown volume	412	019C	413	40413	4	float64	R		
Accumulative wild stream gross observed volume	416	01A0	417	40417	4	float64	R		
Accumulative blend stream gross observed volume	420	01A4	421	40421	4	float64	R		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Accumulative blend stream gross standard volume	424	01A8	425	40425	4	float64	R		
Transactional wild stream gross observed volume	428	01AC	429	40429	4	float64	R		
Transactional blend stream gross observed volume	432	01B0	433	40433	4	float64	R		
Transactional blend stream gross standard volume	436	01B4	437	40437	4	float64	R		
Transaction deviation count	440	01B8	441	40441	4	float64	R		
Transaction current avg temp	444	01BC	445	40445	4	float64	R		
Instantaneous temp	448	01C0	449	40449	4	float64	R		
Instantaneous pressure	452	01C4	453	40453	4	float64	R		
Accumulative leaking blend stream gross observed volume	456	01C8	457	40457	4	float64	R		
Accumulative calibration gross observed volume	460	01CC	461	40461	4	float64	R		
Density (lab)	464	01D0	465	40465	4	float64	R		
Temperature (lab)	468	01D4	469	40469	4	float64	R		
Pressure (lab)	472	01D8	473	40473	4	float64	R		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Density (base)	476	01DC	477	40477	4	float64	R		
Temperature (base)	480	01E0	481	40481	4	float64	R		
Pressure (base)	484	01E4	485	40485	4	float64	R		
Volume (base)	488	01E8	489	40489	4	float64	R		
Density (observed)	492	01EC	493	40493	4	float64	R		
Temperature (observed)	496	01F0	497	40497	4	float64	R		
Pressure (observed)	500	01F4	501	40501	4	float64	R		
VCF lab to base	504	01F8	505	40505	4	float64	R		
VCF base to observed	508	01FC	509	40509	4	float64	R		
Compressibility factor	512	0200	513	40513	4	float64	R		
Expansion factor	516	0204	517	40517	4	float64	R		
Wild stream K-factor	700	02BC	701	40701	2	float32	R		
Blend stream K-factor	702	02BE	703	40703	2	float32	R		
Inner control window limit	704	02C0	705	40705	2	float32	R	0.01... 10000.0	10.0
Reserved	706	02C2	707	40707	2				
Middle control window limit	708	02C4	709	40709	2	float32	R	0.01... 10000	10.0

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Reserved	710	02C6	711	40711	2				
Outer control wndow limit	712	02C8	713	40713	2	float32	R	0.01... 10000.0	100.0
Reserved	714	02CA	715	40715	2				
Calibration high flow rate	716	02CC	717	40717	2	float32	R	1.0... 9999.0	60.0
Reserved	718	02CE	719	40719	2				
Calibration low flow rate	720	2D0	721	40721	2	float32	R	1.0... 100.0	15.0
Reserved	722	2D2	723	40723	2				
Leaking blend valve volume limit	724	02D4	725	40725	2	float32	R	1.0... 9999.0	100.0
Reserved	726	02D6	727	40727	2				
Wild stream closing volume	728	02D8	729	40729	2	float32	R	1.0... 9999.0	150.0
Reserved	730	02DA	731	40731	2				
Transactional blend percentage	732	02DC	733	40733	2	float32	R		

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
See section 7.3.2.1 for parameters with holding register 40801 through 40856.									
Solenoid active dwell	900	0384	901	40901	1	uint16	R	50...1000	100
Solenoid rest dwell	901	0385	902	40902	1	uint16	R	50...1000	100
Reserved	902	0386	903	40903	1				
Permissive function	903	0387	904	40904	1	uint16 (enum)	R	See C.2.9	
Wild stream pulse timeout	904	0388	905	40905	1	uint16	R	1...999	5
Unit address	905	0389	906	40906	1	uint16	R	1...997	123
Broadcast address	906	038A	907	40907	1	uint16	R		
Permissive hysteresis	907	038B	908	40908	1	uint16	R	0...1000	250
Calibration inner flow rate control window	908	038C	909	40909	1	uint16	R	1...100	10
Calibration outer flow rate control window	909	038D	910	40910	1	uint16	R	1...9999	25
VCF status	910	038E	911	40911	1	uint16	R		
Blend stream pulse timeout	1000	03E8	1001	41001	1	uint16	R	1...90	2
Deviation count smoothing value	1001	03E9	1002	41002	1	uint16	R	0...12	10
Flow calculation smoothing value	1002	03EA	1003	41003	1	uint16	R	1...99	10
Control failure alarm timeout	1003	03EB	1004	41004	1	uint16	R	1...30	10

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Blend stream closing timeout	1004	03EC	1005	41005	1	uint16	R	1...240	60
No activity timeout period	1005	03ED	1006	41006	2	uint16	R	1...6535	30
Reset blend deviation counter at transaction start	1100	044C	1101	41101	1	uint16 (enum)	R	See C.2.6	
Factored pulse output resolution 1	1101	044D	1102	41102	1	uint16 (enum)	R	See C.2.5	
Factored pulse output resolution 2	1102	044E	1103	41103	1	uint16 (enum)	R	See C.2.5	
Pre-shutdown volume control	1103	044F	1104	41104	1	uint16 (enum)	R	See C.2.7	
Clean start control	1104	0450	1105	41105	1	uint16 (enum)	R	See C.2.8	
Blend point relative to wild stream meter	1105	0451	1106	41106	1	uint16 (enum)	R	See C.2.3	
Control failure alarm action	1106	0452	1107	41107	1	uint16 (enum)	R	See C.2.2	
Blend percentage alarm action	1107	0453	1108	41108	1	uint16 (enum)	R	See C.2.2	
Leaking blend valve alarm action	1108	0454	1109	41109	1	uint16 (enum)	R	See C.2.2	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Range	Default
	Adress (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Wild stream closing volume alarm action	1109	0455	1110	41110	1	uint16 (enum)	R	See C.2.2	
Blend stream closing timeout aarm action	1110	0456	1111	41111	1	uint16 (enum)	R	See C.2.2	
Reserved	1111	0457	1112	41112	1				
No activity alarm action	1112	0458	1113	41113	1	uint16 (enum)	R	See C.2.2	
Flush volume alarm action	1113	0459	1114	41114	1	uint16 (enum)	R	See C.2.2	
Permissive state	1114	045A	1115	41115	1	uint16 (enum)	R	See C.2.4	
See section 7.3.2.1 for parameters with holding register 41801 through 41834.									
Task register	2000	07D0	2001	42001	1	uint16 (enum)	W	See C.2.1	
See section 7.3.2.1 for parameters with holding register 42801 through 42834.									

7.3.2.1 Fusion4 SSC-B Modbus RTU Block

The following table provides the Modbus RTU register map for holding registers 40801 through 40856, 41801 through 41834, and 42801 through 42834 for the Fusion4 SSC-B (single stream controller for blending). See section B.2 for a description of the parameters.

NOTE: In the following table, the following scaling factors apply to 32-bit integer type parameters:

Flow rate	* 1000
Percentage	* 100
Temperature	* 100
Other	No scaling

Table 7-11: Modbus RTU register map for Fusion4 SSC-B (continued)

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Blend stream state (See also section C.2.17)	800	0320	801	40801	1	uint16	R
	1800	0708	1801	41801	1	uint16	
	2800	0AF0	2801	42801	1	uint16	
Active alarms (See also section C.2.18)	801	0321	802	40802	1	uint16	R
	1801	0709	1802	41802	1	uint16	
	2801	0AF1	2802	42802	1	uint16	
Accumulative total load stream gross observed volume	802	0322	803	40803	4	float64	R
	1802	070A	1803	41803	2	float32	
	2802	0AF2	2803	42803	2	int32	
Accumulative total blend stream gross observed volume	806	0326	807	40807	4	float64	R
	1804	070C	1805	41805	2	float32	
	2804	0AF4	2805	42805	2	int32	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Transactional load stream gross observed volume	810	032A	811	40811	4	float64	R
	1806	070E	1807	41807	2	float32	
	2806	0AF6	2807	42807	2	int32	
Transactional blend stream gross observed volume	814	032E	815	40815	4	float64	R
	1808	0710	1809	41809	2	float32	
	2808	0AF8	2809	42809	2	int32	
Accumulative blend stream gross standard volume	818	0332	819	40819	4	float64	R
	1810	0712	1811	41811	2	float32	
	2810	0AFA	2811	42811	2	int32	
Transactional blend stream gross standard volume	822	0336	823	40823	4	float64	R
	1812	0714	1813	41813	2	float32	
	2812	0AFC	2813	42813	2	int32	
Product stream flow rate	826	033A	827	40827	4	float64	R
	1814	0716	1815	41815	2	float32	
	2814	0AFE	2815	42815	2	int32	
Blend stream flow rate	830	033E	831	40831	4	float64	R
	1816	0718	1817	41817	2	float32	
	2816	0B00	2817	42817	2	int32	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Transactional blend percentage	834	0342	835	40835	4	float64	R
	1818	071A	1819	41819	2	float32	
	2818	0B02	2819	42819	2	int32	
Blend stream temperature	838	0346	839	40839	4	float64	R
	1820	071C	1821	41821	2	float32	
	2820	0B04	2821	42821	2	int32	
Blend stream pressure	842	034A	843	40843	4	float64	R
	1822	071E	1823	41823	2	float32	
	2822	0B06	2823	42823	2	int32	
Software version	846	034E	847	40847	4	char(8)	R
	1824	0720	1825	41825	4	char(8)	
	2824	0B08	2825	42825	4	char(8)	
Product ID	850	0352	851	40851	5	char (10)	R
	1828	0724	1829	41829	5	char (10)	
	2828	0B0C	2829	42829	5	char (10)	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Device serial number	855	0357	856	40856	4	char(8)	R
	1833	0729	1834	41834	4	char(8)	
	2833	0B11	2834	42834	4	char(8)	

7.3.3 Fusion4 MSC-A



The following table provides the Modbus RTU | TCP/IP register map for the Fusion4 MSC-A (multi-stream controller for additive injection). See section B.1 for a description of the parameters.

Table 7-12: Modbus RTU | TCP/IP register map for Fusion4 MSC-A

Parameter Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Accumulative total additive stream gross observed volume	000	0000	001	40001	4	float64	R		

Parameter Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Accumulative transactional additive stream gross observed volume	004	0004	005	40005	4	float64	R		
Accumulative leaking solenoid gross observed volume	008	0008	009	40009	4	float64	R		
Accumulative calibration gross observed volume	012	000C	013	40013	4	float64	R		
Accumulative wild stream gross observed volume	016	0010	017	40017	4	float64	R		
Accumulative total additive stream gross observed volume	020	0014	021	40021	2	float32	R		
Accumulative transactional additive stream gross observed volume	022	0016	023	40023	2	float32	R		
Accumulative leaking solenoid gross observed volume	024	0018	025	40025	2	float32	R		
Accumulative calibration gross observed volume	026	001A	027	40027	2	float32	R		
Accumulative wild stream gross observed volume	028	001C	029	40029	2	float32	R		
Wild stream K-factor	100	0064	101	40101	2	float32	R/W		100.0
Additive K-factor	102	0066	103	40103	2	float32	R/W		750.0

Parameter Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Leaking solenoid volume limit	104	0068	105	40105	2	float32	R/W	0.0... 999.9	0.1
Solenoid dwell time	200	00C8	201	40201	1	uint16	R/W	0...32767	0
Factored pulse output resolution	201	00C9	202	40202	1	uint16 (enum)	R/W	See C.1.5	2
Pacing source	202	00CA	203	40203	1	uint16 (enum)	R/W	See C.1.4	
Unit address	203	00CB	204	40204	1	uint16	R	1...997	123
Reserved	204	00CC	205	40205	1				
Reserved	205	00CD	206	40206	1				
Feedback pulse duration	206	00CE	207	40207	1	uint16	R/W	0...1000	500
Slow flow volume alarm action	207	00CF	208	40208	1	uint16 (enum)	R/W	See C.1.2	
No additive alarm action	208	00D0	209	40209	1	uint16 (enum)	R/W	See C.1.2	
Additive volume deviation alarm action	209	00D1	210	40210	1	uint16 (enum)	R/W	See C.1.2	
Leaking solenoid alarm action	210	00D2	211	40211	1	uint16 (enum)	R/W	See C.1.2	

Parameter Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
No activity timeout alarm action	211	00D3	212	40212	1	uint16 (enum)	R/W	See C.1.2	
Permissive state	212	00D4	213	40213	1	uint16 (enum)	R	See C.1.3	
Solenoid close delay	213	00D5	214	40214	1	uint16	R/W	500... 10000	500
Active alarms	214	00D6	215	40215	1	uint16	R		
Permissive function	215	00D7	216	40216	1	uint16 (enum)	R/W	See C.1.6	
Alarm and permissive state (injectors 1 - 6) #	216	00D8	217	40217	1	uint16 (bits)	R		
Alarm and permissive state (injectors 7 - 12) #	217	00D9	218	40218	1	uint16 (bits)	R		
Alarm and permissive state (injectors 13 - 18) #	218	00DA	219	40219	1	uint16 (bits)	R		
Alarm and permissive state (injectors 19 - 24) #	219	00DB	220	40220	1	uint16 (bits)	R		
Additive deviation basis	300	012C	301	40301	1	uint16	R/W		
Number of solenoid retries	301	012D	302	40302	1	uint16	R/W	0...2	2

Parameter Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
No additive flow timeout period	302	012E	303	40303	1	uint16	R/W	1...9	2
Leaking solenoid timeout period	303	012F	304	40304	1	uint16	R/W	1...99	60
No activity timeout period	304	0130	305	40305	1	uint16	R/W	1...65535	60
Injection volume	400	0190	401	40401	2	float32	R/W	0.10... 9900.00	20,00
Volume per injection cycle	402	0192	403	40403	2	float32	R/W	0.001... 9999.9	40,00
Minimum product volume for transaction	404	0194	405	40405	2	float32	R/W	1.00... 999.00	10,00
Clean start gross observed volume	406	0196	407	40407	2	float32	R/W	0.00... 999.00	0,00
High flow threshold value	408	0198	409	40409	2	float32	R/W	0.0... 30000.0	1000.0
Low flow threshold value	410	019A	411	40411	2	float32	R/W	0.0... 30000.0	1000.0
Number of clean start cycles	600	0258	601	40601	1	uint16	R/W	1...99	10
Injection offset	601	0259	602	40602	1	uint16	R/W	0...100	0

Parameter Name	Starting Holding Register				Data Size/Type		Access	Range	Default
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type			
Pump run timeout	602	025A	603	40603	1	uint16	R/W	1...255	10
Additive volume deviation allowed	603	025B	604	40604	1	uint16	R/W	1...100	10
Transaction closing time	604	025C	605	40605	1	uint16	R/W	5...255	30
See section 7.3.3.1 for parameters with holding register 40801 through 41826.									
Task register	2000	07D0	2001	42001	1	uint16 (enum)	W/R	See C.1.1	
See section 7.3.3.1 for parameters with holding register 42801 through 42826.									

NOTE: Parameters marked with # are global parameters affecting ALL injector channels.

7.3.3.1 Fusion4 MSC-A Modbus RTU | TCP/IP Block

The following table lists the Modbus RTU | TCP/IP protocol parameters with holding register 40801 through 40840, 41801 through 41826, and 42801 through 42826 for the Fusion4 MSC-A. See section B.1 for a description of the parameters.

NOTE: In the following table, the following scaling factors apply to 32-bit integer type parameters:

Flow rate	* 1000
Percentage	* 100
Temperature	* 100
Other	No scaling

Table 7-13: Modbus RTU | TCP/IP protocol parameters for Fusion4 MSC-A (continued)

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Additive stream state (See also section C.1.7)	800	0320	801	40801	1	uint16	R
	1800	0708	1801	41801	1	uint16	
	2800	0AF0	2801	42801	1	uint16	
Active alarms (See also section C.1.8)	801	0321	802	40802	1	uint16	R
	1801	0709	1802	41802	1	uint16	
	2801	0AF1	2802	42802	1	uint16	
Accumulative total load stream gross observed volume	802	0322	803	40803	4	float64	R
	1802	070A	1803	41803	2	float32	
	2802	0AF2	2803	42803	2	int32	
Accumulative total additive stream gross observed volume	806	0326	807	40807	4	float64	R
	1804	070C	1805	41805	2	float32	
	2804	0AF4	2805	42805	2	int32	
Transactional load stream gross observed volume	810	032A	811	40811	4	float64	R
	1806	070E	1807	41807	2	float32	
	2806	0AF6	2807	42807	2	int32	
Transactional additive stream gross observed volume	814	032E	815	40815	4	float64	R
	1808	0710	1809	41809	2	float32	
	2808	0AF8	2809	42809	2	int32	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Product stream flow rate	818	0332	819	40819	4	float64	R
	1810	0712	1811	41811	2	float32	
	2810	0AFA	2811	42811	2	int32	
Additive stream flow rate	822	0336	823	40823	4	float64	R
	1812	0714	1813	41813	2	float32	
	2812	0AFC	2813	42813	2	int32	
Transaction PPM	826	033A	827	40827	4	float64	R
	1814	0716	1815	41815	2	float32	
	2814	0AFE	2815	42815	2	int32	
Software version #	830	033E	831	40831	4	char[8]	R
	1816	0718	1817	41817	4	char[8]	
	2816	0B00	2817	42817	4	char[8]	
Product ID #	834	0342	835	40835	5	char [10]	R
	1820	071C	1821	41821	5	char [10]	
	2820	0B04	2821	42821	5	char [10]	

Parameter Name	Starting Holding Register				Data Size / Type		Access
	Address (Decimal / Hex)		Number (Std. / Modicon)		Regis-ters	Type	
Device serial number #	839	0347	840	40840	4	char[8]	R
	1825	0721	1826	41826	4	char[8]	
	2825	0B09	2826	42826	4	char[8]	

NOTE: Parameters marked # with are global parameters affecting ALL injector channels.

7.3.4 Modbus RTU | TCP/IP register maps for Fusion4 MSC-L



The Fusion4 MSC-L Modbus RTC | TCP/IP register map is divided into two different main maps to better represent the device/arm related parameters, i.e. the Device Modbus register map and the Arm Modbus register map. Access to these 7 maps (one Device map and six Arm maps, one for each arm) is provided via individually configurable Modbus server addresses.

By default, the server addresses are set to 200 (Device) and 123 (Arms). Therefore, to be able to access arms beyond Arm 1 the user needs to change their address from 123.

When accessing submaps of the Device Modbus register map or Arm Modbus register map, it should be noted that submap addresses are offsets to the address in the main map. For example, the [Driver ID] and [Contract ID] parameters belong to the Bay submap of the Device Modbus register map.

Table 7-14: Fusion4 MSC-L Bay Modbus register submap: [Driver ID] and [Contract ID] parameters

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type		
Driver ID	000	0000	000	000	16	uint16 [16]	R/W	
Contract ID	016	0010	016	016	16	uint16 [16]	R/W	

The Device Modbus register map includes two of such submaps (see the table below).

Table 7-15: Fusion4 MSC-L Device Modbus register map: [Bay items] parameters

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Std. / Modicon)		Registers	Type		
Bay 1 items	1000	03E8	1001	41001				
Bay 2 items	2000	07D0	2001	42001				

Therefore, starting holding register number in Modicon terms should be:

- 41001 = 41001+ 000 to access Bay 1 - Driver ID
- 41017 = 41001+ 016 to access Bay 1 - Contract ID

- 42001 = 42001+ 000 to access Bay 2 - Driver ID
- 42017 = 42001+ 016 to access Bay 2 - Contract ID

The starting holding register number in Address terms should be:

- 1000 = 1000 + 000 to access Bay 1 - Driver ID
- 1016 = 1000 + 016 to access Bay 1 - Contract ID
- 2000 = 2000 + 000 to access Bay 2 - Driver ID
- 2016 = 2000 + 016 to access Bay 2 - Contract ID

7.3.4.1 Fusion4 MSC-L Device Modbus register map

The following table provides the Device Modbus register map for the Fusion4 MSC-L.

> NOTE: Refer to APPENDIX B for a description of the parameters.

Table 7-16: Fusion4 MSC-L Device Modbus register map

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Software Version #	000	0000	001	40001	4	char[8]	R	
Device Type #	004	0004	005	40005	5	char [10]	R	
Device Serial Number #	009	0009	010	40010	4	char[8]	R	
Device Name #	013	000D	014	40014	4	char[8]	R	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reset All Alarms #	017	0011	018	40018	1	uint16	RW	1 = Reset All Alarms
Show TAS Prompt #	018	0012	019	40019	1	uint16 (enum)	R/W	Fusion4 TAS Prompt see C.3.1.20
Display Message (show prompt) - Command to Display #	019	0013	020	40020	1	uint16	R/W	1 = Command
Display Message (show prompt) - Prompt Input #	020	0014	021	40021	1	uint16 (enum)	R/W	PROMPT_INUT see C.3.1.46
Display Message (show prompt) - Message #	021	0015	022	40022	32	uint16 [32]	R/W	
User Prompt State #	053	0035	054	40054	1	uint16 (enum)	R	User Prompt State see C.3.1.40
User Response Text #	054	0036	055	40055	10	uint16 [10]	R	
LoginRemotelyAuthorizedUser #	064	0040	065	40065	17	Sruct	W	REMOTELY_ AUTHORIZED_USER_ DATA see C.3.2.37
User Logout #	081	0051	082	40082	1	uint16	W	
Active User #	082	0052	083	40083	14	Struct	W	STRUCT_AUTH_ OBJECT see C.3.2.4

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Display message Arm index #	096	0060	097	40097	1	uint16	R/W	
Number of Loading Bays #	100	0064	101	40101	1	uint16	R	
Bay Type #	101	0065	102	40102	1	uint16 (enum)	R	Bay Type, see C.3.1.27
Active Bay #	102	0066	103	40103	1	uint16 (enum)	R	Loading Bay, see C.3.1.29
Units: Volume #	103	0067	104	40104	1	uint16 (enum)	R	Units: Volume, see C.3.1.22
Units: Pressure #	104	0068	105	40105	1	uint16 (enum)	R	Units: Pressure, see NOTE:
Units: Density #	105	0069	106	40106	1	uint16 (enum)	R	Units: Density, see C.3.1.23
Units: Mass #	106	006A	107	40107	1	uint16 (enum)	R	Units: Mass, see C.3.1.25
Units: Temperature #	107	006B	108	40108	1	uint16 (enum)	R	Units: Temperature, see C.3.1.24
Units: Injection Volume #	108	006C	109	40109	1	uint16 (enum)	R	Units: Injection Volume, see C.3.1.26
Workflow Option: Carrier Identification #	109	006D	110	40110	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Workflow Option: Vehicle Identification #	110	006E	111	40111	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: Trailer Identification #	111	006F	112	40112	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: Load Number Identification #	112	0070	113	40113	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: Compartment Identification #	113	0071	114	40114	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: Return Quantity Entry #	114	0072	115	40115	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: Preset Entry #	115	0073	116	40116	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: User Identification #	116	0074	117	40117	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Workflow Option: Preset Unloading Entry #	117	0075	118	40118	1	uint16 (enum)	R/W	Workflow Option Type, see C.3.1.36
Unprocessed Transactions Available #	118	0076	119	40119	1	uint16 (enum)	R	Unprocessed Transactions Available, see C.3.1.39
Transaction Record Size #	119	0077	120	40120	1	uint16	R	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Transaction Record Version #	120	0078	121	40121	1	uint16	R	
Switch Bay	140	008C	141	40141	1	uint16	R/W	
Workflow Mode	141	008D	142	40142	1	uint16 (enum)	RW	Enum Transaction Workflow mode see C.3.1.65
Restore 1010 Transaction #	142	008E	143	40143	2	uint32	R/W	
Restore 1010 Batch #	144	0090	145	40145	2	uint32	R/W	
Batch Count #	146	0092	147	40147	2	uint32	R	
Transaction Count #	148	0094	149	40149	2	uint32	R	
Mark Transaction As Processed #	150	0096	151	40151	2	uint32	W	
Last Processed Transaction #	152	0098	153	40153	2	uint32	R	
Reset All Alarms #	154	009A	155	40155	1	uint16	W	
Close Screen #	155	009B	156	40156	1	uint16	W	
Restore TAS Control #	156	009C	157	40157	1	uint16	W	
Display Alarm Screen #	157	009D	158	40158	1	uint16	W	
Send Esc Key#	158	009E	159	40159	1	uint16	W	
RIT Ack Input Status #	159	009F	160	40160	1	uint16	R/W	
F4 Portal Scan Register [0] #	160	00A0	161	40161	2	uint32	R	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
F4 Portal Scan Register [1] #	162	00A2	163	40163	2	uint32	R	
F4 Portal Scan Register [2] #	164	00A4	165	40165	2	uint32	R	
F4 Portal Scan Register [3] #	166	00A6	167	40167	2	uint32	R	
F4 Portal Scan Register [4] #	168	00A8	169	40169	2	uint32	R	
F4 Portal Scan Register [5] #	170	00AA	171	40171	2	uint32	R	
F4 Portal Scan Register [6] #	172	00AC	173	40173	2	uint32	R	
F4 Portal Scan Register [7] #	174	00AE	175	40175	2	uint32	R	
F4 Portal Scan Register [8] #	176	00B0	177	40177	2	uint32	R	
F4 Portal Scan Register [9] #	178	00B2	179	40179	2	uint32	R	
F4 Portal Scan Register [10] #	180	00B4	181	40181	2	uint32	R	
F4 Portal Scan Register [11] #	182	00B6	183	40183	2	uint32	R	
F4 Portal Scan Register [12] #	184	00B8	185	40185	2	uint32	R	
F4 Portal Scan Register [13] #	186	00BA	187	40187	2	uint32	R	
F4 Portal Scan Register [14] #	188	00BC	189	40189	2	uint32	R	
F4 Portal Scan Register [15] #	190	00BE	191	40191	2	uint32	R	
Arm Current State #	192	00C0	193	40193	2	uint32	R/W	
Test Register 1 #	194	00C2	195	40195	2	uint16	RW	
Test Register 2 #	196	00C4	197	40197	2	uint16	RW	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Bay Command #	200	00C8	201	40201	4	struct [8]	W	Bay Command, see C.3.2.1
Arm Command #	204	00CC	205	40205	4	struct [8]	W	Arm Command, see C.3.2.12
Plan Init Start Batch #	208	00D0	209	40209	10	struct [19]	W	Plan Init Start Batch, see C.3.2.8
Transaction Authorization Details #	218	00DA	219	40219	25	struct [50]	W	Transaction Authorization Details, see C.3.2.2
Record Request #	243	00F3	244	40244	8	struct [16]	R/W	Record Request, see C.3.2.11
Authorization Data: User #	251	00FB	252	40252	16	struct [32]	R/W	Authorization Data, see C.3.2.7
Authorization Data: Object #	267	010B	268	40268	16	struct [32]	R/W	Authorization Data, see C.3.2.7
Delete Database Entry #	283	011B	284	40284	6	struct [12]	W	Delete Auth Object Request, see C.3.2.13

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Transaction Authorization Details Unicode #	289	0121	290	40290	49	struct [98]	W	Transaction Authorization Details Unicode, see section C.3.2.3
Date	338	0152	339	40339	2	struct [4]	R/W	RTC Date
Time	340	0154	341	40341	2	struct [4]	R/W	Time
Plan Init Start Batch V2	342	0156	343	40343	10	struct [19]	R/W	Plan Init Start Batch V2 see C.3.2.19
Reset Device Alarms	352	0160	353	40353	1	uint16	W	
Reset Bay Alarms	353	0161	354	40354	1	uint16	W	
Reset Arm Alarms	354	0162	355	40355	1	uint16	W	
Reset Product Stream Alarms	355	0163	356	40356	1	uint16	W	
Reset Additive Stream Alarms	356	0164	357	40357	1	uint16	W	
Reset External Additive Stream Alarms	357	0165	358	40358	1	uint16	W	
Arm Card 1: I/O items #, see 7.3.4.1.1	400	0190	401	40401				

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Arm Card 2: I/O items #, see 7.3.4.1.1	500	01F4	501	40501				
I/O Card 1: I/O items #, see 7.3.4.1.2	600	0258	601	40601				
I/O Card 2: I/O items #, see 7.3.4.1.2	700	02BC	701	40701				
I/O Card 3: I/O items #, see 7.3.4.1.2	800	0320	801	40801				
I/O Card 4: I/O items #, see 7.3.4.1.2	900	0384	901	40901				
Bay 1 items #, see 7.3.4.1.3	1000	03E8	1001	41001				
Bay 2 items #, see 7.3.4.1.3	2000	07D0	2001	42001				
Batch/Arm 1 items #, see 7.3.4.1.4	3000	0BB8	3001	43001				
Batch/Arm 2 items #, see 7.3.4.1.4	4000	0FA0	4001	44001				
Batch/Arm 3 items #, see 7.3.4.1.4	5000	1388	5001	45001				
Batch/Arm 4 items #, see 7.3.4.1.4	6000	1770	6001	46001				

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Batch/Arm 5 items #, see 7.3.4.1.4	7000	1B58	7001	47001				
Batch/Arm 6 items #, see 7.3.4.1.4	8000	1F40	8001	48001				
Device Active Alarms	8964	2304	8965	48965	4	uint64 (enum)	R	Device alarms see C.3.1.50
Bay Active Alarms - Bay 1	8968	2308	8969	48969	4	uint64 (enum)	R	Bay alarms see C.3.1.51
Bay Active Alarms - Bay 2	8972	230C	8973	48973	4	uint64 (enum)	R	Bay alarms see C.3.1.51
Arm Active Alarms - Arm 1	8976	2310	8977	48977	4	uint64 (enum)	R	Arm alarms see C.3.1.52
Arm Active Alarms - Arm 2	8980	2314	8981	48981	4	uint64 (enum)	R	Arm alarms see C.3.1.52
Arm Active Alarms - Arm 3	8984	2318	8985	48985	4	uint64 (enum)	R	Arm alarms see C.3.1.52
Arm Active Alarms - Arm 4	8988	231C	8989	48989	4	uint64 (enum)	R	Arm alarms see C.3.1.52
Arm Active Alarms - Arm 5	8992	2320	8993	48993	4	uint64 (enum)	R	Arm alarms see C.3.1.52

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Arm Active Alarms - Arm 6	8996	2324	8997	48997	4	uint64 (enum)	R	Arm alarms see C.3.1.52
Product Stream Active Alarms - Stream 1	9000	2328	9001	49001	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 2	9004	232C	9005	49005	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 3	9008	2330	9009	49009	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 4	9012	2334	9013	49013	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 5	9016	2338	9017	49017	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 6	9020	233C	9021	49021	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 7	9024	2340	9025	49025	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 8	9028	2344	9029	49029	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 9	9032	2348	9033	49033	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Product Stream Active Alarms - Stream 10	9036	234C	9037	49037	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 11	9040	2350	9041	49041	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Product Stream Active Alarms - Stream 12	9044	2354	9045	49045	4	uint64 (enum)	R	Product Stream alarms see C.3.1.49
Additive Stream Active Alarms - Stream 1	9048	2358	9049	49049	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 2	9049	2359	9050	49050	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 3	9050	235A	9051	49051	1	uint16 (enum)	R	Additive alarmssee C.3.1.17
Additive Stream Active Alarms - Stream 4	9051	235B	9052	49052	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 5	9052	235C	9053	49053	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 6	9053	235D	9054	49054	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 7	9054	235E	9055	49055	1	uint16 (enum)	R	Additive alarms see C.3.1.17

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Additive Stream Active Alarms - Stream 8	9055	235F	9056	49056	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 9	9056	2360	9057	49057	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 10	9057	2361	9058	49058	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 11	9058	2362	9059	49059	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 12	9059	2363	9060	49060	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 13	9060	2364	9061	49061	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 14	9061	2365	9062	49062	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 15	9062	2366	9063	49063	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 16	9063	2367	9064	49064	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 17	9064	2368	9065	49065	1	uint16 (enum)	R	Additive alarms see C.3.1.17

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Additive Stream Active Alarms - Stream 18	9065	2369	9066	49066	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 19	9066	236A	9067	49067	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 20	9067	236B	9068	49068	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 21	9068	236C	9069	49069	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 22	9069	236D	9070	49070	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 23	9070	236E	9071	49071	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 24	9071	236F	9072	49072	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 1	9072	2370	9073	49073	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 2	9073	2371	9074	49074	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 3	9074	2372	9075	49075	1	uint16 (enum)	R	Additive alarms see C.3.1.17

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
External Additive Stream Active Alarms - Stream 4	9075	2373	9076	49076	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 5	9076	2374	9077	49077	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 6	9077	2375	9078	49078	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 7	9078	2376	9079	49079	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 8	9079	2377	9080	49080	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 9	9080	2378	9081	49081	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 10	9081	2379	9082	49082	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 11	9082	237A	9083	49083	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 12	9083	237B	9084	49084	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 13	9084	237C	9085	49085	1	uint16 (enum)	R	Additive alarms see C.3.1.17

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
External Additive Stream Active Alarms - Stream 14	9085	237D	9086	49086	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Additive Stream Active Alarms - Stream 15	9086	237E	9087	49087	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 16	9087	237F	9088	49088	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 17	9088	2380	9089	49089	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 18	9089	2381	9090	49090	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 19	9090	2382	9091	49091	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 20	9091	2383	9092	49092	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 21	9092	2384	9093	49093	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 22	9093	2385	9094	49094	1	uint16 (enum)	R	Additive alarms see C.3.1.17
External Additive Stream Active Alarms - Stream 23	9094	2386	9095	49095	1	uint16 (enum)	R	Additive alarms see C.3.1.17

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
External Additive Stream Active Alarms - Stream 24	9095	2387	9096	49096	1	uint16 (enum)	R	Additive alarms see C.3.1.17
Universal Data Interface: State #, &	20000	4E20	20001		1	uint16 (enum)	R	UDI State, see C.3.1.31
Universal Data Interface: Error Code #,&	20001	4E21	20002		1	uint16 (enum)	R	UDI Error Code, see C.3.1.33
Universal Data Interface: Command #, &	20002	4E22	20003		1	uint16 (enum)	R/W	UDI Command, see C.3.1.32
Universal Data Interface: Item #, &	20003	4E23	20004		1	uint16 (enum)	R/W	UDI Item, see APPENDIX A
Universal Data Interface: Item Index (device) #, &	20004	4E24	20005		1	uint16	R/W	
Universal Data Interface: Item Size (bytes) #, &	20005	4E25	20006		1	uint16	R	
Universal Data Interface: Item Elements (device) #, &	20006	4E26	20007		1	uint16	R/W	
Universal Data Interface: Item Data Type #, &	20007	4E27	20008		1	uint16 (enum)	R	UDI Item, see APPENDIX A
Universal Data Interface: Command Counter #, &	20008	4E28	20009		1	uint16	R	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Universal Data Interface: Response UDI Item#, &	20009	4E29	20010		1	uint16	R	
Universal Data Interface: Buffer #, &	20010	4E2A	20011		32768	byte [65536]	R/W	

NOTE: Parameters marked with # are global parameters.

NOTE: Parameters marked with &, see section TABLE 7-25 for more information.

7.3.4.1.1 Fusion4 MSC-L Device Modbus register map - Arm Card submap

The following table provides the Arm Card submap of the Fusion4 MSC-L Device Modbus register map.

Table 7-17: Fusion4 MSC-L Device Modbus register map - Arm Card submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Input (PI) 1	000	0000	000	000	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 2	001	0001	001	001	1	uint16 (enum)	R	Digital State, see C.3.1.18

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Input (PI) 3	002	0002	002	002	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 4	003	0003	003	003	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 5	004	0004	004	004	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 6	005	0005	005	005	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 7	006	0006	006	006	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 8	007	0007	007	007	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 9	008	0008	008	008	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 10	009	0009	009	009	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 11	010	000A	010	010	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (PI) 12	011	000B	011	011	1	uint16 (enum)	R	Digital State, see C.3.1.18

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Output (SSR) 1	012	000C	012	012	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 2	013	000D	013	013	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 3	014	000E	014	014	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 4	015	000F	015	015	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 5	016	0010	016	016	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 6	017	0011	017	017	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 7	018	0012	018	018	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 8	019	0013	029	019	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 9	020	0014	020	020	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 10	021	0015	021	021	1	uint16 (enum)	R/W	Digital State, see C.3.1.18

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Output (SSR) 11	022	0016	022	022	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 12	023	0017	023	023	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Pulse Output 1	024	0018	024	024	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Pulse Output 2	025	0019	025	025	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
RTD Input 1	026	001A	026	026	2	float32	R	
RTD Input 2	028	001C	028	028	2	float32	R	
RTD Input 3	030	001E	030	030	2	float32	R	
Analog Input 1	032	0020	032	032	2	float32	R	
Analog Input 2	034	0022	034	034	2	float32	R	
Analog Input 3	036	0024	036	036	2	float32	R	
Analog Input 4	038	0026	038	038	2	float32	R	
Analog Input 5	040	0028	040	040	2	float32	R	
Analog Input 6	042	002A	042	042	2	float32	R	
Analog Input 7	044	002C	044	044	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Analog Output 1	046	002E	046	046	2	float32	R	
Digital I/O State	048	0030	048	048	2	uint32	R	Arm Card Digital IO States see C.3.1.54

7.3.4.1.2 Fusion4 MSC-L Device Modbus register map: I/O Card submap

The following table provides the I/O Card submap of the Fusion4 MSC-L Device Modbus register map.

Table 7-18: Fusion4 MSC-L Device Modbus register map - I/O Card submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Input (DC) 1	000	0000	000	000	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 2	001	0001	001	001	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 3	002	0002	002	002	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 4	003	0003	003	003	1	uint16 (enum)	R	Digital State, see C.3.1.18

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Input (DC) 5	004	0004	004	004	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 6	005	0005	005	005	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 7	006	0006	006	006	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 8	007	0007	007	007	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 9	008	0008	008	008	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 10	009	0009	009	019	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 11	010	000A	010	010	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 12	011	000B	011	011	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 13	012	000C	012	012	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (DC) 14	013	000D	013	013	1	uint16 (enum)	R	Digital State, see C.3.1.18

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Input (DC) 15	014	000E	014	014	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (AC) 1	015	000F	015	015	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (AC) 2	016	0010	016	016	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Input (AC) 3	017	0011	017	017	1	uint16 (enum)	R	Digital State, see C.3.1.18
Digital Output (SSR) 1	018	0012	018	018	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 2	019	0013	019	019	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 3	020	0014	020	020	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (SSR) 4	021	0015	021	021	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 1	022	0016	022	022	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 2	023	0017	023	023	1	uint16 (enum)	R/W	Digital State, see C.3.1.18

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Digital Output (EMR) 3	024	0018	024	024	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 4	025	0019	025	025	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 5	026	001A	026	026	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 6	027	001B	027	027	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 7	028	001C	028	028	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 8	029	001D	029	029	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 9	030	001E	030	030	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Digital Output (EMR) 10	031	001F	031	031	1	uint16 (enum)	R/W	Digital State, see C.3.1.18
Analog Output 1	032	0020	032	032	2	float32	R	
Digital IO State	034	0022	034	034	2	uint32	R	IO Card Digital IO states see C.3.1.53

7.3.4.1.3 Fusion4 MSC-L Device Modbus register map: Bay submap

The following table provides the Bay submap of the Fusion4 MSC-L Device Modbus register map.

Table 7-19: Fusion4 MSC-L Device Modbus register map - Bay submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Driver ID	000	0000	000	000	16	uint16 [16]	R/W	
Contract ID	016	0010	016	016	16	uint16 [16]	R/W	
Vehicle ID	032	0020	032	032	16	uint16 [16]	R/W	
Carrier ID	048	0030	048	048	8	char[16]	R/W	
Reserved	056	0038	056	056	8	char[16]	R	
Trailer ID	064	0040	064	064	8	char[16]	R/W	
Reserved	072	0048	072	072	8	char[16]	R	
Reference Number	080	0050	080	080	7	char[14]	R/W	
Load Number	087	0057	087	087	10	char[20]	R/W	
Bay Name	097	0061	097	097	10	char[20]	R/W	
Last User Answer	107	006B	107	107	16	char[32]	R/W	
Bay Number	200	00C8	200	200	1	uint16	R/W	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Number of Batches in Transaction	201	00C9	201	201	1	uint16	R	
Bay Side	202	00CA	202	202	1	uint16 (enum)	R	Arm Side Status, see C.3.1.28
Permissive Type: Grounding	203	00CB	203	203	1	uint16 (enum)	R/W	Permissive Type, see C.3.1.30
Permissive Type: Overfill	204	00CC	204	204	1	uint16 (enum)	R/W	Permissive Type, see C.3.1.30
Permissive Type: Vapour Recovery	205	00CD	205	205	1	uint16 (enum)	R/W	Permissive Type, see C.3.1.30
Permissives Connected	206	00CE	206	206	1	uint16 (enum)	R	Boolean, see C.3.1.5
Show TAS Prompt	207	00CF	207	207	1	uint16 (enum)	R/W	Fusion4 TAS Prompt, see C.3.1.20
Message Timeout	208	00D0	208	208	1	uint16	R/W	
Number of Arms: Idle	209	00D1	209	209	1	uint16	R	
Number of Arms: Available	210	00D2	210	210	1	uint16	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Number of Arms: Paused	211	00D3	211	211	1	uint16	R	
Accumulative GOV	300	012C	300	300	2	float32	R	
Accumulative GSV	302	012E	302	302	2	float32	R	
Accumulative Mass	304	0130	304	304	2	float32	R	
Weighbridge indicated weight	306	132	306	306	2	float32	R	
Weighbridge tare weight	308	134	308	308	2	float32	R	
Weibridge steady status	310	136	310	310	1	uint8	R	
Show Internal Prompt	400	0190	400	400	6	struct [12]	W	Internal Prompt Data, see C.3.2.9
Authorization Object	406	0196	406	406	14	struct [28]	R	Authorization Object, see C.3.2.4
Compartment Response	420	01A4	420	420	19	struct [37]	R/W	Compartment Response, see C.3.2.10
User Response	439	01B7	439	439	37	struct [74]	R	User Response, see C.3.2.5

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
GenericNumber 1	476	01DC	476	476	16	uint16 [16]	R/W	
GenericNumber 2	492	01EC	492	492	16	uint16 [16]	R/W	

7.3.4.1.4 Fusion4 MSC-L Device Modbus register map: Batch/Arm submap

The following table provides the Batch/Arm submap of the Fusion4 MSC-L Device Modbus register map.

Table 7-20: Fusion4 MSC-L Device Modbus register map - Batch/Arm submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Arm Name	000	0000	000	000	10	char[20]	R/W	
Arm Location	100	0064	100	100	1	uint16 (enum)	R/W	Loading Bay, see C.3.1.29
Arm Position	101	0065	101	101	1	uint16 (enum)	R	Loading Bay, see C.3.1.29
TAS Max Preset Limit	200	00C8	200	200	2	float32	R/W	
Arm Accumulative GOV	300	012C	300	300	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Arm Accumulative GSV	302	012E	302	302	2	float32	R	
Arm Accumulative Mass	304	0130	304	304	2	float32	R	
Arm Virtual Stream Accumulative GOV	306	0132	306	306	2	float32	R	
Arm Virtual Stream Accumulative GSV	308	0134	308	308	2	float32	R	
Arm Virtual Stream Accumulative Mass	310	0136	310	310	2	float32	R	
Arm State Details	400	0190	400	400	63	struct [125]	R	Arm State Details, see C.3.2.15

7.3.4.2 Fusion4 MSC-L Arm Modbus register map

The following table provides the Arm Modbus register map for the Fusion4 MSC-L.

> NOTE: See APPENDIX B for a description of the parameters.

Table 7-21: Fusion4 MSC-L Arm Modbus register map

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative GOV	000	0000	001	40001	2	float32	R	
Accumulative GSV	002	0002	003	40003	2	float32	R	
Accumulative Mass	004	0004	005	40005	2	float32	R	
Virtual Stream Accumulative GOV	006	0006	007	40007	2	float32	R	
Virtual Stream Accumulative GSV	008	0008	009	40009	2	float32	R	
Virtual Stream Accumulative Mass	010	000A	011	40011	2	float32	R	
Reserved	012	000C	013	40013	2	float32	R	
Reserved	014	000E	015	40015	2	float32	R	
Batch GOV	016	0010	017	40017	2	float32	R	
Batch GSV	018	0012	019	40019	2	float32	R	
Batch Mass	020	0014	021	40021	2	float32	R	
Batch Flow Rate	022	0016	023	40023	2	float32	R	
Reserved	024	0018	025	40025	2	float32	R	
Batch Remaining Time	026	001A	027	40027	2	uint32	R	
Reserved	028	001C	029	40029	2	uint32	R	
Batch Flow Phase	030	001E	031	40031	1	uint16 (enum)	R	Flow Phase, see C.3.1.3

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Batch Permissive State	031	001F	032	40032	1	uint16 (enum)	R	Permissive State, see C.3.1.2
Reserved	032	0020	033	40033	1	uint16	R	
Software Version #	033	0021	034	40034	4	char[8]	R	
Device Type #	037	0025	038	40038	5	char [10]	R	
Device Serial Number #	042	002A	043	40043	4	char[8]	R	
Preset Quantity	100	0064	101	40101	2	float32	R	
Clean Arm Quantity	102	0066	103	40103	2	float32	R	
Full Flow Rate	104	0068	105	40105	2	float32	R	
Initial Flow Rate	106	006A	107	40107	2	float32	R	
Initial Quantity	108	006C	109	40109	2	float32	R	
Maximum Setpoint Flow Rate	110	006E	111	40111	2	float32	R	
Pre-Stop Flow Rate	112	0070	113	40113	2	float32	R	
Pre-Stop Quantity	114	0072	115	40115	2	float32	R	
Preset Maximum	116	0074	117	40117	2	float32	R	
Preset Minimum	118	0076	119	40119	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Overblend Correction Factor	120	0078	121	40121	2	float32	R	
Base Pressure #	122	007A	123	40123	2	float32	R	
Base Temperature #	124	007C	125	400125	2	float32	R	
Preset Overrun Limit	126	007E	127	40127	2	float32	R	
Dynamic Initial Quantity	128	0080	129	40129	2	float32	R	
Selected Recipe	200	00C8	201	40201	1	uint16	R	
Loading Type	201	00C9	202	40202	1	uint16 (enum)	R	Loading Type, see C.3.1.4
Block Valve Fault Alarm Action	202	00CA	203	40203	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Block Valve Feedback Timeout	203	00CB	204	40204	1	uint16	R	
Comms Permissive	204	00CC	205	40205	1	uint16 (enum)	R/W	Enable/ Disable, see C.3.1.6
Arm Card 1: I/O items #, see 7.3.4.1.1	400	0190	401	40401				
Arm Card 2: I/O items #, see 7.3.4.1.1	500	01F4	501	40501				
I/O Card 1: I/O items #, see 7.3.4.1.2	600	0258	601	40601				

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
I/O Card 2: I/O items #, see 7.3.4.1.2	700	02BC	701	40701				
I/O Card 3: I/O items #, see 7.3.4.1.2	800	0320	801	40801				
I/O Card 4: I/O items #, see 7.3.4.1.2	900	0384	901	40901				
Recipe: Product 1 items, see 7.3.4.2.1	1000	03E8	1001	41001				
Recipe: Product 2 items, see 7.3.4.2.1	2000	07D0	2001	42001				
Recipe: Product 3 items, see 7.3.4.2.1	3000	0BB8	3001	43001				
Recipe: Product 4 items, see 7.3.4.2.1	4000	0FA0	4001	44001				
Recipe: Additive 1 items, see 7.3.4.2.2 for internal additive or see 7.3.4.2.3 for external additive	5000	1388	5001	45001				
Recipe: Additive 2 items, see 7.3.4.2.2 for internal additive or see 7.3.4.2.3 for external additive	6000	1770	6001	46001				
Recipe: Additive 3 items, see 7.3.4.2.2 for internal additive or see 7.3.4.2.3 for external additive	7000	1B58	7001	47001				
Recipe: Additive 4 items, see 7.3.4.2.2 for internal additive or see 7.3.4.2.3 for external additive	8000	1F40	8001	48001				

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Recipe: Additive 5 items, see 7.3.4.2.2 for internal additive or see 7.3.4.2.3 for external additive	9000	2328	9001	49001				
Recipe: Additive 6 items, see 7.3.4.2.2 for internal additive or see 7.3.4.2.3 for external additive	10000	2710	10001	50001				
NOTE: Parameters marked with # are global parameters.								

7.3.4.2.1 Fusion4 MSC-L Arm Modbus register map - Product submap

The following table provides the Product submap of the Fusion4 MSC-L Arm Modbus register map.

Table 7-22: Fusion4 MSC-L Arm Modbus register map - Product submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative Volume Total Observed	000	0000	000	000	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative Volume Calibration	002	0002	002	002	2	float32	R	
Accumulative Volume Leaking	004	0004	004	004	2	float32	R	
Accumulative Mass	006	0006	006	006	2	float32	R	
Accumulative Volume Permitted Observed	008	0008	008	008	2	float32	R	
Accumulative Volume Permitted Observed Unloading	010	000A	010	010	2	float32	R	
Accumulative Volume Permitted Standard	012	000C	012	012	2	float32	R	
Accumulative Volume Permitted Standard Unloading	014	000E	014	014	2	float32	R	
Accumulative Volume Total Standard	016	0010	016	016	2	float32	R	
Accumulative Volume Calibration Standard	018	0012	018	018	2	float32	R	
Accumulative Volume Leaking Standard	020	0014	020	020	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative Mass Total Standard	022	0016	022	022	2	float32	R	
Accumulative Mass Calibration Standard	024	0018	024	024	2	float32	R	
Accumulative Mass Leaking Standard	026	001A	026	026	2	float32	R	
Reserved	028	001C	028	028	2	float32	R	
Reserved	030	001E	030	030	2	float32	R	
Reserved	032	0020	032	032	2	float32	R	
Reserved	034	0022	034	034	2	float32	R	
Volume Transaction Observed	036	0024	036	036	2	float32	R	
Volume Transaction Standard	038	0026	038	038	2	float32	R	
Volume Transaction Leaking	040	0028	040	040	2	float32	R	
Mass Transaction	042	002A	042	042	2	float32	R	
Flow Rate	044	002C	044	044	2	float32	R	
Blend Ratio Observed	046	002E	046	046	2	float32	R	
Reserved	048	0030	048	048	2	float32	R	
Average Stream Density	050	0032	050	050	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Average Stream Pressure	052	0034	052	052	2	float32	R	
Average Stream Temperature	054	0036	054	054	2	float32	R	
Density Observed	056	0038	056	056	2	float32	R	
Pressure Observed	058	003A	058	058	2	float32	R	
Temperature Observed	060	003C	060	060	2	float32	R	
Flow Rate Error	062	003E	062	062	2	float32	R	
Density At Metering Conditions	064	0040	064	064	2	float32	R	
Vapour Pressure	066	0042	066	066	2	float32	R	
Back Pressure Control Factor	068	0044	068	068	2	float32	R	
Observed Vapour Pres- sure	070	0046	070	070	2	float32	R	
Effective Setpoint	072	0048	072	072	2	float32	R	
Pulse Input K-Factor	100	0064	100	100	2	float32	R	
Blend Ratio	102	0066	102	102	2	float32	R	
Leaking Quantity Limit	104	0068	104	104	2	float32	R	
Valve Closing Quantity	106	006A	106	106	2	float32	R	
Overrun Quantity Limit	108	006C	108	108	2	float32	R	
Controller Kdb	110	006E	110	110	2	float32	R	
Controller Kff	112	0070	112	112	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Controller Ki	114	0072	114	114	2	float32	R	
Controller Kout	116	0074	116	116	2	float32	R	
Controller Kp	118	0076	118	118	2	float32	R	
Controller Kve	120	0078	120	120	2	float32	R	
Reserved	122	007A	122	122	2	float32	R	
VCF: Calculation Result (CTPL)	124	007C	124	124	2	float32	R	
VCF: Base Pressure	126	007E	126	126	2	float32	R	
VCF: Base Temperature	128	0080	128	128	2	float32	R	
VCF: Lab Density	130	0082	130	130	2	float32	R/W	
VCF: Lab Pressure	132	0084	132	132	2	float32	R/W	
VCF: Lab Temperature	134	0086	134	134	2	float32	R/W	
VCF: Lab Thermal Expansion Coefficient	136	0088	136	136	2	float32	R/W	
VCF: Lab Mixture Percentage	138	008A	138	138	2	float32	R/W	
Reserved	140	008C	140	140	2	float32	R	
Pressure Control Range Factor	142	008E	142	142	2	float32	R	
Vapour Pressure Margin	144	0090	144	144	2	float32	R	
Batch ID	200	00C8	200	200	2	uint32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Valve Closing Alarm Timeout	202	00CA	202	202	2	uint32	R	
Blend Tolerance Limit	300	012C	300	300	1	uint16	R	
Block Valve Feedback Timeout	301	012D	301	301	1	uint16	R	
Clean Line Alarm Limit	302	012E	302	302	1	uint16	R	
Reserved	303	012F	303	303	1	uint16	R	
DCV Minimum Pulse Width	304	0130	304	304	1	uint16	R	
DCV Period	305	0131	305	305	1	uint16	R	
Reserved	306	0132	306	306	1	uint16	R	
Hydraulic Product Pump Timeout	307	0133	307	307	1	uint16	R	
Hydraulic Pump Demand Feedback Timeout	308	0134	308	308	1	uint16	R	
Leaking Timeout Period	309	0135	309	309	1	uint16	R	
No Product Flow Timeout Limit	310	0136	310	310	1	uint16	R	
Product Pump Timeout	311	0137	311	311	1	uint16	R	
Pump Demand Feedback Timeout	312	0138	312	312	1	uint16	R	
Valve Fault Timeout Period	313	0139	313	313	1	uint16	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Block Valve Open Feedback Timeout	314	013A	314	314	1	uint16	R	
Block Valve Closed Feedback Timeout	315	013B	315	315	1	uint16	R	
Permissive State	400	0190	400	400	1	uint16 (enum)	R	Permissive State, see C.3.1.2
Permissive Function	401	0191	401	401	1	uint16 (enum)	R	Permissive Function, see C.3.1.7
Reserved	402	0192	402	402	1	uint16 (enum)	R	
Alarm Set	403	0193	403	403	1	uint16 (enum)	R	Boolean, see C.3.1.5
Critical Alarm Set	404	0194	404	404	1	uint16 (enum)	R	Boolean, see C.3.1.5
Reserved	405	0195	405	405	1	uint16 (enum)	R	
Actuator Type	406	0196	406	406	1	uint16 (enum)	R	Actuator Type, see C.3.1.9

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Clean Line Alarm Action	407	0197	407	407	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Reserved	408	0198	408	408	1	uint16 (enum)	R	
VCF Commodity Group	409	0199	409	409	1	uint16 (enum)	R	VCF Commodity Group, see C.3.1.10
VCF Compensation Options	410	019A	410	410	1	uint16 (enum)	R	VCF Compensation Options, see C.3.1.11
VCF Density Input Used	411	019B	411	411	1	uint16 (enum)	R	Boolean, see C.3.1.5
VCF Derive Manual Status	412	019C	412	412	1	uint16 (enum)	R	Enable/Disable, see C.3.1.6
VCF Table Options	413	019D	413	413	1	uint16 (enum)	R	VCF Table Options, see C.3.1.12
VCF Density Reading Correction	414	019E	414	414	1	uint16 (enum)	R	VCF Density Reading Correction, see C.3.1.13

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
VCF Mixture Calculation Option	415	019F	415	415	1	uint16 (enum)	R	VCF Mixture Calculation Option, see C.3.1.15
VCF Thermal Correction (Meter)	416	01A0	416	416	1	uint16 (enum)	R	VCF Thermal Correction (Meter), see C.3.1.14
Alarm Action: Blend Tolerance	500	01F4	500	500	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Block Valve Failing	501	01F5	501	501	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Block Valve Opening Fault	502	01F6	502	502	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Density Bad Sensor	503	01F7	503	503	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Factored Pulse Out	504	01F8	504	504	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Flowrate Exceeded Meter Limit	505	01F9	505	505	1	uint16 (enum)	R	Alarm Action, see C.3.1.1

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Alarm Action: High Density	506	01FA	506	506	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: High Pressure	507	01FB	507	507	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: High Temperature	508	01FC	508	508	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Invalid Reference Conditions	509	01FD	509	509	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Invalid Temperature Scale	510	01FE	510	510	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Leaking Valve	511	01FF	511	511	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Low Density	512	0200	512	512	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Low Pressure	513	0201	513	513	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Low Temperature	514	0202	514	514	1	uint16 (enum)	R	Alarm Action, see C.3.1.1

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Alarm Action: No Hydraulic Pump	515	0203	515	515	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: No Product	516	0204	516	516	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: No Pump Sense	517	0205	517	517	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: No Reference Fluids	518	0206	518	518	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Non Convergence	519	0207	519	519	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Overrun Exceeded	520	0208	520	520	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Pressure Bad Sensor	521	0209	521	521	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Pulse Hardware	522	020A	522	522	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Pulse Phase	523	020B	523	523	1	uint16 (enum)	R	Alarm Action, see C.3.1.1

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Alarm Action: Supercritical Fluid	524	020C	524	524	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Tank Empty	525	020D	525	525	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Tank Low Level	526	020E	526	526	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Temperature Bad Sensor	527	020F	527	527	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Valve Fault	528	0210	528	528	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Bad Sensor Health	529	0211	529	529	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Pressure Compensation Not Supported	530	0212	530	530	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Alpha60 Out Of Range	531	0213	531	531	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Density Out Of Range	532	0214	532	532	1	uint16 (enum)	R	Alarm Action, see C.3.1.1

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Alarm Action (VCF): Illegal Argument	533	0215	533	533	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Memory Allocation	534	0216	534	534	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): No Solution	535	0217	535	535	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Factor Out Of Range	536	0218	536	536	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Pressure Out Of Range	537	0219	537	537	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action (VCF): Temperature Out Of Range	538	021A	538	538	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Alarm Action: Block Valve Closing Fault	539	021B	539	539	1	uint16 (enum)	R	Alarm Action, see C.3.1.1

7.3.4.2.2 Fusion4 MSC-L Arm Modbus register map - Additive submap

The following table provides the Additive submap of the Fusion4 MSC-L Arm Modbus register map. This submap is used for internal additives.

Table 7-23: Fusion4 MSC-L Arm Modbus register map - Additive submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative total additive stream gross observed volume	000	0000	000	000	2	float32	R	
Accumulative transactional additive stream gross observed volume	002	0002	002	002	2	float32	R	
Accumulative leaking solenoid gross observed volume	004	0004	004	004	2	float32	R	
Accumulative calibration gross observed volume	006	0006	006	006	2	float32	R	
Reserved	008	0008	008	008	2	float32	R	
Reserved	100	0064	100	100	2	float32	R	
Additive K-factor	102	0066	102	102	2	float32	R	
Leaking solenoid volume limit	104	0068	104	104	2	float32	R	
Solenoid dwell time	200	00C8	200	200	1	uint16	R	
Factored pulse output resolution	201	00C9	201	201	1	uint16 (enum)	R	Factored Pulse Output, see C.3.1.8
Reserved	202	00CA	202	202	1	uint16	R	
Reserved	203	00CB	203	203	1	uint16	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	204	00CC	204	204	1	uint16	R	
Reserved	205	00CD	205	205	1	uint16	R	
Feedback pulse duration	206	00CE	206	206	1	uint16	R	
Slow flow volume alarm action	207	00CF	207	207	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
No additive alarm action	208	00D0	208	208	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Additive volume deviation alarm action	209	00D1	209	209	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Leaking solenoid alarm action	210	00D2	210	210	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
No activity timeout alarm action	211	00D3	211	211	1	uint16 (enum)	R	Alarm Action, see C.3.1.1
Permissive state	212	00D4	212	212	1	uint16 (enum)	R	Permissive State, see C.3.1.2
Solenoid close delay	213	00D5	213	213	1	uint16	R	
Active alarms	214	00D6	214	214	1	uint16 (enum)	R	Additive Alarms, see C.3.1.17

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Permissive function	215	00D7	215	215	1	uint16 (enum)	R	Input Control Mode, see C.3.1.16
Alarm and permissive state (injectors 1-6) #	216	00D8	216	216	1	uint16	R	
Alarm and permissive state (injectors 7-12) #	217	00D9	217	217	1	uint16	R	
Alarm and permissive state (injectors 13-18) #	218	00DA	218	218	1	uint16	R	
Alarm and permissive state (injectors 19-24) #	219	00DB	219	219	1	uint16	R	
Additive deviation basis	300	012C	300	300	1	uint16	R	
Number of solenoid retries	301	012D	301	301	1	uint16	R	
No additive flow timeout period	302	012E	302	302	1	uint16	R	
Leaking solenoid timeout period	303	012F	303	303	1	uint16	R	
No activity timeout period	304	0130	304	304	1	uint16	R	
Slow flow volume deviation allowed	305	0131	305	305	1	uint16	R	
Injection volume	400	0190	400	400	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Volume per injection cycle	402	0192	402	402	2	float32	R	
Minimum product volume for transaction	404	0194	404	404	2	float32	R	
Clean start gross observed volume	406	0196	406	406	2	float32	R	
High flow threshold value	408	0198	408	408	2	float32	R	
Low flow threshold value	410	019A	410	410	2	float32	R	
Number of clean start cycles	600	0258	600	600	1	uint16	R	
Injection offset	601	0259	601	601	1	uint16	R	
Pump run timeout	602	025A	602	602	1	uint16	R	
Additive volume deviation allowed	603	025B	603	603	1	uint16	R	
Reserved	604	025C	604	604	1	uint16	R	
Additive stream state	800	0320	800	800	1	uint16 (enum)	R	Additive Control State, see C.3.1.19
Alarms	801	0321	801	801	1	uint16	R	
Reserved	802	0322	802	802	2	float32	R	
Accumulative total additive stream gross observed volume	804	0324	804	804	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	806	0326	806	806	2	float32	R	
Transactional additive stream gross observed volume	808	0328	808	808	2	float32	R	
Reserved	810	032A	810	810	2	float32	R	
Reserved	812	032C	812	812	2	float32	R	
Transaction PPM	814	032E	814	814	2	float32	R	

NOTE: Parameters marked with # are global parameters.

7.3.4.2.3 Fusion4 MSC-L Arm Modbus register map - External Additive submap

Table 7-24: Fusion4 MSC-L Arm Modbus register map - External Additive submap

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative total additive stream gross observed volume	000	0000	000	000	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Accumulative transactional additive stream gross observed volume	002	0002	002	002	2	float32	R	
Accumulative leaking solenoid gross observed volume	004	0004	004	004	2	float32	R	
Reserved	200	00C8	200	200	1	uint16	R	
Reserved	201	00C9	201	201	1	uint16	R	
Reserved	202	00CA	202	202	1	uint16	R	
Reserved	203	00CB	203	203	1	uint16	R	
Reserved	204	00CC	204	204	1	uint16	R	
Reserved	205	00CD	205	205	1	uint16	R	
Reserved	206	00CE	206	206	1	uint16	R	
Reserved	207	00CF	207	207	1	uint16	R	
Reserved	208	00D0	208	208	1	uint16	R	
Reserved	209	00D1	209	209	1	uint16	R	
Reserved	210	00D2	210	210	1	uint16	R	
Reserved	211	00D3	211	211	1	uint16	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Permissive state	212	00D4	212	212	1	uint16 (enum)	R	Permissive State, see C.3.1.2
Reserved	213	00D5	213	213	1	uint16	R	
Active Alarms	214	00D6	214	214	1	uint16 (enum)	R	Additive Alarms, see C.3.1.17
Permissive function	215	00D7	215	215	1	uint16 (enum)	R	Input Control Mode, see C.3.1.16
Reserved	216	00D8	216	216	1	uint16	R	
Reserved	217	00D9	217	217	1	uint16	R	
Reserved	218	00DA	218	218	1	uint16	R	
Reserved	219	00DB	219	219	1	uint16	R	
Injection Volume	400	0190	400	400	2	float32	R	
Volume per injection cycle	402	0192	402	402	2	float32	R	
Additive stream state	800	0320	800	800	1	uint16 (enum)	R	Controller State see C.3.1.47
Alarms	801	0321	801	801	1	uint16	R	Additive Alarms, see C.3.1.17

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	802	0322	802	802	2	float32	R	
Accumulative total additive stream gross observed volume	804	0324	804	804	2	float32	R	
Reserved	806	0326	806	806	2	float32	R	
Transaction additive stream gross observed volume	808	0328	808	808	2	float32	R	
Reserved	810	032A	810	810	2	float32	R	
Reserved	812	032C	812	812	2	float32	R	
Transaction PPM	814	032E	814	814	2	float32	R	

7.3.4.3 Fusion4 MSC-L Device Modbus register map – Optimized map

The following table provides the Optimized map of the Fusion4 MSC-L Device Modbus register map.

> NOTE: If optimized modbus is enabled in the configuration menu, optimized register map and UDI can only be used. The map supports only limited parameters that are listed below.

Table 7-25: Fusion4 MSC-L Device Modbus register map – Optimized map

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Units: Volume	000	0000	001	40001	1	uint16 (enum)	R	Units: Volume see C.3.1.22
Units: Pressure	001	0001	002	40002	1	uint16 (enum)	R	Units: Pressure see C.3.1.21
Units: Density	002	0002	003	40003	1	uint16 (enum)	R	Units: Density see C.3.1.23
Units: Mass	003	0003	004	40004	1	uint16 (enum)	R	Units: Mass see C.3.1.25
Units: Temperature	004	0004	005	40005	1	uint16 (enum)	R	Units: Temperature see C.3.1.24
Units: Injection Volume	005	0005	006	40006	1	uint16 (enum)	R	Units: Injection Volume see C.3.1.26
Date	006	0006	007	40007	2	struct [4]	R/W	RTC Date see C.3.2.29
Reserved	008	0008	009	40009	1	uint16 (enum)	R	
Time	009	0009	010	40010	2	struct [4]	R/W	Time see C.3.2.30

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Arm Current State	011	000B	012	40012	2	uint32	R	Arm Current State
F4 Portal Scan Register [0]	013	000D	014	40014	2	uint32	R	
F4 Portal Scan Register [3]	015	000F	016	40016	2	uint32	R	
F4 Portal Scan Register [11]	017	0011	018	40018	2	uint32	R	
F4 Portal Scan Register [13]	019	0013	020	40020	2	uint32	R	
RIT Ack Input Status	021	0015	022	40022	1	uint16	R/W	
Reserved	022	0016	023	40023	1	uint16 (enum)	R	
Workflow Mode	023	0017	024	40024	1	uint16 (enum)	RW	ENUM_TRANSACTION_ WORKFLOW_MODE see C.3.1.65
Batch Count	024	0018	025	40025	2	uint32	R	
Transaction Count	026	001A	027	40027	2	uint32	R	
User Prompt State	028	001C	029	40029	1	uint16 (enum)	R	User Prompt State see C.3.1.40
User Response Text	029	001D	030	40030	10	uint16 [10]	R	
Restore 1010 Transaction	039	0027	040	40040	2	uint32	RW	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	041	0029	042	40042	1	uint16 (enum)	R	
Restore 1010 Batch	042	002A	043	40043	2	uint32	RW	
Reserved	044	002C	045	40045	1	uint16 (enum)	R	
Close Screen	045	002D	046	40046	1	uint16	RW	1 = Close screen
Reserved	046	002E	047	40047	1	uint16 (enum)	R	
Restore TAS Control	047	002F	048	40048	1	uint16	RW	1 = Restore TAS Control
Reserved	048	0030	049	40049	1	uint16 (enum)	R	
Display Alarm Screen	049	0031	050	40050	1	uint16	RW	1 = Display Alarm Screen
Reserved	050	0032	051	40051	1	uint16 (enum)	R	
Send Esc Key	051	0033	052	40052	1	uint16	RW	1 = Send ESC Key
Reserved	052	0034	053	40053	1	uint16 (enum)	R	
Bay Command	053	0035	054	40054	1	uint16 (enum)	RW	Bay Command (enum) see C.3.1.35

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	054	0036	055	40055	1	uint16 (enum)	R	
Arm 1 - Arm Command	055	0037	056	40056	1	uint16 (enum)	RW	ENUM_ARM_COMMAND see C.3.1.42
Reserved	056	0038	057	40057	1	uint16 (enum)	R	
Arm 2 - Arm Command	057	0039	058	40058	1	uint16 (enum)	RW	ENUM_ARM_COMMAND see C.3.1.42
Reserved	058	003A	059	40059	1	uint16 (enum)	R	
Dynamic Recipe - Arm 1 Blend Percentage	059	003B	060	40060	2	float32	R/W	
Reserved	061	003D	062	40062	1	uint16 (enum)	R	
Dynamic Recipe - Arm 1 Additive PPM	062	003E	063	40063	2	float32	R/W	
Reserved	064	0040	065	40065	1	uint16 (enum)	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Dynamic Recipe - Arm 2 Blend Percentage	065	0041	066	40066	2	float32	R/W	
Reserved	067	0043	068	40068	1	uint16 (enum)	R	
Dynamic Recipe - Arm 2 Additive PPM	068	0044	069	40069	2	float32	R/W	
Reserved	070	0046	071	40071	1	uint16 (enum)	R	
Reset All Alarms	071	0047	072	40072	1	uint16	RW	1 = Reset All Alarms
Reserved	072	0048	073	40073	1	uint16 (enum)	R	
Show TAS Prompt	073	0049	074	40074	1	uint16 (enum)	R/W	Fusion4 TAS Prompt see C.3.1.20
Reserved	074	004A	075	40075	1	uint16 (enum)	R	
Display Message (show prompt) - Command to Display	075	004B	076	40076	1	uint16	R/W	1 = Command

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	076	004C	077	40077	1	uint16 (enum)	R	
Display Message (show prompt) - Prompt Input	077	004D	078	40078	1	uint16 (enum)	R/W	PROMPT_INUT see C.3.1.46
Reserved	078	004E	079	40079	1	uint16 (enum)	R	
Display Message (show prompt) - Message	079	004F	080	40080	32	uint16 [32]	R/W	
Digital IO State	111	006F	112	40112	2	uint32	R	IO Card Digital IO State
Write command success counter	113	0071	114	40114	1	uint16	R	
Write command address	114	0072	115	40115	1	uint16	R	
Display Message Arm Index	115	0073	116	40116	1	uint16	R/W	0 = All Arm, 1 = Arm 1, 2 = Arm 2
Reserved	116	0074	117	40117	1	uint16	R	
Clear User Response and Display Message	117	0075	118	40118	1	uint16	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Reserved	118	0076	119	40119	1	uint16	R	
Stop Button Status	119	0077	120	40120	1	uint16	R/W	Bit 0 = BCU STOP, 1 = Arm 1 RIT Stop, 2 = Arm 2 Stop
Arm 1 Preset Quantity	120	0078	121	40121	2	float32	R	
Arm 1 Compartment Number	122	007A	123	40123	1	uint16	R	
Arm 1 GOV/Mass	123	007B	124	40124	2	float32	R	
Arm 1 Flowrate	125	007D	126	40126	2	float32	R	
Arm 2 Preset Quantity	127	007F	128	40128	2	float32	R	
Arm 2 Compartment Number	129	0081	130	40130	1	uint16	R	
Arm 2 GOV/Mass	130	0082	131	40131	2	float32	R	
Arm 2 Flowrate	132	0084	133	40133	2	float32	R	
Product Stream 1 - GOV/ass	134	0086	135	40135	2	float32	R	
Product Stream 1 - GSV	136	0088	137	40137	2	float32	R	
Product Stream 1 - Temperature	138	008A	139	40139	2	float32	R	
Product Stream 1 - Pressure	140	008C	141	40141	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Product Stream 1 - Density	142	008E	143	40143	2	float32	R	
Product Stream 1 - Flowrate	144	0090	145	40145	2	float32	R	
Product Stream 1 - Blend Ratio	146	0092	147	40147	2	float32	R	
Product Stream 2 - GOV/ass	148	0094	149	40149	2	float32	R	
Product Stream 2 - GSV	150	0096	151	40151	2	float32	R	
Product Stream 2 - Temperature	152	0098	153	40153	2	float32	R	
Product Stream 2 - Pressure	154	009A	155	40155	2	float32	R	
Product Stream 2 - Density	156	009C	157	40157	2	float32	R	
Product Stream 2 - Flowrate	158	009E	159	40159	2	float32	R	
Product Stream 2 - Blend Ratio	160	00A0	161	40161	2	float32	R	
Product Stream 3 - GOV/ass	162	00A2	163	40163	2	float32	R	
Product Stream 3 - GSV	164	00A4	165	40165	2	float32	R	
Product Stream 3 - Temperature	166	00A6	167	40167	2	float32	R	
Product Stream 3 - Pressure	168	00A8	169	40169	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Product Stream 3 - Density	170	00AA	171	40171	2	float32	R	
Product Stream 3 - Flowrate	172	00AC	173	40173	2	float32	R	
Product Stream 3 - Blend Ratio	174	00AE	175	40175	2	float32	R	
Product Stream 4 - GOV/ass	176	00B0	177	40177	2	float32	R	
Product Stream 4 - GSV	178	00B2	179	40179	2	float32	R	
Product Stream 4 - Temperature	180	00B4	181	40181	2	float32	R	
Product Stream 4 - Pressure	182	00B6	183	40183	2	float32	R	
Product Stream 4 - Density	184	00B8	185	40185	2	float32	R	
Product Stream 4 - Flowrate	186	00BA	187	40187	2	float32	R	
Product Stream 4 - Blend Ratio	188	00BC	189	40189	2	float32	R	
Additive Stream 1 Injection Volume	190	00BE	191	40191	2	float32	R	
Additive Stream 1 PPM	192	00C0	193	40193	2	float32	R	
Additive Stream 2 Injection Volume	194	00C2	195	40195	2	float32	R	

Parameter Name	Starting Holding Register Offset from Base Address				Data Size / Type		Access	Enumeration / Structure Type
	Address (Decimal / Hex)		Number (Standard/ Modicon)		Registers	Type		
Additive Stream 2 PPM	196	00C4	197	40197	2	float32	R	
Device Active Alarms	198	00C6	199	40199	4	uint64	R	Device Active Alarms
Bay Active Alarms - Bay 1	202	00CA	203	40203	4	uint64	R	Bay Active Alarms
Arm Active Alarms - Arm 1	206	00CE	207	40207	4	uint64	R	Arm Active Alarms
Arm Active Alarms - Arm 2	210	00D2	211	40211	4	uint64	R	Arm Active Alarms
Product Stream Active Alarms - Stream 1	214	00D6	215	40215	4	uint64	R	Product Stream Active Alarms
Product Stream Active Alarms - Stream 2	218	00DA	219	40219	4	uint64	R	Product Stream Active Alarms
Product Stream Active Alarms - Stream 3	222	00DE	223	40223	4	uint64	R	Product Stream Active Alarms
Product Stream Active Alarms - Stream 4	226	00E2	227	40227	4	uint64	R	Product Stream Active Alarms
Additive Stream Active Alarms - Stream 1	230	00E6	231	40231	1	uint16	R	Additive Stream Active Alarms
Additive Stream Active Alarms - Stream 2	231	00E7	232	40232	1	uint16	R	Additive Stream Active Alarms

7.3.5 Fusion4 MSC-L Universal Data Interface

The Fusion4 MSC-L Universal Data Interface (UDI) provides a powerful and convenient interface for a TAS or SCADA system to access Fusion4 MSC-L data using the Modbus protocol.

A vast number of parameters can be accessed via a single data buffer with small overheads to provide the data integrity. The data buffer serves as a generic read/write buffer together with the help of a few configuration/command registers.

7.3.5.1 UDI Read/Write Procedures

7.3.5.1.1 UDI Read Procedure (All or Indexed)

> NOTE: Refer to APPENDIX B for a description of the parameters.

Perform the following steps to read an UDI item (All or Indexed):

1. Use the [Universal Data Interface: State] parameter (Modbus register 20000: read) to poll the UDI state. Poll the UDI state until the response value is not equal to 3 ('Waiting Result'). This allows UDI to complete the previous request, if any.
2. Use the [Universal Data Interface: Item] parameter (Modbus register 20003: write N, where N is the UDI item number) to set the desired UDI item. See APPENDIX A for an overview of the UDI items.
3. If necessary, use the [Universal Data Interface: Item Index (device)] parameter (Modbus register 20004: write N, where N is the index number of the UDI item) to set the UDI item index if the intention is to write only one element of the (indexed) item.
4. If necessary, use the [Universal Data Interface: Item Size (bytes)] parameter (Modbus register 20005: read) to read the size of the UDI item (element).
5. If necessary, use the [Universal Data Interface: Item Elements (device)] parameter (Modbus register 20006: read) to read the number of UDI item elements.

6. If necessary, use the [Universal Data Interface: Item Data Type] parameter (Modbus register 20007: read) to read the data type of the UDI item.
7. Use the [Universal Data Interface: Command] parameter (Modbus register 20002: write 2) to issue the Read All command.

   or

   Use the [Universal Data Interface: Command] parameter (Modbus register 20002: write 0) to issue the Read Indexed command.

   After successful Read All Command and Read Indexed Command, [Universal Interface: Command Counter] increment by one and [Universal Interface: Command] set to -1 by MSC-L device. This is for sanity check that read command successfully executed.
8. Use the [Universal Data Interface: State] parameter (Modbus register 20000: read) to poll the UDI state. Poll the UDI state until the response value is 0 ('Ready Good'). If the response value is 1 ('Ready Error'), then an exception occurred.
9. If an exception occurred, use the [Universal Data Interface: Error Code] parameter (Modbus register 20001: read) to read the UDI error code. See section C.3.1.33 for an overview of the UDI error codes.
10. Use the [Universal Data Interface: Buffer] parameter (Modbus register 20010: read) to read the UDI buffer.
11. Use the [Universal Data Interface: Response UDI Item] to cross check the UDI item which was requested to Read All or Read Indexed.

> NOTE: Numerical values have little endianness.

7.3.5.1.2 UDI Write Procedure (All or Indexed)

Perform the following steps to write an UDI item (All or Indexed):

1. Use the [Universal Data Interface: State] parameter (Modbus register 20000: read) to poll the UDI state. Poll the UDI state until the response value is not equal to 3 ('Waiting Result'). This allows the UDI to complete the previous request, if any.

2. Use the [Universal Data Interface: Item] parameter (Modbus register 20003: write N, where N is the UDI item number) to set the desired UDI item. See APPENDIX A for an overview of the UDI items.
3. If necessary, use the [Universal Data Interface: Item Index (device)] parameter (Modbus register 20004: write N, where N is the index number of the UDI item) to set the UDI item index if only one element of the (indexed) item needs to be written.
4. If necessary, use the [Universal Data Interface: Item Size (bytes)] parameter (Modbus register 20005: read) to read the size of the UDI item (element).
5. If necessary, use the [Universal Data Interface: Item Elements (device)] parameter (Modbus register 20006: read) to read the number of UDI item elements.
6. If necessary, use the [Universal Data Interface: Item Data Type] parameter (Modbus register 20007: read) to read the data type of the UDI item.
7. Use [Universal Data Interface: Buffer] parameter (Modbus register 20010: write) to the write the UDI buffer.

   > NOTE: Numerical values should have little endianness.

8. Use the [Universal Data Interface: Command] parameter (Register 20002: Write 3) to issue the Write All command.

   or

   Use the [Universal Data Interface: Command] parameter (Register 20002: Write 1) to issue the Write Indexed command.

   After successful Write All Command and Write Indexed Command, [Universal Interface: Command Counter] increment by one and [Universal Interface: Command] set to -1 by MSC-L device. This is for sanity check that read command successfully executed.
9. Use the [Universal Data Interface: State] parameter (Register 20000: Read) to poll the UDI state. Poll the UDI state until the response value is 0 (‘Ready Good’). If the response value is 1 (‘Ready Error’), then an exception occurred.

10. If an exception occurred, read the UDI error code (Modbus register 20001: Read). See section C.3.1.33 of APPENDIX C for an overview of the UDI error codes.

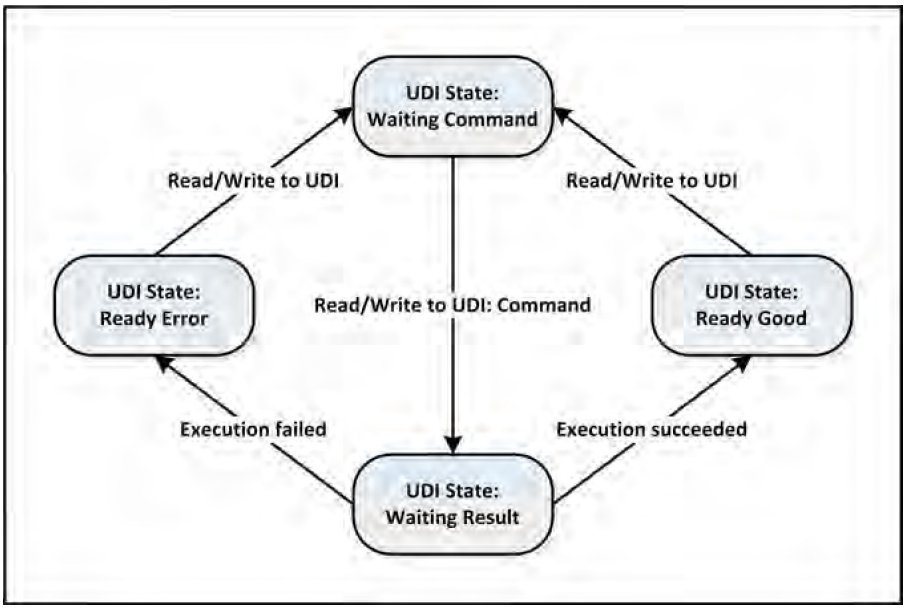
7.3.5.2 UDI State

The UDI state can be one of following:

- Ready: Good, i.e. the UDI finished processing the read/write command and a valid response was returned.
- Ready: Error, i.e. the UDI finished processing the read/write command but execution of the command failed.
- Waiting: Result, i.e. the UDI is busy processing the previous read/ write command. While in 'Waiting: Result' state any read/write command issued to the UDI will be rejected with a 'busy' exception response.
- Waiting: Command, i.e. the UDI is waiting for a read/write command after the buffer data is not valid anymore, for example after writing into an 'Item' register or any other writable UDI register.

The different UDI states in relation to a read/write UDI command are shown in the following figure.

Figure 7-1: UDI state diagram



7.3.5.3 Examples

The following sections provide examples of the UDI read/write procedures.

7.3.5.3.1 Example 1: Show prompt data

To show prompt data, use the UDI Write Indexed procedure (see section 7.3.5.1.2) with:

- Item = 122
- Index = 0
- Data type = 460 (i.e. [Show Prompt Data] structure, see section C.3.2.16 of APPENDIX C)

7.3.5.3.2 Get last user response for bay 1

To obtain the last user response for bay 1, use the UDI Read Indexed procedure (see section 7.3.5.1.1) with:

- Item = 121
- Index = 0
- Data type = 461 (i.e. [User Response] structure, see section C.3.2.5 of APPENDIX C)

7.3.5.3.3 Set Recipe 1 for Arm 1

To set Recipe 1 for Arm 1, use the UDI Write Indexed procedure (see section 7.3.5.1.2) with:

- Item = 2
- Index = 0 (each arm has 50 recipes)
- Data type = 450 (i.e. [Load Recipe] structure, see section C.3.2.14 of APPENDIX C)

7.3.5.3.4 Set batch details for bay 1

To set the batch details for bay 1, use the UDI Write All procedure (see section 7.3.5.1.2) with:

- Item = 95
- Data type = 475 (i.e. [Batch Details] structure, see section C.3.2.6 of APPENDIX C)

7.3.5.3.5 Get last batch record for arm 3

To obtain the last batch record for arm 3, use the UDI Read All procedure (see section 7.3.5.1.1) with:

- Item = 136

7.4 MSC-L Modbus Application Interface

This section describes the generic Modbus protocol interface that expose alarm, batch, and the process information to TAS (Terminal Automation Software) application and DCS. This interface shall be used to provide alarm monitoring, logging functionality, and well-integrated solution for TAS and DCS based loading bay automation.

F4P (Fusion 4 Portal) is a software tool, that communicates with the MSC-L for monitoring and diagnostic purpose. In this document, wherever F4P appear, it can be considered as TAS or DCS if you are communicating to MSC-L from a TAS or DCS system.

> NOTE: Modbus Poll screen shot used in this section for Modbus registers read/write operation and MSC-L device address configured as default address i.e. 200.

7.4.1 Function Details

7.4.1.1 F4 Portal Scan Registers

Table 7-26: F4 Portal Scan Registers

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
F4 Portal Scan Register [0]	160	00A0	161	400161	2	uint32	R	
F4 Portal Scan Register [1]	162	00A2	163	400163	2	uint32	R	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
F4 Portal Scan Register [2]	164	00A4	165	400165	2	uint32	R	
F4 Portal Scan Register [3]	166	00A6	167	400167	2	uint32	R	
F4 Portal Scan Register [4]	168	00A8	169	400169	2	uint32	R	
F4 Portal Scan Register [5]	170	00AA	171	400171	2	uint32	R	
F4 Portal Scan Register [6]	172	00AC	173	400173	2	uint32	R	
F4 Portal Scan Register [7]	174	00AE	175	400175	2	uint32	R	
F4 Portal Scan Register [8]	176	00B0	177	400177	2	uint32	R	
F4 Portal Scan Register [9]	178	00B2	179	400179	2	uint32	R	
F4 Portal Scan Register [10]	180	00B4	181	400181	2	uint32	R	
F4 Portal Scan Register [11]	182	00B6	183	400183	2	uint32	R	

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
F4 Portal Scan Register [12]	184	00B8	185	400185	2	uint32	R	
F4 Portal Scan Register [13]	186	00BA	187	400187	2	uint32	R	
F4 Portal Scan Register [14]	188	00BC	189	400189	2	uint32	R	
F4 Portal Scan Register [15]	190	00BE	191	400191	2	uint32	R	

These 16 registers values are used specifically to support scanning activities across TAS interfaces. These registers can be scanned periodically by the TAS and if there is no change since the last scan, then there have been no device state changes that are relevant to the TAS interfaces.

The F4P Scan registers index are in the following manner:

- Index 0 – Alarming Status Interface, see section 7.4.1.1.1.
- Index 1 – Alarm and Event Log interface, see section 7.4.1.1.2.
- Index 2 – Transaction Interface, see section 7.4.1.1.3.
- Index 3 – Preset Loader Interface, see section 7.4.1.1.4.
- Index 4 – Last Transaction ID Bay 1, see section 7.4.1.1.5.
- Index 5 – Last Transaction ID Bay 2, see section 7.4.1.1.6.
- Index 6 – Loading Arm State, see section 7.4.1.1.7.
- Index 7 – Alarm Log Index, see section 7.4.1.1.8.
- Index 8 – Event Log Index, see section 7.4.1.1.9.

- Index 9 – Calibration Log Index, see section 7.4.1.1.10.
- Index 10 – Batch State, see section 7.4.1.1.11.
- Index 11 – Batch Evaluation State, see section 7.4.1.1.12.
- Index 12 – Number of Batches, see section 7.4.1.1.13.
- Index 13 – Display State, see section 7.4.1.1.14.
- Index 14 – Last Transaction Parked (for Dual Bay), see section 7.4.1.1.15.
- Index 15 – Transaction State, see section 7.4.1.1.16.

> NOTE: Poll F4 Port Scan registers periodically within TAS configured timeout which avoid TAS communication timeout alarm.

7.4.1.1.1 F4 Portal Scan Registers [Index 0] – Alarm Status Interface

The following table specifies the meaning of each bit within the 32-bit value corresponding to the Fusion4 scan register index 0 entity.

Table 7-27: F4 Portal Scan Registers [Index 0] – Alarm Status Interface

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Alarm Status Tracker															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Number of Active Alarms							0	0	0	0	0	0	0	Interface Ready

- Number of Active Alarms – This is a 7-bit unsigned integer number that indicates the number of alarms currently in the active or acknowledged state. Since it is only possible to expose the alarm details for up to 100 alarms the value 101 shall mean that there are 101 or more alarms. No value greater than 101 should be saved in this value. External application should consider this to be a special state in which only incomplete alarm device alarm information is viewable.

- Alarm Status Tracker – This is a 16-bit unsigned integer number used to indicate if there has been a change to the device alarm status. Initially, this value is 0 and it is incremented when there is any change the device's alarm state (it will roll over to the value of 0 after reaching 0xFFFF). The alarm interface transition into the active state upon device startup is the first change to the alarm interface. As such, the alarm status tracker value will be non-zero when the interface first becomes enabled. If more than one alarm changes state at the same time then the value only needs to be incremented once. If the Alarm Status Tracker value remains unchanged then the F4P does not need to read any additional alarming entities and no update to the Alarm Monitor in the F4P is necessary. The difference between two consecutive reads of the Alarm Status Tracker value can help distinguish between device resets and network disconnects (with the exception of the roll-over case).
- Interface is Ready – This bit indicates whether the alarm interface is implemented, initialized, and operational.
  - 0 - The alarm status interface cannot be used.
  - 1 - The alarm status interface is implemented, initialized, and operational.

7.4.1.1.2 F4 Portal Scan Registers [Index 1] – Alarm Log Interface

The following table specifies the meaning of each bit within the 32-bit value corresponding to the Fusion4 scan register index 1 entity.

Table 7-28: F4 Portal Scan Registers [Index 1] – Alarm Log Interface

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	Unprocessed Event Logs Available	Event Interface Ready	Unprocessed Alarm Logs Available	Interface Ready

- Unprocessed Alarm Logs Available – This bit indicates whether there are currently unprocessed alarm log records that need to be processed.

- 0 - There are no alarm log records on the device that have not yet been processed by the F4P.
- 1 - There is at least one alarm log record that is unprocessed by the F4P.

- Interface is Ready – This bit indicates whether the alarm log interface is implemented, initialized, and operational.
  - 0 - The alarm log interface cannot be used.
  - 1 - The alarm log interface is implemented, initialized, and oper- ational.
- Unprocessed Event Logs Available – This bit indicates whether there are currently unprocessed event log records that need to be processed.
  - 0 - There are no event log records on the device that have not yet been processed by the F4P.
  - 1 - There is at least one event log record that is unprocessed by the F4P.
- Interface is Ready – This bit indicates whether the event log interface is implemented, initialized, and operational.
  - 0 - The event log interface cannot be used.
  - 1 - The event log interface is implemented, initialized, and oper- ational.

There is no specification about how many alarm or event log items the device must implement. Therefore it is possible that the Fusion4 Portal does not process alarm and event log records before they are overwritten with new log records. If the last unprocessed log record is over written with a new log record then the last unprocessed log record exposed to the F4P shall advance to next log record.

7.4.1.1.3 F4 Portal Scan Registers [Index 2] – Transaction Interface

The following specifies the meaning of each bit within the 32-bit value corresponding to the Fusion4 scan register index 2 entity.

Table 7-29: F4 Portal Scan Registers [Index 2] – Transaction Interface

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	Unprocessed Transactions	Interface Ready

- Unprocessed Transaction Logs Available – This bit indicates whether there are currently unprocessed transaction log records that need to be processed.
  - 0 - There are no transaction log records on the device that have not yet been processed by the F4P.
  - 1 - There is at least one transaction log record that is unprocessed by the F4P.
- Interface is Ready – This bit indicates whether the transaction log interface is implemented, initialized, and operational.
  - 0 - The transaction log interface cannot be used.
  - 1 - The transaction log interface is implemented, initialized, and operational.

7.4.1.1.4 F4 Portal Scan Registers [Index 3] – Preset Loader Interface

The following table specifies the meaning of each bit within the 32-bit value corresponding to the Fusion4 scan register index 3 entity.

Table 7-30: F4 Portal Scan Registers [Index 3] – Preset Loader Interface

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Arm 6 Position		Arm 6 Alarm State		Arm 5 Position		Arm 5 Alarm State		Arm 4 Position		Arm 4 Alarm State		Arm 3 Position		Arm 3 Alarm State	

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Arm 2 Position		Arm 2 Alarm State		Arm 1 Position		Arm 1 Alarm State		Bay 2 Permissive	Bay 1 Permissive	Enter Workflow Indication	Workflow Status	Device Status	User Response Error	User Response Ready	Interface Ready

- Arm # Alarm State
  - 0 - No active alarms.
  - 1 - Only “display only” (i.e., warnings) alarms active.
  - 2 - At least one control critical alarms is active which has paused the batch.
  - 3 - At least one control critical alarm is active which has stopped the batch.

In the case in which there are multiple active alarms, the most severe alarm state is reported.

- Arm # Position
  - 0 - Arm is in Bay 1.
  - 1 - Arm is in Bay 2.
  - 2 - Arm is located in neither Bay1 nor Bay 2.
  - 3 - Unused/Undefined.
- Bay # Permissive
  - 0 - 1 or more bay permissives are not true and no load may start on the loading bay.

- 1 - All bay permissives are true, loading is permitted

  (The scope of the permissives includes the standard permissive types: grounding, overfill, and vapor recovery as well as any configured custom bay permissives).

- Enter Workflow Indication (bay 1)
  - 0 - A user has not generated an enter work flow indication event.
  - 1 - A user has clicked the OK button in either the standby prompt or the running screen. This indicates that the user is requesting to re-enter the workflow.
- Enter Workflow Indication (bay 1)
  - 0 - A user has not generated an enter work flow indication event.
  - 1 - A user has clicked the OK button in either the standby prompt or the running screen. This indicates that the user is requesting to re-enter the workflow.
- Workflow status
  - 0 - Local (internal) work flow is being executed.
  - 1 - Remote work flow is being executed.
- Device status
  - 0 - No active transactions (system is idle).
  - 1 - There is at least one running transactions (system is running).
- User Response Error – This bit indicates whether there was an error with the user input before a valid response was detected.
  - 0 - The user's input to the prompt was successful or is still in progress.
  - 1 - The user 's input to the prompt was unsuccessful.
- User Response Available – This bit indicates whether there is a valid user response ready for reading.

- 0 - The user's response is not yet valid.
- 1 - The user's response to the last command prompt is valid and ready.

- Interface is Ready – This bit indicates whether the preset loader interface is implemented, initialized, and operational.
  - 0 - The preset loader interface cannot be used.
  - 1 - The preset loader interface is implemented, initialized, and operational.

7.4.1.1.5 F4 Portal Scan Registers [Index 4] – Last Transaction ID Bay 1

This register holds the 32-bit transaction ID of the last transaction to complete on Bay 1. A value of 0 indicates that the register has not yet been initialized or that no transaction has been completed on Bay 1.

7.4.1.1.6 F4 Portal Scan Registers [Index 5] – Last Transaction ID Bay 2

This register holds the 32-bit transaction ID of the last transaction to complete on Bay 2. A value of 0 indicates that the register has not yet been initialized or that no transaction has been completed on Bay 2.

7.4.1.1.7 F4 Portal Scan Registers [Index 6] – Loading Arm State

Table 7-31: F4 Portal Scan Registers [Index 6] – Loading Arm State

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	Arm 6 State					Arm 5 State					Arm 4 State				
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Arm 3 State					Arm 2 State					Arm 1 State				

- Arm # State

  This is a 5-bit realization of the 16-bit enumeration type Controller State, see section C.3.1.47 for more information. All values are the same as per the definition of the Controller State enumeration. These values mirror the value expressed in the controller state entity located on the Batch Control function.

7.4.1.1.8 F4 Portal Scan Registers [Index 7] – Alarm Log Index

This register holds the 32-bit value of the number of alarm events that have been recorded in the entire device history. This value is only reset it all device memory is formatted. The value may be used to identify the last entry in the internal alarm log.

7.4.1.1.9 F4 Portal Scan Registers [Index 8] – Event Log Index

This register holds the 32-bit value of the number of events that have been recorded in the entire device history. This value is only reset it all device memory is formatted. The value may be used to identify the last entry in the internal event log.

7.4.1.1.10 F4 Portal Scan Registers [Index 9] – Calibration Log Index

This register holds the 32-bit value of the number of product and additive calibrations that have been recorded in the entire device history. This value is only reset it all device memory is formatted. The value may be used to identify the last entry in the internal calibration log.

7.4.1.1.11 F4 Portal Scan Registers [Index 10] – Batch State

Table 7-32: F4 Portal Scan Registers [Index 10] – Batch State

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	0	0	0	0	0	0	0	Arm 6 Batch State				Arm 5 Batch State			
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Arm 4 Batch State				Arm 3 Batch State				Arm 2 Batch State				Arm 1 Batch State			

- Arm # Batch State

  This is a 4-bit realization of the 16-bit enumeration type Batch State, see section C.3.1.34. All values and are the same as per the definition of Batch State enumeration. These values mirror the value expressed in the Batch Details V2: enm_BatchState data member of the Bay Batch Details entity. The source batch details index is the batch that is currently running on the loading arm or has last completed on the loading arm in the currently open transaction.

7.4.1.1.12 F4 Portal Scan Registers [Index 11] – Batch Evaluation State

Table 7-33: F4 Portal Scan Registers [Index 11] – Batch Evaluation State

Bit 30	Bits 29 - 25	Bits 20 - 24	Bits 15 - 19	Bits 10 - 14	Bits 5 - 9	Bits 0 - 4
0	Arm 6 BatchEvaluation State	Arm 5 BatchEvaluation State	Arm 4 BatchEvaluation State	Arm 3 BatchEvaluation State	Arm 2 BatchEvaluation State	Arm 1 BatchEvaluation State

7.4.1.1.13 F4 Portal Scan Registers [Index 12] – Number of Batches

Table 7-34: F4 Portal Scan Registers [Index 12] – Number of Batches

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	0	0	0	0	0	0	0	Bay 2 Release Pressure Active	Bay 1 Release Pressure Active	Bay 2 N2 Purging Active	Bay 1 N2 Purging Active	Bay 2 Prompt	Bay 1 Prompt	Bay 2 User Active	Bay 1 User Active
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Bay 2 Number of Batches								Bay 1 Number of Batches							

- Bay # Number of Batches - This 8-bit value represents the number of batches in the last transaction that has started on the loading bay starting from the most recent device start up.
- Bay # User Active – This bit is 1 if the bay N user currently has control of the display, 0 otherwise.

- Bay # Prompt – Indicates that bay N display session currently has a prompt visible. This prompt may not be visible on the screen, based upon the current state of the preset. The value is 1 if there is a prompt and 0 otherwise.

7.4.1.1.14 F4 Portal Scan Registers [Index 13] – Display State

Table 7-35: F4 Portal Scan Registers [Index 13] – Display State

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit	Bit	Bit	Bit	Bit	Bit	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	0	TAS Screen	Selection Screen	Configuration Root Screen	1010 Screen	Alarm Screen	Secure Screen	Driver Screen	Configuration Base

NOTE: Only the Alarm Screen bit is formally defined here. All additional bits are provided for information purpose only. The state and meaning of these bits are subject to change and no external application should consider their presence permanent.

NOTE: If all bits are zero, assume device is in generic screen (example: sub-menu screen).

- Generic Screen – Not supported
- Configuration Base Screen
  - This bit is set to 1 when the current screen is a base configuration screen (i.e., one that shows the current configuration entity values).
- Driver Screen

- This bit is set to 1 when a driver screen is shown (i.e., a screen that does not require SL2 level access)

- Secured Screen
  - If this bit is set to 1 then the currently displayed screen required a SL2 or higher level of access.

> NOTE: Not all screens that require SL2 level access set this bit (e.g. configuration screens).

- Alarm Screen
  - This bit is set to 1 if an alarm summary screen is currently displayed. There are two versions, one for the driver and one for an engineer. This bit is set when either one of these two variants are shown.
- 1010 Screen
  - This bit is set to 1 when a 1010 driver prompt is displayed when using 1010 emulation mode.
- Configuration Root Screen
  - This bit is set to 1 when the first level configuration screen is shown (the screen seen after clicking on a main menu icon unless that screen is a selection screen).
- Selection Screen
  - This bit is set to 1 when a configuration screen involving a selection from a list of options is being shown.
- TAS Screen
  - This bit is set to 1 when screen message send by the TAS.

7.4.1.1.15 F4 Portal Scan Registers [Index 14] – Last Transaction Parked

This register holds the 32-bit transaction ID of the last transaction at parked state for dual bay loading. If there is a leaking in parked state, a transaction will be created which is called as parked transaction. A value of 0 indicates that the

register has not yet been initialized or no transaction has been done at parked state.

7.4.1.1.16 F4 Portal Scan Registers [Index 15] – Transaction State

The following table specifies the meaning of each bit within the 32-bit value corresponding to the Fusion4 scan register index 15 entity.

Table 7-36: F4 Portal Scan Registers [Index 15] – Transaction State

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bit 15	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bay 2 Transaction State	Bay 1 Transaction State

- Bay 1 Transaction State – This bit indicates whether the Bay 1 transaction is running.
  - 0 - Bay 1 transaction is not running.
  - 1 - Bay 1 transaction is running.
- Bay 2 Transaction State – This bit indicates whether the Bay 2 transaction is running.
  - 0 - Bay 2 transaction is not running.
  - 1 - Bay 2 transaction is running.

7.4.1.2 Arm State Details

Table 7-37: Arm State Details

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Arm State Details	120	Arm State Details	125	6

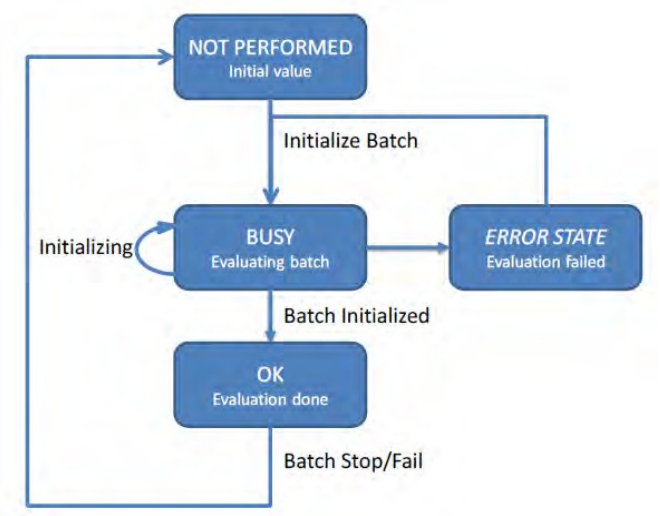
This entity provide a summary of the relevant process data for each load arm that the MSC-L license has enabled. The entity is implemented as an array of 6

elements. Each element contains the relevant process data for exactly one arm. The indexing of the array follows the same indexing used throughout the MSC-L (i.e., index 0 > load arm 1, index 1 > load arm 2). The value of the indexes that correspond to load arms that are not licensed by the MSC-L are undefined. Multiple batch detail records may be requested in a single request using the normal indexed entity read mechanism.

Batch Evaluation Result	Description / Meaning
Evaluation Ok	Batch is feasible and has been initialized successfully.
Not Performed	Batch initialization has not started or is not yet complete.
Preset Value Not Enough	If the preset quantity is smaller than the sum of the initial, pre-stop, and clean-arm quantities (i.e., there is no full-flow phase).
Preset Value Too Low	The requested batch preset quantity is less than the configured arm's minimum preset quantity value.
Preset Value Too High	The requested batch preset quantity is greater than the configured arm's maximum preset quantity value.

Batch Evaluation Result	Description / Meaning
Batch Not Feasible	The batch is not feasible given the constraints of the batch. This includes the meter constraints (maximum and minimum flow rates), the selected recipe's blend ratio, and the load arm's constraints. • All product streams must dispense product during the full flow phase. • The main product must be able be dispense through all three blending phases (initial, full, and pre-stop). • All product stream target flow rates are higher than the product meter's associated minimum linear flow rate and less than the product meter's maximum flow rate for all loading phases (initial, full, and pre-stop). A product stream target flow rate is a function of the product's recipe blend percentage, the clean-arm quantity, the arm flow rate constraints, and the product meter constraints.
VCF Not Configured	If the preset type is configured for either GSV or mass (a there is no mass meter) and volume conversion routine is correctly configured.
Device is Not Healthy	Some part of the device is currently malfunctioning (see system health diagnostic for investigation).
MMQ Not Met	If one of expected base products quantities (or final product quantity in the case of side stream blending) is not larger than the configured MMQ of the associated product meter.
Generic Error	An internal error was encountered during batch initialization. This is not a result of any configuration setting.
Arm in Alarm	The arm in question currently has a critical alarm that prevents it from starting a new batch.

Batch Evaluation Result	Description / Meaning
Permissives Not Connected	The batch initialization failed because at least one of the three bay permissives (grounding, overfill, or vapor recovery) is configured and its state is current INACTIVE.
Busy	The batch evaluation process is currently in progress and has not yet completed.
Arm Not in Position	The requested load arm associated with the batch in not currently in the target loading bay (applicable only for dual bay MSC-L configurations).



7.4.1.3 Last User Response

Table 7-38: User Response

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
User Prompt State	053	0035	054	40054	1	uint16 (enum)	R	User Prompt State
User Response Text	054	0036	055	40055	10	uint16 [10]	R	

Table 7-39: Last User Response (UDI)

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Last User Response	121	User Response	74	3

For single bay loading MSC-L, holding registers '053' and '054' can be used to read the user response. With UDI item '121', you can read user response with full functionality and also for dual bay MSC-L as it is indexed by loading bay.

When MSC-L displayed with TAS prompt or user custom message through show prompt and waiting for user response, the 'User Prompt State' will be in 'Waiting For User Input'. After user has acknowledged the prompt, 'User Prompt State' register has changed to 'User Response Ready'. The data in this registers remains latched until the next prompt is requested.

With UDI item '121', the data is returned as a structure whose values are determined by the last prompt's type. The raw alphanumeric user input text is always return as a unicode string in the 'User Response Text' registers. If the value entered by the user is an integer number then the value will also be converted directly to an integer value and provided in the 'Value' data field. Likewise, if the user has entered a floating point value, the value will be converted to a 32-bit floating point number and stored in the 'Value' field. For message type prompts, the value 'Message Displayed' will be saved to the 'User Prompt State' data member until the screen is closed (either explicitly via Close Screen or when it is replaced by another prompt).

Example:

When 'User Prompt State' is 'Waiting For User Input'

	Alias	00053
53	• User Prompt State	0x0001
54	• User Response Text	0x0000
55		0x0000
56		0x0000
57		0x0000
58		0x0000
59		0x0000
60		0x0000
61		0x0000
62		0x0000
63		0x0000

After user has acknowledged the prompt, 'User Prompt State' register become 'User Response Ready' and 'User Response Text' is "Yes".

	Alias	00053
53	• User Prompt State	0x0002
54	• User Response Text	0x5900
55		0x6500
56		0x7300
57		0x0000
58		0x0000
59		0x0000
60		0x0000
61		0x0000
62		0x0000
63		0x0000

7.4.1.4 Last User Answer

Table 7-40: Last User Answer

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Last User Answer	133	char[32]	32	3

This entity is analogous to the User Response Text field of the Last User Response entity except that this entity is represented as an ASCII string. Therefore this entity value is only useful for Latin alphabet-based languages. This entity is indexed by loading bay.

7.4.1.5 Show Prompt

Table 7-41: Display Message

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Display Message (show prompt) - Command to Display	019	0013	020	40020	1	uint16	R/W	1 = Command
Display Message (show prompt) - Prompt Input	020	0014	021	40021	1	uint16 (enum)	R/W	PROMPT_ INUT
Display Message (show prompt) - Message	021	0015	022	40022	32	uint16 [32]	R/W	

Table 7-42: Show Prompt (UDI)

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Show Prompt	122	Show Prompt Data	271	3

These registers are used to show a user a prompt (or message) whereby they can optionally enter in data about the transaction or batch. If the user enters a value into this prompt it will be saved to the Last User Response entity for post-processing by the TAS or internal transaction workflow of the loader. The input text to be displayed is always expressed in Unicode even if only Latin characters are used. The MSC-L shall have the ability to display any Unicode character. The screen shown on the HMI screen will show the specified text. A prompt created with prompt input = F4_PROMPT_INPUT_NONE will generate a window with any form of

user input mechanism. This screen must be explicitly removed by an external TAS by writing to the Close Screen entity.

For single bay MSC-L, registers '019' to '021' can be used to display user custom message on MSC-L screen. Maximum 32 unicode characters can be display with these registers.

Unicode item '122' is indexed by loading bay. So, used this UDI item to display for dual bay MSC-L or more than 32 unicode characters.

The Show prompt structure contains the following field.

- Message – The Unicode message to be displayed.
- Timeout Period In Sec – The maximum amount of time (in seconds) the prompt will be displayed for user input. If the user does not enter the data within this time frame then the User Prompt State entity will be set to USER_PROMPT_STATE_TIMEOUT. The value of 0 indicates that the screen will never timeout due to lack of user interaction.
- Default Value – Additional data used to build the prompt screen. This value's interpretation depends upon the enm_PromptInput field:
  - F4_PROMPT_INPUT_NON_NEGATIVE_FLOAT – the default value of the prompt. The data must be stored as a 32-bit floating point number.
  - F4_PROMPT_INPUT_FLOAT– the default value of the prompt. The data must be stored as a 32-bit floating point number.
  - F4_PROMPT_INPUT_NON_NEGATIVE_INTEGER – the default value of the prompt. The data must be stored as a 32-bit unsigned integer.
  - F4_PROMPT_INPUT_INTEGER – the default value of the prompt. The data must be stored as a 32-bit unsigned integer.
  - F4_PROMPT_INPUT_ALPHA_NUMERIC – not used.
  - F4_PROMPT_INPUT_NONE – this value is used to specify the icon to be display in the lower center of the screen. The value must be a value from the ENUM_F4_SCREEN_ICON (see thru for icon definitions).
  - F4_PROMPT_INPUT_OK_BUTTON – not used.

- F4_PROMPT_INPUT_PICKLIST – The number of items to display in the picklist. The picklist items are generated from Picklist text entity.
- F4_PROMPT_ARM_SELECTION – not used.
- F4_PROMPT_RECIPE_SELECTION – not used.
- F4_PROMPT_YES_NO – not used.
- F4_PROMPT_NO_YES – not used.
- F4_PROMPT_BATCH_DETAILS – The upper 16-bits of the value specify the bay number. The lower 16-bits specify the index into the batch details entity of the batch whose details should be displayed. The numeric value of the bay number should follow the definition of ENUM_- LOADING_BAY.
- F4_PROMPT_TRANSACTION_DETAILS – The bay number of the transaction whose details should be displayed. The numeric value of the bay number should follow the definition of ENUM_LOADING_BAY.
- F4_PROMPT_ARM_SELECTION_PAUSED – not used.
- F4_PROMPT_INPUT_CARD – The local database against which the card input should be validated.
    a. 0 – User database
    b. 1 – Objects database

- Screen Icon – See section C.3.1.44 for more information.

