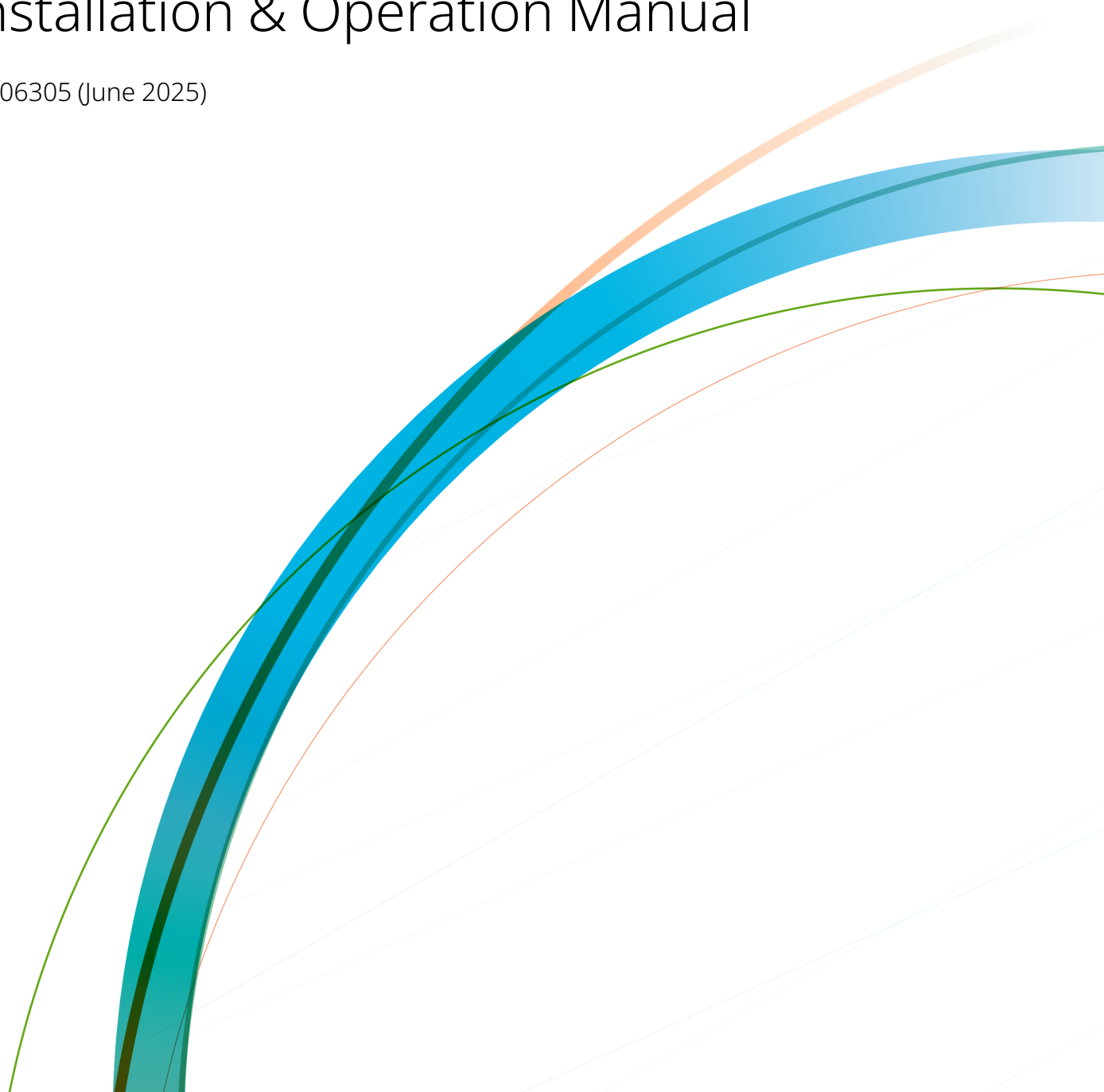




# Fusion4 MSC-A

## Installation & Operation Manual

MN06305 (June 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](mailto: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.

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# 1 General

## 1.1 Product Introduction



The Fusion4 Multi Stream Controller-Additive (MSC-A), is a hazardous area intelligent additive injection controller, utilizing state-of-the-art microprocessor technology for high accuracy additive injection applications, in the global oil storage and distribution industry.



The MSC-A is designed to control up to 24 individual additive streams. It can operate in any product transfer application, such as road tanker loading, rail-off loading or pipeline transfer, where multiple products need to be accurately combined.

The basic principle of operation (see [Figure 1-1: Basic MSC-A principle of operation \(example\)](#)) is achieved by the MSC-A monitoring the flow of the wild stream, and using this flow rate to accurately pace the flow of the additive stream to a pre-determined target ratio in parts per million (ppm). For details about the additional pacing modes, see [Section 3:](#)

### [System Description.](#)

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

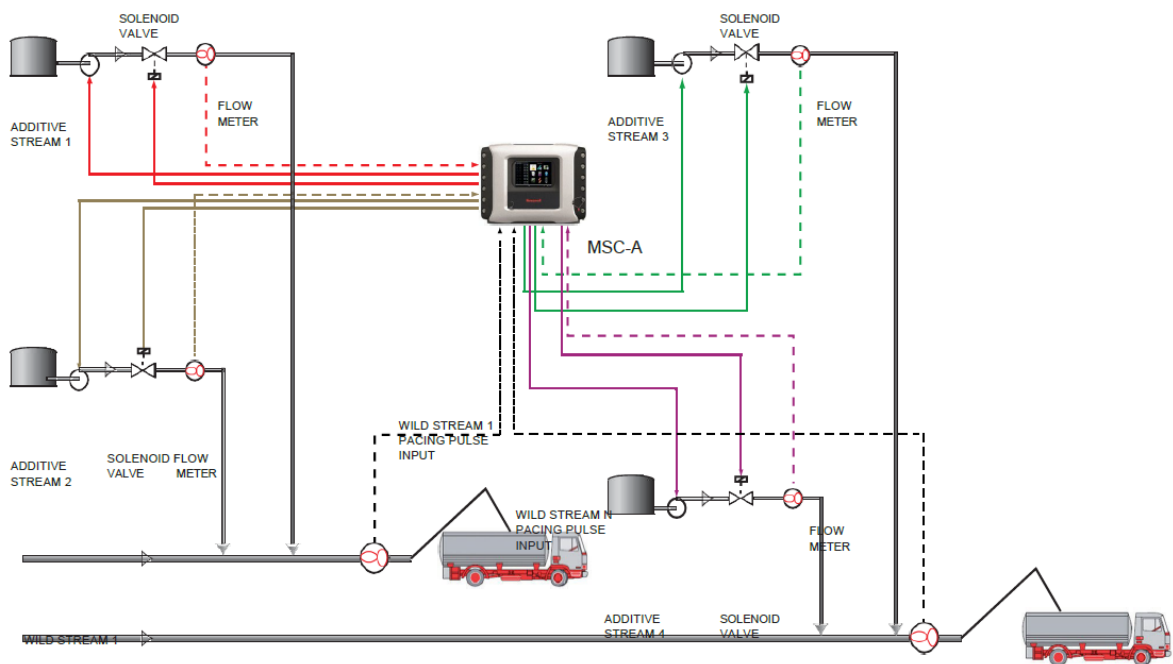
The MSC-A monitors the injection process for errors and accepts appropriate actions if the process does not meet its authorised tolerances.

Auxiliary functionality such as controlling and monitoring peripheral equipment such as pumps, valves, and sensors are also achievable through the MSC-A.

Multiple communication options allow all transactional and operational data to be stored locally or distributed to remote systems for further reconciliation processing.

The MSC-A utilizes the Local Access Device (LAD) for interfacing, local commissioning, configuration, calibration, troubleshooting, and data exchange through the Secure Digital (SD) card.

Figure 1-1: Basic MSC-A principle of operation (example)



**NOTE:** The basic MSC-A principle of operation displayed in the figure is only for four streams. However, MSC-A is applicable for 24 streams.

# 1.2 Functionality Overview

Functionality	MSC-A
Global Ex approvals (ATEX, FM, CSA, IECEx)	✓
Expandable I/O hardware	✓
Firmware in-situ upgradeable	✓
Fully configurable I/O binding	✓

Functionality	MSC-A
Diagnostics dashboard	√
Configuration upload/download	√
Transaction and calibration logs upload/download	√
Interface to Fusion4 Portal (printing, and so on)	√
Multi language display	11
Free programmable language pack	1
Transaction storage	240000
Alarm log records	2000
Calibration log records	1200
Comms ports	7
Ethernet ports	3
Single-pulse inputs	24
Pulse outputs	4
DI-DC	60
DI-AC	12
DO-EMR	40
DO-SSR	40
Analog Inputs	14
Analog Outputs	6
RTD Inputs	6

## 1.3 Target Audience for this Manual

This manual is intended for service technicians, and bay operators (for example, truck drivers) who are assigned to install, commission, service, or operate the MSC-A.

Figure 1-2: MSC-A in Fusion4 MiniPak, EU market



# 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 Safety Instructions for the MSC-A

### 2.2.1 General

**WARNING:** You must strictly follow all the safety instructions mentioned in this manual and the safety instructions shipped with the MSC-A during installation, commissioning, operation, and maintenance for the safe operation of the MSC-A.

The MSC-A may be located in explosion safety areas as follows:

USA (FM) and Canada (CSA)		Canada (CSA)		Rest of the World (ATEX/IECEX)	
Safety level	Remarks	Safety level	Remarks	Safety level	Remarks
Class 1, Division 1	<b>WARNING:</b> Do NOT open when an explosive atmosphere may be present.	Zone 1	<b>WARNING:</b> Do NOT open when an explosive atmosphere may be present.	Zone 1	<b>WARNING:</b> Do NOT open when an explosive atmosphere may be present.
	<b>CAUTION:</b> Seal conduit in 18 inches.		<b>CAUTION:</b> Seal conduit in 18 inches.		
Class 1, Division 2	<b>WARNING:</b> Do NOT open when an explosive atmosphere may be present.	Zone 2	<b>WARNING:</b> Do NOT open when an explosive atmosphere may be present.	Zone 2	<b>WARNING:</b> Do NOT open when an explosive atmosphere may be present.
	<b>CAUTION:</b> Seal conduit in 18 inches.		<b>CAUTION:</b> Seal conduit in 18 inches.		
Safe Area	-	Safe Zone	-	Safe Zone	-

### 2.2.1.1 EC Declaration of Conformity (for EU)

Refer to the EC declaration of conformity and ATEX certificate(s), shipped with the MSC-A for EC declarations.



### 2.2.1.2 Control Drawings for FM & CSA

Refer to the control drawings shipped with the MSC-A for the FM and the CSA certifications.

### 2.2.1.3 Users

The mechanical and electrical installation must be performed only by trained persons with the knowledge of the requirements for installation of explosion proof equipment in hazardous areas.

The entire installation procedure for the MSC-A must be implemented in accordance with national, local, and company regulations.

The entire electrical installation may be performed in accordance with the national requirements for electrical equipment to be installed in hazardous areas.

### 2.2.1.4 Additional Information

For additional information about Guidant's solutions, contact Guidant.

### 2.2.1.5 Environmental Conditions

The environmental conditions regarding the permissible operating temperature for the MSC-A is -40 °C to +65 °C (-40 °F to +149 °F).

**WARNING:** When the MSC-A is used in operating temperatures above 40 °C the enclosure is hot when it is touched.

## 2.2.2 Operation

After commissioning, the MSC-A can be used for its flow controller or a load computer for a multi stream product.

## 2.2.3 Maintenance and Troubleshooting

In the unlikely event of a malfunction, only a qualified service technician, trained by Guidant, and with the knowledge of safety regulations for working in hazardous areas, must be allowed to service, maintain, assemble, and disassemble the MSC-A.

**WARNING:** Any repairs or part replacements must be done by a Guidant trained service technician.

## 2.2.4 Personal Safety

**WARNING:** National, local and company regulations regarding personal safety must be followed.

Consider the weight of the MSC-A when moving, installing, or decommissioning.

At high ambient temperature, pay attention to the fact that the accessible parts on the outside of the MSC-A can be hot.

### 2.2.4.1 General

#### 2.2.4.1.1 Opening the MSC-A

**WARNING:** It is forbidden to open the MSC-A in an explosive hazardous environment, unless otherwise stated on the safety label.

## 2.2.5 Commissioning and Maintenance

**NOTE:** The MSC-A can be mounted on the wall using frame and bolts. The frame and bolts used must be capable of holding four times the weight of the MSC-A being mounted.

**WARNING:** Treat the flange surfaces of the lid and the housing with care. Make sure that the flange surface is clean and undamaged before closing.

This is required to maintain the CSA approval and it is strongly recommended for all Ex approvals. The O-ring must be present and undamaged.

1. National, local, and company regulations regarding installation must be followed.
2. The bolts of the enclosure lid are captive (property class A2-70). Contact Guidant if you need to replace the bolts.
3. Before closing the lid, check that all grounding connections including the grounding connection to the lid, are properly connected.

4. All wiring entries must be closed such that the approvals are not invalidated. See [Section 4.2: Gland Entries](#), to make sure that the correct thread type is selected. For installations using cable glands, always use compound barrier glands. For installations using conduits, each conduit must be sealed within 18 inches of the enclosure.
5. The limiting values of  $U_m$  must be respected for all non-intrinsically safe connections. See [Section 2.2.7.1: Explosion Safety Limiting Values](#), for information regarding the Explosion Safety Limiting Values.

### 2.2.5.1 Tools

**WARNING:** Use non-sparking tools and explosion-proof testers. Use suitable explosion-proof tools (for example, testing devices).

## 2.2.6 Electrical

### 2.2.6.1 Grounding

**WARNING:** Make sure that the housing of the MSC-A is properly bounded to the Protective Earth (PE). See the figures below for external grounding of the MSC-A and bonding any AC mains wire.

Also, make sure that the electrical resistance of the ground connections is below the maximum limit/ value prescribed by national, local, and company requirements.

Figure 2-1: External grounding connections of the MSC-A

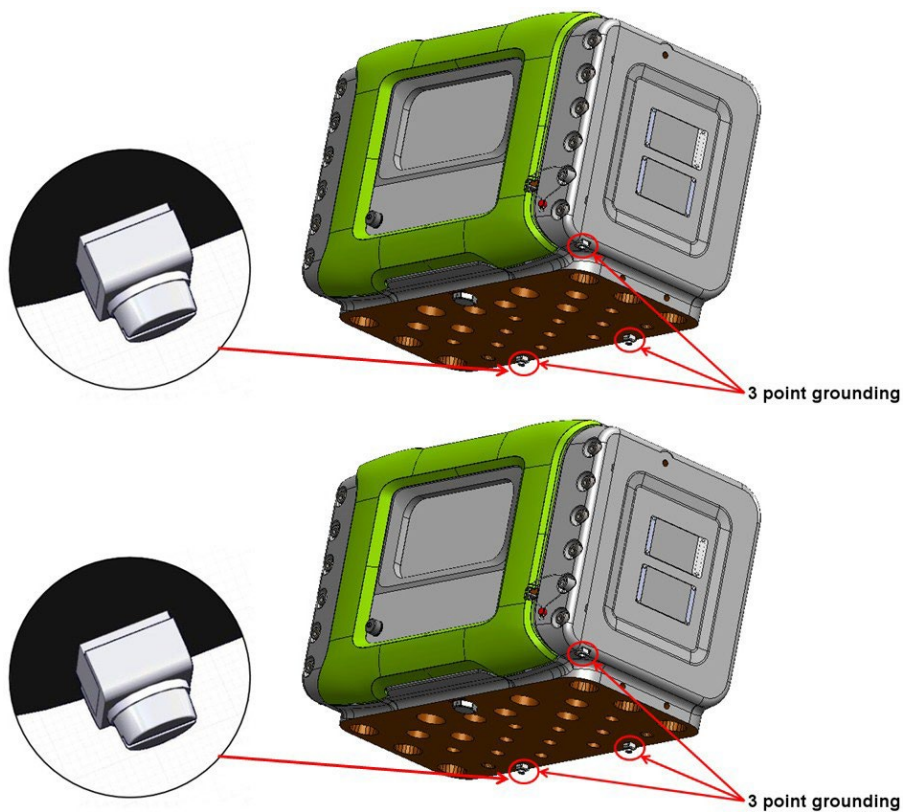


Figure 2-2: Internal grounding connections of the MSC-A




**WARNING:** Maintaining the ground bonding of the lid to the local Protective Earth (PE) using the lid ground wire is crucial for ensuring intrinsic safety.

## 2.2.7 Accordance to Regulations

### 2.2.7.1 Explosion Safety Limiting Values

Explosion safety items	Limiting values	Type of protection
Power supply (Mains input):	100 - 240 V <sub>AC</sub> , 50 - 60 Hz	
Maximum allowed power dissipation inside the enclosure:	90 W	
LAD interface circuit (LAD front connector):	U <sub>o</sub> = 15.75 V, I <sub>o</sub> = 1.49 A, P <sub>o</sub> = 1.92 W, C <sub>o</sub> = 2.69 µF; L <sub>o</sub> = 62 µH	Type of protection intrinsic safety Ex ia IIB
Thermal protection, limitation of the output current	160 mA	
U <sub>m</sub>	250 V <sub>AC</sub>	

### 2.2.7.2 Explosion Safety

Approval	Certificate no.	Type of protection identification		
ATEX	DEKRA 12ATEX0101 X	 II 2 G	Ex d [ia] IIB T6 Gb	Ta = -40 °C ... +65 °C (-40 °F ... +149 °F)
IECEx	DEK 12.0021 X	Zone 1	Ex d [ia] IIB T6 Gb	
FM	3048063	Class I, Division 1	group C, D T4	
CSA	2673172	Class I, Division 1	Group C & D T6	
		Class I, Zone 1	Ex d [ia] IIB T6 Gb	

### 2.2.7.3 Low-Voltage Directive

The MSC-A is suitable for the following categories.

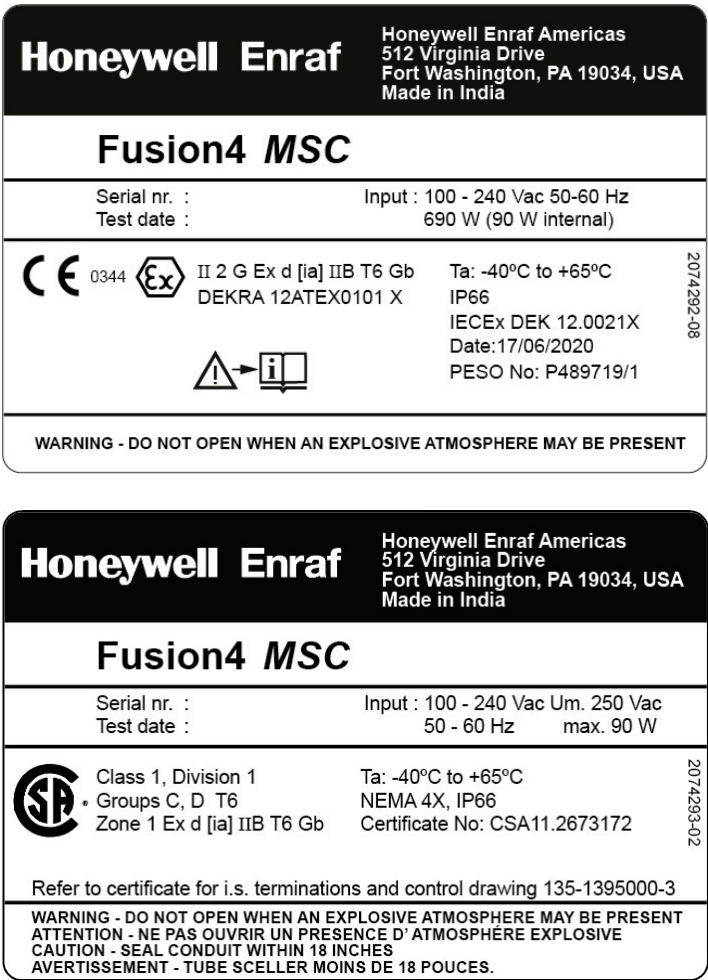
- Pollution degree 2
- Overvoltage category II




- Class I equipment

2.2.7.4 The MSC-A Labels

**NOTE:** Type plates are exemplary and subject to change.

Figure 2-3: Identification labels with the safety note on the MSC-A



<b>Honeywell Enraf</b>		Honeywell Enraf Americas 512 Virginia Drive Fort Washington, PA 19034, USA Made in India		
<b>Fusion4 MSC</b>				
Serial nr. :		Input : 100 - 240 Vac Um.250Vac		
Test date :		50 - 60 Hz max. 90 W		
	Class 1, Division 1 Group C, D T6		207/4294-02	
	Ta: -40°C to +65°C NEMA 4X			
Refer to certificate for i.s. terminations and control drawing 135-1395000-3		 → 		
WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT CAUTION - SEAL CONDUIT WITHIN 18 INCHES				

## 2.2.8 Safety Instructions for the LAD

Figure 2-4: Local Access Device (LAD)



**WARNING:** You must strictly follow all the safety instructions mentioned in this manual and the safety instructions shipped with the MSC-A during installation, commissioning, operation, and maintenance for the safe operation of the device.

The LAD may be used in hazardous areas as follows:

USA (FM) and Canada (CSA)		Canada (CSA)		Rest of the World (ATEX / IECEx)	
Safety level	Remarks	Safety Level	Remarks	Safety level	Remarks
Class 1, Division 1	<b>WARNING:</b> Substitution of components may impair intrinsic safety.	Class 1, Division 1 resp. Zone 1	<b>WARNING:</b> Substitution of components may impair intrinsic safety.	Zone 1	
Class 1, Division 2	<b>WARNING:</b> Substitution of components may impair intrinsic safety.	Class 1, Division 2 resp. Zone 2	<b>WARNING:</b> Substitution of components may impair intrinsic safety.	Zone 2	
Safe Area		Safe Zone		Safe Zone	

## 2.2.9 General

The LocalAccess Device (LAD) is a hand-held controller used to interface with the Fusion4 product family, allowing tasks such as parameter adjustment, alarm resetting, and injector calibration.

The device facilitates two-way data communication between a parent device and the LAD. It allows rapid transfer of transaction data, configuration files and calibration records, and also upgrading the firmware in the field.

## 2.2.10 Explosion Safety

**WARNING:** Only use the instrument for its intended purpose.




### 2.2.10.1 EC declaration of conformity (for EU)

Refer to the EC declaration of conformity and ATEX certificate(s), shipped with the device for EC declarations.

### 2.2.10.2 Control Drawings for FM & CSA

Refer to the control drawings shipped with the MSC-A for FM and CSA.

## 2.2.11 Explosion Safety

Approval	Certificate no.	Type of protection identification		
ATEX	KEMA 10ATEX0152	 II 2 G	Ex ia IIB T4	Ta = -20 °C ... +65 °C (-4 °F ... +149 °F)
IECEX	IECEX KEM 10.0070	Zone 1	Gb	
FM	3041202	Class I, Division 1	group C, D T4	
CSA	11.2395571	Class I, Division 1 Zone 1	group C, D T4 Ex ia IIB T4	

**WARNING:** This is an intrinsically safe device and may only be connected to devices with compatible intrinsically safe parameters, such as the MSC-A.

Connection of non-intrinsically safe signals invalidates the approval. The electrical data of the intrinsically safe circuits is to be taken from the certificate.

### 2.2.12 Commissioning

LAD and Fusion4 parent devices must be commissioned using this controller trained by Guidant. The service technician must have knowledge of the national, local, and company requirements for electrical equipment in hazardous areas.

### 2.2.13 Operation

After connecting to the MSC-A, the LAD can be used for its intended purpose.

## 2.2.14 Maintenance and Troubleshooting

The LAD hardware is non-serviceable, in case of damage contact Guidant for replacement.

## 2.2.15 Additional Information

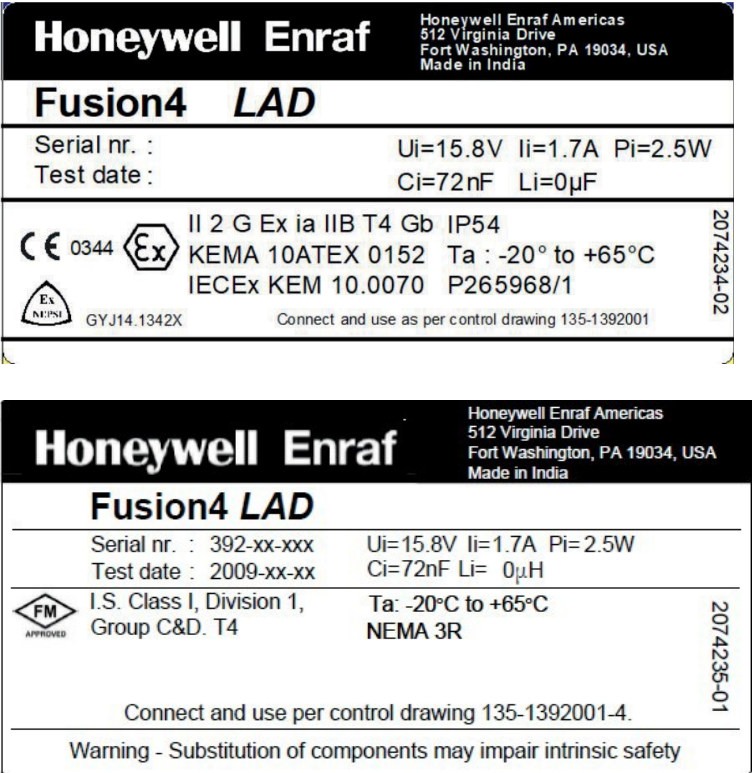
For additional information about Guidant’s solutions, contact Guidant or a representative.

## 2.2.16 Environmental Conditions


The environmental conditions regarding the allowable operating temperature is - 20 °C to +65 °C (-4 °F to +149 °F), relative humidity is RH 5 to 95%, non-condensing, and operating pressure is atmospheric.

## 2.2.17 The LAD Labels

Figure 2-5: Identification labels with safety note on the LAD



NOTE to FM label:  
Ta = -4°F to +149°F

<b>Honeywell Enraf</b>		Honeywell Enraf Americas 512 Virginia Drive Fort Washington, PA 19034, USA Made in India	
<b>Fusion4 LAD</b>			
Serial nr. : 392-xx-xxx		Ui= 15.8V li= 1.7A Pi= 2.5W	
Test date : 2009-xx-xx		Ci= 72nF Li= 0μH	
	I.S. Class I, Division 1,		Ta: -20°C to +65°C
	Group C&D. T4		NEMA 3R, IP54
	Zone1 Ex ia IIB T4		Certificate No: CSA11.2395571
Connect and use per control drawing 135-1392001.			
Warning - Substitution of components may impair intrinsic safety			

## 2.3 Safety Instructions for the IR Controller

Figure 2-6: The IR Controller



**WARNING:** You must strictly follow all the safety instructions mentioned in this manual and the safety instructions shipped with the MSC-A during installation, commissioning, operation, and maintenance for the safe operation of the device.

The IR Controller may be located in explosion safety areas as follows:

USA (FM) and Canada (CSA)		Canada (CSA)		Rest of the World (ATEX / IECEx)	
Safety level	Remarks	Safety Level	Remarks	Safety level	Remarks
Class 1, Division 1	<b>WARNING:</b> Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Class 1, Division 1	<b>WARNING:</b> Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Zone 1	<b>WARNING:</b> Do not open battery compartment in a hazardous area. Use only approved batteries, see label.
Class 1, Division 2	<b>WARNING:</b> Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Class 1, Division 2	<b>WARNING:</b> Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Zone 2	<b>WARNING:</b> Do not open battery compartment in a hazardous area. Use only approved batteries, see label.
Safe Area	-	Safe Zone	-	Safe Zone	-

## 2.3.1 General

The Fusion4 IR Controller is a hand-held remote controller, which is an infrared-type control device. The device facilitates programming the Fluid Technology IR Controlled Equipment remotely.

The device contains all the necessary program codes installed. Hence, the user programming is not required.

## 2.3.2 Precautions

- Clean the device with a damp cloth.
- Use additional protection in areas where damage may occur.
- Do not repair the device without permission to avoid the invalidation of the certificate.
- Do not leave the device in direct sunlight or place it near a heat source.
- Do not drop the device or subject it to other types of stress. Handle the device gently.
- Do not touch any solvent or aggressive substances before touching the enclosure as it is made of plastic.
- Store the device at room temperature in a clean and dry location.
- To avoid damage to the device or shortening of the battery life, use the correct type of batteries.
- To prevent battery usage when storing the device in an unused condition for a long time, make sure that the buttons are not pressed.
- To prevent damage caused by leaking batteries, remove the batteries before storing the device in an unused condition for a long time.

### 2.3.2.1 EC declaration of conformity (for EU)

Refer to the EC declaration of conformity and ATEX certificate(s), shipped with the device for EC declarations.

## 2.3.3 Installation

Perform the following steps to install the device.

1. Remove the security screws from the compartment lid.
2. Slide the battery compartment lid from the device.

3. Install the 3 AAA Alkaline batteries ensuring that the plus (+) and the minus (-) polarity of the batteries are correct.

**NOTE:** Removing the batteries does not remove the Fusion4 IR Controller memory.

Always replace the batteries with new ones. Use only batteries approved for use.

**WARNING:** Do not open the battery compartment or change the batteries in a hazardous area.

## 2.3.4 Commissioning

The IR Controller and the Fusion4 parent devices must be commissioned using this controller by qualified service technicians, trained by Guidant. The service technicians must have the knowledge of the national, local, and company requirements for electrical equipment in hazardous areas.

## 2.3.5 Operation

After connecting to a Fusion4 parent device (for example, the MSC-A), the Fusion4 IR Controller can be used for its intended purpose.

Perform the following steps to use the device.

1. Direct the device at the IR port of the equipment to be programmed.
2. Select ATTN on the IR Controller to turn the device and provide the initial program command to the MSC-A.

**NOTE:** Refer to the specific equipment's user manual for defined programmed functions.

The device automatically stops after 30 seconds if an activity is not performed. This helps in preserving the battery life.

## 2.3.6 Maintenance and Troubleshooting

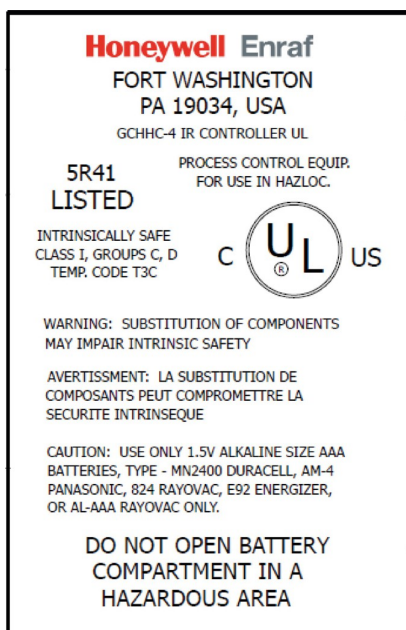
In the unlikely event of a malfunction, only a qualified service technician trained by Guidant and with the knowledge of safety regulations for working in hazardous areas is allowed to repair the MSC-A.

## 2.3.7 Additional Information

For additional information about Guidant's solutions, contact Guidant.

## 2.3.8 IR Controller Labels

Figure 2-7: Identification labels with Safety note on the Fusion4 IR Controller





**Honeywell Enraf**  
ROSWELL, GEORGIA  
TEL. 770-475-1900  
GCHHC-4 IR CONTROLLER  
EPSILON 07 ATEX 2257  
CE II 2 G Ex ib IIB T4  
0081  
YEAR OF BUILD ####  
SERIAL No. #####  
USE ONLY PANASONIC TYPE AM-4  
1.5V ALKALINE SIZE AAA BATTERIES  
  
DO NOT OPEN BATTERY  
COMPARTMENT IN A  
HAZARDOUS AREA

**Honeywell Enraf**  
FORT WASHINGTON  
PA 19034, USA  
GCHHC-4 IR CONTROLLER  
EPSILON 07ATEX2257  
CE II 2 G  
0344  
IECEX ITS.11.0017  
Ex ib op is IIB T4 Gb  
YEAR OF BUILD ####  
SERIAL No. #####  
USE ONLY PANASONIC LR03XWA  
1.5V ALKALINE SIZE AAA BATTERIES  
  
DO NOT OPEN BATTERY  
COMPARTMENT IN A  
HAZARDOUS AREA  
TA: -20 °C to +40 °C

## 2.4 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 MSC-A configuration. All modifications must be in accordance with the guidelines as set forth by Guidant. Modifications not authorized by Guidant invalidates the approval certificates.

# 3 System Description

## 3.1 Introduction

### 3.1.1 General

Figure 3-1: EU version



### 3.1.2 Injection Principle

The pacing of the additive stream is achieved through accurate, rapid injections of small volumes of additive stream, at frequently and evenly spaced intervals.

The MSC-A is a cycle-based injector, that is, the additive process does not distribute continuously. An internal recipe controls the ratio of the additive process being injected to the process stream. In a typical application, the process flow rate is monitored by the controller. As the chemical additive is addressed, the controller opens a solenoid control valve and injects a small quantity of the additive into the process stream. When the required quantity is reached, the controller closes the valve and waits until the next injection is required. This injection cycle repeats, keeping the additive in pace with the process flow.

The cyclical injection technology is defined as the uniform mixing of the product and the additive. Many of the recipes used address a few parts per million ratio of the additive to process.

### 3.1.3 MSC-A Injection Control

In general, the MSC-A requires the following items to operate.

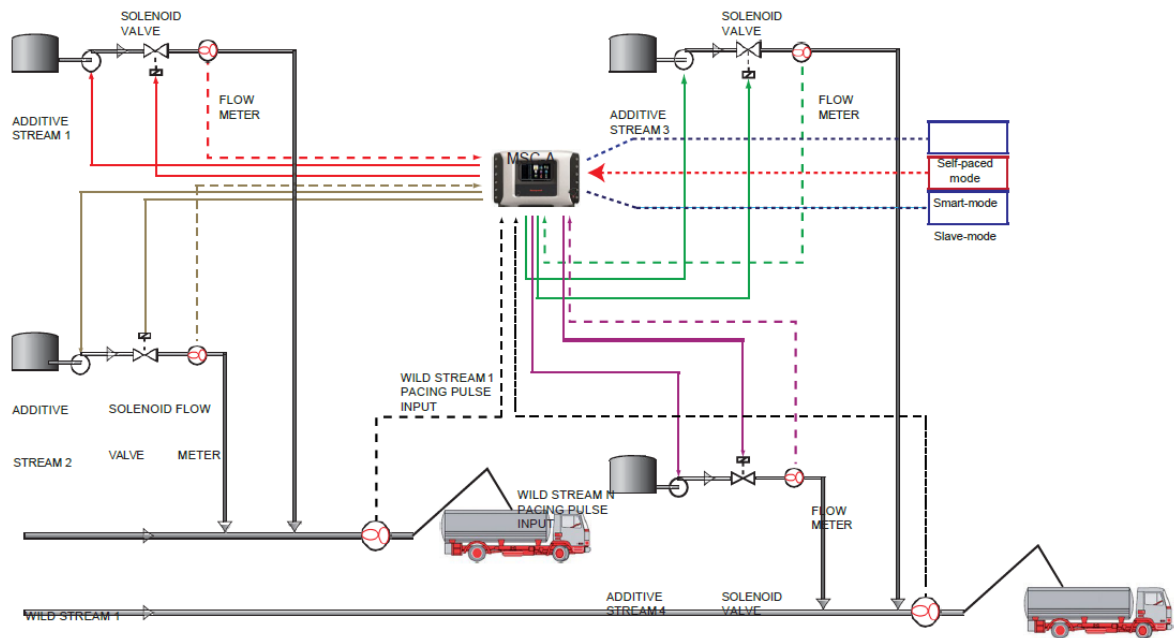
- AC Power
- Pacing-signal setup
- Permissive Signal (optional)
- Target additive ratio to target product (ppm) (not in Slave mode)

The injection control of the MSC-A can be achieved in different pacing modes (see the figure below).

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

To adequately match various specific applications, the MSC-A has a number of configurable parameters available. For an explanation of all these parameters and their specific settings, see [Section 5: Operation](#).

Figure 3-2: MSC-A pacing control modes



## 3.1.4 Menu-based MSC-A Control

By using an external control device, the MSC-A can be controlled through its integrated and menu based interface.

This control device can be one of the following two devices.

- The Fusion4 IR Controller.
- The RS-485 connection based on the Local Access Device (LAD). (Through an Ex d/ Ex i connector on the front of the MSC-A. )

Using one of these devices, it is possible to navigate the menus, change the settings (commissioning), initiate a calibration, and diagnose problems.

## 3.2 MID Compliance

### 3.2.1 Introduction

The Measuring Instruments Directive (MID) (2004/22/EC) is designed to provide a level playing field in Europe, for custody transfer measuring equipment and

systems. The MID currently covers 10 instrument categories, for uniform legislation in the 27 EU countries. The implementation of this directive in national legislation became due on the 30th of October 2006.

The MSC-A is 100% MID-compliant.

This legislation results in breaking down trade barriers and improving competition, which is one of the main objectives of the European Union. In the directive, the specific articles on each of the instrument categories are called Annexes. The Annex relevant to the measurement of petroleum products is “flow metering of liquids other than water” and is identified as Annex MI-005. The requirements in this Annex are based on the OIML recommendation R117-1, which is the pre-eminent set of guidelines for Weight & Measures of petroleum metering installations, for a considerable time.

### 3.2.2 MID Approval Approach

One of the key changes in the Measurement Instruments Directive (MI- 005) compared to previous national legislation, is that the total metering system is now subject to perform in the accuracy specification, and not just specific components. This means that not only the flow meter is subject to certification but also others.

Essential parts of the metering system, such as temperature transmitters, electronic volume converters air-eliminators, and so on. In addition to this, the method with which the system is built is also examined by the Notified body. In turn the Notified Bodies are scrutinized by the European Board of Accreditation.

The system approval process for MID consists of two main steps:

- ‘Bringing on the market’ - type-examination by a Notified body in accordance with Annex-B of the MID. This generates a so-called type-examination certificate.
- ‘Putting it into use’ - conformity check of the essential parts and a wet calibration in the legal specification. This is implemented in accordance with Annex F or D of the MID. This generates the system approval.

The system can now be used for trade and excise applications. The received approval is subject to recalibration at 1 or 2 year interval, and this is determined on national level.

**NOTE:** Evaluation Certificate provides demonstration that the MSC-A as a component of an MID-compliant instrument is approved per MID and OIML requirements.

### 3.2.3 Component-level Requirements

For blending applications such as ethanol and biodiesel-blending, the minimum required accuracy of the metering line is  $\pm 0.5\%$  (class 0.5).

The flow metering element of the system is allowed  $\pm 0.3\%$  in accuracy, and the remainder of the system is permitted to show maximum errors to  $\pm 0.2\%$ .

As the errors are directly related to inaccuracies, they are added to get the total maximum. Therefore,  $\pm 0.5\%$  is the maximum allowed discrepancy between what the seller states as the volume transferred, and the actual volume the buyer receives.

### 3.2.4 System-level Requirements

With any new equipment legislation such as MID, there is a raft of new issues and criteria that need to be understood by both those who are manufacturing the equipment and those who seek to utilise it. In the downstream oil and gas sector the volume of that legislation is vast. In the case of MID where the legislation crosses the boundaries of mechanical and electronic hardware, software, communications, and reconciliation and reproduction of data, correctly understanding the legislation, can be particularly vexing.

For this reason, the provision of “system solutions” is seen by many as the most efficient method of procuring equipment that is in compliance with their regulatory needs. Instead of having to understand the individual technical requisites of each individual component of a system, they only need to understand their “end game”. “I need an MID compliant ethanol blending system” is far easier to define than specifying the individual technical specifications of each component of that system. For this to work though, the acquirer has to have confidence that the supplier is suitably knowledgeable to accurately provide them with the correct solution for their needs. The provision of a “solution” circumnavigates the minefields associated with integrating multiple components into compliant system arrangement.

## 3.2.5 The Fusion4 MSC-A

The heart of the system is the Fusion4 MSC-A.

Founded on Enraf's FlexConn architecture, the MSC-A is part of the Fusion4 portfolio of loading automation and control products family. A modular collection of mechanical, electronic, and software sub-systems can be integrated with each other to create scalable solutions.

The MSC-A incorporates 24 separate devices, each providing individual functionality, and each one configurable from one single device, and selectable through a license key.

The MSC-A's solution approach facilitates the ratification of both the MID compliance steps mentioned previously, 'bringing on the market' and 'putting into use', by pre-configuring all components in accordance with the MID requirements, and checking conformity through pre-installation testing before delivery, as a complete system. This method not only reduces the risk of non-compliance, but also speeds up the MID qualification process for the system owner.

For the owner, 'putting into use' qualification not only includes the accuracy and security of the physical operation of the blend process, but also the reconciliation and reproduction of the measurement data. This is applicable, whether the information is to be stored locally on the device, distributed and stored on peripheral devices, or reconciled as a Bill of Lading print-out. For the system to be fully compliant, any of these functions must also operate in the MID criteria.

As such, the MSC-A offers a number of options to ensure compliance.

Firstly it implements a large transaction storage memory of 10,000 transactions, which allows a device to operate for over three months without losing a single transaction, in standard operating conditions.

Alternatively, the MSC-A can have its transaction data securely downloaded through the Fusion4 LAD (Local Access Device). This allows the MSC-A to have its memory cleared in preparation for the storage of another 10,000 transactions. The transactions subsequently transferred to the LAD can then be manually transferred to any peripheral system for storage or printing through the SD card.



Finally the preferred method is to link the MSC-A through Comms to the Fusion4 Portal software package. When connected, all the transaction data are scanned and collected by Portal from each device. The transaction record is stored and can be printed directly or distributed through OPC to third party systems for separate reconciliation.

The Fusion4 Portal BoL Print facility is fully MID compliant, and therefore can facilitate a stand-alone blending infrastructure that meets all the MID requirements. Along with the MID print functionality and the OPC capability, built-in modules for the Portal software suite also include remote configuration, remote event monitoring and alarm handling and advanced LAD interaction tools.

## 3.3 System Architecture

The MSC-A is installed as per the Enraf's FlexConn architecture. The MSC-A is a member of Fusion4 portfolio of Loading Automation and Control products.

The MSC-A system is built up of interchangeable hardware modules. These modules consist of uniform Printed Circuit Boards (PCBs), each of them representing a different and a unique functionality. See [Section 3.6.1: PCB Details](#) for more information.

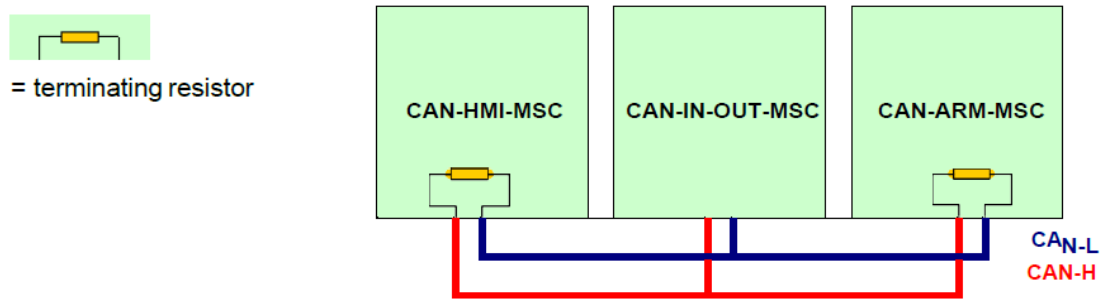
With the software implemented on these hardware parts, each PCB makes up a FlexConn module. These modules communicate with each other through the serial CAN-bus.

## 3.4 FlexConn Modules

### 3.4.1 General

One of the main characteristics of the FlexConn architecture is the placement flexibility of the FlexConn modules. The backbone of this concept is the serial Control Area Network (CAN) bus to which each FlexConn module connects.

Figure 3-3: FlexConn CAN bus concept



Each FlexConn module has one or more specific functions as follows:

- A sensor function - Measures or calculates a process value, or it obtains a process value from a connected external instrument.
- An application function - Controls the high-level operation of a device. For example, stream control, flow control, or device control.
- An Input/Output (I/O) function - Controls digital output or reads digital input from instruments around the loading framework.
- A communication function - Ensures the communication with a communication interface unit or with a DCS, SCADA, tank inventory, or another terminal automation system.
- A display function - Ensures communication with the module(s) through a Human-Machine Interface (HMI).

## 3.5 Hardware Structure

For details on the hardware structure of the MSC-A, see the following sections.

### 3.5.1 Housing

The housing of the MSC-A consists of an enclosure and a cosmetic cover. The enclosure can be opened by removing the cosmetic cover and loosening the 32 captured bolts. See the figures below for more information.

**NOTE:** Turn the bolts two times on the cosmetic cover to loosen the bolts and retain them in the lid.

Figure 3-4: The MSC-A enclosure

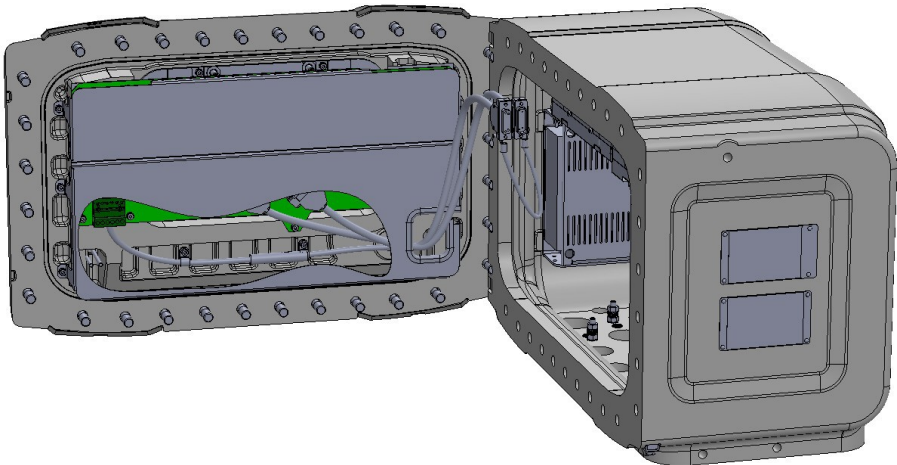
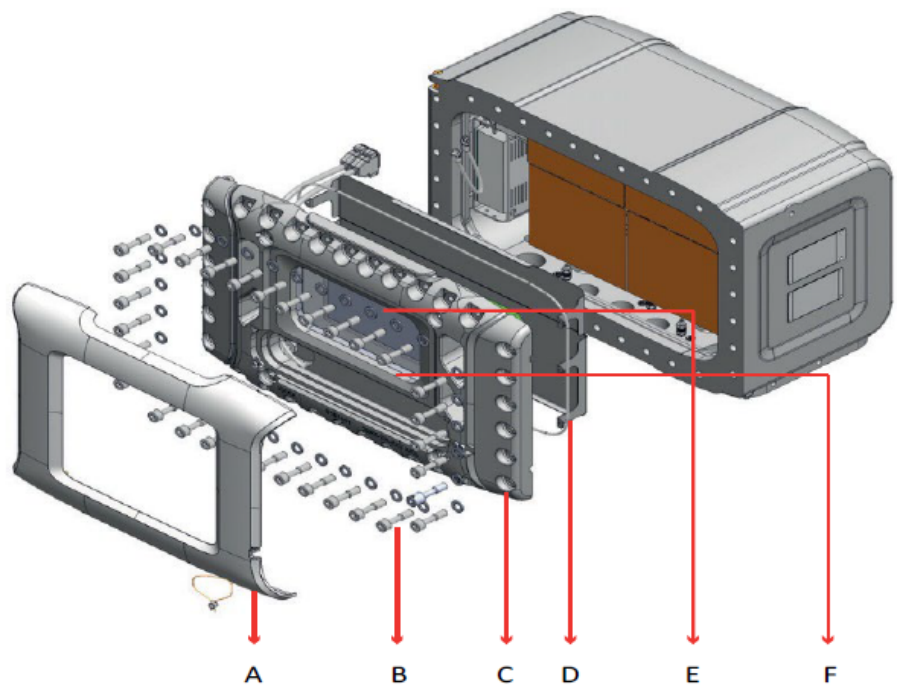


Figure 3-5: Housing of the MSC-A



Label	Description
A	Cosmetic cover
B	Captive socket-head screws (32x), of which one can have an enlarged head for sealing purposes (see figure left)

Label	Description
C	Lid
D	O-ring (standard available part)
E	Glass
F	Glass retainer rings (not visible in the front view of the MSC-A)

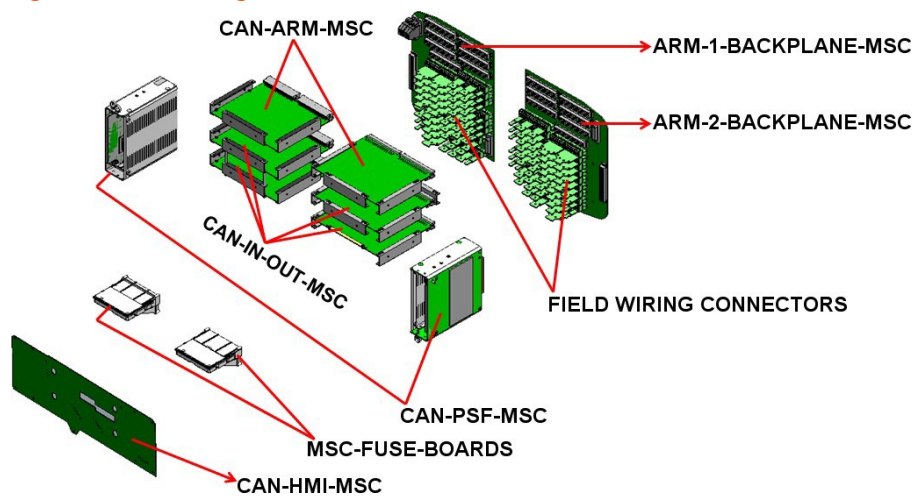
## 3.5.2 Interior

- The boards are mounted on the connector slots provided on the backplanes.
- The CAN-HMI-MSC board is connected to the backplane using a pair of Sub-D 15 cables. The MSC-FUSE-BOARD, CAN-PSF-MSC, CAN-ARM-MSC board, and CAN-IN-OUT-MSC boards are mounted on the connector slots provided on the backplane boards.

The following boards can be placed in the MSC-A.

- MSC-FUSE-BOARD
- ARM1-BACKPLANE-MSC
- ARM2-BACKPLANE-MSC
- EX-IO-HMI-MSC-A
- CAN-PSF-MSC
- CAN-HMI-MSC
- CAN-ARM-MSC
- CAN-IN-OUT-MSC

Figure 3-6: PCB configurations, MSC-FUSE-BOARDS, and the CAN-HMI-MSC



PCB name	Module name	Description
CAN-HMI-MSC	FM-HMI	Controls the display and the LAD interface.
CAN-ARM-MSC	FM-ARM	Provides the I/O functions required for loading and enhanced additive injection processes.
	FM-PI	Provides the firmware to control the pulse input signals from the connected flow meters.
CAN-IN-OUT-MSC	FM-IN-OUT	Provides I/O functions, which are necessary to control the enhanced loading and additive injection processes.
CAN-PSF-MSC	-	Delivers the internal power for the MSC-A.
MSC-FUSE-BOARDS	-	Protects the internal electronics so that the high current can be withdrawn.

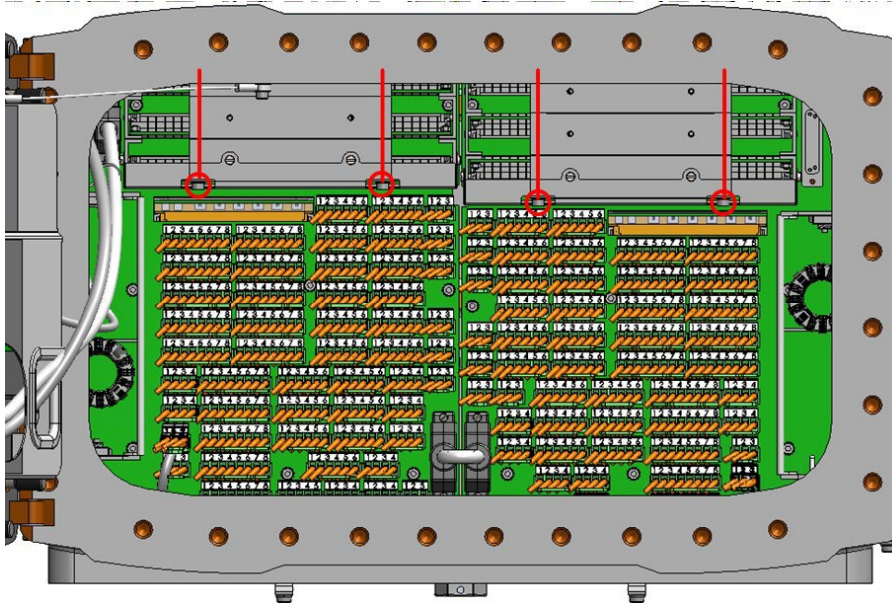
**NOTE:** Module name is a PCB with software installed.

### 3.5.3 Grounding Concept

The CAN-ARM-MSC board and the CAN-IN-OUT-MSC board contain two grounding points, which are mechanically connected with the metal housing using the metal spacers, as displayed in the figure below. In addition, these boards connect GND

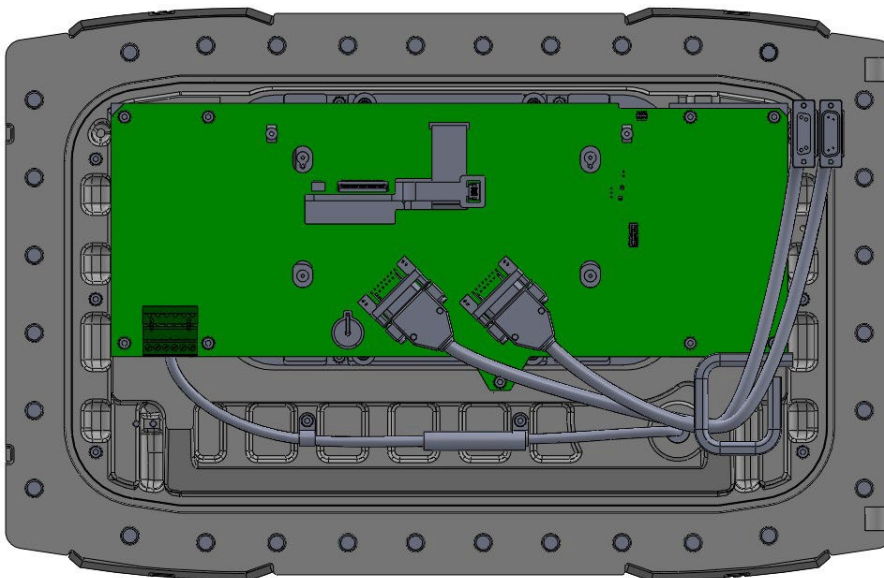
cables, which are connected to the backplane through multiple pins of the DIN41612 F-type 48-pins connector.

Figure 3-7: Mechanical grounding of CAN-ARM-MSC and CAN-IN-OUT-MSC boards



The CAN-HMI-MSC board which is mounted on the lid of the MSC-A enclosure, connects directly to the metal housing through the nine mounting screws, as displayed in the figure below.

Figure 3-8: Mechanical grounding of CAN-HMI-MSC board



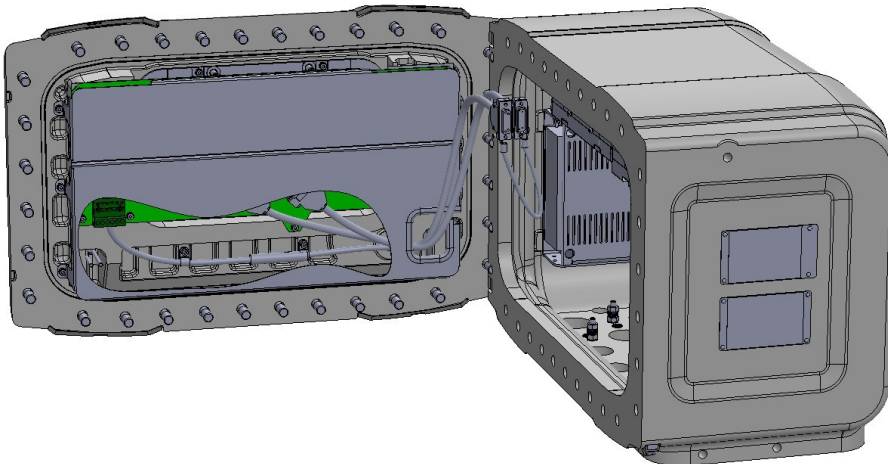
**WARNING:** For ensuring intrinsic safety of the MSC-A, the grounding connection of the lid to the main box and the box to the local grounding system is very crucial. If the grounding cable is required to be detached, make sure you reinstall the device before any operation is performed as follows:

1. Open and install the fasteners from the device with the use of a proper tool.
2. Make sure the construction is similar to the original assembly after the grounding cable is detached and all the parts are repositioned in a similar way when reinstalling. Take special care of the orientation of the cable rings and toothed rings for the grounding cable.
3. Check the wire in the box and the lid. Make sure it is not damaged before reinstalling.
4. Reinstall the original cable assembly. Do not replace it with random parts.

**NOTE:** Complete replacement of the lid should only be done in the Guidant factory and not at the site.

The lid of the metal housing is connected to the MSC enclosure through a separate GND signal transmitted through the GND cable, as displayed in the figure below.

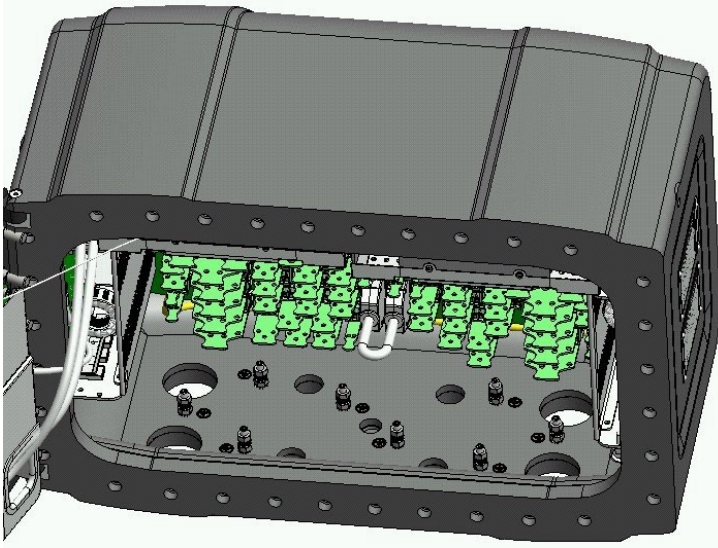
Figure 3-9: Cable (GND cable) used for grounding the lid of the MSC enclosure



The Protected Earth (PE) ground connections for external cables are connected to one of the nine M4 studs on the bottom side using the gland entries as displayed in the figure below.



Figure 3-10: PE ground connections for external cables



## 3.6 PCB Layout




Each FlexConn PCB consists of generic electronic parts and specific electronics part.

The generic electronic parts can be found on any FlexConn modules. The specific electronics part represent an application specific function. On the generic electronics part, the following parts are available.

- Program memory - Contains the module specific software.
- Microprocessor/controller - Executes the module specific software stored in the program memory.
- Non-volatile memory - Stores the commissioning parameters and the diagnostics data when the power is turned off.
- Jumpers - Establish specific hardware settings.
- Health LED (blue) - Indicates the general health status of the FlexConn module.

The following table specifies the health status and the flashing pattern on the FlexConn module.



Health Status	Flashing Pattern
Good	
Uncertain	
Bad	

- Function LEDs - Indicates the module specific activities, such as the data being transmitted or received.
- Voltage monitors and temperature sensors - Used for internal diagnostics purposes.

### 3.6.1 PCB Details

#### 3.6.1.1 CAN-HMI-MSC

##### 3.6.1.1.1 Functions

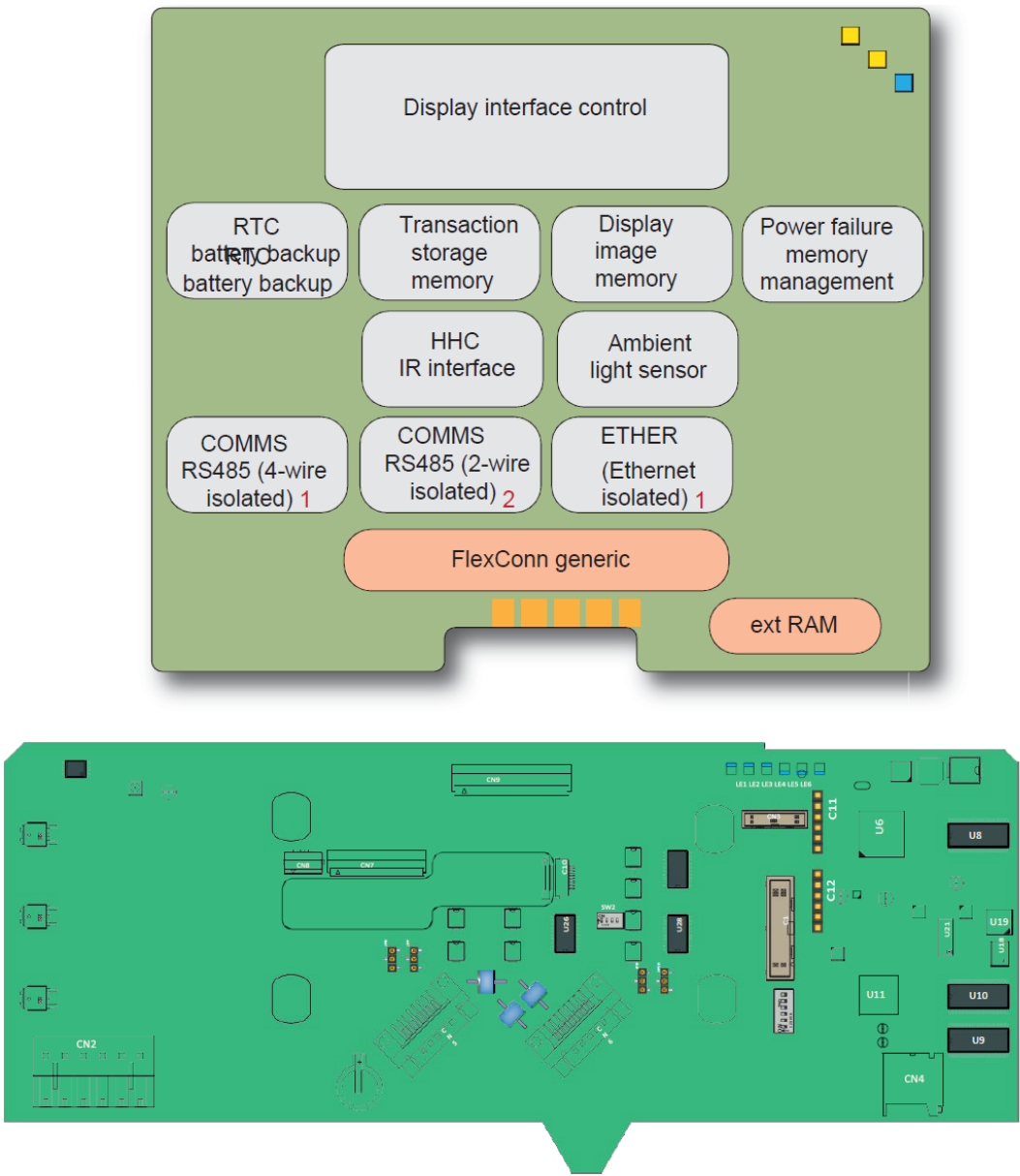
The CAN-HMI-MSC board is used as the basic Human Machine Interface (HMI) for MSC-A. The board supports various communication interfaces, Ex-i interfaces, and the display interface control.

Following are the functions of the CAN-HMI-MSC board.

Function	Description
Display interface control	Displays an 8" WVGA color display in the MSC-A lid.
RTC with battery backup	Used for the date and time stamping of the transaction data. External backup battery is connected to the RTC to retain the real time information even when the main power of the MSC-A is turned off.
Transaction storage memory	An external, non-volatile memory for storage of the transaction details.
Display image memory	Stores video data and it is interfaced to the Field Programmable Gate Array (FPGA).

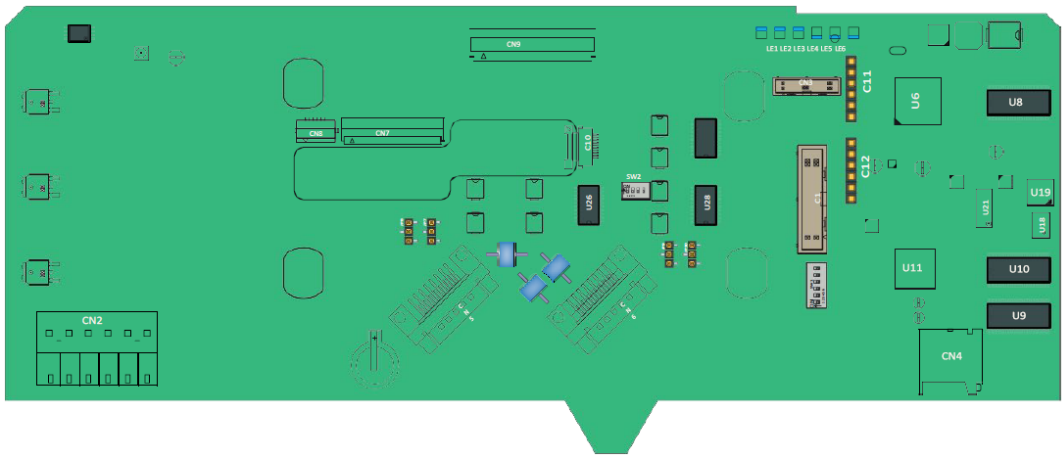
Function	Description
Power failure memory management	A non-volatile memory for storage of measured values as a protection against the power failure.
HHC IR interface	An HHC IR interface for the Fusion4 IR Controller.
Ambient light sensor	A device used for sensing the ambient light condition. It is sensitive to visible light and has peak sensitivity at 570 nm.
RS-COM (2-wire or 4-wire)	The RS-485 serial communication block is used by the FlexConn micro-processor to communicate with external devices using an RS-485 compliant physical layer. It can be configured for a 2-wire half-duplex or a 4-wire full-duplex RS-485 communication.
ETHERNET	The Ethernet communication block is used for allowing the FlexConn microprocessor to communicate with the external devices using an Ethernet-compliant physical layer.

Figure 3-11: CAN-HMI-MSC functions (top) physical layout (bottom)



3.6.1.1.2 Component Locations

Figure 3-12: CAN-HMI-MSC component locations



Item reference	Description
JP7, JP8	FlexConn jumpers for RS-485 CH5 finishing setting
JP9	FlexConn jumpers for RS-485 CH3 finishing setting
JP10	FlexConn jumpers for RS-485 CH4 finishing setting
CN1	Programming connector for U11 (ARM controller)
CN2	LAD or keyboard connections to EX-IO-HMI-MSC-A
CN3	Programming connector for U6 (FPGA)
CN4	microSD connector
CN5, CN6	Connectors for interfacing with the ARM1-BACKPLANE-MSC
CN7, CN8	Connectors for interfacing with the Varitronix display
CN9, CN10	Connectors for interfacing with the Hitachi display
LE1	Health of the board
LE2	Configurable
LE3	Configurable
LE4	Ethernet auto negotiation
LE5	Ethernet speed indicator
LE6	FPGA Health
U8,U9,U10	SDRAM
U6	FPGA
U11	ARM controller

Item reference	Description
U19	Flash memory
U1	A holder for IR receiver
V2	Ambient light sensor

- SW1 - FlexConn jumper function switches

Reference	Jumper name	Function when set to ON
SW1-1	FlexConn JP1	W&M entities protection
SW1-2	FlexConn JP2	Password is read protected
SW1-3	FlexConn JP3	Nothing used
SW1-4	FlexConn JP4	Spare
SW1-5	FlexConn JP5	Spare
SW1-6	FlexConn JP6	CAN bus termination

- S2 - RS-485 CH5 mode selection

Reference	Setting	Function	Description
SW2-1	ON	2-wire interface	2-wire RS-485 communication
SW2-2	ON		
SW2-3	OFF		
SW2-4	OFF		
SW2-5	OFF	4-wire interface	4-wire RS-485 communication
SW2-6	OFF		
SW2-7	ON		
SW2-8	ON		

- Jumper for RS-485 communication terminating setting

Jumper	Position	Description
JP7, JP8, JP9 and JP10	(1-2) Closed	2-wire RS-485 communication termination configuration jumper
JP7, JP8, JP9 and JP10	(2-3) Closed	2-wire RS-485 communication termination configuration jumper

### 3.6.1.2 CAN-ARM-MSC

#### 3.6.1.2.1 Functions

The function of the CAN-ARM-MSC board is to provide minimum I/O functions required for loading and enhanced additive injection processes.

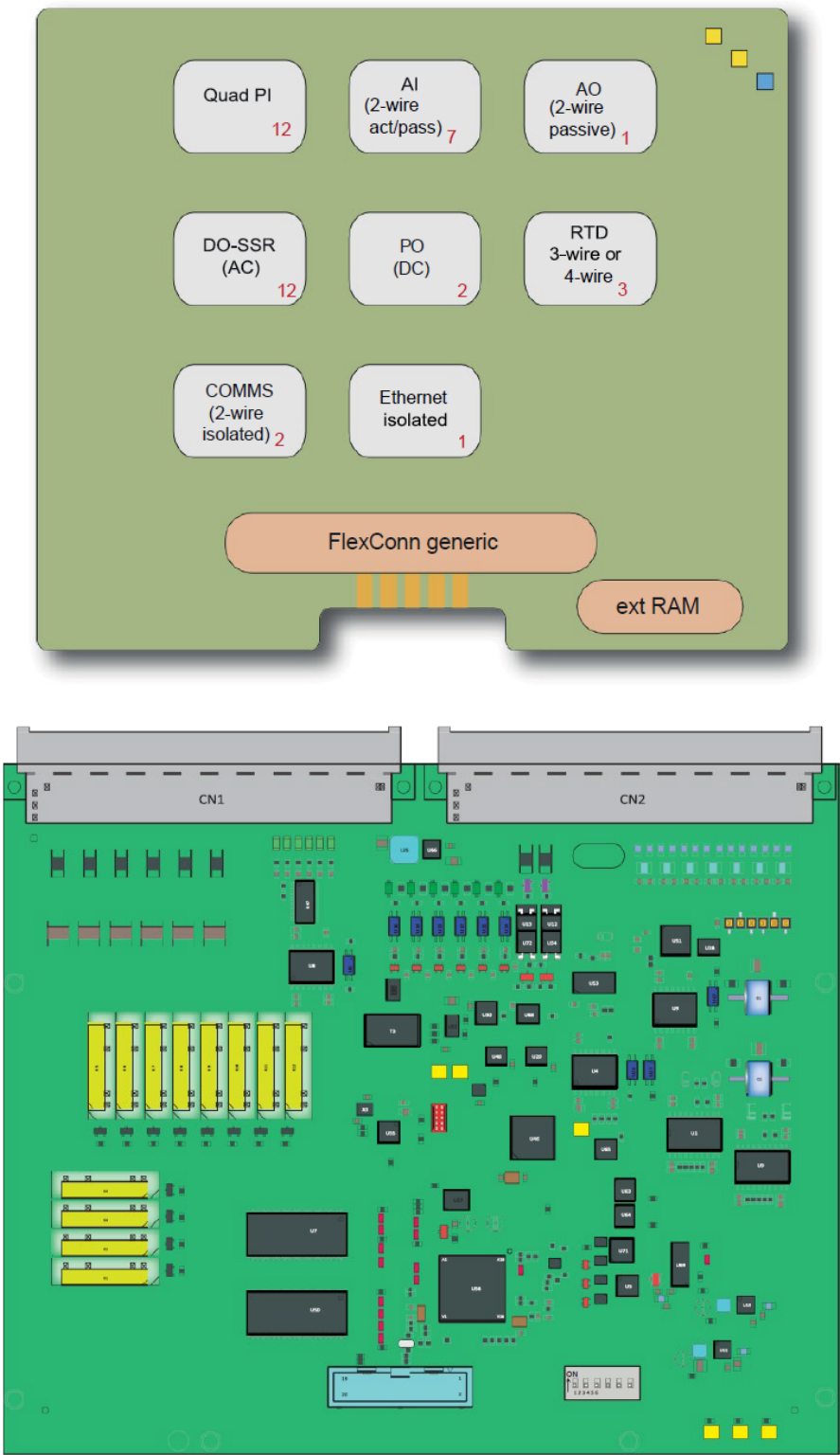
The CAN-ARM-MSC board supports both W&M and non-W&M additive injection and blending processes.

Following are the functions of the CAN-ARM-MSC board.

Function	Description
12 Pulse Input DC (Quad PI) circuit	Converts pulse signals from external flow measuring devices into numeric data that can be read by a FlexConn microprocessor.
7 Analog Input (AI 4-20 mA Active/Passive) circuits	Converts analog signals received from a single external 4-20 mA trans- mitter, into a signal that can be read by the FlexConn microprocessor.
2 Pulse Output DC (PO DC) circuits	Converts logic signals from the FlexConn microprocessor into isolated, switched DC signals.
12 Digital Output Solid State Relay AC (DO- SSR AC) circuits	Converts logic signals from the FlexConn microprocessor into isolated, high voltage, switched AC signals.
Analog Output (AO 4-20 mA Passive) circuit	Converts signals from the FlexConn microprocessor into scaled 4-20 mA analog signals.
2 COMMS circuits (2-wire)	The RS-485 serial communication block, which can be configured as a 2-wire circuit, allows the MSC-A to communicate with external devices through an RS-485 compliant connection.
An ETHER circuit	The Ethernet communication block allows the FlexConn microprocessor to communicate with external devices through an Ethernet physical compliant layer.

Function	Description
3 Resistance Temperature Detector (RTD 3-wire or 4-wire) circuits	Converts the temperature data from a remotely connected PT100 RTD into a resistance value that can be read by the FlexConn microcontroller and then converted back into a temperature value.

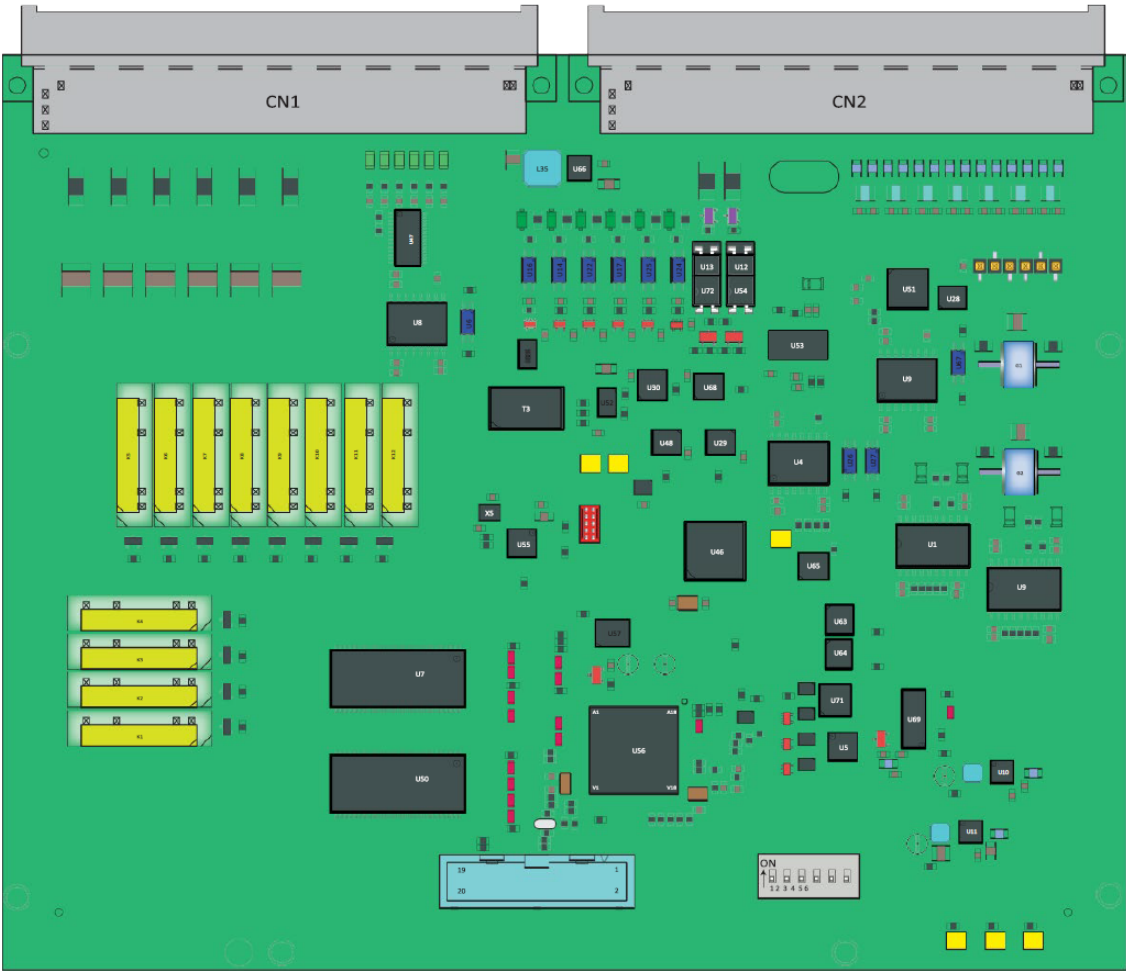
Figure 3-13: CAN-ARM-MSC functions (top) and physical layout (bottom)





3.6.1.2.2 Component Locations

Figure 3-14: CAN-ARM-MSC component locations



Item reference	Description
CN1, CN@	Connectors for interfacing with the ARM-1-BACKPLANE-MSC or ARM2-BACKPLANE-MSC
CN3	Programming connector for U56 (ARM controller)
CN4	Programming connector for U46 (PI processor - Cortex M0)
JP7	2-wire RS-485 communication interface
JP8	2-wire RS-485 communication interface

- SW1 - FlexConn jumper function switches

Reference	Jumper name	Function when set to ON
SW1-1	FlexConn JP1	W&M entities protection
SW1-2	FlexConn JP2	Password is read protected
SW1-3	FlexConn JP3	Nothing is used
SW1-4	FlexConn JP4	Spare
SW1-5	FlexConn JP5	Spare
SW1-6	FlexConn JP6	CAN bus termination

- JP7 to JP8 - Jumper for RS 485 communication terminating setting

Position	Description
JP7 (1-2) Closed	RS-485 communication terminated with 120 W for COM Port 1 / 6
JP7 (2-3) Closed	RS-485 communication NOT terminated for COM Port 1 / 6
JP8 (1-2) Closed	RS-485 communication terminated with 120 W for COM Port 2 / 7
JP8 (2-3) Closed	RS-485 communication NOT terminated or COM Port 2 / 7

### 3.6.1.3 CAN-IN-OUT-MSC

#### 3.6.1.3.1 Functions

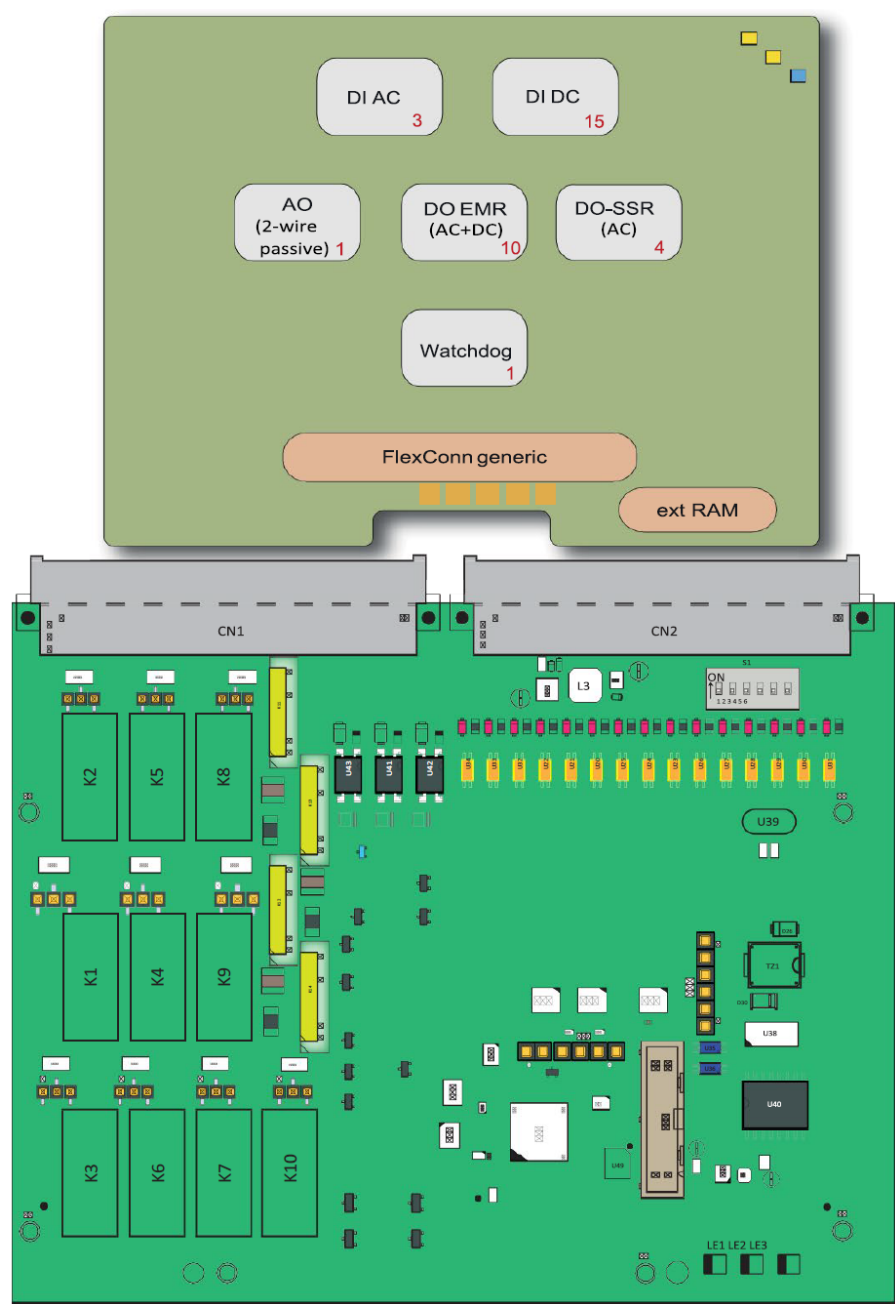
The function of the CAN-IN-OUT-MSC board is to provide I/O functions, which are necessary to control the enhanced loading and additive injection processes.

Following are the functions of the CAN-IN-OUT-MSC board.

Function	Description
3 Digital Input AC (DI-AC) circuits	Converts high voltage switched AC signals into an isolated logic signal that can be read by the FlexConn generic microprocessor.
15 Digital Input DC (DI-DC) circuits	Converts switched DC signals into an isolated logic signal that can be read by the FlexConn microcontroller.
Analog Output (AO) circuit	Converts signals from the FlexConn microcontroller into scaled 4-20 mA analog signals.

