Installation & Operation Manual
Fusion4 MSC-L

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CHAPTER 1 GENERAL

1.1 Product Overview

Fusion4 Multi Stream Controller - Loading (MSC-L) is a Load Computer, Batch Controller Unit (BCU) or a Preset, which is typically installed on a loading bay, at a terminal, in the petro chemical industry. The MSC-L is capable of operating in an explosion hazardous area. The MSC-L is mainly used for accurately transferring products from the storage area into another containment vessel. It takes into account the volume changes necessary for legal measurements. Apart, from loading a single product, the MSC-L also provides necessary functionality for blending products, additive injections and for loading the final products accurately, as required in the global oil storage and distribution industry.

The MSC-L controls the following:

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

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

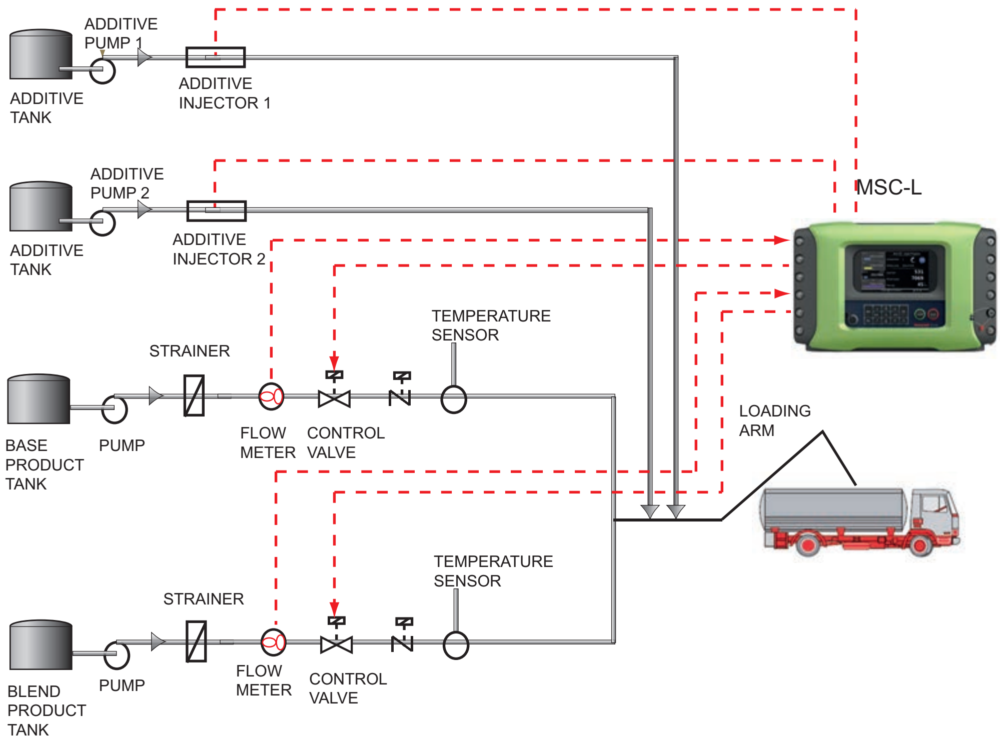


FIGURE 1-1 Basic MSC-L principle of operation (example)

NOTE: The MSC-L can control up to six loading arms simultaneously.

1.2 Functionality Overview

Functionality	MSC-L
Global Ex approvals (ATEX, FM, CSA, IECEx)	√
Expandable I/O hardware	√
Firmware in-situ upgradeable	√
Fully configurable I/O binding	√
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	10000
Alarm log records	2000
Calibration log records	1200
Event records	1000
Comms ports	7
Ethernet ports	3
Single pulse inputs	24
Pulse outputs	4
Digital inputs	36
Digital outputs	52
Analog I/O and RTDs	24

NOTE: The functionality overview lists the maximum available I/O hardware.

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-L.

This Installation and Operations manual is aligned with Fusion4Fusion4 MSC-L software version A2200.

FIGURE 1-2 Fusion4 Multi Stream Controller - Loading (MSC-L)

CHAPTER 2 SAFETY

2.1 Safety Conventions

2.1.1 Warnings

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

Symbol	Description	Remark
	General warning	It is always explained by text.

2.1.2 Cautions

The following caution symbol used in the manual recommends your attention ***to prevent damages to the equipment***.

Symbol	Description
	General caution sign
	ElectroStatic Discharge (ESD) sensitive device

2.2 Safety Instructions for the MSC-L

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-L during installation, commissioning, operation, and maintenance for the safe operation of the MSC-L.*

The MSC-L 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	*WARNING!* Do NOT open when an explosive atmosphere may be present. *CAUTION!* Seal conduit in 18 inches.	Zone 1	*WARNING!* Do NOT open when an explosive atmosphere may be present. *CAUTION!* Seal conduit in 18 inches.	Zone 1	*WARNING!* Do NOT open when an explosive atmosphere may be present.
Class 1, Division 2	*WARNING!* Do NOT open when an explosive atmosphere may be present. *CAUTION!* Seal conduit in 18 inches.	Zone 2	*WARNING!* Do NOT open when an explosive atmosphere may be present. *CAUTION!* Seal conduit in 18 inches.	Zone 2	*WARNING!* Do NOT open when an explosive atmosphere may be present.
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-L for EC declarations.

2.2.1.2 Control Drawings for FM & CSA

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

2.2.1.3 Users

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

The entire installation procedure for the MSC-L 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 Honeywell Enraf's solutions, see the back cover of this manual to contact Honeywell Enraf or its representative.

2.2.1.5 Environmental Conditions

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

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

2.2.2 Operation

After commissioning, the MSC-L 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 Honeywell Enraf, and with the knowledge of safety regulations for working in hazardous areas, must be allowed to service, maintain, assemble, and dismantle the MSC-L.

WARNING! Any repairs or part replacements must be done by a Honeywell Enraf trained service technician.

2.2.4 Personal Safety

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

Consider the weight of the MSC-L when moving, installing, or decommisioning.

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

2.2.4.1 General

2.2.4.1.1 Opening the MSC-L

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

2.2.5 Commissioning and Maintenance

NOTE: *The MSC-L 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-L 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 Honeywell Enraf 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.

2.2.5.0.1 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-L is properly bounded to the Protective Earth (PE). See FIGURE 2-1 for external grounding of the MSC-L and FIGURE 2-2 for 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-L

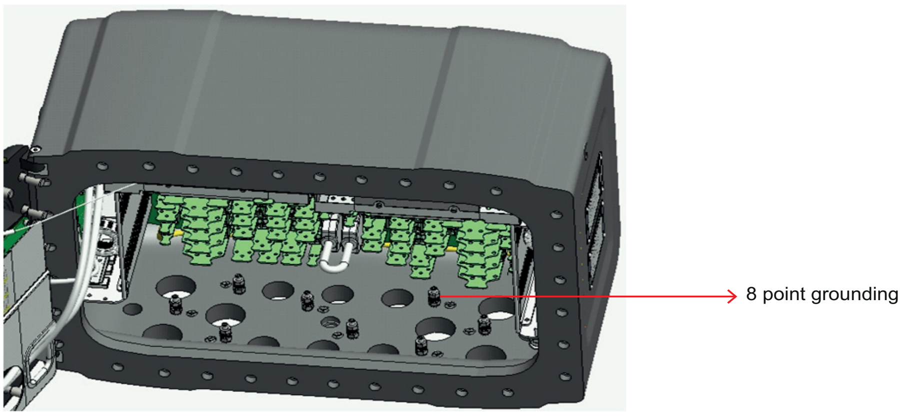


FIGURE 2-2 Internal grounding connections of the MSC-L

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_{AC}, 50 - 60 Hz	
Maximum allowed power dissipation inside the enclosure:	90 W	
LAD interface circuit (LAD front connector):	Uo = 15.75 V, Io = 1.49 A, Po = 1.92 W, Co = 2.69 µF; Lo = 62 µH	Type of protection intrinsic safety Ex ia IIB
Thermal protection, limitation of the output current	160 mA	
U_m	250 V_{AC}	

2.2.7.2 Explosion Safety

Approval	Certificate no.	Type of protection identification		
ATEX	DEKRA 12ATEX0101 X	⟨Ex⟩ II 2 G	Ex d [ia] IIB T6 Gb	
IECEx	DEK 12.0021 X	Zone 1	Ex d [ia] IIB T6 Gb	
FM	3048063	Class I, Division 1	group C, D T4	T_a = -40 °C ... +65 °C (-40 °F ... +149 °F)
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-L is suitable for the following categories.

- Pollution degree 2
- Overvoltage category II
- Class I equipment

2.2.7.4 The MSC-L Labels

NOTE: Type plates are exemplary and subject to change.

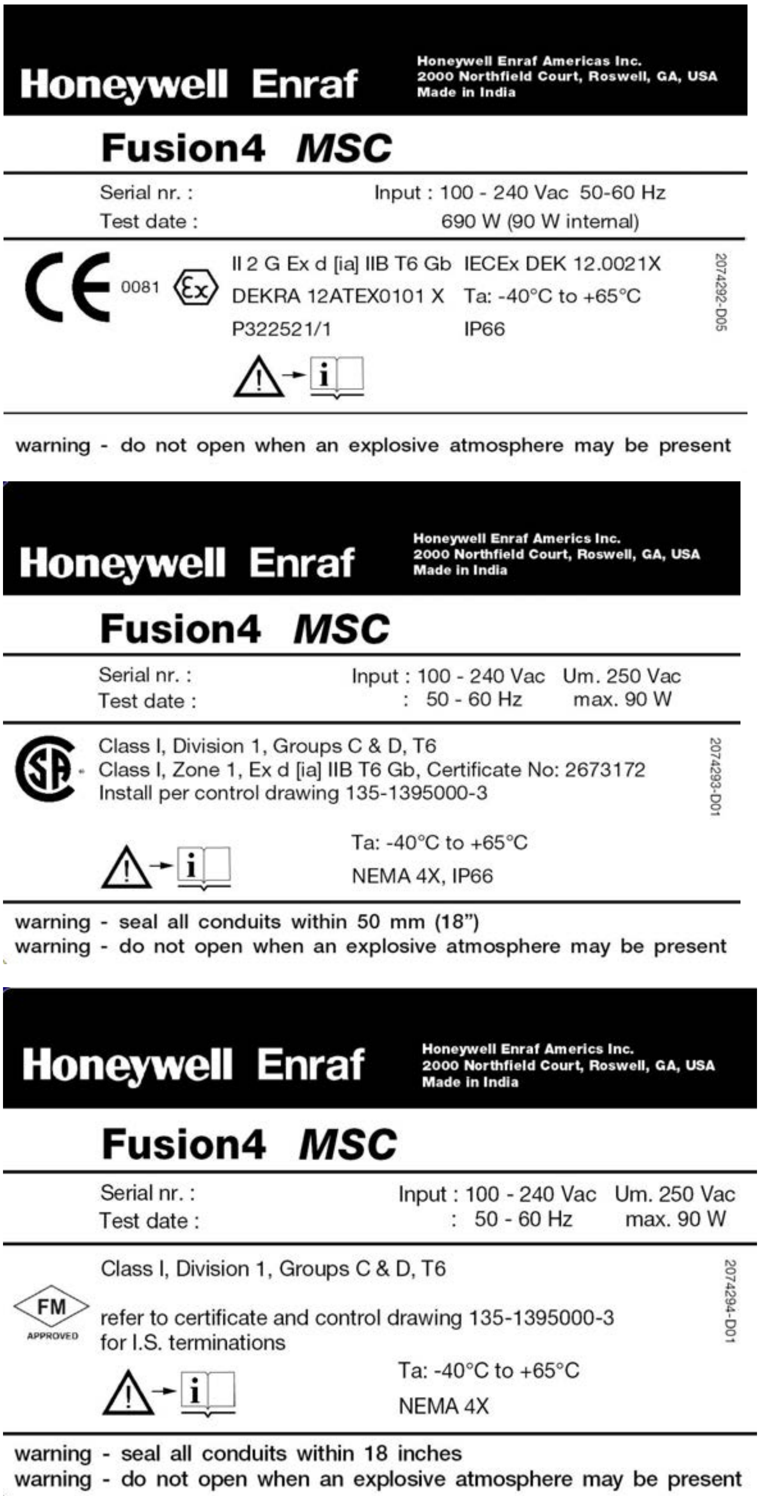


FIGURE 2-3 Identification labels with the safety note on the MSC-L

2.3 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-L 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	*WARNING!* Substitution of components may impair intrinsic safety.	Class 1, Division 1 resp. Zone 1	*WARNING!* Substitution of components may impair intrinsic safety.	Zone 1	-
Class 1, Division 2	*WARNING!* Substitution of components may impair intrinsic safety.	Class 1, Division 2 resp. Zone 2	*WARNING!* Substitution of components may impair intrinsic safety.	Zone 2	-
Safe Area	-	Safe Zone	-	Safe Zone	-

2.3.1 General

The LAD is a hand-held controller used for interfacing with the MSC-L.

WARNING! Only use the instrument for its intended purpose.

2.3.1.1 EC declaration of conformity (for EU)

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

2.3.1.2 Control Drawings for FM & CSA

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

2.3.2 Explosion Safety

Approval	Certificate no.	Type of protection identification		
ATEX	KEMA 10ATEX0152	Ex II 2 G	Ex ia IIB T4 Gb	T_a = -20 °C ... +65 °C (-4 °F ... +149 °F)
IECEx	IECEx KEM 10.0070	Zone 1		
FM	3041202	Class I, Division 1	group C, D T4	
CSA	11.2395571	Class I, Division 1	group C, D T4	
		Zone 1	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-L.
Connection of non-intrinsically safe signals invalidates the approval. The electrical data of the intrinsically safe circuits is to be taken from the certificate.

2.3.3 Commissioning

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

2.3.4 Operation

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

2.3.5 Maintenance and Troubleshooting

The LAD hardware is non-servicable, in case of damage contact Honeywell Enraf for replacement.

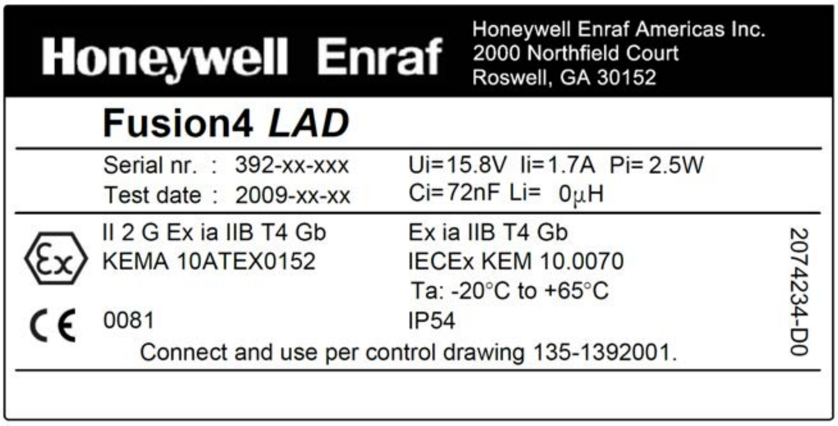
2.3.6 Additional Information

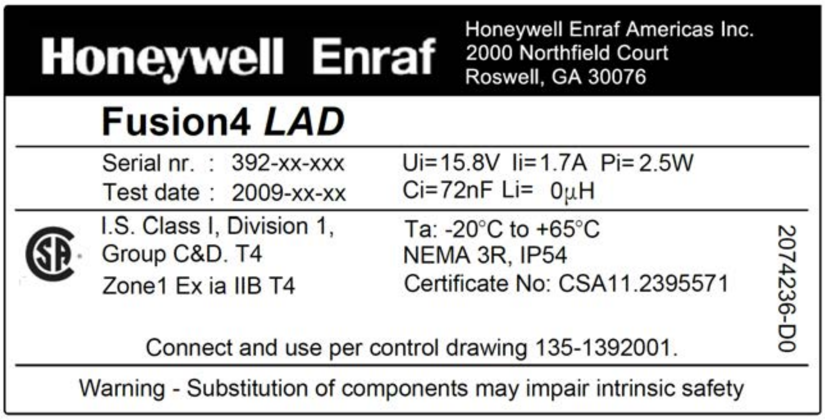
For additional information about Honeywell Enraf's solutions, see the back cover of this manual to contact Honeywell Enraf or its representative.

2.3.7 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.

2.3.8 The LAD Labels





NOTE to FM label:

Ta = -4°F to +149ºF

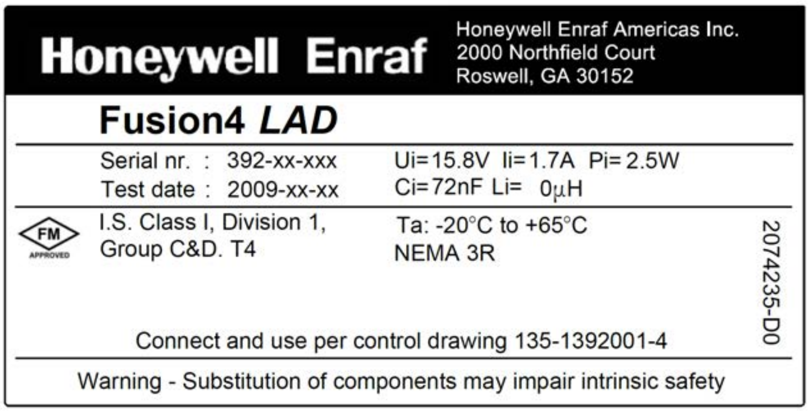


FIGURE 2-5 Identification labels with safety note on the LAD

2.4 Safety Instructions for the IR Controller

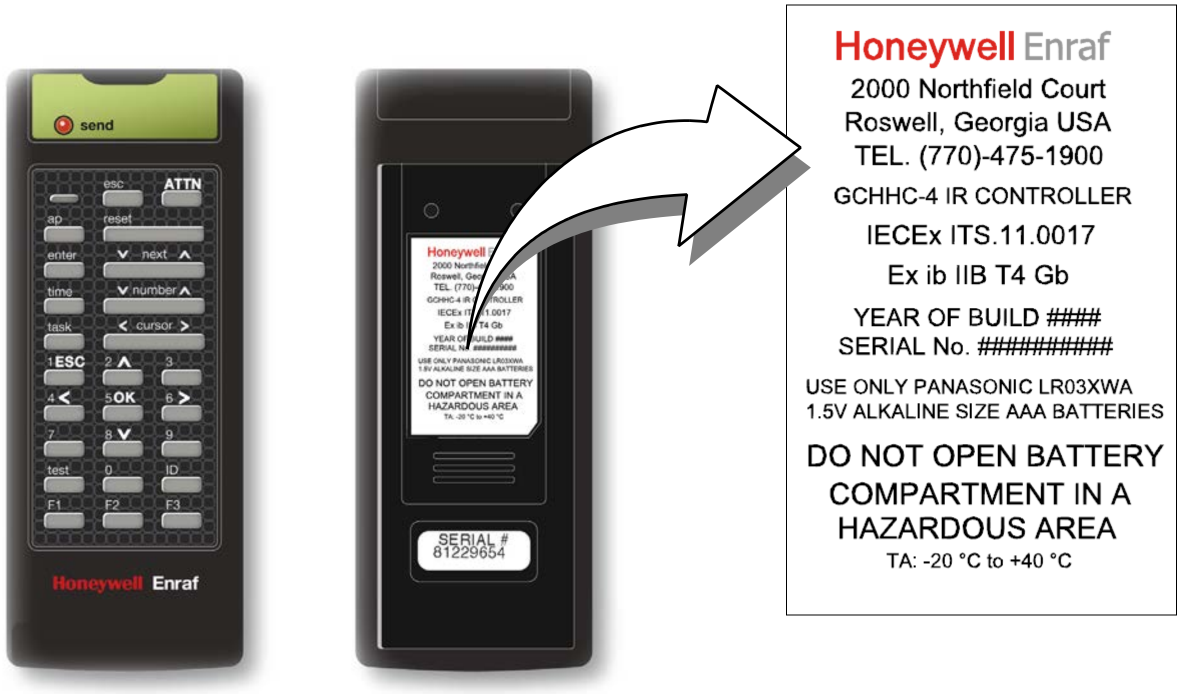


FIGURE 2-6 The IR Controller

WARNING! You must strictly follow all the safety instructions mentioned in this manual and the safety instructions shipped with the MSC-L 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	*WARNING!* Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Class 1, Division 1	*WARNING!* Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Zone 1	*WARNING!* Do not open battery compartment in a hazardous area. Use only approved batteries, see label.

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 2	*WARNING!* Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Class 1, Division 2	*WARNING!* Do not open battery compartment in a hazardous area. Use only approved batteries, see label.	Zone 2	*WARNING!* Do not open battery compartment in a hazardous area. Use only approved batteries, see label.
Safe Area	-	Safe Zone	-	Safe Zone	-

2.4.1 General

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

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

2.4.2 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.
- Handle the device gently. Do not drop the device or subject it to other types of stress.
- 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 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.

2.4.2.1 EC declaration of conformity (for EU)

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

2.4.3 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.

2.4.4 Commissioning

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

2.4.5 Operation

After connecting to a Fusion4 parent device (for example, the MSC-L), 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-L.

REMARK: Refer to the specific equipment's user's 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.

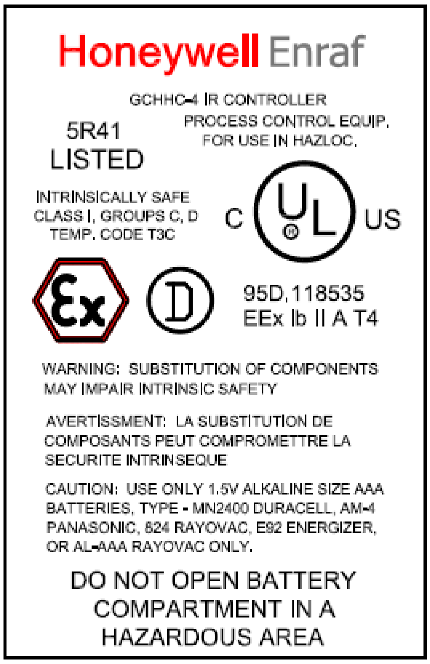
2.4.6 Maintenance and Troubleshooting

In the unlikely event of a malfunction, only a qualified service technician, trained by Honeywell Enraf, and with the knowledge of safety regulations for working in hazardous areas, must be allowed to repair the MSC-L.

2.4.7 Additional Information

For additional information about Honeywell Enraf's solutions, see the back cover of this manual to contact Honeywell Enraf or its representative.

2.4.8 IR Controller Labels



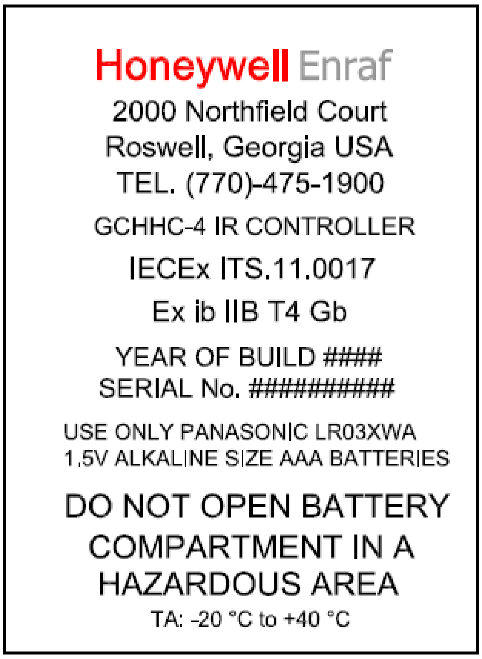


FIGURE 2-7 Identification labels with Safety note on the Fusion4 IR Controller

2.5 Liability

The information in this installation manual is the copyright property of Honeywell International Inc. Honeywell International Inc. disclaims 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. Honeywell International Inc. accepts no responsibility for any errors that may appear in this manual.

WARNING! Only certified technicians are authorized to make changes to the MSC-L configuration. All modifications must be in accordance with the guidelines as set forth by Honeywell International Inc. Modifications not authorized by Honeywell International Inc. invalidates the approval certificates.

CHAPTER 3 SYSTEM DESCRIPTION

3.1 Introduction

3.1.1 General

The main function of the MSC-L is to assist in loading the liquid products from a storage area to another containment vessel. That is, the MSC-L helps the smooth movement and accurate measurement of the liquid product being transferred. The MSC-L is also capable of creating a new composite product during the transfer operation by combining one or more different products together to form a new product. The MSC-L creates the final, required product based on a user-supplied specification, known as a Recipe.

For more information about Recipes, refer to the section *5.13.6 - Arm Configuration . Arm n . Recipes*.

The types of composite products that the MSC-L can create is limited by various physical constraints such as product piping, isolation valves, the availability of pumps, and blend valves.

The MSC-L can create composite products by combining products through one of the following methods.

- Blending - The process of combining two or more products continuously.
- Additive injection - The process of injecting small and discrete amounts of a product (an additive) into another product.

3.1.1.1 Transactions and Batches

The MSC-L uses the following terms to control and record the product transfer process.

- Transaction - A single user session during which one or more batches may be initiated. A transaction also defines the basic unit of financial reconciliation.
- Batch - Loading of a preset amount of final product into a compartment on the vehicle.

3.1.2 Batch principle

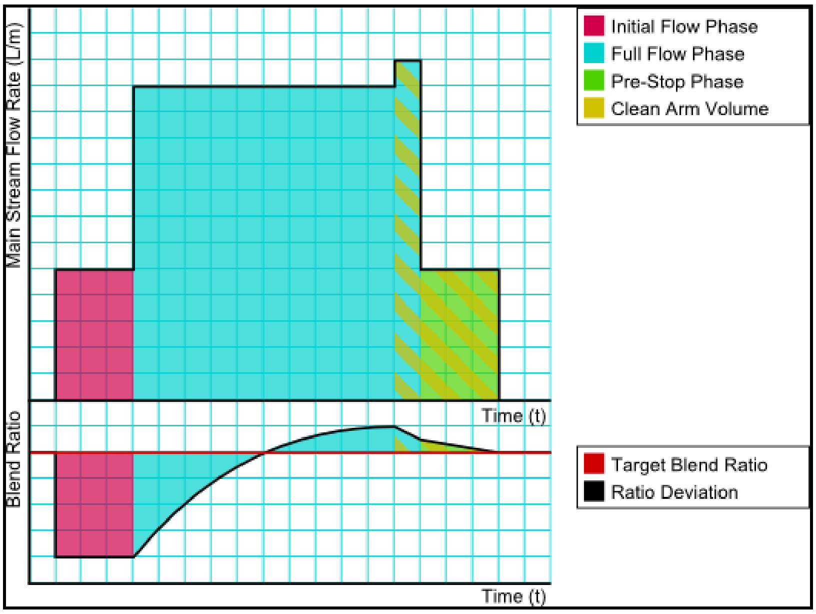
Batch is defined as the loading of a preset amount of the final product into a compartment on the vehicle. This final product may be a single product or a blended product made on-the-fly by the MSC-L. If more than one compartment is available, then more than one batch per transaction can be initiated. There are no dependencies between batches. That is, each compartment has its own independent operation. If there are more than one load arm associated with the MSC-L then multiple batches may be running simultaneously in the MSC-L.

3.1.2.1 Batch Flow Stages

Following are the four batch flow stages for the MSC-L.

- Initial Flow Phase
- Full Flow Phase
- Pre-Stop Phase
- Clean Arm Volume

The following image illustrates how the actual batch blend percentage may vary during the load based on the various configuration settings. For instance, if the initial flow rate is too small for accurate blend product measurement, then blending only starts in the Full Flow Phase. Secondly, if the clean arm functionality is configured, then the MSC-L intentionally over blends to ensure that all the required blend products are dispensed before the clean arm phase begins.



NOTE: To adequately match various specific applications, the MSC-L has a number of configurable parameters. For an explanation of all these parameters and their specific settings, see chapter 5 "OPERATION".

3.1.3 Types of Blending

The following sections describe the various types of blending supported in the MSC-L.

3.1.3.1 Straight Loading

Straight loading is a batch in which only the main product is dispensed without any additional blend products.

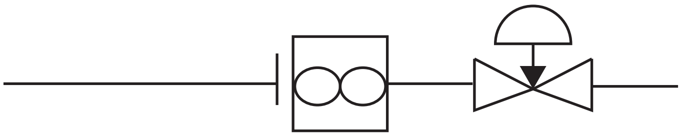


FIGURE 3-1 Straight Arm Loading

3.1.3.2 Ratio Blending

Ratio blending is a process in which the main product is blended with one or more blend products, when a batch is loaded. The amount of each product is defined by the recipe selected for the batch. Each product - main and blend(s) - must be controlled independently by its own product valve and must have its own meter.

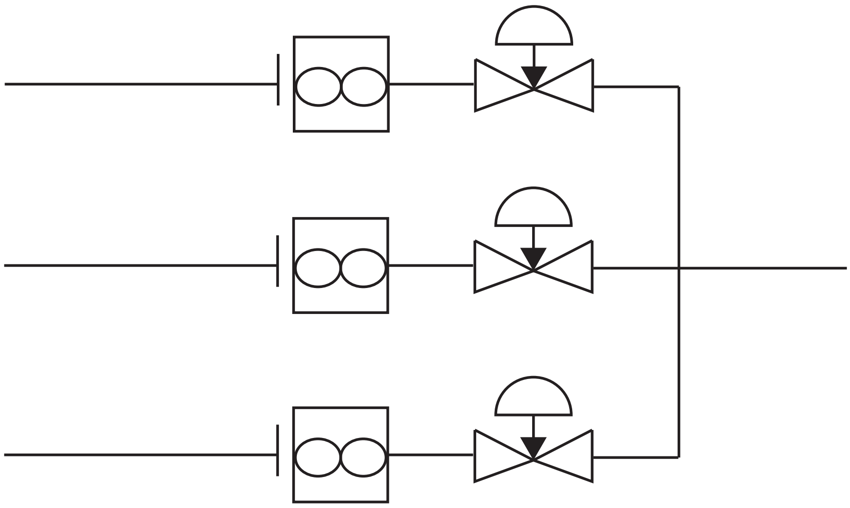


FIGURE 3-2 Ratio Blending Piping

3.1.3.3 Side Stream Blending

Side Stream blending is a batch blending where one blend product is blended into the main product. The blend product must have its own valve and meter. The combined, final, blended product must also have its own valve and meter.