Figure 7-2: Grounding Icon

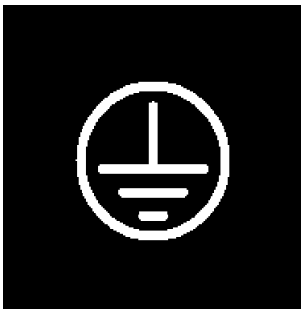


Figure 7-3: Overfill Protection Icon



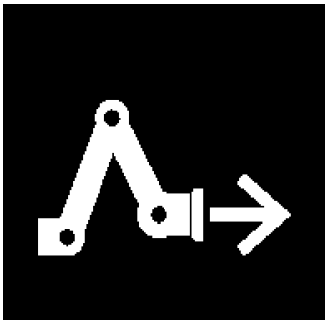
Figure 7-4: Vapor Recovery Icon



Figure 7-5: Start Button Icon



Figure 7-6: Connect Arm Icon



- Prompt Input – Defines the type of the TAS prompt to display:
  - F4_PROMPT_INPUT_FLOAT,F4_PROMPT_INPUT_NON_NEGA-

    TIVE_FLOAT – numeric input only, no soft keypad, value returned in the f32_ UserResponse field of the STRUCT_USER_RESPONSE structure.
  - F4_PROMPT_INPUT_NON_NEGATIVE_INTEGER, F4_PROMPT_IN-

    PUT_INTEGER - numeric input only, no soft keypad, value returned in the i32_ UserResponse field of the STRUCT_USER_RESPONSE structure.
  - F4_PROMPT_INPUT_ALPHA_NUMERIC – All input allowed.
  - F4_PROMPT_INPUT_NONE – A message only—no user input is allowed.
  - F4_PROMPT_INPUT_OK_BUTTON – A dialog box that the user is only allowed to acknowledge.
  - F4_PROMPT_INPUT_PICKLIST – A dialog box with some means to select exactly one element from a list of textual choices. The text asso- ciated with each item is defined via Prompt List Selection Text entity.
  - F4_PROMPT_ARM_SELECTION – A special picklist prompt that will show the list of idle loading arms with the user defined arm names (or “Arm #” if the arm name has not been set). The integer value returned in the user response is not the index of the selection but the 0-based device arm index.
  - F4_PROMPT_RECIPE_SELECTION – A special picklist prompt that will show the list of configured recipes for a specified arm number. The arm number is passed in via u16_NumItems field. The value must be the 0- based arm index number.
  - F4_PROMPT_YES_NO – A special picklist prompt that will show exactly two string values: “Yes” and “No” as they are defined in the internal translation table. The Yes string will be shown at the top of the list and is the default selection for the picklist (where the focus of the window is initially set).
  - F4_PROMPT_NO_YES – A special picklist prompt that will show exactly two string values: “No” and “Yes” as they are defined in the internal translation table. The No string will be shown at the top of the list and is the default selection for the picklist (where the focus of the window is initially set).

F4_PROMPT_BATCH_DETAILS – A special Yes/No dialog in which the batch details are summarized at the bottom of the screen. The batch is specified via the u32_DefaultValue. The value is the index into the Batch Details entity. Only the lower 16-bits u32_DefaultValue are used for the batch index number. The upper 16-bits shall be used to specify the loading bay (in future releases).

- F4_PROMPT_TRANSACTION_DETAILS – A special Yes/No dialog in which the transaction details are summarized at the top of the screen and the user is asked if they would like to close out the transaction.
- F4_PROMPT_ARM_SELECTION_PAUSED – A special picklist in which only the paused arms (that are not in alarm) are listed.
- F4_PROMPT_STANDY_SCREEN – This is a special screen used only in internally driven local workflow while there is no active transaction.
- F4_PROMPT_INPUT_QUANTITY – A special numeric input screen use to prompt a user to enter a preset quantity. This screen includes explicit identification of the preset units.
- F4_PROMPT_INPUT_CARD – This prompt is used to prompt a user for input via serial card reader. The card number is returned as the user response text in the Last User response entity.
- F4_PROMPT_INPUT_START – The prompt is used to allow a user to locally start an initialized batch on a loading arm. The u16_NumItems data member of the show prompt structure is used to identify which arm should be started when the start button is clicked. 0 > load arm 1, 1 > load arm 2, etc.
- F4_PROMPT_BATCH_SCHEDULE – The prompt used in workflows in which the entire batch schedule is known when the driver arrives at the bay. This prompt allows the driver to select a batch from the list of batches as they are defined in the batch details entity. The loading bay is specified in the num_ items field. 0 > bay 1, 1 > bay2.

- Num Items – The number of pick list items to show for F4_PROMPT_INPUT_ PICKLIST type prompts. This field is also used for additional purposes for specific prompt types.

- F4_PROMPT_RECIPE_SELECTION, F4_PROMPT_IN-PUT_START: For recipe selection and start batch type prompts the value is used as a means of identifying the load arm. In such cases, the u16_NumItems indicates the 0-based index of the target loading arm.
- F4_PROMPT_ARM_SELECTION: For arm selection this field is used as a means of identifying the loading bay. In such cases, the u16_Nu- mItems indicates the 0-based index of the target loading bay (0 = bay 1, 1 = bay 2).
- F4_PROMPT_INPUT -- This member is used to select the object type to be identified and is therefore only used when the database type (u32_ DefaultValue) is set to Objects database (via the value 1).

a. 0 – Unknown

b. 1 – Vehicle

c. 2 – Carrier

d. 3 – Trailer

e. 4 – Contract

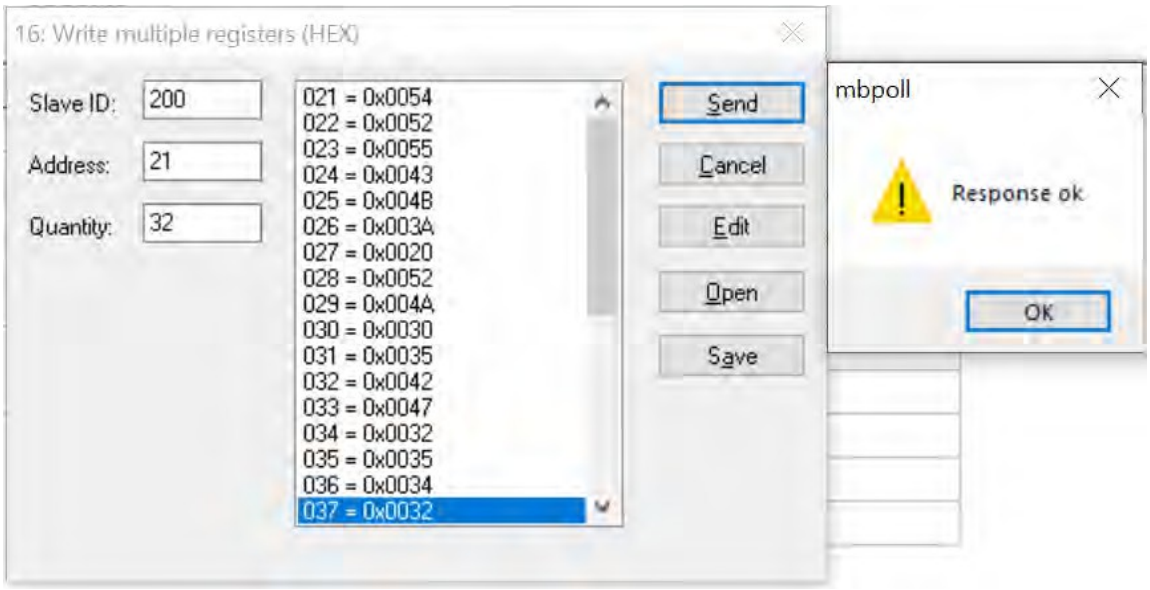
Other: For all other types of prompts if this value is set explicitly to 0x1010 then the text of the prompt will be written in a fixed width font. This special functionality is used in our 1010 emulation functionality.

- Hide Input – This parameter allow the user input characters to be replaced with a "*" character (typically used for password screens).

Example: Shown message "TRUCK: RJ05BG2542" with Yes/No prompt

Use Case #1: Display with Non-UDI Registers

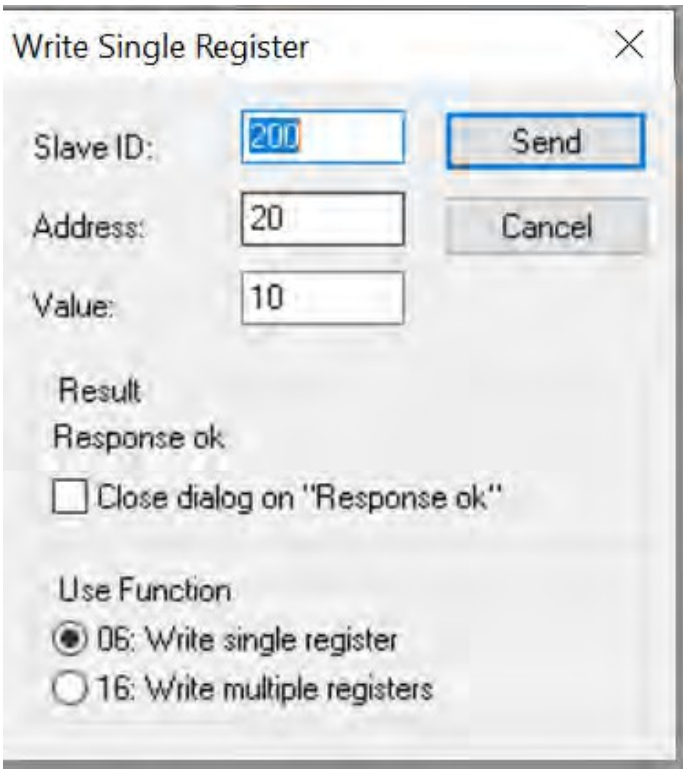
Step 1: Send Message (text)



Step 2: Verify with read all registers

	Alias	00020	Alias	00030	Alias	00040	Alias	00050
0			Message[9]	0x3000	Message[19]	0x0000	Message[29]	0x0000
1	Message[0]	0x5400	Message[10]	0x3500	Message[20]	0x0000	Message[30]	0x0000
2	Message[1]	0x5200	Message[11]	0x4200	Message[21]	0x0000	Message[31]	0x0000
3	Message[2]	0x5500	Message[12]	0x4700	Message[22]	0x0000		
4	Message[3]	0x4300	Message[13]	0x3200	Message[23]	0x0000		
5	Message[4]	0x4B00	Message[14]	0x3500	Message[24]	0x0000		
6	Message[5]	0x3A00	Message[15]	0x3400	Message[25]	0x0000		
7	Message[6]	0x2000	Message[16]	0x3200	Message[26]	0x0000		
8	Message[7]	0x5200	Message[17]	0x0000	Message[27]	0x0000		
9	Message[8]	0x4A00	Message[18]	0x0000	Message[28]	0x0000		

Step 3: Write prompt input to register '020'



Step 4: Send command to display on screen using register '019'

After success display command write, you can see on MSC-L screen as



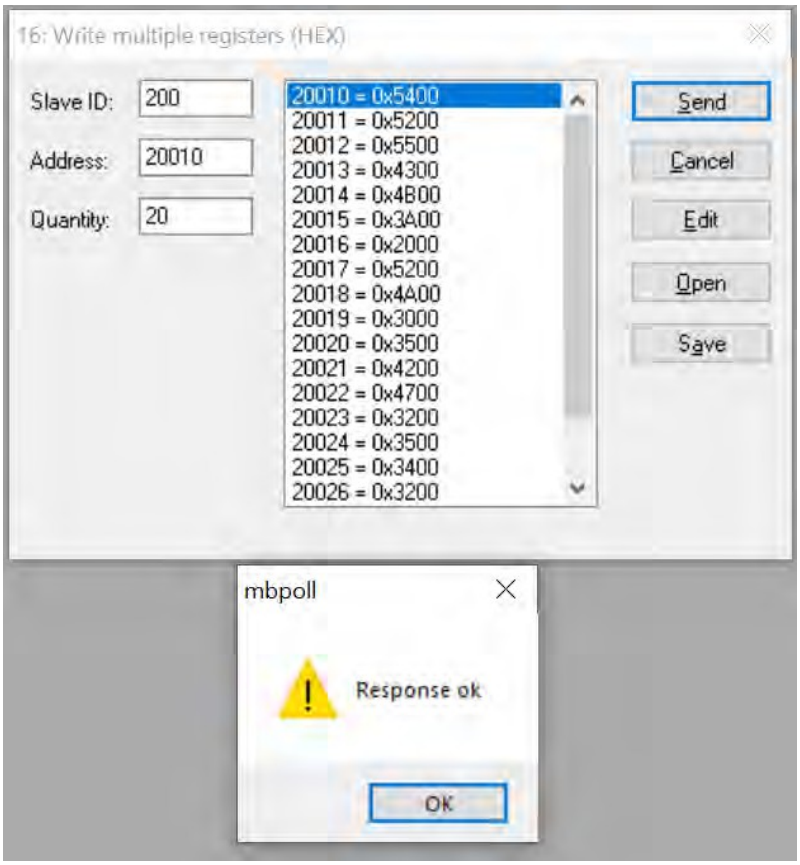
Use Case #2: Display with UDI Registers

Step 1: Wait until UDI state not equal to 3 (“Waiting Result”) Read/Write Definition

Step 2: Write UDI item “122” to UDI item register 20003

	Alias	20000
0	• Universal Data Interface: State	0
1	• Universal Data Interface: Error Code	0
2	• Universal Data Interface: Command	1
3	• Universal Data Interface: Item	122
4	• Universal Data Interface: Item Index (device)	0
5	• Universal Data Interface: Item Size (bytes)	271
6	• Universal Data Interface: Item Elements (device)	3
7	• Universal Data Interface: Item Data Type	460
8	• Universal Data Interface: Command Counter	6
9	• Universal Data Interface: Response UDI Item	0

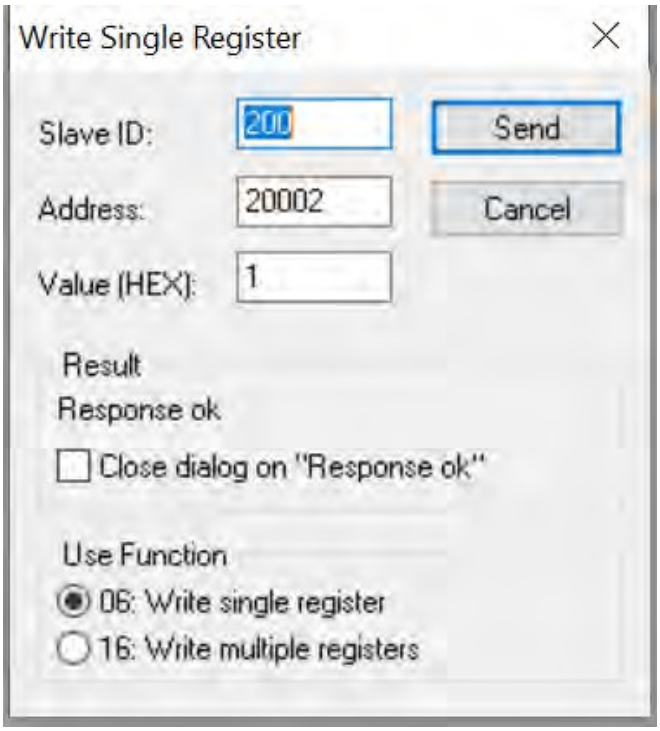
Step 3: Write “TRUCK: RJ05BG2542” to UDI Buffer



	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias	20060	Alias	20070	Alias	20080	Alias	20090	Alias	20100	Alias	20110	Alias	20120	Alias	20130
0	UDI Message	0x5400		0x3500		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000
1		0x5200		0x4200		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000
2		0x5500		0x4700		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000
3		0x4300		0x3200		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000
4		0x4B00		0x3500		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000
5		0x3A00		0x3400		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		
6		0x2000		0x3200		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		
7		0x5200		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		
8		0x4A00		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		
9		0x3000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		0x0000		

	Alias	20130	Alias	20140	Alias	20150
0			Default Value	0x0000		0x0000
1				0x0000		0x0000
2			Screen Icon	0x0000		0x0000
3			Prompt Input	0x000A		0x0000
4			Number of Items to be Displayed	0x0000		0x0000
5		0x0000	Hide Input	0x0000		0x0000
6		0x0000		0x0000		0x0000
7		0x0000		0x0000		0x0000
8	Timeout Period in Sec	0x0000		0x0000		0x0000
9		0x0000		0x0000		0x0000

Step 4: Write Command to register 20002 to Update on Screen



After successful command execution, you can see on MSC-L screen as



7.4.1.6 Show Internal Prompt

Table 7-43: Show Internal Prompt

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Show Internal Prompt	131	Internal Prompt Data	12	3

This entity provides a more compact way of specifying a prompt to show to the truck driver. This interface specifics the text and type of input screen using an enumeration value. The enumeration type Fusion4 TAS Prompt specifies a common set of prompts. If the desired prompt belongs to this set then the Show Internal Prompt entity may be used to show the prompt without having to specify the text or input prompt type. The entity's structure still provides a means to specify the default value, timeout value, and number of pick list elements (only used for picklist type prompts). This entity is indexed by loading bay.

7.4.1.7 Show TAS Prompt

Table 7-44: Show TAS Prompt (Single Bay)

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Show TAS Prompt	018	0012	019	40018	1	uint16 (enum)	R/W	Fusion4 TAS Prompt

Table 7-45: Show TAS Prompt (Dual Bay)

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Show TAS Prompt	207	00CF	208	400208	1	uint16 (enum)	R/W	Fusion4 TAS Prompt

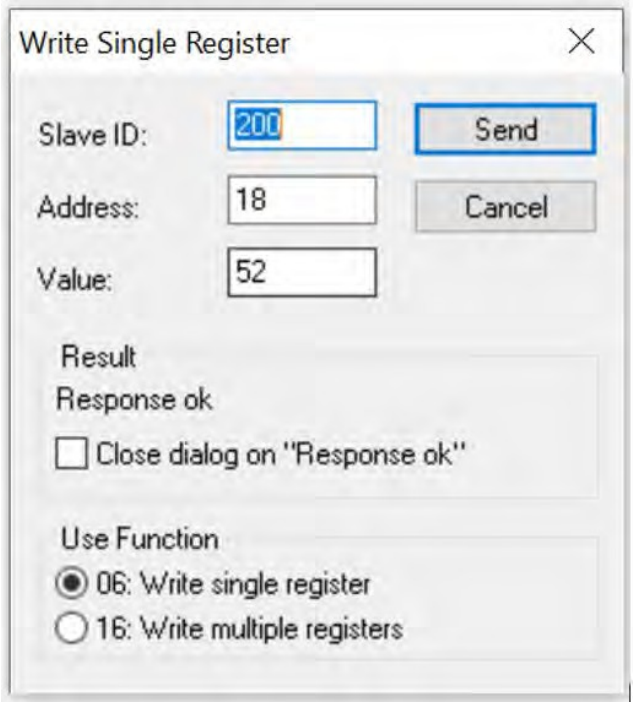
This register provides command to show desire prompt on the display screen. These screens are already available in the device.

For single bay loading system, register '018' can be use for TAS prompt. When using dual bay system, use register '207' as this registered is indexed by loading bay.

As Show TAS Prompt register '207' is Bay Sub map Modbus registers, so add 1000 for Bay 1 and 2000 for Bay 2 to the register.

Example: Prompt to show “Preset driver ID Card”.

Write F4 TAS Prompt enum "Present driver ID card" to register '018' or '1207'(1000 + 207) to display on MSC-L screen.



After successful writing, device screen show as:



NOTE: When write F4 TAS Prompt enum '207', no operation happened with prompt.

7.4.1.8 Bay 1 Batch Details

Table 7-46: Bay 1 Batch Details

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Bay 1 Batch Details	95	Batch Details	15	20

This entity is used by TAS to configure one or more load arms on bay 1 to deliver a product. Prior to writing to this entity all the necessary batch related details must be gathered by TAS by means of prompting or via a known load schedule or contract within the TAS system. Writing to the Batch Details entity will not start a batch since the TAS may need to further configure the load arm and then prompt the user to click the "Start" button.

Some data in the batch details structure will be used to populate the fields within the batch record. Additional data may be added to the batch record by using the Save Record Data entity. The TAS should write the Batch Details with the enm_ BatchState set to CONTROLLER_STATE_BATCH_QUEUED to indicate that the batch is ready to be started.

At the end of each transaction the MSC-L will explicitly cancel any queued batches that still exist in the bay's batch details. These represent batches that were authorized but not started before the Bay Command was received to end the transaction. This action ensures that all batch states are returned to an unscheduled, CONTROLLER_STATE_IDLE state before the next transaction begins. The MSC-L then knows how many batches have been planned in the next transaction by checking the state of the enm_BatchState values when the Show Bay Batch Schedule command is received. Any batch whose enm_ BatchState value is set to CONTROLLER_STATE_BATCH_QUEUED represents a batch that should be shown in the batch schedule display presented to the user.

- ch8_aCompartmentID – This is the compartment number or ID into which the product will be loaded. This data will be included in the batch record.
- f32_PresetQuantity – This is the requested quantity of the final product to be delivered. This value is expressed in the configured units of volume.

- u16_RecipeIndex – This is the index of the recipe defined on the selected arm to be used to create the final product. If the TAS has defined a new recipe via the Dynamic Recipe entity, then this value should be 0xFFFF to select the dynamic recipe.
- f32_ReturnQuantity – This is the amount of product currently in the compartment at the time at which the batch starts. The unit of measurement is assumed to be the same as the f32_PresetQuantity value. This value is *not* use to decrease the preset quantity. It is only record in the batch record for information purposes.
- ch8_aCompartmentID – This is the compartment number or ID into which the product will be loaded. This data will be included in the batch record.
- f32_PresetQuantity – This is the requested quantity of the final product to be delivered. This value is expressed in the configured units of volume.
- u16_RecipeIndex – This is the index of the recipe defined on the selected arm to be used to create the final product. If the TAS has defined a new recipe via the Dynamic Recipe entity, then this value should be 0xFFFF to select the dynamic recipe.
- f32_ReturnQuantity – This is the amount of product currently in the compartment at the time at which the batch starts. The unit of measurement is assumed to be the same as the f32_PresetQuantity value. This value is *not* use to decrease the preset quantity. It is only record in the batch record for information purposes.
- enm_LoadArm – The load arm on which to dispense the product.
- enm_BatchState – The state of the batch.

Batch Details		
Field Description	Data Type	Enumeration/Structure Type
Compartment Number	uint8	
Preset Quantity	float32	
Return Quantity	float32	
Recipe Index	uint16	
Load Arm	uint16 (enum)	Load Arm

Batch Details		
Batch State	uint16 (enum)	Batch State

Batch State	
Description	Value
Idle	0
Queued	1
Running	2
Paused	3
Done	4
Deleted	5
Planning	6
Pausing	7

7.4.1.9 Bay 2 Batch Details

Table 7-47: Bay 2 Batch Details

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Bay2 Batch Details	95	Batch Details	15	20

The same as Bay1 Batch Detail, but for batches dispensed form in a dual-bay MSC-L configuration.

7.4.1.10 Transaction Workflow Mode

Table 7-48: Transaction Workflow Mode

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Transaction Workflow Mode	141	008D	142	40142	1	uint16 (enum)	R/W	Transaction Workflow Mode

This register is used to configure the device's transactional workflow mode. The workflow can either be driven externally by a TAS, locally by the device itself, or remotely driven by TAS with an automatic fall over to a local workflow. This entity does not represent that actual workflow status. The actual workflow status is readable via the Transactional Workflow Status.

7.4.1.11 Restore TAS Control

Table 7-49: Restore TAS Control

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Restore TAS Control	156	009C	157	400157	1	uint16	W	<command >

This register will change over the Transactional Workflow Status from Local Mode to Remote Mode if the TAS writes to the Restore TAS control register when the device is idle (no transaction is active). This command will only re-enable TAS control if the Transactional Workflow mode is set to the Remote or Remote with local fallback.

The status of the transaction workflow will also be visible on the status bar by the presence or absence of a TAS status bar icon. When the MSC-L has a good connection to TAS and TAS is in control of the workflow the following icon will be visible on the status bar.



TAS Workflow Status Bar Icon

Computer symbol with cross symbol in status bar represent workflow mode is in 'remote' mode however workflow status is 'local'.

Write '1' to Modbus Register 156 to Restore TAS Control.



	Alias	00160	Alias	00180
0	F4 Portal Scan Register [0]	0000 0000 0000 0010	F4 Portal Scan Register [10]	0000 0000 0000 0000
1		0000 0001 0000 0001		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000
3		0000 0000 0000 1111		1000 0100 0010 0001
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001
5		0000 0000 0000 0011		0000 0000 0000 0000
6	F4 Portal Scan Register [3]	0001 0001 0001 0001	F4 Portal Scan Register [13]	0000 0000 0000 0000
7		0001 0001 1101 0001		0000 0000 0000 1010
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000
9		0000 0000 0011 0110		0000 0000 0000 0000
10	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
11		0000 0000 0000 0000		0000 0000 0000 0000
12	F4 Portal Scan Register [6]	0000 0000 0000 0000		
13		0000 0000 0000 0000		
14	F4 Portal Scan Register [7]	0000 0000 0000 0000		
15		0000 0000 0100 1111		
16	F4 Portal Scan Register [8]	0000 0000 0000 0000		
17		0000 0010 1111 1000		
18	F4 Portal Scan Register [9]	0000 0000 0000 0000		
19		0000 0000 0000 0000		

Computer symbol (with no cross symbol) in status bar represent workflow status is in 'remote' mode with full control under TAS.

However upon a loss of communication to TAS system, the MSC-L will fall back to its standalone operation (if configured as such). To restore the MSC-L back to a TAS driven transactional workflow status, the TAS must execute Restore TAS Control command again.

7.4.1.12 Close Screen

This register provides a means to explicitly close (clear) a message or prompt screen currently displayed on the device display screen. The device will then show the idle/running screen of the device until the workflow shows the next prompt.



7.4.1.13 Arm Command

Table 7-50: Arm Command

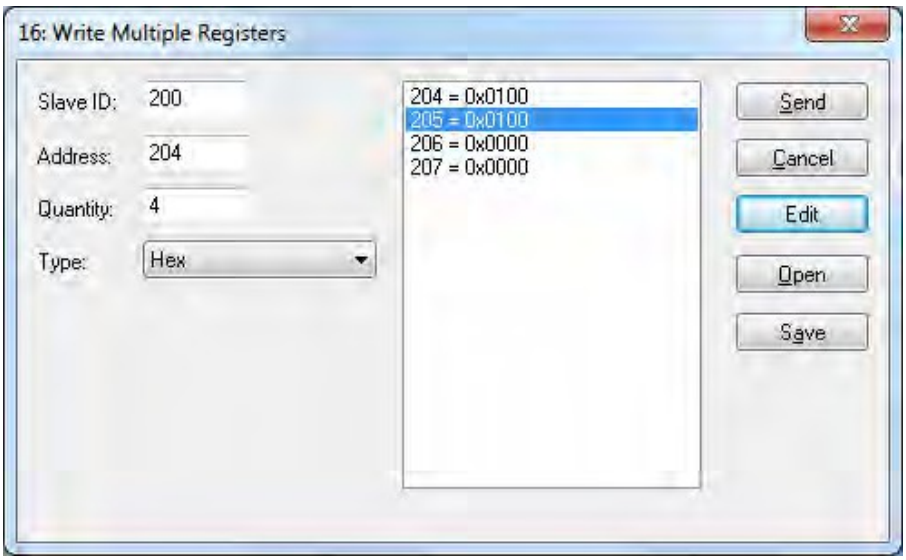
Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Arm Command	204	00CC	205	400205	4	struct [8]	W	Arm Command

This entity proves an interface for a TAS system to remotely command a loading arm. Arm commands include starting and ending a transaction, starting, pausing, and ending a batch. The data structure written to this entity identifies both the arm and command to perform on the arm.

Batch and transactional data should be initialized by writing to the Batch Request and Transactional Details entities before a transaction or batch is commanded to start.

The transaction record data will be collected for transaction and batch header when the arm command is received and cannot be updated later. This structure also contains a data field which is used only for certain arm commands.

In screen shot below STOP command for Arm1 is shown.



ARM_COMMAND_BATCH_INITIALIZE – In the context of this command the Arm Command value corresponds to index into batch details entity that should be initialized. This will also ensure that the preset quantity and selected recipe are written to appropriate entities on the FM-ARM board to make the arm ready for starting the specified batch. If there is an issue with either the preset or recipe index in the requested batch details, then the arm's batch evaluation state will reflect the initialization failure reason. If the value of the batch evaluation state entity is BATCH_EVALUATION_OK then the batch is ready for "START".

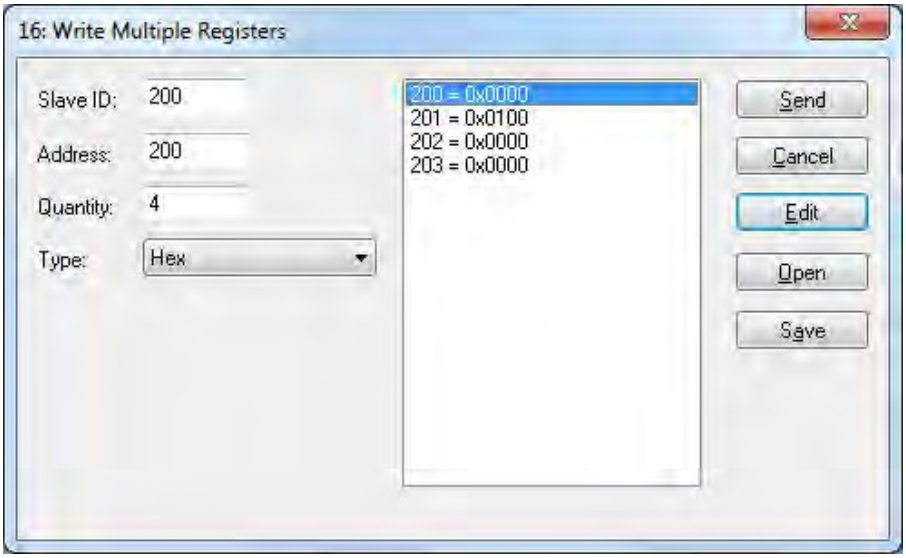
7.4.1.14 Bay Command

Table 7-51: Bay Command

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Bay Command	200	00C8	201	400201	4	struct [8]	W	Bay Command

This entity provides an interface for the TAS system to perform bay oriented operations. The two most common bay operations are: initializing a batch on a bay and ending a transaction on a bay. (A transaction may be explicitly started on a bay by sending a BAY_COMMAND_TRANSACTION_START command, but a transaction will automatically be started if none is currently active when the first batch on a bay is started).

In the following example, STOP Batch transaction command has been given.



7.4.1.15 Plan Init Start Batch V2

Table 7-52: Plan Init Start Batch V2

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Plan Init Start Batch	342	0056	343	400343	10	struct [20]	W	Plan Init Start Batch V2

Table 7-53: UDI Modbus registers

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Plan Init Start Batch V2	220	Plan Init Start Batch V2	20	1

This entity provides an interface for the TAS system to initialize and prompt a user to start a batch (if the device is configured for local start). The batch details provided are saved to the appropriate bay batch details indexed entity as part of the entity write request. This entity write triggers a sequence of actions locally in the device that end with a user interacting with a resulting prompt (if the device is configured for local start). Any batch initialization failure will be explicitly prompted to the user using the batch evaluation failure strings defined in the selected language pack. If the device is configured for remote start, the device will show a prompt indicating that the system is waiting for a remote start command if the batch initialization was successful.

After Plan Init Batch, see section 7.4.1.1 F4 Portal Scan Registers, and execute operation as per truth table below.

7.4.1.16 Batch Static Info

Table 7-54: Batch Static Info

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Batch Static Info	129	Load Batch Static Info	83	6

This entity captures the static information used to build the running screen. The static information is constant throughout the batch.

7.4.1.17 Dynamic Batch Info

Table 7-55: Dynamic Batch Info

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Dynamic Batch Info	130	Load Batch Dynamic Info	60	6

This entity captures the dynamic information that is used to build the running screen. The value of the three STRUCT_SENSOR_VALUE depends upon the current configuration of the running screen.

7.4.1.18 Permissives Connected

Table 7-56: Permissives Connected

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Permissives Connected	111	Boolean	1	2

This entity indicates if all the defined bay permissives (grounding, overfill protection, and vapor recover) are currently connected. Only permissive for which an IO binding has been defined will be evaluated.

7.4.1.19 Generic Record

Table 7-57: Generic Record

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Generic Record	55	Generic Record Info Request	136	1

Generic use to save customer specific data like truck number, wagon number in the transaction or batch record. Maximum 10 transaction generic records and maximum 10 batch generic records can be used for customize information.

7.4.1.20 Arm Current State

Table 7-58: Arm Current State

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Arm Current State	192	00C0	193	400193	2	uint32	R/W	ARM Current State

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Batch Plan Counter								Arm 6 Current State				Arm 5 Current State			
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Arm 4 Current State				Arm 3 Current State				Arm 2 Current State				Arm 1 Current State			

- Batch Counter
  - On every successful Batch Plan command, this counter will get increment by one and reset to zero when cross 255.
- Arm Current State

Table 7-59: Arm Current State

State	Description
0 (None)	Arm is in idle state.

State	Description
1	Batch Planned Failed. Batch planning sent by TAS but failed due to evaluation error. See section 7.4.1.1.12 for more information. In this case, TAS can send same planning command with correct information.
2	Batch Planned with Alarm. Batch is successfully planned, but arm is in alarm. Clear alarms and send planning batch again with same batch index.
3	Batch Planned Success.
4	Batch in Start Prompt.
5	Batch Skipped. Batch planned successfully but ESC key or STOP key pressed to cancel the planning. TAS can send batch planning again with same batch index.
6	Batch in Running.
7	Batch Paused and Alarm Active. Batch paused due to alarm and still alarm is active.
8	Batch Paused with No Alarm.
9	Batch Start Prompt to Resume batch.
10	Batch stopped due to alarm.
11	Batch completed normally.
12	Arm is in idle with alarm active.
15	Busy state. Due to FlexConn communication and other scenario device may take 1~2 seconds to update the next correct state. In this case, arm current state show busy.

NOTE: Cases 13 and 14 are for future enhancement.

7.4.1.21 Authorization Interface

The MSC-L supports two databases for local authorization of users and loading objects. A "user" can be any user of the device whether that is a truck driver/operator, an engineer, a site operator, or a site manager. All of these roles must be mapped into one of the MSC-L's three levels of access (known as SL1, SL2, and SL3). The definition of the each access level is defined the following table.

Priveledge	SL1	SL2	SL3
Loading operations	Yes	Yes	ü
Monitor alarms	Yes	Yes	Yes
Change configuration	No	Yes	Yes
Alarm handling (reset, acknowledge)	No	Yes	Yes
Meter calibration	No	Yes	Yes
Dashboard	No	Yes	Yes
Person database configuration	No	No	Yes
Upgrade firmware	No	No	Yes
Restore to factory defaults	No	No	Yes
Clear all memory	No	No	Yes
All other activities	No	Yes	Yes

MSC-L Access Level Specification

7.4.1.21.1 Authorization Database Update

Table 7-60: Authorization Data

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Authorization Data: User	251	00FB	252	40252	16	struct [32]	R/W	Authorization Data
Authorization Data: Object	267	010B	268	40268	16	Struct [32]	R/W	Authorization Data

To update User or Object database, write the authorization data structure to these registers. See section C.3.2.38 for structure details for more information.

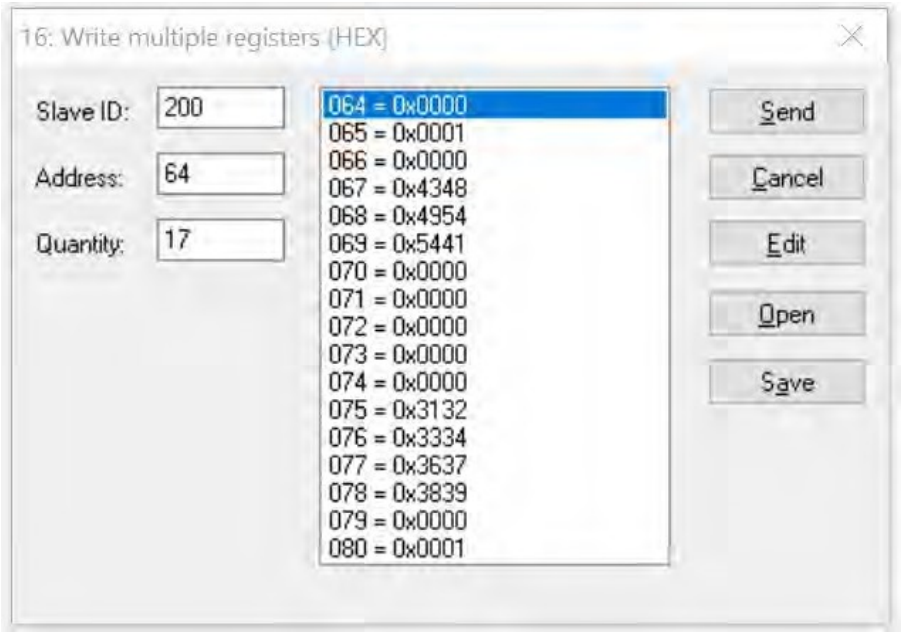
7.4.1.21.2 Login Remotely Authorized User

Table 7-61: Login Remotely Authorized User

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Login Remotely Authorized User	064	040	065	40065	17	struct	W	Remotely AuthorizedUser Data

This entity allows a TAS to create SL1-level user session on the MSC-L when it has determined that the user has been authorized to load. The TAS can provide the user's name as part of the Authorization Object, see section C.3.2.4. This name will be recorded in the MSC-L transaction record. This user name does not need to be member of the MSC-L local user database.

Example: Write remotely authorized user data to registers 064, having name "CHITTA" and password "123456789"



After successfully remotely authorized user date written, you can read active user from registers 082 and verify it. Also, user name can be seen on MSC-L screen.

	Alias	00080	Alias	00090
0			Password	0x3132
1				0x3334
2	Name	0x4348		0x3637
3		0x4954		0x3839
4		0x5441		0x0000
5		0x0000	Attribute	0x0001
6		0x0000		
7		0x0000		
8		0x0000		
9		0x0000		

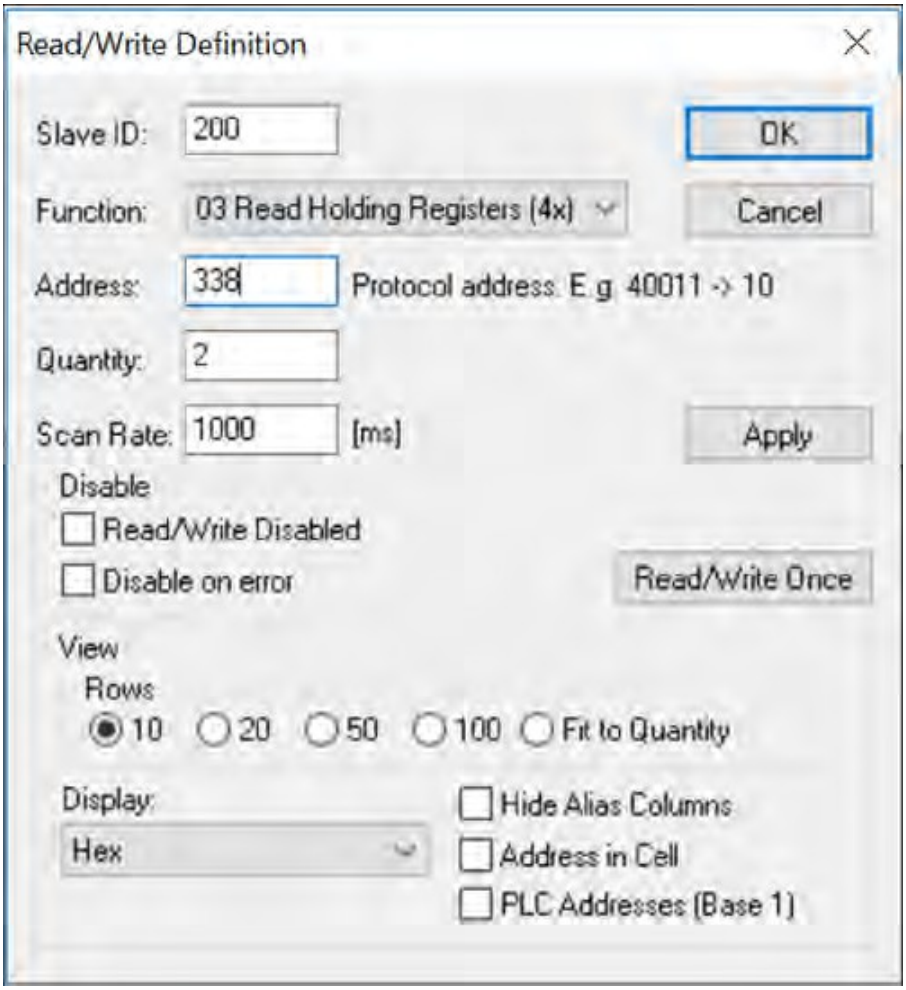


7.4.1.22 Read and Update Date and Time

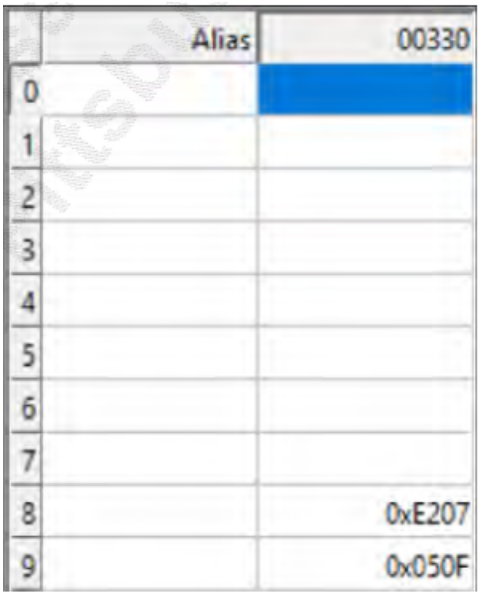
Table 7-62: RTC Date and Time

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Date	338	0152	339	400339	2	struct [4]	R/W	RTC Date
Time	340	0154	341	400341	2	Struct [4]	R/W	RTC Time

Setup Read/Write Definition.



Modbus Response.



	Alias	00330
0		
1		
2		
3		
4		
5		
6		
7		
8		0xE207
9		0x050F

Where: Year = 2018 (0x07E2)

Month = 5 (0x05)

Date = 15 (0x0F)

7.4.2 Remote Loading Use Case

This section describes an use case for the remote loading operation with Fusion4 MSC-L. This will help for smooth integration with TAS or DCS.

7.4.2.1 Prerequisites

Ensure that the device workflow mode is set to either “Remote” or “Remote with local fallback” (System Configuration . Device . Workflow settings . Options . Workflow mode).

Remote loading use case provided in this section is for two loading arms with single bay loading operation.

7.4.2.2 Workflow Sequence

7.4.2.2.1 Read F4 Portal Scan Register

Read F4 Portal Scan Register (See section 7.4.1.1) and Arm Current State (See section 7.4.1.20) periodically to know the current status of the device and individual

arms.

Ensure device is currently idle state, by reading the device status bit in the F4 Portal Scan Registers [Index 3] (See section 7.4.1.1.4) Bit 3 (Device Status) is 0. If not, continue to poll this value until all loading bay is idle.

	Alias	00160	Alias	00180
0	F4 Portal Scan Register [0]	0000 0000 0000 0010	F4 Portal Scan Register [10]	0000 0000 0000 0000
1		0000 0001 0000 0001		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000
3		0000 0000 0000 1111		1000 0100 0010 0001
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001
5		0000 0000 0000 0011		0000 0000 0000 0000
6	F4 Portal Scan Register [3]	0001 0001 0001 0001	F4 Portal Scan Register [13]	0000 0000 0000 0000
7		0001 0001 1100 0001		0000 0000 0000 1010
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000
9		0000 0000 0011 0110		0000 0000 0000 0000
10	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
11		0000 0000 0000 0000		0000 0000 0000 0000
12	F4 Portal Scan Register [6]	0000 0000 0000 0000		
13		0000 0000 0000 0000		
14	F4 Portal Scan Register [7]	0000 0000 0000 0000		
15		0000 0000 0100 1111		
16	F4 Portal Scan Register [8]	0000 0000 0000 0000		
17		0000 0010 1111 1000		
18	F4 Portal Scan Register [9]	0000 0000 0000 0000		
19		0000 0000 0000 0000		

F4 Portal Scan Register [Index 3] Bit 3 is 0 which represent idle state.

F4 Portal Scan Register [Index 3] Bit 4 is 0 which represent workflow status local.



7.4.2.2.2 Restore TAS Control

Restore TAS (remote) control to the device by writing to the Restore TAS control register, see section 7.4.1.11.

Confirm that the workflow status is now remote by reading the workflow status bit in the Preset F4 Portal Scan Registers [Index 3] (see section 7.4.1.1.4) Bit 4 (workflow status). A value of 1 indicates “remote” status.

	Alias	00160	Alias	00180
0	F4 Portal Scan Register [0]	0000 0000 0000 0010	F4 Portal Scan Register [10]	0000 0000 0000 0000
1		0000 0001 0000 0001		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000
3		0000 0000 0000 1111		1000 0100 0010 0001
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001
5		0000 0000 0000 0011		0000 0000 0000 0000
6	F4 Portal Scan Register [3]	0001 0001 0001 0001	F4 Portal Scan Register [13]	0000 0000 0000 0000
7		0001 0001 1100 0001		0000 0000 0000 1010
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000
9		0000 0000 0011 0110		0000 0000 0000 0000
10	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
11		0000 0000 0000 0000		0000 0000 0000 0000
12	F4 Portal Scan Register [6]	0000 0000 0000 0000		
13		0000 0000 0000 0000		
14	F4 Portal Scan Register [7]	0000 0000 0000 0000		
15		0000 0000 0100 1111		
16	F4 Portal Scan Register [8]	0000 0000 0000 0000		
17		0000 0010 1111 1000		
18	F4 Portal Scan Register [9]	0000 0000 0000 0000		
19		0000 0000 0000 0000		

F4 Portal Scan Register [Index 3] Bit 4 is 1 which represent workflow status is remote.

Computer icon with no cross symbol displayed on below screen tool bar represent device is in TAS control remote state.



7.4.2.2.3 Attach Permissive

Using Show TAS Prompt (see section 7.4.1.7), write "Attached Grounding".

In this use case, digital input configured as:

- DI-DC-1 - Grounding
- DI-DC-2 - Overfill
- DI-DC-4 - Vapour recovery

Scan DI-DC status and based on DI status, ask user to connect corresponding permissive.

	Alias	00630
0		
1		
2		
3		
4	Digital IO State	0000 0000 0000 0011
5		1000 0000 0000 1101
6		
7		
8		
9		

Write enum ' Attached grounding' to Show TAS Prompt register.



Display will show as:



Scan F4 Portal Register Index 3 Bit 6. After all permissives connected, this bit become active.

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0000 0000		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0000 0000 0000
3		0000 0000 0000 1111		0000 0000 0000 0000		1000 0100 0010 0001		0000 0000 0000 0000
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0000		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 0001		0000 0001 0000 1001		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

7.4.2.2.4 Clear Screen

Write to the Close Screen (see section 7.4.1.12) register to ensure that any previously generated workflow screens are removed.

7.4.2.2.5 Read Access Card

Write "Present driver ID card" using Show TAS Prompt (see section 7.4.1.7). Monitor F4 Portal Scan Register Index 3 – Bit 1 and also read user prompt state.

After TAS send command to display on screen, the 'TAS Screen' bit 7 of F4 Portal Scan Register Index 13 become active.

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0000 0011	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0000 0000		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0000 0000 0000
3		0000 0000 0000 1111		0000 0000 0000 0000		1000 0100 0010 0001		0000 0000 0000 0000
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0010 0100		0000 0000 0000 0000		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1001 0001		0000 0001 0000 0000		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

User prompt state before "Present driver ID card" displayed on the screen.

	Alias	00050	Alias	00060
0			User Response Text[6]	0x0000
1			User Response Text[7]	0x0000
2			User Response Text[8]	0x0000
3	User Prompt State	0x0000	User Response Text[9]	0x0000
4	User Response Text[0]	0x0000		
5	User Response Text[1]	0x0000		
6	User Response Text[2]	0x0000		
7	User Response Text[3]	0x0000		
8	User Response Text[4]	0x0000		
9	User Response Text[5]	0x0000		

User prompt state after "Present driver ID card" displayed on the screen.

	Alias	00050	Alias	00060
0			User Response Text[6]	0x0000
1			User Response Text[7]	0x0000
2			User Response Text[8]	0x0000
3	User Prompt State	0x0001	User Response Text[9]	0x0000
4	User Response Text[0]	0x0000		
5	User Response Text[1]	0x0000		
6	User Response Text[2]	0x0000		
7	User Response Text[3]	0x0000		
8	User Response Text[4]	0x0000		
9	User Response Text[5]	0x0000		

User prompt state after access card presented on card reader.

	Alias	00050	Alias	00060
0			User Response Text[6]	0x0000
1			User Response Text[7]	0x0000
2			User Response Text[8]	0x0000
3	User Prompt State	0x0002	User Response Text[9]	0x0000
4	User Response Text[0]	0x3000		
5	User Response Text[1]	0x4400		
6	User Response Text[2]	0x3000		
7	User Response Text[3]	0x3000		
8	User Response Text[4]	0x3300		
9	User Response Text[5]	0x3400		

Also, the 'User Response Ready' bit in F4 Portal Scan Register Bit 0 become '1'.

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0000 0000		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0000 0000 0000
3		0000 0000 0000 1111		0000 0000 0000 0000		1000 0100 0010 0001		0000 0000 0000 0000
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0000		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 0001		0000 0001 0000 1001		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

To read the card number, you can read through non-UDI registers or with UDI registers.

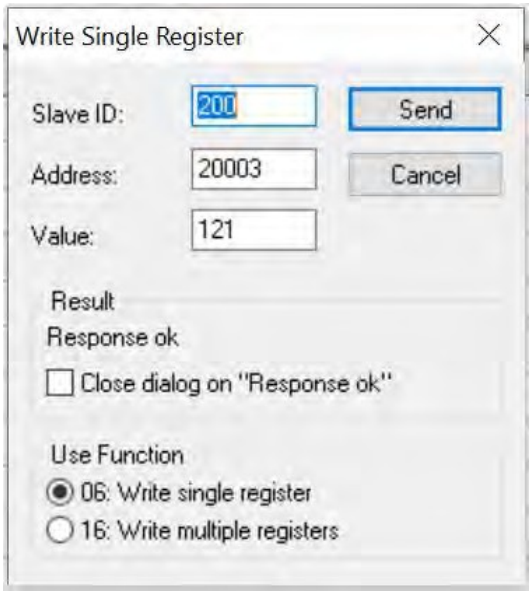
With non-UDI registers, 054 to 063.

	Alias	00050	Alias	00060
0			User Response Text[6]	0x0000
1			User Response Text[7]	0x0000
2			User Response Text[8]	0x0000
3	User Prompt State	0x0002	User Response Text[9]	0x0000
4	User Response Text[0]	0x3000		
5	User Response Text[1]	0x4400		
6	User Response Text[2]	0x3000		
7	User Response Text[3]	0x3000		
8	User Response Text[4]	0x3300		
9	User Response Text[5]	0x3400		

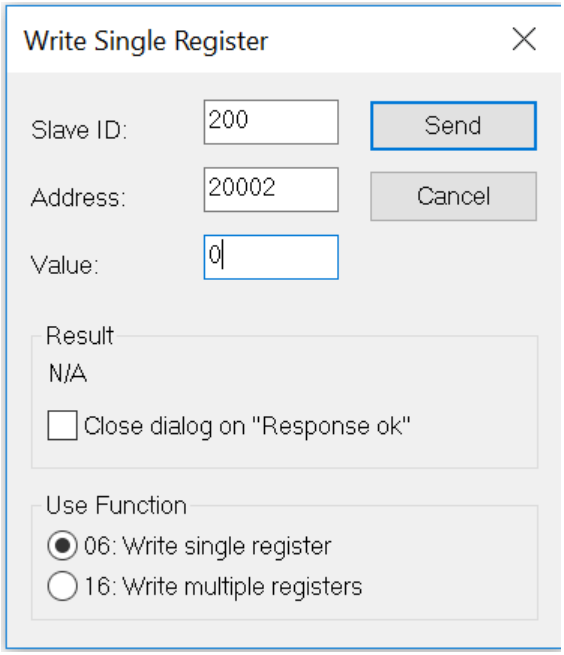
Access Card ID is “0D0034”.

With UDI Item.

Write UDI Item 121.



Initiate UDI Read command.



Read card ID through UDI buffer .

UDI in Hex.

	Alias	20000	Alias	20010	Alias	20020
0	UDI: State	0x0000	UDI: Buffer	0x3000		0x0000
1	UDI: Error Code	0x0000		0x4400		0x0000
2	UDI: Command	0x0000		0x3000		0x0000
3	UDI: Item	0x0079		0x3000		0x0000
4	UDI: Item Index	0x0000		0x3300		0x0000
5	UDI: Item Size	0x004A		0x3400		0x0000
6	UDI: Item Elements	0x0003		0x0000		0x0000
7	UDI: Item Data Type	0x01CD		0x0000		0x0000
8	UDI: Command Counter	0x0001		0x0000		0x0000
9	UDI: Response UDI Item	0x0079		0x0000		0x0000

UDI in unsigned integer.

	Alias	20000	Alias	20010	Alias	20020
0	UDI: State	0	UDI: Buffer	12288		0
1	UDI: Error Code	0		17408		0
2	UDI: Command	0		12288		0
3	UDI: Item	121		12288		0
4	UDI: Item Index	0		13056		0
5	UDI: Item Size	74		13312		0
6	UDI: Item Elements	3		0		0
7	UDI: Item Data Type	461		0		0
8	UDI: Command Counter	1		0		0
9	UDI: Response UDI Item	121		0		0

7.4.2.2.6 Display Message

TAS can send default message which is already exist in the device or customize message to the device to show message on the screen.

Use Show TAS Prompt or Show Internal Prompt to send default message to the device to show on screen, see section 7.4.1.7 or 7.4.1.6.

Use Show Prompt to send customize message to the device to show on the screen, see section 7.4.1.5.

After showing a prompt by any one of these three ways, poll either F4 Portal Scan Registers [Index 3] Bit 1 (User Response Ready), Arm State Details, or Last User Response to determine if the user response is ready.

Then read the user response by reading Last user response entity.

1. Display “Present Card”

"Present Card" is a static message which is available in the device. Use Show TAS Prompt to show "Present Card" on the display.

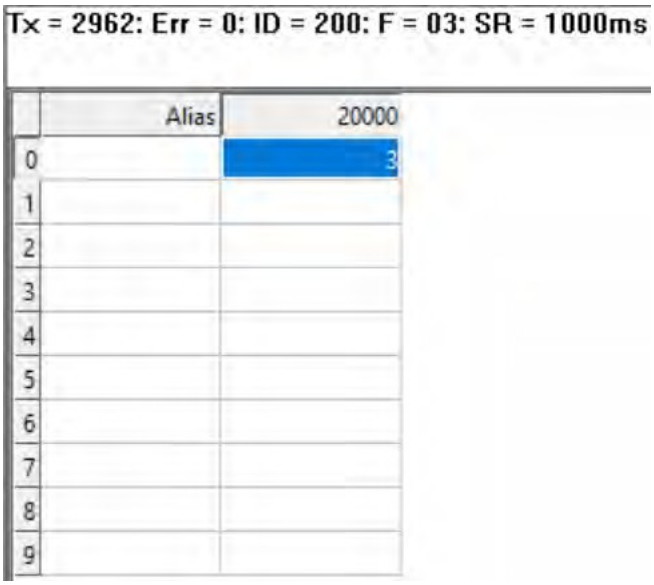
2. Display "Welcome" Screen

Write "Welcome" on MSC-L screen by using Show Prompt as this screen is not available in the device.

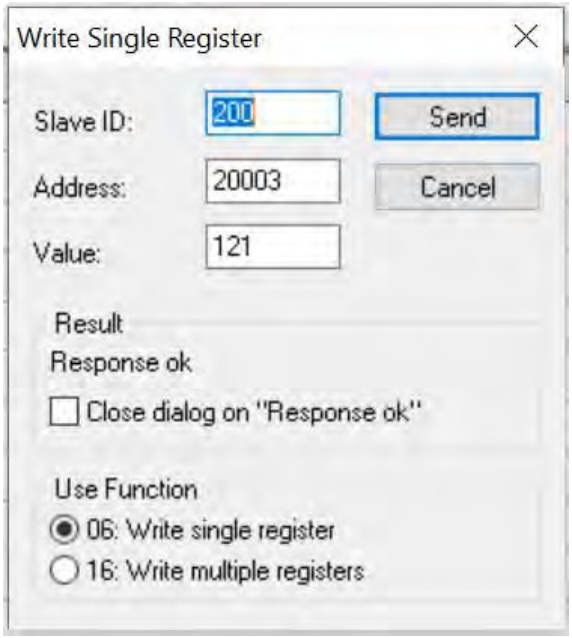
Step 1: Wait until UDI state not equal to 3 ("Waiting Result") Read/Write Definition.



Read values in 20000 register, it should read 3.



Step 2: Write UDI item “122” to UDI item register 20003.



Step 3: Verify UDI item “122”

Tx = 477: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20000
0		3
1		0
2		0
3		122
4		0
5		271
6		3
7		460
8		0
9		0

Step 4: Write “Welcome” to UDI Buffer.

Example: 20010 – 0x5700(W), 20011 – 0x6500(E)

Tx = 158: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20010
0		0x5700
1		0x6500
2		0x6C00
3		0x6300
4		0x6F00
5		0x6D00
6		0x6500
7		0x0000
8		0x0000
9		0x0000

Step 5: Write Prompt type “None” to Buffer, so that in the screen only welcome is visible without any prompt, see section C.3.2.16 for more information.

Step 6: Write Command to Update on Screen



Now you can see “Welcome” on MSC-L screen.

7.4.2.2.7 Remote Authorized

The ID number of remotely authorized users may be included in the transaction record if and only if the TAS writes the driver’s id to Login Remotely Authorized User entity.

Write UDI parameter 170 to send remotely authorized user’s information.

See section 7.4.1.21.2 Login Remotely Authorized User for more information.

7.4.2.2.8 Write Truck Number

To send reference number (for example, Truck Number) to MSC-L, TAS should send details via Generic Record, see section 7.4.1.19.

> NOTE: To use 1010 emulation transaction record, send "TAS Reference #" or "Load Number #" in the Label field of the generic command.

Send Generic Record before sending the Plan Init Start batch.

Example:

Loading Bay = Bay 1

Batch Index = 1st Index = 0

Destination = Transaction Record = 0

Label = "TAS Reference #"

Value = “AP12XY1234”

Loading Bay = Bay 1

Batch Index = 1st Index = 0

Destination = Transaction Record = 0

Label = "Load Number #"

Value = “ABCD1234”

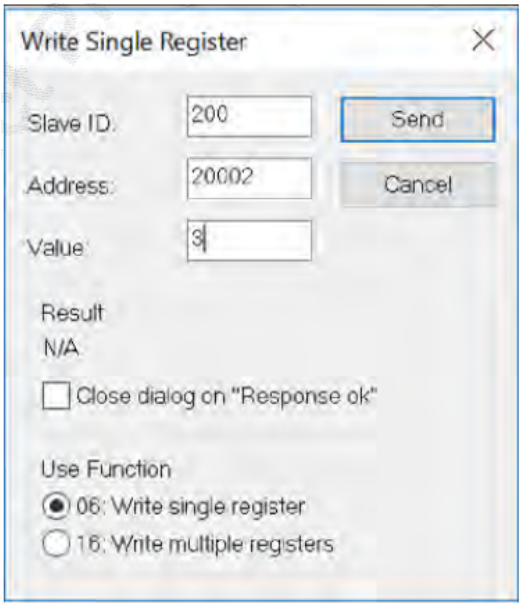
Write Item Code “55” for Generic Record Info.

	Alias	20000
0	UDI: State	3
1	UDI: Error Code	0
2	UDI: Command	0
3	UDI: Item	55
4	UDI: Item Index	0
5	UDI: Item Size	136
6	UDI: Item Elements	1
7	UDI: Item Data Type	519
8	UDI: Reserved	0
9	UDI: Item Response	0

Prepare UDI buffer as below for "TAS Reference #".

	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias	20060	Alias
0	UDI: State	3	Batch Index (LSB)	0	Label [6]	(f?) 0x6600	Label [16]	0	Label [26]	0	Value [4]	(X?) 0x5800	Value [14]	0	Value [24]
1	UDI: Error Code	0	Batch Index (MSB)	0	Label [7]	(e?) 0x6500	Label [17]	0	Label [27]	0	Value [5]	(Y?) 0x5900	Value [15]	0	Value [25]
2	UDI: Command	0	Destination Record	0	Label [8]	(r?) 0x7200	Label [18]	0	Label [28]	0	Value [6]	(1?) 0x3100	Value [16]	0	Value [26]
3	UDI: Item	55	Loading Bay	0	Label [9]	(e?) 0x6500	Label [19]	0	Label [29]	0	Value [7]	(2?) 0x3200	Value [17]	0	Value [27]
4	UDI: Item Index	0	Label [0]	(T?) 0x5400	Label [10]	(n?) 0x6E00	Label [20]	0	Label [30]	0	Value [8]	(3?) 0x3300	Value [18]	0	Value [28]
5	UDI: Item Size	136	Label [1]	(A?) 0x4100	Label [11]	(c?) 0x6300	Label [21]	0	Label [31]	0	Value [9]	(4?) 0x3400	Value [19]	0	Value [29]
6	UDI: Item Elements	1	Label [2]	(S?) 0x5300	Label [12]	(e?) 0x6500	Label [22]	0	Value [0]	(A?) 0x4100	Value [10]	0	Value [20]	0	Value [30]
7	UDI: Item Data Type	519	Label [3]	(?) 0x2000	Label [13]	(?) 0x2000	Label [23]	0	Value [1]	(P?) 0x5000	Value [11]	0	Value [21]	0	Value [31]
8	UDI: Reserved	0	Label [4]	(R?) 0x5200	Label [14]	(#?) 0x2300	Label [24]	0	Value [2]	(1?) 0x3100	Value [12]	0	Value [22]	0	
9	UDI: Item Response	0	Label [5]	(e?) 0x6500	Label [15]	0	Label [25]	0	Value [3]	(2?) 0x3200	Value [13]	0	Value [23]	0	

Send Write All UDI command.

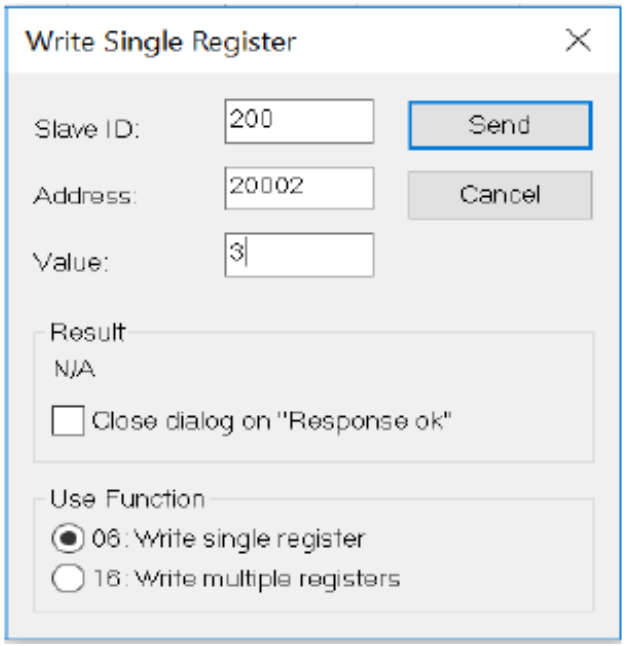


Prepare UDI buffer as below for “Load Number #".

Tx = 2534: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias	20060	Alias
0	UDI: State	3	Batch Index (LSB)	0	Label [6]	(u?) 0x7500	Label [16]	0	Label [26]	0	Value [4]	(1?) 0x3100	Value [14]	0	Value [24]
1	UDI: Error Code	0	Batch Index (MSB)	0	Label [7]	(m?) 0x6D00	Label [17]	0	Label [27]	0	Value [5]	(2?) 0x3200	Value [15]	0	Value [25]
2	UDI: Command	3	Destination Record	0	Label [8]	(b?) 0x6200	Label [18]	0	Label [28]	0	Value [6]	(3?) 0x3300	Value [16]	0	Value [26]
3	UDI: Item	55	Loading Bay	0	Label [9]	(e?) 0x6500	Label [19]	0	Label [29]	0	Value [7]	(4?) 0x3400	Value [17]	0	Value [27]
4	UDI: Item Index	0	Label [0]	(L?) 0x4C00	Label [10]	(r?) 0x7200	Label [20]	0	Label [30]	0	Value [8]	(??) 0x0000	Value [18]	0	Value [28]
5	UDI: Item Size	136	Label [1]	(o?) 0x6F00	Label [11]	(?) 0x2000	Label [21]	0	Label [31]	0	Value [9]	(??) 0x0000	Value [19]	0	Value [29]
6	UDI: Item Elements	1	Label [2]	(a?) 0x6100	Label [12]	(#?) 0x2300	Label [22]	0	Value [0]	(A?) 0x4100	Value [10]	0	Value [20]	0	Value [30]
7	UDI: Item Data Type	519	Label [3]	(d?) 0x6400	Label [13]	(??) 0x0000	Label [23]	0	Value [1]	(B?) 0x4200	Value [11]	0	Value [21]	0	Value [31]
8	UDI: Reserved	0	Label [4]	(?) 0x2000	Label [14]	(??) 0x0000	Label [24]	0	Value [2]	(C?) 0x4300	Value [12]	0	Value [22]	0	
9	UDI: Item Response	0	Label [5]	(N?) 0x4E00	Label [15]	0	Label [25]	0	Value [3]	(D?) 0x4400	Value [13]	0	Value [23]	0	

Send Write All UDI command.

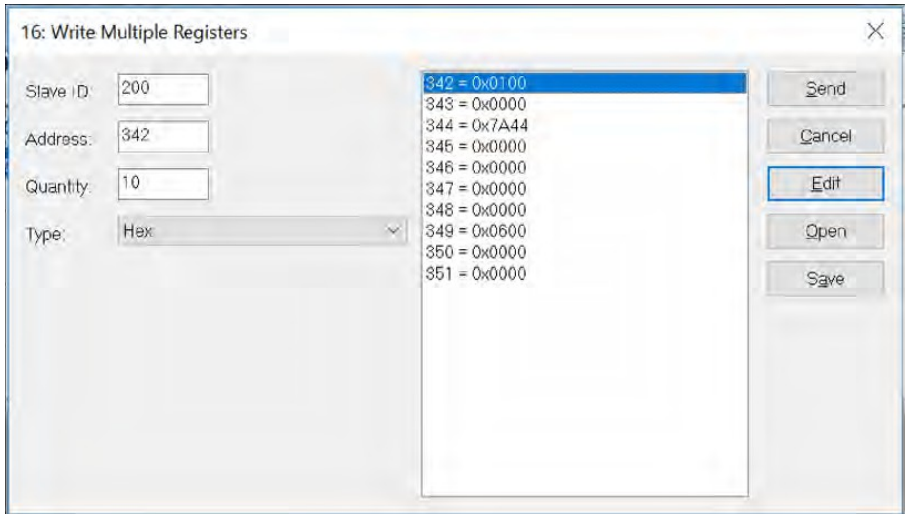


Reference and Load number will save in the transaction record and also same can be seen in device transaction logs.

7.4.2.2.9 Plan Init Start batch

Write batch planning command to MSC-L, to initiate a new batch. See section C.3.2.19 for batch plan detail information.

Send Arm 1 batch details



Registers Descriptions

342 = 0x0100 (Compartment #1)

343 & 344 = 0x00007A44 (Preset Quantity = 1000.0)

345 & 346 = 0x00000000 (Return Quantity = 0.0)

347 = 0x0000 (Recipe Index #1)

348 = 0x0000 (Arm Index #1)

349 = 0x0600 (Batch State = Planning)

350 = 0x0000 (Loading Bay Index #1)

351 = 0x0000 (Batch Index #1)

After sending Arm1 batch details to MSC-L, screen show START prompt screen.



Arm 1 current state become 'Batch in Start Prompt'.

Arm 1 Batch State become 'Planning' (see section 7.4.1.1.11).

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0000 0110		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0001 0000 0000
3		0000 0000 0000 1111		0000 0000 0000 1000		1000 0100 0010 0000		0000 0000 0000 0100
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0000		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 0001		0000 0001 0000 1100		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

Press START to start Arm 1 loading.

Current Arm 1 Status become running.

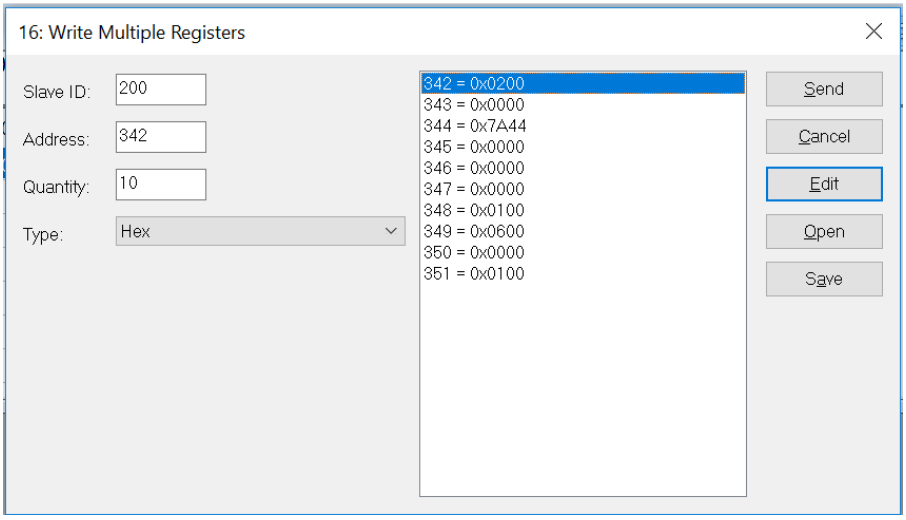
	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0110 0010		0000 0000 0000 0001
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0010 0000 0000
3		0000 0000 0000 1111		0000 0001 0000 0010		1000 0100 0000 0000		0000 0000 0100 0110
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0001		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 1011		0000 0001 0000 1110		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

Now you can send, Write '1'

Clear the screen or can proceed for next compartment loading with next available arm.

Ensure to load next batch, Batch Index should increase by 1. Maximum 20 batches can support by MSC-L.

Send Arm 2 batch details.



Registers Descriptions

342 = 0x0200 (Compartment #2)

343 & 344 = 0x00007A44 (Preset Quantity = 1000.0)

345 & 346 = 0x00000000 (Return Quantity = 0.0)

347 = 0x0000 (Recipe Index #1)

348 = 0x0100 (Arm Index #2)

349 = 0x0600 (Batch State = Planning)

350 = 0x0000 (Loading Bay Index #1)

351 = 0x0100 (Batch Index #2)

After Arm 2 batch planning sent, MSC-L display START prompt.

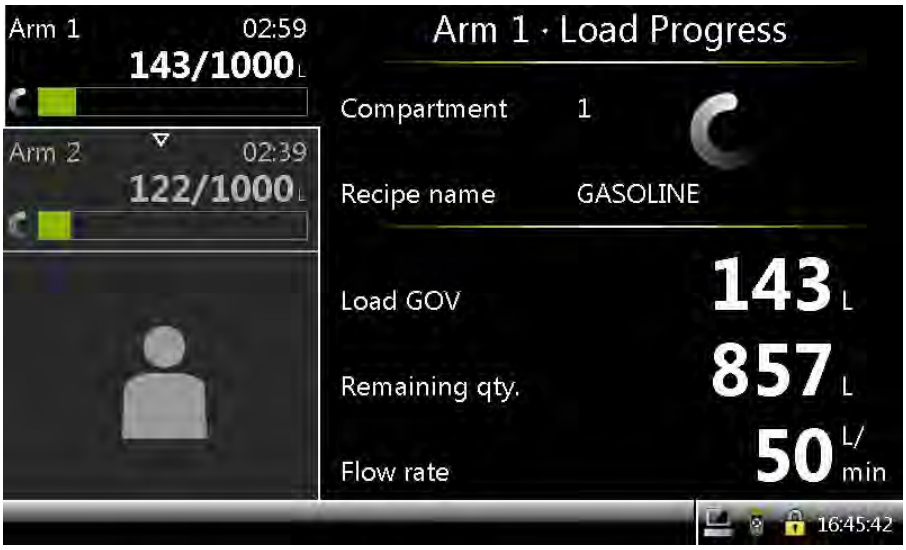


Arm 2 Current State become in start prompt and in planning state.

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0110 0110		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0010 0000 0000
3		0000 0000 0000 1111		0000 0001 0000 1000		1000 0100 0000 0000		0000 0000 0100 0100
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0000		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 0001		0000 0001 0000 1100		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

Press START to start the loading. Arm status become running.

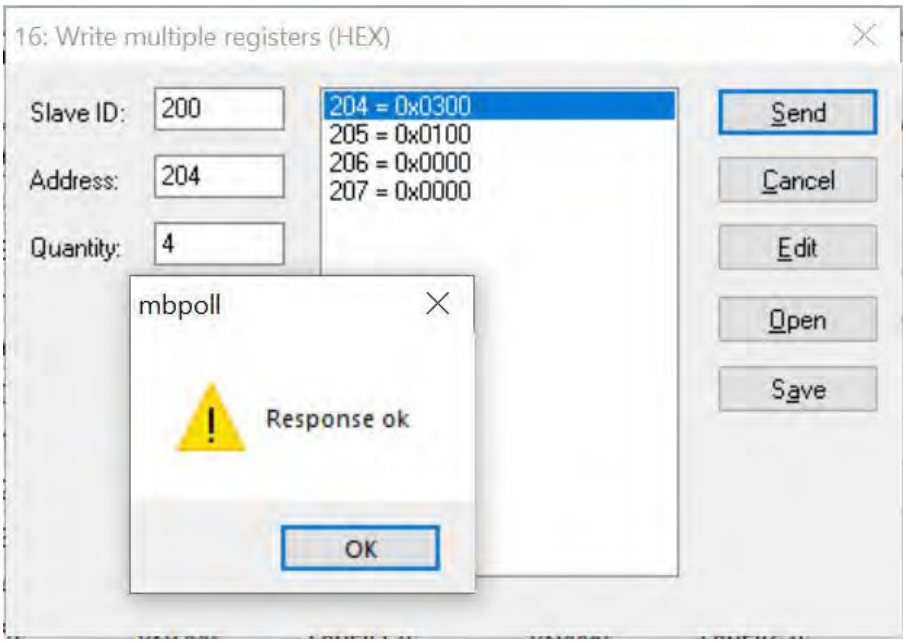
	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0010 0010		0000 0000 0000 0001
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0010 0000 0000
3		0000 0000 0000 1111		0000 0000 0100 0010		1000 0100 0000 0000		0000 0000 0110 0110
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0010		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 1011		0000 0001 0000 1111		0000 0000 1000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		



Arm 2 in paused.

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0001 0001	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0011 0010		0000 0000 0000 0001
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0010 0000 0000
3		0000 0000 0000 1111		0000 0000 1010 0010		1000 0100 0000 0000		0000 0000 1000 0110
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0100		0000 0000 0000 0010		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 1001		0000 0001 0001 0011		0000 0000 0000 0010		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0000 1111		0000 0000 0000 0001		0000 0000 0000 0000		

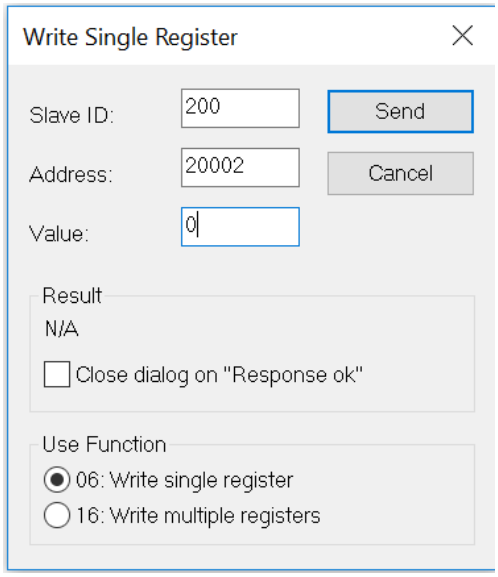
Send Arm command to resume Arm 2.



7.4.2.2.10 Read Batch Static Info

Read Batch Static Info which maintain same during the loading process.

	Alias	20000
0	UDI: State	3
1	UDI: Error Code	0
2	UDI: Command	3
3	UDI: Item	129
4	UDI: Item Index	0
5	UDI: Item Size	83
6	UDI: Item Elements	6
7	UDI: Item Data Type	514
8	UDI: Reserved	0
9	UDI: Item Response	0



	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias
0	UDI: State	0		0		(??) 0x0000		0		0		(??) 0x0400	
1	UDI: Error Code	0		0		(??) 0x0000		0		0		(??) 0x0100	
2	UDI: Command	0		0		(??) 0x0000		0		0		(3?) 0x3300	
3	UDI: Item	129		0		(??) 0x0000		0		(zD) 0x7A44		(4?) 0x3400	
4	UDI: Item Index	0		(??) 0x0000		(??) 0x0000		0		0		(??) 0x0000	
5	UDI: Item Size	83		(??) 0x0000		(??) 0x0000		0		0		(??) 0x0000	
6	UDI: Item Elements	6		(??) 0x0000		(??) 0x0000		0		(??) 0x0000		0	
7	UDI: Item Data Type	514		(??) 0x0000		(??) 0x0000		0		(??) 0x0000		0	
8	UDI: Reserved	0		(??) 0x0000		(??) 0x0000		0		(??) 0x0100		0	
9	UDI: Item Response	129		(??) 0x0000		0		0		(??) 0x0800		0	

7.4.2.2.11 Read Batch Dynamic Info

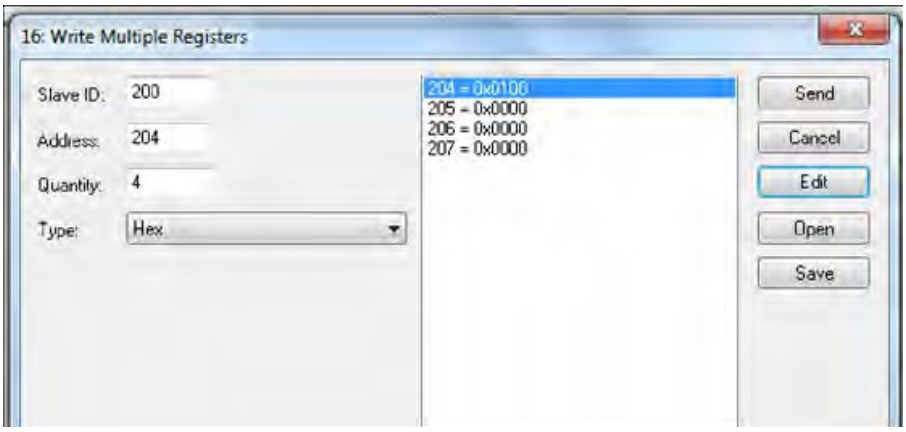
Read batch dynamic information during loading, follow Instantaneous Values process.

7.4.2.2.12 Remote stop/pause loading arm

Use registers Arm Command and Bay Command to stop, pause or resume the batch.

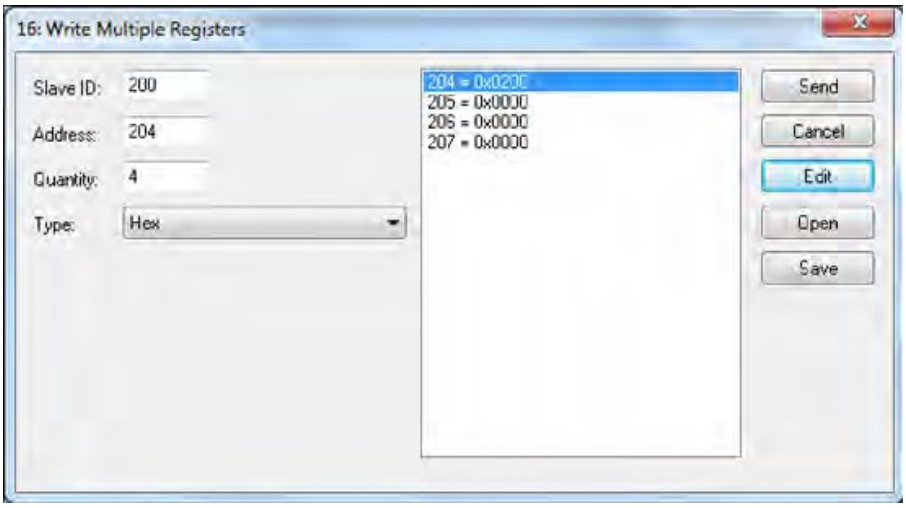
Writing command batch stop (1) to parameter 204 can stop the arm remotely.

Here Arm1 is stopped remotely.



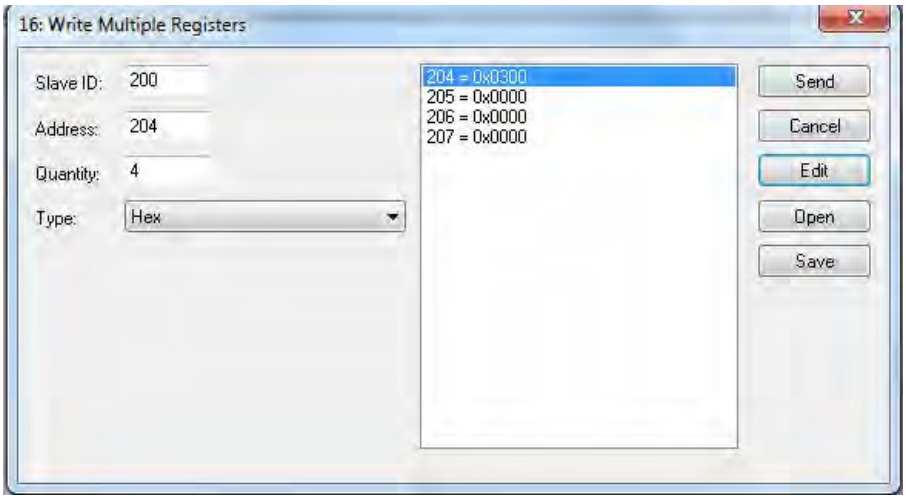
Writing command batch pause (2) to parameter 204 can pause the arm remotely.

Here Arm1 is paused remotely.



Writing command batch resume (3) to parameter 204 can resume load for the arm.

Here Arm1 is resumed remotely.



Arm command structure

Field	Data Type	Enumeration/Structure	Description
Arm Command	uint16 (enum)	ENUM_ARM_COMMAND	The arm command to be issued to the arm. See section C.3.1.42 of APPENDIX C for more information.
Load Arm	uint16 (enum)	Load Arm	The loading arm to which the arm command is to be issued. See section C.3.1.41 of APPEN-DIX C for more information.
Data	uint32		The index of the recipe that needs to be loaded. **Note:** The data field needs to be used only when the Initialize Batch arm command is issued.

Load arm enumeration

Value	Definition
0	Arm 1
1	Arm 2
2	Arm 3
3	Arm 4
4	Arm 5
5	Arm 6

Arm command enumeration

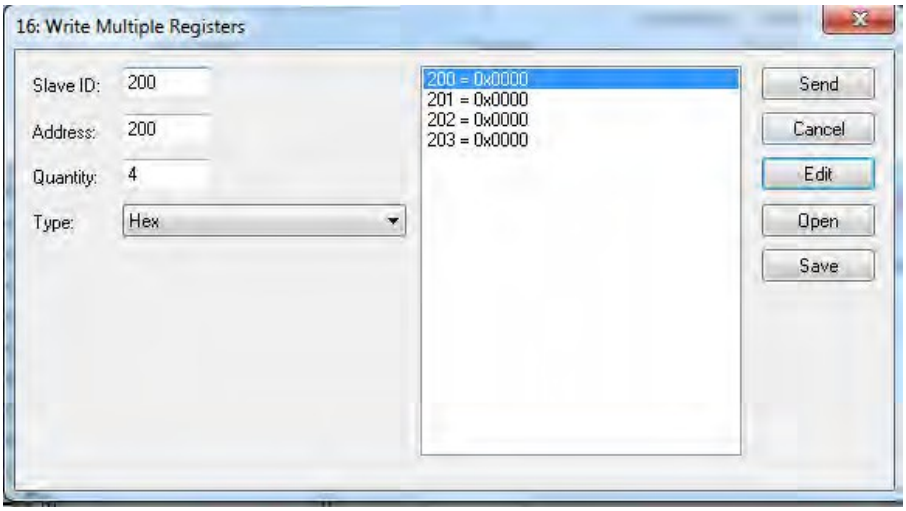
Value	Definition	Description
0	Batch Start	Parameter value set to [0] initiates starting of a batch on the loading arm.
1	Batch Stop	Parameter value set to [1] initiates stopping of the batch currently running on the loading arm.
2	Batch Pause	Parameter value set to [2] initiates pausing of the batch currently running on the loading arm.
3	Batch Restart	Parameter value set to [3] initiates restarting of a paused batch on the loading arm.
4	Batch Initialise	Parameter value set to [4] initiates initialization of a batch on the loading arm.
5	Batch Initialise and Start	Parameter value set to [5] initiates initialization and starting of a batch on the loading arm.

7.4.2.2.13 End Transaction

When the TAS has determined that the user has completed a transaction then it must explicitly end the transaction by writing to the Bay Command entity.

- enm_BayCommand = BAY_COMMAND_TRANSACTION_STOP
- ENUM_LOADING_BAY = LOADING_BAY_1
- u32_Data = 0

Writing all 0 to Bay command entity will stop transactions on bay1.



Field Description	Data Type	Enumeration/Structure	Description
Bay Command	uint16 (enum)	Bay Command	The bay command to be issued. See section C.3.1.35 of APPENDIX C for more information.
Loading Bay	uint16 (enum)	Loading Bay	The bay to which the bay command is to be issued. See C.3.1.29 of APPENDIX C for more information.
Data	uint32		The index in the bay batch details array to identify which batch to initialize. **Note:** The data field needs to be used only when the Initialize Batch bay command is issued.

Value	Definition	Description
0	Transaction Stop	Parameter value set to [0] initiates stopping of the current transaction.
1	Transaction Start	Parameter value set to [1] initiates starting of a transaction
2	Stop Batches	Parameter value set to [2] initiates stopping of all batches currently running on the bay.
3	Pause Batches	Parameter value set to [3] initiates pausing of all batches currently running on the bay.
4	Restart Batches	Parameter value set to [4] results in restarting of all paused batches on the bay.
5	Plan Next Batch	Parameter value set to [5] initiates planning of the next batch on the bay.
6	Initialize Batch	Parameter value set to [6] initiates initialization of a batch on the bay.

7.4.3 Retrieve Transaction Record

MSC-L support two methods to retrieve transaction and batch record.

1. MSC-L Standard Transaction Record
2. 1010 Emulation Transaction Record

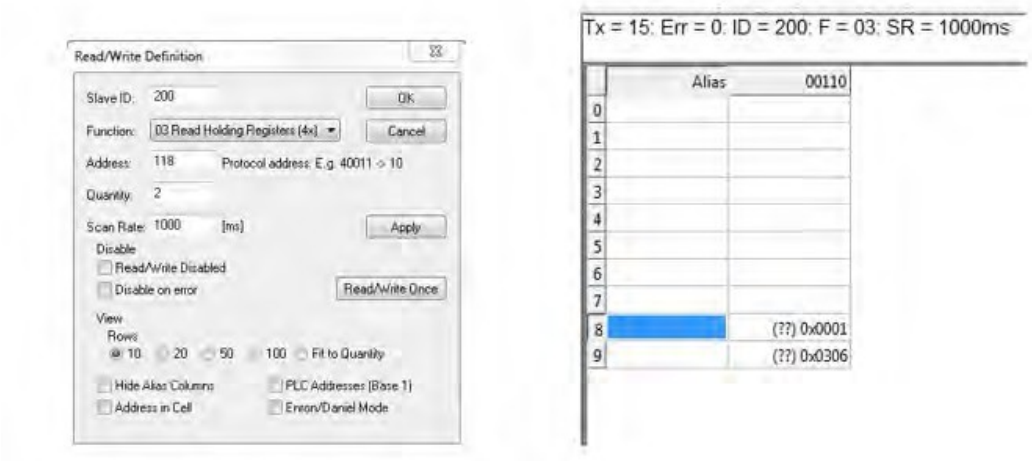
7.4.3.1 Retrieve MSC-L Standard Transaction Record

This is the normal method to retrieve transaction and batch record. Transaction record holds data for first unprocessed transaction. Any transaction is unprocessed till it is marked as processed by sending command. The Unprocessed Transaction Record Available parameter must be checked before reading the Transaction Record.

Unprocessed Transaction Record Available is de-asserted when the Transaction Record entity is being updated. Therefore, the value of the Transaction Record is only valid when Unprocessed Transaction Record Available is TRUE.

7.4.3.1.1 Check Unprocessed Transactions Available

Read device map address 118 to know if any unprocessed transactions are available, and 119 to know its size in bytes.



- Here register 118 show 1 (i.e. true) unprocessed transaction is available and register 119 shows 774 which is the size of the transaction. Register 120 show version of transaction record. It is 1.
- If the value of the Unprocessed Transaction Record Available is FALSE, then the value of the Transaction Record is undefined. If the Transaction Record entity is requested when Unprocessed Transaction Record Available is FALSE then the transactional data entity will be filled with 0s.

Also, Unprocessed transaction available status can be check in F4 Portal Scan Register Index 2 Bit 1.

	Alias	00160	Alias	00170	Alias	00180	Alias	00190
0	F4 Portal Scan Register [0]	0000 0000 0000 0011	F4 Portal Scan Register [5]	0000 0000 0000 0000	F4 Portal Scan Register [10]	0000 0000 0000 0000	F4 Portal Scan Register [15]	0000 0000 0000 0000
1		0000 0000 0000 0001		0000 0000 0000 0000		0000 0000 0000 0000		0000 0000 0000 0000
2	F4 Portal Scan Register [1]	0000 0000 0000 0000	F4 Portal Scan Register [6]	0000 0000 0000 0000	F4 Portal Scan Register [11]	0000 0010 0001 0000	Arm Current State	0000 0010 0000 0000
3		0000 0000 0000 1111		0000 0000 0000 0000		1000 0100 0010 0001		0000 0000 0000 0000
4	F4 Portal Scan Register [2]	0000 0000 0000 0000	F4 Portal Scan Register [7]	0000 0000 0000 0000	F4 Portal Scan Register [12]	0000 0000 0000 0001		
5		0000 0000 0000 0011		0000 0000 0011 0110		0000 0000 0000 0010		
6	F4 Portal Scan Register [3]	0000 0000 0000 0000	F4 Portal Scan Register [8]	0000 0000 0000 0000	F4 Portal Scan Register [13]	0000 0000 0000 0000		
7		0000 0000 1101 0001		0000 0001 0011 1110		0000 0000 0000 0000		
8	F4 Portal Scan Register [4]	0000 0000 0000 0000	F4 Portal Scan Register [9]	0000 0000 0000 0000	F4 Portal Scan Register [14]	0000 0000 0000 0000		
9		0000 0000 0001 0001		0000 0000 0000 0001		0000 0000 0000 0000		

7.4.3.1.2 Read Unprocessed Transaction

- If unprocessed transaction is available, transaction record can be read using UDI-50 with read all UDI command.
- Use the Modbus register 20000: read to poll the UDI state. Poll the UDI state until the response value is not equal to 3 (‘Waiting Result’). This allows UDI to complete the previous request, if any.
- Once the UDI state value is 3, write 50 (0x32 as in picture below) Modbus register 20003.



- Use the Modbus register 20002 to issue the Read All command. Write 2 to register 20002 for the same.
- Use the Modbus register 20000 to poll the UDI state. Poll the UDI state until the response value is 0 (‘ready good’). (If the response value is 1 ‘Ready Error’ then

an exception occurred. If an exception occurred, use the [Universal Data Interface: Error 5]).

- Use the Modbus register 20010 to read the UDI buffer. 20010 to 20396 will have the transaction record in this case (774 bytes and each Modbus register has 2 bytes).

Tx = 111: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20060	Alias	20070	Alias	20080	Alias	20090	Alias	20100
0		(??) 0x141C		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?) 0x20D0
1		(?) 0x1D20		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0703
2		(??) 0xD007		(??) 0x0000		(??) 0x0000		(??) 0x0001		(?A) 0x1141
3		(??) 0x0311		(??) 0x0000		(??) 0x0000		(??) 0x0000		(rm) 0x726D
4		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0014		(1) 0x2031
5		(??) 0x0100		(??) 0x0000		(??) 0x0000		(??) 0x191C		(??) 0x0000
6		(??) 0x0000		(Ad) 0x4164		(??) 0x0000		(?) 0x20D0		(??) 0x0000
7		(??) 0x0100		(mi) 0x6D69		(??) 0x0000		(??) 0x0703		(??) 0x0000
8		(??) 0x0000		(n?) 0x6E00		(??) 0x0000		(??) 0x1114		(??) 0x0000
9		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?') 0x1B27		(??) 0x0000

	Alias	20110	Alias	20120	Alias	20130	Alias	20140	Alias	20150
0		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
1		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
2		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
3		(??) 0x0001		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
4		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
5		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
6		(??) 0x0001		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
7		(?A) 0x0041		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
8		(?B) 0x0042		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
9		(?C) 0x0043		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000

Alias	20210	Alias	20220	Alias	20230	Alias	20240	Alias	20250
	(??) 0xFF00		(??) 0xF0FF		(??) 0x0000		(??) 0x0000		(??) 0x00D5
	(??) 0xF0FF		(??) 0x00F0		(??) 0x0000		(?W) 0xFA57		(??) 0x07E4
	(??) 0x00F0		(??) 0xFF01		(??) 0x0000		(zD) 0x7A44		(??) 0x0C00
	(??) 0xFF00		(??) 0x0000		(??) 0x0000		(??) 0x0300		(??) 0x0000
	(??) 0xF0FF		(??) 0x0100		(??) 0x0000		(??) 0xD507		(??) 0x0000
	(??) 0x00F0		(??) 0x0000		(??) 0x0000		(??) 0x1607		(??) 0x0000
	(??) 0xFF00		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0300
	(??) 0xF0FF		(?z) 0x007A		(??) 0x0000		(??) 0x0000		(??) 0xD507
	(??) 0x00F0		(D?) 0x4400		(??) 0x0000		(??) 0x0000		(??) 0xE40C
	(??) 0xFF00		(??) 0x0000		(??) 0x0000		(??) 0x0003		(??) 0x0000

	Alias	20310	Alias	20320	Alias	20330	Alias	20340	Alias	20350
0		(am) 0x616D		(?W) 0xFA57		(??) 0x07E4		(??) 0x00C8		(??) 0x0000
1		(1) 0x2031		(zD) 0x7A44		(??) 0x0C00		(B?) 0x4200		(??) 0x0000
2		(??) 0x0000		(??) 0x0300		(??) 0x0000		(??) 0x0000		(??) 0x0000
3		(??) 0x0000		(??) 0xD507		(??) 0x0000		(??) 0x0000		(??) 0x0000
4		(??) 0x0000		(??) 0x1607		(??) 0x0000		(??) 0x0000		(??) 0x0000
5		(??) 0x0000		(??) 0x0000		(??) 0x0300		(??) 0x0000		(??) 0x0000
6		(??) 0x0000		(??) 0x0000		(??) 0xD507		(??) 0x0000		(??) 0x0000
7		(??) 0x0000		(??) 0x0000		(??) 0xE40C		(??) 0x0000		(??) 0x0000
8		(??) 0x0000		(??) 0x0003		(??) 0x0000		(??) 0x0000		(??) 0x0000
9		(??) 0x0000		(??) 0x00D5		(??) 0x0000		(??) 0x0000		(??) 0x0000

	Alias	20360	Alias	20370	Alias	20380	Alias	20390	Alias	20400
0		(??) 0x0000		(??) 0x0700		(??) 0x0003		(wx) 0x7778		(??) 0x0000
1		(??) 0x0000		(??) 0x0000		(??) 0x00D5		(??) 0x86B1		(??) 0x0000
2		(??) 0x0000		(??) 0x0000		(??) 0x07E4		(m?) 0x6DA7		(??) 0x0000
3		(??) 0x0000		(??) 0x0000		(??) 0x0C00		(?&) 0x9726		(??) 0x0000
4		(??) 0x0000		(??) 0x0300		(??) 0x0000		(b?) 0x62BD		(??) 0x0000
5		(??) 0x0000		(??) 0xD607		(??) 0x0200		(??) 0xE19A		(??) 0x0000
6		(??) 0x0000		(??) 0x1607		(??) 0x0000		(?@) 0xF840		(??) 0x0000
7		(??) 0x0003		(??) 0x0000		(W?) 0x57F7		(??) 0x0000		(??) 0x0000
8		(??) 0x00D6		(??) 0x0000		(??) 0x0AB9		(??) 0x0000		(??) 0x0000
9		(??) 0x0716		(??) 0x0000		(A?) 0x41E6		(??) 0x0000		(??) 0x0000

- Modbus register 20006 indicates size of item in 20003 here size of transaction record is shown as 65536 bytes. Note that this is deliberately made excessive large to accommodate future devices in fusion4 family. Actual size of transaction record can is at parameter 119 of device map as shown above.

7.4.3.1.3 Transaction record details

Transaction record has header and batch records. Each batch record has batch generic record and product records associated with the batch.

Find below details of all records.

Table 7-63: Transaction Header

	Name	Type	Description	Size	Example Content
1	Transaction Record Version	Uint16	The version of this transaction record	2	1
2	Device Type	ENUM (Fusion4 Device Type)	This describes the type of Fusion4 device the transaction record comes from	2	5
3	Transaction Record Unique Identifier	Char[28]	A string that uniquely identifies the transaction from all other transactions for all Fusion 4 devices	28	"MSC_L TESTSERI AL1_ 0000762304" 20021 to 20029 is 10 digit transaction number

	Name	Type	Description	Size	Example Content
4	Device ID	Char[8]	A user specified identifier for the unit	8	“B-ETHA-07”
5	Number of Batches	Uint8	The number of batches in this transaction	1	50
6	W&M Intended	Boolean	Whether the device is intended for W&M	1	TRUE
7	Base Temperature	STRUCT (Temperature Reference)	Reference temperature that a user defines for volume correction	10	{23.0, DIMENSION_ CELCIUS}
8	Base Pressure	STRUCT (Pressure Reference)	Reference pressure that a user defines for volume correction	10	{0.0, DIMENSION_ KILO_ PASCAL}
9	Units of Temperature	ENUM (Temperature Dimension)	The engineering units associated with all temperaturemeasurements in this record	2	1
10	Units of Density	ENUM (Density Dimension)	The engineering units associated with all density measurements in this record	2	1
11	Units of Pressure	ENUM (Pressure Dimension)	The engineering units associated with all pressure measurements in this record	2	1
12	Transaction Number	Uint32	The number of this transaction record	4	11234
13	Site Name	Char[20]	The name of the site where the transaction happened	20	“SHELL PERNIS”
14	Transaction Start Time	STRUCT (RTC Time)	The time at which the transaction began	4	<17, 22, 13>

	Name	Type	Description	Size	Example Content
15	Transaction Start Date	STRUCT (RTC Date)	The date when the transaction began	4	<2009,06,31>
16	Transaction Stop Time	STRUCT (RTC Time)	The time at which the transaction ended	4	<18, 02, 01>
17	Transaction Stop Date	STRUCT (RTC Date)	The date when the transaction ended	4	<2009,06,31>
18	Preset Type	ENUM (Preset Type)	This specifies whether the preset value is expressed as volume or mass value	2	0
19	Bay Number	Uint16	The number of the bay the device is installed in	2	9
20	Communications Mode	ENUM (Communication Mode)	Expresses whether transaction was done in Local or Remote Mode	2	1
21	Language	ENUM (Language)	Language used by operator during transaction	2	1
22	Contract ID	Char[16]	A string representing the Contract or Order Number	16	“0000001123”
23	Driver ID	Char[16]	A string representing a unique driver Identification (name or number). This value is *NEVER* a driver’s password	16	“Jay Doyle” “3062001”
24	Vehicle ID	Char[16]	A string that uniquely identifies the vehicle used in the transaction	16	“86-NX-VZ (NL)”
25	No of Generic Record			1	

7.4.3.1.4 Batch record

Table 7-64: Batch record

	Name	Type	Description	Size	Example Content
1	Batch Number	Uint32	The batch number associated with the current batch record	4	78
2	Batch Start Time	STRUCT (RTC Time)	The time at which the batch began	4	<17, 22, 13>
3	Batch Start Date	STRUCT (RTC Date)	The date when the batch began	4	<2009,0,6,31>
4	Batch Stop Time	STRUCT (RTC Time)	The time at which the batch ended	4	<18, 02, 01>
5	Batch Stop Date	STRUCT (RTC Date)	The date when the batch end	4	<2009,0,6,31>
6	Arm Name	Char[20]	The name of ARM used to dispense the blended product	20	ARM-01
7	Arm Number	ENUM (Load Arm)	The number of the arm used to deliver the batch	2	9
8	Units of Volume	ENUM (Units:Volume)	The engineering units associated with all volume measurements in this batch record	2	1
9	Units of Mass	ENUM (Units: Mass)	The engineering units associated with all mass measurements in this batch record	2	1

	Name	Type	Description	Size	Example Content
10	Units of Additive Volume	ENUM (Units:InjectionVolume)	The engineering units associated with all additive volume measurements in this batch	2	1
11	Blend Type	ENUM (Loading Type)	Specifies the type of blend (none, ratio, side stream, sequential)	2	1
12	Recipe name	Uint16[32]	The recipe used during the batch (name, blend %, API symbol)	64	
13	Product Symbol	ENUM (ProductSymbol)	product symbol	2	
14	Hazardous Material Classification	Char[50]	Hazardous Material Classification for the finished product	50	
15	Product percentage	Float32[4]	Product percentage of main stream and three blend streams	16	
16	Additive PPM Volume	Float32[6]	Additive PPM for all six additive streams	24	

	Name	Type	Description	Size	Example Content
17	Pacing Volume	Float32[6]	Pacing volume for all six additive streams	24	
18	Product Stream address	Stream Address[4]	Stream address of all four product streams	12 (3 x 4)	
19	Additive stream address	Stream Address[6]	Stream address of all six additive streams	18 (3 x 6)	
20	Valid Recipe	Boolean	Indicates recipe is valid or invalid	1	
21	W&M Compliant	Boolean	Whether the device was W&M compliant during the whole batch	1	TRUE
22	Unintended Stop	Boolean	Whether the batch stopped unexpectedly during the load	1	FALSE
23	Compartment Number	Uint8	The trailer compartment associated with this batch	1	2
24	Returned Quantity	Float32	The amount of product in the compartment at the start of the batch	4	320

	Name	Type	Description	Size	Example Content
25	Preset Volume	Float32	When used with a preset, this value defines the preset quantity for the batch. If not used in preset mode, then this value will be 0	4	2500
	Number of generic records			4	

7.4.3.1.5 Product stream record

The first product stream record is always the finished product record; the second product stream record is always the main stream. The following (optional) product records are the blend products up to 5 Separate Product Stream Records.

Table 7-65: Product stream record

	Name	Type	Description	Size	Example Content
1	Product Name	Char[20]	The name of product 1 (up to 4) NB: This field is not valid for the final finished product stream record. The name of the final finished product is defined in the recipe structure	20	“Diesel”

	Name	Type	Description	Size	Example Content
2	Calibration Number	Uint32	A counter incremented each time flow meter calibration is done	4	1
3	Gross Observed Volume	SensorValue	The total observed volume of the product dispensed during the batch	13	<25012.55, <GOOD, STATUS_ CATEGORY_ GOOD_AC TUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 1>
4	Gross Standard Volume	SensorValue	The total gross standard volume (net) of the product dispensed during the batch	13	<2500.01, <GOOD, STATUS_ CATEGORY_ GOOD_AC TUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 1>

	Name	Type	Description	Size	Example Content
5	Mass	SensorValue	The total mass of the product stream for the batch (For weighbridge loading batched quantity (mass) is also stored here)	13	<0.00, <BAD, STATUS_ CATEGORY_ BAD_NO_ DATA_ AVAILABLE, NO_ ERROR>, NO_ ALARM_ COMBINATION, 1>
6	Actual Blend Percentage	Float32	The actual blend percentage of the product in final finished product (expressed as a value from 0 to 100) in case quantity is delivered. If no quantity is delivered it will show as NaN	4	23.5
7	Start Accumulated Gross Observed Volume	Float64	The gross observed accumulated volume at the start of the batch for the stream	8	238786.23
8	Stop Accumulated Gross Observed Volume	Float64	The gross observed accumulated volume at the end of the batch for the stream Gross Standard Volume is sometimes referred as either Net Volume or Alternate Volume	8	256777.56

	Name	Type	Description	Size	Example Content
9	Start Accumulated Gross Standard Volume	Float64	The gross standard (net) accumulated volume at the start of the batch for the stream	8	238786.23
10	Stop Accumulated Gross Standard Volume	Float64	The gross standard (net) accumulated volume at the end of the batch for the stream	8	256777.56
11	Start Accumulated Mass	Float64	The arm accumulated mass at the start of the batch	8	238786.23
12	Stop Accumulated Mass	Float64	The arm accumulated mass at the end of the batch	8	238786.23
13	Average/Observed Temperature	SensorValue	The average or observed stream temperature during the batch	13	<23.23, <GOOD, STATUS_ CATEGORY_ GOOD_AC TUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 1>

	Name	Type	Description	Size	Example Content
14	Average/Observed Pressure	SensorValue	The average or observed stream pressure during the batch	13	<23.23, <GOOD, STATUS_ CATEGORY_ GOOD_AC TUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 1>
15	Average/Observed Density	SensorValue	The average or observed stream density during the batch	13	<23.23, <GOOD, STATUS_ CATEGORY_ GOOD_AC TUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 1>
16	Fluid Group	(enum) Fluid Group, see section VCF Commodity Group	The fluid group of the product	2	1
17	Batch Product 1 Temperature Compensation Used	Boolean	Expresses whether temperature compensation was used to calculate the batch product gross standard volume	1	TRUE

Table 7-66: Additive Record

	Name	Type	Description	Size	Example Content
1	Batch Additive 1 (up to 6 Separate Additive Stream Records) Name	Char [20]	The name of additive 1 (up to 6) injected into the load stream	20	“DYE”
2	Batch Additive 1 (up to 6 Separate Additive Stream Records) Calibration Number	Uint32	A counter incremented each time flow meter calibration is done	4	1
3	Batch Additive 1 (up to 6 Separate Additive Stream Records) Gross Observed Volume	Sensor Value	The total additive 1 (up to 6) observed volume dispensed during the batch	13	<77.56, <GOOD, STATUS_ CATEGORY_GOOD_ ACTUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 0>
4	Batch Additive 1 (up to 6 Separate Additive Stream Records) Gross Observed Leakage Volume	Sensor Value	The total additive 1 (up to 6) observed leakage volume that occurred during the batch	13	<77.56, <GOOD, STATUS_ CATEGORY_GOOD_ ACTUAL, NO_ ERROR>, NO_ ALARM_ COMBINATION, 0>
5	Batch Start Additive 1 (up to 6 Separate Additive Stream Records) Accumulated Gross Observed Volume	Float64	The additive 1 (up to 6) gross accumulated volume at the start of the batch	8	25012.55

	Name	Type	Description	Size	Example Content
6	Batch Stop Additive 1 (up to 6 Separate Additive Stream Records) Accumulated Gross Observed Volume	Float64	The additive 1 (up to 6) gross accumulated volume at the end of the batch	8	256777.56
7	Batch Additive 1 (up to 6 Separate Additive Stream Records) PPM	Float32	The actual calculated parts per million of additive 1 (up to 6) in the final product	4	20.1
8	Additive 1 (up to 6 Separate Additive Stream Records) Percent Deviation	Float32	The percentage additive deviation from the accumulative target additive 1 (up to 6) injection volume	4	-1.23

7.4.3.1.6 Enumerations used

Table 7-67: Transaction manager

Name	Value	Description
UNPROCESSED_TRANSACTION_RECORD_AVAILABLE_FALSE	0	All transaction records have been processed
UNPROCESSED_TRANSACTION_RECORD_AVAILABLE_TRUE	1	At least one transaction record remains unprocessed.

