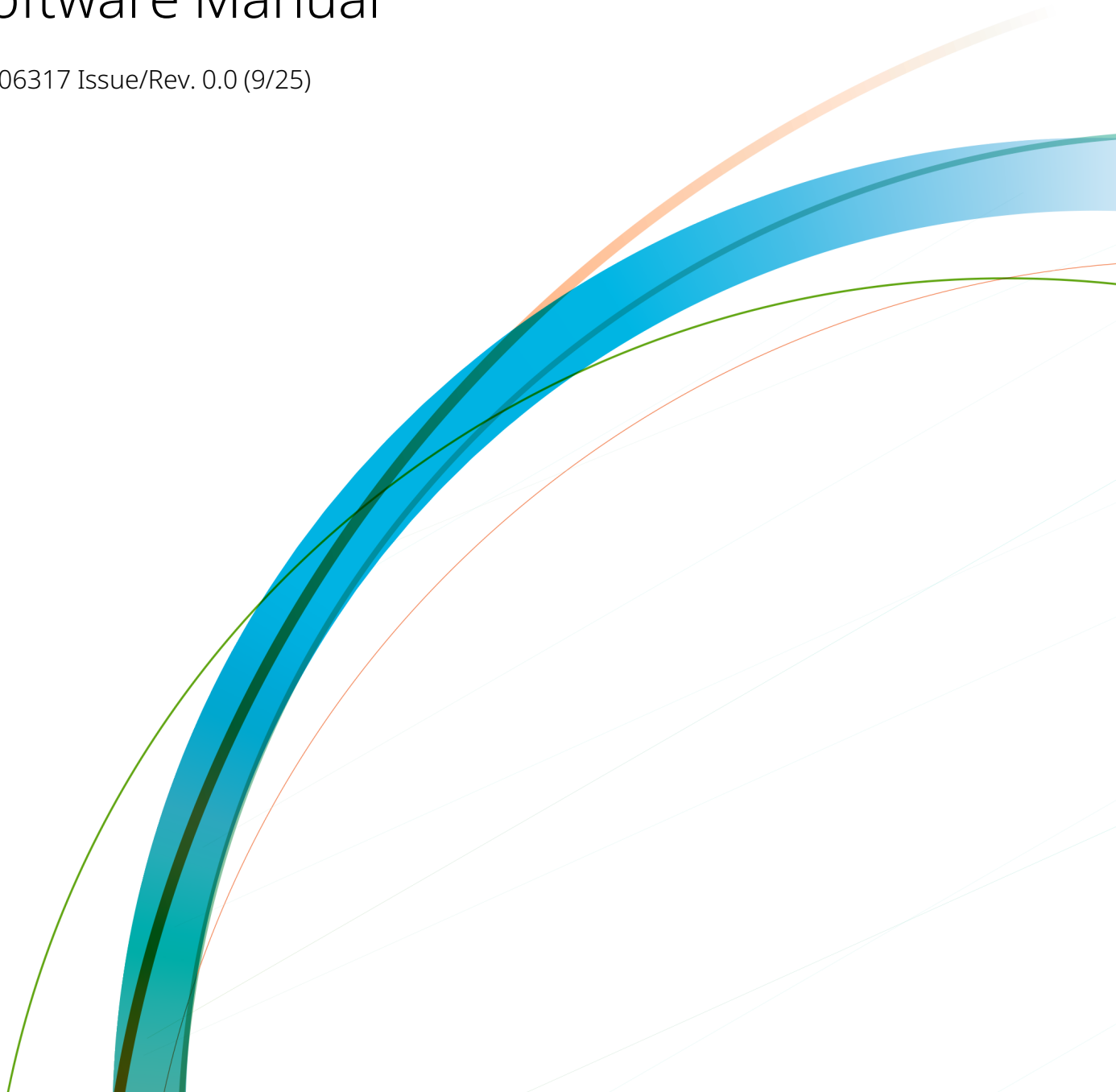
GUIDANT

1010CB Load Computer

Software Manual

MN06317 Issue/Rev. 0.0 (9/25)



Important

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

Caution

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

Disclaimer

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

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Contents

1 Overview

1.1 Description

The software module data sheets list the relevant programmable parameters.

Each module is configured or programmed under the programming menu system. For more information, see the 1010CB Programming Manual.

The order in which the Software Modules are presented generally follows the Programming Manual.

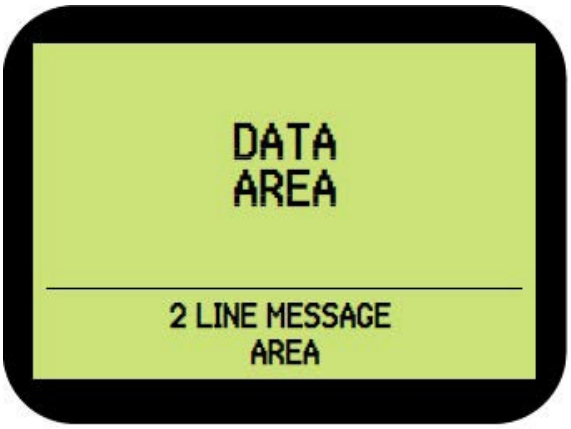
In this document, “instrument” refers to the generic Model 1010 loading system, and “computer” refers to the attached computer, Distributed Control System (DCS), or Terminal Automation System (TAS).

2 Display and Keyboard

2.1 Description

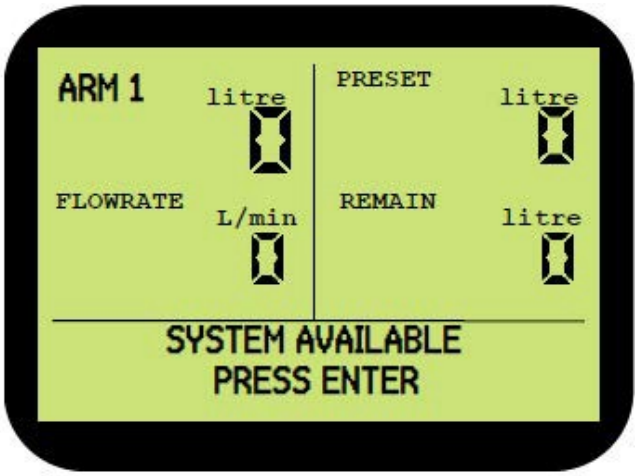
The instrument can be configured to display a variety of screen layouts in a variety of languages.

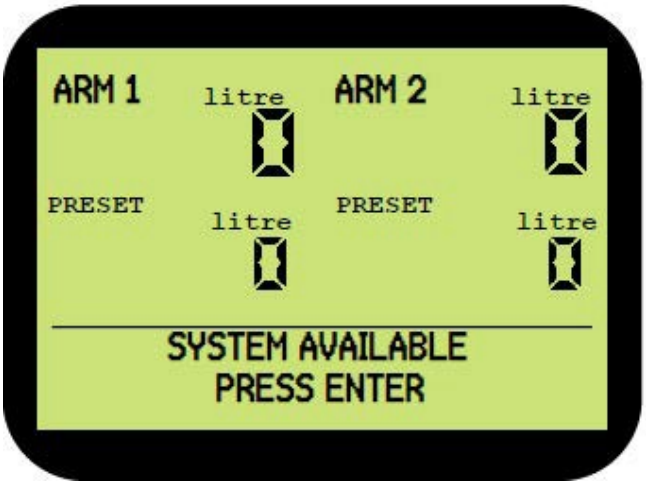
Screens are divided into two areas, the data or counter section at the top and a message area at the bottom.



2.2 Standard Screens

There are several number of standard screen layouts. The layout used depends on the number of arms supported or configured within the instrument.





2.3 Custom Screen Layouts

Screen 2-5 shows a four-arm screen with custom arm names and a custom initial message.

The custom arm names are configured under the relevant arm menu, while custom message is configured under the system message.

For details on configuring screens, see the Programming Manual.

2.3.1 Character Entry

The instrument allows the entry of alphanumeric characters in much the same way as a mobile telephone. The time between key presses determines the cursor

movement.

To enter ‘E’ press the 3 key three times in rapid succession:

1. Press 3 - Display reads “3”
2. Press 3 - Display reads “D”
3. Press 3 - Display reads “E” To enter ‘ARM’

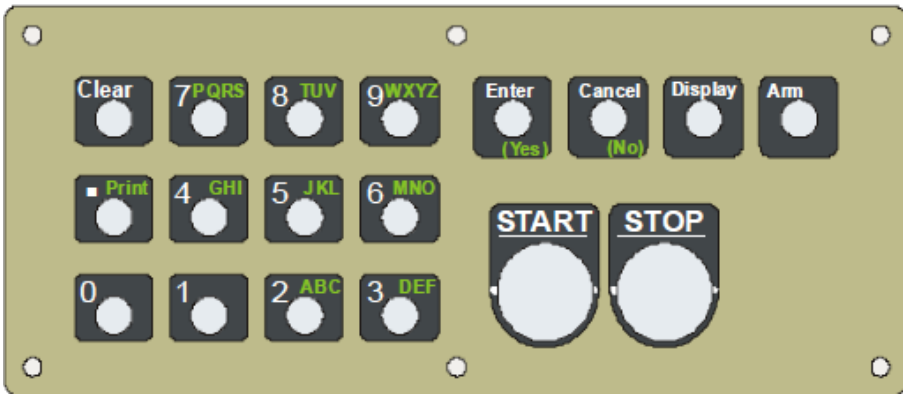
To enter ‘ARM’

1. Press 2 - Display reads “2”
2. Press 2 - Display reads “A”
3. Pause and cursor will shift to allow the next character to be entered.
4. Press 7 - Display reads “A7”
5. Press 7 - Display reads “AP”
6. Press 7 - Display reads “AQ”
7. Press 7 - Display reads “AR”
8. Pause and cursor will shift to allow the next character to be entered.
9. Press 6 - Display reads “AR6”
10. Press 6 - Display reads “ARM”

Clear all Press and hold clear key for 1 sec to clear entire line from the screen.

- 0 Use the 0 key to enter any of the following characters: ‘0’, ‘-’, ‘/’, ‘(’, ‘)’, ‘=‘
- 1 Use the 1 key to enter any of the following characters: ‘1’, ‘ ‘ (the space character), ‘.’, ‘,’, ‘:’
- Decimal point (.) Use the Decimal point key to enter a decimal point within programming mode.

Figure 2-1: Standard Model 1010A - 18 key alphanumeric keypad



2.3.2 Setting Display Contrast

Press and hold down the START key for 10 seconds to reset the display contrast to the default 50% setting. Display contrast can be changed through display contrast menu. Refer to the 1010CB Programming Manual.

The contrast can also be adjusted remotely via the SLIP protocol command DC. For more information, see the 1010CB Protocol Manual.

2.4 Keyboard Timeout

To avoid the situation where an operator may start to enter a transaction and then leave the instrument unattended but authorised to allow fuel movement, a keyboard timeout of between 0 and 6000 seconds can be programmed into the system.

The default setting for the timeout is 60 seconds.

If an operator does not press a key to either enter load information or to respond to a prompt, the 1010 will abort the transaction and return the display to the selected initial message.

3 Password Access

3.1 Description

The Password Access system allows for access to the instrument by authorised personnel for the following processes:

- Set up and review of the instrument non W&M configurable parameters (default password “6789”)
- Set up and review of the instrument W&M configurable parameters (default password “4321”)
- Direct entry of PIN or touch key numbers (default password “1234”)
- Access for the system manager to reset the instrument in the event of system problems (default password “9876”)
- Access to the instrument’s in-built hardware test mode (default password “800”)
- View instrument diagnostics (default password 1111)
- Restore factory default settings (default password 26532668)

  > NOTE: Restore factory default settings returns all settings, including meter k factors, to their defaults, and may result in an instrument that does not function correctly.
  >
  > Restore factory default settings is only available when you use the Weights and Measures switch on the instrument to enter programming mode.

- View transactional data (default password 0100)
- View audit log data (default password 0200)

Each instrument is shipped with its passwords set as per the default number shown above. For better security, change the passwords after the system is commissioned.

3.2 Access for Password Entry

1. Do one of the following:

   - Hold the '8' key down for five seconds.