In side stream blending, the main product does not have its own valve and meter. The flow rates of both the main and blend products are therefore a function of both valves.

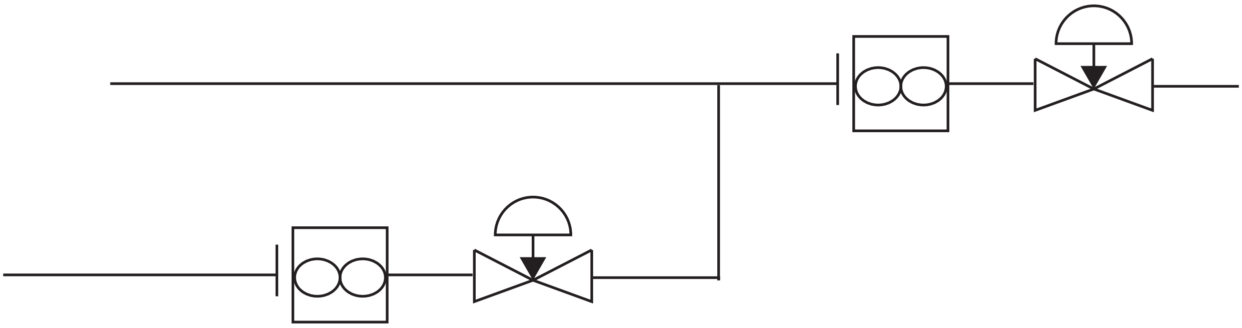


FIGURE 3-3 Side Stream Blending Piping

3.1.4 Additive Injection

Additive injection is a process in which small amounts of additives are added to the final product. The additive product is injected in pace with the product flow. That is, the additive injection occurs after an interval of configured pacing volume until the end of the batch. The recipe configured on the MSC-L controls the rate of additive being injected into the product stream.

When the MSC-L determines that an additive cycle is required, it opens the solenoid control valve and injects a small quantity of additive into the product stream. When the amount of additive is 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.

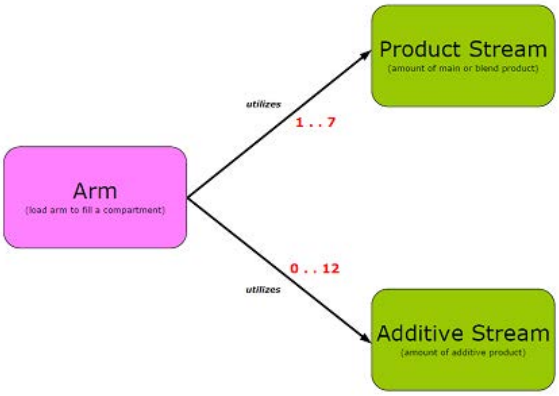
NOTE: The MSC-L assumes that the additive piping is done in such a way that additives comes in upstream (before) the custody transfer flow meter.

When the additive piping is done in such a way that additives comes in downstream (after) the custody transfer flow meter the additive is not a part of the finalized product volume but the individual additive volumes are measured and are part of the transaction record and therefore available when viewing transactions or for printing additive reports by the Fusion4 Portal.

3.1.5 Loading Principle

The loading arm of the MSC-L supports the control of the following as described in the following figure.

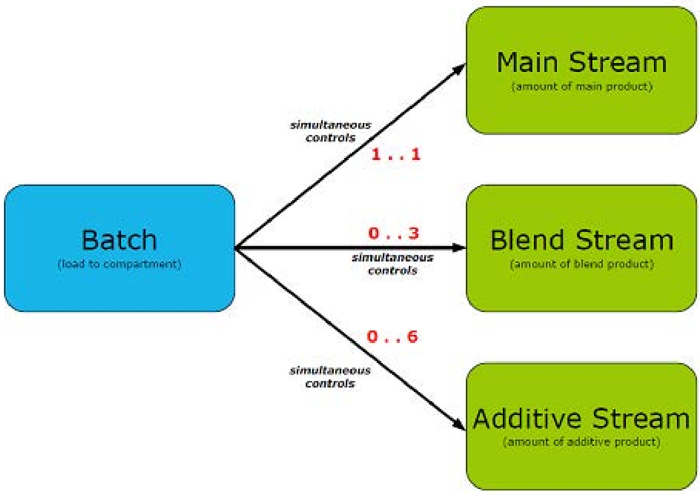
- Maximum 7 product stream
- Maximum12 additive streams



However, a single batch (load to a compartment) can only control a subset of the product streams or the additive streams.

For each batch, the MSC-L supports the control of the following, as described in the following figure.

- Stream with main product
- Maximum 3 blend streams
- Maximum 6 additive streams

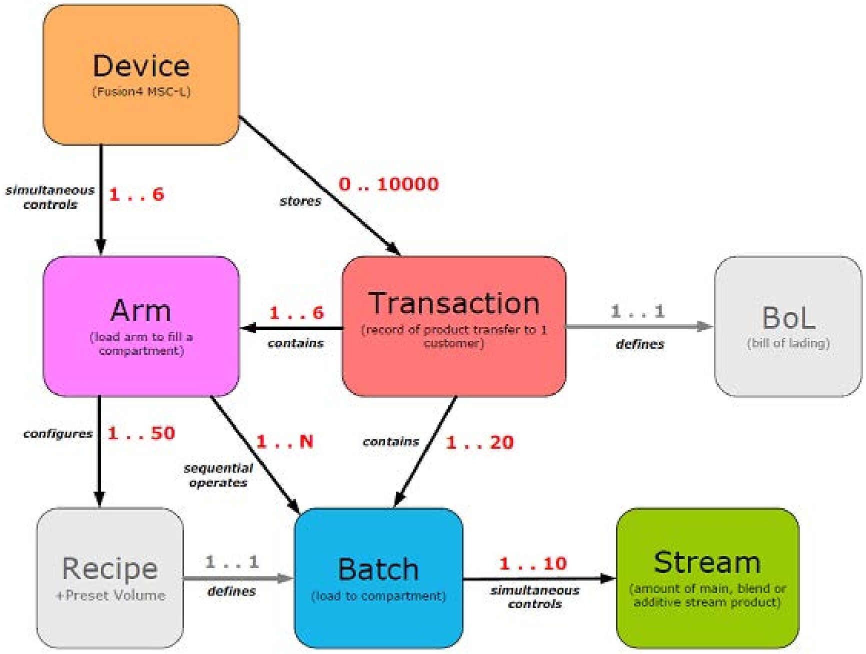


This sub set is defined by the recipes running on that arm.

3.1.5.1 Device loading capabilities

Following are the device loading capabilities, as described in the following figure.

- Maximum of 6 simultaneous loading arms are supported.
- Maximum of 50 recipes can be configured per loading arm.
- Maximum of 10,000 transactions First in First Out (FIFO) can be stored in the device.
- A transaction (record of product transfer to one customer) can be transferred to the Fusion4 Portal (transaction record) for W&M compliant BoL storage and printing.
- A transaction can contain batches loaded with maximum of 6 different loading arms.
- A transaction contains maximum of 20 batches.
- A batch simultaneous controls a maximum of 10 streams:
  - Stream with main product
  - Up to 3 blend streams
  - Up to 6 additive streams



3.1.6 Menu-based MSC-L Control

By using service tools (the LAD, the IR controller, and the integrated keyboard) the MSC-L can be controlled through its integrated and menu based interface.

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

- The RS-485 connection (through an Ex d/ Ex i connector on the front of the MSC-L) based on the LAD.
- The Fusion4 IR Controller.
- Integrated keyboard.

Using one of these devices, it is possible to navigate the menu items, 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-L 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.

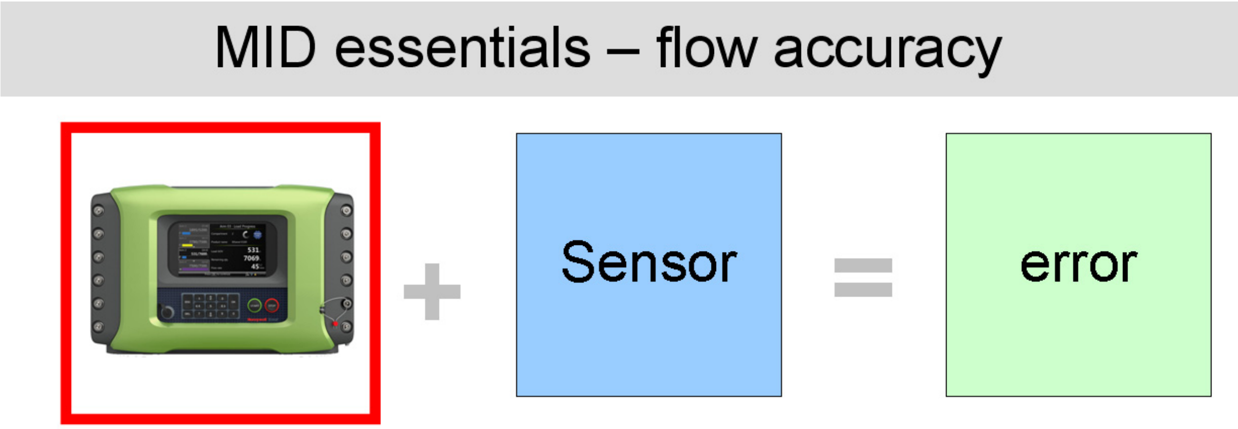
NOTE: Evaluation Certificate provides demonstration that the MSC-L as a component of an MID-compliant instrument is approved per MID and OIML requirements.

3.2.3 Component-level Requirements

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

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

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

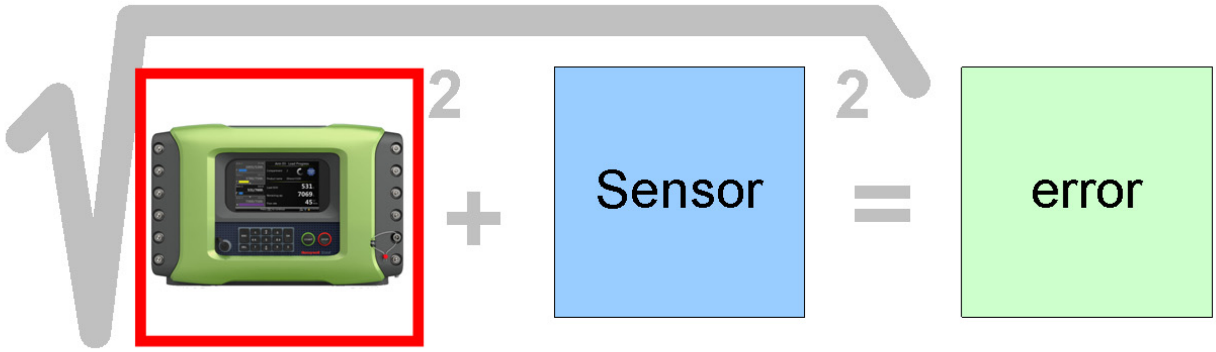


	MSC	Sensor	Total
Flow	± 0.2 %	± 0.3 %	± 0.5 %

FIGURE 3-4 Component-level requirements (flow accuracy)

In the metering line, the essential parts of the system are the flow meter, the temperature sensor, and the load controller itself. The flow meter physically measures the flow and generates pulses, which are related to the volume passed through the meter. For reliability, the pulses are dual phase shifted and are constantly checked by the electronic load controller for integrity, according to API and ISO. Through the temperature sensor (transmitter) the metered volume can be corrected to base temperature of either 15°C (60°F) or 20°C (68°F), in accordance with the ASTM standards. If a temperature transmitter is applied, then component level requirements must also have an evaluation certificate. For the temperature sensor (Pt100) it is not required.

MID essentials – T + D + P accuracy



		MSC	Sensor	Total
Temperature		± 0.3 ºC	± 0.4 ºC	± 0.5 ºC
Density		± 0.6 kg/m^3	± 0.8 kg/m^3	± 1.0 kg/m^3
Pressure	P < 1 MPa	± 30 kPa	± 40 kPa	± 50 kPa
	1 ≤ P ≤ 2 MPa	± 3 %	± 4 %	± 5 %

FIGURE 3-5 Component-level requirements (Temperature and Pressure accuracy)

The load controller evaluation is quite complex, but in principle it has to comply with the security of signal and data handling, as required by MID and working documents of WELMEC.

A very stringent requirement is the EMC standard for industrial use of electronic equipment. Electro-magnetic noise might influence the measurement of the metering signal, and this is not allowed to occur outside the maximum given accuracy.

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.

Pre-configured biofuel blending systems such as the MSC-L do exactly this. Piecing together accurately specified MID-compliant components to provide an end-to-end solution. Combining the physical measuring element with the electronic control device and associated reconciliation options such as digital storage or printing of BoLs. Each of these functions is required to operate under the concise guidelines laid out under MID and associated legislation such as OIML R117 and WELMEC.

3.2.5 The Fusion4 MSC-L

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

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

The FlexConn™ approach has enabled Honeywell to take the well-proven functionality of its additive and blending portfolio and bring all the options together as a single offering, which is configurable to suit the end you need. Subsequently, the MSC-L incorporates 12 separate devices, each providing individual functionality, and each one configurable from one single device, and selectable through a license key.

The MSC-Ls 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-L 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-L can have its transaction data securely downloaded through the *Fusion4 LAD* (Local Access Device). This allows the MSC-L 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-L 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-L is installed as per the Honeywell Enraf's proprietary FlexConn architecture. The MSC-L is a member of Fusion4 portfolio of Loading Automation and Control products.

The MSC-L 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. See *FIGURE 3-6,* for more information.

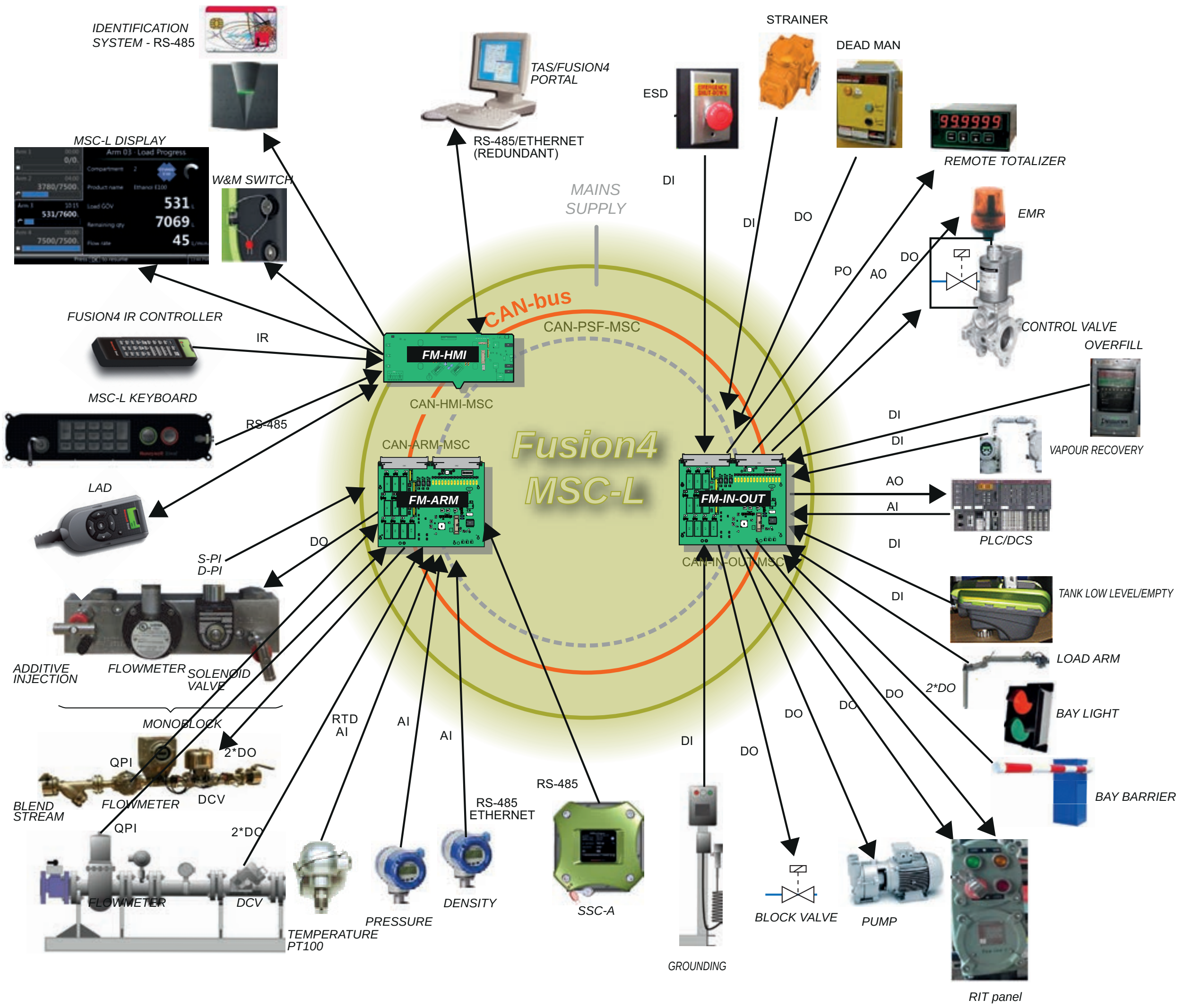


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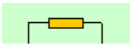
FIGURE 3-6 The Fusion4 MSC-L architecture overview

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.



= terminating resistor

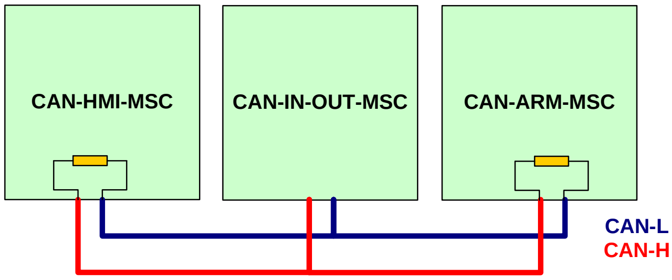


FIGURE 3-7 FlexConn CAN bus concept

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

- A sensor function - Measures or calculates a process value, or 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 an HMI.

3.5 Hardware Structure

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

3.5.1 Housing

The housing of the MSC-L 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 *FIGURE 3-7,* for more information.

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

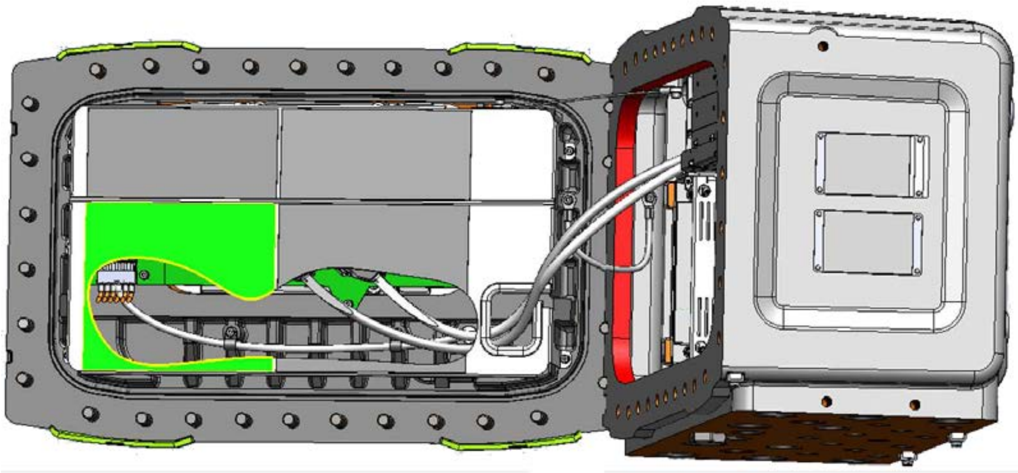


FIGURE 3-8 The MSC-L enclosure

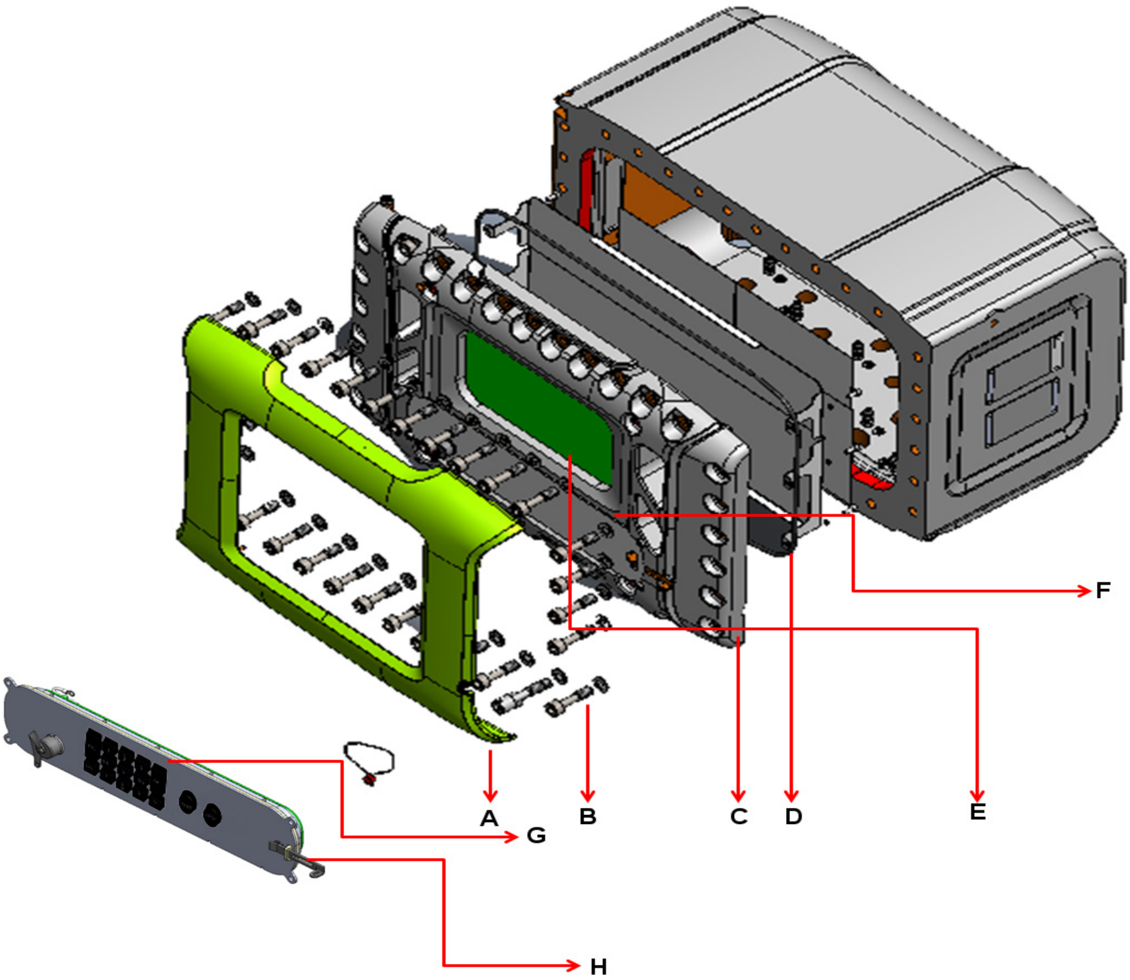


FIGURE 3-9 Housing of the MSC-L

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)
C	Lid
D	O-ring (standard available part)
E	Glass
F	Glass retainer rings (not visible in the front view of the MSC-L)
G	Keyboard
H	W&M switch

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-SHORTCUT-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-L.

- MSC-SHORTCUT-BOARD
- ARM1-BACKPLANE-MSC
- ARM2-BACKPLANE-MSC
- EX-IO-HMI-MSC-L
- CAN-PSF-MSC
- CAN-HMI-MSC
- CAN-ARM-MSC
- CAN-IN-OUT-MSC

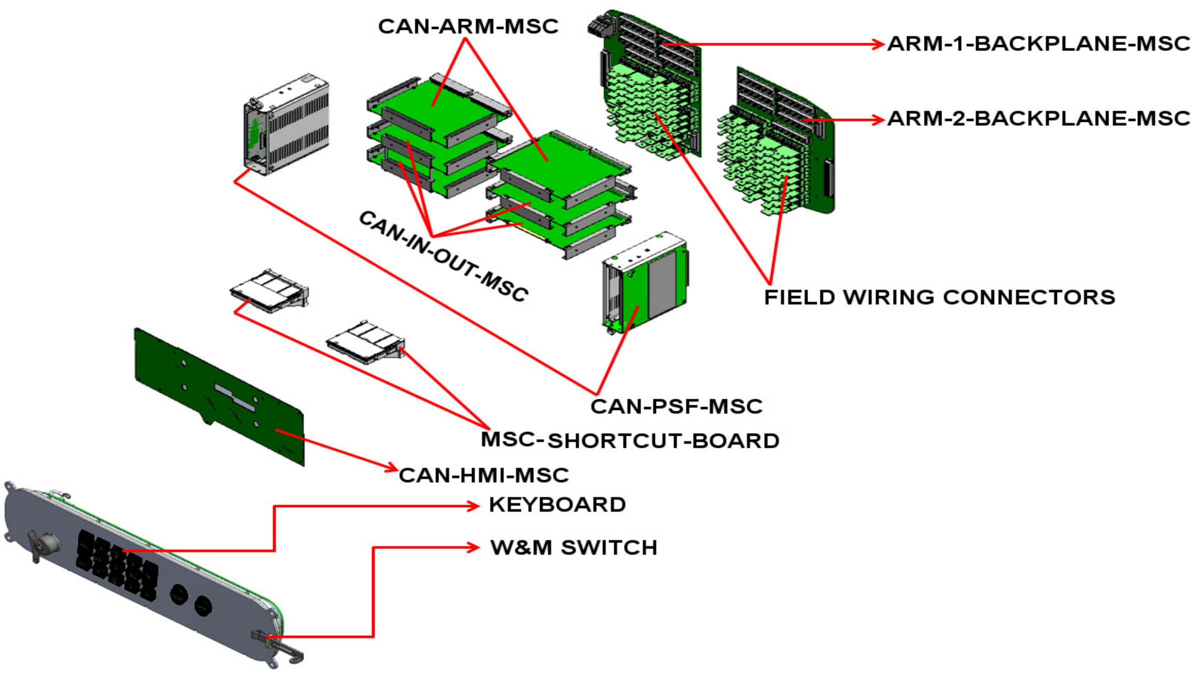


FIGURE 3-10 PCB configurations, MSC-SHORTCUT-BOARD, and the CAN-HMI-MSC

PCB name	Module[a] 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, blending, and 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-L.
MSC-SHORTCUT-BOARDS	-	Protects the internal electronics so that the high current can be withdrawn.

a. 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 FIGURE 3-11. In addition, these boards connect the GND cables, which are connected to the backplane through multiple pins of the DIN41612 F-type 48-pins connector.

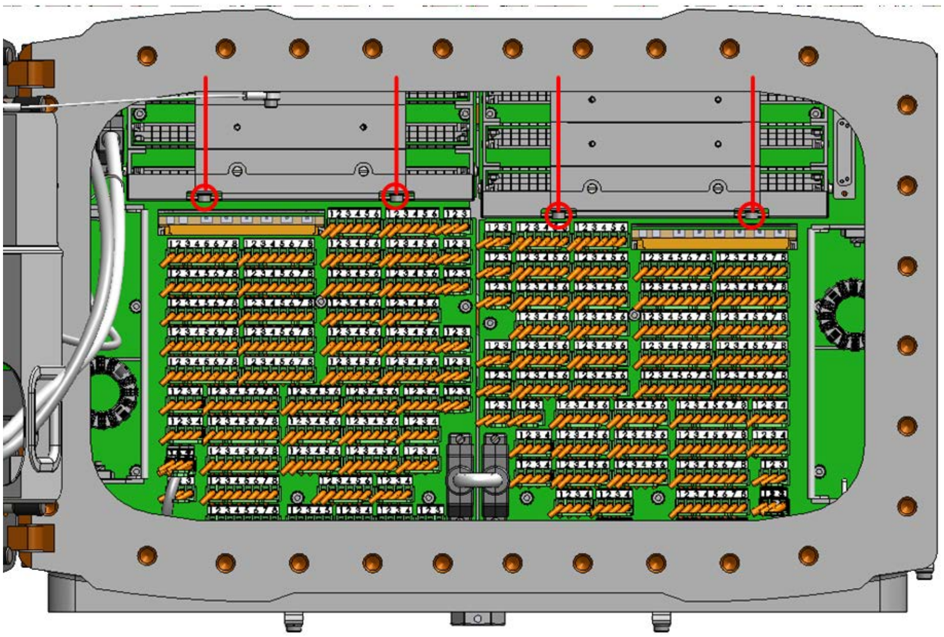


FIGURE 3-11 Mechanical grounding of CAN-ARM-MSC and CAN-IN-OUT-MSC boards

The CAN-HMI-MSC board, which is mounted on the lid of the MSC-L enclosure, connects directly to the metal housing through the nine mounting screws, as displayed in FIGURE 3-12.