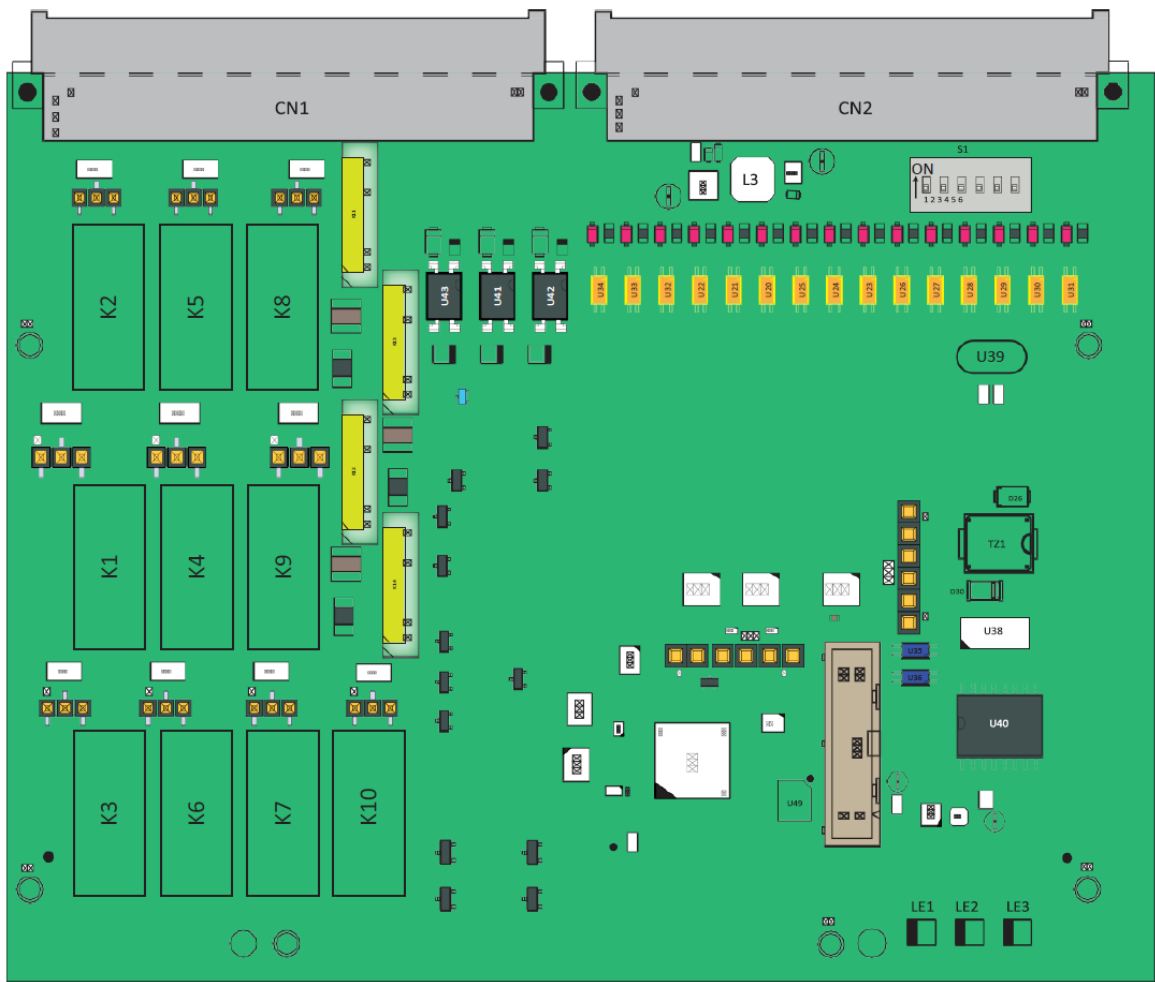
Function	Description
4 Digital Output Solid State Relay AC (DO- SSR AC) circuits	Converts logic signals from the FlexConn generic microcontroller into isolated, high voltage switched AC signals.
10 Digital Output Electromechanical Relay AC or DC (DO-EMR AC or DC) circuits	Converts logic signals from the FlexConn generic microcontroller to switched high power AC or DC signals.

Figure 3-15: CAN-IN-OUT-MSC functions (top) and physical layout (bottom)



3.6.1.3.2 Component Locations

Figure 3-16: CAN-IN-OUT-MSC component locations



Item	Description reference
JP7 to JP16	Jumper for EMR contacts setting
CN1, CN2	Connectors for interfacing with the ARM1-BACKPLANE-MSC or ARM2-BACKPLANE-MSC
LE1	Health of the board
LE2	Configurable
LE3	Configurable
U44	Cortex M4 CPU
K1-K10	Electro Mechanical Relay
K11-K14	Solid State Relay

- S1 - FlexConn jumper function switches

Reference	Jumper name	Function when set to ON
S1-1	FlexConn JP1	W&M entities protection
S1-2	FlexConn JP2	Password is read protected
S1-3	FlexConn JP3	Nothing is used
S1-4	FlexConn JP4	Spare
S1-5	FlexConn JP5	Spare
S1-6	FlexConn JP6	CAN bus termination

- JP7 to JP16 - Jumper for Electro Mechanical Relay contacts setting

Position	Contacts	Description
2 & 3	NO	Relay contacts normally open
1 & 2	NC	Relay contacts normally closed

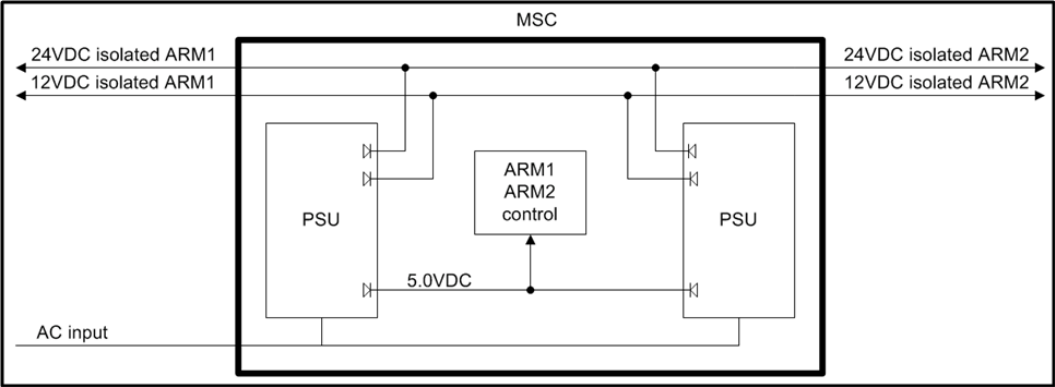
## 3.6.2 CAN-PSF-MSC

### 3.6.2.1 Functions

The function of the CAN-PSF-MSC is to convert single-phase AC main voltage into multiple DC voltages. This powers the other modules in the MSC-A and also provides DC power to external devices such as flow meters, temperature sensors, and so on.

On the system level two separate Power Supply Units (PSUs) operate the sharing current. The two PSUs make the system powering redundant. One PSU is able to power the complete system at maximum temperature. See the figure below for the functions of MSC-A.

Figure 3-17: CAN-PSF-MSC functions

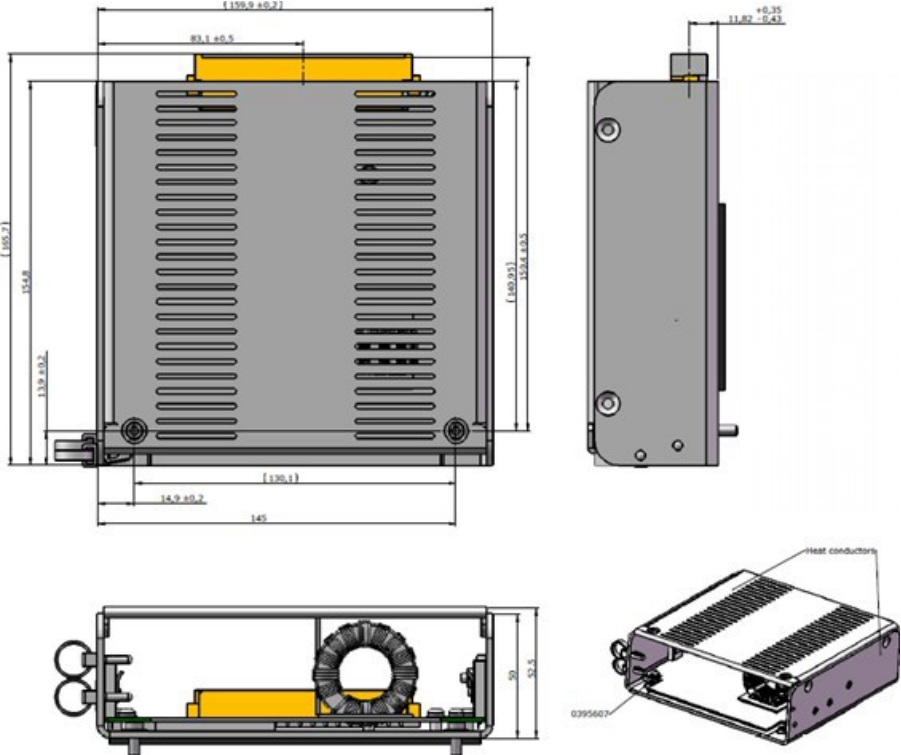


3.6.2.2 Power Board connection

The CAN-PSF-MSC is mounted inside the MSC-A Ex-d box through a DIN41612 F-type 48 pins connector. It is mounted on the ARM-x- BACKPLANE-MSC and connected to AC input and DC outputs.

The heat generating components are conducted to the enclosure. A mechanical cooling method is implemented together with the mechanical design of the enclosure. See the figure below for information regarding the mechanical specification of CAN-PSF-MSC.

Figure 3-18: Mechanical specification drawings



### 3.6.2.3 Hardware Specifications

The following table specifies the hardware I/O specifications of the AC port.

Item	Conditions	Minimum	Typical	Maximum	Unit
Input voltage		100	-	240	V <sub>AC</sub>
Input frequency		50	-	60	Hz
Inrush current	230 V <sub>AC</sub>	-	33	37.3	A
Power Factor (at the maximum current)	115 V <sub>AC</sub> 230 V <sub>AC</sub>		95 90	-	%
Power consumption	-	-	-	120	W
Efficiency	-	80	-	-	%
Insulation voltage	AC Input to all DC outputs	2500 V	-	-	KV AC
Insulation voltage	AC Input to PE	2500 V	-	-	KV AC
Leakage current	AC Input to PE	-	-	3.5	mA

The following table specifies the hardware I/O specifications of the DC output 1, DC output 2, and DC output 3.

DC Output	Item	Conditions	Minimum	Typical	Maximum	Unit
Output 1	DC Voltage	-	4.75	5.0	5.25	V <sub>DC</sub>
	DC Current	5.0 V	10.0	-	-	A
	DC OVP	-	6.25	-	7.0	V <sub>DC</sub>
	Over Current Limit	-	12	-	15	A
Output 2	DC Voltage	-	11.5	12.0	12.5	V <sub>DC</sub>
	DC Current	12.0 V	2.0	-	-	A
	DC OVP	-	14.0	-	15.5	V <sub>DC</sub>
	Over Current Limit	-	2.2	-	3.0	A
Output 3	DC Voltage	-	23.0	24.0	25.0	V <sub>DC</sub>
	DC Current	24.0 V	1.0	-	-	A
	DC OVP	-	28	-	31.0	V <sub>DC</sub>
	Over Current Limit	-	1.1	-	1.5	A

The following table specifies the hardware I/O specifications of the common DC output.

Item	Conditions	Minimum	Typical	Maximum	Unit
S/C protection DC outputs (all)		-	-		-
Load Regulation DC outputs (all)		-	-	1%	-
Line Regulation DC outputs (all)		-	-	1%	-
Ripple and Noise DC Outputs (all)		-	-	100 mV	$V_{P-P}$
Ripple and Noise DC Outputs (all)		-	-	240 mV	$V^{P-P}$
Isolation voltage DC Outputs (all)	Between DC outputs	500	-	-	$V_{DC}$

The CAN-PSF-MSC board contains a 48 pin (DIN41612 F-type) press- fit connector. The signals are grouped as high voltage AC signals and low voltage DC signals.

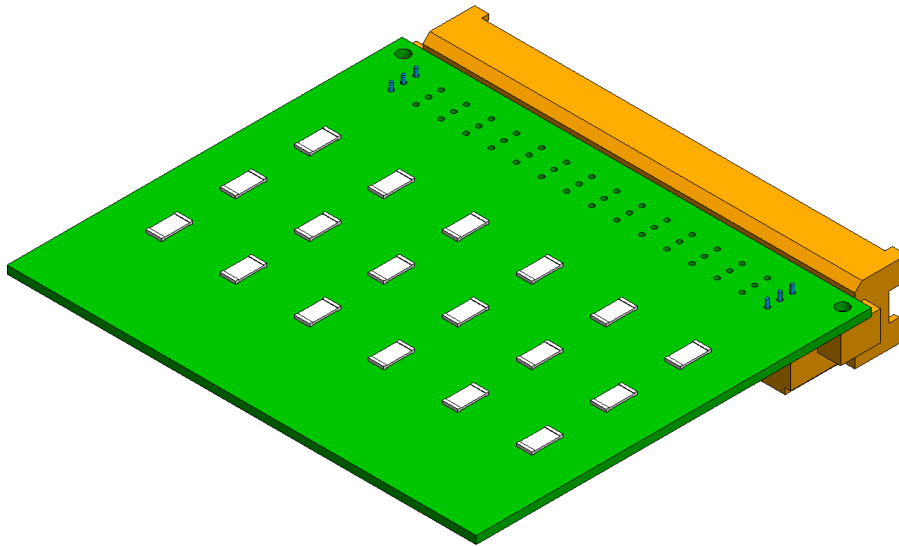
### 3.6.2.4 Fuse Boards

#### 3.6.2.4.1 MSC-FUSE-BOARD

The MSC-Fuse-Board is directly interfaced to the backplane of the MSC-A through the 48 pin connector. The MSC-A contains the Digital Output Solid State Relay AC (DO SSR AC) interface. The SSRs are used for switching AC signals connected to the load. Every DO SSR AC requires an optional fuse to protect the internal electronics so that the high current can be withdrawn. Since the fuse is optional, zero ohm resistor can alternatively be connected in parallel to each fuse.



Figure 3-19: MSC-FUSE-BOARD



#### 3.6.2.4.2 MSC-SHORTCUT-BOARD

The MSC-SHORTCUT-BOARD is similar to the MSC-FUSE-BOARD. The only difference between the MSC-FUSE-BOARD and the MSC-SHORTCUT-BOARD is that the OE resistors are placed in the board instead of the fuses.

## 3.7 Device Features

### 3.7.1 Device Electrical Features

Following are the device electrical features of the MSC-A.

1. Internal power supply.
2. Seven microprocessor controlled modules.
3. Each I/O is galvanic isolated from the internal electronics for safety performance.
4. Optional fuse boards (MSC-FUSE-BOARDS) for fusing the external interfaces/instruments.
5. Backplanes (ARM-1-BACKPLANE-MSC and ARM-2 BACKPLANE-MSC) for external

wiring.

6. Colored connectors on the backplane to distinguish different kinds of signals.

### 3.7.2 System

- Full-color (16 bits) WVGA, 8" diagonal display.
- Multi-language support for main screens which are as follows:
  - English US
  - English UK
  - French
  - German
  - Dutch
  - Spanish
  - Chinese
  - Japanese
  - Polish
  - Portuguese
  - Italian
  - One additional configurable user language
- Menu driven service interface:
  - LAD intrinsic safe interface.
  - IR interface, which is compatible with the Fusion4 IR Controller.
- Real-time clock used for time stamping.
- Seven communication ports and three ethernet ports for interfacing with the safe area tools and systems.

### 3.7.3 Environment

Parameter	MSC	LAD
Operating temperature	-40 °C ... +65 °C (-40 °F ... +149 °F)	-20 °C ... +65 °C (-4 °F ... +149 °F)
Electronics designed	-40 °C ... +85 °C (-40 °F ... +185 °F) and Restriction of Hazardous Substances (RoHS)	-40 °C ... +85 °C (-40 °F ... +185 °F) and RoHS
Storage temperature	-40 °C ... +85 °C (-40 °F ... +185 °F)	-40 °C ... +85 °C (-40 °F ... +185 °F)
Ingress protection	IP66 / NEMA 4X	IP54 / NEMA 3R
SD-card compartment behind lid	-	IP20

## 3.8 Available Input/Output Functions of the MSC-A

The following table provides the different types of interfaces supported by the boards.

I/O block	CAN-ARM- MSC	CAN-IN- OUT-MSC	CAN-HMI- MSC	Refer to section
Single-Pulse Input / DI DC Input	12	15	0	3.9.2 and 3.9.3
Dual-Pulse Input (Quad PI)	6	0	0	3.9.4
Analog Input (4-20mA Active/Passive)	7	0	0	3.9.5
Resistance Temperature Detector- RTD Temperature Input (3-wire or 4- wire)	3	0	0	3.9.6
Digital Input AC	0	3	0	3.9.7
Pulse Output DC	2	0	0	3.10.2

I/O block	CAN-ARM- MSC	CAN-IN- OUT-MSC	CAN- HMI- MSC	Refer to section
Analog Output (4-20 mA Passive)	1	1	0	3.10.3
Digital Output Electromechanical Relay AC or DC	0	10	0	3.10.4
Digital Output AC (Solid state relay)	12	4	0	3.10.5
RS-485 Communication (2-wire)	2	0	2	3.11.2
RS-485 Communication (4-wire)	0	0	1	3.11.2
Ethernet Communication	1	0	1	3.11.3

For the configuration of these I/O functions, see [Section 5: Operation](#).

## 3.9 Input Functions

### 3.9.1 General

The following table describes the electronic input functions the MSC-A supports.

Input function	I/O block name	
	CAN-ARM- MSC	CAN-IN- OUT-MSC
Single-Pulse Input / DI DC Input	PI	DI DC
Dual-Pulse Input	QPI	-
Analog Input (4-20 mA Active/Passive)	AI	-
Resistance Temperature Detector- RTD Temperature Input (3-wire or 4-wire)	RTD	-
Digital Input (AC)	-	DI AC

## 3.10 Output Functions

### 3.10.1 General

The following table describes the electronic output functions the MSC-A supports.

Output function	I/O block name	
	CAN-ARM-MSC	CAN-IN-OUT-MSC
Pulse Output DC	PO	-
Analog Output (4-20 mA Passive)	AO	AO
Digital Output Electromechanical Relay AC or DC	-	DO-EMR AC or DC
Digital Output AC (Solid State Relay)	DO-SSR	DO-SSR AC

### 3.10.2 Pulse Output (PO DC)

#### 3.10.2.1 Functional Description

There are two pulse output channels available in MSC-A i.e. PO1 & PO2.

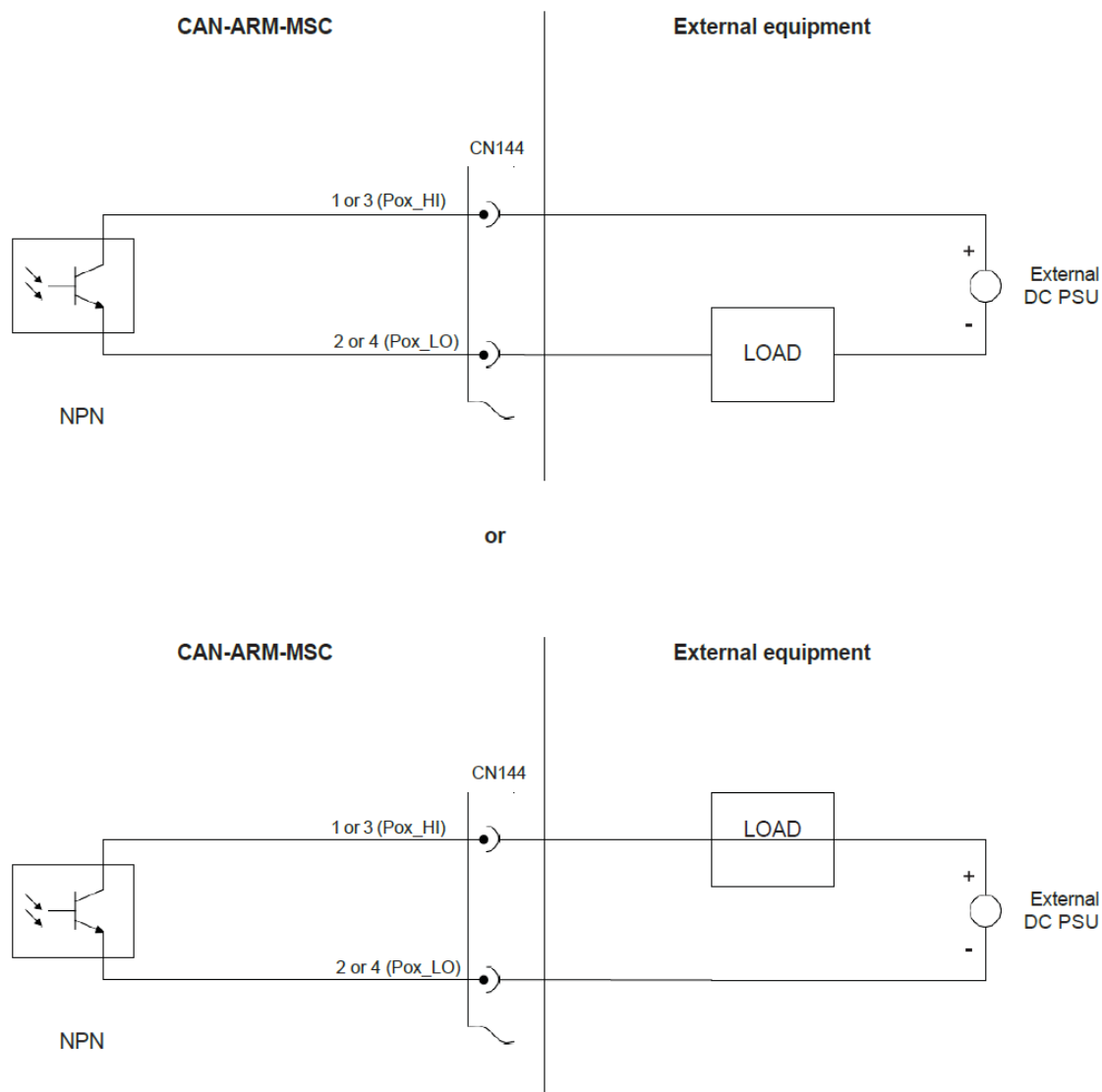
For meter calibration, the pulses coming from Flow Meter are also required to drive the pulse output. The scheme using multiplexer for selection of inputs. Any one pulse from dual-pulse input may be selected to drive the pulse output.

PO1 is real time pulse output, used to connect real time PO for channel A & B of quadrature (dual) pulse input. A single-pulse input out of 12 pulse inputs is selected by using multiplexer 16 to 1 multiplexer and select lines.

PO2 is a factored pulse output, can be used either as a factored pulse output or can be used to connect real time PO for channel B of quadrature (dual) pulse input.

The figure below illustrates the simplified block diagram of the external PO connections.

Figure 3-20: PO connections



### 3.10.2.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	2500	V <sub>AC</sub>
Output load voltage	-	-	30	V <sub>DC</sub>
Output load current (Sink)	-	-	10	mA
Output load current (Source)	-	-	10	mA
FMAX Switching frequency	-	-	10	kHz
TON and TOFF pulse width	15	-	-	μs

Item	Minimum	Typical	Maximum	Unit
Output Saturation voltage (over entire temp range)	-	-	1	V <sub>DC</sub>

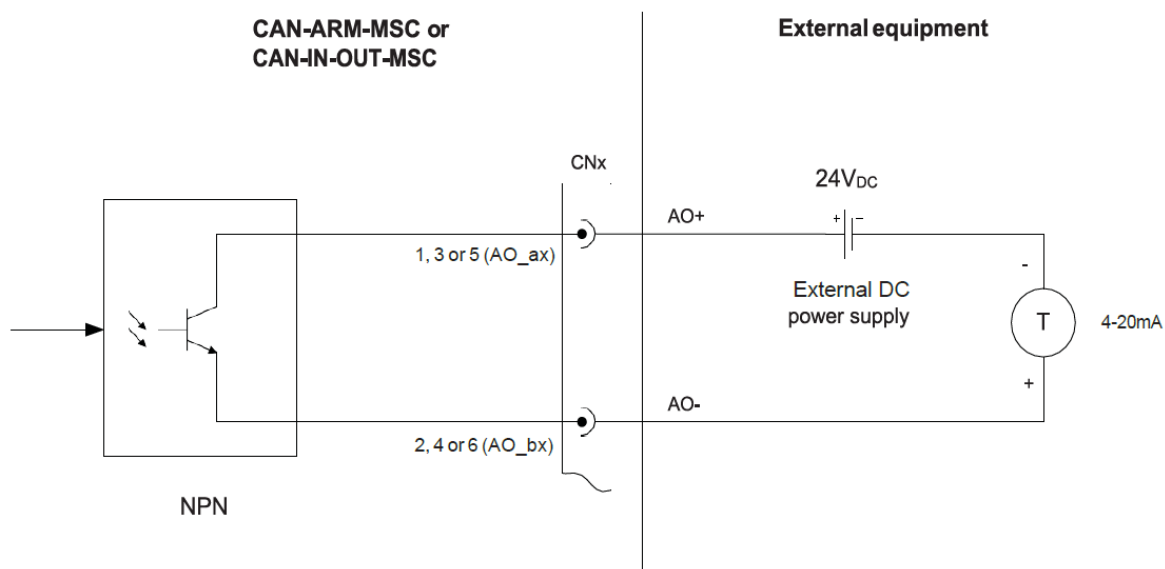
### 3.10.3 Analog Output

#### 3.10.3.1 Functional Description

The Analog Output (AO) supports 2-wire passive 4-20 mA. The AO does NOT provide a power supply to power the loop.

The figure below illustrates the simplified block diagram of the AO connection to the external devices.

Figure 3-21: AO connections



#### 3.10.3.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V <sub>AC</sub>
VLOOP	23.0	24.0	36.0	V <sub>DC</sub>
Nominal loop current range	4	-	20	mA
Loop current control range	3	-	21	mA
Accuracy (without external receiver)	-	-	±1.0	%
Update time	-	-	250	ms

Item	Minimum	Typical	Maximum	Unit
Load resistance	0	-	750	W

## 3.10.4 Digital Output Electromechanical Relay (AC or DC)

### 3.10.4.1 Functional Description

The Digital Output Electromechanical Relay (DO EMR AC or DC) allows the controller to switch DC signals or AC signals to control alarms and other loads.

The two output terminals are “volt-free” contacts and require an external power supply to drive a load.

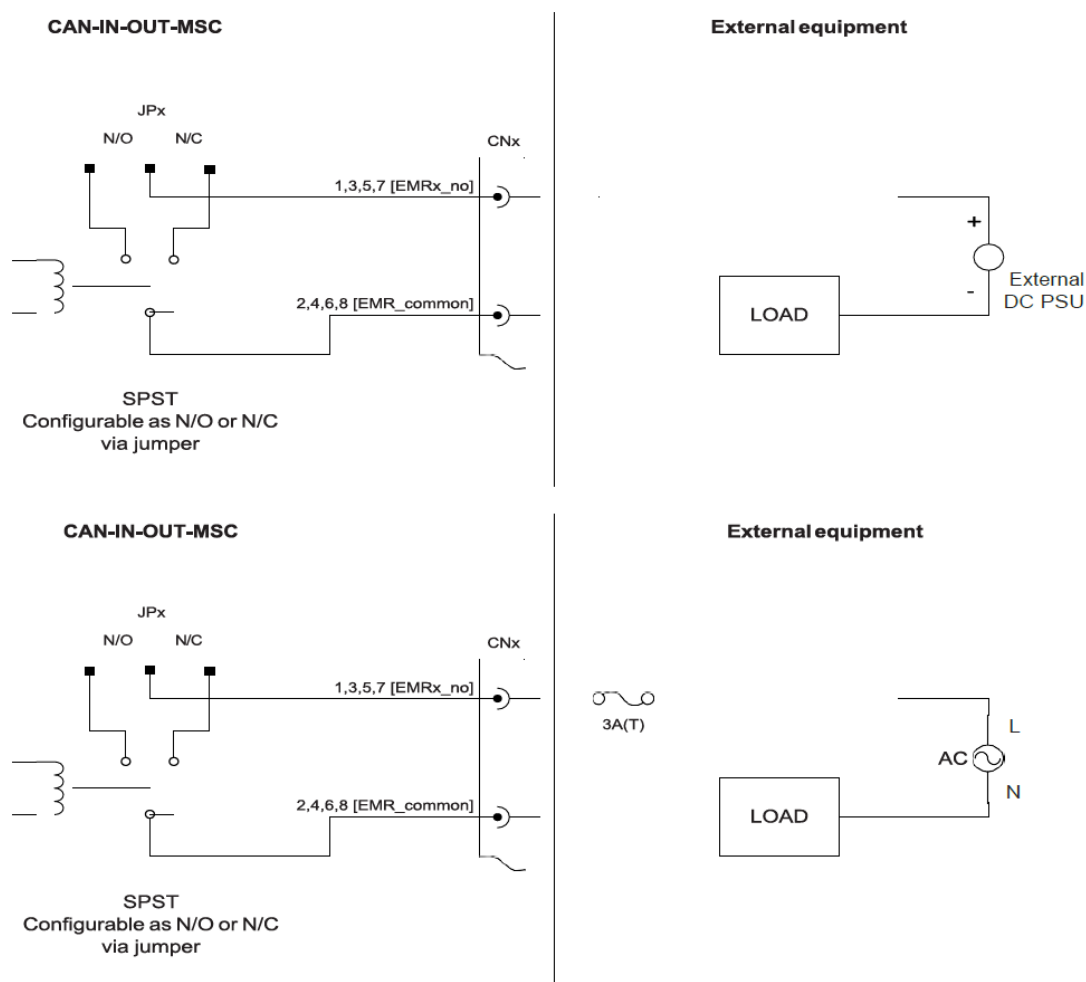
The relay output contacts are effectively Single Pole Single Throw (SPST) and are configurable through a jumper to be either Normally Open (NO) or Normally Closed (NC).

For physical location(s), see [Section 4: Installation](#).

The figure below illustrates the simplified block diagram of the DO EMR connections.



Figure 3-22: DO EMR connections



### 3.10.4.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Load voltage to be switched	-	-	265	V <sub>AC</sub>
Switching current	-	-	1	A
Steady state current	-	-	1	A
Output contact type	-	SPST	-	-
Operate time	-	-	5	ms
Release time	-	-	10	ms
Setting time	-	-	50	ms
Control voltage (high level)	2.5	-	-	V <sub>DC</sub>
Control voltage (low level)	-	-	0.4	V <sub>DC</sub>

Item	Minimum	Typical	Maximum	Unit
Control current (high level)	-	-	1	mA
Load Voltage to be switched	-	-	30	V <sub>DC</sub>
Switching current	-	-	1	A
Steady state current	-	-	1	A
Output contact type	-	SPST	-	-
Operate time	-	-	5	ms
Release time	-	-	10	ms
Setting time	-	-	50	ms
Control voltage (high level)	2.5	-	-	V <sub>DC</sub>
Control voltage (low level)	-	-	0.4	V <sub>DC</sub>
Control current (high level)	-	-	1	mA

## 3.10.5 Digital Output Solid State Relay AC

### 3.10.5.1 Functional Description

The Digital Output Solid State Relay AC (DO-SSR AC) allows the controller to switch high-voltage AC signals to control solenoids, digital control valves, alarms, and other loads.

The two output terminals behave as a “volt-free” contact and require an external AC power supply to drive a load.

The figures below illustrate a simplified block diagram of the DO-SSR AC self powered connections and a simplified block diagram of the DO-SSR AC externally powered connections, respectively.

Figure 3-23: Solid State Relay “Self-powered” connections

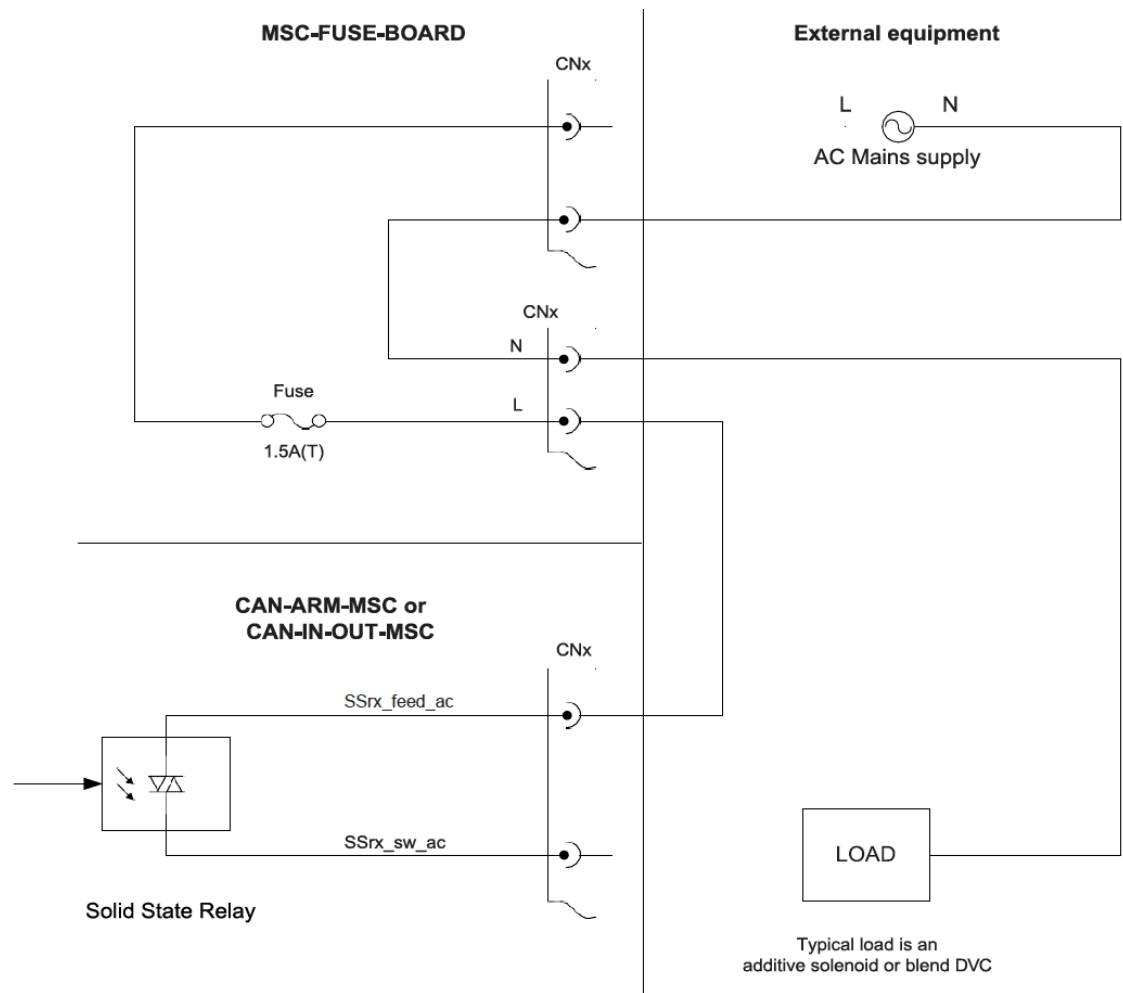
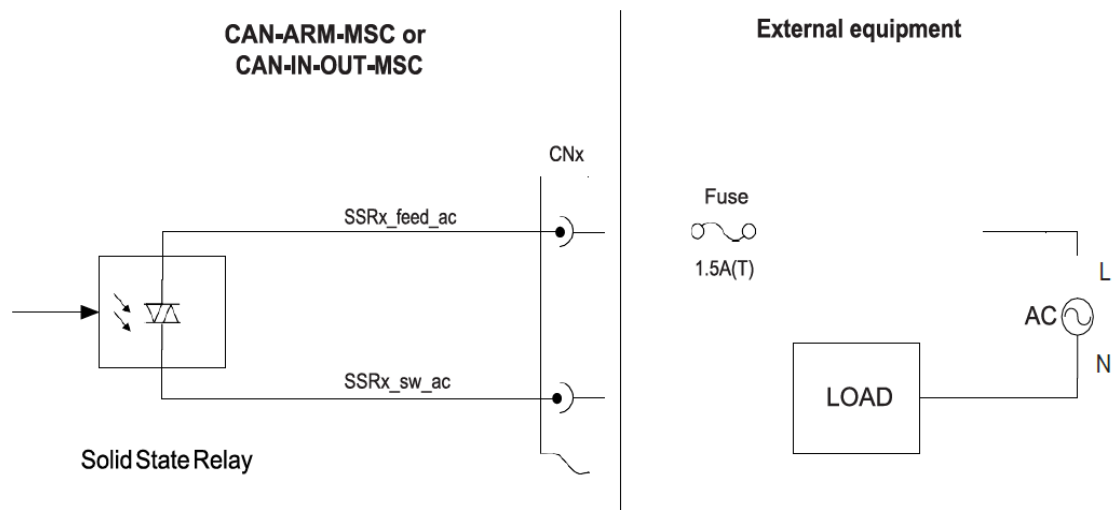


Figure 3-24: Solid State Relay “Externally powered” connections



### 3.10.5.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation voltage	-	-	3700	V <sub>AC</sub> rms
Operating voltage	90	-	265	V <sub>AC</sub>
Operating frequency	47	-	63	Hz
Output steady state load current	1	-	250	mA
Output surge load current	-	-	3	A
Off state output leakage current	-	-	0.1	mA
Off state output blocking voltage	-	-	600	V
Switching time	-	-	10	ms
Control voltage must turn on	2	-	-	V <sub>DC</sub>
Control voltage must turn off	-	-	0.4	V <sub>DC</sub>
Control current	-	-	5	mA

## 3.11 Communication Functions

### 3.11.1 General

The following table describes the electronic communication functions the MSC-A supports.

Communication function	I/O block name	
	CAN-ARM-MSC	CAN-HMI-MSC
RS-485 Communication	RS-485 2-wire	RS-485 2-wire
RS-485 Communication		RS-485 4-wire
Ethernet Communication	ETHERNET	ETHERNET

## 3.11.2 RS-485 Communication (2-wire or 4-wire)

### 3.11.2.1 Functional Description

The Communication block which consists of wires and switches allows the MSC-A to communicate through an RS-485 connection with external devices including a load computer, TAS system, Fusion4 Portal, or other remote interfaces.

For the CAN-HMI-MSC, CH5 can be configured for either a 2-wire half- duplex or a 4-wire full-duplex.

The figures below illustrate the RS Communication 2-wire connections and the RS Communication 4-wire connections, respectively.

Figure 3-25: RS Communication 2-wire connections

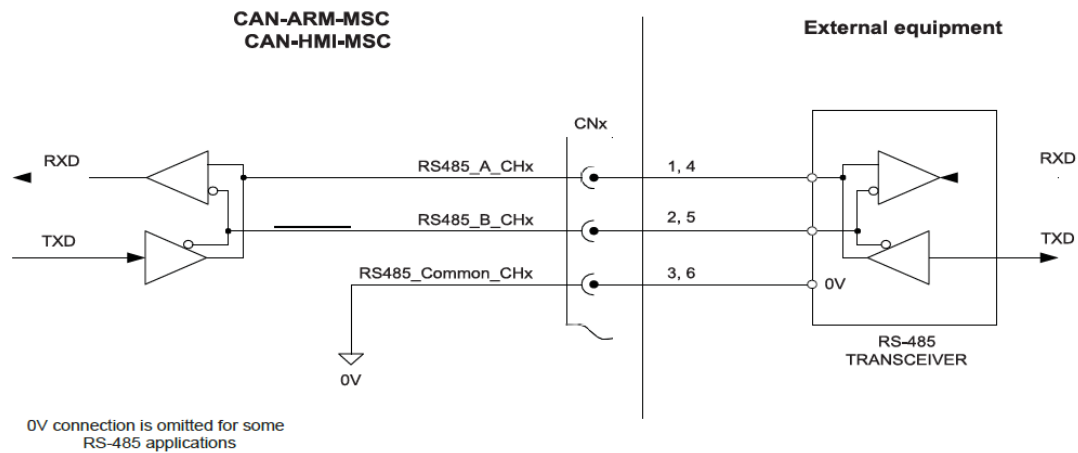
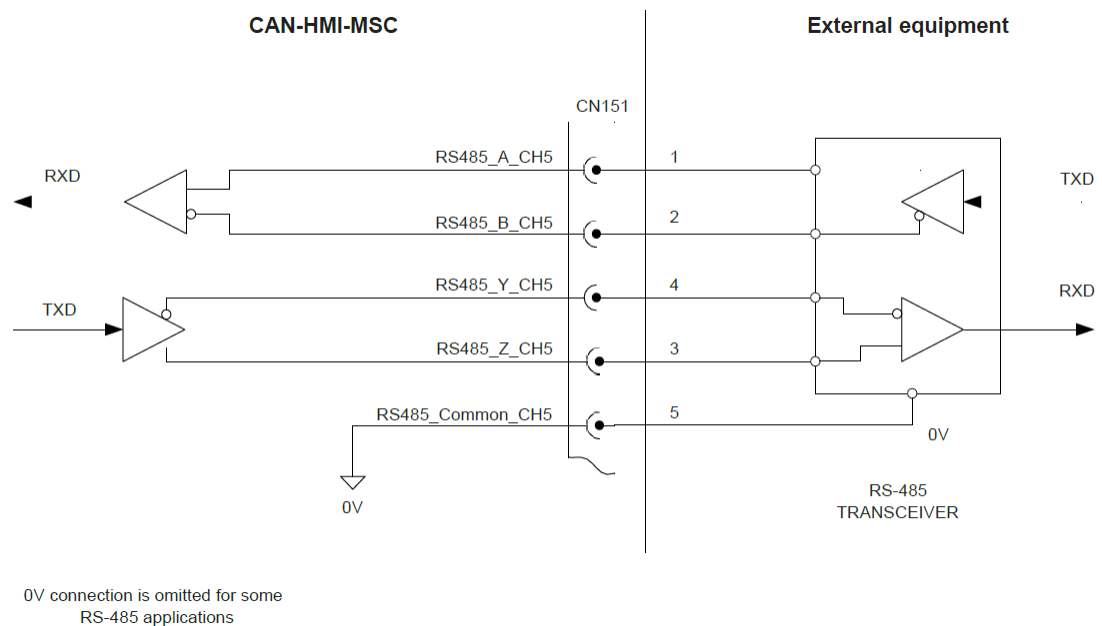


Figure 3-26: RS Communication 4-wire connections (CAN-HMI-MSC only)



### 3.11.2.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V <sub>AC</sub>
RT Terminator resistor	118	120	122	W
Driver output short circuit current	-	-	200	mA
Data transmission rate	-	-	500	kbps

### 3.11.2.3 Cable Specifications

Item	Minimum	Typical	Maximum	Unit
Cable length	-	-	1000	m
Cable characteristic impedance	-	120	-	W
Cable DC loop resistance	-	-	100	W
Cable capacitance	-	-	55.77	pF/m

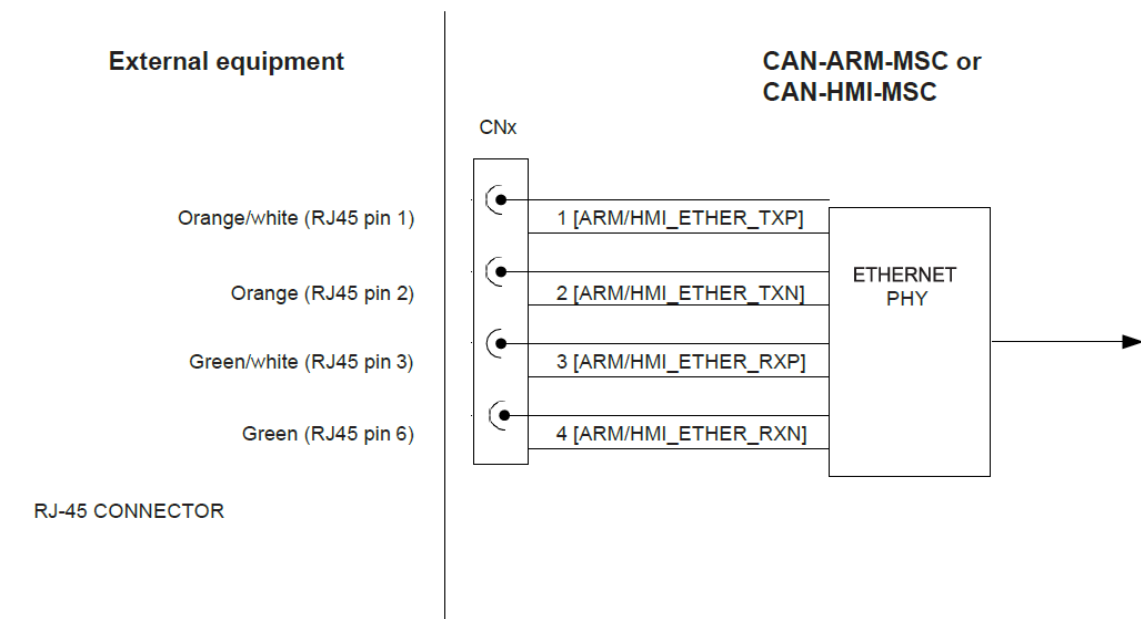
### 3.11.3 Ethernet Communication

#### 3.11.3.1 Functional Description

The function of the Ethernet Communication (ETHERNET) block is to allow the FlexConn microprocessor to communicate through an Ethernet compliant physical layer with external devices including a load computer, TAS system, Fusion4 Portal, or other remote interfaces.

The figure below illustrates the Ethernet connections using the external cables or Ethernet connections to the external devices.

Figure 3-27: Ethernet complaint physical layer



#### 3.11.3.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V <sub>AC</sub>
Data transmission rate	10	-	100	mbps

#### 3.11.3.3 Cable Specifications

Item	Minimum	Typical	Maximum	Unit
Cable length	-	-	100	m
Cable characteristic impedance	85	100	115	W

Item	Minimum	Typical	Maximum	Unit
Cable DC loop resistance	-	$\leq 0.188$	-	W/m
Cable capacitance	-	52	-	pF/m

## 3.12 Security Guidelines

This section provides security guidelines for Fusion4 MSC-A.

### 3.12.1 Device Security Recommendations

Following are the recommendations to prevent malicious users from accessing the device and its data

- Lock the device with password on first use and make sure that the password for locking the device is changed periodically and maintained securely.
- Restrict unauthorized persons near the loading bay area.
- Use earth connection Interlock on the Load Computer / BCU so that loading cannot be initiated without driver being physically present.

### 3.12.2 Network and Security Control Recommendations

The MSC-A provides TCP/IP communication with TAS/Fusion 4 Portal over Ethernet 1 and Ethernet 2 ports to support remote loading and sharing of information. The device support only server mode for TCP/IP communication and only single socket on either Ethernet ports.

Following are recommendations to prevent malicious users from accessing the device and its data over the communications network

- Deploy MSC-A and Remote Host application under secured and physically restricted network within local network.
- Restrict physical access to the device and other devices in the same network.
- Physically secure the connection between the device and host.



- Use a firewall for the business network to process control/monitor network interface to restrict access from the business network to process control network.
- Close all unused TCP and UDP communication ports on system hosting host application.
- Set the minimum required level of privilege for all accounts and enforce a password policy on all systems.
- Restrict usage of unauthorized removable media.
- Prevent the use of unauthorized laptops on the process control network.
- Make sure that your virus protection and Operating system security hot fixes are up to date on all systems.
- Do not connect MSC-A to the public network. Any external connections shall be secured by setting up VPN.

### 3.12.3 Reporting a Security Vulnerability

To report a potential security vulnerability against any Guidant product, report it using one of the following methods:

- Call +1 844.7203-4014
- Contact [Guidant Customer Support](#)

# 4 Installation

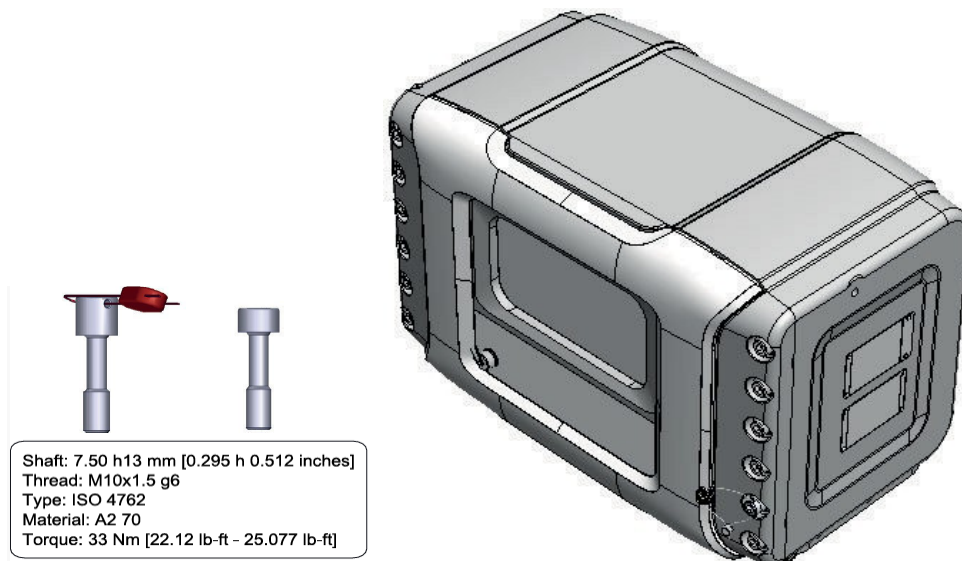
## 4.1 Mounting and Dimensions

For personal safety and for LVD compliance, make sure that the structure on which the housing is mounted and the mounting parts support at least 200 kgs in order to provide permanent support to the device.

Following are the mechanical features of the MSC-A.

1. An enclosure box with an hinged lid which allows M10\*1.5 - g6 fixing bolts.

The weight of the MSC-A device is 53.8 kgs. The width is 525 mm (20.67 inches), depth is 265 mm (10.43 inches), and the height is 344 mm (13.54 inches).



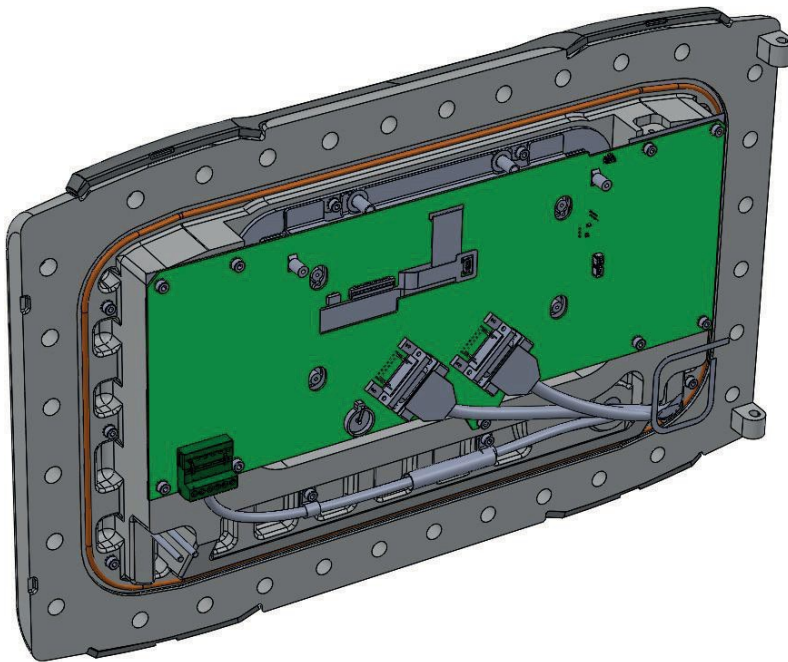
2. An Ex flame path by means of an internal flange.

3. 31 bolts and one sealing bolt as illustrated in the following figure.

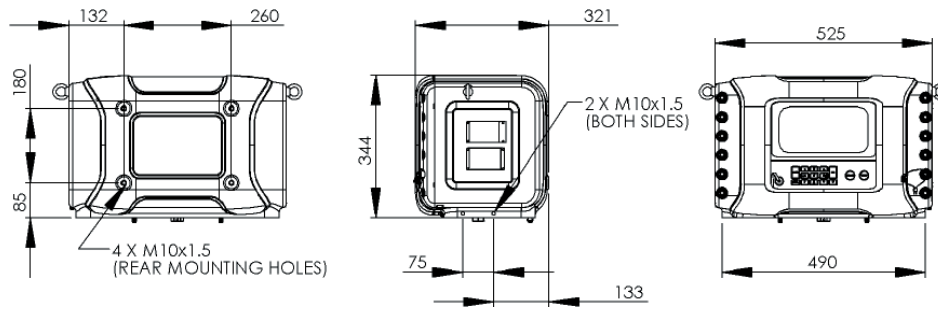


4. An O-ring positioned inside the lid as illustrated in the following figure.

**NOTE:** The standard material for the O-ring is NBR (70 Shore A), as it is used in the current application. For more demanding applications and environments, a special ring is available.

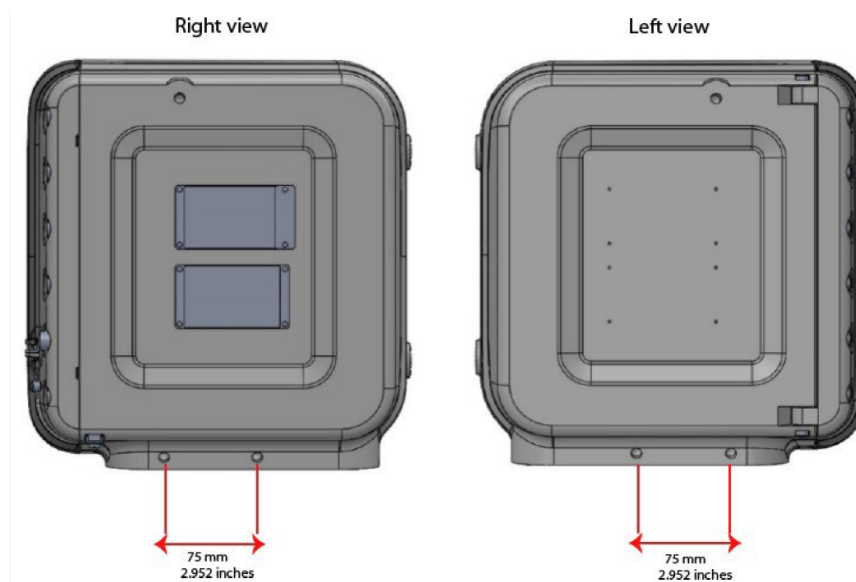


5. Wall mounting facilities - The four wall mounting bolts are available as illustrated in the following figure. The size of the bolts are M10\*1.5 - g6.



6. Base mounting facilities - The base mounting holes are located on the right side and the left side of the MSC-A as illustrated in the following figure.

**NOTE:** The base mounting bolt thread size is M10.



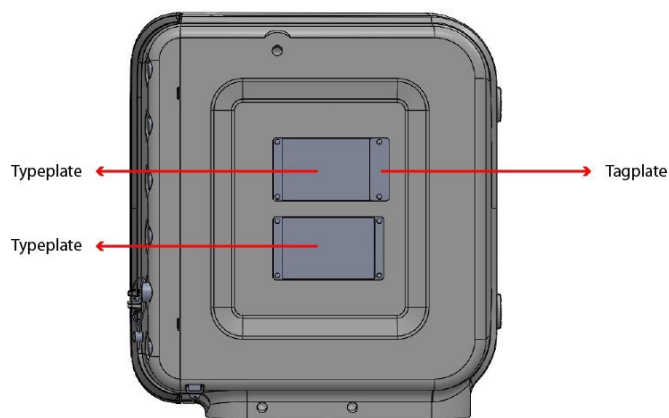
7. Lifting eyes facility for easy installation as illustrated in the following figure. (This facility is not allowed for permanent mounting as it is used only for installation purpose).

**NOTE:** The ring bolt is rotatable, therefore the load direction is adjustable and unintended tightening or loosening is negated. The higher load rating ring bolts allows for smaller connection threads.

The lifting eye thread size is M10.

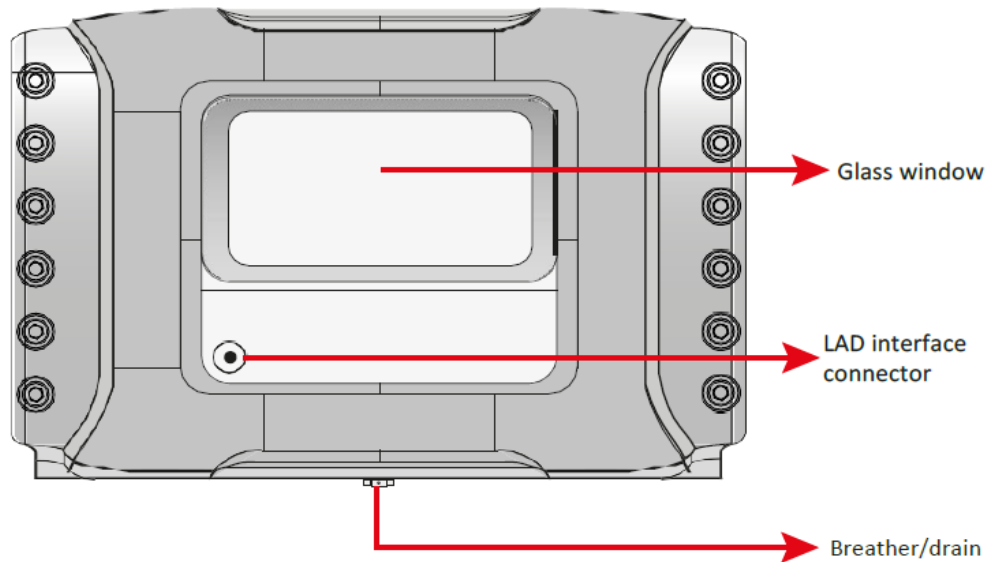


8. Three external grounding facilities are available in order to ground the MSC-A enclosure with an external ground reference/point. See [Section 2.2.6.1: Grounding](#) for more information.
9. Internal grounding which is available for each gland entry to ground the internal electronics and ground/earth signal of the cables. See [Section 2.2.6.1: Grounding](#) for more information.
10. Metric or the NPT cable entry layout. See [Section 4.2: Gland Entries](#) for more information.
11. Mounting facilities for the type plates and an optional tag plate are illustrated in the following figure.



12. Optional breather/drain as illustrated in the following figure.

13. Intrinsically safe interface connector for LAD, as illustrated in the following figure.
14. Glass window for display and IR interface for IR controller, as illustrated in the following figure.



**WARNING:** Do not drill into the housing as this invalidates the explosion safety approvals.

**NOTE:** Refer to the specific equipment's manual for directions to carry and lift the equipment or parts that weigh more than 18 kgs.

## 4.2 Gland Entries

### 4.2.1 General

The mechanics of the MSC-A requires gland entries to connect the cables inside the controller and the wires to the terminals and the connectors.

The gland/cable entries are positioned at the bottom of the MSC-A.

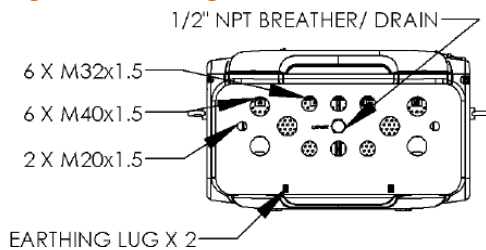
The MSC-A external cables enter the enclosure through one of the cable entries.

## 4.2.2 Metric Gland Entries

The MSC-A implements an optional metric gland assembly layout, which supports the following glands.

- 2 x M20 (meters, solenoids)
- 6 x M40
- 6 x M32 (auxiliary)
- 1 x non-metric (½" NPT) not for wiring, but for optional breather

**Figure 4-1: Metric gland entries overview**

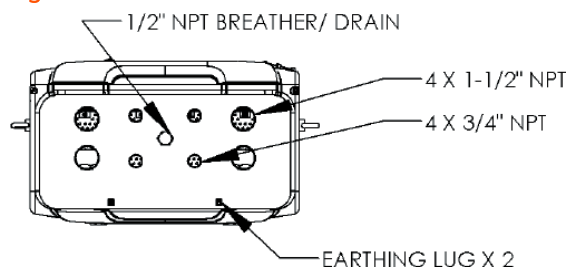


## 4.2.3 NPT Gland Entries

The MSC-A with an optional NPT cable entry layout, supports the following thread sizes.

- 4 x 1½" NPT
- 4 x ¾" NPT
- 1 x ½" NPT (optional breather)

**Figure 4-2: NPT cable entries overview**



## 4.3 Opening the MSC-A

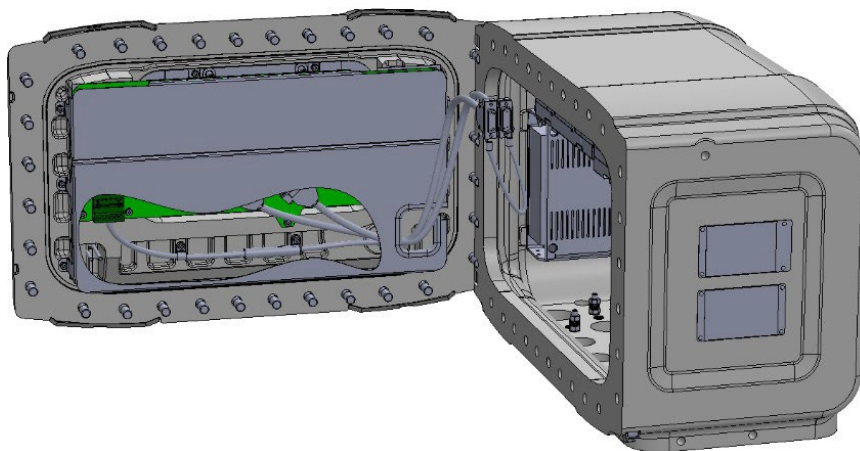
**WARNING:** Do NOT open when an explosive atmosphere is present. It is forbidden to open the MSC-A in an explosive hazardous environment, unless otherwise stated on the safety label.

Treat the flange surface of the cover and the housing with care. Keep the flange surface free of dirt. The O-ring must be present and undamaged.

To open the MSC-A Lid

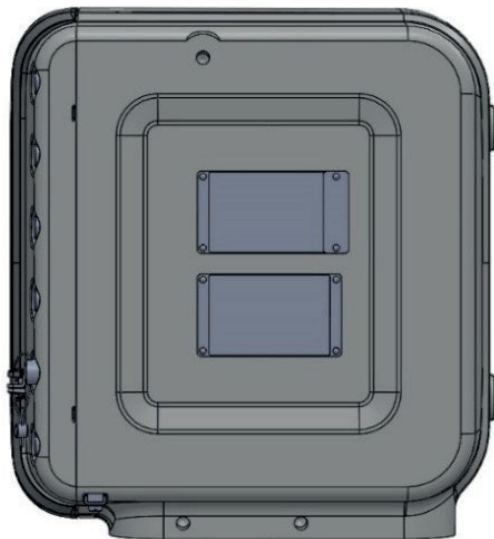
1. Remove the W&M seal, if applicable.
2. Remove the cosmetic cover, by gently pulling the cover.
3. Loosen all the 32 bolts by loosening one or two threads of the bolts with an 8 mm Allen key.

The MSC-A lid can now be opened.



4. If the MSC lid is stuck due to the air seal, carefully force the dedicated notches to open with the screwdrivers as illustrated in the following figure.





**WARNING:** Do not force the MSC-A lid to open in other places. Also, take care not to damage the flame path.

For ensuring intrinsic safety of the MSC-A, the grounding connection of the lid to the main box and the box to the local grounding system is very crucial.

5. Remove the screw of the earth strap protection cable on the MSC-A lid.



6. Remove the screw on the earth strap assembly from the MSC-A lid.



**NOTE:** The screw must be removed only by Guidant trained service technicians.

7. Remove the screws that hold the boards fastened to the enclosure with a 4 mm allen key.
8. Remove the CAN-IN-OUT-MSC boards and CAN-ARM-MSCboards.
9. Remove the 2x cabling from the backplane of the CAN-HMI-MSC boards.
10. Replace all the toothed rings in the MSC-A lid.

**NOTE:** Make sure there is no corrosion between the parts of the MSC-A.

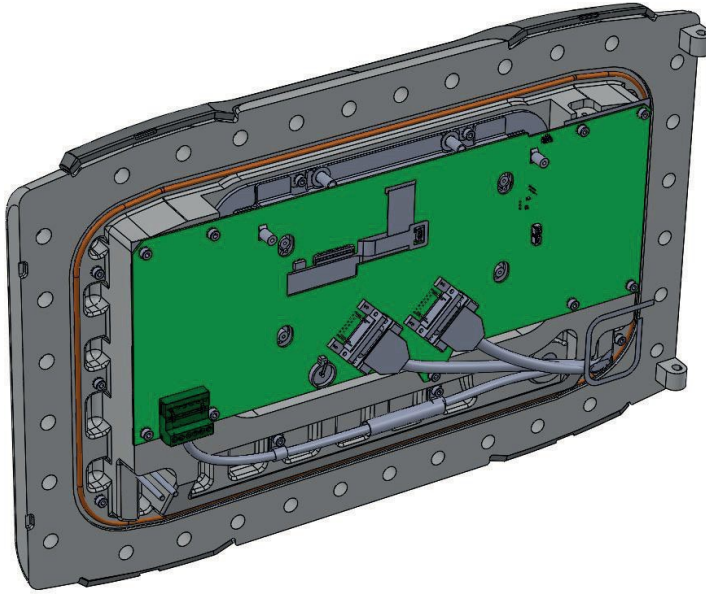
11. Replace the screw of the earth strap protection cable on the MSC-A lid.
12. Replace the screw of the earth strap assembly on the MSC-A lid.

## 4.4 Closing the MSC Lid

To close the MSC-A Lid

1. Make sure the O-ring is in place and it is not damaged. If the O-ring is damaged, replace the O-ring first.
2. Remove the 2x cable (grounding cable and cable to prevent over- stretching door after opening the door) before replacing the O-ring.

**NOTE:** The O-ring should only be replaced by the Guidant trained service technicians.



3. Make sure the wires are not caught between the lid and the box flange.
4. Make sure the ground bonding provided is effective.
5. Tighten all the 32 bolts crosswise using an 8 mm Allen key and the applicable torque value (33 Nm).
6. Replace the cosmetic cover.

## 4.5 Removing/Replacing the PCBs

**CAUTION:** Wear an ESD wrist strap while handling a printed circuit board from the MSC-A, to prevent damage by Electrostatic Discharge (ESD).

1. Perform step 1 through step 3 from the [Section 4.3: Opening the MSC-A](#) before removing/replacing the CAN-HMI-MSC, CAN-IN- OUT-MSC, CAN-ARM-MSC, and MSC-FUSE-BOARD.
2. Check the thermal conductive pads on all the boards are in place.
3. Before placing the boards, remove the protection film, if applicable.

## 4.5.1 To remove the CAN-HMI-MSC board

1. Remove the PCB protector plate MSC lid.
2. Remove the subD 15 (2x) cables.
3. Remove the contra connector with the blue color cable (CN2).
4. Remove the display cables (CN9 and CN10).
5. Loosen and remove the screws that hold the CAN-HMI-MSC board to the MSC-A lid.

**NOTE:** To replace the CAN-HMI-MSC board perform the above steps in the reverse manner to replace it.

## 4.5.2 To remove the CAN-IN-OUT-MSC or CAN-ARM-MSC boards

1. Remove the screw that holds the CAN-IN-OUT-MSC or CAN-ARM- MSC boards to the enclosure.

The screws for both the grounding and the protection cable are M4 Socket Cap screws which need a 3 mm hex key (or Allen key).

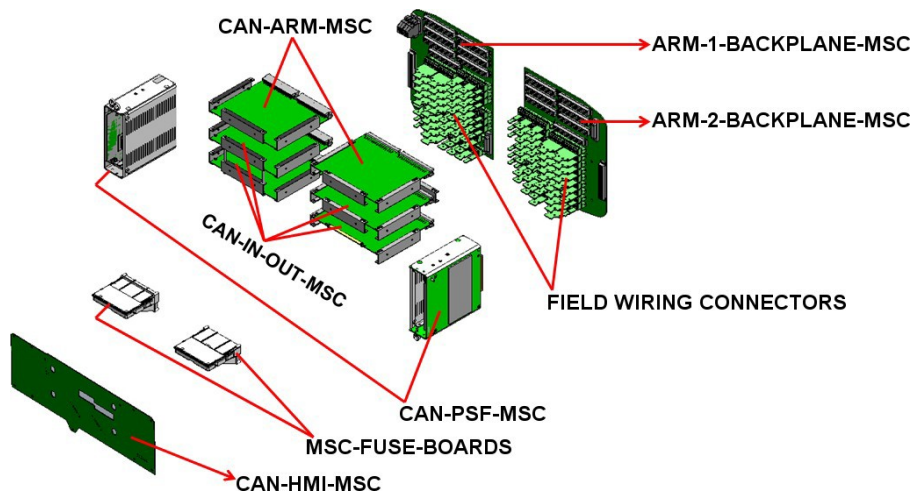
**NOTE:** To replace the CAN-IN-OUT-MSC and CAN- ARM- MSC boards perform the above step in the reverse manner to replace it.

## 4.5.3 To remove the MSC-FUSE-BOARD

1. Remove the MSC-FUSE-BOARD from the backplanes by pulling the MSC-A fuse board cover.

**NOTE:** To replace the MSC-FUSE-BOARD perform the above step in the reverse manner to replace it.

Do not remove CAN-PSF-MSC board.



## 4.5.4 Fusing and Power Consumption

### 4.5.5 Fusing

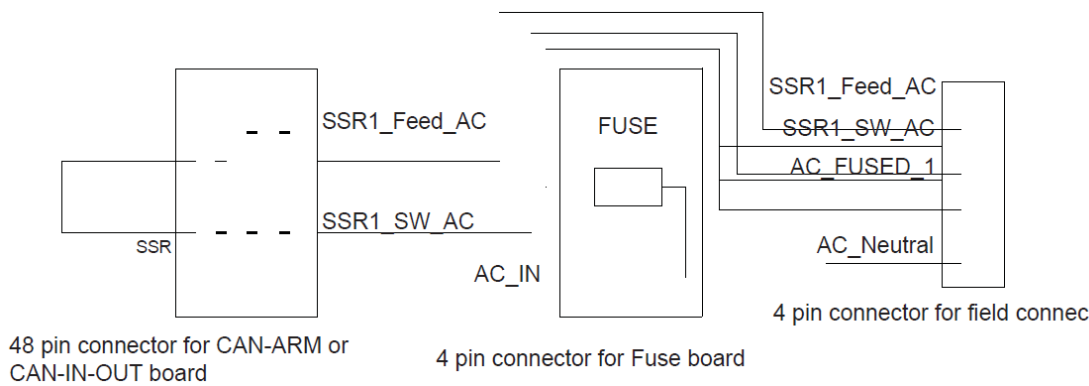
#### 4.5.5.1 Internal Fusing

MSC-A provides internal fuses for the protection of the AC mains as described below.

- The CAN-PSF-MSC (Power supply) board - Converts the mains AC voltage into three different DC voltages. See [Section 3.6.2: CAN-PSF-MSC](#) for more information. The CAN-PSF-MSC board has an internal fuse to protect the external AC mains against any over- current condition or fault condition inside the MSC-A.
- MSC-FUSE-BOARD - The mains AC input which is supplied to the MSC-A is also routed to the external devices through the MSC- FUSE-BOARD. The fuses on the MSC fuse board deliver fuse protected AC power to the external devices.

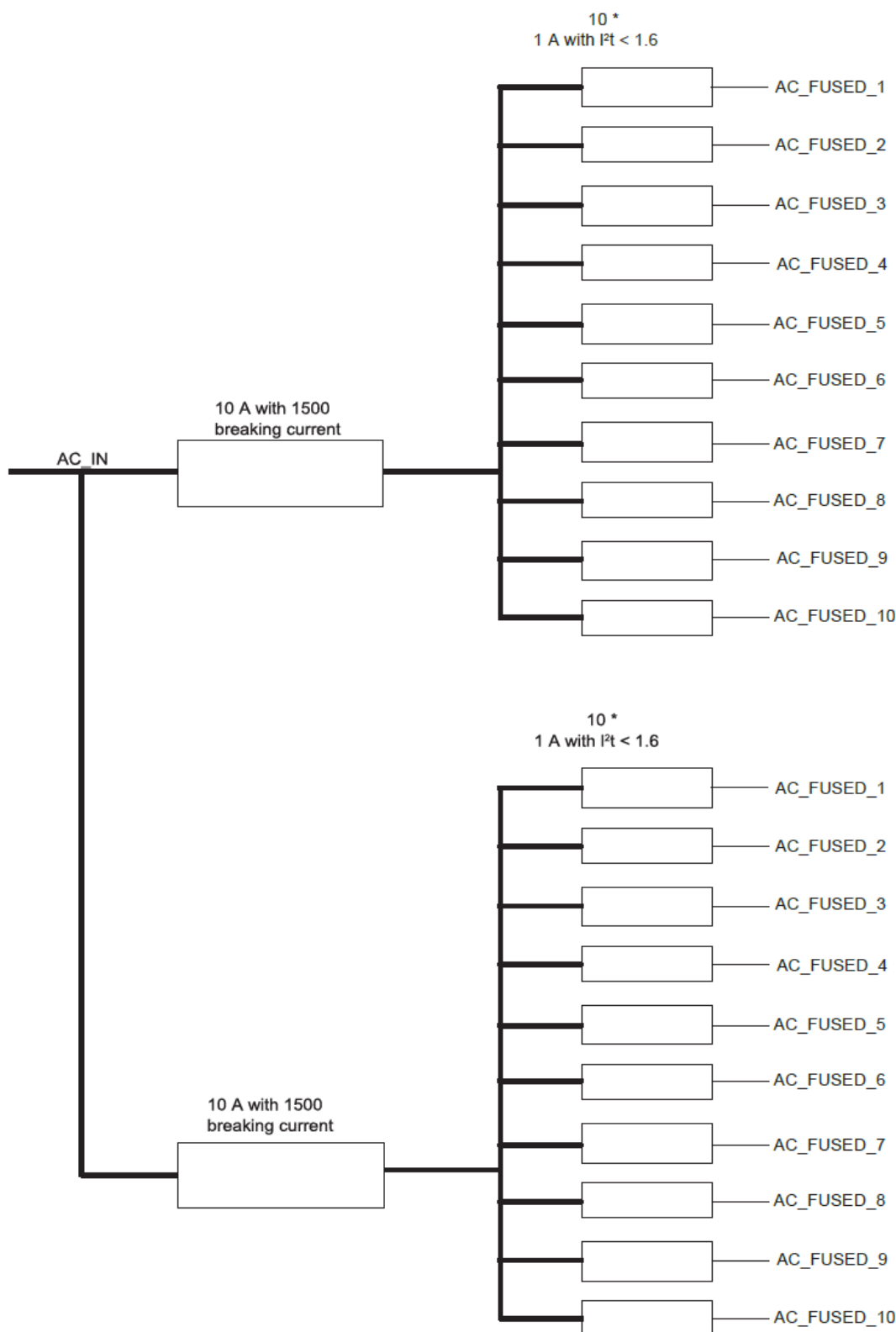
The figure below illustrates the block schematic of a single fuse on the MSC-FUSE-BOARD.

Figure 4-3: Block schematic of a single fuse on the MSC-FUSE-BOARD



The figure below illustrates the architecture of the MSC-FUSE-BOARD.

Figure 4-4: Architecture of MSC-FUSE-BOARD



### 4.5.5.2 External Fusing

External fuse can also be connected to the AC mains input available for the MSC-A. There are two different power supply units which can either be powered using the individual AC sources or the common AC source.

- Use two 217 005.P (little fuse) or equivalent on each AC source for a system with separate AC mains for each power supply.
- Use a single 217 010.P (little fuse) or equivalent for the common AC source.

**NOTE:** External fusing is not required as all the fusing is done internally on the CAN-PSF-MSC board.

## 4.5.6 Power Consumption

The maximum consumed mains power depends on the external loads which can add up to 690 W.

The MSC-A contains DO-SSR-AC interfaces. The SSR relays are used to switch AC signals connected to the MSC-A load.

The following boards in MSC-A contain DO-SSR-AC interfaces.

1. CAN-ARM-MSC (one per backplane)
2. CAN-IN-OUT-MSC (two per backplane)

On each CAN-ARM-MSC board there are 12 SSR interfaces and on each CAN-IN-OUT-MSC board there are four SSR interfaces available.

Every DO-SSR-AC needs an optional fuse in order to protect the internal electronics for high current drawn. The 22 fuses are placed on the optional MSC-FUSE-BOARD. These fuses when placed on the MSC-A protect the electronics against the high current condition.

Since a fuse is optional for MSC-A, 0E resistor is connected in parallel to each fuse. This board is called the MSC-SHORTCUT-BOARD.

For the MSC-FUSE-BOARD board only the fuses are assembled and not the 0E resistors. The MSC-FUSE-BOARD board has 22 fuses, and the SSR output is



connected to the MSC-A load through the fuse. The MSC-FUSE-BOARD is directly interfaced to the backplane through the 48 pin connector.

The following table provides an example of the maximum dissipation of the boards based on the specific main voltage conditions for the particular region/country for the site where the MSC-A is installed.

Boards	Number of boards	Dissipation	Description
CAN-ARM-MSC	2	15.4 W	The dissipation is based on the maximum load.
CAN-IN-OUT-MSC	4	25 W	The dissipation is based on the maximum load.
CAN-HMI-MSC	1	7.2 W	The dissipation is based on the maximum load.
Display KOE TX20D26VM0AAA	1	6 W	The dissipation is based on the maximum load.
CAN-PSF-MSC	2	20.3	Internal dissipation is $0.2 * 53.6 = 10.7 \text{ W}$
			External 12 V dissipation is $0.2 * 24 = 4.8 \text{ W}$
			External 24 V dissipation is $0.2 * 24 = 4.8 \text{ W}$
		Total dissipation - 73.9W	

## 4.5.7 Disconnecting/breaker device

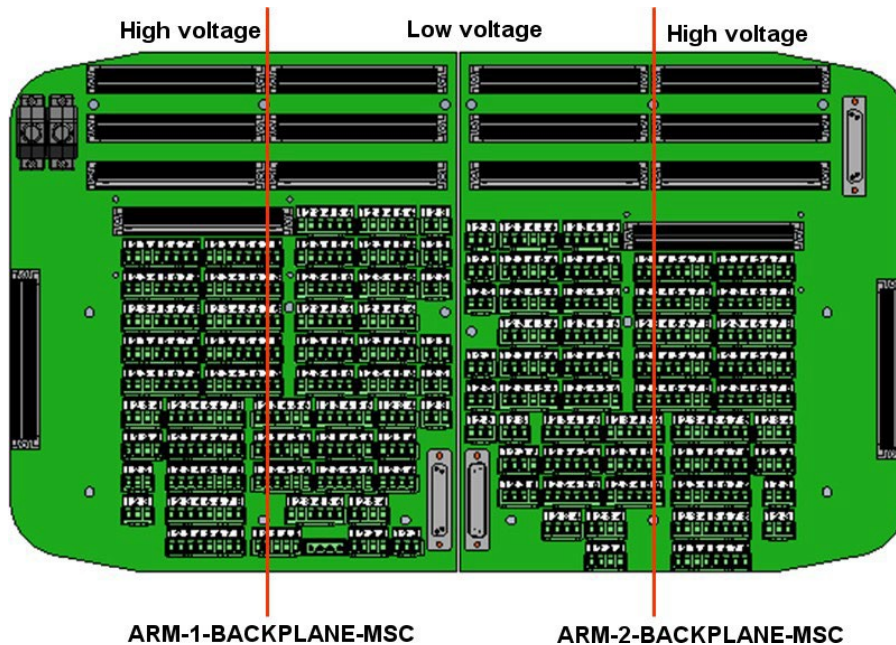
**WARNING:** A readily accessible disconnecting/breaker device with a 20 A fuse shall be incorporated external to the equipment.

## 4.6 Wiring Termination Guidance

### 4.6.1 Wiring Architecture

- Ex i wiring is separated from other wiring.
- In order to limit the interference between low voltage and high voltage signals, a logical separation between cables containing the signals are created.

Figure 4-5: High/low voltages separation concept

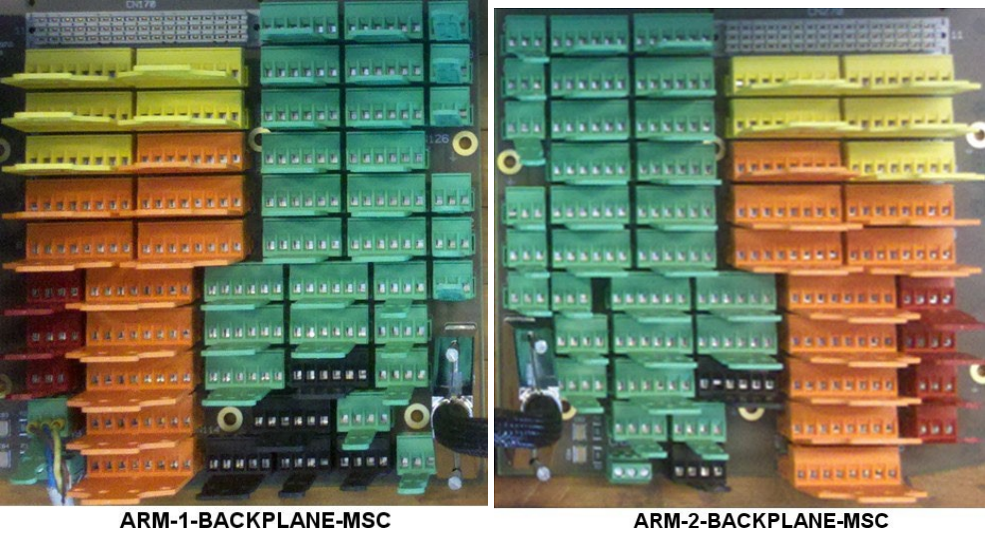


### 4.6.2 Backplane Boards

All the external wires of the MSC-A connect to one of the Phoenix Contact connectors of the backplanes. These backplanes are mounted on the rear of the MSC-A enclosure.

The backplane connectors have a unique CN number, color, and XY coordinate. The connectors contain 3, 4, 5, 6, or 8 pins. ARM-1- Backplane-MSC start with the CN number CN101 and contain 52 connectors. ARM-2-Backplane-MSC start with the CN number CN201 and contain 49 connectors.

Figure 4-6: Backplane boards



4.6.2.1 ARM-1-BACKPLANE-MSC

Figure 4-7: ARM-1-BACKPLANE-MSC



4.6.2.2 Floorplan

The following images illustrates the floorplan for ARM-1-BACKPLANE- MSC board.