Table 7-68: API Symbol Enumeration

Name	Value
API_SYMBOL_NONE	0
API_SYMBOL_BIO_DIESEL	1
API_SYMBOL_ALCOHOL_BASED_FUEL	2
API_SYMBOL_HIGH_GRADE_GASOLINE	3
API_SYMBOL_MIDDLE_GRADE_GASOLINE	4
API_SYMBOL_LOW_GRADE_GASOLINE	5

Name	Value
API_SYMBOL_ULTRA_LOW_SULFUR_DIESEL	6
API_SYMBOL_LOW_SULFUR_DIESEL	7
API_SYMBOL_HIGH_SULFUR_DIESEL	8
API_SYMBOL_LOW_SULFUR_NO_1_FUEL_OIL	9
API_SYMBOL_HIGH_SULFUR_NO_1_FUEL_OIL	10
API_SYMBOL_LOW_SULFUR_NO_2_FUEL_OIL	11
API_SYMBOL_HIGH_SULFUR_NO_2_FUEL_OIL	12
API_SYMBOL_ULTRA_LOW_SULFUR_KEROSENE	13
API_SYMBOL_LOW_SULFUR_KEROSENE	14
API_SYMBOL_HIGH_SULFUR_KEROSENE	15
API_SYMBOL_MONITORING_WHEEL	16
API_SYMBOL_HIGH_SULFUR_NO_1_FUEL_OIL	17
API_SYMBOL_LOW_SULFUR_NO_1_FUEL_OIL	18
API_SYMBOL_HIGH_SULFUR_NO_2_FUEL_OIL	19
API_SYMBOL_LOW_SULFUR_NO_2_FUEL_OIL	20
API_SYMBOL_USED_OIL	21
API_SYMBOL_VAPOR_RECOVERY	22
EU_SYMBOL_B5	23
EU_SYMBOL_B10	24
EU_SYMBOL_B20	25
EU_SYMBOL_BITUMEN	26
EU_SYMBOL_DERV	27
EU_SYMBOL_E5	28
EU_SYMBOL_E10	29
EU_SYMBOL_E20	30
EU_SYMBOL_FAME	31
EU_SYMBOL_FUEL_GRADE_ETHANOL	32
EU_SYMBOL_FUEL_OIL	33
EU_SYMBOL_FUEL_GAS	34
EU_SYMBOL_LEAD_REPLACEMENT_PETROL	35

Name	Value
EU_SYMBOL_MARINE_DESTILATES	36
EU_SYMBOL_PREMIUM_KEROSINE	37
EU_SYMBOL_PREMIUM_UNLEADED	38
EU_SYMBOL_REGULAR_KEROSINE	39
EU_SYMBOL_SUPER_UNLEADED_PETROL	40
EU_SYMBOL_ULTRA_LOW_SULFUR_GAS_OIL	41

Table 7-69: Product Commodity Group Enumeration

Name	Value
COMMODITY_GROUP_NONE	0
COMMODITY_GROUP_CRUDE_OIL	1
COMMODITY_GROUP_REFINED_PRODUCTS	2
COMMODITY_GROUP_SPECIAL_APPLICATIONS	3
COMMODITY_GROUP_LUBRICATING_OILS	4
COMMODITY_GROUP_NGL_AND_LPG	5
COMMODITY_GROUP_FATTY_ACID_METHYL_ESTERS	6

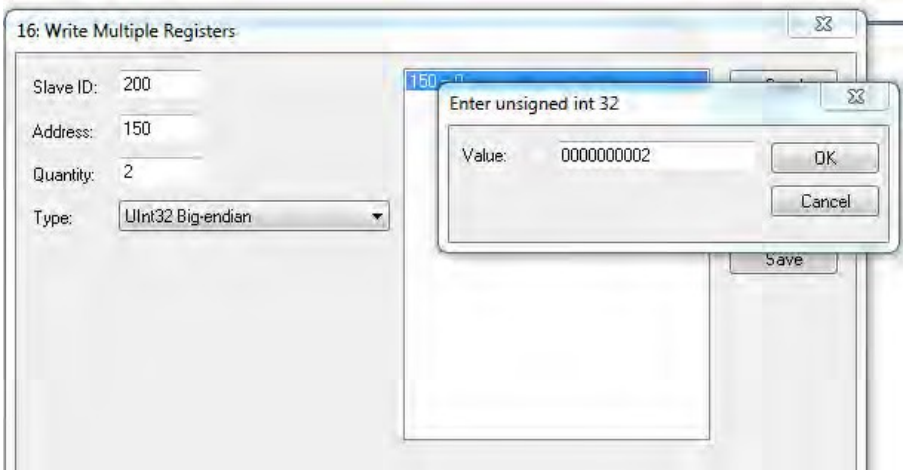
Table 7-70: Product Fluid Group Enumeration

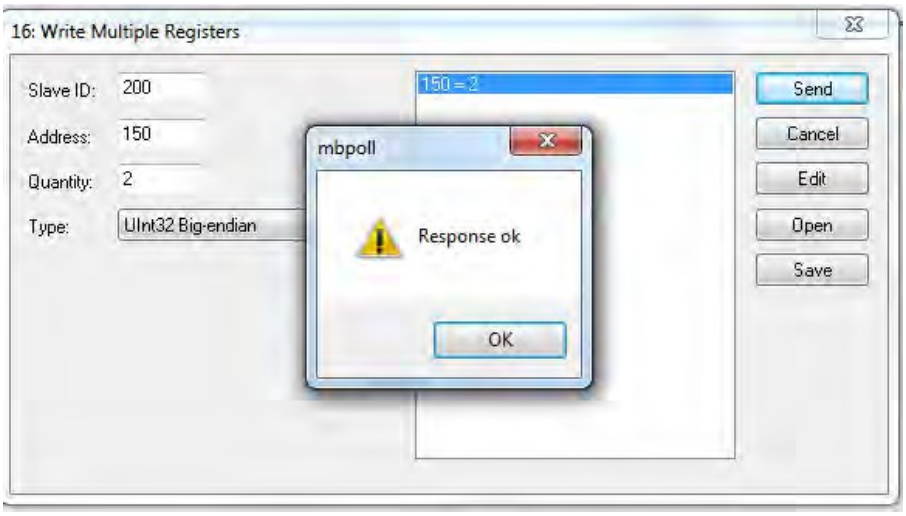
Name	Value
FLUID_GROUP_NONE	0
FLUID_GROUP_D1250_CRUDE_OIL	1
FLUID_GROUP_D1250_REFINED_PRODUCT	2
FLUID_GROUP_D1250_SPECIAL_APPS	3
FLUID_GROUP_D1250_LUB_OILS	4
FLUID_GROUP_TP27_NGL_LPG	5
FLUID_GROUP_EN14214_FAME	6

7.4.3.1.7 Mark Transaction as Processed

The process of marking transactions as processed is done using the transaction ID number. The transaction ID number is a unique 32-bit number embedded in every transaction record as part of the transaction unique identifier field.

Write transaction number to address 150 to mark transaction as processed.





Once the transaction is processed, you can check the unprocessed transaction available parameter to know if there are more transactions available.

> NOTE: the transactions need to be read sequentially.

7.4.3.2 1010 Emulation Transaction and Batch Record

Transaction and Batch records can be retrieve like as 1010 transaction and batch records.

In this case, TAS has flexibility to retrieve transaction and batch record separately by requesting transaction and batch.

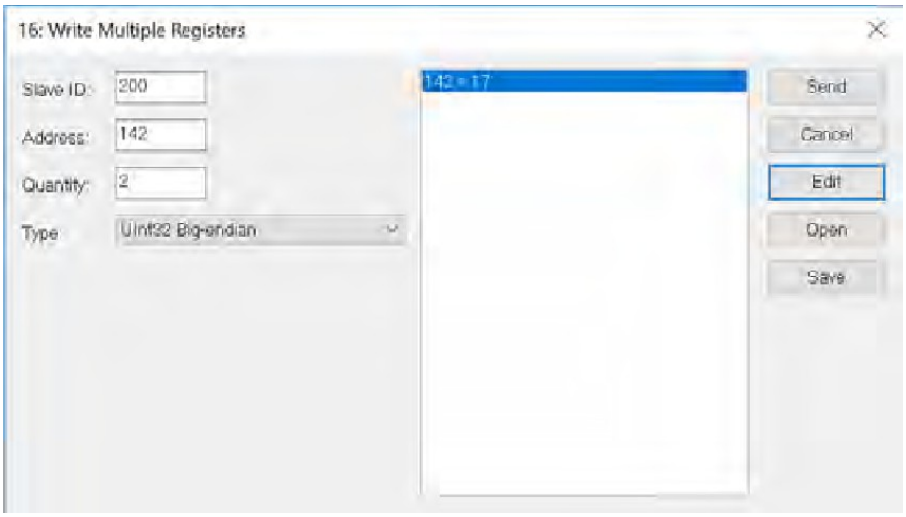
Follow the below steps.

1. Read Last Transaction Count and Batch Count.

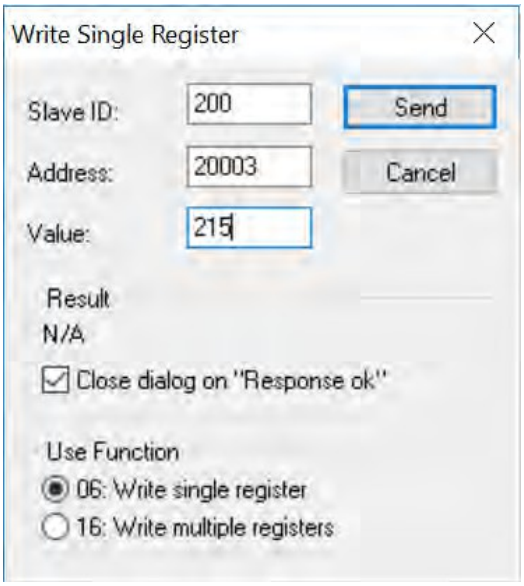
	Alias	00140
0		
1		
2		
3		
4		
5		
6	Batch Count	(??) 0x0000
7		(??) 0x0012
8	Transaction Cont	(??) 0x0000
9		(??) 0x0011

	Alias	00140
0		
1		
2		
3		
4		
5		
6	Batch Count	0
7		18
8	Transaction Cont	0
9		17

2. Request to Restore Transaction Record (Example: Requesting to restore transaction number 17).



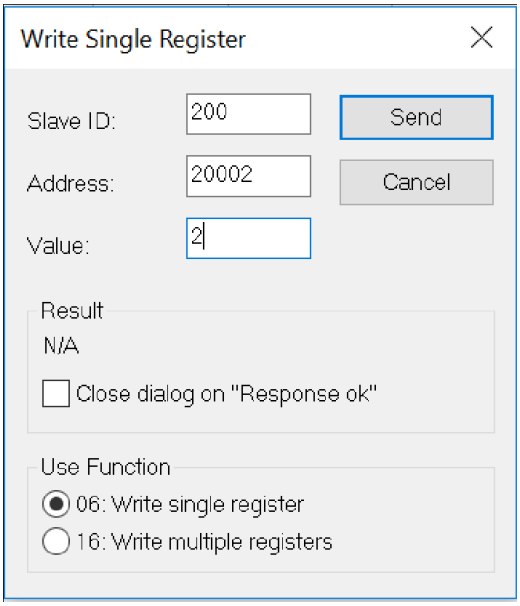
3. Read 1010 Transaction Record in UDI read process. Write Item Code 215.



4. Verify UDI details.

	Alias	20000
0	UDI: State	3
1	UDI: Error Code	0
2	UDI: Command	0
3	UDI: Item	215
4	UDI: Item Index	0
5	UDI: Item Size	168
6	UDI: Item Elements	1
7	UDI: Item Data Type	523
8	UDI: Reserved	0
9	UDI: Item Response	0

5. Send UDI command to Read All.



6. Read UDI Buffer and extract to 1010 Emulation Transaction Record (see section C.3.2.20) structure.

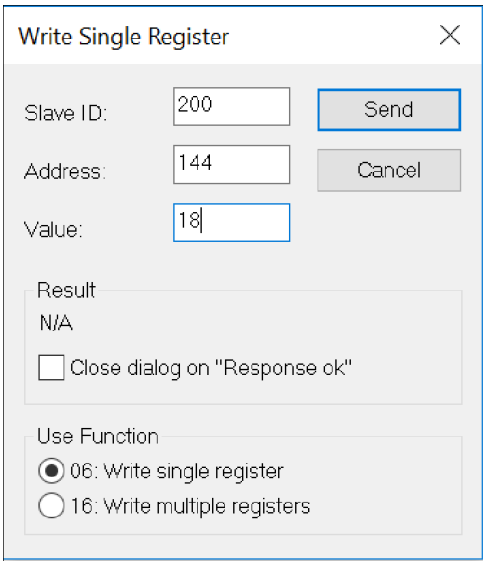
	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias	20060	Alias	20070
0	UDI: State	0		(??) 0x0001		(?) 0x1520		(??) 0x0001		(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0100
1	UDI: Error Code	0		(??) 0x1100		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0100
2	UDI: Command	2		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0100
3	UDI: Item	215		(??) 0xE307		(??) 0x1200		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
4	UDI: Item Index	0		(??) 0x0719		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
5	UDI: Item Size	168		(??) 0xE307		(??) 0x1200		(??) 0x0000		(??) 0x0100		(??) 0x0000		(??) 0x0000		(??) 0x0100
6	UDI: Item Elements	1		(??) 0x0719		(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0000		(??) 0x0000		(??) 0x0000
7	UDI: Item Data Type	523		(??) 0x0E1A		(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0100		(??) 0x0000		(AB) 0x4142
8	UDI: Reserved	0		(?) 0x0C20		(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0100		(??) 0x0000		(CD) 0x4344
9	UDI: Item Response	215		(?$) 0x0E24		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0100		(12) 0x3132

	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050
0	UDI: State	0		(??) 0x0001		(?) 0x1520		(??) 0x0001		(??) 0x0000		(??) 0x0000
1	UDI: Error Code	0	Transaction Nu...	17	Calibration Num...	(??) 0x0000	Unique N...	(??) 0x0000		(??) 0x0000		(??) 0x0000
2	UDI: Command	2		--		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
3	UDI: Item	215	Start Date	(??) 0xE307	Batch Start	18	Arm Den...	(??) 0x0000		(??) 0x0000		(??) 0x0000
4	UDI: Item Index	0		(??) 0x0719		--		(??) 0x0000		(??) 0x0000		(??) 0x0000
5	UDI: Item Size	168	Stop Date	(??) 0xE307	Batch Stop	18		(??) 0x0000	Arm Vol ...	(??) 0x0100		(??) 0x0000
6	UDI: Item Elements	1		(??) 0x0719		--		(??) 0x0000		(??) 0x0100		(??) 0x0000
7	UDI: Item Data Type	523	Start Time	(??) 0x0E1A	Personnel Index	(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0100
8	UDI: Reserved	0		(?) 0x0C20	Vehicle Index	(??) 0x0000		(??) 0x0000		(??) 0x0100		(??) 0x0100
9	UDI: Item Response	215	Stop Time	(?$) 0x0E24	Master Index	(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0100

Alias	20060	Alias	20070	Alias	20080	Alias	20090
	(??) 0x0100		(??) 0x0100		(34) 0x3334		0
	(??) 0x0000		(??) 0x0100		(??) 0x0000		0
	(??) 0x0000		(??) 0x0100		(??) 0x0000		0
	(??) 0x0000		(??) 0x0000		(??) 0x0000		0
	(??) 0x0000		(??) 0x0000		(??) 0x0000		0
	(??) 0x0000		(??) 0x0100	Reference Number	(AP) 0x4150		0
	(??) 0x0000		(??) 0x0000		(12) 0x3132		0
	(??) 0x0000	Load Number	(AB) 0x4142		(XY) 0x5859		0
	(??) 0x0000		(CD) 0x4344		(12) 0x3132		0
	(??) 0x0100		(12) 0x3132		(34) 0x3334		0

7. Similarly process, Read 1010 Emulation Batch Record in UDI read process.

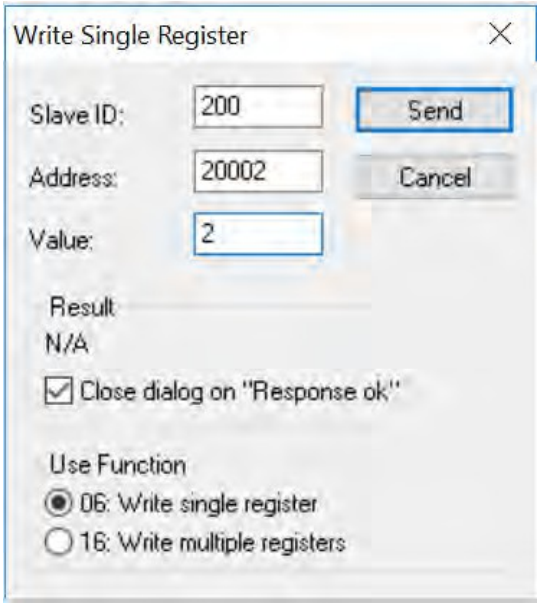
   Request to retrieve batch record (Example: Restore Batch Number 18).



8. Write Item Code 216 and verify details.

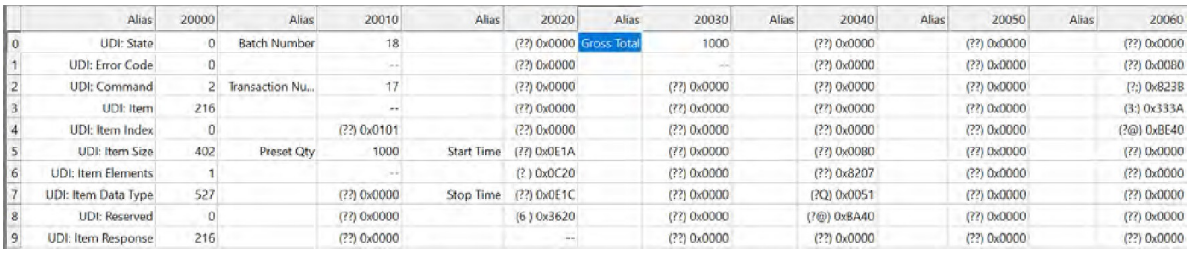
	Alias	20000
0	UDI: State	3
1	UDI: Error Code	0
2	UDI: Command	2
3	UDI: Item	216
4	UDI: Item Index	0
5	UDI: Item Size	402
6	UDI: Item Elements	1
7	UDI: Item Data Type	527
8	UDI: Reserved	0
9	UDI: Item Response	0

9. Send UDI command to Read All.



10. Read UDI buffer and extract to 1010 Emulation Batch Record structure

	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias	20060
0	UDI: State	0		(??) 0x1200		(??) 0x0000		(zD) 0x7A44		(??) 0x0000		(??) 0x0000		(??) 0x0000
1	UDI: Error Code	0		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0080
2	UDI: Command	2		(??) 0x1100		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?; 0x823B
3	UDI: Item	216		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(3; 0x333A
4	UDI: Item Index	0		(??) 0x0101		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?@) 0x8E40
5	UDI: Item Size	402		(??) 0x0000		(??) 0x0E1A		(??) 0x0000		(??) 0x0080		(??) 0x0000		(??) 0x0000
6	UDI: Item Elements	1		(zD) 0x7A44		(?) 0x0C20		(??) 0x0000		(??) 0x8207		(??) 0x0000		(??) 0x0000
7	UDI: Item Data Type	527		(??) 0x0000		(??) 0x0E1C		(??) 0x0000		(?Q) 0x0051		(??) 0x0000		(??) 0x0000
8	UDI: Reserved	0		(??) 0x0000		(6) 0x3620		(??) 0x0000		(?@) 0x8A40		(??) 0x0000		(??) 0x0000
9	UDI: Item Response	216		(??) 0x0000		(?L) 0xCD4C		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000



	Alias	20000	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050	Alias	20060
0	UDI: State	0	Batch Number	18		(??) 0x0000	Gross Total	1000		(??) 0x0000		(??) 0x0000		(??) 0x0000
1	UDI: Error Code	0		--		(??) 0x0000		--		(??) 0x0000		(??) 0x0000		(??) 0x0080
2	UDI: Command	2	Transaction Nu...	17		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?:) 0x8238
3	UDI: Item	216		--		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(3:) 0x333A
4	UDI: Item Index	0		(??) 0x0101		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?@) 0xBE40
5	UDI: Item Size	402	Preset Qty	1000	Start Time	(??) 0x0E1A		(??) 0x0000		(??) 0x0080		(??) 0x0000		(??) 0x0000
6	UDI: Item Elements	1		--		(?) 0x0C20		(??) 0x0000		(??) 0x8207		(??) 0x0000		(??) 0x0000
7	UDI: Item Data Type	527		(??) 0x0000	Stop Time	(??) 0x0E1C		(??) 0x0000		(?Q) 0x0051		(??) 0x0000		(??) 0x0000
8	UDI: Reserved	0		(??) 0x0000		(6) 0x3620		(??) 0x0000		(?@) 0x8A40		(??) 0x0000		(??) 0x0000
9	UDI: Item Response	216		(??) 0x0000		--		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000

7.4.4 Retrieve Stored Records

The following four type of records can retrievable from the MSC.

1. Transaction
2. Batch
3. Alarm
4. Event
5. Calibration

Record Type	Record ID Meaning	Record Sub Index Meaning	Record Definition
Transaction Record	Transaction ID	Not Used	See section 7.4.3.1.3
Batch Record	Transaction ID that holds the batch	0-based index of the batch within its transaction Record	See section 7.4.3.1.4
Alarm Log Entry	Alarm Log ID	Not Used	Section
Event Log Entry	Event Log ID	Not Used	Section

Name	Data Type	Type	Access
Record request	STRUCT_FUSION4_RECORD_ REQUEST	Volatile Setting	Read/Write
Record request buffer	uint8[65535]	Volatile Setting	Read/Write

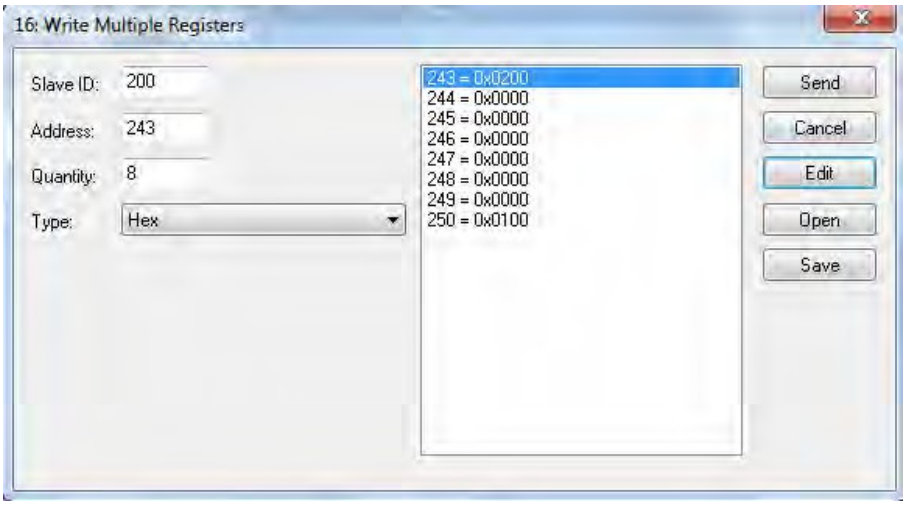
A request record may be requested in the following manner:

1. Write to the record request entity with the data describing the record you wish to retrieve.
2. Read back the value of the record request entity.
3. If the Request State field is PROCESSING then the buffer is busy being updated with the record data. In this case you must poll the entity again to check the status of the request.
4. If the status is READY then record data is ready. You can also see the size of the record in the Record Size field.
5. Read the amount of data indicated from Record Size field from the record request buffer entity and parse the data according to the requested data type.
6. The last 20 bytes of the data read from the request record buffer is the SHA hash code. Verify that the hash code is correct. The hash code is considered part of the record and is thus included in the record size value expressed in the Record Size field.

   See examples of reading records below.

7.4.4.1 Reading transaction Record

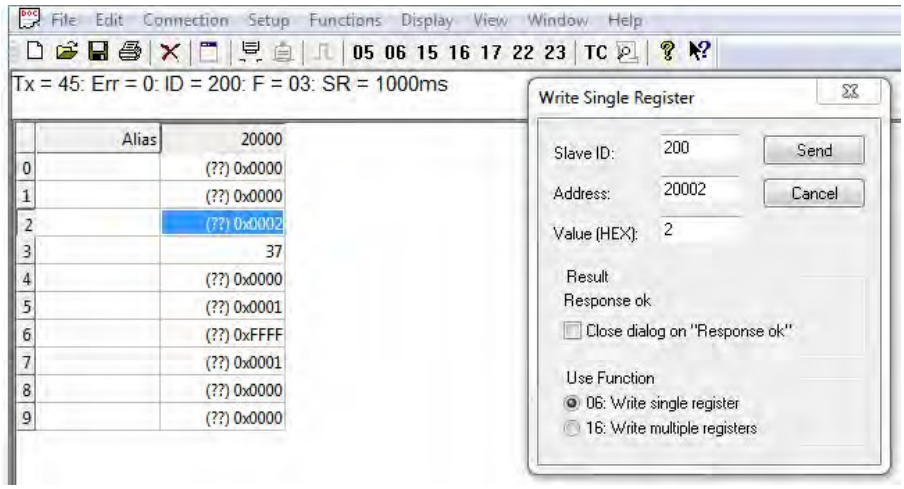
Write Read record parameter 243 in device map as shown below (Transaction number 2 is read here).



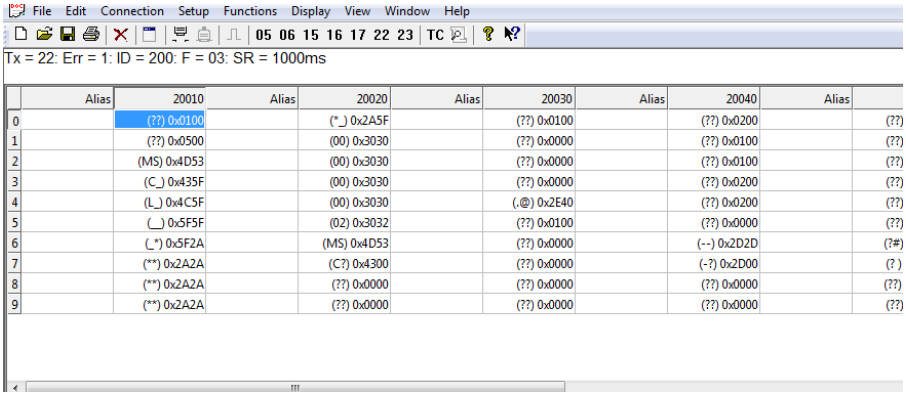
Read back to check the same read record register to know if the data is response is ready.

Address 250 will 0x0300 when response is ready.

Use UDI parameter 37 to read the requested record (Follow the steps for reading UDI parameter).



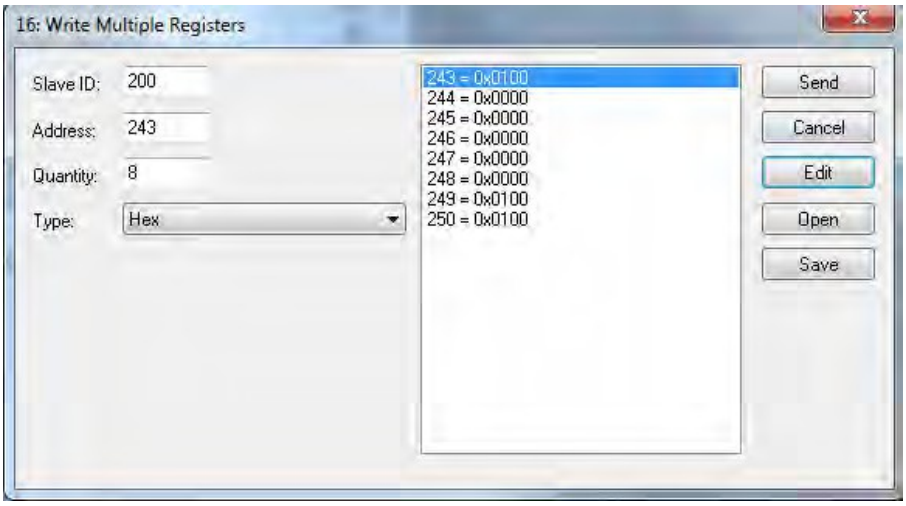
When data is ready (i.e. 20010 is 0x0000) read buffer.

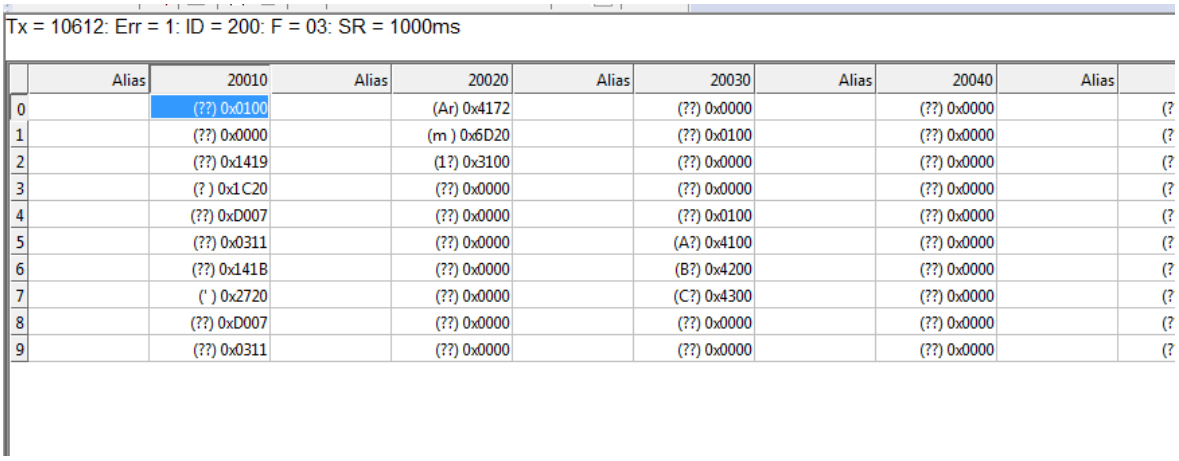


This will contain the transaction.

7.4.4.2 Reading Batch Record

Reading Batch 1 of Transaction 1

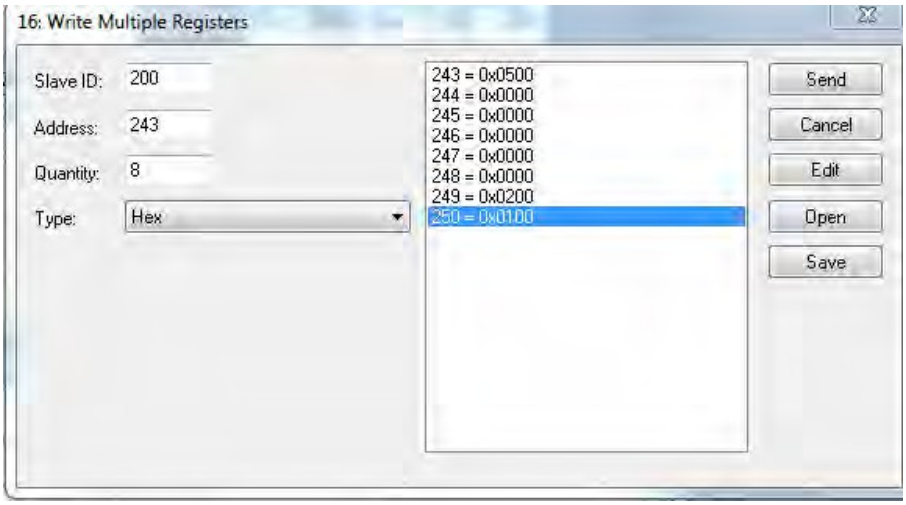


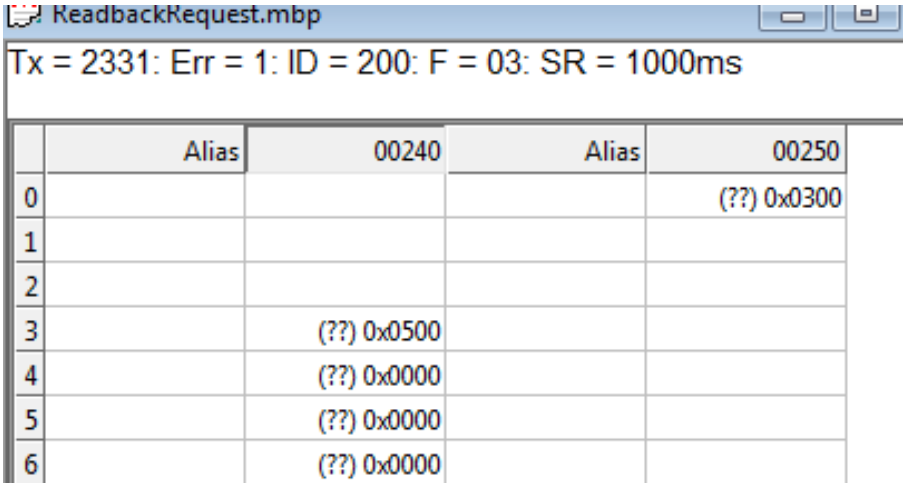


	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	
0		(??) 0x0100		(Ar) 0x4172		(??) 0x0000		(??) 0x0000		(?
1		(??) 0x0000		(m) 0x6D20		(??) 0x0100		(??) 0x0000		(?
2		(??) 0x1419		(1?) 0x3100		(??) 0x0000		(??) 0x0000		(?
3		(?) 0x1C20		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?
4		(??) 0xD007		(??) 0x0000		(??) 0x0100		(??) 0x0000		(?
5		(??) 0x0311		(??) 0x0000		(A?) 0x4100		(??) 0x0000		(?
6		(??) 0x141B		(??) 0x0000		(B?) 0x4200		(??) 0x0000		(?
7		(') 0x2720		(??) 0x0000		(C?) 0x4300		(??) 0x0000		(?
8		(??) 0xD007		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?
9		(??) 0x0311		(??) 0x0000		(??) 0x0000		(??) 0x0000		(?

7.4.4.3 Reading Alarm logs

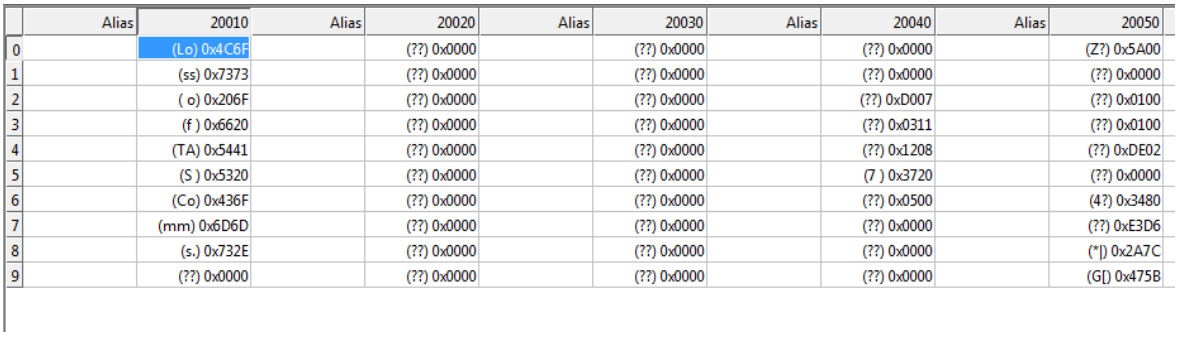
Reading 5th alarm log




ReadbackRequest.mbp

Tx = 2331: Err = 1: ID = 200: F = 03: SR = 1000ms

	Alias	00240	Alias	00250
0				(??) 0x0300
1				
2				
3		(??) 0x0500		
4		(??) 0x0000		
5		(??) 0x0000		
6		(??) 0x0000		



	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050
0		(Lo) 0x4C6F		(??) 0x0000		(??) 0x0000		(??) 0x0000		(Z?) 0x5A00
1		(ss) 0x7373		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000
2		(o) 0x206F		(??) 0x0000		(??) 0x0000		(??) 0xD007		(??) 0x0100
3		(f) 0x6620		(??) 0x0000		(??) 0x0000		(??) 0x0311		(??) 0x0100
4		(TA) 0x5441		(??) 0x0000		(??) 0x0000		(??) 0x1208		(??) 0xDE02
5		(S) 0x5320		(??) 0x0000		(??) 0x0000		(7) 0x3720		(??) 0x0000
6		(Co) 0x436F		(??) 0x0000		(??) 0x0000		(??) 0x0500		(4?) 0x3480
7		(mm) 0x6D6D		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0xE3D6
8		(s.) 0x732E		(??) 0x0000		(??) 0x0000		(??) 0x0000		(*|) 0x2A7C
9		(??) 0x0000		(??) 0x0000		(??) 0x0000		(??) 0x0000		(G[) 0x475B

Type	Name	Description
uint32	u32_Date	A 32-bit value that describes the date on which the alarm occurred. The upper 16-bits are the year. The third byte is the month value (1 = Jan, 12 = December), and the least significant byte is the day within the month.
uint32	u32_Time	A 32-bit value that describes the time on which the alarm occurred. The most significant byte is unused, the next byte shall be the hours (24- hour), the next byte shall be the minutes, and the last (least significant) byte shall be the seconds.
uint32	u32_ AlarmLogRecord	A unique number that identifies a specific alarm log entry for a device. This value must always be non-zero.
uint16	u16_AlarmIndex	The associated alarm's index into the Alarm Table entity.

Type	Name	Description
uint8	u08_AlarmState	The state of the alarm using the name definitions as defined for the Alarm Status entity. The upper 6-bits are unused and will always be 0.
uint8	u08_MetaData	A bitmask value indicates additional alarming information. See definition below.

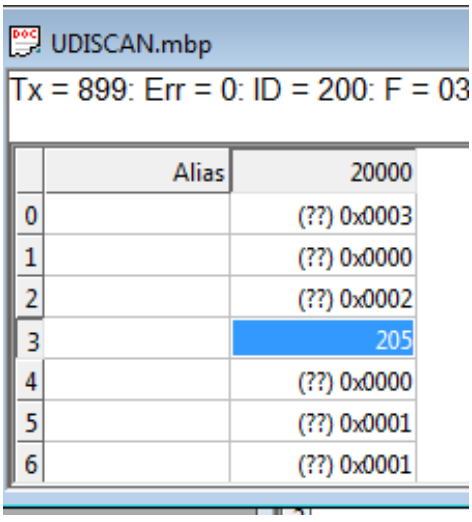
Bit position	Meaning
0 (LSB)	WnM relevant alarm
1-2	(00) No event (01) Device re-enable event – this is not associated with a particular alarm but it is used to add an entry into the alarm log indicating the time at which a device re-enable was commanded by the user. (This will require its own entry in the Alarm Text entity to ensure that there is a translation for the “Device Re-enable”). This entry covers all the individual alarm transitions from active or acknowledged back to the inactive state. Stream re-enable event – this is not associated with a particular alarm but it is used to add an entry into the alarm log indicating the time at which a stream re-enable was commanded by the user. (This will require its own entry in the Alarm Text entity to ensure that there is a translation for the “Device Re-enable”). This entry covers all the individual alarm transitions from active or acknowledged back to the inactive state. Reserved for future use.
3	Unused (reserve for future use).
4	Obsolete alarm type – This bit indicates that the alarm index value in the alarm log record no longer maps to the same alarm that generated the alarm log entry. This will only be true to alarm log records that are presented for processing that occurred in past when the alarm configuration was different. The F4P shall not generate the normal alarm text for these alarms because they may not be correct.
5-7	Unused (reserve for future use).

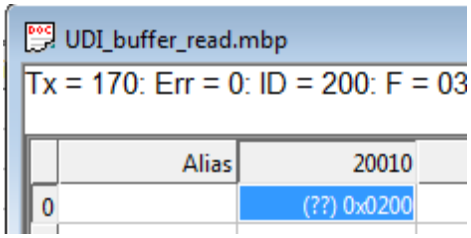
u08_AlarmState Value	Meaning
0	Disabled
1	Inactive
2	Active
3	Acknowledged

7.4.5 Alarm Interface

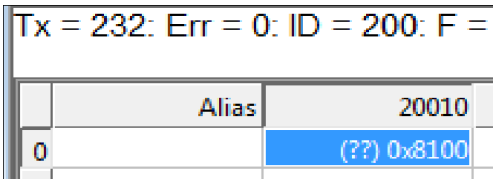
When TAS detects a device startup condition (or when itself starts up) it can build its own local alarm table based upon exposed parameters that describe which alarms are implemented (including the stream to which they are associated). The index into this table can be used for all subsequent alarm operations as a unique identifier of a particular alarm on a particular device. Table construction is a bandwidth intensive operation, it is advised to do it only first time and then use the local table as reference.

Read alarm version using UDI parameter 205 (use read all command for UDI).





Read number of alarms implemented read parameter 204.



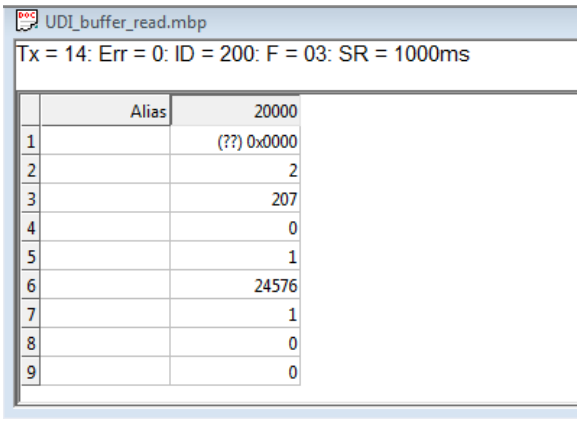
7.4.5.1 Alarm Table construction:

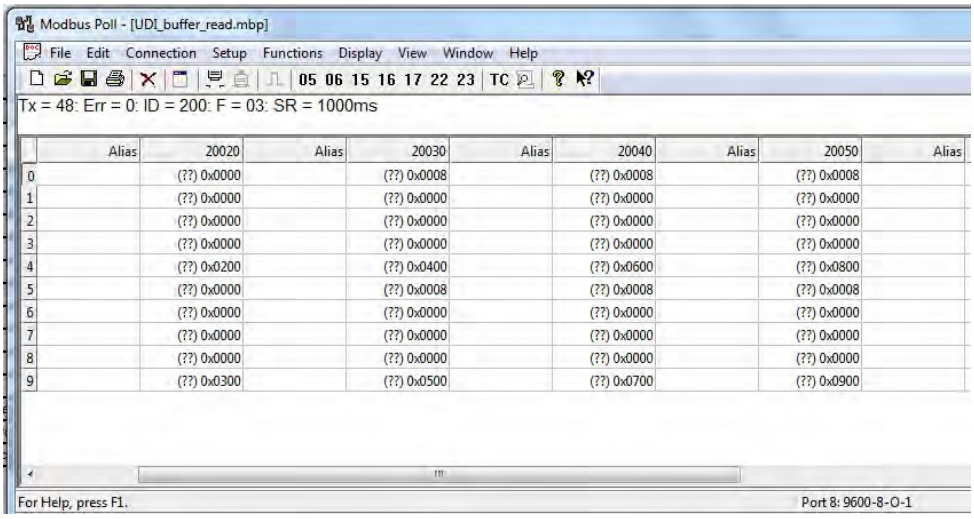
- Reading the alarm interface status can and should be done by reading the alarm interface scan register. The interface's ready bit should be true before any other alarm entities are used. See parameter bitwise details in table below or see section 7.4.1.1.1 for more information.
- The data in Alarm Table shall be constant from the time that the interface is ready.
- The actual size of the Alarm Table will be based upon the number of alarms types implemented.
- The size of the Alarm State Text Table is fixed because the number of states is fixed (4).

Table 7-71: Index 0 Scan register

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24	Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Alarm Status Tracker															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Number of Active Alarms							0	0	0	0	0	0	0	Interface Ready

When Alarm interface is ready, Read alarm table using UDI parameter 207.





Alarm table structure is as below.

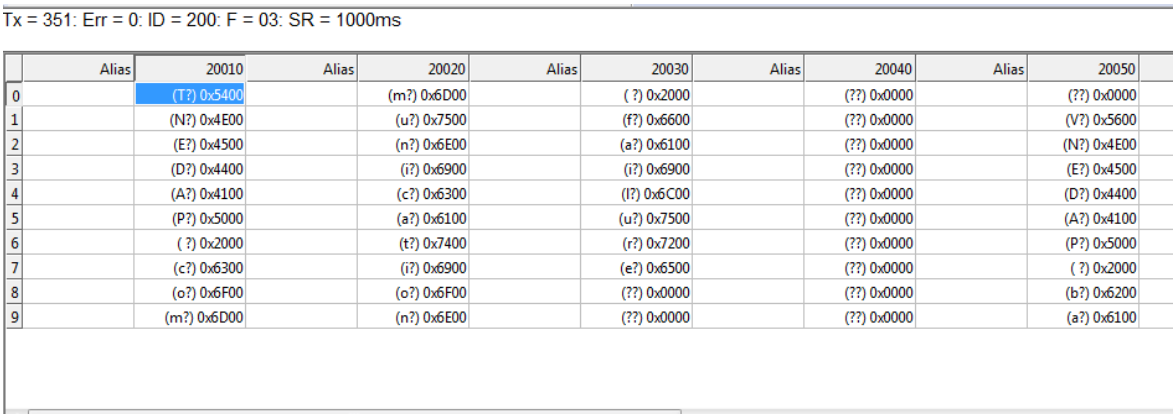
Type	Name	Description
uint32	u32_Scope	The scope type of the alarm's scope together with the index. See Table below for the layout of this field.
uint32	u32_Reserved	Reserved.
uint16	u16_ AlarmTextIndex	This is the index of the alarm's text description in the Alarm Text entity. It can be thought of as the alarm's "type".

Bits 31 ... 16	Bits 15 ... 10	Bits 9 ... 0
Reserved	Scope Type	Index

The value of the Scope type of an alarm has a specific meaning.

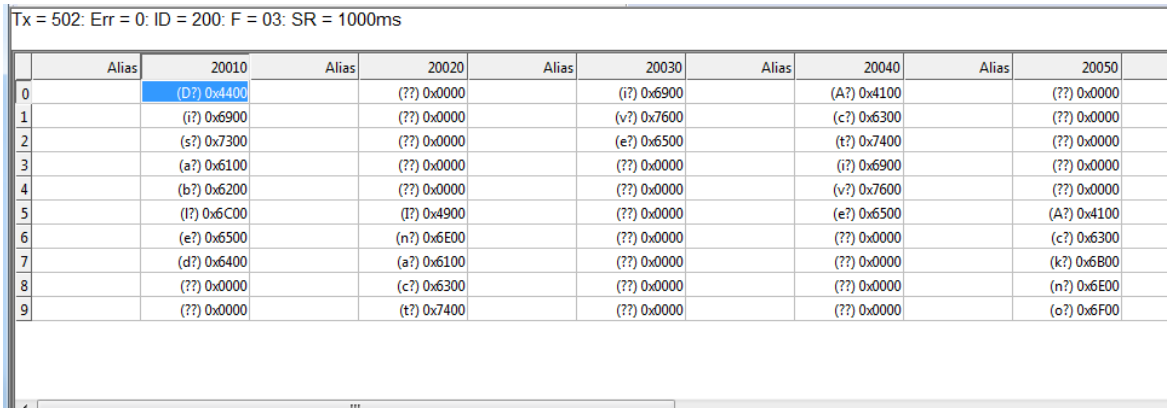
Scope Type	Meaning
0	Device scope
1	Transaction (or Loading Bay) scope
2	Arm (or Batch) scope
3	Product stream scope
4	Additive stream scope
5	External product stream scope
6	External additive stream scope

Read UDI parameter 208 for Alarm text.


Tx = 351: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050
0		(T?) 0x5400		(m?) 0x6D00		(?) 0x2000		(??) 0x0000		(??) 0x0000
1		(N?) 0x4E00		(u?) 0x7500		(f?) 0x6600		(??) 0x0000		(V?) 0x5600
2		(E?) 0x4500		(n?) 0x6E00		(a?) 0x6100		(??) 0x0000		(N?) 0x4E00
3		(D?) 0x4400		(i?) 0x6900		(i?) 0x6900		(??) 0x0000		(E?) 0x4500
4		(A?) 0x4100		(c?) 0x6300		(l?) 0x6C00		(??) 0x0000		(D?) 0x4400
5		(P?) 0x5000		(a?) 0x6100		(u?) 0x7500		(??) 0x0000		(A?) 0x4100
6		(?) 0x2000		(t?) 0x7400		(r?) 0x7200		(??) 0x0000		(P?) 0x5000
7		(c?) 0x6300		(i?) 0x6900		(e?) 0x6500		(??) 0x0000		(?) 0x2000
8		(o?) 0x6F00		(o?) 0x6F00		(??) 0x0000		(??) 0x0000		(b?) 0x6200
9		(m?) 0x6D00		(n?) 0x6E00		(??) 0x0000		(??) 0x0000		(a?) 0x6100

Read UDI parameter 209 for Alarm state text.


Tx = 502: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20010	Alias	20020	Alias	20030	Alias	20040	Alias	20050
0		(D?) 0x4400		(??) 0x0000		(i?) 0x6900		(A?) 0x4100		(??) 0x0000
1		(i?) 0x6900		(??) 0x0000		(v?) 0x7600		(c?) 0x6300		(??) 0x0000
2		(s?) 0x7300		(??) 0x0000		(e?) 0x6500		(t?) 0x7400		(??) 0x0000
3		(a?) 0x6100		(??) 0x0000		(??) 0x0000		(i?) 0x6900		(??) 0x0000
4		(b?) 0x6200		(??) 0x0000		(??) 0x0000		(v?) 0x7600		(??) 0x0000
5		(l?) 0x6C00		(l?) 0x4900		(??) 0x0000		(e?) 0x6500		(A?) 0x4100
6		(e?) 0x6500		(n?) 0x6E00		(??) 0x0000		(??) 0x0000		(c?) 0x6300
7		(d?) 0x6400		(a?) 0x6100		(??) 0x0000		(??) 0x0000		(k?) 0x6B00
8		(??) 0x0000		(c?) 0x6300		(??) 0x0000		(??) 0x0000		(n?) 0x6E00
9		(??) 0x0000		(t?) 0x7400		(??) 0x0000		(??) 0x0000		(o?) 0x6F00

7.4.5.2 Active Alarms

The number of active alarms is found in index register 0. Details associated the active alarm can be read by reading UDI parameter 206.

Active alarm details are as below.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Alarm Action				Alarm State			

This is an indexed parameter that the device fills with alarm details for all the active alarms starting from index 0 until the last active alarm is described. The values for index N up to and including 99 shall be undefined. If there are 100 or more active alarms then all entities.

7.4.5.3 Detecting Alarm Status Change

Index scan register 0 can be read to detect change in alarm state. If the alarm status tracker value is unchanged since the last polling then there has been no change to any device alarm. If there is a change to the value of the entity, then the Active Alarm Query operation must be used to establish the new alarm state. This polled entity value will always be re-enabled to 0 upon device start-up.

7.4.5.4 Acknowledge alarm and reset alarm

Individual alarm can be acknowledged using UDI parameter 202 and can be reset using parameter 201.

7.4.5.5 Active alarm bitmask

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Device Active Alarms	8964	2304	8965	408965	4	uint64	R	Device Active alarms
• Bay Active Alarms - Bay 1	8968	2308	8969	408969	4	uint64	R	Bay Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Bay Active Alarms - Bay 2	8972	230C	8973	408973	4	uint64	R	Bay Active alarms
• Arm Active Alarms - Arm 1	8976	2310	8977	408977	4	uint64	R	Arm Active alarms
• Arm Active Alarms - Arm 2	8980	2314	8981	408981	4	uint64	R	Arm Active alarms
• Arm Active Alarms - Arm 3	8984	2318	8985	408985	4	uint64	R	Arm Active alarms
• Arm Active Alarms - Arm 4	8988	231C	8989	408989	4	uint64	R	Arm Active alarms
• Arm Active Alarms - Arm 5	8992	2320	8993	408993	4	uint64	R	Arm Active alarms
• Arm Active Alarms - Arm 6	8996	2324	8997	408997	4	uint64	R	Arm Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Product Stream Active Alarms - Stream 1	9000	2328	9001	409001	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 2	9004	232C	9005	409005	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 3	9008	2330	9009	409009	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 4	9012	2334	9013	409013	4	uint64	R	Product Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Product Stream Active Alarms - Stream 5	9016	2338	9017	409017	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 6	9020	233C	9021	409021	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 7	9024	2340	9025	409025	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 8	9028	2344	9029	409029	4	uint64	R	Product Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Product Stream Active Alarms - Stream 9	9032	2348	9033	409033	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 10	9036	234C	9037	409037	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 11	9040	2350	9041	409041	4	uint64	R	Product Stream Active alarms
• Product Stream Active Alarms - Stream 12	9044	2354	9045	409045	4	uint64	R	Product Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Additive Stream Active Alarms - Stream 1	9048	2358	9049	409049	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 2	9049	2359	9050	409050	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 3	9050	235A	9051	409051	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 4	9051	235B	9052	409052	1	uint16	R	Additive Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Additive Stream Active Alarms - Stream 5	9052	235C	9053	409053	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 6	9053	235D	9054	409054	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 7	9054	235E	9055	409055	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 8	9055	235F	9056	409056	1	uint16	R	Additive Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Additive Stream Active Alarms - Stream 9	9056	2360	9057	409057	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 10	9057	2361	9058	409058	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 11	9058	2362	9059	409059	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 12	9059	2363	9060	409060	1	uint16	R	Additive Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Additive Stream Active Alarms - Stream 13	9060	2364	9061	409061	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 14	9061	2365	9062	409062	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 15	9062	2366	9063	409063	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 16	9063	2367	9064	409064	1	uint16	R	Additive Stream Active alarms

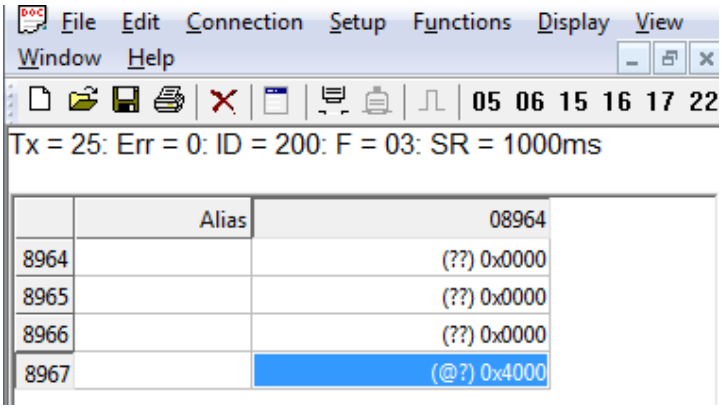
(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Additive Stream Active Alarms - Stream 17	9064	2368	9065	409065	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 18	9065	2369	9066	409066	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 19	9066	236A	9067	409067	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 20	9067	236B	9068	409068	1	uint16	R	Additive Stream Active alarms

(●marks global parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration/Structure Type
• Additive Stream Active Alarms - Stream 21	9068	236C	9069	409069	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 22	9069	236D	9070	409070	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 23	9070	236E	9071	409071	1	uint16	R	Additive Stream Active alarms
• Additive Stream Active Alarms - Stream 24	9071	236F	9072	409072	1	uint16	R	Additive Stream Active alarms

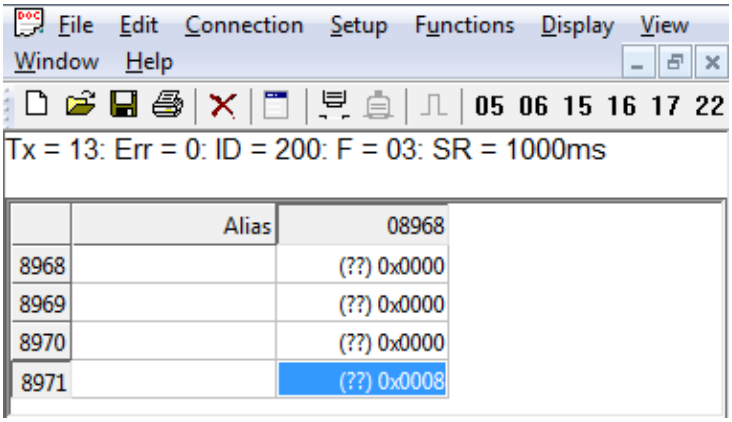
Examples:

Alarm bit Mapping Details, see TABLE C-79.

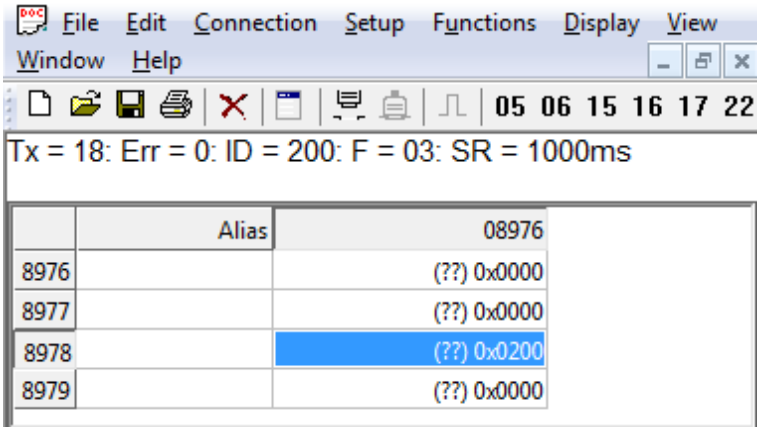
Device - Loss of TAS Comms Active Alarm Map:



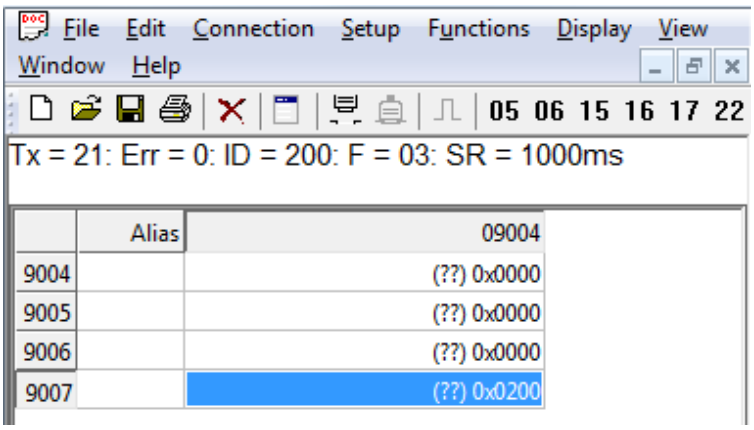
Bay 1 – Grounding Pause Active Alarm Map:



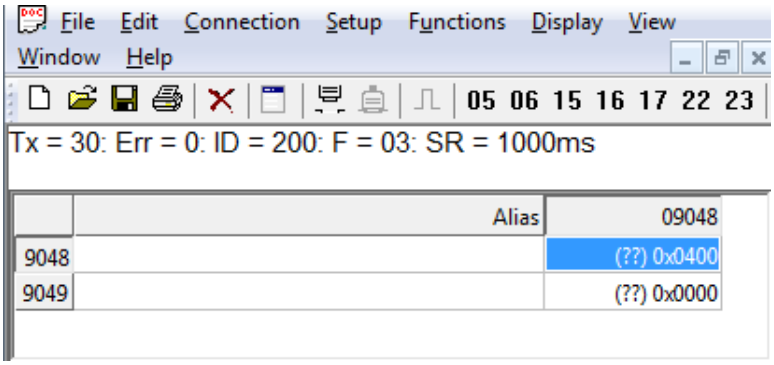
Arm 1 – Clean Arm Volume not Reached Active Alarm Map:



Product Stream 2 – No Product Active Alarm Map:



Additive Stream 1 – Control Failure Active Alarm Map:

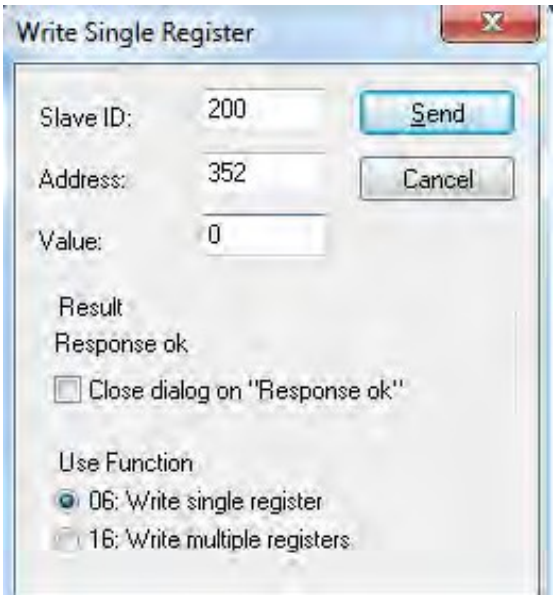


7.4.5.6 Active Alarms Reset:

Active Alarms can be Reset using individual reset bits.

All Active Device Alarms Reset:

Send Value = 0 for All Device alarms reset.



All Active Bay Alarms Reset:

All Bay Active alarms can be reset by sending command as given below.

Bay Details	Value to Send
Bay#1	0
Bay#2	1

Example: All Bay#2 Active alarm Reset.



All Active Arm Alarms Reset:

All Arm Active alarms can be reset by sending command as given below.

Arm Details	Value to Send
Arm#1	0
Arm#2	1
Arm#3	2
Arm#4	3
Arm#5	4
Arm#6	5

Example: All Arm#2 Active alarm Reset.



All Active Product Streams Alarms Reset:

All Product Stream Active alarms can be reset by sending command as given below.

Arm Details	Value to Send
Stream#1	0
Stream#2	1
Stream#3	2
Stream#4	3
Stream#5	4
Stream#6	5

Arm Details	Value to Send
Stream#7	6
Stream#8	7
Stream#9	8
Stream#10	9
Stream#11	10
Stream#12	11

Example: All Active Product Stream#2 Alarm Reset.



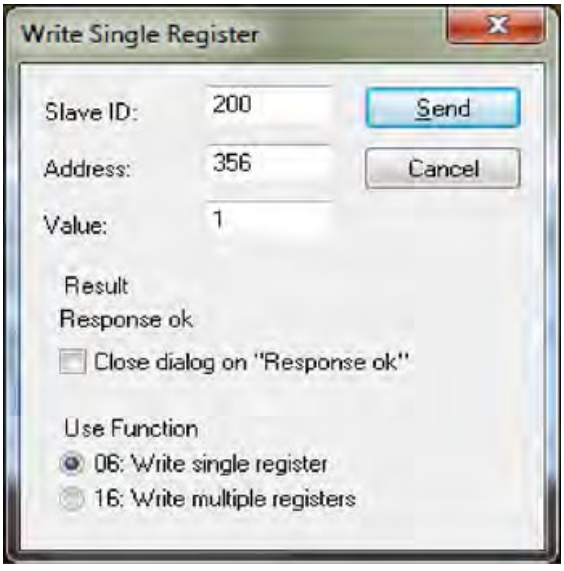
All Active Additive Streams Alarms:

All Product Stream Active alarms can be reset by sending command as given below.

Arm Details	Value to Send
Stream#1	0
Stream#2	1
Stream#3	2
Stream#4	3
Stream#5	4
Stream#6	5
Stream#7	6

Arm Details	Value to Send
Stream#8	7
Stream#9	8
Stream#10	9
Stream#11	10
Stream#12	11
Stream#13	12
Stream#14	13
Stream#15	14
Stream#16	15
Stream#17	16
Stream#18	17
Stream#19	18
Stream#20	19
Stream#21	20
Stream#22	21
Stream#23	22
Stream#24	23

Example: All Active Additive Stream#2 Alarm Reset.



7.4.6 Instantaneous Values

The MSC-L supports a set of buffer type registers each of which holds the instantaneous state of a loading arm including process variables for all streams currently being used by the loading arm. The set of process variables exposed for each stream (including the finished product stream) is defined by the set of configuration registers.

7.4.6.1 Instantaneous Values Configuration State

Table 7-72: MSC-L Instantaneous Batch Value Configuration UDI Registers.

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Inst. Batch Value – Batch GOV	221	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Batch GSV	222	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Batch Mass	223	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Temperature	224	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Pressure	225	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Density	226	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Flow rate	227	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – Blend percentage	228	ENUM_ENABLE_ DISABLE	1	1
Inst. Batch Value – PPM	229	ENUM_ENABLE_ DISABLE	1	1

By default, all above configurable registers are ENABLE.

Enabling a particular instantaneous batch value configuration register will immediately cause all subsequent instantaneous batch values to include the

process variable for all streams (even if the value is not well defined for a given stream).

7.4.6.2 Instantaneous Process Variables

Table 7-73: UDI Modbus registers

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
Inst. Batch Value – Arm 1	140	char [512]	512	1
Inst. Batch Value – Arm 2	141	char [512]	512	1
Inst. Batch Value – Arm 3	142	char [512]	512	1
Inst. Batch Value – Arm 4	143	char [512]	512	1
Inst. Batch Value – Arm 5	144	char [512]	512	1
Inst. Batch Value – Arm 6	145	char [512]	512	1

These registers holds the instantaneous process variables associated with a particular arm currently running on the device (the state of this variable is undefined if the arm is not currently running). This includes final finished product process variables as well as stream-level process variables for all streams used in the current batch. This also includes virtual streams (for side stream blending). This entity is implemented as a buffer since the amount and content of data changes whenever an arm starts to load. The caller is responsible for knowing how much data to request and how incremental requests should be formulated to ensure that consistent set of data is requested. Namely, data should be requested in units of streams to ensure that all stream-related is consistent. All data will be provided in the configured user units of measurement.

The instantaneous value will be populated with sequence of product and additive sub-records in accordance to the currently selected recipe. The order of the sub-records starts with the final finished product subrecord followed by the main product sub-record. These two sub-records will always be present-all subsequent records depend upon whether the selected recipe includes blending and/or additive injection. If the recipe calls for blend streams, then the blend stream sub-records will follow the main product sub record in the order in which they are defined in the recipe. Similarly, if the recipe calls for additives, then the additive stream sub-records will immediately follow the last blend stream sub-record.

The content of each sub-record is based upon the configured device- wide instantaneous value settings. The instantaneous stream header value explicitly defines the set of process variables that follow. The order of these values is defined by the order of process variables' presence bits in the instantaneous stream header value. A presence bit value of "1" shall indicate that the value is present in the sub-record and 0 shall indicate that the value is not present. The order of process variables starts from the LSB of the stream header value.

Order of Sub-records in Instantaneous Values (* indicates Recipe- Dependent Sub-Records).

Sub Record	Type
Finished Product	Product Sub-record
Main Product	Product Sub-record
Blend Product 1*	Product Sub-record
Blend Product 2*	Product Sub-record
Blend Product 3*	Product Sub-record
Additive Product 1*	Additive Sub-record
Additive Product 2*	Additive Sub-record
Additive Product 3*	Additive Sub-record
Additive Product 4*	Additive Sub-record
Additive Product 5*	Additive Sub-record
Additive Product 6*	Additive Sub-record

Table 7-74: Instantaneous Stream Header Definition

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit	Bit 1	Bit 0
0	0	0	0	0	0	0	PPM	Blend Percent	Inst. Flow Rate	Inst. Density	Inst. Pressure	Inst. Temp	Batch Mass	Batch GSV	Batch GOV

Finished Product Stream Sub-record (BATCH)		
Field Description	Data Type	Enumeration/Structure Type
Header definition	uint16	
Inst. Value – GOV/Mass	float32	
Inst. Value – GSV	float32	
Inst. Value – Mass	float32	
Inst. Value – Temperature	float32	
Inst. Value – Pressure	float32	
Inst. Value – Density	float32	
Inst. Value – Flowrate	float32	
Inst. Value - Blend Percent (NA – NaN always)	float32	
Inst Value – ppm (NA – NaN always)	float32	

Main and Blend Product Stream Sub-record		
Field Description	Data Type	Enumeration/Structure Type
Header definition	uint16	
Inst. Value – GOV/Mass	float32	
Inst. Value – GSV	float32	
Inst. Value – Mass	float32	
Inst. Value – Temperature	float32	
Inst. Value – Pressure	float32	
Inst. Value – Density	float32	
Inst. Value – Flowrate	float32	
Inst. Value - Blend Ratio	float32	
Inst. Value – PPM (NA – NaN always)	float32	

Additive Product Stream Sub-record		
Field Description	Data Type	Enumeration/Structure Type
Header definition	uint16	Also, Set Point

Additive Product Stream Sub-record		
Field Description	Data Type	Enumeration/Structure Type
Inst. Value - Injection Volume	float32	
Inst. Value – GSV (NA – NaN always)	float32	
Inst. Value – Mass (NA – NaN always)	float32	
Inst. Value - Temperature	float32	
Inst. Value – Pressure (NA – NaN always)	float32	
Inst. Value – Density (NA – NaN always)	float32	
Inst. Value – Flowrate (NA – NaN always)	float32	
Inst. Value - Blend Percent (NA – NaN always)	float32	
Inst. Value - PPM	float32	

In the following screen shot, Instantaneous values are shown for Arm1 with two products in the recipe.

Tx = 260: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20000	Alias	20020	Alias	20040	Alias	20060	Alias	20080
0	• Universal Data Interface: State	0		--	Inst Value - Density	989.52		--		nan
1	• Universal Data Interface: Error Code	0	Inst Value- Density	990.032		--	Inst Value - Flow Rate	404.036		--
2	• Universal Data Interface: Command	2		--	Inst Value - Flow Rate	306.51		--		nan
3	• Universal Data Interface: Item	140	Inst. Value - Flow Rate	710.545		--	inst Value - Blend ratio	0.459359		--
4	• Universal Data Interface: Item Index (device)	0		--	inst Value - Blend ratio	0.540641		--		0
5	• Universal Data Interface: Item Size (bytes)	1	Inst Value - Blend Ratio	nan		--	Inst value - Additive ppm	nan		0
6	• Universal Data Interface: Item Elements (device)	512		--	Inst value - Additive ppm	nan		--		0
7	• Universal Data Interface: Item Data Type	1	Inst Value - ppm	nan		--		-255		0
8	Reserved	0		--	Header (prod)	(??) 0xFF01		nan		0
9	Reserved	140	Header (prod)	(??) 0xFF01	Inst. Value - GOV	803.365		--		0
10	Header definition	(??) 0xFF01	Inst. Value - GOV	944.816		--		nan		0
11	Inst. Value - GOV	1745.22		--	Inst. Value - GSV	795.67		--		0
12		--	Inst. Value - GSV	934.918		--		nan		0
13	Inst. Value - GSV	1727.66		--	Inst. Value - Mass	795.67		--		0
14		--	Inst. Value - Mass	934.918		--		nan		0
15	Inst. Value - Mass	1727.66		--	Inst. Value - Temperature	29.185		--		0
16		--	Inst. Value - Temperature	30.5151		--		nan		0
17	Inst. Value - Temperature	29.7588		--	Inst. Value - Pressure	nan		--		0
18		--	Inst. Value - Pressure	nan		--		nan		0
19	Inst Value - Pressure	nan		--	Inst Value - Density	990.42		--		0

Table 7-75: Two Products and one additive – values in Hex

Tx = 21: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20000	Alias	20020	Alias	20040	Alias	20060	Alias	20080
0	• Universal Data Interface: State	0		-129	Inst. Value - Density	989.52		--		nan
1	• Universal Data Interface: Error Code	0	Inst. Value - Density	989.52		--	Inst. Value - Density	0		--
2	• Universal Data Interface: Command	2		--	Inst. Value - Flow Rate	404.035		--		nan
3	• Universal Data Interface: Item	140	Inst. Value - Flow Rate	404.036		--	Inst. Value - Flow Rate	0.487322		--
4	• Universal Data Interface: Item Index (device)	0		--	Inst. Value - Blend Ratio	0.512678		--	Inst. Value - PPM	1060
5	• Universal Data Interface: Item Size (bytes)	1		nan		--		nan		--
6	• Universal Data Interface: Item Elements (device)	512		--		nan		--		
7	• Universal Data Interface: Item Data Type	1		nan		--		-255		
8	Reserved	0		--	Header defination	-255	Inst. Value - Injention Volume	4.35467		
9	Reserved	140		-255	Inst. Value - GOV	2001.66		--		
10	Header defination	-255	Inst. Value - GOV	2107.49		--		nan		
11	Inst. Value - GOV	4107.46		--	Inst. Value - GSV	1982.48		--		
12		--	Inst. Value - GSV	2085.39		--		nan		
13	Inst. Value - GSV	4066.21		--	Inst. Value - Mass	1982.48		--		
14		--	Inst. Value - Mass	2085.39		--	Inst. Value - Temperature	29.1666		
15	Inst. Value - Mass	4066.21		--	Inst. Value - Temperature	29.1926		--		
16		--	Inst. Value - Temperature	30.5202		--		nan		
17	Inst. Value - Temperature	30.5202		--	Inst. Value - Pressure	nan		--		
18		--	Inst. Value - Pressure	nan		--		nan		
19	Inst. Value - Pressure	-1		--	Inst. Value - Density	990.42		--		

Table 7-76: Two Products and one additive – values in Float

Tx = 21: Err = 0: ID = 200: F = 03: SR = 1000ms

	Alias	20000	Alias	20020	Alias	20040	Alias	20060	Alias	20080
0	• Universal Data Interface: State	0		-129	Inst. Value - Density	989.52		--		nan
1	• Universal Data Interface: Error Code	0	Inst. Value - Density	989.52		--	Inst. Value - Density	0		--
2	• Universal Data Interface: Command	2		--	Inst. Value - Flow Rate	404.035		--		nan
3	• Universal Data Interface: Item	140	Inst. Value - Flow Rate	404.036		--	Inst. Value - Flow Rate	0.487322		--
4	• Universal Data Interface: Item Index (device)	0		--	Inst. Value - Blend Ratio	0.512678		--	Inst. Value - PPM	1060
5	• Universal Data Interface: Item Size (bytes)	1		nan		--		nan		--
6	• Universal Data Interface: Item Elements (device)	512		--		nan		--		
7	• Universal Data Interface: Item Data Type	1		nan		--		-255		
8	Reserved	0		--	Header defination	-255	Inst. Value - Injention Volume	4.35467		
9	Reserved	140		-255	Inst. Value - GOV	2001.66		--		
10	Header defination	-255	Inst. Value - GOV	2107.49		--		nan		
11	Inst. Value - GOV	4107.46		--	Inst. Value - GSV	1982.48		--		
12		--	Inst. Value - GSV	2085.39		--		nan		
13	Inst. Value - GSV	4066.21		--	Inst. Value - Mass	1982.48		--		
14		--	Inst. Value - Mass	2085.39		--	Inst. Value - Temperature	29.1666		
15	Inst. Value - Mass	4066.21		--	Inst. Value - Temperature	29.1926		--		
16		--	Inst. Value - Temperature	30.5202		--		nan		
17	Inst. Value - Temperature	30.5202		--	Inst. Value - Pressure	nan		--		
18		--	Inst. Value - Pressure	nan		--		nan		
19	Inst. Value - Pressure	-1		--	Inst. Value - Density	990.42		--		

Instantaneous values are for Arm1 with one product in the recipe and 'Disabled Batch Mass' – value in float.

	Alias	20000	Alias	20010	Alias	20020	Alias	20030
0	• UDI: State	0	Finished Prod. (FP) - Header Defi...	(?) 0x7801		(yD) 0x7944	MP - Inst. Value – Temperat...	20.2033
1	• UDI: Error Code	0	FP- Inst. Value – GOV	7434		--		--
2	• UDI: Command	-1		--		--	MP - Inst. Value – Pressure	nan
3	• UDI: Item	140	FP - Inst. Value – GSV	7409.28	FP - Inst. Value – Blend %	nan		--
4	• UDI: Item Index (device)	0		--		--	MP - Inst. Value – Density	996.49
5	• UDI: Item Size (bytes)	1	FP -Inst. Value – Temperature	20.2033	Main Prod. (MP) - Header Def...	(?) 0x7801		--
6	• UDI: Item Elements (devi...	512		--	MP - Inst. Value – GOV	7436.6	MP - Inst. Value – Flowrate	599.641
7	• UDI: Item Data Type	1	FP - Inst. Value – Pressure	nan		--		--
8	Reserved	0		--	MP - Inst. Value – GSV	7411.87	MP - Inst. Value – Blend %	nan
9	• UDI: Response UDI Item	140	FP - Inst. Value – Density	(\?) 0x5C1F		--		--

Instantaneous values are for Arm1 with one product in the recipe and 'Disabled Batch Mass' – value in hex.

	Alias	20000	Alias	20010	Alias	20020	Alias	20030
0	• UDI: State	0	Finished Prod. (FP) - Header Defi...	({?) 0x7B01		(yD) 0x7944	MP - Inst. Value – Temperat...	(Y?) 0x56A0
1	• UDI: Error Code	0	FP- Inst. Value – GOV	(?P) 0x0050		(??) 0xC0F1		(:A) 0xA141
2	• UDI: Command	-1		(?E) 0xE845		(?D) 0x1544	MP - Inst. Value – Pressure	(??) 0xFFFF
3	• UDI: Item	140	FP - Inst. Value – GSV	(B?) 0x428A	FP - Inst. Value – Blend %	(??) 0xFFFF		(??) 0xFF7F
4	• UDI: Item Index (device)	0		(?E) 0xE745		(??) 0xFF7F	MP - Inst. Value – Density	(\?) 0x5C1F
5	• UDI: Item Size (bytes)	1	FP -Inst. Value – Temperature	(V?) 0x56A0	Main Prod. (MP) - Header Def...	({?) 0x7B01		(yD) 0x7944
6	• UDI: Item Elements (devi...	512		(?A) 0xA141	MP - Inst. Value – GOV	(?d) 0xCD64	MP - Inst. Value – Flowrate	(??) 0x02E9
7	• UDI: Item Data Type	1	FP - Inst. Value – Pressure	(??) 0xFFFF		(?E) 0xE845		(?D) 0x1544
8	Reserved	0		(??) 0xFF7F	MP - Inst. Value – GSV	(??) 0xFC9E	MP - Inst. Value – Blend %	(??) 0xFFFF
9	• UDI: Response UDI Item	140	FP - Inst. Value – Density	(\?) 0x5C1F		(?E) 0xE745		(??) 0xFF7F

7.4.6.3 Stream Dynamic Info

Stream Dynamic Info (Temperature, Pressure and Density) can be read by using UDI 189.

	Alias	20000	Alias	20010	Alias	20020
0	• Universal Data Interface: State	0	Stream 1 - Temperature	18.5529	Stream 2 - Density	83.6547
1	• Universal Data Interface: Error Code	0		--		--
2	• Universal Data Interface: Command	2	Stream 1 - Pressure	83.4319		100000
3	• Universal Data Interface: Item	189		--		--
4	• Universal Data Interface: Item Index (device)	0	Stream 1 - Density	66.4169		100000
5	• Universal Data Interface: Item Size (bytes)	12		--		--
6	• Universal Data Interface: Item Elements (device)	6	Stream 2 - Temperature	0.550128		100000
7	• Universal Data Interface: Item Data Type	639		--		--
8	• Universal Data Interface: Command Counter	7	Stream 2 - Pressure	4.91747		100000
9	• Universal Data Interface: Response UDI Item	189		--		--

7.4.7 Digital IO State

7.4.7.1 Arm Board Digital IO State

Consolidated Digital IO states are available in Standard Modbus as well as UDI.

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
eArmEntityBoardDigitalIoState	230	Digital State	4	2

Relative address within Submap (Arm Card)

(● marksglobal parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration Type
Digital I/O State	048	0030	049	400049	2	uint32	R	Digital State

The Submap start addresses for CAN-ARM-MSC-1 and CAN-ARM- MSC-2 can be seen in Map (device) as well as Map (Arm).

The Bitmasks are available in ARM Card Digital IO States. The bit corresponding to the bitmask is set when the corresponding IO is active and 0 when inactive. The mapping between Device IO names and bitmasks are as shown below.

Board	Device IO Name	Digital IO Bitmask
CAN-ARM-MSC-1	DO-SSR-1 to DO-SSR-12	ARM_CARD_DIG_IO_STATE_DO_SSR_1 to ARM_CARD_DIG_IO_STATE_DO_SSR_12
	QPI 1A,1B to QPI 6A,6B	ARM_CARD_DIG_IO_STATE_SPI_DI_DC_1 to ARM_CARD_DIG_IO_STATE_SPI_DI_DC_12
CAN-ARM-MSC-2	DO-SSR-21 to DO-SSR-32	ARM_CARD_DIG_IO_STATE_DO_SSR_1 to ARM_CARD_DIG_IO_STATE_DO_SSR_12
	QPI 7A,7B to QPI 12A,12B	ARM_CARD_DIG_IO_STATE_SPI_DI_DC_1 to ARM_CARD_DIG_IO_STATE_SPI_DI_DC_12

7.4.7.2 In-Out Board Digital IO State

Consolidated Digital IO states are available in Standard Modbus as well as UDI.

UDI Items				
Description/Reference	Value	Data Type	Size	Elements
eIocEntityBoardDigitalIoState	231	Digital State	4	4

Relative address within Submap (IO Card):

(● marksglobal parameters)	Starting Holding Register				Data Size / Type			
Parameter Name	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type	Access	Enumeration Type
Digital IO State	034	0022	035	400035	2	uint32	R	Digital State

The Submap start addresses for CAN-IN-OUT-MSC-1 and CAN-IN-OUT- MSC-4 can be seen in Map (device) as well as Map (Arm).

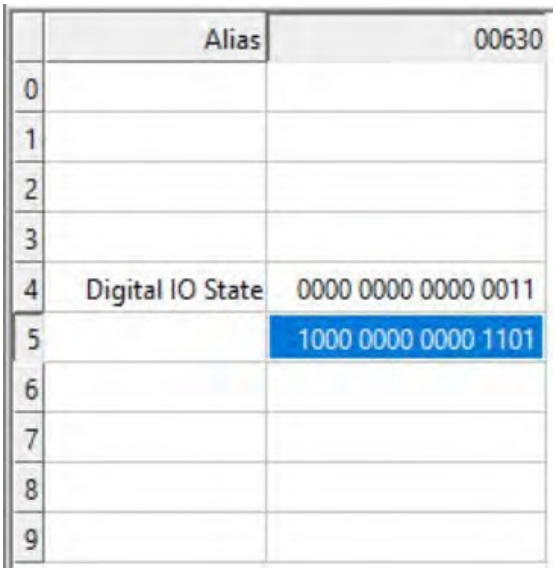
The Bitmasks are available in IO Card Digital IO States. The bit corresponding to the bitmask is set when the corresponding IO is active and 0 when inactive. The mapping between Device IO names and bitmasks are as shown below.

Board	Device IO Name	Digital IO Bitmask
CAN-IN-OUT-MSC-1	DI-DC-1 to DI-DC-15	IO_CARD_DIG_IO_STATE_DI_DC_1 to IO_CARD_DIG_IO_STATE_DI_DC_15
	DO-EMR-1 to DO-EMR-10	IO_CARD_DIG_IO_STATE_DO_EMR_1 to IO_CARD_DIG_IO_STATE_DO_EMR_10
	DO-SSR-13 to DO-SSR-16	IO_CARD_DIG_IO_STATE_DO_SSR_1 to IO_CARD_DIG_IO_STATE_DO_SSR_4
	DI-AC-1 to DI-AC-3	IO_CARD_DIG_IO_STATE_DI_AC_1 to IO_CARD_DIG_IO_STATE_DI_AC_3
CAN-IN-OUT-MSC-2	DI-DC-16 to DI-DC-30	IO_CARD_DIG_IO_STATE_DI_DC_1 to IO_CARD_DIG_IO_STATE_DI_DC_15
	DO-EMR-11 to DO-EMR-20	IO_CARD_DIG_IO_STATE_DO_EMR_1 to IO_CARD_DIG_IO_STATE_DO_EMR_10
	DO-SSR-17 to DO-SSR-20	IO_CARD_DIG_IO_STATE_DO_SSR_1 to IO_CARD_DIG_IO_STATE_DO_SSR_4
	DI-AC-4 to DI-AC-6	IO_CARD_DIG_IO_STATE_DI_AC_1 to IO_CARD_DIG_IO_STATE_DI_AC_3
CAN-IN-OUT-MSC-3	DI-DC-31 to DI-DC-45	IO_CARD_DIG_IO_STATE_DI_DC_1 to IO_CARD_DIG_IO_STATE_DI_DC_15

Board	Device IO Name	Digital IO Bitmask
	DO-EMR-21 to DO-EMR-30	IO_CARD_DIG_IO_STATE_DO_EMR_1 to IO_CARD_DIG_IO_STATE_DO_EMR_10
	DO-SSR-33 to DO-SSR-36	IO_CARD_DIG_IO_STATE_DO_SSR_1 to IO_CARD_DIG_IO_STATE_DO_SSR_4
	DI-AC-7 to DI-AC-9	IO_CARD_DIG_IO_STATE_DI_AC_1 to IO_CARD_DIG_IO_STATE_DI_AC_3
CAN-IN-OUT-MSC-4	DI-DC-46 to DI-DC-60	IO_CARD_DIG_IO_STATE_DI_DC_1 to IO_CARD_DIG_IO_STATE_DI_DC_15
	DO-EMR-31 to DO-EMR-40	IO_CARD_DIG_IO_STATE_DO_EMR_1 to IO_CARD_DIG_IO_STATE_DO_EMR_10
	DO-SSR-37 to DO-SSR-40	IO_CARD_DIG_IO_STATE_DO_SSR_1 to IO_CARD_DIG_IO_STATE_DO_SSR_4
	DI-AC-10 to DI-AC-12	IO_CARD_DIG_IO_STATE_DI_AC_1 to IO_CARD_DIG_IO_STATE_DI_AC_3

Test screen shots with Non-UDI Registers

DI-DC-2 Inactive



	Alias	00630
0		
1		
2		
3		
4	Digital IO State	0000 0000 0000 0011
5		1000 0000 0000 1101
6		
7		
8		
9		

DI-DC-2 Active

	Alias	00630
0		
1		
2		
3		
4	Digital IO State	0000 0000 0000 0011
5		1000 0000 0000 1111
6		
7		
8		
9		

Test Screen shots with UDI registers

All DI-DC of FM-IN-OUT-1 make LOW (Big-Endian).

	Alias	20000	Alias	20010
0	UDI: State	0		0000 0000 1000 0000
1	UDI: Error Code	0		0000 0001 0000 0000
2	UDI: Command	2		0
3	UDI: Item	231		0
4	UDI: Item Index	0		0
5	UDI: Item Size	4		0
6	UDI: Item Elements	1		0
7	UDI: Item Data Type	5		0
8	UDI: Reserved	0		0
9	UDI: Response Item	231		0

DI-DC-1 of FM-IN-OUT-1 make High (Big-Endian).

	Alias	20000	Alias	20010
0	UDI: State	0		0000 0001 1000 0000
1	UDI: Error Code	0		0000 0001 0000 0000
2	UDI: Command	2		0
3	UDI: Item	231		0
4	UDI: Item Index	0		0
5	UDI: Item Size	4		0
6	UDI: Item Elements	1		0
7	UDI: Item Data Type	5		0
8	UDI: Reserved	0		0
9	UDI: Response Item	231		0

DI-DC-1 and DI-DC-2 of FM-IN-OUT-1 make High (Big-Endian).

	Alias	20000	Alias	20010
0	UDI: State	0		0000 0011 1000 0000
1	UDI: Error Code	0		0000 0001 0010 0000
2	UDI: Command	2		0
3	UDI: Item	231		0
4	UDI: Item Index	0		0
5	UDI: Item Size	4		0
6	UDI: Item Elements	1		0
7	UDI: Item Data Type	5		0
8	UDI: Reserved	0		0
9	UDI: Response Item	231		0

DI-DC-1, DI-DC-2 and DI-DC-9 of FM-IN-OUT-1 make High (Big-Endian).

	Alias	20000	Alias	20010
0	UDI: State	0		0000 0011 1000 0001
1	UDI: Error Code	0		0000 0001 0000 0000
2	UDI: Command	2		0
3	UDI: Item	231		0
4	UDI: Item Index	0		0
5	UDI: Item Size	4		0
6	UDI: Item Elements	1		0
7	UDI: Item Data Type	5		0
8	UDI: Reserved	0		0
9	UDI: Response Item	231		0

All DI-DC of FM-IN-OUT-1 make High (Big-Endian).

	Alias	20000	Alias	20010
0	UDI: State	0		1111 1111 1111 1111
1	UDI: Error Code	0		0000 0001 0010 0000
2	UDI: Command	2		0
3	UDI: Item	231		0
4	UDI: Item Index	0		0
5	UDI: Item Size	4		0
6	UDI: Item Elements	1		0
7	UDI: Item Data Type	5		0
8	UDI: Reserved	0		0
9	UDI: Response Item	231		0

7.4.8 Update Authorization Database

7.4.8.1 User Database

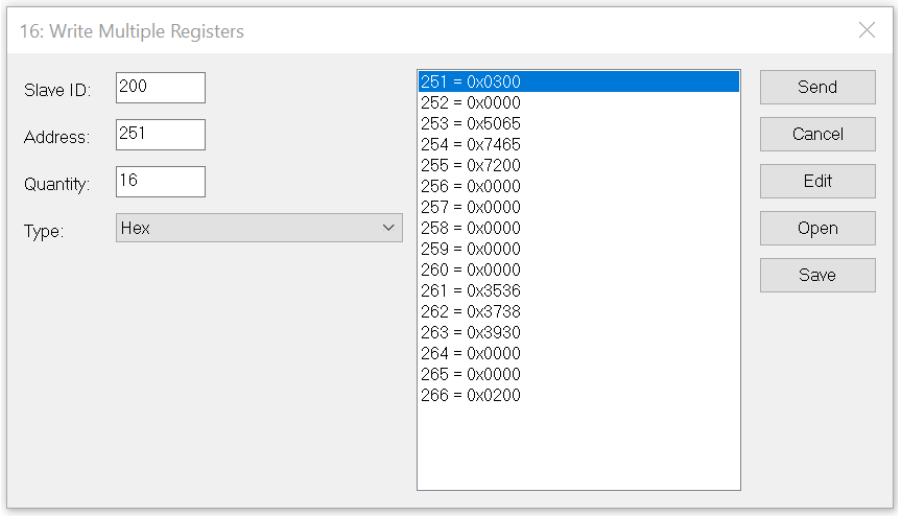
Table 7-77: User Database

Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Authorization Data: User	251	00FB	252	400252	16	struct [32]	R/W	Authorization Data

This register is used to update user database. User database structure.

- Index (range 0 to 999)
- Name (max 16 characters)
- Password (max 10 characters)
- Attribute (SL1 = 1, SL2 = 2, SL3 = 3)

  Example: Update user database to Index 4.
- Authorization Index = 3
- Name = “Peter”
  - Password = “567890”
- Attribut = 2 (SL02)



	Alias	00250	Alias	00260
0				(??) 0x0000
1	Authorization Index	(??) 0x0300	Password	(56) 0x3536
2		(??) 0x0000		(78) 0x3738
3	Name	(Pe) 0x5065		(90) 0x3930
4		(te) 0x7465		(??) 0x0000
5		(r?) 0x7200		(??) 0x0000
6		(??) 0x0000	Attribute	(??) 0x0200
7		(??) 0x0000		
8		(??) 0x0000		
9		(??) 0x0000		

7.4.8.2 Object Database

Table 7-78: Object Database

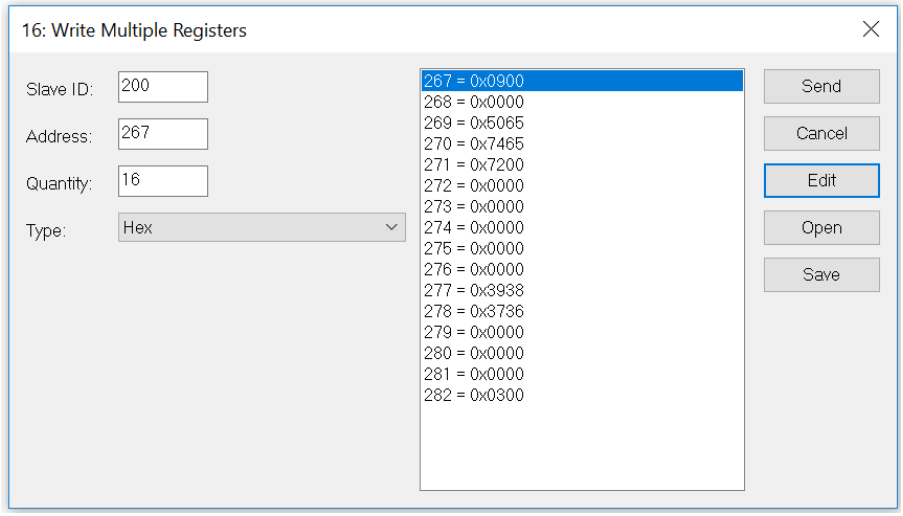
Parameter Name	Starting Holding Register				Data Size / Type		Access	Enumeration Type
	Address (Decimal / Hex)		Number (Standard / Modicon)		Registers	Type		
Authorization Data: Object	267	010B	268	400268	16	struct [32]	R/W	Authorization Data

This register is used to update object database. User database structure.

- Index (range 0 to 999)
- Name (max 16 characters)
- Password (max 10 characters)
- Attribute (Unknown = 0, Vehicle = 1, Carrier = 2, Trailer = 3, Contract = 4)

Example: Update user database to Index 10.

- Authorization Index = 9
- Name = “Peter”
- Password = “9876”
- Attribute = Trailer



	Alias	00260	Alias	00270	Alias	00280
0				(te) 0x7465		(??) 0x0000
1				(r?) 0x7200		(??) 0x0000
2				(??) 0x0000	Attribute	(??) 0x0300
3				(??) 0x0000		
4				(??) 0x0000		
5				(??) 0x0000		
6				(??) 0x0000		
7	Authorization Index	(??) 0x0900	Password	(98) 0x3938		
8		(??) 0x0000		(76) 0x3736		
9	Name	(Pe) 0x5065		(??) 0x0000		

8 Serial Line Internet Protocol (SLIP+)

8.1 Description

SLIP+ is an Internet Protocol designed to work on an RS-232/RS-422/ RS-485 interface using a baudrate of 1200 to 128,000 bps, any parity and 8 data bits.

All data is sent in 8-bit binary data in the general format shown below:

C0H	ADDR	CONTROL	INFORMATION	LRC	C0H

Term	Description
C0H	Each frame is preceded and followed by a special frame end (FEND) character, C0H. The reason for both preceding and ending frames with FENDS is to improve performance when there is noise on the asynchronous line. The maximum number of bytes per frame is 200.
ADDR	Address byte, see section 8.1.1.
CONTROL	Control byte, see section 8.1.2.
INFORMATION	Information field, see section 8.1.3.
LRC	Longitudinal Redundancy Checksum byte, see section 8.1.4.

8.1.1 Address Byte

When information is sent from the host computer to an instrument, the address byte should contain the designation address of the instrument for which the information is intended.

When information is sent from an instrument to a host computer, the Address byte should contain the address of the instrument from which the information is being sent.

The address of the instrument is the identification number (ID) with 80H added to it, where the address is in the range of 80H to 9FH. For example, an instrument ID = 2 would be transmitted as an address of 82H.

8.1.2 Control Byte

The control byte should be one of the following (see the following table):

Table 8-1: Control Byte Description

Control Byte	Hex Value	Description
ENQ	05_{HEX}	Used by the host to poll the instruments.
STX	02_{HEX}	Used to indicate that the information field contains data.
ACK	06_{HEX}	Used by the instrument to indicate that the received frame is valid.
BS		Used by the instrument to indicate that the received command cannot be answered because the instrument is in the wrong mode of operation.
NAK	15_{HEX}	Used by the instrument to indicate that the received frame is invalid.
EOT	04HEX	Used by the host to indicate the end of transmission.

8.1.3 Information Field

The information field is an optional field and is only present when the STX control byte is used. A terminating byte of ETX (03_{HEX}) indicates the end of the information field. An alternating byte of ETB (17HEX) indicates the end of the information field, with more information to follow in the next frame.

The information in the command and data fields must be in the ASCII range of values 20_{HEX} through to $7F_{HEX}$.

The information field must contain a two-byte alphanumeric command and an arbitrary number of data fields.

The NULL (00_{HEX}) character separates the command and data fields.

The general format for the information field is as follows:

Command	00_{HEX}	Data Field 1	00_{HEX}	Data Field 2	*****	****	00_{HEX}	ETX

8.1.4 Longitudinal Redundancy Checksum Byte

The Longitudinal Redundancy Checksum (LRC) byte must be equal to the Exclusive OR (XOR) of all the bytes in the packet, excluding the closing bracket $C0_{HEX}$. The LRC register shall be set to 0 at the beginning of each frame.

The LRC should be derived by the transmitting unit during transmission and then sent to the receiving unit. The receiving unit should, in turn, check each byte for parity, derive the LRC from the information it has received and then compare the LRC it received to the one it derived.

Once the correct closing bracket $C0_{HEX}$ has been received, one of the following conditions would arise (see the following table):

Table 8-2: LRC Scenarios

Receiving Unit	Frame Correct	Frame Incorrect
Instrument	Send data, if command calls for data to be sent. If else, send ACK, NAK or BS.	Do nothing.
Host computer	Send next command or EOT.	Repeat command.

For a frame to be acceptable it must meet the following:

- All bytes (including the frame bracketing bytes) pass the parity check.
- The address byte matches the address of the unit.
- The derived LRC matches the received LRC.
- The two-byte command within any information field is valid for the unit addressed.
- Is one of the supported commands.
- A valid end of frame bracket is received within 200 ms after the opening bracket.

8.2 Fusion4 MSC-A



To provide backward compatibility, the Fusion4 MSC-A (Multi-Stream Controller for Additive Injection) uses the Serial Line Internet Protocol (SLIP+) to replace the Model 1020 Additive Injection System.

8.2.1 Commands

The SLIP+ commands are two-character codes. Some commands also require numeric parameter(s). If the command requests data from the device then the data is returned, prefaced by the command echo. Otherwise, the device responds with ACK. The device returns NAK if the command is not recognized.

8.2.1.1 Query Commands

The following table lists the SLIP+ protocol query commands.

Table 8-3: SLIP+ Protocol Query Commands

Command	Description
AD n	Returns the delivery additive for line n.
PD n	Returns the delivery product for line n.
AR n	Returns the additive rate for line n.
DA	Displays the batch totals on all lines.
DB	Displays the accumulated additive totals on all lines.
DC	Displays the accumulated product totals on all lines.
DD	Displays the date and time.
EC	Displays the number of cycles.
ER	Displays the percentage error for Low Alarm 2.
ET	Display the event timeout.
FS	Displays whether the flow switch is armed.

Command	Description
KA	Displays the k-factors for the additive flow meters on all lines.
KP	Displays the k-factors for the product flow meters on all lines.
PA	Displays the batch preset in cc's or ml's on all lines.
PB	Displays the product preset on all lines.
PI	Displays whether the permissive inputs are armed.
TR	Displays whether transaction space is remaining.
VA	Displays all alarms occurring during a transaction. The VA command is similar to the VH command, except that these alarm variables are reset by the RH command.
VH	Displays all alarms occurring during a transaction. These alarms are only reset at the beginning of a new delivery.
VR	Displays the software version.
AL	Displays whether Alarm Low Flow is armed on each line.

8.2.1.2 Commands for Changing Values

The following table lists the SLIP+ protocol commands for changing values.

> NOTE: With the commands listed in the table below, the first number is the line number and is designated "c".

Table 8-4: SLIP+ Protocol Commands for Changing Values

Command	Description
RAc xxxx.x	Presets the batch total on line c.
RBc xxxxxx.xx	Presets the additive total.
RCc xxxxxxxx	Presets the product total.
KAc xxxxx.xx	Sets the k-factor for the additive flow meter.
KPc xxxxx.xx	Sets the k-factor for the product flow meter.
PAc xxxx.x	Sets the batch preset.
PBc xxxx	Sets the product preset.
TE or TD	Enables or disables the Start key.
TA or TN	Adds or does not add totals.
RHc	Resets all alarms on line c.

Command	Description
AYc or ANc	Arms or disarms Alarm Low Flow 1.
KE or KD	Enables or disables keyboard entry.
SD xxxxxx	Sets the date (Month, Day, Year).
ERcxx	Sets the percentage error for Low Alarm 2 on line c.
ECcxxxx	Sets the number of cycles for Low Alarm 2 on line c.
ETxxxx	Sets the event timeout (in seconds).
PYc	Arms the permissives.
PNc	Disarms the permissives.
FYc	Arms the flow switches.
FNc	Disarms the flow switches.
BYc	Arms Low Flow 2.
BNc	Disarms Low Flow 2.
CD n	Clears the last delivery and product totals for line n.
MO n	Selects Mode 1 or Mode 2 operation.
PS n	Starts pump n.
PX n	Stops pump n. (n = 0 stops all pumps.)
PT n	Enables line n software permissive (TRUE).
PF n	Disables line n software permissive (FALSE).
GOc	Starts an injection pulse (i.e. starts a batch) on line c.

8.3 Fusion4 MSC-L



To provide backward compatibility, the Fusion4 MSC-L (Multi-Stream Controller for Loading) uses the Serial Line Internet Protocol (SLIP+) to replace the Model 1010 load computer (1010CB, 1010CJ, 1010BJ, 1010RD and 1010RT).

8.3.1 1010CB

=> Future implementation

8.3.2 1010CJ

=> Future implementation

8.3.3 1010BJ

The following table provides an overview of the 1010BJ SLIP+ protocol commands supported by the Fusion4 MSC-L.

Table 8-5: 1010BJ SLIP+ protocol commands supported by Fusion4 MSC-L

Command Code	Definition	Description
AA	Alter Arm Name	Remotely set the load arm name to be displayed on the instrument.
AI	Additive Injectors	Returns the additive parameter settings for the particular 1010 unit being addressed.
AM	Arm Status	Returns the status of a particular arm.
AN	Net Accumulated Totals	Returns the net accumulative total for all arms.
AP	Additive Parameters	Upload or download the additive parameters for the requested model 1020 additive injector.
AR	Additive Recipes	Upload or download the additive recipes when using intelligent additive injection.
AS	Arm Settings	Returns set up information unique to each arm.
AT	Accumulated Totals	Returns the accumulated gross totals for all arms.
BT	Batch Totals	Instructs the instrument to send the Batch Totals (similar to an SY command) of the last completed batch for a specific arm.

Command Code	Definition	Description
CA	Control Arm	Allows the host to disable or enabled a particular load arm.
CC	Clear Power Cycle	Clears/resets the Power Cycle/Failure flag. NOTE: The Power Cycle/Failure flag is only set in the ENQ response if power fails during a load.
CM	Clear Message	Clears the on-screen message sent as part of a DM, DP, GA, GC, GH, or GK command and clears the status associated with the relevant command.
CP	Set or Clear PIN Numbers	Adds or removes driver and truck objects to or from the user and object databases in the Fusion4 MSC-L.
DM	Display Message	Displays a message up to 8 lines each of 30 characters on the graphics display. The instrument status then goes to DM and any ENQ command is responded to with a DM reply (see ENQ). The message displayed by this command can be cleared by the CM command, all operator input is ignored while the message is being displayed.
DN	Set Arm Density	Send the product density for a particular arm to the instrument. 1010's manual density is the density at base temperature (e.g. 15 °C), so DN command density allow when density at observed temperature in MSC-L set to base temperature (15 °C).
DP	Display Prompt	Displays a message on the alphanumeric display with an automatic timeout period. The instrument status then goes to DP. If a response is received from an operator (ENTER/YES) the status moves to MT (Message Taken). If the timeout period is allowed to expire before a response is received the status reverts to its previous state.

Command Code	Definition	Description
ENQ	Operational State Enquiry	Checks the operational state of the Loading System.
FR	Flow Rates	Returns the flow rates for all arms.
GA	Get Answer	Displays a message to which the operator should respond using the alpha-numeric keys and/or the YES/NO keys. The instrument status goes to GA until an answer has been entered the response to an ENQ command will then be AA. Note: An alpha-numeric keyboard response is always terminated using the Enter/Yes key.
GD	Get Date and Time	Returns the date and time from the instrument.
GH	Get Hidden	Displays a message to which the operator should respond using numeric keys and/or the YES/NO keys. The instrument status goes to GH until the operator responds at which time the instrument response changes to AA To provide security each key press displays an asterisk rather than the key pressed. Note: An alphanumeric keyboard response is always terminated using the Enter/Yes key.
GT	Gross Totals	Displays a message up to 8 lines each of 30 characters on the graphics display. The instrument status goes to GK and any ENQ command is responded to with GK (see ENQ) until touch key is read at which time the response changes to KA.
IA	Injector Accumulative Totals	Returns the accumulative line totals for the requested model 1020 additive injector.
IT	Instantaneous Temperatures	Returns the instantaneous temperature for all arms.

Command Code	Definition	Description
LT	Last Load Temperatures	Returns the last load temperature for all arms. NOTE: Parameter b indicates how many “temperature” parameters follow. For example, if b = 2 then only parameters [a] through [e] are received.
MI	Message Initial	Allows a custom initial message to be downloaded to the instrument.
MR	Manager Reset	Clears various alarms in the instrument. Has the same effect as a manual manager reset performed by entering the manager password into the instrument.
NT	Net Totals	Returns the net total for all arms.
OP	Option Settings	Returns settings of the -OPTIONS- configuration menu.
PD	Power Cycle Date and Time	Returns the date and time the last Power Cycle was detected (when the Power Cycle flag was last set).
PR	Presets	Returns the preset for all arms.
RA	Remote Authorise	Remotely authorises the presented touch key, card, or PIN when the instrument status is RA. If the driver/truck is not authorised, a message is displayed with a reason. The message can be up to 30 characters on the graphics display.
RC	Compartment Response	In a load schedule application, once the ENQ command has determined that the instrument is waiting for compartment loading information, the RC command is used to send that information.
RD	Reset Date and Time	Sets the instrument date and time.
RL	Load Number Response	In a load schedule application, once the ENQ command has determined that the instrument is waiting for load confirmation, the RL command is used to send that information.
SA	Send Answer	Returns the answer received from the GA or GH commands.

Command Code	Definition	Description
SM	Stop Arm	Stops a load/batch on a particular arm.
SO	System Options	Returns settings of the -SYSTEM- configuration menu.
ST	Send Transaction	Returns the requested transaction.
SV	Software Version	Returns the Fusion4 MSC-L software version, date and time from the instrument, for example "V4-010-,1010A1-00-,V0000.00-0000,JAN012015,01:01:01,FLASH,0,GRAPHIC".
SY	Send batch	Sends an single compartment load (i.e. batch). There may be several batches per transaction.
TC	Transaction Complete	Clears the PL (post loading) state of the Contrec unit taking it to the disconnect prompt.
TT	Terminate Transaction	Aborts a transaction that is currently in progress on the instrument. Remotely stops a transaction on the instrument by removing authorization and forcing it to the disconnect prompt.
VA	Valve Settings and Calibrations	Returns the calibration number, date and time and settings of the -VALVE- menu.

8.3.3.1 AA - Alter Arm Name

The AA command allows the host to remotely set the load arm name to be displayed on the instrument.

- Send

Control Byte	Information Fields
STX	[AA] 0 [a] 0 [b] 0 [ETX] where: a = arm number [x] b = arm name [xxxxxxxx]

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	• If the requested arm number does not exist. • If the number of parameters is less than 2. • If the number of characters within parameter b is greater than 8.

Remarks: The arm name can also be edited from within the arm configuration menu.

Related commands: None

Constraints:

1. Instrument must be in the idle state.
2. This command requires extra time as the instrument must update the non-volatile memory. A minimum of 3 extra seconds should be allowed for both waiting for an acknowledge (ACK) response and before another command is sent to the instrument.

8.3.3.2 AI - Additive Injectors

The AI command allows the host to obtain the additive parameter settings for the particular 1010 unit being addressed.

- Send

Control Byte	Information Fields
STX	[AI] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[AI] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [ETX] where: a = additive injection type [INTELLIGENT] b = missed batches count [xx] c = additive batch timeout [xx] in seconds d = no. of Model 1020 additive injectors [x] e = additive pump start [BY LOAD-ALL] or [BY COMP- AS.REQ]
OR STX	[AI] 0 [a] 0 [b] 0 [ETX] where: a = additive injection type [OPEN COLLECTOR] or [110/ 240 VOLT] b = additive pulse width time [xx.x]
OR STX	[AI] 0 [a] 0 [ETX] where: a = additive injection type [NONE]

Remarks: None

Related commands: AP, AS

Constraints: Instrument must be in the idle state.

8.3.3.3 AN - Accumulated Net Totals

The AN command enables the host to obtain the status of a particular arm.

- Send

Control Byte	Information Fields
STX	[AI] 0 [ETX] where: a = arm number [x]

- Receive

Control Byte	Information Fields
STX	[AM] 0 [a] 0 [b] 0 [ETX] where: a = arm status [x] b = error status, see section 8.3.3.46
NAK	If the requested arm number does not exist

Remarks: Arm Status byte: 0 = DISABLED, 1 = ENABLED, 2 = FAULTY

Related commands: CA

Constraints: The error status indicates the previous batch error status for a particular arm only. Only when a new batch on that particular arm completes does the error status get updated.

8.3.3.4 AN - Net Accumulated Totals

The AN command enables a host to obtain the net accumulative total for all arms.

- Send

Control Byte	Information Fields
STX	[AN] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[AN] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = net accumulated total for first arm [xxxxxxxx] e = net accumulated total for second arm [xxxxxxxx] (if number of arms is greater than 1) f = net accumulated total for third arm [xxxxxxxx] (if number of arms is greater than 2) g = net accumulated total for fourth arm [xxxxxxxx] (if number of arms greater than 3)

Remarks: Parameter b indicates how many 'net accumulated total' parameters follow. For example, if b is equal to 2, then only parameters [a] through [e] are received.

Related commands: AT, FR, GT, IT, LT, NT, PR Constraints: None

8.3.3.5 AP - Additive Parameters

The AP command enables the host to upload or download the additive parameters for the requested model 1020 additive injector.

- Send (Upload)

Control Byte	Information Fields
STX	[AP] 0 [a] 0 [ETX] where: a = additive injector number [x]

- Receive (Upload)

Control Byte	Information Fields
STX	[AP] 0 [a] 0 [b] 0 [c] 0 [d] ... [i] 0 [ETX] where: a = additive injector number [x] b = line 1 load arm number [x] c = line 1 additive K-factor [xx.xxxx] d = line 1 high alarm multiplier [xx] e = line 2 load arm number [x] f = line 2 additive K-factor [xx.xxxx] g = line 2 high alarm multiplier [xx] h = line 3 load arm number [x] i = line 3 additive K-factor [xx.xxxx] j = line 3 high alarm multiplier [xx] k = line 4 load arm number [x] l = line 4 additive K-factor [xx.xxxx] m = line 4 high alarm multiplier [xx]
or	
NAK	• If the requested additive injector is not available. • If the number of command parameters is incorrect.

- Send (Download)

Control Byte	Information Fields
STX	[AP] 0 [a] 0 [b] 0 [c] 0 [d] ... [i] 0 [ETX] where: a = additive injector number [x] b = line 1 load arm number [x] c = line 1 additive K-factor [xx.xxxx] d = line 1 high alarm multiplier [xx] e = line 2 load arm number [x] f = line 2 additive K-factor [xx.xxxx] g = line 2 high alarm multiplier [xx] h = line 3 load arm number [x] i = line 3 additive K-factor [xx.xxxx] j = line 3 high alarm multiplier [xx] k = line 4 load arm number [x] l = line 4 additive K-factor [xx.xxxx] m = line 4 high alarm multiplier [xx]

- Receive (Download)

Control Byte	Information Fields
ACK	
or	
NAK	• If the requested additive injector is not available. • If the number of command parameters is incorrect. • If the load arm number is invalid. • If the 'additive K-factor' is not in the range 0.001...50000. • If the 'high alarm multiplier' is not in the range 2...10.

Remarks:

1. Upload - to obtain additive parameters from the instrument.
2. Download - to transmit the additive parameters to the instrument.

Related commands: AI, AS

Constraints:

1. Instrument must be in the idle state.
2. Intelligent Additives must be enabled.
3. Extra time of up to 3 seconds should be allowed while waiting for an acknowledge (ACK) response to the download command as the instrument must update the non-volatile memory. This extra wait period is not required for the upload command.

8.3.3.6 AR - Additive Recipes

The AR command enables the host to pload or download the additive recipes when using intelligent additive injection.