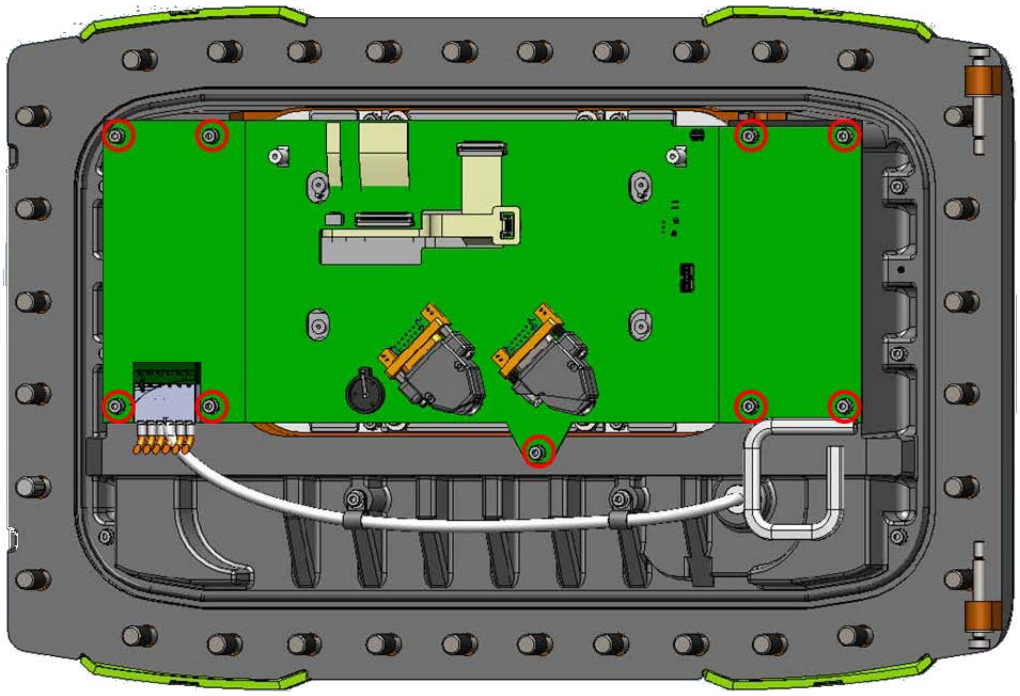


FIGURE 3-12 Mechanical grounding of CAN-HMI-MSC board

WARNING! For ensuring intrinsic safety of the MSC-L, 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.

1. Open and install the fasteners from the device using 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 Honeywell Enraf 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 FIGURE 3-13.

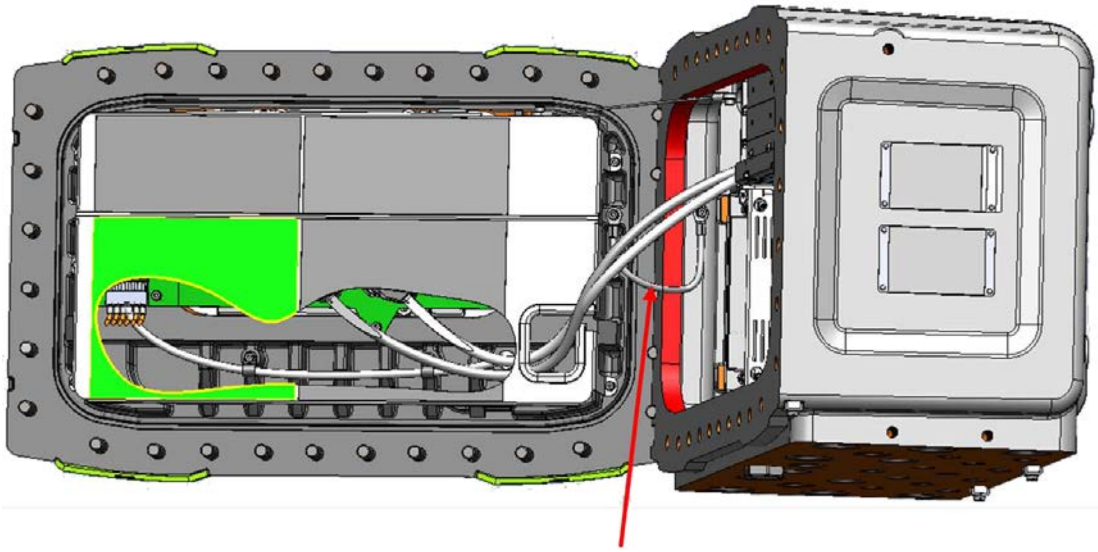


FIGURE 3-13 Cable (GND cable) used for grounding the lid of the MSC enclosure

The Protected Earth (PE) ground connections for external cables are connected to one of the nine M4 studs at the bottom, using the gland entries, as displayed in FIGURE 3-14.

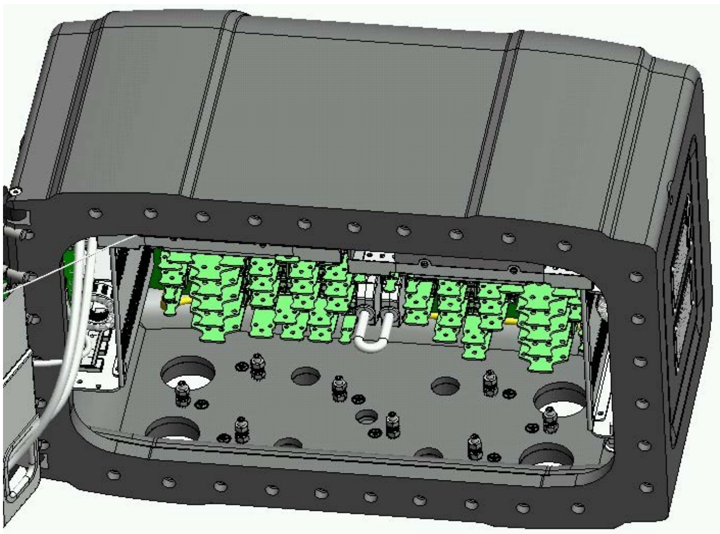


FIGURE 3-14 PE ground connections for external cables

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 the MSC-L. 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 a 8" WVGA color display in the MSC-L lid.
RTC with battery backup	Is 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-L is turned off.
Transaction storage memory	Is the 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).
Power failure memory management	Is the non-volatile memory for storage of measured values as a protection against the power failure.
HHC IR interface	Is the HHC IR interface for the Fusion4 IR Controller.
Ambient light sensor	Is the 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 microprocessor 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.

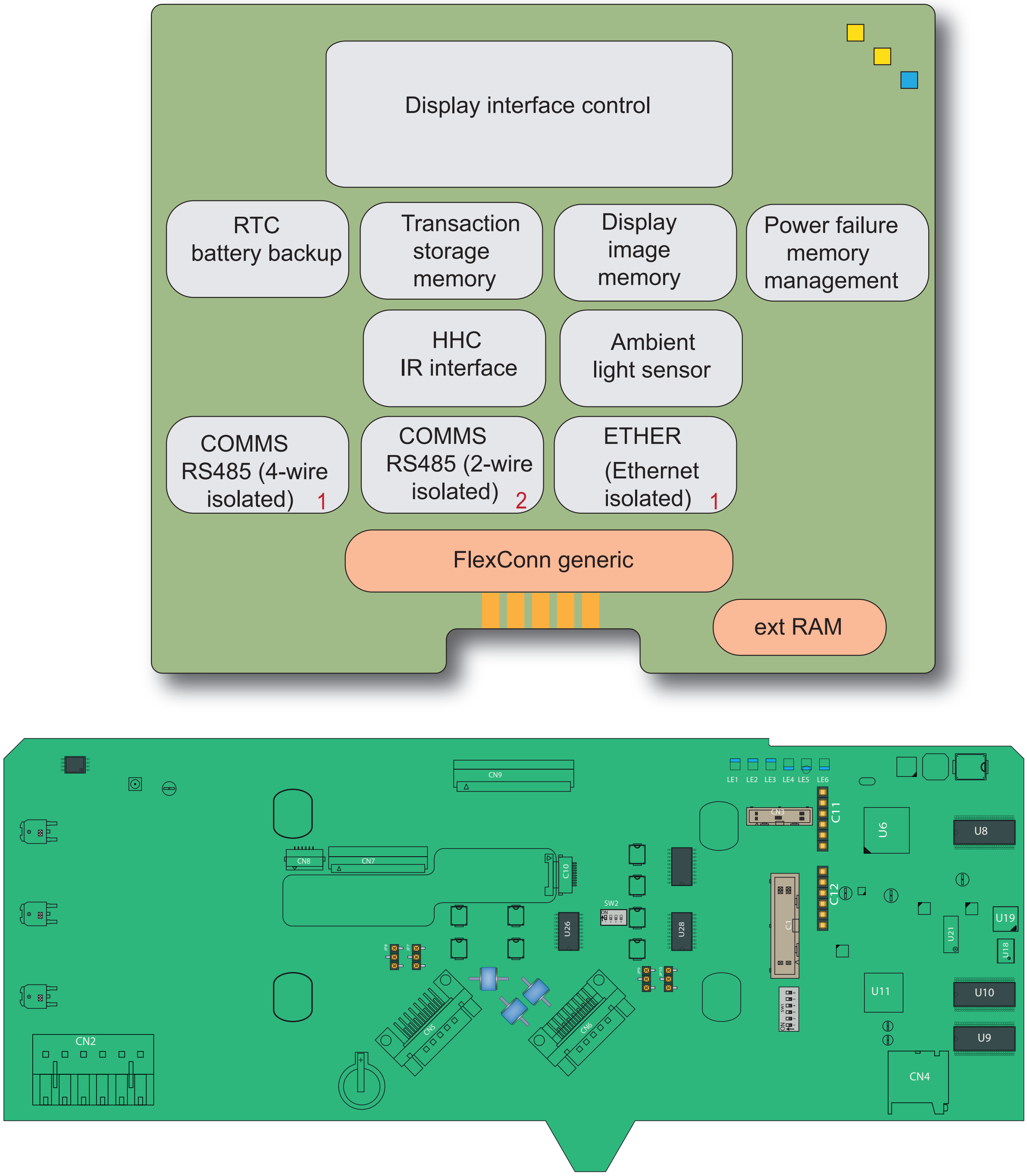


FIGURE 3-15 CAN-HMI-MSC functions (top) and physical layout (bottom)

3.6.1.1.2 Component Locations

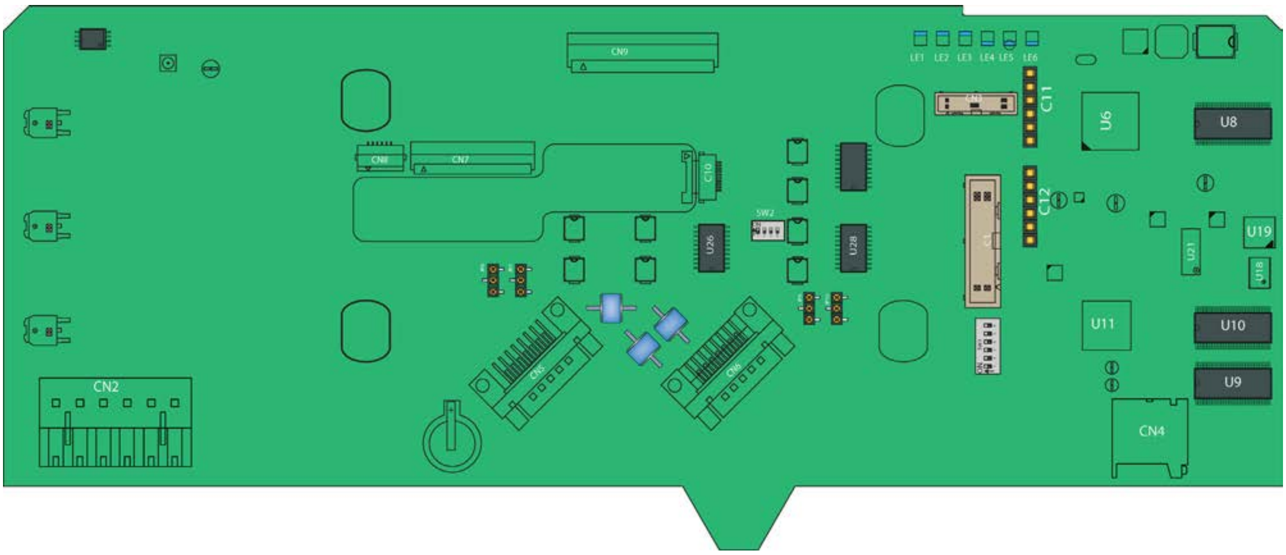


FIGURE 3-16 CAN-HMI-MSC component locations

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-L.
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	ARM controller.
U11	FPGA.
U19	Flash memory.
U1	A holder for IR receiver.
V2	Ambient light sensor.

- 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 used
S1-4	FlexConn JP4	Spare
S1-5	FlexConn JP5	Spare
S1-6	FlexConn JP6	CAN bus termination

- S2 - RS485 CH5 mode selection

Reference	Setting	Function	Description
S2-1	ON	2-wire interface	2-wire RS-485 communication
S2-2	ON		
S2-3	OFF		
S2-4	OFF		
S2-5	OFF	4-wire interface	4-wire RS-485 communication
S2-6	OFF		
S2-7	ON		
S2-8	ON		

- JP7, JP8, JP9, and JP10 - Jumper for RS-485 communication terminating setting

Position	Description
S1-2 Closed	RS-485 communication with 120 Ω is terminated.
S2-3 Closed	RS-485 communication is NOT terminated.

3.6.1.2 CAN-ARM-MSC

3.6.1.2.1 Functions

The function of the CAN-ARM-MSC board is to provide the minimum I/O functions required for loading and for 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 transmitter 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-L 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.
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.

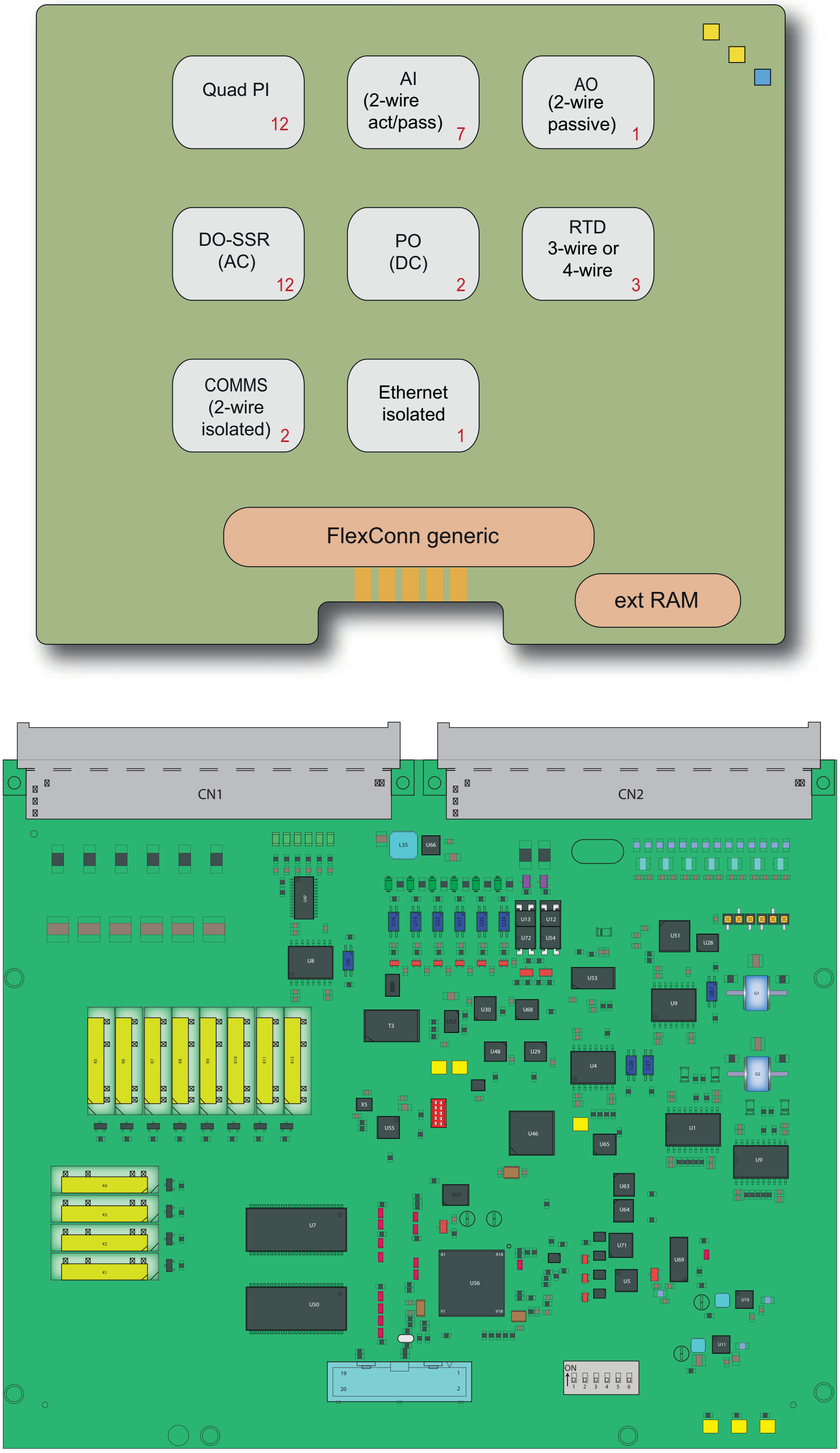


FIGURE 3-17 CAN-ARM-MSC functions (top) and physical layout (bottom)

3.6.1.2.2 *Component Locations*

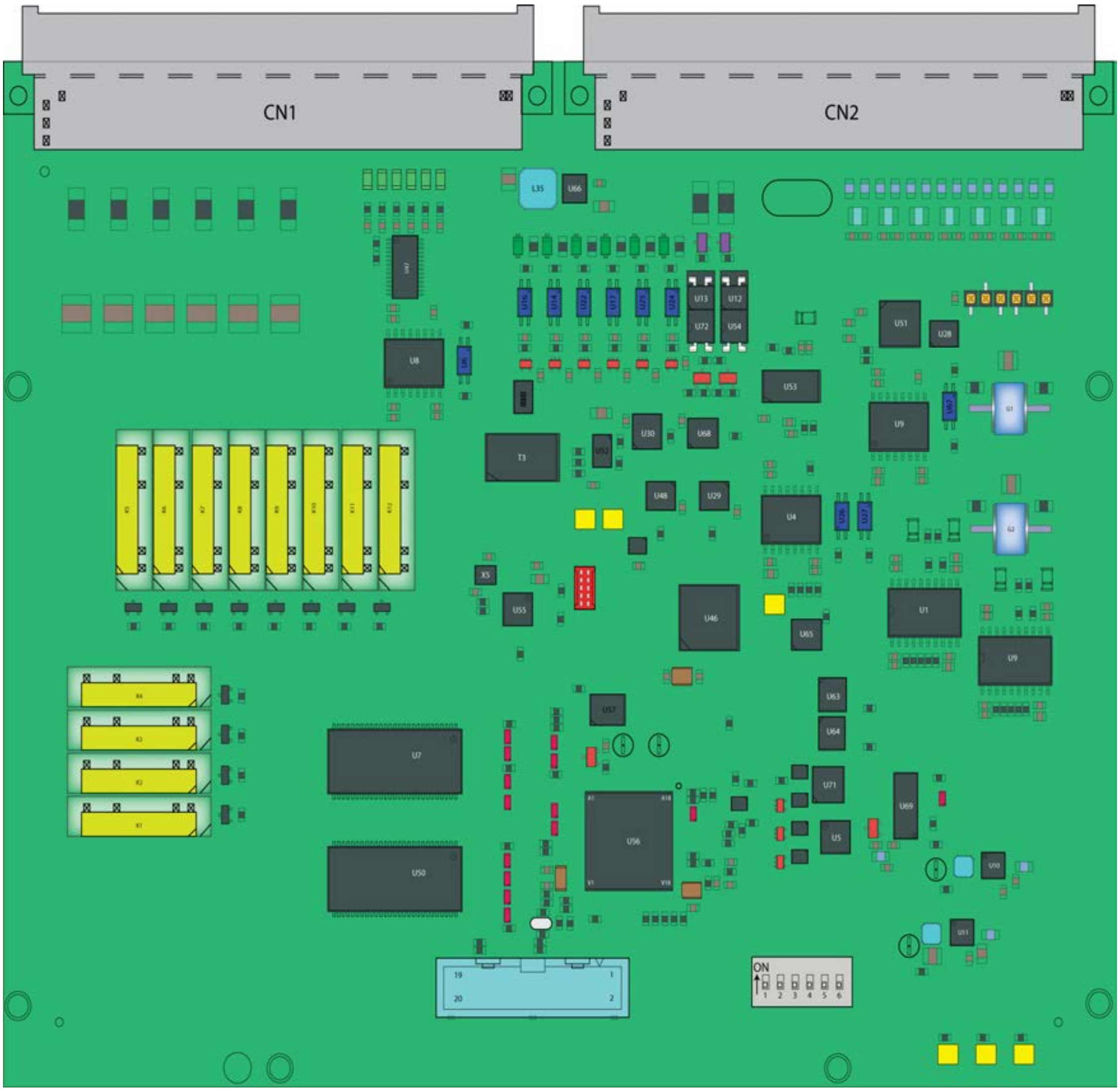


FIGURE 3-18 CAN-ARM-MSC component locations

Item reference	Description
CN1, CN2	Connectors for interfacing with the ARM1-BACKPLANE-MSC or ARM2-BACKPLANE-MSC.
CN3	Programming connector for U56 (ARM controller).
CN4	Programming connector for U46 (PI processor -Cortex M0).

- 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

Reference	Jumper name	Function when set to ON
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 JP8 - Jumper for RS communication terminating setting

Position	Description
S1-2 Closed	RS-485 communication terminated with 120 Ω.
S2-3 Closed	RS-485 communication NOT terminated.

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.
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.
4 Digital Output Solid State Relay AC/DC (DO-SSR) circuits	Converts logic signals from the FlexConn generic microcontroller to switched high power AC or DC signals.

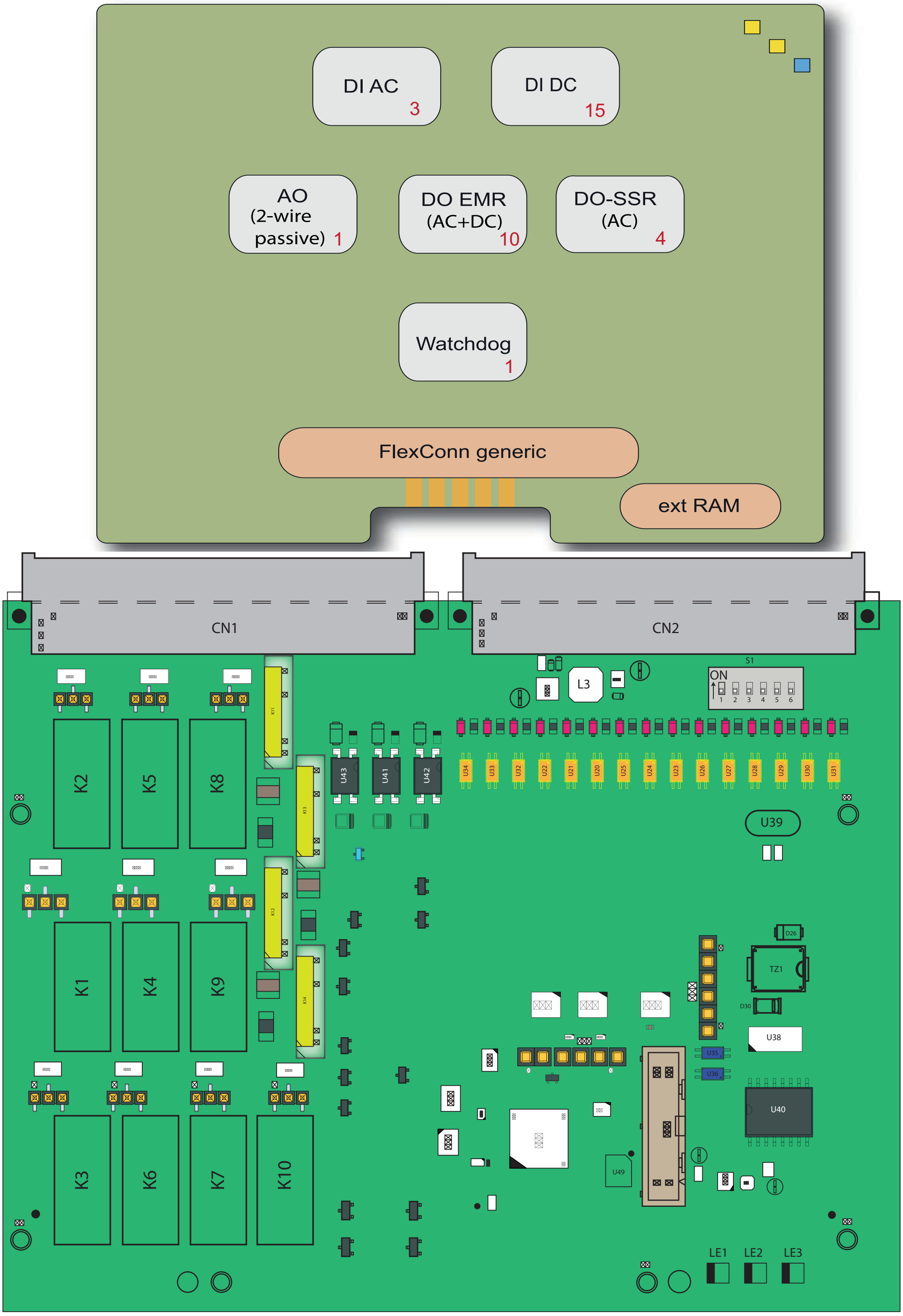


FIGURE 3-19 CAN-IN-OUT-MSC functions (top) and physical layout (bottom)

3.6.1.3.2 *Component Locations*

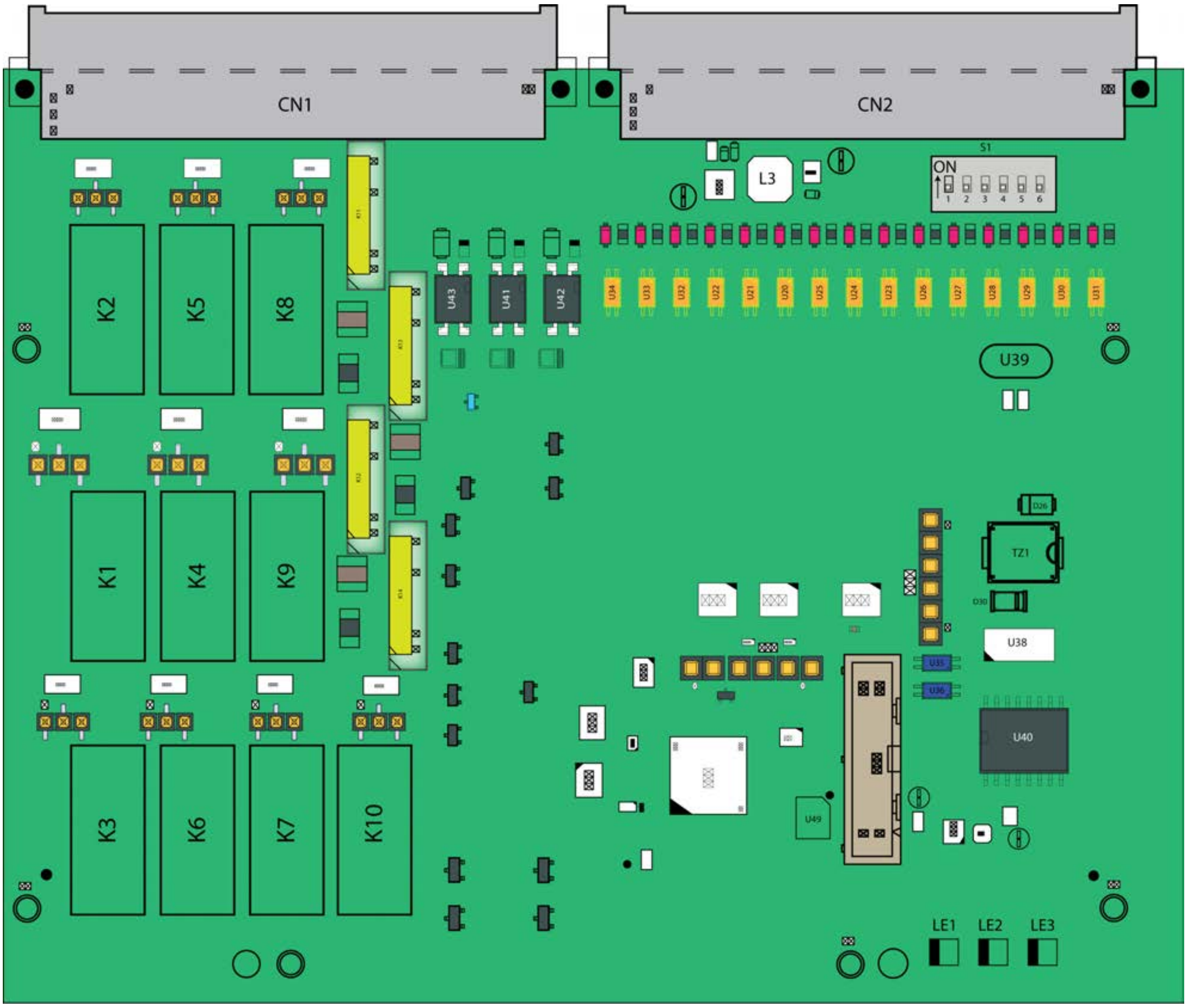


FIGURE 3-20 CAN-IN-OUT-MSC component locations

Item reference	Description
JP7 to JP16	Jumper for EMR contacts setting.
CN1, CN2	Connectors for interfacing with the ARM1-BACKPLANE-MSC or the 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	Description
NO	Relay contacts normally open.
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-L 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 FIGURE 3-21 for the functions of the MSC-L.

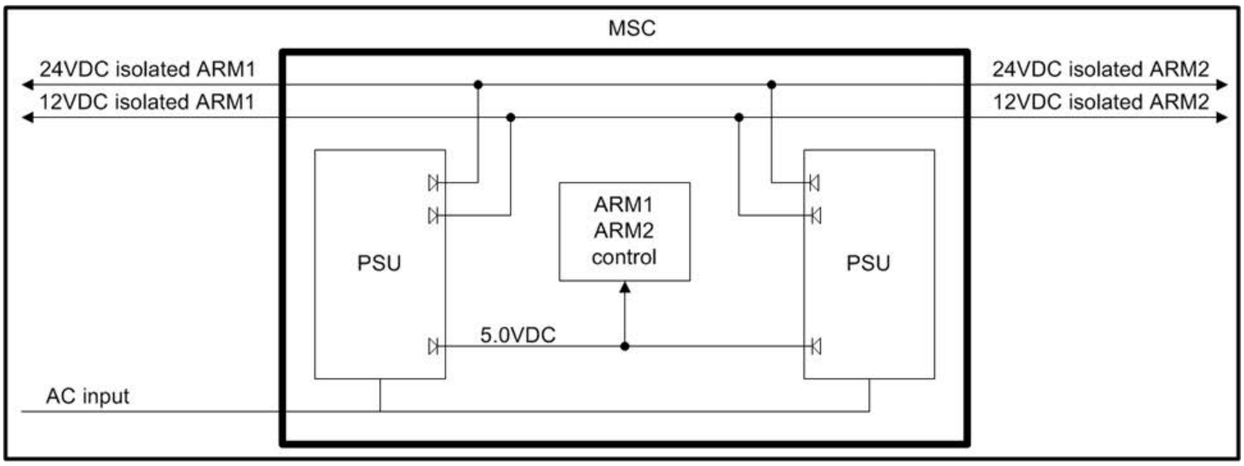


FIGURE 3-21 CAN-PSF-MSC functions

3.6.2.2 Power Board Connection

The CAN-PSF-MSC is mounted inside the MSC-L 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 FIGURE 3-22 for information regarding the mechanical specification of CAN-PSF-MSC.