Figure 4-8: Blackplane arrangement of ARM-1-BACKPLANE-MSC



2074295-D02

Figure 4-9: Fusion4 Multipak



2074299-

Figure 4-10: Expansion Pack 1

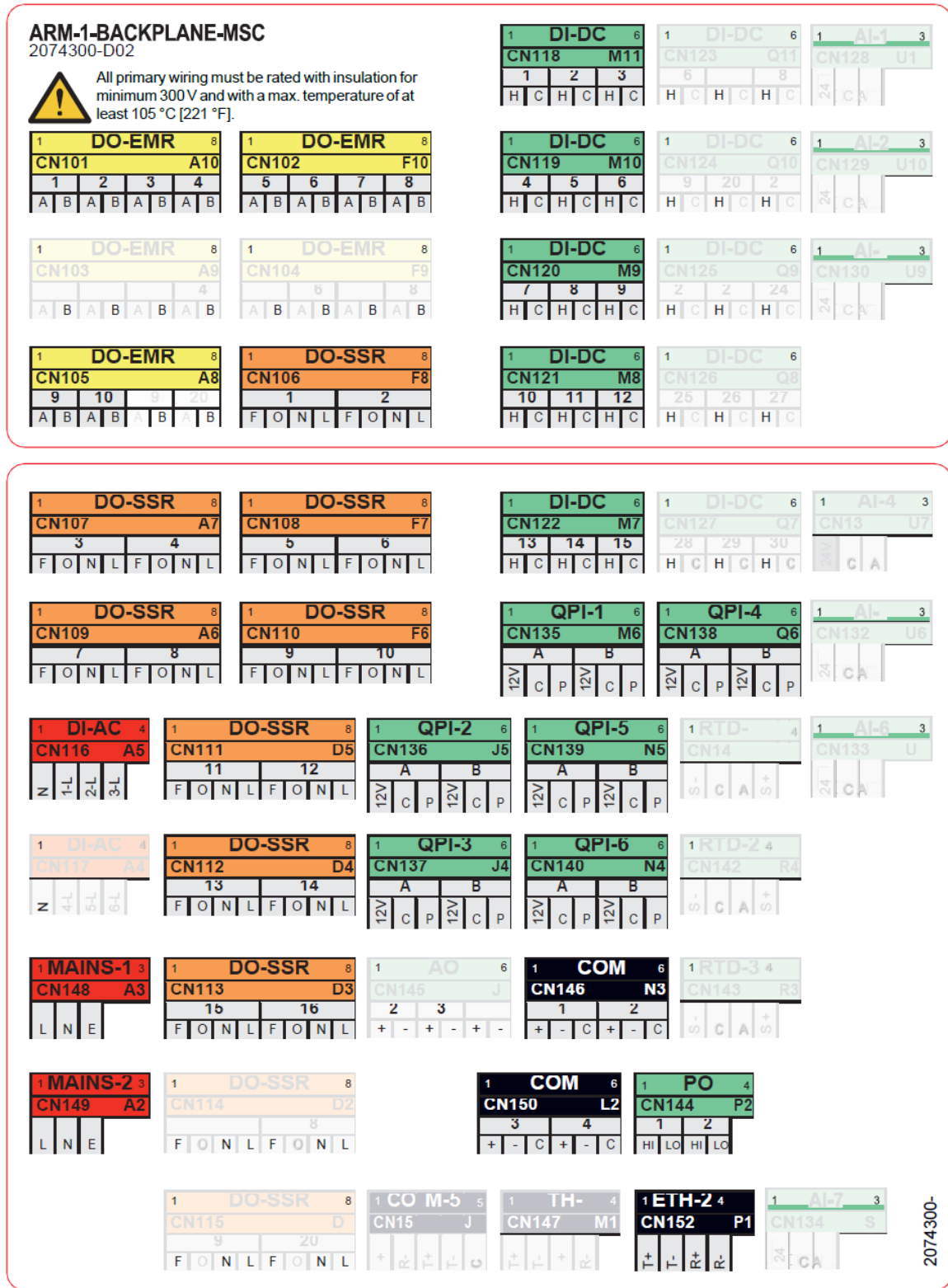
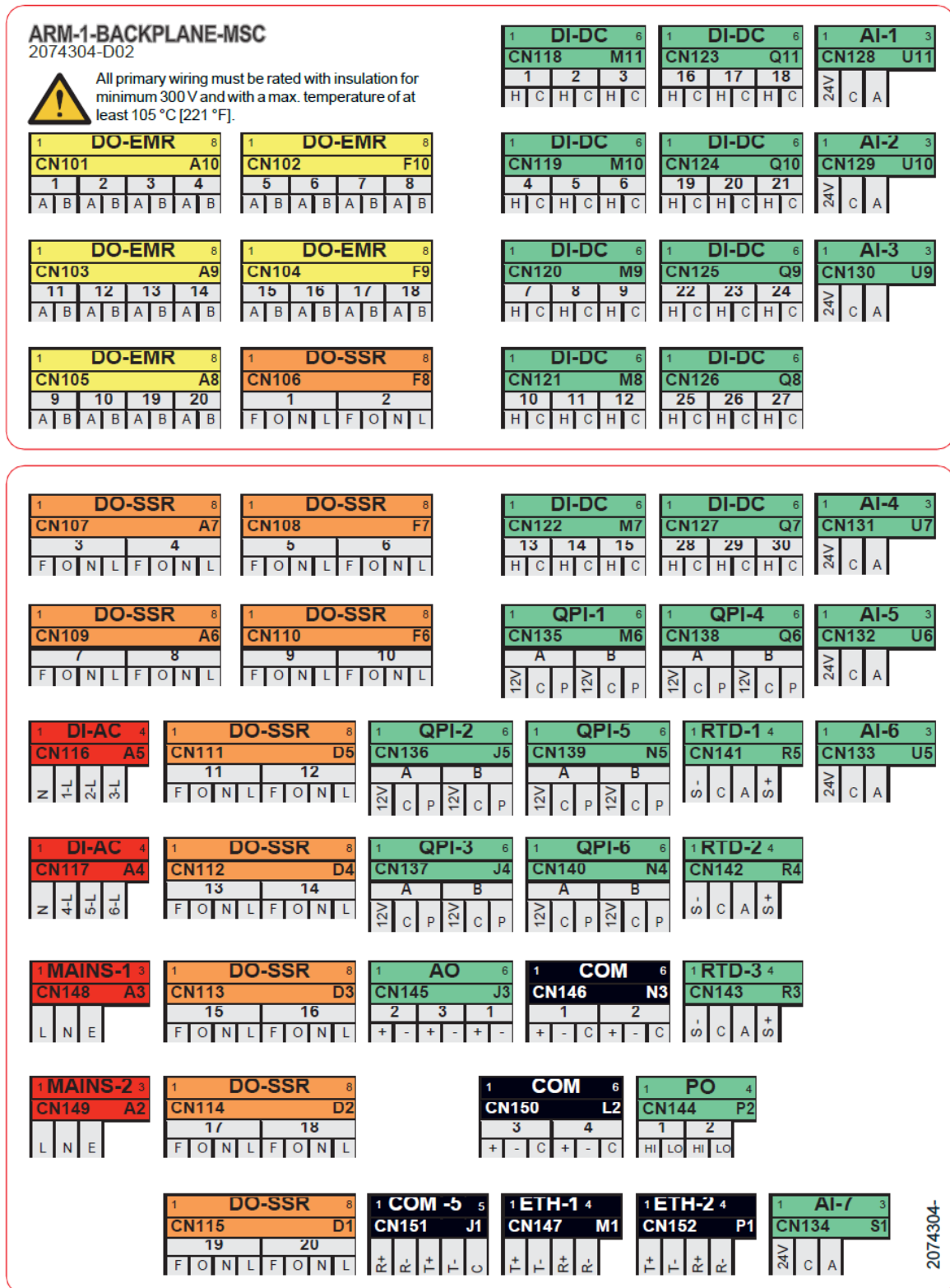




Figure 4-11: Expansion Pack 2



Figure 4-12: Expansion Pack 6





### 4.6.2.3 Connector Overview

The following table provides the connector overview of ARM-1- BACKPLANE-MSC.

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-101	8	DO-EMR-AC-DC 1	CAN-IN-OUT-MSC-1	Yellow	A-10	DO-EMR-1
		DO-EMR-AC-DC 2	CAN-IN-OUT-MSC-1			DO-EMR-2
		DO-EMR-AC-DC 3	CAN-IN-OUT-MSC-1			DO-EMR-3
		DO-EMR-AC-DC 4	CAN-IN-OUT-MSC-1			DO-EMR-4
CN-102	8	DO-EMR-AC-DC 5	CAN-IN-OUT-MSC-1	Yellow	F-10	DO-EMR-5
		DO-EMR-AC-DC 6	CAN-IN-OUT-MSC-1			DO-EMR-6
		DO-EMR-AC-DC 7	CAN-IN-OUT-MSC-1			DO-EMR-7
		DO-EMR-AC-DC 8	CAN-IN-OUT-MSC-1			DO-EMR-8
CN-103	8	DO-EMR-AC-DC 11	CAN-IN-OUT-MSC-2	Yellow	A-9	DO-EMR- 11
		DO-EMR-AC-DC 12	CAN-IN-OUT-MSC-2			DO-EMR- 12
		DO-EMR-AC-DC 13	CAN-IN-OUT-MSC-2			DO-EMR- 13
		DO-EMR-AC-DC 14	CAN-IN-OUT-MSC-2			DO-EMR- 14
CN-104	8	DO-EMR-AC-DC 15	CAN-IN-OUT-MSC-2	Yellow	F-9	DO-EMR- 15
		DO-EMR-AC-DC 16	CAN-IN-OUT-MSC-2			DO-EMR- 16
		DO-EMR-AC-DC 17	CAN-IN-OUT-MSC-2			DO-EMR- 17
		DO-EMR-AC-DC 18	CAN-IN-OUT-MSC-2			DO-EMR- 18
CN-105	8	DO-EMR-AC-DC 9	CAN-IN-OUT-MSC-1	Yellow	A-8	DO-EMR-9
		DO-EMR-AC-DC 10	CAN-IN-OUT-MSC-1			DO-EMR- 10
		DO-EMR-AC-DC 19	CAN-IN-OUT-MSC-2			DO-EMR- 19
		DO-EMR-AC-DC 20	CAN-IN-OUT-MSC-2			DO-EMR- 20
CN-106	8	DO-SSR-AC 1	CAN-ARM-MSC-1	Orange	F-8	DO-SSR-1
		DO-SSR-AC 2	CAN-ARM-MSC-1			DO-SSR-2
CN-107	8	DO-SSR-AC 3	CAN-ARM-MSC-1	Orange	A-7	DO-SSR-3
		DO-SSR-AC 4	CAN-ARM-MSC-1			DO-SSR-4
CN-108	8	DO-SSR-AC 5	CAN-ARM-MSC-1	Orange	F-7	DO-SSR-5
		DO-SSR-AC 6	CAN-ARM-MSC-1			DO-SSR-6
CN-109	8	DO-SSR-AC 7	CAN-ARM-MSC-1	Orange	A-6	DO-SSR-7
		DO-SSR-AC 8	CAN-ARM-MSC-1			DO-SSR-8

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-110	8	DO-SSR-AC 9	CAN-ARM-MSC-1	Orange	F-6	DO-SSR-9
		DO-SSR-AC 10	CAN-ARM-MSC-1			DO-SSR- 10
CN-111	8	DO-SSR-AC 11	CAN-ARM-MSC-1	Orange	D-5	DO-SSR- 11
		DO-SSR-AC 12	CAN-ARM-MSC-1			DO-SSR- 12
CN-112	8	DO-SSR-AC 13	CAN-IN-OUT-MSC-1	Orange	D-4	DO-SSR- 13
		DO-SSR-AC 14	CAN-IN-OUT-MSC-1			DO-SSR- 14
CN-113	8	DO-SSR-AC 15	CAN-IN-OUT-MSC-1	Orange	D-3	DO-SSR- 15
		DO-SSR-AC 16	CAN-IN-OUT-MSC-1			DO-SSR- 16
CN-114	8	DO-SSR-AC 17	CAN-IN-OUT-MSC-2	Orange	D-2	DO-SSR- 17
		DO-SSR-AC 18	CAN-IN-OUT-MSC-2			DO-SSR- 18
CN-115	8	DO-SSR-AC 19	CAN-IN-OUT-MSC-2	Orange	D-1	DO-SSR- 19
		DO-SSR-AC 20	CAN-IN-OUT-MSC-2			DO-SSR- 20
CN-116	4	DI-AC 1	CAN-IN-OUT-MSC-1	Red	A-5	DI-AC-1
		DI-AC 2	CAN-IN-OUT-MSC-1			DI-AC-2
		DI-AC 3	CAN-IN-OUT-MSC-1			DI-AC-3
CN-117	4	DI-AC 4	CAN-IN-OUT-MSC-2	Red	A-4	DI-AC-4
		DI-AC 5	CAN-IN-OUT-MSC-2			DI-AC-5
		DI-AC 6	CAN-IN-OUT-MSC-2			DI-AC-6
CN-118	6	DI-DC 1	CAN-IN-OUT-MSC-1	Green	M-11	DI-DC-1
		DI-DC 2	CAN-IN-OUT-MSC-1			DI-DC-2
		DI-DC 3	CAN-IN-OUT-MSC-1			DI-DC-3
CN-119	6	DI-DC 4	CAN-IN-OUT-MSC-1	Green	M-10	DI-DC-4
		DI-DC 5	CAN-IN-OUT-MSC-1			DI-DC-5
		DI-DC 6	CAN-IN-OUT-MSC-1			DI-DC-6
CN-120	6	DI-DC 7	CAN-IN-OUT-MSC-1	Green	M-9	DI-DC-7
		DI-DC 8	CAN-IN-OUT-MSC-1			DI-DC-8
		DI-DC 9	CAN-IN-OUT-MSC-1			DI-DC-9
CN-121	6	DI-DC 10	CAN-IN-OUT-MSC-1	Green	M-8	DI-DC-10
		DI-DC 11	CAN-IN-OUT-MSC-1			DI-DC-11
		DI-DC 12	CAN-IN-OUT-MSC-1			DI-DC-12

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-122	6	DI-DC 13	CAN-IN-OUT-MSC-1	Green	M-7	DI-DC-13
		DI-DC 14	CAN-IN-OUT-MSC-1			DI-DC-14
		DI-DC 15	CAN-IN-OUT-MSC-1			DI-DC-15
CN-123	6	DI-DC 16	CAN-IN-OUT-MSC-2	Green	Q-11	DI-DC-16
		DI-DC 17	CAN-IN-OUT-MSC-2			DI-DC-17
		DI-DC 18	CAN-IN-OUT-MSC-2			DI-DC-18
CN-124	6	DI-DC 19	CAN-IN-OUT-MSC-2	Green	Q-10	DI-DC-19
		DI-DC 20	CAN-IN-OUT-MSC-2			DI-DC-20
		DI-DC 21	CAN-IN-OUT-MSC-2			DI-DC-21
CN-125	6	DI-DC 22	CAN-IN-OUT-MSC-2	Green	Q-9	DI-DC-22
		DI-DC 23	CAN-IN-OUT-MSC-2			DI-DC-23
		DI-DC 24	CAN-IN-OUT-MSC-2			DI-DC-24
CN-126	6	DI-DC 25	CAN-IN-OUT-MSC-2	Green	Q-8	DI-DC-25
		DI-DC 26	CAN-IN-OUT-MSC-2			DI-DC-26
		DI-DC 27	CAN-IN-OUT-MSC-2			DI-DC-27
CN-127	6	DI-DC 28	CAN-IN-OUT-MSC-2	Green	Q-7	DI-DC-28
		DI-DC 29	CAN-IN-OUT-MSC-2			DI-DC-29
		DI-DC 30	CAN-IN-OUT-MSC-2			DI-DC-30
CN-128	3	AI 1	CAN-ARM-MSC-1	Green	U-11	AI-1
CN-129	3	AI 2	CAN-ARM-MSC-1	Green	U-10	AI-2
CN-130	3	AI 3	CAN-ARM-MSC-1	Green	U-9	AI-3
CN-131	3	AI 4	CAN-ARM-MSC-1	Green	U-7	AI-4
CN-132	3	AI 5	CAN-ARM-MSC-1	Green	U-6	AI-5
CN-133	3	AI 6	CAN-ARM-MSC-1	Green	U-5	AI-6
CN-134	3	AI 7	CAN-ARM-MSC-1	Green	S-1	AI-7
CN-135	6	QPI-A 1	CAN-ARM-MSC-1	Green	M-6	QPI-1A
		QPI-B 1	CAN-ARM-MSC-1			QPI-1B
CN-136	6	QPI-A 2	CAN-ARM-MSC-1	Green	J-5	QPI-2A
		QPI-B 2	CAN-ARM-MSC-1			QPI-2B
CN-137	6	QPI-A 3	CAN-ARM-MSC-1	Green	J-4	QPI-3A

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
		QPI-B 3	CAN-ARM-MSC-1			QPI-3B
CN-138	6	QPI-A 4	CAN-ARM-MSC-1	Green	Q-6	QPI-4A
		QPI-B 4	CAN-ARM-MSC-1			QPI-4B
CN-139	6	QPI-A 5	CAN-ARM-MSC-1	Green	N-5	QPI-5A
		QPI-B 5	CAN-ARM-MSC-1			QPI-5B
CN-140	6	QPI-A 6	CAN-ARM-MSC-1	Green	N-4	QPI-6A
		QPI-B 6	CAN-ARM-MSC-1			QPI-6B
CN-141	4	RTD 1	CAN-ARM-MSC-1	Green	R-5	RTD-1
CN-142	4	RTD 2	CAN-ARM-MSC-1	Green	R-4	RTD-2
CN-143	4	RTD 3	CAN-ARM-MSC-1	Green	R-3	RTD-3
CN-144	4	PO 1	CAN-ARM-MSC-1	Green	P-2	PO-1
		PO 2	CAN-ARM-MSC-1			PO-2
CN-145	6	AO 1	CAN-ARM-MSC-1	Green	J-3	AO-1
		AO 2	CAN-IN-OUT-MSC-1			AO-2
		AO 3	CAN-IN-OUT-MSC-2			AO-3
CN-146	6	COMMS 1	CAN-ARM-MSC-1	Black	N-3	COM-1
		COMMS 2	CAN-ARM-MSC-1			COM-2
CN-147	4	ETHER 1	CAN-ARM-MSC-1	Black	M-1	ETH-1
CN-148	3	MAINS INPUT 1	Internal/external	Red	A-3	MAINS-1
CN-149	3	MAINS INPUT 2	Internal/external	Red	A-2	MAINS-2
CN-150	6	COMMS 3	CAN-HMI-MSC	Black	L-2	COM-3
		COMMS 4	CAN-HMI-MSC			COM-4
CN-151	5	COMMS 5	CAN-HMI-MSC		J-1	COM-5
CN-152	4	ETHER 2	CAN-HMI-MSC	Black	P-1	ETH-2

ID	TYPE	FUNCTION	BOARD	NAME
CN-160	subD15	HMI-LINK-1	CAN-HMI-MSC	CN-160
CN-161	subD15	HMI-LINK-2	CAN-HMI-MSC	CN-161

ID	TYPE	FUNCTION	BOARD	NAME
CN-162	subD25	BACKPLANE-LINK 1	ARM-2-BACKPLANE-MSC	CN-162
CN-163	F48	PSF-BOARD 1	CAN-PSF-MSC-1	CN-163
CN-164	F48	ARM-BOARD 1-A	CAN-ARM-MSC-1	CN-164
CN-165	F48	ARM-BOARD 1-B	CAN-ARM-MSC-1	CN-165
CN-166	F48	IN-OUT-BOARD 1-A	CAN-IN-OUT-MSC-1	CN-166
CN-167	F48	IN-OUT-BOARD 1-B	CAN-IN-OUT-MSC-1	CN-167
CN-168	F48	IN-OUT-BOARD 2-A	CAN-IN-OUT-MSC-2	CN-168
CN-169	F48	IN-OUT-BOARD 2-B	CAN-IN-OUT-MSC-2	CN-169
CN-170	F48	FUSE-BOARD 1	MSC-FUSE-BOARD-1 / MSC- SHORTCUT-BOARD-1	CN-170

#### 4.6.2.4 ARM-2-BACKPLANE-MSC

Figure 4-13: ARM-2-BACKPLANE-MSC



**ARM-2-BACKPLANE-MSC**

## 4.6.2.5 Floorplan

The figure below provides the floorplan of ARM-2-BACKPLANE-MSC board.

Figure 4-14: Blackplane arrangement of ARM-2-BACKPLANE-MSC

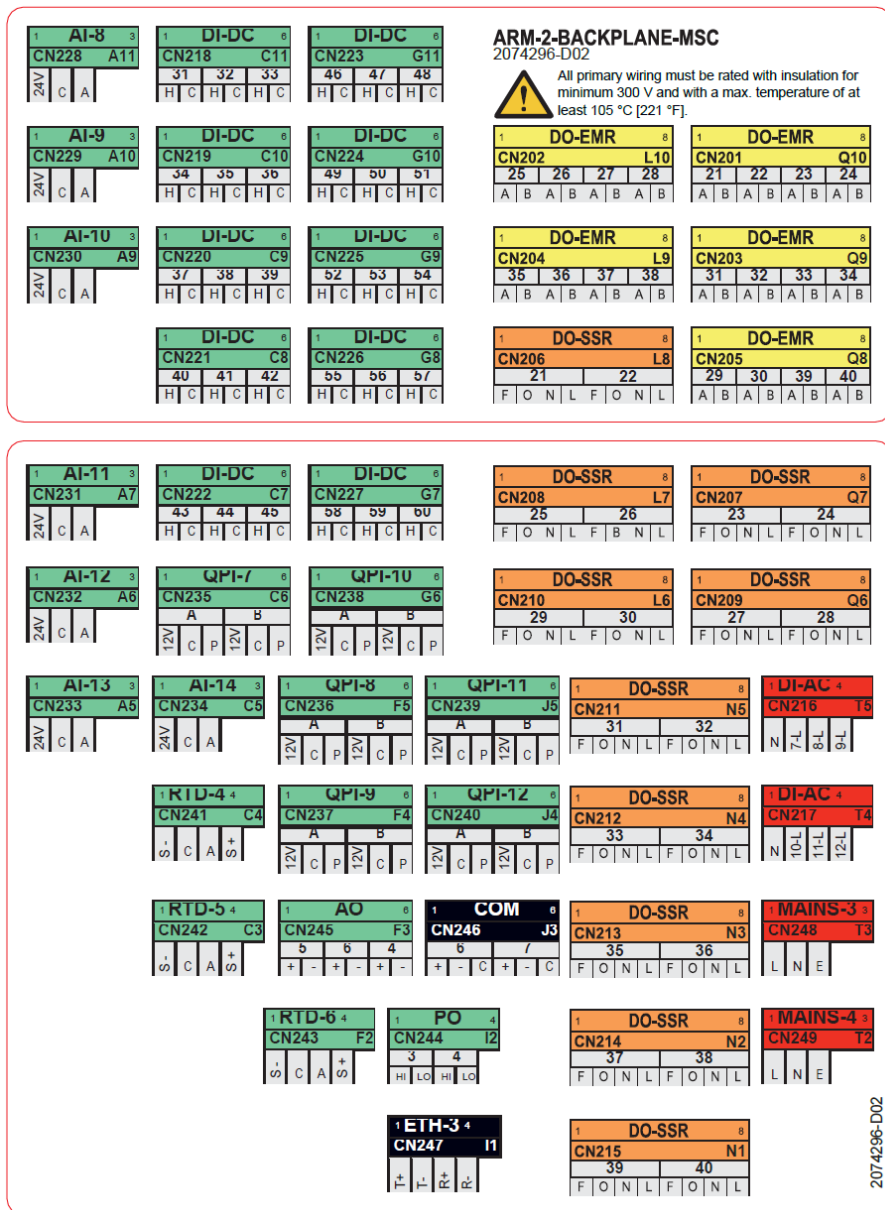
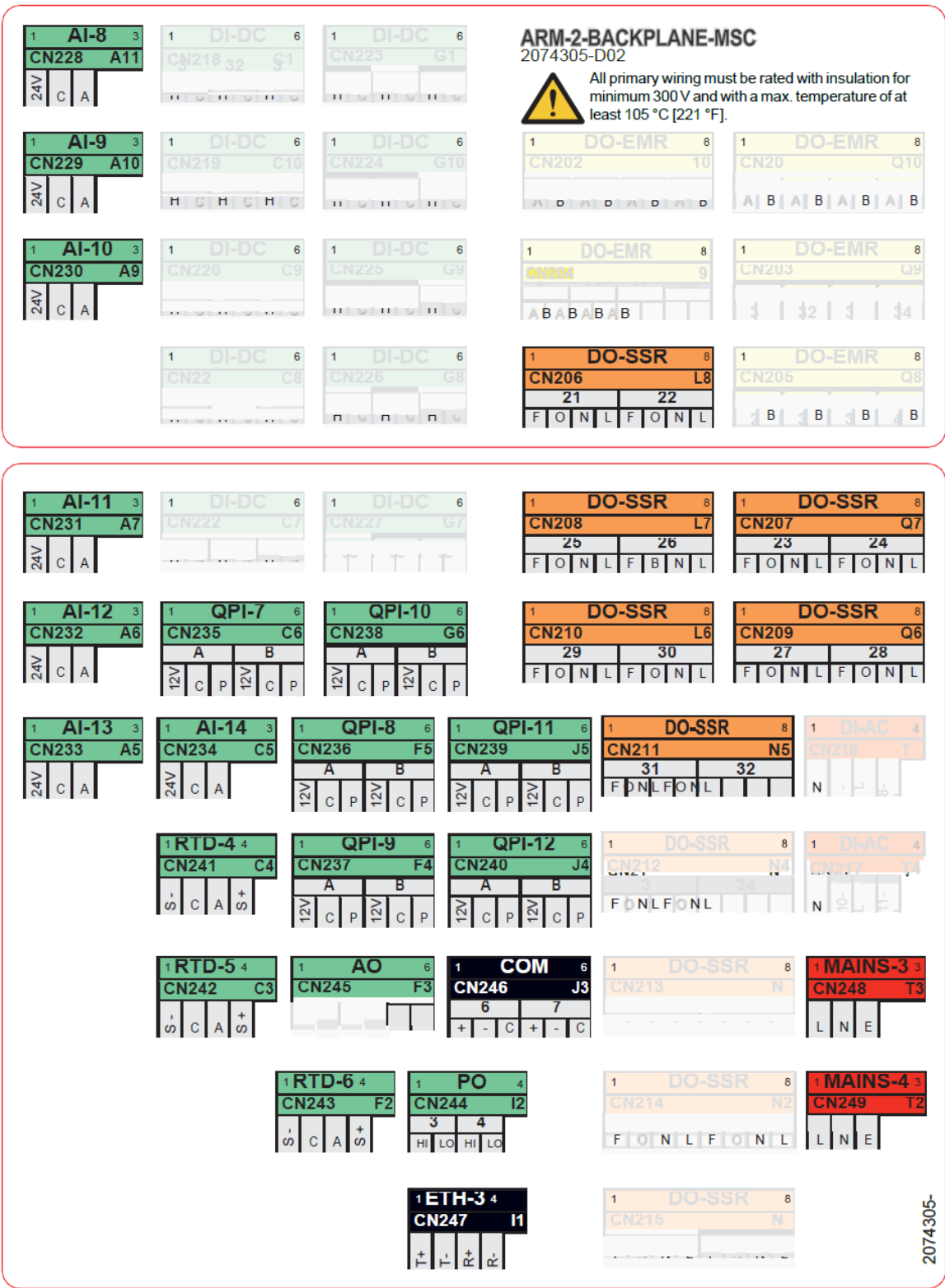
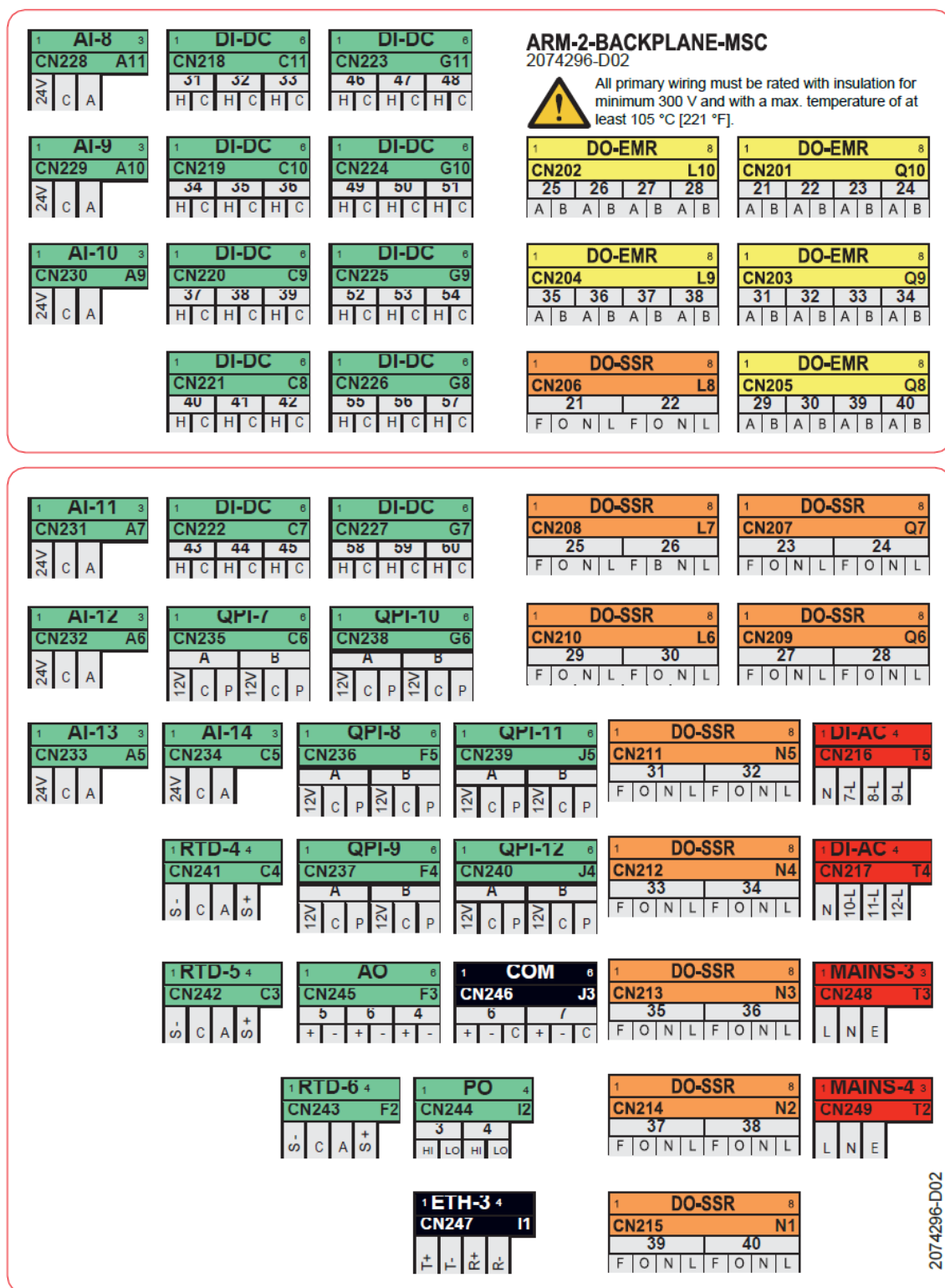


Figure 4-15: Expansion Pack 3



2074305-

Figure 4-16: Expansion pack 6





#### 4.6.2.6 Connector overview

The following table provides the connector overview of ARM-2- BACKPLANE-MSC.

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-201	8	DO-EMR-AC-DC 21	CAN-IN-OUT-MSC-3	Yellow	Q-10	DO-EMR-21
		DO-EMR-AC-DC 22	CAN-IN-OUT-MSC-3			DO-EMR-22
		DO-EMR-AC-DC 23	CAN-IN-OUT-MSC-3			DO-EMR-23
		DO-EMR-AC-DC 24	CAN-IN-OUT-MSC-3			DO-EMR-24
CN-202	8	DO-EMR-AC-DC 25	CAN-IN-OUT-MSC-3	Yellow	L-10	DO-EMR-25
		DO-EMR-AC-DC 26	CAN-IN-OUT-MSC-3			DO-EMR-26
		DO-EMR-AC-DC 27	CAN-IN-OUT-MSC-3			DO-EMR-27
		DO-EMR-AC-DC 28	CAN-IN-OUT-MSC-3			DO-EMR-28
CN-203	8	DO-EMR-AC-DC 31	CAN-IN-OUT-MSC-4	Yellow	Q-9	DO-EMR-31
		DO-EMR-AC-DC 32	CAN-IN-OUT-MSC-4			DO-EMR-32
		DO-EMR-AC-DC 33	CAN-IN-OUT-MSC-4			DO-EMR-33
		DO-EMR-AC-DC 34	CAN-IN-OUT-MSC-4			DO-EMR-34
CN-204	8	DO-EMR-AC-DC 35	CAN-IN-OUT-MSC-4	Yellow	L-9	DO-EMR-35
		DO-EMR-AC-DC 36	CAN-IN-OUT-MSC-4			DO-EMR-36
		DO-EMR-AC-DC 37	CAN-IN-OUT-MSC-4			DO-EMR-37
		DO-EMR-AC-DC 38	CAN-IN-OUT-MSC-4			DO-EMR-38
CN-205	8	DO-EMR-AC-DC 29	CAN-IN-OUT-MSC-3	Yellow	Q-8	DO-EMR-29
		DO-EMR-AC-DC 30	CAN-IN-OUT-MSC-3			DO-EMR-30
		DO-EMR-AC-DC 39	CAN-IN-OUT-MSC-4			DO-EMR-39
		DO-EMR-AC-DC 40	CAN-IN-OUT-MSC-4			DO-EMR-40
CN-206	8	DO-SSR-AC 21	CAN-ARM-MSC-2	Orange	L-8	DO-SSR-21
		DO-SSR-AC 22	CAN-ARM-MSC-2			DO-SSR-22
CN-207	8	DO-SSR-AC 23	CAN-ARM-MSC-2	Orange	Q-7	DO-SSR-23
		DO-SSR-AC 24	CAN-ARM-MSC-2			DO-SSR-24
CN-208	8	DO-SSR-AC 25	CAN-ARM-MSC-2	Orange	L-7	DO-SSR-25
		DO-SSR-AC 26	CAN-ARM-MSC-2			DO-SSR-26
CN-209	8	DO-SSR-AC 27	CAN-ARM-MSC-2	Orange	Q-6	DO-SSR-27
		DO-SSR-AC 28	CAN-ARM-MSC-2			DO-SSR-28

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-210	8	DO-SSR-AC 29	CAN-ARM-MSC-2	Orange	L-6	DO-SSR-29
		DO-SSR-AC 30	CAN-ARM-MSC-2			DO-SSR-30
CN-211	8	DO-SSR-AC 31	CAN-ARM-MSC-2	Orange	N-5	DO-SSR-31
		DO-SSR-AC 32	CAN-ARM-MSC-2			DO-SSR-32
CN-212	8	DO-SSR-AC 33	CAN-IN-OUT-MSC-3	Orange	N-4	DO-SSR-33
		DO-SSR-AC 34	CAN-IN-OUT-MSC-3			DO-SSR-34
CN-213	8	DO-SSR-AC 35	CAN-IN-OUT-MSC-3	Orange	N-3	DO-SSR-35
		DO-SSR-AC 36	CAN-IN-OUT-MSC-3			DO-SSR-36
CN-214	8	DO-SSR-AC 37	CAN-IN-OUT-MSC-4	Orange	N-2	DO-SSR-37
		DO-SSR-AC 38	CAN-IN-OUT-MSC-4			DO-SSR-38
CN-215	8	DO-SSR-AC 39	CAN-IN-OUT-MSC-4	Orange	N-1	DO-SSR-39
		DO-SSR-AC 40	CAN-IN-OUT-MSC-4			DO-SSR-40
CN-216	4	DI-AC 7	CAN-IN-OUT-MSC-3	Red	T-5	DI-AC-7
		DI-AC 8	CAN-IN-OUT-MSC-3			DI-AC-8
		DI-AC 9	CAN-IN-OUT-MSC-3			DI-AC-9
CN-217	4	DI-AC 10	CAN-IN-OUT-MSC-4	Red	T-4	DI-AC-10
		DI-AC 11	CAN-IN-OUT-MSC-4			DI-AC-11
		DI-AC 12	CAN-IN-OUT-MSC-4			DI-AC-12
CN-218	6	DI-DC 31	CAN-IN-OUT-MSC-3	Green	C-11	DI-DC-31
		DI-DC 32	CAN-IN-OUT-MSC-3			DI-DC-32
		DI-DC 33	CAN-IN-OUT-MSC-3			DI-DC-33
CN-219	6	DI-DC 34	CAN-IN-OUT-MSC-3	Green	C-10	DI-DC-34
		DI-DC 35	CAN-IN-OUT-MSC-3			DI-DC-35
		DI-DC 36	CAN-IN-OUT-MSC-3			DI-DC-36
CN-220	6	DI-DC 37	CAN-IN-OUT-MSC-3	Green	C-9	DI-DC-37
		DI-DC 38	CAN-IN-OUT-MSC-3			DI-DC-38
		DI-DC 39	CAN-IN-OUT-MSC-3			DI-DC-39
CN-221	6	DI-DC 40	CAN-IN-OUT-MSC-3	Green	C-8	DI-DC-40
		DI-DC 41	CAN-IN-OUT-MSC-3			DI-DC-41
		DI-DC 42	CAN-IN-OUT-MSC-3			DI-DC-42

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-222	6	DI-DC 43	CAN-IN-OUT-MSC-3	Green	C-7	DI-DC-43
		DI-DC 44	CAN-IN-OUT-MSC-3			DI-DC-44
		DI-DC 45	CAN-IN-OUT-MSC-3			DI-DC-45
CN-223	6	DI-DC 46	CAN-IN-OUT-MSC-4	Green	G-11	DI-DC-46
		DI-DC 47	CAN-IN-OUT-MSC-4			DI-DC-47
		DI-DC 48	CAN-IN-OUT-MSC-4			DI-DC-48
CN-224	6	DI-DC 49	CAN-IN-OUT-MSC-4	Green	G-10	DI-DC-49
		DI-DC 50	CAN-IN-OUT-MSC-4			DI-DC-50
		DI-DC 51	CAN-IN-OUT-MSC-4			DI-DC-51
CN-225	6	DI-DC 52	CAN-IN-OUT-MSC-4	Green	G-9	DI-DC-52
		DI-DC 53	CAN-IN-OUT-MSC-4			DI-DC-53
		DI-DC 54	CAN-IN-OUT-MSC-4			DI-DC-54
CN-226	6	DI-DC 55	CAN-IN-OUT-MSC-4	Green	G-8	DI-DC-55
		DI-DC 56	CAN-IN-OUT-MSC-4			DI-DC-56
		DI-DC 57	CAN-IN-OUT-MSC-4			DI-DC-57
CN-227	6	DI-DC 58	CAN-IN-OUT-MSC-4	Green	G-7	DI-DC-58
		DI-DC 59	CAN-IN-OUT-MSC-4			DI-DC-59
		DI-DC 60	CAN-IN-OUT-MSC-4			DI-DC-60
CN-228	3	AI 8	CAN-ARM-MSC-2	Green	A-11	AI-8
CN-229	3	AI 9	CAN-ARM-MSC-2	Green	A-10	AI-9
CN-230	3	AI 10	CAN-ARM-MSC-2	Green	A-9	AI-10
CN-231	3	AI 11	CAN-ARM-MSC-2	Green	A-7	AI-11
CN-232	3	AI 12	CAN-ARM-MSC-2	Green	A-6	AI-12
CN-233	3	AI 13	CAN-ARM-MSC-2	Green	A-5	AI-13
CN-234	3	AI 14	CAN-ARM-MSC-2	Green	C-5	AI-14
CN-235	6	QPI-A 7	CAN-ARM-MSC-2	Green	C-6	QPI-7A
		QPI-B 7	CAN-ARM-MSC-2			QPI-7B
CN-236	6	QPI-A 8	CAN-ARM-MSC-2	Green	F-5	QPI-8A
		QPI-B 8	CAN-ARM-MSC-2			QPI-8B
CN-237	6	QPI-A 9	CAN-ARM-MSC-2	Green	F-4	QPI-9A

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
		QPI-B 9	CAN-ARM-MSC-2			QPI-9B
CN-238	6	QPI-A 10	CAN-ARM-MSC-2	Green	G-6	QPI-10A
		QPI-B 10	CAN-ARM-MSC-2			QPI-10B
CN-239	6	QPI-A 11	CAN-ARM-MSC-2	Green	J-5	QPI-11A
		QPI-B 11	CAN-ARM-MSC-2			QPI-11B
CN-240	6	QPI-A 12	CAN-ARM-MSC-2	Green	J-4	QPI-12A
		QPI-B 12	CAN-ARM-MSC-2			QPI-12B
CN-241	4	RTD 4	CAN-ARM-MSC-2	Green	C-4	RTD-4
CN-242	4	RTD 5	CAN-ARM-MSC-2	Green	C-3	RTD-5
CN-243	4	RTD 6	CAN-ARM-MSC-2	Green	F-2	RTD-6
CN-244	4	PO 3	CAN-ARM-MSC-2	Green	I-2	PO-3
		PO 4	CAN-ARM-MSC-2			PO-4
CN-245	6	AO 4	CAN-ARM-MSC-2	Green	F-3	AO-4
		AO 5	CAN-IN-OUT-MSC-3			AO-5
		AO 6	CAN-IN-OUT-MSC-4			AO-6
CN-246	6	COMMS 6	CAN-ARM-MSC-2	Black	J-3	COM-6
		COMMS 7	CAN-ARM-MSC-2			COM-7
CN-247	4	ETHER 3	CAN-ARM-MSC-2	Black	I-1	ETH-3
CN-248	3	MAINS INPUT 3	Internal/external	Red	T-3	MAINS-3
CN-249	3	MAINS INPUT 4	Internal/external	Red	T-2	MAINS-4

ID	TYPE	FUNCTION	BOARD	NAME
CN-260	subD25	BACKPLANE-LINK 2	ARM-1-BACKPLANE-MSC	CN-260
CN-262	subD25	BACKPLANE-LINK 3	Program Interface	CN-262
CN-263	F48	PSF-BOARD 2	CAN-PSF-MSC-2	CN-263
CN-264	F48	ARM-BOARD 2-A	CAN-ARM-MSC-2	CN-264

ID	TYPE	FUNCTION	BOARD	NAME
CN-265	F48	ARM-BOARD 2-B	CAN-ARM-MSC-2	CN-265
CN-266	F48	IN-OUT-BOARD 3-A	CAN-IN-OUT-MSC-3	CN-266
CN-267	F48	IN-OUT-BOARD 3-B	CAN-IN-OUT-MSC-3	CN-267
CN-268	F48	IN-OUT-BOARD 4-A	CAN-IN-OUT-MSC-4	CN-268
CN-269	F48	IN-OUT-BOARD 4-B	CAN-IN-OUT-MSC-4	CN-269
CN-270	F48	FUSE-BOARD 2	MSC-FUSE-BOARD-2 / MSC-SHORTCUT-BOARD-2	CN-270



The following measures are taken to adequately identify connections with different functions. To avoid connector placement errors, use the following functions:

- Different number of pins.
- In case of same number of pins with different functions, a connector coding profile of insulating material is applied.
- For color codes of connectors, see the following table.

Color	Function
Red	High voltage input signals
Orange	High voltage output signals
Yellow	High voltage or Low voltage output signals
Green	Low voltage signals
Black	Communication signals
Blue	Ex i signals

## 4.6.3 General

**CAUTION:** IMPORTANT! All terminated cables should be left with sufficient excess length to allow each PCB to be fully withdrawn from the enclosure when the connectors are still in place. This is performed to allow connectors to be affixed to each board outside the enclosure, before locating them inside, and to allow each board to be fully withdrawn from the enclosure before the connectors are removed. This negates the requirement to attach and remove connectors inside the enclosure and facilitates best practice for efficient assembly and disassembly of the electronics stack.

### 4.6.3.1 Wire Sizes and Types

As there are no strictly prescribed wire sizes, the following guidelines are recommended.

- All I/O terminals accept wires with a cross section, an area of 0.2 to 2.5 mm<sup>2</sup> [AWG 24 to 14].
- For mains/high voltage wiring, 1.5 mm<sup>2</sup> [AWG 16].
- For low voltage wiring (DI, PO, AI, AO, RTD, and so on), 0.75 mm<sup>2</sup> [AWG 18] or 0.5 mm<sup>2</sup> [AWG 20].
- The temperature rating of the field wiring must be at least 20 °C [36 °F] above the maximum operating temperature. Therefore, a rating of 85 °C [185 °F] is suitable for the entire temperature range.

All primary wiring needs to be provided with insulation rated for minimum 300 V, with a rated temperature of at least 105 °C [221 °F] and with a conductor size of at least 0.75 mm<sup>2</sup> [AWG 18].

### 4.6.4 Recommended Cables

Cable type	Number of wires	Function
XLPE/SWA/PVC 4C X 1.5MM 600/1000 V BS5467	3	230 V <sub>AC</sub> Mains Supply Input

Cable type	Number of wires	Function
XLPE/SWA/PVC 4C X 1.5MM 600/1000 V BS5467	2	230 V <sub>AC</sub> Alarm Output
XLPE/SWA/PVC 4C X 1.5MM 600/1000 V BS5467	4	230 V <sub>AC</sub> Permissive Input
3C X 0.75 MM <sup>2</sup> YYNR PVC	4	230 V <sub>AC</sub> Digital Controlled Valve Output
3C X 0.75 MM <sup>2</sup> YYNR PVC	4	230 V <sub>AC</sub> VAC Solenoid Supply Output
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	12 V <sub>DC</sub> Switched Output
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	12 V <sub>DC</sub> Switched Input
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	Analog Output (maximum 24 V, 3.2-24 mA)
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	4	Analog Input (maximum 24 V, 3.2-24 mA)
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	Analog Output (maximum 24 V, 3.2- 24 mA)
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	Pulse Output (maximum 12 V, 10 KHz)
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	3	Pulse Input (maximum 12 V, 10 KHz)
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	4	Analog input RTD (maximum 24 V, 1.5 mA)
BELDEN 9842 2PAIR 24AWG LSNH/SWA, ni 120 Ω	4	RS-485 Serial Communication Interface
BELDEN 9842 2PAIR 24AWG LSNH/SWA, ni 120 Ω	4	RS-485 Serial Communication Interface
CAT5E-SWA-FTP-LSZH 24 AWG 4PAIR	4	10/100 Ethernet Communication Interface
CAT5E-SWA-FTP-LSZH 24 AWG 4PAIR	4	10/100 Ethernet Communication Interface

## 4.6.5 Wire Crimps



There are no strictly prescribed wire crimps.

However, it is advised to fit crimps (bootlace ferrules) to multi-strand cable wires.



**NOTE:** Wire crimps are to reinforce the fine wire strands when terminating a cable into a connector block.

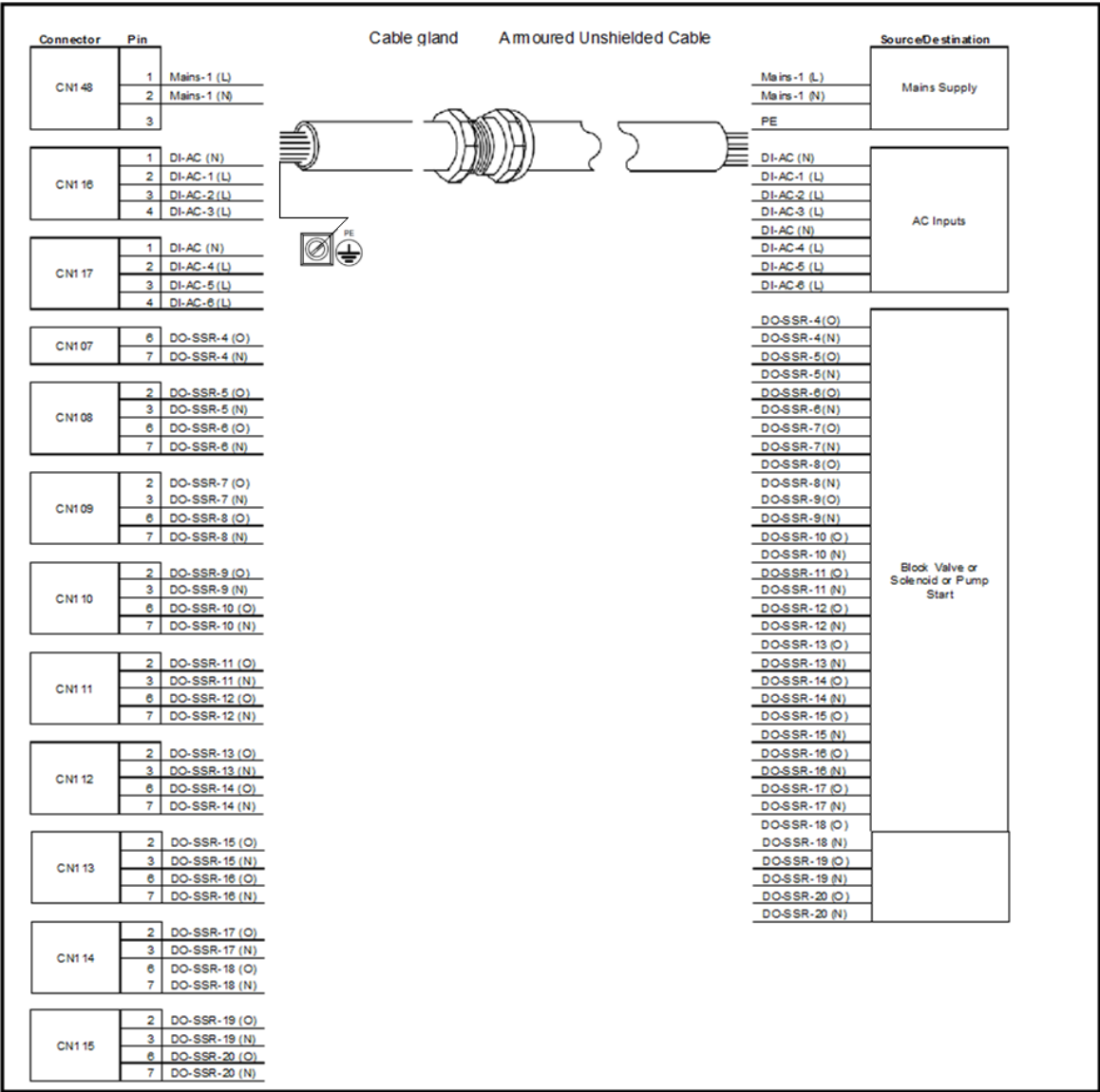
Wire crimps are not required to be fitted for solid-core cable wires.



# 4.6.6 Internal Wiring diagram

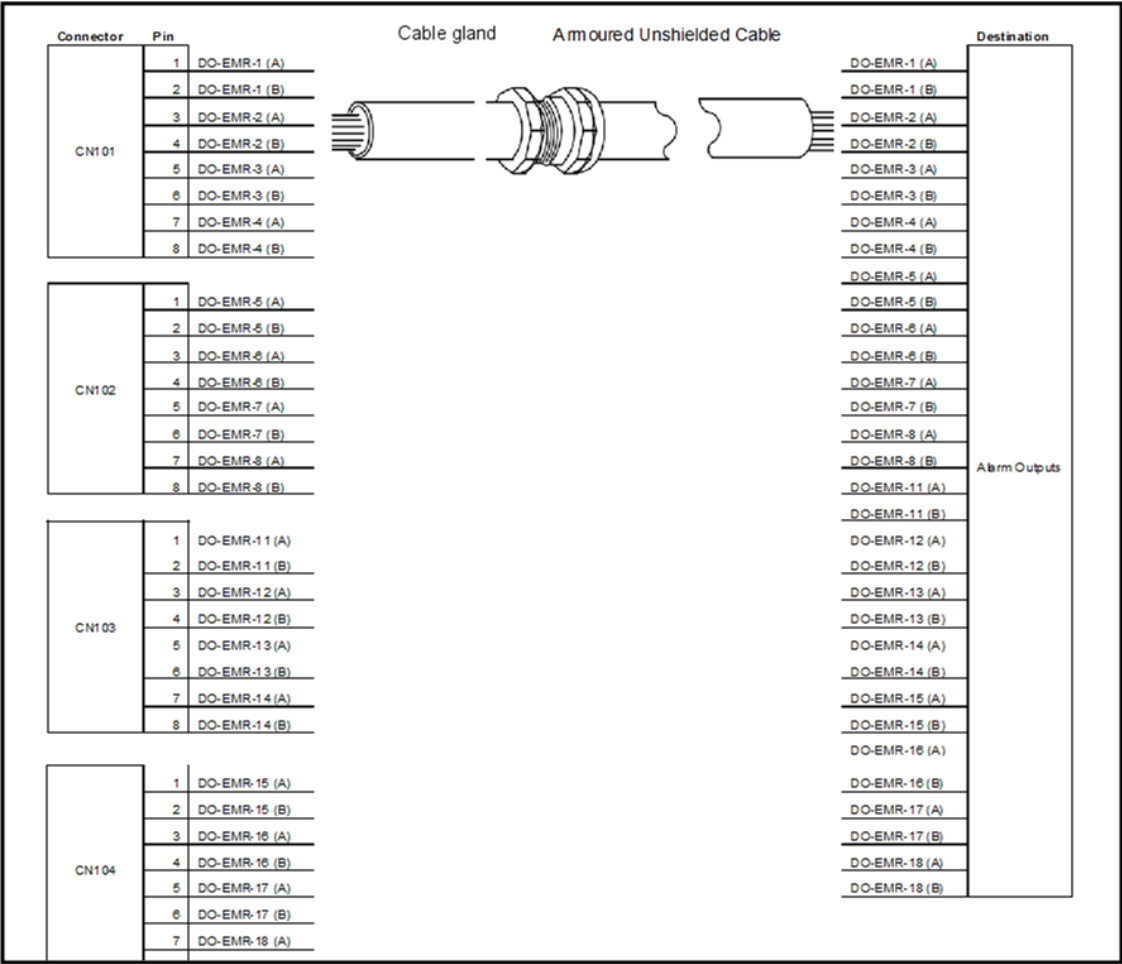
## 4.6.6.1 AC Cable 1 (Gland 1)

Figure 4-17: AC cable 1 (gland 1)



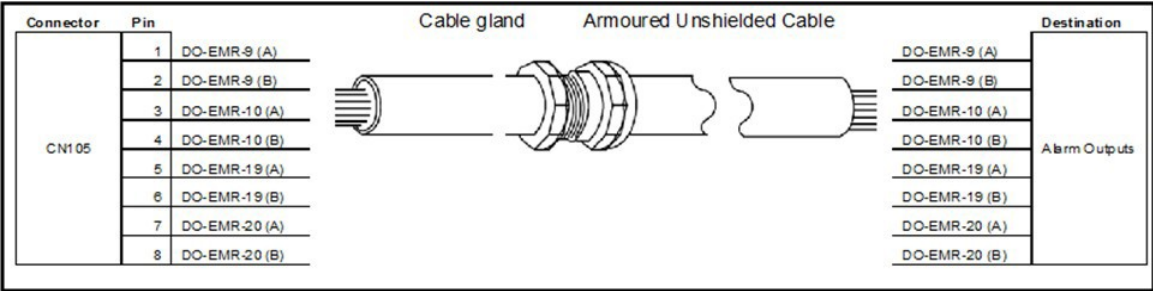
4.6.6.2 AC Cable 2 (Gland 2)

Figure 4-18: AC cable 2 (gland 2)



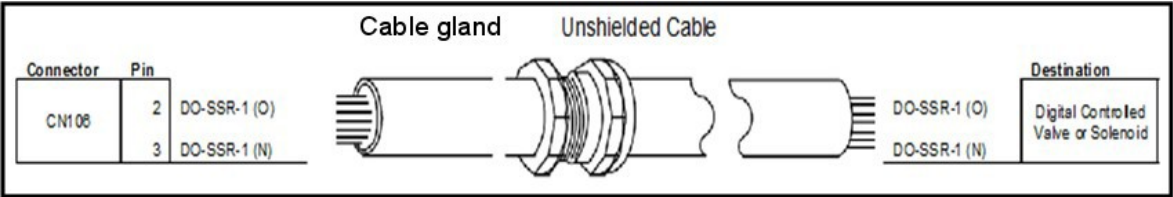
4.6.6.3 DC cable 1 (Gland 3)

Figure 4-19: DC cable 1 (gland 3)



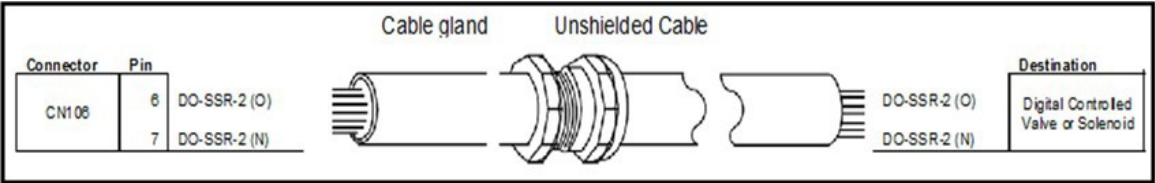
4.6.6.4 AC Cable 3 (Gland 4)

Figure 4-20: AC cable 3 (gland 4)



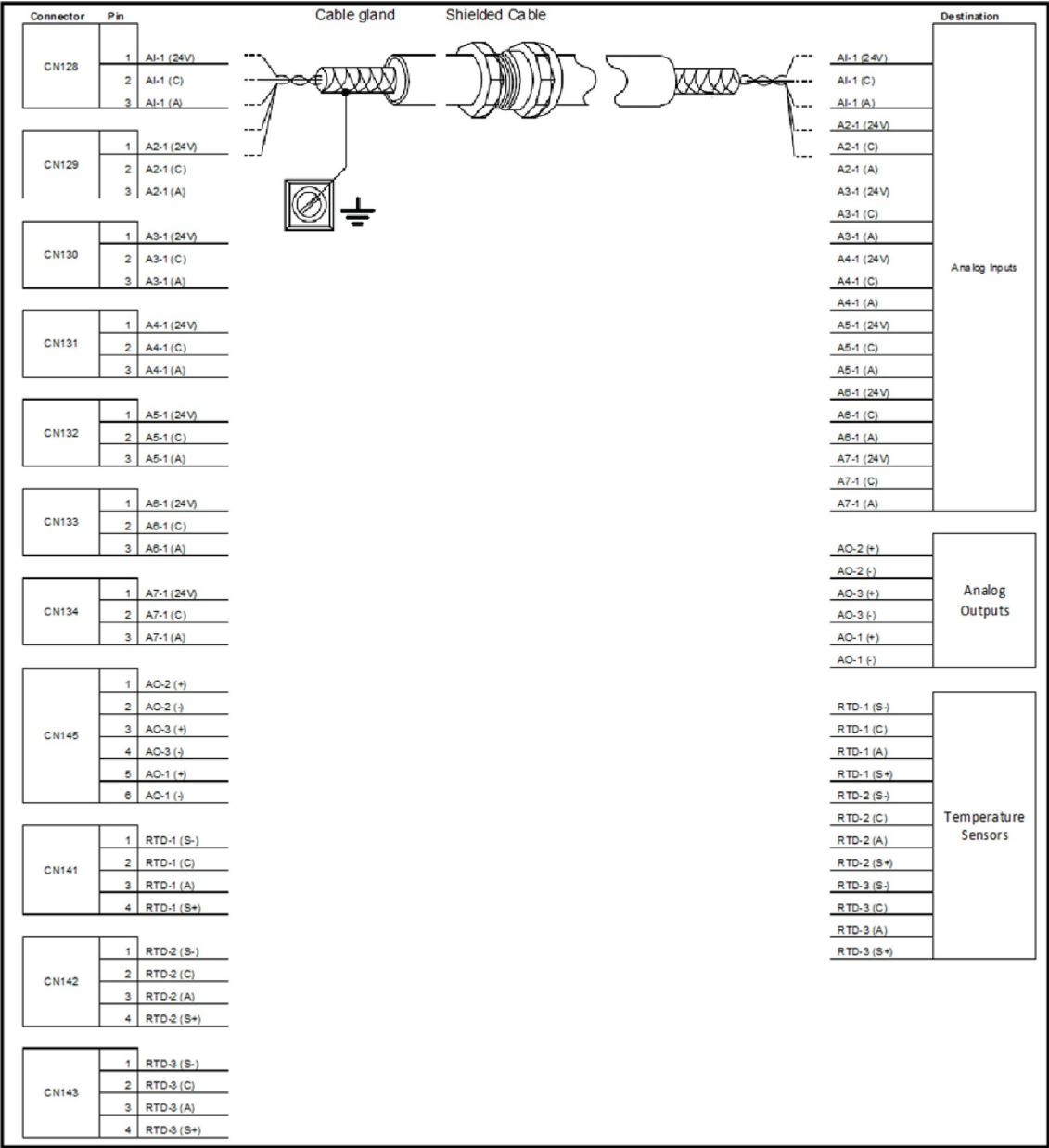
4.6.6.5 AC Cable 4 (Gland 5)

Figure 4-21: AC cable 4 (gland 5)



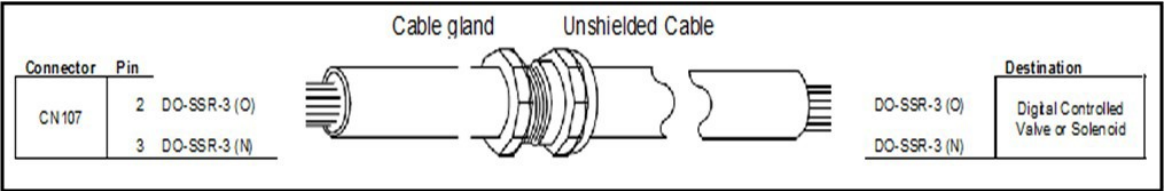
4.6.6.6 Analog Cable 1 (Gland 6)

Figure 4-22: Analog cable 1 (gland 6)



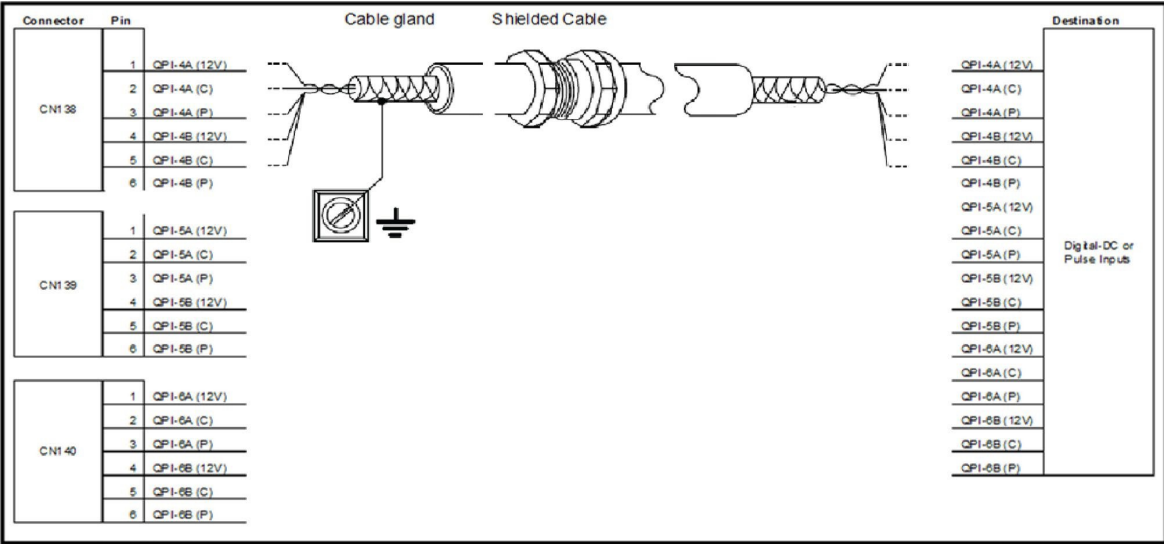
4.6.6.7 AC Cable 5 (Gland 7)

Figure 4-23: AC cable 5 (gland 7)



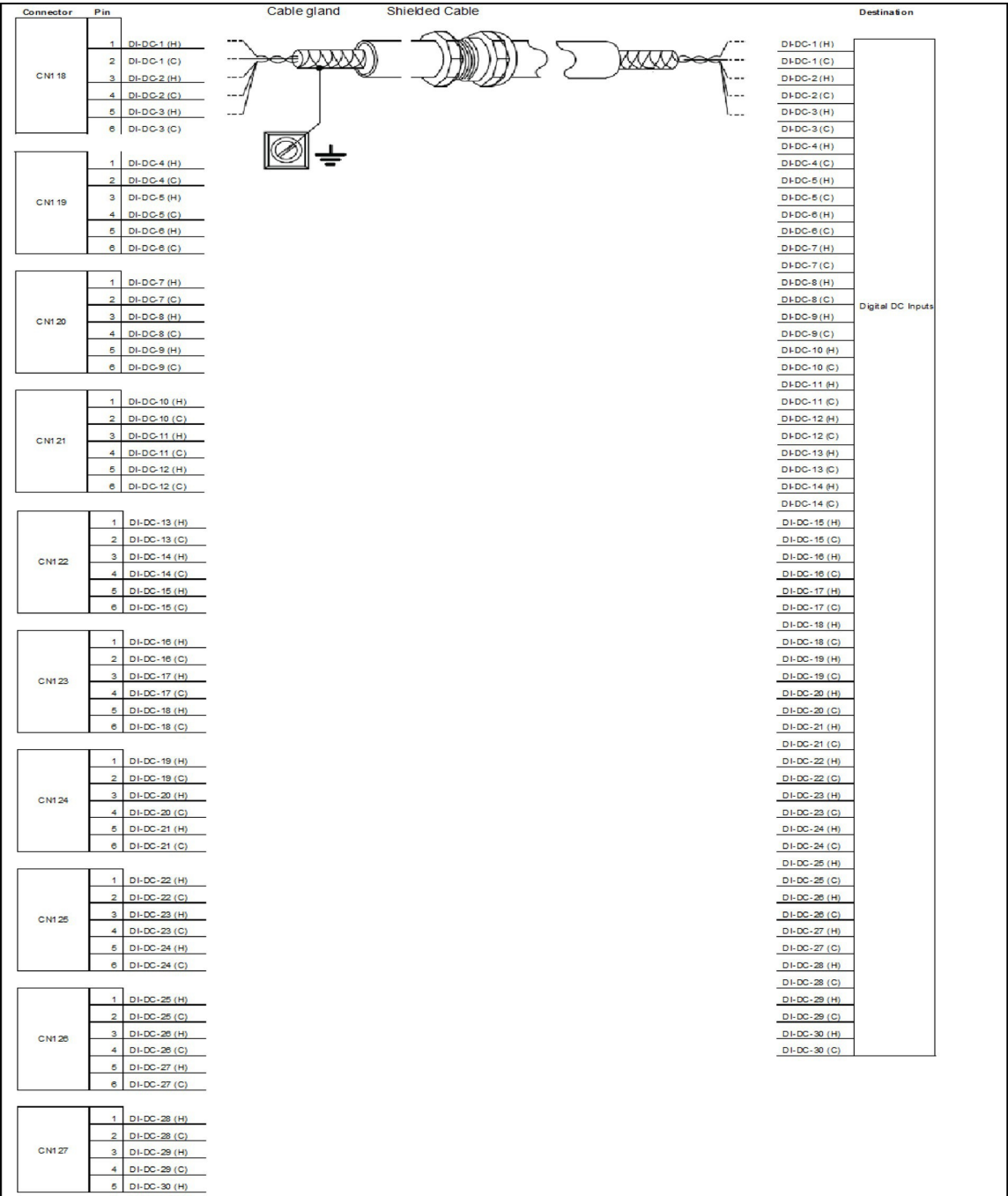
4.6.6.8 DC Cable 2 (Gland 8)

Figure 4-24: DC cable 2 (gland 8)



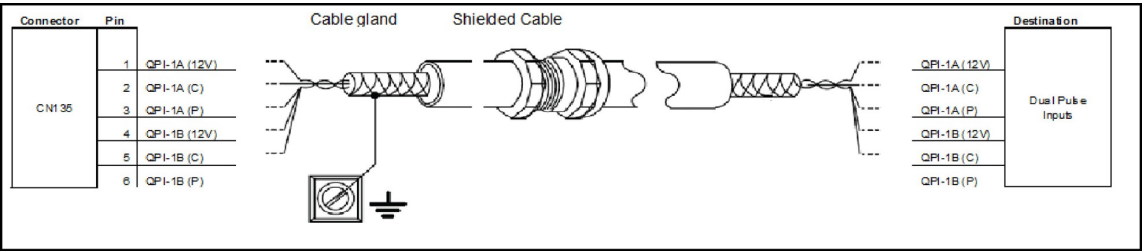
4.6.6.9 DC Cable 3 (Gland 9)

Figure 4-25: DC cable 3 (gland 9)



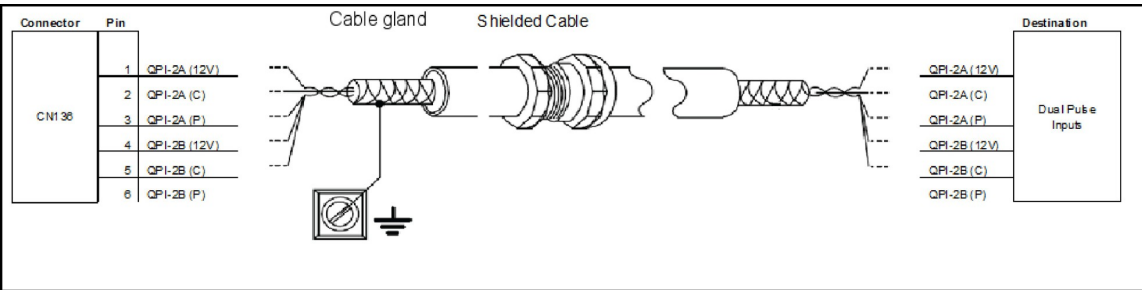
4.6.6.10 DC Cable 4 (Gland 10)

Figure 4-26: DC cable 4 (gland 10)



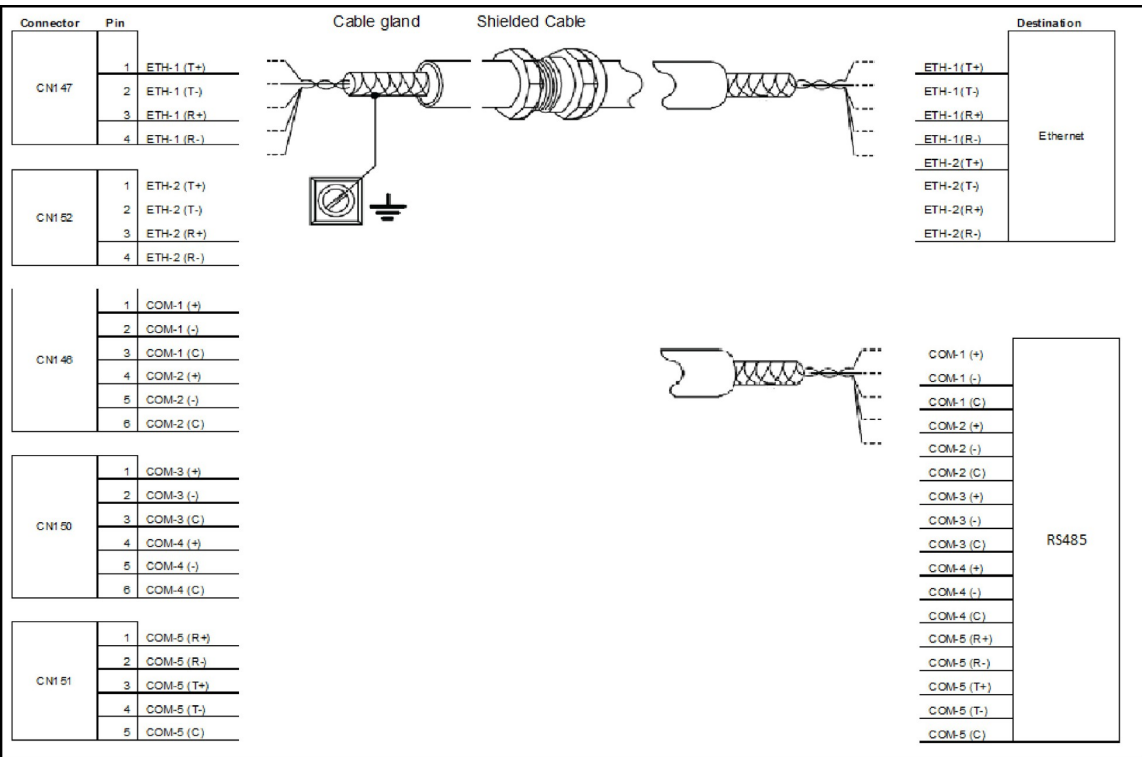
4.6.6.11 DC Cable 5 (Gland 11)

Figure 4-27: DC cable 5 (gland 11)



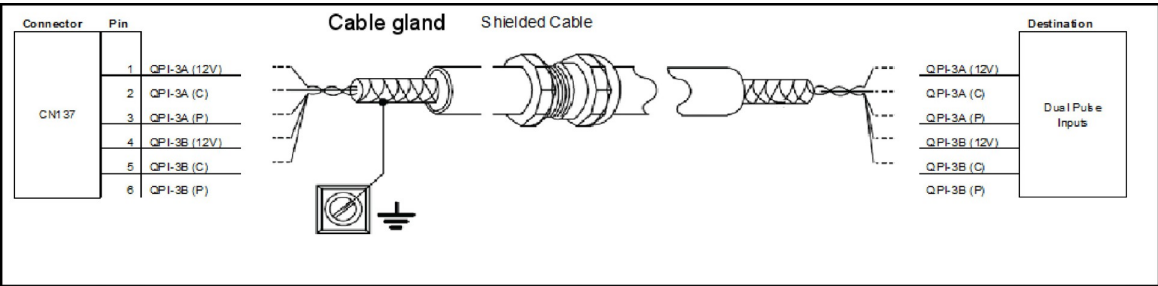
4.6.6.12 Comms Cable 1 (Gland 12)

Figure 4-28: Comms cable 1 (gland 12)



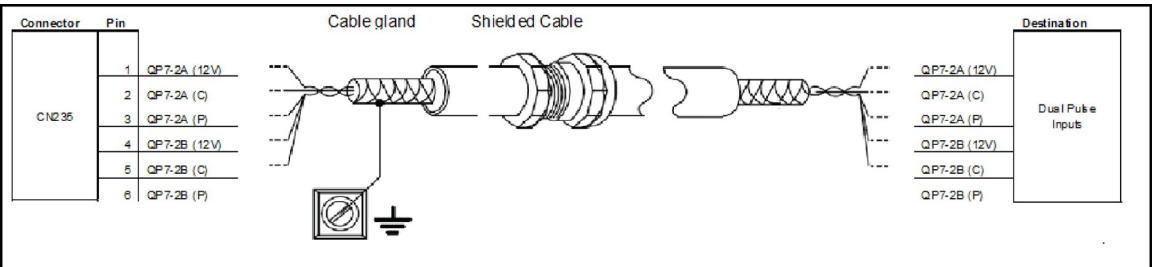
4.6.6.13 DC Cable 6 (Gland 13)

Figure 4-29: DC cable 6 (gland 13)



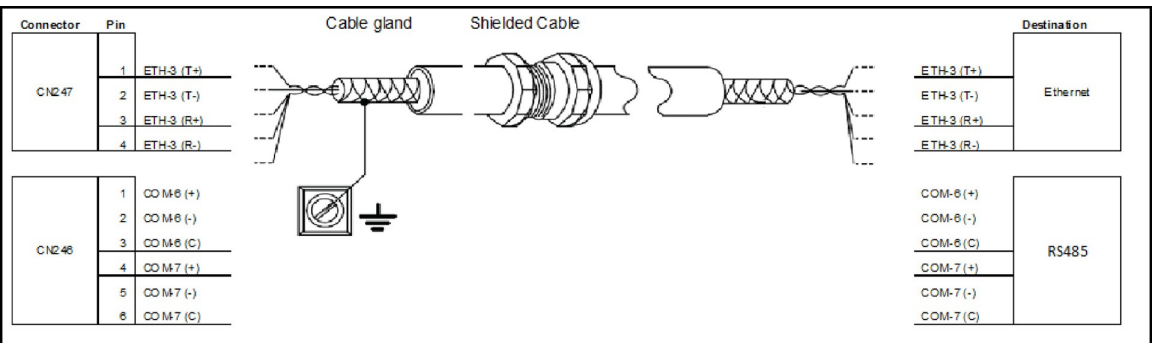
4.6.6.14 DC Cable 7 (Gland 14)

Figure 4-30: DC cable 7 (gland 14)



4.6.6.15 Comms Cable 2 (Gland 15)

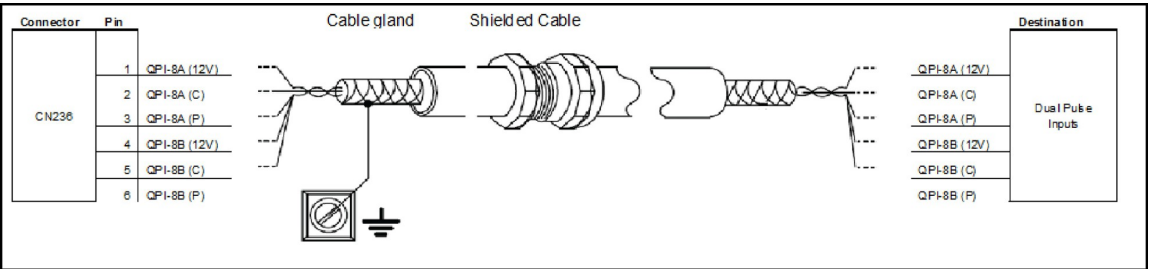
Figure 4-31: Comms cable 2 (gland 15)





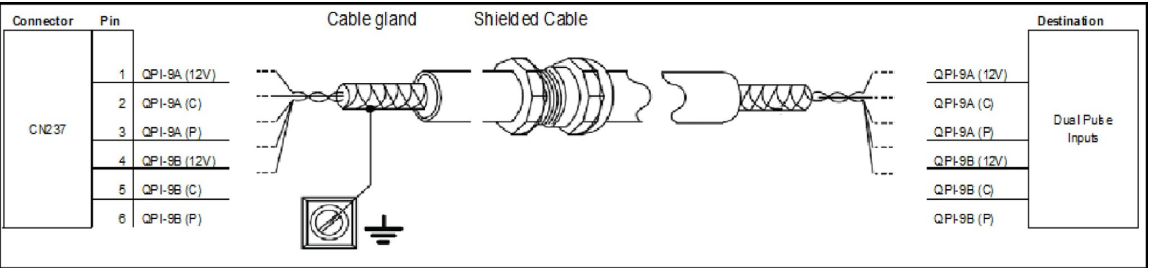
4.6.6.16 DC Cable 8 (Gland 16)

Figure 4-32: DC cable 8 (gland 16)



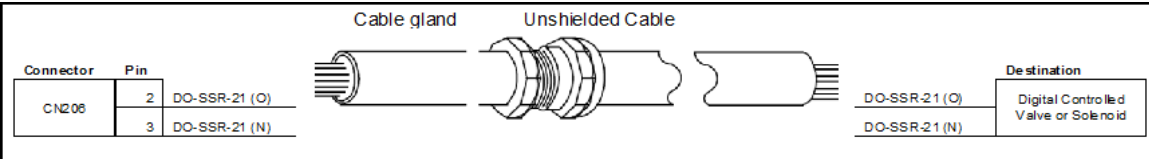
4.6.6.17 DC Cable 9 (Gland 17)

Figure 4-33: DC cable 9 (gland 17)



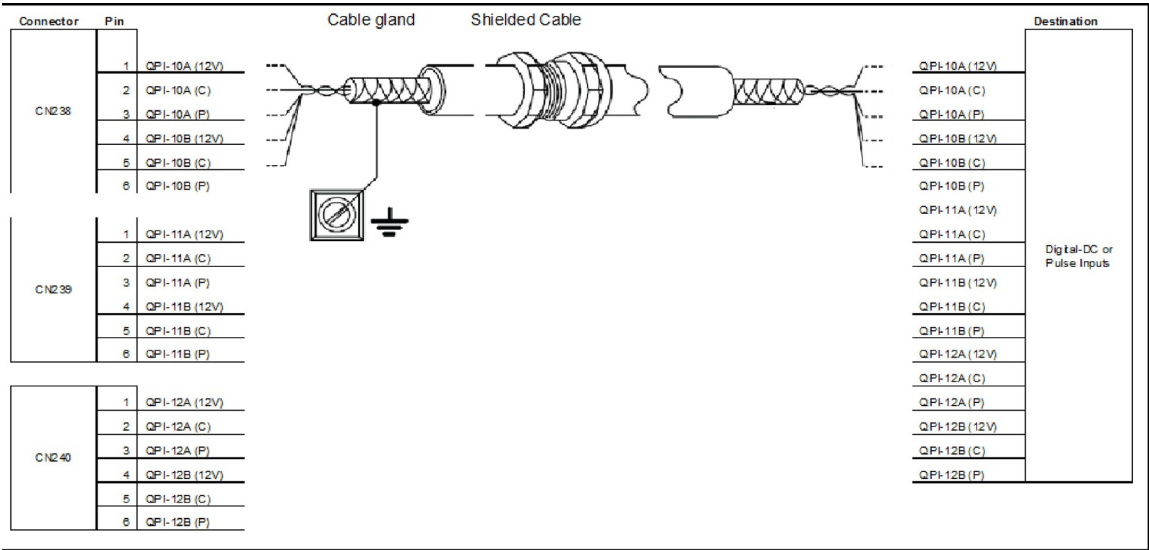
4.6.6.18 AC Cable 6 (Gland 18)

Figure 4-34: AC cable 6 (Gland 18)



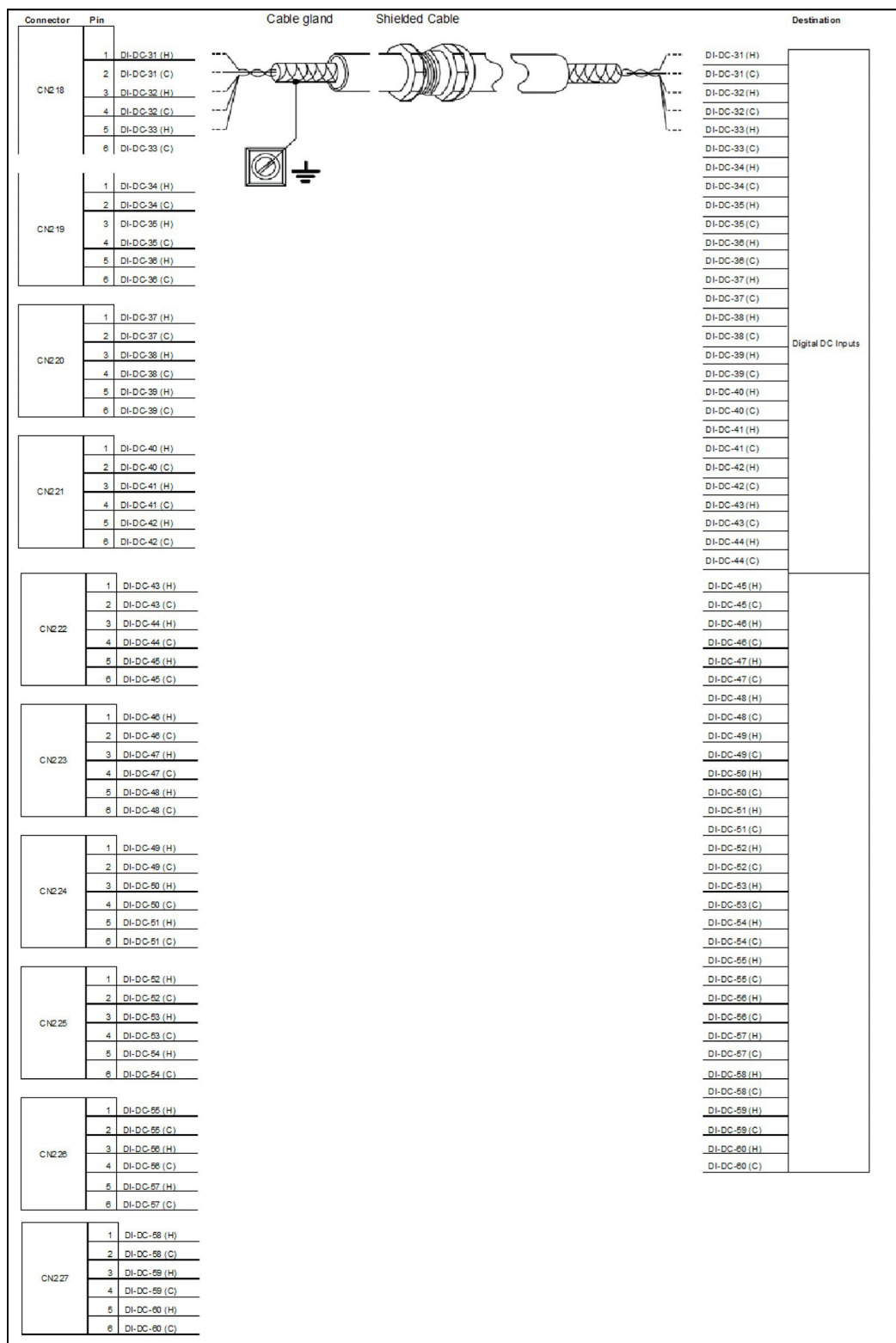
4.6.6.19 DC Cable 10 (Gland 19)

Figure 4-35: DC cable 10 (gland 19)