     After using this method, you cannot alter certain parameters for W&M.

   - Use the switch on the instrument.

   On the Model 1010 the switch is located on the right hand side of the enclosure. This switch may be fitted with a tamper seal for W&M requirements.

Figure 3-1: Model 1010A instrument switch

If the instrument is not idle (for example, the instrument is in use by an operator, or a vehicle overfill or earth system is connected) it displays the following:

In this case, either disconnect the permissives to bring the instrument to the idle state, or wait until loading is complete and then enter your password.

If password mode is available, the instrument displays the following:

2. Enter a valid password.

> NOTE: If the setup password is lost, record the eight digit hexadecimal number that is displayed at the password prompt (XXXX/XXXX), and then contact a Honeywell supplier, who will be able to convert this number to the setup password.
>
> If the current PIN and/or Manager Reset passwords are lost, the Setup Password allows access to them using the SYSTEM menu.

4 Initial Message

4.1 Description

The initial message module allows the selection of the default or idle display of the instrument.

The message that is selected is displayed when the instrument is idle, or not connected to an overfill or grounding system or the selected permissive. It is the first in a series of prompts available to guide an operator through a loading operation.

4.2 Configuration

The following standard messages are available within the Systems/ Initial Message menu item:

- CONNECT GROUND/OVERFILL
- CONNECT VAPOUR RECOVERY
- SYSTEM AVAILABLE, PRESS ENTER
- CONNECT PROGRAMMABLE PERMISSIVE

4.3 Connection of Overfill and/or Grounding Systems

Selection of CONNECT GROUND OVERFILL requires that an overfill or grounding system is connected before loading can begin. By default, the input is provided on Terminals CA21 and CA19 to allow for a remote voltage-free contact to be connected. The input can be programmed for use on any available digital inputs.

5 Personnel Authorization

5.1 Description

This module can be used to restrict access to the instrument, and therefore loading operations, to authorised personnel only. It also allows for the identification of operators for reporting purposes.

Each identification number is assigned an index number and both the index number and PIN are stored within the instrument's database. As standard a maximum of 2750 operators can be stored within the instrument.

Identification numbers can be entered either directly into the instrument, or via the TAS or computer if the instrument is part of a TAS.

The storage of personnel and operator information within the instrument allows for complete stand-alone operation.

5.2 Configuration

The selection of Personnel Authorisation is made within the Systems menu. There following choices are available:

- NONE
- TOUCH
- PIN
- NEXWATCH

If NONE is selected, no prompt is displayed for this menu item and the system displays the next item.

5.3 Operation - Touch Key

If Touch is configured under the Personnel Authorisation menu item, the operator prompt is:

If the touch key is read correctly and its number is programmed into the instrument, the touch key is authorised for use and the instrument displays the following:

If the touch key is read correctly but the key number is not programmed into the instrument, or if the instrument sensed the presence of a touch key but was unable to correctly read it, the instrument displays the following:

5.4 Operation - PIN

If PIN is configured under the Personnel Authorisation menu item, the operator prompt is:

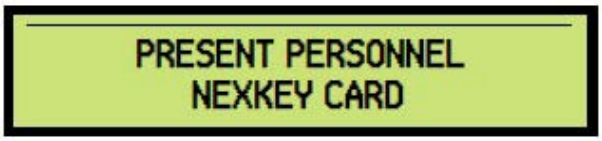
The operator can then enter a four digit PIN.

If the PIN is not stored within the instrument, or is incorrect, an error message is displayed:

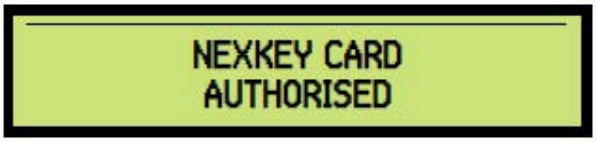
If the instrument recognises the PIN, it displays the following:

5.5 Operation - NexWatch

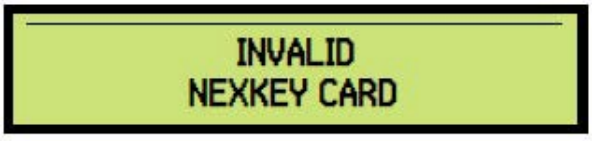
If NEXWATCH is configured under the Personnel Authorisation menu item, the operator prompt is:



If the NexWatch card is read correctly and its number is programmed in the instrument, the NexWatch is authorised for use and the instrument displays the following:



If the card was read correctly but the number is not programmed into the instrument, the instrument displays the following:



6 Vehicle Authorization

6.1 Description

Use this module to identify the vehicle to be loaded.

When used with Load Scheduling in conjunction with a TAS the identification of the vehicle can be used to set automatic Preset load quantities. By matching start the volume of the vehicle or compartment to be loaded to a preset volume the risk of overfilling can be greatly reduced.

Each identification number is assigned an index number and both the Index

Number and PIN are stored within the instrument's database. As standard a maximum of 2750 vehicle identities can be stored within the instrument.

Identification numbers can be entered either directly to the instrument, or via the TAS or computer if the instrument is part of a TAS.

The storage of vehicle information within the instrument allows for complete stand-alone operation.

6.2 Configuration

The selection of Vehicle Authorisation is made within the Systems menu. There are five choices available:

- NONE
- TOUCH
- PIN
- NEXWATCH

6.3 Operation - Touch Key

If Touch is configured under the Vehicle Authorisation menu item, the operator prompt is:

If the touch key is read correctly and its number is programmed into the instrument, the touch key is authorised for use and the instrument displays the following:

If the touch key is read correctly but the key number is not programmed into the instrument, or if the instrument sensed the presence of a touch key but was unable to correctly read it, the instrument displays the following:

6.4 Operation - PIN

If PIN is configured under the Vehicle Authorisation menu item, the operator prompt is:

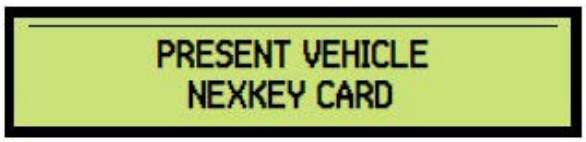
The operator can then enter a four digit PIN.

If the PIN is not stored within the instrument, or is incorrect, an error message is displayed:

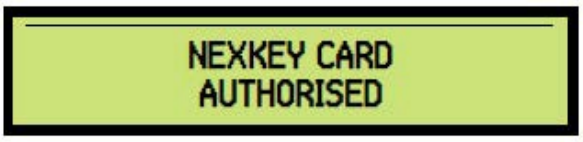
If the instrument recognises the PIN, it displays the following:

6.5 Operation - NexWatch

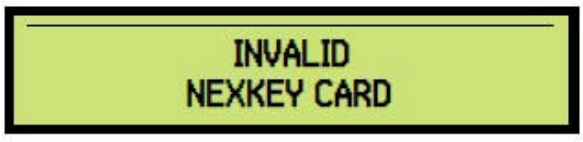
If NexWatch is configured under the Vehicle Authorisation menu item, the operator prompt is:



If the NexWatch card is read correctly and its number is programmed in the instrument, the NexWatch is authorised for use and the instrument displays the following:



If the card was read correctly but the number is not programmed into the instrument, the instrument displays the following:



7 Touch Key

7.1 Description

Touch keys are Honeywell Enraf's preferred method of identifying personnel and vehicles to the instrument and hence to a TAS or computer.

The touch key is a stainless steel can containing a microchip with a unique code laser etched onto the chip. The touch key is intrinsically safe and forms part of the certification.

The touch key may be mounted onto a polypropylene tag or card. When presented to a touch key reader the touch key receives a small amount of power (micro-watts) from an intrinsically safe barrier system.

This arrangement allows the key to pass to the reader its unique identification number.

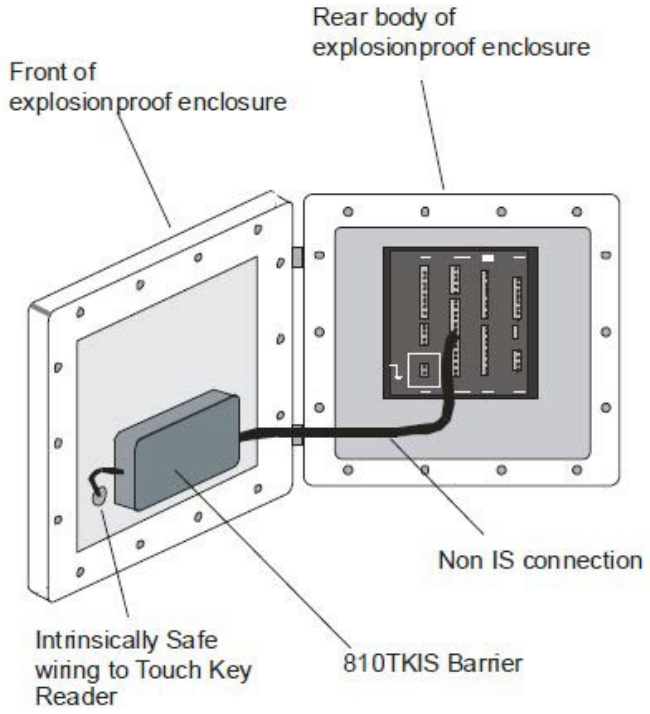
Touch key numbers can either be stored within the instrument to allow local load authorisation, or can be passed by the instrument to a TAS for authorization. As well as being able to authorize loading, a touch key may be used to identify a road tanker, and, via a TAS, set the maximum allowable Preset for the compartment to be loaded.

7.2 Touch Key Reader Installation and Maintenance

During installation or maintenance, take care to ensure the integrity of the intrinsically safe wiring by making sure that cabling from the instrument door to the CPU card cannot be jammed in the door when closed, and that the connectors have not been knocked or disturbed.

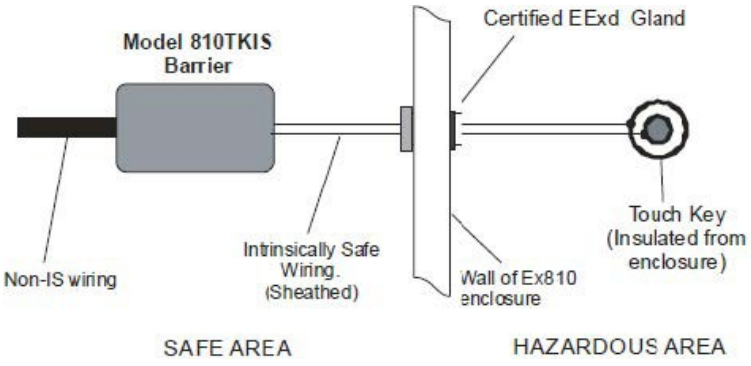
The barrier is an isolation type barrier and does not require an I.S. ground.

Figure 7-1: Touch Key Wiring



If the reader is not installed, a factory supplied and certified blanking plug will be installed in place of the ExD? barrier gland shown in the figure below.

Figure 7-2: Touch Key Wiring Diagram



8 Deadman Timer

8.1 Description

The integral Deadman Timer function of the instrument allows the loading process to be monitored to assure both the operator's attention and safety during the loading operation.

8.2 Operation

Use the CONFIGURE DEADMAN sub-menu of the SYSTEM menu to set the Deadman System time-outs.

- DEADMAN TIMER—If enabled, the operator must repeatedly (within the settable timeout period) press a key on the keypad of the instrument to prevent the Deadman system being triggered.

  Constraints: Any key apart from STOP Select one of the following options:

  - Enable
  - Disable*

- DEADMAN WARNING TIMEOUT—Sets the time after the activation of the Deadman warning indicator within which an instrument key must be pressed to prevent the load being paused.

  If the timeout expires the Deadman Indicator (GP Output) is activated.

  Constraints: Only if Deadman enabled

  It is common practice to have a visual indicator activated by this output contact.

  Enter a value in the following range:

  - 10 to 999 seconds (150*)

- DEADMAN PULSE TIMEOUT—If the timeout expires the Deadman Bell (GP Output) is activated and loading is paused.

  An audible alarm (bell or siren) may be activated by this output contact. Constraints: Only if Deadman is enabled.