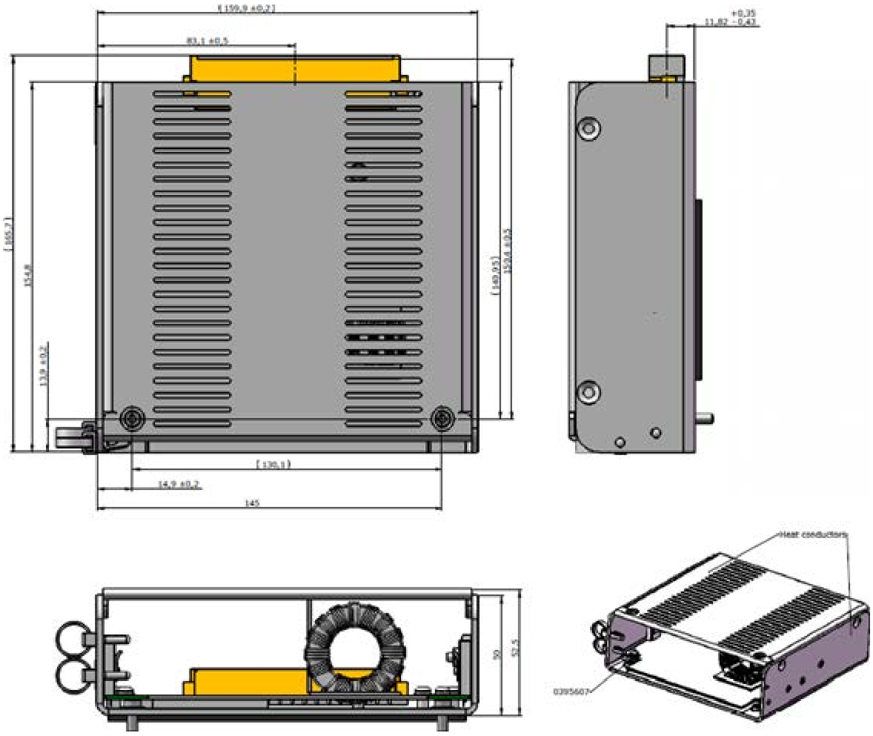


FIGURE 3-22 Mechanical specification drawings

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_{AC}
Input frequency		50	-	60	Hz
Inrush current	230 V_{AC}	-	33	37.3	A
Power Factor (at the maximum current)	115 V_{AC} 230 V_{AC}		95 90	-	%
Power consumption	-	-	-	120	W

Item	Conditions	Minimum	Typical	Maximum	Unit
Efficiency	-	80	-	-	%
Insulation voltage	AC Input to all DC outputs	2500 V	-	-	V_{AC}
Insulation voltage	AC Input to PE	2500 V	-	-	V_{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_{DC}
	DC Current	5.0 V	10.0	-	-	A
	DC OVP	-	6.25	-	7.0	V_{DC}
	Over Current Limit	-	12	-	15	A
Output 2	DC Voltage	-	11.5	12.0	12.5	V_{DC}
	DC Current	12.0 V	2.0	-	-	A
	DC OVP	-	14.0	-	15.5	V_{DC}
	Over Current Limit	-	2.2	-	3.0	A
Output 3	DC Voltage	-	23.0	24.0	25.0	V_{DC}
	DC Current	24.0 V	1.0	-	-	A
	DC OVP	-	28	-	31.0	V_{DC}
	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-SHORTCUT-BOARD

The MSC-SHORTCUT-Board is directly interfaced to the backplane of the MSC-L through the 48 pin connector. The MSC-L 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. Because the fuse is optional, 0 ohm resistor can alternatively be connected in parallel to each fuse.

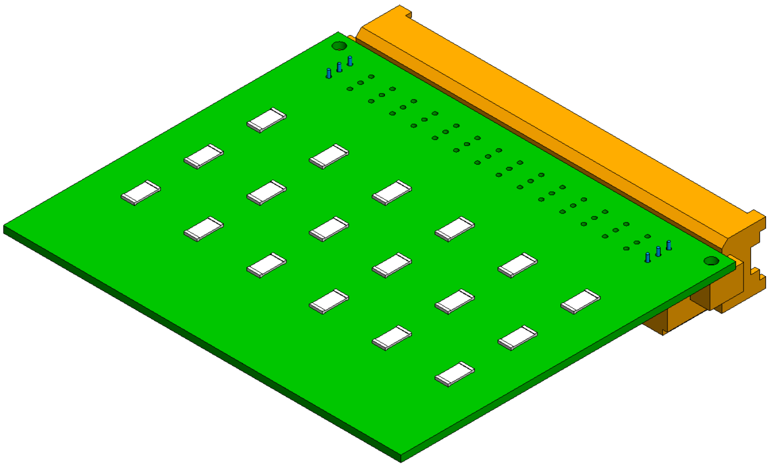


FIGURE 3-23 MSC-SHORTCUT-BOARD

3.6.3 Device Electrical Features

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

1. Internal power supply.
2. Seven microprocessor controlled modules.
3. Each I/O is galvanic isolated from the internal electronics for safety performance.
4. Backplanes (ARM-1-BACKPLANE-MSC and ARM-2 BACKPLANE-MSC) for external wiring.
5. Colored connectors on the backplane to distinguish different kinds of signals.

3.6.4 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
- Thai
- 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 for time stamping.
- Seven communication ports and three ethernet ports for interfacing with the safe area tools and systems.

3.6.5 Environment

Parameter	MSC	LAD
Operating temperature	-40 °C ... +65 °C (-40 ºF ... +149 ºF)	-20 °C ... +65 °C (-4 ºF ... +149 ºF)
Electronics designed	-40 °C ... +85 °C (-40 ºF ... +185 ºF) and RoHS[1]	-40 °C ... +85 °C (-40 ºF ... +185 ºF) and RoHS[1]
Storage temperature	-40 °C ... +85 °C (-40 ºF ... +185 ºF)	-40 °C ... +85 °C (-40 ºF ... +185 ºF)
Ingress protection	IP66 / NEMA 4X	IP54 / NEMA 3R
SD-card compartment behind lid	-	IP20

1 Restriction of Hazardous Substances.

3.7 Available Input/Output Functions of the MSC-L

The following table lists 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	3.8.2 and 3.8.3
Dual Pulse Input (Quad PI)	6	0	0	3.8.4
Analog Input (4-20mA Active/Passive)	7	0	0	3.8.5
Resistance Temperature Detector-RTD Temperature Input (3-wire or 4-wire)	3	0	0	3.8.6

I/O block	CAN-ARM-MSC	CAN-IN-OUT-MSC	CAN-HMI-MSC	Refer to section
Digital Input AC	0	3	0	3.8.7
Pulse Output DC	2	0	0	3.9.2
Analog Output (4-20 mA Passive)	1	1	0	3.9.3
Digital Output Electromagnetic Relay DC	0	3	0	3.9.4
Digital Output Electromechanical Relay AC or DC	0	7	0	3.9.5
Digital Output AC (Solid state relay)	12	4	0	3.9.6
RS-485 Communication (2-wire)	2	0	2	3.10.2
RS-485 Communication (4-wire)	0	0	1	3.10.2
Ethernet Communication	1	0	1	3.10.3

For the configuration of these I/O functions, see *chapter 5 "OPERATION".*

3.8 Input Functions

3.8.1 General

The following table lists the electronic input functions supported by the the MSC-L.

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

3.8.2 Digital Input DC (DI DC)

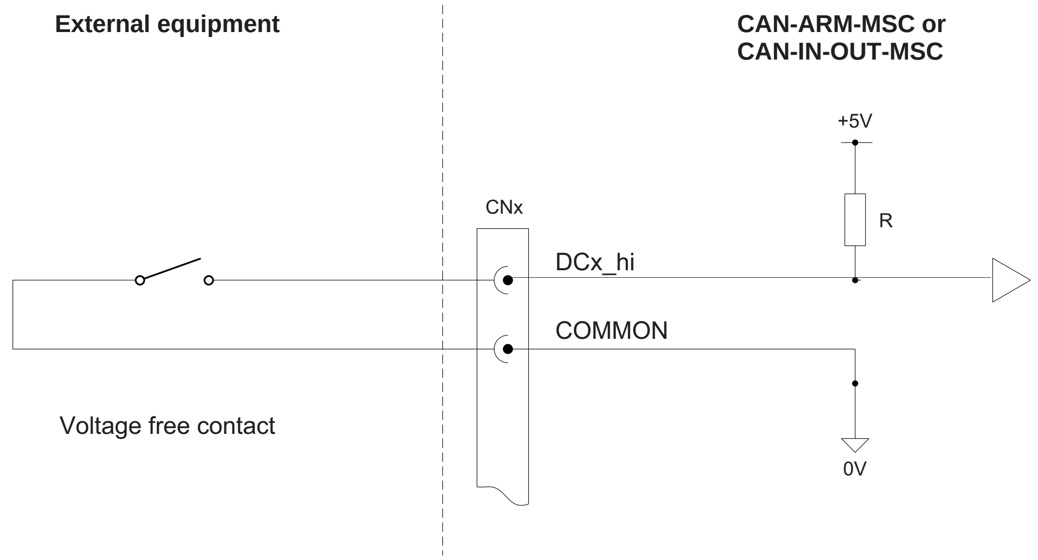
3.8.2.1 Functional Description

The function of the Digital Input DC (DI DC) is to convert the switched DC into a signal that can be used by the controller to ensure specific functionality required.

Two types of contacts are available which are as follows:

1. External DC voltage switching
2. Volt free switching

FIGURE 3-24 illustrates the simplified block diagram of the DI DC connections.



or

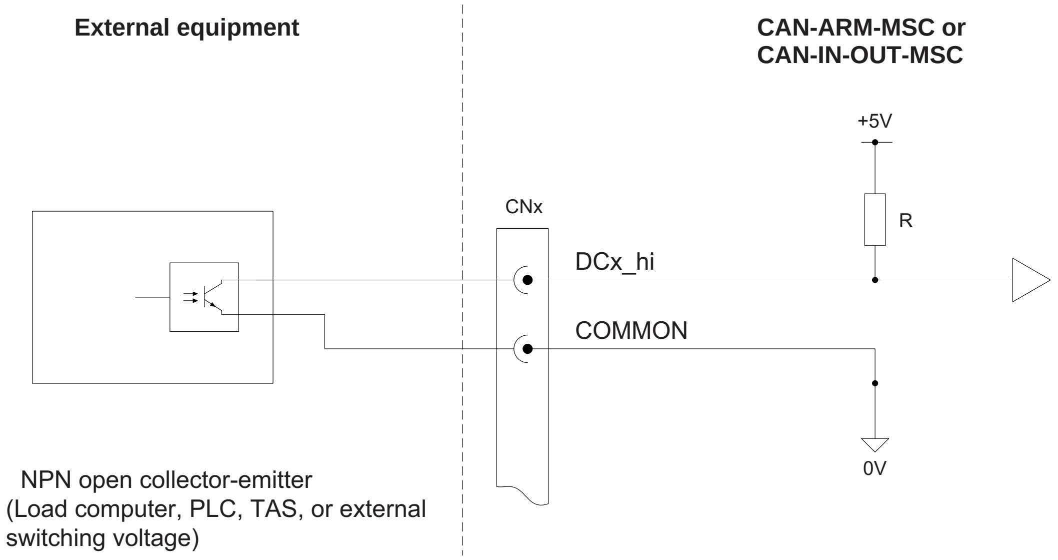


FIGURE 3-24 DI DC connections

3.8.2.2 Characteristics

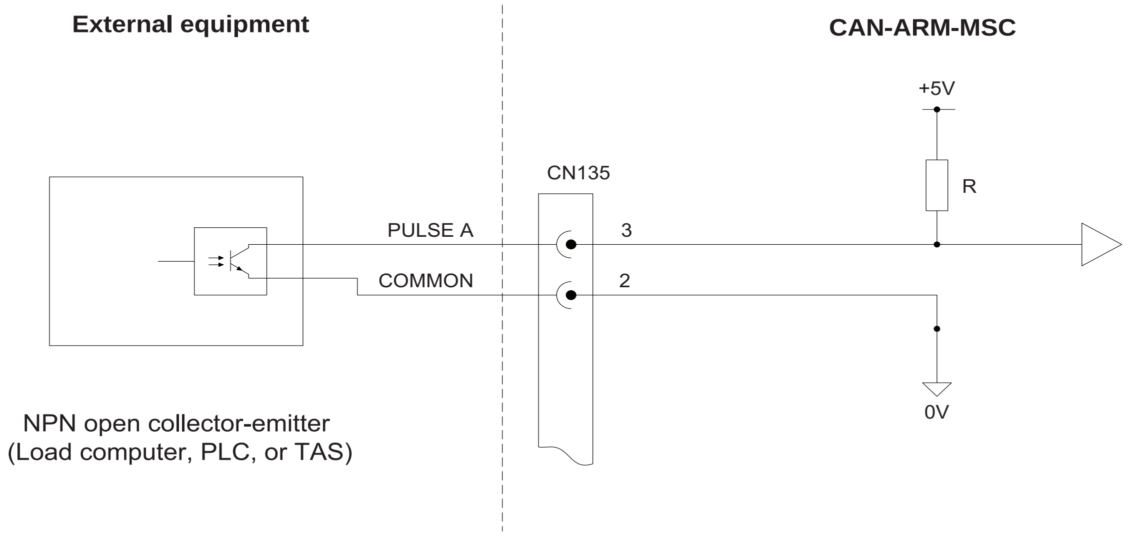
Item	Minimum	Typical	Maximum	Unit
Isolation voltage	-	-	2500	V_{AC}
Switching level V_H (External DC voltage)	5	-	30	V_{DC}
Switching level V_L (External DC voltage)	-	-	2	V_{DC}
Switching current (I_{SW})	-	-	-	mA
Input switching frequency	-	-	-	kHz
Input on time (T_{ON})	50	-	-	µs
Input off time (T_{OFF})	50	-	-	µs

3.8.3 Single Pulse Input

3.8.3.1 Functional Description

The function of the Single Pulse Input is to accept pulse signals from a product stream single pulse flowmeter or an additive stream single pulse flowmeter.

FIGURE 3-25 illustrates the simplified block diagram of the Single Pulse Input connections.



or

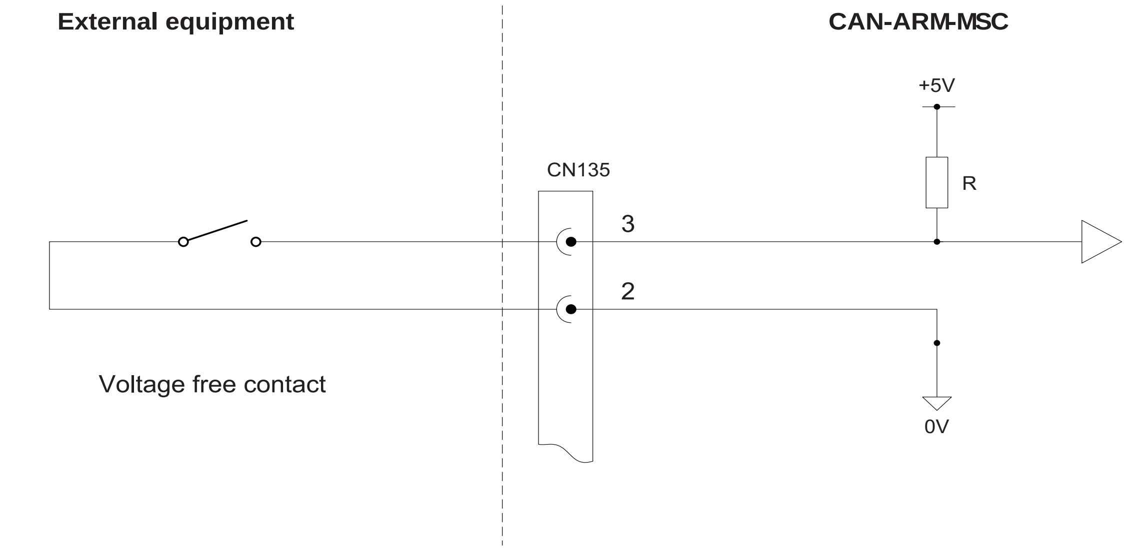


FIGURE 3-25 Single Pulse Input connections

NOTE: *The connector CN135 used in the illustration refers to the connector on the backplane that connects to QPI1. This is only an example.*

3.8.3.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation voltage	-	-	2500	V_{AC}
Switching level V_H	5	-	30	V_{DC}
Switching level V_L	-	-	0.8	V_{DC}
Switching current (I_{SW})	10	-	-	mA
Input switching frequency	-	-	10	kHz
Input on time (T_{ON})	50	-	-	µs
Input off time (T_{OFF})	50	-	-	µs

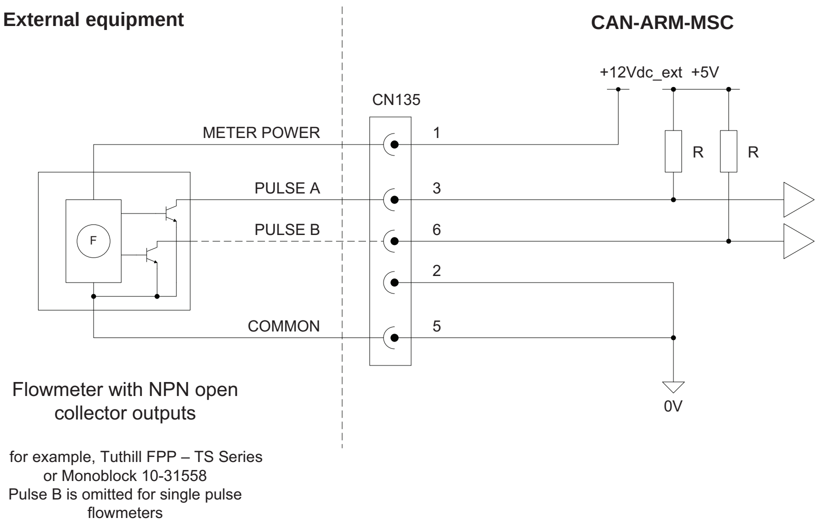
3.8.4 Dual-Pulse Input (Quad PI)

3.8.4.1 Functional Description

The Dual-Pulse Input (Quad PI) can accept signals from one dual pulse flow meter for applications requiring a high level of pulse integrity offered by a dual-pulse flow meter. This is also referred to as a quad (quadrature) flow meter or one single-pulse flow meter. See section *3.8.3 - Single Pulse Input.*

NOTE: The dual-pulse input cannot be used for accepting signals from two separate single-pulse flow meters.

FIGURE 3-26 illustrates the simplified block diagram of the Dual-Pulse Input connections.



or

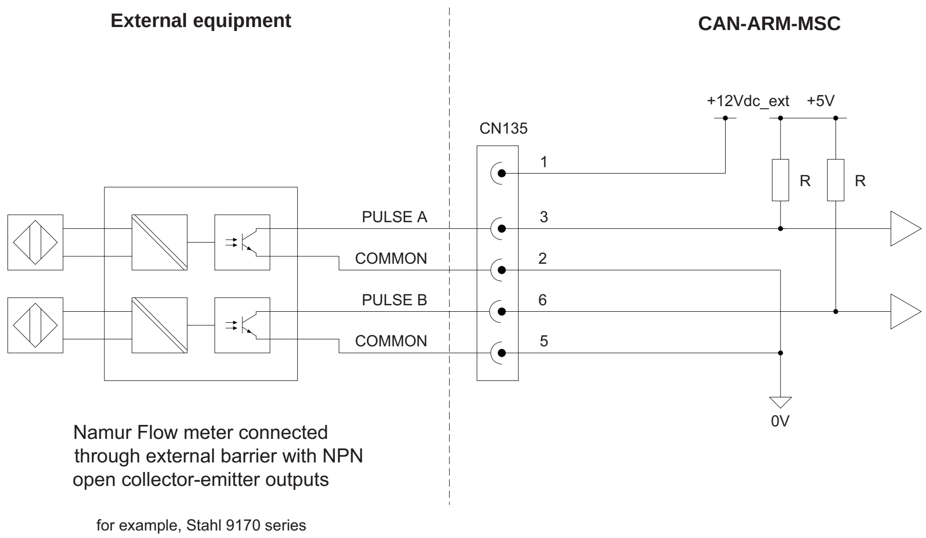


FIGURE 3-26 Dual-Pulse Input connections

NOTE: The connector CN135 used in the illustration refers to the connector on the backplane that connects to QPI1. It is only an example.

3.8.4.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation voltage	-	-	2500	V_{AC}
Switching level V_H	5	-	30	V_{DC}
Switching level V_L	-	-	0.8	V_{DC}
Switching current (I_{SW})	10	-	-	mA
Input switching frequency	-	-	10	kHz
Input on time (T_{ON})	50	-	-	µs
Input off time (T_{OFF})	50	-	-	µs
DPI Phase	-	90°	-	-

3.8.5 Analog Input (AI)

3.8.5.1 Functional Description

The Analog Input (AI) supports 2-wire 4-20 mA, and can be configured by a switch to operate in active mode or passive mode. See FIGURE 3-27.

In the active mode, the external transmitter is directly powered from the 24 V, which is generated by the MSC-L power supply.

In the passive mode, the transmitter is powered externally.

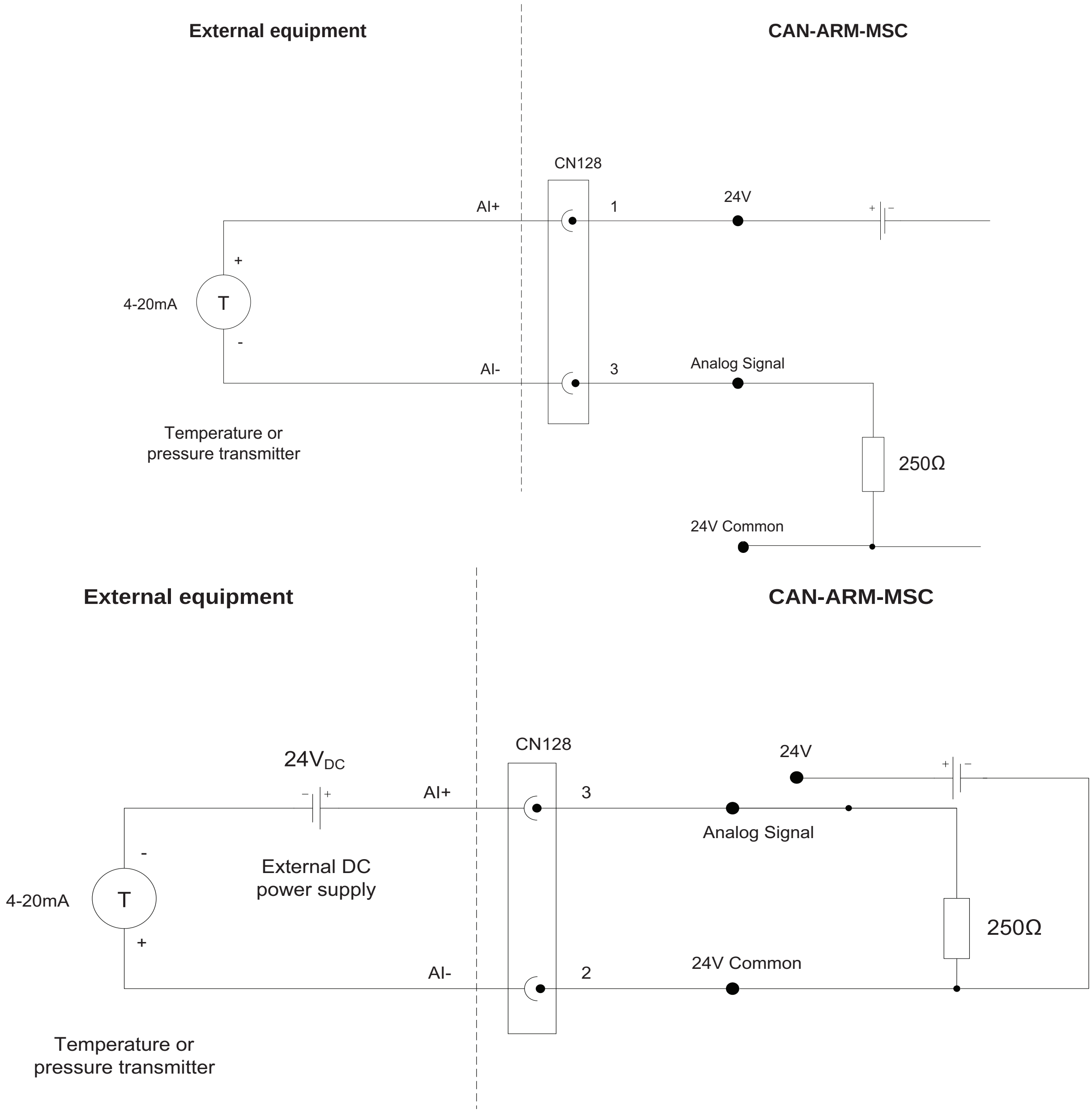


FIGURE 3-27 Analog Input connections - Active mode (top) and Passive mode (bottom)

For non-MID applications, the AI can be used for temperature, pressure, or any other type of analog 4-20 mA signal measurement.

The AI interface is not intrinsically safe, and external devices connected to the AI must conform to Ex d safety standards when used in a hazardous area.

3.8.5.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V_{AC}
V_{Loop}	23.0	24.0	42.5	V_{DC}
$V_{Loop(ISO)}$	24 V			V_{DC}
$I_{Loop(ISO)}$	20			mA
Nominal loop current range	4	-	20	mA
Loop current measurement range	0	-	22.5	mA
Maximum loop current	-	-	27.5	mA
$R_{S(TCR)}$	-	-	0.01	%/°C
Accuracy (Without external transmitter)	24	-	-	uA

3.8.6 Resistance Temperature Detector

3.8.6.1 Functional Description

The Resistance Temperature Detector (RTD) input allows the controller to read the temperature of a remotely connected PT100 resistance temperature detector. FIGURE 3-28 illustrates the RTD connections.

The RTD input supports 3-wire connections and 4-wire connections.

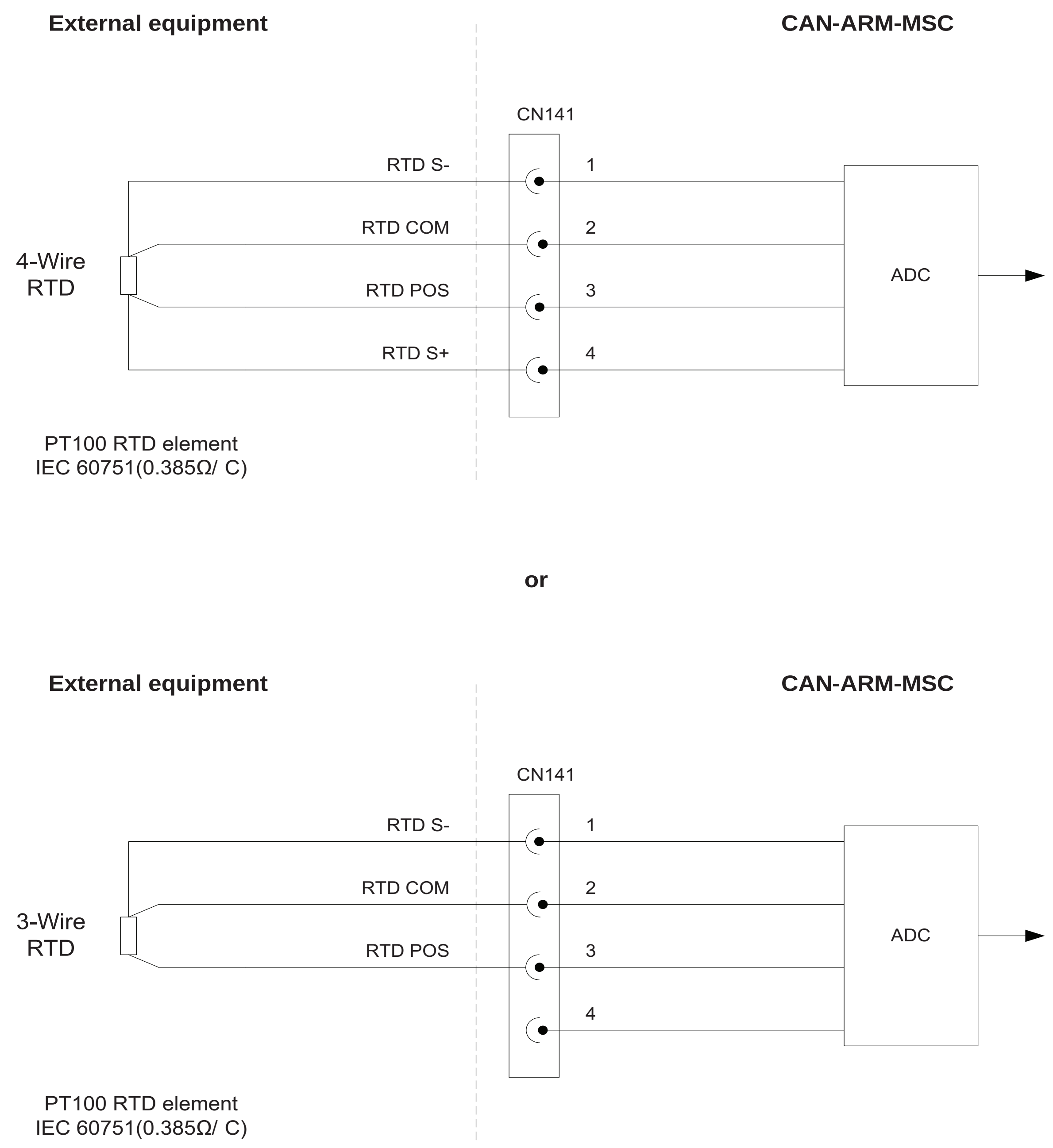


FIGURE 3-28 RTD connections

The following RTD type is accepted.