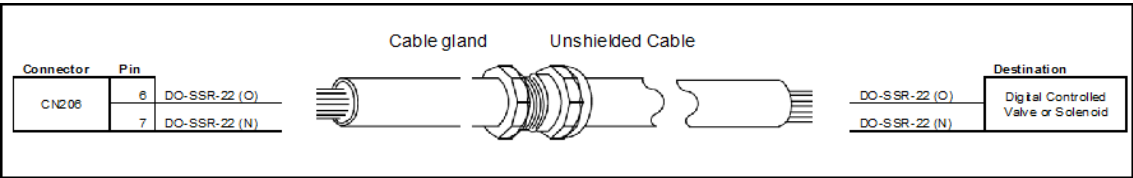
## 4.6.6.20 DC Cable 11 (Gland 20)

Figure 4-36: DC cable 11 (gland 20)



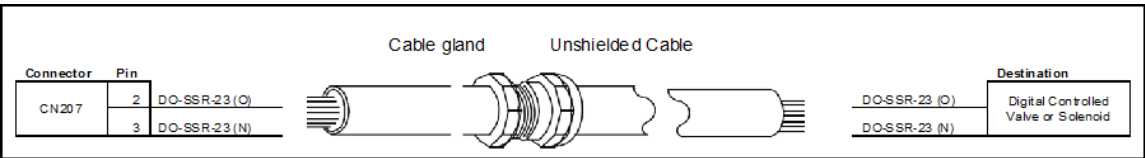
4.6.6.21 AC Cable 7 (Gland 21)

Figure 4-37: AC cable 7 (gland 21)



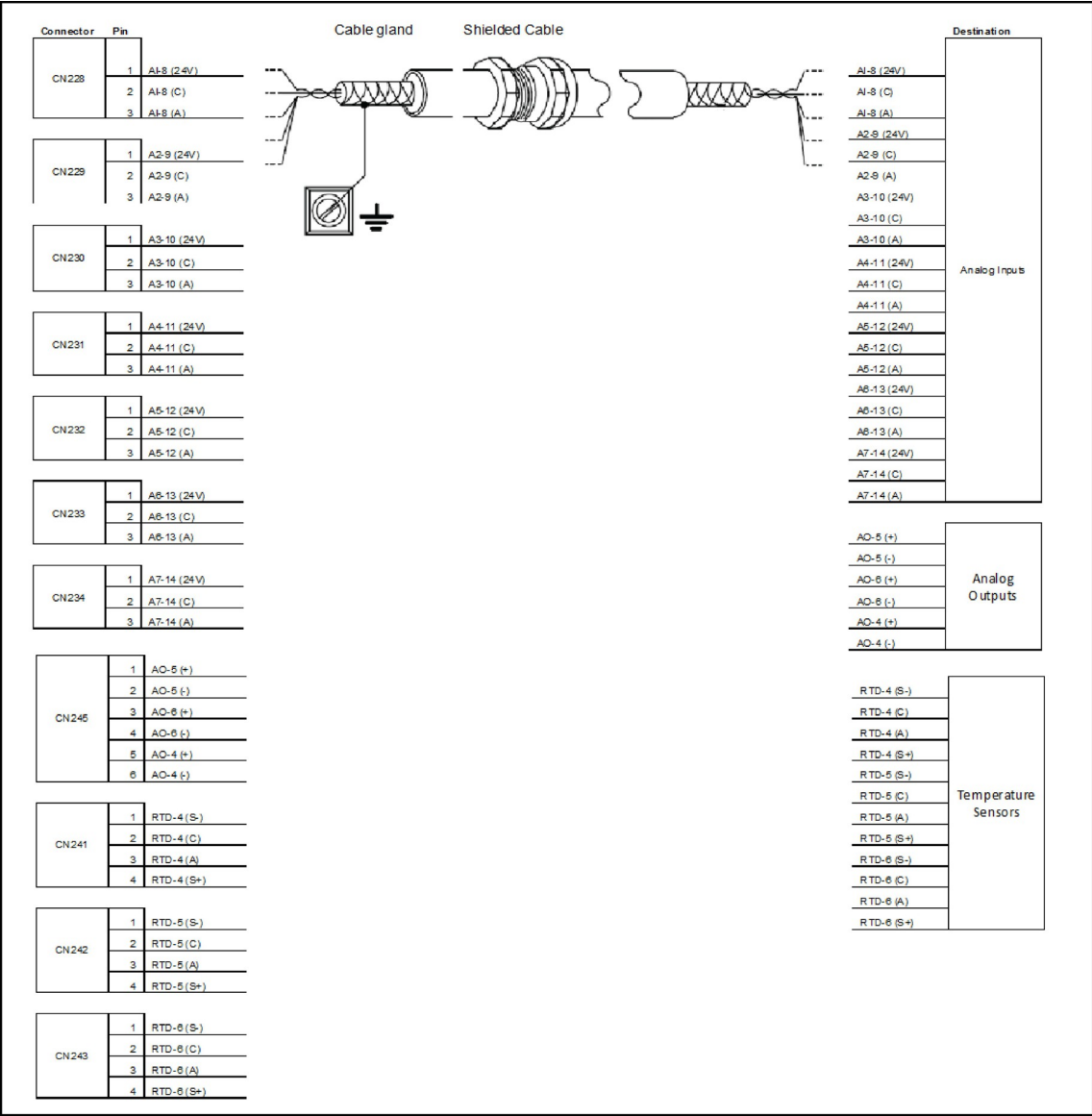
4.6.6.22 AC Cable 8 (Gland 22)

Figure 4-38: AC cable 8 (gland 22)



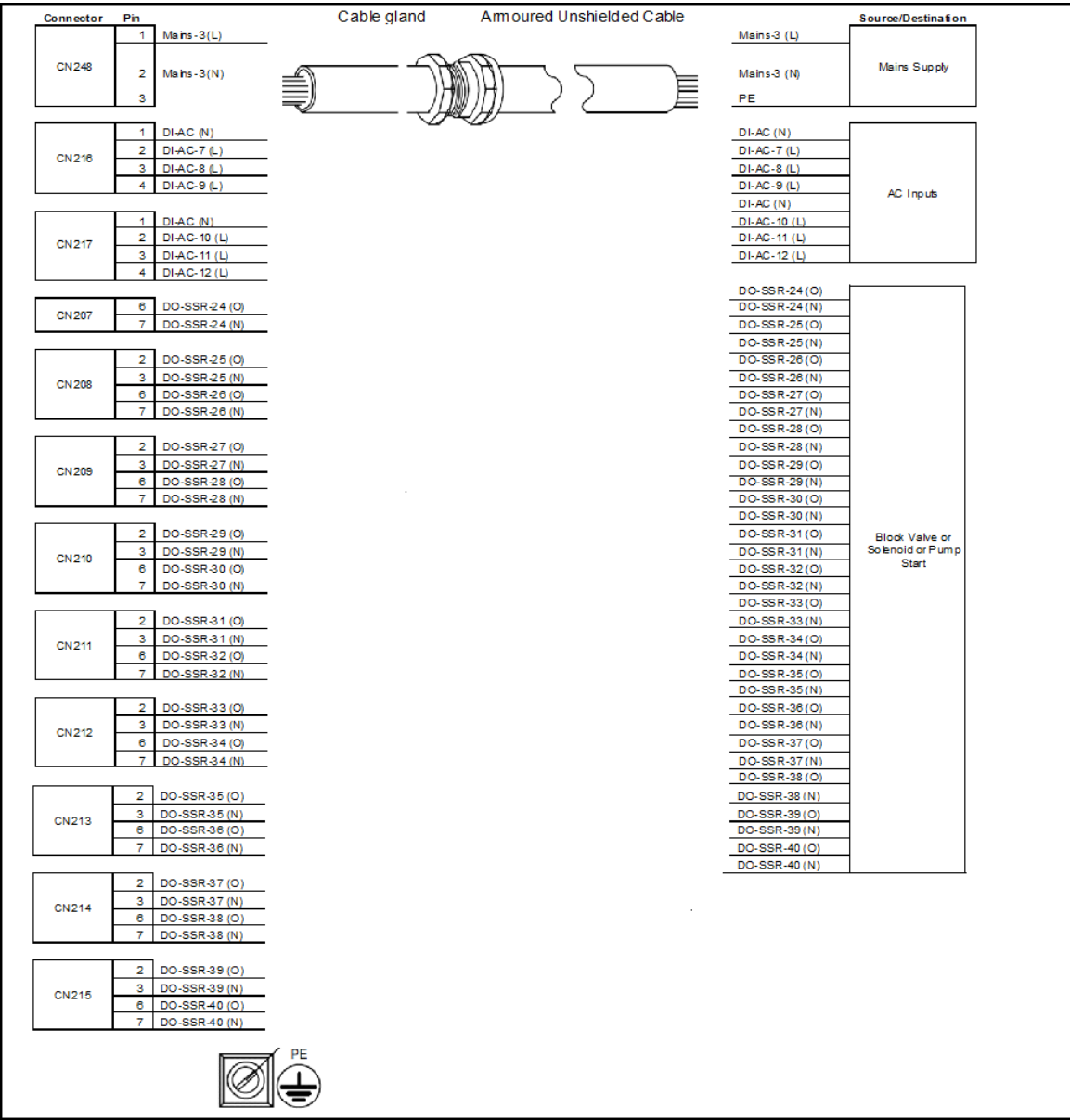
### 4.6.6.23 Analog Cable 2 (Gland 23)

Figure 4-39: Analog cable 2 (gland 23)



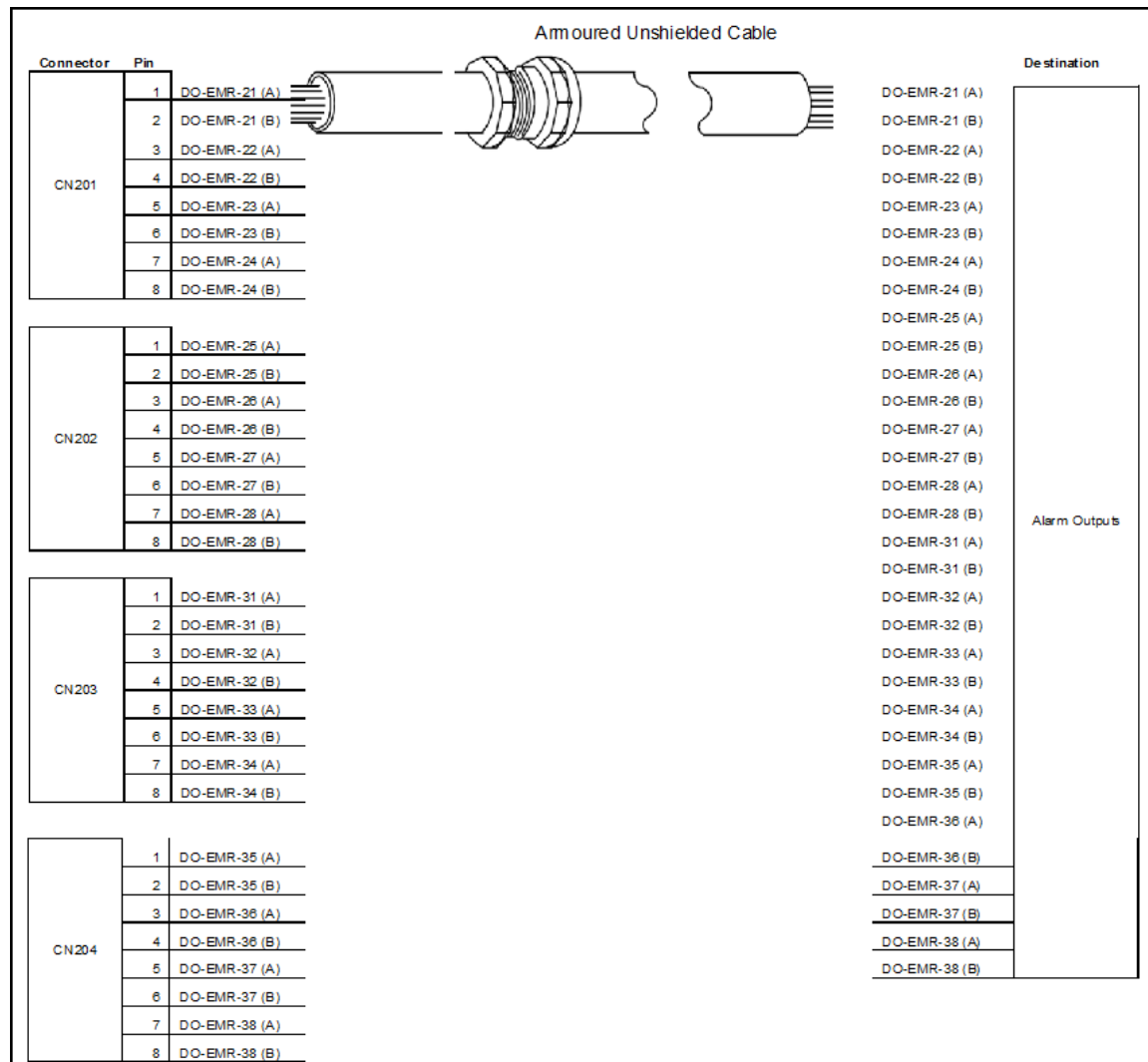
4.6.6.24 AC Cable 9 (Gland 24)

Figure 4-40: AC cable 9 (gland 24)



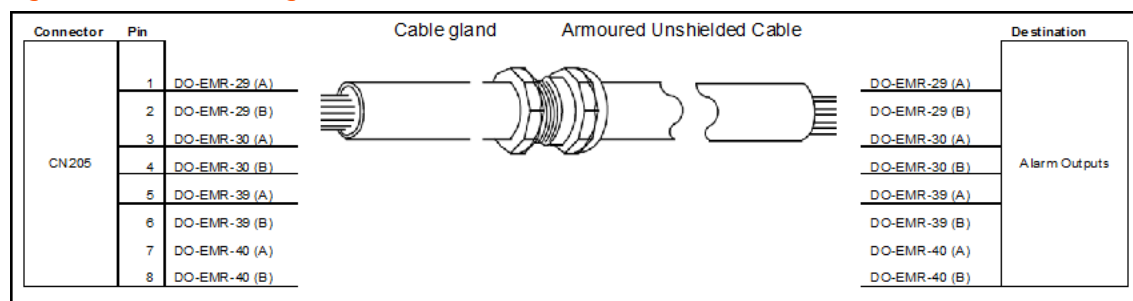
### 4.6.6.25 AC Cable 10 (Gland 25)

Figure 4-41: AC cable 10 (gland 25)



### 4.6.6.26 DC Cable 12 (Gland 26)

Figure 4-42: DC cable 12 (gland 26)



## 4.6.7 ARM-1-BACKPLANE-MSC Terminal Assignment Guide

The following table provides information for the basic function assignment to specific terminals. The majority of the MSC-A functions can be assigned to multiple I/O.

To complete the installation, bind each function to its I/O within the Configuration menu.

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-101						
1	DO-EMR-1	A	EMR1_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-1	B	EMR_common	Neutral		
3	DO-EMR-2	A	EMR2_no	Signal - Output		
4	DO-EMR-2	B	EMR_common	Neutral		
5	DO-EMR-3	A	EMR3_no	Signal - Output		
6	DO-EMR-3	B	EMR_common	Neutral		
7	DO-EMR-4	A	EMR4_no	Signal - Output		
8	DO-EMR-4	B	EMR_common	Neutral		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-102						
1	DO-EMR-5	A	EMR5_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-5	B	EMR_common	Neutral		
3	DO-EMR-6	A	EMR6_no	Signal - Output		
4	DO-EMR-6	B	EMR_common	Neutral		
5	DO-EMR-7	A	EMR7_no	Signal - Output		
6	DO-EMR-7	B	EMR_common	Neutral		
7	DO-EMR-8	A	EMR8_no	Signal - Output		
8	DO-EMR-8	B	EMR_common	Neutral		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-103						
1	DO-EMR-11	A	EMR11_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-11	B	EMR_common	Neutral		
3	DO-EMR-12	A	EMR12_no	Signal - Output		
4	DO-EMR-12	B	EMR_common	Neutral		
5	DO-EMR-13	A	EMR13_no	Signal - Output		
6	DO-EMR-13	B	EMR_common	Neutral		
7	DO-EMR-14	A	EMR14_no	Signal - Output		
8	DO-EMR-14	B	EMR_common	Neutral		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-104						
1	DO-EMR-15	A	EMR15_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-15	B	EMR_common	Neutral		
3	DO-EMR-16	A	EMR16_no	Signal - Output		
4	DO-EMR-16	B	EMR_common	Neutral		
5	DO-EMR-17	A	EMR17_no	Signal - Output		
6	DO-EMR-17	B	EMR_common	Neutral		
7	DO-EMR-18	A	EMR18_no	Signal - Output		
8	DO-EMR-18	B	EMR_common	Neutral		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-105						
1	DO-EMR-9	A	EMR9_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-9	B	EMR_common	Neutral		
3	DO-EMR-10	A	EMR10_no	Signal - Output		
4	DO-EMR-10	B	EMR_common	Neutral		
5	DO-EMR-19	A	EMR19_no	Signal - Output		
6	DO-EMR-19	B	EMR_common	Neutral		
7	DO-EMR-20	A	EMR20_no	Signal - Output		
8	DO-EMR-20	B	EMR_common	Neutral		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-106						
1	DO-SSR-1	F	SSr1_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-1	O	SSr1_sw_ac	Signal - Output		
3	DO-SSR-1	N	N	Neutral		
4	DO-SSR-1	L	L	Live		
5	DO-SSR-2	F	SSr2_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-2	O	SSr2_sw_ac	Signal - Output		
7	DO-SSR-2	N	N	Neutral		
8	DO-SSR-2	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-107						
1	DO-SSR-3	F	SSr3_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-3	O	SSr3_sw_ac	Signal - Output		
3	DO-SSR-3	N	N	Neutral		
4	DO-SSR-3	L	L	Live		
5	DO-SSR-4	F	SSr4_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-4	O	SSr4_sw_ac	Signal - Output		
7	DO-SSR-4	N	N	Neutral		
8	DO-SSR-4	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-108						
1	DO-SSR-5	F	SSr5_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-5	O	SSr5_sw_ac	Signal - Output		
3	DO-SSR-5	N	N	Neutral		
4	DO-SSR-5	L	L	Live		
5	DO-SSR-6	F	SSr6_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-6	O	SSr6_sw_ac	Signal - Output		
7	DO-SSR-6	N	N	Neutral		
8	DO-SSR-6	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-109						
1	DO-SSR-7	F	SSr7_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-7	O	SSr7_sw_ac	Signal - Output		
3	DO-SSR-7	N	N	Neutral		
4	DO-SSR-7	L	L	Live		
5	DO-SSR-8	F	SSr8_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-8	O	SSr8_sw_ac	Signal - Output		
7	DO-SSR-8	N	N	Neutral		
8	DO-SSR-8	L	L	Live		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-110						
1	DO-SSR-9	F	SSr9_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-9	O	SSr9_sw_ac	Signal - Output		
3	DO-SSR-9	N	N	Neutral		
4	DO-SSR-9	L	L	Live		
5	DO-SSR-10	F	SSr10_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-10	O	SSr10_sw_ac	Signal - Output		
7	DO-SSR-10	N	N	Neutral		
8	DO-SSR-10	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-111						
1	DO-SSR-11	F	SSr11_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-11	O	SSr11_sw_ac	Signal - Output		
3	DO-SSR-11	N	N	Neutral		
4	DO-SSR-11	L	L	Live		
5	DO-SSR-12	F	SSr12_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-12	O	SSr12_sw_ac	Signal - Output		
7	DO-SSR-12	N	N	Neutral		
8	DO-SSR-12	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-112						
1	DO-SSR-13	F	SSr13_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-13	O	SSr13_sw_ac	Signal - Output		
3	DO-SSR-13	N	N	Neutral		
4	DO-SSR-13	L	L	Live		
5	DO-SSR-14	F	SSr14_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-14	O	SSr14_sw_ac	Signal - Output		
7	DO-SSR-14	N	N	Neutral		
8	DO-SSR-14	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-113						
1	DO-SSR-15	F	SSr15_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-15	O	SSr15_sw_ac	Signal - Output		
3	DO-SSR-15	N	N	Neutral		
4	DO-SSR-15	L	L	Live		
5	DO-SSR-16	F	SSr16_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-16	O	SSr16_sw_ac	Signal - Output		
7	DO-SSR-16	N	N	Neutral		
8	DO-SSR-16	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-114						
1	DO-SSR-17	F	SSr17_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-17	O	SSr17_sw_ac	Signal - Output		
3	DO-SSR-17	N	N	Neutral		
4	DO-SSR-17	L	L	Live		
5	DO-SSR-18	F	SSr18_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-18	O	SSr18_sw_ac	Signal - Output		
7	DO-SSR-18	N	N	Neutral		
8	DO-SSR-18	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-115						
1	DO-SSR-19	F	SSr19_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-19	O	SSr19_sw_ac	Signal - Output		
3	DO-SSR-19	N	N	Neutral		
4	DO-SSR-19	L	L	Live		
5	DO-SSR-20	F	SSr20_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-20	O	SSr20_sw_ac	Signal - Output		
7	DO-SSR-20	N	N	Neutral		
8	DO-SSR-20	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-116						
1	DI-AC-1, 2, 3	N	AC_NEUTRAL	Neutral	AC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-AC-1	1-L	AC1_L	Live		
3	DI-AC-2	2-L	AC2_L	Live		
4	DI-AC-3	3-L	AC3_L	Live		
CN-117						
1	DI-AC-4, 5, 6	N	AC_NEUTRAL	Neutral	AC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-AC-4	4-L	AC4_L	Live		
3	DI-AC-5	5-L	AC5_L	Live		
4	DI-AC-6	6-L	AC6_L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
<b>CN-118</b>						
1	DI-DC-1	H	DC1_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-1	C	COMMON	Common		
3	DI-DC-2	H	DC2_hi	Signal - Input		
4	DI-DC-2	C	COMMON	Common		
5	DI-DC-3	H	DC3_hi	Signal - Input		
6	DI-DC-3	C	COMMON	Common		
<b>CN-119</b>						
1	DI-DC-4	H	DC4_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-4	C	COMMON	Common		
3	DI-DC-5	H	DC5_hi	Signal - Input		
4	DI-DC-5	C	COMMON	Common		
5	DI-DC-6	H	DC6_hi	Signal - Input		
6	DI-DC-6	C	COMMON	Common		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
<b>CN-120</b>						
1	DI-DC-7	H	DC7_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-7	C	COMMON	Common		
3	DI-DC-8	H	DC8_hi	Signal - Input		
4	DI-DC-8	C	COMMON	Common		
5	DI-DC-9	H	DC9_hi	Signal - Input		
6	DI-DC-9	C	COMMON	Common		
<b>CN-121</b>						
1	DI-DC-10	H	DC10_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-10	C	COMMON	Common		
3	DI-DC-11	H	DC11_hi	Signal - Input		
4	DI-DC-11	C	COMMON	Common		
5	DI-DC-12	H	DC12_hi	Signal - Input		
6	DI-DC-12	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
<b>CN-122</b>						
1	DI-DC-13	H	DC13_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-13	C	COMMON	Common		
3	DI-DC-14	H	DC14_hi	Signal - Input		
4	DI-DC-14	C	COMMON	Common		
5	DI-DC-15	H	DC15_hi	Signal - Input		
6	DI-DC-15	C	COMMON	Common		
<b>CN-123</b>						
1	DI-DC-16	H	DC16_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-16	C	COMMON	Common		
3	DI-DC-17	H	DC17_hi	Signal - Input		
4	DI-DC-17	C	COMMON	Common		
5	DI-DC-18	H	DC18_hi	Signal - Input		
6	DI-DC-18	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-124						
1	DI-DC-19	H	DC19_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-19	C	COMMON	Common		
3	DI-DC-20	H	DC20_hi	Signal - Input		
4	DI-DC-20	C	COMMON	Common		
5	DI-DC-21	H	DC21_hi	Signal - Input		
6	DI-DC-21	C	COMMON	Common		
CN-125						
1	DI-DC-22	H	DC22_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-22	C	COMMON	Common		
3	DI-DC-23	H	DC23_hi	Signal - Input		
4	DI-DC-23	C	COMMON	Common		
5	DI-DC-24	H	DC24_hi	Signal - Input		
6	DI-DC-24	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-126						
1	DI-DC-25	H	DC25_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-25	C	COMMON	Common		
3	DI-DC-26	H	DC26_hi	Signal - Input		
4	DI-DC-26	C	COMMON	Common		
5	DI-DC-27	H	DC27_hi	Signal - Input		
6	DI-DC-27	C	COMMON	Common		
CN-127						
1	DI-DC-28	H	DC28_hi	Signal - Input	DC input control	Alarm reset, slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-28	C	COMMON	Common		
3	DI-DC-29	H	DC29_hi	Signal - Input		
4	DI-DC-29	C	COMMON	Common		
5	DI-DC-30	H	DC30_hi	Signal - Input		
6	DI-DC-30	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-128						
1	AI-1	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-1	C	24 V common	Common (passive mode)		
3	AI-1	A	Analog signal	Signal - Input (active + passive mode)		
CN-129						
1	AI-2	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-2	C	24 V common	Common (passive mode)		
3	AI-2	A	Analog signal	Signal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-130						
1	AI-3	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.
2	AI-3	C	24 V common	Common (passive mode)		4-20 mA input for analog pacing.
3	AI-3	A	Analog signal	Signal - Input (active + passive mode)		Digital mode for "digital input".
CN-131						
1	AI-4	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.
2	AI-4	C	24 V common	Common (passive mode)		4-20 mA input for analog pacing.
3	AI-4	A	Analog signal	Signal - Input (active + passive mode)		Digital mode for "digital input".

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-132						
1	AI-5	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-5	C	24 V common	Common (passive mode)		
3	AI-5	A	Analog signal	Signal - Input (active + passive mode)		
CN-133						
1	AI-6	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-6	C	24 V common	Common (passive mode)		
3	AI-6	A	Analog signal	Signal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-134						
1	AI-7	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-7	C	24 V common	Common (passive mode)		
3	AI-7	A	Analog signal	Signal - Input (active + passive mode)		
CN-135						
1	QPI-1A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-1A	C	COMMON	Common		
3	QPI-1A	P	PULSE A	Pulse Signal - Input A		
4	QPI-1B	12 V	12 V DC METER POWER	Power		
5	QPI-1B	C	COMMON	Common		
6	QPI-1B	P	PULSE B	Pulse Signal - Input B		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-136						
1	QPI-2A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-2A	C	COMMON	Common		
3	QPI-2A	P	PULSE A	Pulse Signal - Input A		
4	QPI-2B	12 V	12 V DC METER POWER	Power		
5	QPI-2B	C	COMMON	Common		
6	QPI-2B	P	PULSE B	Pulse Signal - Input B		
CN-137						
1	QPI-3A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-3A	C	COMMON	Common		
3	QPI-3A	P	PULSE A	Pulse Signal - Input A		
4	QPI-3B	12 V	12 V DC METER POWER	Power		
5	QPI-3B	C	COMMON	Common		
6	QPI-3B	P	PULSE B	Pulse Signal - Input B		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-138						
1	QPI-4A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-4A	C	COMMON	Common		
3	QPI-4A	P	PULSE A	Pulse Signal - Input A		
4	QPI-4B	12 V	12 V DC METER POWER	Power		
5	QPI-4B	C	COMMON	Common		
6	QPI-4B	P	PULSE B	Pulse Signal - Input B		
CN-139						
1	QPI-5A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-5A	C	COMMON	Common		
3	QPI-5A	P	PULSE A	Pulse Signal - Input A		
4	QPI-5B	12 V	12 V DC METER POWER	Power		
5	QPI-5B	C	COMMON	Common		
6	QPI-5B	P	PULSE B	Pulse Signal - Input B		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-140						
1	QPI-6A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-6A	C	COMMON	Common		
3	QPI-6A	P	PULSE A	Pulse Signal - Input A		
4	QPI-6B	12 V	12 V DC METER POWER	Power		
5	QPI-6B	C	COMMON	Common		
6	QPI-6B	P	PULSE B	Pulse Signal - Input B		
CN-141						
1	RTD-1	S-	RTD S-	Three wire connection	Resistance Temperature Detector input control	Preferred: PT100 temperature measurement according to IEC 60751.
2	RTD-1	C	RTD COM	Neutral		
3	RTD-1	A	RTD POS	Signal - Input		
4	RTD-1	S+	RTD S+	Four wire connection		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
<b>CN-142</b>						
1	RTD-2	S-	RTD S-	Three wire connection	Resistance Temperature Detector input control	Preferred: PT100 temperature measurement according to IEC 60751.
2	RTD-2	C	RTD COM	Neutral		
3	RTD-2	A	RTD POS	Signal - Input		
4	RTD-2	S+	RTD S+	Four wire connection		
<b>CN-143</b>						
1	RTD-3	S-	RTD S-	Three wire connection	Resistance Temperature Detector input control	Preferred: PT100 temperature measurement according to IEC 60751.
2	RTD-3	C	RTD COM	Neutral		
3	RTD-3	A	RTD POS	Signal - Input		
4	RTD-3	S+	RTD S+	Four wire connection		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
<b>CN-144</b>						
1	PO-1	HI	Po1_HI	Feed	Pulse output control	Real time pulse output, factored pulse output.
2	PO-1	LO	Po1_LO	Signal - Output		Additive injection feedback, Alarm shutdown,
3	PO-2	HI	Po2_HI	Feed		Alarm indication, Pump start, Additive blocking valve
4	PO-2	LO	Po2_LO	Signal - Output		
<b>CN-145</b>						
1	AO-2	+	AO_a2	Signal - Output (+)	Analog output control	4-20 mA output for primary value presentation:
2	AO-2	-	AO_b2	Signal - Output (-)		
3	AO-3	+	AO_a3	Signal - Output (+)		Additive volume
4	AO-3	-	AO_b3	Signal - Output (-)		Additive flowrate PPM,
5	AO-1	+	AO_a1	Signal - Output (+)		Accumulated additive total,
6	AO-1	-	AO_b1	Signal - Output (-)		Temperature
<b>CN-146</b>						

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
1	COM-1	+	RS485_A_CH1	Receive	RS485 communication interface (2-wire)	Preferred interface to:  Client load computer, BCU, preset.  Secondary interface to: Fusion4 Portal, TAS.
2	COM-1	-	RS485_B_CH1	Transmit		
3	COM-1	C	RS485_Commo n_CH1	0 V		
4	COM-2	-	RS485_A_CH2	Receive		
5	COM-2	+	RS485_A_CH2	Transmit		
6	COM-2	C	RS485_Commo n_CH2	0 V		
CN-147						
1	ETH-1	T+	ETHER_TXP	Transmit positive	Ethernet communication interface	Preferred interface to:  Client load computer, BCU, preset.  Secondary interface to: Fusion4 Portal, TAS.
2	ETH-1	T-	ETHER_TXN	Transmit negative		
3	ETH-1	R+	ETHER_RXP	Receive positive		
4	ETH-1	R-	ETHER_RXN	Receive negative		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-148						
1	MAINS-1	L	Live	Live	Mains AC power input	External AC power for device operation.
2	MAINS-1	N	Neutral	Neutral		
3	MAINS-1	E	Earth	Earth		
CN-149						
1	MAINS-2	L	Live	Live	Mains AC power	Redundant external AC power for device operation or Mains AC power link to second backplane (ARM-2-BACKPLANE-MSC)
2	MAINS-2	N	Neutral	Neutral		
3	MAINS-2	E	Earth	Earth		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-150						
1	COM-3	+	RS485_A_CH3	Receive	RS485 communication interface (2-wire)	Preferred interface to:  Fusion4 Portal, TAS.  Secondary interface to: Client load computer, BCU, preset.
2	COM-3	-	RS485_B_CH3	Transmit		
3	COM-3	C	RS485_Commo n_CH3	0 V		
4	COM-4	+	RS485_A_CH4	Receive		
5	COM-4	-	RS485_B_CH4	Transmit		
6	COM-4	C	RS485_Commo n_CH4	0 V		
CN-151						
1	COM-5	R+	RS485_A_CH5	Receive positive	RS485 communication interface (4-wire)	Preferred interface to:  Fusion4 Portal, TAS.  Secondary interface to: Client load computer, BCU, preset.
2	COM-5	R-	RS485_B_CH5	Receive negative		
3	COM-5	T+	RS485_Y_CH5	Transmit positive		
4	COM-5	T-	RS485_Z_CH5	Transmit negative		
5	COM-5	C	RS485_Commo n_CH5	0 V		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-152						
1	ETH-2	T+	ETHER_TXP	Transmit positive	Ethernet communication interface	Preferred interface to: Fusion4 Portal, TAS.  Secondary interface to: Client load computer, BCU, preset.
2	ETH-2	T-	ETHER_TXN	Transmit negative		
3	ETH-2	R+	ETHER_RXP	Receive positive		
4	ETH-2	R-	ETHER_RXN	Transmit negative		

## 4.6.8 ARM-2-BACKPLANE-MSC Terminal Assignment Guide

The following table provides information for the basic function assignment to specific terminals.

The majority of the MSC-A functions can be assigned to multiple I/O.

To complete the installation, bind each function to its I/O within the Configuration Menu.

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-201						
1	DO-EMR-21	A	EMR21_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-21	B	EMR_common	Neutral		
3	DO-EMR-22	A	EMR22_no	Signal - Output		
4	DO-EMR-22	B	EMR_common	Neutral		
5	DO-EMR-23	A	EMR23_no	Signal - Output		
6	DO-EMR-23	B	EMR_common	Neutral		
7	DO-EMR-24	A	EMR24_no	Signal - Output		
8	DO-EMR-24	B	EMR_common	Neutral		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-202						
1	DO-EMR-25	A	EMR25_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-25	B	EMR_common	Neutral		
3	DO-EMR-26	A	EMR26_no	Signal - Output		
4	DO-EMR-26	B	EMR_common	Neutral		
5	DO-EMR-27	A	EMR27_no	Signal - Output		
6	DO-EMR-27	B	EMR_common	Neutral		
7	DO-EMR-28	A	EMR28_no	Signal - Output		
8	DO-EMR-28	B	EMR_common	Neutral		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-203						
1	DO-EMR-31	A	EMR31_no	Contact for External Supply	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-31	B	EMR_common	Contact for External load switching		
3	DO-EMR-32	A	EMR32_no	Contact for External Supply		
4	DO-EMR-32	B	EMR_common	Contact for External load switching		
5	DO-EMR-33	A	EMR33_no	Contact for External Supply		
6	DO-EMR-33	B	EMR_common	Contact for External load switching		
7	DO-EMR-34	A	EMR34_no	Contact for External Supply		
8	DO-EMR-34	B	EMR_common	Contact for External load switching		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-204						
1	DO-EMR-35	A	EMR35_no	Contact for External Supply	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-35	B	EMR_common	Contact for External load switching		
3	DO-EMR-36	A	EMR36_no	Contact for External Supply		
4	DO-EMR-36	B	EMR_common	Contact for External load switching		
5	DO-EMR-37	A	EMR37_no	Contact for External Supply		
6	DO-EMR-37	B	EMR_common	Contact for External load switching		
7	DO-EMR-38	A	EMR38_no	Contact for External Supply		
8	DO-EMR-38	B	EMR_common	Contact for External load switching		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-205						
1	DO-EMR-29	A	EMR29_no	Contact for External Supply	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Additive blocking valve  Secondary interface for: Additive solenoid Additive feedback
2	DO-EMR-29	B	EMR_common	Contact for External load switching		
3	DO-EMR-30	A	EMR30_no	Contact for External Supply		
4	DO-EMR-30	B	EMR_common	Contact for External load switching		
5	DO-EMR-39	A	EMR39_no	Contact for External Supply		
6	DO-EMR-39	B	EMR_common	Contact for External load switching		
7	DO-EMR-40	A	EMR40_no	Contact for External Supply		
8	DO-EMR-40	B	EMR_common	Contact for External load switching		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-206						
1	DO-SSR-21	F	SSr21_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-21	O	SSr21_sw_ac	Signal - Output		
3	DO-SSR-21	N	N	Neutral		
4	DO-SSR-21	L	L	Live		
5	DO-SSR-22	F	SSr22_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-22	O	SSr22_sw_ac	Signal - Output		
7	DO-SSR-22	N	N	Neutral		
8	DO-SSR-22	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-207						
1	DO-SSR-23	F	SSr23_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-23	O	SSr23_sw_ac	Signal - Output		
3	DO-SSR-23	N	N	Neutral		
4	DO-SSR-23	L	L	Live		
5	DO-SSR-24	F	SSr24_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-24	O	SSr24_sw_ac	Signal - Output		
7	DO-SSR-24	N	N	Neutral		
8	DO-SSR-24	L	L	Live		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-208						
1	DO-SSR-25	F	SSr25_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-25	O	SSr25_sw_ac	Signal - Output		
3	DO-SSR-25	N	N	Neutral		
4	DO-SSR-25	L	L	Live		
5	DO-SSR-26	F	SSr26_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-26	O	SSr26_sw_ac	Signal - Output		
7	DO-SSR-26	N	N	Neutral		
8	DO-SSR-26	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-209						
1	DO-SSR-27	F	SSr27_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-27	O	SSr27_sw_ac	Signal - Output		
3	DO-SSR-27	N	N	Neutral		
4	DO-SSR-27	L	L	Live		
5	DO-SSR-28	F	SSr28_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-28	O	SSr28_sw_ac	Signal - Output		
7	DO-SSR-28	N	N	Neutral		
8	DO-SSR-28	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-210						
1	DO-SSR-29	F	SSr29_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-29	O	SSr29_sw_ac	Signal - Output		
3	DO-SSR-29	N	N	Neutral		
4	DO-SSR-29	L	L	Live		
5	DO-SSR-30	F	SSr30_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-30	O	SSr30_sw_ac	Signal - Output		
7	DO-SSR-30	N	N	Neutral		
8	DO-SSR-30	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-211						
1	DO-SSR-31	F	SSr31_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-31	O	SSr31_sw_ac	Signal - Output		
3	DO-SSR-31	N	N	Neutral		
4	DO-SSR-31	L	L	Live		
5	DO-SSR-32	F	SSr32_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-32	O	SSr32_sw_ac	Signal - Output		
7	DO-SSR-32	N	N	Neutral		
8	DO-SSR-32	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-212						
1	DO-SSR-33	F	SSr33_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-33	O	SSr33_sw_ac	Signal - Output		
3	DO-SSR-33	N	N	Neutral		
4	DO-SSR-33	L	L	Live		
5	DO-SSR-34	F	SSr34_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-34	O	SSr34_sw_ac	Signal - Output		
7	DO-SSR-34	N	N	Neutral		
8	DO-SSR-34	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-213						
1	DO-SSR-35	F	SSr35_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-35	O	SSr35_sw_ac	Signal - Output		
3	DO-SSR-35	N	N	Neutral		
4	DO-SSR-35	L	L	Live		
5	DO-SSR-36	F	SSr36_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-36	O	SSr36_sw_ac	Signal - Output		
7	DO-SSR-36	N	N	Neutral		
8	DO-SSR-36	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-214						
1	DO-SSR-37	F	SSr37_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-37	O	SSr37_sw_ac	Signal - Output		
3	DO-SSR-37	N	N	Neutral		
4	DO-SSR-37	L	L	Live		
5	DO-SSR-38	F	SSr38_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-38	O	SSr38_sw_ac	Signal - Output		
7	DO-SSR-38	N	N	Neutral		
8	DO-SSR-38	L	L	Live		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-215						
1	DO-SSR-39	F	SSr39_feed_ac	Feed	High frequency, fast switching AC output control.	Additive solenoid Additive injection feedback
2	DO-SSR-39	O	SSr39_sw_ac	Signal - Output		
3	DO-SSR-39	N	N	Neutral		
4	DO-SSR-39	L	L	Live		
5	DO-SSR-40	F	SSr40_feed_ac	Feed		Alarm shutdown Alarm indication Pump start Additive blocking valve
6	DO-SSR-40	O	SSr40_sw_ac	Signal - Output		
7	DO-SSR-40	N	N	Neutral		
8	DO-SSR-40	L	L	Live		
CN-216						
1	DI-AC-7, 8, 9	N	AC_NEUTRAL	Neutral	AC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-AC-7	7-L	AC7_L	Live		
3	DI-AC-8	8-L	AC8_L	Live		
4	DI-AC-9	9-L	AC9_L	Live		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-217						
1	DI-AC-10, 11, 12	N	AC_NEUTRAL	Neutral	AC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-AC-10	10-L	AC10_L	Live		
3	DI-AC-11	11-L	AC11_L	Live		
4	DI-AC-12	12-L	AC12_L	Live		
CN-218						
1	DI-DC-31	H	DC31_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-31	C	COMMON	Common		
3	DI-DC-32	H	DC32_hi	Signal - Input		
4	DI-DC-32	C	COMMON	Common		
5	DI-DC-33	H	DC33_hi	Signal - Input		
6	DI-DC-33	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-219						
1	DI-DC-34	H	DC34_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-34	C	COMMON	Common		
3	DI-DC-35	H	DC35_hi	Signal - Input		
4	DI-DC-35	C	COMMON	Common		
5	DI-DC-36	H	DC36_hi	Signal - Input		
6	DI-DC-36	C	COMMON	Common		
CN-220						
1	DI-DC-37	H	DC37_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-37	C	COMMON	Common		
3	DI-DC-38	H	DC38_hi	Signal - Input		
4	DI-DC-38	C	COMMON	Common		
5	DI-DC-39	H	DC39_hi	Signal - Input		
6	DI-DC-39	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
<b>CN-221</b>						
1	DI-DC-40	H	DC40_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-40	C	COMMON	Common		
3	DI-DC-41	H	DC41_hi	Signal - Input		
4	DI-DC-41	C	COMMON	Common		
5	DI-DC-42	H	DC42_hi	Signal - Input		
6	DI-DC-42	C	COMMON	Common		
<b>CN-222</b>						
1	DI-DC-43	H	DC43_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-43	C	COMMON	Common		
3	DI-DC-44	H	DC44_hi	Signal - Input		
4	DI-DC-44	C	COMMON	Common		
5	DI-DC-45	H	DC45_hi	Signal - Input		
6	DI-DC-45	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-223						
1	DI-DC-46	H	DC46_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-46	C	COMMON	Common		
3	DI-DC-47	H	DC47_hi	Signal - Input		
4	DI-DC-47	C	COMMON	Common		
5	DI-DC-48	H	DC48_hi	Signal - Input		
6	DI-DC-48	C	COMMON	Common		
CN-224						
1	DI-DC-49	H	DC49_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-49	C	COMMON	Common		
3	DI-DC-50	H	DC50_hi	Signal - Input		
4	DI-DC-50	C	COMMON	Common		
5	DI-DC-51	H	DC51_hi	Signal - Input		
6	DI-DC-51	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-225						
1	DI-DC-52	H	DC52_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-52	C	COMMON	Common		
3	DI-DC-53	H	DC53_hi	Signal - Input		
4	DI-DC-53	C	COMMON	Common		
5	DI-DC-54	H	DC54_hi	Signal - Input		
6	DI-DC-54	C	COMMON	Common		
CN-226						
1	DI-DC-55	H	DC55_hi	Signal - Input	DC input control	Alarm reset, Slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-55	C	COMMON	Common		
3	DI-DC-56	H	DC56_hi	Signal - Input		
4	DI-DC-56	C	COMMON	Common		
5	DI-DC-57	H	DC57_hi	Signal - Input		
6	DI-DC-57	C	COMMON	Common		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-227						
1	DI-DC-58	H	DC58_hi	Signal - Input	DC input control	Alarm reset, slow flow signal, Permissive, System interlock, Pump feedback, Tank low level, Tank empty, Pacing source, External solenoid control
2	DI-DC-58	C	COMMON	Common		
3	DI-DC-59	H	DC59_hi	Signal - Input		
4	DI-DC-59	C	COMMON	Common		
5	DI-DC-60	H	DC60_hi	Signal - Input		
6	DI-DC-60	C	COMMON	Common		
CN-228						
1	AI-8	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-8	C	24 V common	Common (passive mode)		
3	AI-8	A	Analog signal	Signal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-229						
1	AI-9	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-9	C	24 V common	Common (passive mode)		
3	AI-9	A	Analog signal	Signal - Input (active + passive mode)		
CN-230						
1	AI-10	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-10	C	24 V common	Common (passive mode)		
3	AI-10	A	Analog signal	Signal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-231						
1	AI-11	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-11	C	24 V common	Common (passive mode)		
3	AI-11	A	Analog signal	Signal - Input (active + passive mode)		
CN-232						
1	AI-12	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-12	C	24 V common	Common (passive mode)		
3	AI-12	A	Analog signal	Signal - Input (active + passive mode)		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-233						
1	AI-13	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-13	C	24 V common	Common (passive mode)		
3	AI-13	A	Analog signal	Signal - Input (active + passive mode)		
CN-234						
1	AI-14	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement.  4-20 mA input for analog pacing.  Digital mode for "digital input".
2	AI-14	C	24 V common	Common (passive mode)		
3	AI-14	A	Analog signal	Signal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-235						
1	QPI-7A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-7A	C	COMMON	Common		
3	QPI-7A	P	PULSE A	Pulse Signal - Input A		
4	QPI-7B	12 V	12 V DC METER POWER	Power		
5	QPI-7B	C	COMMON	Common		
6	QPI-7B	P	PULSE B	Pulse Signal - Input B		
CN-236						
1	QPI-8A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-8A	C	COMMON	Common		
3	QPI-8A	P	PULSE A	Pulse Signal - Input A		
4	QPI-8B	12 V	12 V DC METER POWER	Power		
5	QPI-8B	C	COMMON	Common		
6	QPI-8B	P	PULSE B	Pulse Signal - Input B		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-237						
1	QPI-9A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-9A	C	COMMON	Common		
3	QPI-9A	P	PULSE A	Pulse Signal - Input A		
4	QPI-9B	12 V	12 V DC METER POWER	Power		
5	QPI-9B	C	COMMON	Common		
6	QPI-9B	P	PULSE B	Pulse Signal - Input B		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-238						
1	QPI-10A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-10A	C	COMMON	Common		
3	QPI-10A	P	PULSE A	Pulse Signal - Input A		
4	QPI-10B	12 V	12 V DC METER POWER	Power		
5	QPI-10B	C	COMMON	Common		
6	QPI-10B	P	PULSE B	Pulse Signal - Input B		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-239						
1	QPI-11A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-11A	C	COMMON	Common		
3	QPI-11A	P	PULSE A	Pulse Signal - Input A		
4	QPI-11B	12 V	12 V DC METER POWER	Power		
5	QPI-11B	C	COMMON	Common		
6	QPI-11B	P	PULSE B	Pulse Signal - Input B		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-240						
1	QPI-12A	12 V	12 V DC METER POWER	Power	High frequency pulse input control + external power	Additive flow meter (single or dual)  Pacing source (wild stream flow). Digital input.
2	QPI-12A	C	COMMON	Common		
3	QPI-12A	P	PULSE A	Pulse Signal - Input A		
4	QPI-12B	12 V	12 V DC METER POWER	Power		
5	QPI-12B	C	COMMON	Common		
6	QPI-12B	P	PULSE B	Pulse Signal - Input B		
CN-241						
1	RTD-4	S-	RTD S-	Three wire connection	Resistance Temperature Detector input control	Preferred: PT100 temperature measurement according to IEC 60751.
2	RTD-4	C	RTD COM	Neutral		
3	RTD-4	A	RTD POS	Signal - Input		
4	RTD-4	S+	RTD S+	Four wire connection		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-242						
1	RTD-5	S-	RTD S-	Three wire connection	Resistance Temperature Detector input control	Preferred: PT100 temperature measurement according to IEC 60751.
2	RTD-5	C	RTD COM	Neutral		
3	RTD-5	A	RTD POS	Signal - Input		
4	RTD-5	S+	RTD S+	Four wire connection		
CN-243						
1	RTD-6	S-	RTD S-	Three wire connection	Resistance Temperature Detector input control	Preferred: PT100 temperature measurement according to IEC 60751.
2	RTD-6	C	RTD COM	Neutral		
3	RTD-6	A	RTD POS	Signal - Input		
4	RTD-6	S+	RTD S+	Four wire connection		
CN-244						
1	PO-3	HI	Po3_HI	Feed	Pulse output control	Real time pulse output, factored pulse output.
2	PO-3	LO	Po3_LO	Signal - Output		Additive injection feedback, Alarm shutdown,
3	PO-4	HI	Po4_HI	Feed		Alarm indication,
4	PO-4	LO	Po4_LO	Signal - Output		Pump start, Additive blocking valve

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-245						
1	AO-5	+	AO_a5	Signal - Output (+)	Analog output control	4-20 mA output for primary value presentation:  Additive volume Additive flowrate PPM,  Accumulated additive total, Temperature
2	AO-5	-	AO_b5	Signal - Output (-)		
3	AO-6	+	AO_a6	Signal - Output (+)		
4	AO-6	-	AO_b6	Signal - Output (-)		
5	AO-4	+	AO_a4	Signal - Output (+)		
6	AO-4	-	AO_b4	Signal - Output (-)		
CN-246						
1	COM-6	+	RS485_A_CH6	Receive	RS485 communication interface (2-wire)	Preferred interface to:  Client load computer, BCU, preset.  Secondary interface to: Fusion4 Portal, TAS.
2	COM-6	-	RS485_B_CH6	Transmit		
3	COM-6	C	RS485_Commo n_CH6	0 V		
4	COM-7	+	RS485_A_CH7	Receive		
5	COM-7	-	RS485_A_CH7	Transmit		
6	COM-7	C	RS485_Commo n_CH7	0 V		



Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-247						
1	ETH-3	T+	ETHER_TXP	Transmit positive	Ethernet communication interface	Preferred interface to:
2	ETH-3	T-	ETHER_TXN	Transmit negative		Client load computer, BCU, preset.
3	ETH-3	R+	ETHER_RXP	Receive positive		Secondary interface to:
4	ETH-3	R-	ETHER_RXN	Receive negative		Fusion4 Portal, TAS.
CN-248						
1	MAINS-3	L	Live	Live	Mains AC power input	(Redundant) external AC power for device operation.
2	MAINS-3	N	Neutral	Neutral		
3	MAINS-3	E	Earth	Earth		
CN-249						
1	MAINS-4	L	Live	Live	Mains AC power	Redundant external AC power for device operation or Mains AC power link to first backplane (ARM-1-BACKPLANE-MSC)
2	MAINS-4	N	Neutral	Neutral		
3	MAINS-4	E	Earth	Earth		

# 5 Operation

## 5.1 General

### 5.1.1 Introduction

This chapter provides the commissioning information for the MSC-A.

Commissioning the MSC-A is accomplished by configuring entities (or parameters) to the required values. This is performed through the menu functions of the MSC-A. See [Section 5.4: Menu and Navigation](#), for more information.

### 5.1.2 Text Conventions

All [Entity] and <entity-related> text are in a recognizable format.

For example, the Entity is in the format [Units of additive volume] and the entity-related text is in the format <Milliliter>.

## 5.2 Service Interfaces

The MSC-A can be configured through four interfaces as follows:

- The infrared interface with IR Controller.
- The wired Ex i interface with Local Access Device (LAD).
- The COMMS interface which connects to the Fusion4 portal through RS-485 or Ethernet.
- The Ethernet communication.

**Figure 5-1: Service interfaces of the MSC-A**

## 5.3 Service Tools

### 5.3.1 Fusion4 IR Controller

The Fusion4 IR Controller uses infrared (IR) signals to transmit ASCII characters to the MSC-A. This allows the operator to make adjustments in programming the MSC-A without removing the cover of the explosion proof enclosure on-site.

The infrared receiver on the MSC-A is designed to be unaffected by interference from light sources other than the Fusion4 IR Controller. All prompts requiring an operator response are clearly indicated on the display of the MSC-A.

The Fusion4 IR Controller has all the infrared commands permanently stored in its micro-controller. Due to this, if the batteries are drained, it can be restored to complete operation by inserting a fresh set of batteries. The Fusion4 IR Controller has a “sleep” mode to reduce battery consumption. At first use, or after a period of inactivity of approximately 30 seconds, the [ATTN] key must be pressed to “wake-up” the Fusion4 IR Controller. Then the [SEND] light blinks, indicating that the Fusion4 IR Controller is ready for operation.

The MSC-A uses seven of the Fusion4 IR controller buttons. These buttons (^, v, <, >, OK, ESC) are provided in the figure below and explained in detail in [Section 5.3.3.1: Basic Navigation \(Fusion4 IR Controller + Fusion4 LAD\)](#).

Figure 5-2: The key functions of the Fusion4 IR Controller



#### NOTES:

- Three AAA batteries are required for operation.
- The IR controller range is limited to 3 m/10 ft.
- The switch on the right-hand side (if present) is not functional.

## 5.3.2 Fusion4 Local Access Device

### 5.3.2.1 General

The Local Access Device (LAD) is a hand-held controller used for interfacing with the Fusion4 product family, allowing tasks such as parameter adjustment, alarm resetting, and additive calibration.

The device facilitates two-way data communication between a parent device and LAD (see [Section 5.2: Service Interfaces](#)).

The functions supported by LAD are as follows:

1. Rapid transfer of transaction data, configuration of files and calibration of records.
2. Upgrade the firmware in the field.

Figure 5-3: LAD and its system overview



### 5.3.2.2 LAD Application Overview

Figure 5-4: LAD application overview





### 5.3.3 Navigation with Fusion4 IR Controller and Fusion4 LAD

#### 5.3.3.1 Basic Navigation (Fusion4 IR Controller + Fusion4 LAD)

The basic navigation of Fusion4 IR Controller and Fusion4 LAD are identical.

Fusion4 IR Controller	Fusion4 LAD
	
	^ = Up
	v = Down
	< = Left
	> = Right
	OK = Select
	ESC = Back

5.3.3.2 LEDs (Fusion4 IR Controller + Fusion4 LAD)

Fusion4 IR Controller		Fusion4 LAD	
			
Button	Description	Button	Description
send blinking	Fusion4 IR controller is ready for operation.  <b>NOTE:</b> When the LED is OFF, select ATTN key on LAD to “wake up” the Fusion4 IR controller.	status (dual-color)	<ul style="list-style-type: none"><li>• green = OK</li><li>• red = Fault</li></ul>
		data (amber)	ON = data transfer  <b>NOTE:</b> Do NOT disconnect during data transfer.
		test (dual-color)	<ul style="list-style-type: none"><li>• green = mapped I/O function has good health and is active.</li></ul>
			<ul style="list-style-type: none"><li>• red = mapped I/O is inactive.</li><li>• red (blinking) = mapped I/O has bad health.</li><li>• off = no I/O mapping exists.</li></ul>



### 5.3.3.3 Special Function Key (Only LAD)



- User-defined LAD functions such as transfer transactions to LAD, display of the diagnostics screen, and calibration wizard process can be mapped to the F key.
- You can configure the special function key through the HMI of the Fusion4 device.

**NOTE:** The Fusion4 LAD special function key may not be applicable for all Fusion4 devices.

### 5.3.3.4 SD Card

**NOTE:** Format the SD card before using it for the first time. See [Section 5.16.6: Format SD Card](#) for more information about formatting the SD card.

The LAD contains an SD card slot which is located at the top, front face of the LAD.

Figure 5-5: SD card location in LAD (lid opened)



- The SD card uses a FAT file system to allow for interoperability with Microsoft Windows platforms.
- The SD card is used for storage of the following:
  - LAD firmware
  - LAD license key
  - Generic recipes
  - Configuration templates
  - Device firmware
  - Language packs
  - Transaction data
  - Calibration data
  - Configuration data
  - Recipes
  - Alarm logs
  - W&M logs

#### 5.3.3.4.1 Product Type Selection

The selection of an SD card for LAD is important. Due to the intrinsically safe design of LAD, the power drawn by the SD card is strictly limited. For this reason, commercially available SD cards are NOT recommended, as the specification and construction of these devices change frequently.

The following card is recommended by Guidant.

Manufacturer	Series	Type	Capacity	Part Number
SanDisk	Industrial	SDHC	8 GB	HPN-2849856

You are also allowed to use other SD cards, but they must conform to the following specifications.

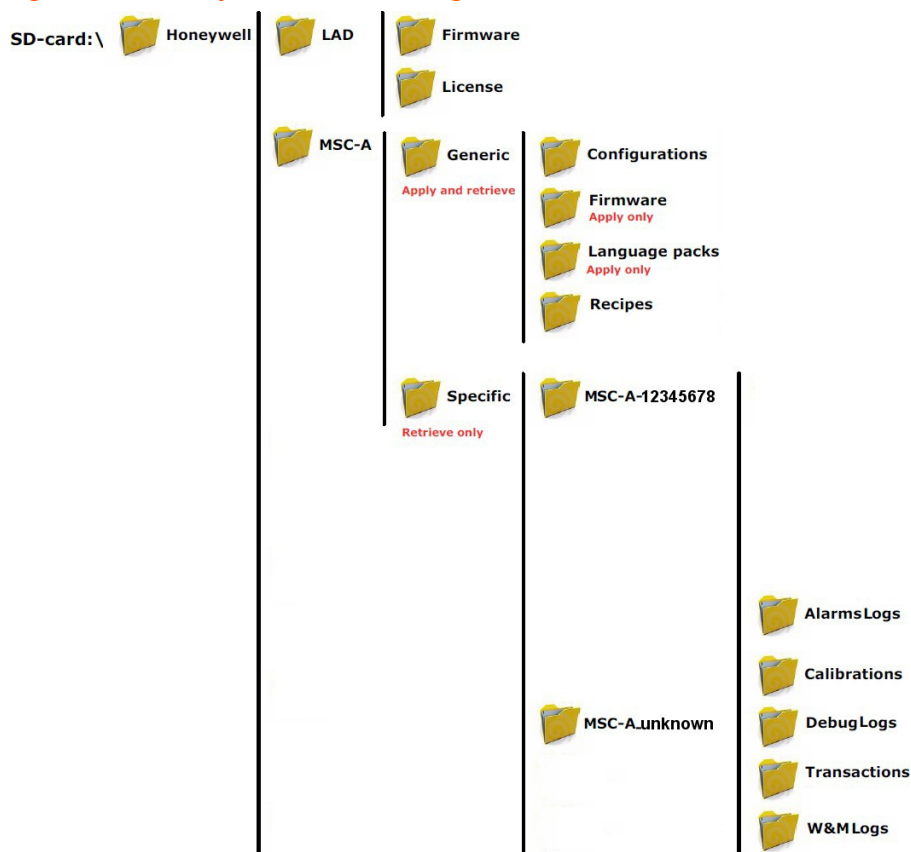
Type	SD or SDHC
Operating temperature	-20 °C to +65 °C [-4 °F to +149 °F]
Maximum current	70 mA

**NOTE:** Guidant does NOT provide support for any cards that are not recommended. Contact Guidant for more information.

**NOTE:** The miniSD and the microSD cards fitted in an SD adaptor should NOT be used in the LAD.

### 5.3.3.4.2 Directory Structure and File Organization

Figure 5-6: Directory structure and file organization of the MSC-A



### 5.3.3.4.3 Guidelines

- All files have \*.xml-format and -extention (except Firmware and License).
- File name identification (file-ID) are as follows:
  - T = Transactions
  - C = Calibrations
  - A = Alarm logs
  - W = W&M logs
  - D = Debug logs
  - R = Recipes

- File name format for Transactions are as follows:
  - <device-type>-<serial number>-<file-id>-<transaction-id>.xml
  - Example: MSC-A-54639823-T-0123456789.xml
- File name format for Calibrations are as follows:
  - <device-type>-<serial number>-<file-id>-<calibration-id>.xml
  - Example: MSC-A-54639823-C-0123456789.xml
- File name format for Alarm logs are as follows:
  - <device-type>-<serial number>-<file-id>.xml
- Example: MSC-A-54639823-A.xml
- File name format for Debug logs are as follows:
  - <device-type>-<serial number>-<file-id>.xml
  - Example: MSC-A-54639823-D.xml
- File name format for Recipes are as follows:
  - <device-type>-<file-id>-<recipe-name>.xml
  - Example: MSC-A-R-E20.xml
- File name format for Configurations are as follows:
  - <user defined string>.xml
  - Example: MY\_CONTROLLER\_1.xml

NOTES:

- 1. Generic files built/edited in a computer environment can differ from the above format.
- 2. Generic files built/edited in a computer environment MUST BE PLACED in the corresponding "Generic" folders as mentioned previously, otherwise they cannot be selected during the MSC-A - LAD interaction.
- 3. Firmware files MUST be placed in the corresponding folders for the LAD and the MSC-A, otherwise they cannot be selected during the MSC-A - LAD interaction.

5.3.3.5 Language Packs

5.3.3.5.1 Configurable Screens of the Language Packs

The following table lists the idle and running screens text items that are displayed according to the language set with the relevant Language Pack.

**NOTE:** The following text items are not used in MSC-A.

- Stream board missing
- Option board missing
- Stream failed alarm
- VCF error alarm
- No hydr. pump alarm
- Pressure error alarm

LAST TRANSACTION SCREEN	ALARM MESSAGES
Last Transaction	License key failure
Location	Batch permissive failure
Product name	Service due reminder
Load volume	Transaction start error
Start time	Transaction stop error

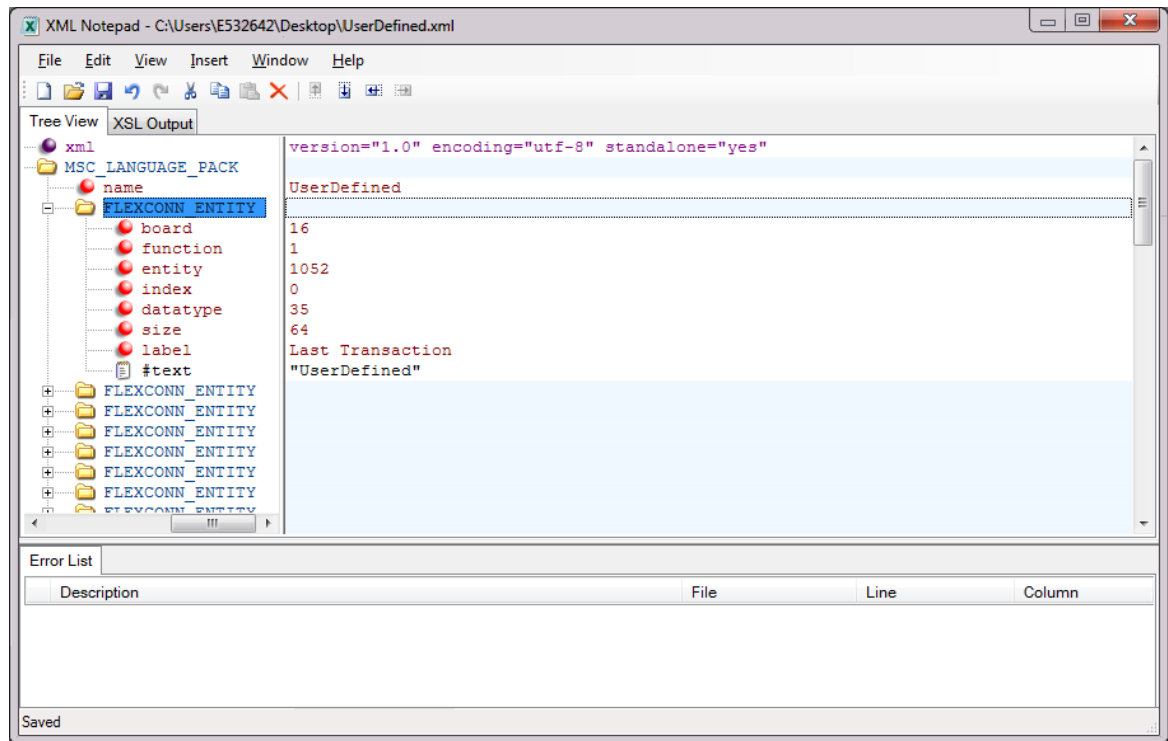
LAST TRANSACTION SCREEN	ALARM MESSAGES
End time	Control failure alarm
Status	Stream failed alarm
No transaction on controller	No activity alarm
<b>DAILY TOTAL SCREEN</b>	Solenoid failing alarm
Daily Totals	Stream failed alarm
No. of trans.	Pulse phase alarm
Total volume	Pulse hardware alarm
<b>ADDITIVE PROGRESS SCREEN</b>	Leaking valve alarm
Additive Progress	Flush volume alarm
Additive mode	No pump alarm
Additive volume	Block valve alarm
ppm	Factored pulse out alarm
Deviation	No hydr. pump alarm
<b>STATUSBAR MESSAGES</b>	Tank low level alarm
Press OK to enter main menu	Tank empty alarm
Press OK to view alarms	Low vol. dev. alarm
Press OK to view process data	High vol. dev. alarm
Press OK to acknowledge alarm	No additive alarm
Press OK to re-enable stream	VCF error alarm
<b>ALARM MESSAGES</b>	Temperature error alarm
Active Alarms	Pressure error alarm
No alarms	Re-enable device
General fail alarm	Re-enable stream
Power failure	No. of alarms
Communication failure	Disabled
HMI fatal error	Inactive
Stream board missing	Active
Option board missing	Acknowledged

### 5.3.3.5.2 Building a Local Language Pack for MSC-A

To create a custom language pack for MSC-A

1. Open the UserDefined.xml file using an XML editor. The .xml file opens in the editor as follows:

Figure 5-7: Screen shot of the XML file

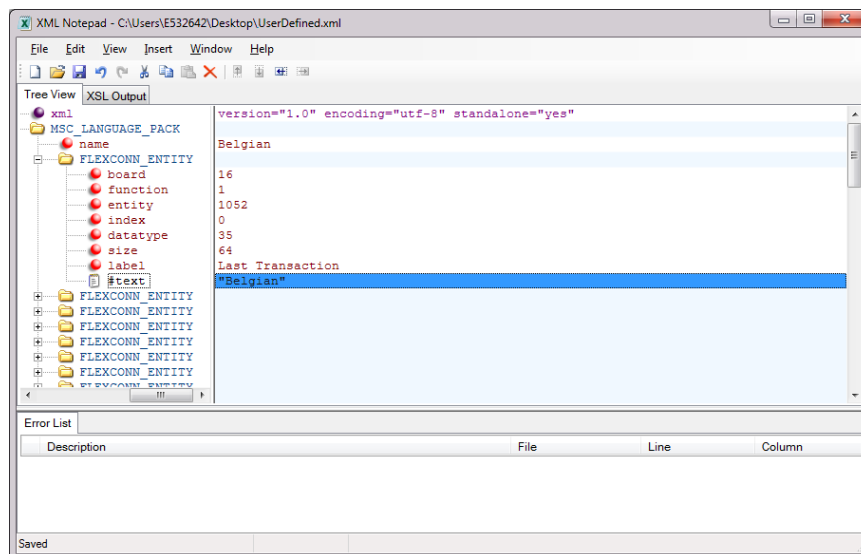
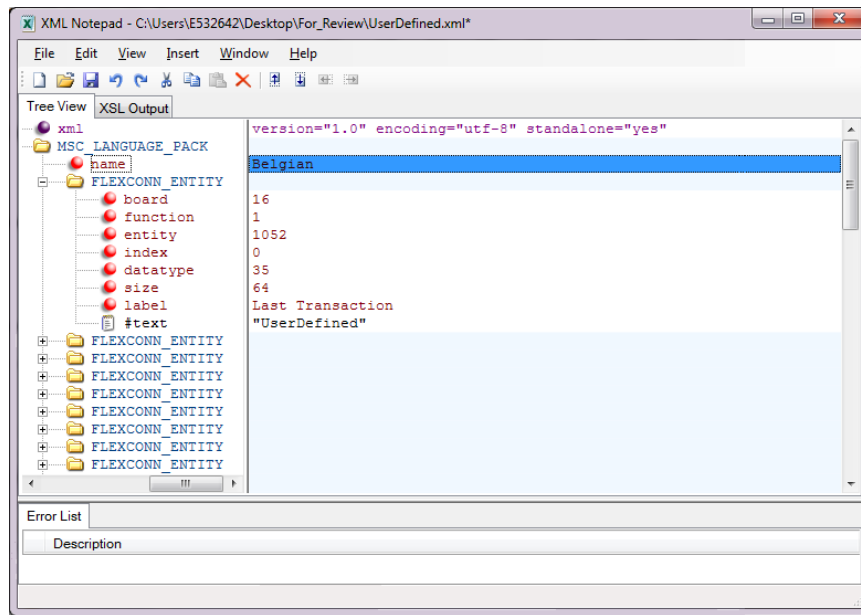


**NOTE:** The screen shots displayed are generated from an XML Notepad 2007, but any other text editor can also be used.

2. Replace the text UserDefined with the name of the local language. For example, Belgian.



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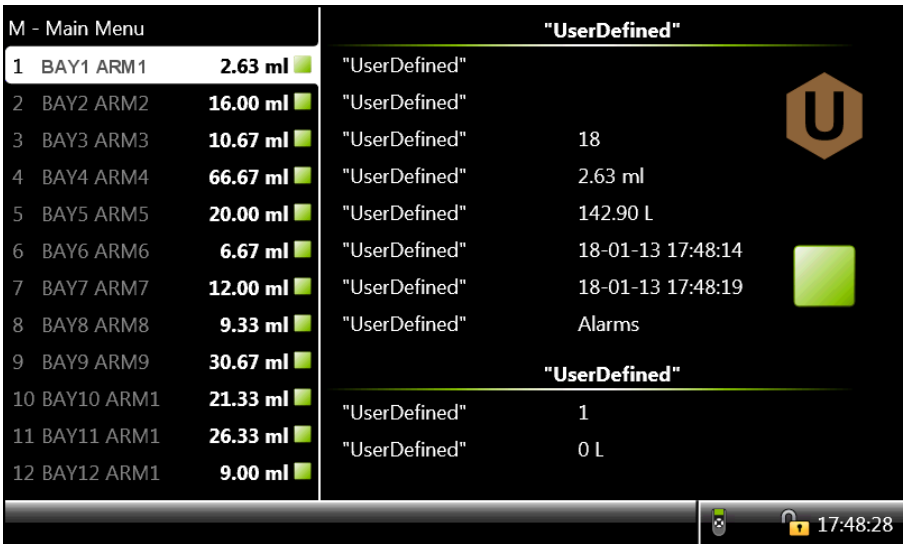
4. Save the file and place it on the SD card in the following path: Honeywell\MSC-A\Generic\Language packs.
5. From the Main Menu screen, select the Transfer icon. The Transfer screen appears.
6. From the Transfer screen, select <Language packs>.
7. Select the files and upload them in the device. For more information to upload the files, see [Section 5.16.2: Firmware Update](#).

- 8. Select <Local Language> as the <User display language> entity in the following path:

Device Configuration > Display > User display language.

- 9. Select the Last Transaction screen for any one of the streams to verify the language pack.

The following screen displays the local language executed.

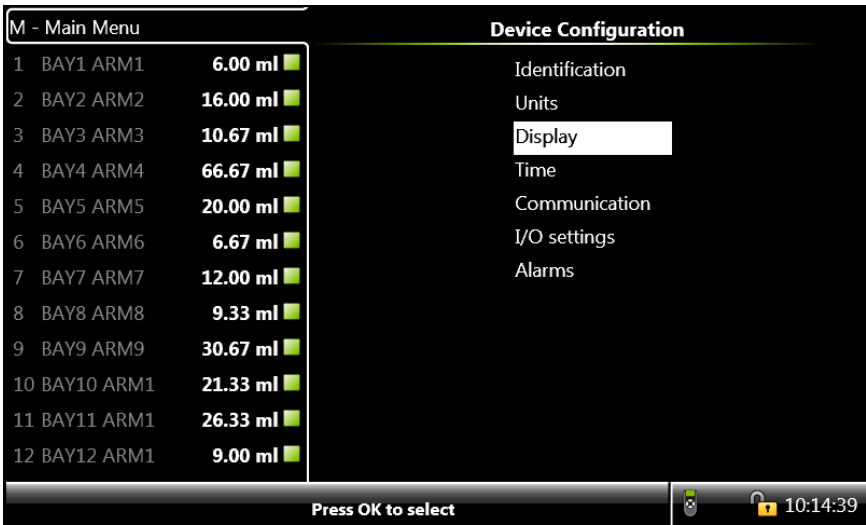


5.3.3.5.3 Configuring a User Display Language for MSC-A

To configure a user display language for MSC-A.

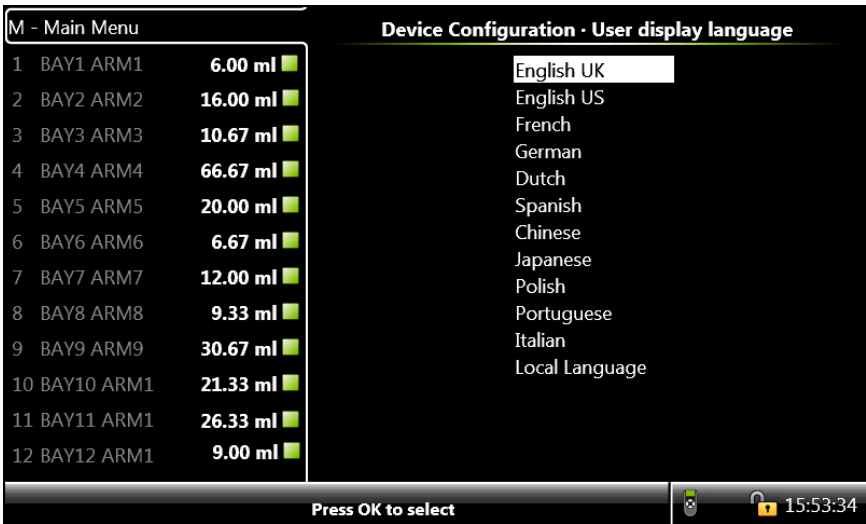
- 1. Select the Device Configuration icon from the Main Menu screen using the IR controller or LAD.

The Device Configuration screen appears with the entities available for device configuration.



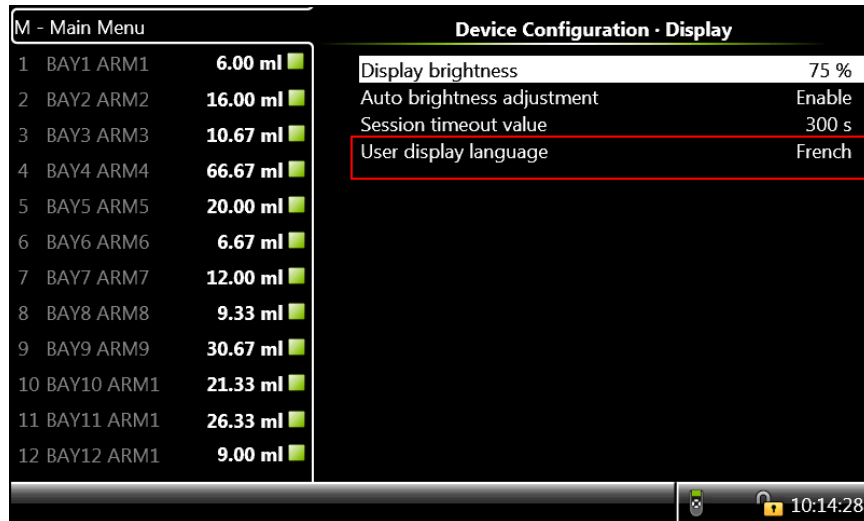
2. Select <Display> on the Device Configuration screen.

The Device Configuration - User display language screen appears, which displays the languages available in MSC-A for user configuration.



3. Select any one of the language based on the requirement. For example, <French>.

The User display language of the MSC-A changes as displayed in the following screen.



## 5.4 Menu and Navigation

### 5.4.1 General

The menu-based Human-Machine Interface (HMI) on the MSC-A, is intuitive and informative. With the HMI interface you can operate, configure, and service the MSC-A.

The Main Menu consists of colored icons and logically structured submenus.

### 5.4.2 Key benefits of the HMI on the Main Menu

Following are the key benefits of the menu-based HMI of the MSC-A.

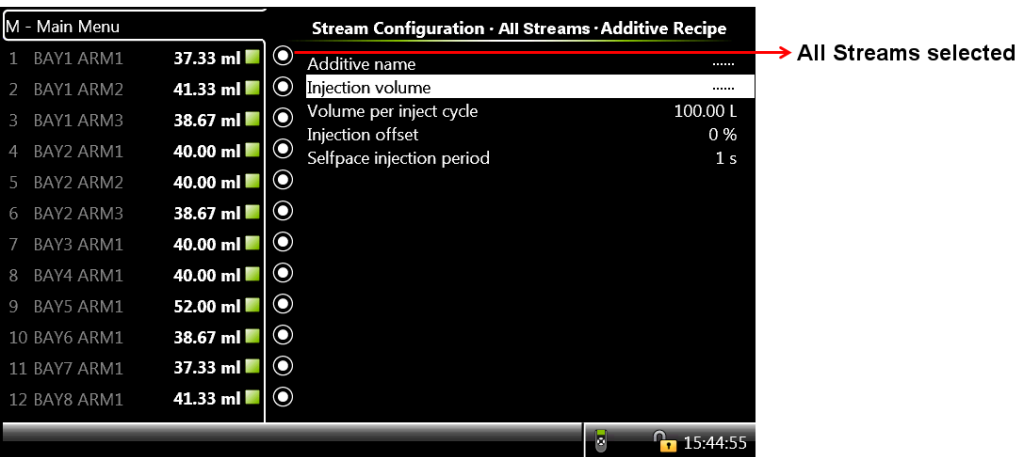
- Clean, intuitive, and informative user interface.
- It is not necessary to memorize parameter codes and enumeration value.
- Wizard-based configuration for the meter calibration.
- Flexible I/O configuration.
- Diagnostic screens.
- Record-based approach to transactions, recipes, and calibrations to make reuse possible.

- Interoperable with Fusion4 IR Controller and Fusion4 LAD.
- Graphical user interface for Fusion4 LAD.

The following sections provide a brief explanation of the main menu items and aspects.

### 5.4.3 Navigation Rules for the Menu-based Screens

Following are the navigation rules for the menu-based screens of the MSC-A.



**NOTE:** If only one stream is selected for example, Stream 1 then only the Stream 1 option is selected.

If all streams are selected, that is, Select all streams, then all the options Stream 1 to Stream 21 are selected.

## 5.4.4 Main Menu

The following table provides detailed information for the main menu items on the MSC-A device. For more details on the main menu items, see the figure below.

Item	Description
Title	The title bar is the section at the top of a screen that contains the name or description of the screen. For example, Main Menu.
Title Hierarchy	The title hierarchy is an arrangement of a particular set of entities. The entities are separated from each other by a dot (.). For example, Stream Configuration . Stream 1 . Additive Recipe.
Selected icon (focus rectangle)	The focus rectangle is used as an indicator which provides an indication of the selected entity.
Status bar icons	The status bar icons provides information of the selected icon. It also provides information if the device is locked or open.

Figure 5-8: Main Menu screens



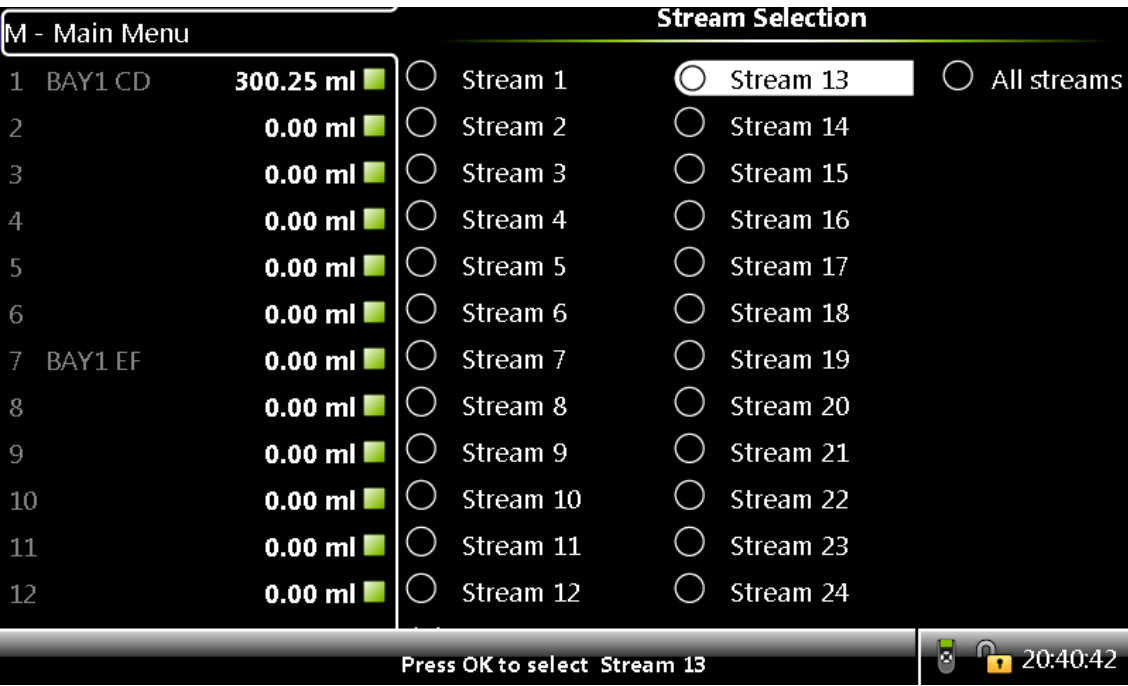
### 5.4.5 Stream Selection

For some of the entities available in the MSC-A, for example, the <Process data>, a specific stream needs to be selected.

When the entity is selected, the Stream Selection screen appears which contains the options to select one of the Streams from Stream 1 to Stream 24 or to select all the streams.



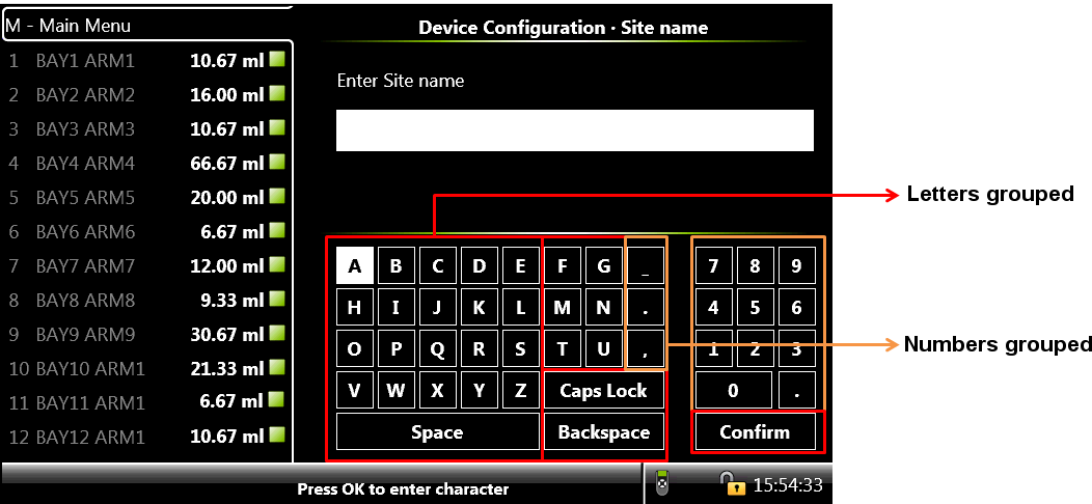
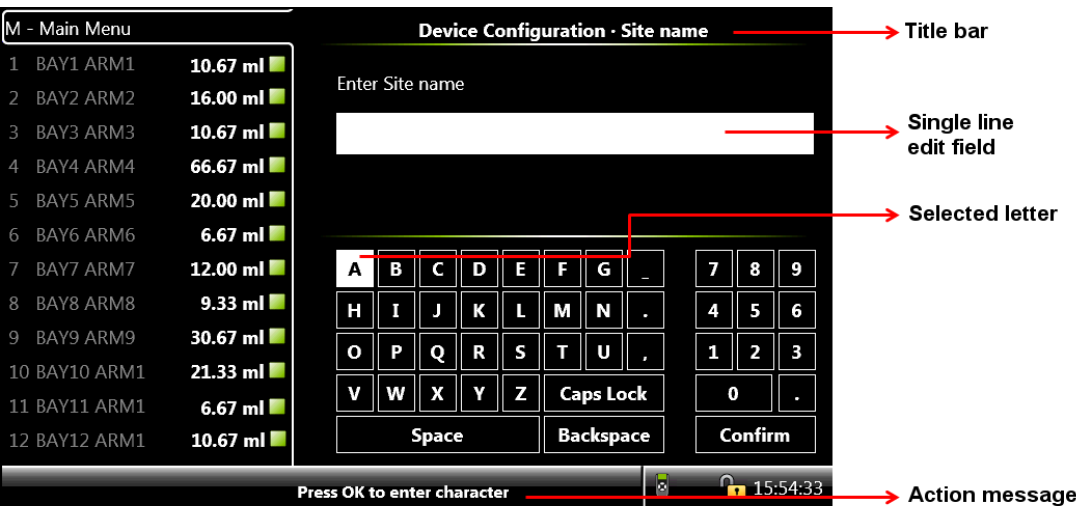
Figure 5-9: Stream Selection screen



## 5.4.6 Text Input Screen

See the figure below for a sample text input screen.