  Enter a value in the following range:

  - 10 to 999 seconds (30*)

- DEADMAN TERMINATE TIMEOUT—Sets the time after the activation of the load pause sequence during which an instrument key must be pressed to prevent a load being terminated. If the load is terminated by activation of the Deadman system the Deadman Callout (GP Output) relay is activated.

  The Deadman Callout output may be used to interlock with the bay or site emergency shutdown system.

  Constraints: Only if Deadman is enabled. Enter a value in the following range:

  - 10 to 999 (120*).

Workflow

If enabled the Deadman timer works as follows:

1. After pressing the START key to start loading, the operator must press any key except STOP at least once within each Deadman Warning Timeout period (by default every 150 seconds).

   Depending on flow rates a simple way to prompt the operator is to have them press a key at every 1000 units loaded.

2. At the set time (150 seconds or 2.5 minutes) after the last button was pressed, the Deadman Timer Relay activates to close, by default, A9 & A10, but can be any GP output. This output is known as the Deadman Indicator.

   This contact closure can be used to issue a warning to the operator that there they have a further 30 seconds or the time set under the Deadman Pause Timeout to press a key before loading is paused.

3. Without a key press within 3 minutes from the start of the loading, loading is paused. At this time the operator is still able to restart the current load.

   A11 & A12 (by default, but this can be any GP output) activate at this stage. This output option is known as the Deadman Bell

4. After a further 2 minutes (or the time set under Deadman Terminate Timeout) without a key press, the Deadman Callout Relay activates to close, by default, contact BB16 & BB17, although this can be can be any GP Output. The System Alarm may also active here at BB13 & BB14 (by default), but this is dependent on the loading option ALARM ON FAULT being set to Enable, which is its default state. The load is terminated and the instrument is locked against further use. This occurs after a total time of 5 minutes if all default settings are used.

   Loading cannot be started without a Manager Reset.

   To carry out a Manager Reset a manager reset password is required to be entered at the Password Prompt (See CHAPTER 3). MR will reset the Deadman Indicator, Deadman Bell, Deadman Callout and System Alarm Relays and allow the instrument to be used again on a new load.

> NOTE: There is no external input to the Deadman system of the instrument to either initiate or reset the Deadman function.

9 Illegal Access

9.1 Description

The Illegal Access function limits the number of operator and vehicle access attempts.

The module can be enabled or disabled from the SYSTEM > LOADING OPTIONS menu.

If Illegal Access is enabled, it is possible to set the permissible number of attempts between 3 and 6 with a default setting of 3:

If an identification number is presented more than the allowable number of times within a 5-minute period, the instrument will display the following:

This message is displayed until one of the following occurs:

- The instrument's power is cycled off/on
- The Manager Reset Password is entered
- A Manager Reset command is received from a host computer.

10 Emergency Shutdown

10.1 Description

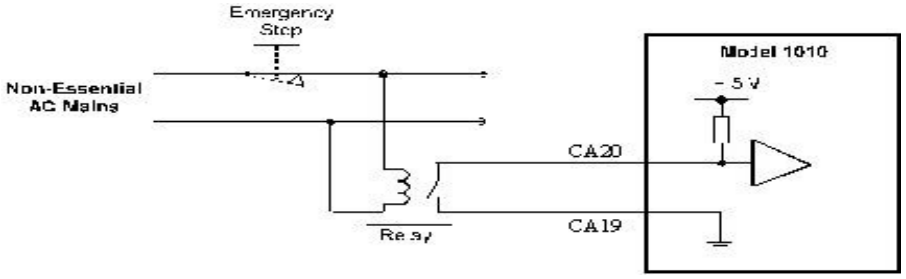
For emergency situations, an Emergency Stop Switch must be provided on the gantry that can cut off power to all non-essential items.

In an emergency situation, power to the non-essential AC mains should be cut off. This will cause the digital control valves and the gantry isolation valves to close as well as stopping the pumps.

Normally power would not be cut off to the instrument since it needs to be able to close off the transaction and log it as an emergency shutdown during the load. The instrument must be informed that the emergency stop switch has been activated and an input is provided that must be closed during normal operation and opened in an emergency.

The input to the Emergency Stop switch must be from a floating contact suitable for switching 5V volt signal inputs.

A typical connection is as follows:



NOTE: The main function of the Emergency Stop switch is to cut off power to the valves. The input on the instrument is only to monitor if the condition has occurred and provide a correct termination of any transactions in progress.

11 Overfill/Ground Input and Control

This module provides the means of monitoring the operation of an Overfill and/or Vehicle Static Grounding System.

A typical grounding system is the Scully Signal where single input used for both Overfill and Grounding system.

The instrument will control the loading operation depending on the status of a control contact within the Scully control unit.

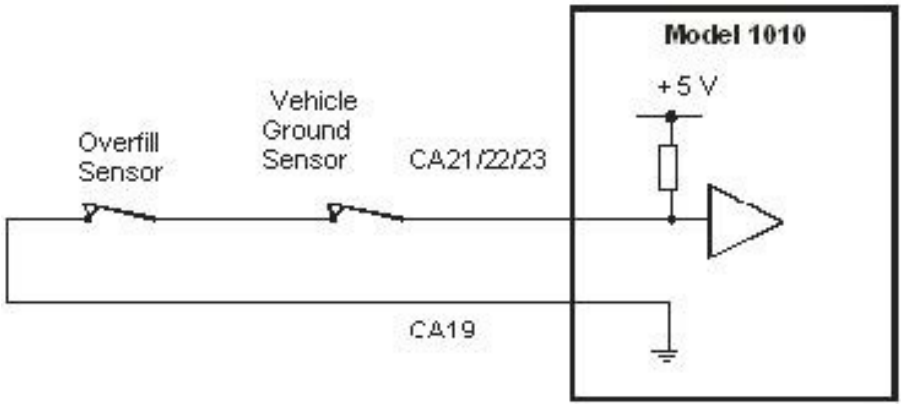
11.1 Configuration

The Clear/Reconnect menu item within the Systems menu allows the setting of the time available to either clear an overfill or reconnect the ground before the load is terminated, provided the overfill is configured to operate in TIMEOUT MODE. For information on modes, see chapter 5 of the 1010CB Programming Manual.

11.2 Connection

With the Scully system, the overfill and ground systems are combined into a common system with one output.

However, where alternative systems are used and these functions are separated, the overfill and ground input can be connected in series.



11.3 Operation

The overfill/ground input must be CLOSED during normal operation. If the input is open it will indicate that:

- There is an overfill condition
- The vehicle is not grounded
- The overfill or ground system is not connected.

The relays on the overfill and ground systems must be floating (i.e. not connected to other circuits) and suitable for switching 5V signal inputs.

If the overfill/ground signal must be sent to other systems, then additional relay logic may be required to ensure that the instrument sees only an isolated relay contact.

If the instrument is configured so that its initial message is CONNECT OVERFILL or CONNECT VAPOUR RECOVERY, the input to Terminals CA21/22/23 and CA19 must be closed before the loading operation can start. For information on initial messages, see chapter 3 of the 1010CB Programming Manual.

If the input opens during a loading operation, then the instrument will behave as according to the mode selected.

Pause mode, Terminate mode, and Manager Reset mode for overfill and vapour recovery are same as described for programmable inputs. This is described in the programming and protocol manuals:

- Timeout Mode

The instrument pauses the load and displays the following:

The load remains paused until the Clear/Reconnect timer elapses or the overfill is reconnected.

If the overfill is cleared or the connection re-established and the overfill and ground is reconnected within the Clear/Reconnect timeout period, the operator is given the option of restarting the load.

If the Clear/Reconnect timeout period is allowed to expire the instrument terminates the load and displays the following:

12 Vapour Recovery Input and Control

12.1 Description

This module provides the means of monitoring the operation of a vapour recovery system.

The instrument controls the loading operation depending on the status of a control contact of the vapour recovery input.

12.2 Configuration

The Clear/Reconnect menu item within the Systems menu allows the setting of the time available to either clear or reconnect the Vapour recovery before the load is terminated, provided this permissive is configured to operate in the TIMEOUT MODE. For information on modes, see chapter 5 of the 1010CB Programming Manual.

12.3 Connection

Vapour recovery is the process of recovering the vapours of gasoline or other fuels, so that they do not escape into the atmosphere.

12.4 Operation

The vapour recovery input must be CLOSED during normal operation. If the input is open it will indicate that:

- There is an vapour condition
- The vapour recovery hose is not connected.

If the instrument is configured so that its initial message is CONNECT OVERFILL or CONNECT VAPOUR RECOVERY, the input to Terminals must be closed before the loading operation can start. For information on initial messages, see chapter 5 of the 1010CB Programming Manual.

If the input opens during a loading operation, then the instrument will behave as follows:

- Timeout Mode

The instrument pauses the load and the displays the following:

The load remains paused until the Clear/Reconnect timer elapses or the vapour recovery is reconnected.

If the vapour recovery is cleared or the connection re-established and the vapour recovery is reconnected within the Clear/Reconnect timeout period, the operator is given the option of restarting the load.

If the Clear/Reconnect timeout period is allowed to expire the instrument terminates the load and displays the following:


VAPOUR RECOVERY REMOVED
PRESS ENTER

13 Programmable Inputs and Permissive

13.1 Description

The instrument has 28 general purpose (GP) inputs. GP input 1 is dedicated for emergency stop. The remaining general purpose inputs can be configured to any of the following types:

- Not used
- Permissive
- Arm input
- System input
- RIT (Only if RIT is enabled).

> NOTE: There can be maximum 6 programmable inputs of the type system input and one programmable permissive can be configured of type permissive.

The instrument controls the loading operation depending on the status of a control contact of these inputs (as configured in the SYSTEM > GENERAL PURPOSE INPUTS menu).

13.2 Configuration

The Clear/Reconnect menu item within the Systems menu allows the setting of the time available to either clear or reconnect the programmable input or permissive before the load is terminated, provided the permissive is configured to operate in timeout mode or manager reset mode. For information on modes, see chapter 5 of the 1010CB Programming Manual.

13.3 Operation

The programmable inputs/programmable permissive must be closed during normal operation.

If the input is open it will indicate that:

- The programmable permissive/input is not connected.

If the instrument is configured so that its initial message is CONNECT PROGRAMMABLE PERMISSIVE (for programmable permissive) or SYSTEM AVAILABLE (for programmable input) the input to terminals must be closed before the loading operation can start. For information on initial messages, see the 1010CB Programming Manual.

If the input opens during a loading operation, then the instrument will behave depending upon the mode selected:

- Pause Mode

The instrument pauses the load and displays the following message:

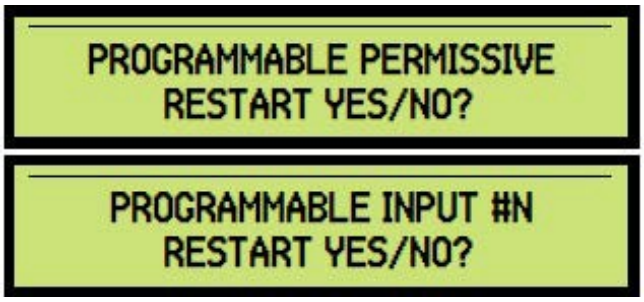
The load remains paused until the programmable permissive or programmable input is reconnected.

- Timeout Mode

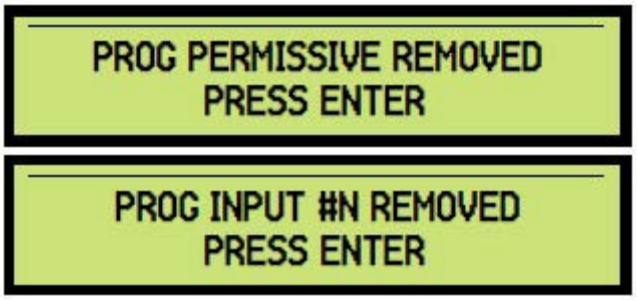
The instrument pauses the load and displays the following message:

The load remains paused until the clear/reconnect timer elapses or the programmable input/permissive is reconnected.