RTD type	Connection	Alpha co-efficient
PT100	3-wire or 4-wire (Kelvin connection)	IEC 60751 (0.385 Ω/°C / 0.214 Ω/°F) DIN 43760 1/3 DIN DIN 43760 1/5 DIN DIN 43760 1/10 DIN

The selection of 3-wire or 4-wire RTD type is performed in the software, but the RTD must be connected to the circuit as displayed in FIGURE 3-28.

3.8.6.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	500	-	V_{AC}
Temperature measurement range	-200	-	+250	°C
MID temperature measurement range	-200	-	+250	°C
Measurement error (-200 ... +250°C/ -328 ... +482°F)	-	-	±116	mΩ
	-	-	±0.3	°C
RTD current source	50	500	1500	µA
RTD cable length	-	-	150	m
Conversion time	-	-	1.0	s

3.8.7 Digital Input AC (DI AC)

3.8.7.1 Functional Description

The function of the Digital Input AC (DI AC) is to convert high-voltage switched AC into a signal that can be used by the controller to ensure the specific functionality required.

FIGURE 3-29 illustrates the simplified block diagram of the DI AC connections.

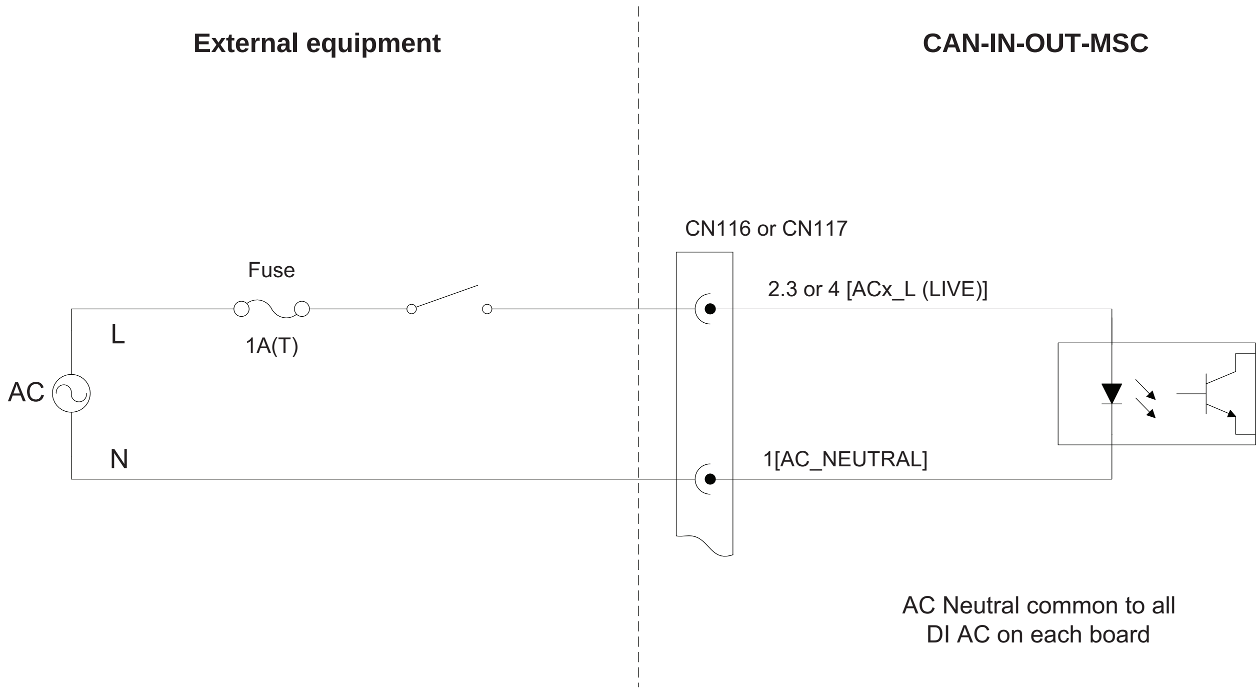


FIGURE 3-29 DI AC connections

3.8.7.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation voltage			2500	V_{AC}
Input voltage	-	-	265	V_{AC}
Input frequency	47	-	63	Hz
Input impedance	-	44	-	kΩ
High input (must turn on) voltage	85	-	-	V_{AC}
Low input (must turn off) voltage	-	-	20	V_{AC}
Maximum input switching frequency	-	-	4	Hz
AC on time (T_{ON})	50	-	-	ms
AC off time (T_{OFF})	200	-	-	ms

3.9 Output Functions

3.9.1 General

The following table describes the electronic output functions the MSC-L 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 DC	-	DO-EMR DC
Digital Output Electromechanical Relay AC or DC	-	DO-EMR AC or DC
Digital Output AC (Solid State Relay)	DO-SSR	DO-SSR

3.9.2 Pulse Output (PO DC)

3.9.2.1 Functional Description

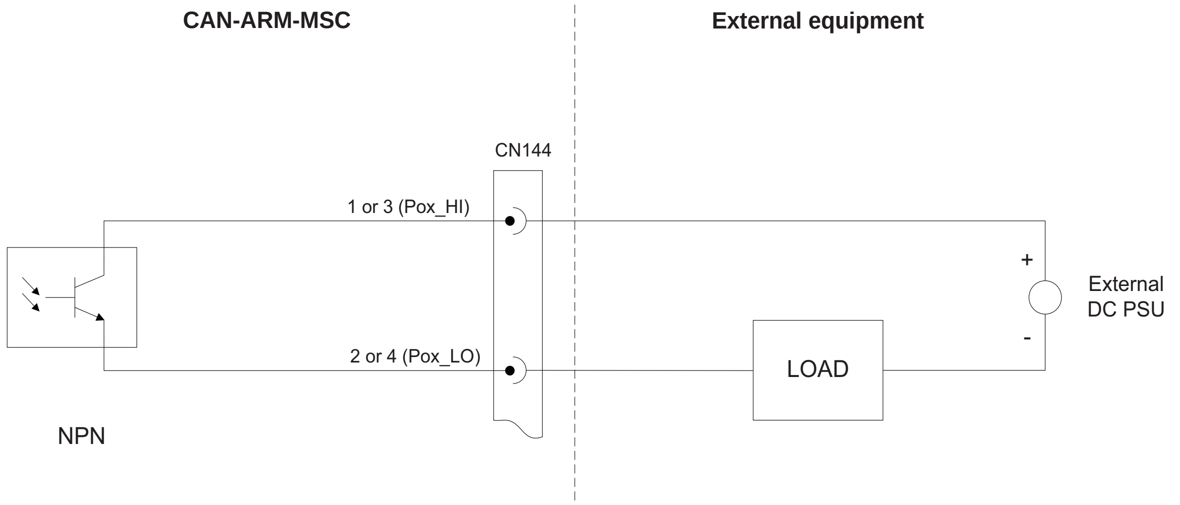
The Pulse Output DC (PO DC) allows the controller to switch DC signals to interface a PLC, TAS, or other systems. The PO is not designed to switch the high-current loads.

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

Real-time PO circuitry contains a multiplexer and a selector, which is controlled by a micro controller to select certain pulse input circuitry to the pulse output channel.

Factored PO circuitry is controlled by a micro controller to present a certain pulse input signal factored (scaled) to the pulse output channel.

FIGURE 3-30 illustrates the simplified block diagram of the external PO connections.



or

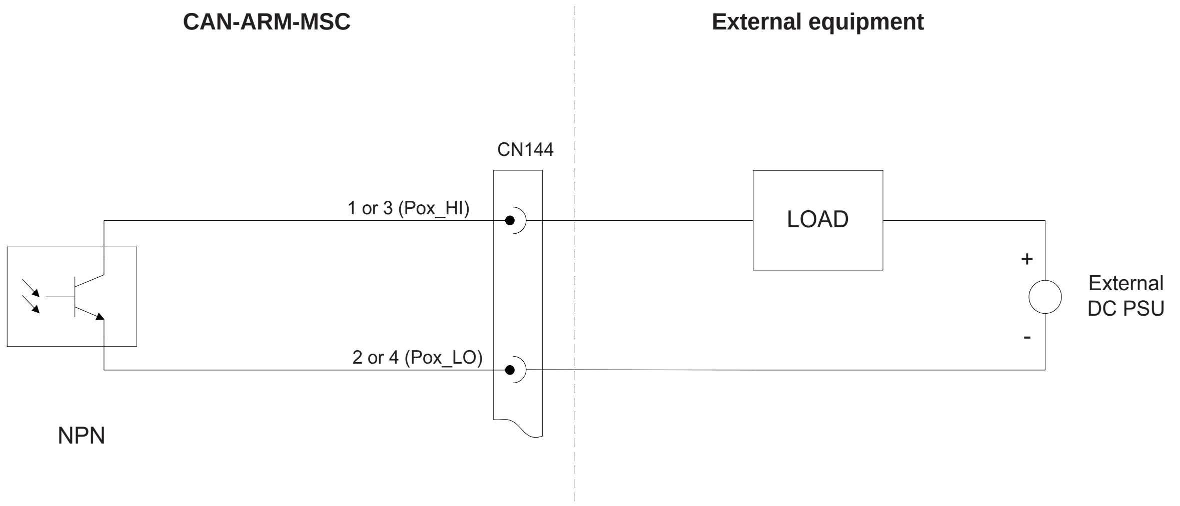


FIGURE 3-30 PO connections

3.9.2.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	2500	V_{AC}
Output load voltage	-	-	30	V_{DC}
Output load current (Sink)	-	-	10	mA
Output load current (Source)	-	-	10	mA
F_{MAX} Switching frequency	-	-	10	kHz
T_{ON} and T_{OFF} pulse width	15	-	-	µs
Output Saturation voltage (over entire temp range)	-	-	1	V_{DC}

3.9.3 Analog Output

3.9.3.1 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.

FIGURE 3-31 illustrates the simplified block diagram of the AO connection to the external devices.

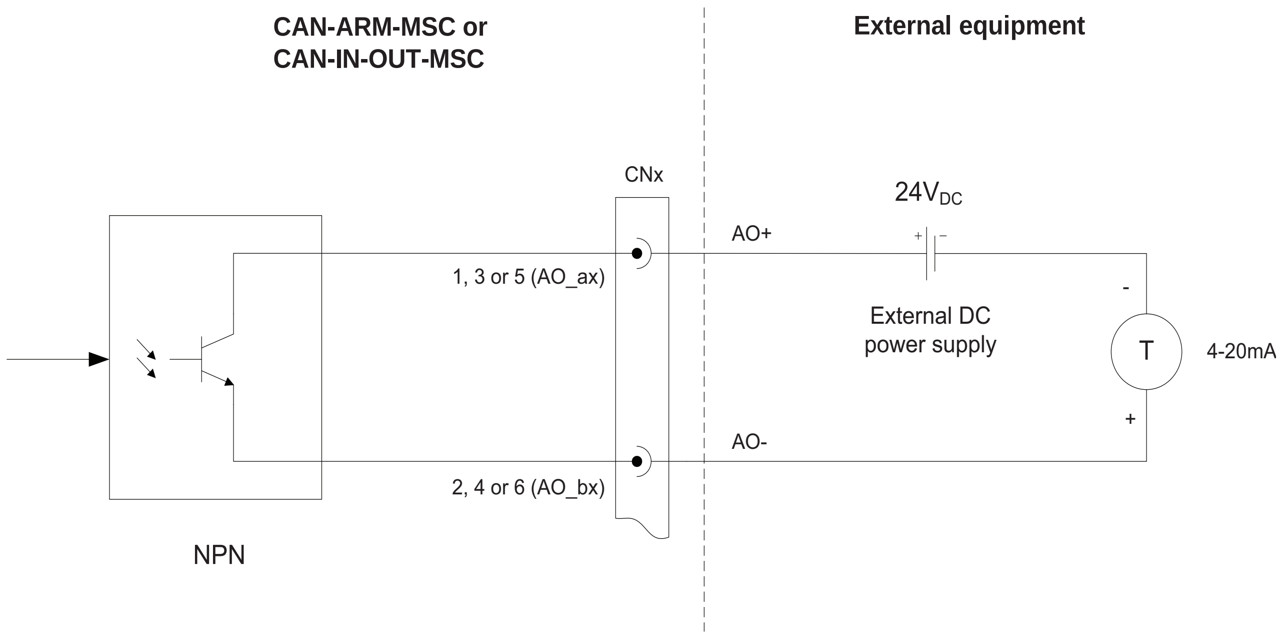


FIGURE 3-31 AO connections

3.9.3.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V_{AC}
V_{LOOP}	23.0	24.0	36.0	V_{DC}
Nominal loop current range	4	-	20	mA
Loop current control range	3	-	21	mA
Accuracy (without external receiver)	-	-	±1.0	%
Update time	-	-	250	ms
Load resistance	0	-	750	Ω

3.9.4 Digital Output Electromechanical Relay (DC)

3.9.4.1 Functional Description

The Digital Output Electromechanical Relay (DO EMR DC) allows the controller to switch DC 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[1] to be either Normally Open (NO) or Normally Closed (NC).

FIGURE 3-32 illustrates the simplified block diagram of the DO EMR DC connections.

1. For physical location(s), see CHAPTER 4 - Installation.

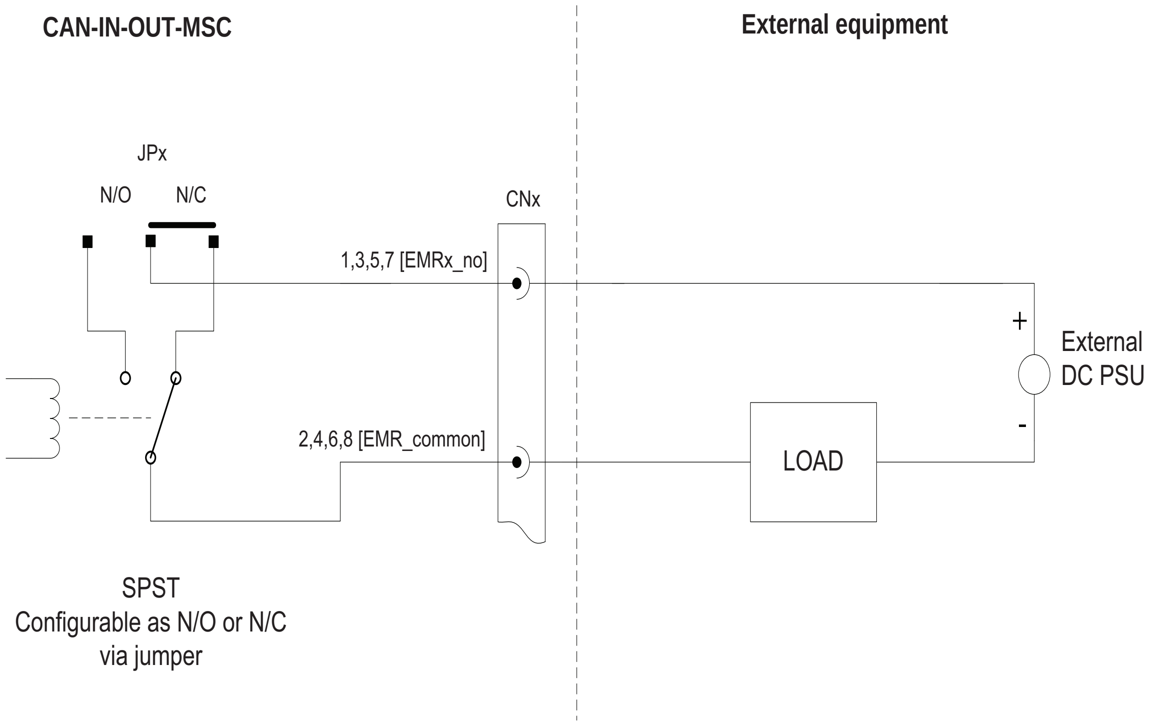


FIGURE 3-32 DO EMR DC connections

3.9.4.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Load Voltage to be switched	-	-	30	V_{DC}
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_{DC}
Control voltage (low level)	-	-	0.4	V_{DC}
Control current (high level)	-	-	1	mA

3.9.5 Digital Output Electromechanical Relay (AC or DC)

3.9.5.1 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[1] to be either Normally Open (NO) or Normally Closed (NC).

See FIGURE 3-33 illustrates the simplified block diagram of the DO EMR connections.

1. For physical location(s), see CHAPTER 4 - Installation.

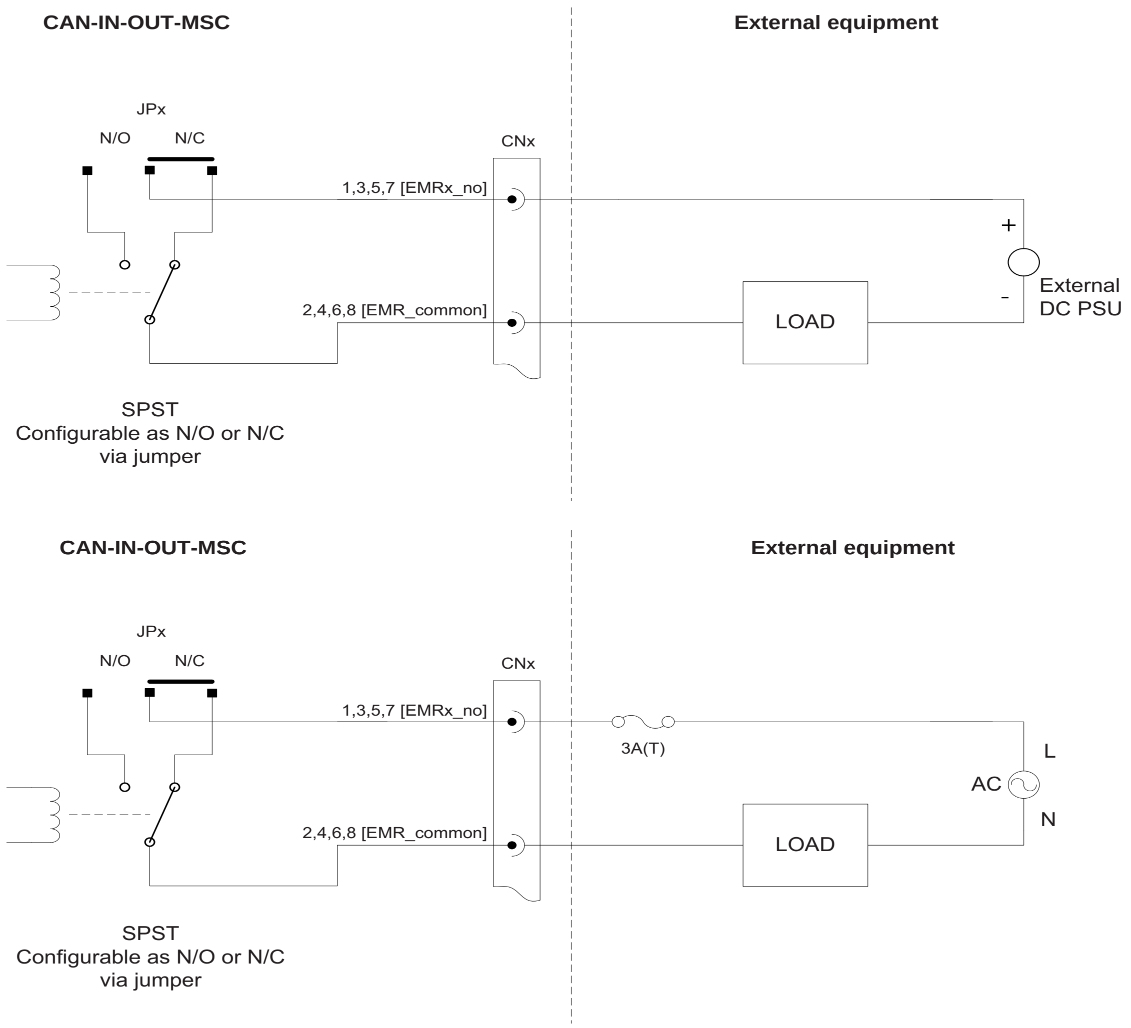


FIGURE 3-33 DO EMR connections

3.9.5.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Load voltage to be switched	-	-	265	V_{AC}
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_{DC}
Control voltage (low level)	-	-	0.4	V_{DC}
Control current (high level)	-	-	1	mA

3.9.6 Digital Output Solid State Relay AC

3.9.6.1 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.

FIGURE 3-34 illustrates a simplified block diagram of the DO-SSR AC self powered connections and FIGURE 3-35 illustrates a simplified block diagram of the DO-SSR AC externally powered connections.

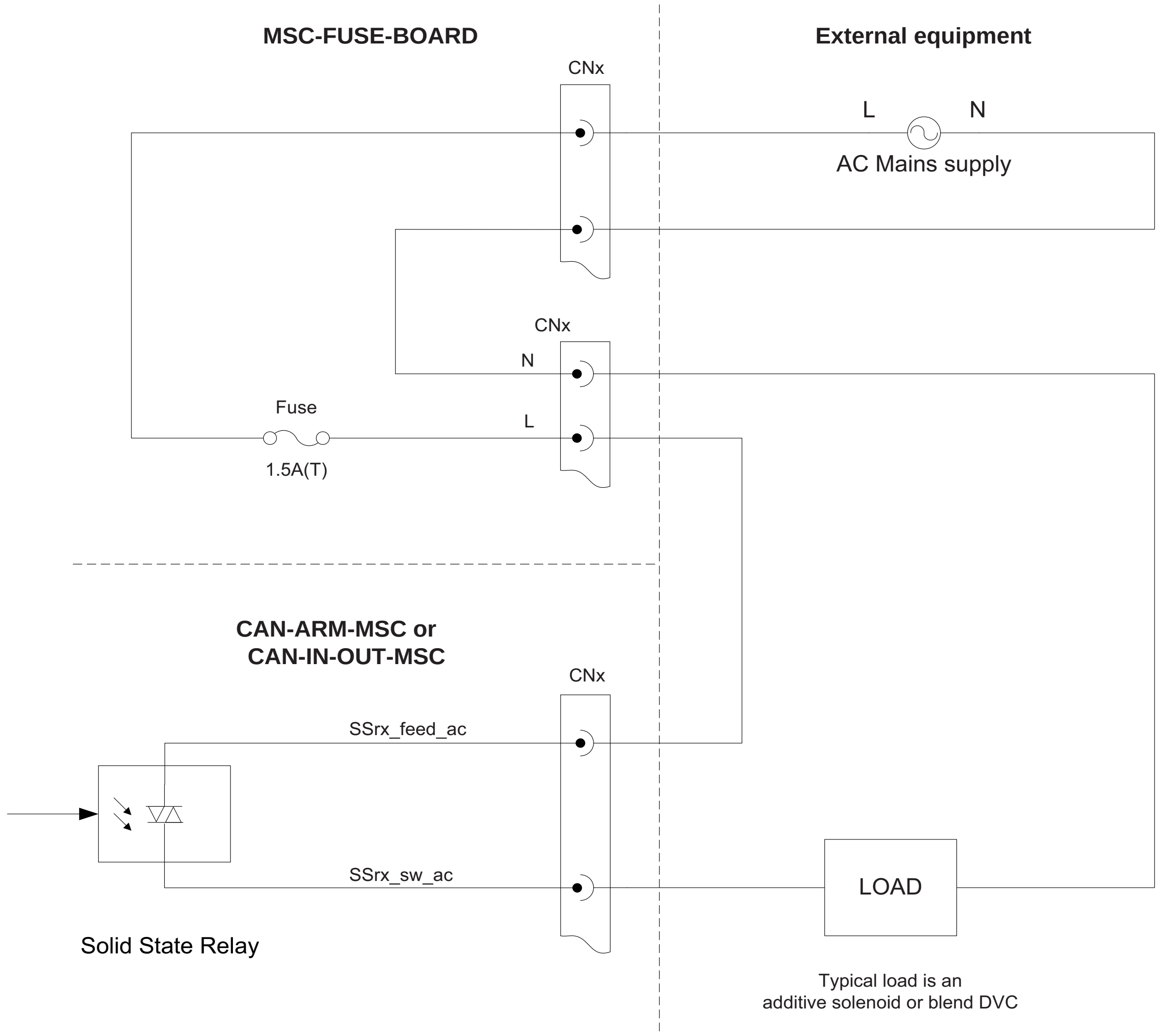


FIGURE 3-34 Solid State Relay “Self-powered” connections

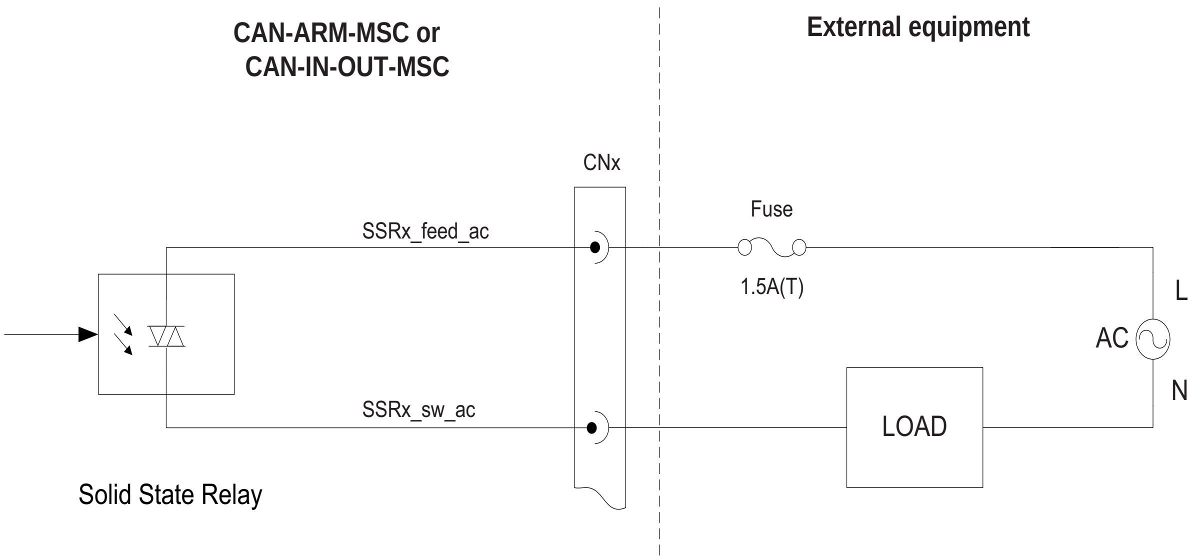


FIGURE 3-35 Solid State Relay “Externally powered” connections

3.9.6.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation voltage	-	-	3700	$V_{AC\ rms}$
Operating voltage	90	-	265	V_{AC}
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_{DC}
Control voltage must turn off	-	-	0.4	V_{DC}
Control current	-	-	5	mA

3.10 Communication Functions

3.10.1 General

The following table describes the electronic communication functions the MSC-L 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

3.10.2 RS-485 Communication (2-wire or 4-wire)

3.10.2.1 Functional Description

The Communication block, which consists of wires and switches allows the MSC-L to communicate through an RS-485 connection with external devices including a 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.

FIGURE 3-36 illustrates the RS Communication 2-wire connections and FIGURE 3-37 illustrates the RS Communication 4-wire connections.