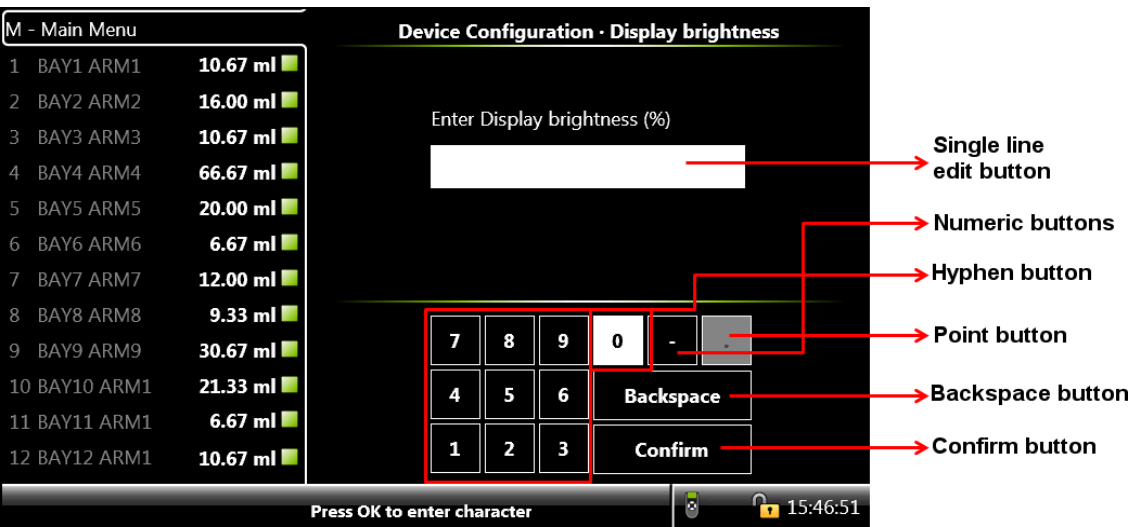
Figure 5-10: Text input screen



### 5.4.7 Numeric Input Screen

See the figure below for a sample numeric input screen.

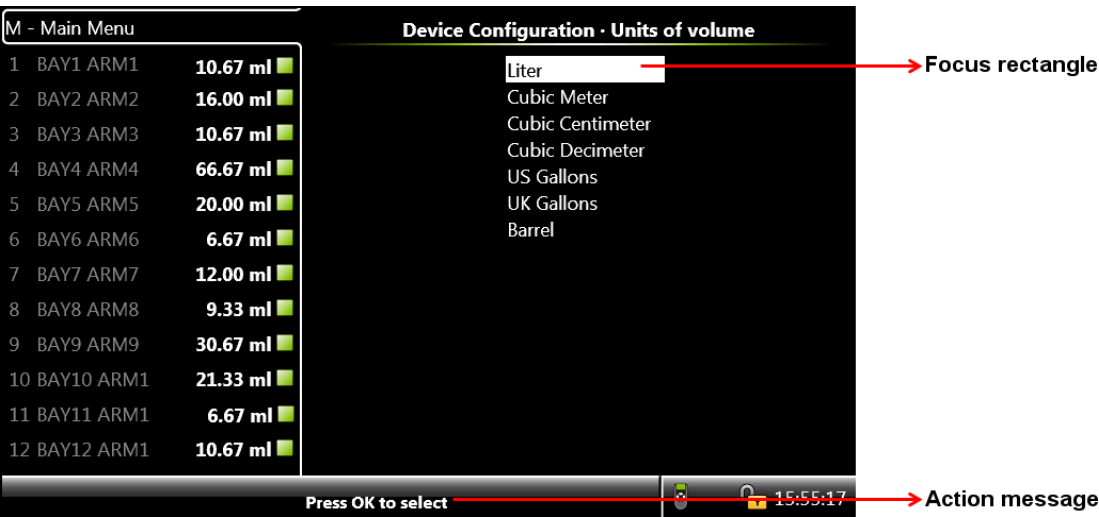
Figure 5-11: Numeric input screen



## 5.4.8 Enumeration Input Screen

See the figure below for a sample enumeration input screen.

Figure 5-12: Enumeration input screen



## 5.4.9 Status Bar

The Status Bar is always visible on all screens and provides the following information.

- Context specific information/directions to the user.
- Status of the connectivity (for example, LAD or IR controller).

- Device Locking icon.
- Actual time

Optionally, the status bar also displays a seal icon.

- The seal icon is displayed when the MSC-A is configured as W&M intended and compliant for W&M custody transfer operations. See the figure below for an example of the status bar displaying the seal icon.
- The seal icon is displayed with a black strikethrough when the MSC-A is configured as W&M intended but not compliant for W&M custody transfer operations. See the figure below for an example of the status bar displaying the seal icon with a strike-through.
- The seal icon is not displayed when the MSC-A is not configured as not intended for W&M custody transfer. See the figure below for an example of the status bar not displaying the seal icon.

Figure 5-13: Status bar displaying the seal icon



Figure 5-14: Status bar displaying the seal icon with a strikethrough



Figure 5-15: Status bar without the seal icon



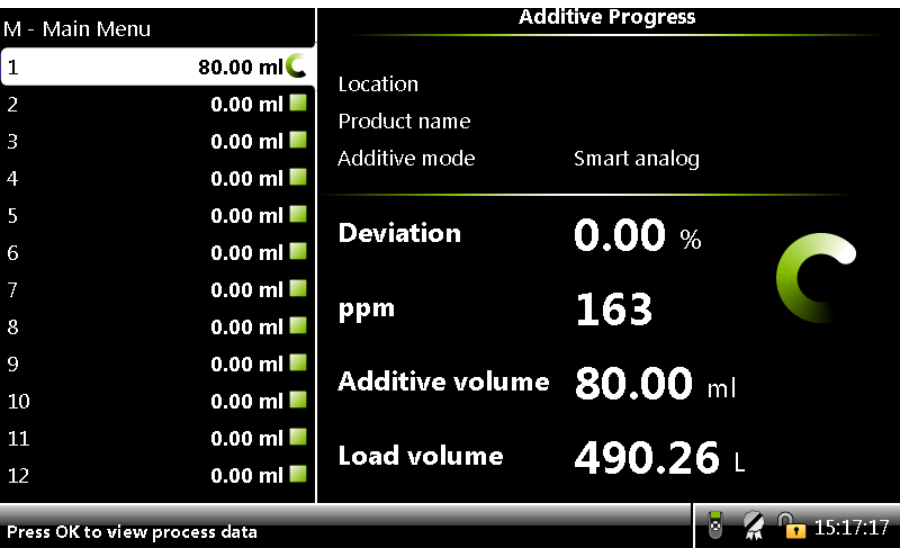
# 5.5 Running Screens

## 5.5.1 Additive Progress

During an active transaction of the streams, the following additive progress screen appears.

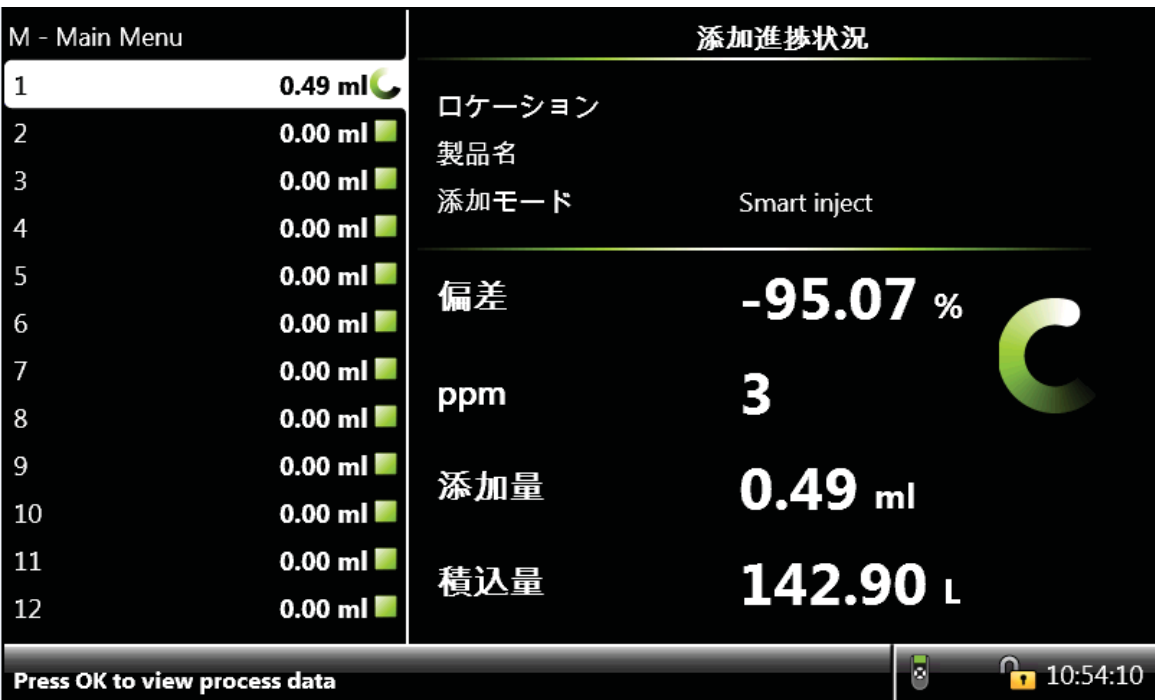
See the figure below for a sample of an additive progress when the default language selected in the <User display language> is <English UK>.

Figure 5-16: Additive progress for the default language



See the figure below for a sample of an additive progress screen when the <User display language> is configured as <Japanese>.

Figure 5-17: Additive progress for the user configured language



Acronym used in the previous screens	Description
ppm	Parts Per Million of additive in the Load volume.
Additive volume	Injected amount of additive.
Load volume	Wild stream measured volume.

5.5.2 Last Transaction and Daily Totals

The MSC-A displays the Last Transaction screen and the Daily Totals screen for the streams at the end of every transaction.

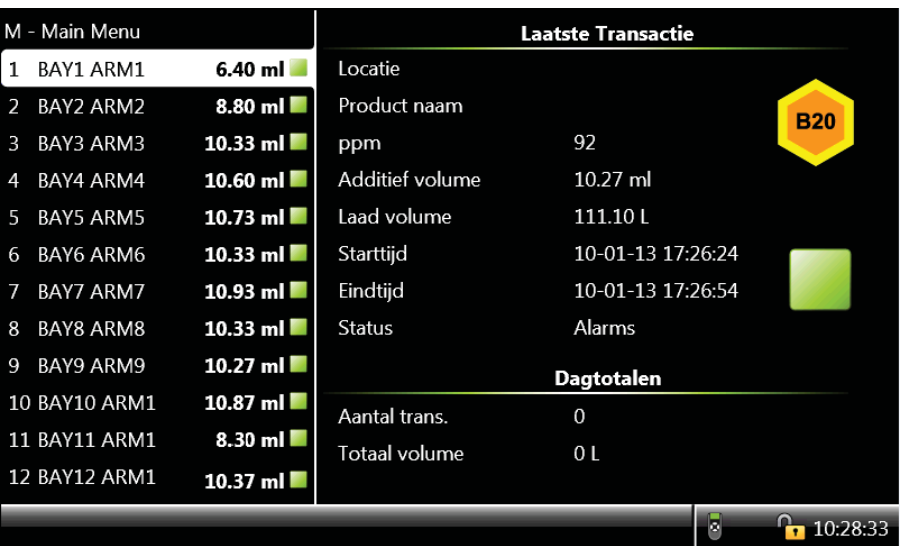
See the figure below for a sample of the Last Transaction and the Daily Totals screen displayed when the default language selected in <User display language> is <English UK>.

Figure 5-18: Last Transaction and Daily Totals screen for the default language



See the figure below for a sample of the Last Transaction and the Daily Totals screen displayed when the <User display language> is selected as <Dutch>.

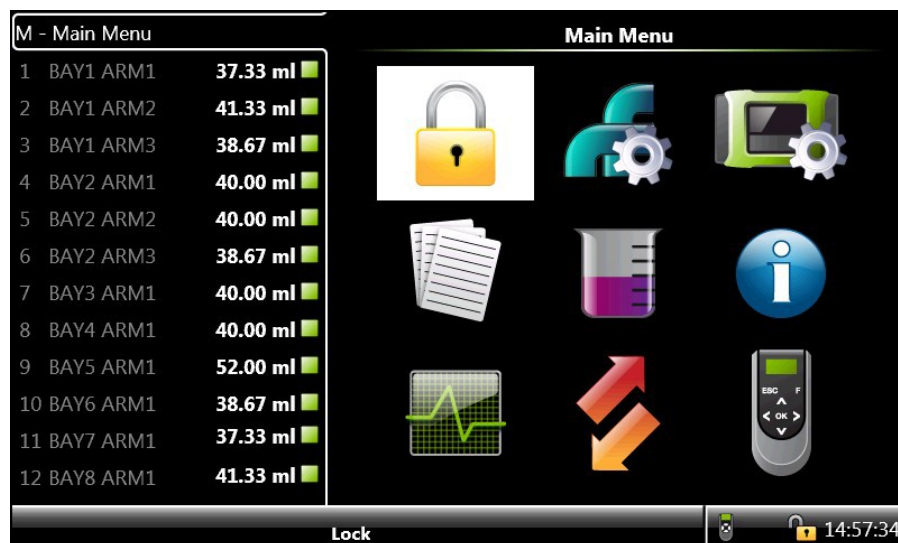
Figure 5-19: Last Transaction and Daily Totals screen for the user configured language



## 5.6 Device Locking

From the Main Menu screen, select the <Lock> icon to lock or unlock the MSC-A device.

Figure 5-20: Lock icon



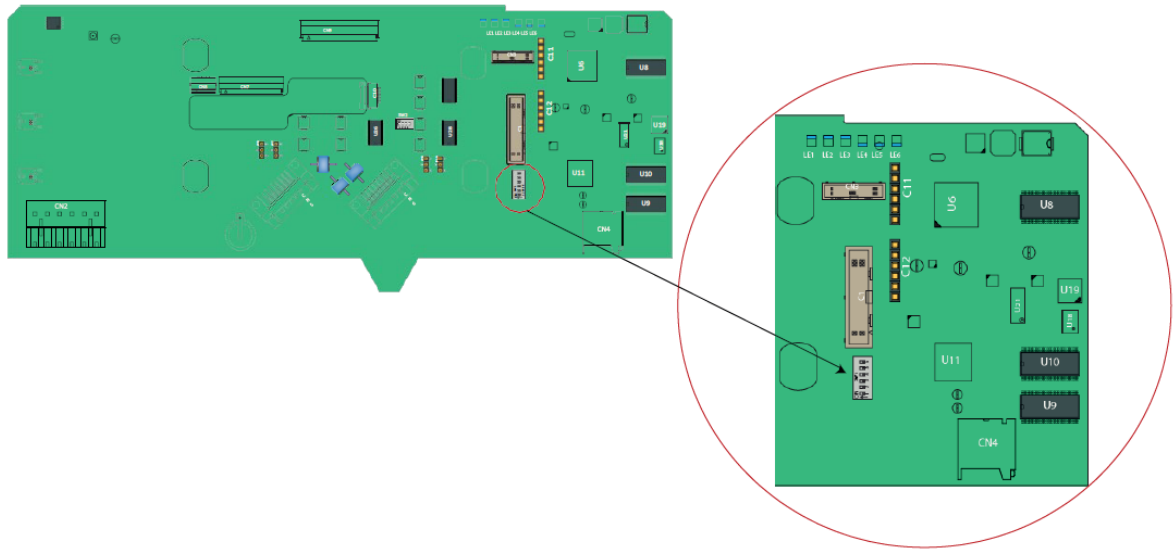
### 5.6.1 About Password Settings

To lock/unlock the MSC-A device, you must enter a password.

- A single password is used to lock the device from further configuration through HMI.
- Password consists of all characters and the size of the password must have a fixed length of six characters.
- Reading the password used for locking the device can be disabled by the jumper JP2.
- The password read is protected by a jumper (JP2 of SW1 on the CAN- HMI-MSC, see the figure below). If you have forgotten your password, remove the jumper and you should be able to read the password again



Figure 5-21: SW1 on CAN-HMI-MSC board



The lock status (open lock or closed lock) appears on the status bar at the bottom-right corner (padlock). See [Figure 5-20: Lock icon](#).

When the device is locked, following functions are disabled.

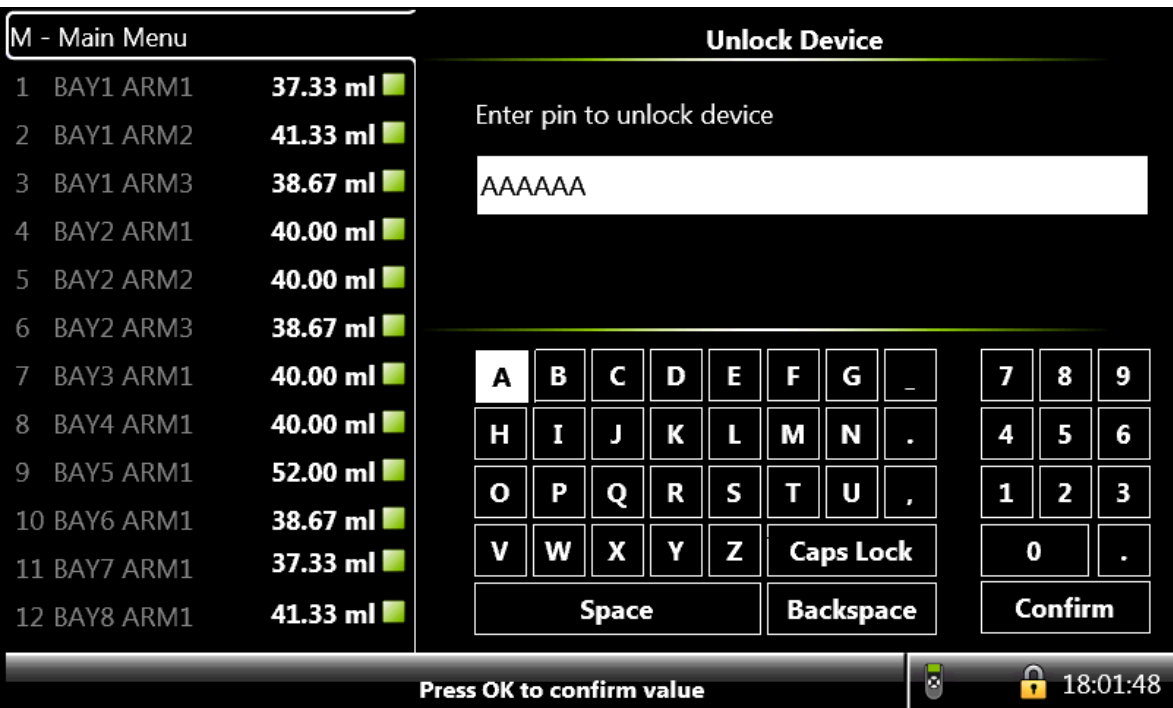
- Device remains locked until explicitly unlocked again.
- Configuration entities cannot be changed through the MSC-A menu.
- The calibration activities, all the available tasks and commands, and the clear alarm function cannot be performed.
- Firmware cannot be updated.

Figure 5-22: Lock device screen



To unlock the device, make sure to enter the same password that is entered to lock MSC-A.

Figure 5-23: Unlock device screen



## 5.7 Device Commissioning

### 5.7.1 Using the Menu

Commissioning of the MSC-A is performed by its menu-based interface.

By using the Fusion4 IR Controller or the Fusion4 LAD, and starting from the Main Menu, various sub-menus can be selected.

In this way all entities can be reached and set.

### 5.7.2 Menu Structure

The following images displays an overview of all the entities and the parameters.

For the complete description of all possible configuration settings, see [Section 5.8: Additive Injection Application Overview](#).

Figure 5-24: Stream n configuration

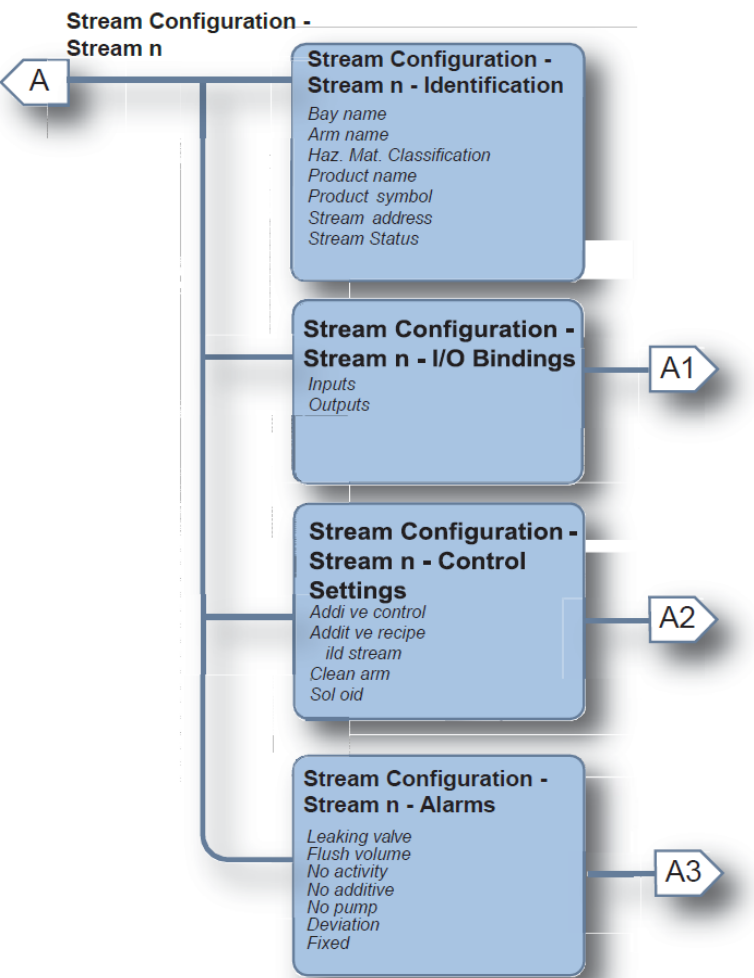


Figure 5-25: Device configuration

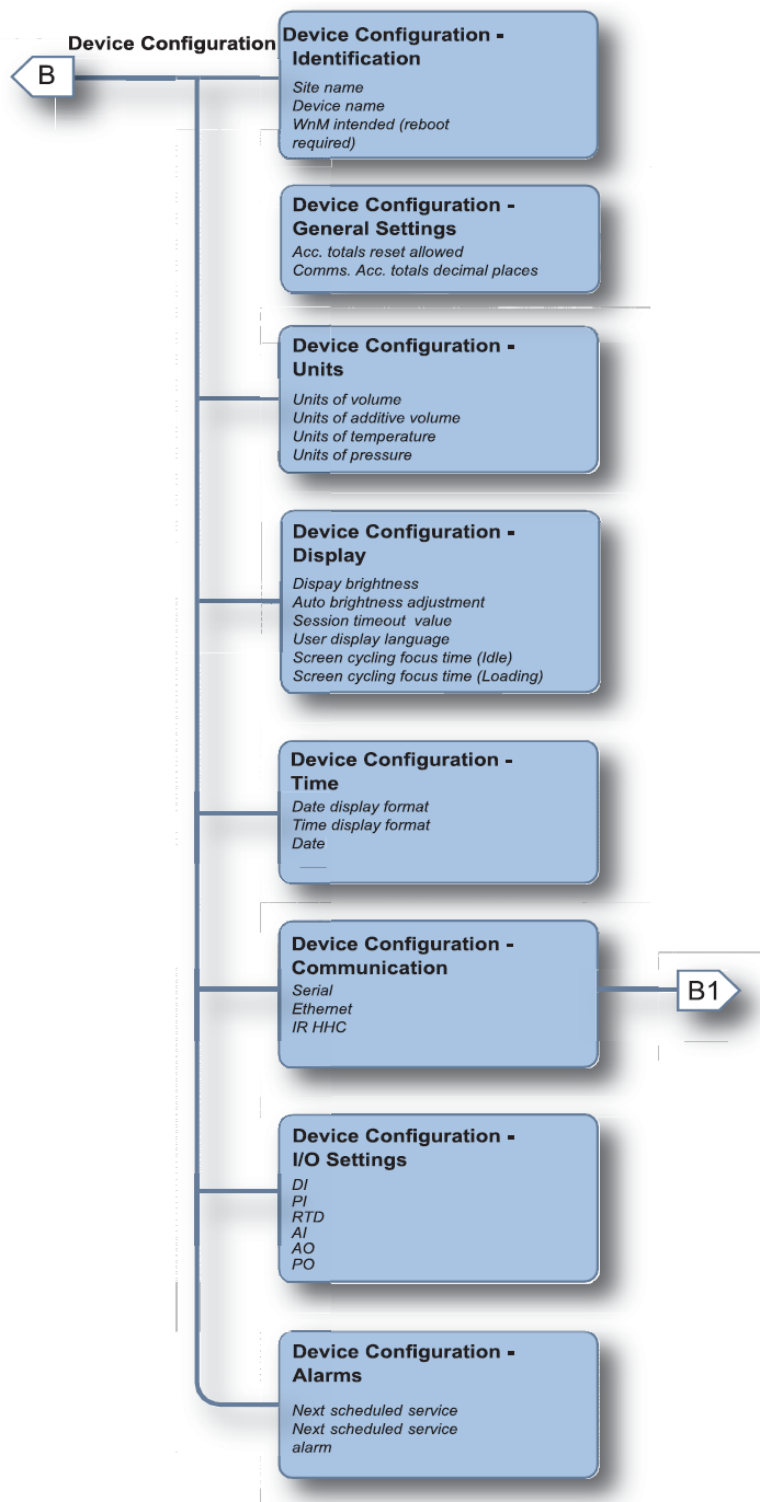


Figure 5-26: Calibration and Info

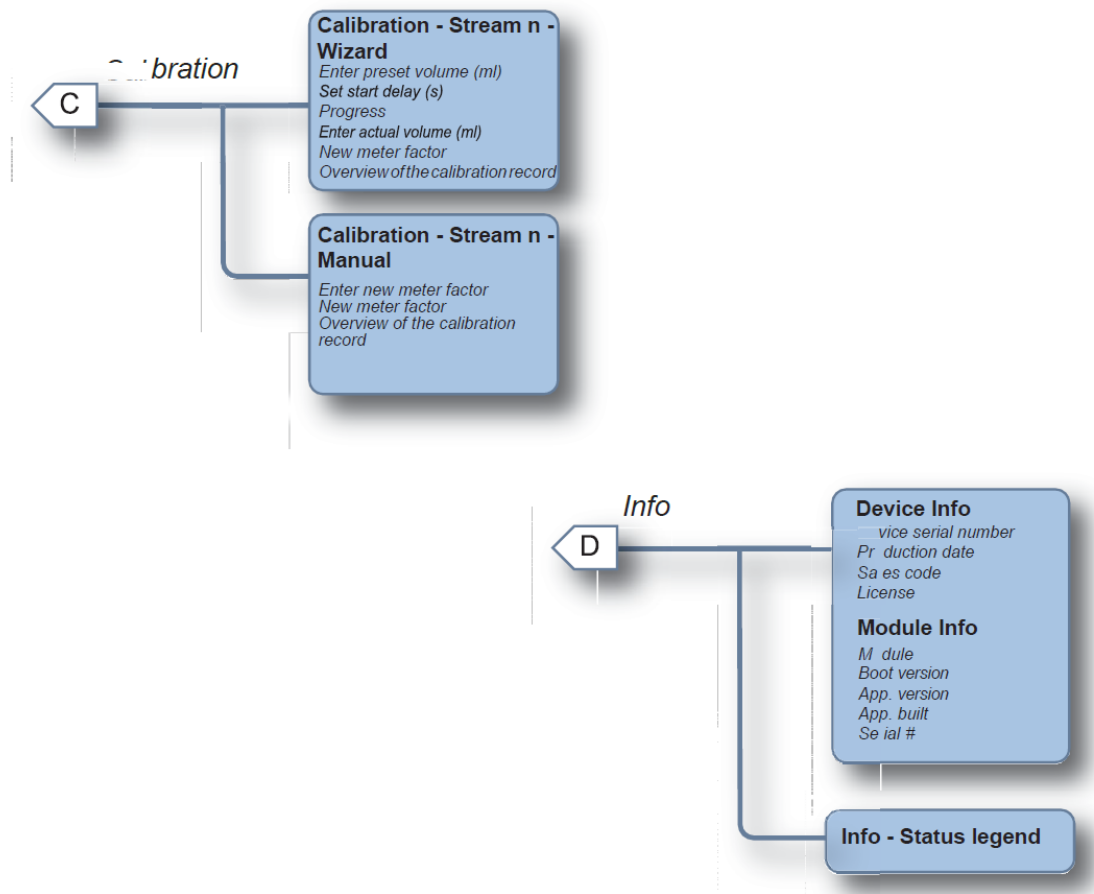
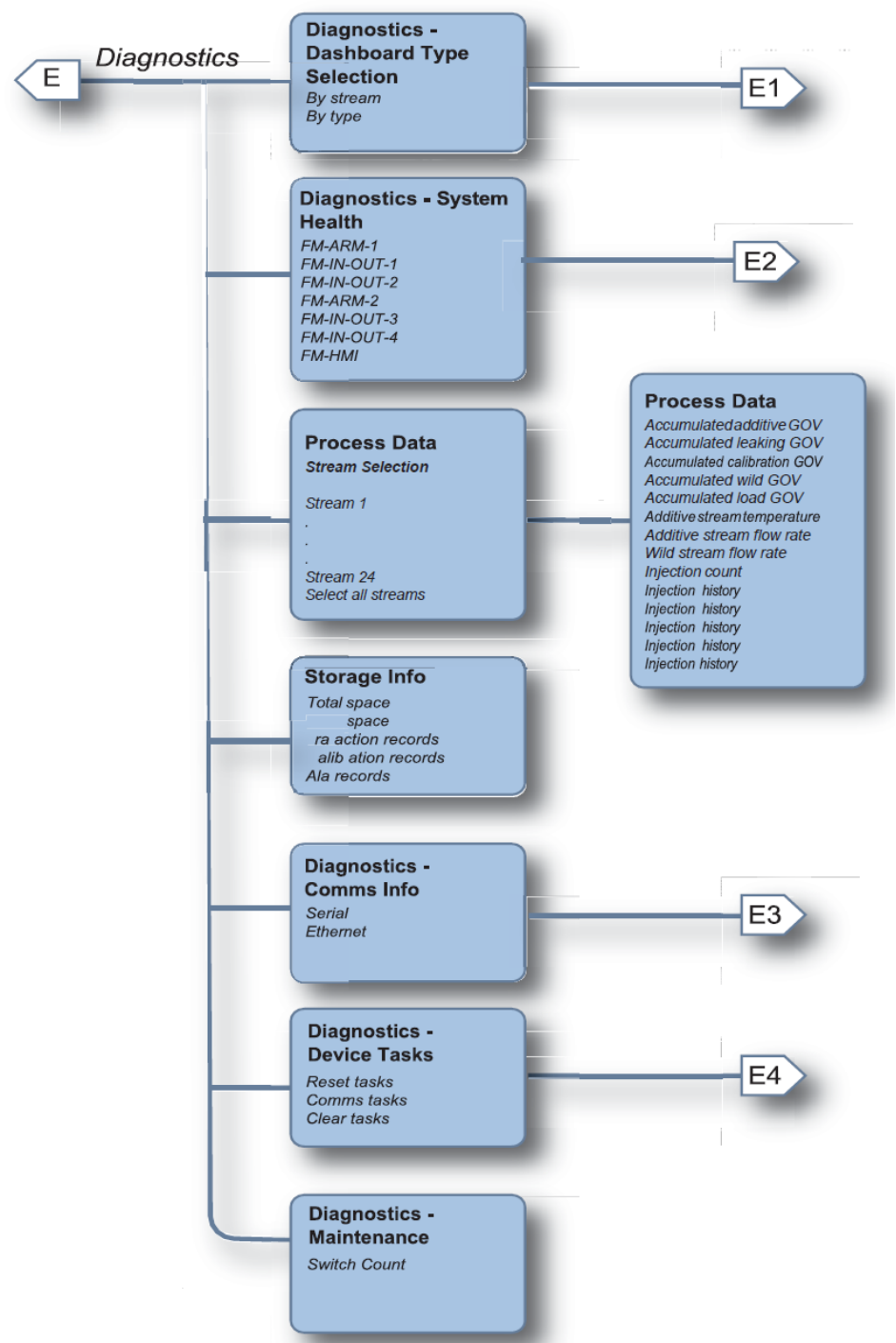


Figure 5-27: Diagnostics



**NOTE:** The content of the Diagnostics - Module Health screen may differ depending on the particular Expansion Pack that is bought.

Figure 5-28: Transfer and LAD functions

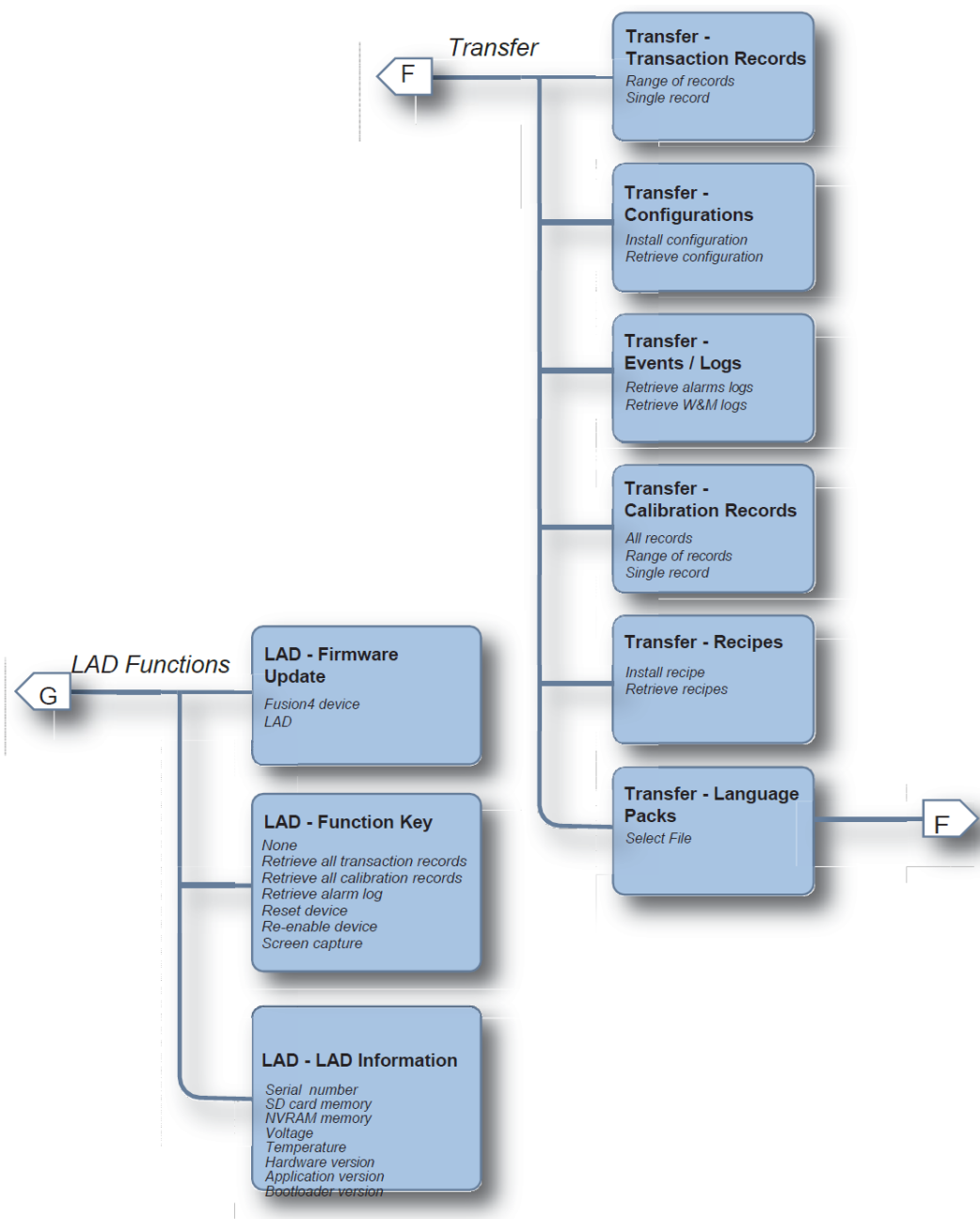




Figure 5-29: Stream configuration control settings and I/O bindings

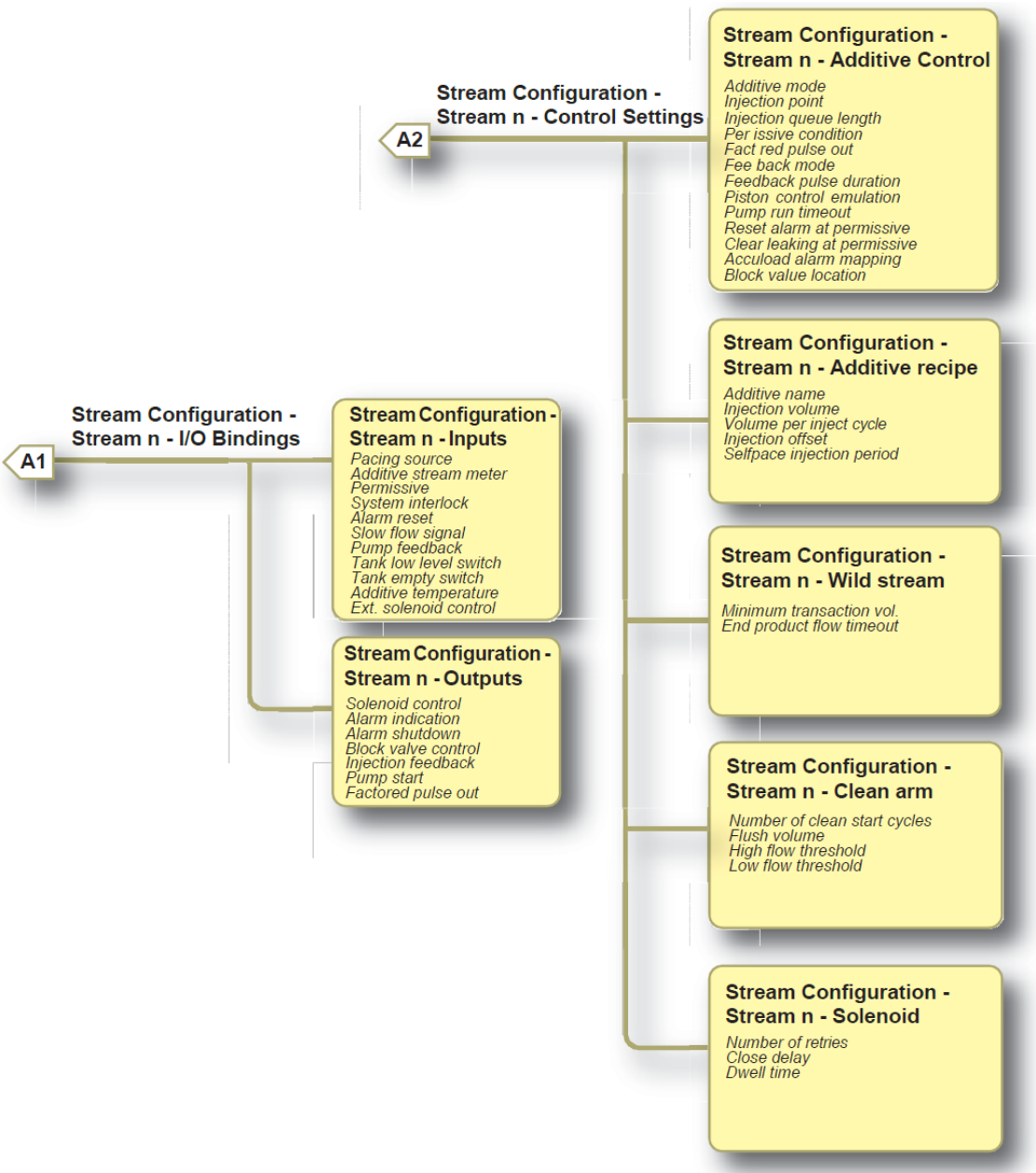


Figure 5-30: Stream configuratoin alarms

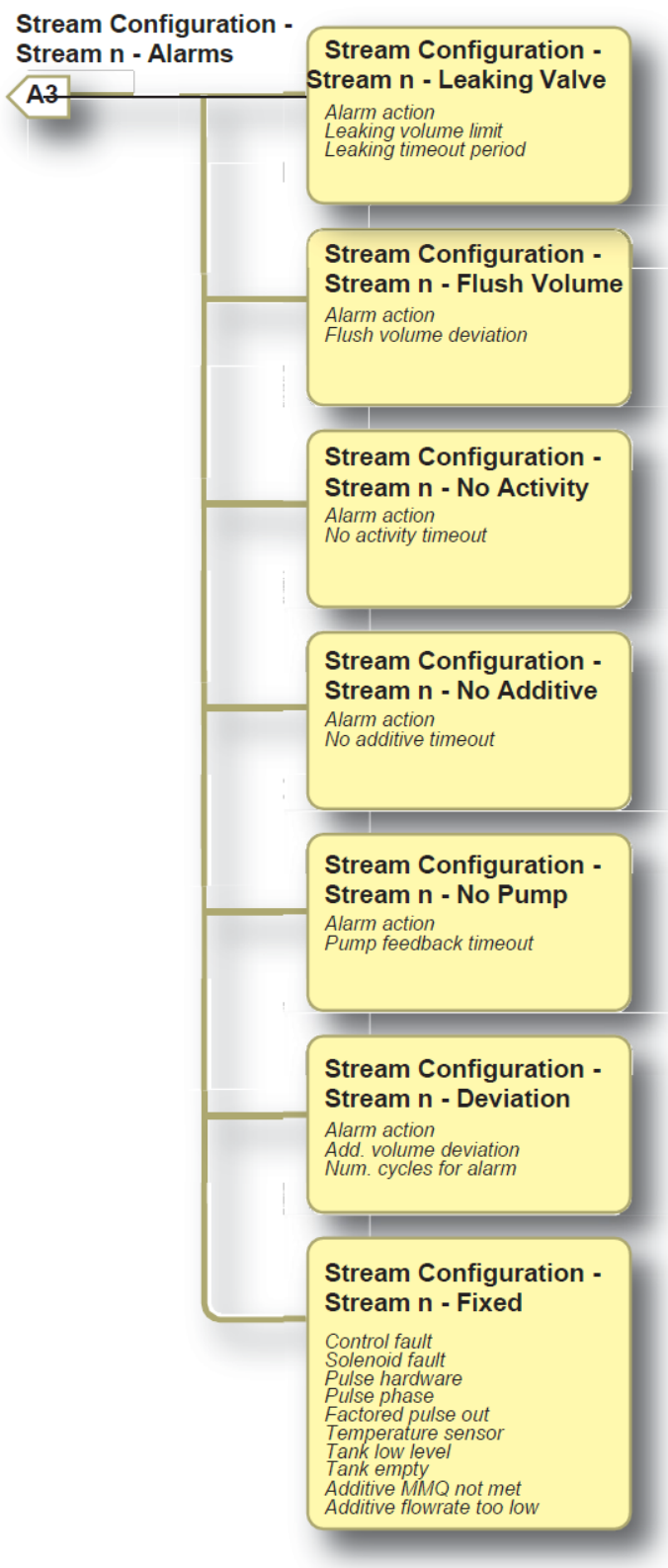
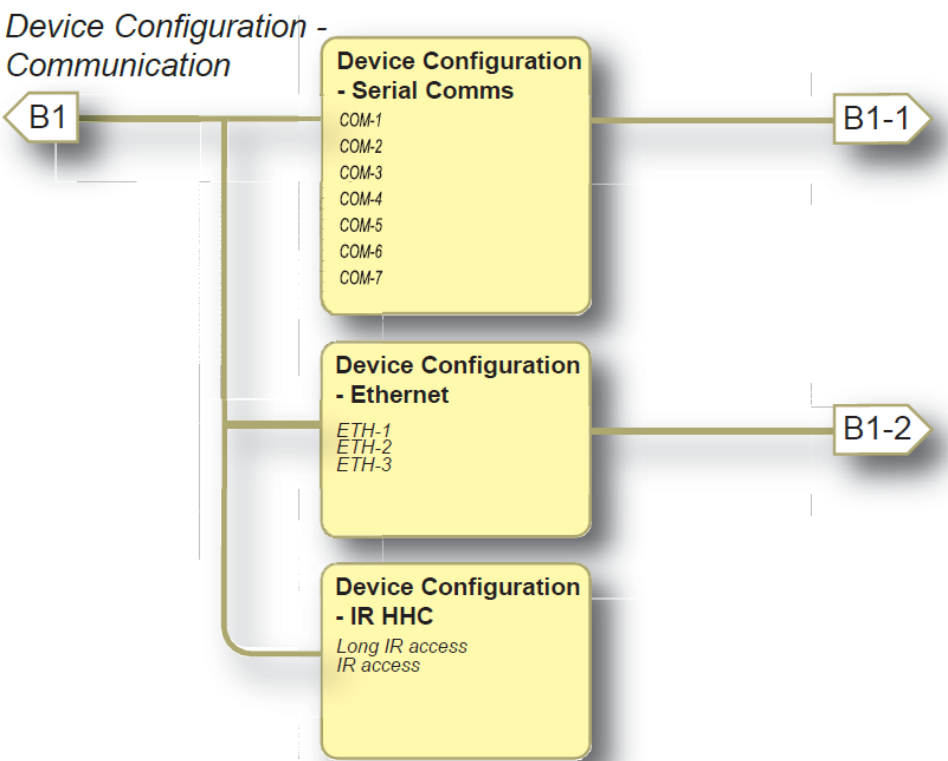


Figure 5-31: Device configuration - communication



**NOTE:** The content of the Device Configuration - Serial Comms and Device Configuration - Ethernet screens may differ depending on the particular Expansion Pack that is bought.

Figure 5-32: Diagnostics - dashboard type selection

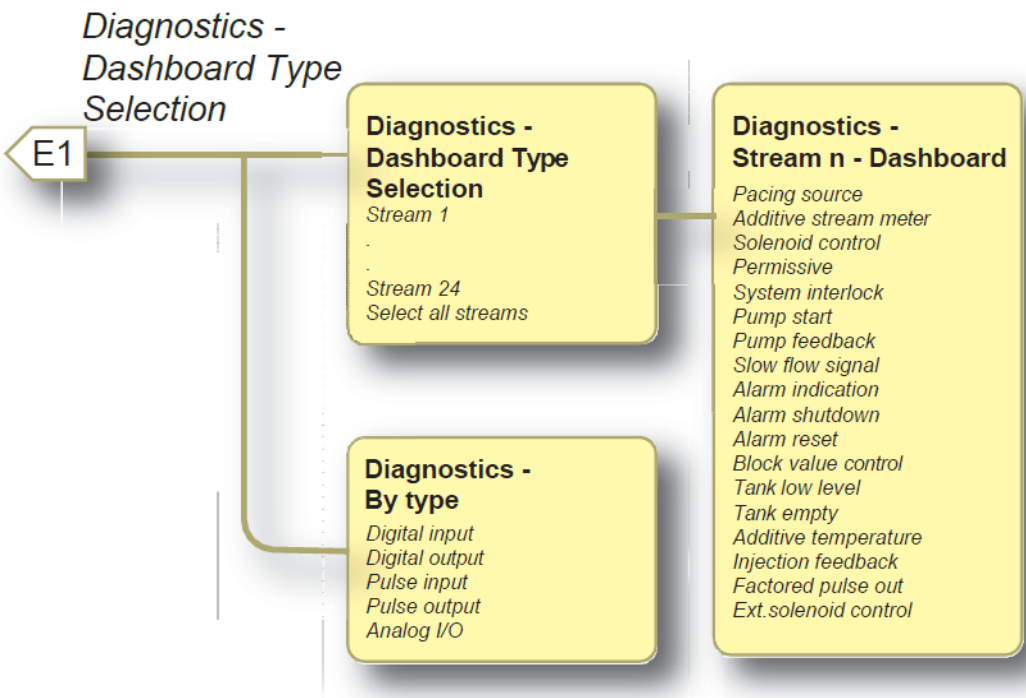
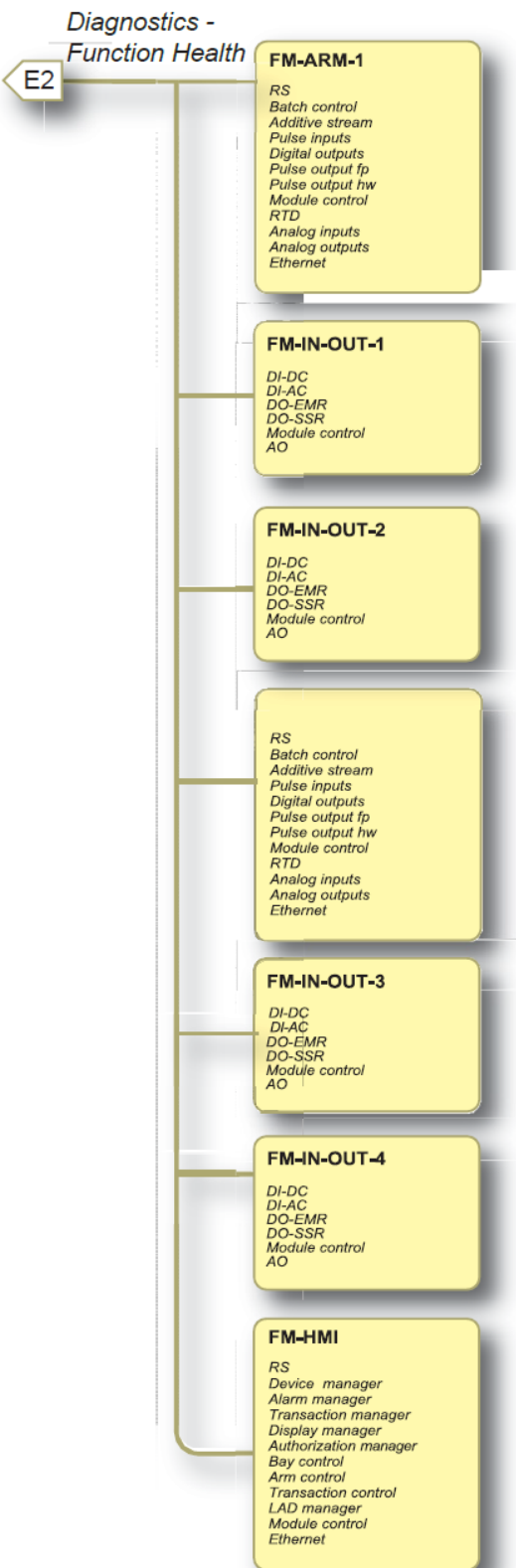


Figure 5-33: Diagnostics - function health



**NOTE:** The content of the Diagnostics - Function Health screen may differ depending on the particular Expansion Pack that is bought.

Figure 5-34: Diagnostics - comms info, device tasks, and transfer - language packs

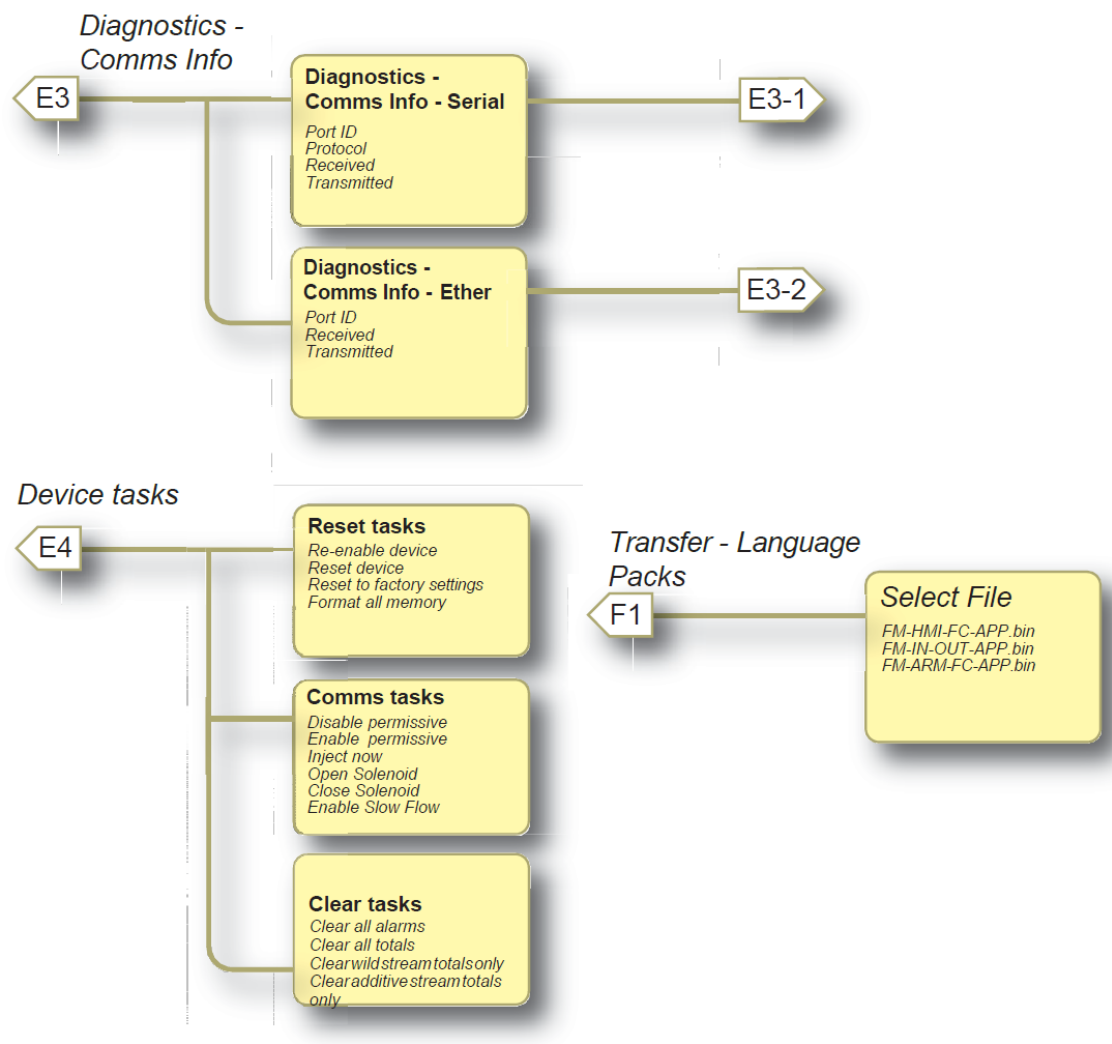


Figure 5-35: Device configuration - communication

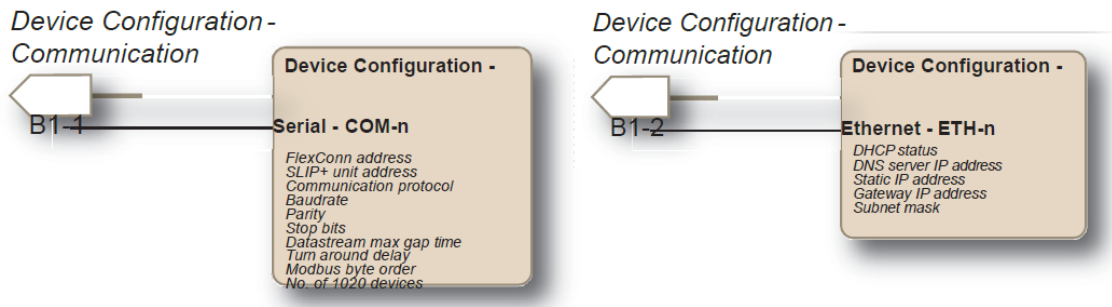
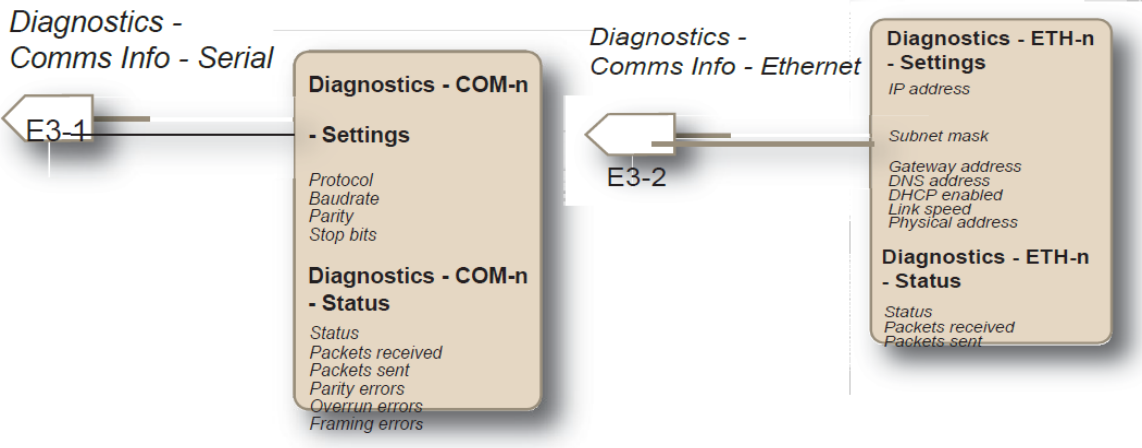
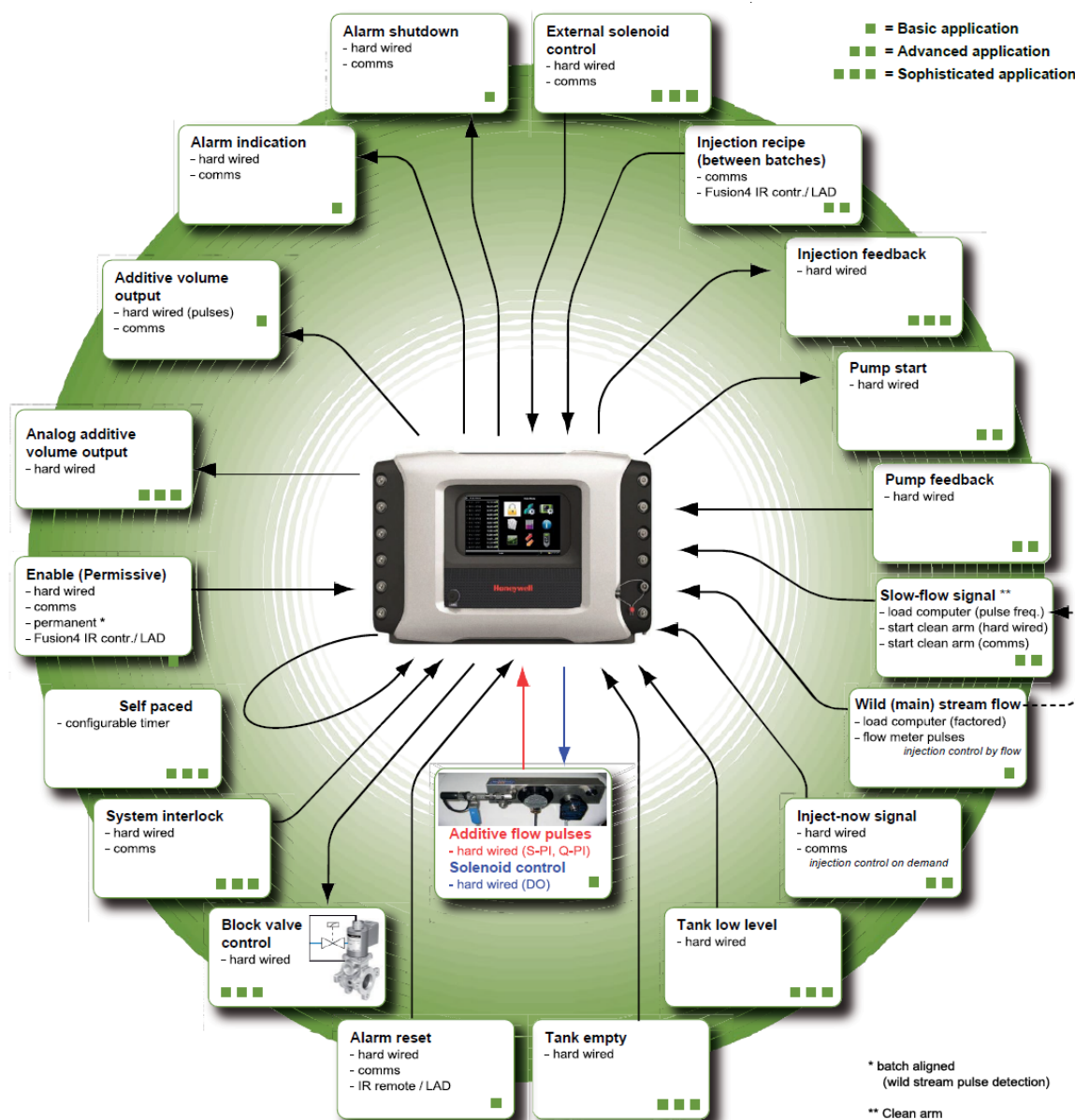


Figure 5-36: Diagnostics - comms info



## 5.8 Additive Injection Application Overview

The figure below illustrates the additive injection application for each stream. This overview is also applicable for all the streams (Stream 1-24).



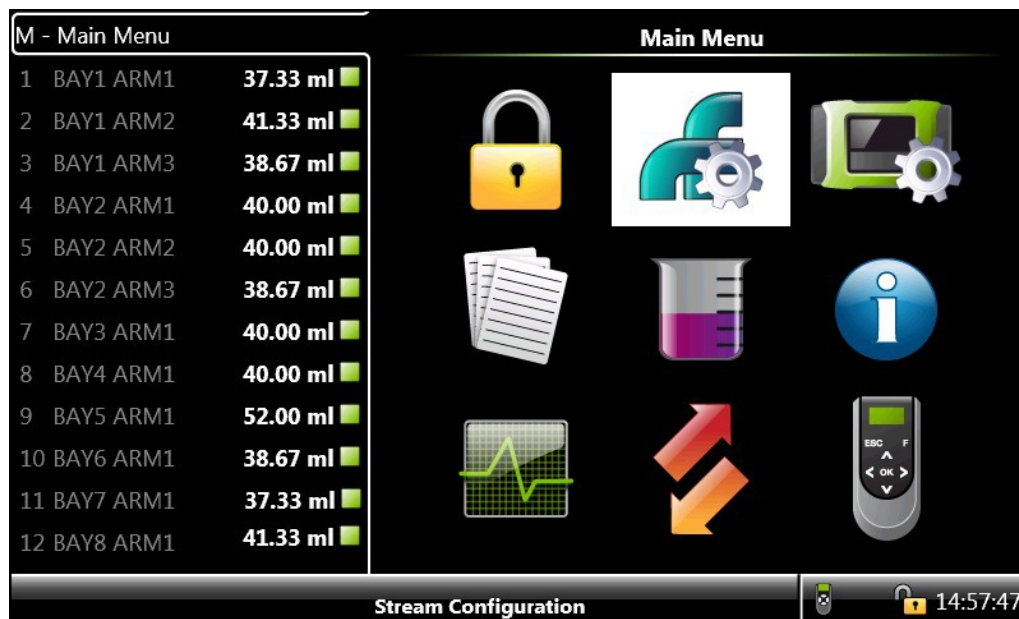
## 5.9 Stream Configuration

To perform the stream configuration process



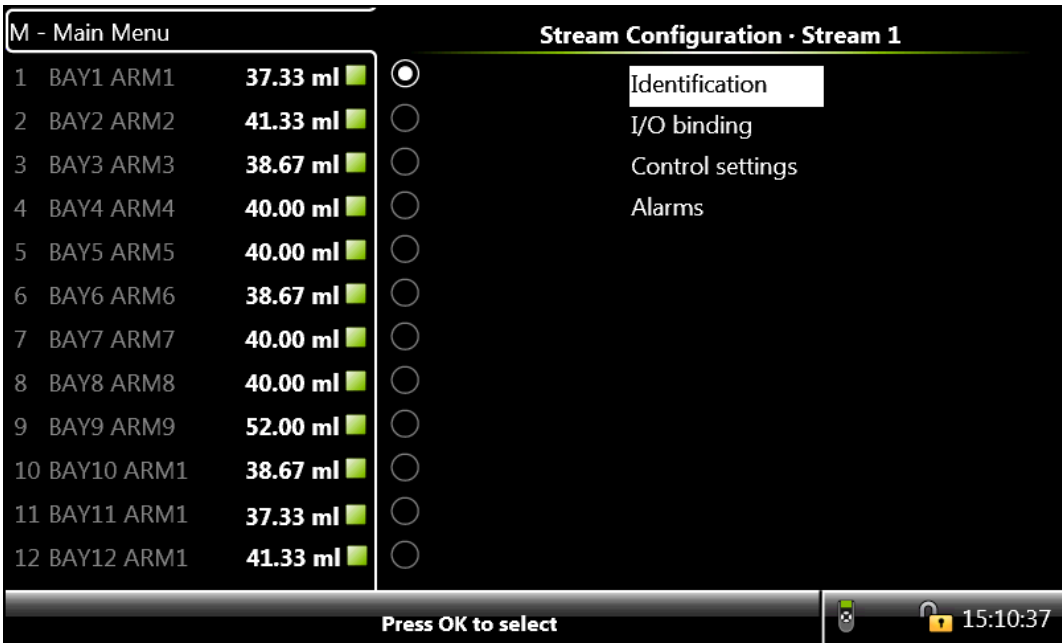
1. From the Main Menu screen, select the Stream Configuration icon.

The Stream Configuration screen appears, which displays the functions available for stream configuration.



2. From the Stream Configuration - Stream n screen, select each entity to configure the streams of the MSC-A.

See [Section 5.9.1: Stream Configuration - Stream n](#) for the detailed information about each entity.



## 5.9.1 Stream Configuration - Stream n

### 5.9.1.1 Stream Configuration - Stream n - Identification

From the Stream Configuration - Stream n screen, select <Identification>. The following entities are displayed.

Entity	Description	Value range
[Bay name]	<p>With this entity you can enter the name of the loading bay at which the MSC-A is located at the site.</p> <p>The Bay name appears on the running screens.</p>	<p>A text string of maximum 20 characters. Use maximum 7 characters in order to view the complete name on the MSC-A display screen.</p>

Entity	Description	Value range
[Arm name]	<p>With this entity you can enter the name of the loading arm at which the MSC-A is located at the site.</p> <p>The Arm name appears on the running screens.</p>	<p>A text string of maximum 20 characters. Use maximum 7 characters in order to view the complete name on the MSC-A screen.</p>
[Haz. Mat. Classification]	<p>With this entity you can specify the hazardous material classification. This entity describes the following:</p> <ul style="list-style-type: none"> <li>• Name of the product.</li> <li>• Character of the product (flammable, explosive, and so on).</li> <li>• Causes of potential harm to people or the environment.</li> <li>• Physical condition of the product (liquified, hot, compressed, and so on).</li> </ul>	<p>A common way to describe the dangerous or hazardous material defined in the ADR-code, which is defined by the "European Agreement concerning the International Carriage of Dangerous Goods by Road". The ADR code consist of a class and a four-digit UN-number.</p> <p>Example: &lt;ALLYL ALCOHOL, 6.1, UN 1098&gt;</p> <p>Product: Allyl alcohol</p> <p>Class = 6.1: Toxic substances UN number: 1098</p>
[Product name]	<p>With this entity you can enter the name of the wild stream product.</p> <p>The Product name appears on the running screens.</p>	<p>A text string of maximum 20 characters. Use maximum 12 characters in order to view the complete name on the MSC display screen.</p> <p>The default value is &lt;None&gt;.</p>







Entity	Description	Value range
[Product symbol]	With this entity you can select a symbol or icon which can be associated to identify the product of the wild stream. This icon appears on the running screens.	For the U.S.-related market, you can select from a list of API symbols. For the E.U.-related market, you can select from a list of EI symbols.
[Stream address]	With this entity you can assign an address in which a particular stream is addressed through comms entities.  Each stream should have a unique address.	The default value is <123>.
[Stream status]	With this entity you can enable/disable a stream.	<Enable> default  <Disable>






#### 5.9.1.1.1 Recipe Identification








In general, the recipe can be associated with a name [Product name]. To the configured additive recipe, a symbol or icon can be associated to identify the wild stream <Wild stream identification>. Both entities, [Product name] and <Wild stream identification>, appear on the running screen.





- For the U.S.-related market, select the product name from the list of API symbols as defined in: API Recommended Practice 1637, Third edition, July 2006.

The product symbols available are as follows:

Description	Menu text displayed	Symbol
High-grade unleaded gasoline	HGU gasoline	
Mid-grade unleaded gasoline	MGU gasoline	
Low grade unleaded gasoline	LGU gasoline	
Ultra low sulfur diesel	ULS diesel	
Low sulfur diesel	LS diesel	
High sulfur diesel	HS diesel	



Description	Menu text displayed	Symbol
Low sulfur no. 1 fuel oil	LS no. 1 fuel oil	
High sulfur no. 1 fuel oil	HS no. 1 fuel oil	
Low sulfur no. 2 fuel oil	LS no. 2 fuel oil	
High sulfur no. 2 fuel oil	HS no. 2 fuel oil	
Ultra low sulfur kerosene	ULS kerosene	

Description	Menu text displayed	Symbol
Low sulfur kerosene	LS kerosene	
High sulfur kerosene	HS kerosene	
E5 (5% Alcohol based fuel)	API E5	
E10 (10% Alcohol based fuel)	API E10	
E20 (20% Alcohol based fuel)	API E20	
B5 (5% Bio blended diesel)	API B5	
B10 (10% Bio blended diesel)	API B10	

Description	Menu text displayed	Symbol
B20 (20% Bio blended diesel)	API B20	
Used oil	Used Oil	
Observation or monitoring well	Monitoring well	
Vapor recovery	Vapor Recovery	







- For the E.U.-related market, select from the following list of symbols as defined in: Code of practice for a product identification system for petroleum products (Energy Institute).


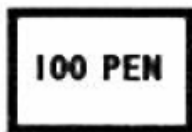


The product symbols available are as follows:

Description	Menu text displayed	Symbol
Lead Replacement Petrol	Lead repl. petrol	
Premium unleaded Petrol (95 octane)	PU petrol	



Description	Menu text displayed	Symbol
Super unleaded petrol (97 octane)	SU petrol	
E5 (5% ethanol, 95% petrol)	EU E5	
E10 (10% ethanol, 90% petrol)	EU E10	
E20 (20% ethanol, 80% petrol)	EU E20	
DERV	DERV	
B5 (5% FAME, 95% diesel)	EU B5	
B10 (10% FAME, 90% diesel)	EU B10	

Description	Menu text displayed	Symbol
B20 (20% FAME, 80% diesel)	EU B20	
Gas oil (marked heating oil)	Gas Oil	
Marine Gas Oil	Marine Gas Oil	
Ultra low sulfur gas oil (marked) (with less than 10 ppm sulfur)	ULS gas oil	
Marine destilates	Marine destilates	
Premium kerosine	Premium kerosine	
Regular kerosine	Regular kerosine	

Description	Menu text displayed	Symbol
Fuel oil: light, medium, heavy For example, HFO for heavy fuel oil	Fuel Oil	
Bitumen: penetration, cutback, oxidised For example, 100 PEN for 100 penetration	Bitumen	
FAME	FAME	
Fuel grade ethanol	Fuel Grade Ethanol	

## 5.9.2 Stream Configuration - Stream n - I/O Bindings

The new Flexible I/O Allocation architecture forms the basis of the Fusion4 product family. The architecture is designed around the common I/O building blocks that can be arranged in different configurations to be used in the MSC-A.

I/O allocation can either be performed through the IR controller through the infrared link or LAD connected to the MSC-A front connector.

**NOTE:** I/O bindings should be configured for each stream. Also, following entities should be unique for each stream.

- Additive stream meter
- Pump feedback
- Ext. solenoid
- Additive temperature
- Solenoid control
- Block valve
- Injection feedback
- Pump start
- Factored pulse out

To configure Input/Output entities

1. From the Main Menu screen, select the Stream Configuration icon.

The Stream Configuration screen appears.

2. Form the Stream Configuration screen, select <I/O binding>.
3. Select <Inputs> or <Outputs> and then select <OK> on the IR controller or LAD.

A specific entity, for example [Pacing source], [Pump feedback], and so on can be selected and linked to a specific I/O function such as <DI AC 1> (Digital Input AC1, number 1), <DO EMR> (Digital Output Electrome- chanical Relay), and so on.

The following table provides the possible entities and the I/O functions to which a specific entity can be linked.

**NOTE:** The available Inputs/Outputs provided in the table are explained using the Expansion Pack 3 License. If the purchased license is different, the number of Inputs/Outputs available varies based on the actual hardware and the license installed.

Inputs/ Outputs	Entity	Can be linked to...
Inputs  <b>NOTE:</b> The default value for the Input entities are None.	[Pacing source]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, Comms, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None
	[Additive stream meter]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, None

Inputs/ Outputs	Entity	Can be linked to...
	[Permissive]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, Comms, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None

Inputs/ Outputs	Entity	Can be linked to...
	[System interlock]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, Comms, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None

Inputs/ Outputs	Entity	Can be linked to...
	[Alarm reset]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None



Inputs/ Outputs	Entity	Can be linked to...
	[Slow flow signal]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, Comms, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None

Inputs/ Outputs	Entity	Can be linked to...
	[Pump feedback]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None

Inputs/ Outputs	Entity	Can be linked to...
	[Tank low level switch]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None

Inputs/ Outputs	Entity	Can be linked to...
	[Tank empty switch]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None
	[Additive temperature]	RTD-1, RTD-2, RTD-3, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, RTD-4, RTD-5, RTD-6, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, None

Inputs/ Outputs	Entity	Can be linked to...
	[Ext. solenoid control]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, Comms, AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12, None

Inputs/ Outputs	Entity	Can be linked to...
Outputs  <b>NOTE:</b> The default value for the Output entities are None, except for Solenoid control entity.	[Solenoid control]	DO-SSR-1, DO-SSR-2, DO-SSR-3, DO-SSR-4, DO-SSR-5, DO-SSR-6, DO-SSR-7, DO-SSR-8, DO-SSR-9, DO-SSR-10, DO-SSR-11, DO-SSR-12, PO-1, PO-2, DO-EMR-1, DO-EMR-2, DO-EMR-3, DO-EMR-4, DO-EMR-5, DO-EMR-6, DO-EMR-7, DO-EMR-8, DO-EMR-9, DO-EMR-10, DO-SSR-13, DO-SSR-14, DO-SSR-15, DO-SSR-16, DO-EMR-11, DO-EMR-12, DO-EMR-13, DO-EMR-14, DO-EMR-15, DO-EMR-16, DO-EMR-17, DO-EMR-18, DO-EMR-19, DO-EMR-20, DO-SSR-17, DO-SSR-18, DO-SSR-19, DO-SSR-20, DO-SSR-21, DO-SSR-22, DO-SSR-23, DO-SSR-24, DO-SSR-25, DO-SSR-26, DO-SSR-27, DO-SSR-28, DO-SSR-29, DO-SSR-30, DO-SSR-31, DO-SSR-32, PO-3, PO-4, DO-EMR-21, DO-EMR-22, DO-EMR-23, DO-EMR-24, DO-EMR-25, DO-EMR-26, DO-EMR-27, DO-EMR-28, DO-EMR-29, DO-EMR-30, DO-SSR-33, DO-SSR-34, DO-SSR-35, DO-SSR-36, DO-EMR-31, DO-EMR-32, DO-EMR-33, DO-EMR-34, DO-EMR-35, DO-EMR-36, DO-EMR-37, DO-EMR-38, DO-EMR-39, DO-EMR-40, DO-SSR-37, DO-SSR-38, DO-SSR-39, DO-SSR-40, None

Inputs/ Outputs	Entity	Can be linked to...
	[Alarm indication]	DO-SSR-1, DO-SSR-2, DO-SSR-3, DO-SSR-4, DO-SSR-5, DO-SSR-6, DO-SSR-7, DO-SSR-8, DO-SSR-9, DO-SSR-10, DO-SSR-11, DO-SSR-12, PO-1, PO-2, DO-EMR-1, DO-EMR-2, DO-EMR-3, DO-EMR-4, DO-EMR-5, DO-EMR-6, DO-EMR-7, DO-EMR-8, DO-EMR-9, DO-EMR-10, DO-SSR-13, DO-SSR-14, DO-SSR-15, DO-SSR-16, DO-EMR-11, DO-EMR-12, DO-EMR-13, DO-EMR-14, DO-EMR-15, DO-EMR-16, DO-EMR-17, DO-EMR-18, DO-EMR-19, DO-EMR-20, DO-SSR-17, DO-SSR-18, DO-SSR-19, DO-SSR-20, DO-SSR-21, DO-SSR-22, DO-SSR-23, DO-SSR-24, DO-SSR-25, DO-SSR-26, DO-SSR-27, DO-SSR-28, DO-SSR-29, DO-SSR-30, DO-SSR-31, DO-SSR-32, PO-3, PO-4, DO-EMR-21, DO-EMR-22, DO-EMR-23, DO-EMR-24, DO-EMR-25, DO-EMR-26, DO-EMR-27, DO-EMR-28, DO-EMR-29, DO-EMR-30, DO-SSR-33, DO-SSR-34, DO-SSR-35, DO-SSR-36, DO-EMR-31, DO-EMR-32, DO-EMR-33, DO-EMR-34, DO-EMR-35, DO-EMR-36, DO-EMR-37, DO-EMR-38, DO-EMR-39, DO-EMR-40, DO-SSR-37, DO-SSR-38, DO-SSR-39, DO-SSR-40, None

Inputs/ Outputs	Entity	Can be linked to...
	[Alarm shutdown]	DO-SSR-1, DO-SSR-2, DO-SSR-3, DO-SSR-4, DO-SSR-5, DO-SSR-6, DO-SSR-7, DO-SSR-8, DO-SSR-9, DO-SSR-10, DO-SSR-11, DO-SSR-12, PO-1, PO-2, DO-EMR-1, DO-EMR-2, DO-EMR-3, DO-EMR-4, DO-EMR-5, DO-EMR-6, DO-EMR-7, DO-EMR-8, DO-EMR-9, DO-EMR-10, DO-SSR-13, DO-SSR-14, DO-SSR-15, DO-SSR-16, DO-EMR-11, DO-EMR-12, DO-EMR-13, DO-EMR-14, DO-EMR-15, DO-EMR-16, DO-EMR-17, DO-EMR-18, DO-EMR-19, DO-EMR-20, DO-SSR-17, DO-SSR-18, DO-SSR-19, DO-SSR-20, DO-SSR-21, DO-SSR-22, DO-SSR-23, DO-SSR-24, DO-SSR-25, DO-SSR-26, DO-SSR-27, DO-SSR-28, DO-SSR-29, DO-SSR-30, DO-SSR-31, DO-SSR-32, PO-3, PO-4, DO-EMR-21, DO-EMR-22, DO-EMR-23, DO-EMR-24, DO-EMR-25, DO-EMR-26, DO-EMR-27, DO-EMR-28, DO-EMR-29, DO-EMR-30, DO-SSR-33, DO-SSR-34, DO-SSR-35, DO-SSR-36, DO-EMR-31, DO-EMR-32, DO-EMR-33, DO-EMR-34, DO-EMR-35, DO-EMR-36, DO-EMR-37, DO-EMR-38, DO-EMR-39, DO-EMR-40, DO-SSR-37, DO-SSR-38, DO-SSR-39, DO-SSR-40, None



Inputs/ Outputs	Entity	Can be linked to...
	[Block valve control]	DO-SSR-1, DO-SSR-2, DO-SSR-3, DO-SSR-4, DO-SSR-5, DO-SSR-6, DO-SSR-7, DO-SSR-8, DO-SSR-9, DO-SSR-10, DO-SSR-11, DO-SSR-12, PO-1, PO-2, DO-EMR-1, DO-EMR-2, DO-EMR-3, DO-EMR-4, DO-EMR-5, DO-EMR-6, DO-EMR-7, DO-EMR-8, DO-EMR-9, DO-EMR-10, DO-SSR-13, DO-SSR-14, DO-SSR-15, DO-SSR-16, DO-EMR-11, DO-EMR-12, DO-EMR-13, DO-EMR-14, DO-EMR-15, DO-EMR-16, DO-EMR-17, DO-EMR-18, DO-EMR-19, DO-EMR-20, DO-SSR-17, DO-SSR-18, DO-SSR-19, DO-SSR-20, DO-SSR-21, DO-SSR-22, DO-SSR-23, DO-SSR-24, DO-SSR-25, DO-SSR-26, DO-SSR-27, DO-SSR-28, DO-SSR-29, DO-SSR-30, DO-SSR-31, DO-SSR-32, PO-3, PO-4, DO-EMR-21, DO-EMR-22, DO-EMR-23, DO-EMR-24, DO-EMR-25, DO-EMR-26, DO-EMR-27, DO-EMR-28, DO-EMR-29, DO-EMR-30, DO-SSR-33, DO-SSR-34, DO-SSR-35, DO-SSR-36, DO-EMR-31, DO-EMR-32, DO-EMR-33, DO-EMR-34, DO-EMR-35, DO-EMR-36, DO-EMR-37, DO-EMR-38, DO-EMR-39, DO-EMR-40, DO-SSR-37, DO-SSR-38, DO-SSR-39, DO-SSR-40, None

Inputs/ Outputs	Entity	Can be linked to...
	[Injection feedback]	DO-SSR-1, DO-SSR-2, DO-SSR-3, DO-SSR-4, DO-SSR-5, DO-SSR-6, DO-SSR-7, DO-SSR-8, DO-SSR-9, DO-SSR-10, DO-SSR-11, DO-SSR-12, PO-1, PO-2, DO-EMR-1, DO-EMR-2, DO-EMR-3, DO-EMR-4, DO-EMR-5, DO-EMR-6, DO-EMR-7, DO-EMR-8, DO-EMR-9, DO-EMR-10, DO-SSR-13, DO-SSR-14, DO-SSR-15, DO-SSR-16, DO-EMR-11, DO-EMR-12, DO-EMR-13, DO-EMR-14, DO-EMR-15, DO-EMR-16, DO-EMR-17, DO-EMR-18, DO-EMR-19, DO-EMR-20, DO-SSR-17, DO-SSR-18, DO-SSR-19, DO-SSR-20, DO-SSR-21, DO-SSR-22, DO-SSR-23, DO-SSR-24, DO-SSR-25, DO-SSR-26, DO-SSR-27, DO-SSR-28, DO-SSR-29, DO-SSR-30, DO-SSR-31, DO-SSR-32, PO-3, PO-4, DO-EMR-21, DO-EMR-22, DO-EMR-23, DO-EMR-24, DO-EMR-25, DO-EMR-26, DO-EMR-27, DO-EMR-28, DO-EMR-29, DO-EMR-30, DO-SSR-33, DO-SSR-34, DO-SSR-35, DO-SSR-36, DO-EMR-31, DO-EMR-32, DO-EMR-33, DO-EMR-34, DO-EMR-35, DO-EMR-36, DO-EMR-37, DO-EMR-38, DO-EMR-39, DO-EMR-40, DO-SSR-37, DO-SSR-38, DO-SSR-39, DO-SSR-40, None

Inputs/ Outputs	Entity	Can be linked to...
	[Pump start]	DO-SSR-1, DO-SSR-2, DO-SSR-3, DO-SSR-4, DO-SSR-5, DO-SSR-6, DO-SSR-7, DO-SSR-8, DO-SSR-9, DO-SSR-10, DO-SSR-11, DO-SSR-12, PO-1, PO-2, DO-EMR-1, DO-EMR-2, DO-EMR-3, DO-EMR-4, DO-EMR-5, DO-EMR-6, DO-EMR-7, DO-EMR-8, DO-EMR-9, DO-EMR-10, DO-SSR-13, DO-SSR-14, DO-SSR-15, DO-SSR-16, DO-EMR-11, DO-EMR-12, DO-EMR-13, DO-EMR-14, DO-EMR-15, DO-EMR-16, DO-EMR-17, DO-EMR-18, DO-EMR-19, DO-EMR-20, DO-SSR-17, DO-SSR-18, DO-SSR-19, DO-SSR-20, DO-SSR-21, DO-SSR-22, DO-SSR-23, DO-SSR-24, DO-SSR-25, DO-SSR-26, DO-SSR-27, DO-SSR-28, DO-SSR-29, DO-SSR-30, DO-SSR-31, DO-SSR-32, PO-3, PO-4, DO-EMR-21, DO-EMR-22, DO-EMR-23, DO-EMR-24, DO-EMR-25, DO-EMR-26, DO-EMR-27, DO-EMR-28, DO-EMR-29, DO-EMR-30, DO-SSR-33, DO-SSR-34, DO-SSR-35, DO-SSR-36, DO-EMR-31, DO-EMR-32, DO-EMR-33, DO-EMR-34, DO-EMR-35, DO-EMR-36, DO-EMR-37, DO-EMR-38, DO-EMR-39, DO-EMR-40, DO-SSR-37, DO-SSR-38, DO-SSR-39, DO-SSR-40, None
	[Factored pulse out]	PO-1, PO-2, PO-3, PO-4, None

### 5.9.2.1 Inputs

Entity	Description	Value range
[Pacing source]	With this entity you can select the physical source for the additive pacing.	See <a href="#">Section 5.9.2: Stream Configuration - Stream n - I/O Bindings</a>
[Additive stream meter]	With this entity you can select the physical pulse input for an additive pulse input.	
[Permissive]	With this entity you can select the physical source for the permissive function.	
[System interlock]	With this entity you can select the physical source for a system interlock or second permissive function.	
[Alarm reset]	With this entity you can select the physical source for the alarm reset function.	
[Slow flow signal]	With this entity you can select the physical source for the slow flow signal.	
[Pump feedback]	With this entity you can select physical source for the pump feedback function.	
[Tank low level switch]	With this entity you can select the physical source for the tank low level function.	
[Tank empty switch]	With this entity you can select the physical source for the tank empty function.	
[Additive temperature]	With this entity you can select the physical source for the additive stream temperature measurement.	
[Ext. solenoid control]	With this entity you can select the physical source for the external solenoid control function.	