- Send (Upload)

Control Byte	Information Fields
STX	[AR] 0 [a] 0 [ETX] where: a = arm number [x] (upload recipes associated with this arm number)

- Receive (Upload)

Control Byte	Information Fields
STX	[AR] 0 [a] 0 [b] 0 [c] 0 [d] ... [w] 0 [ETX] where: a = arm number [x] (upload recipes associated with this arm number) b = additive injectors pulse [xxxx] c = number of recipes [x] (0...4) d = recipe number 1 [1] (number of recipes is equal to or greater than 1) e = line 1 additive amount [xxxx] ml(cc)/additive pulse f = line 2 additive amount [xxxx] ml(cc)/additive pulse g = line 3 additive amount [xxxx] ml(cc)/additive pulse h = line 4 additive amount [xxxx] ml(cc)/additive pulse i = recipe number 2 [2xxxxxxxxxx] (number of recipes is greater than 1) j = line 1 additive amount [xxxx] ml(cc)/additive pulse k = line 2 additive amount [xxxx] ml(cc)/additive pulse l = line 3 additive amount [xxxx] ml(cc)/additive pulse m = line 4 additive amount [xxxx] ml(cc)/additive pulse n = recipe number 3 [3] (number of recipes is greater than 2) o = line 1 additive amount [xxxx] ml(cc)/additive pulse p = line 2 additive amount [xxxx] ml(cc)/additive pulse q = line 3 additive amount [xxxx] ml(cc)/additive pulse r = line 4 additive amount [xxxx] ml(cc)/additive pulse s = recipe number 4 [4] (number of recipes is greater than 3) t = line 1 additive amount [xxxx] ml(cc)/additive pulse u = line 2 additive amount [xxxx] ml(cc)/additive pulse

Control Byte	Information Fields
	v = line 3 additive amount [xxxx] ml(cc)/additive pulse w = line 4 additive amount [xxxx] ml(cc)/additive pulse
or	
NAK	• If there are no associated additive lines (injectors) for the specified arm number. • If the number of command parameters is incorrect.

- Send (Download)

Control Byte	Information Fields
STX	[AR] 0 [a] 0 [b] 0 [c] 0 [d] ... [w] 0 [ETX] where: a = arm number [x] (upload recipes associated with this arm number) b = additive injectors pulse [xxxx] c = number of recipes [x] (0...4) d = recipe number 1 [1] (number of recipes is equal to or greater than 1) e = line 1 additive amount [xxxx] ml(cc)/additive pulse f = line 2 additive amount [xxxx] ml(cc)/additive pulse g = line 3 additive amount [xxxx] ml(cc)/additive pulse h = line 4 additive amount [xxxx] ml(cc)/additive pulse i = recipe number 2 [2xxxxxxxxxx] (number of recipes is greater than 1) j = line 1 additive amount [xxxx] ml(cc)/additive pulse k = line 2 additive amount [xxxx] ml(cc)/additive pulse l = line 3 additive amount [xxxx] ml(cc)/additive pulse m = line 4 additive amount [xxxx] ml(cc)/additive pulse n = recipe number 3 [3] (number of recipes is greater than 2) o = line 1 additive amount [xxxx] ml(cc)/additive pulse p = line 2 additive amount [xxxx] ml(cc)/additive pulse q = line 3 additive amount [xxxx] ml(cc)/additive pulse r = line 4 additive amount [xxxx] ml(cc)/additive pulse s = recipe number 4 [4] (number of recipes is greater than 3)

Control Byte	Information Fields
	t = line 1 additive amount [xxxx] ml(cc)/additive pulse u = line 2 additive amount [xxxx] ml(cc)/additive pulse v = line 3 additive amount [xxxx] ml(cc)/additive pulse w = line 4 additive amount [xxxx] ml(cc)/additive pulse

- Receive (Download)

Control Byte	Information Fields
ACK	
or	
NAK	• If there are no associated additive lines (injectors) for the specified arm number. • If the number of command parameters is incorrect.

Remarks:

1. Upload - to obtain additive parameters from the instrument.
2. Download - to transmit the additive parameters to the instrument.
3. The 'number of recipes' parameter indicates how many parameters follow. For example, if the number of recipes is equal to 1, then only five more parameters follow ('d' through 'h').

Related commands: AI, AP

Constraints:

1. Instrument must be in the idle state.
2. Intelligent Additives must be enabled.
3. This command requires extra time as the instrument must update the non-volatile memory. A minimum of 3 extra seconds should be allowed for both

waiting for an acknowledge (ACK) response and before another command is sent to the instrument. This extra wait period is not required for the upload.

8.3.3.7 AS - Arm Settings

The AS command allows the host to obtain the setup information unique to each arm.

- Send (Upload)

Control Byte	Information Fields
STX	[AS] 0 [a] 0 [ETX] where: a = arm number [x]

- Receive (Upload)

Control Byte	Information Fields
STX	[AS] 0 [a] 0 [b] 0 [c] 0 [d] ... [u] 0 [ETX] where: a = arm number [x] b = single or dual pulse [S] or [D] c = full flow rate [xxxx] for digital valve or [0] for non- digital valve d = arm overrun [xxx] e = quantity/additive pulse [xxx] f = linear or non-linear k-factor [L] or [N] g = number of non-linear k-factors [xx] or [0] if linear h1 = first frequency [xxx] for non-linear or k-factor [xxxxx.xxx] if linear i1 = first k-factor [xxxxx.xxx] for non-linear h5 fifth frequency [xxx] for non-linear i5 fifth k-factor [xxxxx.xxx] for non-linear j = 4mA temperature [xxx.x] (if fitted with RTD's [0]) k = 20mA temperature [xxx.x] (if fitted with RTD's [0]) l = correction type for OIML [NONE] or [REFINED] or [CRUDE OIL] m = density (kg/m3) [xxxx] or relative density [xx.xxx] if US units n = load units [litres] or [liters] or [meters3] or [kg] or [grams] or [gallons] or [pounds] o = additive units [mls] or [cc] or [ppm] p = temperature units [C] or [F] q = auto high flow timeout [xxxx] for digital valve or [0] for non-digital valve

Control Byte	Information Fields
	r = arm status [x] (0=DISABLED, 1=ENABLED, 2=FAULTY) s = minimum preset amount t = minimum linear flow rate [xxxx] u = additive flush volume [xxx]
NAK	• If the requested arm number does not exist. • If no parameter is received.

Remarks: None

Related commands: AM, CA

Constraints: Instrument must be in the idle state.

8.3.3.8 AT - Accumulated Totals

The AT command allows the host to obtain the accumulated gross totals for all arms.

- Send (Upload)

Control Byte	Information Fields
STX	[AT] 0 [ETX]

- Receive (Upload)

Control Byte	Information Fields
STX	[AT] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = accumulated gross total for first arm [xxxxxxxx] e = accumulated gross total for second arm [xxxxxxxx] (if number of arms is greater than 1) f = accumulated gross total for third arm [xxxxxxxx] (if number of arms is greater than 2) g = accumulated gross total for fourth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'accumulative gross total' parameters follow. For example, if b is equal to 2, then only parameters [a] through [e] are received.

Related commands: AN, FR, GT, IT, LT, NT, PR

Constraints: None

8.3.3.9 AV - Application Version

The AV command allows the host to obtain the application version, date and time from the instrument.

- Send

Control Byte	Information Fields
STX	[AV] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[AV] 0 [a] 0 [b] 0 [c] 0 [d] ... [j] 0 [ETX] where: a = software version number [Vx-xxx-] or [Px-xxx-] b = instrument model and application pack [1010Ax-xx-] c = software version and card selection [Vxxxx.xx-xxxx] d = date [mmm dd yyyy] g = time [hh:mm:ss] h = ROM type [EPROM] or [FLASH] i = not yet implemented (ROM size) [0] j = display type [ALPHA] or [GRAPHIC]

Remarks: None

Related commands: SV

Constraints: Instrument must be in the idle state.

8.3.3.10 BT - Batch Totals

The BT command allows the host to instruct the instrument to send the Batch Totals (similar to an SY command) of the last completed batch for a specific arm.

- Send

Control Byte	Information Fields
STX	[BT] 0 [a] 0 [ETX] where: a = arm number [x]

- Receive

Control Byte	Information Fields
STX	[BT] 0 [a] 0 [b] 0 [c] 0 [d] ... [s] 0 [ETX] where: a = entry number [xxxx] b = transaction number [xxxxxxx] c = arm number [x] d = gross (unconverted) total [xxxxxx.x] e = net (converted) total [xxxxxx.x] f = accumulated (unconverted) total before [xxxxxxxx] g = accumulated (unconverted) total after [xxxxxxxx] h = net accumulated (converted) total before [xxxxxxxx] i = net accumulated (converted) total after [xxxxxxxx] j = average temperature [xxxx.x] k = preset quantity [xxxxxx.x] l = error status [x], see section 8.3.3.46 m = additive quantity 1 (cc or ml) n = additive quantity 2 (cc or ml) o = additive quantity 3 (cc or ml) p = additive quantity 4 (cc or ml) q = product density [xxxx] r = compartment number [xx] s = returned quantity [xxxxx]
or	
NAK	If the specified arm number is invalid or the arm is loading

Remarks:

1. This command can be used during loading operations (while other arms are loading), but not while the particular arm is loading for which Batch Totals are required. The ENQ response arm status, in particular the batch complete bit, should be monitored to determine when a load has completed on a particular arm.
2. From the time an instrument is first powered up or an EPROM replaced, the instrument will respond with a NAK until a batch has been completed on the requested arm.

Related commands: ENQ, SY

Constraints: Once a particular arm has been selected for loading the BT command will return a NAK until a new batch is completed on that arm.

8.3.3.11 CA - Control Arm

The CA command allows the host to disable or enable a particular load arm.

- Send

Control Byte	Information Fields
STX	[CA] 0 [a] 0 [b] 0 [ETX] where: a = number of arm to disable/enable [x] b = disable/enable arm [x] (ENABLE = 1, DISABLE = 0)

- Receive

Control Byte	Information Fields
STX	[CA] 0 [a] 0 [b] 0 [c] 0 [d] ... [e] 0 [ETX] where: a = number of arms [x] b = first arm status [x] c = second arm status [x] (if number of arms is greater than 1) d = second arm status [x] (if number of arms is greater than 2) e = second arm status [x] (if number of arms is greater than 3)
NAK	• If the requested arm number does not exist. • If the instrument is in the RC state.

Remarks:

1. Arm Status byte: 0 = DISABLED, 1 = ENABLED, 2 = FAULTY
2. Parameter a indicates how many parameters follow. For example, if a is equal to 2 then only b and c follow.

Related commands: AS

Constraints: You cannot enable or disable an arm that is already faulty. If the host system tries to enable/disable a faulty arm, the arm status will remain faulty and the enable/disable will be ignored.

8.3.3.12 CC - Clear Power Cycle

The CC command allows the host to clears/reset the Power Cycle/ Failure flag. The flag is available from the ENQ response bit 4 of the status byte. See ENQ command.

- Send

Control Byte	Information Fields
STX	[CC] 0 [ETX]

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	If the Power Cycle/Failure flag is not set.

Remarks: None

Related commands: PD, ENQ

Constraints: None

8.3.3.13 CM - Clear Message

The CM command allows the host to clear the on-screen message sent as part of a DM, DP, GA or GH command and clears the status associated with the relevant command.

- Send

Control Byte	Information Fields
STX	[CM] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	
or	
NAK	If there is no message to clear.

Remarks: None

Related commands: DM, DP, GA, GC, GH, GK

Constraints: None

8.3.3.14 CP - Set or Clear PIN Numbers

The CP command allows a host to add or remove driver and truck objects to or from the user and object databases in the Fusion4 MSC-L.

- Send

Control Byte	Information Fields
STX	[CP] 0 [a] 0 [b] 0 [c] 0 [ETX] where: a = [DR] for driver or [TR] for truck b = [XX] to clear all existing driver or truck numbers or [nnn] to program an index number or clear a single driver or truck at index location nnn c = [n1...n16] to program PIN/Touch number if b is equal to nnn or [XX] to clear the driver or truck at location nnn.

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	If DR or TR are not found or if nnn is less than 1 or greater than 1000.

Remarks: This command also applies to swipe cards if this option was ordered.

Related commands: None

Constraints: Instrument must be in the idle state.

8.3.3.15 DM - Display Message

The DM command allows the host to display a message up to 8 lines each of 30 characters on the graphics display. The instrument status then goes to DM and any ENQ command is responded to with a DM reply (see ENQ). The message displayed by this command can be cleared by the CM command, all operator input is ignored while the message is being displayed.

- Send

Control Byte	Information Fields
STX	[DM] 0 [a] 0 [b] 0 [c] 0 [d] ... [h] 0 [ETX] Where: a = line 1 (top line) [justify character & message] b = line 2 [justify character & message] c = line 3 [justify character & message] d = line 4 [justify character & message] e = line 5 [justify character & message] f = line 6 [justify character & message] g = line 7 [justify character & message] h = line 8 (bottom line) [justify character & message] Justify character options (one of the below): | centre justified (vertical bar, $7E_{HEX}$) _ left justified (underscore, $5F_{HEX}$) + right justified (plus sign, $2B_{HEX}$) a number between 0 and 30 in the justify field will justify the text that number of spaces from the left (must be two characters, i.e. 03 for 3 spaces) Message options (one of the below): -1 leave line as is (if previous message still being displayed) -2 clear line (if previous message still being displayed) up to 30 characters of text (in addition to the justify character)

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	• If the command is incorrect. • If the number of parameters is greater than 1.

Remarks:

1. The justify character must always be entered, otherwise the first character of the line of text will be taken as the justify character and it will not be displayed.
2. Some response delay may result when displaying a message to the entire screen (i.e. when the instrument is in the idle or RL state).

Related commands: CM, DP, GA, GC, GH, GK, ENQ

Constraints:

1. The justify character is not used when the message parameter is either -1 or -2.
2. The instrument must be in the appropriate state to display messages when load scheduling is enabled (idle, RL, RC, or PL).
3. If the instrument is not in the idle or RL mode, the parameters [a] through [f] are ignored.

8.3.3.16 DN - Set Arm Density

The DN command allows the host to send the product density for a particular arm to the instrument.

1010's manual density is the density at base temperature (e.g. 15 °C), so DN command density allow when density at observed temperature in MSC-L set to base temperature (15 °C).

- Send

Control Byte	Information Fields
STX	[DN] 0 [a] 0 [b] 0 [c] 0 [ETX] Where: a = arm number [x] b = fuel type [x] for OIML (1 = REFINED, 2 = CRUDE OIL) c = density kg/m3 [xxxx]

- Receive

Control Byte	Information Fields
ACK	
NAK	• If the density value is outside the allowable limits for the fuel type selected. • If the requested arm number does not exist. • If the number of parameters is greater than 3.

Remarks: The density can also be edited from within the arm configuration menu.

Related commands: AS

Remarks:

1. Instrument must be in the idle state.
2. This command requires extra time as the instrument must update the non-volatile memory. A minimum of 3 extra seconds should be allowed for both waiting for an acknowledge (ACK) response and before another command is sent to the instrument.

8.3.3.17 DP - Display Prompt

The DP command allows the host to display a message on the alphanumeric display with an automatic timeout period. The instrument status then goes to DP. If a response is received from an operator (ENTER/YES) the status moves to MT

(Message Taken). If the timeout period is allowed to expire before a response is received the status reverts to its previous state.

- Send

Control Byte	Information Fields
STX	[DP] 0 [a] 0 [b] 0 [c] 0 [d] ... [j] 0 [ETX] Where: a = always set to 1 b = time period in seconds before the prompt will automatically timeout c = line 1 (top line) [justify character & message] d = line 2 [justify character & message] e = line 3 [justify character & message] f = line 4 [justify character & message] g = line 5 [justify character & message] h = line 6 [justify character & message] i = line 7 [justify character & message] j = line 8 (bottom line) [justify character & message]

Control Byte	Information Fields
	Justify character options (one of the below): | centre justified (vertical bar, $7E_{HEX}$) _ left justified (underscore, $5F_{HEX}$) + right justified (plus sign, $2B_{HEX}$) a number between 0 and 30 in the justify field will justify the text that number of spaces from the left (must be two characters, i.e. 03 for 3 spaces) Message options (one of the below): -1 leave line as is (if previous message still being displayed) -2 clear line (if previous message still being displayed) up to 30 characters of text (in addition to the justify character)

- Receive

Control Byte	Information Fields
ACK	
NAK	• If the command is incorrect. • If the number of parameters is greater than 1.

Remarks:

1. The justify character must always be entered, otherwise the first character of the line of text will be taken as the justify character and it will not be displayed.
2. Some response delay may result when displaying a message to the entire screen (i.e. when the instrument is in the idle or RL state).

Related commands: CM, DM, GA, GC, GH, GK, ENQ

Constraints:

1. The justify character is not used when the message parameter is either -1 or -2.
2. The instrument must be in the appropriate state to display messages when load scheduling is enabled (idle, RL, RC, or PL).

8.3.3.18 ENQ - Operational State Enquiry

The ENQ command allows the host to check the operational state of the Loading System.

- Send

Control Byte	Information Fields
ENQ	

- Receive

Control Byte	Information Fields
STX	[SS] 0 [a] 0 [b] 0 [c] 0 [d] ... 0 [ETX] or the command field is one of the following: DM, DP, GA, GC, GH, GK, MT or PL. where: a = system status byte [x], see section 8.3.3.18.2 b = last transaction number [xxxxxxx] c = first arm number [x] d = number of arms [x] e = Arms 1 and 2 status byte [x], see section 8.3.3.18.3 f = Arms 3 and 4 status byte [x] (if > 2 arms), see section 8.3.3.18.3 or where the command field is AA i = operator answer [xxxxxxxxxxxxxx] (14 or more characters), see section 8.3.3.18.4 or where the command field is CA i = card number [xxxxxxxxxxxxxxxx] (16 characters) or where the command field is KA i = touch key number [xxxxxxxxxxxx] (12 characters) or where the command field is RA i = driver index number [xxx] j = vehicle index number [xxx] k = driver touch key/card/PIN number [xxxxxxxxxxxx]/[xxxxxxxxxxxxxxxx]/[xxxx] (12 characters/16 characters/4 characters) l = truck touch key/card/PIN number

Control Byte	Information Fields
	[xxxxxxxxxxxx]/[xxxxxxxxxxxxxxxx]/[xxxx] (12 characters/16 characters/4 characters) or where the command field is RL i = load number [xxxx] j = driver index number [xxx] k = vehicle index number [xxx] l = driver touch key/card/PIN number [xxxxxxxxxxxx]/[xxxxxxxxxxxxxxxx]/[xxxx] (12 characters/16 characters/4 characters) m = truck touch key/card/PIN number [xxxxxxxxxxxx]/[xxxxxxxxxxxxxxxx]/[xxxx] (12 characters/16 characters/4 characters) or where the command field is RP i = transaction number to be printed [xxxxxxx] or where the command field is RC i = load number [xxxx] j = arm number [x] (if no arm selected = 0, compartment cannot be authorised) k = compartment number [xx] l = returned quantity [xxxxxxxx]

Remarks: Parameter d indicates how many 'arm status byte' parameters follow. For example, if d is equal to 1 or 2 then only arm status byte [e] is received.

Related commands: None

Constraints: Instrument must be in the idle state.

8.3.3.18.1 Command Fields

The following table provides an overview of the command fields.

Table 8-6: Command fields

Command Field	Description
AA	When a question that has been posted to the operator using the GA or GH commands has been answered. See Table 4 on page 57.
CA	If a swipe card has been read in response to a GC command.
DM	If the instrument is displaying a message via the DM command.
DP	If the instrument is displaying a message prompt via the DP command.
GA	If the instrument is displaying a question to the operator via the GA command.
GC	If the instrument is requesting the presentation of a card via the GC command.
GH	If the instrument is displaying a question to the operator via the GH command.
GK	If the instrument is requesting the presentation of a touch key via the GK command.
KA	If a touch key has been read in response to a GK command.
MT	If the message prompt (DP command) has been acknowledged.
RA	If the instrument is waiting for entry authorisation (Remote authorise enabled).
RC	If the instrument is in the compartment authorisation state (Load scheduling enabled).
RL	If the instrument is in the load authorisation state (Load scheduling enabled).
RP	If the instrument is waiting for the printing status of the Bill of Lading printer.
SS	Standard enquiry response, the instrument is not in a special state.
PL	If the instrument is in the post loading state (Load scheduling enabled).

8.3.3.18.2 System Status Byte

The following table provides a description of the system status byte.

Table 8-7: System status byte

System Status Byte								Value	Description
7	6	5	4	3	2	1	0		
1	X	X	X	X	X	X	X	128	If the instrument is no longer in the idle state.
X	1	X	X	X	X	X	X	64	If an MR (Manager Reset) command is required.
X	X	1	X	X	X	X	X	32	If the expansion communications have failed (MA Only).
X	X	X	1	X	X	X	X	16	If a power failure has been detected.
X	X	X	X	1	X	X	X	8	If overfill and vapour recovery are connected.
X	X	X	X	X	1	X	X	4	If Programming/Hardware Test/Diagnostics mode is active.
X	X	X	X	X	X	1	X	2	If a server unit power fail has occurred (MA Only).
X	X	X	X	X	X	X	1	1	If an unauthorised flow is in progress on any arm.

8.3.3.18.3 Arm Status Byte (applies to all arm status bytes)

The following table provides a description of the arm status byte.

Table 8-8: Arm status byte

Status Byte								Value	Description
Arm 1				Arm 2					
7	6	5	4	3	2	1	0		
1	X	X	X	X	X	X	X	128	Arm 1 loading
X	1	X	X	X	X	X	X	64	Arm 1 paused by operator
X	X	1	X	X	X	X	X	32	Arm 1 batch complete
X	X	X	1	X	X	X	X	16	Arm 1 previous batch error
X	X	X	X	1	X	X	X	8	Arm 2 loading
X	X	X	X	X	1	X	X	4	Arm 2 paused by operator
X	X	X	X	X	X	1	X	2	Arm 2 batch complete
X	X	X	X	X	X	X	1	1	Arm 2 previous batch error

8.3.3.18.4 Operator Answer

The following table gives an overview of the operator answers.

Table 8-9: Operator Answers

Operator Answer	Command Key	Value	Description
Answer	None	String ≤ 14 characters (0-9, AZ)	The operator has responded to a GA/GH command by entering a response which is returned as a string.
'L'	LINE/ALPHA	The letter L (0x4C)	The operator has pressed the LINE/ ALPHA key in response to a GA/GH command.
'+'	START	The PLUS character (0x2B)	The operator has pressed the START key in response to a GA/GH command.
'#'	STOP	The HASH character (0x23)	The operator has pressed the STOP key in response to a GA/GH command.
'D'	DISPLAY	The letter D (0x44)	The operator has pressed the DISPLAY key in response to a GA/GH command.
'YES'	ENTER	String = 'YES'	The operator has pressed the ENTER key in response to a GA/GH command.
'NO'	CANCEL	String = 'NO'	The operator has pressed the CANCEL key in response to a GA/GH command.

8.3.3.19 FR - Flow Rates

The FR command allows the host to obtain the flow rates for all arms.

- Send

Control Byte	Information Fields
STX	[FR] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[FR] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = flow rate for first arm [xxxxxxxx] e = flow rate for second arm [xxxxxxxx] (if number of arms is greater than 1) f = flow rate for third arm [xxxxxxxx] (if number of arms is greater than 2) g = flow rate for fourth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'accumulative total' parameters follow. For example, if b is equal to 2 then only parameters [a] through [e] are received.

Related commands: AN, AT, GT, IT, LT, NT, PR

Constraints: None

8.3.3.20 GA - Get Answer

The GA command allows the host to display a message to which the operator should respond using the alpha-numeric keys and/or the YES/ NO keys. The instrument status goes to GA until an answer has been entered the response to an ENQ command will then be AA.

> NOTE: An alpha-numeric keyboard response is always terminated using the Enter/Yes key.

- Send

Control Byte	Information Fields
STX	[GA] 0 [a] 0 [b] 0 [c] 0 [d] ... [h] 0 [ETX] Where: a = line 1 (top line) [justify character & message] b = line 2 [justify character & message] c = line 3 [justify character & message] d = line 4 [justify character & message] e = line 5 [justify character & message] f = line 6 [justify character & message] g = line 7 [justify character & message] h = line 8 (bottom line) [justify character & message] Justify character options (one of the below): | centre justified (vertical bar, 7EHEX) _ left justified (underscore, 5FHEX) + right justified (plus sign, 2BHEX) a number between 0 and 30 in the justify field will justify the text that number of spaces from the left (must be two characters, i.e. 03 for 3 spaces) Message options (one of the below): -1 leave line as is (if previous message still being displayed) -2 clear line (if previous message still being displayed) up to 30 characters of text (in addition to the justify character)

- Receive

Control Byte	Information Fields
ACK	
NAK	• If the command is incorrect. • If the number of parameters is greater than 1.

Remarks:

1. The justify character must always be entered, otherwise the first character of the line of text will be taken as the justify character and it will not be displayed.
2. Some response delay may result when displaying a message to the entire screen (i.e. when the instrument is in the idle or RL state).

Related commands: CM, DM, DP, GC, GH, GK, ENQ

Constraints:

1. The justify character is not used when the message parameter is either -1 or -2.
2. The instrument must be in the appropriate state to display messages when load scheduling is enabled (idle, RL, RC, or PL).

8.3.3.21 GD - Get Date and Time

The GD command allows the host to obtain the date and time from the instrument.

- Send

Control Byte	Information Fields
STX	[GD] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[GD] 0 [a] 0 [b] 0 [ETX] where: a = date [dd/mm/yyyy] b = time [hh:mm:ss]

Remarks: None

Related commands: RD

Constraints: Instrument must be in the idle state.

8.3.3.22 GH - Get Hidden

The GH command allows the host to display a message to which the operator should respond using numeric keys and/or the YES/NO keys. The instrument status goes to GH until the operator responds at which time the instrument response changes to AA To provide security each key press displays an asterisk rather than the key pressed.

> NOTE: An alphanumeric keyboard response is always terminated using the Enter/Yes key.

- Send

Control Byte	Information Fields
STX	[GH] 0 [a] 0 [b] 0 [c] 0 [d] ... [h] 0 [ETX] Where: a = line 1 (top line) [justify character & message] b = line 2 [justify character & message] c = line 3 [justify character & message] d = line 4 [justify character & message] e = line 5 [justify character & message] f = line 6 [justify character & message] g = line 7 [justify character & message] h = line 8 (bottom line) [justify character & message] Justify character options (one of the below): | centre justified (vertical bar, $7E_{HEX}$) _ left justified (underscore, $5F_{HEX}$) + right justified (plus sign, $2B_{HEX}$) a number between 0 and 30 in the justify field will justify the text that number of spaces from the left (must be two characters, i.e. 03 for 3 spaces) Message options (one of the below): -1 leave line as is (if previous message still being displayed) -2 clear line (if previous message still being displayed) up to 30 characters of text (in addition to the justify character)

- Receive

Control Byte	Information Fields
ACK	
NAK	• If the command is incorrect. • If the number of parameters is greater than 1.

Remarks:

1. The justify character must always be entered, otherwise the first character of the line of text will be taken as the justify character and it will not be displayed.
2. Some response delay may result when displaying a message to the entire screen (i.e. when the instrument is in the idle or RL state).

Related commands: CM, DM, DP, GA, GC, GK, ENQ

Constraints:

1. The justify character is not used when the message parameter is either -1 or -2.
2. The instrument must be in the appropriate state to display messages when load scheduling is enabled (idle, RL, RC, or PL).

8.3.3.23 GT - Gross Totals

The GT command allows the host to obtain the gross total for all arms.

- Send

Control Byte	Information Fields
STX	[GT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[GT] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = gross total for first arm [xxxxxxxx] e = gross total for second arm [xxxxxxxx] (if number of arms is greater than 1) f = gross total for third arm [xxxxxxxx] (if number of arms is greater than 2) g = gross total for forth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'gross total' parameters follow. For example, if b is equal to 2 then only parameters [a] through [e] are received.

Related commands: AN, AT, FR, IT, LT, NT, PR

Constraints: None

8.3.3.24 IA - Injector Accumulative Totals

The IA command allows the host to obtain the accumulative line totals for the requested model 1020 additive injector.

- Send

Control Byte	Information Fields
STX	[IA] 0 [a] 0 [ETX] where: a = additive injector number [x]

- Receive

Control Byte	Information Fields
STX	[IA] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [ETX] where: a = additive injector number [x] b = additive total for first line [xxxxx.xx] (litres/gallons) c = additive total for second line [xxxxx.xx] (litres/gallons) d = additive total for third line [xxxxx.xx] (litres/gallons) e = additive total for fourth line [xxxxx.xx] (litres/gallons)
or	
NAK	• If Intelligent Additives are not enabled. • If the requested additive injector is not available. • If the number of parameters is less than 1.

Remarks: None

Related commands: None

Constraints:

1. Instrument must be in the idle state.
2. This command requires extra time as the instrument must communicate with the 1020 additive injector. A minimum of 3 extra seconds should be allowed for both waiting for an acknowledge (ACK) response and before another command is sent to the instrument.

8.3.3.25 IT - Instantaneous Temperatures

The IT command allows the host to obtain the instantaneous temperature for all arms.

- Send

Control Byte	Information Fields
STX	[IT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[IT] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = temperature for first arm [xxxxxxxx] e = temperature for second arm [xxxxxxxx] (if number of arms is greater than 1) f = temperature for third arm [xxxxxxxx] (if number of arms is greater than 2) g = temperature for fourth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'temperature' parameters follow. For example, if b is equal to 2 then only parameters [a] through [e] are received.

Related commands: None

Constraints: None

8.3.3.26 LT - Last Load Temperatures

The LT command allows the host to obtain the last load temperature for all arms.

- Send

Control Byte	Information Fields
STX	[LT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[LT] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] Where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = last load temperature for first arm [xxxxxxxx] e = last load temperature for second arm [xxxxxxxx] (if number of arms is greater than 1) f = last load temperature for third arm [xxxxxxxx] (if number of arms is greater than 2) g = last load temperature for fourth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'last load temperature' parameters follow. For example, if b is equal to 2 then only parameters [a] through [e] are received.

Related commands: None

Constraints: None

8.3.3.27 MI - Message Initial

The MI command allows a custom initial message to be downloaded to the instrument.

- Send

Control Byte	Information Fields
STX	[MI] 0 [a] 0 [b] 0 [c] 0 [ETX] where: a = enable/disable initial message permissive [x] (0 = DISABLE, 1 = ENABLE) b = custom initial message top line c = custom initial message bottom line

- Receive

Control Byte	Information Fields
ACK	
NAK	• If the number of parameters is less than 1 or greater than 2. • If the number of characters in parameter c or d exceeds 28 characters.

Remarks: The message of up to 28 characters per line is displayed on the bottom two lines of a graphic display.

Related commands: SO

Constraints: Instrument must be in the idle state.

8.3.3.28 MR - Manager Reset

The MR command allows the host to clear various alarms in the instrument. The MR command has the same effect as a manual manager reset performed by entering the manager password into the instrument.

- Send

Control Byte	Information Fields
STX	[MR] 0 [ETX]

- Receive

Control Byte	Information Fields
ACK	

Remarks: This command will clear: PIN/Touch lockout due to illegal access attempts exceeding the programmed value, Temperature fault alarms on all arms, Dual pulse fault alarms on all arms, Phase error alarms on all arms, and Emergency Stop condition.

Related commands: None

Constraints: None

8.3.3.29 NT - Net Totals

The NT command allows the host to obtain the net total for all arms.

- Send

Control Byte	Information Fields
STX	[NT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[NT] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] Where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = net total for first arm [xxxxxxxx] e = net total for second arm [xxxxxxxx] (if number of arms is greater than 1) f = net total for third arm [xxxxxxxx] (if number of arms is greater than 2) g = net total for fourth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'net total' parameters follow. For example, if b is equal to 2 then only parameters [a] through [e] are received.

Related commands: AN, AT, FR, GT, IT, LT, PR

Constraints: None

8.3.3.30 OP - Option Settings

The OP command allows the host the obtain the settings of the - OPTIONS- configuration menu.

- Send

Control Byte	Information Fields
STX	[OP] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[OP] 0 [a] 0 [b] 0 [c] 0 [d] ... [q] 0 [ETX] where: a = test mode [ENABLE] or [DISABLE] b = deadman timer [ENABLE] or [DISABLE] c = illegal access [ENABLE] or [DISABLE] d = number of illegal tries [x] e = alarm on fault [ENABLE] or [DISABLE] f = prompt for compartment number [ENABLE] or [DISABLE] g = prompt for return quantity [ENABLE] or [DISABLE] h = prompt for load number [ENABLE] or [DISABLE] i = expansion comms [ENABLE] or [DISABLE] j = load scheduling [ENABLE] or [DISABLE] k = server mode [ENABLE] or [DISABLE] l = remote authorisation [ENABLE] or [DISABLE] m = simultaneous arm loading [ENABLE] or [DISABLE] n = prompt for preset quantity [ENABLE] or [DISABLE] o = access to hardware test via '8' key [ENABLE] or [DISABLE] p = multiple loads per arm [ENABLE] or [DISABLE] q = maximum preset [ENABLE] or [DISABLE] r = warning timeout [xxx] s = pause timeout [xxx] t = terminate timeout[xxx]

Remarks: None

Related commands: None

Constraints: Instrument must be in the idle state.

8.3.3.31 PD - Power Cycle Date and Time

The PD command allows the host to obtain the date and time the last Power Cycle was detected (when the Power Cycle flag was last set).

- Send

Control Byte	Information Fields
STX	[PD] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[PD] 0 [a] 0 [b] 0 [ETX] Where: a = date [dd/mm/yyyy] b = time [hh:mm:ss]

Remarks: None

Related commands: CC, ENQ

Constraints: None

8.3.3.32 PR - Presets

The PR command allows the host to obtain the preset for all arms.

- Send

Control Byte	Information Fields
STX	[PR] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[PR] 0 [a] 0 [b] 0 [c] 0 [d] ... [g] 0 [ETX] Where: a = first arm number [x] b = number of arms [x] c = bay number [xx] d = preset for first arm [xxxxxxxx] e = preset for second arm [xxxxxxxx] (if number of arms is greater than 1) f = preset for third arm [xxxxxxxx] (if number of arms is greater than 2) g = preset for forth arm [xxxxxxxx] (if number of arms is greater than 3)

Remarks: Parameter b indicates how many 'preset' parameters follow. For example, if b is equal to 2 then only parameters [a] through [e] are received.

Related commands: AN, AT, FR, GT, IT, LT, NT

Constraints: None

8.3.3.33 RA - Remote Authorise

The RA command allows the host to remotely authorise the presented card or PIN when the instrument status is RA. If the driver/truck is not authorised, a message is displayed with a reason. The message can be up to 30 characters on the graphics display.

- Send

Control Byte	Information Fields
STX	[RA] 0 [Y] 0 [a] 0 [b] 0 [ETX] where: a = driver index to be stored in transaction [xxx] or [0] if not required b = truck index to be stored in transaction [xxx] or [0] if not required
or	
STX	[RA] 0 [N] 0 [a] 0 [ETX] where: a = a text message of up to 30 characters or an asterisk [*] to not display any message

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	• If the command is incorrect. • If the number of parameters is less than 1.

Remarks: None

Related commands: ENQ, RL, RC

Constraints: Instrument must be in the RA state.

8.3.3.34 RC - Compartment Response

In a load schedule application, once the ENQ command has determined that the instrument is waiting for compartment loading information, the RC command is used to send that information.

- Send

Control Byte	Information Fields
STX	[RC] 0 [Y] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [f] 0 [ETX] where: a = preset quantity [xxxxx] b = maximum preset quantity [xxxxx] c = injection rate for injector 1 [xxxx] ppm d = injection rate for injector 2 [xxxx] ppm e = injection rate for injector 3 [xxxx] ppm f = injection rate for injector 4 [xxxx] ppm
or	
STX	[RC] 0 [N] 0 [a] 0 [b] 0 [ETX] where: a = a text message of up to 30 characters or an asterisk [*] to not display any message b = [0] = allow operator to try again [1] = force load completion [2] = skip 'load another compartment' prompt

- Receive

Control Byte	Information Fields
STX	
or	
NAK	If the number of parameters for the [RC] 0 [Y] command is not equal to 6 (with additive injection) or 2 (without additive injection).

Remarks:

1. Parameters ‘c’, ‘d’, ‘e’ & ‘f’ are only required if Intelligent Additive injection is enabled.
2. If parameter ‘a’ of the [RC] 0 [N] response exceeds 30 characters, the line will be truncated to show only the first 30 characters.

Related commands: ENQ, RA, RL

Constraints: Instrument must be in the RC state.

8.3.3.35 RD - Reset Date and Time

The RD command allows the host to set the instrument date and time.

- Send

Control Byte	Information Fields
STX	[RD] 0 [a] 0 [b] 0 [ETX] where: a = date [ddmmyyyy] b = time [hhmmss]

- Receive

Control Byte	Information Fields
ACK	

Remarks: None

Related commands: GD

Constraints:

1. Instrument must be in the idle state.
2. This command requires extra time as the instrument must update the non-volatile memory. A minimum of 3 extra seconds should be allowed for both waiting for an acknowledge (ACK) response and before another command is sent to the instrument.

8.3.3.36 RL - Load Number Response

In a load schedule application, once the ENQ command has determined that the instrument is waiting for load confirmation, the RL command is used to send that information.

- Send

Control Byte	Information Fields
STX	[RL] 0 [Y] 0 [a] 0 [b] 0 [c] 0 [ETX] where: a = unique number [xxxxxxx] b = optional parameter for storage in the transaction, if include: b is driver index number [xxx] or [0] if not required c optional parameter for storage in the transaction, if include: c is truck index number [xxx] or [0] if not required
or	
STX	[RL] 0 [N] 0 [a] 0 [ETX] where: a = a text message of up to 30 characters or an asterisk [*] to not display any message

- Receive

Control Byte	Information Fields
STX	
or	
NAK	If the number of parameters is not correct.

Remarks: If parameter 'a' of the [RC] 0 [N] response exceeds 30 characters, the line will be truncated to show only the first 30 characters.

Related commands: ENQ, RA, RC

Constraints: Instrument must be in the RL state.

8.3.3.37 SA - Send Answer

The SA command allows the host to obtain the answer received from the GA or GH commands.

- Send

Control Byte	Information Fields
	[SA] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[SA] 0 [a] 0 [ETX] where: a = answer [YES] or [NO] or [numeric answer]
or	
NAK	If the instrument is not in the AA mode.

Remarks: None

Related commands: GA, GH, ENQ

Constraints: None

8.3.3.38 SM - Stop Arm

The SM command allows the host to stop a load/batch on a particular arm.

- Send

Control Byte	Information Fields
STX	[SM] 0 [a] 0 [ETX] where: a = arm number [x]

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	• If the requested arm number does not exist. • If the requested arm is not loading. • If the number of parameters is less than 1.

Remarks: None

Related commands: AT, FR, GT, IT, LT, PR

Constraints: None

8.3.3.39 SO - System Options

The SO command allows the host to obtain the settings of the - SYSTEM- configuration menu.

- Send

Control Byte	Information Fields
STX	[SO] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[SO] 0 [a] 0 [b] 0 [c] 0 [d] ... [o] 0 [ETX] where: a = initial message [SYSTEM AVAIL.] or [CONN' OVERFILL] or [CONNOVER, VAPR] or [CONNECT SYSTEM] or [CUSTOM] b = driver authorisation [TOUCH] or [PIN] or [NONE] or *[CARD] c = truck authorisation [TOUCH] or [PIN] or [NONE] or *[CARD] d = entry timeout [xxxx] seconds e = clear/reconnect time [xxx] seconds f = number of arms [x] g = first arm number [x] h = volume decimals [1] or [0.1] i = batch type [NET] or [GROSS] j = bay number [xx] k = language option [ENGLISH] or [OTHER] or [DISABLE]** l = litre/liter spelling [LITRE] or [LITER] m = base temperature [BASE 15°C] or [BASE 20°C] or [BASE 60°F] n = country [AUSTRALIA] or [OTHER] o = system units [US UNITS] or [METRIC-ISO] p = number of load monitoring arms [x] or [0]*** q = system message [DEFAULT] or [CUSTOM] or [DISABLED] (MA unit only)

Remarks:

* If the card option is included in the software.

** If the language option is not available in this software.

*** If the Load Monitoring option is not available in this software.

Related commands: OP, VA

Constraints: None

8.3.3.40 ST - Send Transaction

The ST command allows the host to obtain the requested transaction.

- Send

Control Byte	Information Fields
STX	[ST] 0 [a] 0 [ETX] where: a = transaction number [xxxx]

- Receive

Control Byte	Information Fields
STX	[ST] 0 [a] 0 [b] 0 [c] 0 [d] ... [t] 0 [ETX] where: a = unit address [xx] b = transaction number [xxxxxxx] c = date [dd/mm/yyyy] d = start time [hh:mm:ss] e = stop time [hh:mm:ss] f = calibration number [xxx] g = entry start [xxxx] h = entry stop [xxxx] i = driver index [xxx] j = truck index [xxx] k = load number [xxxxxxxxxx] l = number of arms [x] m = first arm density (kg/m3) [xxxx] or relative density [xx.xxx] if US units m1 = second arm density (kg/m3) [xxxx] or relative density [xx.xxx] if US units (number of arms is greater than 1) m2 = third arm density (kg/m3) [xxxx] or relative density[xx.xxx] if US units (number of arms is greater than 2) m3 = fourth arm density (kg/m3) [xxxx] or relative density [xx.xxx] if US units (number of arms is greater than 3) n = unique number [xxxxxxx] o = first arm number [x]

Control Byte	Information Fields
	p = checksum result [FAULT] or [OK] q = first arm load units [litres] or [liters] or [meters3] or [kg] or [grams] or [gallons] or [pounds] r = first arm additive units [mls] or [cc] s = first arm temperature units [C] or [F] q1 = second arm load units [litres] or [liters] or [meters3] or [kg] or [grams] or [gallons] or [pounds] (number of arms is greater than 1) r1 = second arm additive units [mls] or [cc] (number of arms is greater than 1) s1 = second arm temperature units [C] or [F] (number of arms is greater than 1) q2 = third arm load units [litres] or [liters] or [meters3] or [kg] or [grams] or [gallons] or [pounds] (number of arms is greater than 2) r3 = third arm additive units [mls] or [cc] (number of arms is greater than 2) s2 = third arm temperature units [C] or [F] (number of arms is greater than 2) q3 = fourth arm load units [litres] or [liters] or [meters3] or [kg] or [grams] or [gallons] or [pounds] (number of arms is greater than 3) r3 = fourth arm additive units [mls] or [cc] (number of arms is greater than 3) s3 = fourth arm temperature units [C] or [F] (number of arms is greater than 3) t = bay number [xx]
or	
NAK	If the requested transaction number does not exist.

Remarks: None

Related commands: SY

Constraints: Instrument must be in the idle state.

8.3.3.41 SV - Software Version

The SV command allows the host to obtain the software version, date and time from the instrument.

- Send

Control Byte	Information Fields
STX	[SV] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[SV] 0 [a] 0 [b] 0 [c] 0 [d] ... [h] 0 [ETX] where: a = software version and card selection [Vxxxx.xx] b = date [mmm dd yyyy] e = time [hh:mm:ss] f = ROM type [EPROM] or [FLASH] g = not yet implemented (ROM size) [0] h = display type [ALPHA] or [GRAPHIC]

Remarks: None

Related commands: AV

Constraints: None

8.3.3.42 SY - Send Entry (Batch)

The SY command allows the host to send an individual entry, representing a single compartment load (Batch). There may be several of these entries per transaction.

- Send

Control Byte	Information Fields
STX	[SY] 0 [a] 0 [ETX] where: a = entry number [xxxx]

- Receive

Control Byte	Information Fields
STX	[SY] 0 [a] 0 [b] 0 [c] 0 [d] ... [s] 0 [ETX] where: a = entry number [xxxx] b = transaction number [xxxxxxx] c = arm number [x] d = compartment number [xx] e = gross (unconverted) total [xxxxxx.x] f = net (converted) total [xxxxxx.x] g = accum. (unconverted) total before [xxxxxxxx] h = accum. (unconverted) total after [xxxxxxxx] i = net accum. (unconverted) total before [xxxxxxxx] j = net accum. (unconverted) total after [xxxxxxxx] k = average temperature [xxxx.x] l = preset quantity [xxxxxx.x] m = error status [x], see section 8.3.3.46 n = returned quantity [xxxxx] o = additive quantity 1 [xxxx.x] (cc or ml) p = additive quantity 1 [xxxx.x] (cc or ml) q = additive quantity 1 [xxxx.x] (cc or ml) r = additive quantity 1 [xxxx.x] (cc or ml) s = checksum result [FAULT] or [OK]
or	
NAK	If the entry number is invalid.

Remarks: None

Related commands: BT, ST

Constraints: Instrument must be in the idle state.

8.3.3.43 TC - Transaction Complete

The TC command allows the host to clear the PL (post loading) state of the instrument taking it to the disconnect prompt.

- Send

Control Byte	Information Fields
STX	[TC] 0 [ETX]

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	If the instrument is not in the post loading (PL) state.

Remarks: None

Related commands: ENQ

Constraints: Instrument must be in the idle state.

8.3.3.44 TT - Terminate Transaction

The TT command allows the host to remotely stop a transaction on the instrument by removing authorisation and forcing it to the disconnect prompt.

- Send

Control Byte	Information Fields
STX	[TT] 0 [ETX]

- Receive

Control Byte	Information Fields
ACK	
or	
NAK	If the instrument is in the idle state.

Remarks: None

Related commands: None

Constraints: Transaction must be in progress

8.3.3.45 VA - Valve Settings and Calibration

The VA command allows the host to obtain the calibration number, date and time and settings of the -VALVE- menu.

- Send

Control Byte	Information Fields
STX	[VA] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[VA] 0 [a] 0 [b] 0 [c] 0 [d] ... [n] 0 [ETX] where: a = calibration number [xxx] b = calibration date [dd/mm/yy] c = calibration time [hh:mm:ss] d = no flow timeout [xxx] seconds f = valve pre-stop [xxx] g = maximum preset [xxxxxx] h = pump off delay [xxx] i = valve type [DIGITAL] or [ON/OFF] If valve type = DIGITAL i = slow flowrate [xxx] j = deadband [xxx] k = valve response [x.x] l = auto high flow [ENABLE] or [DISABLE] m = slow start based on [QUANTITY] or [TIME] n = slow start value, if based on QUANTITY [xxx] units, else based on TIME [xx] seconds If valve type = ON/OFF i = slow start based on [QUANTITY] or [TIME] j = slow start value, if based on QUANTITY [xxx] units, else based on TIME [xx] seconds

Remarks: None

Related commands: OP, SO

Constraints: Instrument must be in the idle state.

8.3.3.46 Error Status Code

The following table provides an overview of the error status codes.

Table 8-10: Error status codes1010BJ

0. - No error	7. - Valve fault	14. - No additive
1. - ESD/Emergency stop	8. - Deadman timeout	15. - Remote stop
2. - Overfill disconnected	9. - Not used	16. - LCD failure
3. - Vapour	10. - Power failure	17. - Phase error
4. - Flow meter error	11. - High additive	
5. - Flow meter timeout	12. - Low additive	99. - Transaction file in use
6. - Temperature fault	13. - Additive comms	100. - Illegal flow

8.3.4 1010RD

The following table provides an overview of the 1010RD SLIP+ protocol commands supported by the Fusion4 MSC-L.

Table 8-11: 1010RD SLIP+ protocol commands supported by Fusion4 MSC-L

Command Code	Definition	Description
AS	Arm Settings	Returns set up information unique to each arm.
AT	Accumulated Totals	Returns the accumulated gross totals for all arms.
CM	Clear Message	Clears a message.
DM	Display Message	Displays a message.
DN	Set Arm Density	Sets density of the product associated to arm.

Command Code	Definition	Description
ENQ	Operational State Enquiry	Checks the operational state of the Loading System.
FR	Flow Rates	Checks the current flow rates.
GT	Gross Totals	Reads the gross total.
IT	Instantaneous Temperatures	Reads the instantaneous temperatures.
MO	Set Option Parameters	Remotely sets the Option Menu parameters.
MR	Manager Reset	Not Supported.
OP	Option Settings	Returns the settings of Option Menu parameters.
PA	Set Arm Parameters	Remotely sets the operating parameters for the Arms.
PR	Presets	Get the current preset values.
RD	Reset Date and time	Sets date and time of device.
RL	Load schedule load number response	Load number response.
SA	Send Answer	Sends the response received from the GA (Get Answer) command.
SE	Set System Parameters	Not Supported.
SO	System Options	Returns settings of system options.
ST	Send Transaction	Returns the requested transaction.
SY	Send entry	Sends an individual batch record.
VA	Valve settings and calibration	Returns valve settings.
VE	Set Valve Parameters	Sets valve settings.

8.3.4.1 AS - Arm Settings

Returns setup information unique to each arm.

- Send

Control Byte	Information Fields
STX	[AS] 0 [a] 0 [ETX] where: a = arm number

- Receive

Control Byte	Information Fields
STX	[AS] 0 [a] 0 [b] [s] 0 [ETX] where: a = arm number b = single or dual pulse [S or D] (System config | device |IO settings |PI |QPI x | Meter integrity) c = full flowrate, [xxxx] for digital valve or 0 for non-digital valve (Arm Config | arm n | Full flow rate) d = arm overrun [xxx] (Arm Config | arm n | alarm | preset overrun limit) e = quantity/additive pulse [xxx] ([0] injector not supported in RD) f = linear or non-linear k-factor [L or N] (System config | device |IO settings |PI |QPI x | K factor Type) g = number of non-linear k-factors [xx] [0] if Linear and [1] if non-linear See Note below. h1 = 0 If linear, the k-factor [xxxxx.xxx] i1 = 0 h5 = NA i5 = NA j = 4mA Pressure [xxxx] (System config | device |IO settings |AI |Lower boundary) k = 20mA Pressure [xxxx] (System config | device |IO settings |AI | Upper boundary) l = Correction type for [NONE], [REFINED], [CRUDE OIL], [LUBE OIL], [SPECIAL], [NGL AND LPG]

Control Byte	Information Fields
	(Stream Config |Product x| Volume conversion |Conversion option) m = Density (kg/m^3) [xxxx]or Relative density [xx.xxx] (if US units) Entered if prompt enabled, else observed density Truck offload density for single arm. (Stream Config |Product x| Volume conversion| Lab Observation data |Observed density) n = load units [litres] or [meters3] or [kgs] or [grams] or [gallon] or [lb] (Config |Device | General| Units| Units of Volume) o = temperature units [C] or [F] (Config |Device |General | Units |Units of temperature) p = auto high flow timeout [xxxx] for digital valve or [0] for non-digital valve [0] as Auto high flow not supported. q = minimum preset amount Arm Config| Arm n| Control Settings| minimum preset quantity r = minimum linear flowrate [xxxx] System config | device |IO settings |PI |QPI x | minimum linear flowrate s = additive flush volume [xxx] (0 as not supported)
NAK	• If the requested arm number is not in the device. • If no parameter is received. • If arm does not have associated product or product does not have QPI IO binding.

> NOTE: QPI x: Where x is the QPI number associated with first product associated with Arm n.
>
> MSC-L has only one K factor and multiple meter factors while 1010 has one meter factor and multiple K factors.

8.3.4.2 AT - Accumulated Totals

- Send

Control Byte	Information Fields
STX	[AT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[AT] 0 [a] ... [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = accumulated total for first arm Diagnostic |Accumulated totals |Loading arms |arm 1|GOV d = accumulated total for second arm (only if number of arms > 1) Diagnostic |Accumulated totals |Loading arms |arm 2|GOV e = accumulated total for third arm (only if number of arms > 2) Diagnostic |Accumulated totals |Loading arms |arm 3|GOV f = accumulated. total for fourth arm (only if number of arms > 3) Diagnostic |Accumulated totals |Loading arms |arm 4|GOV g = bay number [xx] System config | Bay |Identification |Bay number

> NOTE: Parameters d, e and f are subject to number of Arms. For 2 Arm configuration parameter e is by number.

8.3.4.3 CM - Clear Message

- Send

Control Byte	Information Fields
STX	[CM] 0 [a] 0 [ETX] where: a = arm number

- Receive

Control Byte	Information Fields
ACK	
NAK	If there is no message to clear.

8.3.4.4 DM - Display Message

Display a message up to two screens long on the alphanumeric display. The instrument status then goes to DM.

- Send

Control Byte	Information Fields
STX	[DM] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [ETX] where: a = the time in one tenth of a second, increments to elapse before displaying the other screen [xxx] e.g. 10 = 1.0 seconds, 18 = 1.8 seconds. b = top line screen 1 text c = bottom line screen 1 text d = top line screen 2 text e = bottom line screen 2 text e.g. DM 10 TOP1 BOTTOM1 TOP2 BOTTOM2 would show two screens alternating every second between TOP1 BOTTOM1 and TOP2 BOTTOM2 if only parameters b or c are received, the value of 'a' is ignored and the screen does not alternate.

- Receive

Control Byte	Information Fields
ACK	
NAK	If only 1 parameter is received or if instrument is in GA, AA or RT mode.

8.3.4.5 DN - Send Density

Sets density of the product associated to Arm.

1010's manual density is the density at base temperature (e.g. 15 °C), so DN command density allow when density at observed temperature in MSC-L set to base temperature (15 °C).

- Send

Control Byte	Information Fields
STX	[DN] 0 [a] 0 [b] 0 [c] 0 [ETX] where: a = arm number [x] b = fuel type [x] for OIML (1 = REFINED, 2 = CRUDE OIL) c = density kg/m3 [xxxx] (This is truck offload density when single arm) (Stream Config |Product x| Volume conversion| Lab Observation data |Observed density)

- Receive

Control Byte	Information Fields
ACK	
NAK	• If the requested arm number is not in the device. • If no parameter is received. • If arm does not have associated product or product does not have QPI IO binding.

8.3.4.6 ENQ - Operational State Enquiry

Checks the operational state of the Loading System

- Send

Control Byte	Information Fields
STX	

- Receive

Control Byte	Information Fields
STX	[DM] 0 [ETX] If the instrument is displaying a message. The message must be acknowledged by
	[MT] 0 [ETX] If the message has been acknowledged.
	[GA] 0 [ETX] If the instrument is displaying a question to the operator.
	[AA] 0 [ETX] If the question has been answered by the operator. Use the SA (Send Answer) command to retrieve the answer from the instrument.

Control Byte	Information Fields
	[RL] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [f] 0 [ETX] If the instrument is waiting for load authorization, where: a = order number [up to 10 characters] b = driver number [up to 10 characters] c = driver PIN [xxxx] d = tanker number [up to 10 characters] e = bay number [xx] f = source of tanker number [R/M] (R -RF ID, M –Manual Entry)[SS] 0 [a] 0 [b] 0 [c] 0 [d] 0 [ETX] If none of the above responses, where: a = status byte [x] Bit7 = 0 If the initial message (e.g. "Connect Overfill") is displayed. Bit6 = Don't care. Bit5 = Don't care. Bit4 = 1 NEDAP reader On-line. Bit3 = 1 If the instrument's fourth arm is loading (if device has 4 arms) Bit2 = 1 If the instrument's third arm is loading (if device has 3 or 4 arms) Bit1 = 1 If the instrument's second arm is loading (if device has more than 1 arm) Bit0 = 1 If the instrument's first arm is loading. b = last transaction number [xxxxx] c = Instrument's first arm number [x]

Control Byte	Information Fields
	d = Number of arms [x]

8.3.4.7 FR - Flow Rate

- Send

Control Byte	Information Fields
STX	[FR] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[FR] 0 [a] [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = flowrate of first arm d = flowrate of second arm (only if number of arms > 1) e = flowrate of third arm (only if number of arms > 2) f = flowrate of fourth arm (only if number of arms > 3) g = bay number [xx]

8.3.4.8 GT - Gross Total

- Send

Control Byte	Information Fields
STX	[GT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[GT] 0 [a] [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = Gross total of first arm d = Gross total of second arm (only if number of arms > 1) e = Gross total of third arm (only if number of arms > 2) f = Gross total of fourth arm (only if number of arms > 3) g = bay number [xx]

NOTE: Parameters d, e, f for FR and GT are subject to number of Arms. For 2 Arm configuration parameter e is by number.

8.3.4.9 IT - Instantaneous Temperature

- Send

Control Byte	Information Fields
STX	[IT] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[GT] 0 [a] [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = Temperature of first arm d = Temperature second arm (only if number of arms > 1) e = Temperature of third arm (only if number of arms > 2) f = Temperature of fourth arm (only if number of arms > 3) g = bay number [xx]

NOTE: Parameters d, e, f for FR and GT are subject to number of Arms. For 2 Arm configuration parameter e is by number.

8.3.4.10 MO - Set Option Parameters

- Send

Control Byte	Information Fields
STX	[MO] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [f] 0 [g] 0 [h] 0 [i] 0 [j] 0 [ETX] where: a = (test mode) [DIS] – not used b = dead man [DIS] or [EN] (System config | Device |Alarms |Deadman |Deadman status) c = alarm on fault [DIS] – not used d = compartment prompt [DIS] or [EN] (System config | Device |Workflow settings |Prompts| Compartment Identification) e = return prompt [DIS] or [EN] (System config | Device |Workflow settings |Prompts |Return Quantity Entry) f = pin entry prompt [DIS] or [EN] (System config | Device |Workflow settings |Prompts | User Identification) g = queuing [DIS] or [EN] (System config | Device |Workflow settings |Prompts | Queuing) h = order no (Load number) prompt [DIS] or [EN] System config | Device |Workflow settings |Prompts | Load number identification i = tanker no prompt [DIS] or [EN] System config | Device |Workflow settings |Prompts | Vehicle Identification j = ('8' key hardware prompt) [DIS] – Not used

- Receive

Control Byte	Information Fields
ACK	
NAK	If ten parameters not received or not DIS or not EN.

8.3.4.11 OP - Returns Settings of Options

- Send

Control Byte	Information Fields
STX	[OP] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[OP] 0 [a] 0 [b] 0 [c] 0 [d] 0 [e] 0 [f] 0 [g] 0 [h] 0 [i] 0 [j] 0 [ETX] where: a = (test mode) [DISABLE] b = dead man [DISABLE /ENABLE] (System config | Device |Alarms |Deadman |Deadman status) c = alarm on fault [ENABLE] d = compartment prompt [DISABLE /ENABLE] (System config | Device |Workflow settings |Prompts| Compartment Identification) e = return prompt [DISABLE /ENABLE] (System config | Device |Workflow settings |Prompts |Return Quantity Entry) f = pin entry prompt [DISABLE /ENABLE] (System config | Device |Workflow settings |Prompts | User Identification) g = queuing [DISABLE /ENABLE] (System config | Device |Workflow settings |Prompts | Queuing) h = order no (Load number) prompt [DISABLE / ENABLE] System config | Device |Workflow settings |Prompts | Load number identification i = tanker no prompt [DISABLE /ENABLE] (System config | Device |Workflow settings |Prompts | Vehicle Identification) System config | Device |Workflow settings |Prompts | Tanker Identification

Control Byte	Information Fields
	j = (‘8’ key hardware prompt) [DISABLE]

8.3.4.12 PA - Set Arm Parameters

Remotely sets the operating parameters for the Arms.

- Send

Control Byte	Information Fields
STX	[PA] 0 [a] [f] 0 [ETX] where: a = [1] for arm 1 [2] for arm2 b = valve full flow setting (> slow flow and <= 3000) c = auto high flow timeout period (not supported) d = additive flush volume (not used) e = [XXXX] additive pulse rate (Not used) f = overrun quantity (<250.0)

- Receive

Control Byte	Information Fields
ACK	
NAK	If six parameters not received or out of limits.

8.3.4.13 PR - Preset

Sends the current preset values of all Arms.

- Send

Control Byte	Information Fields
STX	[PR] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[PR] 0 [a] [g] 0 [ETX] where: a = first arm number [x] b = number of arms [x] c = Preset of first arm d = Preset second arm (only if number of arms > 1) e = Preset of third arm (only if number of arms > 2) f = Preset of fourth arm (only if number of arms > 3) g = bay number [xx]

8.3.4.14 RD - Reset Date and Time

Sets the instrument's date and time.

- Send

Control Byte	Information Fields
STX	[RD] 0 [a] 0 [b] 0 [ETX] where: a = date [ddmmyyyy] b = time [hhmmss]

- Receive

Control Byte	Information Fields
ACK	
NAK	Length of parameters is incorrect.

> NOTE: The following sets 10:10:00am Nov 22nd 2017 (ignoring the null characters): RD 22112017 101000.

8.3.4.15 RL – Load number response

In a load schedule application, once the ENQ command has determined a request, the RL command is sent to allow or disallow the load.

- Send

Control Byte	Information Fields
STX	[RL] 0 [Y] 0 [a] 0 [b] 0 [c] 0 [ETX] If load allowed and where: a = Arm 1 preset volume b = Arm 2 preset volume c = Truck offload density only when single arm
	[RL] 0 [N] 0 [a] 0 [ETX] If load allowed and where: a = A test message [up to 16 characters] or an asterisk [*] to display nothing)

- Receive

Control Byte	Information Fields
ACK	
NAK	Truck offload density is out of limits.

8.3.4.16 SA - Send Answer

The instrument sends the response received from the GA (Get Answer) command.

- Send

Control Byte	Information Fields
STX	[SA] 0 [ETX]

- Receive

Control Byte	Information Fields
ACK	[SA] 0 [a] 0 [ETX] where: a = YES or NO or Numeric answer If the instrument is not in AA mode.

8.3.4.17 SO - System Options

Returns the settings of the set-up menu.

- Send

Control Byte	Information Fields
STX	[SO] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[SO] 0 [a] [i] 0 [ETX] where: a = initial message [CONN. INTERL'K] b = driver authorization (NONE/PIN/RF ID/NEXWATCH) AUTHORISATION_TYPE_USER c = truck authorization (NONE/PIN/RF ID/NEXWATCH) AUTHORISATION_TYPE_USER d = entry timeout [0] as not supported e = first arm number [1] f = base temperature [BASE 15 C] or [BASE 20 C] g = number of decimal points [0.1] h = batch type [NET] or [GROSS] (Preset type) i = date format dd/mm/yy, mm/dd/yy, yy/mm/dd, dd/ mm/yyyy, mm/dd/yyyy

8.3.4.18 ST - Send Transaction

Returns the requested transaction.

- Send

Control Byte	Information Fields
STX	[ST] 0 [a] 0 [ETX] where: a = requested transaction number.

- Receive

Control Byte	Information Fields
STX	[ST] 0 [a] [u] 0 [ETX] where: a = unit address b = transaction number [xxxxxxx] c = date [dd/mm/yyyy] d = start time [hh:mm:ss] e = stop time [hh:mm:ss] f = calibration number [xxx] g = entry start [xxxx] h = entry stop [xxxx] i = order number [up to 10 characters] j = driver number [up to 10 characters] k = tanker number [up to 10 characters] l = number of arms [x] m = density or relative density (if US units) for first arm m1 = density or relative density (if US units) for second arm (only if number of arms > 1) m2 = density or relative density (if US units) for third arm (only if number of arms > 1) m3 = density or relative density (if US units) for fourth arm (only if number of arms > 1) For (m to m3 the density is entered density if density prompt is enabled. If disabled it is observed density and when l= 1 it is truck offload density) n = 0 o = first arm number [x]

Control Byte	Information Fields
	p = checksum result [OK] q = load units [litres / metres3 / kgs / gallons] r = additive units [mls / cc] s = temperature units [C / F] t = source of tanker number [R/M] (R -RF ID, M –Manual Entry) u = bay number [xx]
NAK	If the transaction number is not valid.

8.3.4.19 SY - Send Entry

Returns the requested batch representing a single compartment load.

- Send

Control Byte	Information Fields
STX	[SY] 0 [a] 0 [ETX] where: a = requested batch number.

- Receive

Control Byte	Information Fields
STX	[SY] 0 [a] [q] 0 [ETX] where: a = batch number b = transaction number c = arm number [x] d = compartment number [xx] e = gross (unconverted) total [xxxxxx.x] f = net (converted) total [xxxxxx.x] g = accumulated (unconverted) before [xxxxxxxx] h = accumulated (unconverted) after [xxxxxxxx] i = average temperature [xxxx.x] j = preset quantity [xxxxxx.x] k = error status [x] (see below) l = returned quantity [xxxxxx] m = additive delivered [xxxx.x] n = checksum result [OK] o = net accumulated (converted) before [xxxxxxxx] p = net accumulated (converted) after [xxxxxxxx] q = offload density

Control Byte	Information Fields
NAK	If the batch number if not valid. 0 - No error 1 - Emergency Stop 2 - Overfill disconnected 3 - Flowmeter error 4 - Flowmeter timeout 5 - Temperature fault 6 - Valve fault 7 - 3 minute timer 8 - Expansion comms failure 9 - Power fail 10 - High additive error 11 - Low additive error 12 - Additive comms failure 13 - No additive error 100 - Illegal flow

NOTE: In MSC when volume conversion is not used NET totals are 0.0 whereas in 1010 they are same as Gross totals.

8.3.4.20 VA - Valve Settings

Returns valve settings.

- Send

Control Byte	Information Fields
STX	[VA] 0 [ETX]

- Receive

Control Byte	Information Fields
STX	[VA] 0 [a] [r] 0 [ETX] where: a = calibration number [xxx] b = calibration date [dd/mm/yyyy] c = calibration time [hh:mm:ss] d = no flow timeout, seconds [xxx] e = valve pre-stop [xxx] f = maximum preset [xxxxxx] g = pump off delay [xxx] h = valve type [DIGITAL / ON/OFF] If valve type = DIGITAL i = slow flowrate [xxx] j = deadband [xxx] (KDB) k = valve response [x.x] ((not supported) l = muti ramp up [DISABLE] (not supported) m = multi ramp up time [xx] seconds (0 as not supported) n = auto high flow [DISABLE] (not supported) o = multi ramp down [DISABLE] (not supported) p = slow start based on [QUANTITY] or [TIME]([QUANTITY] as time not supported) q = slow start value, if based on Quantity [xxx] units, else if based on Time [xx] sec r = flow error delay [xx] seconds (0 as not supported)

Control Byte	Information Fields
	If valve type = ON/OFF i = slow start based on [QUANTITY] or [TIME] j = slow start value, if based on QUANTITY [xxx] units, else if based on TIME [xx] seconds k = flow error delay [xx] seconds (Not supported)
NAK	

NOTE: Pump demand in MSC is in minutes while that of 1010 is in seconds. Here to make it compatible with 1010 the value is converted to seconds before sending in parameter g.

Returns settings for Product 1 valve. Time based slow start not supported. Multi ramp up and multi ramp down not supported.

8.3.4.21 VE - Set valve parameters

Remotely sets the valve operating parameters for Product 1 and Product 2 valves.

- Send

Control Byte	Information Fields
STX	[VE] 0 [a] ... [o] 0 [ETX] where: a = no flow timeout (<= 999) Stream Config |Product x| Alarms| No product alarm| b = valve pre-stop (<= 999) c = maximum preset (<= 999999) d = pump off delay (<= 999) e = valve type [DIGITAL] or [ON/OFF] If valve type = DIGITAL f = slow flowrate (>= 100 <= 800) g = deadband (KDB) h = valve response (>= 0.2 <= 1.0) (not supported) i = muti ramp up [ENABLE] or [DISABLE] (not supported) j = multi ramp up time (>= 5 <= 99) (not supported) k = auto high flow [ENABLE] or [DISABLE] (not supported) l = multi ramp down [ENABLE] or [DISABLE] (not supported) m = slow start based on [QUANTITY] or [TIME] (only Quantity supported) n = slow start value, if based on QUANTITY (<= 990), else if based on TIME (<= 99) 0 = flow error delay (not supported) If valve type = ON/OFF p = slow start based on [QUANTITY] or [TIME] (Only time based supported) q = slow start value, if based on QUANTITY (<= 990) (only Quantity

Control Byte	Information Fields
	supported) r = flow error delay (Not supported)

- Receive

Control Byte	Information Fields
ACK	
NAK	If not 15 or not 8 parameters are received.

NOTE: Pump demand in MSC is in minutes while that of 1010 is in seconds. Here to make it compatible with 1010, it is assumed to be coming in seconds and divided by 60 and then set in configuration.

Sets for Product 1 and product 2 valve. Time based slow start not supported. Multi ramp up and multi ramp down not supported.

8.4 Byte Testing

8.4.1 Description

This section describes how frames are correctly received.

8.4.2 3.2 Byte Testing

The transmitter sends a FEND (frame end) character, C0H before and after each frame.

NOTE: Two FEND characters in a row do not delimit an empty frame.

As frames are sent in 8-bit binary, the transmitter translates a FEND into the two byte sequence FESC TFEND (a frame escape byte and a transposed frame end byte), before transmission. The transmitter replaces the FESC character in the user data with the two character sequence FESC TFESC (a frame escape byte and a

transposed frame escape byte), before transmission. The receiver appends characters as they arrive to a buffer containing the current frame. A FEND marks the end of the current frame.

Receiving a FESC puts the receiver into “escaped mode”, which causes the receiver to translate a following TFESC or TFEND back to FESC or FEND, respectively, before adding it to the receive buffer and leaving escaped mode.

> NOTE: Receiving any character other than TFESC or TFEND while in escaped mode is an error; no action is taken and frame assembly continues. A TFEND or TFESC received while not in escaped mode is treated as an ordinary data character.

The FEND character is only sent as an end-of-frame indication. This ensures that any intact frame (properly delimited by FEND characters) is received properly regardless of the starting state of the receiver or corruption of the preceding frame. The special characters used are:

- FEND (frame end) C0 (hex) FESC (frame escape) DB (hex)
- TFEND (transposed frame end) DC (hex) TFESC (transposed frame escape) DD (hex)

The C/C++ programming tip on the following pages demonstrates how to correctly process received characters.

```
void T_COMPORT::vd_Process_SLIP_protocol(uint ui_c)
{
//Check for a frame start or stop character - FRAME CHARACTER
= COH


if(ui_c  ==  FRAMECHARACTER)
{
//If the frame is already started if(un_serial_port.sr_
flag.uf_frame_started)
{
//If    the    number    of    characters    recieved    is
 >=    3 (minimum required for a valid packet)
if(ui_rx_char_count >= 3)
{
un_serial_port.sr_flag.uf_ready_to_decode = TRUE; ui_rx_frame_
char_count = ui_rx_char_count; un_serial_port.sr_flag.uf_
```

```
frame_started = FALSE; if(sr_sci_settings.uc_bus_type ==
(uchar)BT_client)
{
pt_sci_registers->SCR.BIT.RIE = SET_BIT_LOW; pt_sci_registers-
>SCR.BIT.RE = SET_BIT_LOW;
}
}
//Less    than    3    characters    recieved    between
FRAMECHARACTER's therefore invalid packet - reset
else if(ui_rx_char_count < 3)
{
ui_rx_char_count = 0;
}
}
else // ie frame not previously started
{
un_serial_port.sr_flag.uf_frame_started = TRUE; ui_rx_char_
count = 0;
}
un_serial_port.sr_flag.uf_escape_mode = FALSE; pt_receive_
buffer  =  ch_receive_buffer;
}
else if(ui_c == FESC)


//Any FESC puts the receiver into escape mode. un_serial_
port.sr_flag.uf_escape_mode = TRUE; else if(un_serial_port.sr_
flag.uf_escape_mode)
//In escape mode.
{
//The    character    is    TFEND,    so    put    FEND    int
o    the buffer.
if(ui_c == TFEND)
*(uchar*)pt_receive_buffer++  =  CHARFEND;
//The    character    is    TFESC,    so    put    FESC    int
o    the buffer.
else if(ui_c == TFESC)
*(uchar*)pt_receive_buffer++  =  CHARFESC;
//In escape mode and the next character received was not TFEND
//or TFESC, so it is a transmission error. else
{
cl_Comport[uc_port_no].vd_Reset_RX_buffer(); return;
}
//Clear the escape mode and increment the buffer
//ui_rx_char_count. ui_rx_char_count++;
```

```
un_serial_port.sr_flag.uf_escape_mode  =  FALSE;
}
else if(un_serial_port.sr_flag.uf_frame_started)
//Every    other    character    is    added    to    the    r
eceive buffer, and the buffer
//ui_rx_char_count is incremented. The buffer is then checked
//for overflow.
{
*pt_receive_buffer++ = (char)ui_c; ui_rx_char_count++;


if(ui_rx_char_count >= (RX_BUFFER_SIZE - 2)) cl_Comport[uc_
port_no].vd_Reset_RX_buffer();
}
}
//End of function vd_Process_SLIP_protocol
```

9 FlexConn Protocol

FlexConn is a Honeywell Enraf proprietary protocol for exchange of full device data, configuration, diagnostics and command set to be used to communicate between Fusion4 Portal and Fusion4 controllers (Fusion4 SSC, Fusion4 MSC) and between MSC-L and server controllers (Fusion4 SSC-A, Fusion4 SSC-B, Fusion4 MSC-A). The FlexConn protocol is implemented on both RS-485 and Ethernet communication channels.

10 RS-485 Wiring for Fusion4 SSC-A/SSC-B

10.1 Introduction

The Fusion4 SSC-A (Single Stream Controller for Additive Injection) and the Fusion4 SSC-B (Single Stream Controller for Blending) both feature RS-485 terminal connectors to allow the controllers to communicate with external devices via an RS-422/485 compliant connection.

The following connections are supported or will be supported in the future.

- Serial connection between Fusion4 SSC-A/SSC-B and Fusion4 MSC-L (Multi-Stream Controller for Loading), see section 10.3
- Serial connection between Fusion4 SSC-A/SSC-B and 1010 B- series load computer, see section 10.4
- Serial connection between Fusion4 SSC-A/SSC-B and 1010 C-series load computer, see section 10.5
- Serial connection between Fusion4 SSC-A/SSC-B and a PC running Fusion4 Portal, see section 10.6
- Serial connection between Fusion4 SSC-A/SSC-B and a PC running Experion®, see section 10.7

CAUTION: The terms '2-wire' and '4-wire' used in this chapter refer to the data signal line count. The GND connection is mandatory as illustrated in all configurations. This brings the total count of wires to 3 and 5 respectively.

10.2 Fusion4 SSC-A and SSC-B Serial Connectivity

The Fusion4 SSC-A and the Fusion4 SSC-B each house two boards with an RS-422/485 terminal connector to connect the SSC-A/SSC-B to external devices:

- CAN-ADD-BLEND board, see section 10.2.1
- CAN-OPTION-SSC board, see section 10.2.2

10.2.1 CAN-ADD-BLEND Board

The CAN-ADD-BLEND board has an RS-422/485 terminal connector (CN6) that can be used to connect the SSC-A/SSC-B to an external device.

Connector CN6 can be used to establish the following connections:

- 2-Wire half-duplex RS-485 connection between Fusion4 SSC-A/ SSC-B and external device, see section 10.2.1.1. This type of connection is typically used to connect the Fusion4 SSC-A/SSC-B to a Fusion4 MSC-L or to a 1010 B-series or C-series load computer.
- 4-Wire full-duplex RS-485 connection between Fusion4 SSC-A/ SSC-B and external device, see section 10.2.1.2. This type of connection is typically used to connect the SSC-A/SSC-B to a Fusion4 MSC-L.
- 4-Wire full-duplex RS-422 connection between Fusion4 SSC-A/ SSC-B and external device, see section 10.2.1.3. This type of connection is typically used to connect the SSC-A/SSC-B to a 1010 B-series or C-series load computer.

> NOTE: See also the Fusion4 SSC-A Installation & Operation Manual and the Fusion4 SSC-B Installation & Operation Manual for more information.

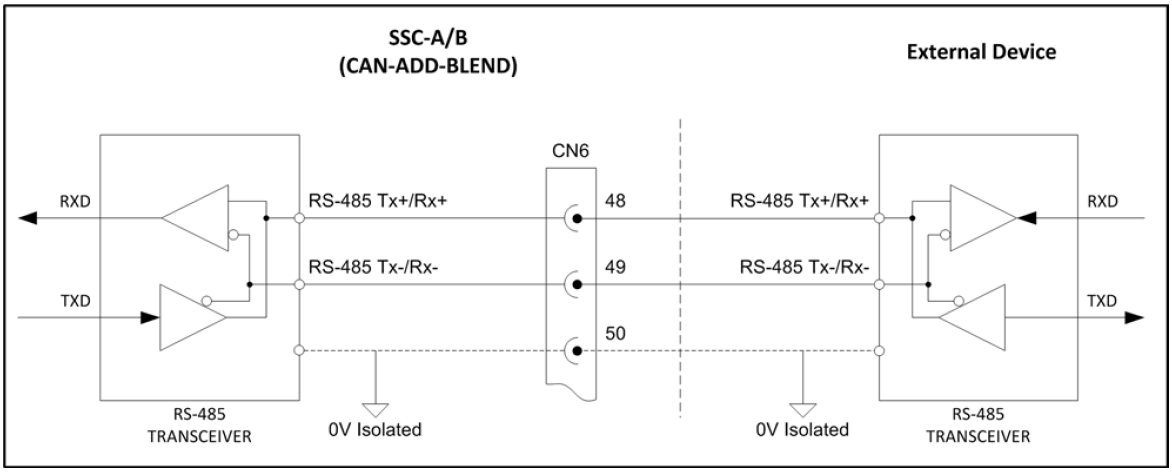
10.2.1.1 2- Wire Half-Duplex RS-485 Connection

A 2-wire half-duplex RS-485 connection is typically used to connect the Fusion4 SSC-A/SSC-B to a Fusion4 MSC-L or to a 1010 B-series or C-series load computer.

> NOTE: When connecting the Fusion4 SSC-A/SSC-B, terminal connector CN6 must be configured for 2-wire half-duplex communication using the RS COMM mode switch on the CAN-ADD-BLEND board.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 SSC-A/SSC-B and an external device.

Figure 10-1: 2-Wire Half-Duplex RS-485 Connection between Fusion4 SSC-A/SSC-B and External Device (CAN-ADD-BLEND Board)



The following table describes the layout of terminal connector CN6 in a 2-wire half-duplex RS-485 connection.

Table 10-1: Layout of Terminal Connector CN6 in 2-Wire Half-Duplex RS-485 Connection

Connector		Signal Name	Signal Description
ID	Pin		
CN6	48	RS485_A	2W RS-485 Tx+/Rx+
	49	RS485_B	2W RS-485 Tx-/Rx-
	50	RS485_0V	0 Volt

10.2.1.2 4-Wire Full-Duplex RS-485 Connection

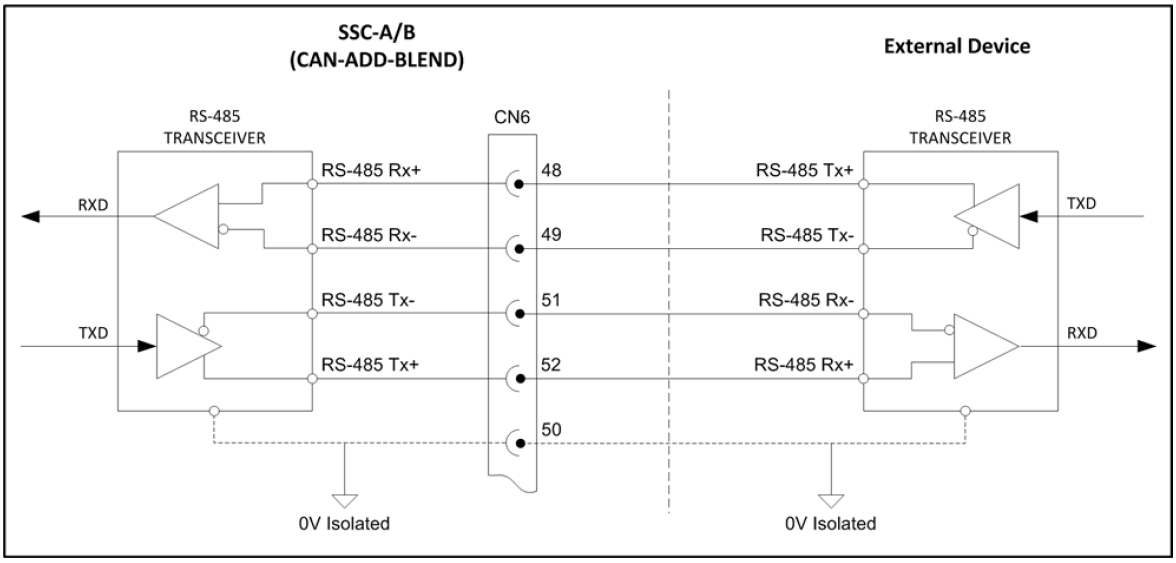
A 4-wire full-duplex RS-485 connection is typically used to connect the Fusion4 SSC-A/SSC-B to a Fusion4 MSC-L.

NOTES:

1. When connecting the Fusion4 SSC-A/SSC-B, terminal connector CN6 must be configured for 4-wire full-duplex communication using the RS COMM mode switch on the CAN-ADD-BLEND board.
2. In a 4-wire full-duplex connection, the external device is always the client and the Fusion4 SSC-A/SSC-B is the server.

The following figure schematically shows a 4-wire full-duplex RS-485 connection between an Fusion4 SSC-A/SSC-B and an external device.

Figure 10-2: 4-Wire Full-Duplex RS-485 Connection between Fusion4 SSC-A/B and External Device (CAN-ADD-BLEND Board)



The following table describes the layout of terminal connector CN6 in a 4-wire full-duplex RS-485 connection.

Table 10-2: Layout of Terminal Connector CN6 in RS-485 4-Wire Full-Duplex Connection

Connector		Signal Name	Signal Description
ID	Pin		
CN6	48	RS485_A	RS-485 4W Rx+
	49	RS485_B	RS-485 4W Rx-
	50	RS485_0V	0 Volt
	51	RS485_Z	RS-485 4W Tx-
	52	RS485_Y	RS-485 4W Tx+

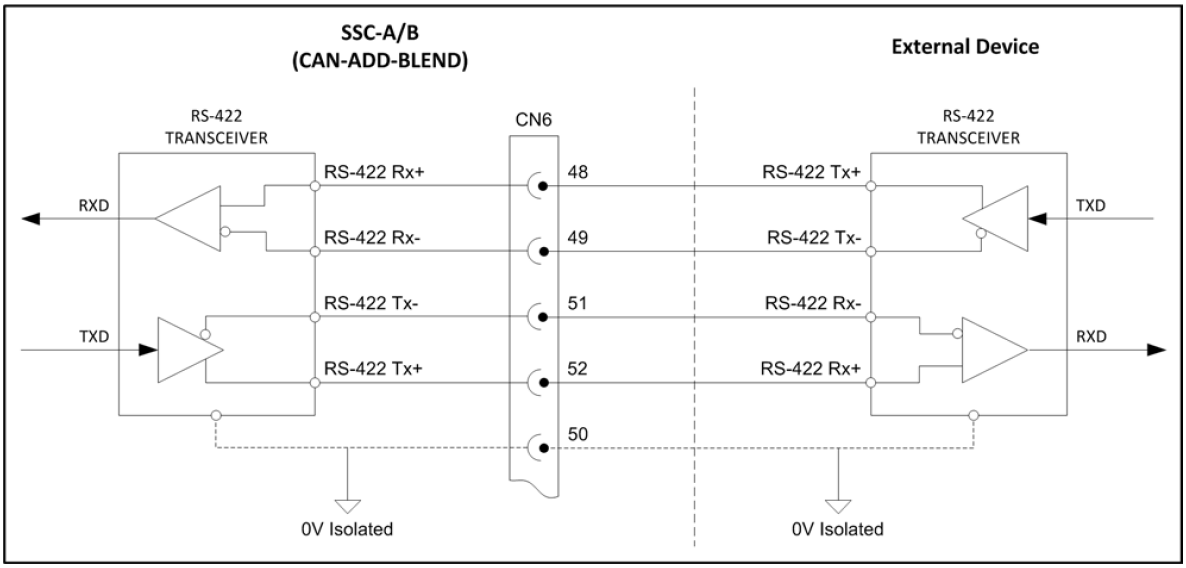
10.2.1.3 4-Wire Full-Duplex RS-422 Connection

A 4-wire full-duplex RS-422 connection is typically used to connect an Fusion4 SSC-A/SSC-B to a 1010 B-series or C-series load computer.

> **NOTES:**
>
> 1. When connecting the Fusion4 SSC-A/SSC-B, terminal connector CN6 must be configured for 4-wire full-duplex communication using the RS COMM mode switch on the CAN-ADD-BLEND board.
> 2. In a 4-wire full-duplex connection, the external device is always the client and the Fusion4 SSC-A/SSC-B is the server.

The following figure schematically shows a 4-wire full-duplex RS-422 connection between an Fusion4 SSC-A/SSC-B and an external device.

Figure 10-3: 4-Wire Full-Duplex RS-422 Connection between Fusion4 SSC-A/B and External Device (CAN-ADD-BLEND Board)



The following table describes the layout of terminal connector CN6 in a 4-wire full-duplex RS-422 connection.

Table 10-3: Layout of Terminal Connector CN6 in 4-Wire Full-Duplex RS-422 Connection

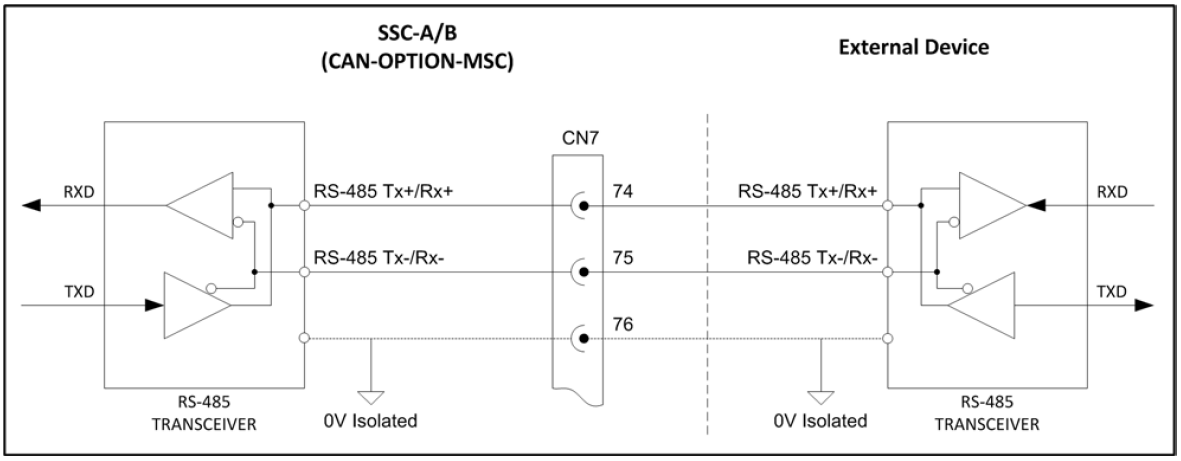
Connector		Signal Name	Signal Description
ID	Pin		
CN6	48	Data In (+)	4W RS-422 Rx+
	49	Data In (-)	4W RS-422 Rx-
	50	GROUND	0 Volt
	51	Data Out (-)	4W RS-422 Tx-
	52	Data Out (+)	4W RS-422 Tx+

10.2.2 CAN-OPTION-SSC Board

The CAN-OPTION-SSC board features an RS-485 terminal connector (CN7) enabling a 2-wire half-duplex RS-485 connection between the SSC-A/SSC-B and an external device. This connector is preferably used to connect the Fusion4 SSC-A/SSC-B to a PC running for example Fusion4 Portal.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between an Fusion4 SSC-A/SSC-B and an external device.

Figure 10-4: 2-Wire Half-Duplex RS-485 Connection between Fusion4 SSC-A/SSC-B and External Device (CAN-OPTION-SSC Board)



The following table describes the layout of terminal connector CN7.

Table 10-4: Layout of Terminal Connector CN7 in 2-wire half-duplex RS-485 connection

Connector		Signal Name	Signal Description
ID	Pin		
CN7	74	RS485_A	2W RS-485 Tx+/Rx+
	75	RS485_B	2W RS-485 Tx-/Rx-
	76	RS485_0V	0 Volt

10.3 Connecting Fusion4 SSC-A/SSC-B to MSC-L

=> Future implementation

10.4 Connecting Fusion4 SSC-A/SSC-B to 1010 B-Series

The Fusion4 SSC-A/SSC-B can be connected to a 1010 B-series load computer via a 2-wire half-duplex RS-485 serial connection. The following terminal connectors/COM ports must be used:

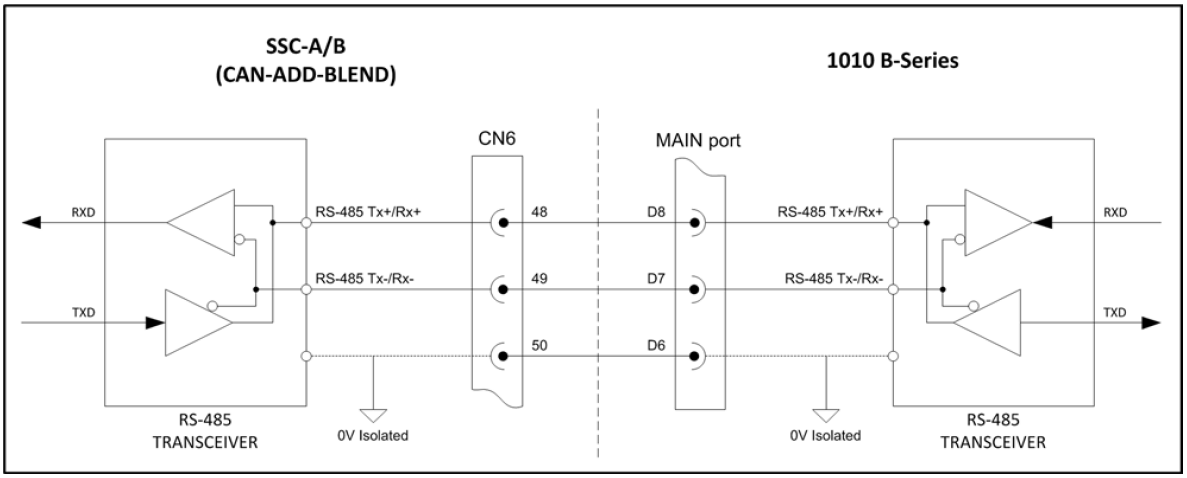
- Fusion4 SSC-A/SSC-B: terminal connector CN6
- 1010 B-series: MAIN port

NOTES:

1. When connecting the Fusion4 SSC-A/SSC-B, terminal connector CN6 must be configured for 2-wire RS-485 communication using the RS COMM mode switch SW2 on the CAN-ADD-BLEND board.
2. If the connection to the Fusion4 SSC-A/SSC-B represents the last link in a multi-drop bus, then the bus must be terminated by setting jumper JP8 on the CAN-ADD-BLEND board to the right-hand (terminated) position. The serial bus will be terminated with a 120 W resistor.
3. When connecting the 1010 B-series load computer, the MAIN port must be set up for 2-wire RS-485 communication through modifying parameters by using the 1010 keyboard and HMI.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 SSC-A/B and the 1010 B-series load computer.

Figure 10-5: 2-Wire Half-Duplex RS-485 Connection between Fusion4 SSC-A/B and 1010 B-Series



The following table describes the layout of the 1010 B-series MAIN port.

Table 10-5: Layout of 1010 B-series MAIN Port

Connector		Signal Name	Signal Description
ID	Pin		
MAIN port	D6	RS485_0V	0 Volt
	D7	RS485_A	2W RS-485 Tx-/Rx-
	D8	RS485_B	2W RS-485 Tx+/Rx+

NOTE: See also Model 1010A Application Pack BJ Wiring Diagrams and Programming Manual for more information.

10.5 Connecting Fusion4 SSC-A/SSC-B to 1010 C-Series

The Fusion4 SSC-A/SSC-B can be connected to a 1010 C-series load computer via a 2-wire half-duplex RS-485 serial connection. The following terminal connectors/COM ports must be used:

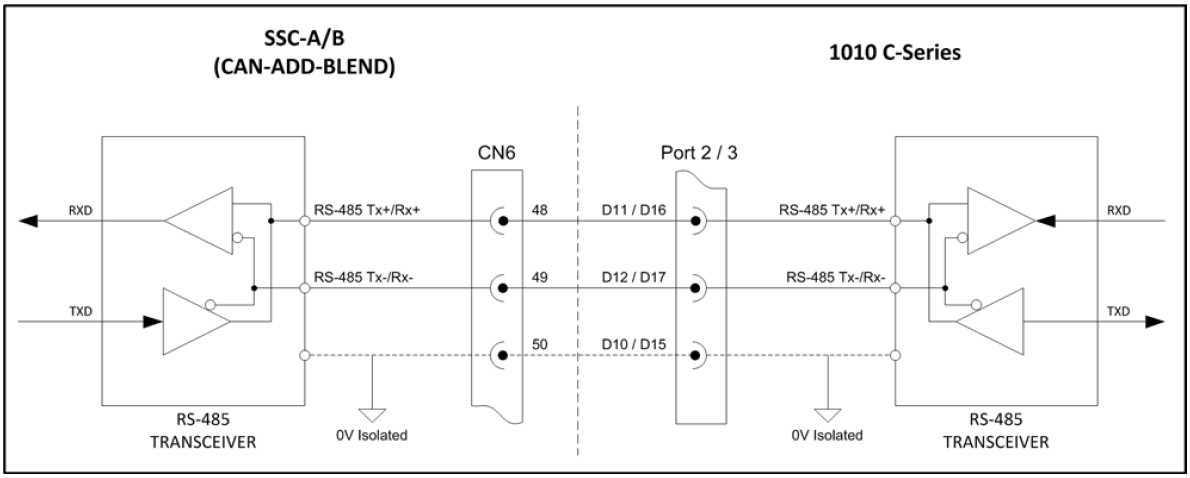
- Fusion4 SSC-A/SSC-B: terminal connector CN6
- 1010 C-series: Port 2 or Port 3

NOTES:

1. When connecting the Fusion4 SSC-A/SSC-B, terminal connector CN6 must be configured for 2-wire RS-485 communication using the RS COMM mode switch SW2 on the CAN-ADD-BLEND board.
2. If the connection to the Fusion4 SSC-A/SSC-B represents the last link in a multi-drop bus, then the bus must be terminated by setting jumper JP8 on the CAN-ADD-BLEND board to the right-hand (terminated) position. The serial bus will be terminated with a 120 W resistor.
3. When connecting the 1010 C-series load computer, the Port 2 / Port 3 must be set up for 2-wire RS-485 communication through modifying parameters by using the 1010 keyboard and HMI.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 SSC-A/B and the 1010 C-series load computer.

Figure 10-6: 2-Wire Half-Duplex RS-485 Connection between Fusion4 SSC-A/B and 1010 C-series



The following table describes the layout of 1010 C-series Port 2 and Port 3.

Table 10-6: Layout of 1010 C-Series Port 2 and Port 3

Connector		Signal Name	Signal Description
ID	Pin		
PORT 2	D10	RS485_0V	0 Volt
	D11	RS485_A	2W RS 485 Tx+/Rx+
	D12	RS485_B	2W RS 485 Tx-/Rx-
PORT 3	D15	RS485_0V	0 Volt
	D16	RS485_A	2W RS 485 Tx+/Rx+
	D17	RS485_B	2W RS 485 Tx-/Rx-

NOTE: See also the Card Descriptions and Wiring Manual Load Computer 1010 CB for more information.

10.6 Connecting Fusion4 SSC-A/SSC-B to Portal

There are a number of ways to connect the Fusion4 SSC-A/SSC-B to a PC running Fusion4 Portal, depending on the connectivity options of the PC:

- A serial connection between the Fusion4 SSC-A/SSC-B and the PC running Fusion4 Portal using an RS-232 to RS-422/485 converter, see section 10.6.1
- A 2-wire half-duplex RS-485 connection between the Fusion4 SSC-A/SSC-B and the PC running Fusion4 Portal, see section 10.6.2
- A serial to Ethernet connection between the Fusion4 SSC-A/SSC-B and the PC running Fusion4 Portal using a serial device server, see section 10.6.3

> NOTE: If the connection to the Fusion4 SSC-A/SSC-B represents the last link in a multi-drop bus, then the bus must be terminated by setting jumper JP8 on the CAN-ADD-BLEND board to the right-hand (terminated) position. The serial bus will be terminated with a 120 W resistor.

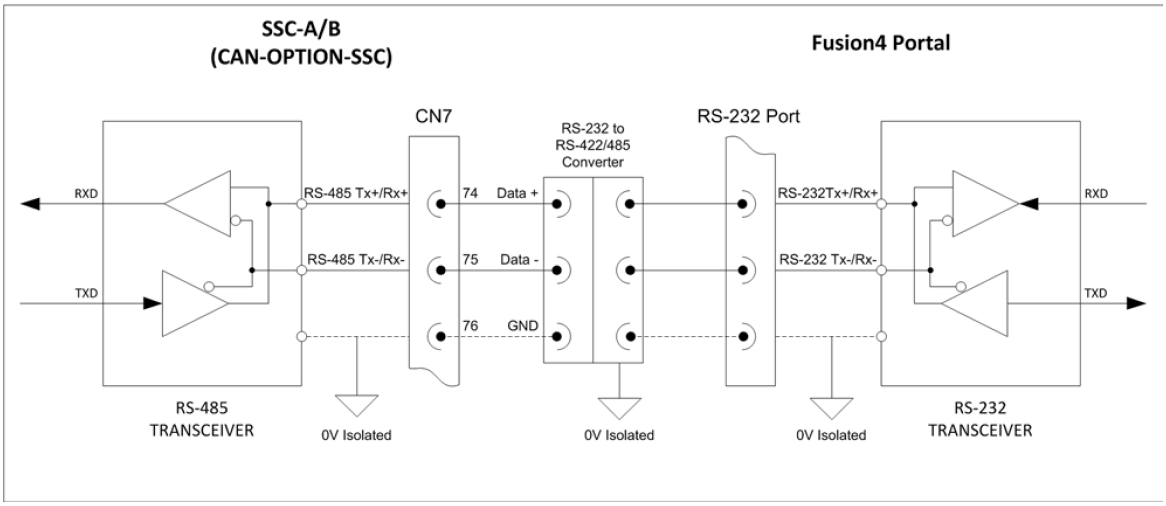
See also the Fusion4 Portal Installation & Operation Manual for more information.

10.6.1 RS-232 to RS-422/485 Converter

For the Fusion4 SSC-A/SSC-B to be connected to an RS-232 serial port on the PC running Fusion4 Portal, an RS-232 to RS-422/485 converter is required.

The following figure schematically shows a serial connection between the Fusion4 SSC-A/SSC-B and the PC running Fusion4 Portal, in which an RS-232 to RS-422/485 converter (e.g. Advantech Adam 4520) is used.

Figure 10-7: Connection between Fusion4 SSC-A/SSC-B and Fusion4 Portal using RS-232 to RS- 422/485 Converter

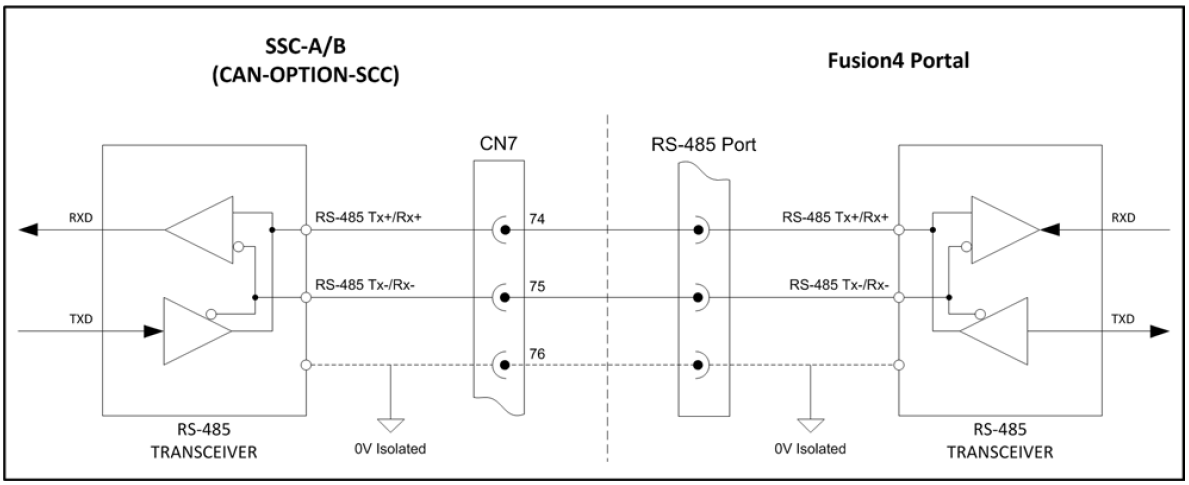


10.6.2 RS-485 Serial Connection

For the Fusion4 SSC-A/SSC-B to be connected directly to the PC running Fusion4 Portal, the PC must have an RS-485 serial port.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 SSC-A/SSC-B and the PC running Fusion4 Portal.

Figure 10-8: 2-Wire Half-Duplex RS-485 Connection between Fusion4 SSC-A/SSC-B and Fusion4 Portal



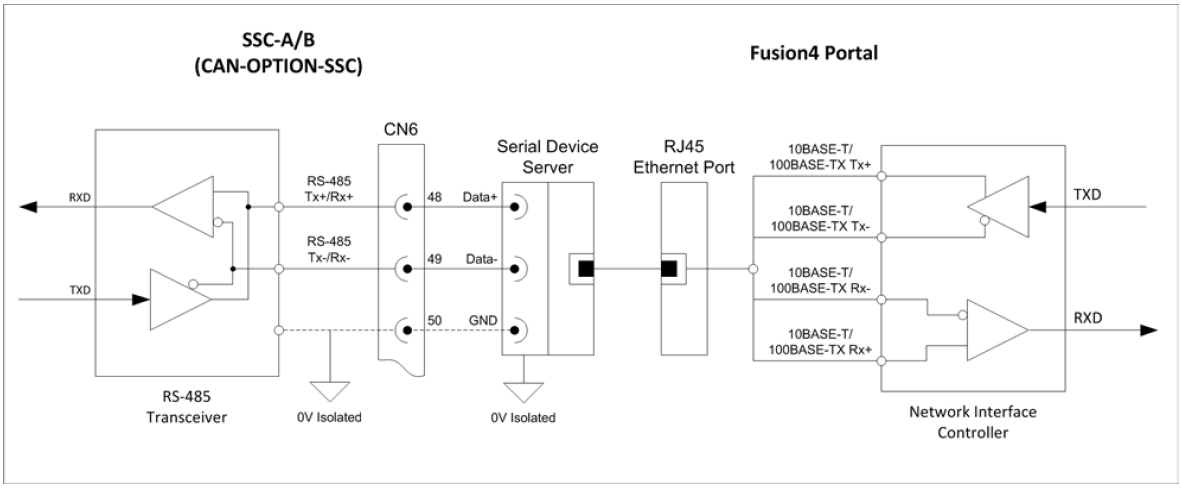
10.6.3 Serial Device Server

For the Fusion4 SSC-A to be connected to an Ethernet port of the PC running Fusion4 Portal, a serial device server is required. The serial device server must support RS-422/485.

> NOTE: Fusion4 Portal supports the serial device driver through Virtual COM and not through the TCP connection.

The following figure schematically shows a serial to Ethernet connection between the Fusion4 SSC-A/SSCB and the PC running Fusion4 Portal, in which a serial device server (e.g. Moxa NPort) is used.

Figure 10-9: Serial to Ethernet Connection between Fusion4 SSC-A/SSC-B and Fusion4 Portal



10.7 Connecting Fusion4 SSC-A/SSC-B to Experion

=> Future implementation

11 RS-485 Wiring for Fusion4 MSC-A/MSC-L

11.1 Fusion4 MSC-A / Fusion4 MSC-L Serial Connectivity

The Fusion4 MSC-A / Fusion4 MSC-L has three printed circuit boards each equipped with one more terminal connectors to connect the Fusion4 MSC-A / Fusion4 MSC-L to an external device via an RS-485 compliant connection.

- CAN-ARM-MSC-1 board, see section 11.1.1
- CAN-ARM-MSC-2 board, see section 11.1.2
- CAN-HMI-MSC board, see section 11.1.3

The following connections are supported or will be supported in the future.

- Serial connection between Fusion4 MSC-A and Fusion4 MSC-L, see section 11.1.4
- Serial connection between Fusion4 MSC-A and 1010 B-series load computer, see section 11.1.5
- Serial connection between Fusion4 MSC-A and 1010 C-series load computer, see section 11.1.6
- Serial connection between Fusion4 MSC-A / Fusion4 MSC-L and a PC running Fusion4 Portal, see section 11.1.7
- Serial connection between Fusion4 MSC-A / Fusion4 MSC-L and a PC running Experion®, see section 11.1.8
- Serial connection between Fusion4 MSC-L and a PC running Terminal Manager, see section 11.1.9

NOTE: See also the Fusion4 MSC-A / Fusion4 MSC-L Installation & Operation Manual for more information.

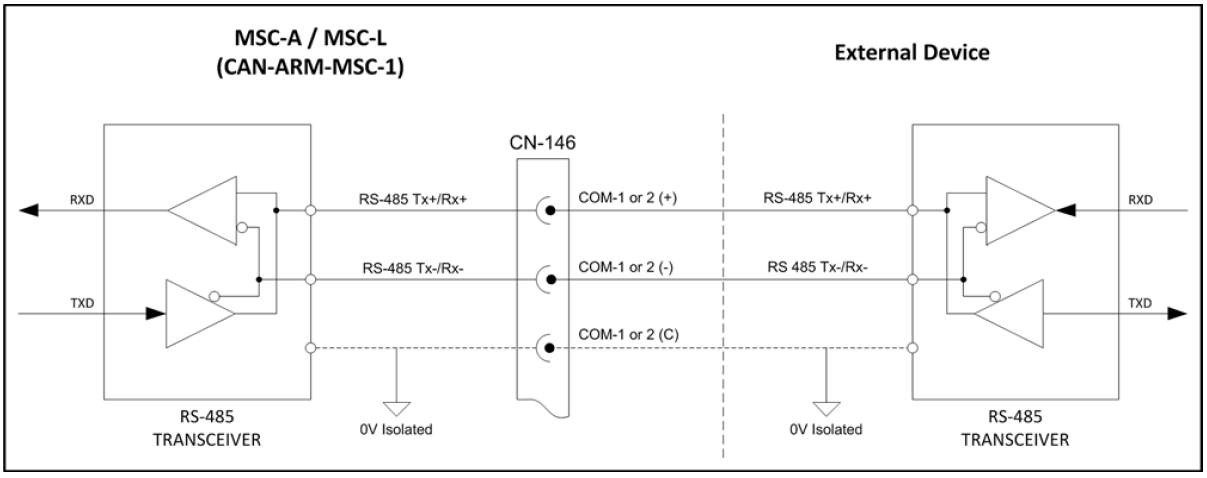
CAUTION: The terms '2-wire' and '4-wire' used in this chapter refer to the data signal line count. The GND connection is mandatory as illustrated in all configurations. This brings the total count of wires to 3 and 5 respectively.

11.1.1 CAN-ARM-MSC-1 Board

The CAN-ARM-MSC-1 board features one terminal connector CN-146 consisting of two serial ports, namely COM-1 and COM-2. Both serial ports can be used to establish a 2-wire half-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device. The serial ports are typically used to connect the Fusion4 MSC-A and the Fusion4 MSC-L to one another or to connect the Fusion4 MSC-A to a 1010 C-series load computer.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device, using one of the serial ports of terminal connector CN-146.

Figure 11-1: 2-wire half-duplex RS-485 connection between Fusion4 MSC-A / Fusion4 MSC-L and external device (CAN-ARM-MSC-1 board)



The following table describes the layout of terminal connector CN-146.

Table 11-1: Layout of terminal connector CN-146

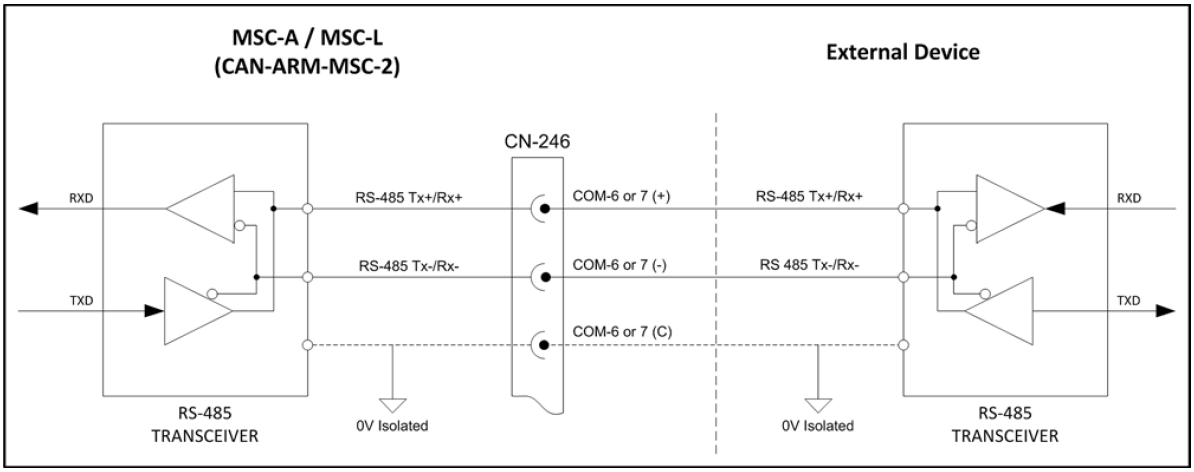
Connector		Signal Name	Signal Description
ID	Pin		
CN-146	COM-1 (+)	RS485_A	2W RS-485 Tx+/Rx+
	COM-1 (-)	RS485_B	2W RS-485 Tx-/Rx-
	COM-1 (C)	RS485_0V	0 Volt
	COM-2 (+)	RS485_A	2W RS-485 Tx+/Rx+
	COM-2 (-)	RS485_B	2W RS-485 Tx-/Rx-
	COM-2 (C)	RS485_0V	0 Volt

11.1.2 CAN-ARM-MSC-2 Board

The CAN-ARM-MSC-2 board features one terminal connector CN-246 consisting of two serial ports, namely COM-6 and COM-7. Both serial ports can be used to establish a 2-wire half-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device. The serial ports are typically used to connect the Fusion4 MSC-A and the Fusion4 MSC-L to one another or to connect the Fusion4 MSC-A to a 1010 C-series load computer.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device, using one of the serial ports of terminal connector CN-246.

Figure 11-2: 2-wire half-duplex RS-485 connection between Fusion4 MSC-A / Fusion4 MSC-L and external device (CAN-ARM-MSC-2 board)



The following table describes the layout of terminal connector CN-246.