If the programmable input/permissive is cleared or the connection reestablished in a PAUSE MODE, and in a TIMEOUT MODE the input or permissive is reconnected within the Clear/Reconnect timeout period, the operator is given the option of restarting the load.



If the Clear/Reconnect timeout period is allowed to expire in the TIMEOUT MODE the instrument terminates the load and displays the following:



- Terminate Mode

The instrument terminates the load as soon as the programmable input/ permissive is disconnected and displays the message above.

- Manager Mode

The instrument pauses the load and allows a restart during the Clear/ Reconnect timeout period. If the timeout expires the Manager Reset password is required to re-enable the instrument. The messages are the same except for the final messages after timeout and enter pressed/ keyboard timeout expired are “PROGRAMMABLE PERMISSIVE WAIT FOR MANAGER” and PROGRAMMABLE INPUT n WAIT FOR MANAGER”.

14 Dual Pulse Flow Meter Input

14.1 Description

Each flowmeter input can accept a wide range of flowmeter signals from positive displacement to pre-amplified turbine flow meters. Two pulse inputs are provided for each flowmeter so that the pulse integrity of the flowmeter is ensured. If one signal fails during a loading operation, the loading on that arm is halted and the operator alerted. The report, produced on each load, will also indicate that the loading stopped due to a flow meter error.

The pulse integrity feature is in accordance with: API Standards, Chapter 5, Section 5

- AS2707 - 1984
- ISO6551 - 1982.

> NOTE: The dual pulse input does not detect reverse flow but is purely for ensuring the integrity of the flow signal.

The dual pulse feature can be disabled during Setup so that only one input is accepted (input a) from each flowmeter.

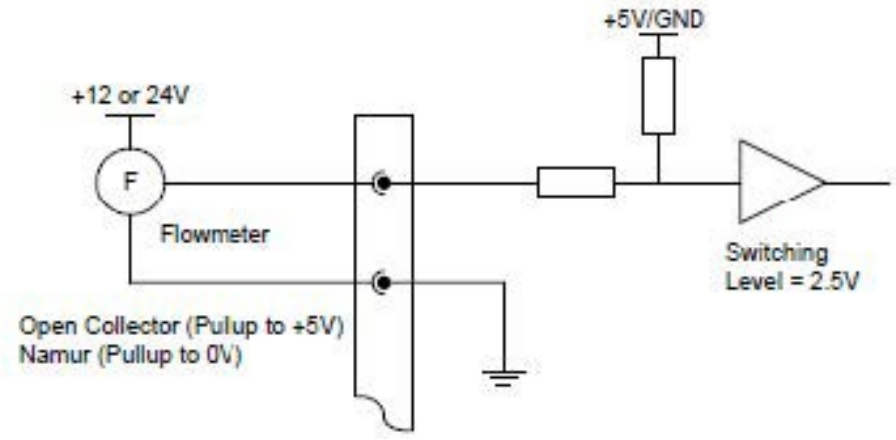
- Meter Features

The K-factor (i.e. pulses per unit volume) are programmed during the Setup Procedure. For more information, see the Programming. Manual. The K-factor can be entered as a single factor or, if multiple calibration points are known, up to ten K-factors and corresponding flow rates can be entered.

14.2 Input Circuit

The input circuit is software selectable, by default connected to the +5V via a pull-up resistor. For more information, see “Flowmeter Input Meter n” in the “Signal Type” topic of the Programming Manual.

Figure 14-1: Input Circuit



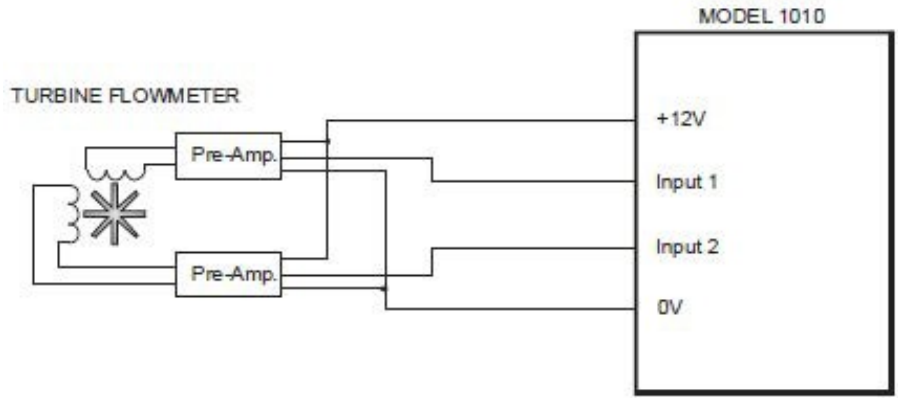
The above circuit has a switching threshold of 2.5V and will accept the following signal types:

- Resistor pull-up to +5V
  - Pulse input
  - Open collector
  - Reed switch
- Resistor pull-down to 0V
  - Namur switch

14.3 Connection Examples

- Veeder Root Pulser Model 7671-30x. Signal type selection is RESISTOR PULL-UP.
- Turbine Flow meters

Figure 14-2: Turbine Flow Meter



Signal type selection is the RESISTOR PULL-UP.

- Namur Switches (Proximity).

Namur Switches are two wire proximity switches which produce a current output between 1 mA and 3 mA and are powered by a voltage source of 5 - 25V. Signal type selection is RESISTOR PULL-DOWN.

Sensors using Namur switches are often classed as intrinsically safe rather than flameproof and, therefore, a barrier needs to be used. Typically, the barrier would be mounted in an auxiliary flameproof enclosure and the signal to the instrument would be a pulse square wave or open collector.

For those applications where the Namur Switch is mounted in their own flameproof enclosure, the instrument can accept a Namur Switch directly.

Figure 14-3: Namur Switches (Proximity)

14.4 Terminations

For the flowmeter inputs to the instrument, see the Application Pack and input card descriptions in the Card Description and Wiring Manual.

15 Setting Cut-Off Frequency

15.1 Description

This procedure sets out the steps necessary to ensure that the correct Cut-off Frequency is set for Dual Pulse error detection. Correct Cut-off

Frequency will prevent unwanted Dual Pulse errors occurring.

15.2 Configuration Parameters

The following parameters are set during the procedure to select the correct Cut-off Frequency:

Table 15-1: TABLE 15-1 Configuration Parameters (*This parameter must be selected)

VALVE TYPE (DIGITAL*)	K FACTOR
VALVE SLOW FLOW	SIGNAL TYPE METER n (SINGLE*)
DEADBAND	MINIMUM LINEAR FLOWRATE

15.3 Metering Lines—Configure line n Menu

15.3.1 K FACTOR Menu

The actual K-Factor for the valve as specified by the flow meter manufacturer in pulses/unit or calculated by a meter prover.

For Non-linear K-factors refer to chapter 17 "Non-Linear Flow Correction".

15.3.2 SIGNAL TYPE Menu

- MINIMUM LINEAR FLOWRATE

  The minimum linear flow rate for the valve as specified by the flowmeter manufacturer in litres/min.

- SIGNAL TYPE METER n (DUAL must be selected)

  Selects the flowmeter output type. SINGLE has one pulse output and DUAL has two pulse outputs (sometimes called quadrature), which are used to monitor signal integrity.

- CUTOFF METER n (Only for signal meter n = DUAL)

  Signal input frequency (Hz) below which the signal integrity of a dual pulse type flowmeter is not monitored.

15.4 Product Streams—Stream n Menu

- VALVE TYPE

  Selects the type of flow control valve to be used on all loading arms.

- VALVE SLOW FLOW

  The desired flow rate when slow flow is required at the start and end of a batch.

- DEADBAND (Only for Valve Type = Digital)

  If the measured flow rate is within the deadband of the required flow rate, no adjustments are made to the flow rate. This prevents continuous adjustments to the flow valve, thereby minimizing wear.

15.5 Default Values

The table below shows the system default values for each parameter (Units = liter):

VALVE SLOW FLOW	300 L/min
DEADBAND	60 L/min
MINIMUM LINEAR FLOW RATE	200 L/min

15.6 Setting the cut-off frequency

1. Select the VALVE SLOW FLOW value (the default is 300 l/min) This value must be greater than the largest MINIMUM LINEAR FLOWRATE + DEADBAND
2. Select the DEADBAND value the default is 60 l/min)

   This value must be less than or equal to the VALVE SLOW FLOW - the largest MINIMUM LINEAR FLOWRATE
3. The software calculates the maximum allowed “minimum linear flow rate” for each arm as follows:

   MAX MINIMUM LINEAR FLOWRATE = VALVE SLOW FLOW - DEADBAND

   Using the default values = 300 - 60 = 240 l/min The allowed range is 0 to 240.
4. Enter the K FACTOR

   K FACTOR = 13.9 pulses/l

   (obtained from flowmeter manufacturer specifications or by a meter prover)
5. Enter the MINIMUM LINEAR FLOWRATE

   MINIMUM LINEAR FLOWRATE = 233 l/min (obtained from flow meter manufacturer specifications)
6. Calculate the maximum allowed Cut-off Frequency as follows:

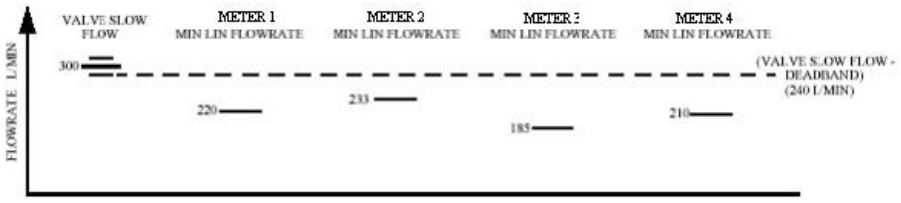
   MAX CUTOFF FREQ = (MINIMUM LINEAR FLOWRATE * K FACTOR)/60

   Using the values in the previous steps = 233 * 13.9)/60 = 54 Hz
7. Enter the CUTOFF ARM n Frequency

   As a guide, the CUTOFF Frequency can be set to half the MAX CUTOFF FREQ

   CUTOFF METER n = MAX CUTOFF FREQ/2 = 27 Hz

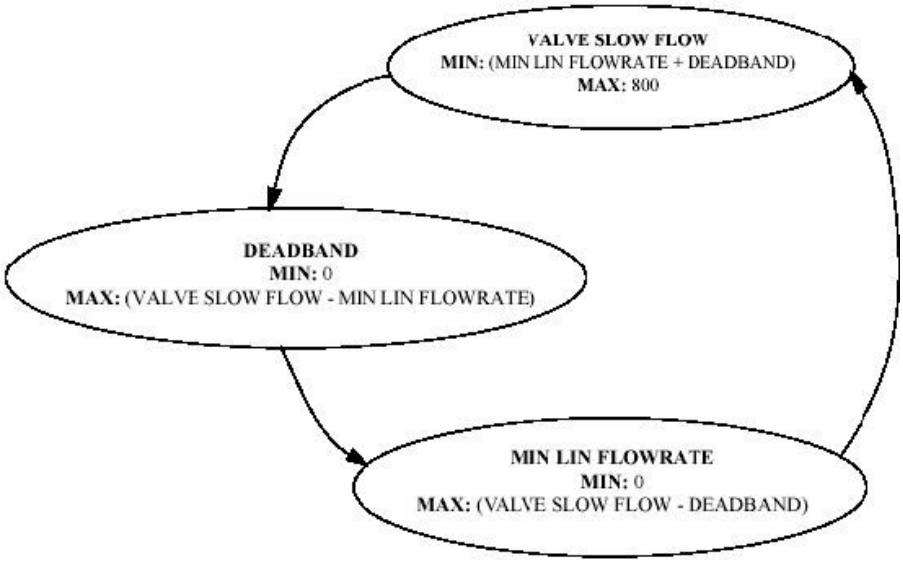
15.7 Notes



If a flowmeter is replaced and the new MINIMUM LINEAR FLOWRATE for that arm needs to be increased to a value greater than the (VALVE SLOW FLOW - DEADBAND), the VALVE SLOW FLOW or DEADBAND

must be altered before you can enter this new value. The instrument calculates the (VALVE SLOW FLOW - DEADBAND) and prevents entry of a MINIMUM LINEAR FLOWRATE that exceeds this calculated value.