### 5.9.2.1.1 Pacing Source I/O Binding

The Guidant line of injectors utilizes the product pacing signals that are pulse-signal based. Pacing consists of either AC, one pulse per injection cycle, or DC, multiple pulses per unit volume product signaling. This pacing signal accumulates product volume in the injector electronic controller and causes it to periodically inject additive to “keep pace” with the customer’s recipe requirements.

Six additive injection modes of operation are supported. The mode of operation is determined by configuration the following three entities.

1. Additive mode
2. [Pacing source] I/O binding
3. [Ext. solenoid control] I/O binding

The requirements for each of these modes are as follows:

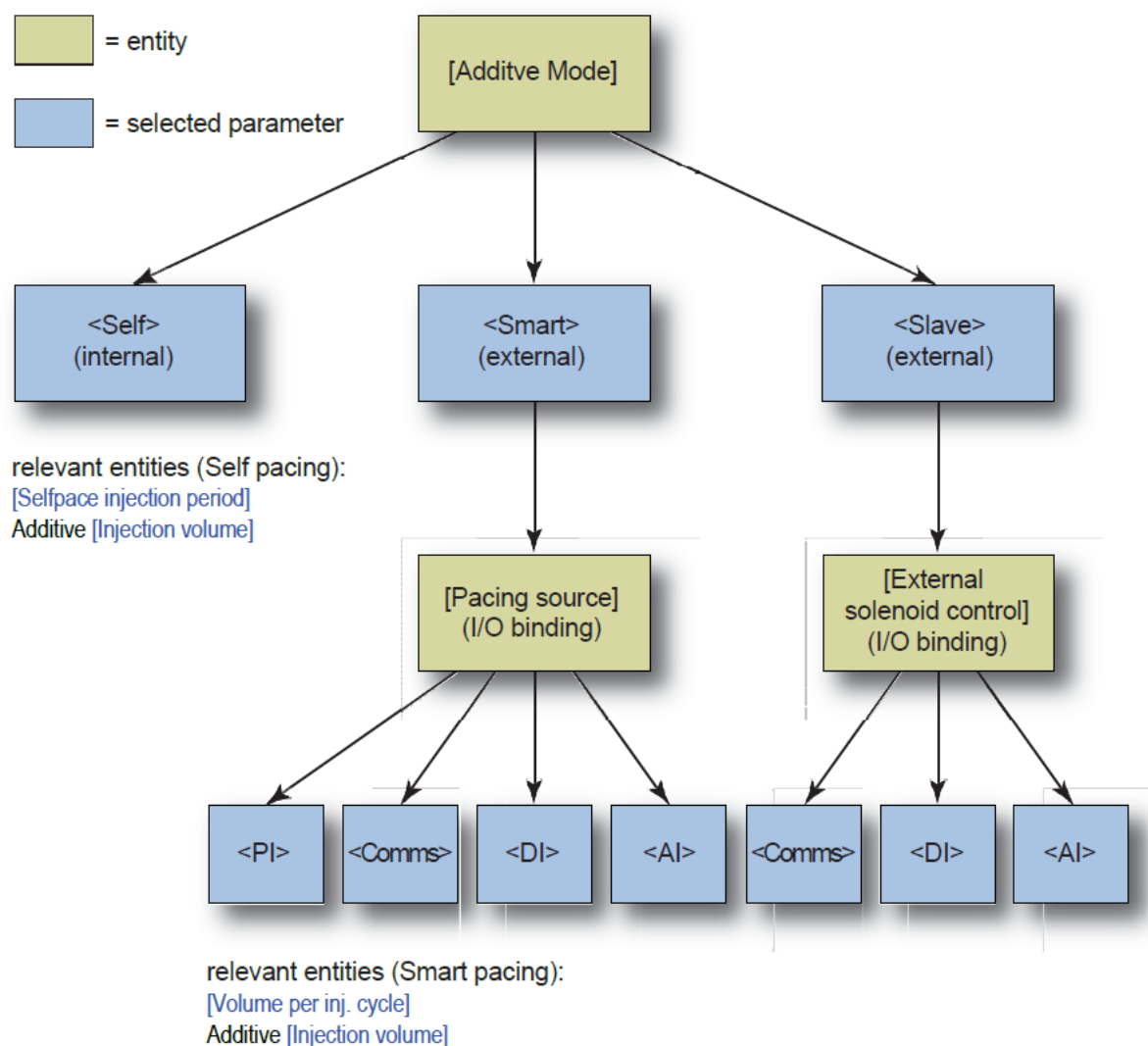
- Smart product pulse - Measures the wild stream by the pulse input.
  - [Additive mode] = Smart
  - [Pacing source] I/O Binding = PI
  - [Ext. solenoid control] I/O Binding = N/A
- Smart analog pulse - Measures the wild stream flow by the analog input.
  - [Additive mode] = Smart
  - [Pacing source] I/O Binding = AI
  - [Ext. solenoid control] I/O Binding = N/A
- Smart inject (DI) - Injects with the digital input
  - [Additive mode] = Smart
  - [Pacing source] I/O Binding = Any Digital Input
  - [Ext. solenoid control] I/O Binding = N/A
- Smart Inject (Comms) - Controlled by the comms.

- [Additive mode] = Smart
- [Pacing source] I/O Binding = Comms
- [Ext. solenoid control] I/O Binding = N/A
- Slave inject pulse - Additive solenoid controlled by the digital input.
  - [Additive mode] = Slave
  - [Pacing source] I/O Binding = N/A
  - [Ext. solenoid control] I/O Binding = any Digital Input
- Slave (Comms) - Additive solenoid controlled by comms.
  - [Additive mode] = Slave
  - [Pacing source] I/O Binding = N/A
  - [Ext. solenoid control] I/O Binding = Comms
- Self paced - Internal pacing. That is, no external pacing sources are available.
  - [Additive mode] = Self
  - [Pacing source] I/O Binding = N/A
  - [Ext. solenoid control] I/O Binding = N/A

**NOTE:** For self paced mode the configuration of the [Pacing source] I/O Binding is NOT relevant.

Number of Pulse inputs needed plays a role in determining number of usable streams. 2 Pulse Inputs are needed per stream in Smart Pulse mode and 1 in all other modes.

Figure 5-37: Additive pacing mode selection



#### 5.9.2.1.1.1 Smart

The Smart mode offers four different options, which can be selected by the [Pacing source] I/O binding entity.

- Pulse Input (PI) mode

In this mode, the MSC-A measures the wild stream.

The [Volume per inj cycle] entity determines when an injection is started. The amount of additive volume is determined by setting the additive [Injection volume] entity. The k-factor of the pacing pulse is determined by setting the [K-factor] entity.

- Comms mode

On receipt of a trigger message from an RS-485 source (Comms), the MSC-A injects the proper amount of additive into the wild stream. The amount of additive can be configured by the additive [Injection volume] entity.

- Digital Input (DI) mode

On receipt of a trigger signal from an Digital Input (DI) source, the MSC-A injects the proper amount of additive into the wild stream. The amount of additive can be configured by the additive [Injection volume] entity.

- Analog Input (AI) mode

In this mode the MSC-A receives wild stream flow from an Analog Input (AI) source. The [Volume per inj cycle] entity determines when an injection is started. The amount of additive volume is determined by setting the additive [Injection volume] entity.

**NOTE:** MSC-A provides the following modes of operation in case of hardwired pacing signals:

- Smart-Pulse Input Mode

- In this mode the I/O binding pacing source is set to Pulse Input. The Wild Stream Input/Product Pulse/DI pacing signal should be connected to the appropriate Pulse Input terminals on the FM- ARM card.
- Product pacing pulses are divided by a wild stream k-factor value to determine the volume of the product that has flowed. Program the wild stream k factor accordingly. If the k factor is 0.025, then each pulse results in 40 gallons of product that has flowed.
- Volume per injection cycle entity decides the number of times to inject. If you want the injector to inject at every 80 gallons, program the entity as 80.

**NOTE:** In case of 1-to-1 injection frequency, where the k factor is programmed to be less than 1, use an offset of around 90%, so that the incoming pulses are not removed.

- Smart-Digital Input Mode



- In this mode the I/O binding pacing source is set to any available Digital DC/AC input. In this case the AC or DC pacing signal should be connected to the appropriate terminals on the IN-OUT board.
- In this mode only the trigger input appearing on the DC/AC input decides the number of times to inject, so that there is an injection on every rising edge on the input.
- The volume per injection cycle is only used to increment the wild stream volume at every pulse that is received on the digital input. If the entity is 40 gallons, every inject pulse increments the wild stream volume by 40.
- If it is expected that an injection should occur at every 80 gallons, the digital input should provide a pulse accordingly after every 80 gallons of the product flow.
- The volume per injection cycle entity should be programmed only to match the wild stream volume with the actual product volume that flows.

**NOTE:** The mode in this entity does not decide how often to inject. Also, in this mode the product K factor is not used.

#### 5.9.2.1.1.2 Inject-Now Signal

The [Pacing source] I/O binding is used for determining the operational mode of the additive injector. If the pacing source I/O binding is set to

<Pulse input>, then the wild stream flow is monitored to determine when to inject. This is performed through a hard-wired connection from the pulse source to the single-pulse input or dual-pulse input of the MSC-A.

When the pacing source is a <Digital input> function, then the input works as an “inject now” indication to the controller. Any low-to-high transition on an “inject now” input results in an injection cycle.

When the pacing source is an <Analog input> function, then the Analog input is used in a digital mode to indicate the “inject now” signal. Any low-to-high transition on an “inject now” input results in an injection cycle.

The [Pacing source] I/O binding can also be set to <Comms>, which means the “inject now” indication is sent to the controller through a message received by the

controller's serial port. The "inject now" message is supported by several serial communication protocols.

#### 5.9.2.1.1.3 Slave

In this case, the solenoid is controlled by an external device. The MSC-A receives a command to open the solenoid. The solenoid then remains open until the MSC-A receives a command to close it again. This command signal can be received either from a Comms (RS-485), a DI (Digital Input), or an AI (Analog Input) source.

This can be configured by the [Ext. solenoid control] I/O binding entity.

**NOTE:** In slave mode, the MSC-A electronics provide a local display of additive volume usage and meter calibration functions, but DOES NOT provide additive injection control. Injection-volume control must be provided by an external source such as a PLC or data system. When the pacing-signal input is ON (voltage present), the solenoid-control output is ON. The external controlling system must accumulate additive flow and determine when to close the solenoid by turning off the pacing-signal input to the MSC-A.

#### 5.9.2.1.1.4 Self

In situations where no pacing signals are available from outside sources like flow meters or other instruments, the MSC-A can be configured to the Self-paced mode. In this mode, the MSC-A injects on a time and fluid volume basis.

The Self-paced mode uses an internal timer, which can be configured by the [Selfpace injection period] entity. On expiration of each timer cycle, an injection is initiated. The volume per injection can be configured by the additive [Injection volume] entity.

#### 5.9.2.1.1.5 Enable Permissive

All transactions start when the stream permissive conditions is <True>, and they stop when the stream permissive is <False>. The [Permissive] I/O binding defines three general means of permissive configuration for the device.

The value of the [Permissive] I/O binding can be one of the following values:

- None – If the [Permissive] I/O binding is set to “None” then the permissive is internally active, based upon the injector mode.
- Smart analog (Analog mode)
  - Transaction start condition – When the wild stream volume is greater than the [Min. transaction volume] entity.
  - Transaction end condition – When the wild stream flow rate is less than the low flow rate for an amount of time defined by the [End transaction time] entity.
- Smart product pulse
  - Transaction start condition – When the wild stream volume is greater than the [Min. transaction volume] entity.
  - Transaction end condition – When the wild stream flow rate is less than the low flow rate for an amount of time defined by the [End transaction time] entity.
- Smart inject (DI or Comms)
  - Transaction start condition – When the first inject signal is received.
  - Transaction end condition – When there is no inject signals for an amount of time defined by the [End transaction time] entity.
- Slave (DI or Comms)
  - Transaction start condition – When the first solenoid-open condition is detected.
  - Transaction end condition – When there is no solenoid open condition detected for an amount of time defined by the [End transaction time] entity.
- Self paced – Not applicable
- Comms – 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.
- Digital Input – Regardless of the injection mode.
  - Transaction start condition – When the digital input is active.
  - Transaction end condition – When the digital input is inactive.

#### 5.9.2.1.2 Enable Secondary Permissive (System Interlock)

- An optional secondary interlock can be defined with an I/O binding.
- The secondary interlock can be used as a secondary permissive signal and combined with the normal permissive signal through a logical AND or OR function.
  - If the permissive condition is OR, then the device is enabled when either (or both) the permissive or secondary interlock is/are <True>.
  - If the permissive condition is AND, then the device is enabled when both the permissive and secondary interlock are <True>.
- If the secondary interlock I/O binding is not defined, then secondary interlock is not used and the permissive condition is not applicable.

#### 5.9.2.1.3 Alarm Reset

- Any active alarms should be resetable through any one of the following three methods:
  - Hard wired digital input defined by [Alarm reset] I/O binding.
  - Serial Comms command.
  - IR Controller/LAD, through the alarm summary screen.

#### 5.9.2.1.4 Wild Stream Low Flow (Slow-Flow Signal/Clean Arm)

- If the flush volume entity [Number of clean start cycles] is greater than zero, then the [Wild stream low flow] I/O binding is defined, and if you are running in a "smart" injector mode then the clean-arm functionality is enabled.

- A clean-arm transaction intentionally over-injects at the start of a transaction for a number of cycles.
- The over-inject quantity per injection = flush volume/number of clean start cycles.
- The number of over-injection cycles is configured by the [Number of clean start cycles] entity.
- During a clean-arm transaction, the slow-flow signal must be provided towards the end of the transaction. When the slow-flow signal is active, the injections stops.
- If the wild stream volume dispensed after the slow-flow signal is active than the flush volume, then a flush-volume alarm should be generated at the end of the transaction.
- If the wild stream flow rate is greater than the high-flow threshold, then the controller should assume a high-flow state.
- The slow-flow signal can be configured through an I/O binding. The determination of the slow-flow state depends on this I/O binding.
  - PI – Indicates the wild stream flow rate which is used for determining the slow-flow condition. If the wild stream flow rate is less than the slow-flow rate threshold, then the controller should assume a slow-flow state.
  - DI – Indicates the active slow-flow digital input signal which indicates when the MSC-A should assume a slow-flow state.
  - Comms – Indicates a serial command which is used for entering the slow-flow state.

#### 5.9.2.1.5 Pump Feedback

- If the additive [Pump feedback] I/O binding is defined, then the controller should generate an error if the pump indication input is inactive after the pump demand is active.
- The allowable delay is defined by the [Pump feedback timeout] entity (defined in the alarm settings submenu for this alarm).

#### 5.9.2.1.6 Slave Solenoid (External Solenoid Control)

In this case, the solenoid is controlled by an external device. The MSC-A receives a command to open the solenoid. The solenoid then remains open until the MSC-A receives a command to close it again. This command signal can be received either from a Comms (RS-485), a DI (Digital Input), or an AI (Analog Input) source.

This can be configured by the [Ext. solenoid control] I/O binding entity.

#### 5.9.2.1.7 Tank low level switch

Supply-tank level monitoring is useful in applications where a very small supply tank is used. This is typical in portable or mobile applications such as truck-mounted systems.

By monitoring a hardware input connected to a level switch in the supply tank, the controller can detect when the level in the tank is nearing empty, and take appropriate action. This prevents the pump from running completely dry, and prevents fueling operations from being interrupted mid-load.

The tank-level signals used should provide a simple form contact closure upon detection of a low level (in excess of some low point) in the supply tank.

Consideration should be given to the pump intake position in the tank and to the amount of blend volume required for a normal fuel delivery.

The switch-activation level should be positioned so that it is slightly higher than the level required for normal delivery. If the tank low-level switch indicates “low” immediately upon the start of the delivery, there is still an adequate volume in the tank to allow the delivery to complete prior to the pump inlet drawing air.

If the low-level condition exists, the MSC-A can operate under normal condition. To clear the tank low-level signal, the tank must be refilled to a point that closes the level switch. At that time, the alarm disappears. There is no need to reset the condition as with normal alarms.

#### 5.9.2.1.8 Tank empty switch

If the tank-empty condition exists, the MSC-A cannot operate under normal condition. To clear the tank-empty signal, the tank must be refilled to a point that closes the level switch. At that instance, the alarm disappears and the MSC-A resumes to normal use. It is not required to reset the condition with normal alarms.

## 5.9.2.2 Outputs

Entity	Description	Value range
[Solenoid control]	With this entity you can select the physical source for the additive solenoid control function.	See <a href="#">Section 5.9.2: Stream Configuration - Stream n - I/O Bindings</a>
[Alarm indication]	With this entity you can select the physical source for the alarm indication function.	
[Alarm shutdown]	With this entity you can select the physical source for the alarm shutdown function.	
[Block valve control]	With this entity you can select the physical source for the block valve control function.	
[Injection feedback]	With this entity you can select the physical source for the injection feedback function.	
[Pump start]	With this entity you can select the physical source for the additive pump start function.	
[Factored pulse out]	With this entity you can select the physical source for the factored pulse out function.	

### 5.9.2.2.1 Solenoid Control

In any operation modes, the additive solenoid should be opened and closed when an additive injection trigger (or solenoid open/close signal) is received.

### 5.9.2.2.2 Alarm Indication

If [Alarm action] is set to <Display>, the following actions occur:

- The [Alarm indication] output is set to ON.
- Alarm appears on the display.

### 5.9.2.2.3 Alarm Shutdown

If [Alarm action] is set to <Display shutdown>, the following actions occur:

- The [Alarm indication] output is set to ON.
- Alarm appears on the display.
- [Alarm shutdown] output is set to ON.
- Running transactions are stopped.
- Start-up of new transactions is impossible.

### 5.9.2.2.4 Block Valve Control

- If the [Block valve] I/O binding is defined, then the block valve output should be active when the permissive is <True>.
- The block valve should remain active until the stream permissive is <False>.

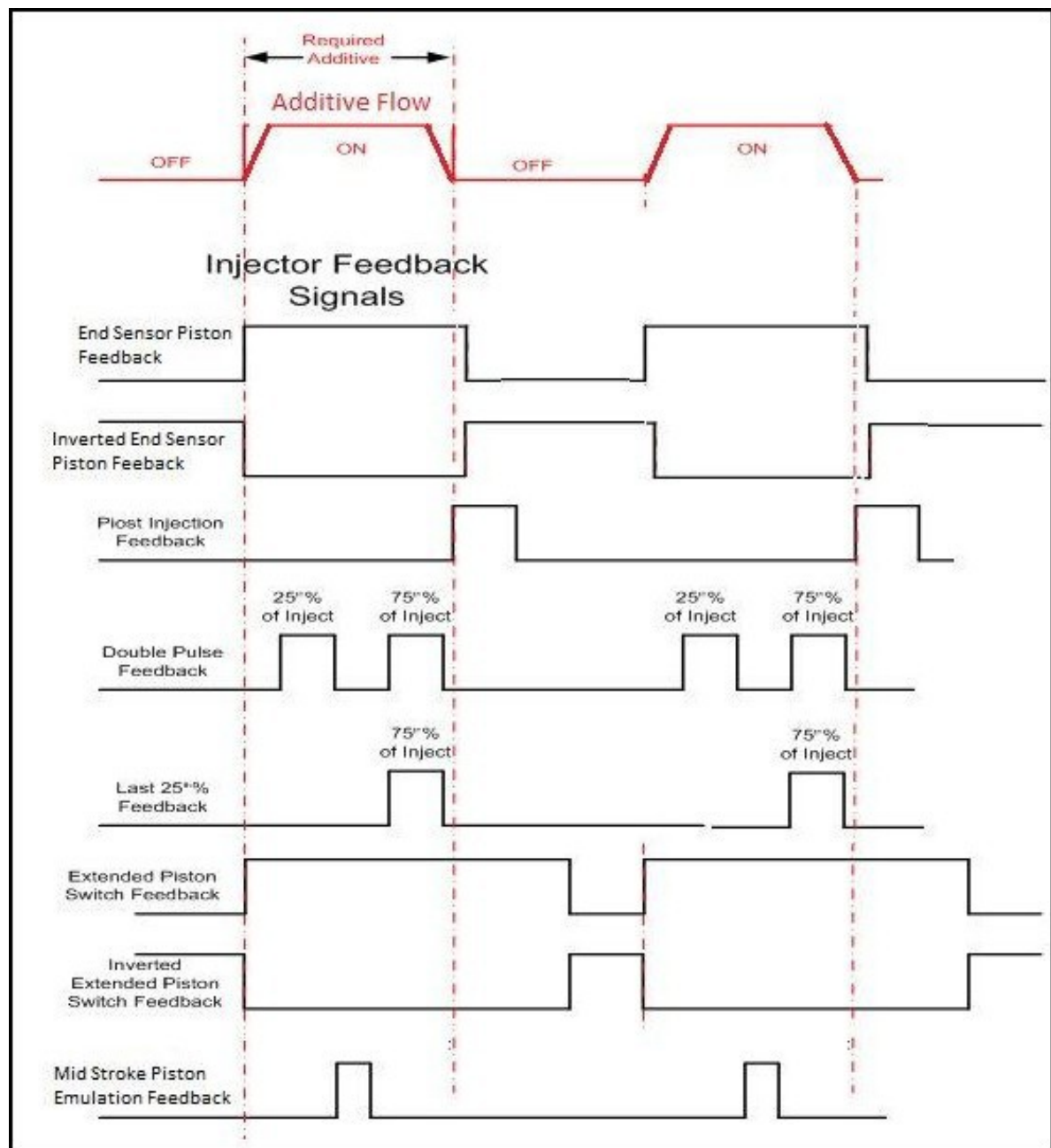
### 5.9.2.2.5 Injection Feedback

- This functionality is enabled by defining the additive injector feedback I/O binding.
- Some injector-feedback modes produce pulses of a fixed length. For these modes, the length of the pulse is determined by the feedback pulse duration entity. The modes in which this setting is applicable are marked as underscored *italic*.
- The specific behavior of the additive injector feedback is defined by entities located in the Solenoid submenu.
  - Piston Switch – The injector feedback output is active as long as the additive injection solenoid is active.
  - Inverted piston switch – The injector output is inactive as long as the additive injector solenoid is active (inverse of previous mode).
  - Post injection – A pulse is generated as soon as the additive injector solenoid becomes inactive.



- Double pulse – A pulse is generated after 25% of the injection volume is injected during an injection cycle. Another pulse is generated after 75% of injection volume has been injected.
- Last 25% – A pulse is generated after 75% of the injection volume is injected.
- Extended piston switch – The injector feedback is active for the complete period during which the additive injection solenoid is active and some additional time (the time equal to the feedback pulse duration entity).
- Inverted extended piston switch – The inverse of extended piston switch mode.
- End sensor piston emulation feedback - It describes the behavior of a piston emulation control signal when configured for end- sensor emulation. When configured, the feedback signal changes its state whenever an injection is started. The state of the feedback signal follows the piston emulation control signal, but it changes its state only when the actual additive flow is detected after the additive injection is activated. The feedback output changes from its state when 25% of the injection is distributed.
- Inverted end sensor piston emulation feedback - The inverse of end sensor piston emulation feedback mode.
- Mid stroke piston emulation feedback - It describes the behavior of a piston emulation control signal when configured for mid- stroke emulation. When configured, a pulse is created whenever an additive injection is started. The pulse is generated after 50% of the injection is dispatched and the length is as per the configured "Pulse duration".

Figure 5-38: Injector feedback signals



#### 5.9.2.2.6 Pump Start

Additive pump start output should be driven high when the permissive becomes <True> (if the [Pump start] I/O binding is defined).

- The pump is deactivated when the permissive becomes <False> and when you are not receiving wild stream pulses for a time-out period in minutes.

### 5.9.2.2.7 Factored Pulse Output

- This functionality is enabled by defining the [Factored pulse out] I/O binding.
- When the functionality is enabled, the output is driven based upon the transaction additive volume and the factored pulse output setting.
- The factored pulse output setting can be one of the following values:
  - 1 pulse for each unit of additive volume dispensed.
  - 10 pulses for each unit of additive volume dispensed.
  - 100 pulses for each unit of additive volume dispensed.
  - 1000 pulses for each unit of additive volume dispensed.
- The unit of volume is defined by the device unit of volume configuration entity and not by the additive volume unit entity.
- The maximum frequency of the pulse output channel is 300 Hz.

## 5.9.3 Stream Configuration - Stream n - Control Settings

### 5.9.3.1 Additive control

Entity	Description	Value range
[Additive mode]	With this entity you can select the pacing source of the injector.	<Smart> (default) <Slave> <Self>
[Injection point]	With this entity you can select the physical plumbing position of the additive pertaining to the product meter.	<Upstream> (default) <Downstream>

Entity	Description	Value range
[Injection queue length]	<p>With this entity the inject queue length can be configured.</p> <p>You can define the number of injections that can be queued up (that is, postponed) if the injection progress is too slow in relation to the calculated or configured injection period time or even the measured wild stream flow.</p>	<p>&lt;0&gt; ... &lt;10&gt; (default = &lt;0&gt;)</p>
[Permissive condition]	<p>With this entity you can select the logical relation between the Permissive and System interlock functions.</p> <p><b>NOTE:</b> The entity [Permissive condition] is only relevant when the System Interlock I/O binding is configured other than &lt;None&gt;.</p>	<ul style="list-style-type: none"> <li>• &lt;OR&gt; (One of the signals should be available to permit the device).</li> <li>• &lt;AND&gt; (default) (Both signals should be available to permit the device).</li> </ul>
[Factored pulse out]	<p>With this entity you can select the amount of pulses for each unit of additive volume dispensed.</p>	<p>&lt;1 Pulse / Unit&gt; (default)</p> <p>&lt;10 Pulses / Unit&gt;</p> <p>&lt;100 Pulses / Unit&gt;</p> <p>&lt;1000 Pulses / Unit&gt;</p>

Entity	Description	Value range
[Feedback mode]	With this entity you can select the type of feedback for each injection.	<None> (default)  <End-sensor switch>  <Inverted end-sensor>  <Mid-stroke switch>  <Piston switch> <Inverted piston switch> <Post injection> <Double pulse> <Last 25% > <Ext. piston emulation> <Inv. ext. piston emulation>
[Feedback pulse duration]	With this entity you can enter the duration of the feedback pulse in ms.	<0> ms ... <1000> ms (default = <500> ms)

Entity	Description	Value range
[Piston control emulation]	<p>With this entity you can inject the control through a digital input channel. When configured for piston emulation control, the injector injects whenever there is a change to logic level of the DI channel bound to the pacing source I/O binding.</p> <p>The MSC-A must also have its piston emulation configuration set to "True".</p>	<p>&lt;False&gt; (default)</p> <p>&lt;True&gt;</p>
[Pump run timeout]	<p>With this entity you can enter the time in minutes between the last injection and the additive pump stop.</p>	<p>&lt;1&gt; min ... &lt;255&gt; mins (default = &lt;10&gt; min)</p>
[Reset alarm at permissive]	<p>With this entity you can set the alarm reset, when the MSC becomes permitted.</p>	<p>&lt;Enable&gt; &lt;Disable&gt; (default)</p>
[Clear leaking at permissive]	<p>With this entity you can &lt;enable&gt; or &lt;disable&gt; the amount of leaking volume at the start of a permissive.</p>	<p>&lt;Enable&gt; &lt;Disable&gt; (default)</p>

Entity	Description	Value range
[Accuload alarm mapping]	<p>With this entity you can ensure that the MSC-A alarms which are not present in the Mini-Pak can be found in an Accuload preset if they are asserted by the MSC-A.</p> <p>The new alarms have status bits associated with them in the parameter 802 alarm status value that are not recognized by the Accuload. When the Accuload alarm mapping configuration is true, then all these alarms drive the Program Failure bit in parameter 802. This is found in the Accuload as a General Additive (GA) alarm.</p> <p>The alarms affected include the following:</p> <ul style="list-style-type: none"> <li>• No activity</li> <li>• Flush Volume</li> <li>• Valve Error</li> <li>• No Pump</li> <li>• License Error</li> <li>• Control Error</li> <li>• Power Failure</li> <li>• Pulse Error</li> <li>• Tank Monitor</li> <li>• Service Due</li> </ul>	<p>&lt;Enable&gt;</p> <p>&lt;Disable&gt; (default)</p>
[Block valve location]	<p>With this entity you can configure the physical position of the block valve pertaining to the additive meter.</p>	<p>&lt;Upstream from meter&gt; (default)</p> <p>&lt;Downstream from meter&gt;</p>

### 5.9.3.2 Additive recipe

Entity	Description	Value range
[Additive name]	With this entity you can enter the name of the additive stream product.	Text string of maximum 20 characters can be used.
[Injection volume]	With this entity you can enter the amount of volume to be injected per injection cycle.	default = <20.00> ml
[Volume per inj. cycle]	With this entity the amount of wild stream volume per injection cycle can be set.	default = <40> L



Entity	Description	Value range
[Injection offset]	<p>With this entity a percentage to determine at what point the MSC-A provides the first injection during a transaction is entered. The percentage is applied to the [Volume per inj. cycle] and determines the volume of wild stream product, when the first injection occurs.</p> <p>Subsequent injections occur on the normal [Volume per inj. cycle] interval. This entity is only applicable for the Smart Pulse Input mode.</p> <p>The entity guarantees the delivery of the intended additive amount in the complete batch.</p> <p>Example:</p> <p>Volume per inj. Cycle = 100 l [26.417 gal]</p> <p>Injection offset = 50%</p> <p>First injection: 50 l [13.209 gal] Second injection: 150 l [39.626 gal]</p> <p>Third injection: 250 l [66.043 gal]</p> <p>Fourth injection: 350 l [92.460 gal]</p>	<p>&lt;0&gt; % ... &lt;100&gt; % (default = &lt;0&gt; %)</p>
[Selfpace injection period]	<p>With this entity the time between injection cycles can be set.</p> <p>This entity is only applicable in Self- paced mode.</p> <p>In this case, the entity [Pacing source] must be set to &lt;Self&gt;.</p>	<p>&lt;1&gt; s ... &lt;32&gt; s (default = &lt;1&gt; s)</p>

### 5.9.3.2.1 Injection Recipe

- There is only one recipe for additive injections, and its configuration entities exist for the following:
  - Additive name
  - Additive injection volume

- Wild stream volume per injection
- Self paced injection period (only used in self pace mode)
- This recipe is used for all transactions.
- The recipe definition can be changed between transactions.

#### 5.9.3.2.2 Definition of Injection

Recipe is defined as the ratio of the chemical additive to the process flow (fuel).

The recipe consists of 2 parts:

- First part - The amount of additive [Injection volume] chemical which is required to be added in each injection cycle.
- Second part - The frequency in which the [Volume per inj. cycle] occurs.

The above mentioned criterias are interrelated. Changing either one of them affects the ratio and also the recipe. By changing both the values, it is possible to adjust the operating characteristics of the injector to an optimum setting, without changing the actual recipe.

#### 5.9.3.2.3 Where do I get my recipe?

Recipes are defined by the chemical suppliers and by decision makers within your company. They may also be determined by law. In the case of detergent additives, testing determines the optimum concentrations of the chemical in the fuel, and company policies are set which regulate the amounts available. Odorants, dyes, and tracers are generally regulated by government decree and the dosage rates required to meet the needs that are established in advance.

Chemical suppliers, company management, and other similar facilities are all sources for determining the “typical” setup for your injection recipe.

#### 5.9.3.2.4 Conversion of recipe volumes

Determine the additive concentration required by your company.

This may be specified in volume of additive per volume of product delivered, parts per million, or a percentage. Injections occur at some regularly spaced product volume interval.

In the USA, it is typical to use cc's per 40 gallons. In areas outside of the USA, a more typical concentration is cc's per 100 liters.

The following table provides factors for the conversion of recipe volumes.

This ↓ X Factor = This →	lbs / Mbbls	cc's / 40 gal	gal / Mgal	ppm	cc's / 100 l
lbs / Mbbls	1	0.4312	0.002845	2.845	0.2845
cc's / 40 gal	2.32	1	0.0066	6.6	0.66
gal / Mgal	351.5	151.5	1	1000	100
ppm	0.3515	0.1515	0.001	1	0.1
cc's / 100 l	3.515	1.515	0.01	0.1	1

#### 5.9.3.2.4.1 Example

Assume that the recipe from the additive manufacturer is provided in parts per million (ppm). The recipe uses 285 ppm. The injector sets up to inject every 40 gallons.

Find ppm in the left-hand column. Follow the row across the cc's / 40 gal column and find the factor of 0.1515.

Now multiply 285 PPM by 0.1515 to 43.2. To meet the 285 ppm requirement, set up the injector to inject 43.2 cc's every 40 gallons.

#### 5.9.3.2.5 Frequency of injection

The example above used a 40 gallon interval for injections. The frequency of injections depends upon several factors that may apply to your situation.

Pacing injectors which are used for carrying out exclusively with pulse transmitters are placed in the mechanical meter stack. Due to gearing limitations and injection volumes at that time, it is a common place to send a pacing pulse that was ON for 20 gallons and OFF for 20 gallons. This is the standard pacing injectors.

With the modern pulse transmitters, electronic pulse splitters, and the capability of presets to send virtually any factored pulse output, the 40 gallon interval has become less used.

One criterion in determining how often to inject is the k-factor of the pacing pulse. This k-factor represents the total number of pulses that equals one unit of flow.

For example, if 5 pulses equals 1 liter [0.264 gal], the k-factor is 5.

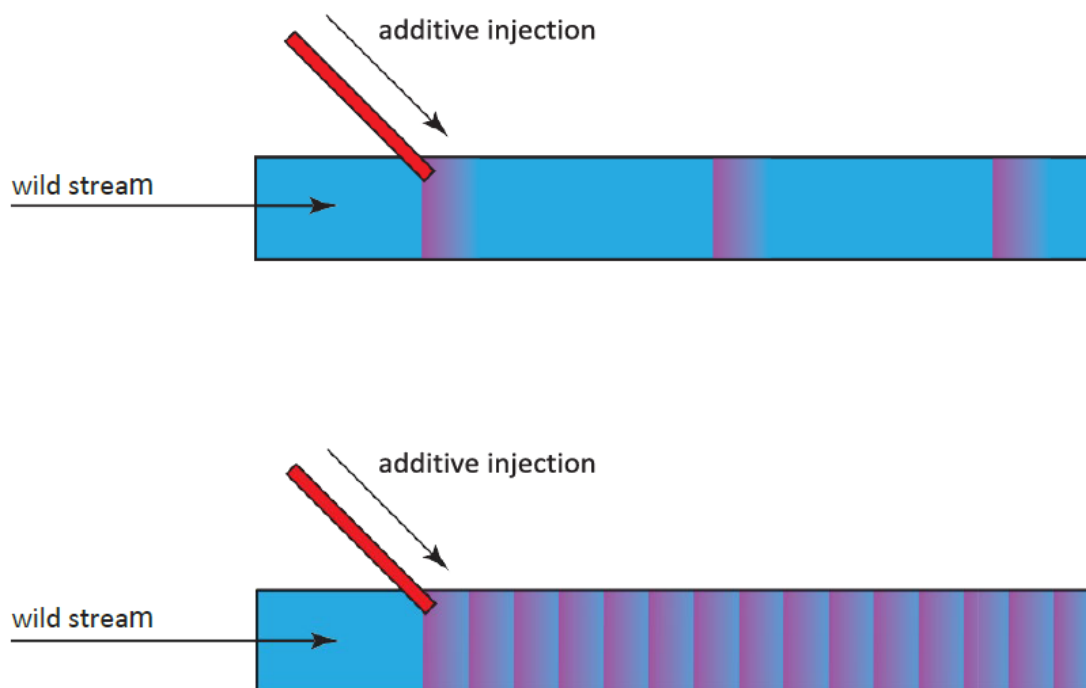
If one pulse represents more than one unit of flow, the k-factor is less than one. For example, if 1 pulse equals 100 liters [26.417 gal], the k-factor is 0.010.

If the k-factor is less than one, the interval between injections MUST be set to an exact multiple of the number of units that the pulse represents. In the above example of 100 liters [26.417 gal] per pulse, the limits of injecting for every 100, 200, 300, and so on liters is 26.417, 52.834, 79.252, and so on gallons. Setting the injection interval to an amount that is not a multiple of the units per pulse (for example, 150 liters [39.626 gal]) causes irregular injection cycles to occur, with a resultant loss of accuracy.

Similarly, if the pacing pulse is one pulse every 40 gallons, the interval between injections must be set to 40, 80, 120, and so on. For example, 50 gallons do not work.

Pulse rates of 1 pulse per unit volume of fuel flow or higher allows the user to configure any interval in limitation of the other factors mentioned hereafter.

One of the factors to consider is the homogeneity of the result. The longer time between injections, the less consistent the blend becomes. See the following figure for more information.



For this reason it is desirable to inject more frequently.

The limiting factor here is the limitation of the injector hydraulics to meter and to control very small volumes. The typical Enraf injector can handle injection volumes down to 1 cc. It is much more accurate to put in several cc's.

For this reason, the volume of fuel in one cycle must be large enough to receive at least 2 or 3 cc's of additive.

The factors above must be considered, and a balance must be achieved to allow the injector to cycle in an optimum manner. The ideally tuned injection system should be set up to be injecting 50% of the time at maximum fuel flow rate.

That is, the additive-system pressure, injection interval, injection volume, and manual throttling of manifold needle valves should be adjusted until the injector solenoid is open 50% of the time when the fuel is flowing at its fastest flow rate. This ensures the most accurate injection and allows for the widest possible compensation for variations in flow.

### 5.9.3.3 Wild stream

Entity	Description	Value range
[Minimum transaction vol.]	With this entity the minimum amount of wild stream volume before the MSC-A is permitted to start a new injection transaction can be set.  The [Permissive I/O binding] must be configured as <None>.	<1> L ... <999> L (default = <10.00> L)
[End product flow timeout]	With this entity the time in seconds can be configured to indicate the end of the transaction. When [End product flow timeout] the wild stream pulses are not received, and the transaction is finished.  The [Permissive I/O binding] must be configured as <None>.	<5> s ... <255> s (default = <30> s)

#### 5.9.3.3.1 Minimum Product Volume for Transaction Record

The [Minimum transaction vol.] is the minimum volume of the product that is loaded before the transaction starts. Setting this parameter to a value greater than

one limits the false transaction data record that may be generated in case the MSC-A permissive-enable inputs have bounced. This only works in case the [Permissive I/O binding] is set to <None>.

#### 5.9.3.4 Clean arm

Entity	Description	Value range
[Number of clean start cycles]	With this entity you can set the number of injection cycles at the beginning of the transaction to be used for "over injection". The "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 loading arm.	<1> ... <99>  (default = <10>)
[Flush volume]	With this entity you can set 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 [Num of clean start cycles] determines the additional additive volume to be injected at the start of the transaction (over injection). When [Flush volume] equals zero, the clean arm operation is disabled.	<0> L ... <999> L  (default = <0.00> L)
[High flow threshold]	With this entity you can set the flow rate which must be exceeded to start the injection process during clean arm operation.	<0> L/min ... <30000> L/min  (default = <1000.00> L/min)
[Low flow threshold]	With this entity you can set the flow rate at which the flushing starts by stopping the additive injection process.	<0> L/min ... <30000> L/min  (default = <1000.00> L/min)

### 5.9.3.5 Solenoid

Entity	Description	Value range
[Number of retries]	With this entity you can set the number of retries for opening the solenoid again, in case additive pulses are not received.	<0> ... <2> (default = <2>)
[Close delay]	With this entity you can set the time in ms. The additive pulses must be stopped after the solenoid is closed.	<500> ms ... <10000> ms (default = <500> ms)
[Dwell time]	With this entity you can set the minimum time in ms that the solenoid opens and closes. 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 in milliseconds. The OFF time is equal to the ON time. When this value is non- zero, the controller continues to pulse the valve control output until the amount of additive available in the 'Injection Volume' setting is dispensed. The stroke repeat rate is double the 'Solenoid Dwell Time'.	<0> ms ... <32767> ms (default = <0> ms)

### 5.9.4 Stream Configuration - Stream n - Alarms

Alarms have one of the following alarm action items by which you can configure the alarm behavior.

- Disable: Disables the alarm.
- Display: Displays only the alarm. However, the operation can continue.
- Display shutdown: Displays the alarm and shutdowns the operation.

### 5.9.4.1 Leaking valve

Entity	Description	Value range
[Alarm action]	<p>With this entity you can configure the alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt; (default)</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt;</p>
[Leaking volume limit]	<p>With this entity you can set the maximum amount of additive volume in [Leaking timeout period] before a leaking valve alarm is generated. If this limit is exceeded, an alarm occurs depending on the [Alarm action].</p>	<p>&lt;1.0&gt; ml ...</p> <p>&lt;9999&gt; ml</p> <p>(default = &lt;100.00&gt; ml)</p>
[Leaking timeout period]	<p>With this entity you can set the time in seconds in which the [Leaking volume limit] is checked.</p>	<p>&lt;1&gt; s ...</p> <p>&lt;99&gt; s</p> <p>(default = &lt;60&gt; s)</p>

**NOTE:** The leaking valve alarm can be generated when the device is idle or is between two injections. If the quantity of additive flow accumulated in [leaking timeout period] exceeds [leaking volume limit] then the leaking valve alarm is generated.

If the additive is leaking, but cannot accumulate a quantity equal to or greater than the [leaking volume limit] in the [leaking timeout period], then the leaking quantity is reset and the timer is re-started to check for the alarm. That is, the rate at which the additive is leaking, decides if the alarm can be generated. Also,



The [leaking volume limit] must be viewed in the [leaking period timeout] before the alarm is triggered.

### 5.9.4.2 Flush volume

Entity	Description	Value range
[Alarm action]	<p>With this entity you can configure the alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p>
[Flush volume deviation]	<p>With this entity you can set the maximum percentage of the [Flush volume] that must be allowed to be lower than the [Flush volume] without resulting in an alarm situation (Slow flow alarm).</p>	<p>&lt;0&gt; % ... &lt;100&gt; %</p> <p>(default = &lt;10&gt; %)</p>

### 5.9.4.3 No activity

Entity	Description	Value range
[Alarm action]	<p>With this entity you can configure the alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt; (default)</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt;</p>
[No activity timeout]	<p>With this entity you can set the time in seconds in which wild stream pulses should be received when the device is permitted. After this time the wild stream pulses are not received and an alarm occurs depending on the [Alarm action].</p>	<p>&lt;1&gt; s ... &lt;120&gt; s (default = &lt;60&gt; s)</p>

### 5.9.4.4 No additive

Entity	Description	Value range
[Alarm action]	<p>With this entity you can configure the alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;: The alarm is ignored.</p> <p>&lt;Display&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p> <p><b>NOTE:</b> No Activity Alarm must be enabled for No Additive Alarm to work.</p>	<p>&lt;Disabled&gt; (default)</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt;</p>
[No additive timeout]	<p>With this entity you can set the time in seconds in which additive stream pulses should be received when the solenoid is opened. The additive stream pulses are not received after the configured [number of retries] and an alarm occurs depending on the [Alarm action].</p>	<p>&lt;1&gt; s ... &lt;9&gt; s</p> <p>(default = &lt;2&gt; s)</p>

### 5.9.4.5 No pump

Entity	Description	Value range
[Alarm action]	<p>With this entity you can configure the alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt; (default)</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt;</p>
[Pump feedback timeout]	<p>With this entity you can set the time in seconds in which the additive pump should give feedback to the MSC. If the pump feedback is not received in [Pump feedback timeout] then an alarm occurs depending on the [Alarm action].</p>	<p>&lt;1&gt; s ...</p> <p>&lt;255&gt; s</p> <p>(default = &lt;15&gt; s)</p>

### 5.9.4.6 Deviation

Entity	Description	Value range
[Alarm action]	<p>With this entity you can configure the alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt; (default)</p> <p>&lt;Display shutdown&gt;</p>

Entity	Description	Value range
[Add. volume deviation]	With this entity you can set the percentage of additive volume that is accepted without resulting in an alarm situation. If this percentage is exceeded, an alarm occurs depending on the [Alarm action]. The alarm is evaluated after every injection.	<1> % ... <100> %  (default = <10> %)
[Num. cycles for alarm]	With this entity you can set the number of additive injection cycles over which the deviation is calculated.	<1 ... 99>  (default = <1>)

#### 5.9.4.7 Fixed

Entity	Description	Value range
[Control fault]	<p>With this entity you can configure the [Control fault] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt; (default)</p> <p>&lt;Display shutdown&gt;</p>

Entity	Description	Value range
[Solenoid fault]	<p>With this entity you can configure the [Solenoid fault] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt; (default)</p> <p>&lt;Display shutdown&gt;</p>
[Pulse hardware]	<p>With this entity you can configure the [Pulse hardware] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p>

Entity	Description	Value range
[Pulse phase]	<p>With this entity you can configure the [Pulse phase] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p>
[Factored pulse out]	<p>With this entity you can configure the [Factored pulse out] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p>

Entity	Description	Value range
[Temperature sensor]	<p>With this entity you can configure the [Temperature sensor] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p>
[Tank low level]	<p>With this entity you can configure the [Tank low level] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions is are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt; (default)</p> <p>&lt;Display shutdown&gt;</p>



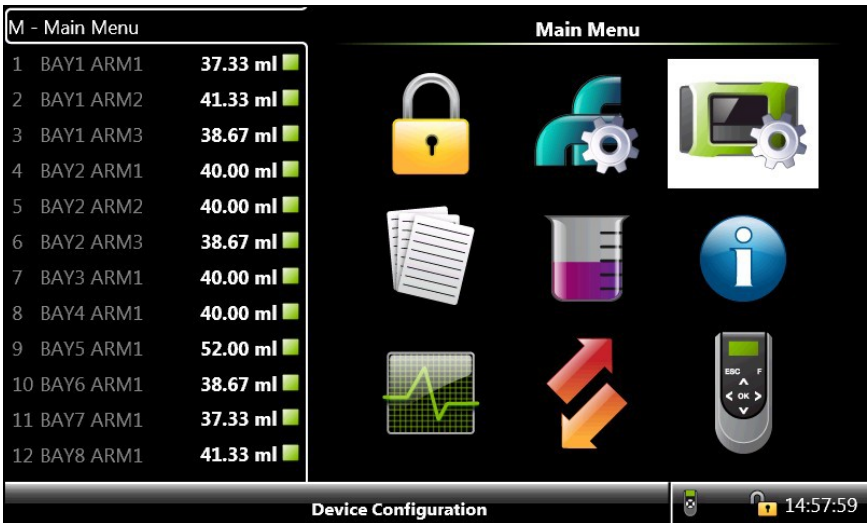
Entity	Description	Value range
[Tank empty]	<p>With this entity you can configure the [Tank empty] alarm behavior in case this particular alarm occurs.</p> <p>&lt;Disabled&gt;:The alarm is ignored.</p> <p>&lt;Display&gt;:Alarm appears on the display.</p> <p>Alarm-indication output is set to ON.</p> <p>&lt;Display shutdown&gt;: Alarm appears on the display.</p> <p>Alarm-indication output is set to ON. Alarm-shutdown output is set to ON. Running transactions are stopped. Start-up of new transactions are impossible.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p>
[Additive MMQ not met]	<p>With this entity you can configure the [Additive MMQ not met] alarm in case this particular alarm occurs.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p> <p>&lt;Display pause&gt;</p>
[Additive flowrate too low]	<p>With this entity you can configure the [Additive flowrate too low] alarm in case this particular alarm occurs.</p>	<p>&lt;Disabled&gt;</p> <p>&lt;Display&gt;</p> <p>&lt;Display shutdown&gt; (default)</p> <p>&lt;Display pause&gt;</p>

## 5.10 Device Configuration

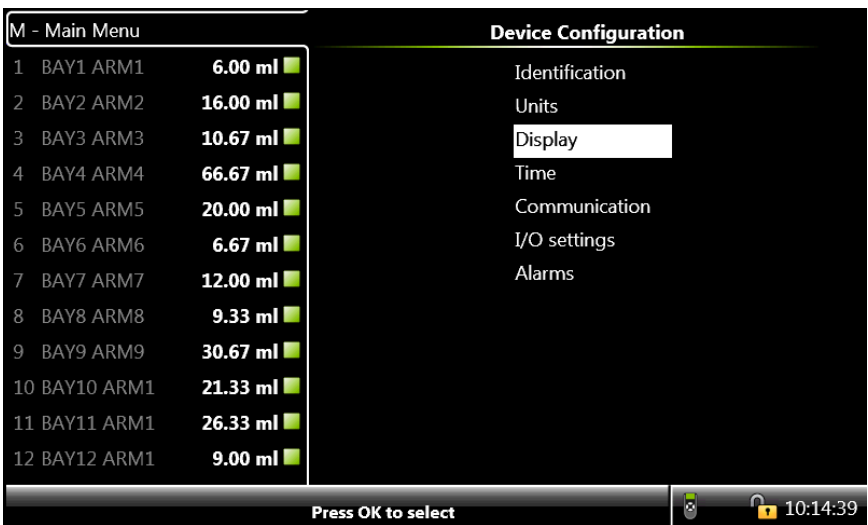
To perform the device configuration process

1. From the Main Menu screen, select the Device Configuration icon.

The Device Configuration screen appears, which displays the functions available for device configuration.



2. From the Device Configuration screen, select each entity to configure the MSC-A device.



### 5.10.1 Device Configuration - Identification

From the Device Configuration screen, select <Identification>. The following entities are displayed.

Entity	Description	Value range
[Site name]	The name of the site at which the MSC is located.	A text string of maximum 20 characters.
[Device name]	The name of the MSC-A. This entity specifies a unique identification of the device by a text string.  The name appears on the running screens.	A text string of maximum 20 characters.
[WnM intended (reboot required)]	This entity denotes if the MSC-A is W&M intended.  <b>NOTE:</b> You need to restart the MSC-A after changing the entity.	<True> - W&M compliant (default)  <False> - Not W&M compliant

## 5.10.2 Device Configuration - General Settings

From the Device Configuration screen, select <general settings>. The following entities are displayed.

Entity	Description	Value range
[Acc. totals reset allowed]	With this entity you can enable / disable the ability to reset accumulator totals.	<No> (default) <Yes>
[Comms. Acc. totals decimal places]	With this entity you can set the precision of accumulated totals that are that are sent over comms by setting the number of decimal places.  This feature is useful when using Product units as Gallons.	<3>....<4>  <3> (default)

## 5.10.3 Device Configuration - Units

From the Device Configuration screen, select <Units>. The following entities are displayed.

Entity	Description	Value range
[Units of volume]	With this entity you can select the engineering units for volume.	<Liter> (default) <Cubic Meter> <Cubic Centimeter> <Cubic Decimeter> <US Gallons> <UK Gallons> <Barrel>
[Units of additive volume]	With this entity you can select the engineering units for additive volume.	<Milliliter> (default) <Cubic centimeter>
[Units of temperature]	With this entity you can select the engineering units for temperature.	<Degree Celsius> (default) <Degree Fahrenheit>
[Units of pressure]	With this entity you can select the engineering units for pressure.	<Pascal> (default) <Kilo Pascal> <Pounds per Square Inch> <Bar>

Description	Name	Unit
Transaction volume	Liter	L
	Cubic meter	m3
	Cubic centimeter	cm3
	Cubic decimeter	dm3
	US Gallons	US gal
	UK Gallons	UK gal
	Barrel	bbls
Acc. Tot. volume	Liter	L
	Cubic meter	m3
	Cubic centimeter	cm3
	Cubic decimeter	dm3
	US Gallons	US gal
	UK Gallons	UK gal
	Barrel	bbls
Additive volume	Milliliter	ml
	Cubic centimeter	cc
Temperature	Celsius	°C
	Fahrenheit	°F
Pressure	Bar	bar
	Pascal	Pa
	Kilo Pascal	kPa
	PSI RANGE 100	psi_r100
	PSI RANGE 1000	psi_r1000
Ratio	Percentage	%
	Parts per million	ppm

## 5.10.4 Device Configuration - Display

From the Device Configuration screen, select <Display>. The following entities are displayed.

Entity	Description	Value range
[Display brightness]	With this entity you can enter the brightness of the display. The brightness is controlled by the backlight of the display.	<0> % (low) ... <100> % (high) (default = <75> %)
[Auto brightness adjustment]	With this entity you can enable the auto brightness feature. When enabled, the ambient light sensor on the HMI senses the ambient light and automatically adjusts the brightness of the display.	<Enable> (default) <Disable>
[Session timeout value]	With this entity you can enter the time in seconds between the last key pressed on IR Controller and the moment the display switches back to one of the running screens.	<10> s ... <600> s (default = <300> s)

Entity	Description	Value range
[User display language]	With this entity you can select the display language for the running screens.	<English UK> <English US> (default) <French> <German> <Dutch> <Spanish> <Chinese> <Japanese> <Polish> <Portuguese> <Italian> <Local Language>
[Screen cycling focus timing (Idle)]	With this entity, you can configure the focus time spent on each screen that is not being loaded. When set to 0, idle streams shall be excluded from automatic cycling if there is any loading stream. If no streams are being loaded and this entity is set to 0, the focus time shall be 2 seconds.	<0>...<20> secs <0> secs (default)
[Screen cycling focus timing (Loading)]	With this entity, you can configure the focus time spent on each screen that is being loaded.	<1>...<20> secs <8> secs (default)

### 5.10.5 Device Configuration - Time

From the Device Configuration screen, select <Time>. The following entities are displayed.

Entity	Description	Value range
[Date display format]	<p>With this entity you can select the format of the date.</p> <p><b>NOTE:</b> The local site time should be configured (synchronized) in the MSC-A device in order to have all the transactions and the alarms being timestamped correctly in the local time.</p> <p>The MSC-A device does not support Daylight Saving Time.</p>	<p>&lt;DD-MM-YY&gt; (default)</p> <p>&lt;MM-DD-YY&gt;</p> <p>&lt;YY-MM-DD&gt;</p> <p>&lt;DD-MM-YYYY&gt;</p> <p>&lt;MM-DD-YYYY&gt;</p> <p><b>NOTE:</b> Only the first 3 selections are completely visible on the MSC-A screen.</p>
[Time display format]	<p>With this entity you can select the format of the time.</p>	<p>&lt;12-hour&gt;</p> <p>&lt;24-hour&gt; (default)</p> <p><b>NOTE:</b> Only the 24-hour selection is completely visible on the MSC-A screen.</p>
[Date]	<p>With this entity you can select the actual date that is used for time stamping of transactions, calibrations, and alarms.</p>	<p>&lt;Year&gt;</p> <p>&lt;Month&gt;</p> <p>&lt;Day&gt;</p> <p><b>NOTE:</b> By default, the current date appears. However, to change the default date, enter the year, month, and day.</p>



Entity	Description	Value range
[Time]	With this entity you can select the actual time that is used for time stamping of transactions, calibrations, and alarms.	<p>&lt;Hour&gt;</p> <p>&lt;Minute&gt;</p> <p>&lt;Second&gt;</p> <p>&lt;Millisecond&gt;</p> <p><b>NOTE:</b> By default, the current time appears. However, to change the default time, enter the hour, minute, second, and millisecond.</p>

## 5.10.6 Device Configuration - Communication

From the Device Configuration screen, select <Communication>.

Serial, Ethernet, and IP HHC communication entities can be configured.

The built-in communication monitoring in the MSC-A device are as follows:

- Up to seven 485 communication ports
- Up to three Ethernet ports

### 5.10.6.1 Serial

The following table lists the entities available for the Serial communication which provides configuration for the available serial ports.

Entity	Description	Value range
[FlexConn address]	With this entity you can select the device address for the FlexConn protocol.	<0>...<1900>
[Slip+ unit address]	With this entity you can select the starting unit address of 1020 that MSC- A is emulating. This entity is only applicable in case the protocol is Slip+.	

Entity	Description	Value range
[Communication Protocol]	With this entity you can select the protocol for the communication port.	<Flexconn> <FMC Smith> <Modbus RTU> <Modbus Legacy> <Slip+>
[Baudrate]	With this entity you can select baudrate for the communication port.	<Baudrate 1200> <Baudrate 2400> <Baudrate 4800> <Baudrate 9600> <Baudrate 19200> <Baudrate 38400> <Baudrate 57600> <Baudrate 115200> <Baudrate 128000>

Entity	Description	Value range
[Parity]	With this entity you can set the parity for the communication port.	<Odd> <Even> <None>
[Stop Bits]	With this entity you can configure the number of stop bits for the communication port.	<One> <Two>
[Data stream max gap time]	With this entity you can select the time- out between characters in one single record (ms).	<0>...<10000>
[Turn around delay]	With this entity you can select the time between the request received from the client and the time the answer is sent (ms).	<0>...<10000>
[Modbus byte order]	With this entity you can select the byte order used for the data when Modbus protocols are used.	<Little Endian> <Big Endian>
[No of 1020 devices]	With this entity you can configure the number of 1020s that an MSC-A is emulating. This entity is only used when the protocol is Slip+.	<1>...<2>

### 5.10.6.2 Ethernet

The following table lists the entities available for the Ethernet communication which provides configuration for the available ethernet ports.

Entity	Description	Value range
[DHCP status]	With this entity you can enable the DHCP to use a dynamic IP address.	<Disabled> <Enabled>
[Static IP address]	With this entity you can assign static IP address to the MSC-A when DHCP is disabled.	
[Gateway IP address]	With this entity the default gateway IP address is displayed.	
[Subnet mask]	With this entity the subnet mask is displayed.	

### 5.10.6.3 IP HHC

The following table lists the entities available for the IP HHC communication parameters which provides configuration for Long IR access and IR access.

Entity	Description	Value range
[IR access]	With this entity you can enable the IR interface if it is turned off.	<Enable> (default) <Disable>
[Long IR access]	Disabling this entity (default) uses the short login sequence of pressing only the [ATTN] key.  Enabling this entity makes the controller require the long login sequence of four buttons being pressed, [ATTN], [F1], [F2], and [F3].	<Enable> <Disable> (default)

**NOTE:** In a few installations of controllers, it is reported that sunlight or any strong artificial light-sources can "unlock" the infrared port the same way as pressing the ATTN key on the Hand-Held Controller. If this occurs, parameter values may accidentally be changed. It should be noted that this is an EXTREMELY rare possibility.

**NOTE:** The Long Infrared access parameter enables or disables an extended login sequence of characters for the infrared communications port on the bezel of the MSC-A. Using an extended login character sequence raises the odds of a random pattern of interference matching the correct login sequence to astronomical levels.

### 5.10.7 Device Configuration - I/O Settings

From the Device Configuration screen, select <I/O Settings>. The following entities are displayed.

Entity	Available I/Os
[DI]	DI-DC-1, DI-DC-2, DI-DC-3, DI-DC-4, DI-DC-5, DI-DC-6, DI-DC-7, DI-DC-8, DI-DC-9, DI-DC-10, DI-DC-11, DI-DC-12, DI-DC-13, DI-DC-14, DI-DC-15, DI-AC-1, DI-AC-2, DI-AC-3, DI-DC-16, DI-DC-17, DI-DC-18, DI-DC-19, DI-DC-20, DI-DC-21, DI-DC-22, DI-DC-23, DI-DC-24, DI-DC-25, DI-DC-26, DI-DC-27, DI-DC-28, DI-DC-29, DI-DC-30, DI-AC-4, DI-AC-5, DI-AC-6, DI-DC-31, DI-DC-32, DI-DC-33, DI-DC-34, DI-DC-35, DI-DC-36, DI-DC-37, DI-DC-38, DI-DC-39, DI-DC-40, DI-DC-41, DI-DC-42, DI-DC-43, DI-DC-44, DI-DC-45, DI-AC-7, DI-AC-8, DI-AC-9, DI-DC-46, DI-DC-47, DI-DC-48, DI-DC-49, DI-DC-50, DI-DC-51, DI-DC-52, DI-DC-53, DI-DC-54, DI-DC-55, DI-DC-56, DI-DC-57, DI-DC-58, DI-DC-59, DI-DC-60, DI-AC-10, DI-AC-11, DI-AC-12
[PI]	QPI-1A, QPI-1B, QPI-2A, QPI-2B, QPI-3A, QPI-3B, QPI-4A, QPI-4B, QPI-5A, QPI-5B, QPI-6A, QPI-6B, QPI-7A, QPI-7B, QPI-8A, QPI-8B, QPI-9A, QPI-9B, QPI-10A, QPI-10B, QPI-11A, QPI-11B, QPI-12A, QPI-12B
[RTD]	RTD-1, RTD-2, RTD-3, RTD-4, RTD-5, RTD-6
[AI]	AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, AI-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14
[AO]	AO-1, AO-2, AO-3, AO-4, AO-5, AO-6
[PO]	PO-1, PO-2, PO-3, PO-4

From the Device Configuration - I/O Settings screen, select the available I/Os. The following entities are displayed.

#### 5.10.7.1 DI (for both AC# and DC#)

From the Device Configuration screen, select the available Digital Inputs (DIs). The following entities are displayed.

Entity	Description	Value range
[Hysteresis time]	With this entity you can set the active time in milliseconds (ms) of the input signal before accepting it as a valid input signal. Hence, the time between two signal transitions must be greater than the [Hysteresis time].	250 ms (default)

### 5.10.7.2 PI

From the Device Configuration screen, select the available Pulse Inputs (PIs). The following entities are displayed.

Entity	Description	Value range
[K-factor]	With this entity you can set the K-factor of the additive flow meter supplied by the vendor, in pulses per [Units of volume].	The K-factor must be the number of pulses per liter (gallon), regardless of the configured unit of volume selection. (default = <750.000>)
[Meter Integrity check]	With this entity you can select the pulse type of the flow meter.	<Disable> = single pulse (default) <Enable> = dual pulse (quad)
[Pulse phase relationship]		
[MMQ]	With this entity you can set the smallest quantity specified for which the flow meter is capable of measuring within the applicable prescribed limit of error. The preset value entered is validated against the MMQ. If the value is less than the MMQ, then a batch cannot be started.	default = <0.00> L
[Minimum linear flowrate]	With this entity you can program the minimum linear flowrate for the flow meter installed.	default = <0.0> L/min
[Maximum flowrate]	With this entity you can set the maximum allowed flowrate.	default = <2000.00> L/min

Entity	Description	Value range
[Meter error threshold]	<p>With this entity you can enter the maximum number of quad pulse errors permitted for every 1000 pulses. If more than the specified number of pulses are missing in a batch of 1000 pulses, then a pulse hardware error is generated if the pulse integrity check is configured.</p> <p>Missing pulses that occur when the pulse input frequency is below the meter cutoff frequency, then they are not counted towards the pulse hardware alarm. A quad pulse phase error also increments the pulse hardware error count.</p>	default = 3
[DI hysteresis time]	With this entity you can set the active time in milliseconds (ms) of the input signal before accepting it as a valid input signal. The time between two signal transitions must be greater than the [Hysteresis time].	default = <250> ms
[Flow meter serial #]	With this entity you can program the manufacturer serial number of the flowmeter.	

### 5.10.7.3 RTD

From the Device Configuration screen, select the available RTDs. The following entities are displayed.

Entity	Description	Value range
[RTD serial #]	With this entity you can enter the serial number of the connected PT100 temperature probe.	Alphanumeric string of maximum 8 characters.
[Temperature offset]		default = 0.00 °C

Entity	Description	Value range
[RTD wiring]	With this entity you can set the wiring configuration of the RTD.	default = 4 wire
[HH Alarm Threshold]	With this entity you can set the high high temperature alarm threshold. When exceeded a temperature alarm occurs.	<b>NOTE:</b> The entity is blank (empty) by default.
[H Alarm Threshold]	With this entity you can set the high temperature alarm threshold. When exceeded a temperature alarm occurs.	
[L Alarm Threshold]	With this entity you can set the low temperature alarm threshold. When exceeded a temperature alarm occurs.	
[LL Alarm Threshold]	With this entity you can set the low low temperature alarm threshold. When exceeded a temperature alarm occurs.	
[Alarm Hysteresis]	<p>With this entity you can set the hysteresis around the alarm levels. This hysteresis is used to avoid alarm ON/OFF-toggling situations at an alarm level.</p> <ul style="list-style-type: none"> <li>• A High (High) alarm occurs when the value becomes higher than [HH/H Alarm Threshold].</li> <li>• A Low (Low) alarm occurs when the value becomes lower than [LL/L Alarm Threshold].</li> <li>• A High (High) alarm disappears when the value becomes lower than [HH/H Alarm Threshold] - [Alarm Hysteresis], and a Low (Low) alarm disappears when the value becomes higher than [L/LL Alarm Threshold] + [Alarm Hysteresis].</li> </ul>	

#### 5.10.7.4 AI

From the Device Configuration screen, select the available Analog Inputs (AIs). The following entities are displayed.



Entity	Description	Value range
[PV value 20 mA]	With this entity the process value at 20 mA can be configured.	default = 100.00
[PV value 4 mA]	With this entity the process value at 4 mA can be configured.	default = 0.00
[AI threshold]	With this entity the analog input threshold value defines the range for 0 or 1.  For example, 0 or not active from 4-12 mA and 1 or active from 12 mA to 20 mA.	default = 0.00
[AI logic state]	With this entity you can determine how the injector controller uses the analog input signal.  <ul style="list-style-type: none"> <li>• &lt;Positive&gt;: 0 or inactive from 4-[AI threshold] mA and 1 or active from [AI threshold] to 20 mA.</li> <li>• &lt;Negative&gt;: 1 or active from 4-[AI threshold] mA and 0 or inactive from [AI threshold] to 20 mA.</li> </ul>	<Positive> (default)  <Negative>
[AI serial #]	With this entity you can enter the serial number of the connected analog input device or transmitter.	Alphanumeric string of maximum 8 characters.

Entity	Description	Value range
[HH Alarm Threshold]	With this entity you can set the high high PV alarm threshold. When exceeded a PV alarm occurs.	
[H Alarm Threshold]	With this entity you can set the high PV alarm threshold. When exceeded a PV alarm occurs.	
[L Alarm Threshold]	With this entity you can set the low PV alarm threshold. When exceeded a PV alarm occurs.	
[LL Alarm Threshold]	With this entity you can set the low low PV alarm threshold. When exceeded a PV alarm occurs.	
[Alarm Hysteresis]	<p>With this entity you can set the hysteresis around the alarm levels. This hysteresis is used to avoid alarm ON/OFF toggling situations at an alarm level.</p> <ul style="list-style-type: none"> <li>• A high (high) alarm occurs when the value becomes higher than [HH/H Alarm Threshold].</li> <li>• A low (low) alarm occurs when the value becomes lower than [LL/L Alarm Threshold].</li> <li>• A high (high) alarm disappears when the value becomes lower than [HH/H Alarm Threshold - Hysteresis] and a low (low) alarm disappears when the value becomes higher than [L/LL Alarm Threshold + Hysteresis].</li> </ul>	<p><b>NOTE:</b> The entity is blank (empty) by default.</p>

### 5.10.7.5 AO

From the Device Configuration screen, select the available Analog Outputs (AOs). The following entities are displayed.

Entity	Description	Value range
[Operational mode]	With this entity you can select between 2 modes for the analog output.	<Explicitly Driven> (default) - The output value is set by the application (for example, valve control).  <Follow PV> - The output reflects one of the Primary Values measured by the MSC-A.
[Follow PV source]		default = None
[Upper boundary]	With this entity you can select the PV value at 20 mA.  For the actual current value linear interpolation is used between [Lower boundary] and [Upper boundary].	default = 0.00  For units, see Value range of [PV address]. Note: The Upper boundary values are set as per the units selected in the [PV address] entity.
[Lower boundary]	With this entity you can select the PV value at 4 mA.  For the actual current value linear interpolation is used between [Lower boundary] and [Upper boundary].	default = 0.00  For units, see Value range of [PV address].  <b>NOTE:</b> The Lower boundary values are set as per the units selected in the [PV address] entity.
[Burn out value]		

### 5.10.7.6 PO

From the Device Configuration screen, select the available Pulse Outputs (POs). The following entities are displayed.

Entity	Available I/Os
[Pulse output selection]	None, QPI-1A, QPI-1B, QPI-2A, QPI- 2B, QPI-3A, QPI-3B, QPI-4A, QPI-5B, QPI-6A, QPI-6B, FPO

## 5.10.8 Device Configuration - Alarms

From the Device Configuration screen, select <Alarms>. The following entities are displayed.

Entity	Description	Value range
[Next scheduled service]	With this entity you can select the date when the next service activities should take place for the MSC-A. It is handled like an alarm and it can be configured to desired alarm behavior (Disable, Display, or Display shutdown).	Year Month Date  <b>NOTE:</b> By default, 01-01-10 appears. However, to change the default date enter the year, month, and day.
[Next scheduled service alarm]	With this entity you can select the date when the next service activities of an alarm should take place for the MSC-A. It is handled like an alarm and it can be configured to desired alarm behavior (Disable, Display, or Display shutdown).	Disabled Display Display shutdown (default)

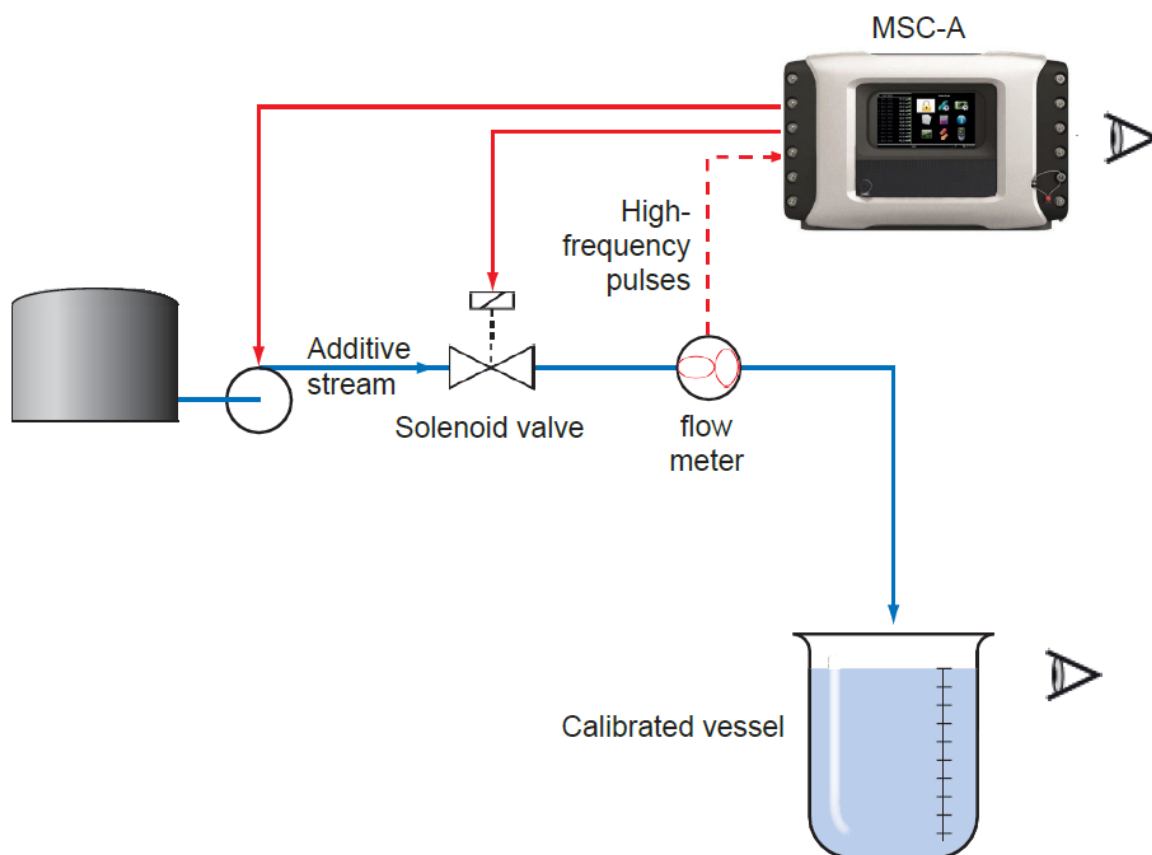
## 5.11 Calibration

### 5.11.1 Why Calibrate?

A flow meter provides a number of pulses per amount of fuel that passes the meter. The number of pulses per unit of volume the meter provides is called K-factor. This K-factor is specified per delivered flow meter, by the manufacturer.

To increase the accuracy of the flow meter, a calibration process can be performed. This process is performed by comparing the actual resulting fuel volume received in a calibrated vessel (see the figure below) with the displayed value on the MSC-A display, which is the result of the value returned from the flow meter.

Figure 5-39: Calibrating the flow meter



With the flow meter and the K-factor value, a correction factor can be calculated, which is used for (re-)calibrating the flow meter.

This correction factor is called the meter factor.

The resulting injection volume (V) is then calculated as follows:  $V = \text{Number of pulses} / (\text{K-factor} * \text{meter factor})$ .

### 5.11.2 Calibration Menu Choice

From the Main Menu screen, select the Calibration icon to perform the calibration process.

Figure 5-40: Calibration icon

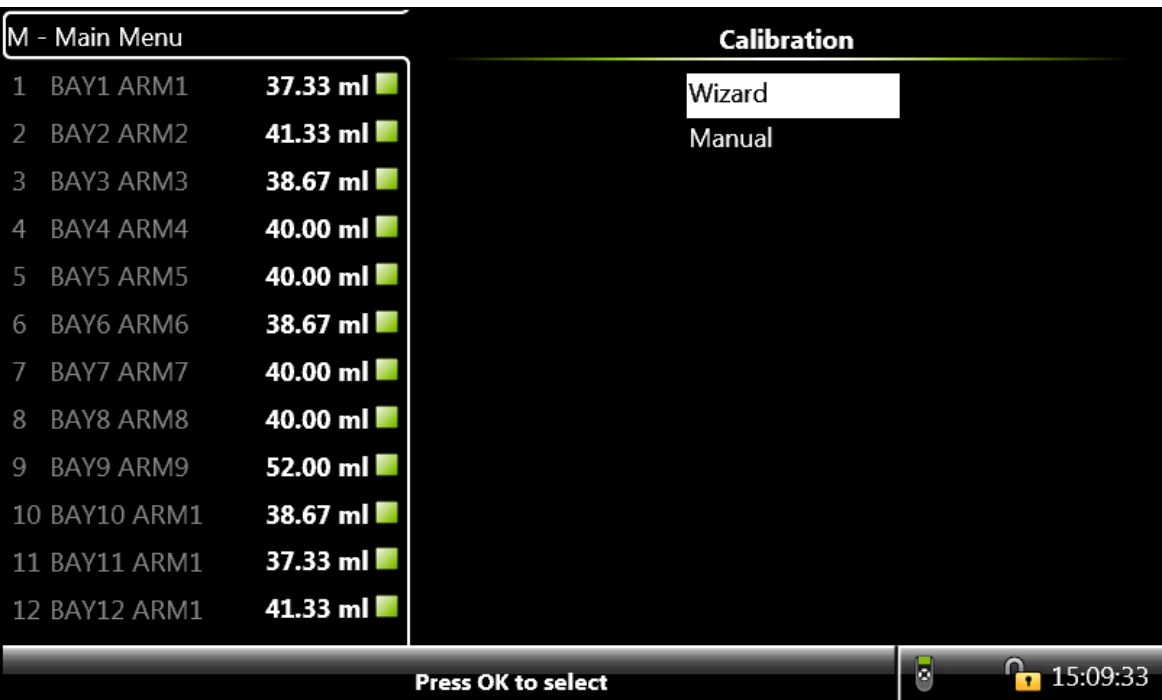


From the Calibration screen, select either <Wizard> calibration method or the <Manual> calibration method.

In the <Wizard> calibration method, the meter factor is calculated by comparing the measured volume with the device dispensed volume. In the <Manual> calibration method, you must enter the meter factor.

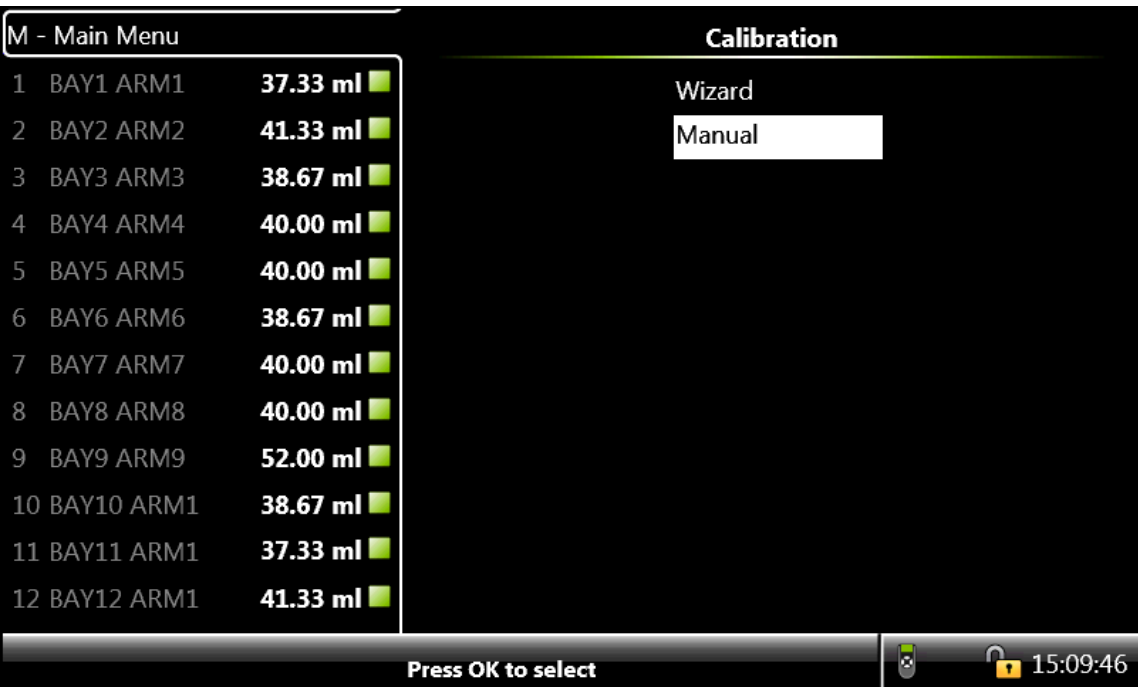
The default meter factor for the <Wizard> calibration method and the <Manual> calibration method is 1. The range which can be specified for the meter factor is between 0.5 and 1.5.

Figure 5-41: Calibration menu choices

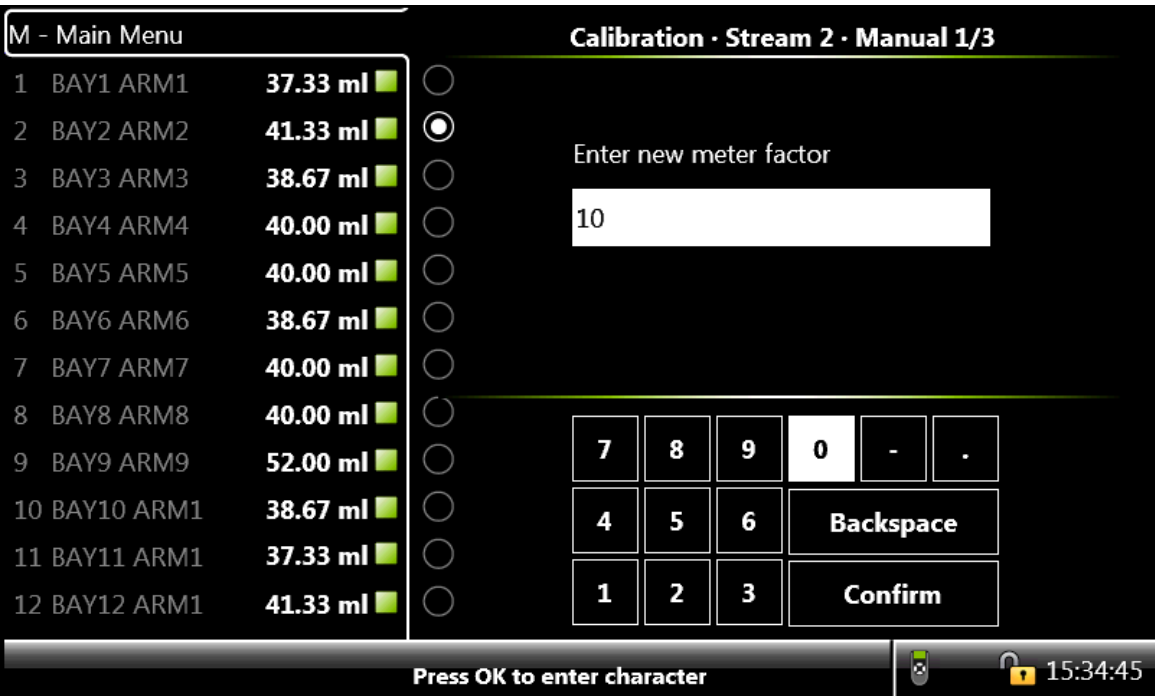


### 5.11.3 Manual Calibration

From the Calibration screen, select <Manual> calibration and then select <OK> on the IR controller or LAD to select the Manual calibration.