Table 11-2: Layout of terminal connector CN-246

Connector		Signal Name	Signal Description
ID	Pin		
CN-246	COM-6 (+)	RS485_A	2W RS-485 Tx+/Rx+
	COM-6 (-)	RS485_B	2W RS-485 Tx-/Rx-
	COM-6 (C)	RS485_0V	0 Volt
	COM-7 (+)	RS485_A	2W RS-485 Tx+/Rx+
	COM-7 (-)	RS485_B	2W RS-485 Tx-/Rx-
	COM-7 (C)	RS485_0V	0 Volt

11.1.3 CAN-HMI-MSC Board

The CAN-HMI-MSC board features two terminal connectors that can be used to establish an RS-485 compliant connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device:

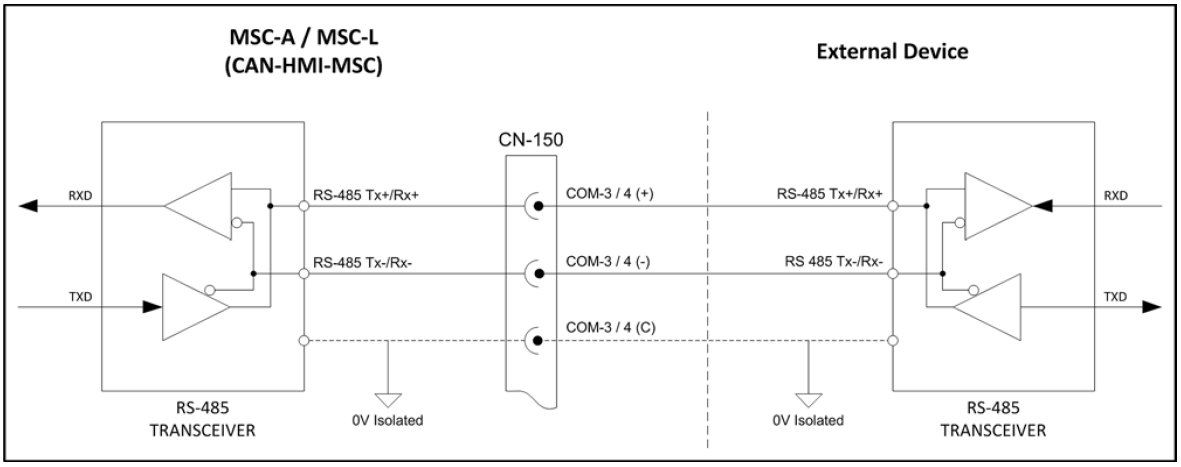
- Connector CN-150, see section 11.1.3.1
- Connector CN-151, see section 11.1.3.2

11.1.3.1 CAN-HMI-MSC Board: Connector CN-150

Terminal connector CN-150 features two serial ports, namely COM-3 and COM-4. Both serial ports can be used to establish a 2-wire half- duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device. The serial ports are typically used to connect the Fusion4 MSC-A / Fusion4 MSC-L to a PC running for example Fusion4 Portal.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device, using one of the serial ports of terminal connector CN-150.

Figure 11-3: 2-wire half-duplex RS-485 connection between Fusion4 MSC-A / Fusion4 MSC-L and external device (CAN-HMI-MSC board)



The following table describes the layout of terminal connector CN-150.

Table 11-3: Layout of terminal connector CN-150

Connector		Signal Name	Signal Description
ID	Pin		
CN-150	COM-3 (+)	RS485_A	2W RS-485 Tx+/Rx+
	COM-3 (-)	RS485_B	2W RS-485 Tx-/Rx-
	COM-3 (C)	RS485_0V	0 Volt
	COM-4 (+)	RS485_A	2W RS-485 Tx+/Rx+
	COM-4 (-)	RS485_B	2W RS-485 Tx-/Rx-
	COM-4 (C)	RS485_0V	0 Volt

11.1.3.2 CAN-HMI-MSC Board: Connector CN-151

Terminal connector CN-151 can be used to establish a 4-wire full- duplex RS-422/485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device, for example to connect:

- Fusion4 MSC-A to a 1010 B-series load computer
- Fusion4 MSC-A to the Fusion4 MSC-L
- Fusion4 MSC-A / Fusion4 MSC-L to a PC running for example Fusion4 Portal

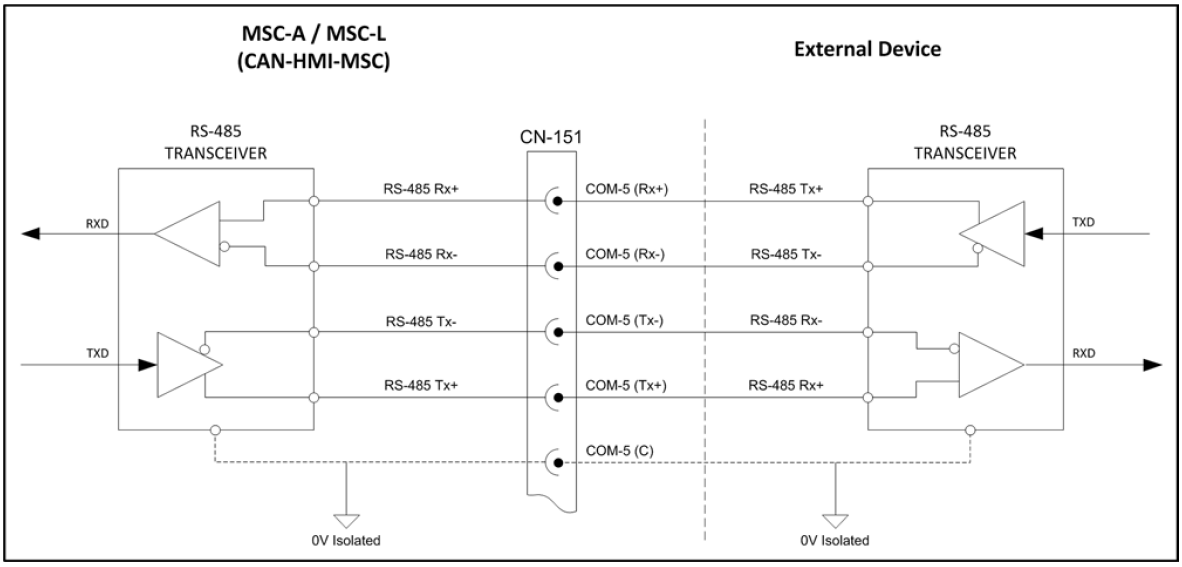
NOTES:

1. In a 4-wire full-duplex RS-422/485 connection, the external device (e.g. Fusion4 MSC-L, 1010 B-series load computer, PC running Fusion4 Portal) is always the client and the Fusion4 MSC-A is the server.
2. When connecting the Fusion4 MSC-A / Fusion4 MSC-L, terminal connector CN-151 must be configured for 4-wire RS-485 communication using the RS COMM mode switch SW2 on the CAN-HMI-MSC board.
3. If the connection to the Fusion4 MSC-A / Fusion4 MSC-L represents the last link in a multi-drop bus, then the bus must be terminated by setting jumpers JP7 and JP8 on the CAN-HMI-MSC board to the right-hand (terminated) position. The serial bus will be terminated with a 120 Ohms resistor.

11.1.3.2.1 4-Wire Full-Duplex RS-485 Connection

The following figure schematically shows a 4-wire full-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device.

Figure 11-4: 4-wire full-duplex RS-485 connection between Fusion4 MSC-A / Fusion4 MSC-L and external device (CAN-HMI-MSC board)



The following figure describes the terminal layout of connector CN-151 in a 4-wire full-duplex RS-485 connection.

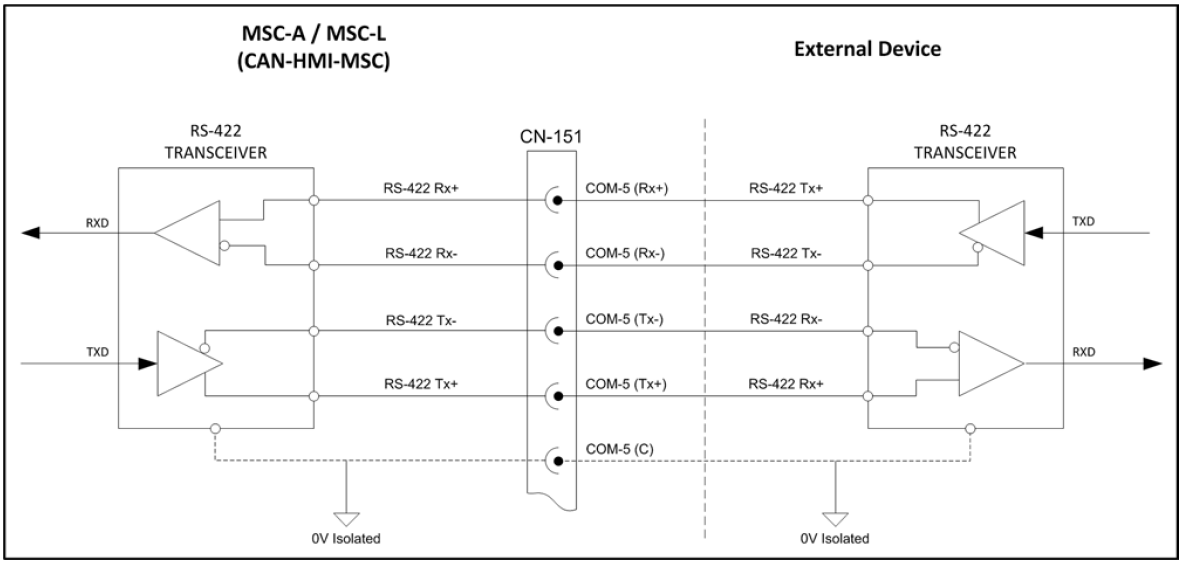
Table 11-4: Layout of terminal connector CN-151

Connector		Signal Name	Signal Description
ID	Pin		
CN-151	COM-5 (Rx+)	RS485_A	4W RS-485 Rx+
	COM-5 (Rx-)	RS485_B	4W RS-485 Rx-
	COM-5 (Tx+)	RS485_Y	4W RS-485 Tx+
	COM-5 (Tx-)	RS485_Z	4W RS-485 Tx-
	COM-5 (C)	RS485_0V	0 Volt

11.1.3.2.2 4-Wire Full-Duplex RS-422 Connection

The following figure schematically shows a 4-wire full-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device.

Figure 11-5: 4-wire full-duplex RS-422 connection between Fusion4 MSC-A / Fusion4 MSC-L and external device (CAN-HMI-MSC board)



The following table describes the terminal layout of connector CN-151 in a 4-wire full-duplex RS-422 connection.

Table 11-5: Layout of terminal connector CN-151Fusion4 MSC-A

Connector		Signal Name	Signal Description
ID	Pin		
CN-151	COM-5 (Rx+)	Data In (+)	4W RS-485 Rx+
	COM-5 (Rx-)	Data In (-)	4W RS-485 Rx-
	COM-5 (Tx+)	Data Out (+)	4W RS-485 Tx+
	COM-5 (Tx-)	Data Out (-)	4W RS-485 Tx-
	COM-5 (C)	GROUND	0 Volt

11.1.4 Connecting Fusion4 MSC-A to Fusion4 MSC-L

The Fusion4 MSC-A can be connected to a Fusion4 MSC-L via 2-wire half-duplex RS-485 serial connection. The following terminal connectors/ports can be used:

- Fusion4 MSC-A: terminal connector CN-146 for COM-1 or COM-2 (CAN-ARM-MSC-1 board), or terminal connector CN-150 for COM-3 or COM-4 (CAN-HMI-MSC board), or terminal connector CN-246 for COM-6 or COM-7 (CAN-ARM-MSC-1 board)
- Fusion4 MSC-L: terminal connector CN-146, COM-1 or COM-2 (CAN-ARM-MSC-1 board) – For External Additives 1 to 12 on CAN- ARM-MSC-1 board of MSC-L
- Fusion4 MSC-L: terminal connector CN-246, COM-6 or COM-7 (CAN-ARM-MSC-2 board) – For External Additives 13 to 24 on CAN- ARM-MSC-2 board of MSC-L

The following figures schematically show a 2-wire half- duplex RS-485 connection between the Fusion4 MSC-A and the Fusion4 MSC-L.

Figure 11-6: 2-wire half-duplex RS-485 connection between Fusion4 MSC-A and CAN-ARM-MSC-1 on Fusion4 MSC-L

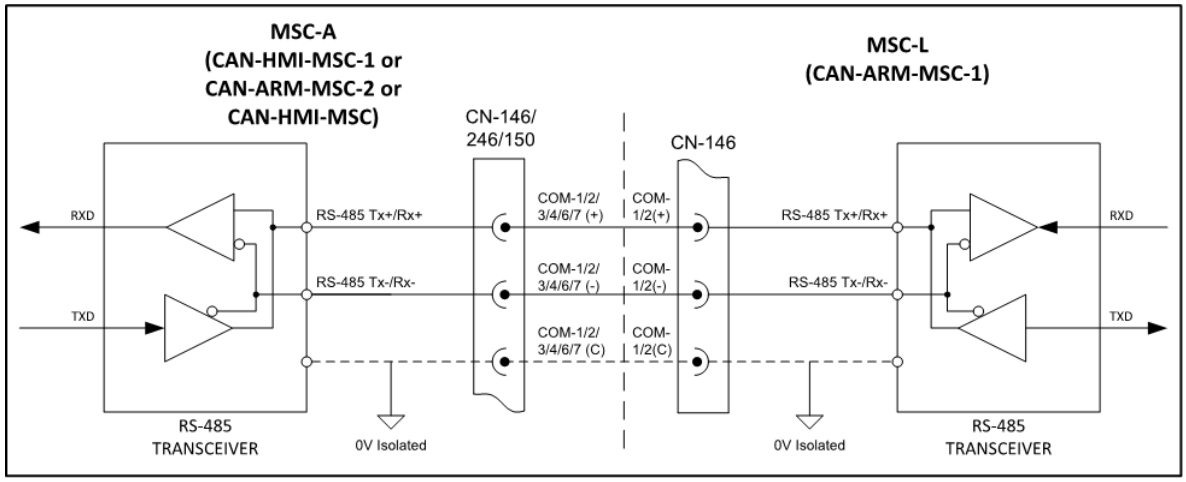
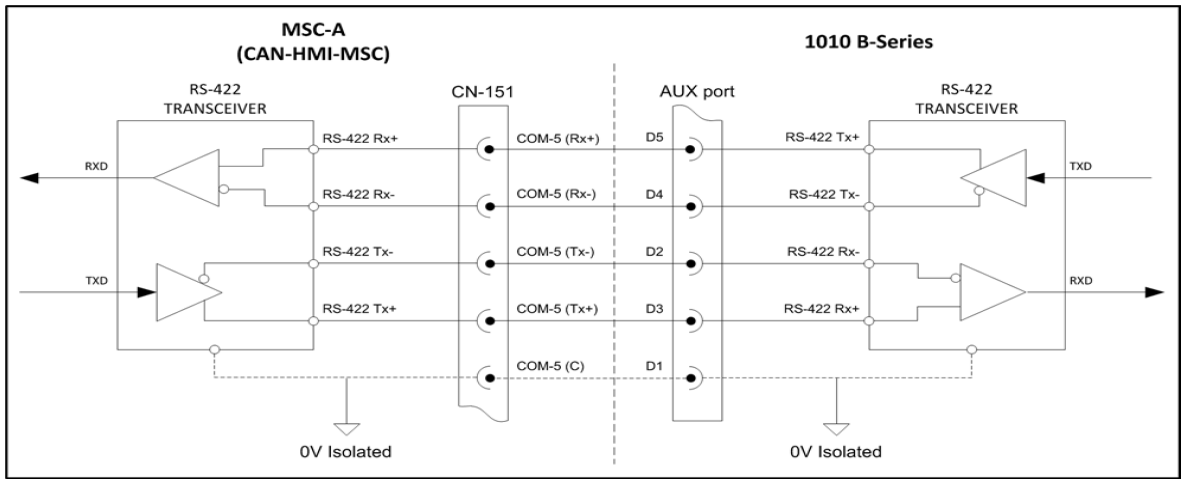


Figure 11-7: 2-wire half-duplex RS-485 connection between Fusion4 MSC-A and CAN-ARM-MSC-1 on Fusion4 MSC-L



11.1.5 Connecting Fusion4 MSC-A to 1010 B-series load computer

The Fusion4 MSC-A can be connected to a 1010 B-series load computer via a 4-wire full-duplex RS-422 serial connection. The following terminal connectors/serial ports must be used:

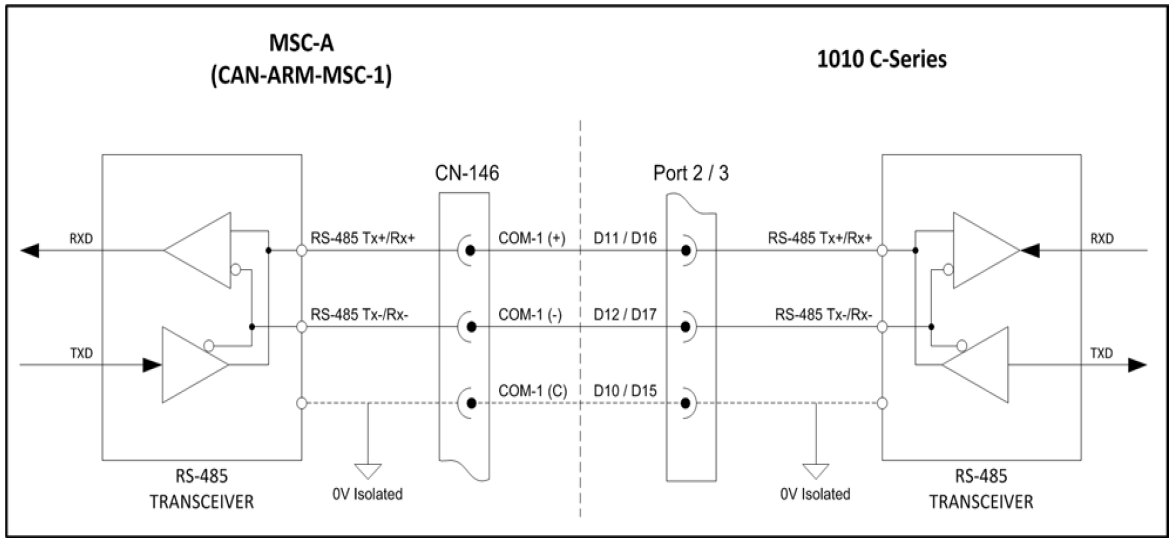
- Fusion4 MSC-A: terminal connector CN-151
- 1010 B-series: AUX port

NOTES:

1. When connecting the Fusion4 MSC-A, terminal connector CN-151 must be configured for 4-wire RS-485 communication using the RS COMM mode switch SW2 on the CAN-HMI-MSC board.
2. If the connection to the Fusion4 MSC-A represents the last link in a multi-drop bus, then the bus must be terminated by setting jumper JP8 on the CAN-HMI-MSC board to the right-hand (terminated) position. The serial bus will be terminated with a 120 W resistor.
3. When connecting the 1010 B-series load computer, the AUX port must be set up for 4-wire RS-422 communication through modifying parameters by using the 1010 keyboard and HMI.

The following figure schematically shows a 4-wire full-duplex RS-422 connection between the Fusion4 MSC-A and the 1010 B-series load computer.

Figure 11-8: 4-wire full-duplex RS-422 connection between Fusion4 MSC-A and 1010 B-series



The following table describes the layout of the 1010 B-series AUX port.

Table 11-6: Layout of 1010 B-series AUX port

Connector		Signal Name	Signal Description
ID	Pin		
AUX port	D1	GROUND	0 Volt
	D2	Data In (-)	4W RS-422 Rx-
	D3	Data In (+)	4W RS-422 Rx+
	D4	Data Out (-)	4W RS-422 Tx-
	D5	Data Out (+)	4W RS-422 Tx+

NOTE: See also Model 1010A Application Pack BJ Wiring Diagrams and Programming Manual for more information.

11.1.6 Connecting Fusion4 MSC-A to 1010 C-series load computer

The Fusion4 MSC-A can be connected to a 1010 C-series load computer via 2-wire half-duplex RS-485 serial connection. The following terminal connectors/ports can be used:

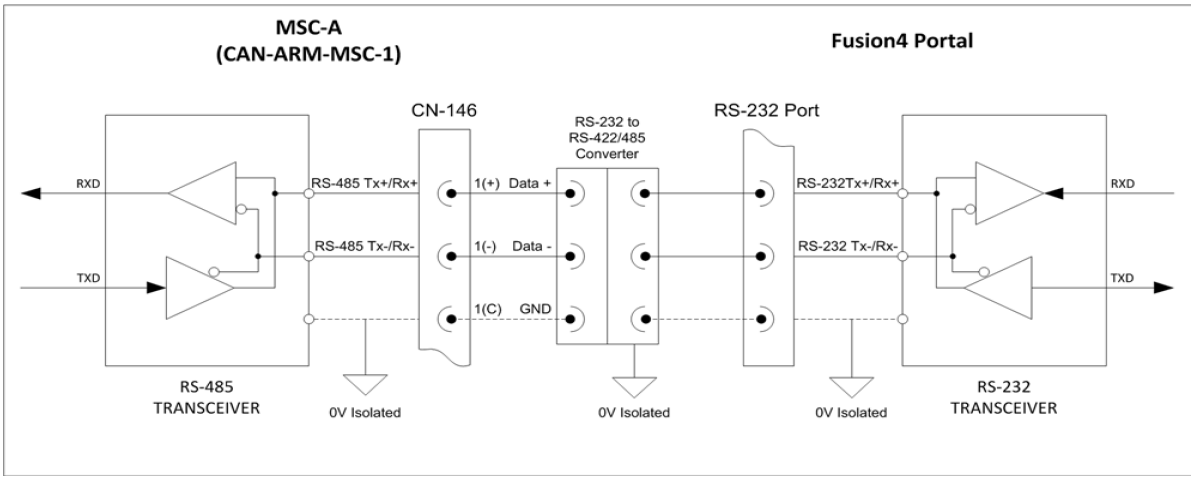
- Fusion4 MSC-A: terminal connector CN-146, COM-1 or COM-2 (CAN-ARM-MSC-1 board), or terminal connector CN-246, COM-6 or COM-7 (CAN-ARM-MSC-1 board)
- 1010 C-series load computer: Port 2 or Port 3

NOTES:

1. If the connection to the Fusion4 MSC-A represents the last link in a multi-drop bus, then the bus must be terminated by setting jumper JP8 on the CAN-ARM-MSC-1/CAN-ARM-MSC-2 board to the right-hand (terminated) position. The serial bus will be terminated with a 120 W resistor.
2. When connecting the 1010 C-series load computer, Port 2/Port 3 port must be set up for 2-wire RS-485 communication through modifying parameters by using the 1010 keyboard and HMI.

The following figure schematically shows a 2-wire half-duplex RS-485 connection between the Fusion4 MSC-A and the 1010 C-series load computer.

Figure 11-9: 2-wire half-duplex RS-485 connection between Fusion4 MSC-A and 1010 C-series



The following table describes the layout of 1010 C-series Port 2 and Port 3.

Table 11-7: Layout of 1010 C-Series Port 2 and Port 3

Connector		Signal Name	Signal Description
ID	Pin		
Connector 2	D10	RS485_0V	0 Volt
	D11	RS485_A	RS-485 2W Tx+/Rx+
	D12	RS485_B	RS-485 2W Tx-/Rx-
Connector 3	D15	RS485_0V	0 Volt
	D16	RS485_A	RS485 2W Tx+/Rx+
	D17	RS485_B	RS485 2W Tx-/Rx-

NOTE: See also the Card Descriptions and Wiring Manual Load Computer 1010 CB for more information.

11.1.7 Connecting Fusion4 MSC-A / Fusion4 MSC-L to Fusion4 Portal

There are a number of ways to connect the Fusion4 MSC-A / Fusion4 MSC-L to a PC running Fusion4 Portal, depending on the connectivity options of the PC:

- Serial connection between the Fusion4 MSC-A / Fusion4 MSC-L and the PC running Fusion4 Portal using an RS-232 to RS-422/485 converter, see section 11.1.7.1
- 2-Wire half-duplex or 4-wire full-duplex RS-485 connection between the Fusion4 MSC-A / Fusion4 MSC_L and the PC running Fusion4 Portal, see section 11.1.7.2
- Serial to Ethernet connection between the Fusion4 MSC-A / Fusion4 MSC_L and the PC running Fusion4 Portal using a serial device server, see section 11.1.7.3

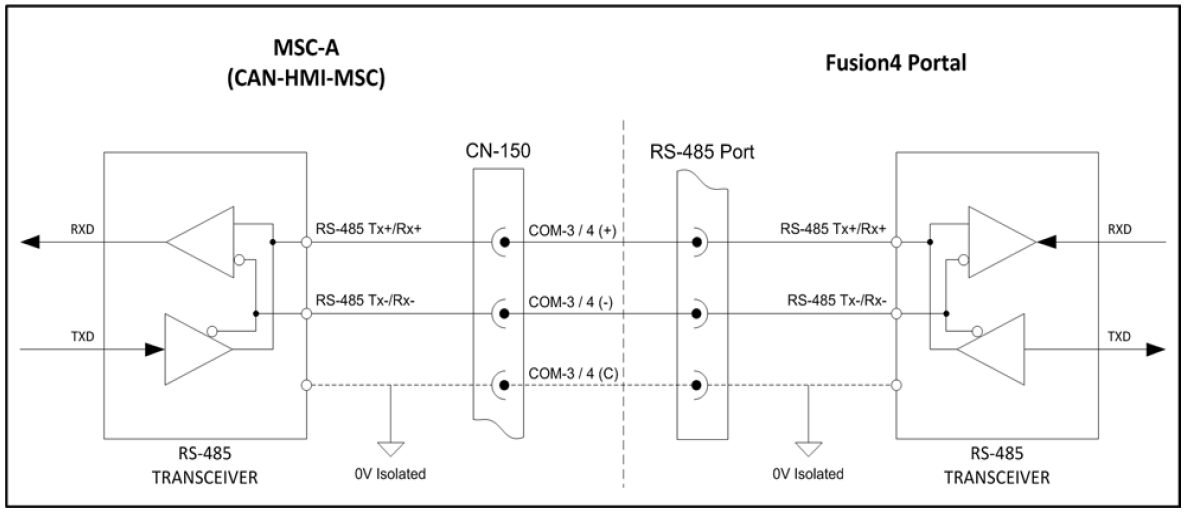
> NOTE: See also the Fusion4 Portal Installation & Operation Manual for more information.

11.1.7.1 RS-232 to RS-422/485 converter

For the Fusion4 MSC-A to be connected to an RS-232 serial port on the PC running Fusion4 Portal, an RS-232 to RS-422/485 converter is required.

The following figure schematically shows a serial connection between the Fusion4 MSC-A and a PC running Fusion4 Portal, in which an RS-232 to RS-422/485 converter (e.g. Advantech ADAM 4520) is used.

Figure 11-10: Connection between Fusion4 MSC-A and Fusion4 Portal using RS-232 to RS-422/485 converter

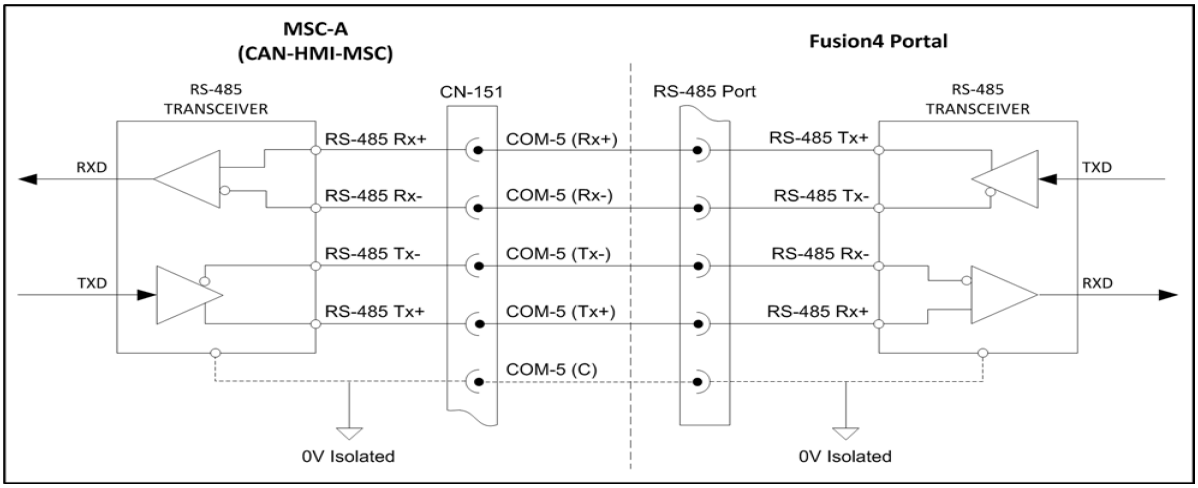


11.1.7.2 RS-485 serial connection

For the Fusion4 MSC-A to be connected directly to a PC running Fusion4 Portal, the PC must have an RS-485 serial port.

The following figure schematically shows a 2-wire half-duplex serial RS-485 connection between the Fusion4 MSC-A and a PC running Fusion4 Portal.

Figure 11-11: RS-485 2-wire half-duplex serial connection between Fusion4 MSC-A and Fusion4 Portal

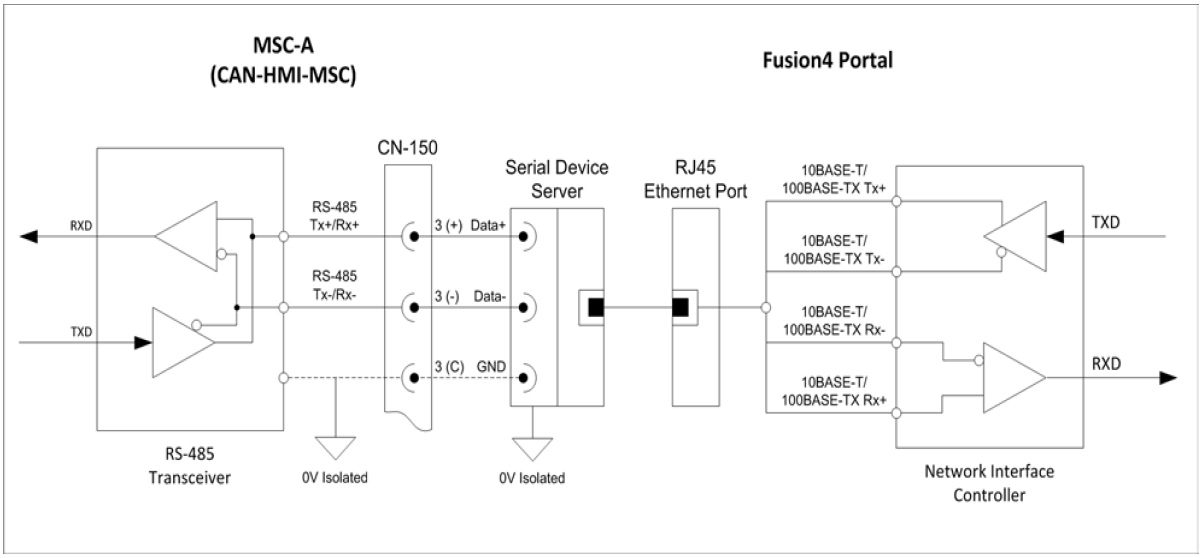


The following figure schematically shows a 4-wire full-duplex RS-485 connection between the Fusion4 MSC-A and a PC running Fusion4 Portal.

NOTES:

1. When connecting the Fusion4 MSC-A, terminal connector CN-151 must be configured for 4-wire RS-485 communication using the RS COMM mode switch SW2 on the CAN-HMI-MSC board.
2. If the connection to the Fusion4 MSC-A represents the last link in a multi-drop bus, then the bus must be terminated by setting jumper JP8 on the CAN-HMI-MSC board to the right-hand (terminated) position. The serial bus will be terminated with a 120 W resistor.

Figure 11-12: 4-wire full-duplex RS-485 connection between Fusion4 MSC-A and Fusion4 Portal



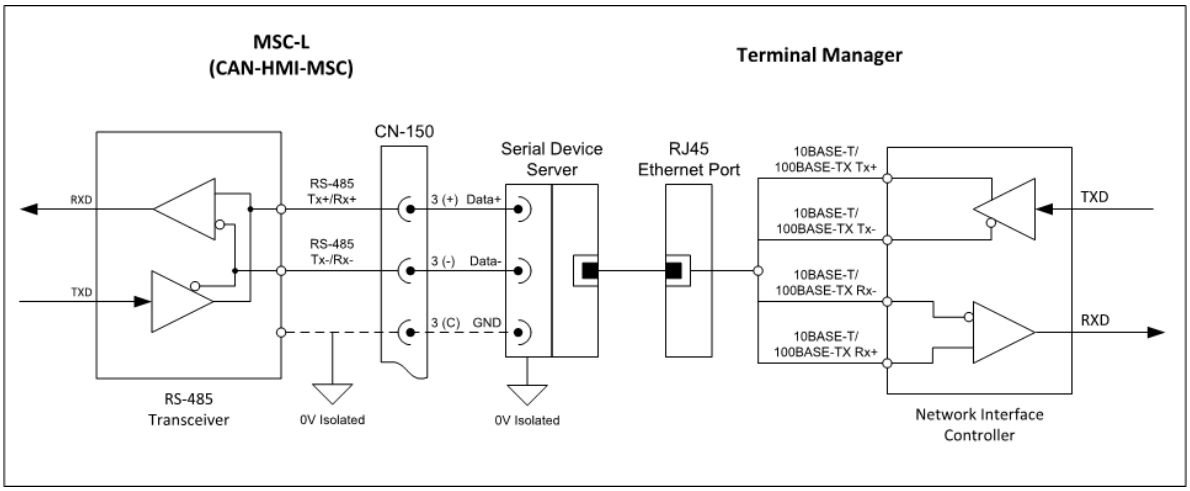
11.1.7.3 Serial device server

For the Fusion4 MSC-A to be connected to an Ethernet port of a PC running Fusion4 Portal, a serial device server is required. The serial device server must support RS-422/485.

> NOTE: Fusion4 Portal supports the serial device driver through Virtual COM and not through the TCP connection.

The following figure schematically shows a serial to Ethernet connection between the Fusion4 MSC-A and a PC running Fusion4 Portal, in which a a serial device server (for example, Moxa NPort) is used.

Figure 11-13: Serial to Ethernet connection between Fusion4 MSC-A and Fusion4 Portal



11.1.8 Connecting Fusion4 MSC-A to Experion®

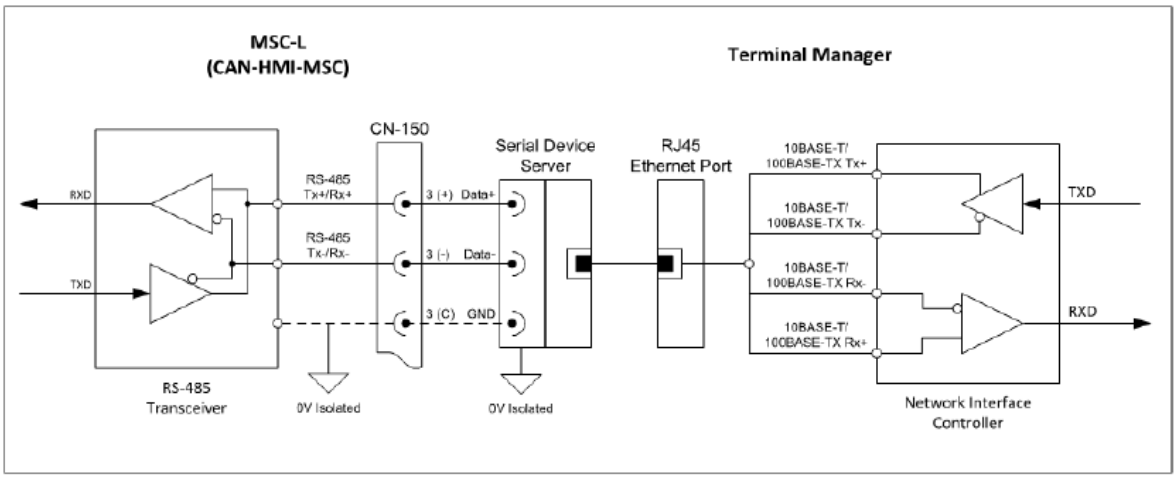
=> Future implementation.

11.1.9 Connecting Fusion4 MSC-L to Terminal Manager

For the Fusion4 MSC-A to be connected to an Ethernet port of a PC running Fusion4 Portal, a serial device server is required. The serial device server must support RS-422/485.

The following figure schematically shows a serial to Ethernet connection between the Fusion4 MSC-L and a PC running Terminal Manager, in which a a serial device server (for example, Moxa NPort) is used.

Figure 11-14: Serial to Ethernet connection between Fusion4 MSC-L and Terminal manager



12 Ethernet Communications

12.1 Modbus TCP/IP Protocol

The Modbus messaging service provides a Client/Server communication between devices connected on an Ethernet TCP/IP network.

This client/server model is based on four types of messages:

- Modbus Request

  A Modbus Request is the message sent on the network by the Client to initiate a transaction.

- Modbus Indication

  A Modbus Indication is the Request message received on the Server side.

- Modbus Response

  A Modbus Response is the Response message sent by the Server.

- Modbus Confirmation

  A Modbus Confirmation is the Response Message received on the Client side.

The Modbus messaging services (Client/Server Model) are used for real time information exchange between:

- Two device applications
- Device application and other device
- HMI/SCADA applications and devices
- PC and device program providing on line services

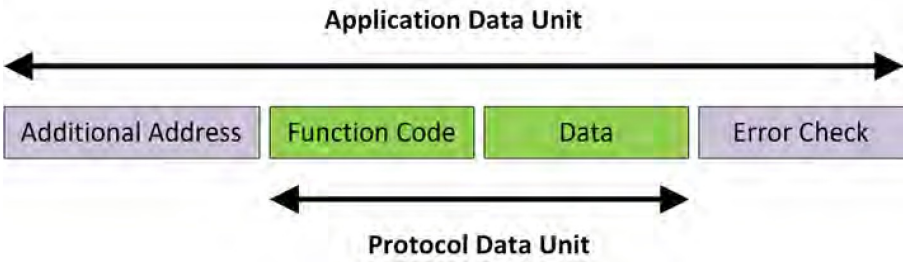
12.1.1 Protocol Description

A communicating system over Modbus TCP/IP may include different types of device:

- A Modbus TCP/IP Client and Server devices connected to a TCP/IP network.
- The Interconnection devices like bridge, router or gateway for interconnection between the TCP/IP network and a serial line subnetwork which permit connections of Modbus Serial line Client and Server end devices.

Modbus protocol on specific buses or networks can introduce some additional fields on the Application Data Unit (ADU).

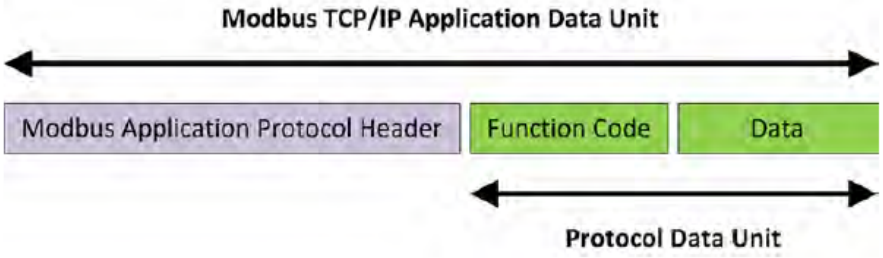
Figure 12-1: General Modbus Frame



The client that initiates a Modbus transaction builds the Modbus Application Data Unit. The function code indicates to the server which kind of action to perform.

12.1.1.1 Modbus On TCP/IP Application Data Unit

Figure 12-2: Modbus Request/Response over TCP/IP



A dedicated header is used on TCP/IP to identify the Modbus Application Data Unit. It is called the MBAP header (Modbus Application Protocol header).

This header provides some differences compared to the Modbus RTU application data unit used on serial line:

- The Modbus 'server address' field usually used on Modbus Serial Line is replaced by a single byte 'Unit Identifier' within the MBAP Header. The 'Unit Identifier' is used to communicate via devices such as bridges, routers and gateways that use a single IP address to support multiple independent Modbus end units.
- All Modbus requests and responses are designed in such a way that the recipient can verify that a message is finished. For function codes where the Modbus PDU has a fixed length, the function code alone is sufficient. For function codes carrying a variable amount of data in the request or response, the data field includes a byte count.
- When Modbus is carried over TCP, additional length information is carried in the MBAP header to allow the recipient to recognize message boundaries even if the message has been split into multiple packets for transmission. The existence of explicit and implicit length rules, and use of a CRC-32 error check code (on Ethernet) results in an infinitesimal chance of undetected corruption to a request or response message.

12.1.1.2 MBAP Header description

The MBAP Header contains the following fields:

Fields	Length	Description	Client	Server
Transaction Identifier	2 Bytes	Identification of a Modbus Request / Response transaction.	Initialized by the client	Recopied by the server from the received request
Protocol Identifier	2 Bytes	0 = Modbus protocol	Initialized by the client	Initialized by the server (See Response)
Length	2 Bytes	Number of following bytes	Initialized by the client (request)	Recopied by the server from the received request
Unit Identifier	1 Byte	Identification of a remote server connected on a serial line or on other buses.	Initialized by the client	Recopied by the server from the received request

The header is 7 bytes long:

- Transaction Identifier - It is used for transaction pairing, the Modbus server copies in the response the transaction identifier of the request.
- Protocol Identifier – It is used for intra-system multiplexing. The Modbus protocol is identified by the value 0.
- Length - The length field is a byte count of the following fields, including the Unit Identifier and data fields.
- Unit Identifier – This field is used for intra-system routing purpose. It is typically used to communicate to a Modbus+ or a Modbus serial line server through a gateway between an Ethernet TCP/IP network and a Modbus serial line. This field is set by the Modbus Client in the request and must be returned with the same value in the response by the server.

All Modbus TCP ADU are sent via TCP to registered port 502.

12.1.1.3 Modbus Functions Codes Description

See section 7.3 for more information.

12.2 Fusion4 MSC-A / MSC-L

12.2.1 Connecting Fusion4 MSC-A / MSC-L to Ethernet Network

The Fusion4 MSC-A (Multi-Stream Controller for Additive Injection) / MSC-L (Multi-Stream Controller for Loading) houses three boards each equipped with an Ethernet terminal connector:

- CAN-ARM-MSC-1 board, see section 12.2.2
- CAN-ARM-MSC-2 board, see section12.2.3
- CAN-HMI-MSC board, see section 12.2.4

Each terminal connector allows the Fusion4 MSC-A to communicate with external devices via an 802.3i 10BASE-T / 802.3u 100BASE-TX compliant connection. The following connections are supported or will be supported in the future:

- Ethernet connection between the Fusion4 MSC-A and a Fusion4 MSC-L (Multi-Stream Controller for Loading), see section 12.2.5
- Ethernet connection between the Fusion4 MSC-A / MSC-L and a PC running Fusion4 Portal, see section 12.2.6
- Ethernet connection between the Fusion4 MSC-A / MSC-L and a PC running Experion®, see section 12.2.7
- Ethernet connection between the Fusion4 MSC-L and a PC running Terminal Manager, see section 12.2.8

12.2.2 CAN-ARM-MSC-1 Board

The CAN-ARM-MSC-1 board features one ethernet connector CN-147 namely ETH-1.

This port can be used to establish a connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device. Ethernet port can be used to connect with external devices including Fusion4 Portal, TAS system or other remote interface. The device support only server mode for TCP/IP communication and only single socket.

The following figure schematically shows the ethernet connections connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device using terminal connector CN147.

Figure 12-3: Ethernet connections connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device using terminal connector CN147

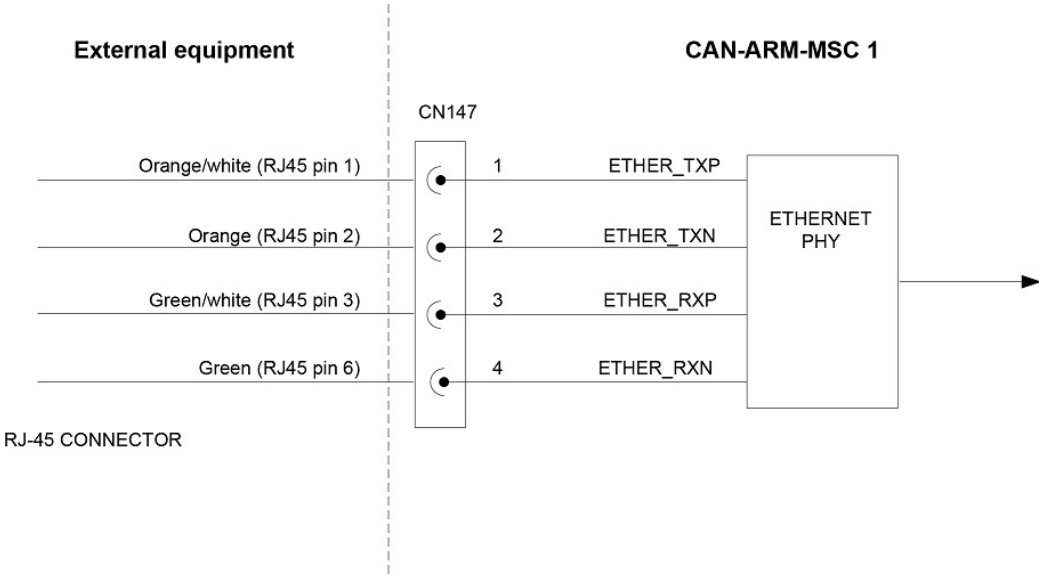


Table 12-1: Layout of terminal connector CN-147

Connector		Signal Name	Signal Description
ID	Pin		
CN-147	ETH-1-1 (Tx+)	ETHER_TXP	Transmit Positive
	ETH-1-2 (Tx-)	ETHER_TXN	Transmit Negative
	ETH-1-3 (Rx+)	ETHER_RXP	Receive Positive
	ETH-1-4 (Rx-)	ETHER_RXN	Receive Negative

12.2.3 CAN-ARM-MSC-2 Board

The CAN-ARM-MSC-2 board features one ethernet connector CN-247 namely ETH-3.

This port can be used to establish a connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device. Ethernet port can be used to connect with external devices including Fusion4 Portal, TAS system or other remote interface. The device support only server mode for TCP/IP communication and only single socket.

The following figure schematically shows the ethernet connections connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device using terminal connector CN247.

Figure 12-4: Ethernet connections connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device using terminal connector CN247

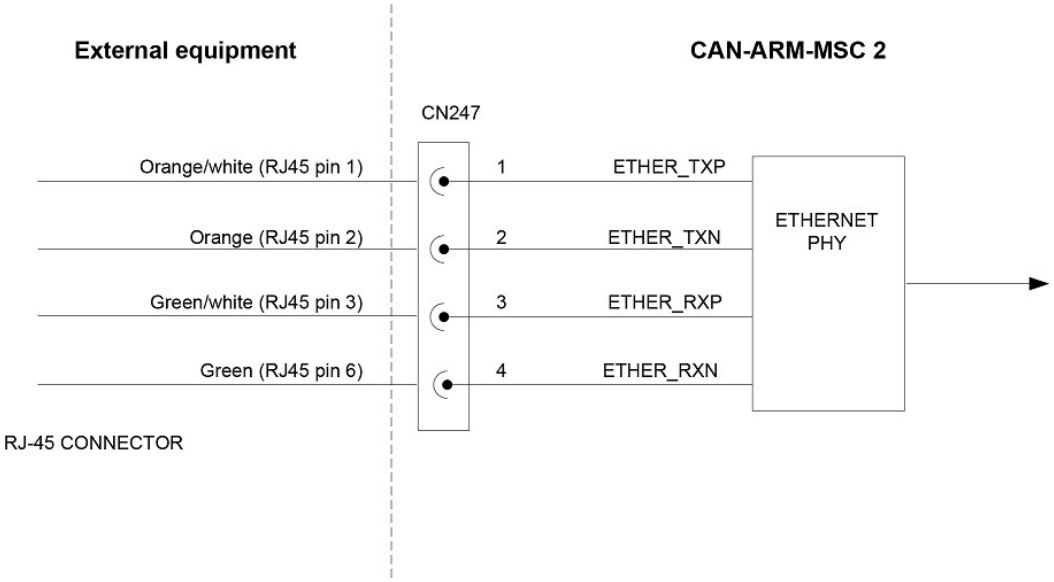


Table 12-2: Layout of Terminal Connector CN-247

Connector		Signal Name	Signal Description
ID	Pin		
CN-247	ETH-3-1 (Tx+)	ETHER_TXP	Transmit Positive
	ETH-3-2 (Tx-)	ETHER_TXN	Transmit Negative
	ETH-3-3 (Rx+)	ETHER_RXP	Receive Positive
	ETH-3-4 (Rx-)	ETHER_RXN	Receive Negative

12.2.4 CAN-HMI-MSC Board:

The CAN-HMI-MSC board features one ethernet connector CN-152 namely ETH-2.

This port can be used to establish a connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device. Ethernet port can be used to connect with external devices including Fusion4 Portal, TAS system or other remote interface. The device support only server mode for TCP/IP communication and only single socket.

The following figure schematically shows the ethernet connections connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device using terminal connector CN152.

Figure 12-5: Ethernet connections connection between the Fusion4 MSC-A / Fusion4 MSC-L and an external device using terminal connector CN152

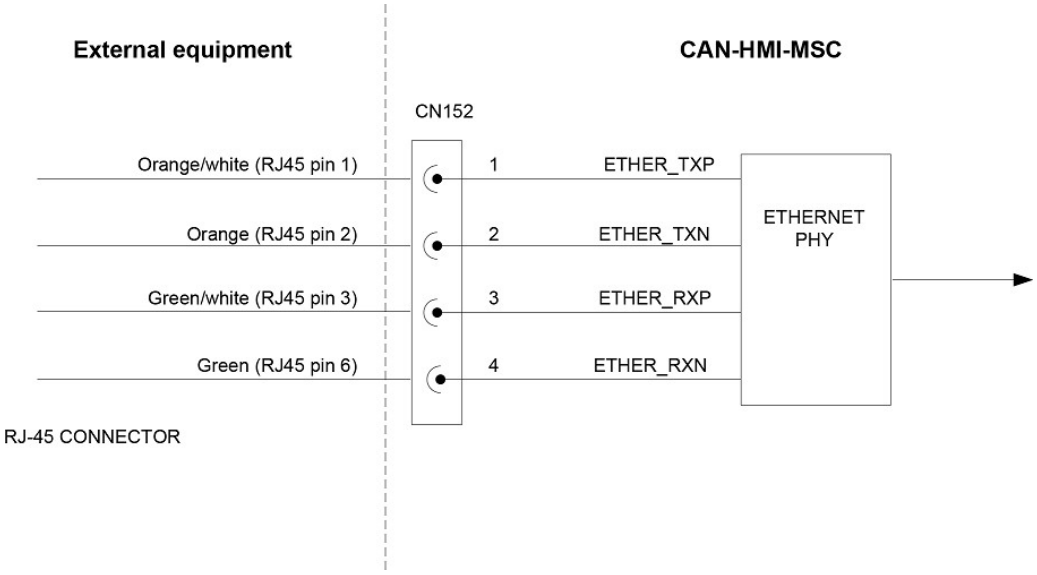


Table 12-3: Layout of terminal connector CN-152.

Connector		Signal Name	Signal Description
ID	Pin		
CN-152	ETH-2-1 (Tx+)	ETHER_TXP	Transmit Positive
	ETH-2-2 (Tx-)	ETHER_TXN	Transmit Negative
	ETH-2-3 (Rx+)	ETHER_RXP	Receive Positive
	ETH-2-4 (Rx-)	ETHER_RXN	Receive Negative

12.2.5 Connecting Fusion4 MSC-A to MSC-L over Ethernet

=> Future implementation

12.2.6 Connecting Fusion4 MSC-A / MSC-L to Fusion4 Portal over Ethernet

Any one of the available Ethernet ports ETH-1 to ETH-3 can be used for connecting Fusion4 MSC-A / MSC-L to Fusion4 Portal. The communication protocol to be used is FlexConn. The user needs to ensure that the FlexConn port number that is set for the Ethernet port in MSC-A / MSC-L is configured on the Fusion4 Portal settings as well.

12.2.7 Connecting Fusion4 MSC-A / MSC-L to Experion over Ethernet

=> Future implementation

12.2.8 Connecting Fusion4 MSC-L to Terminal manager over Ethernet

Any one of the available Ethernet ports ETH-1 to ETH-3 can be used for connecting Fusion4 MSC-L to Terminal Manager. The communication protocol to be used is FlexConn. The user needs to ensure that the FlexConn port number that is set for the Ethernet port in MSC-L is configured on the Terminal manager settings as well.

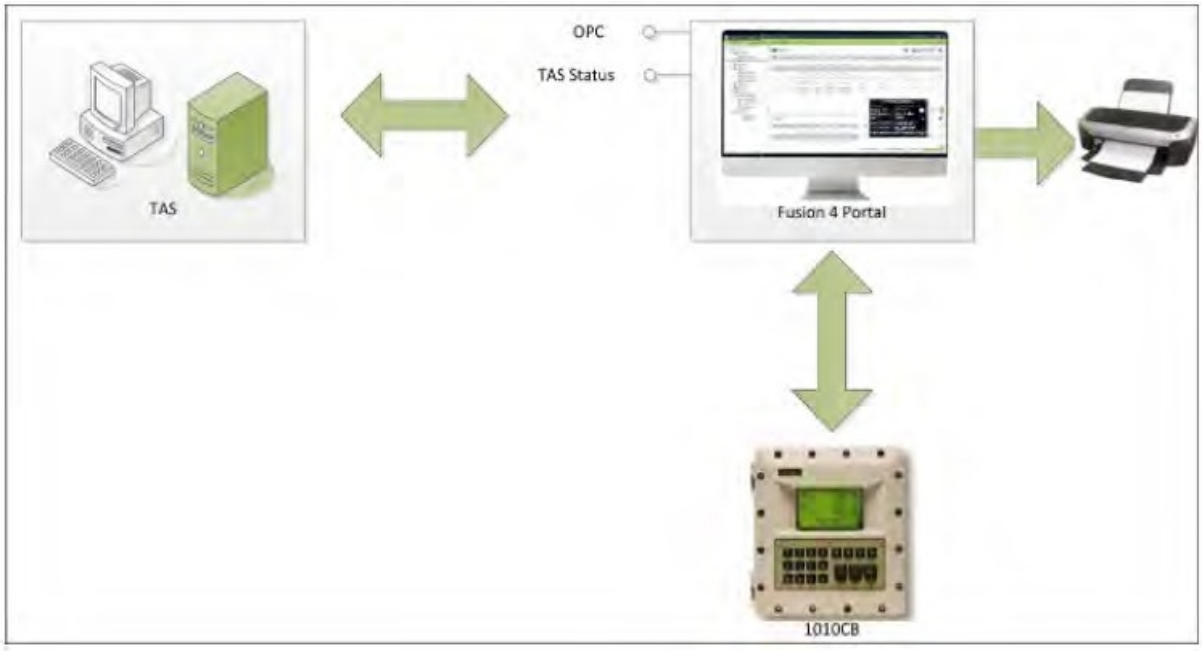
See section 12.2.2, 12.2.3 and 12.2.4 for connection diagrams for Ethernet port.

13 Portal OPC

13.1 Introduction

Fusion4 Portal features an OPC server named Fusion4. Fusion4 OPC server communicates with the 1010CB device over COM port and exposes real time values, transaction details and alarms as OPC items to external clients. The Terminal Automation System (TAS) subscribes as one of the OPC clients to retrieve the data change of these OPC items. TAS can issue the commands to the 1010CB device through Fusion4 OPC server. When the transactions are ready the Bill of Lading is printed by Fusion4 Portal.

Figure 13-1: Fusion4 Portal OPC Communication



Fusion4 OPC server offers OPC clients to:

- Read or subscribe to one or more OPC items
- Set manual density
- Read/subscribe to alarms at the connected device, acknowledge the alarms

Possible OPC clients for Fusion4 OPC server are:

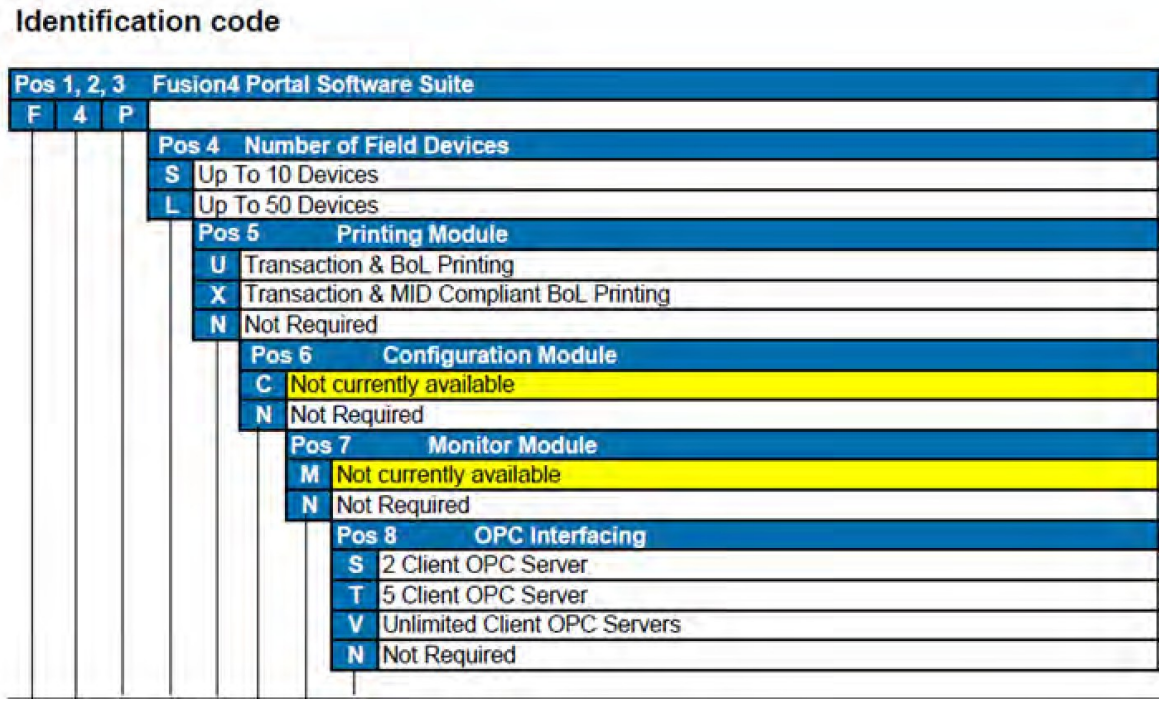
- Any Terminal Automation System, like Honeywell Terminal Manager, to achieve the work flow for a transaction at the loading bay with 1010CB
- Any SCADA system, like Honeywell Experion®, that uses the values for operator displays

13.1.1 Available licenses for OPC Clients

The license identification code determines the behavior of Fusion4 OPC Server, see the following figure.

- When position 8 is “S” only 2 client connections are possible.
- When position 8 is “T” only 5 client connections are possible.
- When position 8 is “V” an unlimited number of client connections are possible.
- When position 8 is “N” Fusion4 OPC server will not have any OPC items in its namespace.

Figure 13-2: License Identification Code



13.1.2 DCOM Configuration

> NOTE: This information in this section applies to both the Fusion4 OPC Server machine and the Client machine.

There are three steps involved in setting up DCOM for remote access.

- Changing the Windows fire wall settings (see section 13.1.2.1)
- Checking presence of “mngr” account on server and client machine (see section 13.1.2.2)
- Configuring the DCOM machine default settings (see section 13.1.2.3)

13.1.2.1 Windows Fire Wall Setting

By default the Windows fire wall is switched on. If the machine is sufficiently protected behind a corporate fire wall, it may be appropriate to permanently turn off the individual Windows fire wall. When switched off, the individual fire wall settings outlined here need not be performed to allow OPC communication.

13.1.2.2 User Accounts

Ensure that local machine “mngr” account is present at both the server and client machine with the same password.

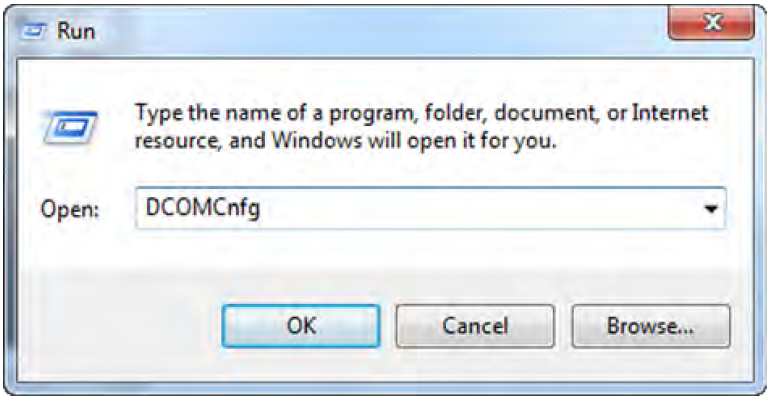
13.1.2.3 DCOM Machine Default Settings

Perform the following steps to configure the DCOM machine default settings to enable OPC communications:

1. Go to Start | Run....

   The Run window is displayed.

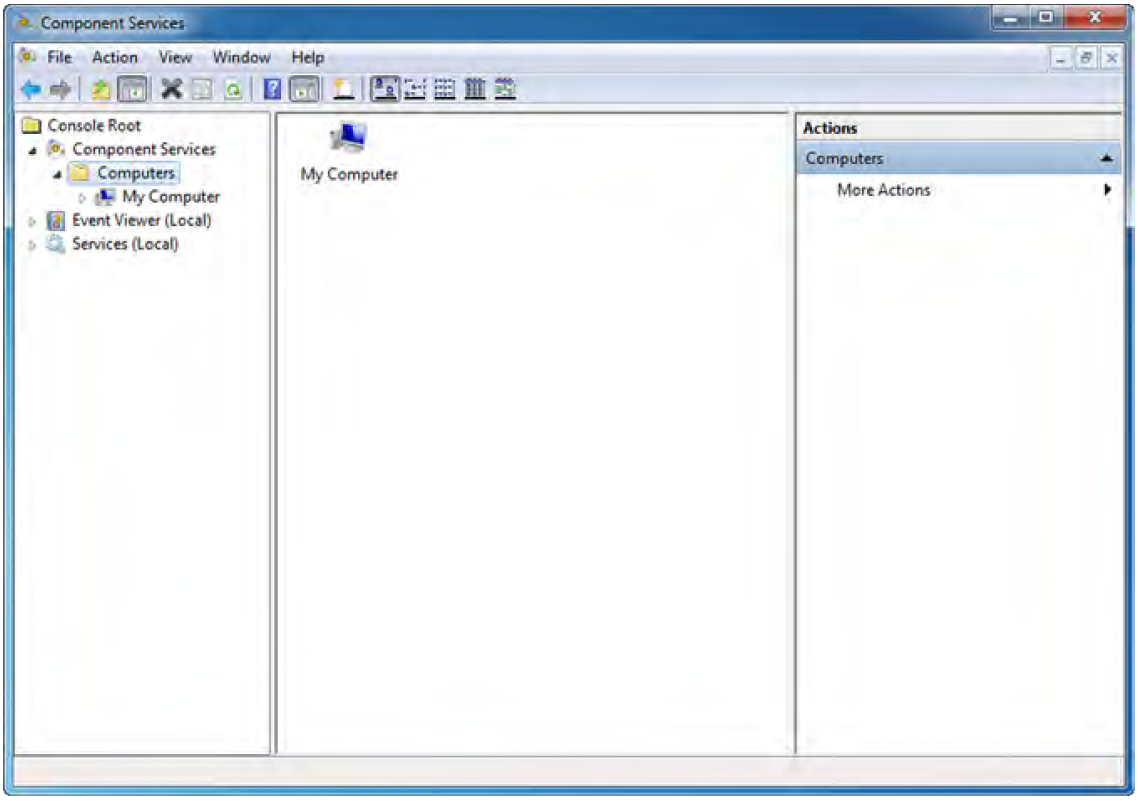
Figure 13-3: Run window



NOTE: If Run... is not displayed in the Start menu: (1) Right-click on the Start icon and select Properties from the pop-up menu; (2) In the Task bar and Start Menu Properties window go to the Start Menu tab; (3) Click Customize...; (4) Select the Run command check box; (5) Click OK to save the changes and to close the window, (6) Click Apply and then OK to save the changes and to close the window.

2. In the text field after Open: enter DCOMCnfg and click OK. The Component Services window is displayed.

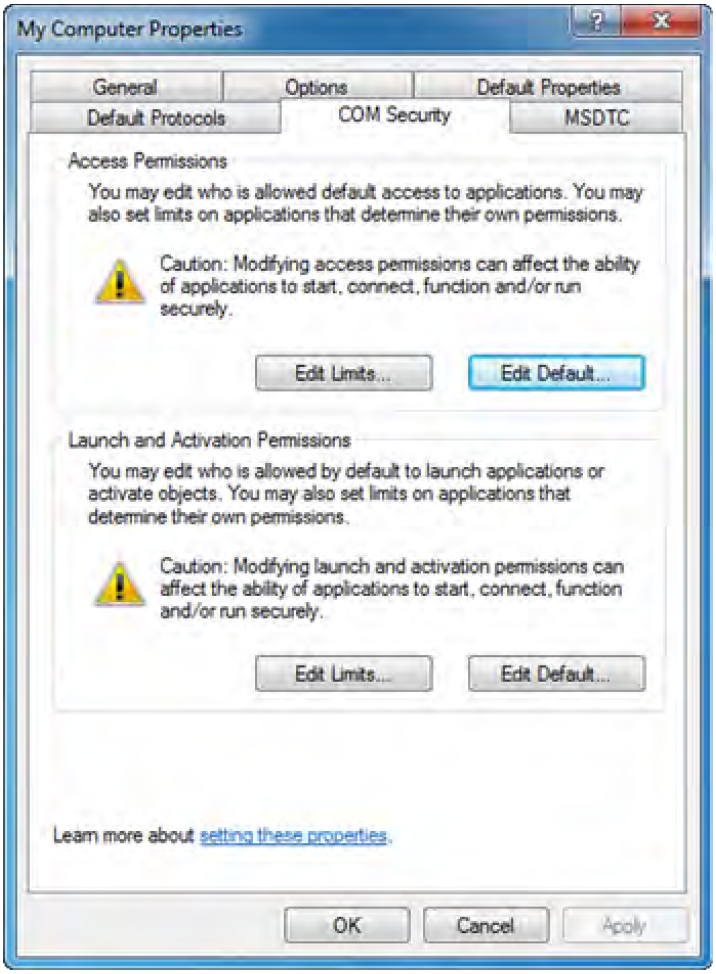
Figure 13-4: Component Services window



3. Under Console Root double-click Component Services to expand it.
4. Under Component Services double-click Computers to expand it.
5. In the pane on the right, right click on My Computer and select Properties.

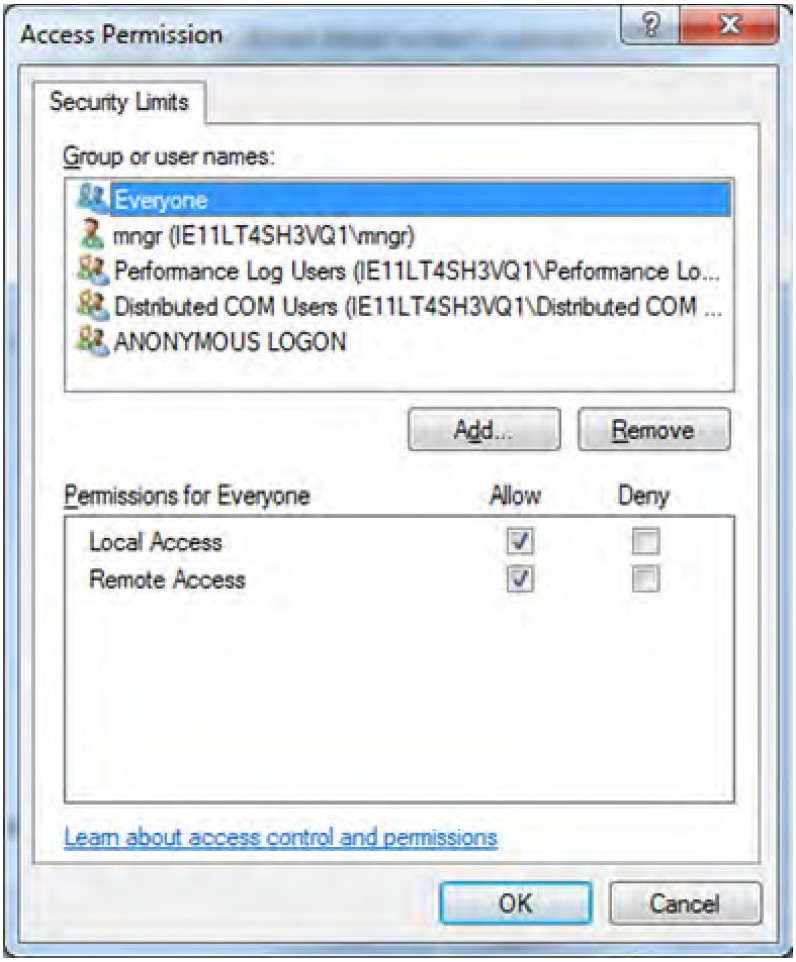
   The My Computer Properties window is displayed.

Figure 13-5: My Computer Properties window



6. Go to the tab COM Security.
7. Under Access Permissions click Edit Limits.... The Access Permissions window is displayed.

Figure 13-6: Access Permissions window - Security Limits

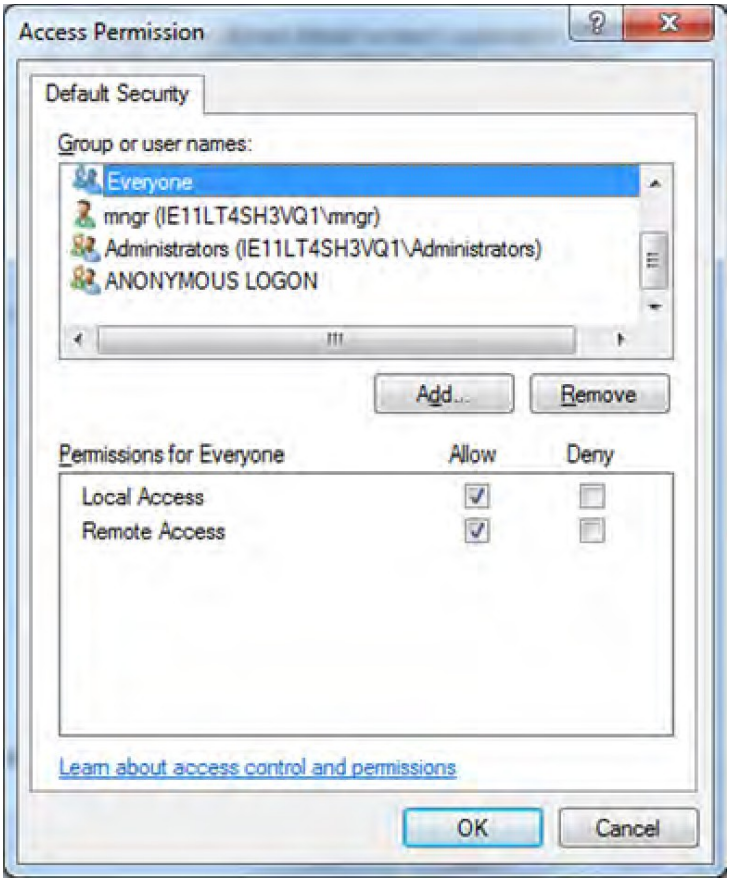


8. Check the Local Access and Remote Access check boxes for the following user accounts: Everyone, mngr and ANONYMOUS LOGIN. Click OK to save the changes and to close the window.

   You will return to the My Computer Properties window.

9. Under Access Permissions click Edit Default.... The Access Permissions window is displayed.

Figure 13-7: Access Permissions window - Default Security

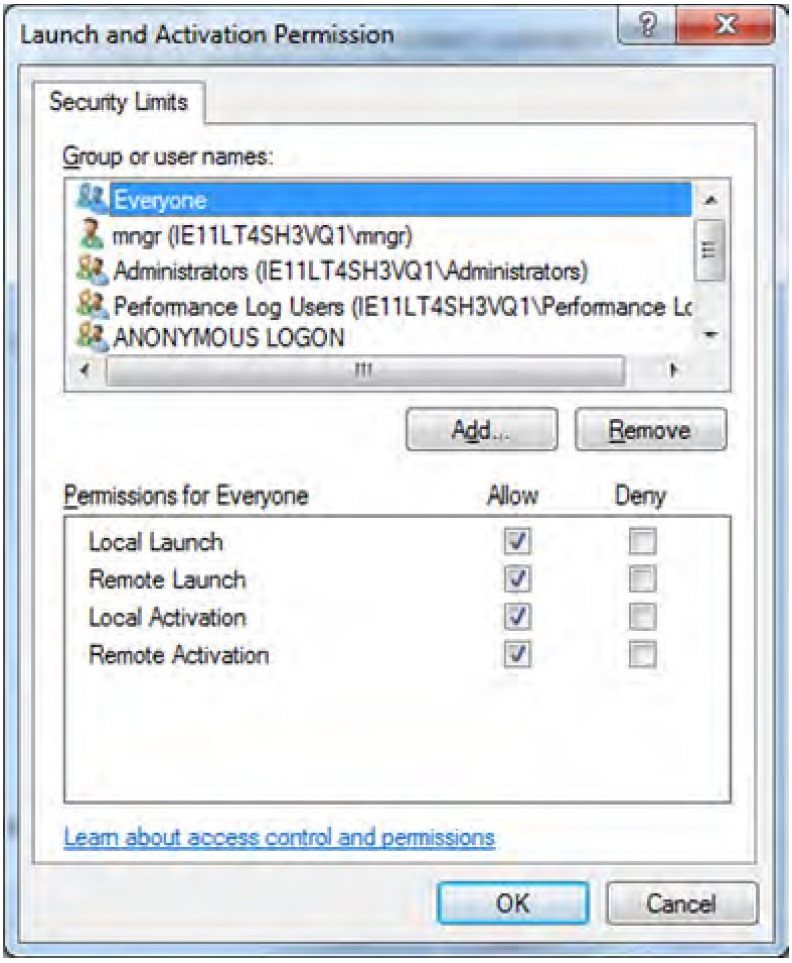


10. Check the Local Access and Remote Access check boxes for the following user accounts: Everyone, mngr and ANONYMOUS LOGIN. Click OK to save the changes and to close the window.

    You will return to the My Computer Properties window.

11. Under Launch and Activation Permissions click Edit Limits.... The Launch and Activation Permissions window is displayed.

Figure 13-8: Launch and Activation Permissions window - Security Limits



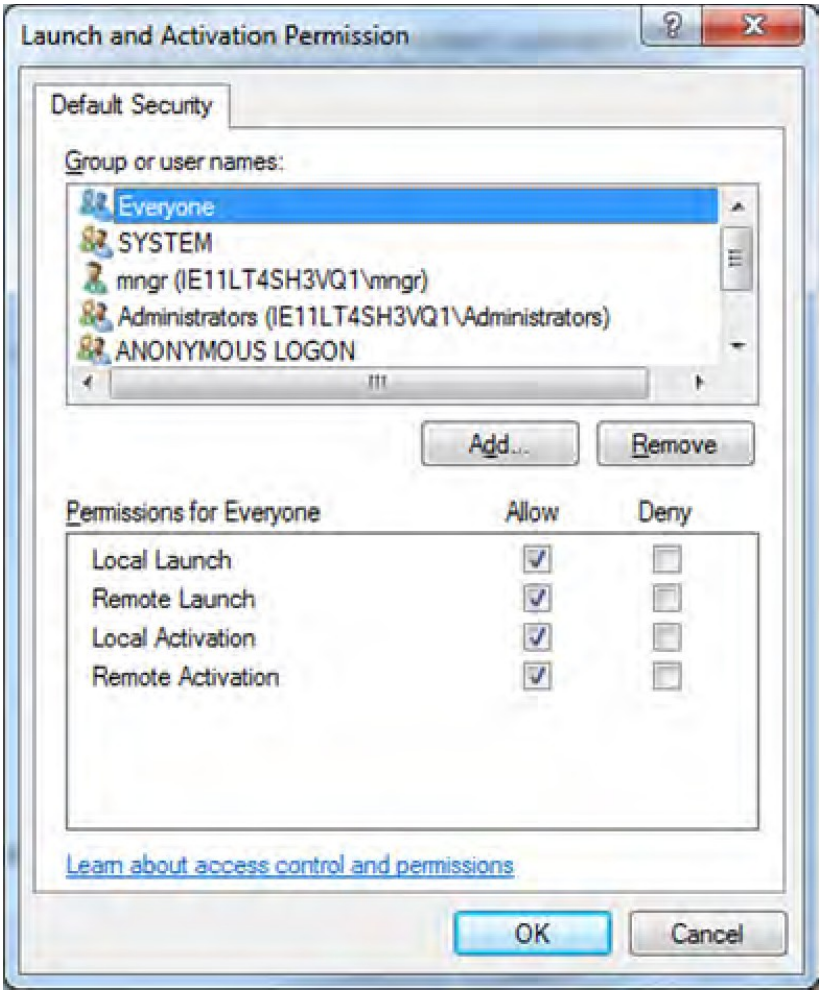
12. Check the Local Launch, Remote Launch, Local Activation and Remote Activation check boxes for the following user accounts: Everyone, mngr and ANONYMOUS LOGIN. Click OK to save the changes and to close the window.

    You will return to the My Computer Properties window.

13. Click Edit Default... under Launch and Activation Permissions.

    The Launch and Activation Permissions window is displayed.

Figure 13-9: Launch and Activation Permissions window - Default Security



14. Check the Local Launch, Remote Launch, Local Activation and Remote Activation check boxes for the following user accounts: Everyone, mngr and ANONYMOUS LOGIN. Click OK to save the changes and to close the window.

    You will return to the My Computer Properties window.

15. Click OK to save all changes and to close the window.

13.1.3 Prerequisites for OPC Client Machine

13.1.3.1 OPC Core Components

As a prerequisite OPC core components 2.00.220 or higher is required. Please visit http://www.opcfoundation.org/ to download the latest version. A version can also

be found on the Fusion4 Portal CD at <<root>>/Fusion4_Portal_R120/OPC Core Components 2.00 Redistributable 2.20.msi.

13.1.3.2 Check Logon Permission between Client and Server

Client and Server machines need logon permissions set at both ends. This can be checked on the server by typing \\<<Client machine ip>> at the server machine's Windows browser. Check if you get an "Access denied error". In that case contact your administrator to provide the necessary logon rights for server machine on the client machine. Similarly, type \\<<server machine IP>> on the client machine. Assign the necessary logon rights for the client machine on the server machine if required. Restart both client and server machine.

13.1.4 Prerequisites for Visual Basic OPC Client Machine

Fusion4 OPC server can be connected from a Visual Basic 6 client. However, the client may need additional dependencies to achieve such a solution. Contact the vendor of such a client application for more details.

13.1.5 TAS/OPC acquiring Information from Fusion4 OPC Server

13.1.5.1 Setting Type of TAS Status for Site

Fusion4 Portal Configuration enables you to set the type of TAS status. The type of TAS status indicates whether TAS is online or offline.

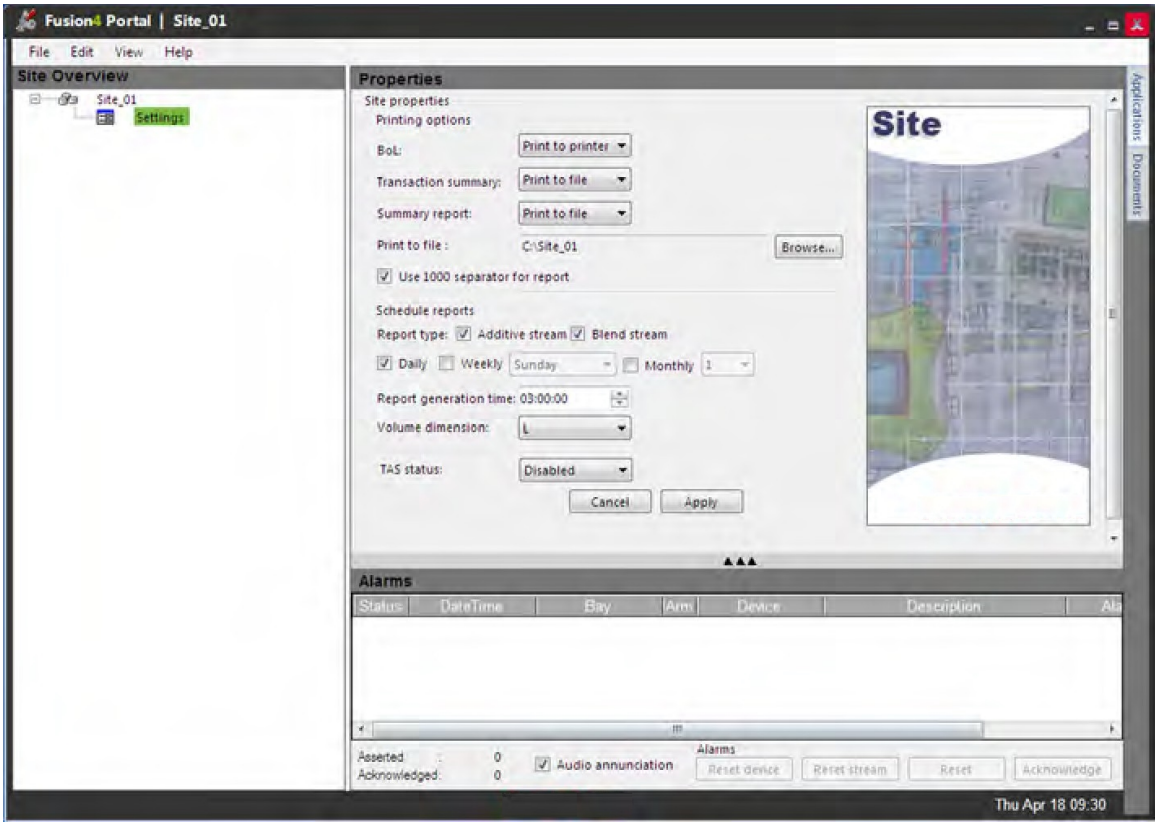
> NOTE: After you set the type of TAS status you need to restart Fusion4 Portal for the settings to come into effect.

To set the type of TAS status for a site:

1. From the Start menu select All Programs | Enraf | Fusion4 Portal. The main window of Fusion4 Portal is displayed.
2. In the navigation tree on the left click Settings under the selected site.

   The properties of the site are displayed.

Figure 13-10: Fusion4 Portal - Site Properties panel



3. Select the type of TAS status from the selection list box. The types of TAS status are described in TABLE 13-1.

Table 13-1: TAS Status Types

Type	Description
Binary	• If TAS is running the value of the OPC item is set to TRUE • If TAS is not running the value of the OPC item is set to FALSE If TAS is not running Fusion4 Portal will stop scanning the devices, resulting in a "TAS COMMUNICATION FAILURE" message displayed on the 1010CB.
Time Ticker	TAS indicates its presence by continuously changing the value of the OPC item. If the changing of the value stops, then Fusion4 OPC server will behave as if the TAS is absent. If TAS is not running Fusion4 Portal will stop scanning the devices, resulting in a "TAS COMMUNICATION FAILURE" message displayed on the 1010CB.

Type	Description
Disabled	Fusion4 Portal will not consider the status of TAS. Irrespective whether TAS is present or absent Fusion4 OPC Server will continue to scan the devices.

13.1.5.2 COM Port Settings and Refresh Rate

Fusion4 Portal Configuration enables you to set the time out period (in ms) and the turn around delay (TAD, in ms) for a COM port. The recommended TAD settings is a maximum of (a) and (b), where (a) is equal to 200 ms / No. COM ports configured in the site tree and (b) is equal to [(10 ms * No. of devices under the parent COM port) + 30 ms].

> NOTE: After you set the time out period and/or TAD for a COM Port you need to restart Fusion4 Portal for the settings to come into effect.

13.1.6 OPC Value, Quality and Timestamp Properties

Every OPC item on the Fusion4 OPC server has three properties that fully qualifies the item:

- Value--The value of an OPC item is the last value that Fusion4 OPC server stored for that particular item.
- Quality--Quality represents the characteristics of the value updated on the server cache. Quality is represented as a 2 byte unsigned integer. There can be 3 possible values in Fusion4 Portal
  - Good - 0xC0 (decimal 192
  - Uncertain - 0x50 (decimal 80)
  - Bad - 0x00 (decimal 0)
  - Bad Last Known 0x14 (decimal 20)
- Timestamp--Timestamp represents the latest date and time when the value was updated on the server cache.

13.1.7 Subscription

Fusion4 OPC server will intelligently optimize interaction with the connected device (s) themselves, based on the OPC items needed by connected TAS/ OPC Client systems. Hence it is required for TAS/ OPC Client to subscribe certain OPC items, subscribe in the sense some of the OPC items needs to be part of OPC refresh group at the client side.

The following table lists the supported OPC items for subscription:

Table 13-2: OPC items available for subscription

Command	Transaction Phase	OPC items to subscribe to
PR	After initiation of compartment load	[B].[D].PR.1.A1Preset [B].[D].PR.1.A2Preset [B].[D].PR.1.A3Preset [B].[D].PR.1.A4Preset [B].[D].PR.1.BayNum

Command	Transaction Phase	OPC items to subscribe to
IV[n]	Loading	[B].[D].A[n].FlowRate [B].[D].A[n].GOV [B].[D].A[n].GOVacc [B].[D].A[n].GSV [B].[D].A[n].GSVacc [B].[D].A[n].M1.FlowRate [B].[D].A[n].M1.GOV [B].[D].A[n].M1.GOVacc [B].[D].A[n].M1.GSV [B].[D].A[n].M1.GSVacc [B].[D].A[n].M1.Press [B].[D].A[n].M1.RefDensity [B].[D].A[n].M1.Temp [B].[D].A[n].M2.FlowRate [B].[D].A[n].M2.GOV [B].[D].A[n].M2.GOVacc [B].[D].A[n].M2.GSV [B].[D].A[n].M2.GSVacc [B].[D].A[n].M2.Press [B].[D].A[n].M2.RefDensity [B].[D].A[n].M2.Temp

Command	Transaction Phase	OPC items to subscribe to
TB	Loading	[B].[D].TB.A1CurrentRatio [B].[D].TB.A1TargetRatio [B].[D].TB.A2CurrentRatio [B].[D].TB.A2TargetRatio [B].[D].TB.BayNum [B].[D].TB.FirstArmNum [B].[D].TB.TotalArms
TF	Loading	[B].[D].TF.1.A1FlowRate [B].[D].TF.1.A1TargetFlowRate [B].[D].TF.1.A2FlowRate [B].[D].TF.1.A2TargetFlowRate [B].[D].TF.1.A3FlowRate [B].[D].TF.1.A3TargetFlowRate [B].[D].TF.1.A4FlowRate [B].[D].TF.1.A4TargetFlowRate [B].[D].TF.1.BayNum [B].[D].TF.1.FirstArmNum [B].[D].TF.1.TotalArms

Command	Transaction Phase	OPC items to subscribe to
BT[n]	After loading of compartment is completed	[B].[D].A[n].Load.ArmNo [B].[D].A[n].Load.BatchComplete [B].[D].A[n].Load.BatchNo [B].[D].A[n].Load.BlendAcy [B].[D].A[n].Load.BlendType [B].[D].A[n].Load.CheckSum [B].[D].A[n].Load.CompNo [B].[D].A[n].Load.Error [B].[D].A[n].Load.PresetQty [B].[D].A[n].Load.RecipeID [B].[D].A[n].Load.ReturnQty [B].[D].A[n].Load.StartTime [B].[D].A[n].Load.StopTime [B].[D].A[n].Load.TransNo [B].[D].A[n].Load.Units [B].[D].A[n].LoadAdditive.Quantity1 [B].[D].A[n].LoadAdditive.Quantity2 [B].[D].A[n].LoadAdditive.Quantity3 [B].[D].A[n].LoadAdditive.Quantity4 [B].[D].A[n].LoadAdditive.Quantity5

Command	Transaction Phase	OPC items to subscribe to
		[B].[D].A [n].LoadAdditive.Quantity6 [B].[D].A [n].LoadAdditive.BatchNo [B].[D].A [n].LoadAdditive.TransNo [B].[D].A[n].LoadBase.BatchNo [B].[D].A [n].LoadBase.CheckSum [B].[D].A [n].LoadBase.Commodity [B].[D].A[n].LoadBase.DensFWA [B].[D].A[n].LoadBase.Error [B].[D].A[n].LoadBase.ExpFactor [B].[D].A[n].LoadBase.GOV [B].[D].A [n].LoadBase.GOVaccAft [B].[D].A [n].LoadBase.GOVaccBef [B].[D].A[n].LoadBase.GSV [B].[D].A[n].LoadBase.GSVaccAft [B].[D].A [n].LoadBase.GSVaccBef [B].[D].A[n].LoadBase.MeterNo [B].[D].A[n].LoadBase.Preset [B].[D].A[n].LoadBase.PressFWA

Command	Transaction Phase	OPC items to subscribe to
		[B].[D].A [n].LoadBase.ProdDensObs [B].[D].A[n].LoadBase.TempFWA [B].[D].A[n].LoadBase.TransNo [B].[D].A[n].LoadBlend.BatchNo [B].[D].A [n].LoadBlend.CheckSum

Command	Transaction Phase	OPC items to subscribe to
		[B].[D].A [n].LoadBlend.Commodity [B].[D].A [n].LoadBlend.DensFWA [B].[D].A[n].LoadBlend.Error [B].[D].A [n].LoadBlend.ExpFactor [B].[D].A [n].LoadBlend.TempFWA [B].[D].A[n].LoadBlend.TransNo [B].[D].A[n].LoadBlend.GOV [B].[D].A [n].LoadBlend.GOVaccAft [B].[D].A [n].LoadBlend.GOVaccBef [B].[D].A[n].LoadBlend.GSV [B].[D].A [n].LoadBlend.GSVaccAft [B].[D].A [n].LoadBlend.GSVaccBef [B].[D].A[n].LoadBlend.MeterNo [B].[D].A[n].LoadBlend.Preset [B].[D].A [n].LoadBlend.PressFWA [B].[D].A [n].LoadBlend.ProdDensObs

Command	Transaction Phase	OPC items to subscribe to
AM	After a transaction is completed	[B].[D].AM.[n].ArmErrStatus [B].[D].AM.[n].ArmInterruptStatus [B].[D].AM.[n].ArmNum [B].[D].AM.[n].ArmStatus [B].[D].AM.[n].M1ErrStatus [B].[D].AM.[n].M2ErrStatus [B].[D].AM.[n].SysInterruptStatus

Command	Transaction Phase	OPC items to subscribe to
ST	After a transaction is completed	[B].[D].ST.BayNum [B].[D].ST.CalibNum [B].[D].ST.FirstArmNum [B].[D].ST.LoadNum [B].[D].ST.clientIndex [B].[D].ST.PerIndex [B].[D].ST.PowCycCount [B].[D].ST.RefNum [B].[D].ST.Result [B].[D].ST.StartBatch [B].[D].ST.StartDate [B].[D].ST.StartTime [B].[D].ST.StopBatch [B].[D].ST.StopTime [B].[D].ST.TASMode [B].[D].ST.TotalArms [B].[D].ST.TransNum [B].[D].ST.UniqueNum [B].[D].ST.UnitAddress [B].[D].ST.VehIndexT
AL	Alarm	See section 13.5.
GD	Get date and time	[B].[D].GD.Date [B].[D].GD.Time

13.1.8 Sales Codes

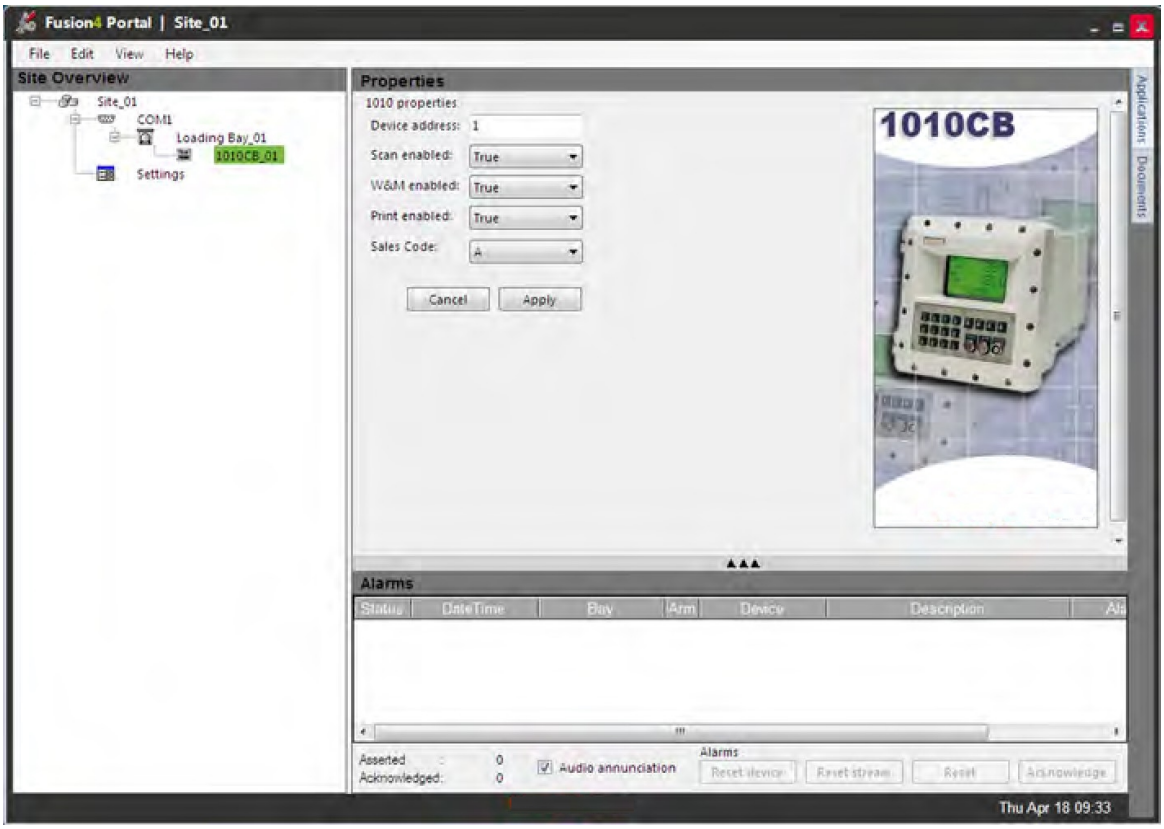
The type of 1010CB device configured determines the 1010CB OPC items that will be created by Fusion4 OPC server. The type of 1010CB device is defined in the sales code.

Fusion4 Portal enables you to set the sales code for a 1010CB device:

> NOTE: After you set the sales code for a 1010CB device you need to restart Fusion4 Portal for the setting to come into effect.

1. From the Start menu select All Programs | Enraf | Fusion4 Portal. The main window of Fusion4 Portal is displayed.
2. Select the 1010CB device in the navigation tree at the left panel. The properties of the selected 1010CB device are displayed.

Figure 13-11: Fusion4 Portal - 1010CB Properties panel



3. Select the sales code from the selection list box. The sales codes are described in TABLE 13-3.

Table 13-3: 1010CB Sales Codes

Sales Code	Description	OPC items available for
A	One arm loading with straight loading	Arm1 - [Base meter] Meter 1
B	One arm loading with ratio blending	Arm1 - [Base and Blend meter] Meter 1 Meter 2
C	One arm loading with side stream blending	Arm1 - [Base and Blend meter] Meter 1 Meter 2
D	Two arm loading with straight loading	Arm1 - [Base meter] Arm2 - [Base meter] Meter 1 Meter 2
E	Two arm loading: one straight loading and one with ratio blending	Arm 1 - [Base meter] Arm 2 - [Base and Blend meter] Meter 1 Meter 2 Meter 3
F	Two arm loading: one straight loading and one with side stream blending	Arm 1 - [Base meter] Arm 2 - [Base and Blend meter] Meter 1 Meter 2 Meter 3

Sales Code	Description	OPC items available for
G	Two arm loading each with ratio blending	Arm 1 - [Base and Blend meter] Arm 2 - [Base and Blend meter] Meter 1 Meter 2 Meter 3 Meter 4
H	Two arm loading each with side stream blending	Arm 1 - [Base and Blend meter] Arm 2 - [Base and Blend meter] Meter 1 Meter 2 Meter 3 Meter 4
J	Four arm loading with straight loading	Arm 1 - [Base meter] Arm 2 - [Base meter] Arm 3 - [Base meter] Arm 4 - [Base meter] Meter 1 Meter 2 Meter 3 Meter 4

13.1.9 Engineering Units

The engineering units of a device will be retrieved and updated in the OPC items listed in TABLE 13-4:

Table 13-4: Engineering Units for Device

OPC Item	Access	Data Type	Range	Description
[B].[D].EU.FetchEU	RW	VT_UI2	1	Command to fetch Engineering units (1 = Fetch)
[B].[D].EU.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].EU.A[n].MassUnit	R	VT_UI2		Mass units on loading arm n
[B].[D].EU.A[n].VolumeUnit	R	VT_UI2		Volume units on loading arm n
[B].[D].EU.AdditiveInjectionUnit	R	VT_UI2		Additive injection units
[B].[D].EU.LeakingSolenoidVolUnit	R	VT_UI2		Leak solenoid volume units
[B].[D].EU.M[n].DensityBreakDownUnit	R	VT_UI2		Density breakdown units for flow meter n
[B].[D].EU.M[n].DensityUnit	R	VT_UI2		Density units for flow meter n
[B].[D].EU.M[n].PressureUnit	R	VT_UI2		Density pressure units for flow meter n
[B].[D].EU.TemperatureUnit	R	VT_UI2		Temperature units

TAS/OPC client should convert the enumerated value to units as shown in TABLE 13-5.

Table 13-5: Conversion Table for Engineering Units

Entity	METRIC-ISO		US UNITS	
	Units	Enumerated Value	Units	Enumerated Value
Density Break Down	kg/m3	60	RD60	63
Manual Density	kg/m3	60	RD60	63
Analog Density	kg/m3	60	lb/ft3	62
Manual Pressure	kPa	32	PSIg	42
Analog Pressure	kPa	32	PSI	41
Temperature	°C	20	°F	21
Leaking Solenoid Volume	ml	257	cc	258
Loading Arm Units (Volume)	L & L/min	50	Gal & Gal/min	52
	m3 & m3/h	51		
Loading Arm Units (Mass)	kg & kg/min	100	lb & lb/min	106
	t & t/h	101		
	g & g/min	105		
Additive Injection	ml	257	cc	258
Blend/Additive Recipes (Preset prompt for arm is Volume/Disabled)	PPM	259	PPM	259
Blend/Additive Recipes (Preset prompt for arm is Mass)	ml	257	cc	258

13.2 Communication

13.2.1 Checking TAS Status

You can find out the status of the TAS system by checking the OPC item listed in the following table.

Table 13-6: OPC item for checking TAS status

OPC Item	Access Type	Data Type	Range	Description
Sys.TASStatus	R or RW	VT_UI2 or VT_BOOL		Represents the status of TAS connected to the Fusion4 OPC server

Value for Sys.TASStatus is set by TAS/ OPC client to instruct Fusion4 portal whether TAS/ OPC client is connected and in running state. The values depends on the TAS Status setting described in section 13.1.5.1. When the TAS Status setting is 'Time Ticker' the TAS status is checked every 10 seconds.

13.2.2 Checking Device Communications Status

You can find out the communications status of Fusion4 OPC server to a device by checking the OPC item listed in the following table.

Table 13-7: OPC item for checking device communications status

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CommSts	R	VT_UI2		Represents communications status of Fusion4 OPC server to device: • 0 = Initial • 1 = Good • 2 = Bad, i.e. communications port is not properly connected to device, device is not good or cable failure/device not properly connected • 3 = [B].[D].DeviceScanDisable is set to TRUE, i.e. device is manually over- ridden to killed state to stop scanning on device

13.2.2.1 Stopping and Restarting Scanning on Device

There may be situations where a device should not be scanned, e.g. the device is out of service due to maintenance. TAS/OPC client can kill the device by setting the value of the OPC item listed in the following table to TRUE.

Table 13-8: OPC Item enabling/disabling device scan

OPC Item	Access Type	Data Type	Range	Description
[B].[D].DeviceScanDisable	RW	VT_BOOL	TRUE or FALSE	Represents whether TAS/OPC has overridden device to killed state to stop scanning on the device: TRUE or FALSE.

Once the device has to be scanned again, the value of the OPC item needs to be set to FALSE.

13.2.3 Checking Health of Fusion4 OPC Server

You can monitor the health of Fusion4 OPC server by checking the following OPC item.

- Heartbeat

If the health of the Fusion4 OPC server is good the value of the OPC item is incremented every 5 seconds. If the value is not incremented then it is likely that the OPC server is not scanning the device.

13.2.4 Handshaking between Client and Fusion4 OPC Server

When TAS/OPC client issues a command to a device, Fusion4 OPC server stores the response of the device to the command as an OPC item with the following format:

- [B].[D].[Command].DevResp

The OPC item can have one of the values listed in the following table.

Table 13-9: Possible values for [B].[D].[Command].DevResp

Value	Description
0	None, i.e. Fusion4 OPC server has not yet issued the command to the device.
1	Fusion4 OPC server received an ACK from the device, i.e. the device processed the command without any errors
2	Fusion4 OPC server received a NAK from the device, i.e. the device did not process the command due to one or more errors.
3	Fusion4 OPC server received a BUSY from the device.

Based on the value of DevResp the TAS/OPC client should take appropriate action to retry few times.

13.3 Loading Workflow Support for TAS System

13.3.1 About Loading Workflow Support

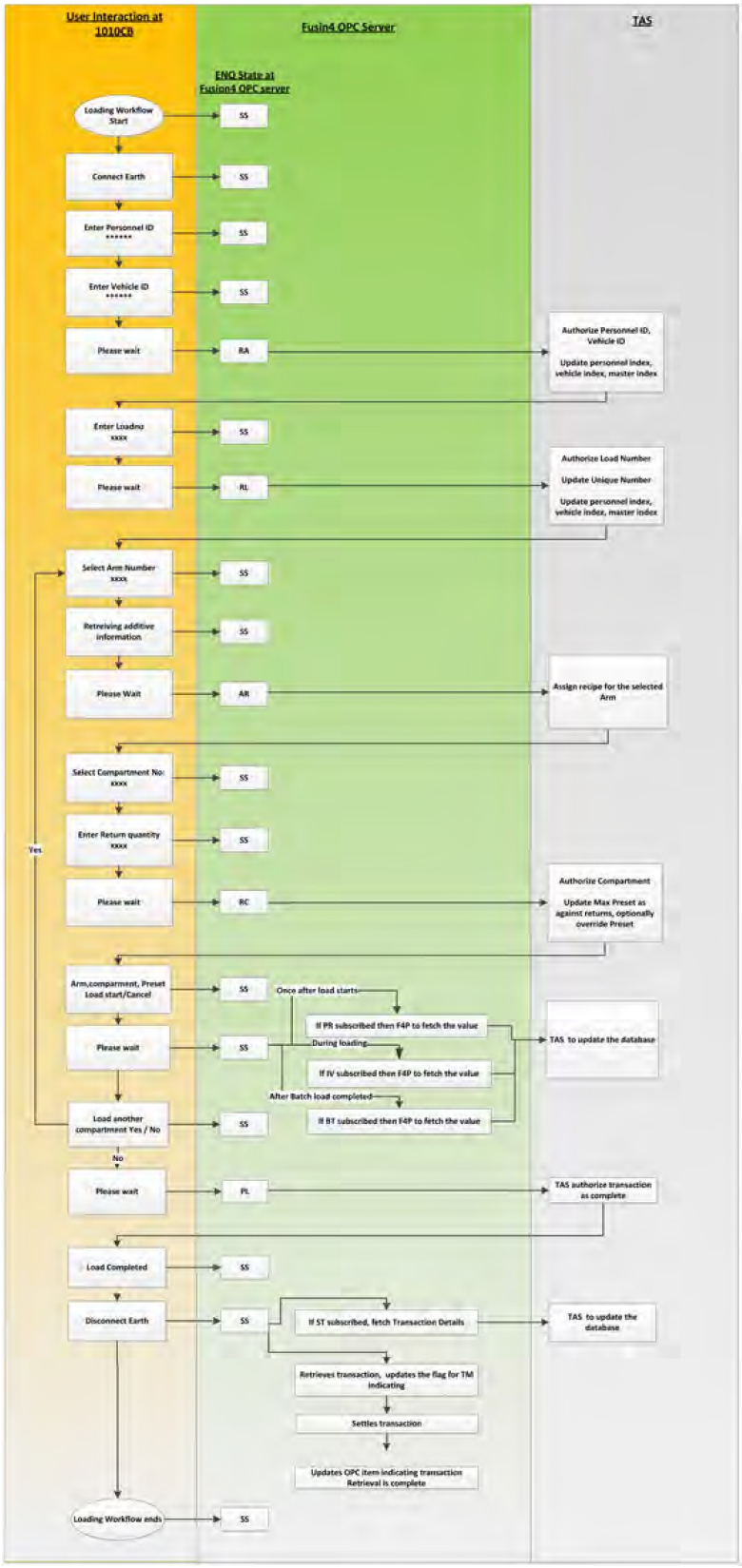
Typically, the Terminal Automation System (TAS) remotely controls and monitors the loading at the 1010CB device. Examples could be, TAS authorizes the vehicle whether it is eligible for the product at the bay, authorize the load quantity against the purchase order, monitor the flow rate when the fluid is being filled into the container OR to display a message at the device about non-availability of certain products. Fusion4 OPC server offers OPC items to support such workflow, subjected to appropriate settings achieved at the 1010CB device itself.

Fusion4 OPC server through various OPC items will constantly watch the loading status at the device and will notify TAS when actions are needed.

13.3.2 Example of Workflow

> NOTE: The following workflow is subjected to the setting at the 1010CB device itself. Refer to the 1010CB Programming Manual and the 1010CB Protocol Manual for details on the setting.

Figure 13-12: Workflow for Typical Loading a Site



13.3.3 Loading States - ENQ

TAS/ OPC client can determine the loading state at the device through the group of OPC items listed in the following table.

Table 13-10: OPC items for determining loading state at device

OPC Item	Access Type	Data Type	Range	Description
[B].[D].ENQ.	R	VT_BSTR		ENQ status for the device.
[B].[D].ENQ.FirstArmNum	R	VT_UI2		First arm number
[B].[D].ENQ.Idle	R	VT_BOOL		Device idle status
[B].[D].ENQ.LastTransNum	R	VT_UI4		Last transaction number
[B].[D].ENQ.PowerFailureDetected	R	VT_BOOL		A power failure detect
[B].[D].ENQ.ProgrammableInputsConnected	R	VT_BOOL		Programmable inputs are connected
[B].[D].ENQ.ProgrammingDiagnosticMode	R	VT_BOOL		Programming/Hardware test/ Diagnostics mode is active
[B].[D].ENQ.TotalArms	R	VT_UI2		Total number of arms
[B].[D].ENQ.UnauthorisedFlowInProgress	R	VT_BOOL		Unauthorized flow is in progress on an arm
[B].[D].Sts.Alarm	R	VT_BOOL		Alarm Status • 0 = Off • 1 = On (i.e. there is alarm condition)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Sts.EOF	R	VT_BOOL		Earth / Overfill Input Status • 0 = Off • 1 = On
[B].[D].sts.MngrReset	R	VT_BOOL		Manager Reset Status • 0 = Manager reset not required • 1 = Manager reset required
[B].[D].Load.TransNum	R	VT_UI4		Current/last completed transaction. Incremented after passing 'RA' state.
[B].[D].Load.TransNumCompare	R	VT_I4		Current/ last retrieved transaction by Fusion4 Portal. Incremented after Fusion4 Portal retrieves data and prints (if print is enabled).
[B].[D].KA.TouchKeyNum	R	VT_BSTR		TouchKey number when ENQ state is 'KA'
[B].[D].NA.NexWatchNum	R	VT_BSTR		NexWatch key number when ENQ state is 'NA'
[B].[D].RIT.A1.Ack	R	VT_BOOL		RIT ack arm 1
[B].[D].RIT.A1.NotUsed	R	VT_BOOL		Not used

OPC Item	Access Type	Data Type	Range	Description
[B].[D].RIT.A1.Start	R	VT_BOOL		RIT start arm 1
[B].[D].RIT.A1.Stop	R	VT_BOOL		RIT stop arm 1
[B].[D].RIT.A2.Ack	R	VT_BOOL		RIT ack arm 2
[B].[D].RIT.A2.NotUsed	R	VT_BOOL		Not used
[B].[D].RIT.A2.Start	R	VT_BOOL		RIT start arm 2
[B].[D].RIT.A2.Stop	R	VT_BOOL		RIT stop arm 2

13.3.4 Remote Authorisation State - RA

The value “RA” at [B].[D].ENQ indicates Remote Authorisation state. At this state, Fusion4 OPC server provides the necessary information to TAS/ OPC Client that are required to authorise, like driver ID and vehicle ID. TAS/ OPC Client is required to authorise these details by writing into OPC items that have ReadWrite access (optionally) and then to [B].[D].RA.Response. Note that 1010CB will not proceed to further state until TAS/ OPC Client responds.

The following table lists the OPC items for the Remote Authorisation State.

Table 13-11: OPC Items for Remote Authorisation State

OPC Item	Access	Data Type	Range	Description
[B].[D].RA.PerID	R	VT_ BSTR		Personnel ID entered at 1010CB.
[B].[D].RA.VehID	R	VT_ BSTR		Vehicle ID entered at 1010CB.
[B].[D].RA.MastrID	R	VT_ BSTR		client ID entered at 1010CB.
[B]. [D].RA.PerIndex	RW	VT_ BSTR		Personnel Index entered at 1010CB. TAS/ OPC client can override after validating, but before writing to [B]. [D].RA.Response.
[B]. [D].RA.VehIndex	RW	VT_ BSTR		Vehicle Index entered at 1010CB. TAS/ OPC client can override after validating, but before writing to [B]. [D].RA.Response.
[B]. [D].RA.MastrIndex	RW	VT_ BSTR		client Index entered at 1010CB. TAS/ OPC client can override after validating, but before writing to [B]. [D].RA.Response.
[B]. [D].RA.DenyMsg	RW	VT_ BSTR	1 to 30	Text message to display on 1010CB when authorisation is denied (or an asterisk * to not display any message). The value to be set by TAS/ OPC client before writing to [B].[D].RA.Response.
[B]. [D].RA.Response	RW	VT_ UI2	0 to 2	The value to be set by TAS/OPC Client in response to the authorization request. The response is passed to 1010CB by Fusion4 OPC Server. Possible values are 0 = None, 1 = OK, 2 = denied.

OPC Item	Access	Data Type	Range	Description
[B].[D].RA.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.3.5 Remote Load Authorisation State - RL

The value "RL" at [B].[D].ENQ indicates Remote Load Authorisation state. At this state, Fusion4 OPC server provides the necessary information to TAS/ OPC Client that are required to authorise the load. TAS/ OPC Client is required to authorise these details by writing into OPC items that have ReadWrite access (optionally) and then to [B].[D].RL.Response. Note that 1010CB will not proceed to further state until TAS/ OPC Client responds.

The following table lists the OPC items for the Remote Load Authorisation State.