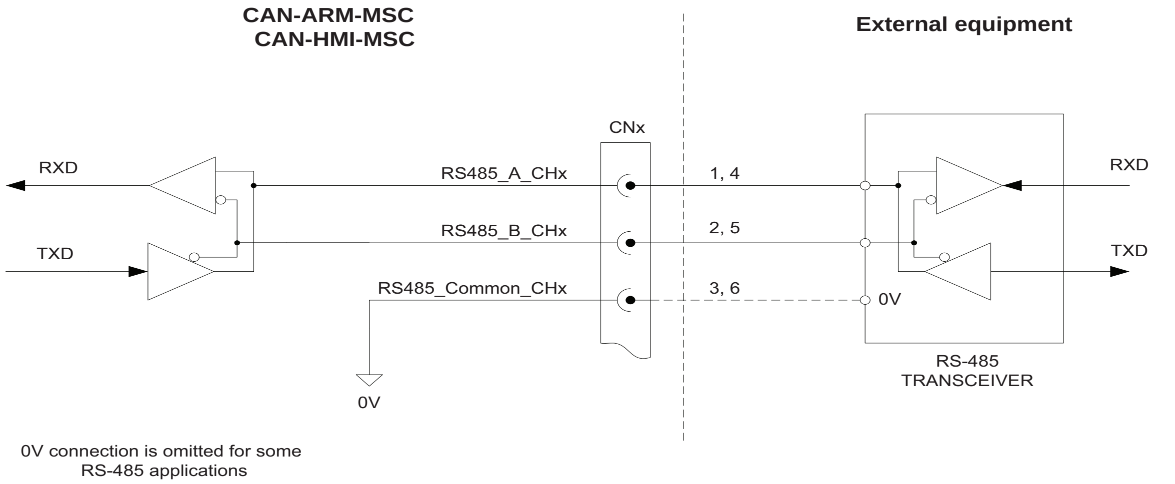


FIGURE 3-36 RS Communication 2-wire connections

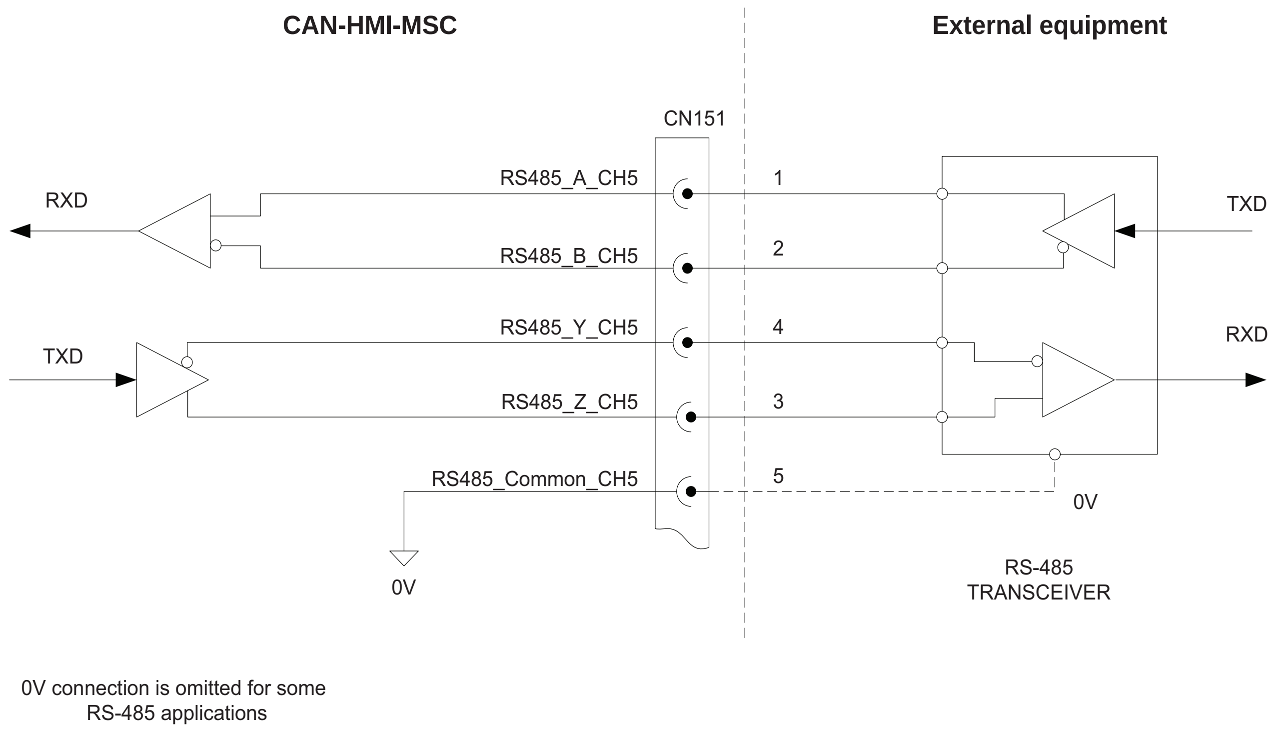


FIGURE 3-37 RS Communication 4-wire connections (CAN-HMI-MSC only)

3.10.2.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V_{AC}
R_T Terminator resistor	118	120	122	Ω
Driver output short circuit current	-	-	200	mA
Data transmission rate	-	-	500	kbps

3.10.2.3 Cable Specifications

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

3.10.3 Ethernet Communication

3.10.3.1 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 TAS system, Fusion4 Portal, or other remote interfaces.

FIGURE 3-38 illustrates the Ethernet connections using the external cables or Ethernet connections to the external devices.

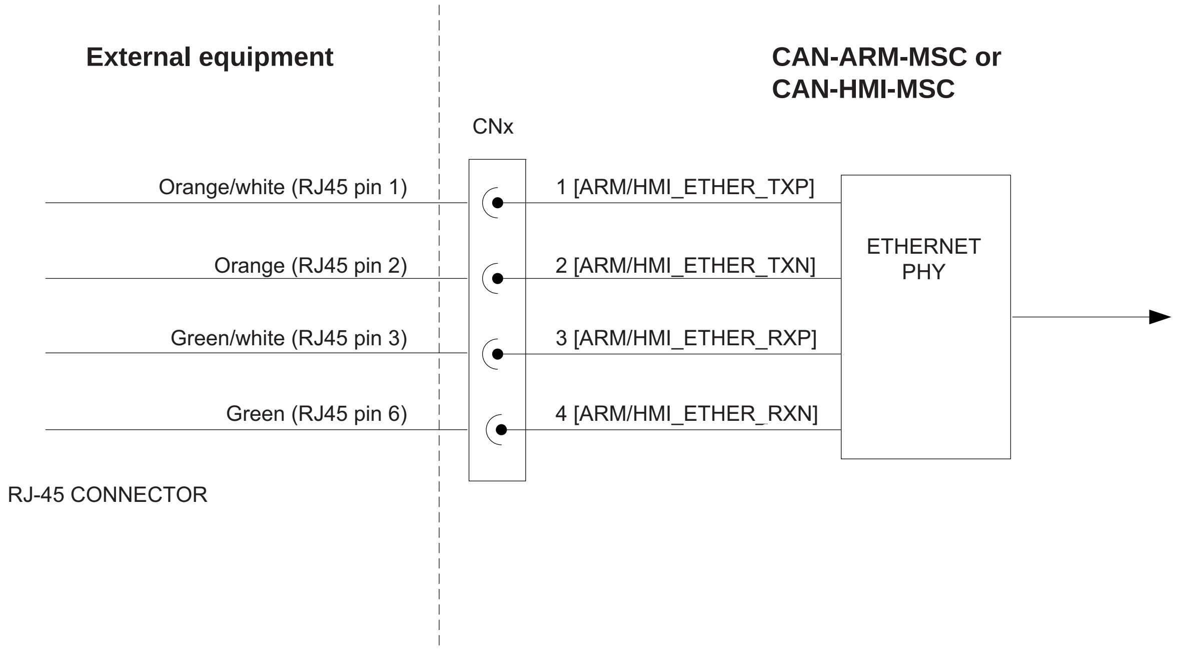


FIGURE 3-38 Ethernet complaint physical layer

3.10.3.2 Characteristics

Item	Minimum	Typical	Maximum	Unit
Isolation	-	-	500	V_{AC}
Data transmission rate	10	-	100	mbps

3.10.3.3 Cable Specifications

Item	Minimum	Typical	Maximum	Unit
Cable length	-	-	100	m
Cable characteristic impedance	85	100	115	Ω
Cable DC loop resistance	-	≤ 0.188	-	Ω/m
Cable capacitance	-	52	-	pF/m

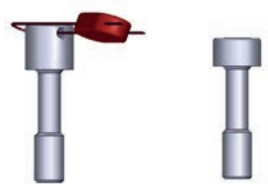
CHAPTER 4 INSTALLATION

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, to provide permanent support to the device.

Following are the mechanical features of the MSC-L.

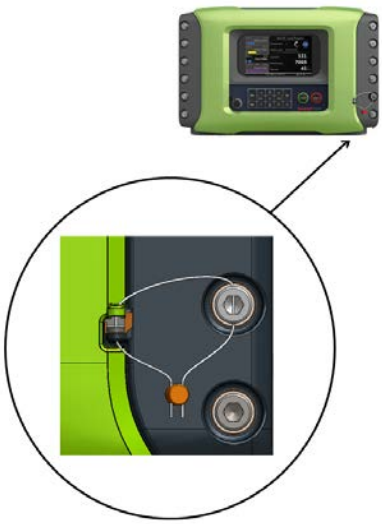
1. An enclosure box with a hinged lid, which allows M10*1.5 - g6 fixing bolts.
   The weight of the MSC-L is 53.8 kgs. The width is 525 mm (20.67 inches), depth is 265 mm (10.43 inches), and the height is 344 mm (13.54 inches).



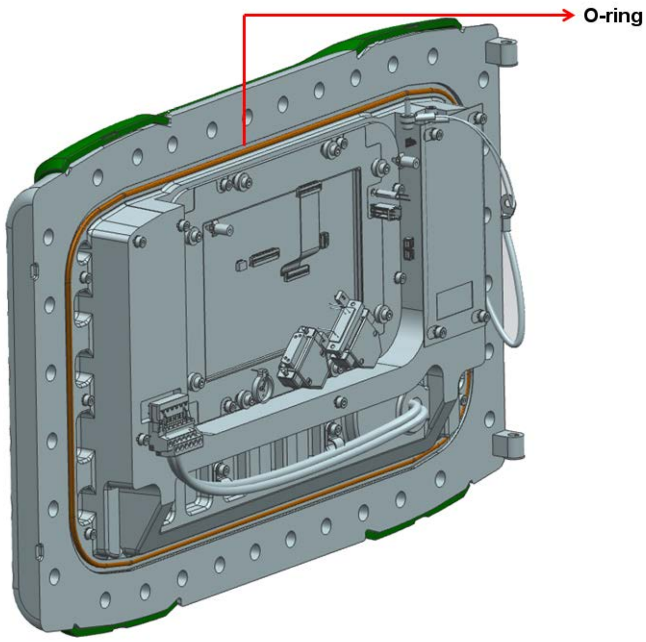
Shaft: 7.50 h13 mm [0.295 h 0.512 inches]
Thread: M10x1.5 g6
Type: ISO 4762
Material: A2 70
Torque: 33 Nm [22.12 lb-ft - 25.077 lb-ft]

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

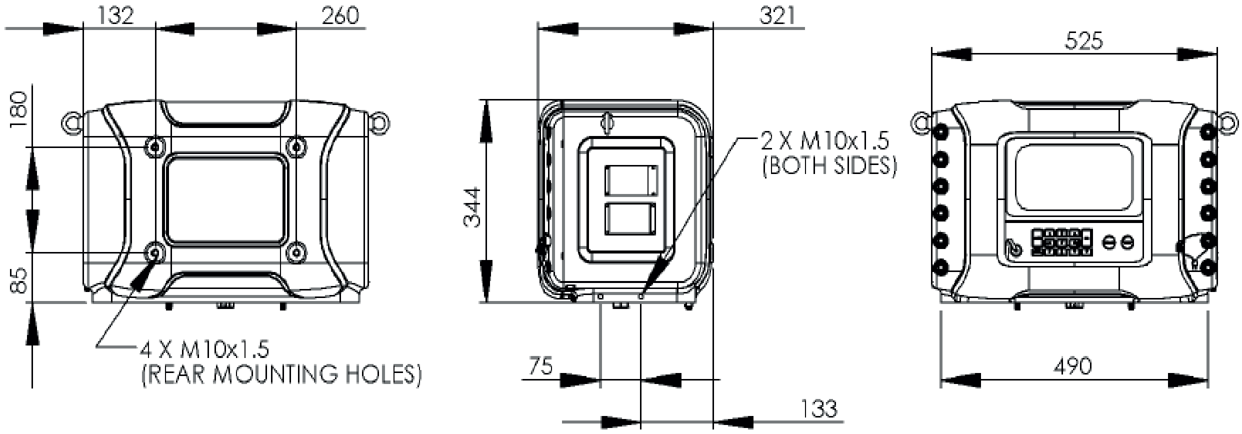
3. 31 bolts and one sealing bolt, as illustrated in the following figure.



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

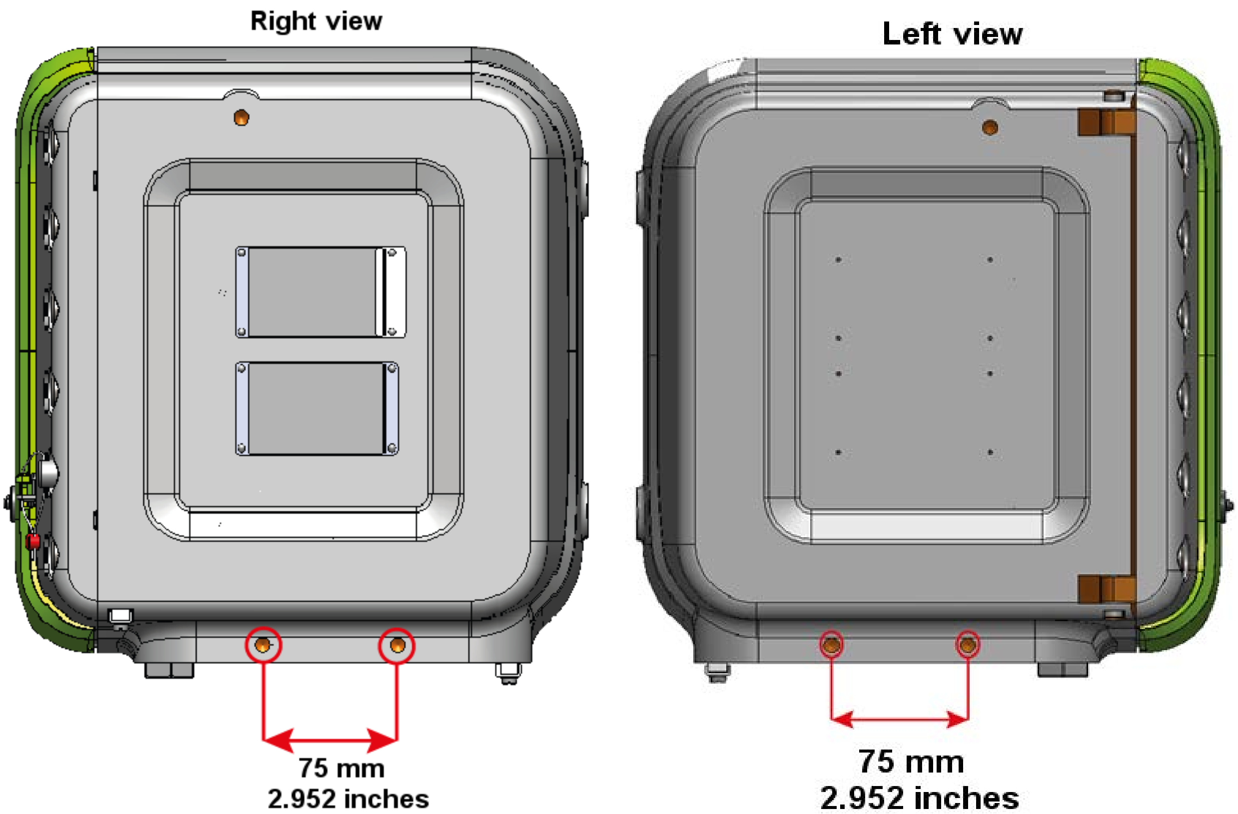


5. Wall mounting facilities - There are four wall mounting bolts, as illustrated in the following figure. The size of the bolts is M10*1.5 - g6.

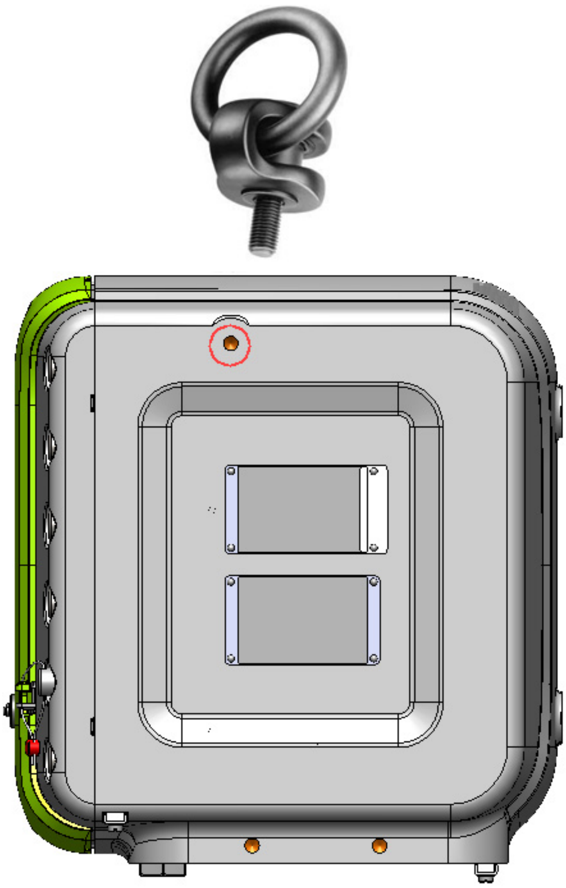


6. Base mounting facilities - The base mounting holes are located on the right side and the left side of the MSC-L, as illustrated in the following figure.

NOTE: The base mounting bolt thread size is M10.



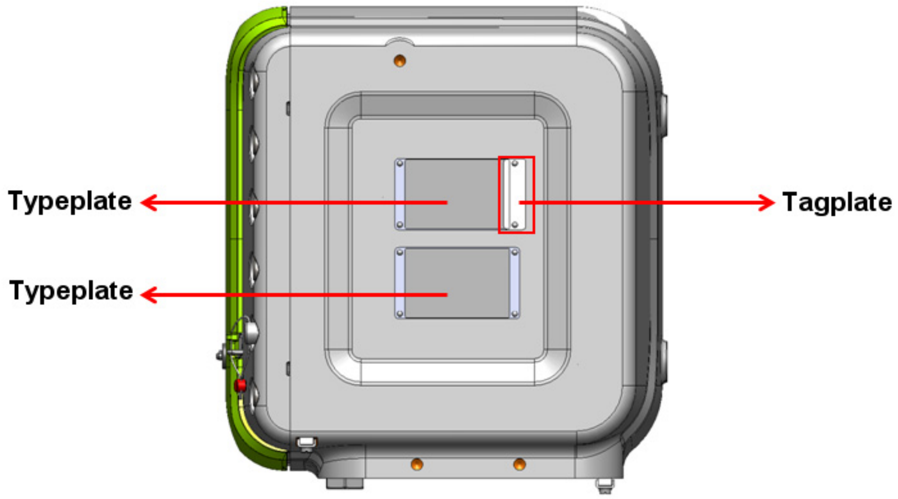
7. Lifting eyes facility for easy installation, as illustrated in the following figure. (This facility is not allowed for permanent mounting as it is used only for installation purpose).



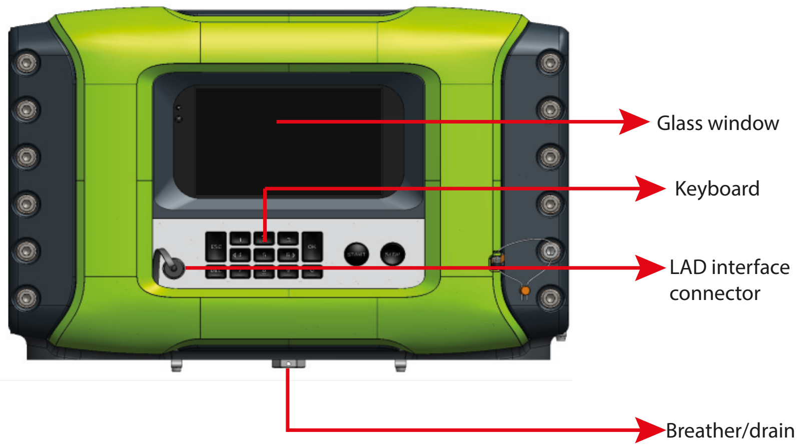
NOTE: *The ring bolt is rotatable, therefore the load direction is adjustable and unintended tightening or loosening is negated. The higher load rating ring bolts allows for smaller connection threads.*

The lifting eye thread size is M10.

8. Three external grounding facilities are available to ground the MSC-L enclosure with an external ground reference/point. See section *2.2.6.1 - Grounding,* for more information.
9. Internal grounding 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, as 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.

REMARK: Refer to the specific equipment's guides 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-L 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-L.

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

4.2.2 Metric Gland Entries

The MSC-L 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.

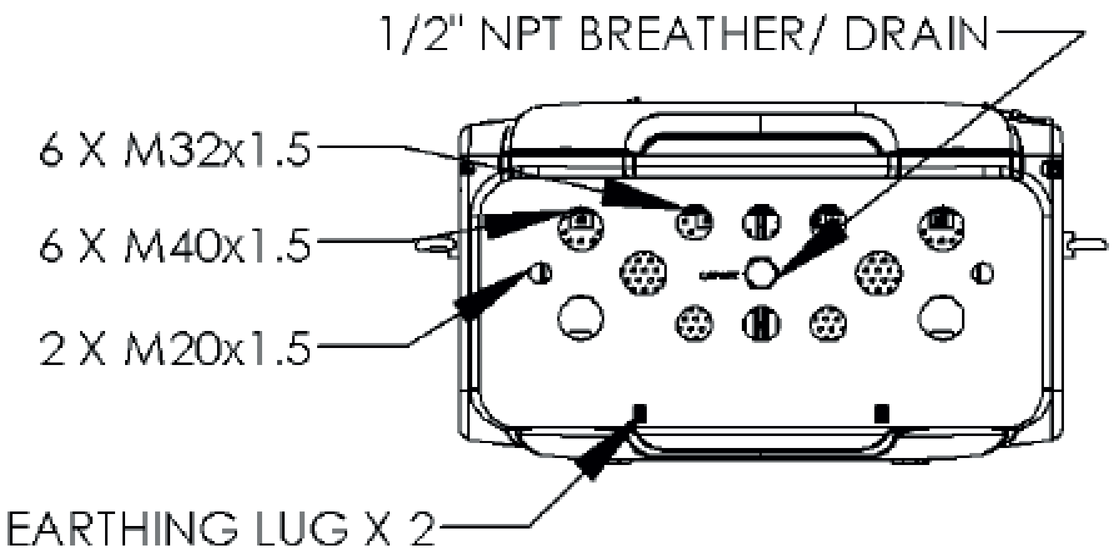


FIGURE 4-1 Metric gland entries overview

4.2.3 NPT Cable Entries

The MSC-L 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)

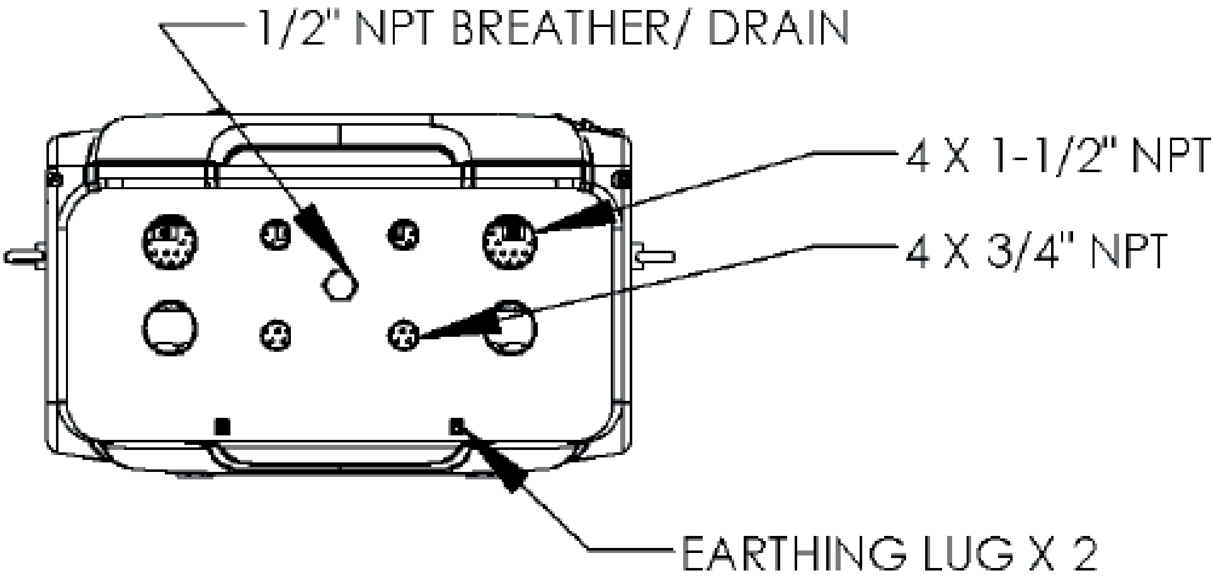


FIGURE 4-2 NPT cable entries overview

4.3 Opening the MSC-L

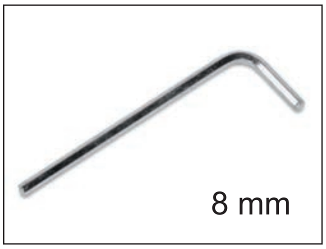
WARNING! Do NOT open when an explosive atmosphere is present. It is forbidden to open the MSC-L in an explosive hazardous environment, unless otherwise stated on the safety label.

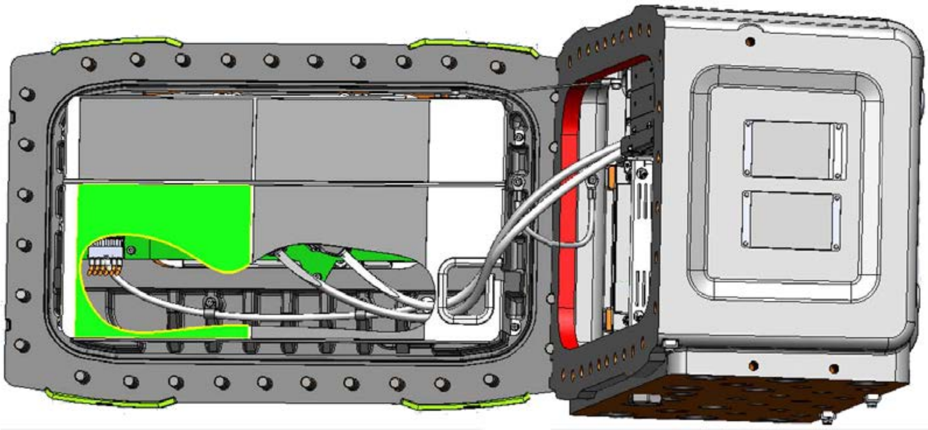
WARNING! Treat the flange surface of the cover and the housing with care. Keep the flange surface free of dirt. The O-ring must be present and undamaged.

To open the MSC-L Lid

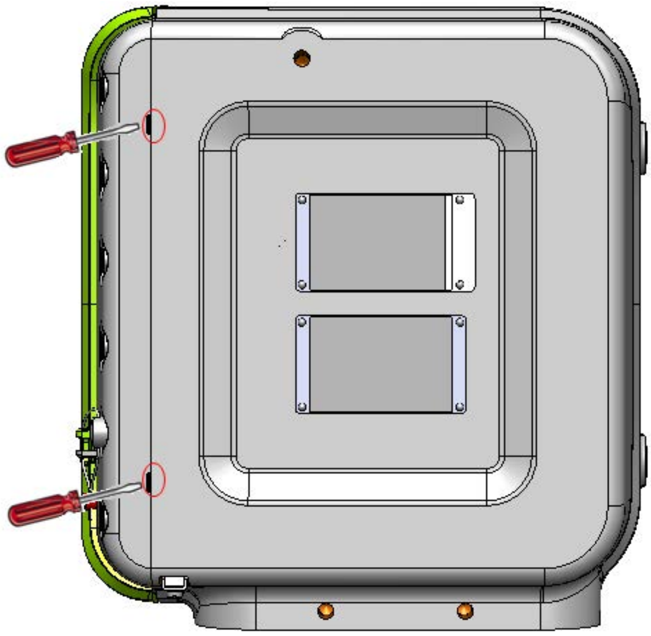
1. Remove the W&M seal, if present.
2. Remove the cosmetic cover, by gently pulling the cover.
3. Loosen all the 32 bolts by loosening one or two threads of the bolts with an 8 mm Allen key.

   The MSC-L lid can now be opened.





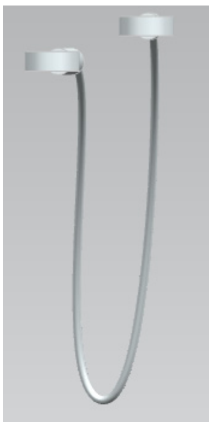
4. If the MSC-L lid is stuck due to the air seal, carefully force it to open with the screwdrivers, as illustrated in the following figure.



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

WARNING! *For ensuring intrinsic safety of the MSC-L, 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-L lid.



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

NOTE: The screw must be removed only by Honeywell Enraf 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-MSC boards.
9. Remove the 2x cabling from the backplane of the CAN-HMI-MSC boards.
10. Replace all the toothed rings in the MSC-L lid.

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

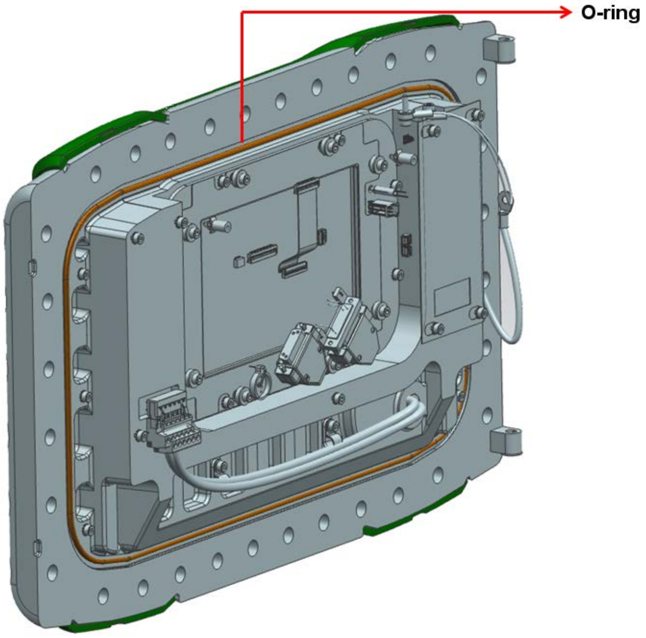
11. Replace the screw of the earth strap protection cable on the MSC-L lid.
12. Replace the screw of the earth strap assembly on the MSC-L lid.

4.4 Closing the MSC Lid

To close the MSC-L Lid

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

NOTE: The O-ring must be replaced only by the Honeywell Enraf trained by service technician*.*



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-L, to prevent damage by Electrostatic Discharge (ESD).

1. Perform step 1 through step 3 in section *4.3 - Opening the MSC-L,* before removing/replacing the CAN-HMI-MSC, CAN-IN-OUT-MSC, CAN-ARM-MSC, and MSC-SHORTCUT-BOARD.
2. Ensure that the thermal conductive pads on all the boards are in place.
3. Before placing the boards, remove the protection film, if present.

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-L lid.

NOTE: To replace the CAN-HMI-MSC board, perform the previous steps in reverse order.

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).