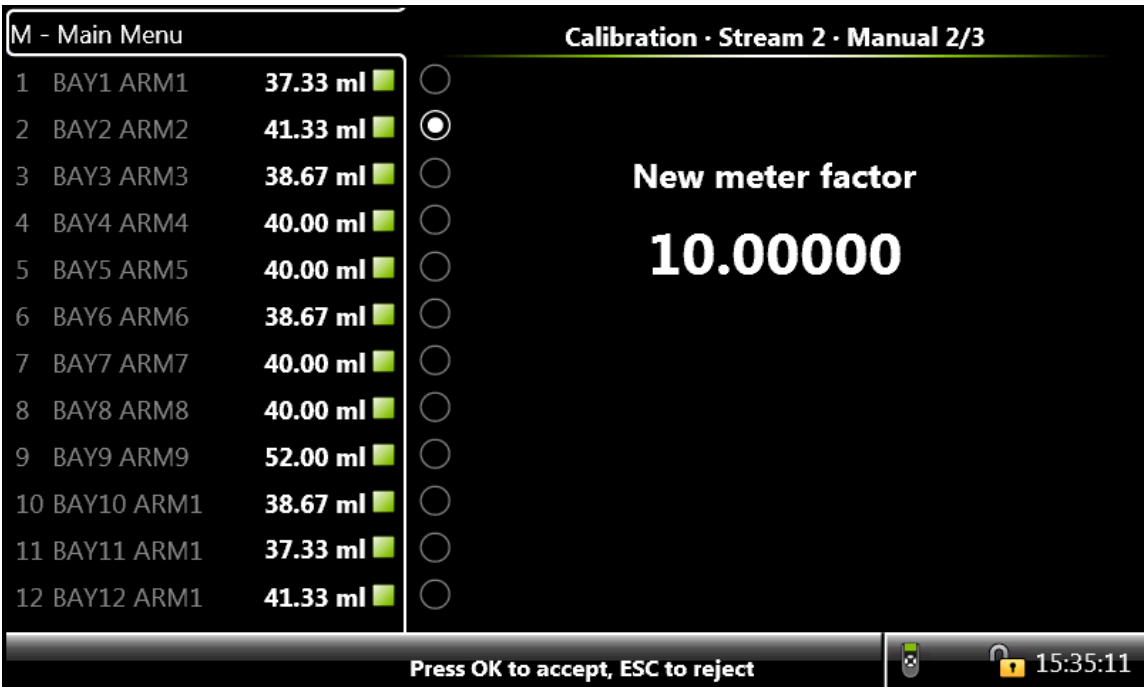
The Calibration - Stream n - Manual 1/3 screen appears, in which the new meter factor must be entered.



On the Calibration - Stream n - Manual 1/3 screen, enter the new meter factor value and then select <Confirm>.

The Calibration - Stream n - Manual 2/3 screen appears, which displays the new meter factor.

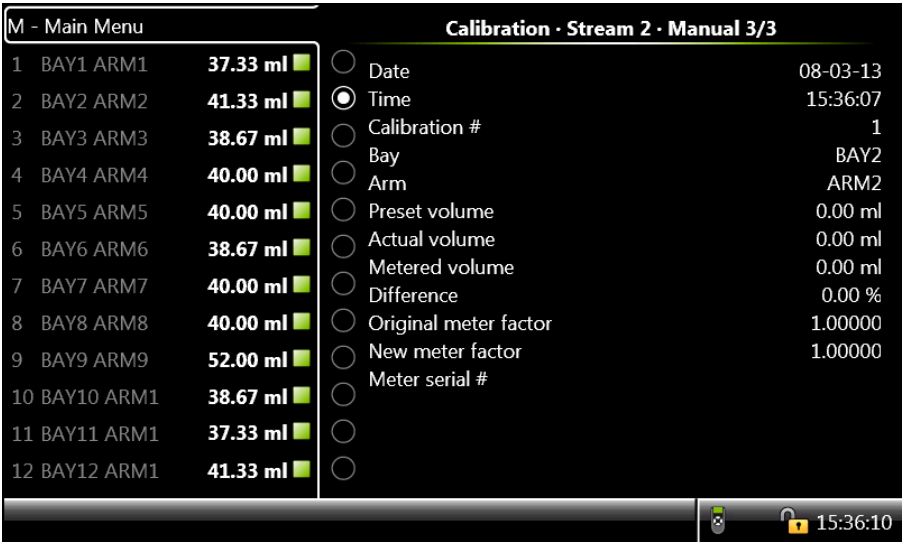




From the Calibration - Stream n - Manual 2/3 screen, select <OK> on the IR controller or LAD, to accept the new meter factor and view the calibration details.

The Calibration - Stream n - Manual 3/3 screen appears, which displays the calibration details.

**NOTE:** Select <ESC> to restore the old meter factor.



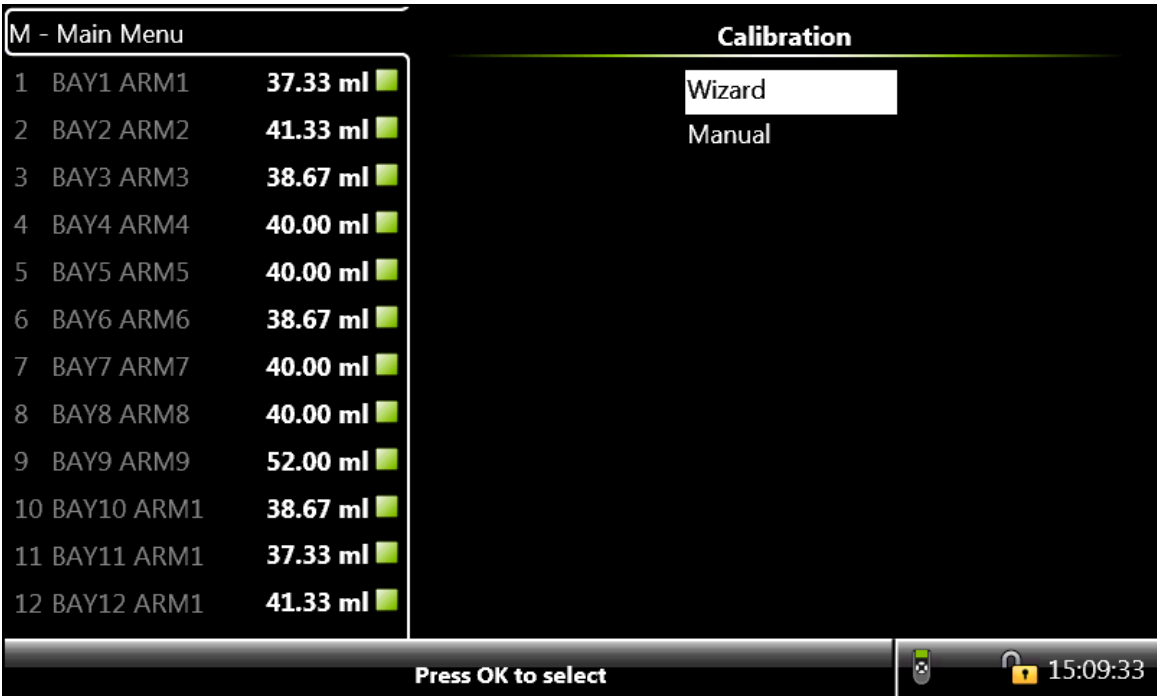
**NOTE:** The Calibration process is applicable for all the streams (Stream 1-24). Stream n indicates Stream 1 to 24.

### 5.11.4 Wizard Calibration

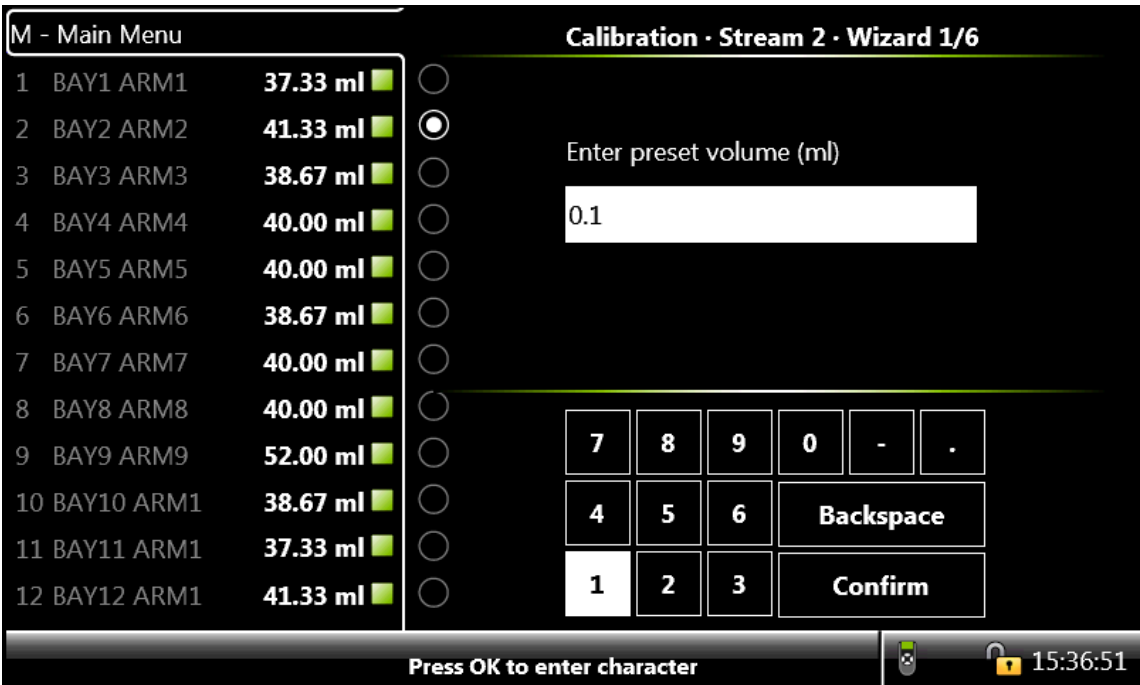
The built-in calibration wizard makes it easy to (re-)calibrate the flow meter.

**WARNING:** Do all the necessary preparations (calibrated vessel in place, and so on), before starting the actual calibration.

From the Calibration screen, select <Wizard> calibration and then select <OK> on the IR controller or LAD to select the Wizard calibration.

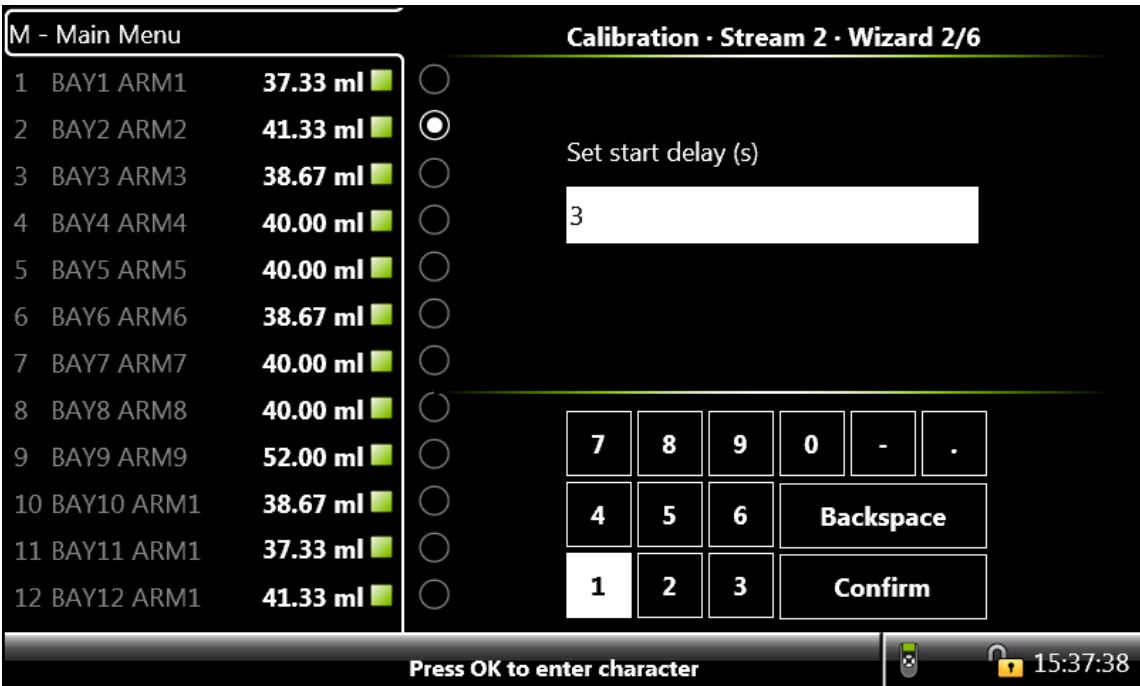


The Calibration - Stream n - Wizard 1/6 screen appears, in which the preset volume must be entered.



On the Calibration - Stream n - Wizard 1/6 screen, enter the preset volume that the MSC-A must inject for the calibration process and then select <Confirm>.

The Calibration - Stream n - Wizard 2/6 screen appears, in which the delay time must be entered.



On the Calibration - Stream n - Wizard 2/6 screen, enter the start delay time in seconds and then select <Confirm>.

A suitable delay time should be entered so that you can move to another place (for example, to observe the result) until the process continues.

The Calibration - Stream n - Wizard 3/6 screen appears with the preset volume, delay time in seconds, and the progress status.



Check the Progress bar to monitor the calibration progress.

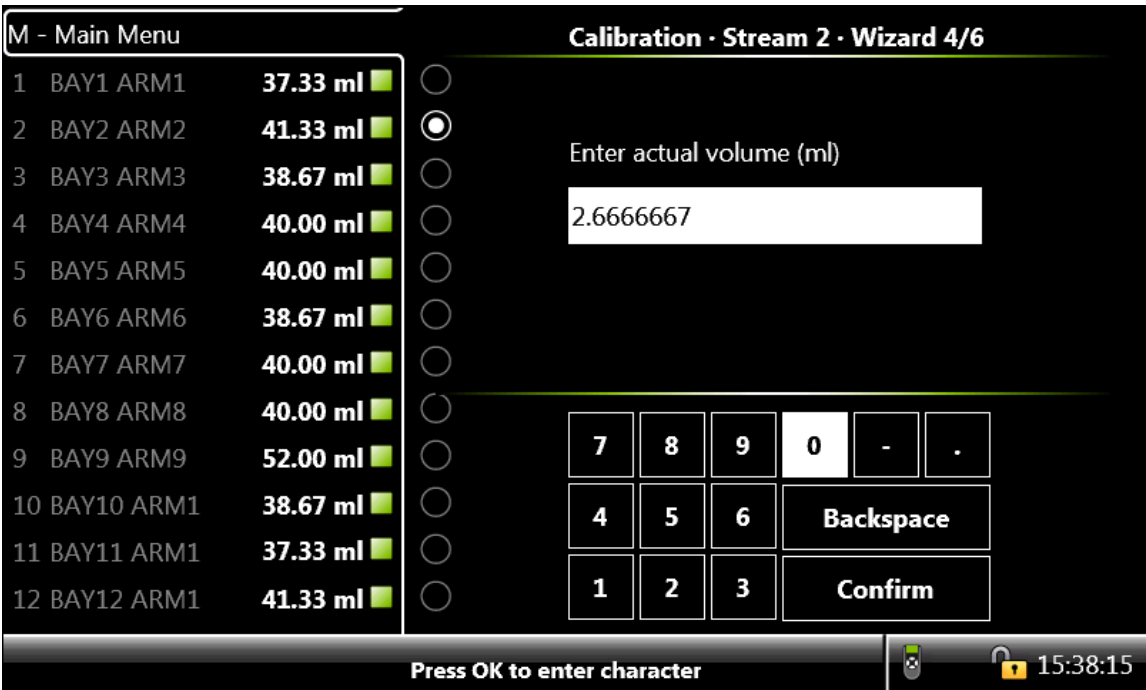
Select <OK> on the IR controller or LAD.

The countdown of the delay time starts. After the expiration of the delay time, the injection process starts.

The following screen appears, which displays the progress of the injection process on the progress bar.



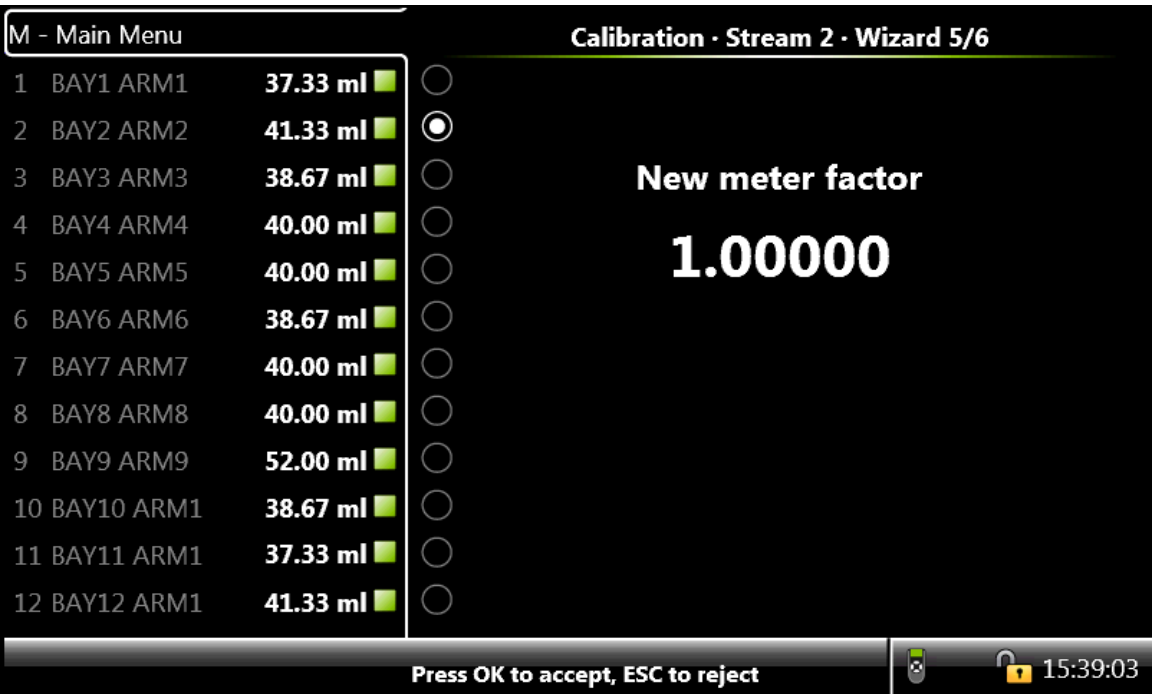
After the process is completed, the Calibration - Stream n - Wizard 4/6 screen appears, in which you must enter the actual volume to be calibrated.



On the Calibration - Stream n - Wizard 4/6 screen, enter the actual measured volume (calibrated vessel) and then select <Confirm>.

With the actual value and the value of the MSC-A measured, a new meter factor is calculated.

The Calibration - Stream n - Wizard 5/6 screen appears, which displays the new meter factor.

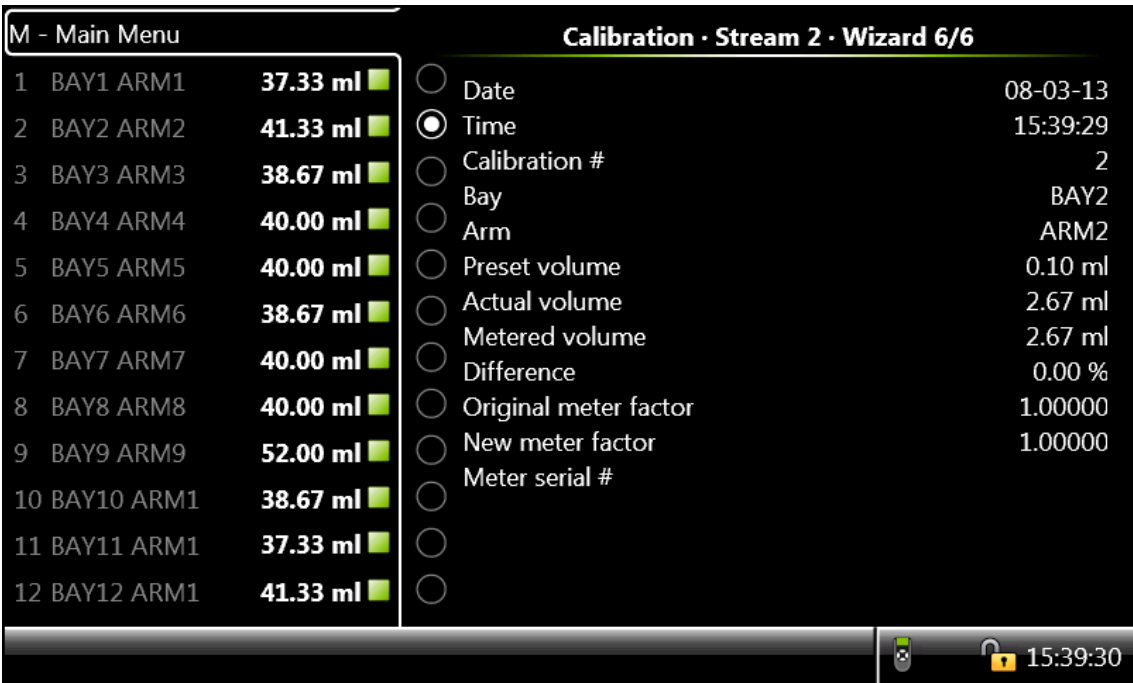


On the Calibration - Stream n - Wizard 5/6 screen, select <OK> on the IR controller or LAD, to accept the new meter factor and view the calibration details.

The Calibration - Stream n - Wizard 6/6 screen appears, which displays the calibration details.

A new calibration record is created and stored in the system. Each calibration is saved in a non-volatile memory, with date, time, old and new values.

**NOTE:** Select <ESC> to restore the old meter factor.

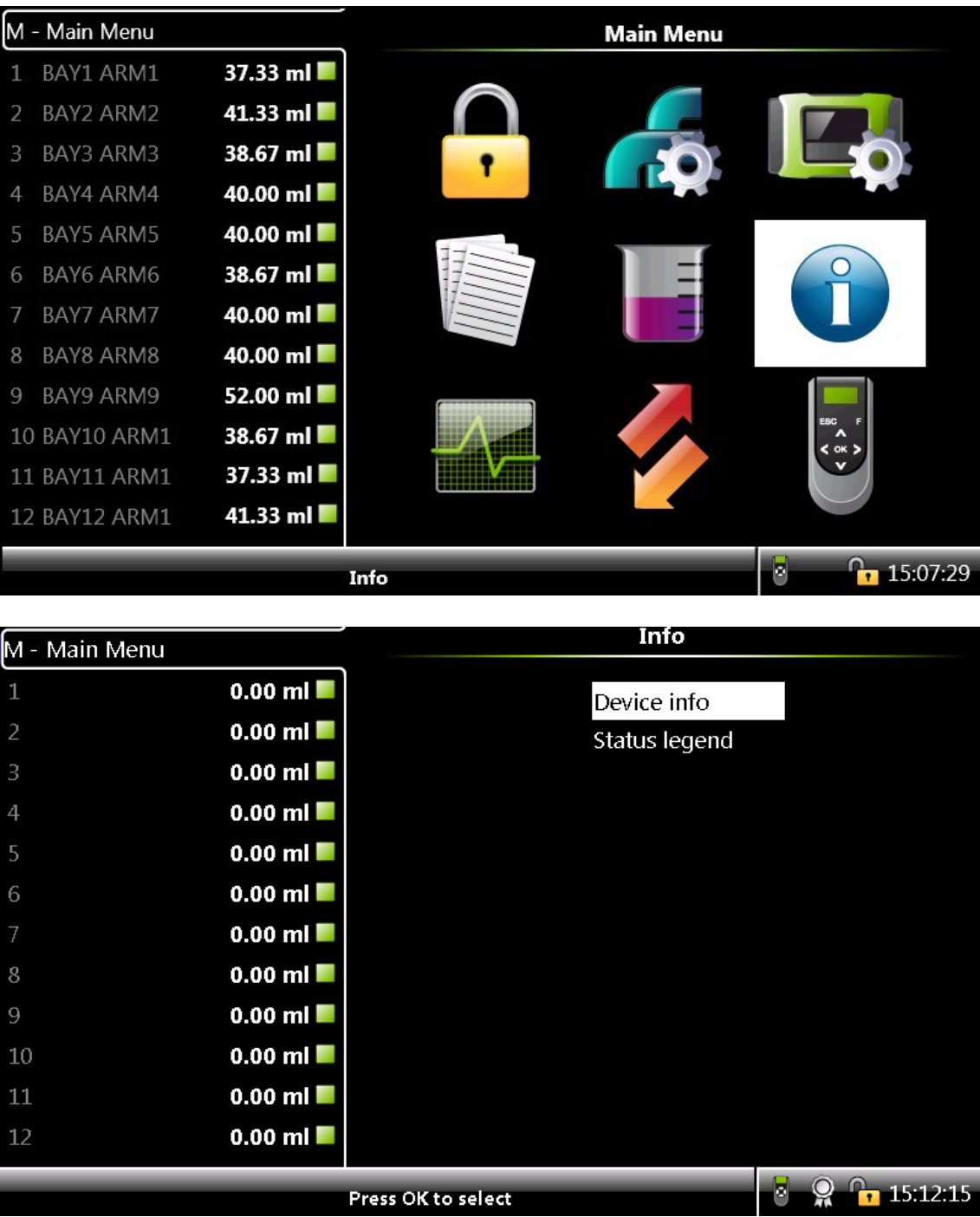


**NOTE:** The Calibration process is applicable for all the streams (Stream 1-24). Stream n indicates Stream 1 to 24.

# 5.12 Info (Device Information)

From the Main Menu screen, select the Info icon to view the device and module information.

Figure 5-42: Info icon



### 5.12.1 Device info

The MSC-A Device Info screen displays the Device Info and Module Info.



The Device Info section displays the important information about the device which includes the following:

- Device serial number
- Product date
- Sales code
- License

**NOTE:** All the above device information is programmed by the factory as per the order received.

The Module Info section provides the identification information about the individual boards and the firmware modules available in the device. The module information includes the following:

- Module name
- Bootloader version
- Application firmware version
- Application build version
- Serial number

Figure 5-43: Device Info/Module Info screen



### 5.12.2 Status Legend

The Status Legend displays the overview of the status characters that are displayed along with the PV data. Following table explains when the status character are displayed. See the following figure for more information.

Status Character	Category
#	Data is not W&M approved
Space	Data is actual
S	Data is stored
?	Data has reduced accuracy
K	Data is killed
v	Data is under range
&	Data is manually overwritten
O	Data is old
^	Data is over range
U	Data is uninitialized
F	Data is in Fail



# 5.13 Logs

From the Main Menu screen, select the <Logs> icon to view the various logs maintained in the non-volatile memory.

Figure 5-44: Logs icon

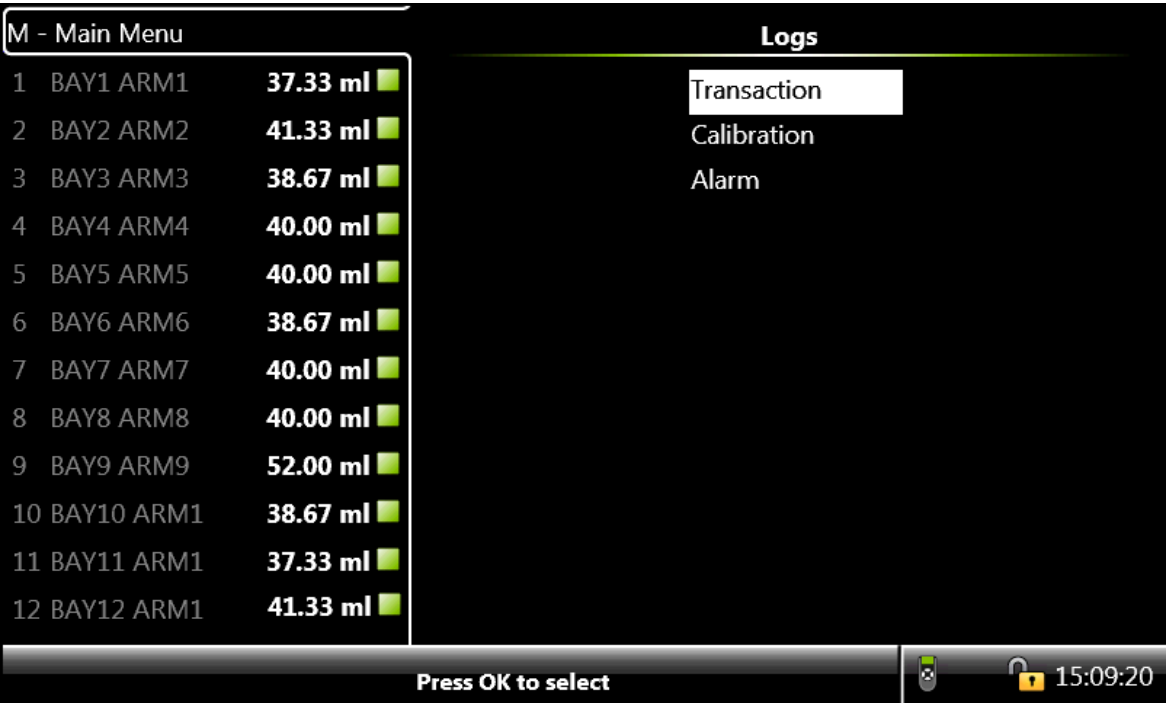


From the Logs screen, you can view the following data logs.

- Transaction logs: Displays the complete information about all the available transaction records. The storage space for the transaction logs in the MSC-A device is 240000 records.
- Calibration logs: Displays the sequence of additive meter factor calibrations over time for all the available calibration records. The storage space for the calibration logs in the MSC-A device is 1200 records.
- Alarm logs: Displays a chronological list on the occurrence of the alarms and the type of alarms for all the available alarm records. The storage space for the alarm logs in the MSC-A device is 2000 records.

When the log record is full, the oldest one is automatically deleted and overwritten. Then, the transaction cannot be retrieved through the Fusion4 Portal or the LAD.

**NOTE:** To view the logs, use the right arrow (>) on the LAD or IR Controller to view the previous set of records in a list of records which spans more than a page and left arrow (<) on the LAD or IR Controller to view the next set of records in a list of records which spans more than one page.



### 5.13.1 Transaction

From the Logs screen, select <Transaction> and then select <OK> on the IR controller or LAD.

The Logs - All Streams - Transaction Log screen appears, which displays all the transaction records.

M - Main Menu		Logs - Transaction Log			
		<input checked="" type="radio"/> Date	Time	Product	Volume
1	200.00 ml	<input checked="" type="radio"/>	12-05-16	15:33:36	200.00 ml
2	0.00 ml	<input checked="" type="radio"/>	12-05-16	15:33:10	200.00 ml
3	0.00 ml	<input checked="" type="radio"/>	12-05-16 *	15:29:31	18.67 ml
4	0.00 ml	<input checked="" type="radio"/>	12-05-16 *	15:25:13	58.67 ml
5	0.00 ml	<input checked="" type="radio"/>	12-05-16	15:24:33	160.00 ml
6	0.00 ml	<input checked="" type="radio"/>	12-05-16 *	15:23:09	18.67 ml
7	0.00 ml	<input checked="" type="radio"/>	12-05-16 *	15:22:57	18.67 ml
8	0.00 ml	<input checked="" type="radio"/>	12-05-16 *	15:22:21	0.00 ml
9	0.00 ml	<input checked="" type="radio"/>	12-05-16	15:21:07	220.00 ml
10	0.00 ml	<input checked="" type="radio"/>	12-05-16	15:20:31	201.33 ml
11	0.00 ml	<input checked="" type="radio"/>	12-05-16	15:18:57	418.67 ml
12	0.00 ml	<input checked="" type="radio"/>	12-05-16	15:17:53	441.33 ml
		<input checked="" type="radio"/>	12-05-16	15:16:10	220.00 ml
		<input checked="" type="radio"/>	12-05-16	15:14:34	200.00 ml

Page 1 / 1 --- Use the arrows to scroll 15:33:48

From the Logs - All Streams - Transaction Log screen, select any one of the transactions and then select <OK> on the IR controller or LAD.

The Logs - All Streams - Transaction Record screen appears, which displays the details of the transaction record.

**NOTE:** A transaction with \* indicates that the transaction has alarms.

M - Main Menu		Logs · All Streams · Transaction Record	
1	200.00 ml ■	<input type="radio"/> Transaction record version	1
2	0.00 ml ■	<input type="radio"/> Transaction id	14
3	0.00 ml ■	<input type="radio"/> Calibration id	0
4	0.00 ml ■	<input type="radio"/> Transaction start	12-05-16 15:33:12
5	0.00 ml ■	<input type="radio"/> Transaction stop	12-05-16 15:33:36
6	0.00 ml ■	<input type="radio"/> Site name	---
7	0.00 ml ■	<input type="radio"/> Bay name	
8	0.00 ml ■	<input type="radio"/> Arm name	
9	0.00 ml ■	<input type="radio"/> Device name	MSC
10	0.00 ml ■	<input type="radio"/> Device type	MSC_A_
11	0.00 ml ■	<input type="radio"/> Hazardous mat. class	
12	0.00 ml ■	<input type="radio"/> Product name	
		<input type="radio"/> Additive name	Stream 1
		<input type="radio"/> Injection volume	20.00 ml
		<input type="radio"/> Wild stream per injection	100.00 L

Press OK to save on LAD

15:34:26

M - Main Menu		Logs · All Streams · Transaction Record	
1	200.00 ml ■	<input type="radio"/> Device type	MSC_A_
2	0.00 ml ■	<input type="radio"/> Hazardous mat. class	
3	0.00 ml ■	<input type="radio"/> Product name	
4	0.00 ml ■	<input type="radio"/> Additive name	Stream 1
5	0.00 ml ■	<input type="radio"/> Injection volume	20.00 ml
6	0.00 ml ■	<input type="radio"/> Wild stream per injection	100.00 L
7	0.00 ml ■	<input type="radio"/> Deviation	-9.09 %
8	0.00 ml ■	<input type="radio"/> PPM	181
9	0.00 ml ■	<input type="radio"/> Additive volume	200.00 ml
10	0.00 ml ■	<input type="radio"/> Load volume	1102.59 L
11	0.00 ml ■	<input type="radio"/> Accumulated start GOV	2.235 L
12	0.00 ml ■	<input type="radio"/> Accumulated stop GOV	2.435 L
		<input type="radio"/> Non critical error	No alarm
		<input type="radio"/> Critical error	No alarm
		<input type="radio"/> W&M compliant	Yes

Press OK to save on LAD

15:35:05

Following are the transaction details that appear on the Logs - All Streams - Transaction Record screen.

- Transaction record version
- Transaction id
- Calibration id

- Transaction start
- Transaction stop
- Site name
- Bay name
- Arm name
- Device name
- Device type
- Hazardous mat. class
- Product name
- Additive name
- Injection volume
- Wild stream per injection
- Deviation
- PPM
- Additive volume
- Load volume
- Accumulated start GOV
- Accumulated stop GOV
- Non critical error
- Critical error
- W&M compliant

## 5.13.2 Calibration

From the Logs screen, select <Calibration> and then select <OK> on the IR controller or LAD.

The Logs - All Streams - Calibration Log screen appears, which displays all the calibration records.

M - Main Menu

1

BAY1 ARM1

37.33 ml

2

BAY2 ARM2

41.33 ml

3

BAY3 ARM3

38.67 ml

4

BAY4 ARM4

40.00 ml

5

BAY5 ARM5

40.00 ml

6

BAY6 ARM6

38.67 ml

7

BAY7 ARM7

40.00 ml

8

BAY8 ARM8

40.00 ml

9

BAY9 ARM9

52.00 ml

10

BAY10 ARM1

38.67 ml

11

BAY11 ARM1

37.33 ml

12

BAY12 ARM1

41.33 ml

Date

Time

Old meter factor

New meter factor

24-12-12

14:57:35

1.02000

1.00000

24-12-12

14:56:42

1.02000

1.02000

24-12-12

14:55:45

1.00000

1.02000

Page 1 of 1 --- Use the arrows to scroll

14:59:06

From the Logs - All Streams - Calibration Log screen, select any one of the transactions and then select <OK> on the IR controller or LAD.

The Logs - All Streams - Calibration Record screen appears, which displays the details of the transaction record.

M - Main Menu			Logs - All Streams - Calibration Record	
1	BAY1 ARM1	37.33 ml	<input type="radio"/> Date	24-12-12
2	BAY2 ARM2	41.33 ml	<input type="radio"/> Time	14:57:35
3	BAY3 ARM3	38.67 ml	<input type="radio"/> Calibration id	3
4	BAY4 ARM4	40.00 ml	<input type="radio"/> Bay	
5	BAY5 ARM5	40.00 ml	<input type="radio"/> Arm	
6	BAY6 ARM6	38.67 ml	<input type="radio"/> Preset volume	0.00 ml
7	BAY7 ARM7	40.00 ml	<input type="radio"/> Actual volume	0.00 ml
8	BAY8 ARM8	40.00 ml	<input type="radio"/> Metered volume	0.00 ml
9	BAY9 ARM9	52.00 ml	<input type="radio"/> Difference	0.00 %
10	BAY10 ARM1	38.67 ml	<input type="radio"/> Original meter factor	1.02000
11	BAY11 ARM1	37.33 ml	<input type="radio"/> New meter factor	1.00000
12	BAY12 ARM1	41.33 ml	<input type="radio"/> Meter serial #	
Press OK to save on LAD			14:59:19	



### 5.13.3 Alarm

From the Logs screen, select <Alarm> and then select <OK> on the IR controller or LAD.

The Logs - All Streams - Alarm Log screen appears, which displays all the alarm records.

M - Main Menu			Logs - All Streams - Alarm Log			
			Timestamp	Id	Alarm	State
1	BAY1 ARM1	37.33 ml	21-12-12 17:52	2	Re-enabled	
2	BAY2 ARM2	41.33 ml	21-12-12 17:52	2	No activity	Ack
3	BAY3 ARM3	38.67 ml	21-12-12 17:52	1	Re-enabled	
4	BAY4 ARM4	40.00 ml	21-12-12 17:52	1	No activity	Ack
5	BAY5 ARM5	40.00 ml	21-12-12 17:25	2	No activity	On
6	BAY6 ARM6	38.67 ml	21-12-12 17:24	1	No activity	On
7	BAY7 ARM7	40.00 ml	21-12-12 17:24	2	Re-enabled	
8	BAY8 ARM8	40.00 ml	21-12-12 17:24	2	No activity	Ack
9	BAY9 ARM9	52.00 ml	21-12-12 17:24	1	Re-enabled	
10	BAY10 ARM1	38.67 ml	21-12-12 17:24	1	No activity	On
11	BAY11 ARM1	37.33 ml	21-12-12 17:24	2	No activity	On
12	BAY12 ARM1	41.33 ml	21-12-12 17:23	1	Re-enabled	
			21-12-12 17:23	1	No activity	Ack
			21-12-12 17:23	2	Re-enabled	

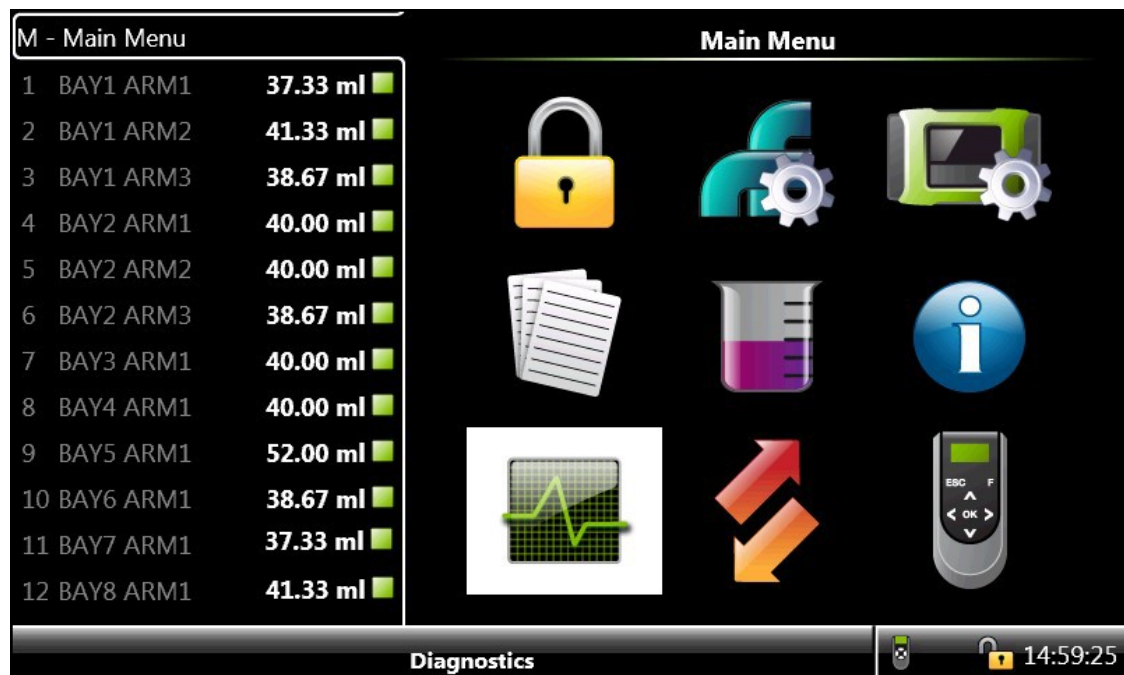
Page 1 of 5 --- Use the arrows to scroll

 14:59:35

### 5.14 Diagnostics

From the Main Menu screen, select the Diagnostics icon.

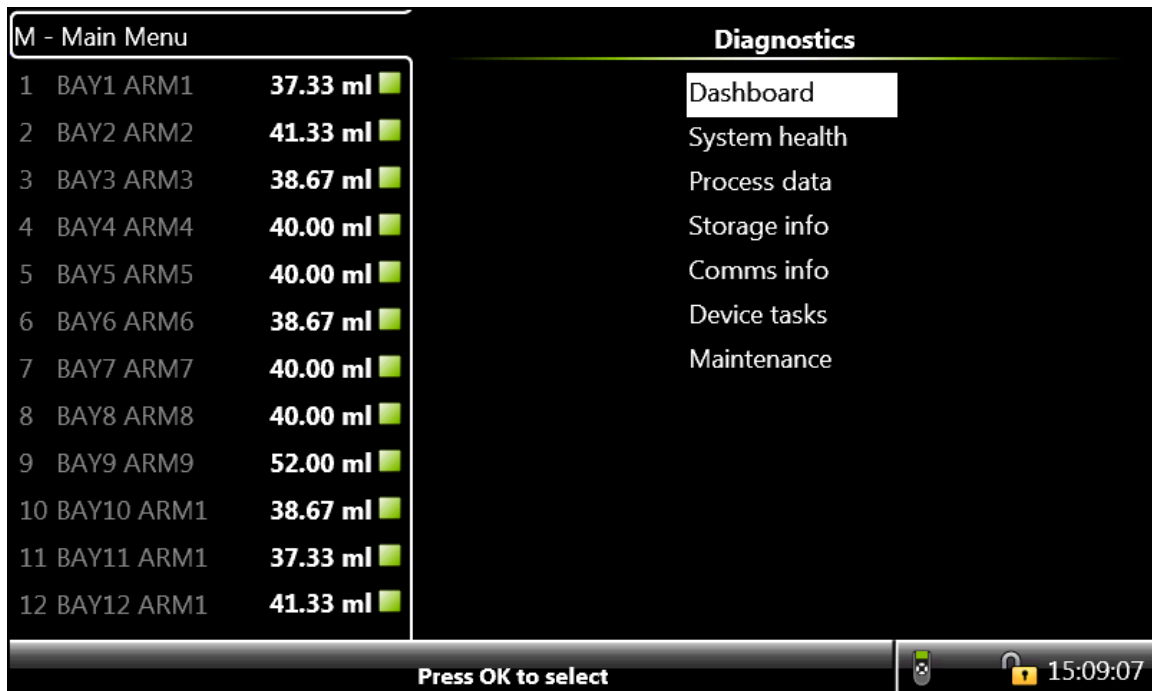
Figure 5-45: Diagnostics icon



Diagnostics function has the following features.

- Provides a high-level view of the current state of all the device I/O functions.
- Provides digital inputs/outputs display for the state as High/ Low.
- Provides the values of all output channels (digital and analog) which can be set explicitly. Outputs can be operated manually to activate, control, and test the field equipments. This function is extremely useful for commissioning the tests.
- Provides the internal memory usage overview.
- Provides system health overview.

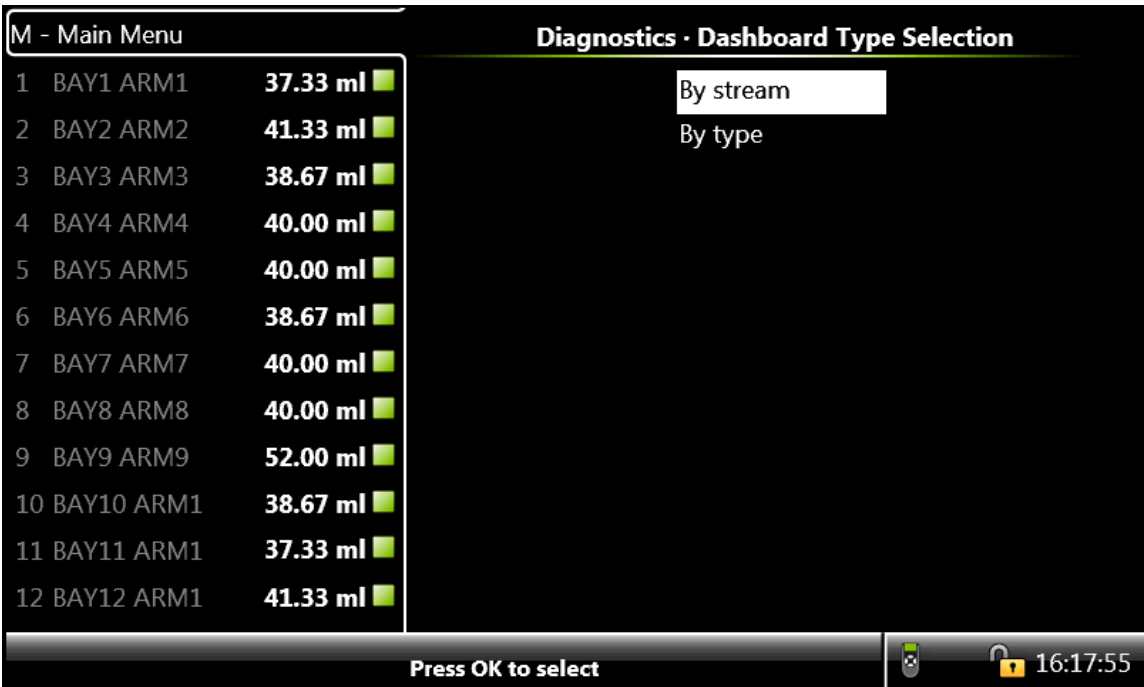
From the Diagnostics screen, you can view the diagnostics of the following features.



- Dashboard - Provides an overview of all the I/O (Dashboard).
- System health - Provides an overview of the system health.
- Process data - Provides an overview of the process data, such as accumulated totals, flow rate, temperature, and so on for each of the selected screen.
- Storage info - Provides an overview of the available memory space for data logs and the total number of available logs.
- Comms info - Provides an overview of the diagnostic information related to the available serial and ethernet ports in the system.
- Device tasks - Provides an overview of the reset tasks, comms tasks, and clear tasks.
- Maintenance - Provides an overview of the switch counts which maintains the number of times certain output is switched on or off.

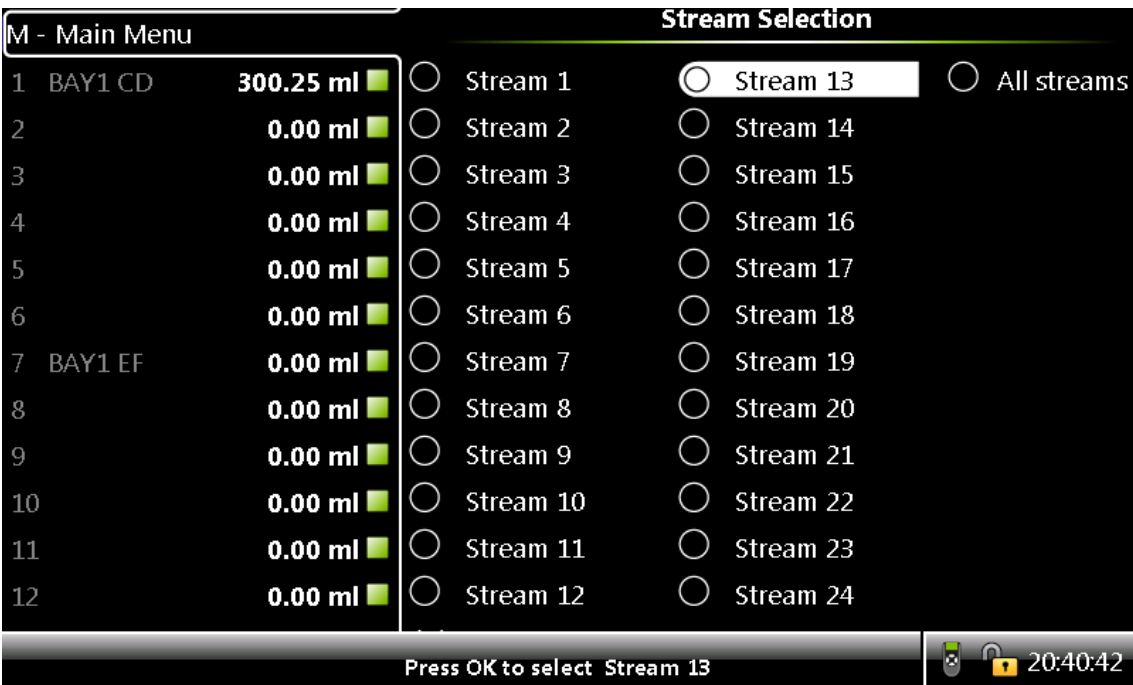
### 5.14.1 Dashboard

From the Diagnostics screen, select <Dashboard> to view the state or value of all the available I/O blocks in the MSC-A.



### 5.14.1.1 Dashboard - By stream

From the Diagnostics - Dashboard Type Selection screen, select <By stream>.

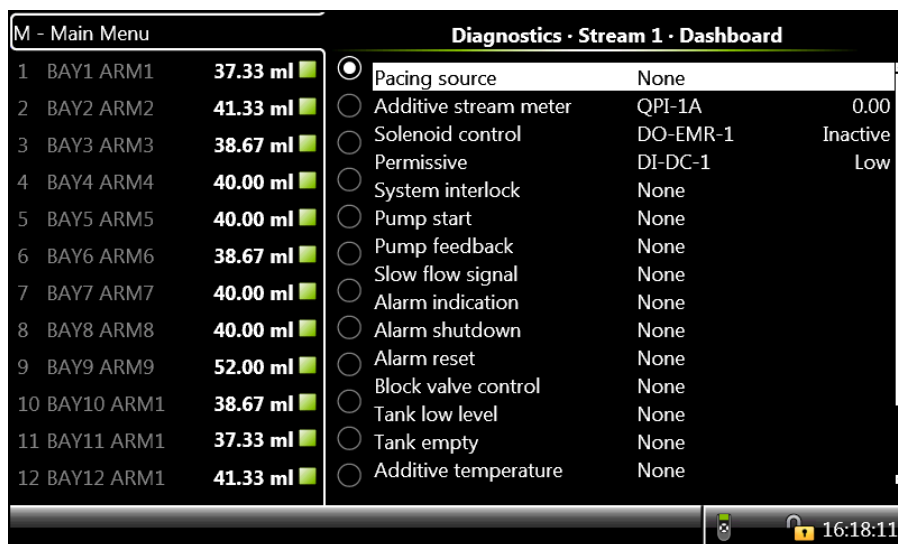


The Stream Selection screen appears.

- Select any one stream or select all the streams.

The Diagnostics - Stream n - Dashboard screen appears, which displays the state or value of all the available I/O blocks.

Select the following blocks to test and activate the I/O blocks.



Following are the parameters available on the Diagnostics - Stream n

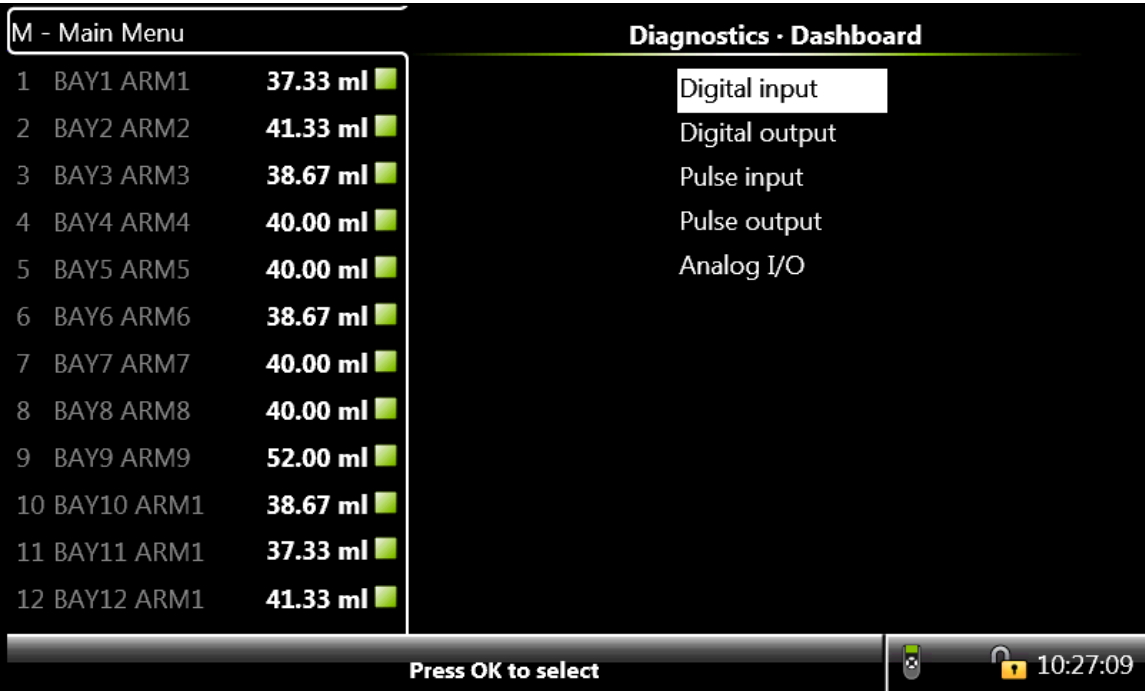
- Dashboard screen.
  - Pacing source
  - Additive stream meter
  - Solenoid control
  - Permissive
  - System interlock
  - Pump start
  - Pump feedback
  - Slow flow signal
  - Alarm indication
  - Alarm shutdown
  - Alarm reset
  - Block valve control
  - Tank low level
  - Tank empty
  - Additive temperature
  - Injection feedback

- Factored pulse out
- Ext.solenoid control

5.14.1.2 Dashboard - By type

From the Diagnostics - Dashboard Type Selection, select <By type>.

The Diagnostics - Dashboard screen appears, which displays the following input/output features.



**NOTE:** You can activate or de-activate the individual output for test purpose by selecting the output and then selecting <OK> on the IR controller or LAD. Activating the output energises the actual field equipment connected.



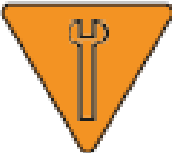



**NOTE:** The content of the following sections may differ depending on the particular Expansion Pack that is bought.

5.14.1.2.1 Dashboard I/O Type Symbols

The diagnostic dashboard displays the detailed I/O diagnostics together with the NAMUR NE-107 compliant icons which reflect the high level category of the I/O diagnostics.

The following table lists the icons on the Diagnostics - Dashboard

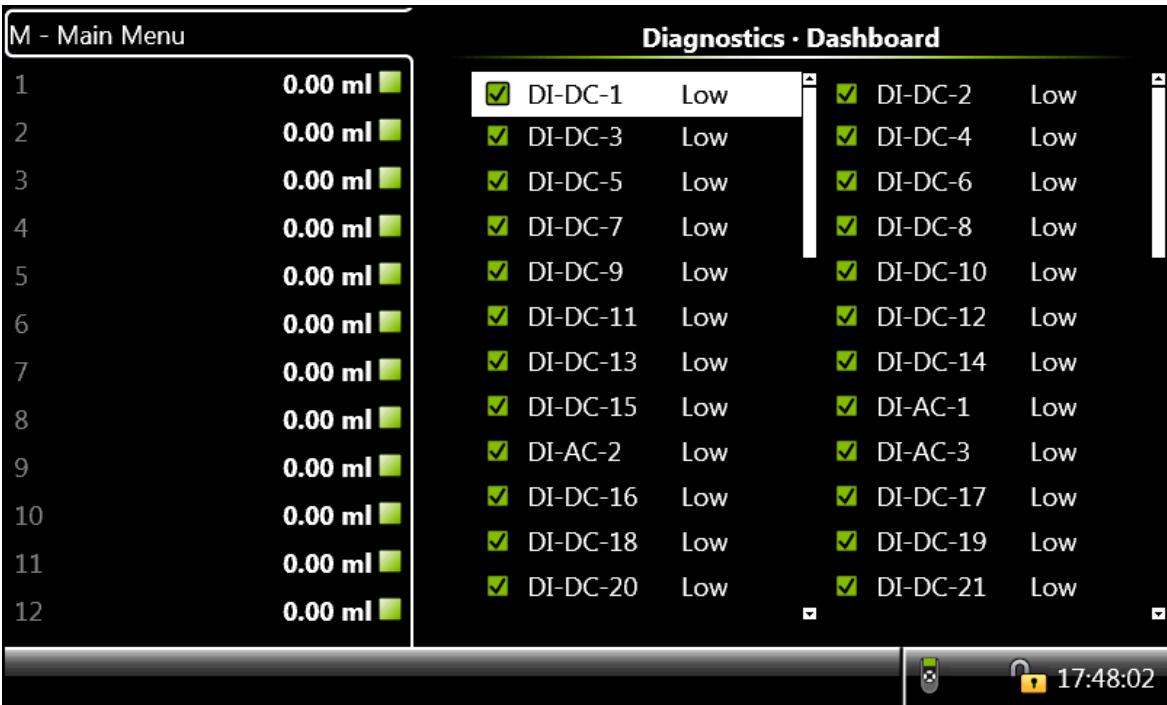
screen.

Icon	Description
	Maintenance is required
	Out of specification
	Check the function
	Failure
	Diagnostics is active
	Diagnostics is passive

5.14.1.2.2 Digital Input

From the Diagnostics - Dashboard screen, select <Digital input>.

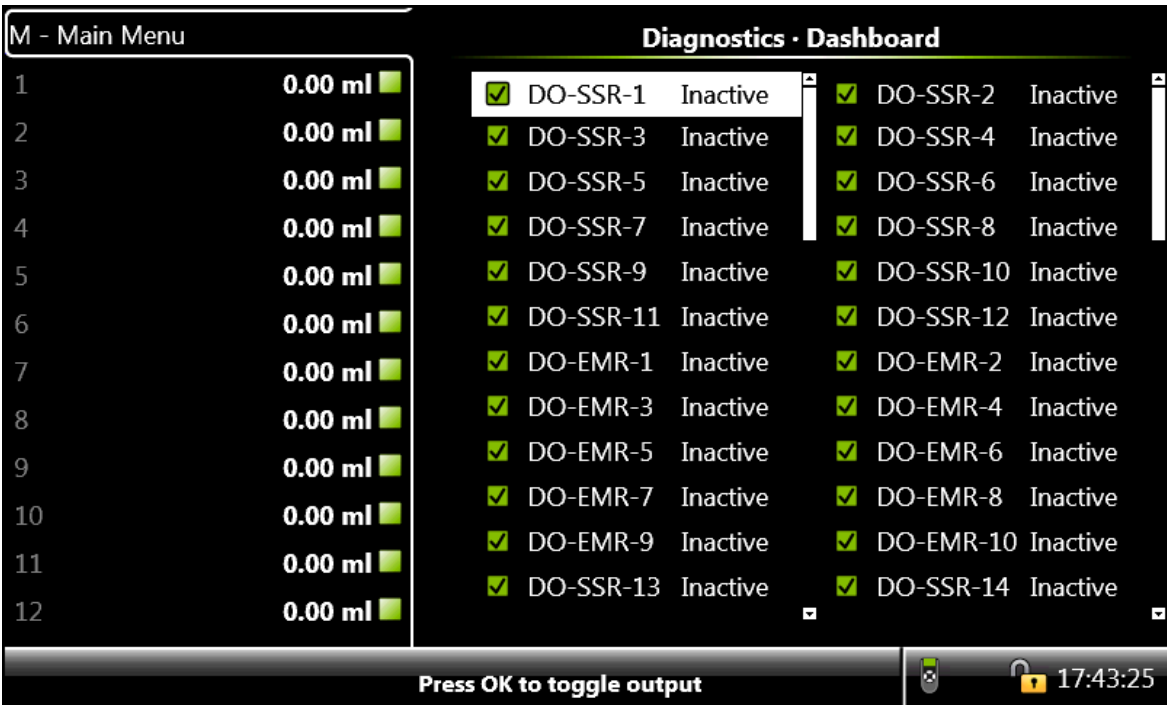
The Diagnostics - Dashboard screen appears, which displays the state or value of all the available Digital input blocks.



### 5.14.1.3 Digital Output

From the Diagnostics - Dashboard screen, select <Digital output>.

The Diagnostics - Dashboard screen appears, which displays the state or value of all the available Digital output blocks.






5.14.1.4 Pulse Input

From the Diagnostics - Dashboard screen, select <Pulse input>.

The Diagnostics - Dashboard screen appears, which displays the state or value of all the available Pulse input blocks.

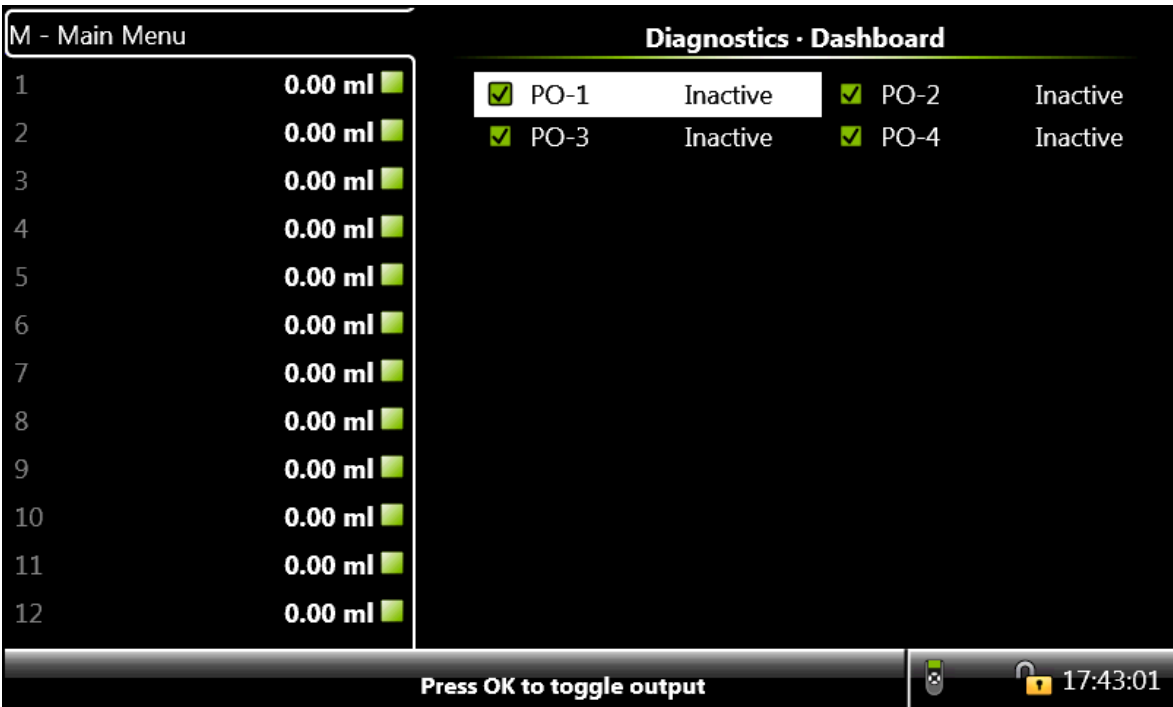
M - Main Menu		Diagnostics - Dashboard			
1	0.00 ml	<input checked="" type="checkbox"/> QPI-1A	0.00	<input checked="" type="checkbox"/> QPI-1B	0.00
2	0.00 ml	<input checked="" type="checkbox"/> QPI-2A	0.00	<input checked="" type="checkbox"/> QPI-2B	0.00
3	0.00 ml	<input checked="" type="checkbox"/> QPI-3A	0.00	<input checked="" type="checkbox"/> QPI-3B	0.00
4	0.00 ml	<input checked="" type="checkbox"/> QPI-4A	0.00	<input checked="" type="checkbox"/> QPI-4B	0.00
5	0.00 ml	<input checked="" type="checkbox"/> QPI-5A	0.00	<input checked="" type="checkbox"/> QPI-5B	0.00
6	0.00 ml	<input checked="" type="checkbox"/> QPI-6A	0.00	<input checked="" type="checkbox"/> QPI-6B	0.00
7	0.00 ml	<input checked="" type="checkbox"/> QPI-7A	0.00	<input checked="" type="checkbox"/> QPI-7B	0.00
8	0.00 ml	<input checked="" type="checkbox"/> QPI-8A	0.00	<input checked="" type="checkbox"/> QPI-8B	0.00
9	0.00 ml	<input checked="" type="checkbox"/> QPI-9A	0.00	<input checked="" type="checkbox"/> QPI-9B	0.00
10	0.00 ml	<input checked="" type="checkbox"/> QPI-10A	0.00	<input checked="" type="checkbox"/> QPI-10B	0.00
11	0.00 ml	<input checked="" type="checkbox"/> QPI-11A	0.00	<input checked="" type="checkbox"/> QPI-11B	0.00
12	0.00 ml	<input checked="" type="checkbox"/> QPI-12A	0.00	<input checked="" type="checkbox"/> QPI-12B	0.00

 17:42:24

5.14.1.5 Pulse Output

From the Diagnostics - Dashboard screen, select <Pulse output>.

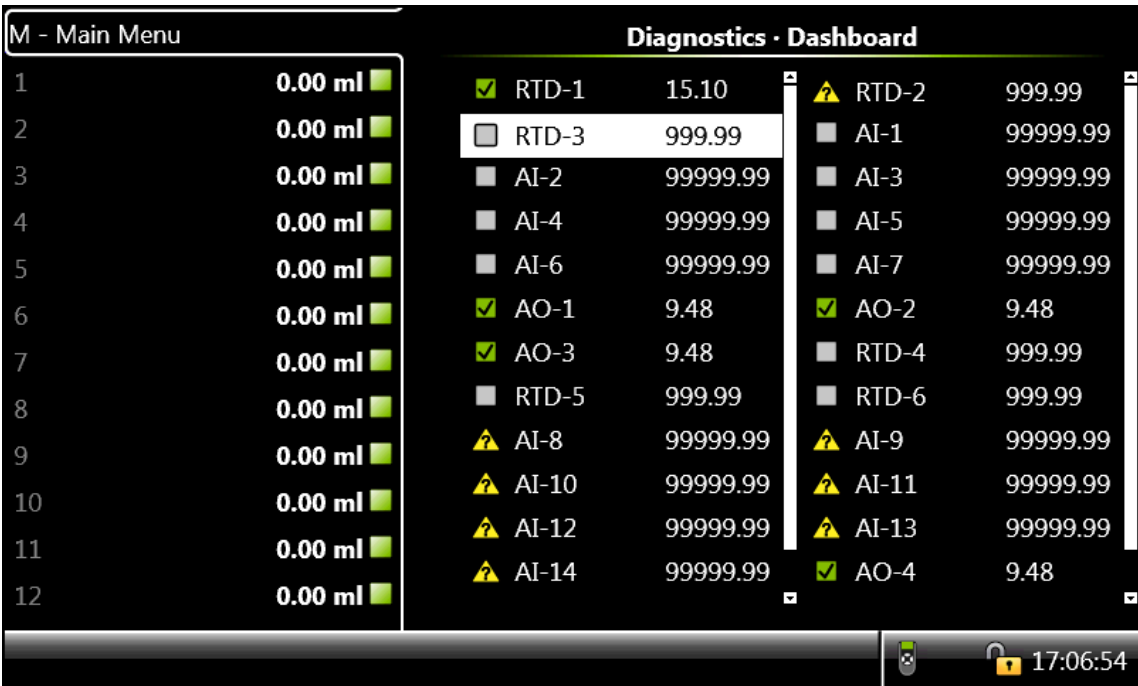
The Diagnostics - Dashboard screen appears, which displays the state or value of all the available Pulse output blocks.



### 5.14.1.6 Analog I/O

From the Diagnostics - Dashboard screen, select <Analog I/O>.

The Diagnostics - Dashboard screen appears, which displays the state or value of all the available Analog I/O blocks.



## 5.14.2 System Health

**NOTE:** The content of the Diagnostics - System Health may differ depending on the particular Expansion Pack that is bought.















From the Diagnostics screen, select <System health>.

The Diagnostics - Module Health screen appears, which displays the health of the boards available in the MSC-A.

M - Main Menu		Diagnostics - Module Health		
1	0.00 ml	FM-ARM-1	Good	No error
2	0.00 ml	FM-IN-OUT-1	Good	No error
3	0.00 ml	FM-IN-OUT-2	Good	No error
4	0.00 ml	FM-ARM-2	Good	No error
5	0.00 ml	FM-IN-OUT-3	Good	No error
6	0.00 ml	FM-IN-OUT-4	Good	No error
7	0.00 ml	FM-HMI	Good	No error
8	0.00 ml			
9	0.00 ml			
10	0.00 ml			
11	0.00 ml			
12	0.00 ml			
Press OK to view function health				
				17:07:57















1. From the Diagnostics - Module Health screen, select <FM-ARM-1>.

The Diagnostics - Function Health screen appears, which displays the details of the ARM board.

M - Main Menu		Diagnostics - Function Health		
1	0.00 ml 	RS	Good	No error
2	0.00 ml 	Batch control	Good	No error
3	0.00 ml 	Additive stream	Good	No error
4	0.00 ml 	Pulse inputs	Good	No error
5	0.00 ml 	Digital outputs	Good	No error
6	0.00 ml 	Pulse outputs fp	Good	No error
7	0.00 ml 	Pulse outputs hw	Good	No error
8	0.00 ml 	Module control	Good	No error
9	0.00 ml 	RTD	Good	No error
10	0.00 ml 	Analog inputs	Bad	No data available
11	0.00 ml 	Analog outputs	Good	No error
12	0.00 ml 	Ethernet	Good	No error
Press OK to view sensor health				
				  15:00:57

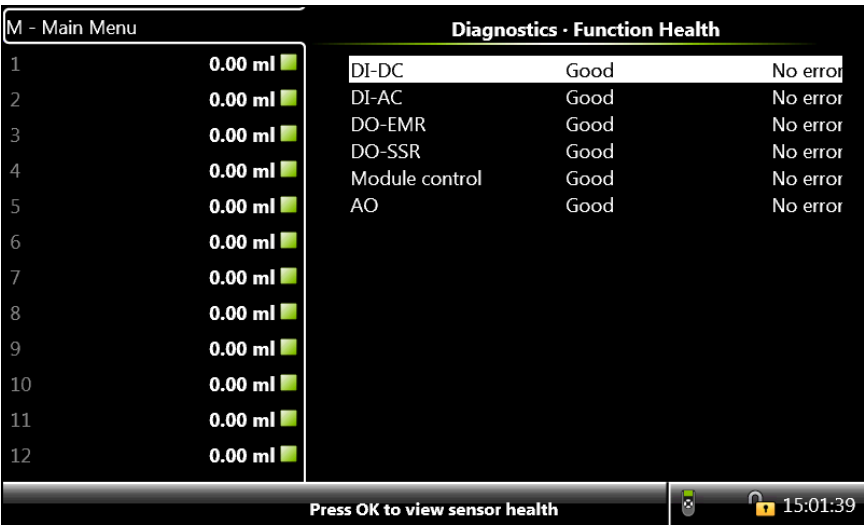
2. From the Diagnostics - Module Health screen, select <FM-IN-OUT- 1>.

The Diagnostics - Function Health screen appears, which displays the details of the IN-OUT board.

M - Main Menu		Diagnostics - Function Health		
1	0.00 ml 	DI-DC	Good	No error
2	0.00 ml 	DI-AC	Good	No error
3	0.00 ml 	DO-EMR	Good	No error
4	0.00 ml 	DO-SSR	Good	No error
5	0.00 ml 	Module control	Good	No error
6	0.00 ml 	AO	Good	No error
7	0.00 ml 			
8	0.00 ml 			
9	0.00 ml 			
10	0.00 ml 			
11	0.00 ml 			
12	0.00 ml 			
Press OK to view sensor health				
				  15:01:20

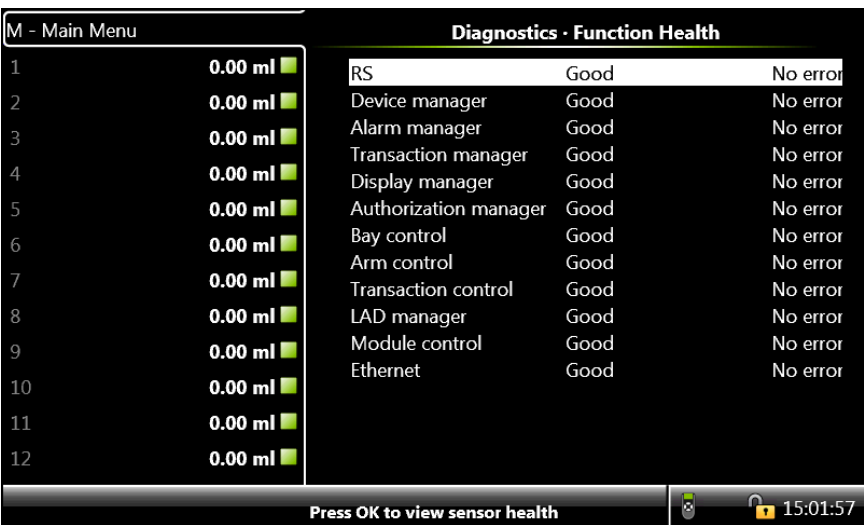
3. From the Diagnostics - Module Health screen, select <FM-IN-OUT- 2>.

The Diagnostics - Function Health screen appears, which displays the details of the IN-OUT board.



4. From the Diagnostics - Module Health screen, select <FM-HMI>.

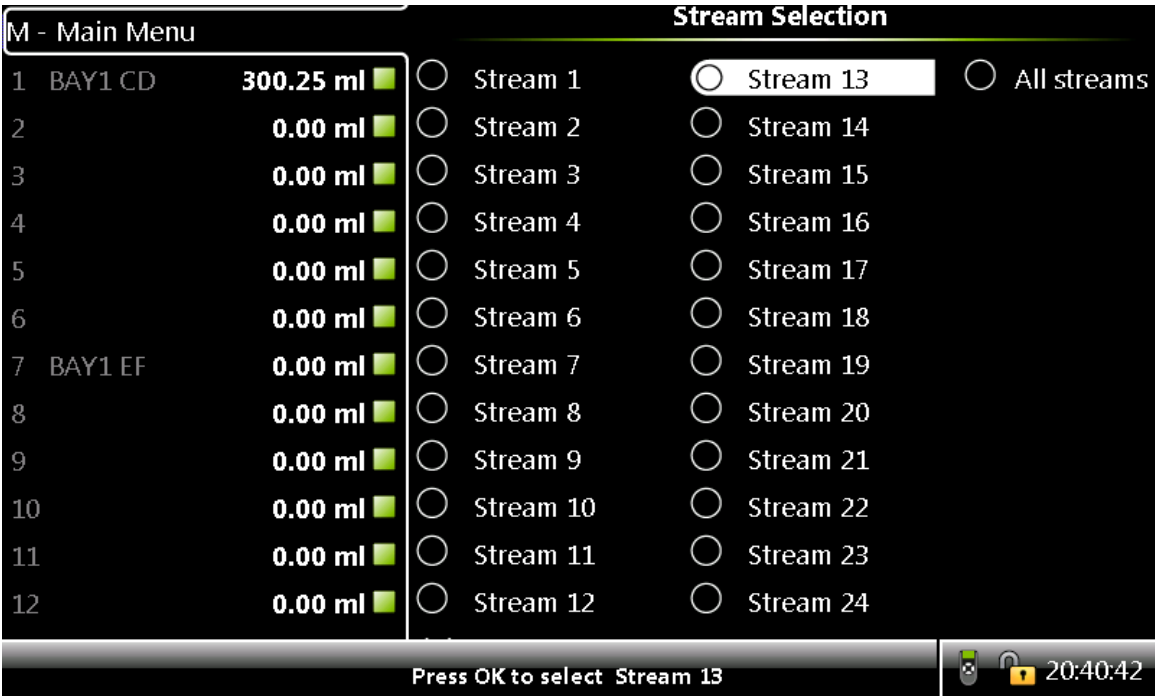
The Diagnostics - Function Health screen appears, which displays the details of the HMI board.



### 5.14.3 Process Data

From the Diagnostics screen, select <Process data>.













The Stream Selection screen appears.






Select one stream or all the streams to view the transactions.

The Diagnostics - Stream n - Process Data additive screen appears, which displays the transactions related run time data.

**NOTE:** The wild stream flow rate displays only the useful data when real wild stream meter pulses are connected to one of the Pulse input of the MSC-A.

M - Main Menu		Process data additive	
1	58.67 ml 	Accumulated additive GOV	2.016 L
2	0.00 ml 	Accumulated leaking GOV	0.000 L
3	0.00 ml 	Accumulated calibration GOV	0.000 L
4	0.00 ml 	Accumulated wild GOV	-2 L
5	0.00 ml 	Accumulated load GOV	0 L
6	0.00 ml 	Additive stream temperature	1.00e5 °C
7	0.00 ml 	Additive stream flow rate	3.99 L/min
8	0.00 ml 	Wild stream flow rate	0.00 L/min
9	0.00 ml 	Injection count	3
10	0.00 ml 	Injection history	16.00 ml
11	0.00 ml 	Injection history	24.00 ml
12	0.00 ml 	Injection history	18.67 ml
		Injection history	20.00 ml
		Injection history	20.00 ml

 15:25:19

**NOTE:** The wild stream flow rate displays only the useful data when the real wild stream meter pulses are connected to one of the Pulse input of the MSC-A.

### 5.14.4 Storage Info

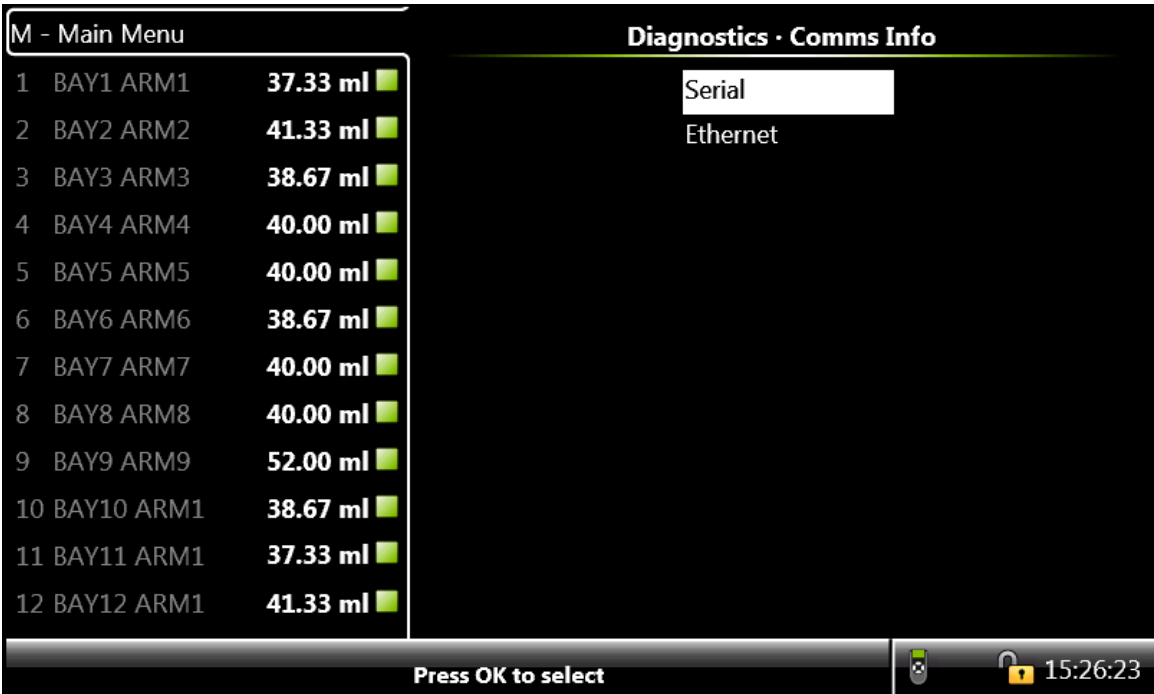
From the Diagnostics screen, select <Storage info>.

The Storage Info screen appears, which displays an overview of the actual stored logs in the internal SD card located on the CAN-HMI-MSC board.



### 5.14.5 Comms Info

From the Diagnostics screen, select <Comms Info> to view the serial and ethernet details.





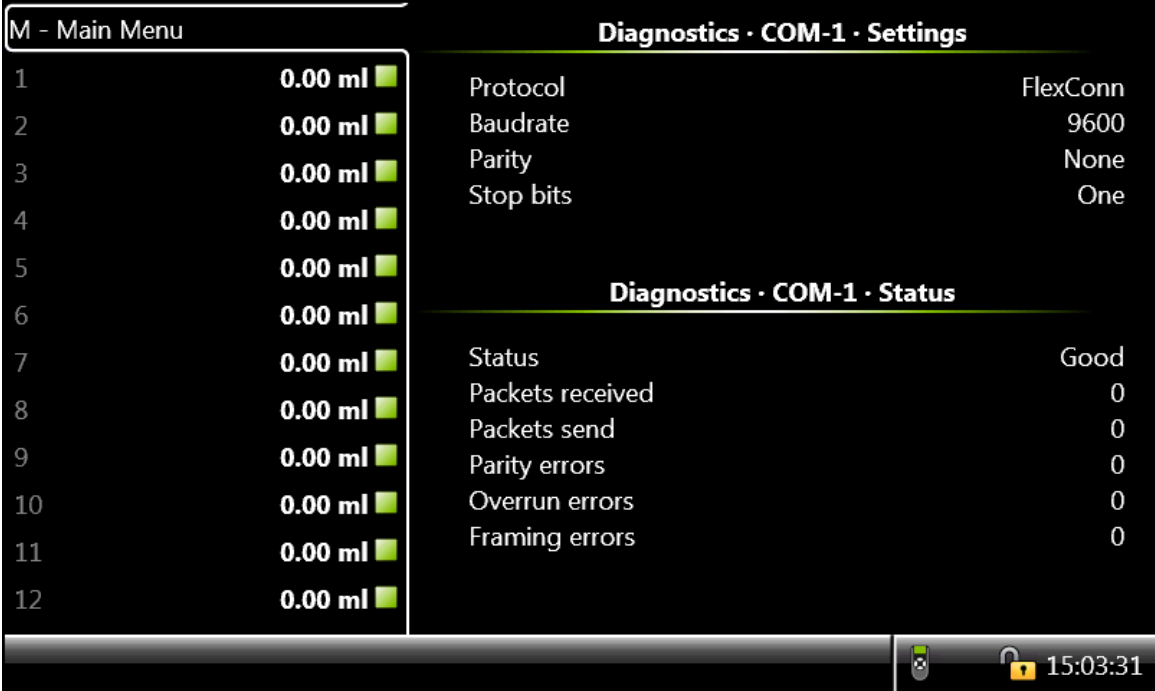
From the Diagnostics - Comms Info screen, select <Serial>.