This prevents the instrument attempting to control the flow rate of an arm below the linear operating range for the flowmeter.



16 Gantry Isolation Valve

16.1 Description

An output to operate a Gantry Isolation Valve is provided for each arm. All outputs can be set individually to have normally open or closed contacts, so the energised state driven here are for NO configuration. The output is energised (closed) as soon as the operator starts the load on the arm, and de-energised (opened) once the load is complete.

The outputs can be Solid State or electromechanical relays. Solid State relays are recommended for driving solenoids and contactors, while electromechanical relays are recommended for driving DC loads or as an interface to a PLC.

The electromechanical relays have an isolated contact rated at 24 VDC max or 240 VAC max at 3 amps.

> NOTE: If the electromechanical relays are used to drive inductive loads, use "snubbers" across the load.

16.2 RC Networks for Interference Suppression (Snubbers)

When driving inductive loads with the electromechanical relay outputs, it is recommended that RC suppression networks (often called "Snubbers") are used for two reasons:

- To limit the amount of electrical noise caused by arcing across the contacts which may, in extreme cases, cause the microprocessor to act erratically.
- To protect the relay contacts against premature wear through pitting.

RC suppression networks consist of a capacitor and a series resistor and are commonly available in the electrical industry. The values of R and C are dependent

entirely on the load. However, if the user is unsure of the type of snubber to use, values of 0.25 µF and 100 ohms will usually suffice.

> NOTE: Use only mains approved RC suppression networks.

The basic principle of operation is that the capacitor prevents a series of sparks arcing across the contact as the contact breaks. The series resistor limits the current through the contact when the contact first makes.

17 Non-Linear Flow Correction

17.1 Description

Each flowmeter connected to the instrument can be programmed with a single K-factor, or if the flow signal is non-linear over the operating range up to ten K-factors. If non-linearity is used, the 1010 uses linear interpolation between the K-factor points entered.

17.2 Programming Non-linear K-factors

1. If the NON LINEAR correction option has been selected, the instrument displays the following under the METERING LINE menu:

   In this screen, k is the K-factor at 0 Hz.

2. Enter a K-factor for 0 Hz using the numeric keys, followed by the Enter key. The instrument displays the following:

   In this screen, f is the frequency point number, and n is the next point between 0 and 2000 Hz.

3. Enter a frequency for point n using the numeric keys, followed by the Enter key.

   If any frequency point is programmed as 2000 Hz, this point becomes the final K-factor and no further points can be programmed.

4. The instrument displays the following:

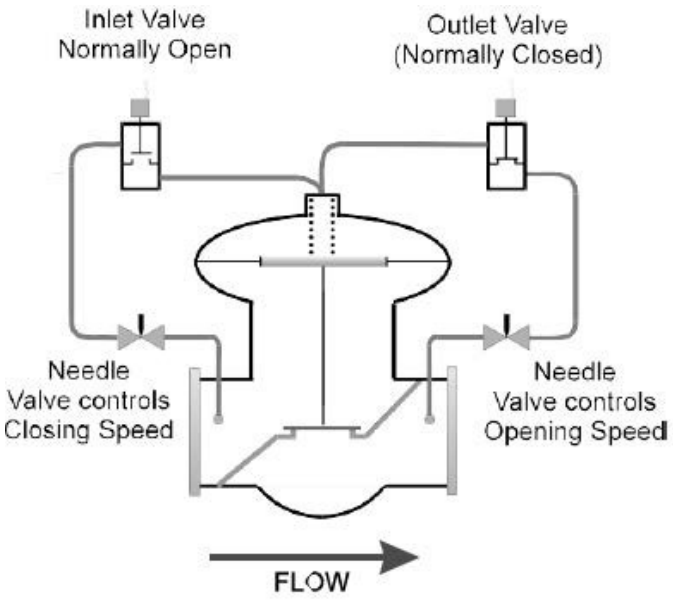
5. In this screen, f is the frequency number n entered in the previous step and k is the corresponding K-factor.
6. Enter a K-factor for this frequency using the numeric keys, followed by the Enter key.

If the number of points entered is less than 5, operation returns to Step 2 for the next point. In this way, up to 10 frequencies and corresponding K-factors may be entered

18 Digital Control Valve

18.1 Description

The advantage of a Digital Control Valve lies in its ability to control flow rate through a pilot operation. Normally, the liquid flowing through the valve is used to control its operation although some valve types are also pneumatically controlled.



DIGITAL CONTROL VALVE
PRINCIPLE OF OPERATION

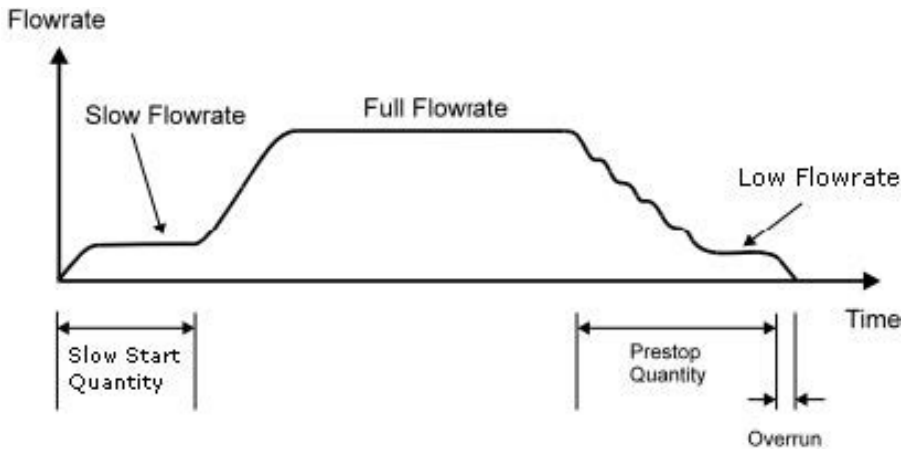
The instrument will switch on and off the solenoids in sequence to increase, hold and decrease flow as follows:

Condition	Normally Open Inlet Valve	Normally Open Outlet Valve
Increase Flow rate	Energised	Energised
Hold Flow rate	Energised	De-energised
Decrease Flow rate	De-energised	De-energised

If power is lost to the system, the valve will close.

By systematically energising and de-energising the solenoids, it is possible to control the flow rate.

Typical flow profile is as follows:



Flow is kept at low flow rates at the start of the load until the percentage vapour is beyond the explosive mixture level. The flow rate can then be increased to maximum desired flow until the preset value is approached, at which point the flow rate is decreased. The last amount of product is then added at low flow rates since it is easier to achieve a more accurate cut-off.

The instrument also incorporates a programmable overrun quantity to account for any overrun once both relays are de-energised, and the valve closes fully.

The instrument allows the following parameters to be programmed:

- No Flow Timeout
- Slow Flow rate
- Deadband
- Valve Response
- Low Flow Rate
- Prestop Quantity
- Pump Off Delay
- Full Flow rate
- Overrun Quantity

- Auto High Flow
- High Flow Timeout
- Slow Start Quantity
- Prestop Quantity
- Meter Factor
- Unauthorised Flow Threshold

The Deadband feature is designed to stop the control valve being continually energised and de-energised in an attempt to exactly reach the desired flow rate. The Deadband can be programmed in litres/minute, and providing the flow rate is within the set flow rate ± the deadband, the instrument does not try to adjust flow.

The response of the valve is primarily controlled by the needle valves on the control valves which govern the opening and closing speeds of the valve. Because these valves introduce a “lag” in the system, it is possible for the system to “go into oscillation” under some settings. This is because the phase difference between the flow rate as read by the flowmeter and the valve response are 180 degrees out of phase.

If oscillation is encountered, it can be stopped by:

- Changing the Valve Response (by trial and error)
- Adjusting the needle valves
- Increasing the deadband.

Ensure that there is no air in the pilot valve mechanism since this can also cause unstable operation. Generally, there is provision to “bleed” air out of the system on most valves.

18.2 Parameters

- NO FLOW TIMEOUT—If there is an absence of pulses for a time exceeding this setting during a load, then the instrument will terminate the load and display an error. Enter a value in the following range:

- 0 to 999 seconds (5*)

- VALVE TYPE—Selects the type of flow control valve to be used on the Meter Run.

  Select one of the following options:

  - Digital*
  - On/Off (Includes 2-stage function)

- DEADBAND—If the measured flow rate is within the deadband of the required flow rate, no adjustments are made to the flow rate. This prevents continuous adjustments to the flow valve, thereby minimizing wear.

  For example, for a desired flow rate of 300 and a deadband of 60, no adjustment is made if the flow rate is between 240 and 360.

  Constraints: Only for Valve Type = Digital. Enter a value in the following range:

  - 0 to (Slow Flow - Minimum Linear Flow Rate) (60*)

- VALVE SLOW FLOW—Flow The desired flow rate when slow flow is required at the start of a batch.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - (Minimum Linear Flow Rate + Dead Band) to 800 (300*)

- VALVE LOW FLOW—The minimum flow rate throughout a batch, especially at the end of batch.

  Constraints: None

  Enter a value in the following range:

  - (Minimum Linear Flow Rate + Dead Band) to 800 (300*)

- VALVE RESPONSE—Valve response is a measure of the magnitude of adjustment made to the flow control valve. A value of 0.2 results in a slower change of flow rate than a value of 1.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

- 0.2 to 1.0 (0.7*)

- SLOW START QUANTITY—For Off/On valves, the load is started and the slow flow relay opens. After the flow meter measures the Slow Start Quantity, the high flow relay opens.

  For digital valves, the time after which the flow rate is adjusted from the valve slow flow rate to the valve full flow rate.

  For Digital valves, the load is started and the slow flow relay opens. After the flow meter measures the Slow Start Quantity, the instrument adjusts the flow rate Valve Slow Flow rate to the Valve Full Flow rate. Enter a value in the following range:

  - 0 to 9999 litres (300*)

- PRESTOP QUANTITY—Sets the point near the end of the load at which the flow will switch from high to low. A low flow at the end of the load helps prevent pipe stresses and gives a more accurate cut off.

  Enter a value in the following range:

  - 0 to 999 litres (300*)

- PUMP OFF DELAY—Sets a time period between loads during which the pump may continue to run. This reduces the number of pump starts.

  This is applicable only during the same transaction, that is, for multiple batches. The pump will shut down immediately if the transaction is terminated.

  Enter a value in the following range:

  - 0 to 999 seconds (0*)

- VALVE FULL FLOW—Sets the desired flow rate when full flow is required. Flow is set to full flow rate after the start time has elapsed, and remains at this flow rate until the delivered quantity has reached the preset less the pre-stop quantity.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - (Slow Flow) to 3000 (1800*)

- PRE-BATCH STOP—The overrun quantity is the amount of product that flows during the time it takes the flow control valve to close.

  The instrument signals the flow control valve to close when the quantity delivered equals the preset quantity less the overrun quantity.

  Enter a value in the following range:

  - 0 to 250 (0*)

18.3 Auto high flow

18.3.1 Description

If the Target Full Flowrate cannot be achieved within the High Flow Timeout period, the target flow rate is reduced by the deadband until the actual flow rate is within the deadband of the reduced target flow rate. The reduced target set point is held for the restarted timeout period.

If the target flow is achieved, then the set point is again increased by deadband and is held for the timeout period. But if the target flow is not achieved within the timeout period then the target flow rate is further reduced by the deadband and the cycle continues during the high flow period until the target flow rate matches the set high flow rate.

18.3.2 Additional Parameter

- Auto High Flow—When enabled, if the actual flow rate does not reach the target flow rate within the High Flow Timeout period, the target flow rate is reduced by deadband and the High Flow Timeout is restarted. This sequence continues until the target flow rate matches the actual flow rate allowing for the dead band setting.

  Constraints: Only for Valve Type = Digital.