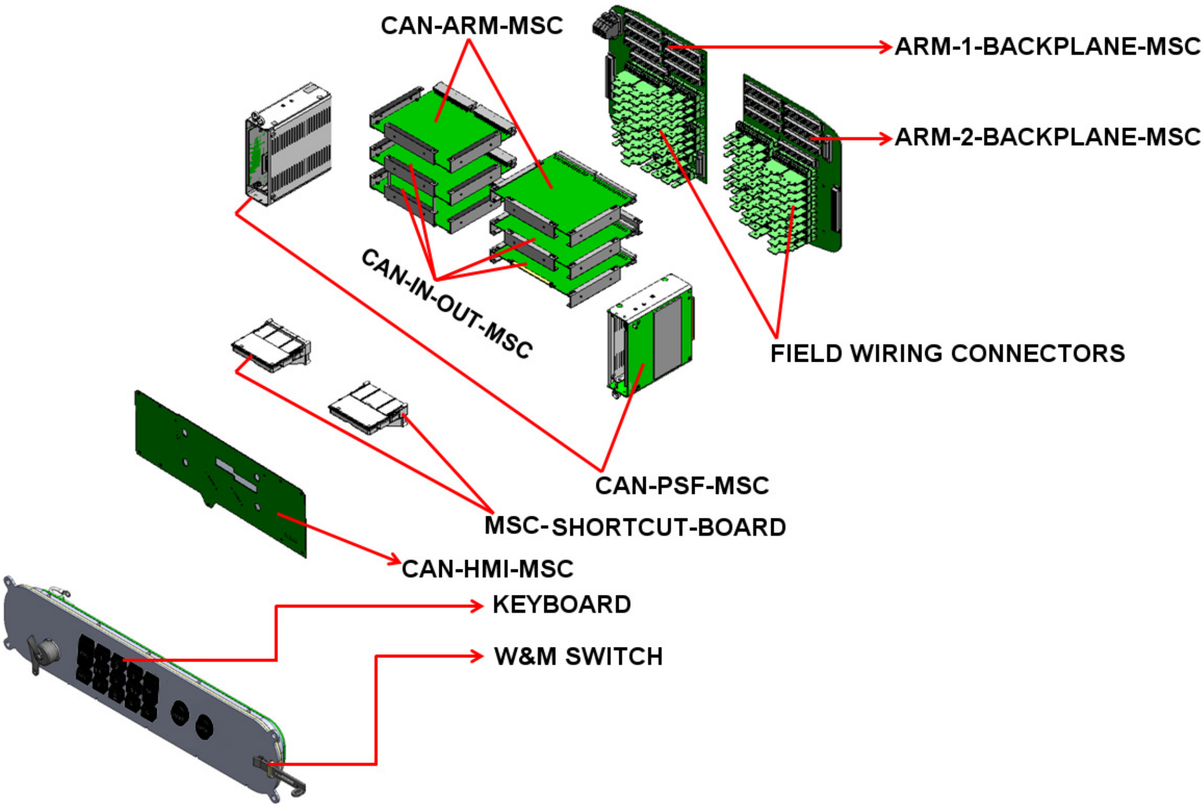
NOTE: To replace the CAN-IN-OUT-MSC and CAN-ARM-MSC boards, *perform the previous steps in reverse order.*

To remove the MSC-SHORTCUT-BOARD

1. Remove the MSC-SHORTCUT-BOARD from the backplanes by pulling the MSC-L fuse board cover.

NOTE: To replace the MSC-SHORTCUT-BOARD *perform the previous steps in reverse order.*

NOTE: Do not remove the CAN-PSF-MSC board.



4.6 Fusing and Power Consumption

4.6.1 Fusing

4.6.1.1 Internal Fusing

The MSC-L provides internal fuses for the protection of the AC mains as follows.

- 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-L.
- MSC-SHORTCUT-BOARD - The mains AC input, which is supplied to the MSC-L is also routed to the external devices through the MSC-SHORTCUT-BOARD. The fuses on the MSC fuse board deliver fuse protected AC power to the external devices.

FIGURE 4-3 illustrates the block schematic of a zero ohm resistor on the MSC-SHORTCUT-BOARD.

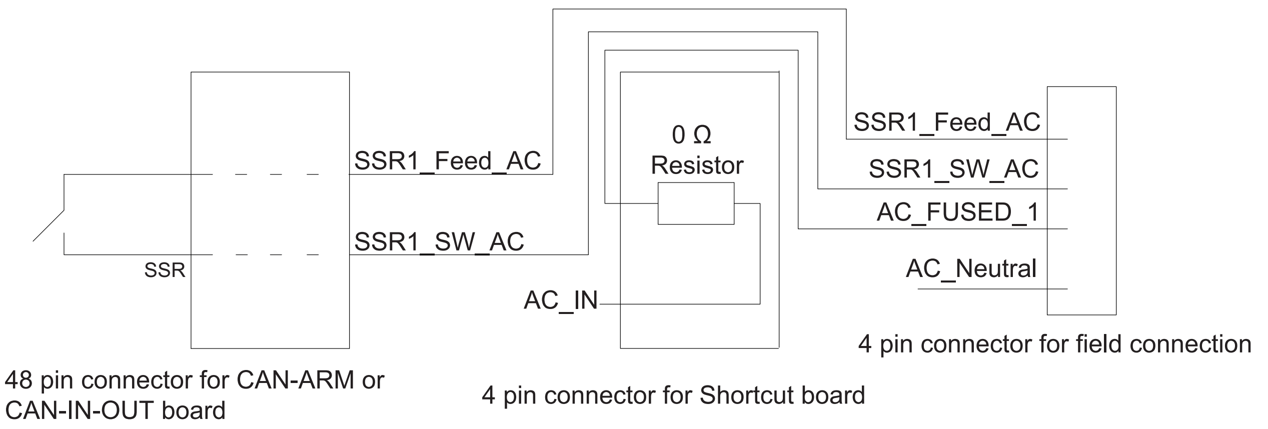


FIGURE 4-3 Block schematic of a zero ohm resistor on the MSC-SHORTCUT-BOARD

FIGURE 4-4 illustrates the architecture of the MSC-SHORTCUT-BOARD.

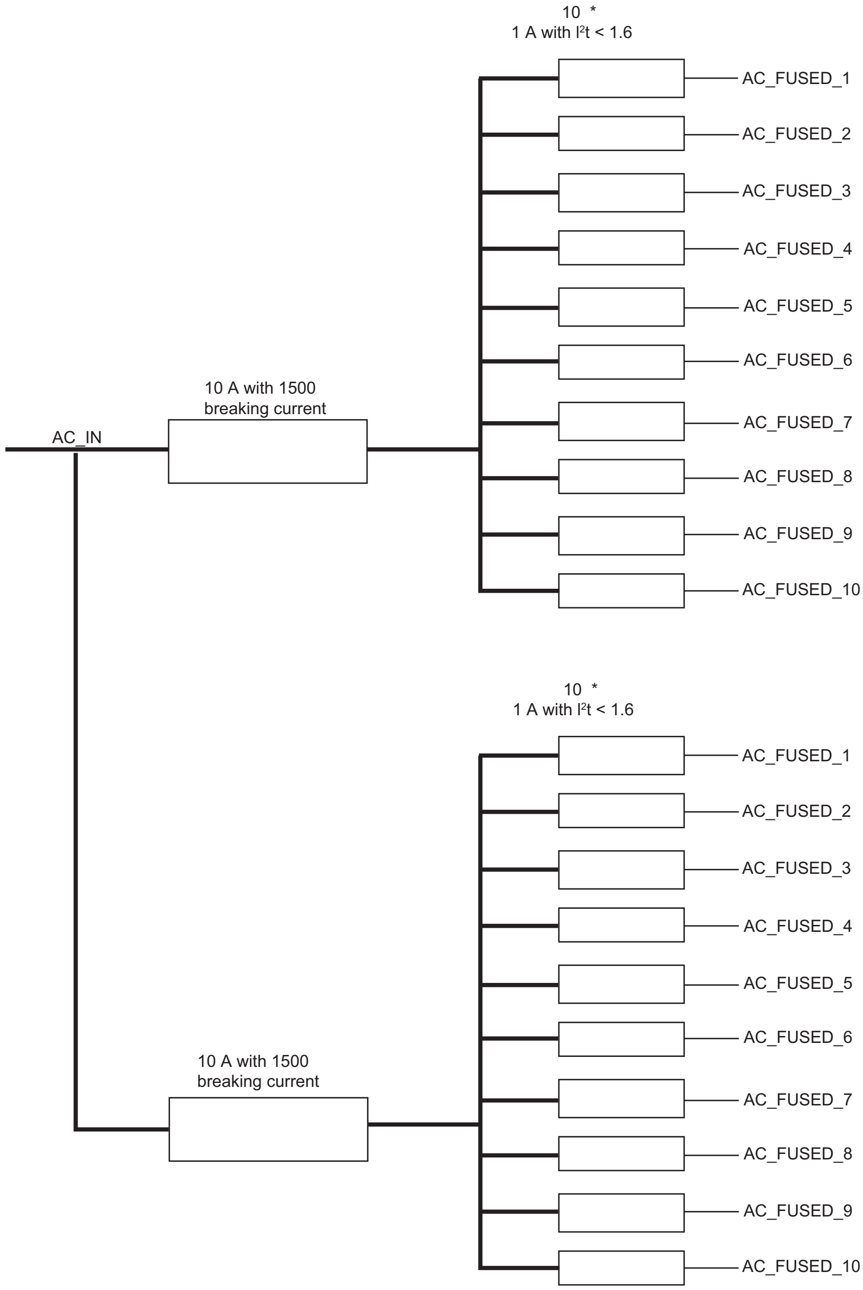


FIGURE 4-4 Architecture of MSC-SHORTCUT-BOARD

4.6.1.2 External Fusing

External fuse can also be connected to the AC mains input available for the MSC-L. 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.

4.6.2 Power Consumption

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

The MSC-L contains DO-SSR-AC interfaces. The SSR relays are used for switching AC signals connected to the MSC-L load.

The following boards in the MSC-L 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.

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

For the MSC-SHORTCUT-BOARD board only the fuses are assembled and not the 0E resistors. The MSC-SHORTCUT-BOARD board has 22 fuses, and the SSR output is connected to the MSC-L load through the fuse. The MSC-SHORTCUT-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-L 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.

Boards	Number of boards	Dissipation	Description
CAN-PSF-MSC	2	20.3	Internal dissipation is 0.2 * 53.6 = 10.7 W
			External 12 V dissipation is 0.2 * 24 = 4.8 W
			External 24 V dissipation is 0.2 * 24 = 4.8 W
		Total dissipation - 73.9W	

4.6.3 Disconnecting/breaker device

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

4.7 Wiring Termination Guidance

4.7.1 Wiring Architecture

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

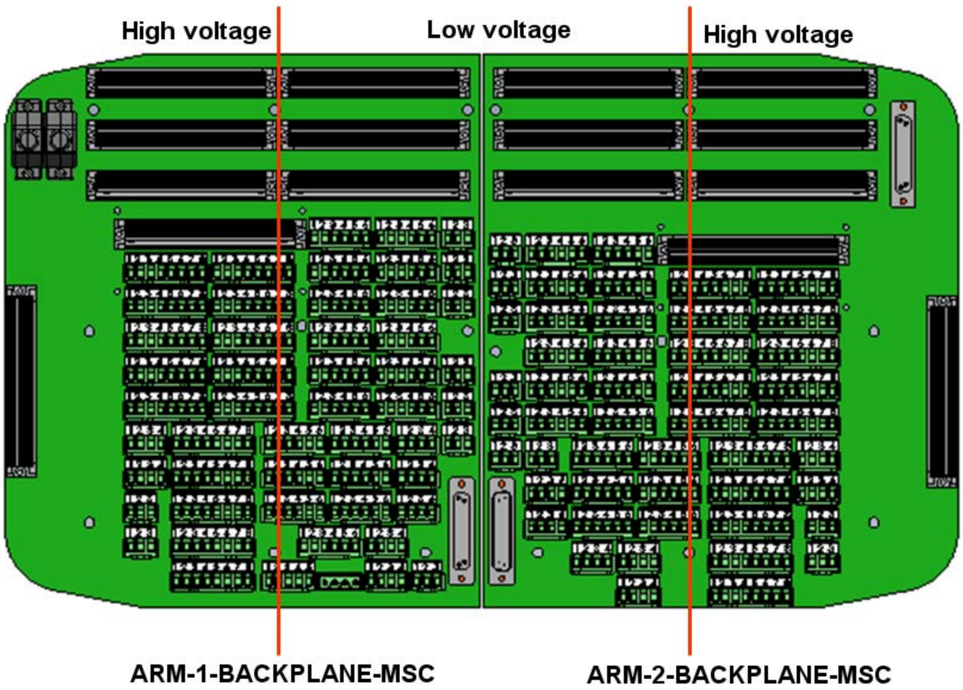


FIGURE 4-5 High/low voltages separation concept

4.7.2 Backplane Boards

All the external wires of the MSC-L connect to one of the Phoenix Contact connectors of the backplanes. These backplanes are mounted on the rear of the MSC-L 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 contains 52 connectors. ARM-2-Backplane-MSC start with the CN number CN201 and contains 49 connectors.

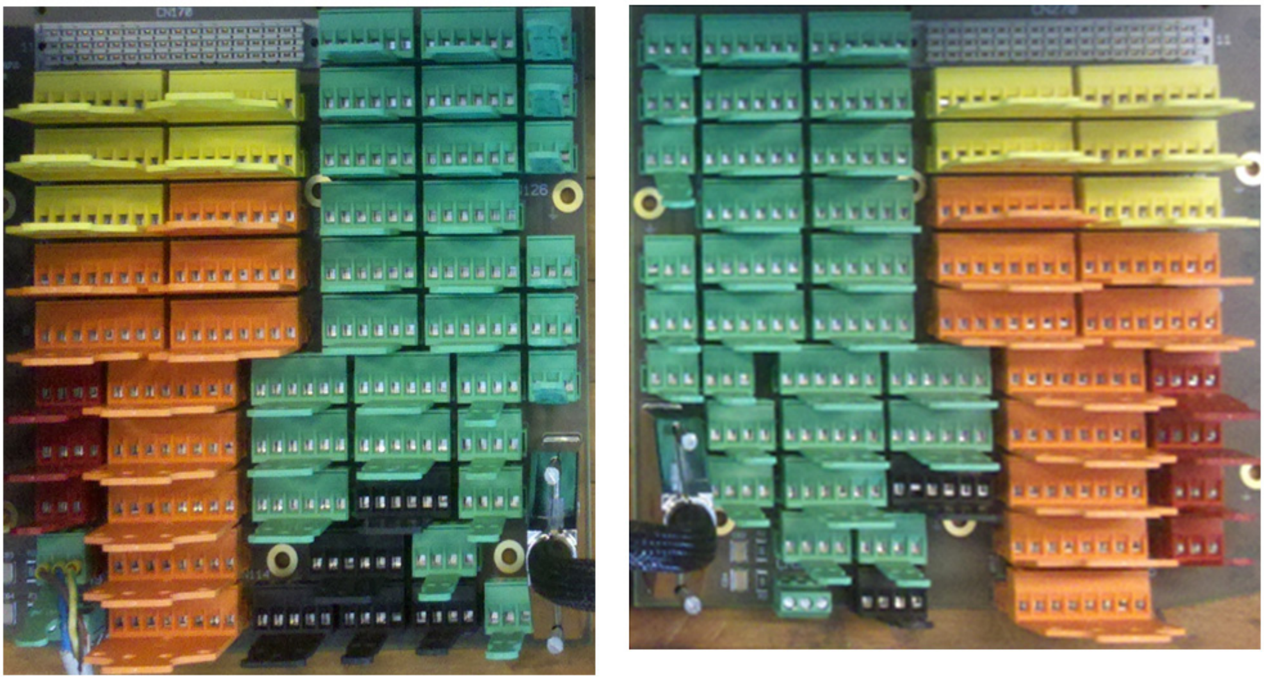


FIGURE 4-6 Backplane boards

4.7.2.1 ARM-1-BACKPLANE-MSC

FIGURE 4-7 ARM-1-BACKPLANE-MSC

4.7.2.2 Floorplan

The following image illustrate the floorplan for ARM-1-BACKPLANE-MSC board.

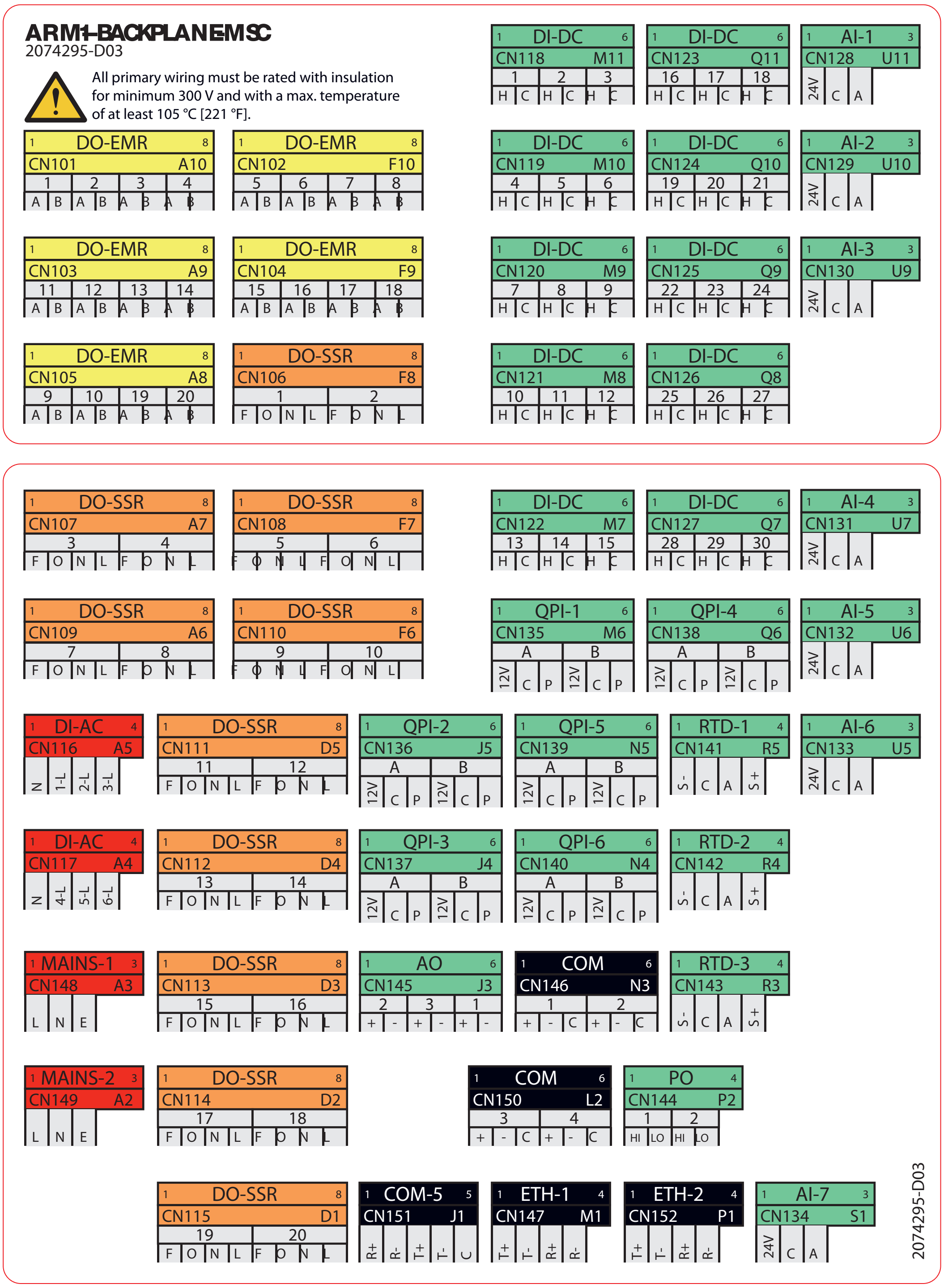


FIGURE 4-8 Blackplane arrangement of ARM-1-BACKPLANE-MSC

4.7.2.3 Connector Overview

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

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

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
		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
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

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
		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
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

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
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
		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
CN-162	subD25	BACKPLANE-LINK **1**	ARM-2-BACKPLANE-MSC	CN-162

ID	TYPE	FUNCTION	BOARD	NAME
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-SHORTCUT-BOARD-1	CN-170

4.7.2.4 ARM-2-BACKPLANE-MSC

FIGURE 4-9 ARM-2-BACKPLANE-MSC

4.7.2.5 Floorplan

The following image illustrate the floorplan for ARM-2-BACKPLANE-MSC board..

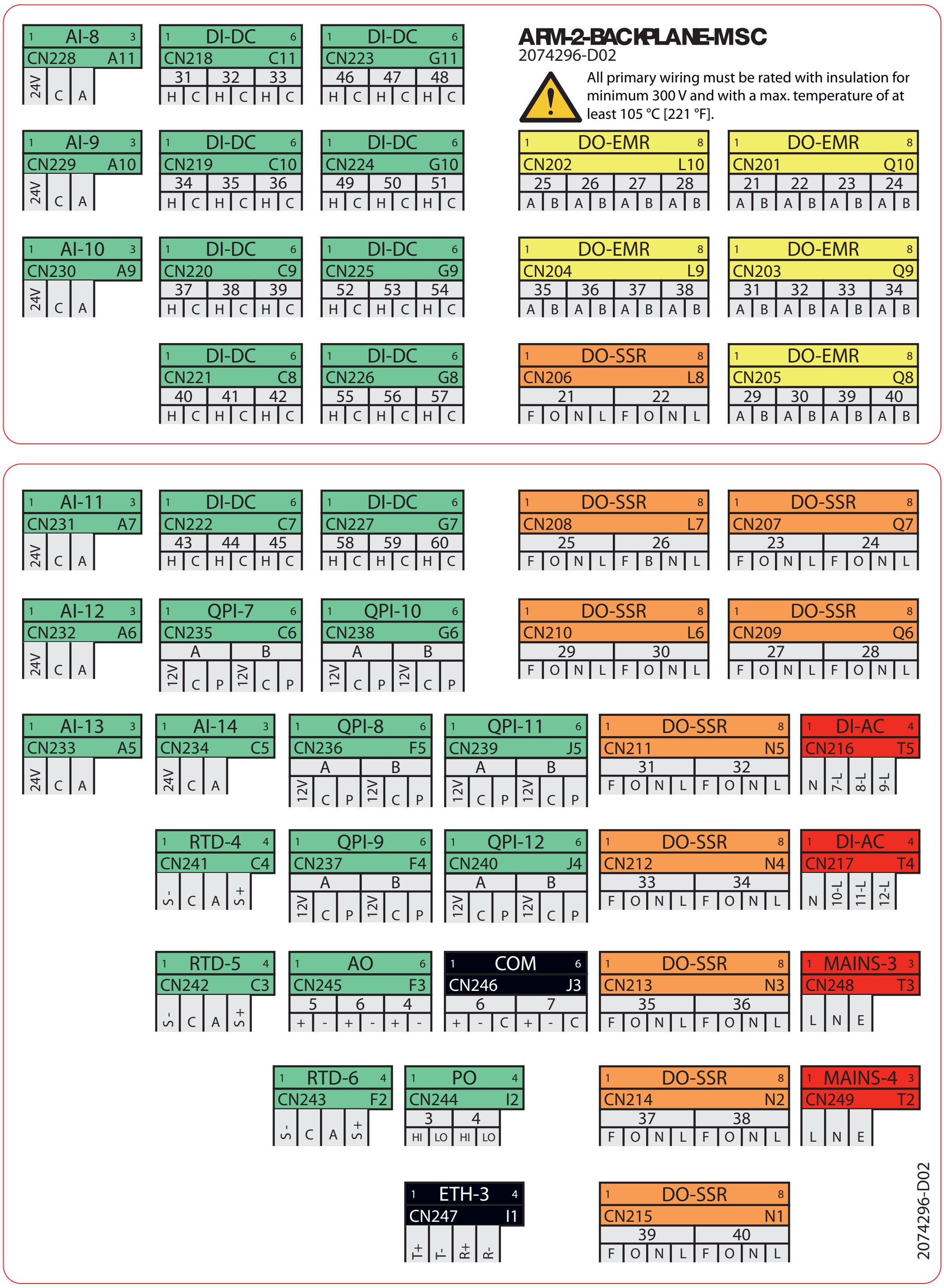


FIGURE 4-10 Blackplane arrangement of ARM-2-BACKPLANE-MSC

4.7.2.6 Connector Overview

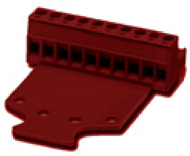
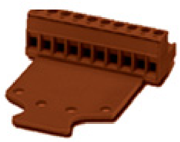
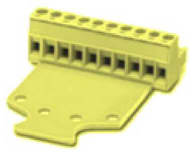
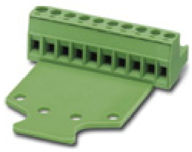
The following table provides an overview of the ARM-2-BACKPLANE-MSC connector.

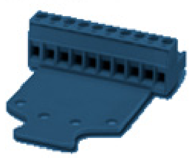
ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
CN-201	8	DO-EMR-AC-DC **21**	CAN-IN-OUT-MSC-3	Yellow	Q-10	DO-EMR-21
		DO-EMR-AC-DC **22**	CAN-IN-OUT-MSC-3			DO-EMR-22
		DO-EMR-AC-DC **23**	CAN-IN-OUT-MSC-3			DO-EMR-23
		DO-EMR-AC-DC **24**	CAN-IN-OUT-MSC-3			DO-EMR-24
CN-202	8	DO-EMR-AC-DC **25**	CAN-IN-OUT-MSC-3	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
CN-210	8	DO-SSR-AC **29**	CAN-ARM-MSC-2	**Orange**	L-6	DO-SSR-29

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
		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
CN-222	6	DI-DC **43**	CAN-IN-OUT-MSC-3	**Green**	C-7	DI-DC-43

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
		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
		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

ID	PINS	FUNCTIONS	BOARD	COLOR	X-Y	NAME
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
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-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

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

4.7.3 General

CAUTION! *IMPORTANT! All terminated cables must have 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.*

4.7.3.1 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^2 [AWG 24 to 14].
- For mains/high voltage wiring, 1.5 mm^2 [AWG 16].
- For low voltage wiring (DI, PO, AI, AO, RTD, and so on), 0.75 mm^2 [AWG 18] or 0.5 mm^2 [AWG 20].
- The temperature rating of the field wiring must be at least 20 ºC [36 ºF] above the maximum operating temperature. Therefore, a rating of 85 °C [185 ºF] 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^2 [AWG 18].

4.7.4 Recommended Cables

Cable type	Number of wires	Function
XLPE/SWA/PVC 4C X 1.5MM 600/1000 V BS5467	3	230 V_{AC} Mains Supply Input
XLPE/SWA/PVC 4C X 1.5MM 600/1000 V BS5467	2	230 V_{AC} Alarm Output
XLPE/SWA/PVC 4C X 1.5MM 600/1000 V BS5467	4	230 V_{AC} Permissive Input
3C X 0.75 MM^2 YYNR PVC	4	230 V_{AC} Digital Controlled Valve Output
3C X 0.75 MM^2 YYNR PVC	4	230 V_{AC} VAC Solenoid Supply Output
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	12 V_{DC} Switched Output
BS5308 1X4X0.5 MM COL SCREEN SWA P1T2 PVC	2	12 V_{DC} 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

4.7.5 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.