Table 13-12: OPC Items for Remote Load Authorisation State

OPC Item	Access	Data Type	Range	Description
[B].[D].RL.PerID	R	VT_BSTR		Personnel ID entered at 1010CB.
[B].[D].RL.VehID	R	VT_BSTR		Vehicle ID entered at 1010CB.
[B].[D].RL.MastrID	R	VT_BSTR		client ID entered at 1010CB
[B].[D].RL.LoadNum	R	VT_BSTR		Load number entered at 1010CB.
[B].[D].RL.PerIndex	RW	VT_BSTR		Personnel Index entered at 1010CB. TAS/ OPC client can override after validating, but before writing to [B].[D].RL.Response.

OPC Item	Access	Data Type	Range	Description
[B].[D].RL.VehIndex	RW	VT_BSTR		Vehicle Index entered at 1010CB. TAS/ OPC client can override after validating, but before writing to [B].[D].RL.Response.
[B].[D].RL.MastrIndex	RW	VT_BSTR		client Index entered at 1010CB. TAS/ OPC client can override after validating, but before writing to [B].[D].RL.Response.
[B].[D].RL.UniqueNum	RW	VT_UI4		TAS/ OPC Client can set a Unique Number (optional) to identify the load. This Unique Number when set by TAS/ OPC Client will appear on BOL at the place of Load Number. The write actions should be before writing to [B].[D].RL.Response.
[B].[D].RL.SkipFlag	RW	VT_BOOL		A boolean to prevent 1010CB to force “Disconnect Earth”. This is optional. 1010CB will retry with Loading details when not specified with TRUE. The write actions should be before writing to [B].[D].RL.Response.
[B].[D].RL.DenyMsg	RW	VT_BSTR	1 to 30	Text message to display on 1010CB when authorisation is denied (or an asterisk * to not display any message). The value to be set by TAS/ OPC client before writing to [B].[D].RL.Response.
[B].[D].RL.Response	RW	VT_UI2	0 to 2	The value to be set by TAS/OPC Client in response to the authorization request. The response is passed to 1010CB by Fusion4 OPC Server. Possible values are 0 = None, 1 = OK, 2 = denied.

OPC Item	Access	Data Type	Range	Description
[B].[D].RL.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.3.6 Allocate Recipe State - AR

The value “AR” at [B].[D].ENQ indicates Allocate Recipe state. At this state, Fusion4 OPC server provides the necessary information to TAS/ OPC Client that are required to allocate a recipe. TAS/ OPC Client is required to authorise these details by writing suitable values to [B].[D].AR.WriteAR. Note that 1010CB will not proceed to further state until TAS/ OPC Client responds.

There are three options:

- Option 1 - Device uses a recipe stored in its own memory (see section 13.3.6.1)
- Option 2 - Device uses a recipe downloaded for the loading arm configured for additive and straight product loading (see section 13.3.6.2)
- Option 3 - Device uses a recipe downloaded for the loading arm configured for blending, with or without additive injection (see section 13.4.1.3)

13.3.6.1 Option 1

The following table lists the OPC items for the allocate recipe (AR) state, whereby the device uses a recipe stored in the its own memory.

Table 13-13: OPC items for AR state - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AR.ArmNum	R	VT_UI2		Loading arm number entered at 1010CB.

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AR.RecipeAvailable	R	VT_BOOL		• TRUE = Recipes available associated with this loading arm • FALSE = No recipe available
[B].[D].AR.Index	RW	VT_UI2		Recipe index to use
[B].[D].AR.WriteAR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].AR.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.3.6.2 Option 2

The following table lists the OPC items for the allocate recipe (AR) state, whereby the device uses a recipe downloaded for the loading arm configured for additive and straight product loading.

Table 13-14: OPC items for AR state - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AR.ArmNumber	R	VT_UI2		Loading arm number
[B].[D].AR.RecipeAvailable	R	VT_BOOL		• TRUE = Recipes available associated with this loading arm • FALSE = No recipe available
[B].[D].AR.2.Line1Additive	RW	VT_R8		Line 1 additive amount
[B].[D].AR.2.Line2Additive	RW	VT_R8		Line 2 additive amount

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AR.2.Line3Additive	RW	VT_R8		Line 3 additive amount
[B].[D].AR.2.Line4Additive	RW	VT_R8		Line 4 additive amount
[B].[D].AR.2.Line5Additive	RW	VT_R8		Line 5 additive amount
[B].[D].AR.2.Line6Additive	RW	VT_R8		Line 6 additive amount
[B].[D].AR.2.AdditiveFlushVol	RW	VT_R8		Additive flush volume
[B].[D].AR.2.WriteAR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].AR.2.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.3.6.3 Option 3

The following table lists the OPC items for the allocate recipe (AR) state, whereby the device uses a recipe downloaded for the arm configured for blending, with or without additive injection.

Table 13-15: OPC items for AR state - Option 3

OPC Item	Access	Data Type	Range	Description
[B].[D].AR.ArmNumber	R	VT_UI2		Loading arm number
[B].[D].AR.RecipeAvailable	R	VT_BOOL		• TRUE = Recipes available associated with this loading arm • FALSE = No recipe available
[B].[D].AR.3.Line1Additive	RW	VT_R8		Line 1 additive amount
[B].[D].AR.3.Line2Additive	RW	VT_R8		Line 2 additive amount

OPC Item	Access	Data Type	Range	Description
[B].[D].AR.3.Line3Additive	RW	VT_R8		Line 3 additive amount
[B].[D].AR.3.Line4Additive	RW	VT_R8		Line 4 additive amount
[B].[D].AR.3.Line5Additive	RW	VT_R8		Line 5 additive amount
[B].[D].AR.3.Line6Additive	RW	VT_R8		Line 6 additive amount
[B].[D].AR.3.AdditiveFlushVol	RW	VT_R8		Additive flush volume
[B].[D].AR.3.TargetBlendPerc	RW	VT_R8		Target blend percentage
[B].[D].AR.3.CleanLineVol	RW	VT_R8		Clean line volume
[B].[D].AR.3.WriteAR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].AR.3.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AR.3.AllocArm	R	VT_UI2		Associated loading arm
[B].[D].AR.3.Status	R	VT_UI2		Recipe status: • 0 = Disabled • 1 = Enabled
[B].[D].AR.3.MinPreset	R	VT_R4		Calculated recipe minimum preset
[B].[D].AR.3.BaseHighFlow	R	VT_R4		Base calculated high flow
[B].[D].AR.3.BaseLowFlow	R	VT_R4		Base calculated low flow
[B].[D].AR.3.BaseSlowFlow	R	VT_R4		Base calculated slow flow

OPC Item	Access	Data Type	Range	Description
[B].[D].AR.3.BlendHighFlow	R	VT_R4		Blend calculated high flow
[B].[D].AR.3.BlendLowFlow	R	VT_R4		Blend calculated low flow
[B].[D].AR.3.BlendSlowFlow	R	VT_R4		Blend calculated slow flow
[B].[D].AR.3.Error	R	VT_UI2		Recipe error code

13.3.7 Remote Compartment Authorisation State - RC

The value "RC" at [B].[D].ENQ indicates Remote Compartment Authorisation (RC) state. At this state, Fusion4 OPC server provides the necessary information to TAS/ OPC Client that are required to authorise the compartment. TAS/ OPC Client is required to authorise these details by writing into OPC items that have ReadWrite access (optionally) and then to [B].[D].RC.Response. Note that 1010CB will not proceed to further state until TAS/ OPC Client responds.

The following table lists the OPC items for the RC state.

Table 13-16: OPC Items for RC State

OPC Item	Access	Data Type	Range	Description
[B].[D].RC.LoadNum	R	VT_BSTR		Load Number entered at 1010CB device
[B].[D].RC.ReqArm	R	VT_UI2		Loading arm number entered at 1010CB device
[B].[D].RC.ReqComp	R	VT_UI2		Compartment number entered at 1010CB device
[B].[D].RC.Return	R	VT_R4		Return quantity entered at 1010CB device
[B].[D].RC.Preset	RW	VT_R4		Preset for selected compartment

OPC Item	Access	Data Type	Range	Description
[B].[D].RC.MaxPreset	RW	VT_R4		Maximum preset for selected compartment
[B].[D].RC.RetryParam	RW	VT_UI2		0 = Retry allowed, 1 = Force load completion
[B].[D].RC.SkipPrompt	RW	VT_BOOL		Skip preset prompt S
[B].[D].RC.DenyMsg	RW	VT_BSTR	1 to 30	Text message to display on 1010CB when authorisation is denied (or an asterisk * to not display any message). The value to be set by TAS/ OPC client before writing to [B].[D].RC.Response.
[B].[D].RC.Response	RW	VT_UI2	0 to 2	The value to be set by TAS/OPC Client in response to the authorization request. The response is passed to 1010CB by Fusion4 OPC Server. Possible values are: • 0 = None • 1 = OK • 2 = denied.
[B].[D].RC.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.3.8 Batch Loading State - IV

The IV command enables TAS/OPC Client to fetch the loading arm where loading is in progress. The values for the OPC items are retrieved from the device through instantaneous value.

The following table lists the OPC items for the IV command.

Table 13-17: OPC items for IV command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A [n].FetchIV	RW	VT_ UI2	1	Fetch command flag (1 = Fetch)
[B].[D].A [n].IV.DevResp	R	VT_ UI2		Device reply to SLIP IV command: 0 = None 1 = ACK 2 = NAK 3 = Busy
[B].[D].A [n].BatchError	R	VT_ UI2		Loading batch error
[B].[D].A [n].BatchPaused	R	VT_ UI2		Loading paused: • 0 = None • 1 = Paused
[B].[D].A [n].BatchProgress	R	VT_ UI2		Loading in progress • 0 = None • 1 = In progress
[B].[D].A [n].FlowRate	R	VT_R4		Loading arm flow rate
[B].[D].A[n].GOV	R	VT_R4		Loading Gross (Natural) Volume through loading arm
[B].[D].A [n].GOVacc	R	VT_R8		Accumulative Total Gross (Natural) Volume through loading arm
[B].[D].A[n].GSV	R	VT_R4		Loading Standard Volume through loading arm
[B].[D].A [n].GSVacc	R	VT_R8		Accumulative Total Standard Volume through loading arm

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A [n].M1.FlowRate	R	VT_R4		Product meter flow rate
[B].[D].A [n].M1.GOV	R	VT_R4		Loading Gross (Natural) Volume through product meter
[B].[D].A [n].M1.GOVacc	R	VT_R8		Accumulative Total Gross (Natural) Volume through product meter
[B].[D].A [n].M1.GSV	R	VT_R4		Loading Standard Volume through product meter
[B].[D].A [n].M1.GSVacc	R	VT_R8		Accumulative Total Standard Volume through product meter
[B].[D].A [n].M1.Press	R	VT_R4		Product stream pressure
[B].[D].A [n].M1.RefDensity	R	VT_R4		Product stream density
[B].[D].A [n].M1.Temp	R	VT_R4		Product stream temperature
[B].[D].A [n].M2.FlowRate	R	VT_R4		Product meter flow rate
[B].[D].A [n].M2.GOV	R	VT_R4		Loading Gross (Natural) Volume through product meter
[B].[D].A [n].M2.GOVacc	R	VT_R8		Accumulative Total Gross (Natural) Volume through product meter
[B].[D].A [n].M2.GSV	R	VT_R4		Loading Standard Volume through product meter
[B].[D].A [n].M2.GSVacc	R	VT_R8		Accumulative Total Standard Volume through product meter
[B].[D].A [n].M2.Press	R	VT_R4		Product stream pressure
[B].[D].A [n].M2.RefDensity	R	VT_R4		Product stream density
[B].[D].A [n].M2.Temp	R	VT_R4		Product stream temperature

13.3.9 Batch Loading Completed - BT

The BT command enables TAS/OPC Client to the loading arm where batch loading is completed.

The following table lists the OPC items for batch loading completed.

> NOTE: In the OPC items listed in the following table, [n] indicates the number of the loading arm and can be 1 to 4.

Table 13-18: OPC items for batch loading completed

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A[n].FetchBT	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].A[n].BTDevResp	R			Device reply to SLIP BT command: 0 = None 1 = ACK 2 = NAK 3 = Busy
[B].[D].A[n].Load.BatchComplete	R	VT_UI2		Load complete status from 1010CB on the arm: • 0 = None • 1 = Complete
[B].[D].A[n].Load.BatchNo	R	VT_UI2		Batch number
[B].[D].A[n].Load.BlendAcy	R	VT_UI2		Blend accuracy
[B].[D].A[n].Load.BlendType	R	VT_UI2		Blend type
[B].[D].A[n].Load.CheckSum	R	VT_BSTR		Checksum result

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A[n].Load.CompNo	R	VT_UI2		Compartment number
[B].[D].A[n].Load.Error	R	VT_BSTR		Error status
[B].[D].A[n].Load.PresetQty	R	VT_R4		Preset quantity
[B].[D].A[n].Load.RecipeID	R	VT_UI2		Recipe number
[B].[D].A[n].Load.ReturnQty	R	VT_R4		Return quantity
[B].[D].A[n].Load.StartTime	R	VT_BSTR		Batch start time (hhmmss) (24 hours format)
[B].[D].A[n].Load.StopTime	R	VT_BSTR		Batch stop time (hhmmss) (24 hours format)
[B].[D].A[n].Load.TransNo	R	VT_UI4		Transaction number
[B].[D].A[n].Load.Units	R	VT_BSTR		Loading units
[B].[D].A[n].LoadAdditive.BatchNo	R	VT_UI2		Batch number
[B].[D].A[n].LoadAdditive.Quantity1	R	VT_R4		Injected additive 1 quantity
[B].[D].A[n].LoadAdditive.Quantity2	R	VT_R4		Injected additive 2 quantity
[B].[D].A[n].LoadAdditive.Quantity3	R	VT_R4		Injected additive 3 quantity
[B].[D].A[n].LoadAdditive.Quantity4	R	VT_R4		Injected additive 4 quantity
[B].[D].A[n].LoadAdditive.Quantity5	R	VT_R4		Injected additive 5 quantity

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A [n].LoadAdditive.Quantity6	R	VT_ R4		Injected additive 6 quantity
[B].[D].A [n].LoadAdditive.TransNo	R	VT_ UI4		Transaction number
[B].[D].A [n].LoadBase.BatchNo	R	VT_ UI2		Batch number
[B].[D].A [n].LoadBase.CheckSum	R	VT_ BSTR		Checksum results
[B].[D].A [n].LoadBase.Commodity	R	VT_ UI2		Commodity
[B].[D].A [n].LoadBase.DensFWA	R	VT_ R4		Product meter calculated density at meter flow weighted average
[B].[D].A[n].LoadBase.Error	R	VT_ BSTR		Error status
[B].[D].A [n].LoadBase.ExpFactor	R	VT_ R4		Product meter expansion co-efficient
[B].[D].A[n].LoadBase.GOV	R	VT_ R4		Loaded Gross Observed Volume through product meter
[B].[D].A [n].LoadBase.GOVaccAft	R	VT_ R8		Product meter accumulative total Gross Observed Volume before batch
[B].[D].A [n].LoadBase.GOVaccBef	R	VT_ R8		Product meter accumulative total Gross Observed Volume after batch
[B].[D].A[n].LoadBase.GSV	R	VT_ R4		Loaded Gross Standard Volume through product meter
[B].[D].A [n].LoadBase.GSVaccAft	R	VT_ R8		Product meter accumulative total Gross Standard Volume before batch

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A [n].LoadBase.GSVaccBef	R	VT_ R8		Product meter accumulative total Gross Standard Volume after batch
[B].[D].A [n].LoadBase.MeterNo	R	VT_ UI2		Base meter number
[B].[D].A[n].LoadBase.Preset	R	VT_ R4		Product meter preset quantity calculated after load authorisation
[B].[D].A [n].LoadBase.PressFWA	R	VT_ R4		Product meter batch pressure flow weighted average
[B].[D].A [n].LoadBase.ProdDensObs	R	VT_ R4		Product meter product observed density
[B].[D].A [n].LoadBase.TempFWA	R	VT_ R4		Product meter batch temperature flow weighted average
[B].[D].A [n].LoadBase.TransNo	R	VT_ UI4		Transaction number
[B].[D].A [n].LoadBlend.BatchNo	R	VT_ UI2		Batch number
[B].[D].A [n].LoadBlend.CheckSum	R	VT_ BSTR		Checksum results
[B].[D].A [n].LoadBlend.Commodity	R	VT_ UI2		Commodity
[B].[D].A [n].LoadBlend.DensFWA	R	VT_ R4		Blend meter calculated density at meter flow weighted average
[B].[D].A[n].LoadBlend.Error	R	VT_ BSTR		Error status
[B].[D].A [n].LoadBlend.ExpFactor	R	VT_ R4		Product meter expansion co-efficient
[B].[D].A[n].LoadBlend.GOV	R	VT_ R4		Loaded Gross Observed Volume through blend meter

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A [n].LoadBlend.GOVaccAft	R	VT_ R8		Blend meter accumulative total Gross Observed Volume after batch
[B].[D].A [n].LoadBlend.GOVaccBef	R	VT_ R8		Blend meter accumulative total Gross Observed Volume before batch
[B].[D].A[n].LoadBlend.GSV	R	VT_ R4		Loaded Gross Standard Volume through blend meter
[B].[D].A [n].LoadBlend.GSVaccAft	R	VT_ R8		Blend meter accumulative total Gross Standard Volume after batch
[B].[D].A [n].LoadBlend.GSVaccBef	R	VT_ R8		Blend meter accumulative total Gross Standard Volume before batch
[B].[D].A [n].LoadBlend.MeterNo	R	VT_ UI2		Blend meter number
[B].[D].A[n].LoadBlend.Preset	R	VT_ R4		Blend meter preset quantity calculated after load authorisation
[B].[D].A [n.LoadBlend.PressFWA	R	VT_ R4		Blend meter batch flow weighted average
[B].[D].A [n].LoadBlend.ProdDensObs	R	VT_ R4		Blend meter product observed density
[B].[D].A [n].LoadBlend.TempFWA	R	VT_ R4		Blend meter batch flow weighted average
[B].[D].A [n].LoadBlend.TransNo	R	VT_ UI4		Transaction number

OPC Item	Access Type	Data Type	Range	Description
[B].[D].A [n].BatchTotalComplete	R	VT_ UI12		Indicates Fusion4 has completed retrieving all information about the current batch completed: • 0 = None • 1 = Complete

13.3.10 Authorizing Transaction Complete from TAS/ OPC client

Fusion4 OPC server offers a handshaking mechanism to wait until TAS/ OPC Client authorizes the transaction as complete before allowing 1010CB to proceed further. This is to ensure TAS/ OPC Client has got all the data required for the transaction and before the next one.

The value “PL” at [B].[D].ENQ indicates Post Loading ENQ state. TAS/ OPC Client is required to authorize transaction as complete by writing “1” on [B].[D].Load.TransCompete. After successful write, ENQ state will pass “PL” state and move to “ss” state.

The following table lists the OPC Items for the PL state.

Table 13-19: OPC items for Post Loading (PL) state

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Load.TransComplete	RW	VT_ UI2	1	Flag for TM to set when PL state (Transaction Complete): 0 = Unset, 1 = TC

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Load.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.3.10.1 Settling Transaction- TS

TAS/OPC Client can settle a transaction so that it can be overwritten by a new transaction every 292 transactions. If a transaction is not settled, when the next transaction number is equal to this unsettled transaction position in memory, no further loading can be performed until it is settled. By settling the transaction you are indicating that the transaction information no longer needs to be stored in the instrument memory.

> NOTE: this step is required only when the license has “N” at pos 5 (No BoL Printing).

The following table lists the OPC Items for transaction settling.

Table 13-20: OPC items for settling transaction (TS)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TS.TransNum	RW	VT_UI2		Transaction number
[B].[D].TS.WriteTS	R	VT_UI2	1	Write command flag (1 = Write)
[B].[D].TS.DevResp				Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TS.TransStatus				Transaction status: • 0 = Transaction settled successfully • 1 = Transaction in progress/ Valves not closed • 2 = Transaction not found

13.4 TAS/OPC Client Commands

13.4.1 Internal Additive Injectors - AD

TAS/OPC client can retrieve the internal additive injector settings of the device by issuing the AD command.

There are three options:

- Option 1 - Retrieving the internal additive injection type and the number of injection points (see section 13.4.1.1)
- Option 2 Retrieving the specific internal additive injector settings for the device (see section 13.4.1.2)
- Option 3 Retrieving the specific internal additive injector settings for the device (see section 13.4.1.3)

13.4.1.1 Option 1

The following table lists the OPC items for the AD command for retrieving the internal additive injection type and number of injection points.

Table 13-21: OPC items for AD command - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.1.FetchAD	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AD.1.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AD.1.InternalAdditiveInjector1.AllocatedArm	R	VT_UI2		Internal additive injection allocated arm
[B].[D].AD.1.InternalAdditiveInjector1.Type	R	VT_UI2		Internal additive injection type
[B].[D].AD.1.InternalAdditiveInjector2.AllocatedArm	R	VT_UI2		Internal additive injection allocated arm

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.1.InternalAdditiveInjector2.Type	R	VT_UI2		Internal additive injection type
[B].[D].AD.1.InternalAdditiveInjector3.AllocatedArm	R	VT_UI2		Internal additive injection allocated arm
[B].[D].AD.1.InternalAdditiveInjector3.Type	R	VT_UI2		Internal additive injection type
[B].[D].AD.1.InternalAdditiveInjector4.AllocatedArm	R	VT_UI2		Internal additive injection allocated arm
[B].[D].AD.1.InternalAdditiveInjector4.Type	R	VT_UI2		Internal additive injection type
[B].[D].AD.1.InternalAdditiveInjector5.AllocatedArm	R	VT_UI2		Internal additive injection allocated arm
[B].[D].AD.1.InternalAdditiveInjector5.Type	R	VT_UI2		Internal additive injection type

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.1.InternalAdditiveInjector6.AllocatedArm	R	VT_UI2		Internal additive injection allocated arm
[B].[D].AD.1.InternalAdditiveInjector6.Type	R	VT_UI2		Internal additive injection type

13.4.1.2 Option 2

The following table lists the OPC items for the AD command for retrieving the internal additive injection type and number of injection points.

Table 13-22: OPC items for AD command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.2.InternalAdditiveInjectorNum	RW	VT_UI2		Injector number
[B].[D].AD.2.FetchAD	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AD.2.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.2.InternalAdditiveDeviationAlm	R	VT_BSTR		Additive deviation alarm enabled
[B].[D].AD.2.InternalAdditiveDeviationInjectionCycle	R	VT_UI2		Additive deviation basis injection cycles
[B].[D].AD.2.InternalAdditiveDeviationVolPerc	R	VT_R4		Additive volume deviation [xxx] percentage
[B].[D].AD.2.LeakingSolenoidAlmEnabled	R	VT_BSTR		Leaking solenoid alarm enabled
[B].[D].AD.2.LeakingSolenoidTimePeriod	R	VT_UI2		Leaking solenoid time period
[B].[D].AD.2.LeakingSolenoidVolume	R	VT_R4		Leaking solenoid volume limit
[B].[D].AD.2.NoAdditiveFlowTimeOut	R	VT_UI2		No additive flow timeout in seconds

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.2.NoAdditiveFlowTimeOutAlm	R	VT_BSTR		No additive flow timeout alarm enabled
[B].[D].AD.2.SolenoidNoOfRetries	R	VT_UI2		Number of solenoid retries [x]

13.4.1.3 Option 3

The following table lists the OPC items for the AD command for retrieving the internal additive injection type and number of injection points.

Table 13-23: OPC items for AD command - Option 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.3.InternalAdditiveInjectorNum	RW	VT_UI2		Injector number
[B].[D].AD.3.FetchAD	RW	VT_UI2	1	Fetch command flag (1 =Fetch)
[B].[D].AD.3.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AD.3.ArmNum	R	VT_UI2		Allocated arm number
[B].[D].AD.3.InternalAdditiveInjectorCode	R	VT_BSTR		Additive injector code
[B].[D].AD.3.InternalAdditiveInjectorPositionEnabled	R	VT_UI2		Injector position enabled
[B].[D].AD.3.InternalAdditiveMeterFactor	R	VT_R4		Additive meter factor
[B].[D].AD.3.InternalAdditiveMeterKfactor	R	VT_R4		Additive meter K-factor
[B].[D].AD.3.InternalAdditivePacingVolume	R	VT_R4		Pacing volume
[B].[D].AD.3.InternalAdditivePumpOffDelay	R	VT_R4		Pump off delay in seconds

13.4.2 External Additive Injectors - AI

TAS/OPC client can retrieve the external additive injector settings for the device by issuing the AI command to the device.

There are two options:

- Option 1 - Retrieving the external additive injection type and the number of injection points (see section 13.4.2.1).
- Option 2 - Retrieving the specific external additive injector settings of the device (see section 13.4.2.2).

13.4.2.1 Type and Number of Injection Points

Table 13-24: OPC items for AI command - Option 1

OPC Item	Access Type	Data Type	Length	Description
[B].[D].AI.1.FetchAI	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AI.1.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AI.1.ExternalAdditiveInjectionNoOfPoints	R	VT_UI2		Number of Injection points
[B].[D].AI.1.ExternalAdditiveInjectorType	R	VT_UI2		Additive injection type
[B].[D].AI.1.ExternalAdditivePulseWidth	R	VT_R4		Pulse width

13.4.2.2 Specific External Additive Injector Settings

Table 13-25: OPC Items for AI Command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AI.2.ExternalAdditiveInjectorNum	RW	VT_UI2		Injector number (Range is 1 to 24)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AI.2.FetchAI	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AI.2.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AI.2.ExternalAdditiveAllocatedArmNum	R	VT_UI2		Allocated arm
[B].[D].AI.2.ExternalAdditiveInjectionPointAddress	R	VT_BSTR		Address of injection point
[B].[D].AI.2.ExternalAdditiveInjectorCode	R	VT_BSTR		Additive injector code

13.4.3 Arm Status - AM

TAS/OPC client can retrieve the status of a specific loading arm by issuing the AM command.

The following table lists the OPC items for the AM command.

> NOTE: In the OPC items listed in TABLE 13-26 [n] indicates the loading arm number and can be 1 to 4.

Table 13-26: OPC items for AM command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AM.[n].FetchAM	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AM.[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AM.[n].ArmNum	R	VT_UI2		Arm number
[B].[D].AM.[n].ArmErrStatus	R	VT_UI2		Arm error status
[B].[D].AM.[n].ArmInterruptStatus	R	VT_UI2		Arm Interrupt/Pause status
[B].[D].AM.[n].ArmStatus	R	VT_UI2		Arm status (1 = Enabled 2 = Disabled 3 = Faulty)
[B].[D].AM.[n].M1ErrStatus	R	VT_UI2		Straight meter error status
[B].[D].AM.[n].M2ErrStatus	R	VT_UI2		Blend meter error status
[B].[D].AM.[n].SysInterruptStatus	R	VT_UI2		System Interrupt/Pause status

13.4.4 Arm Settings - AS

TAS/OPC client can retrieve the setup information unique to each loading arm by issuing the AS command.

There are two options:

- Option 1 (see section 13.4.4.1)
- Option 2 (see section 13.4.4.2)

13.4.4.1 Option 1

The following table lists the OPC items for the AS command - Option 1.

> NOTE: In the OPC items listed in the following table [n] indicates the loading arm number and can be 1 to 4.

Table 13-27: OPC items for AS command - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AS.1.A [n].FetchAS	RW	VT_ UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AS.1.A [n].DevResp	R	VT_ UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AS.1.A [n].ArmName	R	VT_ BSTR		Loading arm name
[B].[D].AS.1.A [n].ArmNum	R	VT_ UI2		Loading arm number
[B].[D].AS.1.A [n].ArmStatus	R	VT_ UI2		Loading arm status (1 = Enabled, 2 = Disabled, 3 = Faulty)
[B].[D].AS.1.A [n].ArmType		VT_ UI2		Loading arm type
[B].[D].AS.1.A [n].BaseMeterNum	R	VT_ UI2		Straight meter number
[B].[D].AS.1.A [n].BlendMeterNum	R	VT_ UI2		Blend meter number
[B].[D].AS.1.A [n].FullFlow	R	VT_R4		Loading arm full flow

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AS.1.A [n].LoadUnits	R	VT_ UI2		Load units: • 0 = litres/liters • 1 = m^3, 2 = kg • 3 = tonnes • 4 = grams • 5 = gallons • 6 = pounds)
[B].[D].AS.1.A [n].MaxPreset	R	VT_R4		Maximum preset
[B].[D].AS.1.A [n].SlowFlow	R	VT_R4		Loading arm slow flow
[B].[D].AS.1.A [n].SlowStartQty	R	VT_R4		Slow start quantity

13.4.4.2 Option 2

The following table lists the OPC items for the AS command - Option 2.

Table 13-28: OPC items for AS command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AS.2.A1.FetchAS	RW	VT_ UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AS.2.A1.DevResp	R	VT_ UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AS.2.A1.ArmNum	R	VT_UI2		Loading arm number
[B].[D].AS.2.A1.BlendToleranceAlm	R	VT_UI2		Blend tolerance alarm (0 = DISABLE, 1 = ENABLE)
[B].[D].AS.2.A1.BlendToleranceHighPerc	R	VT_R4		Blend tolerance high percentage
[B].[D].AS.2.A1.BlendToleranceLowPerc	R	VT_R4		Blend tolerance low percentage
[B].[D].AS.2.A1.HighFlowAlm	R	VT_UI2		High flow alarm: • 0 = DISABLE • 1 = ENABLE)
[B].[D].AS.2.A1.HighFlowAlmDelay	R	VT_BSTR		High flow alarm delay
[B].[D].AS.2.A1.HighFlowHighPerc	R	VT_R4		High flow high percentage
[B].[D].AS.2.A1.HighFlowLowPerc	R	VT_R4		High flow low percentage
[B].[D].AS.2.A1.LowFlowAlm	R	VT_UI2		Low flow alarm (0 = DISABLE, 1 = ENABLE)
[B].[D].AS.2.A1.LowFlowAlmDelay	R	VT_BSTR		Low flow alarm delay
[B].[D].AS.2.A1.LowFlowHighPerc	R	VT_R4		Low flow high percentage
[B].[D].AS.2.A1.LowFlowLowPerc	R	VT_R4		Low flow low percentage
[B].[D].AS.2.A1.MinBlendVol	R	VT_R4		Minimum blend volume
[B].[D].AS.2.A1.SlowFlowAlm	R	VT_UI2		Slow flow alarm (0 = DISABLE, 1 = ENABLE)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AS.2.A1.SlowFlowAlmDelay	R	VT_ BSTR		Slow flow alarm delay
[B].[D].AS.2.A1.SlowFlowHighPerc	R	VT_ R4		Slow flow high percentage
[B].[D].AS.2.A1.SlowFlowLowPerc	R	VT_ R4		Slow flow low percentage

13.4.5 Application Version - AV

TAS/OPC client can retrieve the application version, date and time from the device by issuing the AV command.

> NOTE: The AV command can only be used while the device is in the idle state.

The following table lists the OPC items for the AV command.

Table 13-29: OPC items for AV command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AV.FetchAV	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].AV.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].AV.Date	R	VT_ BSTR		Date [mm:dd:yyyy]
[B].[D].AV.DisplayType	R	VT_ BSTR		Display type
[B].[D].AV.FlashROMSize	R	VT_UI4		FLASH ROM size

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AV.InstrumentModel	R	VT_BSTR		Device model and application pack
[B].[D].AV.ROMType	R	VT_BSTR		ROM type
[B].[D].AV.SoftwareCard	R	VT_BSTR		Software version and card selection
[B].[D].AV.SoftwareVersion	R	VT_BSTR		Software version
[B].[D].AV.Time	R	VT_BSTR		Time [hh:mm:ss]

13.4.6 Blend/Additive Recipes - BR

TAS/OPC client can upload blend/additive recipes to the computer or to download blend/additive recipes to the device by issuing the BR command. These recipes contain both blend and additive components. They apply when either blending two products or when using intelligent additive injection (Honeywell Enraf Mini-Pak additive injection system), or when blending two products and using intelligent additive injection.

There are two options:

- Option 1 - Uploading additive/blend recipe to the computer (see section 13.4.6.1)
- Option 2 - Downloading Additive/Blend Recipe to Device (see section 13.4.6.2)

> NOTE: The BR command can only be used while the device is in the idle state.

13.4.6.1 Option 1 - Uploading Additive/Blend Recipe to Computer

The following table lists the OPC items for the BR command, where an additive/blend recipe is uploaded to the computer.

Table 13-30: OPC items for BR command - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].BR.Upload.RecipeNumber	RW	VT_UI2		Recipe number (Range is 0 to 16)
[B].[D].BR.Upload.WriteBR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].BR.Upload.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].BR.Upload.AdditiveFlushVol	R	VT_R4		Additive flush volume
[B].[D].BR.Upload.ArmNum	R	VT_UI2		Number of the arm associated with recipe
[B].[D].BR.Upload.BaseHighFlow	R	VT_R4		Base calculated high flow
[B].[D].BR.Upload.BaseLowFlow	R	VT_R4		Base calculated low flow
[B].[D].BR.Upload.BaseSlowFlow	R	VT_R4		Base calculated slow flow
[B].[D].BR.Upload.BlendHighFlow	R	VT_R4		Blend calculated high flow
[B].[D].BR.Upload.BlendLowFlow	R	VT_R4		Blend calculated low flow
[B].[D].BR.Upload.BlendSlowFlow	R	VT_R4		Blend calculated slow flow
[B].[D].BR.Upload.CleanLineVol	R	VT_R4		Clean line volume

OPC Item	Access Type	Data Type	Range	Description
[B].[D].BR.Upload.Line1AdditiveAmount	R	VT_R4		Line 1 additive amount
[B].[D].BR.Upload.Line2AdditiveAmount	R	VT_R4		Line 2 additive amount
[B].[D].BR.Upload.Line3AdditiveAmount	R	VT_R4		Line 3 additive amount
[B].[D].BR.Upload.Line4AdditiveAmount	R	VT_R4		Line 4 additive amount
[B].[D].BR.Upload.Line5AdditiveAmount	R	VT_R4		Line 5 additive amount
[B].[D].BR.Upload.Line6AdditiveAmount	R	VT_R4		Line 6 additive amount
[B].[D].BR.Upload.RecipeMinimumPreset	R	VT_R4		Calculated recipe minimum preset
[B].[D].BR.Upload.RecipeName	R	VT_BSTR		Recipe name
[B].[D].BR.Upload.RecipeStatus	R	VT_UI2		Recipe status (0 = DISABLED, 1 = ENABLED)
[B].[D].BR.Upload.TargetBlendPerc	R	VT_R4		Target blend percentage

13.4.6.2 Option 2 - Downloading Additive/Blend Recipe to Device

The following table lists the OPC items for the BR command, where an additive/blend recipe is downloaded to the device.

Table 13-31: OPC items for BR Command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].BR.Download.RecipeNum	RW	VT_UI2		Number of recipe to be downloaded

OPC Item	Access Type	Data Type	Range	Description
[B].[D].BR.Download.RecipeStatus	RW	VT_UI2		Recipe status (0 = DISABLED, 1 = ENABLED)
[B].[D].BR.Download.RecipeName	RW	VT_BSTR		Recipe name
[B].[D].BR.Download.ArmNum	RW	VT_UI2		Number of arm to be associated with recipe
[B].[D].BR.Download.TargetBlendPerc	RW	VT_R4		Target blend percentage
[B].[D].BR.Download.CleanLineVol	RW	VT_R4		Clean line volume (Range is 1 to 999)
[B].[D].BR.Download.Line1AdditiveAmount	RW	VT_R4		Line 1 additive amount or 0 if disabled
[B].[D].BR.Download.Line2AdditiveAmount	RW	VT_R4		Line 2 additive amount or 0 if disabled
[B].[D].BR.Download.Line3AdditiveAmount	RW	VT_R4		Line 3 additive amount or 0 if disabled
[B].[D].BR.Download.Line4AdditiveAmount	RW	VT_R4		Line 4 additive amount or 0 if disabled
[B].[D].BR.Download.Line5AdditiveAmount	RW	VT_R4		Line 5 additive amount or 0 if disabled
[B].[D].BR.Download.Line6AdditiveAmount	RW	VT_R4		Line 6 additive amount or 0 if disabled
[B].[D].BR.Download.AdditiveFlushVol	RW	VT_R4		Additive flush volume or 0 if no flush volume

OPC Item	Access Type	Data Type	Range	Description
[B].[D].BR.Download.WriteBR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].BR.Download.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].BR.Download.Error	R	VT_UI2		Recipe error code
[B].[D].BR.Download.BaseSlowFlow	R	VT_R4		Base calculated slow flow
[B].[D].BR.Download.BaseHighFlow	R	VT_R4		Base calculated high flow
[B].[D].BR.Download.BaseLowFlow	R	VT_R4		Base calculated low flow
[B].[D].BR.Download.BlendSlowFlow	R	VT_R4		Blend calculated slow flow
[B].[D].BR.Download.BlendHighFlow	R	VT_R4		Blend calculated high flow
[B].[D].BR.Download.BlendLowFlow	R	VT_R4		Blend calculated low flow
[B].[D].BR.Download.RecipeMinimumPreset	R	VT_R4		Calculated recipe minimum preset

13.4.7 Clear Power Cycle - CC

TAS/OPC client can clear/reset the power failure flag. The flag is available from the ENQ response bit 4 of the status byte.

The following table lists the OPC items for the CC command.

Table 13-32: OPC items for CC command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CC.WriteCC	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].CC.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.8 Clear General Purpose Input Latches - CL

TAS/OPC client can clear the latched status byte sent in the IS command for digital inputs by issuing the CL command. This command also clears the RIT status byte in the ENQ command where applicable.

The following table lists the OPC items for the CL command.

Table 13-33: OPC items for CL command

OPC Item	Access Type	Data Type	Length	Description
[B].[D].CL.AllInputClear	RW	VT_UI2		Write command flag to clear all latched inputs (1 = Write)
[B].[D].CL.CA20LatchedInputClear	RW	VT_UI2		Write command flag to clear CA20 latched inputs (1 = Write)
[B].[D].CL.CA21LatchedInputClear	RW	VT_UI2		Write command flag to clear CA21 latched inputs (1 = Write)
[B].[D].CL.CA22LatchedInputClear	RW	VT_UI2		Write command flag to clear CA22 latched inputs (1 = Write)
[B].[D].CL.CA23LatchedInputClear	RW	VT_UI2		Write command flag to clear CA23 latched inputs (1 = Write)

OPC Item	Access Type	Data Type	Length	Description
[B].[D].CL.CA25LatchedInputClear	RW	VT_UI2		Write command flag to clear CA25 latched inputs (1 = Write)
[B].[D].CL.CA26LatchedInputClear	RW	VT_UI2		Write command flag to clear CA26 latched inputs (1 = Write)
[B].[D].CL.CA27LatchedInputClear	RW	VT_UI2		Write command flag to clear CA27 latched inputs (1 = Write)
[B].[D].CL.CA28LatchedInputClear	RW	VT_UI2		Write command flag to clear CA28 latched inputs (1 = Write)
[B].[D].CL.CB20LatchedInputClear	RW	VT_UI2		Write command flag to clear CB20 latched inputs (1 = Write)
[B].[D].CL.CB21LatchedInputClear	RW	VT_UI2		Write command flag to clear CB21 latched inputs (1 = Write)
[B].[D].CL.CB22LatchedInputClear	RW	VT_UI2		Write command flag to clear CB22 latched inputs (1 = Write)
[B].[D].CL.CB23LatchedInputClear	RW	VT_UI2		Write command flag to clear CB23 latched inputs (1 = Write)
[B].[D].CL.CB25LatchedInputClear	RW	VT_UI2		Write command flag to clear CB25 latched inputs (1 = Write)
[B].[D].CL.CB26LatchedInputClear	RW	VT_UI2		Write command flag to clear CB26 latched inputs (1 = Write)

OPC Item	Access Type	Data Type	Length	Description
[B].[D].CL.CB27LatchedInputClear	RW	VT_UI2		Write command flag to clear CB27 latched inputs (1 = Write)
[B].[D].CL.CB28LatchedInputClear	RW	VT_UI2		Write command flag to clear CB28 latched inputs (1 = Write)
[B].[D].CL.RITArm1InputClear	RW	VT_UI2		Write command flag to clear RIT latched inputs for arm 1 (1 = Write)
[B].[D].CL.RITArm2InputClear	RW	VT_UI2		Write command flag to clear RIT latched inputs for arm 2 (1 = Write)
[B].[D].CL.RITBothArmsInputClear	RW	VT_UI2		Write command flag to clear RIT latched inputs for both arms (1 = Write)
[B].[D].CL.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.9 Communication Settings - CO

TAS/OPC client can retrieve the communications settings from the device by issuing the CO command.

> NOTE: The CO command can only be used while the device is in the idle state.

There are two options:

- Option 1 - Retrieving the general communication settings (see section 13.4.9.1)
- Option 2 - Retrieving settings for a specific COM port (see section 13.4.9.2)

13.4.9.1 Option 1 - Retrieving the General Communications Settings

The following table lists the OPC items for the CO command, whereby the general communications are retrieved.

Table 13-34: OPC Items for CO command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CO.GeneralSettings.FetchCO	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].CO.GeneralSettings.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].CO.GeneralSettings.CommunicationTimeOut	R	VT_UI2		Comms timeout [seconds]
[B].[D].CO.GeneralSettings.DebugResp	R	VT_UI2		Debug response (0 = DISABLED, 1 = ENABLED)
[B].[D].CO.GeneralSettings.RemoteAuthorinable	R	VT_UI2		Remote authorise (0 = DISABLED, 1 = ENABLED)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CO.GeneralSettings.TASModeEnable	R	VT_UI2		Terminal automation mode (0 = STAND ALONE, 1 = [LOAD SCHEDULING)
[B].[D].CO.GeneralSettings.TotalCOMPorts	R	VT_UI2		Number of communications ports

13.4.9.2 Option 2 - Communication Port Settings

The following table lists the OPC items for the CO command, whereby the communication port settings are retrieved.

> NOTE: In the OPC items listed in the following table [n] indicates the number of the communication port and can be 1 to 3.

Table 13-35: OPC Items for the CO command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CO.COMPort [n].FetchCO	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].CO.COMPort [n].DevResp	R	VT_UI2		Device reply to SLIP command • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CO.COMPort [n].BaudRate	R	VT_UI2		Communications port baud rate • 0 = 300 • 1 = 600 • 2 = 1200 • 3 = 2400 • 4 = 4800 • 5 = 9600 • 6 = 19200 • 7 = 38,400)
[B].[D].CO.COMPort [n].COMDevice	R	VT_UI2		Communications port n device • 0 = COMPUTER • 1 = INTELLIGENT ADDITIV • 2 = NEXWATCH)
[B].[D].CO.COMPort [n].COMMode	R	VT_UI2		Communications port n mode • 0 = RS232 • 1 = RS485 • 2 = RS422)
[B].[D].CO.COMPort [n].COMPort	R	VT_ BSTR		Communications port number

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CO.COMPort [n].Parity	R	VT_UI2		Communications port n parity • 0 = NONE • 1 = EVEN • 2 = ODD)
[B].[D].CO.COMPort [n].StopBits	R	VT_UI2		Communications port stop bits
[B].[D].CO.COMPort [n].UnitAddress	R	VT_UI2		Communications port unit address

13.4.10 Correction Settings - CS

TAS/OPC client can retrieve the commodity based correction settings for all flow meters by issuing the CS command.

> NOTE: The CS command can only be used while the device is in the idle state.

There are five options:

- Option 1 - Retrieving the commodity based correction settings for all flow meters (see section 13.4.10.1)
- Option 2 - Retrieving the break down settings for a specific flow meter (see section 13.4.10.2)
- Option 3 - Retrieving the density settings for a specific flow meter (see section 13.4.10.3)
- Option 4 - Retrieving the pressure settings for a specific flow meter (see section 13.4.10.4)
- Option 5 - Retrieving the temperature settings for a specific flow meter (see section 13.4.10.5)

13.4.10.1 Option 1

The following table lists the OPC items for the CS command, whereby the commodity based correction settings for all flow meters are retrieved.

Table 13-36: OPC items for CS command - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.1.FetchCS	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].CS.1.DevResp	R	VT_UI2		Device reply to SLIP command • 0 = none • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].CS.1.M1Commodity	R	VT_UI2		Commodity setting for meter 1
[B].[D].CS.1.M1DensityCorrectionTable	R	VT_BSTR		Density correction table for meter 1
[B].[D].CS.1.M1VolumeCorrectionTable	R	VT_BSTR		Volume correction table for meter 1
[B].[D].CS.1.M2Commodity	R	VT_UI2		Commodity setting for meter 2
[B].[D].CS.1.M2DensityCorrectionTable	R	VT_BSTR		Density correction table for meter 2
[B].[D].CS.1.M2VolumeCorrectionTable	R	VT_BSTR		Volume correction table for meter 2
[B].[D].CS.1.M3Commodity	R	VT_UI2		Commodity setting for meter 3
[B].[D].CS.1.M3DensityCorrectionTable	R	VT_BSTR		Density correction table for meter 3
[B].[D].CS.1.M3VolumeCorrectionTable	R	VT_BSTR		Volume correction table for meter 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.1.M4Commodity	R	VT_ UI2		Commodity setting for meter 4
[B]. [D].CS.1.M4DensityCorrectionTable	R	VT_ BSTR		Density correction table for meter 4
[B]. [D].CS.1.M4VolumeCorrectionTable	R	VT_ BSTR		Volume correction table for meter 4

13.4.10.1.1 Commodity Types

In the following table, the various commodity types are listed.

Table 13-37: Commodity Types

No.	Commodity Type
0	NONE
1	CRUDE OILS (A)
2	REFINED (B)
3	SPECIAL (C)
4	LUBE OILS (D)
5	NGL AND LPG (E)
6	FAME (F)

13.4.10.1.2 Density Correction

In the following table, the density correction table for each commodity type is listed.

Table 13-38: Density Correction

Commodity Type					Base Temp.
Crude Oils (A)	Refined (B)	Special (C)	Lube Oils (D)	NGL and LPG (E)	
53A	53B	53C	53D	53E	15 °C
59A	59B	59C	59D	59E	20 °C
23A	23B	23C	23D	23E	60 °F

13.4.10.1.3 Volume Correction

In the following table, the volume correction table for each commodity type is listed.

Table 13-39: Volume Correction

Commodity Type					Base Temp.
Crude Oils (A)	Refined (B)	Special (C)	Lube Oils (D)	NGL and LPG (E)	
54A	54B	54C	54D	54E	15 °C
60A	60B	60C	60D	60E	20 °C
24A	24B	24C	24D	24E	60 °F

13.4.10.2 Option 2

The following table lists the OPC items for the CS command, whereby the break down settings for the flow meter are retrieved.

Table 13-40: OPC Items for CS command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.BD.MeterNum	RW	VT_UI2		Meter number (Range is 1 to 4)
[B].[D].CS.BD.FetchCS	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].CS.BD.DevResp	R	VT_UI2		Device reply to SLIP command • 0 = None • 1 = ACK • 2 = NAK • 3 = BUSY
[B].[D].CS.BD.DensityBreakDown	R	VT_UI2		Pressure break down value: • 0 = DISABLED • 1 = ENABLED]

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.BD.DensityBreakDownValue	R	VT_R4		Pressure break down value
[B].[D].CS.BD.PressureBreakDownEnabled	R	VT_UI2		Pressure break down value: • 0 = DISABLED • 1 = ENABLED
[B].[D].CS.BD.PressureBreakDownValue	R	VT_R4		Pressure break down value
[B].[D].CS.BD.TempBreakDownEnabled	R	VT_UI2		Temperature break down value: • 0 = DISABLED • 1 = ENABLED
[B].[D].CS.BD.TempBreakDownValue	R	VT_R4		Temperature break down value

13.4.10.3 Option 3

The following table lists the OPC items for the CS command, whereby the density settings for the flow meter are retrieved.

Table 13-41: OPC items for CS command - Option 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.DS.MeterNum	RW	VT_UI2		Meter number (Range is 1 to 4)
[B].[D].CS.DS.FetchCS	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.DS.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].CS.DS.20MADensity	R	VT_R4		20 mA density
[B].[D].CS.DS.4MADensity	R	VT_R4		4 mA density
[B]. [D].CS.DS.DensityCorrection	R	VT_UI2		Density correction: • 1 = ENABLED • 0 = DISABLED
[B].[D].CS.DS.DensityType	R	VT_UI2		Type of density value: • 0 = None • 1 = Manual • 2 = Analog]
[B].[D].CS.DS.ManualDensity	R	VT_R4		Manual density value

13.4.10.4 Option 4

The following table lists the OPC items for the CS command, whereby the pressure settings for the flow meter are retrieved.

Table 13-42: OPC items for CS command - Option 4

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.PS.MeterNum	RW	VT_ UI2		Meter number (Range is 0 to 4)
[B].[D].CS.PS.FetchCS	RW	VT_ UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.PS.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].CS.PS.20MAPressure	R	VT_R4		20 mA pressure
[B].[D].CS.PS.4MAPressure	R	VT_R4		4 mA pressure
[B].[D].CS.PS.CommoditySetting	R	VT_UI2		Commodity setting
[B].[D].CS.PS.ManualCompressabilityFactor	R	VT_R4		Manual compressibility factor
[B].[D].CS.PS.ManualDP	R	VT_R4		Manual entry of DP
[B].[D].CS.PS.PressCorrection	R	VT_UI2		Pressure correction: • 0 = DISABLED • 1 = ENABLED

13.4.10.5 Option 5

The following table lists the OPC items for the CS command, whereby the temperature settings for the flow meter are retrieved.

Table 13-43: OPC items for CS command - Option 5

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.TS.MeterNum	RW	VT_UI2		Meter number (Range: 1 to 4)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CS.TS.FetchCS	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].CS.TS.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].CS.TS.ExpansionCoefficient	R	VT_R4		Expansion co-efficient
[B].[D].CS.TS.MaximumErrorTemp	R	VT_R4		RTD maximum error temperature for RTD or 20 ma
[B].[D].CS.TS.MinimumErrorTemp	R	VT_R4		RTD minimum error temperature for RTD or 4 mA
[B].[D].CS.TS.SensorType	R	VT_UI2		Temperature sensor type: • 0 = None in device • 1 = RTD • 2 = 4-20 mA
[B].[D].CS.TS.TempCorrection	R	VT_UI2		Temperature correction: • 0 = DISABLED • 1 = ENABLED

13.4.11 Set Meter Density - DN

TAS/OPC Client can download the product density for the specified fluid group for a particular meter to the instrument.

The following table lists the OPC items for the DN command.

Table 13-44: OPC items for DN command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].DN.MeterNo	RW	VT_UI2		Meter number for which density must be set
[B].[D].DN.RefDens	RW	VT_R4		Lab density at 15 °C
[B].[D].DN.WriteDN	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].DN.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.12 Get Date and Time - GD

TAS/OPC client can retrieve the date and time from the device by issuing the GD command.

> NOTE: The GD command can only be used while the device is in the idle state.

The following table lists the OPC items for the GD command.

Table 13-45: OPC items for GD command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GD.FetchGD	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].GD.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = AC • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GD.Date	R	VT_BSTR		Date [dd:mm:yyyy]
[B].[D].GD.Time	R	VT_BSTR		Time [hh:mm:ss]

13.4.13 General Purpose Inputs - GI

TAS/OPC client can retrieve the configuration settings and status for a specific general purpose input by issuing the GI command.

Table 13-46: The following table lists the OPC items for the GI command.

OPC items for GI command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GI.InputNum	RW	VT_UI2		General purpose input number
[B].[D].GI.FetchGI	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].GI.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].GI.AllocArm	R	VT_UI2		Arm number assigned to requested input: • 0 = Not applicable • 1 = Arm 1 • 2 = Arm 2 • 3 = Arm 3 • 4 = Arm 4]

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GI.InputFun	R	VT_UI2		General purpose input function assigned to the requested general purpose input number: • 0 = None • 1 = Emergency Stop • 2 = Overfill/Ground • 3 = Vapour Recovery • 4 = Programmable Permissive • 5 = System Programmable 1 • 6 = System Programmable 2 • 7 = System Programmable 3 • 8 = System Programmable 4 • 9 = System Programmable 5 • 10 = System Programmable 6 • 11 = Arm Programmable 1 • 12 = Arm Programmable 2 • 13 = Arm Programmable 3 • 14 = Arm Programmable 4 • 15 = Arm Programmable 5 • 16 = Arm Programmable 6 • 17 = Arm Programmable 7 • 18 = Arm Programmable 8 • 19 = RIT Start arm

OPC Item	Access Type	Data Type	Range	Description
				• 20 = RIT Stop Arm • 21 = RIT Ack
[B].[D].GI.InputType	R	VT_UI2		Input type assigned to the requested general purpose input: • 0 = None • 1 = Emergency stop • 2 = Permissive • 3 = System Input • 4 = Arm Input • 5 = RIT input
[B].[D].GI.LoadEffect	R	VT_UI2		General purpose input loading effect: • 0 = NONE • 1 = PAUSE • 2 = TIMEOUT • 3 = TERMINATE • 4 = MANAGER RESET]
[B].[D].GI.Status	R	VT_UI2		Current general purpose input status: • 0 = Open • 1 = Closed

13.4.14 General Purpose Outputs - GO

TAS/OPC client can retrieve the configuration settings and status for a specific general purpose output issuing the GO command.

The following table lists the OPC items for the GO command.

Table 13-47: OPC items for GO command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GO.OutputNum	RW	VT_UI2		General purpose output number
[B].[D].GO.FetchGO	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].GO.DevResp	R	VT_UI2		Device reply to SLIP command: 0 = None 1 = ACK 2 = NAK 3 = Busy
[B].[D].GO.AllocArm	R	VT_UI2		Arm /stream number assigned to requested output: • 0 = None • 1= Alarm output • 2 = Stream Control output • 3 = Control valve output • 4 = Additive output • 5 = Internal additive output • 6 = RIT output]
[B].[D].GO.OPCondition	R	VT_UI2		General purpose output condition: • 0 = normally open • 1 = normally closed

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GO.OutputFun	R	VT_UI2		Output function assigned to the requested general purpose output: • 0 = None • 1 = Deadman Indicator • 2 = Deadman Bell • 3 = Deadman Callout • 4 = System Alarm • 5 = Device Alarm • 6 = Bay Active • 7 = ESD • 8 = Pump Demand • 9 = Isolation Valve (Range: Stream 1 to max available on system) • 10 = DCV Inlet (Range: Stream 1 to max available on system) • 11 = DCV Outlet (Range: Stream 1 to max available on system) • 12 = Additive Pulse Prod • 13 = Int. Additive Pulse 1 • 14 = Int. Additive Pulse 2 • 15 = Int. Additive Pulse 3 • 16 = Int. Additive Pulse 4 • 17 = Int. Additive Pulse 5 • 18 = Int. Additive Pulse 6

OPC Item	Access Type	Data Type	Range	Description
				• 19 = Additive Pump Demand 1 (Range: Stream 1 to max available on system) • 20 = Additive Pump Demand 2 (Range: Stream 1 to max available on system) • 21 = Additive Pump Demand 3 (Range: Stream 1 to max available on system) • 22 = Additive Pump Demand 4 (Range: Stream 1 to max available on system) • 23 = Additive Pump Demand 5 (Range: Stream 1 to max available on system) • 24 = Additive Pump Demand 6 (Range: Stream 1 to max available on system) • 25 = RIT Red (Range: Arm 1 to max available on system)
				• 26 = RIT Amber (Range: Arm 1 to max available on system) • 27 = RIT Green (Range: Arm 1 to max available on system)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GO.OutputType	R	VT_UI2		Output type assigned to the requested general purpose output: • 0 = None • 1= Alarm output • 2 = Stream Control output • 3 = Control valve output • 4 = Additive output • 5 = Internal additive output • 6 = RIT output
[B].[D].GO.Status	R	VT_UI2		General purpose output status: • 0 = Inactive • 1 = Active

13.4.15 Injector Accumulative Total - IA

TAS/OPC client can retrieve the accumulative total for a specific additive injector by issuing the IA command.

> NOTE: The IA command can only be used while the instrument is in the idle state.

There are two options:

- Option 1 - Retrieving the accumulative total for a specific additive injector (see section 13.4.15.1)
- Option 2 - Retrieving the accumulative total for a specific loading arm (see section 13.4.15.2)

13.4.15.1 Option 1

The following table lists the OPC items for the IA command, whereby the accumulative total for a specific additive injector are retrieved.

Table 13-48: OPC items for IA command - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IA.1.InjNum	RW	VT_UI2		Additive injector number (Range: 1 to 24, 1 to 18 are used for external additive, 19 to 24 are used for internal additives)
[B].[D].IA.1.FetchIA	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].IA.1.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].IA.1.TotalVol	R	VT_R8		Additive total [litres/gallons]

13.4.15.2 Option 2

The following table lists the OPC items for the IA command, whereby the accumulative total for a specific loading arm is retrieved.

> NOTE: In the OPC items listed in TABLE 13-49 [n] indicates the loading arm number and can be 1 to 4.

Table 13-49: OPC items for IA Command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IA.2.A[n].FetchIA	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IA.2.A[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].IA.2.A[n].ArmNum	R	VT_UI2		Arm number
[B].[D].IA.2.A [n].Injector1AdditiveTotal	R	VT_R8		Injector point 1 additive accumulated total
[B].[D].IA.2.A [n].Injector2AdditiveTotal	R	VT_R8		Injector point 2 additive accumulated total
[B].[D].IA.2.A [n].Injector3AdditiveTotal	R	VT_R8		Injector point 3 additive accumulated total
[B].[D].IA.2.A [n].Injector4AdditiveTotal	R	VT_R8		Injector point 4 additive accumulated total
[B].[D].IA.2.A [n].Injector5AdditiveTotal	R	VT_R8		Injector point 5 additive accumulated total
[B].[D].IA.2.A [n].Injector6AdditiveTotal	R	VT_R8		Injector point 6 additive accumulated total

13.4.16 General Purpose Input Status - IS

TAS/OPC client can retrieve the current status as well as the latched status since the last CL command for all inputs of the device by issuing the IS command.

The following table lists the OPC items for the IS command.

Table 13-50: OPC items for IS Command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.FetchIS	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].IS.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].IS.GeneralPurposeInputCA20ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CA20
[B].[D].IS.GeneralPurposeInputCA20ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CA20

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCA20CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CA20
[B].[D].IS.GeneralPurposeInputCA21ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CA21
[B].[D].IS.GeneralPurposeInputCA21ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CA21
[B].[D].IS.GeneralPurposeInputCA21CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CA21

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCA22ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CA22
[B].[D].IS.GeneralPurposeInputCA22ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CA22
[B].[D].IS.GeneralPurposeInputCA22CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CA22
[B].[D].IS.GeneralPurposeInputCA23ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CA23

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCA23ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CA23
[B].[D].IS.GeneralPurposeInputCA23CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CA23
[B].[D].IS.GeneralPurposeInputCA25ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CA25
[B].[D].IS.GeneralPurposeInputCA25ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CA25

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCA25CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CA25
[B].[D].IS.GeneralPurposeInputCA26ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CA26
[B].[D].IS.GeneralPurposeInputCA26ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CA26
[B].[D].IS.GeneralPurposeInputCA26CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CA26

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCA27ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CA27
[B].[D].IS.GeneralPurposeInputCA27ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CA27
[B]. [D].IS.GeneralPurposeInputCA27CurrentStatus	R	VT_ BOOL		General purpose input current status byte for inputs CA27
[B].[D].IS.GeneralPurposeInputCA28ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CA28

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCA28ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CA28
[B]. [D].IS.GeneralPurposeInputCA28CurrentStatus	R	VT_ BOOL		General purpose input current status byte for inputs CA28
[B].[D].IS.GeneralPurposeInputCB20ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CB20
[B].[D].IS.GeneralPurposeInputCB20ActiveLow	R	VT_ BOOL		General purpose input latched (active low status byte for inputs CB20

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCB20CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CB20
[B].[D].IS.GeneralPurposeInputCB21ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CB21
[B].[D].IS.GeneralPurposeInputCB21ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CB21
[B].[D].IS.GeneralPurposeInputCB21CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CB21

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCB22ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CB22
[B].[D].IS.GeneralPurposeInputCB22ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CB22
[B]. [D].IS.GeneralPurposeInputCB22CurrentStatus	R	VT_ BOOL		General purpose input current status byte for inputs CB22
[B].[D].IS.GeneralPurposeInputCB23ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CB23

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCB23ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CB23
[B]. [D].IS.GeneralPurposeInputCB23CurrentStatus	R	VT_ BOOL		General purpose input current status byte for inputs CB23
[B].[D].IS.GeneralPurposeInputCB25ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CB25
[B].[D].IS.GeneralPurposeInputCB25ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CB25

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCB25CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CB25
[B].[D].IS.GeneralPurposeInputCB26ActiveHigh	R	VT_BOOL		General purpose input latched (active high) status byte for inputs CB26
[B].[D].IS.GeneralPurposeInputCB26ActiveLow	R	VT_BOOL		General purpose input latched (active low) status byte for inputs CB26
[B].[D].IS.GeneralPurposeInputCB26CurrentStatus	R	VT_BOOL		General purpose input current status byte for inputs CB26

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCB27ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CB27
[B].[D].IS.GeneralPurposeInputCB27ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CB27
[B]. [D].IS.GeneralPurposeInputCB27CurrentStatus	R	VT_ BOOL		General purpose input current status byte for inputs CB27
[B].[D].IS.GeneralPurposeInputCB28ActiveHigh	R	VT_ BOOL		General purpose input latched (active high) status byte for inputs CB28

OPC Item	Access Type	Data Type	Range	Description
[B].[D].IS.GeneralPurposeInputCB28ActiveLow	R	VT_ BOOL		General purpose input latched (active low) status byte for inputs CB28
[B]. [D].IS.GeneralPurposeInputCB28CurrentStatus	R	VT_ BOOL		General purpose input current status byte for inputs CB28

13.4.17 Loading Arm Information - LA

TAS/OPC client can send the loading arm information from the computer to the device by issuing the LA command.

> NOTE: The LA command can only be issued while the device is in the LA state.

The following table lists the OPC items for the LA command.

Table 13-51: OPC items for LA Command

OPC Item	Access Type	Data Type	Range	Description
[B]. [D].LA.ArmNum	RW	VT_UI2		Arm number
[B]. [D].LA.CompNum	RW	VT_UI2		Compartment number (Range: 1 to 99)
[B].[D].LA.WriteLA	RW	VT_UI2	1	Write command flag (1 = Write)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].LA.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].LA.LoadNum	R	VT_BSTR		Load number

13.4.18 Alter Meter Name - MN

TAS/OPC client can alter the name of a flow meter issuing the MN command to the device.

The following table lists the OPC items for the MN command.

Table 13-52: OPC items for MN Command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].MN.MeterNum	RW	VT_UI2	1 to 4	Meter number (Range: 1 to 4)
[B].[D].MN.MeterName	RW	VT_BSTR		Meter name
[B].[D].MN.WriteMN	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].MN.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.19 Manager Reset - MR

TAS/OPC client can perform a manager reset by issuing the MR command. Execution of the command has the same effect as a manual manager reset performed by entering the manager password into the device.

The command clears the following:

- Authorisation lockout due to illegal access attempts exceeding the programmed value
- Temperature and pressure fault alarms on all loading arms
- Dual pulse fault alarms on all loading arms
- Phase error alarms on all loading arms
- Emergency Stop condition
- Error for programmable inputs with loading effect set to Manager Reset

The following table lists the OPC items for the MR command.

Table 13-53: OPC items for the MR command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].MR.WriteMR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].MR.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.20 Flow Meter Settings - MS

TAS/OPC client can retrieve the settings for a specific flow meter by issuing the MS command.

> NOTE: The MS command can only used while the device is in the idle state.

The following table lists the OPC items for the MS command.

> NOTE: In the OPC items listed in the following table, [n] indicates the flow meter number and can be 1 to 4.

Table 13-54: OPC items for MS command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].MS.[n].FetchMS	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].MS.[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].MS.[n].CalibrationDate	R	VT_BSTR		Calibration date
[B].[D].MS.[n].CalibrationNum	R	VT_BSTR		Calibration number
[B].[D].MS.[n].CalibrationTime	R	VT_BSTR		Calibration time
[B].[D].MS.[n].CutOffFrequency	R	VT_R4		Cut off frequency for dual pulse or 0 for single pulse
[B].[D].MS.[n].Frequency1	R	VT_R4		First frequency for non-linear or k-factor if linear
[B].[D].MS.[n].Frequency2	R	VT_R4		Second frequency for non-linear or k-factor if linear
[B].[D].MS.[n].Frequency3	R	VT_R4		Third frequency for non-linear or k-factor if linear
[B].[D].MS.[n].Frequency4	R	VT_R4		Fourth frequency for non-linear or k-factor if linear

OPC Item	Access Type	Data Type	Range	Description
[B].[D].MS.[n].Frequency5	R	VT_R4		Fifth frequency for non-linear or k-factor if linear
[B].[D].MS.[n].IPFilter	R	VT_UI2		Flow meter input filter
[B].[D].MS.[n].IPResistor	R	VT_UI2		Flow meter input resistor
[B].[D].MS.[n].KFactor1	R	VT_R4		First k-factor for non-linear
[B].[D].MS.[n].KFactor2	R	VT_R4		Second k-factor for non-linear
[B].[D].MS.[n].KFactor3	R	VT_R4		Third k-factor for non-linear
[B].[D].MS.[n].KFactor4	R	VT_R4		Fourth k-factor for non-linear
[B].[D].MS.[n].KFactor5	R	VT_R4		Fifth k-factor for non-linear
[B].[D].MS.[n].KFactorType	R	VT_BSTR		Linear or non-linear k-factor
[B].[D].MS.[n].MeterFactor	R	VT_R4		Meter factor
[B].[D].MS.[n].MeterName	R	VT_BSTR		Meter name
[B].[D].MS.[n].MeterNum	R	VT_UI2		Meter number
[B].[D].MS.[n].MinLinearFlowrate	R	VT_R4		Minimum linear flow rate
[B].[D].MS.[n].MinPreset	R	VT_R4		Minimum preset amount
[B].[D].MS.[n].NLKFactorNum	R	VT_UI2		Number of non-linear k-factors or 0 if linear k-factor

OPC Item	Access Type	Data Type	Range	Description
[B].[D].MS.[n].OverRunQty	R	VT_R4		Overrun quantity
[B].[D].MS.[n].PulseType	R	VT_BSTR		Single or dual pulse
[B].[D].MS.[n].UnauthorisedThresholdFlow	R	VT_R4		Unauthorized flow threshold

13.4.21 Preset - PR

TAS/OPC client can retrieve the minimum presets by issuing the PR command to the device.

There are two options:

- Option 1 - Retrieving the minimum preset for all loading arms (see section 13.4.21.1)
- Option 2 - Retrieving the minimum preset for a specific flow meter (see section 13.4.21.2)

13.4.21.1 Option 1 - Minimum Preset for All Loading Arms

The following table lists the OPC items for the PR command, whereby the minimum preset for all loading arms is retrieved.

Table 13-55: OPC items for PR command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].PR.1.FetchPR	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].PR.1.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].PR.1.A1Preset	R	VT_R4		Preset of first arm
[B].[D].PR.1.A2Preset	R	VT_R4		Preset of second arm
[B].[D].PR.1.A3Preset	R	VT_R4		Preset of third arm
[B].[D].PR.1.A4Preset	R	VT_R4		Preset of fourth arm
[B].[D].PR.1.BayNum	R	VT_UI2		Bay number
[B].[D].PR.1.FirstArmNum	R	VT_UI2		First arm number
[B].[D].PR.1.TotalArms	R	VT_UI2		Number of arms

13.4.21.2 Option 2 - Minimum Preset for Flow Meter

The following table lists the OPC items for the PR command, whereby the minimum preset for a flow meter is retrieved.

> NOTE: In the OPC items listed in the following table [n] indicates the flow meter number and can be 1 to 4.

Table 13-56: OPC items for PR command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].PR.M[n].FetchPR	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].PR.M[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].PR.M[n].Preset	R	VT_R4		Preset for the meter

13.4.22 Reset Date and Time - RD

TAS/OPC client can set the device's date and time by issuing the RD command to the device.

> NOTE: The RD command can only be used while the device is in the idle state.

The following table lists the OPC items for the RD command.

Table 13-57: OPC items for RD command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].RD.Date	RW	VT_BSTR		Device's date [ddmmyyyy]
[B].[D].RD.Time	RW	VT_BSTR		Device's time [hhmmss]
[B].[D].RD.WriteRD	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].RD.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.23 Set RIT Lamps - SL

TAS/OPC client can set the condition of the RIT lamps by updating the following OPC items with the required value, and by subsequently issuing the SL command.

The following table lists the OPC items for the SL command.

Table 13-58: OPC items for SL command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SL.A1FlashGreen	RW	VT_BOOL		Arm 1 Flash Green
[B].[D].SL.A1FlashRed	RW	VT_BOOL		Arm 1 Flash Red
[B].[D].SL.A1FlashYellow	RW	VT_BOOL		Arm 1 Flash Yellow
[B].[D].SL.A1Spare1	R	VT_BOOL		Arm 1 Spare1
[B].[D].SL.A1Spare2	R	VT_BOOL		Arm 1 Spare2
[B].[D].SL.A1SteadyGreen	RW	VT_BOOL		Arm 1 Steady Green
[B].[D].SL.A1SteadyRed	RW	VT_BOOL		Arm 1 Steady Red
[B].[D].SL.A1SteadyYellow	RW	VT_BOOL		Arm 1 Steady Yellow
[B].[D].SL.A2FlashGreen	RW	VT_BOOL		Arm 2 Flash Green
[B].[D].SL.A2FlashRed	RW	VT_BOOL		Arm 2 Flash Red
[B].[D].SL.A2FlashYellow	RW	VT_BOOL		Arm 2 Flash Yellow
[B].[D].SL.A2Spare1	R	VT_BOOL		Arm 2 Spare1
[B].[D].SL.A2Spare2	R	VT_BOOL		Arm 2 Spare2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SL.A2SteadyGreen	RW	VT_BOOL		Arm 2 Steady Green
[B].[D].SL.A2SteadyRed	RW	VT_BOOL		Arm 2 Steady Red
[B].[D].SL.A2SteadyYellow	RW	VT_BOOL		Arm 2 Steady Yellow
[B].[D].SL.WriteSL	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].SL.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.24 Stop Arm - SM

TAS/OPC client can stop or pause the load/batch on a particular loading arm by issuing the SM command to the device.

The following table lists the OPC items for the SM command.

Table 13-59: OPC items for SM command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SM.ArmNum	RW	VT_UI2		Arm number
[B].[D].SM.WriteSM	RW	VT_UI2	1	Write command flag (1 = Write)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SM.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.25 System Options - SO

TAS/OPC client can retrieve the user configuration settings of the SYSTEM set-up menu by issuing the SO command to the device.

> NOTE: The SO command can only be used while the device is in the idle state.

The following table lists the OPC items for the CO command.

Table 13-60: OPC Items for SO command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SO.FetchSO	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].SO.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].SO.BaseTemperature	R	VT_BSTR		Base temperature
[B].[D].SO.BatchType	R	VT_BSTR		Batch type: NET or GROSS
[B].[D].SO.BayNum	R	VT_UI2		Bay number

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SO.ClearTime	R	VT_R4		Clear/reconnect time [seconds]
[B].[D].SO.EntryTimeout	R	VT_R4		Entry timeout [seconds]
[B].[D].SO.FirstArmNum	R	VT_UI2		First arm number
[B].[D].SO.HWTest8Key	R	VT_UI2		Hardware test via 8 key
[B].[D].SO.InitMsg	R	VT_BSTR		Initial message
[B].[D].SO.LangOption	R	VT_BSTR		Language option
[B].[D].SO.LitSpelling	R	VT_BSTR		Litre/liter spelling
[B].[D].SO.MasIdTASOvrRide	R	VT_UI2		Client ID TAS override
[B].[D].SO.clientAuth	R	VT_BSTR		Client authorisation
[B].[D].SO.PersAuth	R	VT_BSTR		Personnel authorisation
[B].[D].SO.SysUnits	R	VT_BSTR		System units
[B].[D].SO.TotalArms	R	VT_UI2		Number of arms
[B].[D].SO.VehAuth	R	VT_BSTR		Vehicle authorisation
[B].[D].SO.VolDec	R	VT_R4		Volume decimals

13.4.26 Send Transaction - ST

Loading information for each vehicle is stored in two sections in the devices. The two sections are called TRANSACTION and BATCH. The transaction contains information about the load that is common to all the compartments loaded, for example personnel, vehicle, date, start time, load number and so on. The batch information contains information for each compartment that the device has attempted to load, for example compartment number, arm number, preset quantity, gross loaded and so on.

TAS/OPC client can retrieve a transaction by issuing the ST command.

> NOTE: The ST command can only be used while the device is in the idle state.

The following table lists the OPC items for the ST command.

Table 13-61: OPC Items for ST command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].ST.TransNum	RW	VT_UI2		Transaction number
[B].[D].ST.FetchST	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].ST.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].ST.BayNum	R	VT_UI2		Bay number
[B].[D].ST.CalibNum	R	VT_BSTR		Calibration number
[B].[D].ST.FirstArmNum	R	VT_UI2		First arm number
[B].[D].ST.LoadNum	R	VT_UI4		Load number
[B].[D].ST.clientIndex	R	VT_BSTR		client index
[B].[D].ST.PerIndex	R	VT_BSTR		Personnel index
[B].[D].ST.PowCycCount	R	VT_UI2		Power cycle count
[B].[D].ST.RefNum	R	VT_BSTR		Reference number
[B].[D].ST.Result	R	VT_BSTR		Checksum result
[B].[D].ST.StartBatch	R	VT_UI2		Batch start
[B].[D].ST.StartDate	R	VT_BSTR		Date start
[B].[D].ST.StartTime	R	VT_BSTR		Start time [in hh:mm:ss format]
[B].[D].ST.StopBatch	R	VT_UI2		Batch stop
[B].[D].ST.StopTime	R	VT_BSTR		Stop time [in hh:mm:ss format]
[B].[D].ST.TASMode	R	VT_UI2		Communication mode

OPC Item	Access Type	Data Type	Range	Description
[B].[D].ST.TotalArms	R	VT_UI2		Number of arms
[B].[D].ST.UniqueNum	R	VT_UI4		Unique number
[B].[D].ST.UnitAddress	R	VT_UI2		Unit address
[B].[D].ST.VehIndex	R	VT_BSTR		Vehicle index

13.4.27 Software Version - SV

TAS/OPC client can retrieve the device's software version number and the date and time the library was last modified by issuing the SV command.

> NOTE: The SV command can only be used while the device is in the idle mode.

The following table lists the OPC items for the SV command.

Table 13-62: OPC Items for SV command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SV.FetchSV	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].SV.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].SV.AppVersion	R	VT_BSTR		Application Version number
[B].[D].SV.Date	R	VT_BSTR		Date [in dd:mm:yyyy format]
[B].[D].SV.DisplayType	R	VT_BSTR		Display type: GRAPHIC
[B].[D].SV.ROMSize	R	VT_UI2		Flash ROM size

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SV.ROMType	R	VT_BSTR		ROM Type: FLASH
[B].[D].SV.Time	R	VT_BSTR		Time [in hh:mm:ss format]

13.4.28 Send Batch - SY

Loading information for each vehicle is stored in two sections in the devices. The two sections are called TRANSACTION and BATCH. The transaction contains information about the load that is common to all the compartments loaded, for example personnel, vehicle, date, start time, load number and so on. The batch information contains information for each compartment that the device has attempted to load, for example compartment number, arm number, preset quantity, gross loaded and so on.

TAS/OPC client can retrieve an individual batch, representing a single compartment load by uploading the following OPC items with the required value, and by subsequently issuing the SY command.

There may be up to 20 of these batches per transaction. There are four options:

- Option 1 - Retrieving the batch information for a loading arm (see section 13.4.28.1)
- Option 2 - Retrieving the batch information for a base flow meter (see section 13.4.28.2)
- Option 3 - Retrieving the batch information for a blend flow meter (see section 13.4.28.3)
- Option 4 - Retrieving the batch information for a additive injector (see section 13.4.28.4)

> NOTE: The SY command can only be used while the device is in the idle state.

13.4.28.1 Option 1

The following table lists the OPC items for the SY command, whereby the batch information for a particular loading arm is retrieved.

Table 13-63: OPC items for SY command - Option 1

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.AA.BatchNum	RW	VT_UI2		Batch number
[B].[D].SY.AA.FetchSY	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].SY.AA.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].SY.AA.ArmNum	R	VT_UI2		Arm number
[B].[D].SY.AA.BlendAccy	R	VT_UI2		Blend accuracY: • 0 = No fault • 1 = High Alarm • 2 = Low Alarm
[B].[D].SY.AA.BlendType	R	VT_UI2		Blend type
[B].[D].SY.AA.CompNum	R	VT_UI2		Compartment number
[B].[D].SY.AA.Error	R	VT_BSTR		Error status
[B].[D].SY.AA.Preset	R	VT_R4		Preset quantity
[B].[D].SY.AA.ReceipeNum	R	VT_UI2		Recipe number
[B].[D].SY.AA.Result	R	VT_BSTR		Checksum result
[B].[D].SY.AA.RetQty	R	VT_R4		Returned quantity
[B].[D].SY.AA.StartTime	R	VT_BSTR		Start time [in hh:mm:ss format]
[B].[D].SY.AA.StopTime	R	VT_BSTR		Stop time [in hh:mm:ss format]

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.AA.TransNum	R	VT_UI2		Transaction number
[B].[D].SY.AA.Units	R	VT_BSTR		Units setting

13.4.28.2 Option 2

The following table lists the OPC items for the SY command, whereby the batch information for a particular base flow meter is retrieved.

Table 13-64: OPC items for SY command - Option 2

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.M1.BatchNum	RW	VT_UI2		Batch number
[B].[D].SY.M1.FetchSY	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].SY.M1.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].SY.M1.Commodity	R	VT_UI2		Commodity setting • 0 = NONE • 1 = CRUDE OILS (A) • 2 = REFINED (B) • 3 = SPECIAL (C) • 4 = LUBE OILS (D) • 5 = NGL AND LPG (E) • 6 = FAME (F)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.M1.DensFWA	R	VT_R4		Product meter calculated density at meter flow weighted average
[B].[D].SY.M1.Error	R	VT_BSTR		Error status
[B].[D].SY.M1.ExpCoeff	R	VT_R4		Expansion co-efficient/Thermal expansion factor
[B].[D].SY.M1.GOV	R	VT_R4		Loaded Gross Observed Volume through product meter
[B].[D].SY.M1.GOVaccAft	R	VT_R8		Product meter Accumulative Total Gross Observed Volume before batch
[B].[D].SY.M1.GOVaccBef	R	VT_R8		Product meter Accumulative Total Gross Observed Volume after batch
[B].[D].SY.M1.GSV	R	VT_R4		Loaded Gross Standard Volume through product meter
[B].[D].SY.M1.GSVaccAft	R	VT_R8		Product meter Accumulative Total Gross Standard Volume before batch
[B].[D].SY.M1.GSVaccBef	R	VT_R8		Product meter Accumulative Total Gross Standard Volume after batch
[B].[D].SY.M1.MeterNum	R	VT_UI2		Meter number
[B].[D].SY.M1.Preset	R	VT_R4		Meter preset
[B].[D].SY.M1.PressFWA	R	VT_R4		Product meter batch pressure flow weighted average
[B].[D].SY.M1.ProdDensObs	R	VT_R4		Product meter product observed density
[B].[D].SY.M1.Result	R	VT_BSTR		Checksum result

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.M1.TempFWA	R	VT_R4		Product meter batch temperature flow weighted average
[B].[D].SY.M1.TransNum	R	VT_UI2		Transaction number

13.4.28.3 Option 3

The following table lists the OPC items for the SY command, whereby the batch information for a particular blend flow meter is retrieved.

Table 13-65: OPC items for SY command - Option 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.M2.BatchNum	RW	VT_UI2		Batch number
[B].[D].SY.M2.FetchSY	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].SY.M2.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.M2.Commodity	R	VT_UI2		Commodity setting 0 = NONE 1 = CRUDE OILS (A) 2 = REFINED (B) 3 = SPECIAL (C) 4 = LUBE OILS (D) 5 = NGL AND LPG (E) 6 = FAME (F)
[B].[D].SY.M2.DensFWA	R	VT_R4		Blend Meter batch flow weighted average density
[B].[D].SY.M2.Error	R	VT_BSTR		Error status
[B].[D].SY.M2.ExpCoeff	R	VT_R4		Expansion co-efficient/Thermal expansion factor
[B].[D].SY.M2.GOV	R	VT_R4		Loaded gross observed volume through blend meter
[B].[D].SY.M2.GOVaccAft	R	VT_R4		Blend meter accumulative total gross observed volume after batch
[B].[D].SY.M2.GOVaccBef	R	VT_R4		Blend meter accumulative total gross observed volume before batch
[B].[D].SY.M2.GSV	R	VT_R4		Loaded gross standard volume through blend meter
[B].[D].SY.M2.GSVaccAft	R	VT_R4		Blend meter accumulative total gross standard volume after batch
[B].[D].SY.M2.GSVaccBef	R	VT_R4		Blend meter accumulative total gross standard volume before batch

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.M2.MeterNum	R	VT_UI2		Meter number
[B].[D].SY.M2.Preset	R	VT_R4		Meter preset
[B].[D].SY.M2.PressFWA	R	VT_R4		Blend meter batch flow weighted average pressure
[B].[D].SY.M2.ProdDensObs	R	VT_R4		Blend meter product observed density
[B].[D].SY.M2.Result	R	VT_BSTR		Checksum result
[B].[D].SY.M2.TempFWA	R	VT_R4		Blend meter batch flow weighted average temperature
[B].[D].SY.M2.TransNum	R	VT_UI2		Transaction number

13.4.28.4 Option 4

The following table lists the OPC items for the SY command, whereby the batch information for a particular additive injector is retrieved.

Table 13-66: OPC items for SY command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.IV.BatchNum	RW	VT_UI2		Batch number
[B].[D].SY.IV.FetchSY	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].SY.IV.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].SY.IV.Line1Qty	R	VT_R4		Quantity line 1
[B].[D].SY.IV.Line2Qty	R	VT_R4		Quantity line 2
[B].[D].SY.IV.Line3Qty	R	VT_R4		Quantity line 3
[B].[D].SY.IV.Line4Qty	R	VT_R4		Quantity line 4
[B].[D].SY.IV.Line5Qty	R	VT_R4		Quantity line 5
[B].[D].SY.IV.Line6Qty	R	VT_R4		Quantity line 6
[B].[D].SY.IV.Result	R	VT_BSTR		Checksum result: FAULT or OK
[B].[D].SY.IV.TransNum	R	VT_UI2		Transaction number

13.4.29 Type of Loading Arm - TA

TAS/OPC client can retrieve the type of loading arm and the number of flow meters associated with that loading arm by issuing the TA command.

> NOTE: The TA command can only be used while the device is in the idle state.

The following table lists the OPC items for the TA command.

> NOTE: In the OPC items listed in the following table [n] indicates the loading arm number and can be 1 to 4.

Table 13-67: OPC items for TA command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TA.[n].FetchTA	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].TA.[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].TA.[n].ArmNum	R	VT_UI2		Arm number
[B].[D].TA.[n].ArmType	R	VT_UI2		Arm type
[B].[D].TA.[n].BaseMeterNum	R	VT_UI2		Base meter number
[B].[D].TA.[n].TotalMeters	R	VT_UI2		Number of meters

13.4.30 Blend Target and Ratio - TB

TAS/OPC client can retrieve the blend target and ratio for all loading arms by issuing the TB command.

The following table lists the OPC items for the TB command.

Table 13-68: OPC items for TB command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TB.FetchTB	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TB.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].TB.A1CurrentRatio	R	VT_R4		Current ratio for first arm
[B].[D].TB.A1TargetRatio	R	VT_R4		Target ratio for first arm
[B].[D].TB.A2CurrentRatio	R	VT_R4		Current ratio for second arm
[B].[D].TB.A2TargetRatio	R	VT_R4		Target ratio for second arm
[B].[D].TB.BayNum	R	VT_UI2		Bay number
[B].[D].TB.FirstArmNum	R	VT_UI2		First arm number
[B].[D].TB.TotalArms	R	VT_UI2		Number of arms

13.4.31 Actual and Current Target Flow - TF

TAS/OPC client can retrieve the actual and current target flow rates for all loading arms or for a particular flow meter by issuing the TF command.

13.4.31.1 Actual and Current Target Flow for All Loading Arms

The following table lists the OPC items for the TF command, whereby the actual and current target flows for all loading arms are retrieved.

Table 13-69: OPC items for TF command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TF.1.FetchTF	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].TF.1.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].TF.1.A1FlowRate	R	VT_R4		Flow rate for first arm
[B].[D].TF.1.A1TargetFlowRate	R	VT_R4		Current target flow rate for first arm
[B].[D].TF.1.A2FlowRate	R	VT_R4		Flow rate for second arm
[B].[D].TF.1.A2TargetFlowRate	R	VT_R4		Current target flow rate for second arm
[B].[D].TF.1.A3FlowRate	R	VT_R4		Flow rate for third arm
[B].[D].TF.1.A3TargetFlowRate	R	VT_R4		Current target flow rate for third arm
[B].[D].TF.1.A4FlowRate	R	VT_R4		Flow rate for fourth arm
[B].[D].TF.1.A4TargetFlowRate	R	VT_R4		Current target flow rate for fourth arm
[B].[D].TF.1.BayNum	R	VT_UI2		Bay number
[B].[D].TF.1.FirstArmNum	R	VT_UI2		First arm number
[B].[D].TF.1.TotalArms	R	VT_UI2		Number of arms

13.4.31.2 Actual and Current Target Flow for Particular Flow Meter

The following table lists the OPC items for the TF command, whereby the actual and current target flows for a particular flow meter are retrieved.

> NOTE: In the OPC items listed in TABLE 13-56 [n] indicates the flow meter number and can be 1 to 4.

Table 13-70: OPC items for TF command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TF.M[n].FetchTF	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].TF.M[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].TF.M[n].FlowRate	R	VT_R4		Flow rate for first arm
[B].[D].TF.M [n].TargetFlowRate	R	VT_R4		Current target flow rate for first arm

13.4.32 Type of Instrument - TI

TAS/OPC client can retrieve the type of the device by issuing the TI command.

> NOTE: The TI command can only be used while the device is in the idle state.

The following table lists the OPC items for the TI command.

Table 13-71: OPC items for TI command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TI.FetchTI	RW	VT_ UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TI.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].TI.AnalogOP	R	VT_UI2		4-20 mA outputs available
[B].[D].TI.InstCode	R	VT_BSTR		Device code
[B].[D].TI.RIT	R	VT_UI2		RIT panel
[B].[D].TI.TotalArms	R	VT_UI2		Number of arms
[B].[D].TI.TotalCOMPorts	R	VT_UI2		Number of communications ports
[B].[D].TI.TotalInternalAdditiveInjectors	R	VT_UI2		Number of internal additive injectors
[B].[D].TI.TotalMeters	R	VT_UI2		Number of flow meters

13.4.33 Terminate Transaction - TT

TAS/OPC client can stop a transaction that is currently in progress on the device by issuing the TT command. The command remotely stops a transaction on the device by removing authorisation and forcing it to the disconnect prompt.

> NOTE: The TT command can only be used while the transaction is in progress.

The following table lists the OPC items for the TT command.

Table 13-72: OPC items for TT command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].TT.WriteTT	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].TT.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.34 Volume Correction Factor - VC

TAS/OPC client can retrieve the volume correction factor (Correction Temperature Pressure Liquid) for all flow meters from the device by issuing the VC command.

The following table lists the OPC items for the VC command.

Table 13-73: OPC items for VC command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].VC.FetchVC	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].VC.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].VC.BayNum	R	VT_UI2		Bay number
[B].[D].VC.FirstMeterNum	R	VT_UI2		Number of first flow meter
[B].[D].VC.M1VCFactor	R	VT_R4		Volume correction factor (CTPL) for first flow meter.

OPC Item	Access Type	Data Type	Range	Description
[B].[D].VC.M2VCFactor	R	VT_R4		Volume correction factor (CTPL) for second flow meter.
[B].[D].VC.M3VCFactor	R	VT_R4		Volume correction factor (CTPL) for third flow meter.
[B].[D].VC.M4VCFactor	R	VT_R4		Volume correction factor (CTPL) for fourth flow meter.
[B].[D].VC.TotalMeters	R	VT_UI2		Number of flow meters

13.4.35 Displaying Messages and Getting Answers

TAS/OPC client can send text messages to the device to inform or prompt the operator, by issuing one of the following commands:

- Display message - DM (see section 13.4.35.3)
- Display prompt - DP (see section 13.4.35.4)
- Get answer - GA (see section 13.4.35.5)
- Get hidden answer - GH (see section 13.4.35.6)
- Get touch key - GK (see section 13.4.35.7)
- Get Nexwatch card - GN (see section 13.4.35.8)
- Get RF ID (GR) (see section 13.4.35.9)
- Clear message - CM (see section 13.4.35.10)

13.4.35.1 Justify Character Options

The commands all have a similar structure and involve the use of a justification character to set the spacing on each line. The justify character is the first character of each parameter of the command.

The justify character options are listed in the following table.

Table 13-74: Justify Character Options

Justify Character	Description
|	Centre justified (vertical bar,7CH)
_	Left justified (underscore, 5FH)
+	Right justified (plus, 2BH)
0 to 30	A number between 0 and 30 in the justify field will justify the text that number of spaces from the left (must be two characters, i.e. 03 for 3 spaces).

13.4.35.2 Message Options

The device has an 8 line x 30 character display. However, because meter totals must remain on the screen at most times it is not always possible to display 8 lines. A message of 8 lines can be displayed only during the idle, RA or RL state. Load Scheduling mode messages can be displayed only during the idle, RA, RC, and PL states. In RC and PL states the device can display messages of only two lines. These two line messages are displayed on the bottom two lines of the display. Two line messages should contain either '-1' or '-2' for the first six line parameters.

The message options are listed in the following table.

Table 13-75: Message Options

Message Option	Description
-1	Leave line as is (if previous message still being displayed)
-2	Clear line (if previous message still being displayed)

13.4.35.3 Display Message - DM

The Display Message (DM) command allows TAS/OPC client to display a message on the device without requiring a response from the operator.

After the device received the DM command, the response of the device to the ENQ command is DM.

After using the DM command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command.

The DM command can only be used for full screen messaging when the device is in the idle, RA or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The following table lists the OPC items for the DM command.

Table 13-76: OPC Items for Display Message (DM) Command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].DM.Line1	RW	VT_BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].DM.Line2	RW	VT_BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].DM.Line3	RW	VT_BSTR	0 to 33	Text + display parameter line 3
[B].[D].DM.Line4	RW	VT_BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].DM.Line5	RW	VT_BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].DM.Line6	RW	VT_BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].DM.Line7	RW	VT_BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)
[B].[D].DM.Line8	RW	VT_BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)
[B].[D].DM.WriteDM	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].DM.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.4 Display Prompt - DP

The Display Prompt (DP) command allows TAS/OPC client to display a message on the device prompting the operator to press the Enter/Yes key.

After the device received the DP command, the response of the device to the ENQ command is DP. After the operator answers the message, the device displays 'PLEASE WAIT'. The response of the device to the ENQ command from the computer is MT (Message Taken).

After using the DP command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command. To automatically clear the message, TAS/OPC client can send an automatic timeout period as part of the DP command.

The DP command can only be used for full screen messaging when the device is in the idle, AR, PL, RA, RC or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The followig table lists the OPC items for the DP command.

Table 13-77: OPC items for Display Prompt (DP) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].DP.Line1	RW	VT_BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].DP.Line2	RW	VT_BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].DP.Line3	RW	VT_BSTR	0 to 33	Text + display parameter line 3
[B].[D].DP.Line4	RW	VT_BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].DP.Line5	RW	VT_BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].DP.Line6	RW	VT_BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].DP.Line7	RW	VT_BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].DP.Line8	RW	VT_ BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)
[B]. [D].DP.MsgTimeout	RW	VT_UI2		Message timeout [seconds]
[B].[D].DP.WriteDP	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].DP.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.5 Get Answer GA

The Get Answer GA command allows TAS/OPC client to display a message on the device prompting the operator enter an answer. The operator must answer by either entering a number and pressing Enter, or by pressing the Yes, No, Display, ALPHA/LINE, or START keys.

After the device receives the GA command, the response of the device to the ENQ command is GA. After the operator answers the message, the device displays 'PLEASE WAIT'. The response of the device to the ENQ command from the computer is AA (Answer Available).

After using the GA command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command.

The GA command can only be used for full screen messaging when the device is in the idle, AR, PL, RA, RC or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The following table lists the OPC items for the GA command.

Table 13-78: OPC items for Get Answer (GA) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GA.Line1	RW	VT_ BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].GA.Line2	RW	VT_ BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].GA.Line3	RW	VT_ BSTR	0 to 33	Text + display parameter line 3
[B].[D].GA.Line4	RW	VT_ BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].GA.Line5	RW	VT_ BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].GA.Line6	RW	VT_ BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].GA.Line7	RW	VT_ BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)
[B].[D].GA.Line8	RW	VT_ BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)
[B]. [D].GA.WriteGA	RW	VT_UI2	1	Write command flag (1 = Write)
[B]. [D].GA.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.6 Get Hidden - GH

The Get Hidden (GH) command allows TAS/OPC client to display a message on the display of the device prompting the operator enter a PIN or password. The operator must answer by either entering a number and pressing Enter, or by pressing the Yes, No, Display, ALPHA/LINE, or START keys. To provide security each key press displays an asterisk.

After the device received the GH command, the response of device to the ENQ command is GH. After the operator answers the message, the device displays the answer and 'PLEASE WAIT'. The response of the device to the ENQ command from the computer is AA (Answer Available).

After using the GH command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command.

The GH command can only be used for full screen messaging when the device is in the idle, AR, PL, RA, RC or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The following table lists the OPC items for the GH command.

Table 13-79: OPC items for Get Hidden (GH) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GH.Line1	RW	VT_ BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].GH.Line2	RW	VT_ BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].GH.Line3	RW	VT_ BSTR	0 to 33	Text + display parameter line 3
[B].[D].GH.Line4	RW	VT_ BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].GH.Line5	RW	VT_ BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].GH.Line6	RW	VT_ BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].GH.Line7	RW	VT_ BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)
[B].[D].GH.Line8	RW	VT_ BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)
[B]. [D].GH.WriteGH	RW	VT_UI2	1	Write command flag (1 = Write)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GH.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.7 Get Touch Key - GK

If a touch key is fitted to the device the Get Touch Key (GK) command allows TAS/OPC client to display a message on the display of the device prompting the operator to touch his/her key.

After the device received the GK command, the response of the device to the ENQ command is GK. After the message is acknowledged by the operator the response of the device to the ENQ command from the computer is KA (Touch Key Available).

After using the GK command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command.

The GK command can only be used for full screen messaging when the device is in the idle, AR, PL, RA, RC or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The following table lists the OPC items for the GK command.

Table 13-80: OPC items for Get Touch Key (GK) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GK.Line1	RW	VT_BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].GK.Line2	RW	VT_BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].GK.Line3	RW	VT_BSTR	0 to 33	Text + display parameter line 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GK.Line4	RW	VT_ BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].GK.Line5	RW	VT_ BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].GK.Line6	RW	VT_ BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].GK.Line7	RW	VT_ BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)
[B].[D].GK.Line8	RW	VT_ BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)
[B]. [D].GK.WriteGK	RW	VT_UI2	1	Write command flag (1 = Write)
[B]. [D].GK.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.8 Get NexWatch Card - GN

If a touch key is fitted to the device the Get NexWatch Card (GN) command allows TAS/OPC client to display a message on the display of the device prompting the operator to present his/her card.

After the device received the GN command, the response of the device to the ENQ command is GN. After the message is acknowledged by the operator the response of the device to the ENQ command from the computer is NA (NexWatch Card Available).

After using the GN command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command.

The GN command can only be used for full screen messaging when the device is in the idle, AR, PL, RA, RC or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The following table lists the OPC items for the GN command.

Table 13-81: OPC items for Get NexWatch Card (GN) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GN.Line1	RW	VT_ BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].GN.Line2	RW	VT_ BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].GN.Line3	RW	VT_ BSTR	0 to 33	Text + display parameter line 3
[B].[D].GN.Line4	RW	VT_ BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].GN.Line5	RW	VT_ BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].GN.Line6	RW	VT_ BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].GN.Line7	RW	VT_ BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)
[B].[D].GN.Line8	RW	VT_ BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)
[B]. [D].GN.WriteGN	RW	VT_UI2	1	Write command flag (1 = Write)
[B]. [D].GN.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.9 Get RF ID - GR

If a touch key is fitted to the device the Get RF ID (GR) command allows TAS/OPC client to display a message on the display of the device prompting the operator to present his/her card.

After the device received the GR command, the response of the device to the ENQ command is GR. After the RFID is read the response changes FA (RF ID Available).

After using the GR command, TAS/OPC client can return the device to its original display by issuing the Clear Message (CM) command.

The GR command can only be used for full screen messaging when the device is in the idle, RA or RL state. The RL and RA states requiring Load Scheduling and Remote Authorise respectively to be enabled.

The following table lists the OPC items for the GR command.

Table 13-82: OPC items for Get RF ID (GR) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GR.Line1	RW	VT_BSTR	0 to 33	Text + display parameter line 1 (Range is 0 to 33)
[B].[D].GR.Line2	RW	VT_BSTR	0 to 33	Text + display parameter line 2 (Range is 0 to 33)
[B].[D].GR.Line3	RW	VT_BSTR	0 to 33	Text + display parameter line 3
[B].[D].GR.Line4	RW	VT_BSTR	0 to 33	Text + display parameter line 4 (Range is 0 to 33)
[B].[D].GR.Line5	RW	VT_BSTR	0 to 33	Text + display parameter line 5 (Range is 0 to 33)
[B].[D].GR.Line6	RW	VT_BSTR	0 to 33	Text + display parameter line 6 (Range is 0 to 33)
[B].[D].GR.Line7	RW	VT_BSTR	0 to 33	Text + display parameter line 7 (Range is 0 to 33)
[B].[D].GR.Line8	RW	VT_BSTR	0 to 33	Text + display parameter line 8 (Range is 0 to 33)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].GR.WriteGR	RW	VT_UI2	1	Write command flag (1 = Write)
[B].[D].GR.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.10 Clear Message - CM

The Clear Message (CM) command enables TAS/OPC client to return the device to its original display after using the DM, DP, GA, GH, GK, GN or GR command.

The following table lists the OPC items for the CM command.

Table 13-83: OPC items for Clear Message (CM) command

OPC Item	Access Type	Data Type	Range	Description
[B].[D].CM.WriteCM	RW	VT_UI2		Write command flag (1 = Write)
[B].[D].CM.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.4.35.11 Answer Available - AA

The following table lists the OPC items for Answer Available.

Table 13-84: OPC items for Answer Available (AA)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].AA.OperRes	R	VT_BSTR		Answer of GA or GH command

13.5 Alarms

If Fusion4 OPC server detects one or more alarms on a device it will collect these alarms and update the relevant alarm OPC items. When the error is recovered TAS/OPC client can acknowledge the alarm condition by resetting alarms.

13.5.1 Types of Alarms

Fusion4 will retrieve alarm conditions from the connected device(s) automatically when occurred. Following are type of alarms that any TAS/ OPC client can monitor:

- System (see section 13.5.1.2)
- Meters (see section 13.5.1.3)
- Loading arms (see section 13.5.1.4)
- Additive injection (see section 13.5.1.5)
- Recipes (see section 13.5.1.6)

13.5.1.1 Fetching Alarms on Demand

Fusion4 OPC items for alarms needs to be subscribed in order to scan relevant details from 1010CB. If TAS/ OPC Client requires alarms information on demand without subscription then it has to perform a write operation on [B].[D].Alm.FetchAlm.

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.FetchAlm	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].Alm.DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.1.2 System Alarms

In the following table, the OPC items concerning system alarms are listed.

Table 13-85: OPC items concerning system alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.FetchSysAlm	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].Alm.SysDevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].Alm.Assert	RW	VT_BOOL		System Alarm - Assert
[B].[D].Alm.CalbrationFactorChanged	RW	VT_BOOL		System Alarm - Calibration Factor Changed
[B].[D].Alm.CommAlm	RW	VT_BOOL		System Alarm - Communication Alarm
[B].[D].Alm.COMPortNotAssignedIntelligentAdditive	RW	VT_BOOL		System Alarm - Comport not assigned to Intelligent Additive
[B].[D].Alm.COMPortNotAssignedNexWatch	RW	VT_BOOL		System Alarm - Comport not assigned to NexWatch

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.CPUAddress	RW	VT_BOOL		System Alarm - CPU Address
[B].[D].Alm.CriticalDataCorrupt	RW	VT_BOOL		System Alarm - Critical data Corrupt
[B].[D].Alm.Custom1	RW	VT_BOOL		System Alarm - Custom alarm 1
[B].[D].Alm.DeadManBell	RW	VT_BOOL		System Alarm - Deadman Bell
[B].[D].Alm.DeadManCallout	RW	VT_BOOL		System Alarm - Deadman Callout
[B].[D].Alm.DeadManIndicator	RW	VT_BOOL		System Alarm - Deadman Indicator
[B].[D].Alm.DispFail	RW	VT_BOOL		System Alarm - Display Failure
[B].[D].Alm.EarthOverfillDisconnect	RW	VT_BOOL		System Alarm - Overfill Disconnected
[B].[D].Alm.EmergencyStop	RW	VT_BOOL		System Alarm - Emergency Stop
[B].[D].Alm.IllegalInstruction	RW	VT_BOOL		System Alarm - Illegal Instruction
[B].[D].Alm.InstrumentCorrupt	RW	VT_BOOL		System Alarm - Instrument type corrupt
[B].[D].Alm.MngrReset	RW	VT_BOOL		System Alarm - MPK Reserved

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.Multiple100ms	RW	VT_BOOL		System Alarm - Multiple 100ms
[B].[D].Alm.NexWatchComm	RW	VT_BOOL		System Alarm - NexWatch Communications
[B].[D].Alm.PrgDiscon	RW	VT_BOOL		System Alarm - Program Disconnection
[B].[D].Alm.PwrFail	RW	VT_BOOL		System Alarm - Power Failure
[B].[D].Alm.RAMCorruption	RW	VT_BOOL		System Alarm - RAM corruption
[B].[D].Alm.ReprogramFlash	RW	VT_BOOL		System Alarm - Reprogram Flash
[B].[D].Alm.ReprogramInProgress	RW	VT_BOOL		System Alarm - Reprogramming in Progress
[B].[D].Alm.SDFClr	RW	VT_BOOL		System Alarm - SDF Cleared
[B].[D].Alm.SDFDataCorrup	RW	VT_BOOL		System Alarm - SDF Data corruption
[B].[D].Alm.SDFFail	RW	VT_BOOL		System Alarm - SDF Failure
[B].[D].Alm.Spare1	RW	VT_BOOL		System Alarm - Spare alarm 1
[B].[D].Alm.Spare2	RW	VT_BOOL		System Alarm - Spare alarm 2
[B].[D].Alm.Spare3	RW	VT_BOOL		System Alarm - Spare alarm 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.Spare4	RW	VT_BOOL		System Alarm - Spare alarm 4
[B].[D].Alm.Spare5	RW	VT_BOOL		System Alarm - Spare alarm 5
[B].[D].Alm.SysFlt	RW	VT_BOOL		System Alarm - System Corruption
[B].[D].Alm.SysStack	RW	VT_BOOL		System Alarm - System Stack
[B].[D].Alm.SystemInput1Disconnected	RW	VT_BOOL		System Alarm - System input 1 disconnected
[B].[D].Alm.SystemInput2Disconnected	RW	VT_BOOL		System Alarm - System input 2 disconnected
[B].[D].Alm.SystemInput3Disconnected	RW	VT_BOOL		System Alarm - System input 3 disconnected
[B].[D].Alm.SystemInput4Disconnected	RW	VT_BOOL		System Alarm - System input 4 disconnected
[B].[D].Alm.SystemInput5Disconnected	RW	VT_BOOL		System Alarm - System input 5 disconnected
[B].[D].Alm.SystemInput6Disconnected	RW	VT_BOOL		System Alarm - System input 6 disconnected
[B].[D].Alm.SysTrap	RW	VT_BOOL		System Alarm - System Trap
[B].[D].Alm.TransStoreFull	RW	VT_BOOL		System Alarm - Transaction storage Full

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.UsrAlmA	RW	VT_BOOL		System Alarm - User alarm A
[B].[D].Alm.UsrAlmB	RW	VT_BOOL		System Alarm - User alarm B
[B].[D].Alm.UsrAlmC	RW	VT_BOOL		System Alarm - User alarm C
[B].[D].Alm.UsrAlmD	RW	VT_BOOL		System Alarm - User alarm D
[B].[D].Alm.VapourDisconnected	RW	VT_BOOL		System Alarm - Vapor Disconnected
[B].[D].Alm.WatchDog	RW	VT_BOOL		System Alarm - Watchdog

13.5.1.3 Flow Meter Alarms

In the following table the OPC items concerning flow meter alarms are listed.

> NOTE: In the OPC items listed in the following table [n] indicates the flow meter number and can be 1 to 4.

Table 13-86: OPC items concerning flow meter alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.M[n].FetchAlm	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].Alm.M[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.M [n].CalculationNoSolution	RW	VT_ BOOL		Meter Alarm - Calculation No solution
[B].[D].Alm.M [n].DensityBadPV	RW	VT_ BOOL		Meter Alarm - Density or Exp. co-efficientOut of Range
[B].[D].Alm.M[n].DensitFault	RW	VT_ BOOL		Meter Alarm - Density Probe
[B].[D].Alm.M [n].IllegalArgument	RW	VT_ BOOL		Meter Alarm - Illegal Argument
[B].[D].Alm.M[n].MtrError	RW	VT_ BOOL		Meter Alarm - Dual pulse
[B].[D].Alm.M [n].MtrIllegalFlow	RW	VT_ BOOL		Meter Alarm - Unauthorized flow
[B].[D].Alm.M[n].MtrTimeout	RW	VT_ BOOL		Meter Alarm - No flow timeout
[B].[D].Alm.M [n].NonConvergence	RW	VT_ BOOL		Meter Alarm - Non-convergence
[B].[D].Alm.M [n].NoReferenceFluid	RW	VT_ BOOL		Meter Alarm - No Reference Fluid
[B].[D].Alm.M[n].Pharror	RW	VT_ BOOL		Meter Alarm - Phase error
[B].[D].Alm.M [n].PressureBadPV	RW	VT_ BOOL		Meter Alarm - Pressure Out of Range
[B].[D].Alm.M [n].PressureFault	RW	VT_ BOOL		Meter Alarm - Pressure Probe
[B].[D].Alm.M[n].Spare1	RW	VT_ BOOL		Meter Alarm - Spare Alarm 1
[B].[D].Alm.M[n].Spare2	RW	VT_ BOOL		Meter Alarm - Spare Alarm 2
[B].[D].Alm.M[n].Spare3	RW	VT_ BOOL		Meter Alarm - Spare Alarm 3

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.M[n].Spare4	RW	VT_ BOOL		Meter Alarm - Spare Alarm 4
[B].[D].Alm.M[n].Spare5	RW	VT_ BOOL		Meter Alarm - Spare Alarm 5
[B].[D].Alm.M[n].Spare6	RW	VT_ BOOL		Meter Alarm - Spare Alarm 6
[B].[D].Alm.M[n].Spare7	RW	VT_ BOOL		Meter Alarm - Spare Alarm 7
[B].[D].Alm.M [n].SupercriticalFluid	RW	VT_ BOOL		Meter Alarm - Supercritical Fluid
[B].[D].Alm.M[n].tempBadPV	RW	VT_ BOOL		Meter Alarm - Temperature Out of Range
[B].[D].Alm.M[n].tempFault	RW	VT_ BOOL		Meter Alarm - Temperature probe
[B].[D].Alm.M[n].ValveFault	RW	VT_ BOOL		Meter Alarm - Valve fault
[B].[D].Alm.M [n].VolCorrectionOutOfRange	RW	VT_ BOOL		Meter Alarm - Volume correction factor (CTPL) Out of Range

13.5.1.4 Loading Arm Alarms

In the following table the OPC items concerning loading arm alarms are listed.

> NOTE: In the OPC items listed in the following table [n] indicates the loading arm number and can be 1 to 4 based on the sales code. See section 13.1.8.

Table 13-87: OPC items concerning loading arm alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.A[n].FetchAlm	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].Alm.A [n].BlendErrorHigh	RW	VT_ BOOL		Arm Alarm - Blend error High

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.A [n].BlendErrorLow	RW	VT_ BOOL		Arm Alarm - Blend error Low
[B].[D].Alm.A [n].Input1Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 1 disconnected
[B].[D].Alm.A [n].Input2Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 2 disconnected
[B].[D].Alm.A [n].Input3Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 3 disconnected
[B].[D].Alm.A [n].Input4Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 4 disconnected
[B].[D].Alm.A [n].Input5Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 5 disconnected
[B].[D].Alm.A [n].Input6Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 6 disconnected
[B].[D].Alm.A [n].Input7Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 7 disconnected
[B].[D].Alm.A [n].Input8Disconnected	RW	VT_ BOOL		Arm Alarm - Arm input 8 disconnected
[B].[D].Alm.A [n].LeakingBlendStream	RW	VT_ BOOL		Arm Alarm - Leaking Blend Stream
[B].[D].Alm.A[n].MtrHiFlow1	RW	VT_ BOOL		Arm Alarm - Slow flow High
[B].[D].Alm.A[n].MtrHiFlow2	RW	VT_ BOOL		Arm Alarm - High flow High
[B].[D].Alm.A[n].MtrHiFlow3	RW	VT_ BOOL		Arm Alarm - Low flow High
[B].[D].Alm.A[n].MtrLoFlow1	RW	VT_ BOOL		Arm Alarm - Slow flow Low
[B].[D].Alm.A[n].MtrLoFlow2	RW	VT_ BOOL		Arm Alarm - High flow Low

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.A[n].MtrLoFlow3	RW	VT_ BOOL		Arm Alarm - Low flow Low
[B].[D].Alm.A [n].RemoteStop	RW	VT_ BOOL		Arm Alarm - Remote Stop
[B].[D].Alm.A [n].RemoteTerminate	RW	VT_ BOOL		Arm Alarm - Remote Terminate
[B].[D].Alm.A[n].Spare1	RW	VT_ BOOL		Arm Alarm - Spare alarm 1
[B].[D].Alm.A[n].Spare2	RW	VT_ BOOL		Arm Alarm - Spare alarm 2
[B].[D].Alm.A[n].Spare3	RW	VT_ BOOL		Arm Alarm - Spare alarm 3
[B].[D].Alm.A[n].Spare4	RW	VT_ BOOL		Arm Alarm - Spare alarm 4
[B].[D].Alm.A[n].Spare5	RW	VT_ BOOL		Arm Alarm - Spare alarm 5
[B].[D].Alm.A[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.1.5 Additive Injection Alarms

In the following table the OPC items concerning additive injection alarms are listed.

> NOTE: In the OPC items listed in the following table [n] indicates the additive injection point number and can be 1 to 24.