  Select one of the following options:

  - Enable
  - Disable

- High Flow Timeout—The time allowed for the actual flow rate to reach the target flow rate before the target flow rate is reduced by deadband.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - 0 to 300 second (10*)

18.3.3 Example

If the supply pressure of a system is not constant, for example if it is influenced by supply tank level, and or other arms loading off the same pump, then the flow rate achievable by the system with a full supply tank will not be maintained as the tank empties. In these circumstances the digital control valve may not be able to be set to take advantage of the full flow rate conditions while at the same time avoiding excessive pulsing of the control valve solenoids on reduced flow rates. By automatically reducing the target flow rate as the supply tank empties the digital control valve will always be operating at its optimum condition.

19 Single/Two Stage Valve

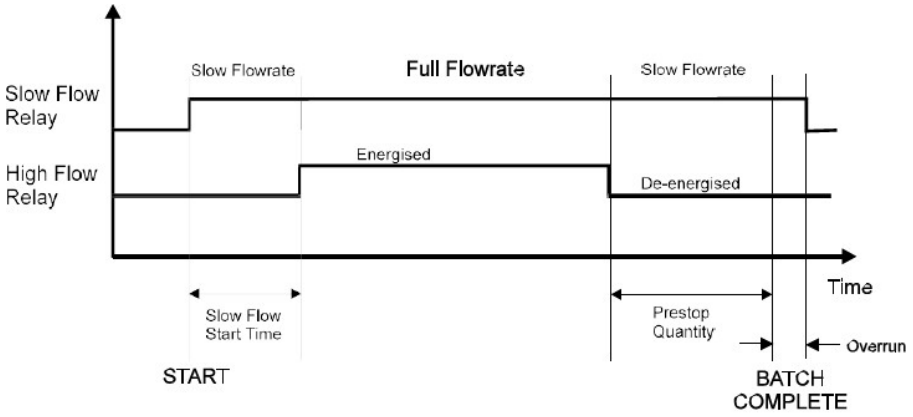
19.1 Description

Single stage or On/Off valves are connected to the Slow Flow Relay contacts and are opened and closed at the start and end of the batch.

> NOTE: If there is a requirement for accurate and repeatable cut-offs to the batch then the use of single stage valves is not recommended.

Two stage control valves do not have electronic flow control via the instrument, although they may have a hydraulic control built into the valve.

In a two stage valve system, two solenoid valves are controlled as follows:



ON/OFF VALVE - RELAY OPERATION

The instrument allows the following parameters to be programmed:

- No Flow Timeout
- Slow Start Quantity
- Prestop Quantity.
- Pump Off Delay

19.2 Parameters

- No Flow Timeout—If there is an absence of pulses for a time exceeding this setting during a load, then the instrument will terminate the load and display an error.

  Enter a value in the following range:

  - 0 to 999 seconds (5*)

- Valve Type—Selects the type of flow control valve to be used on the Meter Run.

  Select one of the following options:

  - Digital*
  - On/Off (Includes 2-stage function)

- Deadband—If the measured flow rate is within the deadband of the required flow rate, no adjustments are made to the flow rate. This prevents continuous adjustments to the flow valve, thereby minimizing wear.

  For example, for a desired flow rate of 300 and a deadband of 60, no adjustment is made if the flow rate is between 240 and 360.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - 0 to (Slow Flow - Minimum Linear Flow Rate) (60*)

- VALVE SLOW FLOW—Flow The desired flow rate when slow flow is required at the start of a batch.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - (Minimum Linear Flow Rate + Dead Band) to 800 (300*)

- VALVE LOW FLOW—The minimum flow rate throughout a batch, especially at the end of batch.

  Constraints: None

Enter a value in the following range:

- (Minimum Linear Flow Rate + Dead Band) to 800 (300*)

- VALVE RESPONSE—Valve response is a measure of the magnitude of adjustment made to the flow control valve. A value of 0.2 results in a slower change of flow rate than a value of 1.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - 0.2 to 1.0 (0.7*)

- Slow Start Quantity—For Off/On valves, the load is started and the slow flow relay opens. After the flow meter measures the Slow Start Quantity, the high flow relay opens.

  For digital valves, the time after which the flow rate is adjusted from the valve slow flow rate to the valve full flow rate.

  For Digital valves, the load is started and the slow flow relay opens. After the flow meter measures the Slow Start Quantity, the instrument adjusts the flow rate Valve Slow Flow rate to the Valve Full Flow rate.

  Enter a value in the following range:

  - 0 to 9999 litres (300*)

- Prestop Quantity—Sets the point near the end of the load at which the flow will switch from high to low. A low flow at the end of the load helps prevent pipe stresses and gives a more accurate cut off.

  Enter a value in the following range:

  - 0 to 999 litres (300*)

- Pump Off Delay—Sets a time period between loads during which the pump may continue to run. This reduces the number of pump starts.

  This is applicable only during the same transaction, that is, for multiple batches. The pump will shut down immediately if the transaction is terminated.

  Enter a value in the following range:

- 0 to 999 litres (300*)

- VALVE FULL FLOW—Sets the desired flow rate when full flow is required. Flow is set to full flow rate after the start time has elapsed, and remains at this flow rate until the delivered quantity has reached the preset less the pre-stop quantity.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - (Slow Flow) to 3000 (1800*)

- PRE-BATCH STOP The overrun quantity is the amount of product that flows during the time it takes the flow control valve to close.

  The instrument signals the flow control valve to close when the quantity delivered equals the preset quantity less the overrun quantity.

  Enter a value in the following range:

  - 0 to 250 (0*)

19.3 Auto high flow

19.3.1 Description

If the Target Full Flowrate cannot be achieved within the High Flow Timeout period, the target flow rate is reduced by the deadband until the actual flow rate is within the deadband of the reduced target flow rate. The reduced target set point is held for the restarted timeout period.

If the target flow is achieved, then the set point is again increased by deadband and is held for the timeout period. But if the target flow is not achieved within the timeout period then the target flow rate is further reduced by the deadband and the cycle continues during the high flow period until the target flow rate matches the set high flow rate.

19.3.2 Additional Parameter

- Auto High Flow—When enabled, if the actual flow rate does not reach the target flow rate within the High Flow Timeout period, the target flow rate is reduced by deadband and the High Flow Timeout is restarted. This sequence continues until the target flow rate matches the actual flow rate allowing for the dead band setting.

  Constraints: Only for Valve Type = Digital.

  Select one of the following options:

  - Enable
  - Disable

- High Flow Timeout—The time allowed for the actual flow rate to reach the target flow rate before the target flow rate is reduced by deadband.

  Constraints: Only for Valve Type = Digital.

  Enter a value in the following range:

  - 0 to 300 second (10*)

19.3.3 Example

If the supply pressure of a system is not constant, for example if it is influenced by supply tank level, and or other arms loading off the same pump, then the flow rate achievable by the system with a full supply tank will not be maintained as the tank empties. In these circumstances the digital control valve may not be able to be set to take advantage of the full flow rate conditions while at the same time avoiding excessive pulsing of the control valve solenoids on reduced flow rates. By automatically reducing the target flow rate as the supply tank empties the digital control valve will always be operating at its optimum condition.

20 Analog Control Valve

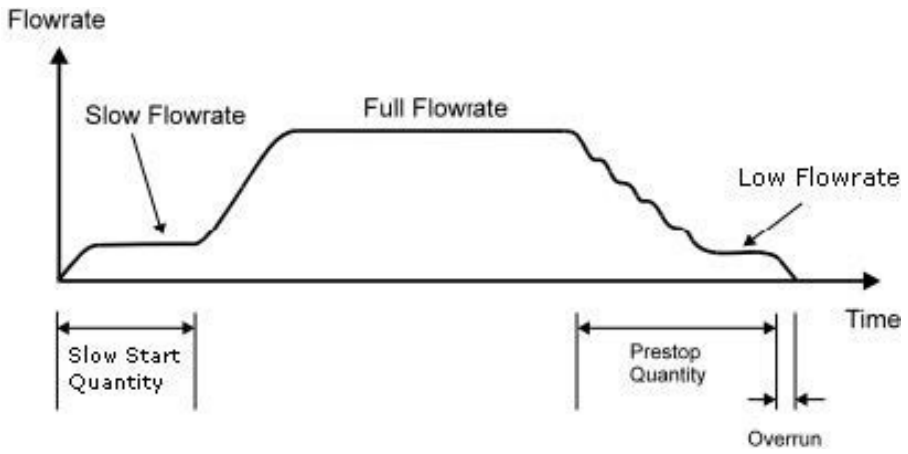
20.1 Description

The analog control valves operate from a 4mA to 20mA signal that indicates the proportional opening of the valve.

- An analog signal of less than or equal to 4mA will drive the valve completely closed (0%).
- An analog signal of greater than or equal to 20mA will drive the valve completely open (100%).
- An analog signal between 4mA and 20mA will drive the valve to a percent open between 0% and 100%.

An analog valve by itself does not target a flow rate, so the valve control signal will be adjusted by the Batch Controller to target a flow rate profile.

Typical flow profile is as follows:



Flow is kept at low flow rates at the start of the load until the percentage vapour is beyond the explosive mixture level. The flow rate can then be increased to maximum desired flow until the preset value is approached, at which point the flow rate is decreased. The last amount of product is then added at low flow rates since it is easier to achieve a more accurate cut-off.

The instrument also incorporates a programmable overrun quantity to account for any overrun once both relays are de-energised, and the valve closes fully.

The instrument allows the following parameters to be programmed:

- No Flow Timeout
- Slow Flow rate
- Low Flow Rate
- Prestop Quantity
- Pump Off Delay
- Full Flow rate
- Overrun Quantity
- Slow Start Quantity
- Prestop Quantity
- Meter Factor
- Unauthorised Flow Threshold

Refer to the 1010CB Programming manual for detail about above configuration.

21 Temperature, Pressure, and Density Correction

21.1 Description

Temperature variations in petroleum products alter the product's volume and density. In simple terms one litre of product at 25 ºC becomes 0.99 litres when metered at 15 ºC (i.e. a change of approximately 1%) and one litre of product at 30 ºC becomes 0.95 litres when metered at 20 ºC. It is therefore obvious that in any situation where reconciliation of the receipt, storage and dispensing of a product is required that a common basis of comparison be used. It would be impossible to balance the throughput of a facility by comparing the receipt of product at 18 ºC, its storage at 22 ºC and its dispensing at 25 ºC unless there was a standardized method of calculation.

Petroleum Measurement Tables published by the American Petroleum Institute (API), prepared in close co-operation with the Institute of Petroleum, London (IP) and the American Society for Testing and Materials (ASTM) form the basis of calculating density and volumes to internationally agreed standards of 60 ºF and 15 ºC. (Note some countries operate to a standard of 20 °C).

The instrument can perform temperature, pressure and density correction for the products measured by the attached volumetric flow meters. The temperature can be measured by RTD or via temperature sensors with 4-20 mA outputs. Both the pressure and density can only be measured using sensors with 4-20 mA outputs and is dependant on the available 4-20 mA inputs. (For sales codes A,B,C, and D both pressure and density can be measured and for sales codes E and F either the pressure or the denisty can be measured for each meter.) The temperature, pressure, and density correction calculations comply with API MPMS Chapter 11.1 (known as ASTM D 1250-04) and API MPMS Chapter 11.2.4 (known as GPA TP-27).

The following API Density and Volume Correction Tables are supported:

Table 21-1: Commodity Based Table Designation

Description	Density Units	Base Temp.	Crude Oils (A)	Refined (B)	Special (C-thermal exp.)	Lube Oils (D)	NGL and LPG (E)
Correction of Observed Specific Gravity to Specific Gravity 60/60 °F	Relative Density (RD60)	60 °F	23A	23B	N/A	23D	23E
Correction of Volume to 60 °F Against Specific Gravity 60/60 °F	Relative Density (RD60)	60 °F	24A	24B	24C	24D	24E
Correction of Observed Density to Density at 15 °C	kg/m3	15 °C	53A	53B	N/A	53D	53E
Correction of Volume to 15 °C Against Density at 15 °C	kg/m3	15 °C	54A	54B	54C	54D	54E
Correction of Observed Density to Density at 20 °C	kg/m3	20 °C	59A	59B	N/A	59D	59E
Correction of Volume to 20 °C Against Density at 20 °C	kg/m3	20 °C	60A	60B	N/A	60D	60E

In the instrument the term 'GROSS' is used to indicate actual volumes i.e. GOV, while 'NET' is used to indicate a corrected volume i.e.GSV. The instrument calculates the NET volume delivered for the meters for which correction is enabled.