The Diagnostics - Comms Info - Serial screen appears, which displays the serial communication details.

M - Main Menu		Diagnostics - Comms Info - Serial			
		Port Id	Protocol	Received	Transmitted
1	0.00 ml ■	COM-1	FlexConn	0	0
2	0.00 ml ■	COM-2	FlexConn	0	0
3	0.00 ml ■	COM-6	FlexConn	0	0
4	0.00 ml ■	COM-7	FlexConn	0	0
5	0.00 ml ■	COM-3	FlexConn	0	0
6	0.00 ml ■	COM-4	FlexConn	0	0
7	0.00 ml ■	COM-5	FlexConn	0	0
8	0.00 ml ■				
9	0.00 ml ■				
10	0.00 ml ■				
11	0.00 ml ■				
12	0.00 ml ■				
Press OK to view detailed data					
				17:08:59	

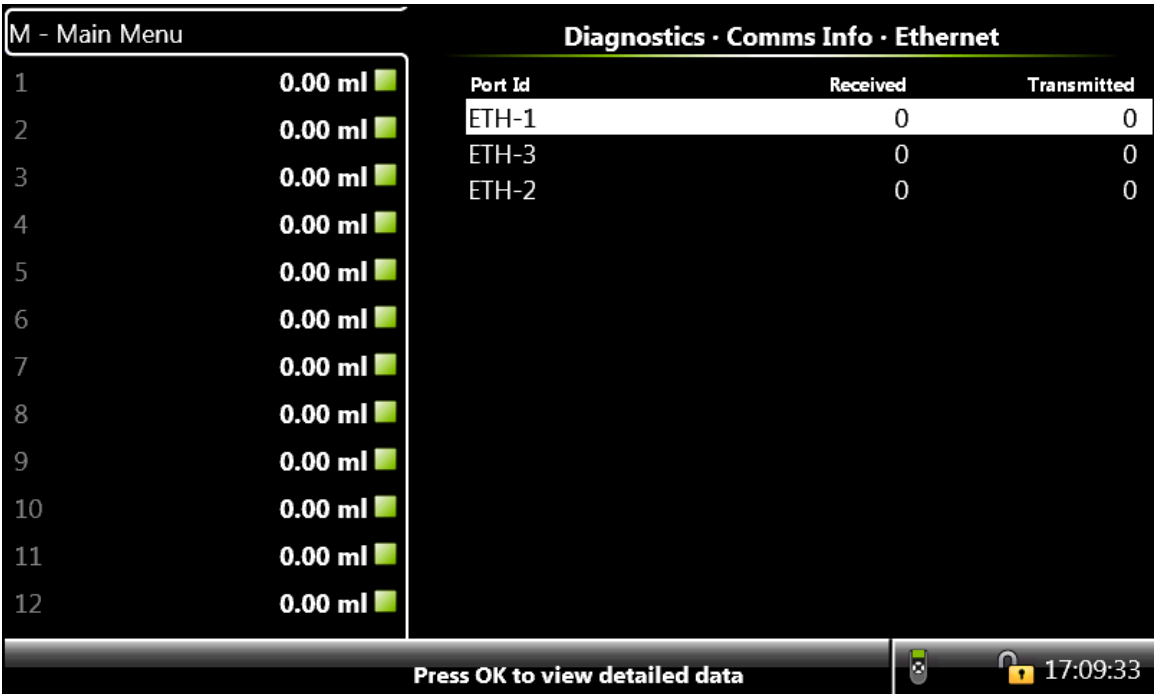
From the Diagnostics - Comms Info - Serial screen, select any one of the serial ports to view the details of the communication settings and the status.

- The Diagnostics - COM-1 - Settings screen appears, which displays the details of the communication settings.
- The Diagnostics - COM-1 - Status screen appears, which displays the errors that have occurred on the port, and also the number of packets that are received and transmitted.



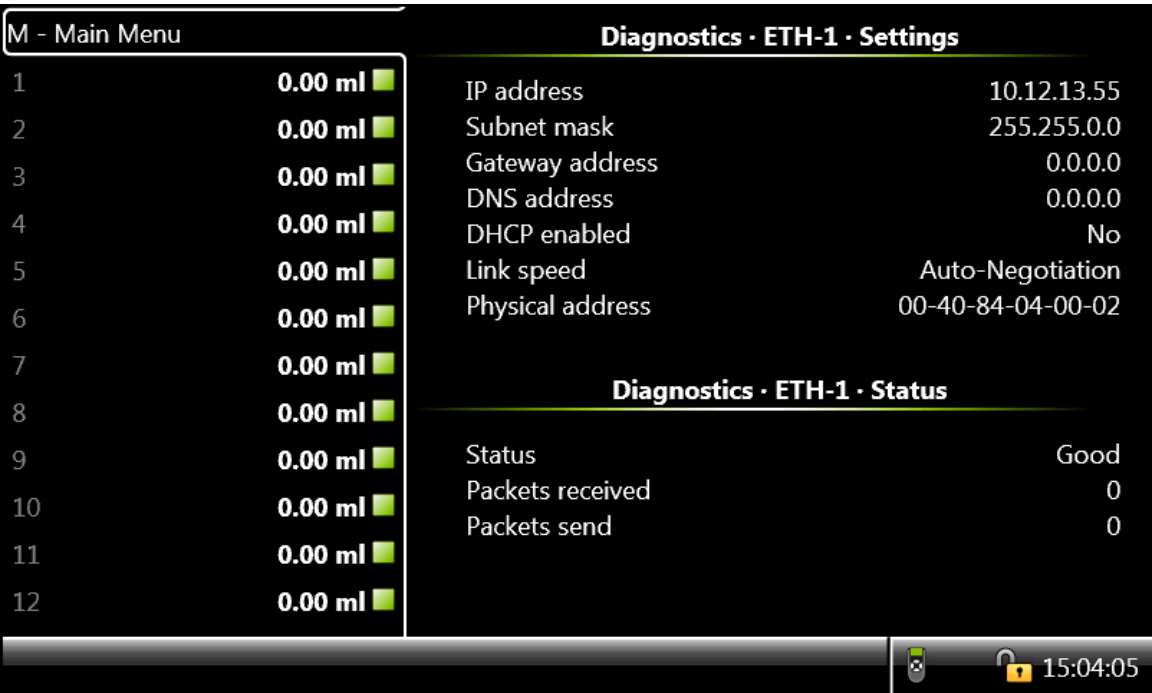
From the Diagnostics - Comms Info screen, select <Ethernet> to view the ethernet communication details.

The Diagnostics - Comms Info - Ethernet screen appears, which displays the ethernet communication details.



From the Diagnostics - Comms Info - Ethernet screen, select any one of the ethernet ports to view the details of the ethernet settings and the status.

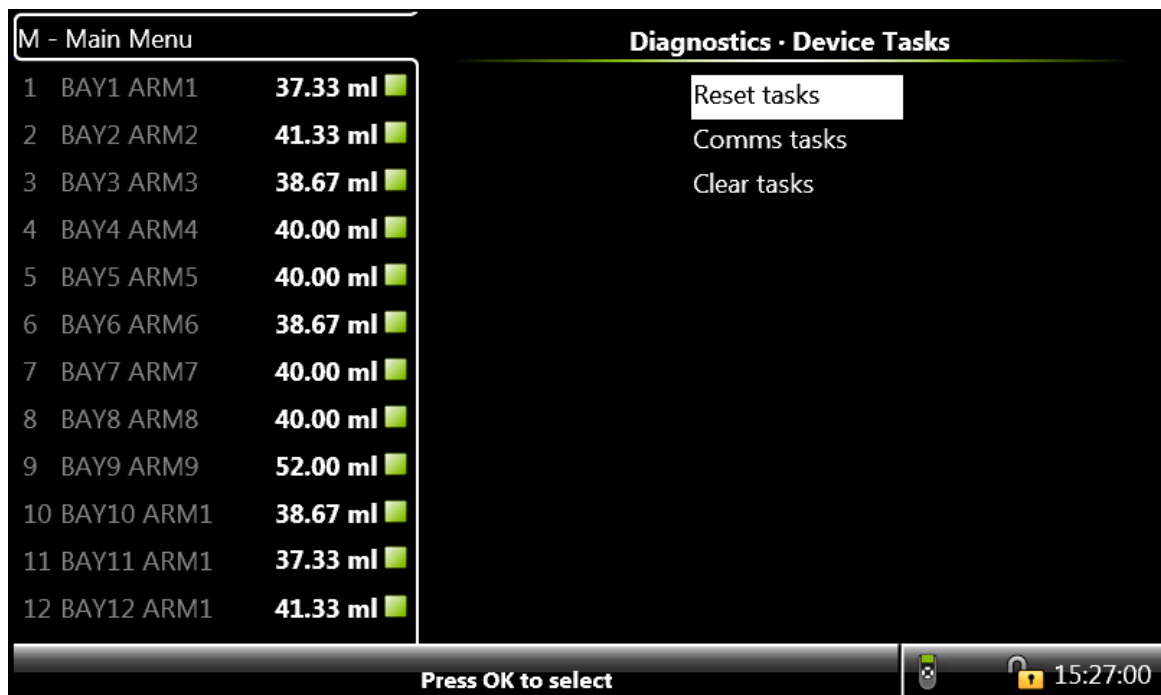
- The Diagnostics - ETH-1 - Settings screen appears, which displays the details of the ethernet settings.
- The Diagnostics - ETH-1 - Status screen appears, which displays the number of packets that are received and transmitted.



### 5.14.6 Device Tasks

From the Diagnostics screen, select <Device tasks>.

The Diagnostics - Device Tasks screen appears, which displays the options to reset tasks, comms tasks, and clear tasks.

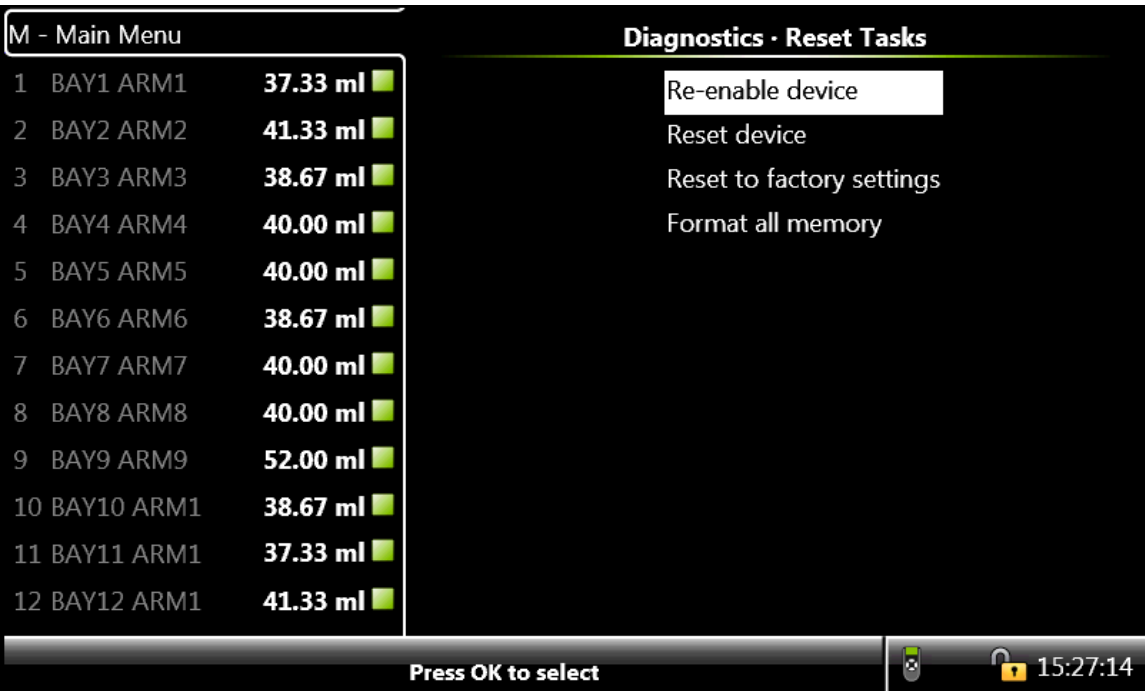


#### 5.14.6.1 Reset Tasks

From the Diagnostics - Device Tasks screen, select <Reset tasks>.

The Diagnostics - Reset Tasks screen appears, which displays the following options to reset the device.

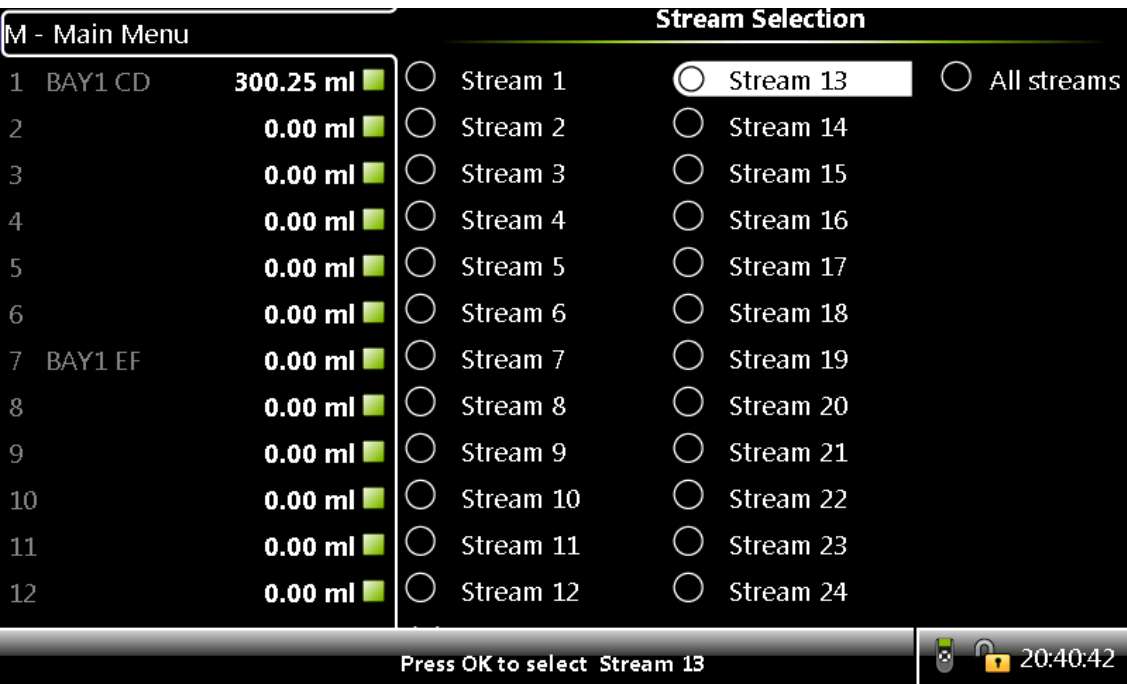
- Re-enable device - Allows you to clear all the alarms and re- enable the MSC-A.
- Reset device - Allows you to reset the MSC-A.
- Reset to factory settings - Allows you to reset all the configuration entities to the factory settings.
- Format all memory - Allows you to format the complete memory on all the boards.



### 5.14.6.2 Comms Tasks

From the Diagnostics - Device Tasks screen, select <Comms tasks>.

The Stream Selection screen appears.

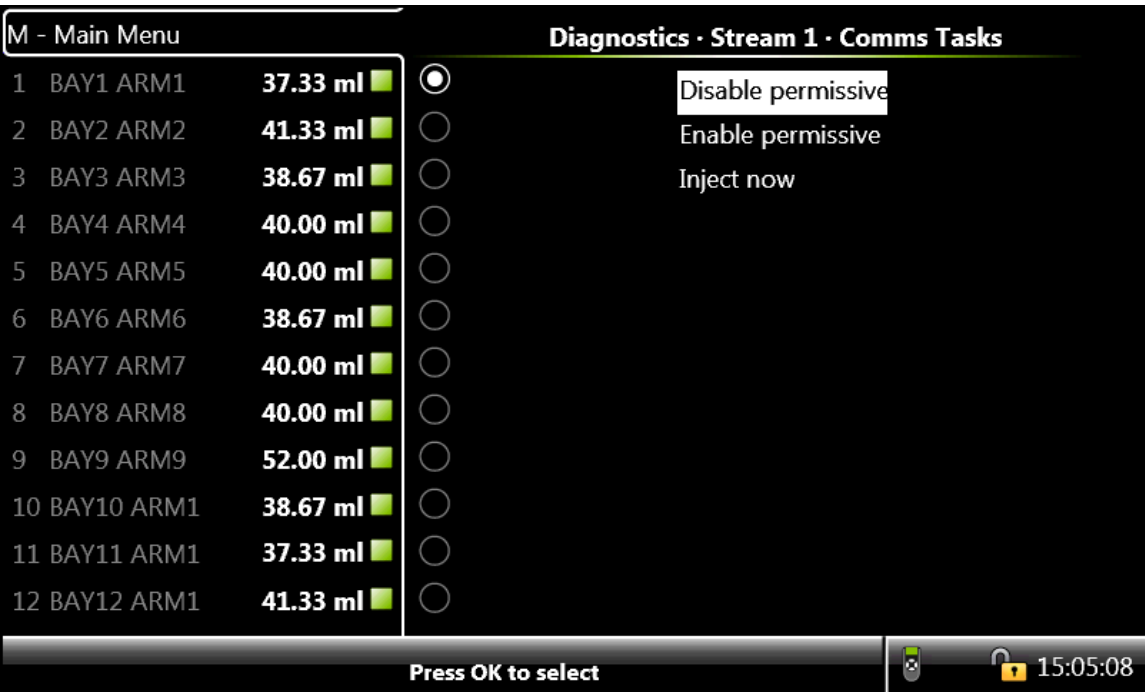


Select <OK> on the IR controller or LAD to select any one of the stream or all the streams.

The Diagnostics - Stream n - Comms tasks screen appears, which simulates the following actions by Comms.

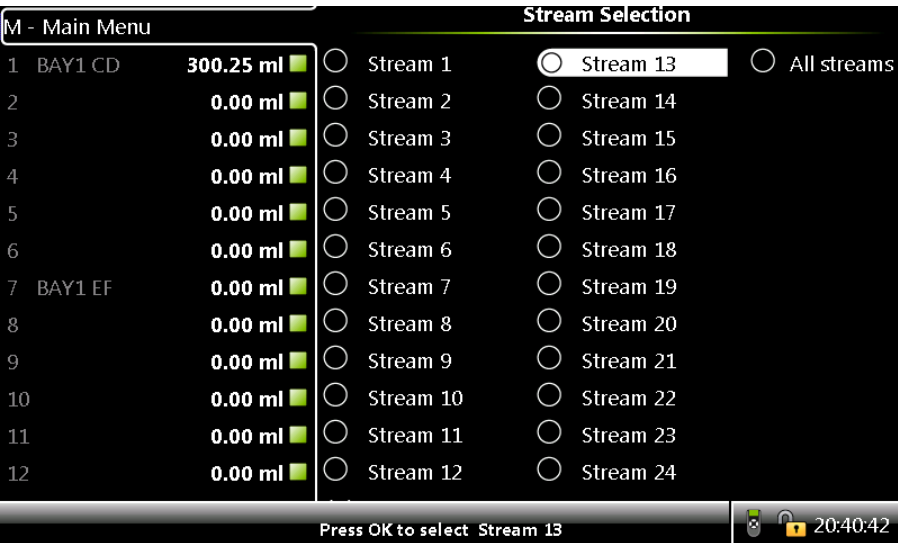
- Disable permissive - Allows you to simulate disabling the permissive to end a transaction on the stream selected.
- Enable permissive - Allows you to enable the permissive to start a transaction on the stream selected.
- Inject now - Allows you to inject one shot of additive.
- Open solenoid - Allows you to provide the open solenoid command if the selected stream is configured for slave comms mode.
- Close solenoid - Allows you to provide the close solenoid command if the selected stream is configured for slave comms mode.
- Enable slow flow - Allows you to enable slow flow command if clean arm is configured for the selected stream.

**NOTE:** For the Comms tasks the I/O bindings for the particular stream selected must be configured before using the tasks.



### 5.14.6.3 Clear Tasks

From the Diagnostics - Device Tasks screen, select <Clear tasks>.

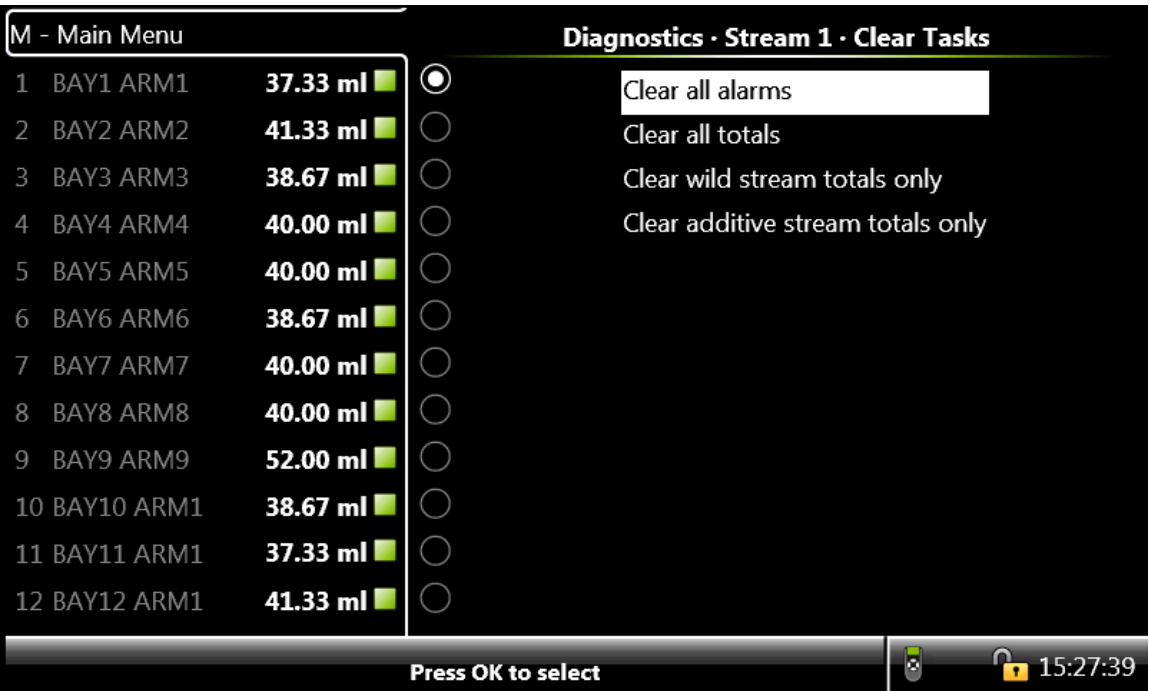


The Stream Selection screen appears.

Select <OK> on the IR controller or LAD, to select any one of the stream or all the streams.

The Diagnostics - Stream n - Clear Tasks screen appears, which displays the following options to clear the tasks selected for the stream.

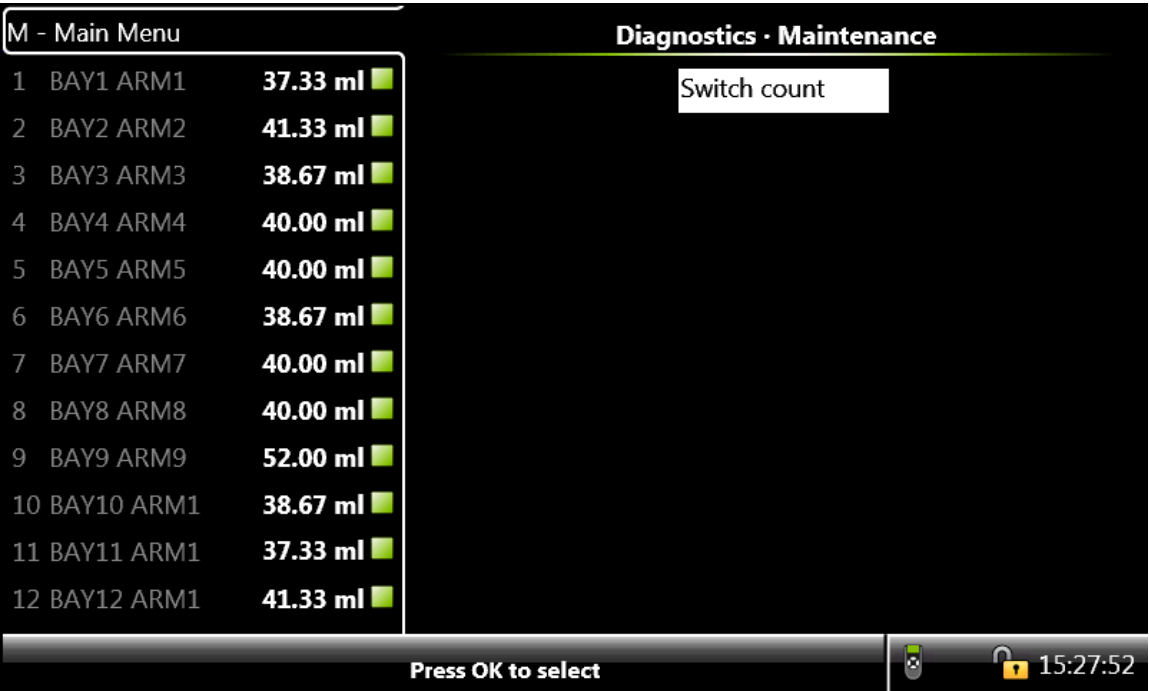
- Clear all alarms - Clears all the alarms on all the streams and device level alarms.
- Clear all totals - Clears all the totals.
- Clear wild stream totals only - Clears the wild stream totals.
- Clear additive stream totals only - Clears the additive stream totals.



#### 5.14.6.4 Maintenance

From the Diagnostics screen, select <Maintenance>.

The Diagnostics - Maintenance screen appears, which displays the option to view the switch counts.

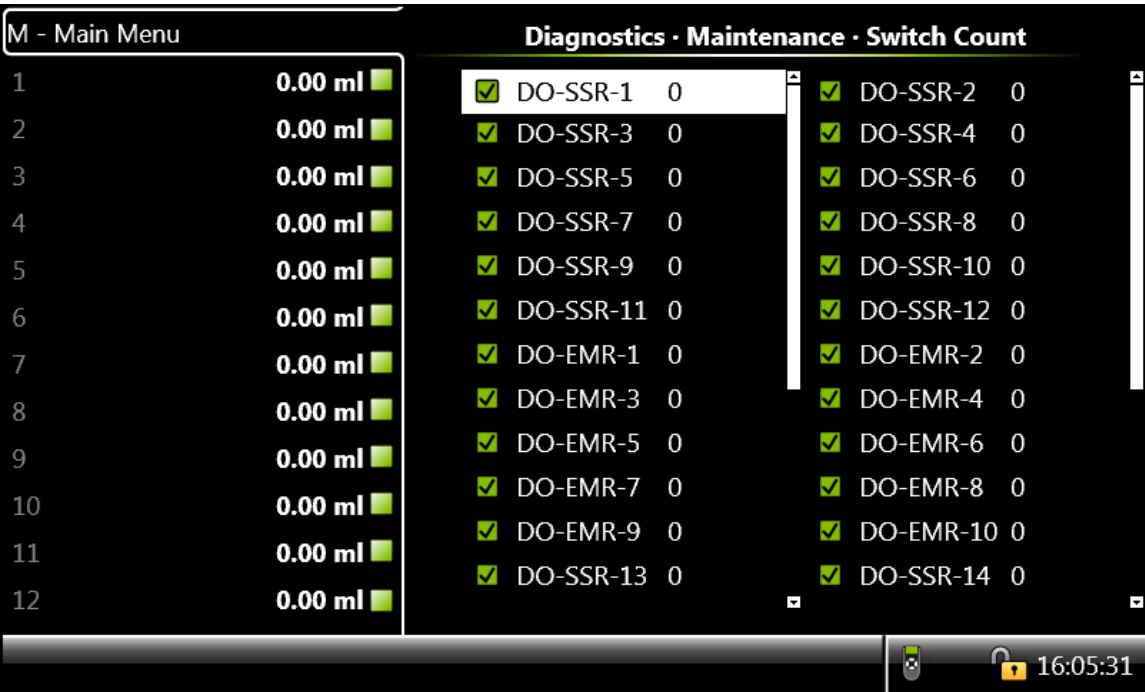




From the Diagnostics - Maintenance screen, select <Switch count>.

The Diagnostics - Maintenance - Switch Count screen appears, which displays the switch count that maintains the number of times the digital output is switched ON or OFF.

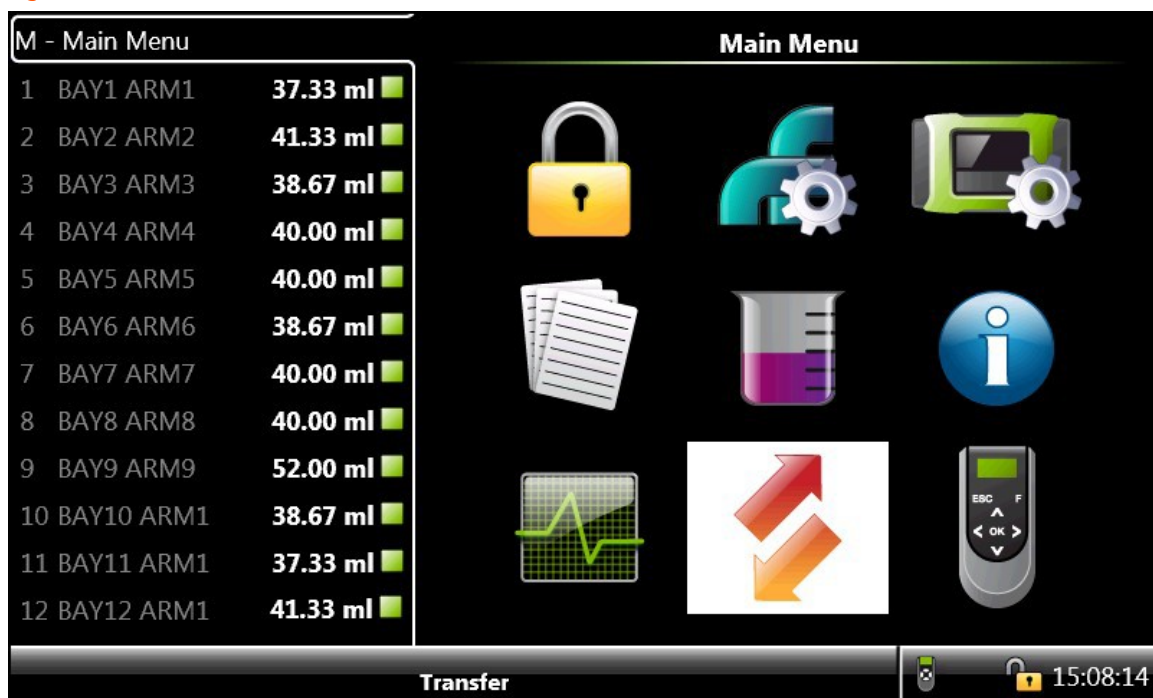
DO-SSR switch count provides an indication for the duration of an external connected device for example, solenoid. It can also provide indication for the duration of an Electro Mechanical Relay (EMR).



# 5.15 Transfer

**NOTE:** The Transfer functions are available only when LAD is connected to the MSC-A.

Figure 5-46: Transfer icon



Using the Transfer menu, the following types of records can be transferred between the MSC and LAD.

- Transaction records
- Configurations
- Events / Logs
- Calibration records
- Recipes
- Language packs

### 5.15.1 General

From the Main Menu screen, select the Transfer icon.

The Transfer screen appears, which displays the various data sets that can be transferred between the MSC-A and LAD.

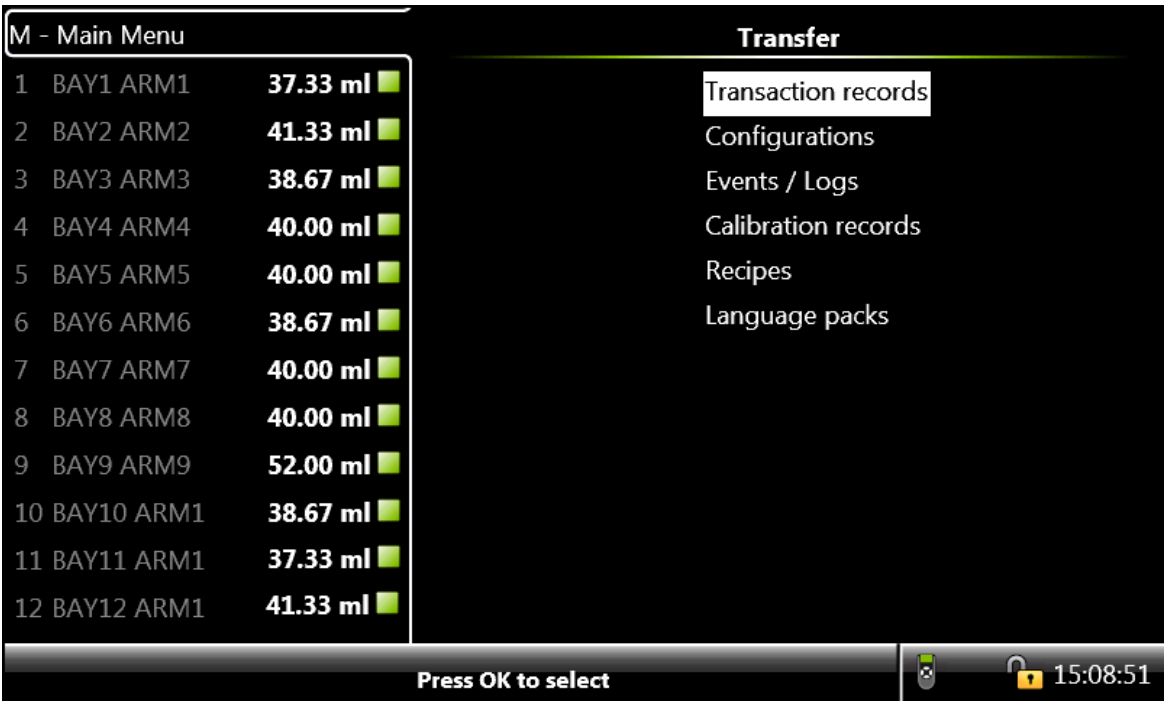


Figure 5-47: Data-transfer directions



## 5.15.2 Retrieving Transaction Records

The MSC-A provides an interface to read the transaction records through the FlexConn entities. These entities are used for transferring transactional data to the Fusion4 Portal through a serial link.

From the Transfer screen, select <Transaction records> to transfer transactional data.

The Transfer - Transaction Records screen appears, which displays the various transaction record activities.



**NOTE:** The <Single record> command cannot be used through Fusion4 Portal. The <Single record> screen is only used by copying a transaction record to LAD.

**NOTE:** All transactions are overwritten and the transaction cannot be retrieved through the Fusion4 Portal or LAD. You must settle all transactions before the oldest one is automatically deleted and overwritten. Maximum 240000 unsettled transactions can reside in the transaction memory of the MSC-A.

## 5.15.3 Additive Transaction Record Explained

Transaction record parameter	Description
[transaction_record_version]	The version of the transaction record.
[transaction_id]	A user specified transaction ID.
[calibration_id]	A user specified calibration ID.
[transaction_start_time]	The time in which the transaction begins (sampled from RTC entity).
[transaction_start_date]	The date when the transaction begins (sampled from RTC entity).
[transaction_stop_time]	The time when the transaction ended (sampled from RTC entity).
[transaction_stop_date]	The date when the transaction ended (sampled from RTC entity).
[site_name]	The name of the site where the transaction occurs.
[bay_name]	The name of the bay at which the transaction occurred.
[arm_name]	The name of the arm used for dispense the blended product.
[device_name]	The user specified name of the device.
[device_type]	The description of the type of Fusion4 device the transaction record appears from.
[hazardous_material_classification]	A string that describes the hazardous material classification of the resulting product.
[product_name]	The name of the final product.
[additive_name]	The name of the additive product.
[load_number]	An optional number supplied by TAS when the blender is used with loader.
[injection_volume]	The amount of injection volume dispensed per injection cycle.
[wild_stream_per_injection]	The amount of injection volume dispensed per stream.

Transaction record parameter	Description
[Deviation]	The percentage of deviation from the target additive injection volume.
[ppm]	The actual calculated parts per million of the additive in the final product.
[additive_volume]	The amount of injection volume dispensed per injection cycle.
[load_volume]	The total wild stream volume moved during the transaction.
[accumulated_start_GOV]	The gross accumulated volume at the start of the batch.
[accumulated_stop_GOV]	The gross accumulated volume at the end of the batch.
[critical_error]	An error condition associated with the transaction that breaks W&M compliance.
[non_critical_error]	An error condition associated with the transaction that does not break W&M compliance.
[W&M complaint]	Indicates if the transaction is W & M compliant.

### 5.15.3.1 Transaction Alarm Codes

From the Bill of Lading (BOL) document, alarm message can be denoted as an alarm code. The following table describes the alarm codes.

For an overview of all critical and non-critical alarms, see [Section 6: Alarm Handling](#).

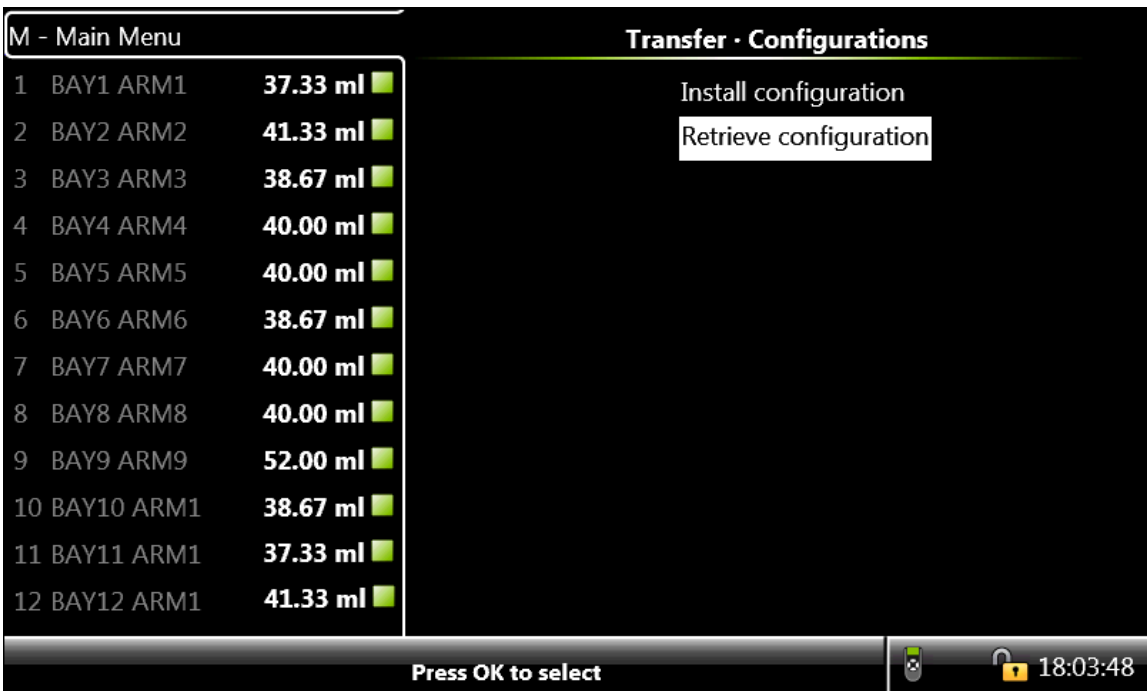
Alarm code	Description
0	ALARM_NO_ALARM
1	ALARM_GENERAL_FAIL
50	HMI_ALARM_NO_COMMUNICATION
54	HMI_ALARM_LICENSE_FAILURE
56	HMI_ALARM_SERVICE_DUE_REMINDER
57	HMI_ALARM_TRANSACTION_START_ERROR
58	HMI_ALARM_TRANSACTION_STOP_ERROR

Alarm code	Description
100	STREAM_ALARM_CONTROL_FAILURE
101	STREAM_ALARM_NO_ACTIVITY_TIMEOUT
102	STREAM_ALARM_SOLENOID_FAILING
103	STREAM_ALARM_STREAM_START_ERROR
104	STREAM_ALARM_PULSE_PHASE
105	STREAM_ALARM_PULSE_GENERAL
106	STREAM_ALARM_LEAKING_STREAM_VALVE
107	STREAM_ALARM_SLOW_FLOW_VOLUME
108	STREAM_ALARM_NO_PUMP_SENSE
109	STREAM_ALARM_BLOCK_VALVE_FAILING
110	STREAM_ALARM_FACTORED_PULSE_OUT
112	STREAM_ALARM_TANK_LOW_LEVEL
113	STREAM_ALARM_TANK_EMPTY
150	STREAM_ALARM_LOW_VOLUME_DEVIATION
151	STREAM_ALARM_HIGH_VOLUME_DEVIATION
152	STREAM_ALARM_NO_ADDITIVE
201	STREAM_ALARM_TEMPERATURE_ERROR

## 5.15.4 Configurations

From the Transfer screen, select <Configurations> to install or retrieve the configuration on the SD card.

The Transfer - Configurations screen appears, which displays the options to install and retrieve configuration on the SD card.



The following entities are available on the Transfer - Configurations screen.

- <Install configuration> - Select this option to install the configuration present on the SD card.
- <Retrieve configuration> - Select this option to save the present configuration on the SD card.

### 5.15.5 Events / Logs

From the Transfer screen, select <Events / Logs> to retrieve the events and logs from MSC-A.

The Transfer - Events / Logs screen appears, which displays the options to retrieve the events and logs from the MSC-A.





The following entities are available on the Transfer - Events / Logs screen.

- <Retrieve alarm logs> - Select this option to view the historian of the enabled device alarms.
- <Retrieve W&M logs> - Select this option to view the device complaint of the device.

### 5.15.6 Calibration Records

From the Transfer screen, select <Calibration records> to view the calibration record details.

The Transfer - Calibration Records screen appears, which displays the options to view the calibration records.



The following entities are available on the Transfer - Calibration Records screen.

- All records - This option retrieves all the calibration records available on the device.
- Range of records - This option allows you to select the desired range of calibration logs from the available records.
- Single record - This option allows you to retrieve a single record.

## 5.15.7 Recipes

From the Transfer screen, select <Recipes> to install and save the recipes available on the SD card.

The Transfer - Recipes screen appears, which displays the options to install and save recipes available on the SD card.



The following entities are available on the Transfer - Recipes screen.

- <Install recipe> - Select this option to install a recipe present on the SD card.
- <Retrieve recipes> - Select this option to save the current recipes on the SD card.

## 5.15.8 Language Packs

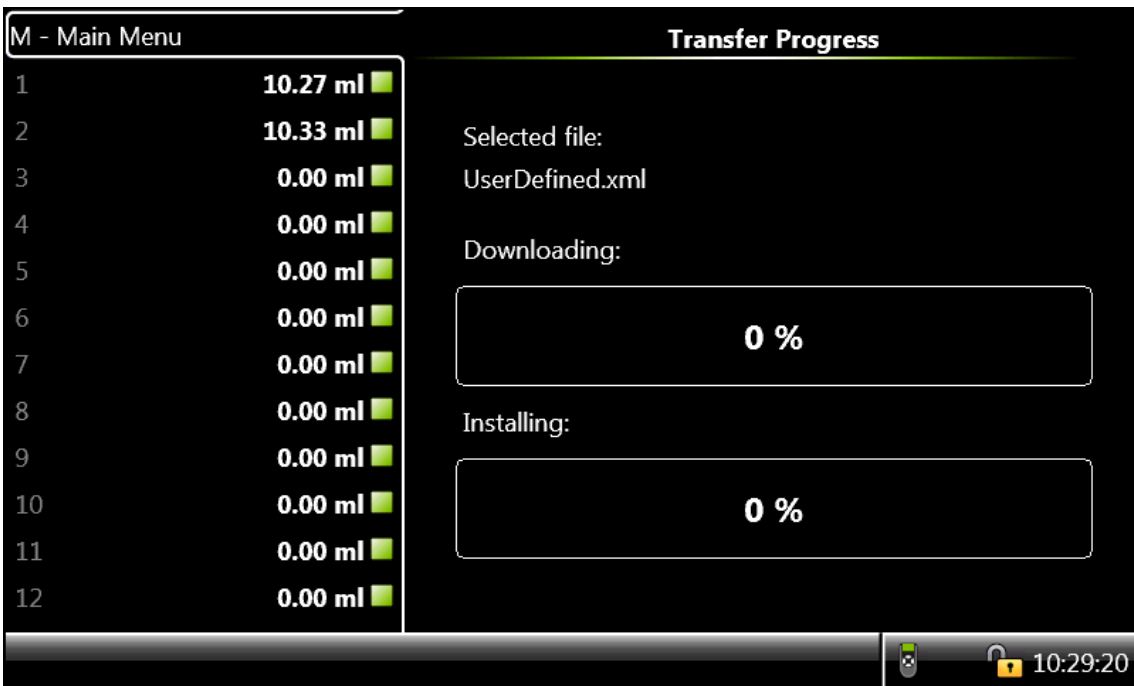
From the Transfer screen, select <Language packs> to download and install the file in LAD.

The Select File screen appears, which displays the default .xml file.



Select the file to download and install the files in LAD. See [Section 5.16.2: Firmware Update](#) for the sequence in which the files need to be installed.

The Transfer Progress screen appears, displaying the progress of the file download and the status of the installation in LAD.

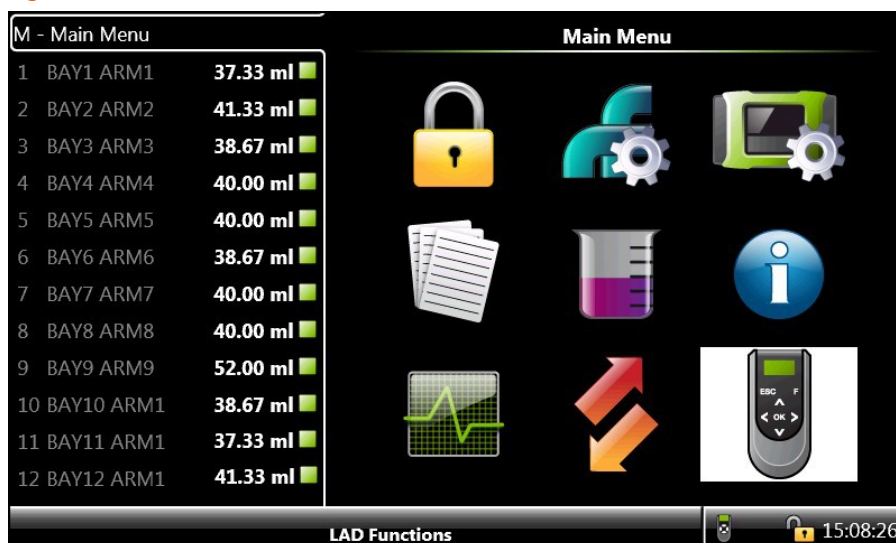


The files are downloaded and installed in LAD.

## 5.16 LAD Functions

**NOTE:** LAD functions are available only when LAD is connected to the MSC-A.

Figure 5-48: LAD icon



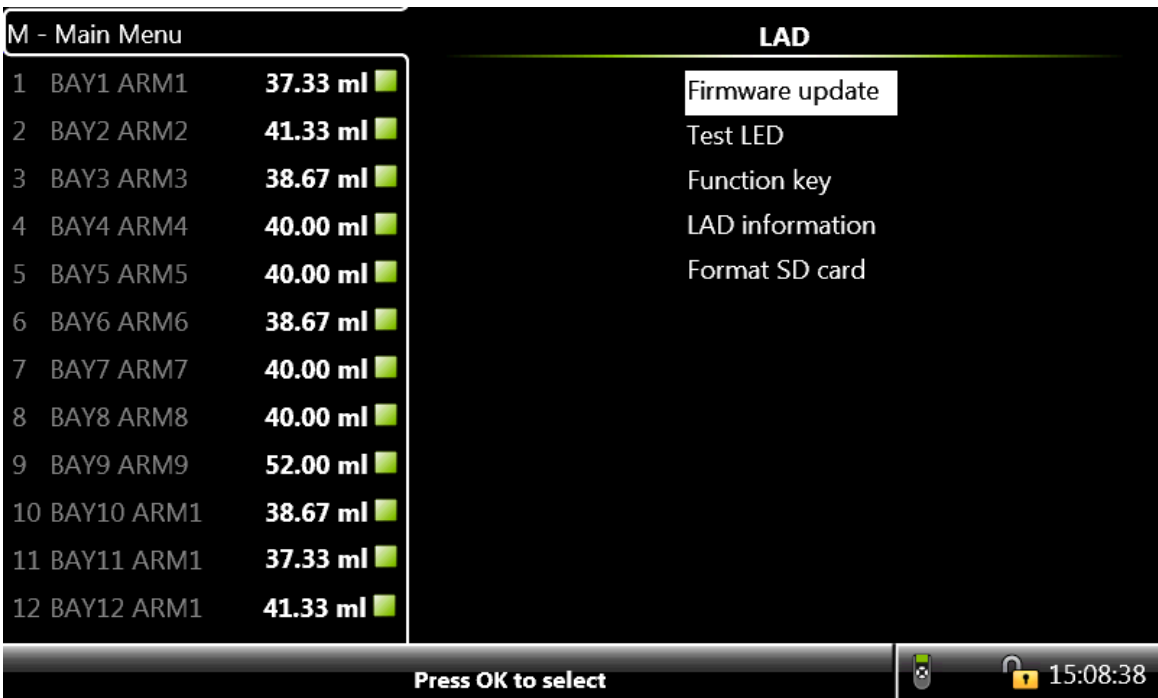
LAD functions provide the following LAD functionalities.

- Facility to download the firmware in the MSC-A device and LAD.
- Facility to navigate the screen.
- Configuration of the Test LED.
- Configuration of LAD's special function key.
- Information about LAD.
- Facility to format SD card.
- W&M (MID) sealing.

### 5.16.1 General

From the Main Menu screen, select LAD icon.

The LAD function screen appears, which displays the various LAD functions and their activities.



## 5.16.2 Firmware Update

**NOTE:** Remove the old files that are available in Honeywell\MSC-A\Generic\Firmware\ directory from previous upgrades before updating the files.

**CAUTION:** When upgrading from prior versions to A2420 or later: Check the configuration of Bay name and Stream name for all the additive streams. Ensure that the combined length of Bay name and Stream name does not exceed 18 characters for any of streams prior to taking a backup of configuration.

To update the firmware using LAD.

1. It is highly recommended that a backup of the configuration and device info file is created before upgrading to a new firmware version. This can be created via the Fusion4 LAD and it will be stored on its SD card. This can be done via: (Main Menu | Transfer | Configurations | Retrieve configuration) and (Main Menu | Transfer | Configurations | Retrieve device info)
2. Replace the following updated firmware files received in the Honeywell\MSC-A\Generic\Firmware\ directory.

- FM-ARM-FC-APP.bin
- FM-HMI-FC-APP.bin
- FM-HMI-FC-FPGA.bin
- FM-HMI-FC-IMG.bin
- FM-IN-OUT-APP.bin (optional)

**NOTE:** FM-IN-OUT-APP.bin file is only required if the CAN- IN-OUT-MSC card is installed in the device.

3. Connect LAD to the MSC and make sure the SD card is inserted in LAD before connecting LAD.

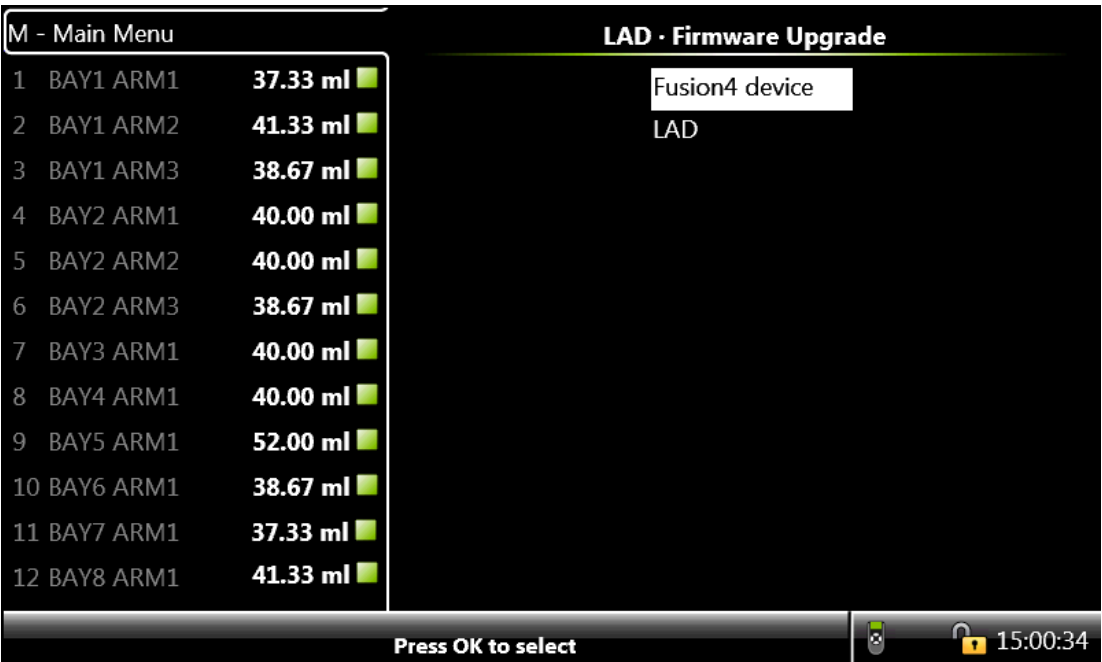
A green status light on LAD indicates that the SD card is inserted correctly and a red status light indicates that the SD card is missing.

**NOTE:**

- Update the firmware only when the device is not being used.
- Do not insert or remove the SD card when LAD is connected to the device and do not remove LAD when an upgrade file is downloading.
- Do not perform the update procedure when there can be a power outage, as this can cause problems and/or make the device unusable.

4. From the LAD screen, select <Firmware update> to either update the firmware of the MSC boards or LAD firmware itself.

The LAD - Firmware Upgrade screen appears.



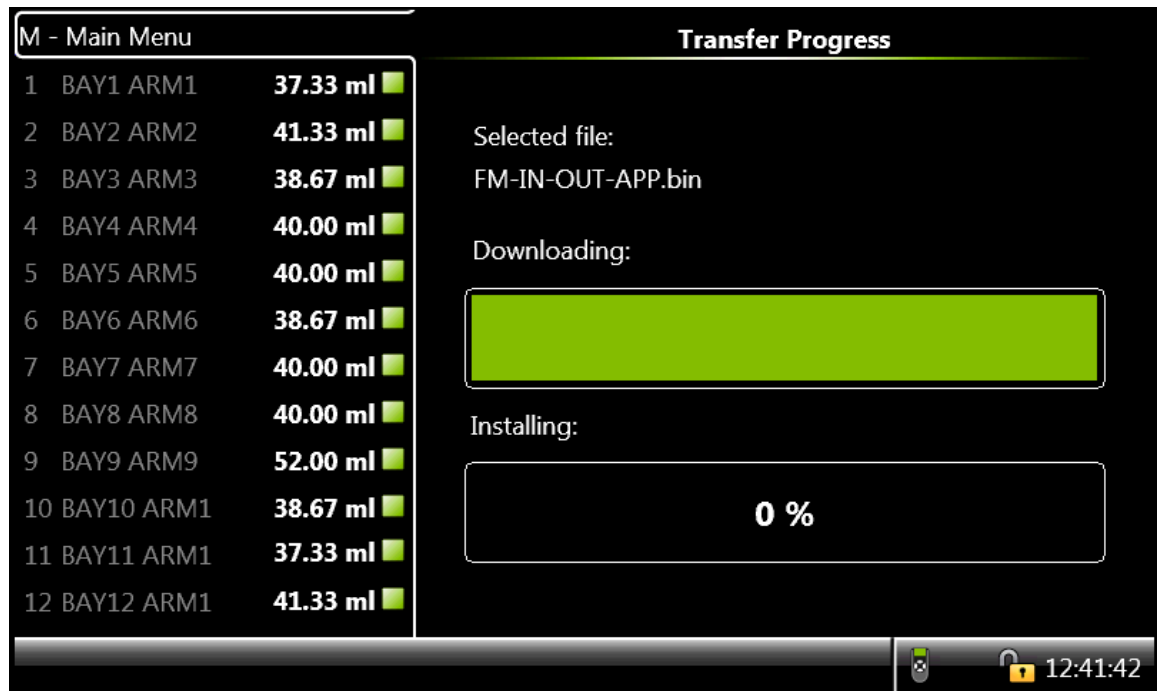
5. Select Fusion4 device to update the files. The Select File screen appears.



6. From the Select File screen, select the firmware files in the following order to update the files.

The Transfer Progress screen appears for the particular file selected, displaying the progress of the file download and the status of the installation in LAD.





a. FM-IN-OUT-APP.bin (if required)

- The total time for the firmware update file is 35 seconds approximately.
- If there are more than one CAN-IN-OUT-MSC boards, firmware on all those boards gets updated simultaneously.
- Update the file only if it is available.

b. FM-ARM-FC-APP.bin

- The total time for the firmware update file is 2 minutes approximately.
- If there are more than one CAN-ARM-MSC boards, firmware on all those boards are updated simultaneously.

c. FM-HMI-FC-APP-MSCA.bin

- The total time for the firmware update file is 3.5 minutes approximately.

**NOTE:** The HMI will reboot at the end of firmware installation.

d. FM-HMI-FC-FPGA.bin

- The total time for the firmware update file is 3 minutes approximately.
- Update the file only if it is available.

**NOTE:** The HMI will reboot at the end of firmware installation.

e. FM-HMI-FC-IMG.bin

- The total time for the firmware update file is 3 minutes approximately.
- Update the file only if it is available.

**NOTE:** The HMI will reboot at the end of firmware installation.

f. Power cycle device.

**NOTE:** Update the files in above sequence, unless mentioned in the release notes.

### 5.16.2.1 Verify the Firmware Update

Verify the following to make sure that the files are updated.

1. On the Module Info screen, make sure that the latest version is available in the column App. version, as shown in the following screen.

**NOTE:** In case one of the versions is different, repeat the installation instructions section for only those files which failed to update correctly.

The screenshot shows the 'Device Info' screen with a 'Module Info' table. The 'App. version' column is highlighted with a red box. The table lists modules and their versions.

Module	Boot. version	App. version	App. build	Serial #
FM-ARM-1	A1000	A1000	1022	2
FM-IN-OUT-1	N/A	A1000	1022	42
FM-IN-OUT-2	N/A	A1000	1022	3
FM-ARM-2	A1000	A1000	1022	40
FM-IN-OUT-3	N/A	A1000	1022	5
FM-IN-OUT-4	N/A	A1000	1022	3
FM-HMI	A1000	A1000	1022	1234
FM-PT	N/A	A1000	1022	N/A

2. Verify the parameter settings to check if they are the same as they were in the previous old firmware.
3. From the Diagnostic screen, select <System health> on any one of the boards and then select <OK> on the IR controller or LAD. The test "Good/No Error" should be displayed on the screen, as illustrated in the following figure.



**NOTE:** In case one of the boards shows a bad health (which could result in Device health fault alarm shown on unit), a format operation followed by restoring of configuration file is necessary. Format of all memory can be executed by Main Menu | Diagnostics | Device tasks | Reset tasks | Format all memory. In firmware versions A2423 and later, format of only the configuration memory (instead of formatting all memory) can be executed by Main Menu | Diagnostics | Device tasks | Reset tasks | Format NOVRAM.

After the system has cleared all the configurations, the device will soft reset. After this, power cycle the device. Ensure the health of all modules is now good. If this is the case, the saved configuration file can be uploaded to the device to restore the original settings.

### 5.16.3 Test LED and LAD Information Submenus

From the LAD screen, select <Test LED> to view the diagnostics or the I/ O tests on the "Test" LED of LAD.

From the LAD screen, select <Test LED> to view the diagnostics or the I/ O tests on the “Test” LED of LAD.

The LAD - Test LED screen appears, which displays the I/O tests available on the MSC-A device.

M - Main Menu			LAD - Test LED		
1	BAY1 ARM1	37.33 ml ■	QPI-1A	QPI-1B	QPI-2A
2	BAY2 ARM2	41.33 ml ■	QPI-2B	QPI-3A	QPI-3B
3	BAY3 ARM3	38.67 ml ■	QPI-4A	QPI-4B	QPI-5A
4	BAY4 ARM4	40.00 ml ■	QPI-5B	QPI-6A	QPI-6B
5	BAY5 ARM5	40.00 ml ■	DO-SSR-1	DO-SSR-2	DO-SSR-3
6	BAY6 ARM6	38.67 ml ■	DO-SSR-4	DO-SSR-5	DO-SSR-6
7	BAY7 ARM7	40.00 ml ■	DO-SSR-7	DO-SSR-8	DO-SSR-9
8	BAY8 ARM8	40.00 ml ■	DO-SSR-10	DO-SSR-11	DO-SSR-12
9	BAY9 ARM9	52.00 ml ■	PO-1	PO-2	COM-1
10	BAY10 ARM1	38.67 ml ■	COM-2	RTD-1	RTD-2
11	BAY11 ARM1	37.33 ml ■	RTD-3	AI-1	AI-2
12	BAY12 ARM1	41.33 ml ■	AI-3	AI-4	AI-5
			AI-6	AI-7	AO-1
			ETH-1	DI-DC-1	DI-DC-2
			DI-DC-3	DI-DC-4	DI-DC-5
Press OK to select			18:02:45		

**NOTE:** The Test LED on the LAD displays the status of the health of the selected I/O.

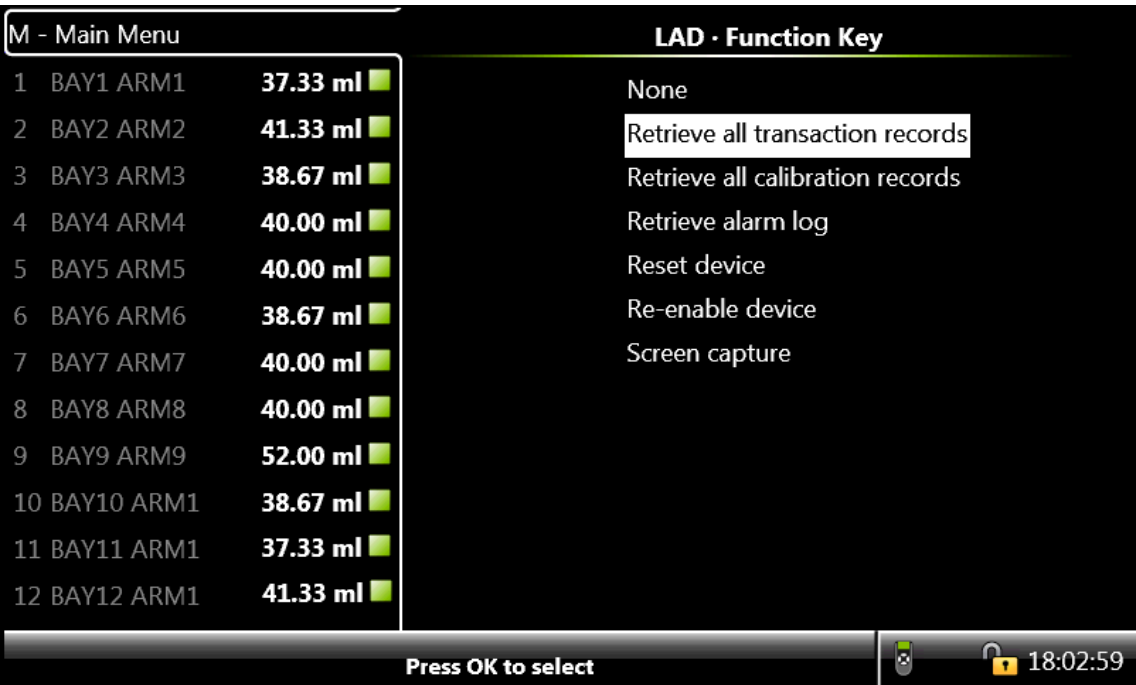
Select the status of the I/O which is displayed on the Test LED of LAD, and select <OK>. The Test LED is red if the health of the assigned I/O is bad, and is green if the health of the assigned I/O is good.

### 5.16.4 Function Key

From the LAD screen, select <Function key> to specify the functions that can be programmed to the function “F” key on LAD to achieve a quicker operation of the MSC-A.

The LAD - Function Key screen appears, which specifies the functions that can be programmed.

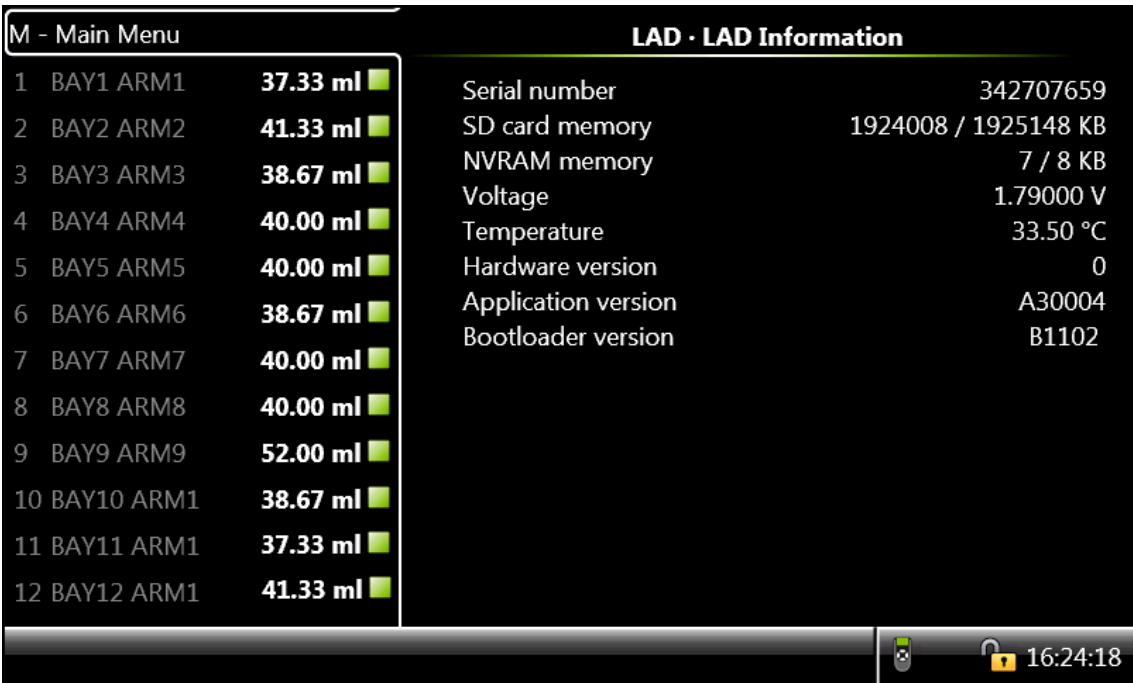
The configuration is saved on LAD. Changes made to the function key works for other Fusion4 devices also.



### 5.16.5 LAD Information

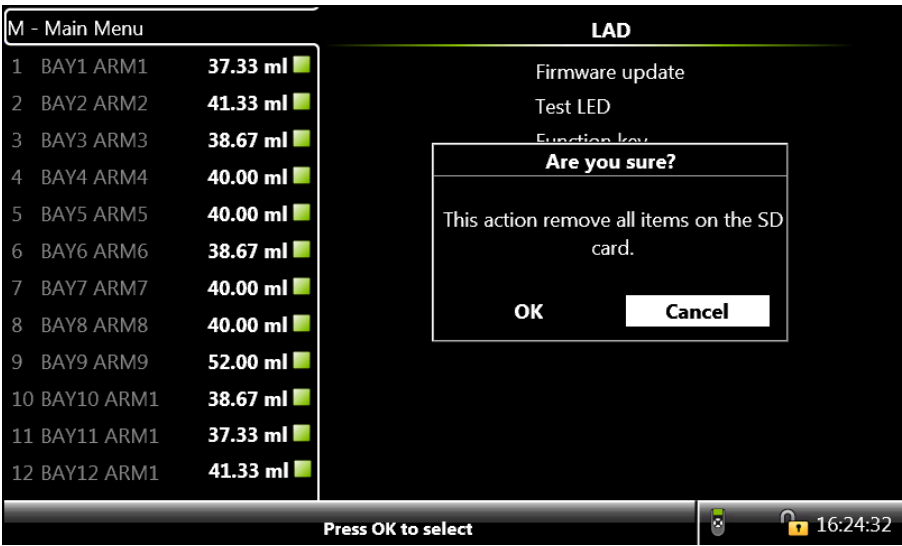
From the LAD screen, select <LAD information>.

The LAD - LAD Information screen appears which displays the relevant LAD information and diagnostics of LAD.



### 5.16.6 Format SD Card

From the LAD screen, select <Format SD card> to format the SD card of the LAD. The following dialog box appears.

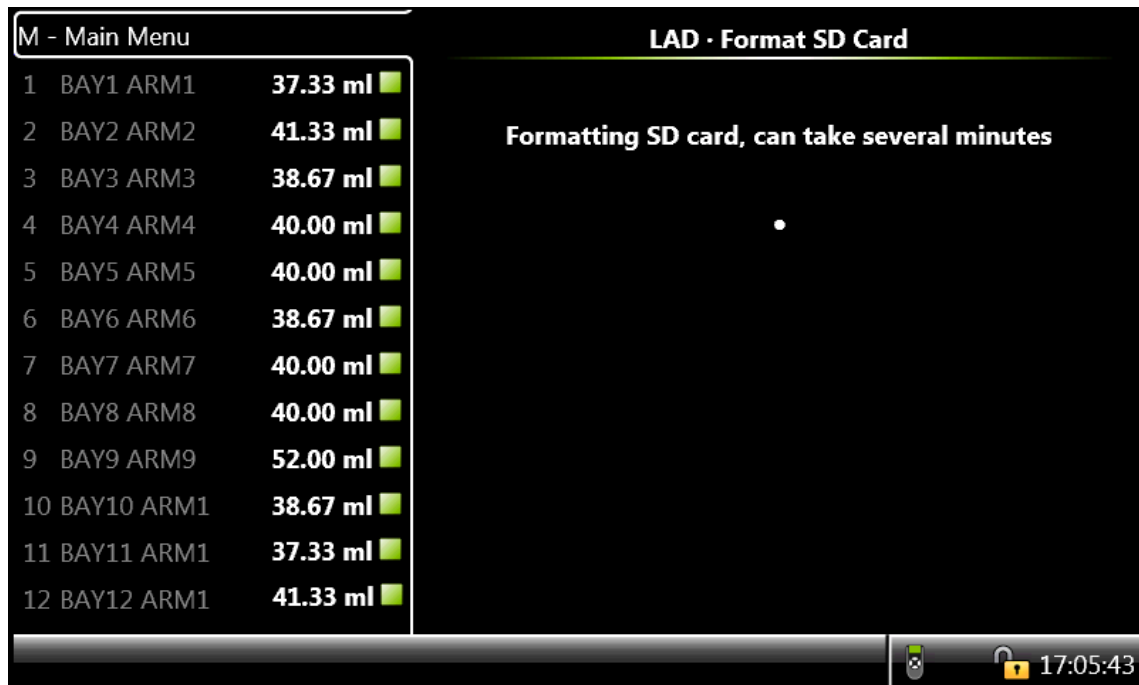


**CAUTION:** All content is erased if you select OK.

Perform any one of the following.

- Click OK to erase all the content available in the SD card.

The LAD - Format SD Card screen appears, which provides the status of the format.



or

- Click Cancel to terminate the operation.

## 5.17 W&M Compliance

W&M compliance of the MSC-A is based on the following criteria.

- Configuration of the W&M Intended entity
- Sealing
- Device Health

Following sections explain the criteria in more details.

## 5.17.1 W&M Intended

For the MSC-A to be intended for W&M custody transfer, the configuration entity W&M intended should be set to <True>.

See [Section 5.10.1: Device Configuration - Identification](#) for more information.

This setting can be changed by a user who has SL2 or higher access (typically a service technician or a notified body engineer).

## 5.17.2 W&M Sealing

The MSC-A can be W&M sealed in the following two ways.

1. Using a board jumper/switch on every Flexconn board in the MSC-A.

The MSC-A W&M relevant configuration and the MSC-A relevant firmware is sealed when the jumper is set to ON.

The MSC-A W&M relevant configuration and the MSC-A relevant firmware is not sealed when the jumper is set to OFF.

**NOTE:** The W&M board jumper/switches are daisy chained (logical OR-ed) hence only one board needs to have the W&M board jumper/switch in the ON position to seal all boards. Consequently, multiple W&M board jumper/switches placed in the ON position must be removed before the device is unsealed.

## 5.17.3 Device Health

For the MSC-A to be W&M compliant the device health should be good. The device health is good in the following scenarios:

- All the hardware is available and functional.
- All memory and interface checks are passed.
- All boards are in valid temperature range.
- All board voltages are in valid range.

If any of the board has bad or uncertain health the device health is bad.



**NOTE:** CAN-IN-OUT-MSC board is not taken into account because of non relevance for W&M.

## 5.17.4 MSC-A W&M compliance

The MSC-A is compliant for W&M custody transfer if all the following criteria are met.

- The W&M Intended is set to <True>.
- The MSC-A is W&M sealed - either the jumper in ON or the switch is activated.
- The device health is good.

# 6 Alarm Handling

## 6.1 General

Various alarm configurations can be set using the MSC-A menu. The active alarms, transactions alarms, and alarm logs can also be displayed on the MSC-A menu.

## 6.2 Alarm Output Configuration

- The alarm-indication output can be set with [Alarm indication] I/O binding entity.
- The alarm-shutdown output can be set with [Alarm shutdown] I/O binding entity.

## 6.3 Alarm Configuration

Each alarm initiates an action, which can be configured on the MSC-A menu.

The following table describes the alarm settings and their effects.

Alarm Setting	Active Effect	Acknowledged Effect
Disabled	The alarm is ignored by the MSC-A device.	Not Applicable
Display	<ul style="list-style-type: none"><li>• Alarm appears on the display.</li></ul>	<ul style="list-style-type: none"><li>• Alarm appears on the display.</li></ul>
Note: All alarms are by default set to Display state.	<ul style="list-style-type: none"><li>• Alarm-indication output is set to ON.</li></ul>	<ul style="list-style-type: none"><li>• Alarm-indication output is set to OFF.</li></ul>

Alarm Setting	Active Effect	Acknowledged Effect
Display Shut-down	<ul style="list-style-type: none"> <li>Alarm appears on the display.</li> <li>Alarm-indication output is set to ON.</li> <li>Alarm-shutdown output is set to ON.</li> <li>Running transactions are stopped.</li> <li>Start up of new transactions is impossible.</li> </ul>	<ul style="list-style-type: none"> <li>Alarm appears on the display.</li> <li>Alarm-shutdown output is set to ON.</li> <li>Running transactions are stopped.</li> <li>Start up of new transactions is impossible.</li> </ul>

**NOTE:** For each alarm, more options can be configured.

## 6.4 Stream Alarms

Alarm	Cause
Leaking valve	This alarm is generated when the MSC-A is idle, and only when the [leaking timeout period] is more than the [leaking volume limit] measured at the pulse input of that particular stream. It is also generated in between injections (during a transaction) if the [leaking volume limit] is measured inside the [leaking timeout period].
Flush volume	This alarm is generated when the wild stream between entering the slow flow state and closing the transaction is less than the configured [Flush volume] - [Flush volume deviation]. The [Flush volume deviation] is entered as the percentage of the [Flush volume].
Control failure	<p>This alarm is generated when the MSC-A is not configured appropriately and does not have sufficient time to handle all the inject triggers.</p> <p><b>NOTE:</b> The maximum number of triggers that can be stored inside the buffer is 10.</p>

Alarm	Cause
No activity	<p>This alarm is generated when the following errors occur.</p> <ul style="list-style-type: none"> <li>• In Smart Product Pulse, the wild stream pulses are not detected in [no activity timeout].</li> <li>• In Smart Comms/Smart Inject mode, the Inject now command is not received in the [no activity timeout], either after enabling permissive command or after a previous inject now command.</li> <li>• In slave mode, the Open/Close solenoid command is not received in the [no activity timeout], either after enabling permissive command or after a previous open/close solenoid command.</li> </ul>
No additive	<p>This alarm is generated when the [number of retries] * [no additive timeout] is elapsed and during an injection process when the additive pulses stop.</p> <p>As soon as the additive solenoid opens, the timer [no additive timeout] starts.</p> <p><b>NOTE:</b> No Activity Alarm must be enabled for No Additive Alarm to work.</p>
No pump	<p>This alarm is generated when the pump does not receive a feedback signal within the [pump feedback timeout].</p> <p><b>NOTE:</b> It is only possible if the I/O Binding for the pump is ON/OFF and the pump indication are configured.</p>
Low deviation	<p>This alarm is generated if the average of the additive injection volume calculated over configured number of cycles is lower than the additive deviation percentage. The alarm is evaluated after every injection.</p> <p>With the entity [Additive volume deviation], the acceptable deviation can be set.</p> <p>With the entity [Number of cycles before deviation alarm evaluation], the number of additive injection cycles that are used for calculating the average of the injection volume for the deviation calculations can be set.</p>

Alarm	Cause
High deviation	<p>This alarm is generated if the average of the additive injection volume calculated over configured number of cycles exceeds the additive deviation percentage. The alarm is evaluated after every injection.</p> <p>With the entity [Additive volume deviation], the acceptable deviation can be set.</p> <p>With the entity [Number of cycles before deviation alarm evaluation], the number of additive injection cycles that are used for calculating the average of the injection volume for the deviation calculations can be set.</p>
Pulse phase	<p>This alarm is generated when the dual-pulse input are out of phase.</p> <p><b>NOTE:</b> It is only possible if MSC-A is configured for quad pulse.</p>
Solenoid failing	This alarm is generated when the system cannot activate or deactivate the solenoid. (This is an internal firmware control failure).
Block valve failing	This alarm is generated when the system cannot activate or deactivate the block valve. (This is an internal firmware control failure).
Pulse hardware fault	<p>This alarm is generated when the pulse input module detects the following error conditions.</p> <ul style="list-style-type: none"> <li>• Not able to read the information from the PICcontroller.</li> <li>• Pulse overflow errors.</li> <li>• BAD health of the pulse input function.</li> </ul>

Alarm	Cause
Tank empty alarm	This alarm is generated 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.
Tank low level	This alarm is generated 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.
Factored pulse output alarm	This alarm is generated when MSC-A cannot perform the configured output on time.
Transaction start error	This alarm is generated when a new transaction cannot be started.
Transaction stop error	This alarm is generated when a running transaction cannot be stopped.
Temperature alarm	This alarm is generated when the instantaneous temperature is not within the configured limits.
Additive MMQ not met	This alarm is generated when the transaction is failed for any of the W&M related checks
Additive flow rate too low	This alarm is generated when the transaction is failed for any of the W&M related checks

## 6.5 HMI Alarms

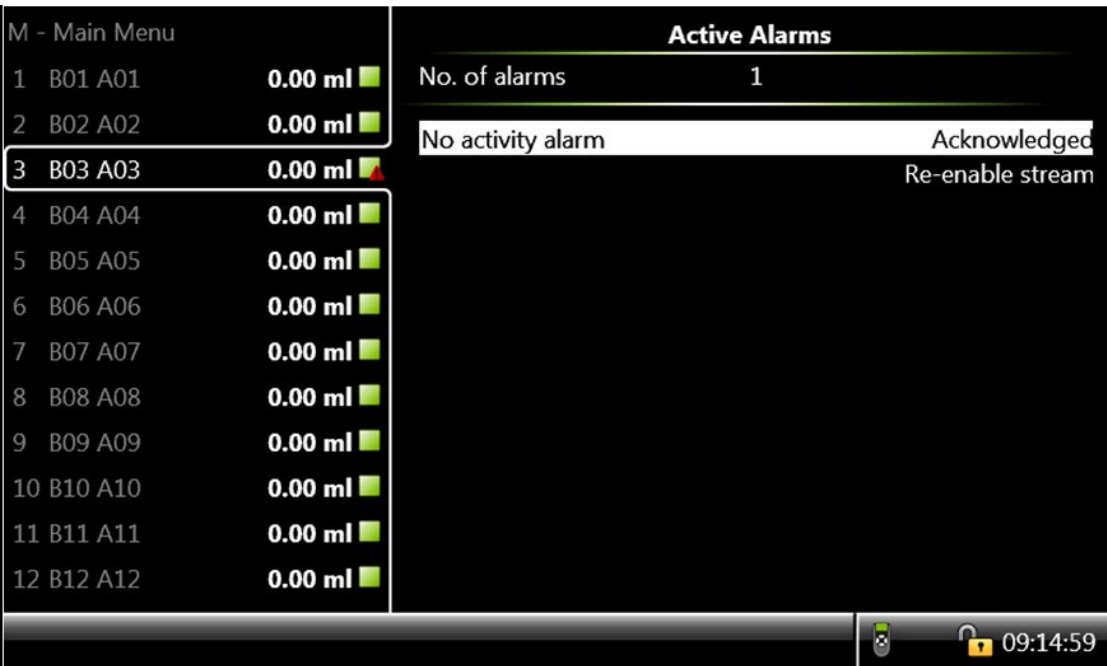
Alarm	Cause
HMI fatal error	This alarm is generated when an unknown fatal error occurs.
Service due reminder alarm	This alarm is generated when the [Next scheduled service] date expires.

# 6.6 Alarm Logs

Any alarm-state change that occurs is logged with a timestamp. Alarms can have the following three states.

- Inactive (default)
- Active
- Acknowledged - All alarms per stream are acknowledged.

On the Alarm log screen, all alarm states that are changed can be examined.



# 6.7 Active Alarms

The Active alarms screen displays all active and acknowledged alarms per stream.

- To change the state of the alarm to <ACKNOWLEDGED>:

On the Active alarm screen, select the alarm and then select <OK> on the IR controller or the LAD to acknowledge the alarm.

The state of the alarm changes to <ACKNOWLEDGED>, and a new alarm log item is created.

This can also be performed through the communication channel (Comms), by entering the relevant alarm number into [acknowledge the specified alarm] entity.

**NOTE:** Only the FlexConn protocol supports the <acknowledge alarm> command.

The command <RE-ENABLE> can be used for resetting all alarms per stream. All the alarms of that stream are reset to the state <ALARM\_INACTIVE>.

This can also be performed through Comms channel through [reset all alarms], or hard-wired. The entity [I/O binding alarm reset input] must be configured accordingly for this function to operate.

A special function key can be assigned to the “F” key on the LAD to re-enable the device. This function <Re-enable device> clears all the alarms on all the Stream alarms and the HMI alarms.

The command <Clear all alarms> can be used for resetting all alarms per stream.

## 6.8 Alarms through Communication

MSC-A alarms listed in the following table are used within the protocols running through the communication channel (Comms). These values are determined by reading the 4-digit alarm value in the transaction- record detail for a previously completed transaction.

The entity [alarm\_name\_alarm\_action] defines if the particular alarm is handled as a “Critical transaction alarm” or a “Non-critical transaction alarm”.

When configured as “Shutdown”, the particular entity is managed as a “Critical transaction alarm”.

See the following table for more information regarding the Alarm message.

ID	Alarm message
0x0001	ALARM_ADDITIVE_CYCLE_VOLUME
0x0002	ALARM_NO_ADDITIVE



ID	Alarm message
0x0004	ALARM_LEAKING_SOLENOID
0x0008	ALARM_FIRMWARE_FAILURE
0x0010	ALARM_PROGRAM_FAILURE
0x0020	ALARM_NO_ACTIVITY
0x0040	ALARM_FLUSH_VOLUME_ERROR
0x0080	ALARM_VALVE_ERROR
0x0100	ALARM_NO_PUMP
0x0200	ALARM_LICENSE_ERROR
0x0400	ALARM_CONTROL_FAILURE
0x0800	ALARM_POWER_FAILURE
0x1000	ALARM_PULSE_ERROR
0x2000	ALARM_TANK_MONITOR_ERROR
0x4000	ALARM_SERVICE_DUE_REM

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