Table 13-88: OPC items concerning additive injection alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.IP[n].FetchAlm	RW	VT_UI2	1	Fetch command flag (1 = Fetch)
[B].[D].Alm.IP[n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].Alm.IP[n].AdditiveCommunicationFailure	RW	VT_BOOL		Additive Alarm - Calibration Factor changed
[B].[D].Alm.IP[n].AdditiveCommunicationResp	RW	VT_BOOL		Additive Alarm - Communications Response (MPK)
[B].[D].Alm.IP[n].AdditiveEEPROMFail	RW	VT_BOOL		Additive Alarm - EEPROM Fail
[B].[D].Alm.IP[n].AdditiveFirmwareFail	RW	VT_BOOL		Additive Alarm - Firmware Fail
[B].[D].Alm.IP[n].AdditiveHigh	RW	VT_BOOL		Additive Alarm - High Additive (Internal Additive)
[B].[D].Alm.IP[n].AdditiveLow	RW	VT_BOOL		Additive Alarm - Low Additive (Internal Additive)
[B].[D].Alm.IP[n].AdditiveMPKReserved	RW	VT_BOOL		Reserved for MiniPAK
[B].[D].Alm.IP[n].AdditiveMeterNoFlow	RW	VT_BOOL		Additive Alarm - No Additive

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.IP[n].AdditiveNoActivity	RW	VT_ BOOL		Additive Alarm - No activity
[B].[D].Alm.IP [n].AdditiveNoCommunicationResponse	RW	VT_ BOOL		Additive Alarm - Comms Response No (MPK)
[B].[D].Alm.IP[n].AdditiveValvelLeak	RW	VT_ BOOL		Additive Alarm - Leaking Additive
[B].[D].Alm.IP[n].AddVolumeTolerance	RW	VT_ BOOL		Additive Alarm - Additive Volume Tolerance (MPK)
[B].[D].Alm.IP[n].Spare1	RW	VT_ BOOL		Additive Alarm - Spare alarm 1
[B].[D].Alm.IP[n].Spare2	RW	VT_ BOOL		Additive Alarm - Spare alarm 2
[B].[D].Alm.IP[n].Spare3	RW	VT_ BOOL		Additive Alarm - Spare alarm 3
[B].[D].Alm.IP[n].Spare4	RW	VT_ BOOL		Additive Alarm - Spare alarm 4

13.5.1.6 Recipe Alarms

In the following table the OPC items concerning Fusion4 recipe alarms are listed.

> NOTE: In the OPC items listed in the following table [n] indicates the recipe number and can be 1 to 16.

Table 13-89: OPC items concerning recipe alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.RS [n].FetchAlm	RW	VT_UI2	1	Fetch command flag (1 = Fetch)

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.RS [n].DevResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy
[B].[D].Alm.RS [n].DisableAlm	RW	VT_ BOOL		Recipe Alarm - Disabled Alarm
[B].[D].Alm.RS [n].HighFlow	RW	VT_ BOOL		Recipe Alarm - High Flow alarm
[B].[D].Alm.RS [n].LowFlow	RW	VT_ BOOL		Recipe Alarm - Low Flow alarm
[B].[D].Alm.RS [n].SlowFlow	RW	VT_ BOOL		Recipe Alarm - Slow Flow alarm
[B].[D].Alm.RS[n].Spare1	RW	VT_ BOOL		Recipe alarm - Spare alarm 1
[B].[D].Alm.RS[n].Spare2	RW	VT_ BOOL		Recipe alarm - Spare alarm 2
[B].[D].Alm.RS[n].Spare3	RW	VT_ BOOL		Recipe alarm - Spare alarm 3
[B].[D].Alm.RS[n].Spare4	RW	VT_ BOOL		Recipe alarm - Spare alarm 4

13.5.2 Resetting Alarms

TAS/OPC client can reset alarms on the 1010CB.

13.5.2.1 Resetting All Alarms

The following table lists the OPC items relating to resetting all alarms.

Table 13-90: OPC items relating to resetting all alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.Reset	RW	VT_UI2	1	Reset all alarms command flag (1 = Reset)
[B].[D].Alm.ResResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.2.2 Resetting System Alarms

The following table lists the OPC items relating to resetting system alarms.

Table 13-91: OPC items relating to resetting system alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.ResetSysAlms	RW	VT_UI2	1	Reset system alarms command flag (1 = Reset)
[B].[D].Alm.ResetSysAlmsResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.2.3 Resetting Flow Meter Alarms

The following table lists the OPC items relating to resetting flow meter alarms.

Table 13-92: OPC items relating to resetting flow meter alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.ResetMtrAlms	RW	VT_UI2	1	Reset meter alarms command flag (1 = Reset)
[B].[D].Alm.ResetMtrAlmsResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.2.4 Resetting Loading Arm Alarms

The following table lists the OPC items relating to resetting loading arm alarms.

Table 13-93: OPC Items for Resetting Loading Arm Alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.ResetArmAlms	RW	VT_UI2	1	Reset arm alarms command flag (1 = Reset)
[B].[D].Alm.ResetArmAlmsResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.2.5 Resetting Additive Injection Alarms

The following table lists the OPC items relating to resetting additive injection alarms.

Table 13-94: OPC items relating to resetting additive injection alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.ResetAdditiveAlms	RW	VT_UI2	1	Reset additive alarms command flag (1 = Reset)
[B].[D].Alm.ResetAdditiveAlmsResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.2.6 Resetting Recipe Alarms

The following table lists the OPC item relating to resetting recipe alarms.

Table 13-95: OPC items relating to resetting recipe alarms

OPC Item	Access Type	Data Type	Range	Description
[B].[D].Alm.ResetRecipeAlms	RW	VT_UI2	1	Reset recipe alarms command flag (1 = Reset)
[B].[D].Alm.ResetRecipeAlmsResp	R	VT_UI2		Device reply to SLIP command: • 0 = None • 1 = ACK • 2 = NAK • 3 = Busy

13.5.2.7 Resetting Individual Alarms

TAS/OPC client can reset each alarm individually by writing into the particular alarm OPC item. For example: To reset the dead man bell alarm, TAS/OPC client can write False to [B].[D].Alm.DeadManBell.

13.6 Diagnostics

Fusion4 OPC Server will log messages at some events. These can be viewed from the Log Viewer application.

13.6.1 Application Log Events

The following table lists the application log events logged by Fusion4 OPC Server.

Table 13-96: Application Log Events

Application Log Event	Occurs when
Fusion4 OPC Server client 2 connected successfully.Total client connections is 2.	Any TAS/ OPC Client establishes a new OPC connection.
Fusion4 OPC Server client 2 disconnected. Total client connections is 1.	One of the connected TAS/ OPC Client terminates OPC connection.
Terminal Automation System is online.	TAS/ OPC Client set Sys.TASStatus to suitable value as connected.
Terminal Automation System is offline.	TAS/ OPC Client sets Sys.TASStatus to suitable value as disconnected.
Scan for CM is not dispatched due to invalid input.	TAS/ OPC Client sets [B].[D].CM.WriteCM value other than 1.
Scan for TC is not dispatched due to invalid input	TAS/ OPC Client sets [B].[D].Load.TransComplete value other than 1.
Error while scanning STX:RL with N, Deny_ Message on device Bay1_1010 at port [COM] :NO_ ERROR(NAK = NAK)	IF NAK received is from 1010 CB for RL command.
Error while scanning STX:RA with N, Deny_ Message on device Bay1_1010 at port [COM] :NO_ ERROR(NAK = NAK)	IF NAK is received from 1010 CB for RAC command.

Application Log Event	Occurs when
Error while scanning STX:RC with N, Deny_ Message on device Bay1_1010 at port [COM] :NO_ ERROR(NAK = NAK)	IF NAK is received from 1010 CB for RC command.

13.6.2 Audit Log Events

The following table lists the audit log events logged by Fusion4 OPC Server.

Table 13-97: Audit Log Events

Audit Log Event	Occurs when
Fusion4 Portal started	Fusion4 OPC Server starts.
Fusion4 Portal ended	Fusion4 OPC server ends.
Communication alive on device [D] at [COM]	TAS/ OPC Clients sets [B].[D].DeviceScanDisable to 'False' (Killed to Alive).
Communication killed manually on device [D] at [COM].	TAS/ OPC Clients sets [B].[D].DeviceScanDisable to 'True' (Alive to Killed).
Product density for meter [Meter] on device [D] at [COM] is set to <Value>.	TAS/OPC client sets density to manual value using [B].[D].DN.RefDens.
Power failure flag on device [D] at [COM] has been reset by CC command.	TAS/ OPC Clients sets [B].[D].CC.WriteCC value as 1.
Name of meter number [M_old] is changed to [M_NewName] on device [D] at [COM] by MN command.	TAS/ OPC Client sets [B].[D].MN.MeterNum value as <num>.
Manager reset done on device [D] at [COM] from Fusion4 OPC Server by MR command.	TAS/ OPC Client sets [B].[D].MR.WriteMR value as 1.
Instrument's date and time have been set to date [ddmmyyyy] and time [hhmmss] on device [D] at [COM] by RD command.	TAS/ OPC client sets date and time using RD OPC items.
Stop or pause has been done on load/ batch on arm number [Arm_Num] on device [D] at [COM] by SM command.	TAS/ OPC client issues stop/ pause on load/ batch on arm using SM OPC items.

Audit Log Event	Occurs when
Transaction has been settled for transaction number [Trans_Num] on device [D] at [COM] by TS command.	TAS/ OPC Client settles a transaction using TS OPC items.
Transaction number [Trans_Num] that is currently in progress on device [D] at [COM] has been stopped by TT command.	TAS/ OPC Client terminates transaction using TT OPC items.
Download of blend/additive recipes has been done to the instrument on device [D] at [COM] by BR command.	TAS/ OPC Client downloads recipe using BR OPC items.
General Purpose latched inputs for arm [Arm_ Num] have been reset on device [D] at [COM] by CL command.	TAS/ OPC Client resets General Purpose inputs for particular arm using CL OPC Items.
General Purpose latched inputs for both arms have been reset on device [D] at [COM] by CL command.	TAS/ OPC Client resets General Purpose inputs for both arms using CL OPC Items.
All General Purpose latched inputs have been reset on device [D] at [COM] by CL command.	TAS/ OPC Client resets General Purpose inputs on device.
General Purpose latched input for [Input_ Name] has been reset on device [D] at [COM] by CL command.	TAS/ OPC Client resets a particular General Purpose input.
All arm alarms on Device [D] at [COM] are reset by RT command.	TAS/ OPC Client resets all alarms for each of arms.
All meter alarms on device [D] at [COM] are reset by the RT command.	TAS/ OPC Client resets all alarms for each of meters.
All system alarms on device [D] at [COM] are reset by RT command.	TAS/ OPC Client resets all system alarms.
All recipe alarms on device [D] at [COM] are reset by RT command.	TAS/ OPC Client resets all recipe alarms.

Audit Log Event	Occurs when
All internal\external additive alarms on device [D] at [COM] are reset by RT command.	TAS/ OPC Client resets all alarms for each of internal/ external additive injectors.
All alarms on device [D] at [COM] are reset by the [RT] command.	TAS/ OPC client resets all alarms.
The [Alarm Name] alarm on device [D] at [COM] for arm [Arm_Num] has been reset.	TAS/ OPC Client resets a particular alarm on a specified arm.
The [Alarm_Name] alarm on device [D] at [COM] for meter [Meter_Num] has been reset.	TAS/ OPC Client resets a particular alarm on a specified meter.
The [Alarm_Name] alarm on device [D] at [COM] for system has been reset.	TAS/ OPC Client resets a particular system alarm.
The [Alarm_Name] alarm on device [D] at [COM] for recipe [RecipeArm_Num] has been reset.	TAS/ OPC Client resets a particular recipe alarm on a specified arm.
The [Alarm_Name] alarm on device [D] at [COM] for injection point [Injector Num] has been reset.	TAS/ OPC Client resets a particular injection point alarm on a specified arm.

Appendix A: Fusion4 MSC-L Modbus UDI Items

The following table provides an overview of the Fusion4 MSC-L UDI items.

Table A-1: Fusion4 MSC-L UDI items

Description/Reference	Value	Data Type	Size	Elements
eArmEntityBatchControlRecipes	2	STRUCT_LOAD_RECIPE See section Appendix C.3.2.14 - Load Recipe for more information.	211	600
eHmiEntityAlarmManagerCommandResetAllAlarms	3	N/A (command item)	0	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerCarrierIdentification See the [Workflow Option: Carrier Identification] parameter in section B.3.1 for a description of this UDI item.	21	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1
eHmiEntityDeviceManagerVehicleIdentification See the [Workflow Option: Vehicle Identification] parameter in section B.3.1 for a description of this UDI item.	22	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1
eHmiEntityDeviceManagerTrailerIdentification See the [Workflow Option: Trailer Identification] parameter in section B.3.1 for a description of this UDI item.	23	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerLoadNumberIdentification See the [Workflow Option: Load Number Identification] parameter in section B.3.1 for a description of this UDI item.	24	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1
eHmiEntityDeviceManagerCompartmentIdentification See the [Workflow Option: Compartment Identification] parameter in section B.3.1 for a description of this UDI item.	25	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1
eHmiEntityDeviceManagerReturnQuantityEntry See the [Workflow Option: Return Quantity Entry] parameter in section B.3.1 for a description of this UDI item.	26	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerPresetEntry See the [Workflow Option: Preset Entry] parameter in section B.3.1 for a description of this UDI item.	27	ENUM_WORKFLOW_OPTION_TYPE See section C.3.1.36 of APPENDIX C for more information.	2	1
eHmiEntityDeviceManagerBatchStart	30	ENUM_BATCH_START_OPTIONS See section C.3.1.66 of APPENDIX C for more information.	2	1
eHmiEntityDeviceManagerRecordRequest- Buffer	37		1	65535

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerRecordRequest See [Record Request] parameter in section B.3.1 for a description of this UDI item.	38	STRUCT_FUSION4_RECORD_RE- QUEST See section C.3.2.11 of APPENDIX C for more information.	16	1
eHmiEntityDeviceManagerF4PortalScanRegisters	41		4	16
eHmiEntityDeviceManagerDate	42	STRUCT_RTC_DATE See section Appendix C.3.2.29 - RTC Date for more information.	4	1
eHmiEntityDeviceManagerTime	43	STRUCT_TIME See section Appendix C.3.2.30 - RTC Time for more information.	4	1
eHmiEntityDeviceManagerRitInputStatus	44	uint16	2	1
eHmiEntityTransactionManagerTransactionRecord	50		1	65535

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityTransactionManagerUnprocessedTransactionsAvailable	51	ENUM_ UNPROCESSED_ TRANSAC-TION_ RECORD_ AVAILABLE See section C.3.1.39 of APPENDIX C for more information.	2	1
eHmiEntityTransactionManagerMarkTransactionAsProcessed See [Unprocessed Transactions Available] parameter in section B.3.1 for a description of this UDI item.	52	uint32	4	1
eHmiEntityTransactionManagerTransactionCounter	53	uint32	4	1
eHmiEntityTransactionManagerWorkflow- Mode	56	ENUM_ TRANSACTION_ WORK-FLOW_ MODE See section C.3.1.65 of APPENDIX C for more information.	2	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityTransactionManagerTransactionRecordSize See [Transaction Record Size] parameter in section B.3.1 for a description of this UDI item.	60	uint16	2	1
eHmiEntityTransactionManagerTransactionRecordVersion See [Transaction Record Version] parameter in section B.3.1 for a description of this UDI item.	61	uint16	2	1
eHmiEntityTransactionManagerLastProcessedTransaction See [Last Processed Transaction] parameter in section B.3.1 for a description of this UDI item.	62	uint32	4	1
eHmiEntityTransactionManagerCommandRestoreTasControl	67	N/A (command item)	0	1
eHmiEntityTransactionManagerRestore101 0Batch	68	uint32	4	1
eHmiEntityTransactionManagerRestore101 0Transaction	69	uint32	4	1
eHmiEntityTransactionControlActiveAlarmBitmask	71	uint16	2	24
eHmiEntityTransactionControlActiveDeviceAlarmBitmask	82	uint64	4	1
eHmiEntityTransactionControlActiveBayAlarmBitmask	83	uint64	4	2
eHmiEntityTransactionControlActiveArmAlarmBitmask	84	uint64	4	6
eHmiEntityTransactionControlActiveProductStreamAlarmBitmask	85	uint64	4	12
eHmiEntityTransactionControlActiveExternalAdditiveAlarmBitmask	86	uint16	2	24

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityBayControlBayCommand See [Bay Command] parameter in section B.3.1 for a description of this UDI item.	90	STRUCT_BAY_COMMAND See section C.3.2.1 of APPENDIX C for more information.	8	1
eHmiEntityBayControlLoadNumber See [Load Number] parameter in section B.3.1 for a description of this UDI item.	94	char[20]	20	2
eHmiEntityBayControlBay1BatchDetails	95	STRUCT_BATCH_DETAILS See section C.3.2.6 of APPENDIX C for more information.	15	20
eHmiEntityBayControlBay2BatchDetails	96	STRUCT_BATCH_DETAILS See section C.3.2.6 of APPENDIX C for more information.	15	20

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityBayControlContractId See [Contract ID] parameter in section B.3.1 for a description of this UDI item.	97	uint16[16]	32	2
eHmiEntityBayControlDriverId See [Driver ID] parameter in section B.3.1 for a description of this UDI item.	98	uint16[16]	32	2
eHmiEntityBayControlVehicleId See [Vehicle ID] parameter in section B.3.1 for a description of this UDI item.	99	uint16[16]	32	2
eHmiEntityBayControlCarrierId See [Carrier ID] parameter in section B.3.1 for a description of this UDI item.	100	char[16]	16	2
eHmiEntityBayControlTrailerId See [Trailer ID] parameter in section B.3.1 for a description of this UDI item.	101	char[16]	16	2
eHmiEntityBayControlReferenceNumber See [Reference Number] parameter in section B.3.1 for a description of this UDI item.	102	char[14]	14	2

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityBayControlTransactionAuthorizationDetails See [Transaction Authorization Details] parameter in section B.3.1 for a description of this UDI item.	103	STRUCT_TRANSACTION_AUTHORIZATION_DETAILS See section C.3.2.2 of APPENDIX C for more information.	50	1
eHmiEntityBayControlPlanInitStartBatch See [Plan Init Start Batch] parameter in section B.3.1 for a description of this UDI item.	104	STRUCT_PLAN_INIT_START_BATCH See section C.3.2.8 of APPENDIX C for more information.	19	1
eHmiEntityBayControlPermissiveType- Grounding See [Permissive Type: Grounding] parameter in section B.3.1 for a description of this UDI item.	108	ENUM_PERMISSIVE_TYPE See section C.3.1.30 of APPENDIX C for more information.	2	2

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityBayControlPermissiveTypeOverfill See [Permissive Type: Overfill] parameter in section B.3.1 for a description of this UDI item.	109	ENUM_PERMISSIVE_TYPE See section C.3.1.30 of APPENDIX C for more information.	2	2
eHmiEntityBayControlPermissiveTypeVapourRecovery See [Permissive Type: Vapour Recovery] parameter in section B.3.1 for a description of this UDI item.	110	ENUM_PERMISSIVE_TYPE See section C.3.1.30 of APPENDIX C for more information.	2	2
eHmiEntityBayControlPermissivesConnected See [Permissives Connected] parameter in section B.3.1 for a description of this UDI item.	111	Boolean	1	2
eHmiEntityBayControlTransactionAuthorizationDetailsUnicode	116	STRUCT_TRANSACTION_AUTHORIZATION_DETAILS_UNICODE	98	1
eHmiEntityBayControlWeighbridgeIndicatedWeight	117	float32	2	
eHmiEntityBayControlWeighbridgeTareWeight	118	float32	2	

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityBayControlWeighbridgeSteadyState	119	uint8	1	
eHmiEntityArmControlArmStateDetails See [Arm State Details] parameter in section C.3.2.15 for a description of this UDI item.	120	Arm State Details See section [C.3.2.15] of APPENDIX C for more information.	125	6
eHmiEntityArmControlLastUserResponse See [User Response] parameter in sectionB.3.1 for a description of this UDI item.	121	STRUCT_USER_RESPONSE See section C.3.2.5 of APPENDIX C for more information.	74	2

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityArmControlShowPrompt	122	STRUCT_SHOW_PROMPT_DATA See section Appendix C.3.2.16 - Show Prompt Data for more information.	271	2
eHmiEntityArmControlArmCommand See [Arm Command] parameter in section B.3.1 for a description of this UDI item.	123	STRUCT_ARM_COMMAND See section C.3.2.12 of APPENDIX C for more information.	8	1
eHmiEntityArmControlPromptListSelection- Text	124	Unicode [32]	64	100
eHmiEntityArmControlNumberIdleArms See [Number of Arms: Idle] parameter in section B.3.1 for a description of this UDI item.	125	uint32	4	2
eHmiEntityArmControlNumberAvail- ableArms See [Number of Arms: Availble] parameter in section B.3.1 for a description of this UDI item.	126	uint32	4	2

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityArmControlNumberPausedArms See [Number of Arms: Paused] parameter in section B.3.1 for a description of this UDI item.	127	uint32	4	2
eHmiEntityArmControlShowInternalPrompt See [Internal Prompt Data] parameter in section B.3.1 for a description of this UDI item.	131	STRUCT_INTERNAL_PROMPT_DATA See section C.3.2.9 of APPENDIX C for more information.	12	2
eHmiEntityArmControlShowTasPrompt See [Show TAS Prompt] parameter in section B.3.1 for a description of this UDI item.	132	ENUM_F4_TAS_PROMPT See section C.3.1.20 of APPENDIX C for more information.	2	2
eHmiEntityArmControlLastUserAnswer See [Last User Answer] parameter in section B.3.1 for a description of this UDI item.	133	char[32]	32	2
eHmiEntityArmControlBatchRecordBuffer- Arm1	134		1	2700
eHmiEntityArmControlBatchRecordBuffer- Arm2	135		1	2700
eHmiEntityArmControlBatchRecordBuffer- Arm3	136		1	2700

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityArmControlBatchRecordBuffer- Arm4	137		1	2700
eHmiEntityArmControlBatchRecordBuffer- Arm5	138		1	2700
eHmiEntityArmControlBatchRecordBuffer- Arm6	139		1	2700
eHmiEntityArmControlInstantaneousValuesArm1	140		1	512
eHmiEntityArmControlInstantaneousValuesArm2	141		1	512
eHmiEntityArmControlInstantaneousValuesArm3	142		1	512
eHmiEntityArmControlInstantaneousValuesArm4	143		1	512
eHmiEntityArmControlInstantaneousValuesArm5	144		1	512
eHmiEntityArmControlInstantaneousValuesArm6	145		1	512
eHmiEntityArmControlRecipeAccumulativeGov	155	float64	8	600
eHmiEntityArmControlRecipeAccumulativeGsv	156	float64	8	600
eHmiEntityArmControlRecipeAccumulative- Mass	157	float64	8	600
eHmiEntityArmControlCommandClose- Screen	158	N/A (command item)	0	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityAuthorizationManagerUpdateUserData See [Authorization Data: User] parameter in section B.3.1 for a description of this UDI item.	172	STRUCT_AUTH_DATA See section C.3.2.7 of APPENDIX C for more information.	32	1
eHmiEntityAuthorizationManagerUpdateObjectData See [Authorization Data: Object] parameter in section B.3.1 for a description of this UDI item.	173	STRUCT_AUTH_DATA See section C.3.2.7 of APPENDIX C for more information.	32	1
eHmiEntityAuthorizationManagerDeleteDatabaseEntry See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	183	STRUCT_DELETE_AUTH_OBJECT_REQUEST See section C.3.2.13 of APPENDIX C for more information.	12	1

Description/Reference	Value	Data Type	Size	Elements
eArmEntityArmExtAddAccumulativeTotalAdditiveStreamGrossObservedVolume See [Authorization Data: User] parameter in section B.3.1 for a description of this UDI item.	185	float64	8	12
eArmEntityAdditiveStreamControlAccumulativeTotalAdditiveStreamGrossObservedVolume See [Authorization Data: Object] parameter in section B.3.1 for a description of this UDI item.	186	float64	8	12
eArmEntityProductStreamControlVolume-AccumulativeTotalObserved See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	187	float64	8	6
eArmEntityProductStreamControlVolume-AccumulativeTotalStandard See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	188	float64	8	6
eArmEntityProductStreamControlDynamicInfo See [Authorization Data: User] parameter in section B.3.1 for a description of this UDI item.	189	STRUCT_STREAM_DYNAMIC_INFO See section Appendix C.3.2.28 - Stream Dynamic Info for more information.	12	6

Description/Reference	Value	Data Type	Size	Elements
eArmEntityProductStreamControlVcfLab- Density See [Authorization Data: Object] parameter in section B.3.1 for a description of this UDI item.	190	STRUCT_DENSITY_REFERENCE See section Appendix C.3.2.32 - Density Reference for more information.	10	12
eArmEntityProductStreamControlVcfLab- Pressure See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	191	STRUCT_PRESSURE_REFERENCE See section Appendix C.3.2.33 - Pressure Reference for more information.	10	12

Description/Reference	Value	Data Type	Size	Elements
eArmEntityProductStreamControlVcfLab- Temprature See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	192	STRUCT_TEMPERATURE_REFERENCE See section Appendix C.3.2.34 - Temperature Reference for more information.	10	12
eArmEntityProductStreamControlVcfLabExpansionCoefficient See [Authorization Data: User] parameter in section B.3.1 for a description of this UDI item.	193	STRUCT_THERMAL_COEFF_REFERENCE See section Appendix C.3.2.35 - Thermal Coeff Reference for more information.	10	12
eArmEntityProductStreamControlVcfMixturePercentage See [Authorization Data: Object] parameter in section B.3.1 for a description of this UDI item.	194	float32	4	12

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityAlarmManagerCommandReset-DeviceSpecificAlarms See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	195	N/A (command item)	0	1
eHmiEntityAlarmManagerResetBaySpecificAlarms See [Delete Database Entry] parameter in section B.3.1 for a description of this UDI item.	196	uint16	2	1
eHmiEntityAlarmManagerResetArmSpecificAlarms See [Authorization Data: User] parameter in section B.3.1 for a description of this UDI item.	197	uint16	2	1
eHmiEntityAlarmManagerResetProduct-StreamSpecificAlarms	198	uint16	2	1
eHmiEntityAlarmManagerResetAdditiveStreamSpecificAlarms	199	uint16	2	1
eHmiEntityAlarmManagerCommandResetAllAlarms	200	N/A (command item)	0	1
eHmiEntityAlarmManagerResetAlarm	201	uint16	2	1
eHmiEntityAlarmManagerAlarmAcknowledgement	202	uint16	2	1
eHmiEntityAlarmManagerF4aiNumberOfAlarms	203	uint16	2	1
eHmiEntityAlarmManagerNumberOfAlarmTypes	204	uint16	2	1
eHmiEntityAlarmManagerAlarmInterfaceVersion	205	uint8	1	1
eHmiEntityAlarmManagerActiveAlarmDetails	206		1	1100

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityAlarmManagerAlarmTable	207		1	24576
eHmiEntityAlarmManagerAlarmText	208		1	16384
eHmiEntityAlarmManagerAlarmStateText	209	STRUCT_ALARM_STATE_TEXT See section Appendix C.3.2.36 - Alarm State Text for more information.	30	4
eHmiEntityAlarmManagerAlarmLogRecord	210		1	256
eHmiEntityAlarmManagerAlarmLogRecord Status	211	ENUM_ALARM_LOG_RECORD_STAT US See section Appendix C.3.1.63 - Alarm Log Record Status for more information.	2	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityAlarmManagerLastProcessedAlarmLogRecord	212	uint32	4	1
eHmiEntityAlarmManagerMarkAlarmLogRecordAsProcessed	213	uint32	4	1
eHmiEntityAlarmManagerAlarmLogUnprocessedRecordsAvailable	214	ENUM_UNPROCESSED_ALARM_RECORD_AVAILABLE See section Appendix C.3.1.64 - Unprocessed Alarm Record Available for more information.	2	1
eHmiEntityTransactionManager1010TransactionRecord	215	1010 Transaction Record See section Appendix C.3.2.20 - 1010 Transaction Record for more information.	162	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityTransactionManager1010BatchRecord	216	1010 Batch Record See section Appendix C.3.2.21 - 1010 Batch Record for more information.	402	1
eHmiEntityDisplayManagerCurrentScreen- Title	217	char[140]	140	1
eHmiEntityDisplayManagerCommandDisplayAlarmScreenCommand	218	N/A (command item)	2	1
eHmiEntityDisplayManagerCommandSendEscKeyCommand	219	N/A (command item)	2	1
eHmiEntityBayControlPlanInitStartBatchV2	220	Plan Init Start Batch V2 See section Appendix C.3.2.21 - 1010 Batch Record for more information.	20	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerInstantBatchValueBatchGov	221	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information.	1	1
eHmiEntityDeviceManagerInstantBatchValueBatchGsv	222	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1
eHmiEntityDeviceManagerInstantBatchValueBatchMass	223	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerInstantBatchValueInstantTemperature	224	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1
eHmiEntityDeviceManagerInstantBatchValueInstantPressure	225	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1
eHmiEntityDeviceManagerInstantBatchValueInstantDensity	226	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1

Description/Reference	Value	Data Type	Size	Elements
eHmiEntityDeviceManagerInstantBatchValueFlowRate	227	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1
eHmiEntityDeviceManagerInstantBatchValueBlendPercentage	228	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1
eHmiEntityDeviceManagerInstantBatchValuePpm	229	ENUM_ENABLE_DISABLE See section Appendix C.3.1.6 - Enable/ Disable for more information	1	1

Description/Reference	Value	Data Type	Size	Elements
eArmEntityBoardDigitalIoState	230	Arm Card Digital IO States See section Appendix C.3.1.54 - ARM Card Digital IO States for more information.	1	1
eIocEntityBoardDigitalIoState	231	IO Card Digital IO States See section Appendix C.3.1.53 - IO Card Digital IO States for more information.	1	1
eHmiEntityAlarmManagerResetExternalAdditiveStreamSpecificAlarms	237	uint16	2	1

Appendix B: Description of Parameters

B.1 Fusion4 controllers for additive injection

The following table provides a description of the parameters for the Fusion4 controllers for additive injection, i.e. the Fusion4 SSC-A and the Fusion4 MSC-A.

Table B-1: Description of parameters for Fusion4 additive controllers

Parameter Name	Description
Accumulative additive stream gross observed volume	The accumulative gross observed volume of the additive stream excluding leaking additive and additive dispensed during calibration. The unit of measurement is unit of volume.
Accumulative calibration gross observed volume	The accumulative gross observed volume (GOV) of the product received in a calibrated vessel over all calibration operations. The unit of measurement is unit of volume. To increase the accuracy of the flow meter, a calibration can be performed. This is done by comparing the actual resulting fuel volume received in a calibrated vessel with the displayed value on the screen of the controller, being the result of the value returned from the flow meter. With these two values a correction factor can be calculated, which then is used to (re-) calibrate the flow meter.
Accumulative leaking solenoid gross observed volume	The accumulative gross observed volume (GOV) of leaked additive product as a result of a leaking valve. The unit of measurement is unit of volume.

Parameter Name	Description
Accumulative load stream gross observed volume	The accumulative gross observed volume (GOV) of the load stream. The unit of measurement is unit of volume.
Accumulative total additive stream gross observed volume	The accumulative total gross observed volume (GOV) of the additive stream. The unit of measurement is unit of volume.
Accumulative transactional additive stream gross observed volume	The accumulative gross observed volume of additive product dispensed within the current transaction. The unit of measurement is unit of volume.
Accumulative wild stream gross observed volume	The accumulative gross observed volume (GOV) of the wild stream. The unit of measurement is unit of volume.
Active alarms	Displays all active alarms. See section C.1.8 for more information.
Additive deviation basis	The number of injection cycles over which the average injection amount will be calculated and be used to determine if a deviation alarm condition exists.
Additive K-factor	The K-factor of the flow meter that measures the additive stream. The unit of measurement is pulses per unit of volume.
Additive stream flow rate	The flow rate of the additive stream. The unit of measurement is unit of volume per minute.
Additive stream state	The state of the additive stream. See section C.1.7 for more information.
Additive volume deviation alarm action	The alarm action taken when the Additive volume deviation alarm occurs. See section C.1.2 for more information.

Parameter Name	Description
Additive volume deviation allowed	The percentage of additive volume deviation that is accepted without resulting in an alarm situation. If this percentage is exceeded an alarm will occur depending on the setting of the Additive volume deviation alarm action parameter. The alarm will occur at the end of the transaction.
Alarm and permissive state (injectors 1-6)	This parameter contains the stream permissive and alarm states for the first 6 additive streams as a 16-bit bit mask. In this bit mask the least significant bit is the stream permissive status of stream 1 (0 = Unpermitted, 1 = Permitted). The second least significant bit is the alarm status of stream 0 (0 = No alarm, 1 = at least one active alarm). The third and fourth least significant bits represent the same data from additive stream 2. This pattern continues until the 11th and 12th least significant bits for the permissive and alarm status for stream 6. The four most significant bits are unused and will always be zero.
Alarm and permissive state (injectors 7-12)	This parameter contains the stream permissive and alarm states for additive streams 7-12 as a 16-bit bit mask. See the previous parameter for implementation details.
Broadcast address	The secondary address recognized by the Fusion4 SSC-A. It is not necessarily unique to any particular controller. This address is used by the client if it wants to transmit a command to more than one controller simultaneously. The controller will act upon a message addressed to its own broadcast address, but will not acknowledge it.
Clean start gross observed volume	The minimum amount of volume of main product that must be flushed through piping at the end of a load to ensure that all traces of additive product have been removed from the piping downstream from injection point. The unit of measurement is the unit of volume.
Communications delay port 1	The time between the received request from the client and the moment the answer will be sent. The unit of measurement is milliseconds (ms).
Communications delay port 2	‘Communications delay port 1’.

Parameter Name	Description
Device serial number	The serial number of the device.
DI hysteresis time	The active time of the input signal before accepting it as a valid input signal. So the time between two signal transitions must be greater then the DI hysteresis time. The unit of measurement is milliseconds.
Factored pulse output resolution	The number of pulses transmitted for each unit of volume of additive stream flow. See section C.1.5 for more information.
Feedback pulse duration	The duration of the feedback pulse. The unit of measurement is milliseconds.
Firmware version number	A six character string used to identify the firmware version number.
Flush volume	The amount of wild stream volume to realize the flushing, by stopping the injections before the end of the transaction. The flush volume is the amount of wild stream product that is to remain additive free in order to realize a clean arm when the flow stops. The flush volume and Number of clean start cycles determine the additional additive volume to be injected at the start of the transaction ('over injection'). When the flush volume equals zero, the clean arm operation is disabled.
High flow threshold value	The flow rate which must be exceeded to start the injection process during clean arm operation. The unit of measurement is unit of volume per minute.
Injection offset	The percentage to determine at what point the controller gives the first injection during a transaction. The percentage is applied to the volume per injection cycle and determines the volume of wild stream product at the moment that the first injection occurs. Subsequent injections occur on the normal volume per injection cycle interval. The Injection offset will guarantee the delivery of the intended additive amount within the complete batch.
Injection volume	The amount of injection volume to be dispensed per injection cycle. The unit of measurement is unit of additive volume.

Parameter Name	Description
Leaking solenoid alarm action	The alarm action taken when the Leaking solenoid alarm occurs. See section C.1.2 for more information.
Leaking solenoid timeout period	The time in which the leaking solenoid volume limit will be checked. The unit of measurement is seconds.
Leaking solenoid volume limit	The maximum amount of additive volume within the leaking solenoid timeout period before the Leaking solenoid alarm is generated. The unit of measurement is unit of additive volume. If the leaking volume limit is exceeded, an alarm will occur depending on the setting of the 'Leaking solenoid alarm action' parameter.
Leaking timeout period	The time in which the leaking volume limit will be checked. The unit of measurement is seconds.
Load stream flow rate	The flow rate of the load stream. The unit of measurement is unit of volume per minute.
Low flow threshold value	The flow rate at which the flushing starts by stopping the additive injection process. The unit of measurement is units of volume per minute.
Minimum product volume for transaction	The minimum volume of wild stream that is required for a transaction to start. The unit of measurement is unit of volume.
No activity timeout alarm action	The alarm action taken when the 'No activity' alarm occurs. See section C.1.2 for more information.
No activity timeout period	The time in which wild stream pulses should be received when the controller is permitted. The unit of measurement is seconds. When after this time no wild stream pulses have been received, an alarm will occur depending on the setting of the No activity alarm action parameter.
No additive alarm action	The alarm action taken when the 'No additive' alarm occurs. See section C.1.2 for more information.

Parameter Name	Description
No additive flow timeout period	The time in which additive stream pulses should be received when the solenoid is opened. The unit of measurement is seconds. When after this time no additive stream pulses have been received after the configured number of retries, an alarm will occur depending on the setting of the 'No additive alarm action' parameter.
Number of clean start cycles	The number of injection cycles at the start of the transaction to be used for "over injection". This 'over injection' at the start compensates the injection stop at the end of the transaction, in order to realize the clean arm or flushing of the arm.
Number of solenoid retries	The number of retries for opening the solenoid again in case no additive pulses are received.
Pacing source	The physical source for the additive pacing. See section C.1.4 for more information.
Permissive function	The permissive configuration for the controller. See section C.1.6 for more informa- tion.
Permissive state	The permissive state of the controller. See section C.1.3 for more information.
Product ID	The ID of the controller, e.g. SSC_A or MSC_A.
Product stream flow rate	The flow rate of the main product stream. The unit of measurement is unit of volume per minute.
Pump run timeout	The time between the last injection and the additive pump stop. The unit of measurement is seconds.
Pump start timeout	The amount of time after the pump demand output is driven that the pump indication input must be active. Otherwise, a No pump alarm is generated.
Slow flow volume alarm action	The alarm action taken when the Slow flow volume alarm occurs. See section C.1.2 for more information.
Software version	The software version of the board through which the data is read.
Solenoid close delay	Displays the time in which the additive pulses must be stopped after the solenoid is closed. The unit of measurement is milliseconds.

Parameter Name	Description
Solenoid dwell time	Displays the minimum time the solenoid will open and close. The unit of measurement is milliseconds. The parameter value is normally set to zero in injectors that require the solenoid to open and stay open until the full volume per cycle is injected. The numeric value represents the 'ON' time of the solenoid. The 'OFF' time is equal to the 'ON' time. When this value is nonzero, the controller will continue to pulse the valve control output until the amount of additive called for in the 'Injection Volume' setting is dispensed. The stroke repeat rate is double the solenoid dwell time.
Task register	Executes a task. See section C.1.1 for more information.
Transaction closing time	The time to indicate the end of the transaction. The unit of measurement is sec- onds. When within the end transaction time no wild stream pulses are received, the transaction will be finished.
Transaction PPM	The calculated additive PPM (parts per million) of the current transaction. This value is not updated synchronously with the transactional volumes.
Transactional additive stream gross observed volume	The transactional gross observed volume (GOV) of the additive stream. The unit of measurement is unit of additive volume.
Transactional load stream gross observed volume	The transactional gross observed volume (GOV) of the load stream. The unit of measurement is unit of volume.
Unit address	The primary address of the controller. The primary address is the value used to identify a particular controller to the client computer. This 3-digit number must be unique to each controller on a communication loop.
Volume per injection cycle	The amount of wild stream volume per injection cycle. The unit of measurement is unit of volume.
Wild stream K-factor	The calibration K-factor of the flow meter that measures the wild stream. The unit of measurement is pulses per unit of volume.

B.2 Fusion4 controllers for blending

The following table provides a description of the parameters for the Fusion4 controllers for blending, i.e. the Fusion4 SSC-B.

Table B-2: Description of parameters for Fusion4 controllers for blending

Parameter Name	Description
Accumulative blend stream gross observed volume	The accumulative gross observed volume (GOV) of the blend stream. The unit of measurement is unit of volume.
Accumulative blend stream gross standard volume	The accumulative gross standard volume (GSV) of the blend stream. The unit of measurement is unit of volume.
Accumulative blend volume (emulation mode only)	When the blender is operating in Mini-Pak emulation mode the blender responds to certain serial commands in the same manner as the SSC-A does. This emulation mode allows the SSC-B to be used by external preset loaders that only support external additive injectors. In order for the SSC-B to be externally controlled by via additive injector serial interface, it must return the accumulative blend volume for parameter 850 just as the SSC-A returns the accumulative additive volume for parameter 850. When operating in Mini-Pak emulation mode, this parameter will return the accumulative gross observed volume of blend product across all transactions.

Parameter Name	Description
Accumulative calibration gross observed volume	The accumulative gross observed volume of the product received in a calibrated vessel over all calibration operations. The unit of measurement is unit of volume. To increase the accuracy of the flow meter, a calibration can be performed. This is done by comparing the actual resulting fuel volume received in a calibrated vessel with the displayed value on the screen of the controller, being the result of the value returned from the flow meter. With these two values a correction factor can be calculated, which then is used to (re-)calibrate the flow meter.
Accumulative leaking blend stream gross observed volume	The accumulative gross observed volume (GOV) of leaked blend product as a result of a leaking valve. The unit of measurement is unit of volume.
Accumulative load stream gross observed volume	The accumulative gross observed volume (GOV) of the load stream. The unit of measurement is unit of volume.
Accumulative wild stream gross observed volume	The accumulative gross observed volume (GOV) of the wild stream. The unit of measurement is unit of volume.
Active alarms	Displays the active alarms. See section C.1.8 for more information.
Blend high percentage allowed	The high percentage allowed before the 'Blend percentage deviation' alarm is generated. This is only evaluated at the end of the transaction with the total volumes.
Blend low percentage allowed	The low percentage allowed before the 'Blend percentage deviation' alarm is gener- ated. This is only evaluated at the end of the transaction with the total volumes.

Parameter Name	Description
Blend percentage deviation alarm action	The alarm action taken when the 'Blend percentage deviation' alarm occurs. See section C.2.2 for more information.
Blend point relative to wild stream meter	The insertion point of the physical blend piping. See section C.2.3 for more information.
Blend product expansion coeff	The expansion coefficient of the blend product.
Blend product observed density	The density of a 'lab sample' of blend product. The unit of measurement is unit of density.
Blend Product observed pres-sure	The pressure of the 'lab sample' of blend product when its density was measured. The unit of measurement is unit of pressure.
Blend Product observed temperature	The temperature of the 'lab sample' of blend product when its density was measured. The unit of measurement is unit of temperature.
Blend stream closing time	The maximum time that is allowed for closing the blend valve. The unit of measurement is seconds. If the controller still measures blend stream volume after this time, an alarm will be generated depending on the setting of the 'Blend stream closing timeout alarm action' parameter.
Blend stream closing timeout alarm action	The alarm action taken when the 'Blend stream closing timeout' alarm occurs. See section C.2.2 for more information.
Blend stream flow rate	The flow rate of the blend stream. The unit of measurement is unit of volume per minute.
Blend stream K-factor	The calibration K-factor of the flow meter that measures the blend stream. The unit of measurement is pulses per unit of volume.
Blend stream pressure	The pressure of the blend stream. The unit of measurement unit of measurement is unit of pressure.

Parameter Name	Description
Blend stream pulse timeout	The time the controller keeps on being active after the blend stream pulses stop and the permissive is removed. The unit of measurement is seconds. Once the per- missive is removed, the controller will not report a control failure alarm. After the permissive is removed, the controller will close the digital control valve (DGV) immediately. The remaining blend stream volume during the pulse timeout period will be used to determine the final blend percentage.
Blend stream state	The state of the blend stream. See section C.2.17 for more information.
Blend stream temperature	The temperature of the blend stream. The unit of measurement is unit of temperature.
Broadcast address	The secondary communications address recognized by the Fusion4 SSC-B. It is not necessarily unique to any particular controller. This address is used by the client if it wants to transmit a command to more than one controller, simultaneously. The Fusion4 SSC-B will not respond to a message addressed to its broadcast address.
Calibration end flow volume	The amount of volume before the end of delivery of the calibration procedure when the controller will transition from the high flow rate to the low flow rate. The unit of measurement is unit of volume. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Calibration end low flow volume	The amount of volume before the target calibration volume at which the blend flow rate should be reduced from full flow to the configured slow flow rate. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.

Parameter Name	Description
Calibration final shut down volume	The amount of volume before the end of delivery, when the controller will signal the digital control valve (DGV) to close. The unit of measurement is unit of volume. Normally used when using slow valves to prevent 'over' flow at the end of the calibration process. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Calibration high flow rate	The maximum flow rate that is allowed through the blend stream. The unit of measurement is unit of volume per minute. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Calibration inner control window limit	The volume at which the digital control valve (DCV) is pulsed open or closed. The unit of measurement is unit of volume. If the flow rate is determined to be less than the value set by the Calibration inner control window limit, the control valve will remain locked at the current flow rate. If the flow rate is determined to be outside the value set by the Calibration inner control window limit, the controller will signal the DCV to either open or close, depending if the deviation volume is positive or negative. The maximum value for the Calibration inner control window limit must not be greater than the value for the Calibration outer control window limit. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Calibration low flow rate	The minimum flow rate that is allowed through the blend stream. The unit of measurement is units of volume per minute. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.

Parameter Name	Description
Calibration low flow volume	The amount of volume at the start of a calibration run at during which the blend must remain at the slow flow rate before transitioning to the full flow rate. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Calibration outer flow rate control window	The volume at which the digital control valve (DCV) is continuously signaled to open or close. The unit of measurement is unit of volume. If the flow rate is determined to be less than the value set by Calibration outer control window limit, the DCV will remain under control of the Calibration inner control window limit. If the flow rate is determined to be outside the value set by the Calibration outer control window limit, the controller will signal the DCV to either open or close by holding the proper solenoid continuously open or closed, depending if the deviation volume is positive or negative. The maximum value for the Calibration outer control window limit must be greater than the value for the Calibration inner control window limit. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Calibration start low flow volume	The amount of volume that will be delivered at the low flow rate during the calibration procedure before the controller begins the transition to the high flow rate. The unit of measurement is units of volume. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Clean start control	Defines how the controller knows when to stop blending while doing a clean arm operation. See section C.2.8 for more information.

Parameter Name	Description
Commodity group	The commodity group of the blend product. See section C.2.12 for more information.
Compressibility factor	A value calculated for type E commodities that describes how the volume is affected by pressure.
Control failure alarm action	The alarm action taken when the 'Control failure' alarm occurs. See section C.2.2 for more information.
Control failure alarm timeout	The time the controller will try to correct an out-of-tolerance blend, before generating the 'Control failure' alarm. The unit of measurement is seconds.
Dead band control window limit	The allowed volume deviation from target blend volume. When the observed blend volume is less than dead band control window limit, the control output from the controller is locked. No correction is made to the blend stream control valve. This value effectively establishes the 'dead band' in which the blend stream volume can deviate without correction. The dead band is plus or minus this value.
Density (Base)	The calculated blend product base density based upon the lab sample data (density, temperature, and pressure). The unit of measurement is unit of density.
Density (Lab)	The density of a 'lab sample' of blend product. The unit of measurement is unit of density.
Density (Observed)	The currently calculated blend product density based upon the observed temperature, pressure, and base density. The unit of measurement is unit of density.
Deviation count smoothing value	The number of successive samples that are averaged before calculating an actual deviation volume. This parameter eliminates incremental dips and spikes in the deviation volume calculation.
Device serial number	The serial number of the device.

Parameter Name	Description
DI hysteresis time	The active time of the input signal before accepting it as a valid input signal. So the time between two signal transitions must be greater than the DI Hysteresis time. The unit of measurement is milliseconds.
Expansion factor	A factor that describes the rate of expansion for commodity type C products. It is expressed in units of (1/units of temperature) e.g., 1/°C or 1/°F.
Factored pulse output resolution 1	The physical source for the 'Blend volume output 1' function (factored pulses). See section C.2.5 for more information.
Factored pulse output resolution 2	The physical source for the 'Blend volume output 2' function (factored pulses). See section C.2.5 for more information.
Firmware version number	A six character string used to identify the firmware version number.
Flow calculation smoothing value	The number of successive samples that are averaged before calculating an actual deviation volume. This parameter eliminates incremental dips and spikes in the deviation volume calculation. NOTE: This parameter is only applicable when doing a calibration of the blend stream flow meter.
Flush volume	The amount of wild stream volume to realize the flushing by stopping the blending before the end of the transaction. The unit of measurement is unit of volume. The flush volume is the amount of wild stream product that is to remain blend-product free in order to realize a clean arm when the flow stops. When the flush volume equals zero, the clean arm operation is disabled.
Flush volume alarm action	The alarm action taken when the Flush volume alarm occurs. See section C.2.2 for more information.
Flush volume deviation	The maximum percentage of the flush volume that is allowed to be lower than the flush volume without resulting in an alarm situation (Slow flow alarm).

Parameter Name	Description
Glass hydrometer used	Indicates whether a glass hydrometer was used to meter the observed blend prod- uct density. If a glass hydrometer was used, the blend product observed density will be corrected for measurement error associated with glass hydrometers. See section C.2.14 for more information.
Gross standard volume calculation interval	The amount of incremental gross observed volume over which the volume correction factor (CTPL) calculations are done (provided that the time since the last volume correction factor (CTPL) is between the minimum and maximum calculation interval values).
Inner control window limit	The allowed volume deviation from the target blend volume. The inner control window limit should be greater than the dead band window limit and less than middle control window limit. When the volume deviation is greater than the dead band window limit and less than the inner control window limit, the controller uses one-half the Solenoid active dwell configuration setting and double the Solenoid rest dwell configuration setting for controlling the blend stream control valve.
Instantaneous pressure	The current blend product pressure as measured from the 4-20 mA input (if used). The unit of measurement is unit of pressure.
Instantaneous temperature	The instantaneous blend product temperature as measured from the temperature probe (if used). The unit of measurement is unit of temperature.
Leaking blend valve alarm action	The alarm action taken when the Leaking blend valve alarm occurs. See section C.2.2 for more information.
Leaking blend valve volume limit	The maximum amount of leaking blend volume permitted. The unit of measurement is unit of volume. If this limit is exceeded, an alarm will occur depending on the set- ting of the Leaking blend valve alarm action parameter.

Parameter Name	Description
Middle control window limit	The allowed volume deviation from the target blend volume. The middle control window limit should be greater than the inner control window limit and less than outer control window limit. When the volume deviation is greater than the inner control window limit and less than the outer control window limit, the controller uses the Solenoid active dwell and the Solenoid rest dwell configuration settings for con- trolling the blend stream control valve.
Minimum wild stream volume for alarm	The minimum amount of wild stream product that must be dispensed before the blend percentage alarm criteria are evaluated for alarm purposes. If the transactional blend percentage is outside the configured window after this time a blend percentage alarm will be generated.
Multifunction DC output #1	The physical source for the Blend volume output function (factored pulses). See section C.2.5 for more information.
Multifunction DC output #2	Multifunction DC output #2.
No activity alarm action	The alarm action taken when the No activity alarm occurs. See section C.2.2 for more information
No activity timeout period	The time in which wild stream pulses should be received if the controller is permitted. When after this time no wild stream pulses have been received, an alarm will occur depending on the setting of the No Activity alarm action parameter. The unit of measurement is seconds.
Outer control window limit	The allowed volume deviation from the target blend volume. The unit of measurement is unit of volume. The outer control window limit should be greater than middle control window limit. When the volume deviation is greater than the Middle control window limit and less than the Outer control window limit, the controller uses double the Solenoid active dwell value and one-half the Solenoid rest dwell configuration settings for con- trolling the blend stream control valve.

Parameter Name	Description
Permissive function	The permissive configuration for the controller. See section C.2.9 for Modbus RTU and section C.2.10 for Modbus Legacy.
Permissive Hysteresis	The configured hysteresis time for DI AC 1 input channel (commonly used for permissive input). This parameter value always reflects the configured hysteresis time of this particular input channel and not the input channel configured for the permissive.
Permissive state	The permissive state of the controller. See section C.2.4 for more information.
Pre-shutdown closure volume	The pre-shutdown volume used to correct the volume that is measured while closing the valve. The unit of measurement is unit of volume.
Pre-shutdown volume	The mode of pre-shutdown control. NOTE: This parameter is only applicable if the Clean start control parameter is configured for Volume. See section C.2.7 for more information.
Preset gross observed volume	The volume of product to be loaded during the transaction. The unit of measurement is units of volume. The blend percentage is adjusted according to the amount defined in the Preset volume in order to increase the amount of blend stream product going into the load prior to flushing the arm at the end of the delivery. NOTE: This parameter is only applicable if the Flush volume is non-zero.
Pressure (base)	The pressure reference used to determine the base conditions of the volume correction of the GSV and mass. This base pressure must be set to a value accepted by the associated volume correction factor (VCF) table configuration entity. The unit of measurement is unit of pressure.
Pressure (lab)	The pressure of the 'lab sample' of blend product when its density was measured. The unit of measurement is unit of pressure.

Parameter Name	Description
Pressure (observed)	The currently observed blend product pressure. The unit of measurement is unit of pressure.
Pressure compensation used	Indicates whether pressure compensation was used to calculate the gross standard volume.
Product ID	The ID of the controller, e.g. 'SSC_B'.
Product stream flow rate	The flow rate of the main product. The unit of measurement is unit of volume per minute.
Recipe 1 target blend percentage	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive 1 status input or via communications.
Recipe 2 target blend percentage	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive 2 status input or via communications.
Recipe 3 target blend percentage	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive 3 status input or via communications.
Recipe 4 target blend percentage	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive 4 status input or via communications.
Recipe 5 target blend percentage	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive 5 status input or via communications.
Reference pressure	The reference pressure used for volume correction. The unit of measurement is unit of pressure.
Reference pressure units	The engineering unit for the reference pressure. See section C.2.16 for more information.

Parameter Name	Description
Reference temperature	The reference temperature used for volume correction. The unit of measurement is unit of temperature.
Reference temperature units	The engineering unit for the reference temperature. See section C.2.15 for more information.
Reset blend deviation counter at transaction start	Defines if the deviation count is reset at the start of a new transaction. See section C.2.6 for more information.
Software version	The software version of the board through which the data is read.
Solenoid active dwell	The time a solenoid is held in the state (energized or de-energized) that allows flow through it. The unit of measurement is milliseconds. In case of a normally-closed (N.C.) solenoid, it is the energized open state. In case of a normally-open (N.O.) solenoid, it is the de-energized open state.
Solenoid rest dwell	The time a solenoid is held in the state (energized or de-energized) that stops flow through it. The unit of measurement is milliseconds. In the case of a normally- closed (N.C.) solenoid, it is the de-energized closed state. In the case of a normally- open (N.O.) solenoid, it is the energized closed state.
Target blend percentage rate A	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive A status input or via communications.
Target blend percentage rate B	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive B status input or via communications.

Parameter Name	Description
Target blend percentage rate C	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive C status input or via communications.
Target blend percentage rate D	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive D status input or via communications.
Target blend percentage rate E	The ratio of the blend product compared to the combined total flow. The ratio is expressed as a percentage. This blend percentage is selected by a high or true signal on the Permissive E status input or via communications.
Task register	Executes a task. See section C.2.1 for more information
Temperature (base)	The temperature reference used to determine the base conditions of the volume correction of the GSV and mass. This base temperature must be set to a value accepted by the associated volume correction factor (CTPL) table configuration entity. The unit of measurement is unit of temperature.
Temperature (lab)	The temperature of the 'lab sample' of blend product when its density was measured. The unit of measurement is unit of temperature.
Temperature (observed)	The currently observed blend product temperature. The unit of measurement is unit of temperature.
Temperature compensation used	Indicates whether temperature compensation is used to calculate the gross standard volume (GOV).
Transaction deviation count	The difference between the actual measured transactional blend product volume and the expected blend product volume. The expected value is equal to the transactional load volume times the selected blend ratio. This deviation count is maintained after the transaction stops and is only cleared when a new transaction starts (or the device is reset).

Parameter Name	Description
Transactional blend percentage	The transactional blend stream percentage.
Transactional blend stream gross observed volume	The transactional gross observed volume (GOV) of the blend stream. The unit of measurement is unit of volume.
Transactional blend stream gross standard volume	The transactional gross standard volume (GSV) of the blend stream. The unit of measurement is unit of volume.
Transactional current average temperature	The transactional current average temperature of the blend stream. The unit of measurement is unit of temperature.
Transactional load stream gross observed volume	The transactional gross observed volume (GOV) of the load stream. The unit of measurement is unit of volume.
Transactional wild stream gross observed volume	The transactional gross observed volume (GOV) of the wild stream. The unit of measurement is unit of volume.
Unit address	The primary communications address of the Fusion4 SSC-B. The primary address is the value used to identify a particular controller to the client computer. This 3-digit number must be unique to each controller on a communication loop.
VCF base to observed	The current volume correction factor (CTPL) used to convert the base blend product density to the calculated observed blend product density for the observed temperature and pressure.
VCF calculation interval max	The maximum amount of time between volume correction factor (CTPL) calculations on the incremental GOV. The unit of measurement is seconds.

Parameter Name	Description
VCF calculation interval min	The minimum amount of time between volume correction factor (CTPL) calculations on the incremental GOV. The unit of measurement is seconds.
VCF calculation interval volume	The amount of incremental GOV over which the volume correction factor (CTPL) calculations are done (as long at the time since the last volume correction factor (CTPL) is between the min and max calculation interval values). The unit of measurement is unit of volume.
VCF lab to base	The current volume correction factor (CTPL) used to convert the measured lab sample density to a density of the same product as measured at base conditions.
VCF options	The options enabled when using the volume correction factor (CTPL) table. The extended temperature and pressure and range give the ability to do the volume conversion over a broader range than covered by the earlier versions of the standard. For instance at locations where it is very cold, like Alaska. See section C.2.13 for more information. NOTE: When selected 'None' and the application goes beyond the normal range, an error will occur.
VCF status	The current status of the incremental volume conversion factor calculation. This value is 0 when no volume correction factor (CTPL) calculations are currently active and 1 when the controller is in the process of calculating a new volume correction factor (CTPL).
Volume (base)	The calculated standardized incremental volume for the last, incremental observed volume value. The unit of measurement is unit of volume.
Volume correction table	The volume correction method use during the transaction. See section C.2.11 for more information.

Parameter Name	Description
Wild stream closing volume	The maximum wild stream volume that is allowed after the permissive is removed. The unit of measurement is unit of volume. If the controller detects an overrun of the maximum wild stream volume, an alarm will be generated depending on the setting of the 'Wild stream closing volume alarm action' parameter.
Wild stream closing volume alarm action	The alarm action taken when the Wild stream closing volume alarm occurs. See section C.2.2 for more information.
Wild stream flow rate	The flow rate of the wild stream. The unit of measurement is unit of volume per minute.
Wild stream K-factor	The calibration K-factor of the flow meter that measures the wild stream. The unit of measurement is pulses per unit of volume.
Wild stream pulse timeout	The time the controller will delay after the removal of the permissive and the absence of wild stream flow before determining the final transaction totals. The unit of measurement is seconds.

B.3 Fusion4 controllers for loading

The Modbus protocol parameters for Fusion4 controllers for loading, i.e. the Fusion4 MSC-L, are divided into:

- Device-based protocol parameters, see section B.3.1
- Arm-based protocol parameters, see section B.3.2

B.3.1 Device-based protocol parameters

The following table provides a description of the device-based protocol parameters for Fusion4 controllers for loading.

Table B-3: Description of device-based protocol parameters for Fusion4 controllers for loading

Parameter Name	Description
Active Bay	The bay that is currently active. See C.3.1.29 for more information about the possible parameter values.
Accumulative GOV	The accumulative gross observed volume (GOV) of the product dispensed during total number of transactions. The unit of measurement is unit of volume.
Accumulative GSV	The accumulative gross standard volume (GSV) of the product dispensed during total number of transactions. The unit of measurement is unit of volume.
Accumulative Mass	The accumulative mass of the product dispensed during total number of transactions. The unit of measurement is unit of mass.
Analog Input 1...7	The value measured by the single external 4-20 mA transmitter (temperature, pressure) connected to the analog input.
Analog Output 1	The primary value of 4-20 mA analog output. This value can either be explicitly driven or follow one of the process variables, such as batch flow rate.
Arm Accumulative GOV	The accumulative gross observed volume (GOV) of the product dispensed by the arm during total number of transactions. The unit of measurement is unit of volume.
Arm Accumulative GSV	The accumulative gross standard volume (GSV) of the product dispensed by the arm during total number of transactions. The unit of measurement is unit of volume.
Arm Accumulative Mass	The accumulative mass of the product dispensed by the arm during total number of transactions. The unit of measurement is unit of mass.
Arm Virtual Stream Accumulative GOV	The accumulative gross observed volume (GOV) of the calculated product stream dispensed with the arm. The unit of measurement is unit of volume.
Arm Virtual Stream Accu-mulative GSV	The accumulative gross standard volume (GSV) of the calculated product stream dispensed with the arm. The unit of measurement is unit of volume.

Parameter Name	Description
Arm Virtual Stream Accumulative Mass	The accumulative mass of the calculated product stream dispensed with the arm. The unit of measurement is unit of mass.
Arm Command	This parameter is used to issue an arm command. See section C.3.2.12 for more information.
Arm Location	The location of the arm used to dispense the product. See section C.3.1.29 for more information about the possible parameter values.
Arm Name	The name of the arm used to dispense the product.
Arm Position	The position of the swing arm used to dispense the product. See section C.3.1.29 for more information about the possible parameter values.
Arm State Details	Dynamic, real-time information about the state of the arm. See section C.3.2.15 for more information.
Authorization Object	This parameter is used to issue a request for the database details of an authorized user or object. See also section C.3.2.4 for more information.
Authorization Data: Object	This parameter is used to add a new object to the local objects database. See section C.3.2.7 for more information.
Authorization Data: User	This parameter is used to add a new user to the local user database. See section C.3.2.7 for more information.
Bay Command	This parameter is used to issue a bay command. See section C.3.2.1 for more information.
Bay Name	This parameters is used to configure the name of the bay.
Bay Number	This parameters is used to configure the number of the bay.
Bay Side	The side of the bay at which the swing arm currently is located. See section C.3.1.28 for the possible parameter values.
Bay Type	The type of the bay. See section C.3.1.27 for more information about the possible parameter values.
Carrier ID	The unique identification of the carrier.

Parameter Name	Description
Compartment Response	This is a Honeywell Enraf proprietary parameter.
Contract ID	The unique identification of the contract or the order number.
Delete Database Entry	This parameter is used to remove an entry (user or object) from the Fusion4 MSC-L authorization database. See section C.3.2.13 for more information.
Device Name	The unique identification of the Fusion4 device.
Device serial number	The serial number of the Fusion4 device in the device line that created the transaction record. This serial number must be consistent with the serial number in the transaction record.
Device Type	The type of Fusion4 device the transaction record originates from.
Digital Input (AC)	The state of the Digital Input AC (DI AC). See section C.3.1.18 for more information about the possible parameter values.
Digital Input (DC)	The state of the Digital Input DC (DI DC). See section C.3.1.18 for more information about the possible parameter values.
Digital Input (PI)	The state of the Pulse Input (PI). See section C.3.1.18 for more information about the possible parameter values.
Digital Output (EMR)	The state of the Digital Output Electromechanical Relay (DO EMR). See section C.3.1.18 for more information about the possible parameter values.
Digital Output (SSR)	The state of the Digital Output Solid State Relay (DO SSR). See section C.3.1.18 for more information about the possible values.
Driver ID	The unique identification (name or number) of the driver performing the loading operations. NOTE: This value is never the driver's password.
Internal Prompt Data	This parameter is used to specify a Fusion4 TAS prompt to be shown using an internally defined string. See section C.3.2.9 for more information.
Last Processed Transaction	The last transaction marked as processed by Fusion4 Portal/TAS via a write to the [Mark Transaction As Processed] parameter.

Parameter Name	Description
Last User Answer	The last user response to a prompt, if any.
Load Number	The unique number of the transaction.
Mark Transaction As Processed	This parameter is used to mark a transaction as processed. When a transaction record has been copied to Fusion4 Portal, the transaction record can be declared processed. The process of marking transactions as processed is done using the transaction ID number. The transaction ID number is a unique 32-bit number embedded in every transaction record as part of the transaction unique identifier field.
Message Timeout	This is a Honeywell Enraf proprietary parameter.
Number of Arms: Available	The number of arms that are licensed and in position (for swing arms) for each particular bay. A bay is fully idle when the number of idle arms equals the number of available arms.
Number of Arms: Idle	The number of idle arms in the bay. If this value is 0 then no further loading should be planned on the bay (unless batch planning is allowed). An arm is considered idle for the bay if the arm is in position for the bay (in the case of a swing arm) and the arm is licensed for operation.
Number of Arms: Paused	The number of paused arms in the bay. This entity counts only arms that are paused without alarms (or with display-only alarms).
Number of Batches in Transaction	The number of batches in the last transaction that was started on the bay starting from the most recent device start up.
Number of Loading Bays	The number of bays: 1 (= Single bay) or 2 (= Dual bay).
Permissive Type: Grounding	The action taken when the grounding input is detached. See section C.3.1.30 for more information about the possible parameter values.

Parameter Name	Description
Permissive Type: Overfill	The action taken when the overfill protection input is detached. See section C.3.1.30 for more information about the possible parameter values.
Permissive Type: Vapour Recovery	The action taken when the vapour recovery input is detached. See section C.3.1.30 for more information about the possible parameter values.
Permissives Connected	Displays whether all the defined bay permissives (grounding, overfill protection, and vapour recovery) are connected. See section C.3.1.5 for more information about the possible parameter values. NOTE: Only permissives for which an I/O binding has been defined will be evaluated.
Plan Init Start Batch	This parameter is used to initialize and prompt a user to start a batch (if the device is con- figured for local start). The batch details provided are saved to the appropriate Batch Details Index entity as part of the parameter write request. This parameter write triggers a sequence of actions locally in the device that end with a user interacting with a resulting prompt (if the device is configured for local start). If the device is configured for remote start, the device will show a prompt indicating that the system is waiting for a remote start command if the batch initialization was successful. See also section C.3.2.8 for more information.
Pulse Output	The state of the Pulse Output DC (PO DC). See section C.3.1.18 for more information about the possible parameter values.
Record Request	This parameter is used to issue a request for an internal record and to read the status of a request. See section C.3.2.11 for more information.
Reference Number	The reference number of the arm.
RTD Input	The value measured by the PT100 resistance temperature detector (RTD) connected to the RTD input.

Parameter Name	Description
Show TAS Prompt	This parameter is used to request a Fusion4 TAS prompt. See section C.3.1.20 for more information about the possible parameter values.
Software version	The software version of the board through which the data is read.
TAS Max Preset Limit	
Trailer ID	The unique identification of the trailer associated with the transaction.
Transaction Authorization Details	This parameter is used to define the authorization details for a transaction. This data is only defined within the context of the TAS and should be included as part of the Fusion4 MSC-L transaction record to ensure that a complete Bill of Lading can be generated using only the data provided in the transaction record. See section C.3.2.2 for more information.
Transaction Record Size	The actual size of the transaction record currently exposed. The value of the [Transaction Record Size] parameter is used by Fusion4 Portal to determine the actual portion of the transaction record to read.
Transaction Record Version	The data structure version of the transaction record currently exposed. In the Fusion4 devices there will only be one type of transaction record supported and therefore this entity value will be a constant.
Units: Density	The engineering units associated with all density measurements in the batch record. See section C.3.1.23 for more information about the possible values.
Units: Injection Volume	The engineering units associated with all injection volume measurements in the batch record. See section C.3.1.26 for more information about the possible values.
Units: Mass	The engineering units associated with all mass measurements in the batch record. See section C.3.1.25 for more information about the possible values.

Parameter Name	Description
Units: Pressure	The engineering units associated with all pressure measurements in the batch record. See section NOTE: for more information about the possible values.
Units: Temperature	The engineering units associated with all temperature measurements in the batch record. See section C.3.1.24 for more information about the possible values.
Units: Volume	The engineering units associated with all volume measurements in the batch record. See section C.3.1.22 for more information about the possible values.
Universal Data Interface: Buffer	A vast number of parameters can be accessed via a single data buffer with small overheads to provide the data integrity. The data buffer serves as a generic read/write buffer together with the help of a few configuration/command registers.
Universal Data Interface: Command	The Universal Data Interface (UDI) command. See section C.3.1.32 for more information about the possible parameter values.
Universal Data Interface: Error Code	The Universal Data Interface (UDI) error code. See section C.3.1.33 for more information about the possible parameter values.
Universal Data Interface: Item	The Universal Data Interface (UDI) item. See APPENDIX A for an overview of the UDI items.
Universal Data Interface: Item Data Type	The data type of the Universal Data Interface (UDI) item.
Universal Data Interface: Item Elements (device)	The number of Universal Data Interface (UDI) item elements.

Parameter Name	Description
Universal Data Interface: Item Index (device)	The index number of the Universal Data Interface (UDI) item.
Universal Data Interface: Item Size (bytes)	The size of the Universal Data Interface (UDI) item.
Universal Data Interface: State	The state of the Universal Data Interface. See section C.3.1.31 for more information about the possible parameter values.
Unprocessed Transactions Available	This parameter is used to inform Fusion4 Portal that the device has unprocessed transaction records. See section C.3.1.39 for the possible parameter values. Fusion4 Portal can periodically poll this parameter in order to determine when to request the transaction record. The value of this entity is TRUE until Fusion4 Portal has acknowledged processing of every transaction in the transaction store of the device. A transaction can only be marked as processed by writing the associated transaction number in the [Mark Transaction As Processed] parameter.
User Response	The user's response on the prompt. See section C.3.2.5 for more information.
Vehicle ID	The unique identification of the vehicle associated with the transaction.
Workflow Option: Carrier Identification	Displays whether the Carrier Identification prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.

Parameter Name	Description
Workflow Option: Com-partment Identification	Displays whether the Compartment Identification prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: Load Number Identification	Displays whether the Load Number Identification prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: Preset Entry	Displays whether the Preset Entry prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: Preset Unloading Entry	Displays whether the Preset Unloading Entry prompt is enabled or disabled from the work- flow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: Return Quantity Entry	Displays whether the Return Quantity Entry prompt is enabled or disabled from the work- flow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: Trailer Identification	Displays whether the Trailer Identification prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: User Identification	Displays whether the User Identification prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.
Workflow Option: Vehicle Identification	Displays whether the Vehicle Identification prompt is enabled or disabled from the workflow options on the device configuration menus. See section C.3.1.36 for more information about the possible parameter values.

B.3.2 Arm-based protocol parameters

The following table provides an overview of the arm-based protocol parameters for Fusion4 load controllers.

Table B-4: Description of arm-based protocol parameters for Fusion4 load controllers

Parameter Name	Description
Accumulative calibration gross observed volume	The accumulative gross observed volume of the product received in a calibrated vessel over all calibration operations. The unit of measurement is unit of volume. To increase the accuracy of the flow meter, a calibration can be performed. This is done by comparing the actual resulting product volume received in a calibrated vessel with the displayed value on the screen of the controller, being the result of the value returned from the flow meter. With these two values a correction factor can be calculated, which then is used to (re-)calibrate the flow meter.
Accumulative GOV	The accumulative gross observed volume of product dispensed during total number of transactions. The unit of measurement is unit of volume.
Accumulative GSV	The accumulative gross standard volume of the product dispensed during total number of transactions. The unit of measurement is unit of volume.
Accumulative leaking solenoid gross observed volume	The accumulative gross observed volume of leaked additive product during total number of transactions as a result of a leaking solenoid/valve. The unit of measurement is unit of volume.
Accumulative Mass	The accumulative mass of the product dispensed during total number of transactions. The unit of measurement is unit of mass

Parameter Name	Description
Accumulative Mass Calibration Standard	The accumulative mass of the product received in a calibrated vessel over all calibration operations. The unit of measurement is unit of mass. To increase the accuracy of the flow meter, a calibration can be performed. This is done by comparing the actual resulting product volume received in a calibrated vessel with the displayed value on the screen of the controller, being the result of the value returned from the flow meter. With these two values a correction factor can be calculated, which then is used to (re-)calibrate the flow meter.
Accumulative Mass Leaking Standard	The accumulative mass of leaked product during total number transactions as a result of a leaking solenoid/valve. The unit of measurement is unit of volume.
Accumulative Mass Total Standard	The total sum of the values for the [Accumulative Mass] parameter, the [Accumulative Mass Calibration Standard] parameter and the [Accumulative Mass Leaking Standard] parameter.
Accumulative total additive stream gross observed volume	The accumulative total gross observed volume of the additive stream injected during total number of transactions. The unit of measurement is unit of volume.
Accumulative transactional additive stream gross observed volume	The accumulative gross observed volume of the additive stream injected during the transaction. The unit of measurement is unit of volume.

Parameter Name	Description
Accumulative Volume Calibration	The accumulative gross observed volume of the product received in a calibrated vessel over all calibration operations. The unit of measurement is unit of mass. To increase the accuracy of the flow meter, a calibration can be performed. This is done by comparing the actual resulting product volume received in a calibrated vessel with the displayed value on the screen of the controller, being the result of the value returned from the flow meter. With these two values a correction factor can be calculated, which then is used to (re-)calibrate the flow meter.
Accumulative Volume Calibration Standard	The accumulative gross standard volume of the product received in a calibrated vessel over all calibration operations. The unit of measurement is unit of mass. To increase the accuracy of the flow meter, a calibration can be performed. This is done by comparing the actual resulting product volume received in a calibrated vessel with the displayed value on the screen of the controller, being the result of the value returned from the flow meter. With these two values a correction factor can be calculated, which then is used to (re-)calibrate the flow meter.
Accumulative Volume Leaking	The accumulative gross observed volume of leaked product during total number of batches/transactions as a result of a leaking solenoid/valve. The unit of measurement is unit of volume.
Accumulative Volume Leaking Standard	The accumulative gross standard volume of leaked product during total number of batches/transactions as a result of a leaking solenoid/valve. The unit of measurement is unit of volume.
Accumulative Volume Permitted Observed	The accumulative gross observed volume of the product dispensed since the last reset by the user.

Parameter Name	Description
Accumulative Volume Permitted Observed Unloading	This is a Honeywell Enraf proprietary parameter.
Accumulative Volume Permitted Standard	The accumulative standard observed volume of the product dispensed since the last reset by the user.
Accumulative Volume Permitted Standard Unloading	This is a Honeywell Enraf proprietary parameter.
Accumulative Volume Total Observed	The total sum of the values for the [Accumulative GOV] parameter, the [Accumulative Volume Calibration] parameter and the [Accumulative Volume Leaking] parameter.
Accumulative Volume Total Standard	The total sum of the values for the [Accumulative GSV] parameter, the [Accumulative Volume Calibration Standard] parameter and the [Accumulative Volume Leaking Standard] parameter.
Active alarms	Displays all additive alarms currently in active or acknowledged state. See section C.3.1.17 for more information about the possible parameter values.
Actuator Type	The type of actuator (= valve). See section C.3.1.9 for more information about the possible parameter values.
Additive deviation basis	The number of injection cycles over which the average additive injection volume is calculated, and which is used to determine if an Additive Volume Deviation alarm condition exists.
Additive K-factor	The k-factor of the flow meter that measures the additive stream. The unit of measurement is pulses per unit of volume.
Additive stream state	The state of the additive stream. See section C.3.1.19 for more information.

Parameter Name	Description
Additive volume deviation alarm action	The alarm action taken when the Additive volume deviation alarm is raised. This alarm is raised when the additive volume deviation exceeds the [Additive volume deviation allowed]. See section C.3.1.1 for the possible parameter values.
Additive volume deviation allowed	The percentage of additive volume deviation that is accepted without resulting in an alarm situation. If this percentage is exceeded an alarm will occur depending on the setting of the [Additive volume deviation alarm action] parameter. The alarm will occur at the end of the transaction.
Alarm Action (VCF): Alpha60 Out Of Range	The alarm action taken when the Alpha60 Out Of Range alarm is raised when an Alpha60 Out of Range error occurs. This error could occur during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Bad Sensor Health	The alarm action taken when the Bad Sensor Health alarm is raised due to a Bad Sensor Health error. This error could occur during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Density Out Of Range	The alarm action taken when the Density Out of Range alarm raised. This alarm is raised when the density sensor output is out of range during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Factor Out Of Range	The alarm action taken when the Factor Out Of Range alarm is raised due to a Factor Out Of Range error. This error could occur during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Illegal Argu- ment	The alarm action taken when the Illegal Argument alarm is raised due to an Illegal Argument error. This error could occur during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.

Parameter Name	Description
Alarm Action (VCF): Memory Allocation	The alarm action taken when the Memory Allocation alarm is raised due to a Memory Allocation error. This error could occur during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): No Solution	The alarm action taken when the No Solution alarm is raised due to a No Solution error. This error could occur during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Pressure Compensation Not Supported	The alarm action taken when the Pressure Compensation Not Supported alarm is raised due to a Pressure Compensation Not Supported error. This could occur occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Pressure Out Of Range	The alarm action taken when the Pressure Out of Range alarm is raised. This alarm is raised when the pressure sensor output is out of range during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action (VCF): Tempera- ture Out Of Range	The alarm action taken when the Temperature Out Of Range alarm raised. This alarm is raised when a Temperature Out Of Range error occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action: Blend Tolerance	The alarm action taken when the Blend Tolerance alarm is raised. This alarm is raised when the blend ratio between the delivered product quantity with the delivered batch quantity is less than the blend ratio specified in the recipe by [Blend Tolerance Limit]. See section C.3.1.1 for the possible parameter values.

Parameter Name	Description
Alarm Action: Block Valve Failing	The alarm action taken when the Block Valve Failing alarm is raised. This alarm is raised when the block valve feedback signal is not detected within the [Block Valve Feedback Timeout] period. It is only possible if the I/O binding for the block valve is ON/ OFF and the block valve indications are configured. See section C.3.1.1 for the possible parameter values.
Alarm Action: Block Valve Fault	This is a Honeywell Enraf proprietary parameter.
Alarm Action: Density Bad Sensor	The alarm action taken when the Density Bad Sensor alarm occurs. See section C.3.1.1 for the possible parameter values.
Alarm Action: Factored Pulse Out	The alarm action taken when the Factored Pulse Out alarm is raised. This alarm is raised when the configured number of pulses cannot be generated on the pulse output. See section C.3.1.1 for the possible parameter values.
Alarm Action: Flowrate Exceeded Meter Limit	The alarm action taken when the Flowrate Exceeded Meter Limit alarm is raised. This alarm is raised when the flow rate exceeds the configured meter limits. See section C.3.1.1 for the possible parameter values.
Alarm Action: High Density	The alarm action taken when the High Density alarm is raised. This alarm is raised when the instantaneous density is greater than the configured limits. See section C.3.1.1 for the possible parameter values.
Alarm Action: High Pressure	The alarm action taken when the High Pressure alarm is raised. This alarm is raised when the instantaneous pressure is greater than the configured limits. See section C.3.1.1 for the possible parameter values.
Alarm Action: High Temperature	The alarm action taken when the High Temperature alarm raised. This alarm is raised when the instantaneous temperature is greater than the configured limits. See section C.3.1.1 for the possible parameter values.

Parameter Name	Description
Alarm Action: Invalid Reference Conditions	The alarm action taken when the Invalid Reference Conditions alarm raised. This alarm is raised when the Invalid Reference Conditions error occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action: Invalid Temperature Scale	The alarm action taken when the Invalid Temperature Scale alarm raised. This alarm is raised when the Invalid Temperature Scale error occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action: Leaking Valve	The alarm action taken when the Leaking Valve alarm is raised. This alarm is raised when the volume accumulated on the additive stream meter within the [Leaking Timeout Period] is more than the [Leaking Volume Limit] (when the stream is idle or in between injections). See section C.3.1.1 for the possible parameter values.
Alarm Action: Low Density	The alarm action taken when the Low Density alarm is raised. This alarm is raised when the instantaneous density is less than the configured limits. See section C.3.1.1 for the possible parameter values.
Alarm Action: Low Pressure	The alarm action taken when the Low Pressure alarm is raised. This alarm is raised when the instantaneous pressure is less than the configured limits. See section C.3.1.1 for the possible parameter values.
Alarm Action: Low Temperature	The alarm action taken when the Low Temperature alarm is raised. This alarm is raised when the instantaneous temperature is less than the configured limits. See section C.3.1.1 for the possible parameter values.
Alarm Action: No Hydraulic Pump	The alarm action taken when the No Hydraulic Pump alarm is raised. This alarm is raised when the feedback signal is not detected within the [Hydraulic Pump Demand Feedback Timeout] period. It is only possible if the I/O binding for hydraulic pump is ON/ OFF and the hydraulic pump indication is configured. See section C.3.1.1 for the possible parameter values.

Parameter Name	Description
Alarm Action: No Product	The alarm action taken when the No Product alarm is raised. This alarm is raised when no product flow is detected from the product stream meter within the [No Product Flow Timeout Limit]. See section C.3.1.1 for the possible parameter values.
Alarm Action: No Pump Sense	The alarm action taken when the No Pump Sense alarm is raised. This alarm is raised when the pump feedback signal is not detected within the [Pump Demand Feedback Timeout] period. It is only possible if the I/O binding for the pump is ON/ OFF and the pump indications are configured.See section C.3.1.1 for the possible parameter values.
Alarm Action: No Reference Flu- ids	The alarm action taken when the No Reference Fluid alarm is raised due to the No Reference Fluid error. This error occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action: Non Convergence	The alarm action taken when the Non Convergence alarm is raised due to the Non Convergence error. This error occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action: Overrun Exceeded	The alarm action taken when the Overrun Exceeded alarm is raised. This alarm is raised when the product quantity delivered exceeds the preset quantity by the con- figured [Overrun Quantity Limit]. See section C.3.1.1 for the possible parameter values.
Alarm Action: Pressure Bad Sensor	The alarm action taken when the Pressure Bad Sensor alarm is raised. See section C.3.1.1 for the possible parameter values.

Parameter Name	Description
Alarm Action: Pulse Hardware	The alarm action taken when the Pulse Hardware alarm raised. This alarm is raised when the pulse input module detects the following error conditions. • Reading information from the Pulse Input processor • Pulse overflow errors • BAD health of the pulse input function See section C.3.1.1 for the possible parameter values.
Alarm Action: Pulse Phase	The alarm action taken when the Pulse Phase alarm is raised. This alarm is raised when the dual pulse inputs are out of phase. It is only possible if the Fusion4 MSC-L is configured for quad pulse. See section C.3.1.1 for the possible parameter values.
Alarm Action: Supercritical Fluid	The alarm action taken when the Supercritical Fluid alarm is raised due to the Supercritical Fluid error. This error occurs during the volume correction calculation used in the Fusion4 MSC-L. See section C.3.1.1 for the possible parameter values.
Alarm Action: Tank Empty	The alarm action taken when the Tank Empty alarm is raised. This alarm is raised when a Tank Empty Signal is received. This signal is received only when the I/O binding input (DI, PI, and so on) are not active for the Tank empty input. See section C.3.1.1 for the possible parameter values.
Alarm Action: Tank Low Level	The alarm action taken when the Tank Low Level alarm is raised. This alarm is raised when a Tank Low Level signal is received. This signal is received only when the I/O binding input (DI, PI, and so on) are not active for the Tank low level input. See section C.3.1.1 for the possible parameter values.
Alarm Action: Temperature Bad Sensor	The alarm action taken when the Temperature Bad Sensor alarm occurs. See section C..1.1 for the possible parameter values.

Parameter Name	Description
Alarm Action: Valve Fault	The alarm action taken when the Valve Fault alarm is raised. This alarm is raised when the product stream valve is not closed in the [Valve Fault Timeout Period] parameter after sending the signal to close the product stream valve. See section C.3.1.1 for the possible parameter values.
Alarm and permissive state (injectors 1-6)	This parameter contains the stream permissive and alarm states for additive streams 1...6 as a 16-bit bit mask. In this bit mask the least significant bit is the stream permissive status of stream 1 (0 = Unpermitted, 1 = Permitted). The second least significant bit is the alarm status of stream 0 (0 = No alarm, 1 = at least one active alarm). The third and fourth least significant bits represent the same data from additive stream 2. This pattern continues until the 11th and 12th least significant bits for the permissive and alarm status for stream 6. The four most significant bits are unused and will always be zero.
Alarm and permissive state (injectors 7-12)	This parameter contains the stream permissive and alarm states for additive streams 7...12 as a 16-bit bit mask. See the [Alarm and Permissive State (Injectors 1-6)] parameter for implementation details.
Alarm and permissive state (injectors 13-18)	This parameter contains the stream permissive and alarm states for additive streams 13...18 as a 16-bit bit mask. See the [Alarm and Permissive State (Injectors 1-6)] parameter for implementation details.
Alarm and permissive state (injectors 19-24)	This parameter contains the stream permissive and alarm states for additive streams 19...24 as a 16-bit bit mask. See the [Alarm and Permissive State (Injectors 1-6)] parameter for implementation details.
Alarm Set	This parameter indicates whether there are one or more alarms active. See section C.3.1.5 for more information about the possible parameter values.
Alarms	Displays all additive alarms currently in active or acknowledged state.

Parameter Name	Description
Analog Input 1...7	The value measured by the single external 4-20 mA transmitter (temperature, pres- sure) connected to the analog input.
Analog Output	The primary value of 4-20 mA analog output. This value can either be explicitly driven or follow one of the process variables, such as batch flow rate.
Average Stream Density	The average or observed stream density during the batch. The unit of measurement is unit of density.
Average Stream Pressure	The average or observed stream pressure during the batch. The unit of measurement is unit of pressure.
Average Stream Temperature	The average or observed stream temperature during the batch. The unit of measurement is unit of temperature.
Back Pressure Control Factor	The calculated factor (range: 0.0 1.0) used as the product flow rate setpoint adjustment factor in order to reduce the flow rate when the pressure decreases and becomes too close to the vapour pressure. Reducing the flow rate is supposed to prevent further pressure decrease and therefore to avoid the risk of product vaporizing.
Base Pressure	The pressure reference used to determine the base conditions of the volume correction of the gross observed volume and mass. The base pressure must be set to a value accepted by the associated [VCF Table Options] parameter. The unit of measurement is unit of pressure.
Base Temperature	The temperature reference used to determine the base conditions of the volume correction of the gross observed volume and mass. The base temperature must be set to a value accepted by the associated [VCF Table Options] parameter The unit of measurement is unit of temperature.
Batch Flow Phase	The current phase of the batch. See section C.3.1.3 for more information about the possible parameter values.

Parameter Name	Description
Batch Flow Rate	The flow rate of the product stream during transfer of the batch. The unit of measurement is unit of volume per minute.
Batch GOV	The total gross observed volume of the product dispensed during the batch. The unit of measurement is unit of volume.
Batch GSV	The total gross standard volume of the product dispensed during the batch. The unit of measurement is unit of volume.
Batch ID	The unique identification of the batch.
Batch Mass	The total mass of the product dispensed during the batch. The unit of measurement is unit of mass.
Batch Permissive State	The permissive state of the batch. See section C.3.1.2 for the possible parameter values.
Batch Remaining Time	The remaining time for the batch to complete.
Blend Ratio	The blend ratio between delivered product quantity with delivered batch quantity.
Blend Ratio Observed	The actual blend ratio.
Blend Tolerance Limit	The blend tolerance limit configured for the Fusion4 MSC-L. When the blend ratio between delivered product quantity and delivered batch quantity is less or greater than the [Blend Tolerance Limit] the Blend Tolerance alarm is raised.
Block Valve Fault Alarm Action	The alarm action taken when the Block Valve Fault alarm is raised. See section C.3.1.1 for the possible parameter values.
Block Valve Feedback Timeout	The time in seconds in which the additive pump provides to the Fusion4 MSC-L. If the feedback from the pump is not received within this time, an alarm is raised depending on the [Block Valve Fault Alarm Action].
Clean Arm Quantity	The amount of the unblended main product at the end of a batch. The unit of measurement is unit of volume.

Parameter Name	Description
Clean Line Alarm Action	The alarm action taken when the Clean Line alarm is raised. This alarm is raised when the [Clean Arm Quantity] is less than the specified [Clean Line Alarm limit]. See section C.3.1.1 for the possible parameter values.
Clean Line Alarm Limit	The minimum clean arm volume that is allowed. If the measured clean arm volume is less than the specified clean arm volume minus the clean arm tolerance, this results in an Clean Line alarm situation.
Clean start gross observed volume	The minimum amount of volume of main product that must be flushed through piping at the end of a batch to ensure that all traces of additive product have been removed from the piping downstream from injection point. The unit of measurement is the unit of volume.
Comms Permissive	See section C.3.1.6 for more information about the possible parameter values.
Controller Kdb	These are Honeywell Enraf proprietary parameters.
Controller Kff	
Controller Ki	
Controller Kout	
Controller Kp	
Controller Kve	
Critical Alarm Set	Indicates whether one or more critical alarms are active. See section C.3.1.5 for more information about the possible parameter values.
DCV Minimum Pulse Width	The minimal time between solenoid changes (range = 50...950 ms).
DCV Period	The time between DCV output updates (range = 100...1000 ms).
Density At Metering Conditions	The density of the product at metering conditions. The unit of measurement is unit of density.
Density Observed	The density of the product stream as it is measured in the lab. The unit of measurement is unit of density.

Parameter Name	Description
Device Serial Number	The serial number of the Fusion4 device in the device line that created the transaction record. This serial number must be consistent with the serial number in the transaction record.
Device Type	The type of Fusion4 device the transaction record originates from.
Digital Input (AC)	The current state of the Digital Input AC (DI AC). See section C.3.1.18 for more information about the possible parameter values.
Digital Input (DC)	The state of the Digital Input DC. See section C.3.1.18 for more information about the possible parameter values.
Digital Input (PI)	The state of the Pulse Input (PI). See section C.3.1.18 for more information about the possible states.
Digital Output (EMR)	The current state of the Digital Output Electromechanical Relay (DO EMR). See section C.3.1.18 for more information about the possible parameter values.
Digital Output (SSR)	The current state of the Digital Output Solid State Relay AC (DO-SSR AC). See section C.3.1.18 for more information about the possible parameter values.
Factored pulse output resolution	The number of pulses transmitted for each unit of additive volume dispensed. See C.3.1.8 for the possible parameter values.
Feedback pulse duration	The duration of the feedback pulse in ms. The range is 0 ms...1000 ms. Some injector-feedback modes (i.e. Post injection, Double pulse, Last 25%, Extended piston switch, Inverted extended piston switch) produce pulses of a fixed length. For these modes, the length of the pulse is determined by the [Feedback pulse duration].
Flow Rate	The actual flow rate of the currently active batch. The unit of measurement is volume per minute.
Flow Rate Error	The difference between the actual flow rate and the set point flow rate.
Full Flow Rate	The target flow rate of he final product when it is neither in Initial or Pre-stop state.

Parameter Name	Description
High flow threshold value	This is a Honeywell Enraf proprietary parameter.
Hydraulic Product Pump Timeout	The time in minutes between stopping the blend stream flow and closing the hydraulic pump.
Hydraulic Pump Demand Feedback Timeout	The time in seconds in which the hydraulic pump must give feedback to the Fusion4 MSC-L. If no hydraulic pump feedback is received within [Hydraulic Pump Demand Feedback Timeout], an alarm is raised depending on the [No Hydraulic Pump] alarm action.
Initial Flow Rate	The rate at which the final product is initially filled into the compartment until the delivered volume is greater than the Initial Volume is determined. The range is <1> L/min to <1000000> L/min (default = <300> L/min).
Initial Quantity	The amount of product that must be delivered into the compartment at the [Initial Flow Rate] to ensure that the risk of static discharge is eliminated. The range is <0> L to <1000000> L (default = <300> L).
Injection offset	The percentage to determine at what point the controller gives the first injection during a transaction. The percentage is applied to the volume per injection cycle and determines the volume of wild stream product at the moment that the first injection occurs. Subsequent injections occur on the normal volume per injection cycle interval. The Injection offset will guarantee the delivery of the intended additive amount within the complete batch.
Injection volume	The amount of injection volume to be dispensed per injection cycle. The unit of measurement is unit of volume.
Leaking solenoid alarm action	The alarm action taken when the Leaking Solenoid alarm occurs. See section C.3.1.1 for information about the possible parameter values.

Parameter Name	Description
Leaking solenoid timeout period	The time in which the leaking solenoid volume limit will be checked. The unit of measurement is seconds.
Leaking solenoid volume limit	The maximum amount of additive volume within the leaking solenoid timeout period before the leaking solenoid alarm is generated. The unit of measurement is unit of volume. If the leaking volume limit is exceeded, an alarm will occur depending on the [Leaking Solenoid Alarm Action].
Leaking Timeout Period	The time in which the leaking volume limit will be checked. The unit of measurement is seconds.
Leaking Volume Limit	The maximum amount of additive volume within the leaking timeout period before a leaking solenoid alarm is generated. The unit of measurement is unit of volume. If the leaking volume limit is exceeded, an alarm will occur depending on the [Leaking Solenoid Alarm Action].
Loading Type	The type of the batch loading. See section C.3.1.4 for more information about the possible parameter values.
Low flow threshold value	This is a Honeywell Enraf proprietary parameter.
Mass Transaction	The total mass of the product stream(s) for the batch.
Maximum Setpoint Flow Rate	This is a Honeywell Enraf proprietary parameter.
Minimum product volume for transaction	The minimum volume of wild stream that is required for a transaction to start. The unit of measurement is unit of volume.

Parameter Name	Description
No activity timeout alarm action	The alarm action taken when the No Activity Timeout alarm is raised. This alarm is raised when no wild stream pulses have been received after the [No activity timeout period].
No activity timeout period	The time in seconds in which wild stream pulses should be received when the controller is permitted. When after this time no wild stream pulses have been received, an alarm is raised depending on the [No Activity] alarm action.
No additive alarm action	The alarm action taken when the No Additive alarm is raised. This alarm is raised when after the [No additive flow timeout period] no additive stream pulses have been received when the solenoid is opened after the configured number of retries.
No additive flow timeout period	The time in seconds in which additive stream pulses should be received when the solenoid is opened. When after this time no additive stream pulses have been received after the configured number of retries, an alarm is raised depending on the [No additive alarm action].
No Product Flow Timeout Limit	The time in seconds within which it is allowed that no product flow is detected from the product stream meter. When after this time no product flow has been detected an alarm is raised depending on the [No Product] alarm action.
Number of clean start cycles	The number of injection cycles at the start of the transaction to be used for 'over injection'. This 'over injection' at the start compensates the injection stop at the end of the transaction, in order to realize the clean arm or flushing of the arm.
Number of solenoid retries	The number of retries for opening the solenoid again in case no additive pulses are received.
Overblend Correction Factor	This is a Honeywell Enraf proprietary parameter.

Parameter Name	Description
Overrun Quantity Limit	The configured overrun quantity limit. If the quantity of the delivered product exceeds this limit, an alarm is raised depending on the setting of the [Alarm Action: Overrun Exceeded] parameter.
Permissive function	The permissive configuration for the controller. See section C.3.1.7 for more information about the possible values.
Permissive state	The permissive state of the controller. See section C.3.1.2 for more information about the possible values.
Pre-Stop Flow Rate	The target flow rate of the final product when the amount of delivered product is greater than the following (Batch Preset Volume - Pre-stop Volume) is determined.
Pre-Stop Quantity	The volume before the end of the batch at which the flow rate must be adjusted to dispense the exact quantity requested.
Preset Maximum	The maximum preset quantity for a batch. Presets entered above this value are not accepted for a valid batch.
Preset Minimum	The minimum preset quantity for a batch. Presets entered below this value are not accepted for a valid batch.
Preset Quantity	The total final required gross observed volume of the (blended) product.
Pressure Control Range Factor	The back pressure control feature is used to reduce the flow rate when the pressure decreases and becomes too close to the vapour pressure. The flow rate is decreased once the pressure is within the range of 'Minimum limit point' and 'Maximum limit point' values, i.e. these points refer to the range where back pressure control feature becomes active. The maximum limit point can be adjusted via the [Pressure control range factor] parameter: Maximum limit point = Minimum limit point * (1.0 + Pressure control range factor).
Pressure Observed	The pressure at which measurement of the product density was performed.
Product Pump Timeout	The time in minutes between the last injection and the product pump stop.

Parameter Name	Description
Pulse Input K-Factor	Number of pulses for a unit of quantity.
Pulse Output	The current state of the Pulse Output DC (PO DC). See section B.3.1.19 for more information about the possible parameter values.
Pump Demand Feedback Time- out	The time in seconds in which the additive or product pump must give feedback to the Fusion4 MSC-L. If no pump feedback is received within the [Pump Demand Feedback Timeout], the No Pump alarm is raised depending on the alarm action.
Pump run timeout	The time in minutes between the last injection and the additive pump stop.
RTD Input	The value measured by the PT100 resistance temperature detector (RTD) connected to the RTD input.
Selected Recipe	The recipe used during the batch.
Slow flow volume alarm action	The alarm action taken when the Slow Flow Volume alarm is raised. This alarm is raised when the slow flow volume (= clean arm volume) exceeds the [Slow flow volume deviation allowed]. See section C.3.1.1 for more information about the possible parameter values.
Slow flow volume deviation allowed	The maximum percentage of the slow flow volume (= clean arm volume) that is allowed to be lower than the slow flow volume without resulting in an Slow flow volume alarm situation.
Software Version	The software version of the board through which the data is read.
Solenoid close delay	Displays the time in which the additive pulses must be stopped after the solenoid is closed. The unit of measurement is milliseconds.

Parameter Name	Description
Solenoid dwell time	Displays the minimum time the solenoid will open and close. The unit of measurement is milliseconds. The parameter value is normally set to zero in injectors that require the solenoid to open and stay open until the full volume per cycle is injected. The numeric value represents the 'ON' time of the solenoid. The 'OFF' time is equal to the 'ON' time. When this value is nonzero, the controller will continue to pulse the valve control output until the amount of additive called for in the 'Injection Volume' setting is dispensed. The stroke repeat rate is double the solenoid dwell time.
Temperature Observed	The temperature at which measurement of the product density was performed. The unit of measurement is unit of temperature.
Transaction PPM	The calculated additive PPM (parts per million) of the current transaction. This value is not updated synchronously with the transactional volumes.
Transactional additive stream gross observed volume	The gross observed volume of additive dispensed within the current transaction. The unit of measurement is unit of volume.
Valve Closing Alarm Timeout	The time in which a valve should be closed after the maximum stream volume allowed has been dispensed. The unit of measurement is seconds. When after this time the valve is not closed, i.e. the Fusion4 MSC-L detects more stream volume, an alarm is raised depending on the Valve Closing alarm action.
Valve Closing Volume	The maximum stream volume that is allowed after the permissive is removed. If the Fusion4 MSC-L detects more stream volume, the Valve Closing alarm will be raised depending on the Valve Closing alarm action parameter.

Parameter Name	Description
Valve Fault Timeout Period	The time in which the product stream valve should be closed after receiving the signal to close. The unit of measurement is seconds. When after this time the product stream valve is not closed, an alarm is raised depending on the Valve Fault alarm action.
Vapour Pressure	The calculated vapour pressure of the product at observed (measured) product temperature.
Vapour Pressure Margin	The back pressure control feature is used to reduce the flow rate when the pressure decreases and becomes too close to the vapour pressure. The flow rate is decreased once the pressure is within the range of 'Minimum limit point' and 'Maximum limit point' values, i.e. these points refer to the range where the back pressure control feature becomes active. The 'Minimum limit point' is the calculated pressure value where it is considered that the product may start vaporizing. This means that pressure dropping to this value should be prevented, so the flow must be completely stopped at this pressure level. The minimum limit point can be adjusted via the [Vapour Pressure Margin] parameter: Minimum limit point = 1.1 * Vapour pressure + Vapour pressure margin.
VCF Commodity Group	The commodity group of the product. See section C.3.1.10 for more information about the possible parameter values.
VCF Compensation Options	The type of compensation used during the calculation of GSV and mass. See section C.3.1.11 for more information about the possible parameter values.
VCF Density Input Used	This parameter indicates whether the density sensor input at metering conditions is used for volume conversion calculations (instead of laboratory observed density value). See section C.3.1.5 for more information about the possible parameter val- ues.
VCF Density Reading Correction	The type of density reading correction reading used during the calculation of GSV and mass. See section C.3.1.13 for more information about the possible parameter values.

Parameter Name	Description
VCF Derive Manual Status	This parameter indicates if the manual status of the density is propagated in the GSV and Mass. See also section C.3.1.6. • <Disable>: Manual status does not appear in the status of the GSV and Mass (default setting) • <Enable>: Manual status appears in the status of the GSV and Mass.
VCF Mixture Calculation Option	The mixture calculation option used during the calculation of GSV and mass. See section C.3.1.15 for more information about the possible parameter values.
VCF Table Options	This parameter indicates whether the extended range options are enabled when using the VCF table. See section C.3.1.12 for more information about the possible parameter values.
VCF Thermal Correction (Meter)	The type of thermal correction used during the calculation of GSV and mass. See section C.3.1.14 for more information about the possible parameter values.
VCF: Base Pressure	The pressure reference used to determine the base conditions of the volume correction of the GSV and mass. This base pressure must be set to a value accepted by the associated volume correction factor (VCF) table configuration entity. The unit of measurement is unit of pressure.
VCF: Base Temperature	The temperature reference used to determine the base conditions of the volume correction of the GSV and mass. This base temperature must be set to a value accepted by the associated volume correction factor (VCF) table configuration entity. The unit of measurement is unit of temperature.
VCF: Calculation Result (CTPL)	The VCF (Volume Conversion Factor), also known as CTPL (Correction for Temperature and Pressure of a Liquid) in some standards. This parameter is used as the multiplication factor to determine volume at base conditions from volume at observed conditions.

Parameter Name	Description
VCF: Lab Density	A lab-measured density sample of the product. This value need not be an actual 'lab' measurement, but can be more generally considered a density measurement calculated external to the device.
VCF: Lab Mixture Percentage	This parameter is used instead of Lab density to perform volume conversions for commodity groups that are defined by mixture percentage - currently only NBR15639-08 (Ethanol Mix) group.
VCF: Lab Pressure	The product pressure when the VCF lab density value was obtained.
VCF: Lab Temperature	The product temperature when the VCF lab density value was obtained.
VCF: Lab Thermal Expansion Coefficient	The product thermal expansion coefficient required for volume conversion when D1250-04 (Special apps.) commodity group is configured.
Virtual Stream Accumulative GOV	The accumulative gross observed volume (GOV) of the calculated product stream dispensed with the arm. The unit of measurement is unit of volume.
Virtual Stream Accumulative GSV	The accumulative gross standard volume (GSV) of the calculated product stream dispensed with the arm. The unit of measurement is unit of volume.
Virtual Stream Accumulative Mass	The accumulative mass of the calculated product stream dispensed with the arm. The unit of measurement is unit of mass.
Volume per injection cycle	The amount of additive(s) added to the final product during an injection cycle.
Volume Transaction Leaking	The volume of leaked product during a transaction as a result of a leaking solenoid/ valve. The unit of measurement is unit of volume.
Volume Transaction Observed	The gross observed volume (GOV) of the product transferred during the transaction.

Parameter Name	Description
Volume Transaction Standard	The gross standard volume (GSV) of the product transferred during the transaction.

Appendix C: Modbus Enumerations and Structures

C.1 Controllers for Additive Injection

C.1.1 Task Register

The following table lists the elements of the [Task register] enumeration for Fusion4 additive controllers.

Table C-1: Elements of [Task register] enumeration

Value	Legacy Parameter	Description
0x0001	001	Disable permissive
0x0002	010	Enable permissive
0x0004	050	Inject now
0x0008	070	Open solenoid
0x0010	071	Close solenoid
0x0020	301	Clear all alarms
0x0040	800	Clear all totals, see also TABLE C-2
0x0080	801	Clear wild stream totals only, see TABLE C-2
0x0100	802	Clear additive stream totals only, see TABLE C-2
0x0200	940	Reset device
0x0400	030	Slow flow enable
0x0800	031	Slow flow disable

Table C-2: Description of Clear Stream Commands

Value	Legacy Parameter	Description	Parameter Number				
			810	850	860	870	880
0x0040	800	Clear all totals	x	x	x	x	x
0x0080	801	Clear wild stream totals only	x				

Value	Legacy Parameter	Description	Parameter Number				
			810	850	860	870	880
0x0100	802	Clear additive stream totals only		x	x	x	x

Table C-3: Description of volume parameters

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. additive volume	Acc. calibration volume	Acc. leaking volume
810	Accumulative wild stream gross observed volume	x			
850	Accumulative total additive stream gross observed volume		x	x	x
860	Accumulative transactional additive stream gross observed volume		x		
870	Accumulative leaking solenoid gross observed volume				x
880	Accumulative calibration gross observed volume			x	

C.1.2 Alarm Action

The following table lists the elements of the [Alarm action] enumeration for Fusion4 additive controllers.

Table C-4: Elements of [Alarm action] enumeration

Value	Definition	Description
0	Disabled	Parameter value set to [0] indicates that the alarm indication output is set to OFF.

Value	Definition	Description
1	Display	Parameter value set to [1] indicates that the following actions take place: • The alarm-indication output is set to ON. • The alarm is shown on the display.
2	Shutdown	Parameter value set to [2] indicates that the following actions take place: • The alarm-indication output is set to ON. • The alarm is shown on the display. • The alarm-shutdown output is set to ON. • The running transactions are stopped. • The start-up of new transactions impossible.

C.1.3 Permissive State

The following table lists the elements of the [Permissive state] enumeration for Fusion4 additive controllers.

Table C-5: Elements of [Permissive state] enumeration

Value	Definition	Description
0	Not permitted	Parameter value set to [0] indicates that the controller is not permitted to start a (new) injection transaction.
1	Permitted	Parameter value set to [1] indicates that the controller is permitted to start a (new) injection transaction.

C.1.4 Pacing Source

The following table lists the elements of the [Pacing source] enumeration for Fusion4 additive controllers.

Table C-6: Elements of [Pacing source] enumeration

Value	Definition	Description
0	Smart	Parameter value set to [0] indicates that the solenoid is controlled by an external device. The Smart mode offers four different options, which can be chosen by the [Pacing source] I/O binding entity. • PI (Pulse Input) Mode In this mode, the controllers measures the wild stream itself. The [Volume per injection cycle] parameter determines when an injection is started. The amount of additive volume is determined by setting the [Additive injection volume] parameter. The K-factor of the pacing pulse is determined by setting the [K-factor] parameter. • Comms Mode On receipt of a trigger message from an RS-485 source (Comms), the controller injects the proper amount of additive into the wild stream. The amount of additive can be configured by the [Additive injection volume] parameter. • DI (Digital Input) Mode On receipt of a trigger signal from an Digital Input (DI)source, the controller injects the proper amount of additive into the wild stream. The amount of additive can be configured by the [Additive injection volume] parameter. • AI (Analog Input) Mode In this mode the controller receives wild stream flow from an Analog Input (AI) source. The [Volume per injection cycle] parameter determines when an injection is started. The amount of additive volume is determined by setting the [Additive injection volume] parameter. The K- factor of the pacing pulse is determined by setting the [K-factor] parameter.

Value	Definition	Description
1	Server	Parameter value set to [1] indicates that the solenoid is controlled by an external device. The controller receives a command to open the solenoid. The solenoid then remains open until the controller receives a command to close it again.
2	Self	In situations where no pacing signals are available from outside sources like flow meters or other instruments, the [Pacing source] parameter value of the controller can be set to [2]. In this mode, the controller injects on a time and fluid volume basis.

C.1.5 Factored Pulse Output

The following table lists the elements of the [Factored pulse output] enumeration for Fusion4 additive controllers.

> NOTE: The values in brackets are used in legacy protocols.

Table C-7: Elements of [Factored pulse output] enumeration

Value	Definition
2 (0)	1 pulse per unit volume
3 (1)	10 pulses per unit volume
4 (2)	100 pulses per unit volume
5 (3)	1000 pulses per unit volume

C.1.6 Permissive Function

The following table lists the elements of the [Permissive function] enumeration for Fusion4 additive controllers.

Table C-8: Elements of [Permissive function] enumeration

Value	Definition	Description
0	None	Parameter value set to [0] indicates that the permissive is internally asserted based upon the injector mode. Smart product pulse • Transaction start condition: When the wild stream volume is greater than the [Minimum product volume for transaction] parameter. • Transaction end condition: When the wild stream flow rate has been less than the low flow rate for an amount of time defined by the [Transaction closing time] parameter. Smart inject (DI or Comms) • Transaction start condition: When the first inject signal is received. • Transaction end condition: When there has been no inject signals for an amount of time defined by the [Transaction closing time] parameter. Server (DI or Comms) • Transaction start condition: When the first solenoid-open condition is detected. • Transaction end condition: When there has been no solenoid-open condition detected for an amount of time defined by the [Transaction closing time] parameter.

Value	Definition	Description
1	Hard-wired	Parameter value set to [1] indicates that the following conditions are valid regardless of the injection mode: • Transaction start condition - When the digital input is asserted • Transaction end condition - When the digital input is unasserted
2	Communications	Parameter value set to [2] indicates that the following conditions are valid regardless of the injection mode: • Transaction start condition - When a serial command is received to enable the device • Transaction end condition -When a serial command is received to disable the device

C.1.7 Additive Stream State

The following table lists the elements of the [Additive stream state] enumeration for Fusion4 additive controllers.

Table C-9: Elements of [Additive stream state] enumeration

Value	Definition
0	Stop
1	Startup
2	Interrupted
3	Failed
4	Permitted
5	Running
6	Paused
7	Testing
8	Starting

C.1.8 Active Alarms (individual bits in 16-bits data)

The following table lists the elements of the [Active alarms] enumeration for Fusion4 additive controllers.

Table C-10: Elements of [Active alarms] enumeration type

Value	Definition
0x0001	Additive Cycle Volume
0x0002	No Additive
0x0004	Leaking Solenoid
0x0008	Firmware Failure
0x0010	Program Failure
0x0020	No Activity
0x0040	Flush Volume Error
0x0080	Valve Error
0x0100	No Pump
0x0200	License Error
0x0400	Control Failure
0x0800	Power Failure
0x1000	Pulse Error
0x2000	Tank Monitor Error
0x4000	Service Due Rem
0x8000	Reserved

C.2 Controllers for Blending

C.2.1 Task Register

The following table lists the elements of the [Task register] enumeration for Fusion4 blend controllers.