The configuration menu to select the commodity type, the temperature sensor type, temperature, pressure and density ranges is METERING LINES / CONFIGURE LINE n / CORRECTION. This menu is accessible via the configuration password.

Flowmeter readings are sampled every 100 milliseconds. The analog inputs are sampled once every 1.2 sec (each channel, max of 4 channels, is sampled 300 msec apart). After the actual (GROSS) volume has been calculated using the flowmeter K-Factor, the corrected (NET) volume is calculated by multiplying the GROSS volume by the calculated CTPL. CTPL (Correction for the effect of Temperature and Pressure on Liquid) is calculated as follows:

CTPL = CTL × CPL

Where:

CTL is the temperature portion of the correction CPL is pressure portion of the correction.

CTL and CPL are calculated using the correction tables mentioned above.

NET Volume = GROSS Volume × CTPL.

The instrument can be programmed to show its accumulated total as either GROSS or NET. This is known as the Batch Type.

> NOTE: Loading by volume is always carried out as a GROSS (actual) volume.
>
> It would be dangerous to load in NET volume due to the probability of overfilling a compartment.

For the best accuracy possible, the 1010CB uses 64-bit calculations and weighted average for analog inputs. The weighted average gives the most accurate reading for the entire batch. The volume weighted average calculation is:

$$\text{Volume weighted average} = \frac{\Sigma(\Delta\text{volume} \times \text{current observed value})}{\text{Total volume}}$$

This applies to the observed temperature, pressure, and density values. The final observed average value is stored in the transaction.

The 1010CB is also compliant with NEN-EN14214 for FAME/Bio- Diesel; it can be used only with base temperature as 15 degree celsius.

22 Communication

22.1 Description

Although an instrument controller can operate as a standalone device, it is common practice to have one or more controllers connected to either a Terminal Automation System or other host computer system, such as a Digital Control System. The connection between the instrument and the computer or DCS is made via standard data communication ports. instrument controllers have two communications ports (Main & Auxiliary) available for external use. Generally the main communication port is used for communications to a host computer or DCS while the auxiliary port is used as a back-up communications port.

For information on the software protocol, which covers the commands and message handling techniques between the instrument and the host computer, see the Protocol Manual.

22.2 Communication Interface Standard Selection

The instrument supports two interface standards:

- RS232
- RS485

22.2.1 RS232

RS232 allows for point to point communications over a maximum distance of 15 to 30 metres, depending on the installation.

22.2.2 RS485

RS485 allows for reliable serial data communications at distances of up to 1.2 km (4,000 feet) and permits operation of up to 32 devices over two wires (plus a signal common).

22.2.3 Isolated RS485/RS232

The Model 1010A has Isolated RS485/RS232 selection available depending on the configured ports (Port 1, Port 2 or Port 3), which individually isolates each instrument and gives protection from spurious voltages that may be induced in the communication lines.

- Port 1: Isolated RS485/RS232
- Port 2: Isolated RS485
- Port 3: Isolated RS485

> NOTE: Some publications detail far greater distances at lower baud rates for RS232. We do not recommend this, but concede that under ideal conditions it may prove to give acceptable performance.

Although this section covers hard-wired forms of communication between the instrument and the control room, other types of high integrity communications such as fibre optics can be used.

In installations involving more than one controller the use of a multi-port isolator/converter is strongly recommended. A multi-port isolator/ converter ensures a flexible and reliable communication system based on two basic communication principles:

- Using RS485 communication with a multi-port isolator/ converter allows for separate cables between each controller and the computer. This eliminates problems that can occur on multidrop links where one failed transmitter can cause complete communications failure to all units. Fault diagnosis is also simplified since connections can be interchanged or individually removed on the isolator/ converter without having to open flameproof enclosures.

- Each connection is isolated, which eliminates ground loop problems that can occur on long communication lines.

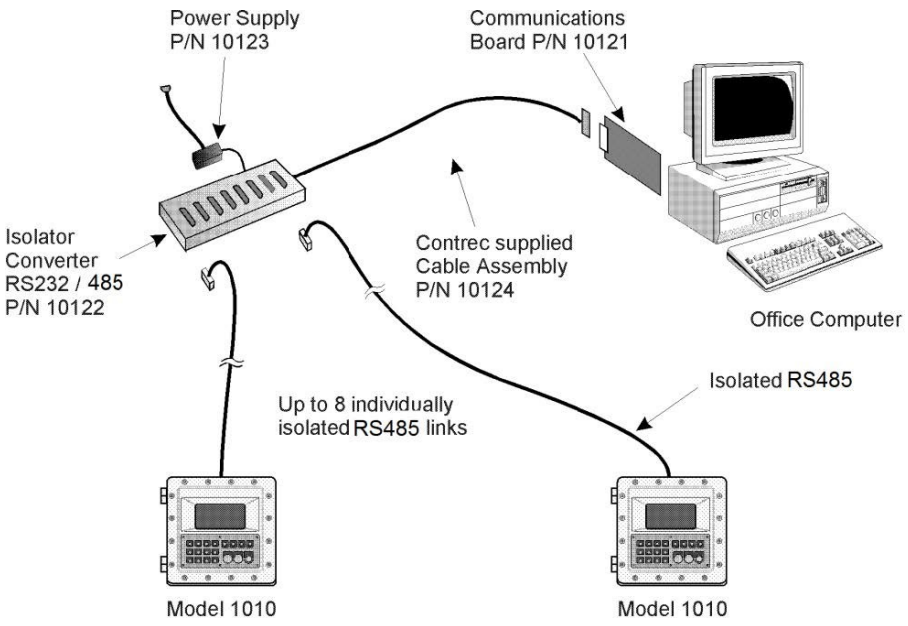
Use shielded twisted pair wires for all communications between the instrument and the isolator/converter.

The connector at the isolator/converter is a 25 way standard “D” type connector with male pins.

Wiring between the instrument and the isolator/converter is shown in the figure below.

A typical computer/instrument setup is shown in the figure below. The setup requires an 8 channel communications board to be inserted in the computer and field connections are routed via the 8 channel isolator/ converter.

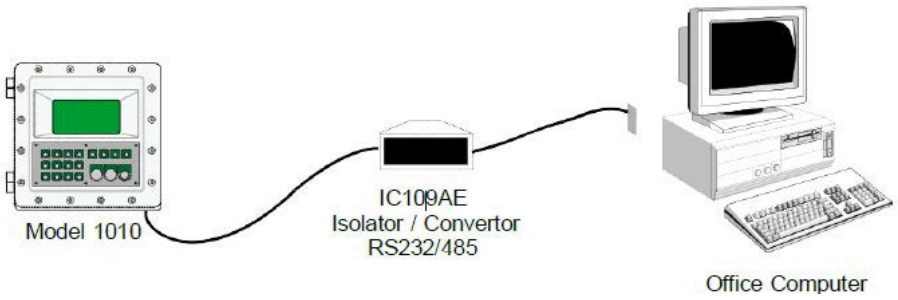
Figure 22-1: Computer Communication



For installations with more than 8 instruments, it is possible to multi- drop each RS485 line to multiple instruments. However, multi-dropping should only be done between instruments that are relatively close, to avoid ground loop problems.

Where only a single instrument is installed, a single channel isolator/ converter such as a Black Box IC109AE may be installed as shown in the following figure.

Figure 22-2: Single 1010 to Host Computer



Note that on RS485 links, an external terminating resistor must be used. This must be connected at the furthest point from the transmitting device. Only one termination resistor is required per line, even if multiple instruments are connected across the line.

The termination resistors need to have the same impedance as the line and for most twisted pairs, this is 120 ohms.

The purpose of the resistors is to prevent signals going back up the line and causing unreliable communications. The effect is much like sound hitting a wall and being reflected back as an echo.

As an aid to commissioning the system, the instrument has test facilities to enable characters to be transmitted and received.

23 Recipe

Recipe is an entity that describes an end product in terms of its primary products, additive quantity, and target blend percentage. Use the recipe sub-menu to set the number, name, amount of additive and blend percentage associated with the selected loading arm. The following parameters can be configured for the selected recipe:

- Associated Loading Arm—The Associated Loading Arm parameter selects the loading arm that this recipe will be associated with. For example, if arm 1 is selected then the recipe will only be avail- able for loading carried out on load arm 1.
- Target Blend Percentage—This parameter determines the ratio of the blend product to the base product. The ratio is expressed as a percentage of the blend component. For example if this parameter is set to 10.0%, the final product will be composed of 10% of the blend product and 90% of the base product.

  If straight loading of the base product is required then enter 0% to obtain 100% of the base product. This parameter is available only for the blending type arm.

  Pre Blend Vol. % of Preset This parameter assigns the pre-blend volume of the base product. This prompt is only available if the blend percentage is greater than zero Post Blend Vol. % of Preset This parameter assigns the post-blend volume of the base product. This prompt is only available if the blend percentage is greater than zero.
- Injection Quantity—This parameter assigns the amount of additive to be injected in ppm (for volume pre- sets) or per injection quantity in ml/cc (for mass presets).

  For the volume presets the amount of additive to inject per cycle is calculated before the load starts and is based on the batch size and pacing rate (how many injections will occur). This prompt is only available if the associated loading arm is configured for additive injection.

Additive injection can be controlled using the instrument's available meters (internal additive). Use the "Additive Lines" sub menu to set up the operating parameters of the additive system.

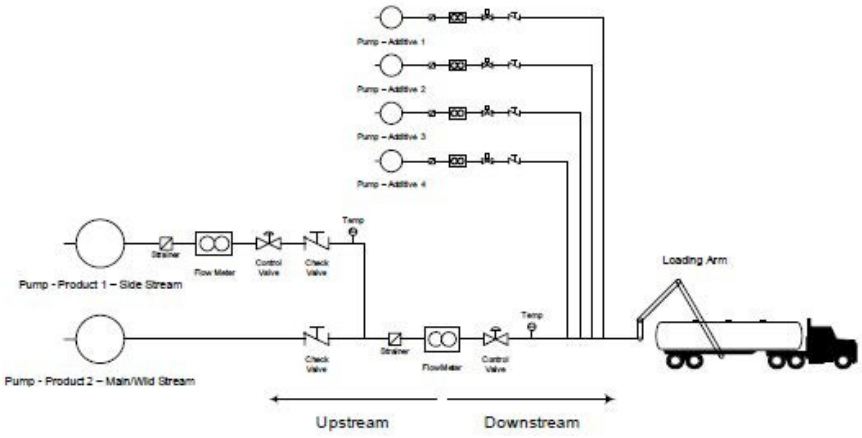
- Additive Flush Volume—This parameter assigns the additive flush volume for the recipe. This quantity is usually equivalent to the volume of the loading arm measured from the injection point on the associated loading arm plus a small amount to allow a margin of error in the volume calculation.

  This is only needed for additives. This prompt is only available if the associated loading arm is configured for additive injection.

24 Blending

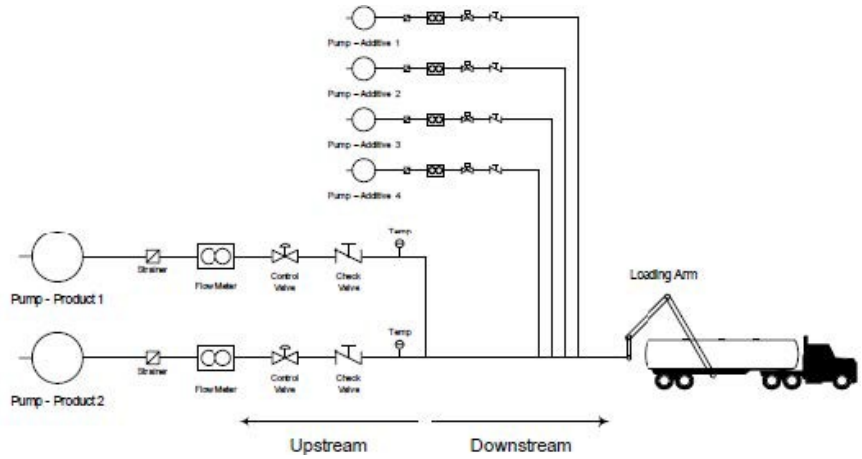
This instrument can perform Side Stream Blending of two product streams. Alternatively this instrument can perform ratio blending of two product streams.