Table C-11: Elements of [Task register] enumeration

Value	Legacy Parameter	Description
0x0001	001	Disable permissive
0x0002	010	Enable blend Rate A
0x0004	011	Enable blend Rate B
0x0008	012	Enable blend Rate C
0x0400	013	Enable blend Rate D
0x0800	014	Enable blend Rate E
0x0010	301	Clear all alarms
0x0020	800	Clear all totals, see also TABLE C-12
0x0040	801	Clear wild stream totals only, see also TABLE C-12
0x0080	802	Clear blend stream totals only, see also TABLE C-12
0x0200	940	Reset device

Table C-12: Description of Clear Stream Commands

Value	Legacy Parameter	Description	Parameter Number				
			810	820	825	870	880
0x0020	800	Clear all totals	x	x	x	x	x
0x0040	801	Clear wild stream totals only	x				
0x0080	802	Clear blend stream totals only		x	x	x	x

Table C-13: Description of volume parameters

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. blend volume	Acc. calibration volume	Acc. leaking volume
810	Accumulative wild stream gross observed volume	x			
820	Accumulative blend stream gross observed volume		x		
825	Accumulative blend stream gross standard volume		x		

Parameter Number	Parameter Name	Acc. wild stream volume	Acc. blend volume	Acc. calibration volume	Acc. leaking volume
870	Accumulative leaking blend stream gross observed volume				x
880	Accumulative calibration gross observed volume			x	

C.2.2 Alarm Action

The following table lists the elements of the [Alarm action] enumeration for Fusion4 blend controllers.

Table C-14: Elements of [Alarm action] enumeration

Value	Definition	Description
0	Disabled	Parameter value set to [0] indicates that the alarm is ignored.
1	Display	Parameter value set to [1] indicates that the following actions take place: • The alarm-indication output is set to ON. • The alarm is shown on the display.
2	Shutdown	Parameter value set to [2] indicates that the following actions take place: • The alarm-indication output is set to ON. • The alarm is shown on the display. • The alarm-shutdown output is set to ON. • The running transactions are stopped. • The start-up of new transactions impossible.

C.2.3 Blend Point Relative to Wild Stream

The following table lists the elements of the [Blend point relative to wild stream] enumeration for Fusion4 blend controllers.

Table C-15: Elements of [Blend point relative to wild stream] enumeration

Value	Definition	Description
0	Upstream	Parameter value set to [0] indicates that the insertion point of the physical blend piping will be before the wild stream custody transfer meter.
1	Downstream	Parameter value set to [1] indicates that the insertion point of the physical blend piping will be after the wild stream custody transfer meter.

C.2.4 Permissive State

The following table lists the elements of the [Permissive state] enumeration for Fusion4 blend controllers.

Table C-16: Elements of [Permissive state] enumeration

Value	Definition	Description
0	Not permitted	Parameter value set to [0] indicates that the controller is not permitted to start a (new) injection transaction.
1	Permitted	Parameter value set to [1] indicates that the controller is permitted to start a (new) injection transaction.

C.2.5 Factored Pulse Output

The following table lists the elements of the [Factored pulse output] enumeration for Fusion4 blend controllers.

> NOTE: The values in brackets are used in Legacy protocols.

Table C-17: Elements of [Factored pulse output] enumeration

Value	Definition
2 (0)	1 pulse per unit volume

Value	Definition
3 (1)	10 pulses per unit volume
4 (2)	100 pulses per unit volume
5 (3)	1000 pulses per unit volume

C.2.6 Reset Blend Deviation Counter at Transaction Start

The following table lists the elements of the [Reset blend deviation counter at transaction start] enumeration for Fusion4 blend controllers.

Table C-18: Elements of [Reset blend deviation counter at transaction start] enumeration

Value	Definition	Description
0	No reset	Parameter value set to [0] indicates that the deviation volume count is never reset to zero at the start of a new transaction.
1	Reset deviation	Parameter value set to [1] indicates that the deviation volume count is reset to zero at the start of each new transaction.

C.2.7 Pre-Shutdown Control

The following table lists the elements of the [Pre-shutdown control] enumeration for Fusion4 blend controllers.

Table C-19: Elements of [Pre-shutdown control] enumeration

Value	Definition	Description
0	No pre-shutdown	Parameter value set to [0] indicates that the controller enters the clean arm operation when the measured volume is equal to the preset volume minus the flush volume.
1	Fixed pre-shutdown	Parameter value set to [1] indicates that the controller enters the clean arm operation when the measured volume is equal to the preset volume minus the flush volume and the pre-shutdown volume.

Value	Definition	Description
2	Calculated pre-shutdown	Parameter value set to [2] indicates that the controller enters the clean arm operation when the measured volume is equal to the preset volume minus the flush volume and the pre-shutdown volume. At the end of every transaction the pre-shutdown volume is calculated to get a more precise number on when to stop blending. It can be seen as a correction factor for the valve closing time.

C.2.8 Clean Start Control

The following table lists the elements of the [Clean start control] enumeration for Fusion4 blend controllers.

Table C-20: Elements of [Clean start control] enumeration

Value	Definition	Description
0	Permissive controlled	Parameter value set to [0] indicates that the controller stops blending when the permissive is removed. The controller expects the flush volume to flow to bring the blend percentage down to the target blend percentage.
1	Volume controlled	Parameter value set to [1] indicates that the controller is monitoring the delivered volume to determine when to stop blending, regardless of the permissive signal. To enable this functionality the controller needs to know the preset volume.

C.2.9 Permissive Function (Modbus RTU | TCP/IP)

The following table lists the elements of the Modbus RTU | TCP/IP [Permissive function] enumeration for Fusion4 blend controllers.

Table C-21: Elements of Modbus RTU | TCP/IP [Permissive function] enumeration

Value	Definition	Description
0	Logic OR	Parameter value set to [0] indicates that the controller is enabled when either (or both) the primary or (and) secondary permissives are true.

Value	Definition	Description
1	Logic AND	Parameter value set to [1] indicates that the controller is enabled when both the primary and secondary permissives are true.

C.2.10 Permissive Function (Modbus Legacy)

The following table lists the elements of the Modbus Legacy [Permissive function] enumeration for Fusion4 blend controllers.

Table C-22: Elements of Modbus Legacy [Permissive function] enumeration

Value	Definition	Description
0	Permitted only via hardware	Parameter value set to [0] indicates if a blend stream has both a permissive and a secondary interlock defined then either one or both must be active in order for the stream to be permitted. The SSC_B I/O binding possibilities for both the permissive function and the secondary interlock function include options for both hard wired digital inputs as well as 'Comms' inputs. If a hardwired digital input binding is selected then the input must be active and if 'Comms' is selected then the device must be permitted either by a serial Comms message or locally by a hand-held controller.
1	Permitted via hardware and software	Parameter value set to [1] indicates if a blend stream has both a permissive and a secondary interlock defined then both must be active in order for the stream to be permitted. The SSC_B I/O binding possibilities for both the permissive function and the secondary interlock function include options for both hard wired digital inputs as well as 'Comms' inputs. If a hardwired digital input binding is selected then the input must be active and if 'Comms' is selected then the device must be permitted either by a serial Comms message or locally by a hand-held controller.

C.2.11 Volume Correction Table

The following table lists the elements of the [Volume correction table] enumeration for Fusion4 blend controllers.

Table C-23: Elements of [Volume correction table] enumeration

Value	Definition
0	NO VCF TABLE
1	ASTM D1250_04 5/6
2	ASTM D1250_04 23/24
3	ASTM D1250_04 53/54
4	ASTM D1250_04 59/60
5	ASTM GPA TP27 2007 23/24
6	ASTM GPA TP27 2007 53/54
7	ASTM GPA TP27 2007 59/60
8	EN 14214 2008

C.2.12 Commodity Group

The following table lists the elements of the [Commodity group] enumeration for Fusion4 blend controllers.

Table C-24: Elements of [Commodity group] enumeration

Value	Definition
0	None
1	Crude Oil
2	Commodity Group Refined Products
3	Special Applications
4	Lubricating Oils
5	NGL And LPG
6	Fatty Acid Methyl Esters

C.2.13 VCF Options

The following table lists the elements of the [VCF options] enumeration for Fusion4 blend controllers.

Table C-25: Elements of [VCF options] enumeration

Value	Definition	Description
0	None	Parameter value set to [0] indicates that the Volume Conversion Tables do not accept observed temperatures within the extended temperature range.
1	Extended ranges	Parameter value set to [1] indicates that the Volume Conversion Tables accept observed temperatures within the extended temperature range. • For ASTM tables this range is -94°F to 338°F. • For GPA-TP27 tables this range is 213.25K to 369.82K. • FAME conversions do not support any extended temperature range. Therefore, it will continue to only support the range limits of 20°C to 60°C even if configured for extended range. Observed temperatures exceeding this range will generate an error.

C.2.14 Glass Hydrometer Used

The following table lists the elements of the [Glass hydrometer used] enumeration type for Fusion4 blend controllers.

Table C-26: Elements of [Glass hydrometer used] enumeration

Value	Definition	Description
0	Glass hydrometer used for density	Parameter value set to [0] indicates that the glass hydrometer is used to measure the observed blend product density. In this case, the observed blend product observed will be corrected for measurement error associated with glass hydro-meters.
1	Glass hydrometer not used for density	Parameter value set to [1] indicates that the glass hydrometer is not used to measure the observed blend product density.

C.2.15 Reference Temperature Units

The following table lists the elements of the [Reference temperature units] enumeration for Fusion4 blend controllers.

Table C-27: Elements of [Reference temperature units] enumeration

Value	Definition	Description
1	Celsius	Parameter value set to [1] indicates that degrees Celsius (°C) is used as unit of temperature for the [Reference temperature] parameter.
2	Fahrenheit	Parameter value set to [2] indicates that degrees Fahrenheit (°F) is used as unit of temperature for the [Reference temperature] parameter.

C.2.16 Reference Pressure Units

The following table lists the elements of the [Reference pressure units] enumeration for Fusion4 blend controllers.

Table C-28: Elements of [Reference pressure units] enumeration

Value	Definition	Description
1	Pascal	Parameter value set to [1] indicates that Pascal (Pa) is used as unit of pressure for the [Reference pressure] parameter.
2	kilo Pascal	Parameter value set to [2] indicates that kilo Pascal (kPa) is used as unit of pressure for the [Reference pressure] parameter.
3	pounds per square inch (small)	Parameter value set to [3] indicates that pounds per square inch (Psi) small is used as unit of pressure for the [Reference pressure] parameter.
4	pounds per square inch (large)	Parameter value set to [4] indicates that pounds per square inch (Psi) large is used as unit of pressure for the [Reference pressure] parameter.
5	bar	Parameter value set to [5] indicates that bar is used as unit of pressure for the [Reference pressure] parameter.

C.2.17 Blend Stream State

The following table lists the elements of the [Blend stream state] enumeration for Fusion4 blend controllers.

Table C-29: Elements of [Blend stream state] enumeration type

Value	Definition
0	Idle
1	Startup
2	Interrupted
3	Failed
4	Permitted
5	Running
6	Paused
7	Testing
8	Starting

C.2.18 Active Alarms (individual bits in 16-bits data)

The following table lists the elements of the [Active alarms] enumeration for Fusion4 blend controllers.

Table C-30: Elements of [Active alarms] enumeration

Value	Definition
0x0001	Control Failure
0x0002	Blend Percentage
0x0004	Leaking Blend Valve
0x0008	Wild Stream Closing Volume
0x0010	Blend Stream Closing Time
0x0020	No Activity
0x0040	Firmware Corrupt
0x0080	VCF Error
0x0100	Flush Volume
0x0200	License Error

Value	Definition
0x0400	Valve Error
0x0800	Power Failure
0x1000	Pulse Error
0x2000	No Pump
0x4000	Sensor Error
0x8000	Tank Monitor Error

C.3 Fusion4 controllers for loading

C.3.1 Enumerations

C.3.1.1 Alarm Action

The following table lists the elements of the [Alarm Action] enumeration for Fusion4 load controllers.

Table C-31: Elements of [Alarm Action] enumeration

Value	Definition	Description
0	Disabled	Parameter value set to [0] indicates that the alarm is ignored.
1	Display	Parameter value set to [1] indicates that the following actions take place: • The alarm is shown on the display. • The alarm indication output is set to ON.
2	Shutdown	Parameter value set to [2] indicates that the following actions take place: • The alarm is shown on the display. • The alarm indication output is set to ON. • The alarm shutdown output is set to ON. • The running batch is stopped.

Value	Definition	Description
3	Pause	Parameter value set to [3] indicates that the following actions take place: • The alarm is shown on the display. • The alarm indication output is set to ON. • The alarm shutdown output is set to ON. • The running batch is paused.

C.3.1.2 Permissive State

The following table lists the elements of the [Permissive State] enumeration for Fusion4 load controllers.

Table C-32: Elements of [Permissive state] enumeration

Value	Definition	Description
0	Not permitted	Parameter value set to [0] indicates that the controller is not permitted to start a new transaction.
1	Permitted	Parameter value set to [1] indicates that the controller is permitted to start a (new) transaction.

C.3.1.3 Flow Phase

The following table lists the elements of the [Flow Phase] enumeration for Fusion4 load controllers.

Table C-33: Elements of [Flow Phase] enumeration

Value	Definition	Description
0	No flow	Parameter value set to [0] indicates that there currently is no flow.
1	Initial flow	Parameter value set to [1] indicates that the current batch is in the initial flow phase, i.e. the phase at the beginning where the system loads at initial flow rate conditions.
2	Resuming flow	Parameter value set to [2] indicates that the current batch is in the resuming flow phase, i.e. some time after the batch is resumed, the system loads at resuming flow at initial flow rate conditions.

Value	Definition	Description
3	Full flow	Parameter value set to [3] indicates that the current batch is in the full flow phase, i.e. the phase where the system loads as fast as it can at high flow rate conditions.
4	Clean arm in full flow	Parameter value set to [4] indicates that the current batch is in the clean arm in full flow phase, i.e. the phase where the system loads as fast as it can at high flow rate conditions, but does not allow for any blend products.
5	Pre-stop flow	Parameter value set to [5] indicates that the current batch is in the pre-stop flow phase, i.e. the phase at the end where the system loads at pre-stop flow conditions.
6	Done	Parameter value set to set to [6] indicates that the batch is completed.

C.3.1.4 Loading Type

The following table lists the elements of the [Loading Type] enumeration for Fusion4 load controllers.

Table C-34: Elements of [Loading Type] enumeration

Value	Definition	Description
0	Sequential	Parameter value set to [0] indicates that different products are loaded in sequence using the same arm.
1	Ratio	Parameter value set to [1] indicates that ratio blending is used to load the batch. Ratio blending is a process in which the main product is blended with one or more blend products. The amount of each product is defined by the recipe selected for the batch.
2	Side stream	Parameter value set to [2] indicates that side stream blending is used to load the batch. Side stream blending is a batch blending where one blend product is blended into the main product.
3	Unloading	Parameter value set to [3] indicates that unloading is used to transfer product from one of the compartments of the truck to the storage tank.
4	Straight with VRU	Parameter value set to [4] indicates that straight product loading with Vapour return is used. (Used for LPG /LNG loading)

C.3.1.5 Boolean

The following table lists the elements of the [Boolean] enumeration for Fusion4 load controllers.

Table C-35: Elements of [Boolean] enumeration

Value	Definition
0	False
1	True

C.3.1.6 Enable/Disable

The following table lists the elements of the [Enable/Disable] enumeration for Fusion4 load controllers.

Table C-36: Elements of [Enable/Disable] enumeration

Value	Definition
1	Enable
2	Disable

C.3.1.7 Permissive Function

The following table lists the elements of the [Permissive Function] enumeration for Fusion4 load controllers.

Table C-37: Elements of [Permissive Function] enumeration

Value	Definition	Description
0	Permitted only via hardware	Parameter value set to [0] indicates that if a stream has both a permissive and a secondary interlock defined, then either one or both must be active in order for the stream to be permitted. The Fusion4 MSC-A I/O binding possibilities for both the permissive function and the secondary interlock function include options for both hard-wired digital inputs as well as 'Comms' inputs. If a hard-wired digital input binding is selected, then the input must be active. If 'Comms' is selected, then the device must be permitted either by a serial Comms message or locally by a hand-held controller.

Value	Definition	Description
1	Permitted via hardware and software	Parameter value set to [1] indicates that if a stream has both a permissive and a secondary interlock defined then both must be active in order for the stream to be permitted. The Fusion4 MSC-AI/O binding possibilities for both the permissive function and the secondary interlock function include options for both hard-wired digital inputs as well as 'Comms' inputs. If a hard-wired digital input binding is selected, then the input must be active. If 'Comms' is selected, then the device must be permitted either by a serial Comms message or locally by a hand-held controller.

C.3.1.8 Factored Pulse Output

The following table lists the elements of the [Factored Pulse Output] enumeration for Fusion4 load controllers.

Table C-38: Elements of [Factored Pulse Output] enumeration

Value	Definition
2	1 pulse per unit volume
3	10 pulses per unit volume
4	100 pulses per unit volume
5	1000 pulses per unit volume

C.3.1.9 Actuator Type

The following table lists the elements of the [Actuator Type] enumeration for Fusion4 load controllers.

Table C-39: Elements of [Actuator Type] enumeration

Value	Definition
0	None
1	DCV
2	Analog 4-20 mA valve
3	Two-stage valve
4	Binary valve
5	Simulated DCV

C.3.1.10 VCF Commodity Group

The following table lists the elements of the [VCF Commodity Group] enumeration for Fusion4 load controllers.

Table C-40: Elements of [VCF Commodity Group] enumeration

Value	Definition
0	None
1	D1250-04 Crude Oil
2	D1250-04 Refined Products
3	D1250-04 Special Applications
4	D1250-04 Lubricating Oils
5	TP27-07 NGL and LPG
6	EN14214 Fatty Acid Methyl Esters
7	CNP6-70 Brazilian Petroleum
8	NBR15639-08 Ethanol Mixture
9	MPMS 11.3.3 Pure Ethanol
10	MPMS 11.3.3 Denatured Fuel Ethanol

C.3.1.11 VCF Compensation Options

The following table lists the elements of the [VCF Compensation Options] enumeration for Fusion4 load controllers.

Table C-41: Elements of [VCF Compensation Options] enumeration

Value	Definition	Description
0	None	Parameter value set to [0] indicates that no compensation has been used during the calculation of GSV and mass.
1	Temperature	Parameter value set to [1] indicates that temperature compensation has been used during the calculation of GSV and mass.
2	Temperature and pressure	Parameter value set to [2] indicates that temperature and pressure compensation has been used during the calculation of GSV and mass. NOTE: Pressure compensation is not applicable for the "EN14214 Fatty Acid Methyl Esters" commodity group.

C.3.1.12 VCF Table Options

The following table lists the elements of the [VCF Table Options] enumeration for Fusion4 load controllers.

Table C-42: Elements of [VCF Table Options] enumeration

Value	Definition	Description
0	None	Parameter value set to [0] indicates that the extended range options are disabled when using the VCF table. NOTE: If the application exceeds the normal range, an error occurs.
1	Extended ranges	Parameter value set to [1] indicates that the extended range options are enabled when using the VCF table. The extended temperature, pressure and range give the ability to do the volume conversion over a broader range than covered by the earlier versions of the standard. For instance at locations where it is very cold, like Alaska.

C.3.1.13 VCF Density Reading Correction

The following table lists the elements of the [VCF Density Reading Correction] enumeration for Fusion4 load controllers.

Table C-43: Elements of [VCF Density Ready Correction] enumeration

Value	Definition
0	None
1	D1298-12B

C.3.1.14 VCF Thermal Correction (Meter)

The following table lists the elements of the [VCF Thermal Correct (Meter)] enumeration for Fusion4 load controllers.

Table C-44: Elements of [VCF Thermal Correction (Meter)] enumeration

Value	Definition
0	None
1	NBR15639-08

C.3.1.15 VCF Mixture Calculation Option

The following table lists the elements of the [VCF Mixture Calculation Option] enumeration for Fusion4 load controllers.

Table C-45: Elements of [VCF Mixture Calculation] enumeration

Value	Definition	Description
0	Observed density	Parameter value set to [0] indicates that for 'mixture' commodity groups (currently only NBR15639-08 Ethanol Mix) lab observed density is used in VCF calculations.
1	Percentage (by mass)	Parameter value set to [1] indicates that for 'mixture' commodity groups (currently only NBR15639-08 Ethanol Mix) percentage by mass is used in VCF calculations.
2	Percentage (by volume)	Parameter value set to [1] indicates that for 'mixture' commodity groups (currently only NBR15639-08 Ethanol Mix) percentage by volume is used in VCF calculations.

C.3.1.16 Input Control Mode

The following table lists the elements of the [Input Control Mode] enumeration for Fusion4 load controllers.

Table C-46: Elements of [Input Control Mode] enumeration

Value	Definition	Description
0	None	Parameter value set to [0] indicates that the permissive is internally asserted based upon the injector mode. Smart product pulse • Transaction start condition: When the wild stream volume is greater than the [Minimum product volume for transaction] parameter. • Transaction end condition: When the wild stream flow rate has been less than the low flow rate for an amount of time defined by the [Transaction closing time] parameter. Smart inject (DI or Comms) • Transaction start condition: When the first inject signal is received. • Transaction end condition: When there has been no inject signals for an amount of time defined by the [Transaction closing time] parameter. Server (DI or Comms) • Transaction start condition: When the first solenoid-open condition is detected. • Transaction end condition: When there has been no solenoid-open condition detected for an amount of time defined by the [Transaction closing time] parameter.

Value	Definition	Description
1	Hard-wired	Parameter value set to [1] indicates that the following conditions are valid regardless of the injection mode: • Transaction start condition - When the digital input is asserted • Transaction end condition - When the digital input is unasserted
2	Communications	Parameter value set to [2] indicates that the following conditions are valid regardless of the injection mode: • Transaction start condition - When a serial command is received to enable the device • Transaction end condition -When a serial command is received to disable the device
3	Hard-wired (1)	See above
4	Communications (1)	See above

C.3.1.17 Additive Alarms

The following table lists the elements of the [Additive Alarms] enumeration for Fusion4 load controllers.

Table C-47: Elements of [Additive Alarms] enumeration

Value	Definition
0x0001	Additive Cycle Volume or Ext additive Batch additive deviation
0x0002	No Additive
0x0004	Leaking Solenoid
0x0008	Firmware Failure
0x0010	Program Failure
0x0020	No Activity
0x0040	Flush Volume Error
0x0080	Valve Error
0x0100	No Pump

Value	Definition
0x0200	License Error
0x0400	Control Failure
0x0800	Power Failure
0x1000	Pulse Error
0x2000	Tank Monitor Error
0x4000	Service Due Rem
0x8000	Ext Additive only: Device Offline or Injector Command rejected

C.3.1.18 Digital State

The following table lists the elements of the [Digital State] enumeration for Fusion4 load controllers.

Table C-48: Elements of [Digital State] enumeration

Value	Definition	Description
0	Inactive	Parameter value set to [0] indicates that the digital input is inactive.
1	Active	Parameter value set to [1] indicates that the digital input is active.

C.3.1.19 Additive Control State

The following table lists the elements of the [Additive Control State] enumeration for Fusion4 load controllers.

Table C-49: Elements of [Additive Control State] enumeration

Value	Definition
0	IDLE
1	RUNNING_CLEAN_START
2	RUNNING
3	DETECT_FLOW
4	INJECTING
5	SOLENOID_CLOSING
6	STOP
7	WAITING

Value	Definition
8	ERROR
9	ERROR_IDLE

C.3.1.20 Fusion4 TAS Prompt

The following table lists the elements of the [Fusion4 TAS Prompt] enumeration for Fusion4 load controllers.

Table C-50: Elements of [Fusion4 TAS Prompt] enumeration

Value	Definition
0	GROUNDING
1	OVERFILL
2	VAPOR_RECOVERY
3	WELCOME
4	ENTER_PIN
5	ENTER_PRESET
6	PRESS_START
7	SELECT_ARM
8	SELECT_RECIPE_ARM1
9	SELECT_RECIPE_ARM2
10	SELECT_RECIPE_ARM3
11	SELECT_RECIPE_ARM4
12	SELECT_RECIPE_ARM5
13	SELECT_RECIPE_ARM6
14	ENTER_VEHICLE_ID
15	ENTER_COMPARTMENT
16	LOAD_ANOTHER_COMPARTMENT
17	TRANSACTION_DETAILS
18	ENTER_RETURN_QUANTITY
19	RETURN_QUANTITY_PRESENT
20	ERROR_MAX_BATCHES
21	ERROR_INVALID_PIN

Value	Definition
22	DISCONNECT
23	PICK_PAUSED_ARM_ACTION
24	SELECT_PAUSED_ARM
25	BATCH_DETAILS
26	ERROR_INVALID_COMPARTMENT
27	ERROR_INVALID_PRESET
28	ERROR_NO_TAS_RESPONSE
29	ERROR_PRESET_NOT_ENOUGH
30	ERROR_PRESET_TOO_LARGE
31	ERROR_PRESET_TOO_SMALL
32	ERROR_BATCH_NOT_FEASIBLE
33	STOP_BATCHES
34	ENTER_CONTRACT_NUMBER
35	ENTER_CARRIER_ID
36	ENTER_TRAILER_ID
37	ENTER_LOAD_NUMBER
38	ERROR_VCF_NOT_CONFIGURED
39	ENTER_CONTRACT
40	DISCONNECT_GROUNDING
41	DISCONNECT_OVERFILL
42	DISCONNECT_VAPOR_RECOVERY
43	ERROR_DEVICE_NOT_HEALTHY
44	ERROR_MMQ_NOT_MET
45	PRESENT_CARD
46	START_ARM1
47	START_ARM2
48	START_ARM3
49	START_ARM4
50	START_ARM5
51	START_ARM6

Value	Definition
52	PRESENT_CARD_DRIVER
53	PRESENT_CARD_VEHICLE
54	PRESENT_CARD_CARRIER
55	PRESENT_CARD_TRAILER
56	PRESENT_CARD_CONTRACT
57	SHOW_BAY1_BATCH_SCHEDULE
58	SHOW_BAY2_BATCH_SCHEDULE
59	WAITING_FOR_REMOTE_START
60	OPTION_USER_PIN
61	OPTION_VEHICLE_ID
62	OPTION_CARRIER_ID
63	OPTION_TRAILER_ID
64	OPTION_LOAD_NUMBER
65	OPTION_CONTRACT_NUMBER
66	OPTION_PRESET
67	OPTION_COMPARTMENT_NUMBER
68	ERROR_GENERIC_ERROR
69	ERROR_ARM_IN_ALARM
70	ERROR_PERMISSIVES_NOT_CONNECTED
71	ERROR_ARM_NOT_IN_POSITION
72	ENTER_DRIVER_PIN
73	ENTER_DRIVER_PASSWORD
74	ENTER_OFFICER_PIN
75	ENTER_OFFICER_PASSWORD
76	PRESENT_CARD_OFFICER
77	PRESENT_RFID_VEHICLE
78	PRESENT_RFID_TRAILER
79	PRESENT_CARD_PRIME_MOVER
80	PRESENT_RFID_PRIME_MOVER
81	ENTER_LOAD_NUMBER_ALPHA

Value	Definition
82	ENTER_CONTRACT_ALPHA
83	ENTER_ORDER_CODE
84	ENTER_ORDER_CODE_ALPHA
85	ENTER_ARM_NUMBER
86	ENTER_VEHICLE_PIN
87	ERROR_INVALID_METER_TYPE
88	END_SESSION
89	ERROR_ARM_NOT_IDLE
90	ERROR_RECIPE_NOT_VALID
91	ERROR_ARM_DISABLED
92	CHECKING_LOAD_NUMBER
93	SELECT_BAY
94	WAITING_FOR_LOAD
95	CARD_DETECTED_PLEASE_WAIT
96	ERROR_INVALID_CARD
97	INPUT_ACK_ARM1
98	INPUT_ACK_ARM2
99	INPUT_ACK_ARM3
100	INPUT_ACK_ARM4
101	INPUT_ACK_ARM5
102	INPUT_ACK_ARM6
103	ERROR_ARM1_IN_ALARM
104	ERROR_ARM2_IN_ALARM
105	ERROR_ARM3_IN_ALARM
106	ERROR_ARM4_IN_ALARM
107	ERROR_ARM5_IN_ALARM
108	ERROR_ARM6_IN_ALARM
109	DISCONNECT_ARM1
110	DISCONNECT_ARM2
111	DISCONNECT_ARM3

Value	Definition
112	DISCONNECT_ARM4
113	DISCONNECT_ARM5
114	DISCONNECT_ARM6
115	ERROR_GROUNDING_NOT_CONNECTED
116	ERROR_OVERFILL_NOT_CONNECTED
117	ERROR_VAPOR_RECOVERY_NOT_CONNECTED
118	ERROR_REMOTE_STOP_ACTIVATED
119	ARM1_PRESS_ACK_TO_ABORT
120	ARM2_PRESS_ACK_TO_ABORT
121	ARM3_PRESS_ACK_TO_ABORT
122	ARM4_PRESS_ACK_TO_ABORT
123	ARM5_PRESS_ACK_TO_ABORT
124	ARM6_PRESS_ACK_TO_ABORT
125	PARK_ARM1
126	PARK_ARM2
127	PARK_ARM3
128	PARK_ARM4
129	PARK_ARM5
130	PARK_ARM6
131	UPLOADING_TO_LRC
132	LOADING_COMPLETE_DISCONNECT_GROUND
133	LOADING_COMPLETE_DISCONNECT_ARM1
134	LOADING_COMPLETE_DISCONNECT_ARM2
135	LOADING_COMPLETE_DISCONNECT_ARM3
136	LOADING_COMPLETE_DISCONNECT_ARM4
137	LOADING_COMPLETE_DISCONNECT_ARM5
138	LOADING_COMPLETE_DISCONNECT_ARM6
139	SELECT_LOADSPOT_ARM1
140	SELECT_LOADSPOT_ARM2
141	SELECT_LOADSPOT_ARM3

Value	Definition
142	SELECT_LOADSPOT_ARM4
143	SELECT_LOADSPOT_ARM5
144	SELECT_LOADSPOT_ARM6
145	ENTER_RAKE_REGISTRATION_NUMBER
146	ENTER_WAGON_NUMBER
147	INLET_SDV_OPEN_IN
148	OUTLET_SDV_OPEN_IN
149	DCV_OPEN_IN
150	SELECTED_LAPS_NOT_CONNECTED
151	NOT_SELECTED_LAPS_CONNECTED
152	CONNECT_ARM1
153	CONNECT_ARM2
154	CONNECT_ARM4
155	CONNECT_ARM4
156	CONNECT_ARM5
157	CONNECT_ARM6
158	DISCONNECT_PARK_ARM1
159	DISCONNECT_PARK_ARM2
160	DISCONNECT_PARK_ARM3
161	DISCONNECT_PARK_ARM4
162	DISCONNECT_PARK_ARM5
163	DISCONNECT_PARK_ARM6
164	DISCONNECT_VAPOR_PARK_ARM1
165	DISCONNECT_VAPOR_PARK_ARM2
166	DISCONNECT_VAPOR_PARK_ARM3
167	DISCONNECT_VAPOR_PARK_ARM4
168	DISCONNECT_VAPOR_PARK_ARM5
169	DISCONNECT_VAPOR_PARK_ARM6
170	CONNECT_VAPOR_PARK_ARM1
171	CONNECT_VAPOR_PARK_ARM2

Value	Definition
172	CONNECT_VAPOR_PARK_ARM3
173	CONNECT_VAPOR_PARK_ARM4
174	CONNECT_VAPOR_PARK_ARM5
175	CONNECT_VAPOR_PARK_ARM6
176	CONNECT_VAPOR_ARM1
177	CONNECT_VAPOR_ARM2
178	CONNECT_VAPOR_ARM3
179	CONNECT_VAPOR_ARM4
180	CONNECT_VAPOR_ARM5
181	CONNECT_VAPOR_ARM6
182	DISCONNECT_VAPOR_ARM1
183	DISCONNECT_VAPOR_ARM2
184	DISCONNECT_VAPOR_ARM3
185	DISCONNECT_VAPOR_ARM4
186	DISCONNECT_VAPOR_ARM5
187	DISCONNECT_VAPOR_ARM6
188	SELECT_ARM_ALL
189	READY_FOR_NEW_RAKE
190	TURN_ON_PUMP
191	WAITING_FOR_TOP_VALVE_CLOSE
192	WAITING_FOR_BOTTOM_VALVE_CLOSE
193	WAITING_FOR_TOP_VALVE_OPEN
194	WAITING_FOR_BOTTOM_VALVE_OPEN
195	CONNECT_SELECTED_ALARM1 INPUT
196	DISCONNECT_NOT_SELECTED_ALARM1 INPUT
197	WAITING_FOR_TAS_PERMISSIVE
198	ARM1_OVERFILL_ACTIVATED
199	ARM2_OVERFILL_ACTIVATED
200	ARM3_OVERFILL_ACTIVATED
201	ARM4_OVERFILL_ACTIVATED

Value	Definition
202	ARM5_OVERFILL_ACTIVATED
203	ARM6_OVERFILL_ACTIVATED
204	INITIALIZING_BCU_PLEASE_WAIT
205	LOCAL_UPLOAD_IS_IN_PROGRESS
206	TIME_SYNC_IS_IN_PROGRESS
207	DUMMY (NONE)
208	CONNECT_INTERLOCKS
209	ORDER_NUMBER
210	DRIVER_NUMBER
211	TANKER_NUMBER
212	LOADING_COMPLETE
213	INVALID_TRANSPONDER_CARD
214	ARM1_NOT_READY
215	ARM2_NOT_READY
216	ARM3_NOT_READY
217	ARM4_NOT_READY
218	ARM5_NOT_READY
219	ARM6_NOT_READY
220	DENSITY_ENTRY_ENABLE
221	ENTER_DENSITY
222	DENSITY_OUT_OF_RANGE
223	UNLOADING_COMPLETE
224	ENTER_ARM_1_PRESET
225	ENTER_ARM_1_PRESET
226	ENTER_ARM_1_PRESET
227	ENTER_ARM_1_PRESET
228	ENTER_ARM_1_PRESET
229	ENTER_ARM_1_PRESET
230	PROMPT_PIN_AUTHORIZED
231	TRANSPONDER_CARD_AUTHORIZED

Value	Definition
232	CONNECT_SELECTED_ALARM2_INPUT
233	DISCONNECT_NOT_SELECTED_ALARM2_INPUT
234	PURGE_TO_TRUCK
235	RE_CIRCULATION
236	PURGING_TO_TRUCK_ACTIVE
237	RELEASE_PRESSURE
238	PRESSURE_RELEASE_ACTIVE
240	PURGE_TO_OPEN_AIR
241	PURGING_TO_OPEN_AIR_ACTIVE
242	WATING_WEIGHBRIDGE_STEADY_STATE
243	PLEASE_WAIT

NOTE: The Fusion4 TAS Prompt BATCH_DETAILS(25) can only be used to view the details of first batch planned for the selected Arm. To view details of further batches, F4_PROMPT_BATCH_DETAILS(12) must be used with Show Internal Prompt (7.4.1.6) parameter. In this case the batch number (starting from 0 for the first batch) has to be set in the 'Default Value in Text Input Box' field of the 'Show Prompt Data (C.3.2.16)' structure.

C.3.1.21 Units: Pressure

The following table lists the elements of the [Units: Pressure] enumeration for Fusion4 load controllers.

Table C-51: Elements of [Units: Pressure] enumeration

Value	Definition
1	PASCAL
2	KILO_PASCAL
3	PSI_SMALL
4	PSI_LARGE
5	BAR

C.3.1.22 Units: Volume

The following table lists the elements of the [Units: Volume] enumeration for Fusion4 load controllers.

Table C-52: Elements of [Units: Volume] enumeration

Value	Definition
1	LITRES
2	CUBIC_METRES
3	CUBIC_CENTIMETRES
4	CUBIC_DECIMETRES
5	GALLONS_US
6	GALLONS_IMPERIAL
7	BARRELS

C.3.1.23 Units: Density

The following table lists the elements of the [Units: Density] enumeration for Fusion4 load controllers.

Table C-53: Elements of [Units: Density] enumeration

Value	Definition
1	KILOGRAM_M3
2	DEGREES_API
3	POUNDS_FT3
4	RELATIVE_DENSITY_AT_60F
5	KILOGRAM_L

C.3.1.24 Units: Temperature

The following table lists the elements of the [Units: Temperature] enumeration for Fusion4 load controllers.

Table C-54: Elements of [Units: Temperature] enumeration

Value	Definition
1	CELSIUS
2	FAHRENHEIT

C.3.1.25 Units: Mass

The following table lists the elements of the [Units: Mass] enumeration for Fusion4 load controllers.

Table C-55: Elements of [Units: Mass] enumeration

Value	Definition
0	KILOGRAM
1	METRIC_TON
2	POUND
3	LONG_TON
4	SHORT_TON

C.3.1.26 Units: Injection Volume

The following table lists the elements of the [Units: Injection Volume] enumeration for Fusion4 load controllers.

Table C-56: Elements of [Units: Injection Volume] enumeration

Value	Definition
0	VOLUME_ML
1	VOLUME_CC

C.3.1.27 Bay Type

The following table lists the elements of the [Bay Type] enumeration for Fusion4 load controllers.

Table C-57: Elements of [Bay Type] enumeration

Value	Definition	Description
0	Single	Parameter value set to [0] indicates that the bay is a single bay.
1	Dual	Parameter value set to [1] indicates that the bay is a dual bay.

C.3.1.28 Arm Side Status

The following table lists the elements of the [Arm Side Status] enumeration for Fusion4 load controllers.

Table C-58: Elements of [Arm Side Status] enumeration

Value	Definition	Description
0	Right	Parameter value set to [0] indicates that the swing arm is positioned on the right side of the (dual) bay.
1	Left	Parameter value set to [1] indicates that the swing arm is positioned on the left side of the (dual) bay.

C.3.1.29 Loading Bay

The following table lists the elements of the [Loading Bay] enumeration for Fusion4 load controllers.

Table C-59: Elements of [Loading Bay] enumeration

Value	Definition
0	Bay 1
1	Bay 2
2	None

C.3.1.30 Permissive Type

The following table lists the elements of the [Permissive Type] enumeration for Fusion4 load controllers.

Table C-60: Elements of [Permissive Type] enumeration

Value	Definition	Description
0	Pause	If the physical input associated with the permissive is disconnected during loading and the parameter value is set to [0], all the batches running on this bay are paused.
1	Shutdown	If the physical input associated with the permissive is disconnected during loading and the parameter value is set to [1], all the batches running on this bay are terminated. The alarm is auto cleared after the transaction is terminated.

Value	Definition	Description
2	Timeout	If ther physical input associated with the permissive is disconnected during loading and the parameter value is set to [2], all the batches running on this bay are paused. If the input is reconnected within the timeout configured from the device configuration, the alarm is auto cleared and the batches can be resumed. If the input is not reconnected during the timeout, the transaction running on that bay is terminated and the alarm is auto cleared.
3	Manual Reset	If the physical input associated with the permissive is disconnected during loading and the parameter value is set to [3], all the batches running on this bay are paused. If the input is reconnected within the timeout configured from the device configuration, the alarm is auto cleared and the batches can be resumed. If the input is not reconnected during the timeout, the transaction running on that bay is terminated and the alarm needs to reset manually.

C.3.1.31 UDI State

The following table lists the elements of the [UDI State] enumeration for Fusion4 load controllers.

Table C-61: Elements of [UDI State] enumeration

Value	Definition	Description
0	Ready Good	Parameter value set to [0] indicates that UDI finished processing the R/W command/request and a valid response was returned.
1	Ready Error	Parameter value set to [1] indicates that UDI finished processing the R/W command/request and an error was returned. See section C.3.1.33 of APPENDIX C for more information about the UDI error codes.
2	Waiting Result	Parameter value set to [2] indicates that UDI is busy processing the previous command/request.

Value	Definition	Description
3	Waiting Command	Parameter value set to [3] indicates that UDI is waiting for R/W command/ request after buffer data is not valid anymore, for example after writing into 'Item' register or any other writable UDI register. NOTE: While in 'Waiting Command' state, users can freely change 'Item', 'Item Index', 'Item Elements' or 'Buffer' registers to required values.

C.3.1.32 UDI Command

The following table lists the elements of the [UDI Command] enumeration for Fusion4 load controllers.

Table C-62: Elements of [UDI Command] enumeration

Value	Definition	Description
0	Read Indexed	Parameter value set to [0] initiates a Read Indexed command.
1	Write Indexed	Parameter value set to [1] initiates a Write Indexed command.
2	Read All	Parameter value set to [2] initiates a Read All command.
3	Write All	Parameter value set to [3] initiates a Write All command.
4	Dummy	Parameter value set to [4] for Dummy command. No operation initiates for this command.

C.3.1.33 UDI Error Code

The following table lists the elements of the [UDI Error Code] enumeration for Fusion4 load controllers.

Table C-63: Elements of [UDI Error Code] enumeration

Value	Definition
0	None
1	General
2	Busy
3	Invalid Index

Value	Definition
4	No Write Access
5	Data Not Ready
6	Unknown Item
7	Controller Error
8	Data Too Long
9	Unknown Command

C.3.1.34 Batch State

The following table lists the elements of the [Batch State] enumeration for Fusion4 load controllers.

Table C-64: Elements of [Batch State] enumeration

Value	Definition
0	Idle
1	Queued
2	Running
3	Paused
4	Done
5	Deleted
6	Planning
7	Pausing

C.3.1.35 Bay Command

The following table lists the elements of the [Bay Command] enumeration for Fusion4 load controllers.

Table C-65: Elements of [Bay Command] enumeration

Value	Definition	Description
0	Transaction Stop	Initiates stopping of the current transaction.
1	Transaction Start	Initiates starting of a transaction
2	Stop Batches	Initiates stopping of all batches currently running on the bay.

Value	Definition	Description
3	Pause Batches	Initiates pausing of all batches currently running on the bay.
4	Restart Batches	Results in restarting of all paused batches on the bay.
5	Plan Next Batch	Initiates planning of the next batch on the bay.
6	Initialize Batch	Initiates initialization of a batch on the bay.
7	None (Dummy)	
8	Start purging to truck	Starts nitrogen purging to truck in LNG loading
9	Stop purging to truck	Stops nitrogen purging to truck in LNG loading
10	Start purging to open air	Starts nitrogen purging to open air in LNG loading
11	Stop purging to open air	Stops nitrogen purging to open air in LNG loading
13	Start release truck pressure	Starts release truck pressure sequence in LNG loading
14	Stop release truck pressure	Stops release truck pressure in LNG loading

C.3.1.36 Workflow Option Type

The following table lists the elements of the [Workflow Option Type] enumeration for Fusion4 load controllers.

Table C-66: Elements of [Workflow Option Type] enumeration

Value	Definition	Description
0	DISABLED	Parameter value set to [0] indicates that the workflow prompt is disabled.
1	OPTIONAL	Parameter value set to [1] indicates that the workflow prompt is enabled and optional, i.e. additional 'Yes/No' screen appears before the prompt screen allowing the user either to skip or show the prompt screen. For example, the 'PRESET' prompt screen will be precluded with the 'Enter Preset? [Yes/No]' screen.

Value	Definition	Description
2	MANDATORY	Parameter value set to [2] indicates that the workflow prompt is enabled and mandatory, i.e. the prompt screen must be answered by the user, for example enter preset quantity for 'PRESET' prompt screen.

C.3.1.37 Fusion4 Record Type

The following table lists the elements of the [Fusion4 Record Type] enumeration for Fusion4 load controllers.

Table C-67: Elements of [Fusion4 Record Type] enumeration

Value	Definition
0	TRANSACTION
1	BATCH
2	ALARM_LOG
3	EVENT_LOG
4	CALIBRATION

C.3.1.38 Record Req State

The following table lists the elements of the [Record Req State] enumeration for load controllers.

Table C-68: Elements of [Record Req State] enumeration

Value	Definition
0	UNINITIALIZED
1	QUERY
2	PROCESSING
3	READY
4	ERROR

C.3.1.39 Unprocessed Transactions Available

The following table lists the elements of the [Unprocessed Transactions Available] enumeration for Fusion4 load controllers.

Table C-69: Elements of [Unprocessed Transactions Available] enumeration

Value	Definition
0	False
1	True

C.3.1.40 User Prompt State

The following table lists the elements of the [User Prompt State] enumeration for Fusion4 load controllers.

Table C-70: Elements of [User Prompt State] enumeration

Value	Definition	Description
0	No Prompt	Parameter value set to [0] indicates that no prompt is displayed.
1	Waiting For User Input	Parameter value set to [1] indicates that the Fusion4 MSC-L is waiting for input from the user.
2	User Response Ready	Parameter value set to [2] indicates that input from the user is received within the configured timeout value.
3	User Cancel	Parameter value set to [3] indicates that the user cancelled input for example by pressing the ESC button to return to the previous prompt.
4	Error	Parameter value set to [4] indicates that an occurred due to an invalid input from the user.
5	Timeout	Parameter value set to [5] indicates that a timeout occurred because the user did not enter the input message within the configured timeout value.
6	Message Displayed	Parameter value set to [6] indicates that the prompt displays a message.
7	Processing Next Prompt Request	Parameter value set to [7] indicates that the Fusion4 MSC-L is processing the request for displaying the next prompt.

C.3.1.41 Load Arm

The following table lists the elements of the [Load Arm] enumeration for Fusion4 load controllers.

Table C-71: Elements of [Load Arm] enumeration

Value	Definition
0	Arm 1
1	Arm 2
2	Arm 3
3	Arm 4
4	Arm 5
5	Arm 6

C.3.1.42 Arm Command

The following table lists the elements of the [Arm Command] enumeration for Fusion4 load controllers.

Table C-72: Elements of [Arm Command] enumeration

Value	Definition	Description
0	Batch_Start	Parameter value set to [0] initiates starting of a batch on the loading arm.
1	Batch_Stop	Parameter value set to [1] initiates stopping of the batch currently running on the loading arm.
2	Batch_Pause	Parameter value set to [2] initiates pausing of the batch currently running on the loading arm.
3	Batch_Restart	Parameter value set to [3] initiates restarting of a paused batch on the loading arm.
4	Batch_ Initialise	Parameter value set to [4] initiates initialization of a batch on the loading arm.
5	Batch_Init_ and_Start	Parameter value set to [5] initiates initialization and starting of a batch on the loading arm.
6	Batch_None (Dummy)	Dummy

C.3.1.43 MSCL Auth Db

The following table lists the elements of the [MSCL Auth Db] enumeration for Fusion4 load controllers.

Table C-73: Elements of [MSCL Auth Db] enumeration

Value	Definition	Description
0	AUTH_DB_ USERS	Parameter value set to [0] indicates the user authorization database.
1	AUTH_DB_ OBJECTS	Parameter value set to [1] indicates the object authorization database.
2	AUTH_DB_ UNKNOWN	Parameter value set to [2] indicates that the authorization database is unknown.

C.3.1.44 F4 Screen Icon

The following table lists the elements of the [F4 Screen Icon] enumeration for Fusion4 load controllers.

Table C-74: Elements of [F4 Screen Icon] enumeration

Value	Definition
0	None
1	Grounding
2	Vapor recovery
3	Overfill protection
4	Start button
5	Connect arm

C.3.1.45 Product Symbol

The following table lists the elements of the [Product Symbol] enumeration for Fusion4 load controllers.

Table C-75: Elements of [Product Symbol] enumeration

Value	Definition
0	API symbol: None
1	API symbol: B5
2	API symbol: B10
3	API symbol: B20
4	API symbol: High sulfur diesel
5	API symbol: Low sulfur diesel

Value	Definition
6	API symbol: Ultra low sulfur diesel
7	API symbol: E5
8	API symbol: E10
9	API symbol: E20
10	API symbol: High grade unleaded
11	API symbol: Middle grade unleaded
12	API symbol: Low grade unleaded
13	API symbol: High sulfur kerosine
14	API symbol: Low sulfur kerosine
15	API symbol: Ultra low sulfur kerosine
16	API symbol: Monitoring wheel
17	API symbol: High sulfur No. 1 fuel oil
18	API symbol: Low sulfur No. 1 fuel oil
19	API symbol: High sulfur No. 2 fuel oil
20	API symbol: Low sulfur No. 2 fuel oil
21	API symbol: Used oil
22	API symbol: Vapour recovery
23	EU symbol: B5
24	EU symbol: B10
25	EU symbol: B20
26	EU symbol: Bitumen
27	EU symbol: Derv
28	EU symbol: E5
29	EU symbol: E10
30	EU symbol: E20
31	EU symbol: Fame
32	EU symbol: Fuel Grade Ethanol
33	EU symbol: Fuel oil
34	EU symbol: Fuel gas
35	EU symbol: Lead replacement petrol

Value	Definition
36	EU symbol: Marine destilates
37	EU symbol: Premium kerosine
38	EU symbol: Premium unleaded
39	EU symbol: Regular kerosine
40	EU symbol: Super unleaded petrol
41	EU symbol: Ultra low sulfur gas oil

C.3.1.46 F4 Prompt Input

The following table lists the elements of the [F4 Prompt Input] enumeration for Fusion4 load controllers.

Table C-76: [F4 Prompt Input] enumeration

Value	Definition
0	F4_PROMPT_INPUT_NON_NEGATIVE_FLOAT
1	F4_PROMPT_INPUT_FLOAT
2	F4_PROMPT_INPUT_NON_NEGATIVE_INTEGER
3	F4_PROMPT_INPUT_INTEGER
4	F4_PROMPT_INPUT_ALPHA_NUMERIC
5	F4_PROMPT_INPUT_NONE
6	F4_PROMPT_INPUT_OK_BUTTON
7	F4_PROMPT_INPUT_PICKLIST
8	F4_PROMPT_ARM_SELECTION
9	F4_PROMPT_RECIPE_SELECTION
10	F4_PROMPT_YES_NO
11	F4_PROMPT_NO_YES
12	F4_PROMPT_BATCH_DETAILS
13	F4_PROMPT_TRANSACTION_DETAILS
14	F4_PROMPT_ARM_SELECTION_PAUSED
15	F4_PROMPT_STANDY_SCREEN
16	F4_PROMPT_INPUT_QUANTITY
17	F4_PROMPT_INPUT_CARD

Value	Definition
18	F4_PROMPT_INPUT_START
19	F4_PROMPT_BATCH_SCHEDULE
20	F4_PROMPT_INPUT_AUTHORIZATION_PASSCODE

C.3.1.47 Controller State

The following table lists the elements of the [Controller State] enumeration for Fusion4 load controllers.

Table C-77: [Controller State] enumeration

Value	Definition
0	CONTROLLER_STATE_IDLE
1	CONTROLLER_STATE_INITIALIZING
2	CONTROLLER_STATE_RUNNING
3	CONTROLLER_STATE_STOPPING
4	CONTROLLER_STATE_FAILING
5	CONTROLLER_STATE_PAUSED
6	CONTROLLER_STATE_ERROR
8	CONTROLLER_STATE_INITIALIZED
10	CONTROLLER_STATE_INITIALIZING_CALIBRATION
11	CONTROLLER_STATE_INITIALIZED_CALIBRATION
12	CONTROLLER_STATE_CALIBRATING
13	CONTROLLER_STATE_STOPPING_CALIBRATION
14	CONTROLLER_STATE_RESUMING
15	CONTROLLER_STATE_PAUSING
17	CONTROLLER_STATE_DISABLED
19	CONTROLLER_STATE_DISABLING
20	CONTROLLER_STATE_PAUSING_DISABLED
21	CONTROLLER_STATE_PAUSED_DISABLED
23	CONTROLLER_STATE_PAUSING_RUNNING
24	CONTROLLER_STATE_PAUSED_RUNNING
25	CONTROLLER_STATE_FINISHING
26	CONTROLLER_STATE_FINISHED

C.3.1.48 Batch Evaluation State

The following table lists the elements of the [Batch Evaluation State] enumeration for Fusion4 load controllers.

Table C-78: [Batch Evaluation State] enumeration

Value	Definition
0	BATCH_EVALUATION_OK
1	BATCH_EVALUATION_NOT_PERFORMED
2	BATCH_EVALUATION_BUSY
3	BATCH_EVALUATION_PRESET_VALUE_NOT_ENOUGH
4	BATCH_EVALUATION_PRESET_VALUE_TOO_LOW
5	BATCH_EVALUATION_PRESET_VALUE_TOO_HIGH
6	BATCH_EVALUATION_BATCH_NOT_FEASIBLE
7	BATCH_EVALUATION_VCF_NOT_CONFIGURED
8	BATCH_EVALUATION_DEVICE_IS_NOT_HEALTHY
9	BATCH_EVALUATION_MMQ_NOT_MET
10	BATCH_EVALUATION_GENERIC_ERROR
11	BATCH_EVALUATION_ARM_IN_ALARM
12	BATCH_EVALUATION_PERMISSIVES_NOT_CONNECTED
13	BATCH_EVALUATION_ARM_NOT_IN_POSITION
14	BATCH_EVALUATION_INVALID_METER_TYPE
15	BATCH_EVALUATION_ARM_NOT_IDLE
16	BATCH_EVALUATION_RECIPE_NOT_VALID
17	BATCH_EVALUATION_ARM_DISABLED
18	BATCH_EVALUATION_PRE_COOLING_FLOWRATE_LOW
19	BATCH_EVALUATION_RECIRCULATION_FLOWRATE_LOW
20	BATCH_EVALUATION_WEIGHBRIDGE_NOT_STEADY

C.3.1.49 Product Stream Alarms

The following table lists the elements of the [Product Stream Alarms] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the alarm is active and 0 when inactive.

Table C-79: [Product Stream Alarms] enumeration

Alarm	Bit Position
PULSE_PHASE	0x0000000000000001
PULSE_GENERAL	0x0000000000000002
LEAKING_STREAM_VALVE	0x0000000000000004
NO_PUMP_SENSE	0x0000000000000008
BLOCK_VALVE_FAILING	0x0000000000000010
FACTORED_PULSE_OUT	0x0000000000000020
NO_HYDRAULIC_PRESSURE	0x0000000000000040
TANK_LOW_LEVEL	0x0000000000000080
TANK_EMPTY	0x0000000000000100
NO_PRODUCT	0x0000000000000200
DENSITY_ERROR	0x0000000000000400
LOW_TEMPERATURE	0x0000000000000800
HIGH_TEMPERATURE	0x0000000000001000
LOW_PRESSURE	0x0000000000002000
HIGH_PRESSURE	0x0000000000004000
LOW_DENSITY	0x0000000000008000
HIGH_DENSITY	0x0000000000010000
VCF_OUT_OF_RANGE	0x0000000000020000
NON_CONVERGENCE	0x0000000000040000
SUPERCRITICAL_FLUID	0x0000000000080000
NO_REFERENCE_FLUID	0x0000000000100000
INVALID_REFERENCE_CONDITION	0x0000000000200000
INVALID_TEMPERATURE_SCALE	0x0000000000400000
BLEND_TOLERANCE_LOW	0x0000000000800000
BLEND_TOLERANCE_HIGH	0x0000000001000000
EXCEEDS_OVERRUN_LIMIT	0x0000000002000000
VALVE_FAULT	0x0000000004000000
FLOWRATE_EXCEEDED_METER_LIMIT	0x0000000008000000
VCF_MEMORY_ALLOC	0x0000000010000000

Alarm	Bit Position
VCF_TEMPERATURE_OUT_OF_RANGE	0x0000000020000000
VCF_PRESSURE_OUT_OF_RANGE	0x0000000040000000
VCF_DENSITY_OUT_OF_RANGE	0x0000000080000000
VCF_ALPHA60_OUT_OF_RANGE	0x0000000100000000
VCF_NO_SOLUTION	0x0000000200000000
VCF_ILLEGAL_ARGUMENT	0x0000000400000000
VCF_INVALID_COMMODITY_GROUP	0x0000000800000000
VCF_INVALID_TABLE	0x0000001000000000
VCF_INVALID_FLOW_METER_HEALTH	0x0000002000000000
VCF_ROUNDING_ERROR	0x0000004000000000
VCF_PRESSURE_COMPENSATION_NOT_ SUPPORTED	0x0000008000000000
VCF_BAD_SENSOR_HEALTH	0x0000010000000000
TEMPERATURE_ERROR	0x0000020000000000
PRESSURE_ERROR	0x0000040000000000
PRODUCT_VAPORIZING	0x0000080000000000
PRODUCT_VAPORIZING_RISK	0x0000100000000000
BLOCK_VALVE_OPENING_FAULT	0x0000200000000000
BLOCK_VALVE_CLOSING_FAULT	0x0000400000000000
BLOCK_VALVE_FEEDBACK_FAULT	0x0000800000000000

C.3.1.50 Device Alarms

The following table lists the elements of the [Device Alarms] enumeration for Fusion4 load controllers.This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the alarm is active and 0 when inactive.

Table C-80: [Device Alarms] enumeration

Alarm	Bit Position
GENERAL_FAIL	0x0000000000000001
POWER_FAILURE	0x0000000000000002
ALARM_BLOCKING_TASK	0x0000000000000004
ALARM_SERVICE_DUE_REMINDER	0x0000000000000008
DEADMAN_INDICATOR	0x0000000000000010

Alarm	Bit Position
DEADMAN_BELL	0x0000000000000020
DEADMAN_CALLOUT	0x0000000000000040
CARDREADER_COMMS_FAILURE	0x0000000000000080
NEDAP_COMMS_FAILURE	0x0000000000000100
WEIGHBRIDGE_COMMS_FAILURE	0x0000000000000200
NEDAP_BATTERY_LOW	0x0000000000000400
EMERGENCY_STOP	0x0000000000000800
POWER_SUPPLY_FAULT	0x0000000000001000
HEALTH_FAULT	0x0000000000002000
TAS_COMMS	0x0000000000004000
PROGRAMMABLE_INPUT_1	0x0000000000008000
PROGRAMMABLE_INPUT_2	0x0000000000010000
PROGRAMMABLE_INPUT_3	0x0000000000020000
PROGRAMMABLE_INPUT_4	0x0000000000040000

C.3.1.51 Bay Alarms

The following table lists the elements of the [Bay Alarms] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the alarm is active and 0 when inactive.

Table C-81: [Bay Alarms] enumeration

Alarm	Bit Position
TRANSACTION_START_ERROR	0x0000000000000001
TRANSACTION_STOP_ERROR	0x0000000000000002
NUM_BATCHES_EXCEEDED	0x0000000000000004
GROUNDING_PAUSE	0x0000000000000008
OVERFILL_PAUSE	0x0000000000000010
VAPOUR_RECOVERY_PAUSE	0x0000000000000020
GROUNDING_SHUTDOWN	0x0000000000000040
OVERFILL_SHUTDOWN	0x0000000000000080
VAPOUR_RECOVERY_SHUTDOWN	0x0000000000000100
PROGRAMMABLE_INPUT_1	0x0000000000000200

Alarm	Bit Position
PROGRAMMABLE_INPUT_2	0x0000000000000400
PROGRAMMABLE_INPUT_3	0x0000000000000800
PROGRAMMABLE_INPUT_4	0x0000000000001000
PROGRAMMABLE_INPUT_5	0x0000000000002000
PROGRAMMABLE_INPUT_6	0x0000000000004000
WEIGHBRDIGE_COMMS_FAIL	0x0000000000008000
WEIGHBRIDGE_TOLERENCE	0x0000000000010000

C.3.1.52 Arm Alarms

The following table lists the elements of the [Arm Alarms] enumeration for Fusion4 load controllers.This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the alarm is active and 0 when inactive.

Table C-82: [Arm Alarms] enumeration

Alarm	Bit Position
BATCH_CALIBRATION_INITIALIZE_ERROR	0x0000000000000001
BATCH_START_ERROR	0x0000000000000002
BATCH_START_CALIBRATION_ERROR	0x0000000000000004
BATCH_STOP_ERROR	0x0000000000000008
BATCH_STOP_CALIBRATION_ERROR	0x0000000000000010
BATCH_PAUSE_ERROR	0x0000000000000020
BATCH_RESUME_ERROR	0x0000000000000040
BATCH_INITIALIZE_ERROR	0x0000000000000080
SWING_ARM_INVALID_POSITION	0x0000000000000100
SWING_ARM_INVALID_TRANSITION	0x0000000000000200
MAX_INTERRUPTS_PER_BATCH_EXCEEDED	0x0000000000000400
MAX_ALARMS_PER_BATCH_EXCEEDED	0x0000000000000800
PROGRAMMABLE_INPUT_1	0x0000000000001000
PROGRAMMABLE_INPUT_2	0x0000000000002000
PROGRAMMABLE_INPUT_3	0x0000000000004000
PROGRAMMABLE_INPUT_4	0x0000000000008000
PROGRAMMABLE_INPUT_5	0x0000000000010000

Alarm	Bit Position
PROGRAMMABLE_INPUT_6	0x0000000000020000
INITIAL_LOW_FLOW_RATE	0x0000000000040000
INITIAL_HIGH_FLOW_RATE	0x0000000000080000
FULL_LOW_FLOW_RATE	0x0000000000100000
FULL_HIGH_FLOW_RATE	0x0000000000200000
PRE_STOP_LOW_FLOW_RATE	0x0000000000400000
PRE_STOP_HIGH_FLOW_RATE	0x0000000000800000
BLOCK_VALVE_FAILING	0x0000000001000000
BELOW_CLEAN_LINE_LIMIT	0x0000000002000000
ARM_PARKED	0x0000000004000000
EXCEEDS_PRESET_OVERRUN_LIMIT	0x0000000008000000
STOP_SWITCH_NOT_COVERED	0x0000000010000000
INVALID_SWITCH_STATES	0x0000000020000000
PRE_COOLING_QTY_REACHED	0x0000000040000000
RECIRCULATION_TEMP_NOT_MET	0x0000000080000000
LOADSPOT_INPUT_1	0x0000000100000000
LOADSPOT_INPUT_2	0x0000000200000000
LOADSPOT_INPUT_3	0x0000000400000000
LOADSPOT_INPUT_4	0x0000000800000000
LOADSPOT_INPUT_5	0x0000001000000000
LOADSPOT_INPUT_6	0x0000002000000000
LOADSPOT_INPUT_7	0x0000004000000000
LOADSPOT_INPUT_8	0x0000008000000000
LOADSPOT_INPUT_9	0x0000010000000000
LOADSPOT_INPUT_10	0x0000020000000000
LOADSPOT_INPUT_11	0x0000040000000000
LOADSPOT_INPUT_12	0x0000080000000000
LOADSPOT_INPUT_13	0x0000100000000000
LOADSPOT_INPUT_14	0x0000200000000000
LOADSPOT_INPUT_15	0x0000400000000000

Alarm	Bit Position
LOADSPOT_INPUT_16	0x0000800000000000

C.3.1.53 IO Card Digital IO States

The following table lists the elements of the [IO Card Digital IO States] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the IO state is active and 0 when inactive.

Table C-83: [IO Card Digital IO States] enumeration

Alarm	Bit Position
DI_DC_1	0x00000001
DI_DC_2	0x00000002
DI_DC_3	0x00000004
DI_DC_4	0x00000008
DI_DC_5	0x00000010
DI_DC_6	0x00000020
DI_DC_7	0x00000040
DI_DC_8	0x00000080
DI_DC_9	0x00000100
DI_DC_10	0x00000200
DI_DC_11	0x00000400
DI_DC_12	0x00000800
DI_DC_13	0x00001000
DI_DC_14	0x00002000
DI_DC_15	0x00004000
DI_AC_1	0x00008000
DI_AC_2	0x00010000
DI_AC_3	0x00020000
DO_EMR_1	0x00040000
DO_EMR_2	0x00080000
DO_EMR_3	0x00100000
DO_EMR_4	0x00200000
DO_EMR_5	0x00400000

Alarm	Bit Position
DO_EMR_6	0x00800000
DO_EMR_7	0x01000000
DO_EMR_8	0x02000000
DO_EMR_9	0x04000000
DO_EMR_10	0x08000000
DO_SSR_1	0x10000000
DO_SSR_2	0x20000000
DO_SSR_3	0x40000000
DO_SSR_4	0x80000000

C.3.1.54 ARM Card Digital IO States

The following table lists the elements of the [ARM Card Digital IO States] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the IO state is active and 0 when inactive.

Table C-84: [ARM Card Digital IO States] enumeration

Alarm	Bit Position
SPI_DI_DC_1	0x00000001
SPI_DI_DC_2	0x00000002
SPI_DI_DC_3	0x00000004
SPI_DI_DC_4	0x00000008
SPI_DI_DC_5	0x00000010
SPI_DI_DC_6	0x00000020
SPI_DI_DC_7	0x00000040
SPI_DI_DC_8	0x00000080
SPI_DI_DC_9	0x00000100
SPI_DI_DC_10	0x00000200
SPI_DI_DC_11	0x00000400
SPI_DI_DC_12	0x00000800
DO_SSR_1	0x00001000
DO_SSR_2	0x00002000

Alarm	Bit Position
DO_SSR_3	0x00004000
DO_SSR_4	0x00008000
DO_SSR_5	0x00010000
DO_SSR_6	0x00020000
DO_SSR_7	0x00040000
DO_SSR_8	0x00080000
DO_SSR_9	0x00100000
DO_SSR_10	0x00200000
DO_SSR_11	0x00400000
DO_SSR_12	0x00800000

C.3.1.55 ARM Current State

The following table lists the elements of the [ARM Current States] enumeration for Fusion4 load controllers.

Table C-85: ARM Current State

Description	Value
NONE	0
BATCH_PLANNED_FAILED	1
BATCH_PLANNED_WITH_ALARM	2
BATCH_PLANNED_SUCCESS	3
BATCH_IN_START_PROMPT	4
BATCH_SKIPPED	5
BATCH_RUNNING	6
BATCH_PAUSED_AND_ALARM_ACTIVE	7
BATCH_PAUSED_AND_ALARM_CLEARED	8
BATCH_START_PROMPT_TO_RESUME	9
BATCH_STOPPED_DUE_TO_ALARM	10
BATCH_STOPPED_NORMALLY	11
BATCH_BUSY	15

C.3.1.56 Communication Mode

The following table lists the elements of the [Communication Mode] enumeration for Fusion4 load controllers.

Table C-86: Communication Mode

Description	Value
COMMUNICATION_MODE_STANDALONE	0
COMMUNICATION_MODE_REMOTE	1

C.3.1.57 Destination Record Type

The following table lists the elements of the [Destination Record Type] enumeration for Fusion4 load controllers.

Table C-87: Destination Record Type

Description	Value
DESTINATION_RECORD_TYPE_TRANSACTION	0
DESTINATION_RECORD_TYPE_BATCH	1

C.3.1.58 Preset Type

The following table lists the elements of the [Preset Type] enumeration for Fusion4 load controllers.

Table C-88: Preset Type

Description	Value
PRESET_TYPE_GOV	0
PRESET_TYPE_MASS	1
PRESET_TYPE_GSV	2

C.3.1.59 Temperature Dimension

The following table lists the elements of the [Temperature Dimension] enumeration for Fusion4 load controllers.

Table C-89: Temperature Dimension

Description	Value
DIMENSION_CELCIUS	1
DIMENSION_FAHRENHEIT	2

C.3.1.60 Pressure Dimension

The following table lists the elements of the [Pressure Dimension] enumeration for Fusion4 load controllers.

Table C-90: Pressure Dimension

Description	Value
DIMENSION_PASCAL	1
DIMENSION_KILO_PASCAL	2
DIMENSION_PSI_SMALL	3
DIMENSION_PSI_LARGE	4
DIMENSION_BAR	5

C.3.1.61 Density Dimension

The following table lists the elements of the [Density Dimension] enumeration for Fusion4 load controllers.

Table C-91: Density Dimension

Description	Value
DIMENSION_KILOGRAM_M3	1
DIMENSION_DEGREES_API	2
DIMENSION_POUNDS_FT3	3
DIMENSION_RELATIVE_DENSITY_AT_60F	4
DIMENSION_KILOGRAM_L	5

C.3.1.62 Thermal Coeff Dimension

The following table lists the elements of the [Thermal Coeff Dimension] enumeration for Fusion4 load controllers.

Table C-92: Thermal Coeff Dimesion

Description	Value
DIMENSION_UNIT_PER_CELCIUS	1
DIMENSION_UNIT_PER_FAHRENHEIT	2
DIMENSION_FACTORED_UNIT_PER_CELCIUS	3
DIMENSION_FACTORED_UNIT_PER_FAHRENHEIT	4

C.3.1.63 Alarm Log Record Status

The following table lists the elements of the [Alarm Log Record Status] enumeration for Fusion4 load controllers.

Table C-93: Alarm Log Record Status

Description	Value
ALARM_LOG_RECORD_NOT_READY	0
ALARM_LOG_RECORD_READY	1

C.3.1.64 Unprocessed Alarm Record Available

The following table lists the elements of the [Unprocessed Alarm Record Available] enumeration for Fusion4 load controllers.

Table C-94: Unprocessed Alarm Record Available

Description	Value
UNPROCESSED_ALARM_RECORD_AVAILABLE_F ALSE	0
UNPROCESSED_ALARM_RECORD_AVAILABLE_T RUE	1

C.3.1.65 Transaction Workflow Mode

The following table lists the elements of the [Transaction Workflow Mode] enumeration for Fusion4 load controllers.

Table C-95: Transaction Workflow Mode

Description	Value
Standalone	0
Remote With Local Fallback	1
Remote	2

C.3.1.66 Batch Start Option

The following table lists the elements of the [Batch Start Option] enumeration for Fusion4 load controllers.

Table C-96: Batch Start Option

Description	Value
BATCH_START_LOCAL	0
BATCH_START_REMOTE	1

C.3.1.67 Permissive State (External Additive 1 -12)

The following table lists the elements of the [Permissive State (External Additive 1 - 12)] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the permissive is active and 0 when inactive.

Table C-97: Permissive State (External Additive 1 -12)

Description	Value
Ext. Add. 1 Permissive active	0x0001
Ext. Add. 2 Permissive active	0x0002
Ext. Add. 3 Permissive active	0x0004
Ext. Add. 4 Permissive active	0x0008
Ext. Add. 5 Permissive active	0x0010
Ext. Add. 6 Permissive active	0x0020
Ext. Add. 7 Permissive active	0x0040
Ext. Add. 8 Permissive active	0x0080
Ext. Add. 9 Permissive active	0x0100
Ext. Add. 10 Permissive active	0x0200
Ext. Add. 11 Permissive active	0x0400
Ext. Add. 12 Permissive active	0x0800
Reserved	0x1000
Reserved	0x2000
Reserved	0x4000
Reserved	0x8000

C.3.1.68 Permissive State (External Additive 13 - 24)

The following table lists the elements of the [Permissive State (External Additive 13 - 24)] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the permissive is active and 0 when inactive.

Table C-98: Permissive State (External Additive 13 - 24)

Description	Value
Ext. Add. 13 Permissive active	0x0001

Description	Value
Ext. Add. 14 Permissive active	0x0002
Ext. Add. 15 Permissive active	0x0004
Ext. Add. 16 Permissive active	0x0008
Ext. Add. 17 Permissive active	0x0010
Ext. Add. 18 Permissive active	0x0020
Ext. Add. 19 Permissive active	0x0040
Ext. Add. 20 Permissive active	0x0080
Ext. Add. 21 Permissive active	0x0100
Ext. Add. 22 Permissive active	0x0200
Ext. Add. 23 Permissive active	0x0400
Ext. Add. 24 Permissive active	0x0800
Reserved	0x1000
Reserved	0x2000
Reserved	0x4000
Reserved	0x8000

C.3.1.69 Permissive State (External Additive 1 - 6)

The following table lists the elements of the [Permissive State (Product 1 - 6)] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the permissive is active and 0 when inactive.

Table C-99: Permissive State (External Additive 1 - 6)

Description	Value
Product 1 Permissive active	0x0001
Product 2 Permissive active	0x0002
Product 3 Permissive active	0x0004
Product 4 Permissive active	0x0008
Product 5 Permissive active	0x0010
Product 6 Permissive active	0x0020
Reserved	0x0040
Reserved	0x0080

Description	Value
Reserved	0x0100
Reserved	0x0200
Reserved	0x0400
Reserved	0x0800
Reserved	0x1000
Reserved	0x2000
Reserved	0x4000
Reserved	0x8000

C.3.1.70 Permissive State (External Additive 7 - 12)

The following table lists the elements (Product 1 -6 not external additive) of the [Permissive State (Product 7 - 12)] enumeration for Fusion4 load controllers. This is a bit enumeration. The bit indicated by the bit position shall have a value of 1 when the permissive is active and 0 when inactive.

Table C-100: Permissive State (External Additive 7 - 12)

Description	Value
Product 7 Permissive active	0x0001
Product 8 Permissive active	0x0002
Product 9 Permissive active	0x0004
Product 10 Permissive active	0x0008
Product 11 Permissive active	0x0010
Product 12 Permissive active	0x0020
Reserved	0x0040
Reserved	0x0080
Reserved	0x0100
Reserved	0x0200
Reserved	0x0400
Reserved	0x0800
Reserved	0x1000
Reserved	0x2000
Reserved	0x4000

Description	Value
Reserved	0x8000

C.3.1.71 Permissive State (Internal Additive 1 -12)

The following table lists the elements of the [Permissive State (Internal Additive 1 - 12)] enumeration for Fusion4 load controllers.

Table C-101: Permissive State (Internal Additive 1 -12)

Description	Value
Int. Add. 1 Permissive active	0x0001
Int. Add. 2 Permissive active	0x0002
Int. Add. 3 Permissive active	0x0004
Int. Add. 4 Permissive active	0x0008
Int. Add. 5 Permissive active	0x0010
Int. Add. 6 Permissive active	0x0020
Int. Add. 7 Permissive active	0x0040
Int. Add. 8 Permissive active	0x0080
Int. Add. 9 Permissive active	0x0100
Int. Add. 10 Permissive active	0x0200
Int. Add. 11 Permissive active	0x0400
Int. Add. 12 Permissive active	0x0800
Reserved	0x1000
Reserved	0x2000
Reserved	0x4000
Reserved	0x8000

C.3.1.72 Permissive State (Internal Additive 13 - 24)

The following table lists the elements of the [Permissive State (Internal Additive 13 - 24)] enumeration for Fusion4 load controllers.

Table C-102: Permissive State (Internal Additive 13 - 24)

Description	Value
Int. Add. 13 Permissive active	0x0001
Int. Add. 14 Permissive active	0x0002

Description	Value
Int. Add. 15 Permissive active	0x0004
Int. Add. 16 Permissive active	0x0008
Int. Add. 17 Permissive active	0x0010
Int. Add. 18 Permissive active	0x0020
Int. Add. 19 Permissive active	0x0040
Int. Add. 20 Permissive active	0x0080
Int. Add. 21 Permissive active	0x0100
Int. Add. 22 Permissive active	0x0200
Int. Add. 23 Permissive active	0x0400
Int. Add. 24 Permissive active	0x0800
Reserved	0x1000
Reserved	0x2000
Reserved	0x4000
Reserved	0x8000

C.3.1.73 Language

The following table lists the elements of the [Language] enumeration for Fusion4 load controllers.

Table C-103: Language

Language	Value
ENGLISH_UK	1
ENGLISH_US	2
FRENCH	3
GERMAN	4
DUTCH	5
SPANISH	6
CHINESE	7
JAPANESE	8
POLISH	9
PORTUGUESE	10

Language	Value
ITALIAN	11
LOCAL_LANGUAGE	12
THAI	13
HINDI	14
SWEDISH	15
RUSSIAN	16
ARABIC	17
PORTUGUESE_BRASIL	18
TURKISH	19
HEBREW	20

C.3.1.74 User Attributes

The following table lists the elements of the [User Attributes] enumeration for Fusion4 load controllers.

Table C-104: User Attributes

User Attribute	Value
SECURITY_LEVEL_0	0
SECURITY_LEVEL_1	1
SECURITY_LEVEL_2	2
SECURITY_LEVEL_3	3
SECURITY_LEVEL_REMOTE_LEVEL_1	10

C.3.1.75 Object Attributes

The following table lists the elements of the [Object Attributes] enumeration for Fusion4 load controllers.

Table C-105: Object Attributes

Object Attribute	Value
OBJECT_TYPE_UNKNOWN	0
OBJECT_TYPE_VEHICLE	1
OBJECT_TYPE_CARRIER	2
OBJECT_TYPE_TRAILER	3

Object Attribute	Value
OBJECT_TYPE_CONTRACT	4

C.3.1.76 Device Type

The following table lists the elements of the [Device Type] enumeration for Fusion4 load controllers.

Table C-106: Device Type

Name	Number of Characters	Description
Device Type	6	The type of device from which the transaction came. This value should be the enumeration text associate with the device type field in the transaction record. All characters must be used. If the enumeration text < 6 characters then the "_" should be used after the enumeration text to fill the remaining characters.
Serial Number	10	A unique identifier that identifies which particular device in the device line created the transaction. This serial number so be consistent with the serial number in the transaction record. All 10 characters must be used. Unspecified characters should be filled with the "_" character on the left hand side. This serial number is stored on the HMI board.
Transaction Number	10	A number that uniquely identifies a transactions from the same device. All 10 characters should be used.

C.3.1.77 Device Type

The following table lists the elements of the [Device Type] enumeration for Fusion4 load controllers.

Table C-107: Device Type enumeration

Name	Value	Description
SSC_A	1	single stream additive injector
SSC_B	2	single stream blender
MSC_A	3	Multi stream additive injector
MSC_B	4	Multi stream blender

Name	Value	Description
MSC_L	5	Multi stream loader
MSC_XA	6	Multi stream x additive injector
MSC_XB	7	Multi stream x blender
MSC_XL	8	Multi stream x loader

C.3.1.78 Sensor Category

The following table lists the elements of the [Sensor Category] enumeration for Fusion4 load controllers.

Table C-108: Sensor Category

Name	Value
Good Actual	0
Good Manual	1
Good Last Valid	2
Good Stored	3
Uncertain Instrument	1001
Uncertain Environment	1002
Bad General Hardware Fail	2001
Bad General Firmware Fail	2002
Bad General Commissioning Fail	2003
Bad General Calibration Fail	2004
Bad General Operational Fail	2005
Bad No Data Available	2006
Bad Un Initialized	2007
Bad Killed	2008
Bad Over Range	2009
Bad Under Range	2010

C.3.1.79 Sensor Health

The following table lists the elements of the [Sensor Health] enumeration for Fusion4 load controllers.

Table C-109: Sensor Health

Name	Value
UNDEFINED	0
GOOD	1
UNCERTAIN	2
BAD	3

C.3.1.80 Status Code

The following table lists the elements of the [Status Code] enumeration for Fusion4 load controllers.

Table C-110: Status Code

Name	Value
No CAN error	0
No FlexConn error	1
RAM error	2
ROM error	3
RAM warning	4
CAN error passive state entered	5
CAN error counter limit reached	6

C.3.1.81 Alarm Severity

The following table lists the elements of the [Alarm Severity] enumeration for Fusion4 load controllers.

Table C-111: Alarm Severity

Name	Value
None	0
Display	1
Pause	2
Shutdown	3

C.3.2 Structures

C.3.2.1 Bay Command

The following table describes the [Bay Command] structure for Fusion4 load controllers.

Table C-112: Bay Command structure (UDI data type: 471)

Field Description	Data Type	Enumeration/ Structure	Description
Bay Command	uint16 (enum)	Bay Command	The bay command to be issued. See section C.3.1.35 of APPENDIX C for more information.
Loading Bay	uint16 (enum)	Loading Bay	The bay to which the bay command is to be issued. See C.3.1.29 for more information.
Data	uint32		The index in the bay batch details array to identify which batch to initialize. NOTE: The data field needs to be used only when the Initialize Batch bay command is issued.

C.3.2.2 Transaction Authorization Details

The following table describes the [Transaction Authorization Details] structure for Fusion4 controllers for loading.

Table C-113: Transaction Authorization Details structure (UDI data type: 563)

Field Description	Data Type	Enumeration/ Structure	Description
Loading Bay	uint16 (enum)	Loading Bay	The loading bay on which the authorisation takes place. See C.3.1.29 for more information.
Contract ID	char [16]		The unique identification of the contract or the order number.
Driver ID	char [16]		The unique identification (name or number) of the driver performing the loading operations.
Vehicle ID	char [16]		The unique identification of the vehicle associated with the transaction.

C.3.2.3 Transaction Authorization Details Unicode

The following table describes the [Transaction Authorization Details Unicode] structure for Fusion4 controllers for loading.

Transaction Authorization Details Unicode structure (UDI data type: 573)

Field Description	Data Type	Enumeration/ Structure	Description
Loading Bay	uint16 (enum)	Loading Bay	The loading bay on which the authorisation takes place. See C.3.1.29 for more information.
Contract ID	uint16 [16]		The unique identification of the contract or the order number.
Driver ID	uint16 [16]		The unique identification (name or number) of the driver performing the loading operations.
Vehicle ID	uint16 [16]		The unique identification of the vehicle associated with the transaction.

C.3.2.4 Authorization Object

The following table describes the [Authorization Object] structure for Fusion4 load controllers.

Table C-114: Authorization Object structure (UDI data type: 498)

Field Description	Data Type	Enumeration/ Structure	Description
Name	char [16]		The name or reference by which the person or object can be identified.
Password	char [10]		The secret pass word by which the person or object can be identified.
Attribute	uint16		The attribute that belongs to this database record (i.e security level or object type). See section C.3.1.74 User Attributes.

C.3.2.5 User Response

The following table describes the [User Response] structure for Fusion4 load controllers.

Table C-115: User Response structure (UDI data type: 461)

Field	Data Type	Enumeration/ Structure	Description
Unicode Text	uint16 [32]		The unicode string that holds the user response.
Selected Item	int32		The selected item from the picklist.
Value	float32		The floating point value holding the user response.
State of Input	uint16 (enum)	User Prompt State	The state of the user response input. See section C.3.1.40 of APPENDIX C for more information.

C.3.2.6 Batch Details

The following table describes the [Batch Details] structure for Fusion4 load controllers.

Table C-116: Batch Details structure (UDI data type: 475)

Field	Data Type	Enumeration/ Structure	
Compartment Number	uint8		The number of the compartment associated with the batch.
Preset Quantity	float32		The preset quantity.
Return Quantity	float32		The return quantity.
Recipe Index	uint16		The index of the selected recipe.
Load Arm	uint16 (enum)	Load Arm	The loading arm associated with the batch. See section C.3.1.41 of APPENDIX C for more information.
Batch State	uint16 (enum)	Batch State	The state of the batch. See section C.3.1.34 of APPENDIX C for more information.

C.3.2.7 Authorization Data

The following table describes the [Authorization Data] structure for Fusion4 controllers for loading.

Table C-117: Authorization Data structure (UDI data type: 532)

Field Description	Data Type	Enumeration/ Structure	Description
Authorization Index	uint32		The index of the object that needs to be updated.
Authorization Object	struct [28]	Authorization Object	The object that needs to updated. See section C.3.2.4 of APPENDIX C for more information.

C.3.2.8 Plan Init Start Batch

The following table describes the [Plan Init Start Batch] structure for Fusion4 controllers for loading.

Table C-118: Plan Init Start Batch structure (UDI data type: 562)

Field Description	Data Type	Enumeration/ Structure	Description
Batch Details	struct [15]	Batch Details	The details of the batch to be planned, initialised and started. See C.3.2.6 of APPENDIX C for more information.
Loading Bay	uint16 (enum)	Loading Bay	The loading bay on which the batch is to be performed. See C.3.1.29 for more information.
Batch Details Index	uint16		The index in the batch state details array at which the batch should be saved.

C.3.2.9 Internal Prompt Data

The following table describes the [Internal Prompt Data] structure for Fusion4 load controllers.

Table C-119: Internal Prompt Data structure (UDI data type: 531)

Field	Data Type	Enumeration/ Structure	Description
Timeout Period in Sec	uint32		The timeout value within the user needs to enter the input message.

Field	Data Type	Enumeration/ Structure	Description
Default value in Text Input Box	uint32		The default value in the text input box.
Type of Input Required	uint16 (enum)	Fusion4 TAS Prompt	The type of input required. See section C.3.1.20 of APPENDIX C for more information.
Number of Items to be Displayed	uint16		The number of items to be displayed (picklist only)

C.3.2.10 Compartment Response

The following table describes the [Compartment Response] structure for Fusion4 load controllers.

Table C-120: Compartment Response structure (UDI data type: 508)

Field	Data Type	Enumeration/ Structure	Description
Response Value	uint8 (bool)	Boolean	Displays whether response value was send.
Error Message	char[32]		Displays the error message, if any.
Next Prompt Option	uint32		Displays the next prompt.

C.3.2.11 Record Request

C.3.2.11.1 Read response data

The following table describes the [Record Request] structure for Fusion4 load controllers.

> NOTE: The record request state must be 'Ready'. Otherwise, all fields remain undefined.

Table C-121: Record Request structure: Read response data (UDI data type: 557)

Field	Data Type	Enumeration/ Structure	Description
Record ID	uint32		The ID of the record stored in the record request buffer.
Record Sub Index	uint32		The sub-index of the record stored in the record request buffer. This is the additional record information ID (only used for batch records, if not used then value does not matter).
Record Size	uint32		The size of the record stored in the record request buffer.
Record Type	uint16 (enum)	Fusion4 Record Type	The type of the record stored in the record request buffer. See section C.3.1.37 of APPENDIX C for more information.
Request State	uint16 (enum)	Fusion4 Record Request State	The state of the last record request. See section C.3.1.38 of APPENDIX C for more information.

C.3.2.11.2 Write request data

The following table describes the [Record Request] structure for Fusion4 load controllers.

Table C-122: Record Request structure: Write request data

Field	Data Type	Enumeration/ Structure	Description
Record ID	uint32		The ID of the requested record.
Record Sub Index	uint32		Additional record information.
Record Size	uint32		Not used
Record Type	uint16 (enum)	ENUM_ FUSION4_ RECORD_ TYPE	The type of the record requested. See section C.3.1.37 of APPENDIX C for more information.

Field	Data Type	Enumeration/ Structure	Description
Request State	uint16 (enum)	ENUM_ FUSION4_ RECORD_REQ_ STATE	The state of the record request. The state must be set to 'QUERY'. See section C.3.1.38 of APPENDIX C for more information.

C.3.2.12 Arm Command

The following table describes [Arm Command] structure for Fusion4 controllers for loading.

Table C-123: Arm Command structure (UDI data type: 474)

Field	Data Type	Enumeration/ Structure	Description
Arm Command	uint16 (enum)	ENUM_ARM_ COMMAND	The arm command to be issued to the arm. See section C.3.1.42 of APPENDIX C for more information.
Load Arm	uint16 (enum)	Load Arm	The loading arm to which the arm command is to be issued. See section C.3.1.41 of APPENDIX C for more information.
Data	uint32		The index of the recipe that needs to be loaded. NOTE: The data field needs to be used only when the Initialize Batch arm command is issued.

C.3.2.13 Delete Auth Object Request

The following table describes the [Delete Auth Object Request] structure for Fusion4 controllers for loading.

Table C-124: Delete Auth Object Request structure (UDI data type: 564)

Field	Data Type	Enumeration/ Structure	Description
Database Type	uint16 (enum)	ENUM_MSCL_ AUTH_DB	The authorization database from which the entry is to be deleted. See section C.3.1.43 of APPENDIX C for more information.
Pass Code	char [10]		The secret password of the entry to be deleted from the selected authorization database.

C.3.2.14 Load Recipe

The following table describes the [Load Recipe] structure for Fusion4 load controllers.

Table C-125: Load Recipe structure (UDI data type: 450)

Field	Data Type	Enumeration/ Structure	Description
Recipe Name	uint16 [32]		The unicode string holding the name of the finished product.
Product Symbol	uint16 (enum)	ENUM_ PRODUCT_ SYMBO L	The symbol of the finished product. See section C.3.1.45 of APPENDIX C for more information.
Hazardous Material Classification	uint8 [50]		The hazardous material classification for the finished product.
Product Percentage	float32 [4]		The percentage of product to be loaded.
Additive PPM Volume	float32 [6]		The quantity of additive per injection in ppm or volume.
Pacing Volume Per Injection	float32 [6]		The pacing volume per injection for the additives.
Product Stream Address	struct [4]	STRUCT_ STREAM_ ADDRE SS	The stream address for the product. See Appendix C.3.2.17 - Stream Address
Additive Stream Address	struct [6]	STRUCT_ STREAM_ ADDRE SS	The stream address for the additive. See Appendix C.3.2.17 - Stream Address

Field	Data Type	Enumeration/ Structure	Description
Is Valid	uint8 (enum)	Boolean	Indicates if the recipe is valid or invalid.

C.3.2.15 Arm State Details

The following table describes the [Arm State Details] structure for Fusion4 load controllers.

Table C-126: Arm State Details structure (UDI data type: 477)

Field	Data Type	Enumeration/ Structure	Description
Batch state	uint16 (enum)	ENUM_ CONTROLLER_ STATE	The Fusion4 controller state. See section C.3.1.47 for more information.
Batch error	uint16 (enum)	ENUM_BATCH_ EVALUATION_ STATE	The batch evaluation state. See section C.3.1.49 for more information.
Batch ID	uint32		The unique identification of the batch.
Remaining time	uint32		The time for the batch to complete.
Preset	float32		The batch preset quantity.
Delivered product: GOV		STRUCT_ SENSOR_ VALUE	The gross observed volume (GOV) of the final, finished product. See C.3.2.31 for more information.
Delivered product: GSV		STRUCT_ SENSOR_ VALUE	The gross standard volume (GSV) of the final, finished product. See C.3.2.31 for more information.
Delivered product: Mass		STRUCT_ SENSOR_ VALUE	The mass of the final, finished product. See C.3.2.31 for more information.
Delivered product: Flow rate		STRUCT_ SENSOR_ VALUE	The flow rate of the final, finished product. See C.3.2.31 for more information.

Field	Data Type	Enumeration/ Structure	Description
Delivered product: Temperature		STRUCT_ SENSOR_ VALUE	The instantaneous temperature of the final, finished product. See C.3.2.31 for more information.
Delivered product: Pressure		STRUCT_ SENSOR_ VALUE	The instantaneous pressure of the final, finished product. See C.3.2.31 for more information.
Delivered product: Density		STRUCT_ SENSOR_ VALUE	The instantaneous density of the final, finished product. See C.3.2.31 for more information.
Digital states	uint16		Digital I/O states of the arm.
Fusion4 scan register	uint32		

C.3.2.16 Show Prompt Data

The following table describes the [Show Prompt Data] structure for Fusion4 load controllers.

Table C-127: Show Prompt Data structure (UDI data type: 460)

Field	Data Type	Enumeration/ Structure	Description
Message	uint16 [128]		The unicode string to be displayed on the screen.
Timeout Period in Sec	uint32		The timeout value within the user needs to enter the input message
Default Value	uint32		The default value in the text input box.
Screen Icon	uint16 (enum)	F4 Screen Icon	The icon to be displayed with the prompt., See C.3.1.44 of APPENDIX C for more information.
Prompt Input	uint16 (enum)	F4 Prompt Input	The type of input required. See C.3.1.46 of APPENDIX C for more information.
Number of Items to be Displayed	uint16		The number of items to be displayed (picklist only).

Field	Data Type	Enumeration/ Structure	Description
Hide Input	uint8 (enum)	Boolean	Indicates whether the input message should be displayed or not.

C.3.2.17 Stream Address

The following table describes the [Stream Address] structure for Fusion4 load controllers.

Table C-128: Stream Address structure (UDI data type: 24)

Field	Data Type	Enumeration/Structure	Description
Data	uint8[32]		Data array to hold the compressed address.

The STRUCT_STREAM_ADDRESS structure contains three bytes that uniquely address a stream within the device.

Bitmasks need to be used to decipher 5 addressing values from these 3 bytes are described below:

- Device Address Flag bit (1 bit) [m]
- Device Number (11 bits) [d]
- Board Number (4 bits) [b]
- Function Number (4 bits) [f]
- Index Number (4 bits) [i]

These are mapped onto the three bytes as such: byte 2 - byte 1 - byte 0

C.3.2.17.1 Device Address Flag (1 Bit, Bit 23)

This first (most significant) bit indicates how to process the other bits in the device number field.

C.3.2.17.2 Device Number (11 Bits, Bits 23-12)

If the Device address flag is 1 and the Device Number is not equal to 11111111111b then this value is an index into a t.b.d. device address lookup table.

Otherwise, if the Device address flag is 0, then the Device Number field is the actual FlexConn device address value.

C.3.2.17.3 Board Number (3 Bits, Bits 10-8)

This value represents the MSC-L slot number (and FlexConn board instance value) of the board.

C.3.2.17.4 Function Number (4 Bits, Bits 7-4)

This value represents the FlexConn function instance value of the stream. For the MSC-L streams this is either 4 (Additive stream) or 5 (Product stream).

C.3.2.18 Index Number (4 Bits, Bits 3-0)

This value represents the entity index number for target stream on the specified FlexConn board.

C.3.2.19 Batch Details V2

The following table describes the [Batch Details V2] structure for Fusion4 load controllers.

Table C-129: Batch Details V2 (UDI data type: 628)

Field Description	Data Type	Enumeration/ Structure Type	Description
Compartment Number	uint16		The number of the compartment associated with the batch.
Preset Quantity	float32		The preset quantity.
Recipe Index	uint16		The index of the selected recipe.
Load Arm	uint16 (enum)	Load Arm	The loading arm associated with the batch. See C.3.1.41 of APPENDIX C for more information.
Batch State	uint16 (enum)	Batch State	The state of the batch. See C.3.1.34 of APPENDIX C for more information.

C.3.2.20 Plan Init Start Batch V2

The following table describes the [Plan Init Start Batch V2] structure for Fusion4 load controllers.

Table C-130: Plan Init Start Batch V2 (UDI data type: 629)

Field Description	Data Type	Enumeration/ Structure Type	
Batch Details	struct [16]	Batch Details V2	The details of the batch to be planned, initialised and started. See C.3.2.6 of APPENDIX C for more information.
Loading Bay	uint16 (enum)	Loading Bay	The loading bay on which the batch is to be performed. See C.3.1.29 of APPENDIX C for more information.
Batch Details Index	uint16		The index in the batch state details array at which the batch should be saved.

C.3.2.21 1010 Transaction Record

The following table describes the [1010 Transaction Record] structure for Fusion4 load controllers.

Table C-131: 1010 Transaction Record (UDI data type: 523)

Field Description	Data Type	Enumeration/ Structure Type	Description
Transaction Number	uint32		The transaction number
Start Date	struct	RTC Date	The transaction start date. See C.3.2.29 of APPENDIX C for more information.
Stop Date	struct	RTC Date	The transaction start date. See C.3.2.29 of APPENDIX C for more information.
Start Time	struct	RTC Time	The transaction start date. See C.3.2.30 of APPENDIX C for more information.

Field Description	Data Type	Enumeration/ Structure Type	Description
StopTime	struct	RTC Time	The transaction start date. See C.3.2.30 of APPENDIX C for more information.
Batch Stop	uint32	-	The last batch number of the transaction.
Communication Mode	uint16 (enum)	ENUM_ COMMUNICATION_ MODE	-
Unit Address	uint8	-	The unit address of the device.
Bay Number	uint8	-	The Bay Number of the transaction
Calibration Number	uint32	-	Last calibration number
Personnel Index	uint16	-	The authorization index number of user
Vehicle Index	uint16	-	The authorization index number of object
Supervisor Index	uint16	-	Always 0
Number of Arms	uint8	-	Maximum number of available arms
First Arm Number	uint8	-	NA
Unique Number	uint32	-	The unique identification number
Arm Density	float32 [6]	-	The density value of each arms
Arm Volume Units	uint16 (enum) [6]	ENUM_VOLUME_ DIMENSI ON	The units of volume used in transaction. See Appendix C.3.1.22 - Units: Volume for more information.

Field Description	Data Type	Enumeration/ Structure Type	Description
Arm Additive Units	uint16 (enum) [6]	ENUM_INJECTION_ VOLUME_ ENGINEERING_ UNITS	The additive units used for transaction. See Appendix C.3.1.26 - Units: InjectionVolume for more information.
Arm Temperature Units	uint16 (enum) [6]	ENUM_ TEMPERATURE_ DIMENSION	The temperature units used in transaction. See Appendix C.3.1.24 -Units: Temperature for more information.
Arm Mass Units	uint16 (enum) [6]	ENUM_MASS_ DIMENSION	The mass units used in transaction. SeeAppendix C.3.1.25 - Units: Mass for more information.
Density Unit Type	uint16 (enum) [6]	ENUM_DENSITY_ DIMENSI ON	The density units used in transaction. SeeAppendix C.3.1.23 - Units: Density for more information.
Preset Type	uint16 (enum)	ENUM_PRESET_ TYPE	See Appendix C.3.1.58 - Preset Type
Load Number	uint8 [16]	-	The load number of the transaction.
Reference Number	uint8 [16]	-	The reference number of the transaction.
Power Cycle Count	uint8	-	NA
Load Number	uint8 [16]	-	The load number of the transaction.
Reference Number	uint8 [16]	-	The reference number of the transaction.
Power Cycle Count	uint8	-	NA
Checksum Result	uint8 (bool)	-	

Field Description	Data Type	Enumeration/ Structure Type	Description
Tanker Number	uint8 [16]	-	Tanker Number

C.3.2.22 1010 Batch Record

The following table describes the [1010 Batch Record] structure for Fusion4 load controllers.

Table C-132: 1010 Batch Record (UDI data type: 527)

Field Description	Data Type	Enumeration/ Structure Type	Description
Batch Number	uint32		The Batch number
Transaction Number	uint32		The transaction number associated to the batch.
Arm Number	uint8		The arm number of the batch
Compartment Number	uint8		The compartment number
Preset Quantity	float32 [4]		The batch preset quantity.
Start Time	struct	RTC Time	The batch start time. See C.3.2.30 of APPENDIX C for more information.
Stop Time	struct	RTC Time	The batch start time. See C.3.2.30 of APPENDIX C for more information.
Gross Total	float32 [4]		GOV of all four products.
Accum Total Before	float64 [4]		Start GOV accumulated total of all four products.
Accum Total After	float64 [4]		Stop GOV accumulated total of all four products.
Mass Total	float32 [4]		The mass value of all four products

Field Description	Data Type	Enumeration/ Structure Type	Description
Average Temperature	float32 [4]		The average temperature of four products
Average Density	float32 [4]		The average density of four products
Additive Quantity	float32 [6]		Additive injection quantity of six injectors
Accum Additive Quantity	float64 [6]		Accumulated additive quantity of six injectors
Average Pressure	float32 [4]		The average pressure of four products
Net Total	float32 [4]		GSV of all four products.
Net Accum Total Before	float64 [4]		Start GSV accumulated total of all four products.
Net Accum Total After	float64 [4]		Stop GSV accumulated total of all four products.
Returned Quantity	float32		The batch return quantity
Finished Product GOV	float32		The finished product GOV.
Finished Product Mass	float32		The finished product mass value
Product Density	float32 [4]		The manual density of four products
Finished Product Avg Temperature	float32		The batch average temperature
Finished Product Avg Pressure	float32		The batch average pressure

Field Description	Data Type	Enumeration/ Structure Type	Description
Finshed Product Avg Density	float32		The batch average density
Recipe Number	uint8		The batch recipe number
Blend Accuracy	uint8		Blend percentage
Blend Type	uint16 (enum)	ENUM_ BLEND_TYPE	The batch blend type. See Appendix C.3.1.4 - Loading Type
Fluid Group	uint16 (enum) [2]	ENUM_VCF_ FLUID_ GROUP	The batch commodity group. See Appendix C.3.1.10 - VCF CommodityGroup for more information.
Volume Unit Type	uint16 (enum)	ENUM_ VOLUME_D IMENSION	Units of the volume used for the batch. See Appendix C.3.1.22 - Units:Volume for more information.
Mass Unit Type	uint16 (enum)	ENUM_MASS_ DIM ENSION	The units of the mass used for the batch. See Appendix C.3.1.25 - Units:Mass for more information.
Preset Type	uint16 (enum)	ENUM_ PRESET_T YPE	See Appendix C.3.1.58 - Preset Type
Density Unit Type	uint16 (enum) [4]	ENUM_ DENSITY_D IMENSION	Unit of density used for the batch. See Appendix C.3.1.23 - Units: Density for more information.
Error Status	uint8		NA
Meter Error Status	uint8		NA
Checksum Result	uint8 (bool)		
Generic number 1	uint8 [16]		Wagon number / Truck tare weight
Generic number 2	uint8 [16]		Truck weight

C.3.2.23 Generic Record Info Request

The following table describes the [Generic Record Info Request] structure for Fusion4 load controllers.

Table C-133: Generic Record Info Request

Field Description	Data Type	Enumeration/Structure Type	Description
Batch Index	uint32		The index of the batch, this generic record should be added
Destination Record	uint16 (enum)	ENUM_DESTINATION_RECORD_TYPE	The destination where the generic record should be added. See Appendix C.3.1.57 - DestinationRecord Type
Loading Bay	uint16 (enum)	ENUM_LOADING_BAY	The bay where the generic record should be added. See Appendix C.3.1.29 - Loading Bay for more information.
Generic Record Data Field	struct	Generic Record Data Field	The generic record data See Appendix C.3.2.23 - GenericRecord Data Field for more information.

C.3.2.24 Generic Record Data Field

The following table describes the [Generic Record Data Field] structure for Fusion4 load controllers.

Table C-134: Generic Record Data Field

Field Description	Data Type	Enumeration/Structure Type	Description
Label	uint16 [32]		The unicode string that holds label of the generic record.
Value	uint16 [32]		The unicode string that holds value of the generic record.

C.3.2.25 Load Batch Static Info

The following table describes the [Load Batch Static Info] structure for Fusion4 load controllers.

Table C-135: Load Batch Static Info

Field Description	Data Type	Enumeration/ Structure Type	Description
Recipe Name	uint16 [32]		The unicode string that holds recipe name of the batch.
Preset Quantity	float32		The batch preset quantity
Return Quantity	float32		The batch return quantity
Recipe Index	uint16		The batch recipe index number
Product symbol	uint16 (enum)	ENUM_PRODUCT_ SYMBOL	Finished product symbol
Running Screen labels	uint16 (enum)	ENUM_MSCL_ RUNNING_SCREEN_I TEM	Labels on running screens
Compartment number	uint8		Compartment number

C.3.2.26 Finished Product Stream Sub-record

The following table describes the [Finished Product Stream Sub-record] structure for Fusion4 load controllers.

Table C-136: Finished Product Stream Sub-record

Field Description	Data Type	Enumeration/ Structure Type	Description
Header defination	uint16		The batch header information.
Inst. Value - GOV	float32		The batch instantaneous GOV.
Inst. Value - GSV	float32		The batch instantaneous GSV.

Field Description	Data Type	Enumeration/ Structure Type	Description
Inst. Value - Mass	float32		The batch instantaneous mass.
Inst. Value - Temperature	float32		The batch instantaneous temperature.
Inst. Value - Pressure	float32		The batch instantaneous pressure.
Inst. Value - Density	float32		The batch instantaneous density.
Inst. Value - Flowrate	float32		The batch instantaneous flowrate.
Inst. Value - Blend Ratio (NA)	float32		NA
Inst. Value - PPM (NA)	float32		NA

C.3.2.27 Main and Blend Product Stream Sub-record

The following table describes the [Main and Blend Product Stream Sub- record] structure for Fusion4 load controllers.

Table C-137: Main and Blend Product Stream Sub-record

Field Description	Data Type	Enumeration/ Structure Type	Description
Header definition	uint16		The header information.
Inst. Value - GOV	float32		The instantaneous product stream's GOV.
Inst. Value - GSV	float32		The instantaneous product stream's GSV.
Inst. Value - Mass	float32		The instantaneous product steam's mass.
Inst. Value - Temperature	float32		The instantaneous product stream's temperature.
Inst. Value - Pressure	float32		The instantaneous product stream's pressure.

Field Description	Data Type	Enumeration/ Structure Type	Description
Inst. Value - Density	float32		The instantaneous product stream's density.
Inst. Value - Flowrate	float32		The instantaneous product stream's flowrate.
Inst. Value - Blend Ratio	float32		The instantaneous product stream's blend ratio.
Inst. Value - PPM (NA)	float32		NA

C.3.2.28 Additive Product Stream Sub-record

The following table describes the [Additive Product Stream Sub-record] structure for Fusion4 load controllers.

Table C-138: Additive Product Stream Sub-record

Field Description	Data Type	Enumeration/ Structure Type	Description
Header definition	uint16		The header information.
Inst. Value - Injection Volume	float32		The instantaneous additive stream's injection volume.
Inst. Value - GSV (NA)	float32		NA
Inst. Value - Mass (NA)	float32		NA
Inst. Value - Temperature	float32		The instantaneous additive stream's temperature.
Inst. Value - Pressure (NA)	float32		NA
Inst. Value - Density (NA)	float32		NA
Inst. Value - Flowrate (NA)	float32		NA

Field Description	Data Type	Enumeration/ Structure Type	Description
Inst. Value - Blend Ratio (NA)	float32		NA
Inst. Value - PPM	float32		The additive stream's ppm

C.3.2.29 Stream Dynamic Info

The following table describes the [Stream Dynamic Info] structure for Fusion4 load controllers.

Table C-139: Stream Dynamic Info

Field Description	Data Type	Enumeration/ Structure Type	Description
Temperature	float32		The instantaneous stream's temperature value.
Pressure	float32		The instantaneous stream's pressure value.
Density	float32		The instantaneous stream's density value

C.3.2.30 RTC Date

The following table describes the [RTC Date] structure for Fusion4 load controllers.

Table C-140: RTC Date

Field Description	Data Type	Enumeration/ Structure Type	Description
Year	uint16		The year field of the date being represented by the structure.
Month	uint8		The month field of the date being represented by the structure.
Day	uint8		The day field of the date being represented by the structure.

C.3.2.31 RTC Time

The following table describes the [RTC Time] structure for Fusion4 load controllers.

Table C-141: RTC Time

Field Description	Data Type	Enumeration/ Structure Type	Description
Hours	uint8		The hours field of the time being represented by the structure.
Minutes	uint8		The minutes field of the time being represented by the structure.
Seconds	uint8		The seconds field of the time being represented by the structure.
Milliseconds	uint8		The milliseconds field of the time being represented by the structure.

C.3.2.32 Sensor Value

The following table describes the [Sensor Value] structure for Fusion4 load controllers.

Table C-142: Struct Sensor Value

Field Description	Data Type	Enumeration/Structure Type	Description
Value	Float 32		The value of the sensor data.
Health	stuct	Health	The health of the sensor data. See section C.3.2.39.
Alarm Status	uint16 (enum)	Alarm Combination	The alarms associated with the sensor value.
Qualification	bit8		The qualification bits of the sensor data. A bit map value with the LSB defining the W&M status. 1èW&M sealed.

C.3.2.33 Density Reference

The following table describes the [Density Reference] structure for Fusion4 load controllers.

Table C-143: Density Reference

Field Description	Data Type	Enumeration/Structure Type	Description
Value	float 64		The value of the density reference.
Units	uint16	ENUM_DENSITY_ DIMENSION	The units of the density reference. See TABLE C.3.1.61 for more information.

C.3.2.34 Pressure Reference

The following table describes the [Pressure Reference] structure for Fusion4 load controllers.

Table C-144: Pressure Reference

Field Description	Data Type	Enumeration/Structure Type	Description
Value	float 64		The value of the pressure reference.
Units	uint16	ENUM_PRESSURE_ DIMENSI ON	The units of the pressure reference. See TABLE C.3.1.60 for more information.

C.3.2.35 Temperature Reference

The following table describes the [Temperature Reference] structure for Fusion4 load controllers.

Table C-145: Temperature Reference

Field Description	Data Type	Enumeration/Structure Type	Description
Value	float 64		The reference temperature value.
Units	uint16	ENUM_TEMPERATURE_ DIME NSION	The reference temperature units. See TABLE C.3.1.59 for more information.

C.3.2.36 Thermal Coeff Reference

The following table describes the [Thermal Coeff Reference] structure for Fusion4 load controllers.

Table C-146: Thermal Coeff Reference

Field Description	Data Type	Enumeration/Structure Type	Description
Value	float 64		The reference thermal coefficient value.
Units	uint16	ENUM_THERMAL_ COEFF_DI MENSION	The reference thermal coefficient units. See TABLE C.3.1.62 for more information.

C.3.2.37 Alarm State Text

The following table describes the [Alarm State Text] structure for Fusion4 load controllers.

Table C-147: Alarm State Text

Field Description	Data Type	Enumeration/ Structure Type	Description
Unicode Text	uint16[15]		The alarm state text.

C.3.2.38 Remotely Authorized User Data

The following table describes the [Remotely Authorized User Data] structure for Fusion4 load controllers.

Table C-148: Remotely Authorized User Data

Field Description	Data Type	Enumeration/ Structure Type	Description
Remote Database User ID	uint32		
Loading Bay	uint16 (enum)		Bay Type (see section C.3.1.27)
Authorization Object	struct		Authorization Object (see section C.3.2.4)

C.3.2.39 Authorization Data

The following table describes the [Authorization Data] structure for Fusion4 load controllers.

Authorization Data

Field Description	Data Type	Enumeration/ Structure Type	Description
Authorization Index	uint32		
Authorization Object	struct	Authorization Object	See section C.3.2.4

C.3.2.40 Sensor Value Health

The following table describes the [Sensor Value Health] structure for Fusion4 load controllers.

Table C-149: Sensor Value Health

Name	Type	Description
Status	ENUM (Status Health), see section C.3.1.79	The high level status of the sensor.
Status Category	ENUM (Status Category), see section C.3.1.78	More specific information about the health of the sensor.
Status Code	ENUM (Status Code), see section C.3.1.80	The highest level of health status description.

C.3.2.41 Load Batch Dynamic Info

The following table describes the [Load Batch Dynamic Info] structure for Fusion4 load controllers.

Table C-150: Load Batch Dynamic Info

Field Description	Data Type	Enumeration/ Structure Type	Description
Batch State	uint16 (enum)	Batch State (see section C.3.1.34)	
Running Screen Values [3]	struct	Sensor Value (see section C.3.2.31)	
Remaining Time	uint32		
Delivered Quantity	struct	Sensor Value (see section C.3.2.31)	

Field Description	Data Type	Enumeration/ Structure Type	Description
Alarm Severity	uint16 (enum)	Alarm Severity (see section C.3.1.81)	

Notice

All procedures, data, information, drawings, specifications or other material, whether accompanying this document or separately supplied in furtherance of this document, contain confidential and proprietary information which (i) is the property of Guidant Measurement (Guidant) and its subsidiaries, (ii) is disclosed by Guidant only in confidence, and (iii) except as Guidant may otherwise permit in writing, is to be used, disclosed or copied only to the extent necessary for the evaluation and use thereof by the recipient.

The foregoing shall not apply to any such material to the extent that the contents (i) are now or subsequently become available to the public without payment, (ii) were previously known to the recipient, or (iii) subsequently become otherwise known to the recipient without restriction.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware and software, nor to provide for every possible contingency in connection with installation, operation and maintenance.

Guidant makes no representation or warranty, either expressed or implied, with respect to, and assumes no responsibility for, the accuracy, completeness, or sufficiency of the information contained herein. No warranties of merchantability or fitness for a particular purpose shall apply.

The Guidant logo is a trademark.

This document takes precedence over and supercedes in their entirety all previous versions or revisions.

MN06309

© 2025 Guidant Corporation
All rights reserved.

GuidantMeasurement.com

Corporate Headquarters
5825 North Sam Parkway West
Suite 120
Houston, TX 77086 USA

USA
1602 Wagner Avenue
Erie, PA 16510 USA
+1 814.898.5000

Germany
Regentstrasse 1
25474 Ellerbek, Germany
+49 4101 304.0