- Side Stream Blending—Side Stream blending is a form of two-product stream ratio blending, where the products are loaded simultaneously into a vessel. This is usually done via a single loading arm into a truck compartment.



The process involves a main or wild product stream and a minor blend product stream. The minor of the two products is metered and controlled by a valve. The main product is free-flowing or wild. The blended product streams are metered and controlled downstream from where the two products merge.

- Ratio Blending—Ratio blending is the process of loading multiple products into a vessel simultaneously. This is usually done via a single loading arm into a truck compartment.



All product streams that make up the loading arm have their own dedicated flow meter, pump, and control valve. Only digital valves are used for ratio blending—two-stage valves are not used.

25 Internal Additive

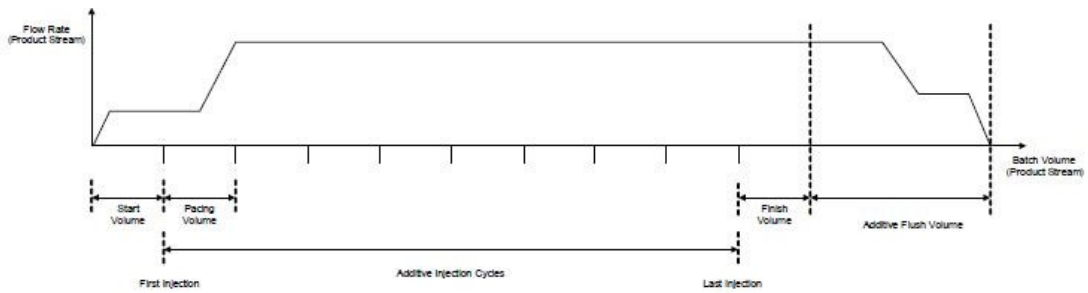
Internal additive injection feature will use the pulse inputs available on the instrument to meter the additive product. The additive will be injected in pace with main product flow which means that additive injection occurs after an interval of configured pacing volume till the end of the batch. Either an internal recipe or a recipe downloaded to the 1010CB during load scheduling mode controls the rate of additive being injected into the product stream.

When the instrument determines that an additive cycle is required, it opens the solenoid control valve and injects a small quantity of additive into the product stream. Once the amount of additive has been reached for that cycle, the solenoid valve is closed and the instrument waits until the next additive cycle is required. The additive injection cycle repeats in this manner which keeps the additive synchronised with the product flow.

- Cyclic Additive Injection—Once a recipe is selected a check is performed to determine if there is additive to be injected during the current batch. If so, the internal additive is configured based on the following information:
  - The amount of additive required (from the recipe, given in ppm)
  - Flush quantity
  - Pacing quantity
  - Preset quantity

  This information is used to calculate the additive amount per injection and the number of injections required. This is then used during the batch.

  The following illustration is an example of cyclic additive injection.



- Additive Flush Volume—This is the quantity before end of the batch preset that will be free of contaminating additives.
- Pacing Quantity—The Pacing Quantity is the amount of product between each injection cycle.
- Injection Compensation—During the cyclic additive injection the instrument monitors and compensates for the situation where the actual total additive injected exceeds or trails the calculated total additive.
- Calibration—Calibration of the additive system is aided by the ability of the instrument to perform test injections or additive meter proving. The instrument provides the capability to set a predetermined quantity that is injected once.

26 LNG Loading Application

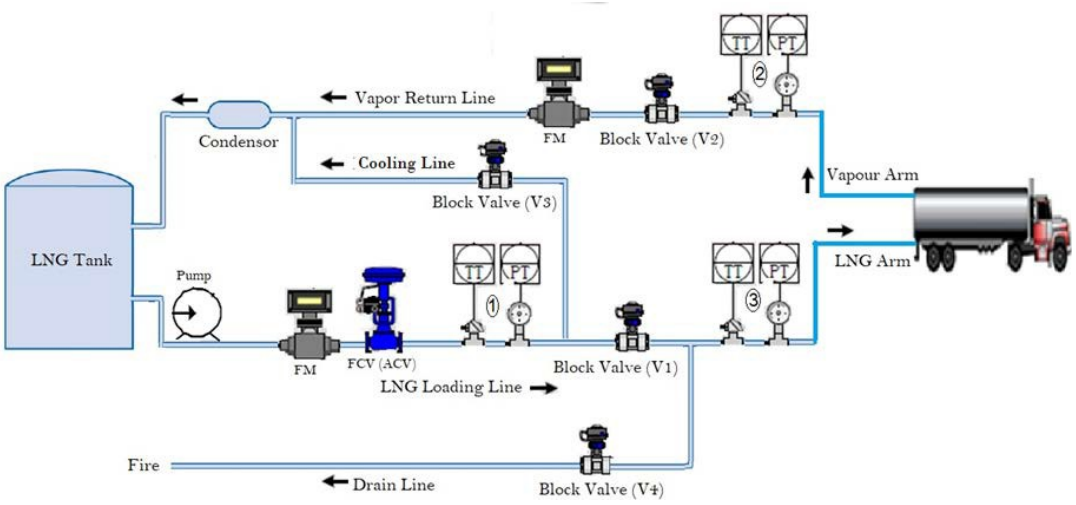
26.1 Description

Liquefied natural gas (LNG) is natural gas (predominantly methane (CH4) with some mixture of ethane (C2H6). It is use for energy and power generation.

LNG is very low boiling point and vaporized very quick quickly, so stored and transport in highly cooled cryogenic vessel and maintain about - 1620C temperature.

26.2 Operation

Typical flow profile is as follows:



Instrument carried out following operation for LNG loading

- Release Truck Pressure
- Cooling Cycle
- Loading Mode
- Draining

26.2.1 Truck Pressure Release

When truck comes to the loading bay area, if truck pressure is high, driver press '9' key for 5 seconds to open vapour isolation valve (V2). Device display "PRESSURE RELESE ACTIVE".

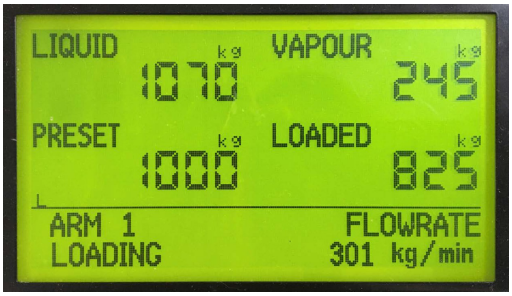
Again press '9' key to close the vapour isolation valve (V2).

26.2.2 Cooling Cycle

Cooling cycle is to maintain proper cooling state to loading skids for better measurement. In this state, LNG re-circulate from tank to tank via loading skid.

26.2.3 Loading Cycle

This is the normal loading cycle start for slow flow, full flow and then followed by low flow state. In loading, loaded quantity is the actual quantity loaded in the truck i.e. subtraction of vapor quantity from the liquid quantity. The batch will get closed when loaded quantity reached the preset quantity.



26.2.4 Draining

In idle state the drain valve (V4) always active to drain the loading arm.

26.2.5 Isolation Valves Operation

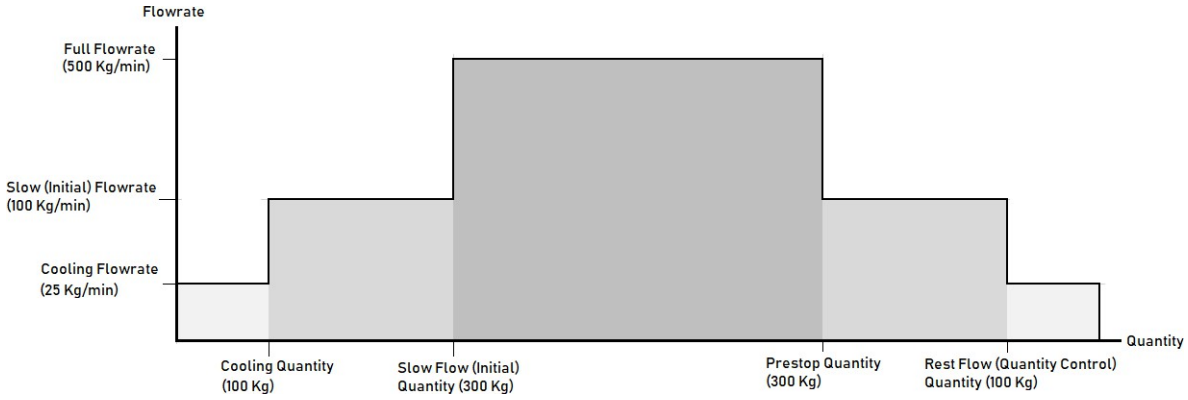
Isolation valve operate as per below truth table.

Loading Sequence	Flow Control Valve (FCV)	Liquid (V1)	Vapour (V2)	Cooling (V3)	Drain (V4)	Description
Idle	0%	OFF	OFF	OFF	ON	Keep drain line ON during idle condition to clear loading arm.
Release truck pressure	0%	OFF	ON	OFF	OFF	This is optional and operated by driver if the truck pressuer is more than 4 barg (configurable). This step is to reduce truck pressure.
Cooling Cycle	10%	OFF	OFF	ON	OFF	Cooling cycle is to maintain proper cooling state to load skids for better measurement.
Loading (Initial State)	20%	ON/OFF	ON/OFF	OFF	OFF	If PT2 > Set1, V1 - OFF, V2 - ON If PT2 < Set1, V1 - ON, V2 - ON If PT2 < Set2, V1 - ON, V2 - OFF NOTE: Set2 (3 barg) < Set1 (6 barg) V4 - OFF, if PT3 <= PT Set. Set value approx 16 bar. V4 - ON, if PT3 > PT set
Loading (Full Flow State)	100%	ON/OFF	ON/OFF	OFF	OFF	
Loading (Pre-Stop State)	20%	ON/OFF	ON/OFF	OFF	OFF	
Loading Rest Flow (Quantity Controlled) State	10%	ON/OFF	ON/OFF	OFF	OFF	

26.3 Load Profile

During loading, flow profile follows as:

- Cooling Cycle (5% of the Full Flow)
- Initial (Slow Flow) State (20% of the Full Flow)
- Full Flow State
- Prestop (Low Flow) State (20% of the Full Flow)
- Rest Flow (Quantity Controlled) Quantity (5% of the Full Flow)



27 Security Guidelines

27.1 Security Control Recommendation

Following are recommendation to prevent malicious user to access to the device and sniffing of data.

- Recommended not to connect 1010CB to the public network and recommend secured by setting up VPN.
- Use a firewall for the business network to process control network interface to restrict access from the business network to process control network.
- Set the minimum level of privilege for all accounts, and enforce a strong password policy.
- Use physical security for process control network systems
- Do not allow the use of unauthorized removable media
- Prevent the use of unauthorized laptops on the process control network
- Restrict unauthorized person near to loading bay area
- User credentials to be maintained securely
- TAS should be protected by anti-virus and patch updated

27.2 Security Guidelines

This section provides security guidelines for the instrument 1010CB.

27.2.1 Device Security Recommendations

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

- Change the default password on first use and ensure that the user passwords are changed periodically and maintained securely
- Restrict unauthorized persons near the loading bay area
- Use earth connection Interlock so that loading cannot be initiated without driver physically present

27.2.2 Network and security control Recommendations

The 1010CB provides TCP/IP communication with TAS 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 1010CB 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
- Ensure that your virus protection and Operating system security hot fixes are up to date on all systems.

- Do not connect 1010CB to the public network. Any external connections shall be secured by setting up VPN.

27.2.3 How to report a security vulnerability

For the purpose of submission, a security vulnerability is defined as a software defect or weakness that can be exploited to reduce the operational or security capabilities of the software. Guidant investigates all reports of security vulnerabilities affecting Guidant products and services.

To report a potential security vulnerability against any Guidant product, contact Guidant Support (see details in the Guidant Knowledge Base (kb.GuidantMeasurement.com).

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