4.7.6 Internal Wiring diagram

4.7.6.1 AC Cable 1 (Gland 1)

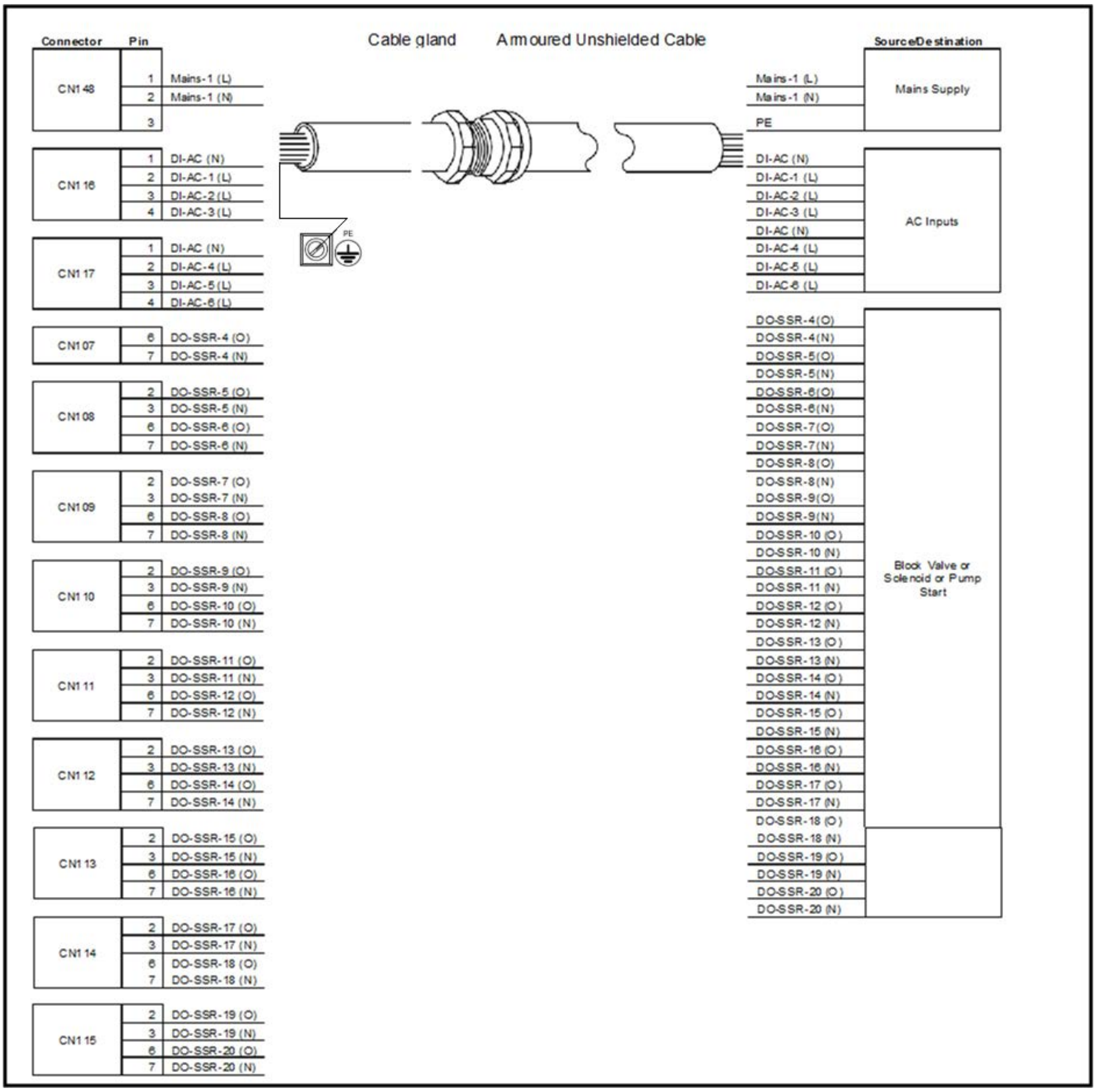


FIGURE 4-11 AC cable 1 (gland 1)

4.7.6.2 AC Cable 2 (Gland 2)

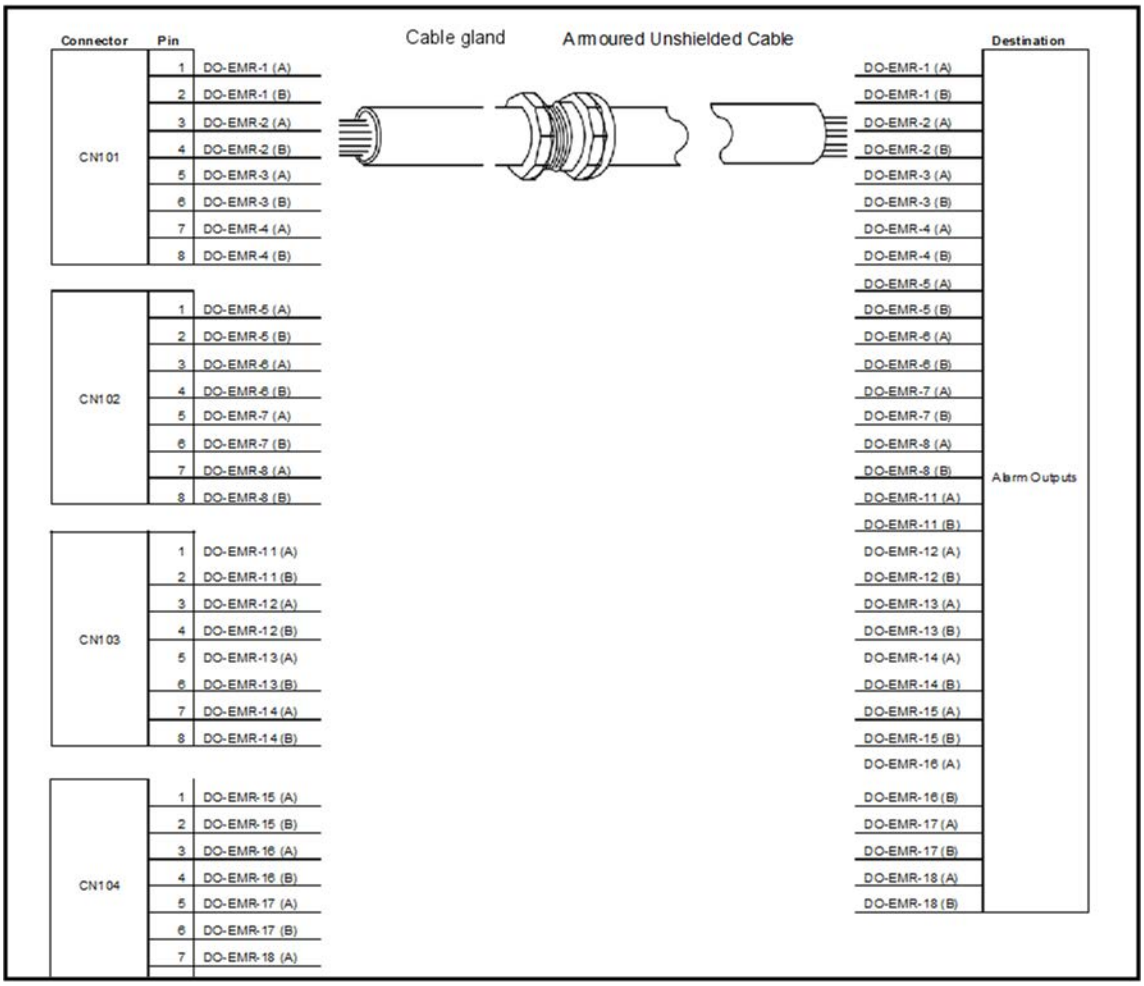


FIGURE 4-12 AC cable 2 (gland 2)

4.7.6.3 DC cable 1 (Gland 3)

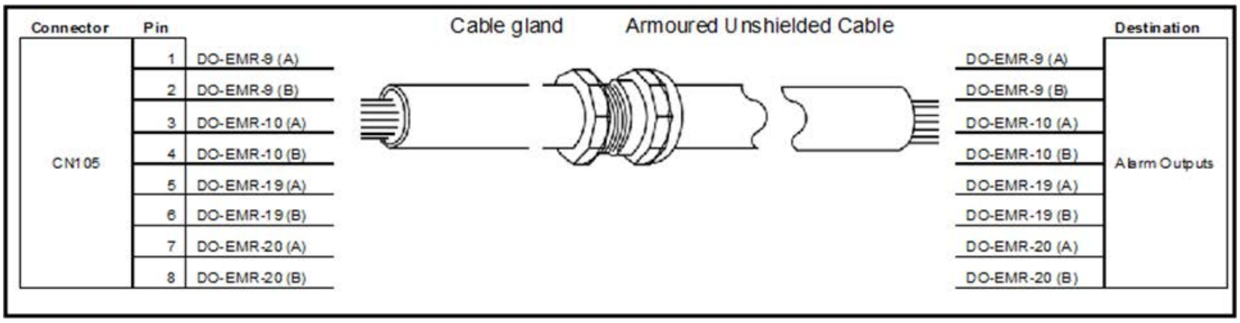


FIGURE 4-13 DC cable 1 (gland 3)

4.7.6.4 AC Cable 3 (Gland 4)

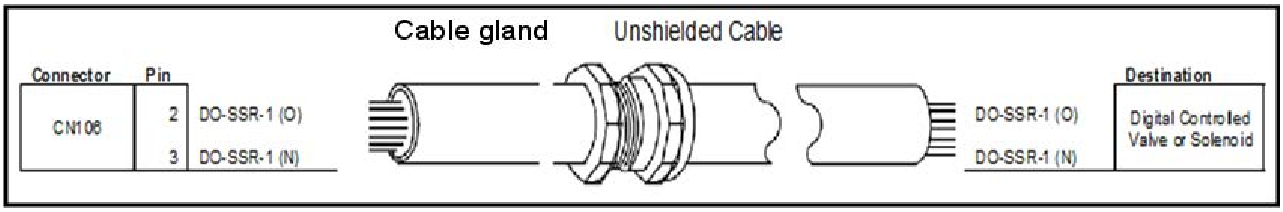


FIGURE 4-14 AC cable 3 (gland 4)

4.7.6.5 AC Cable 4 (Gland 5)

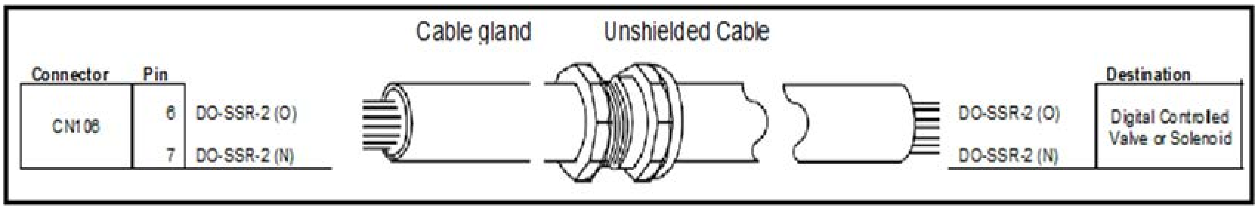


FIGURE 4-15 AC cable 4 (gland 5)

4.7.6.6 Analog Cable 1 (Gland 6)

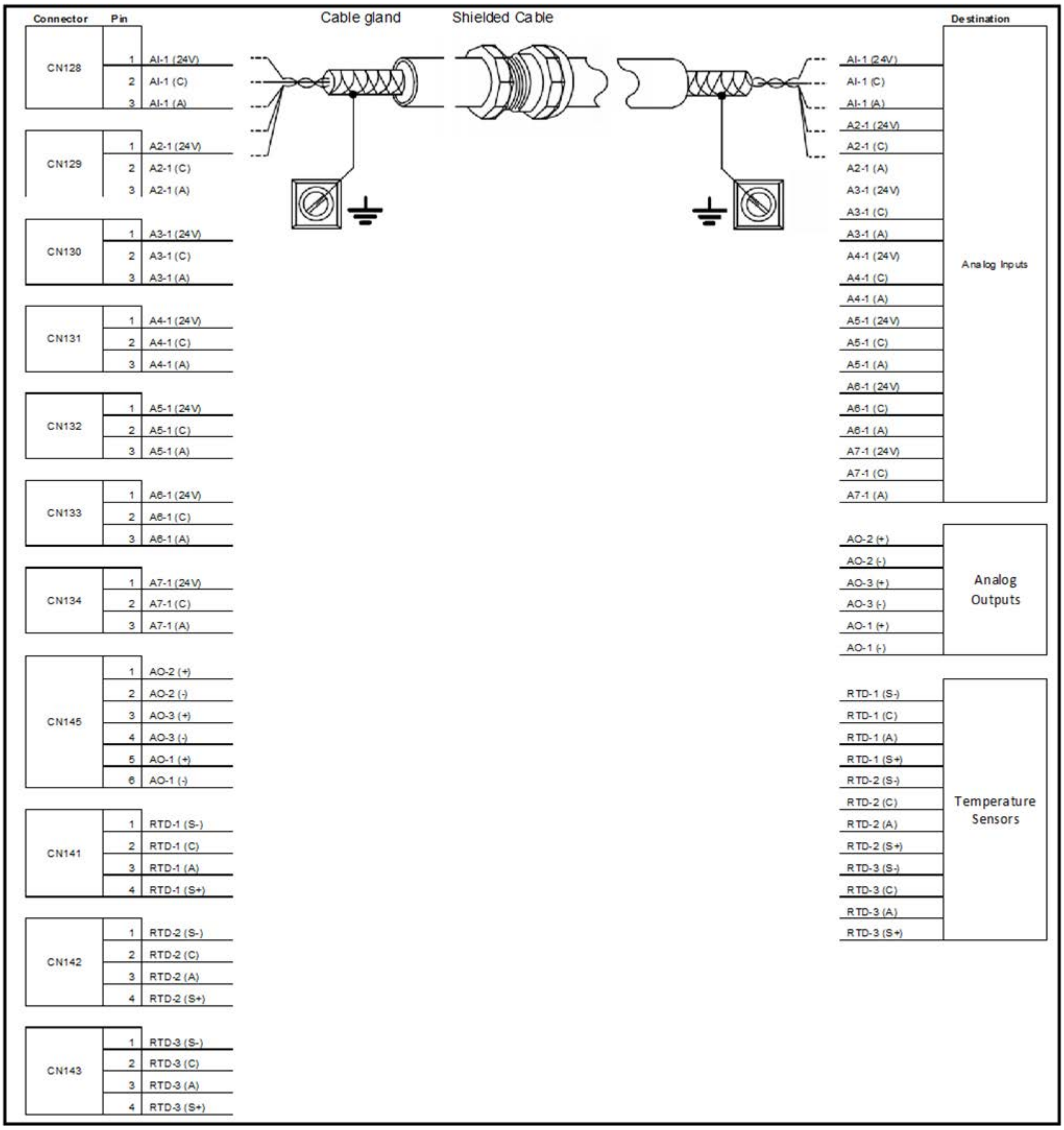


FIGURE 4-16 Analog cable 1 (gland 6)

4.7.6.7 AC Cable 5 (Gland 7)

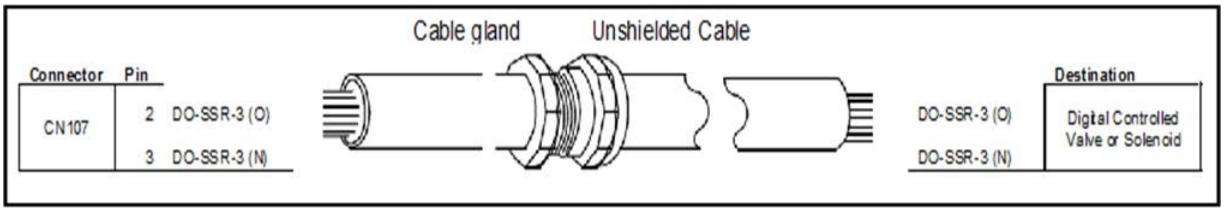


FIGURE 4-17 AC cable 5 (gland 7)

4.7.6.8 DC Cable 2 (Gland 8)

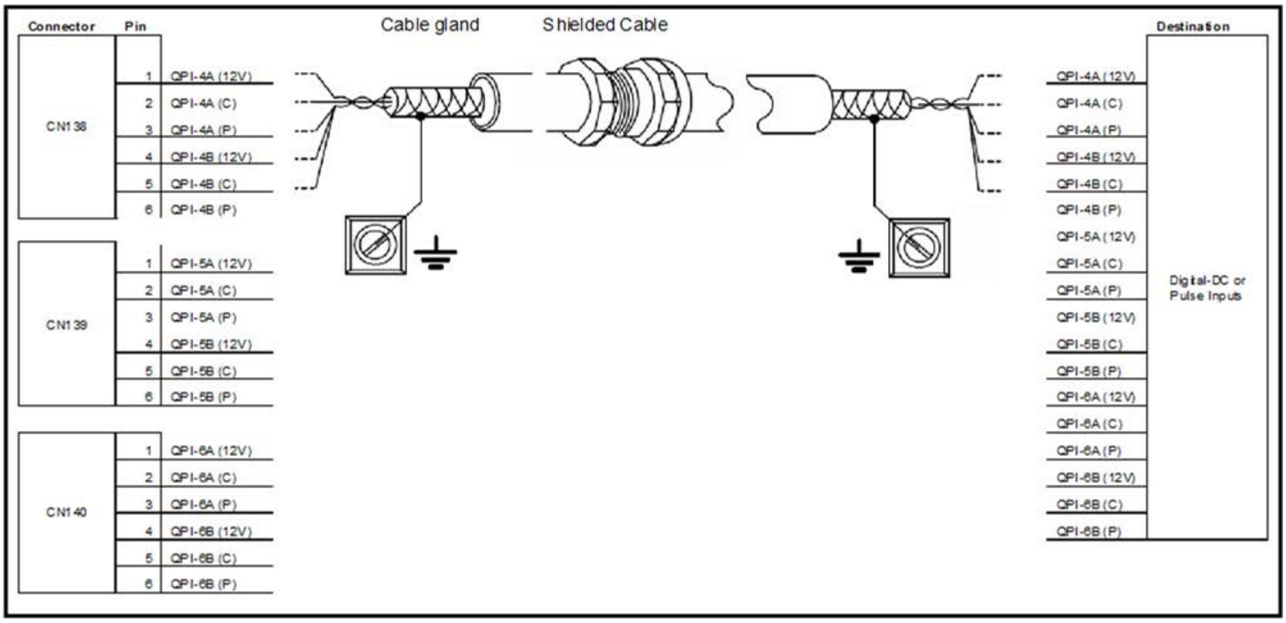


FIGURE 4-18 DC cable 2 (gland 8)

4.7.6.9 DC Cable 3 (Gland 9)

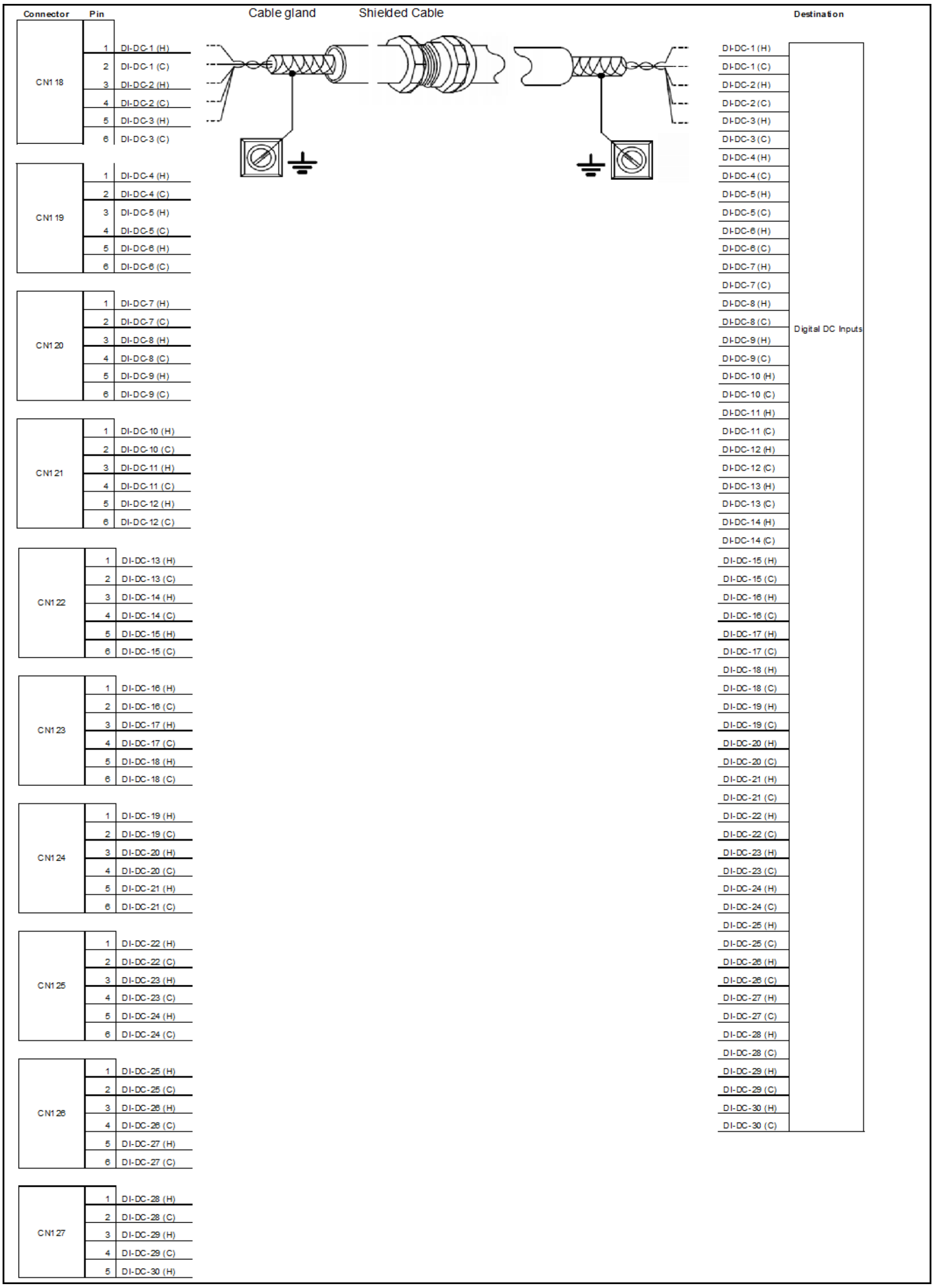


FIGURE 4-19 DC cable 3 (gland 9)

4.7.6.10 DC Cable 4 (Gland 10)

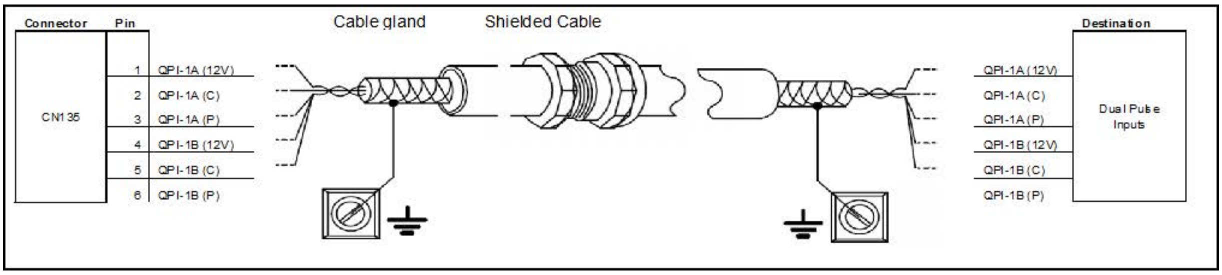


FIGURE 4-20 DC cable 4 (gland 10)

4.7.6.11 DC Cable 5 (Gland 11)

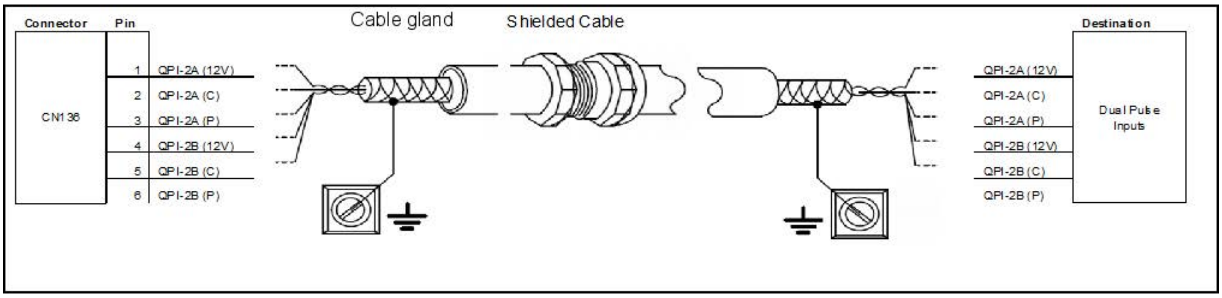


FIGURE 4-21 DC cable 5 (gland 11)

4.7.6.12 Comms Cable 1 (Gland 12)

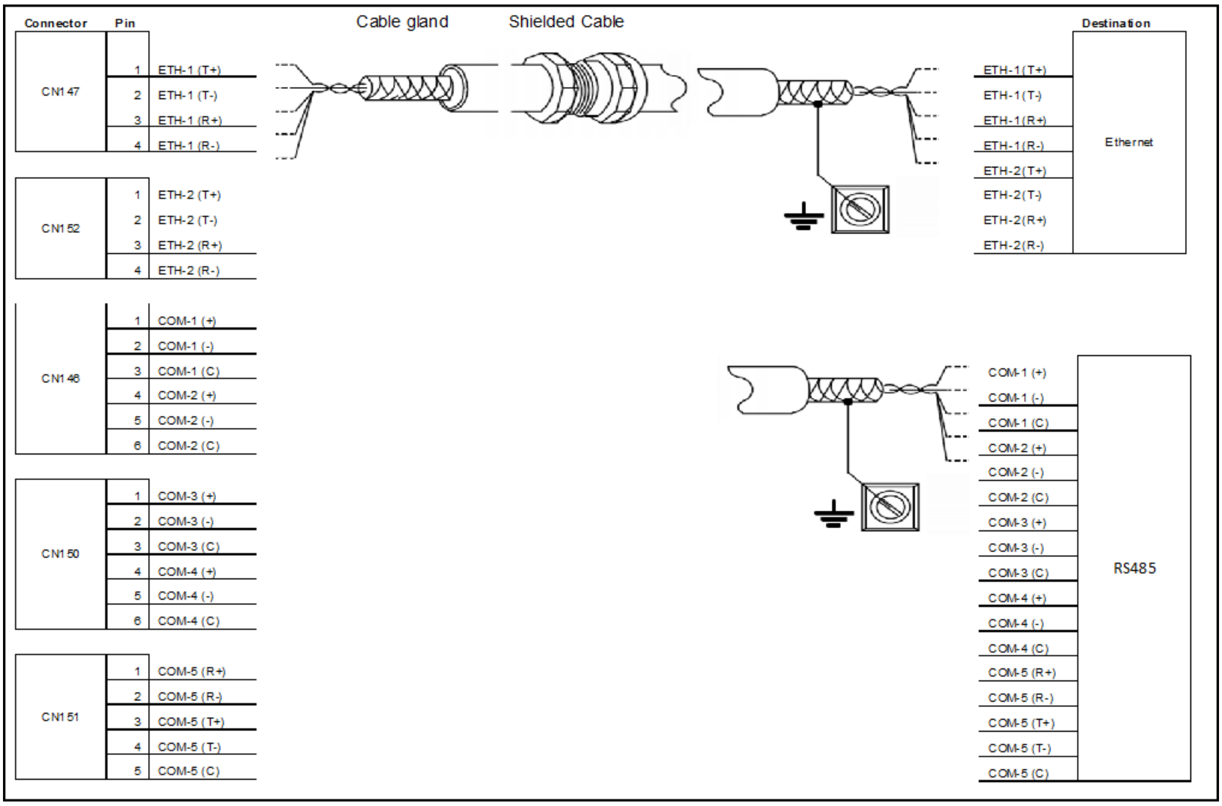


FIGURE 4-22 Comms cable 1 (gland 12)

4.7.6.13 DC Cable 6 (Gland 13)

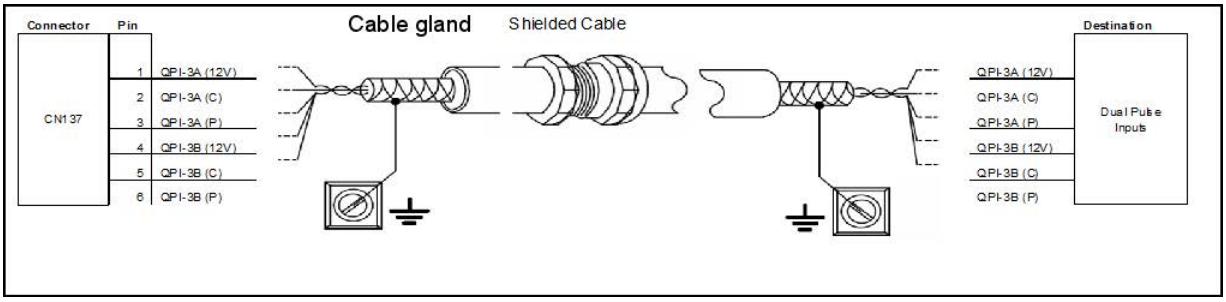


FIGURE 4-23 DC cable 6 (gland 13)

4.7.6.14 DC Cable 7 (Gland 14)

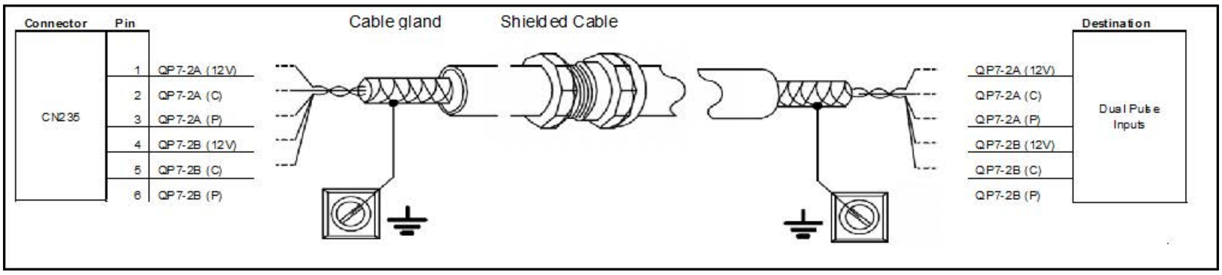


FIGURE 4-24 DC cable 7 (gland 14)

4.7.6.15 Comms Cable 2 (Gland 15)

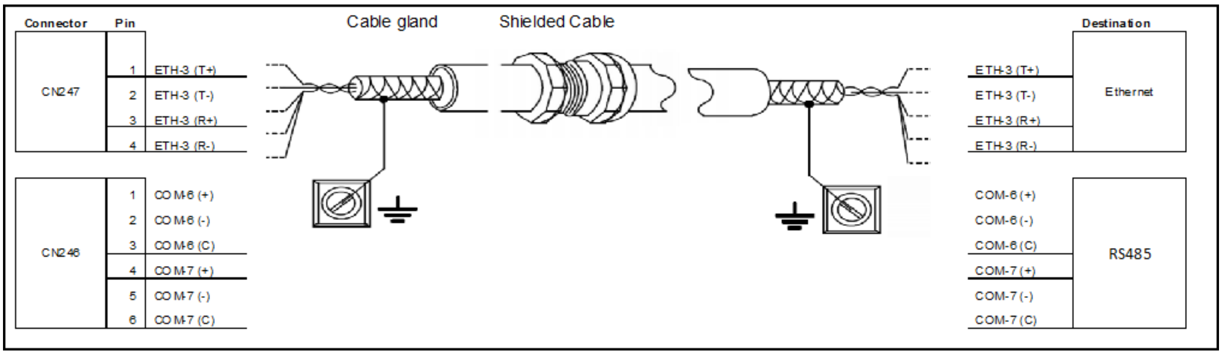


FIGURE 4-25 Comms cable 2 (gland 15)

4.7.6.16 DC Cable 8 (Gland 16)

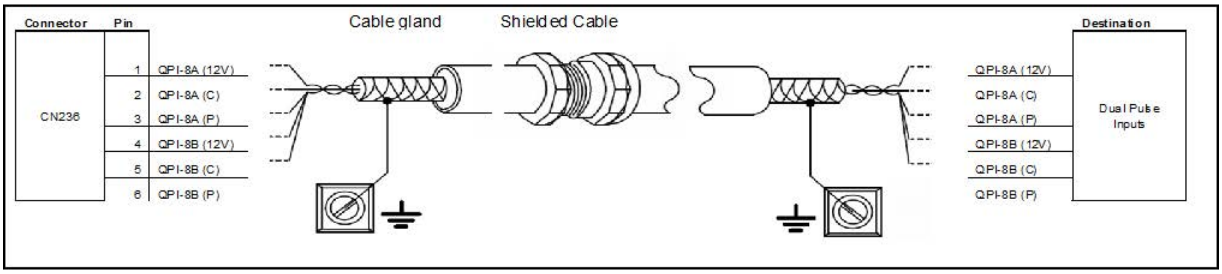


FIGURE 4-26 DC cable 8 (gland 16)

4.7.6.17 DC Cable 9 (Gland 17)

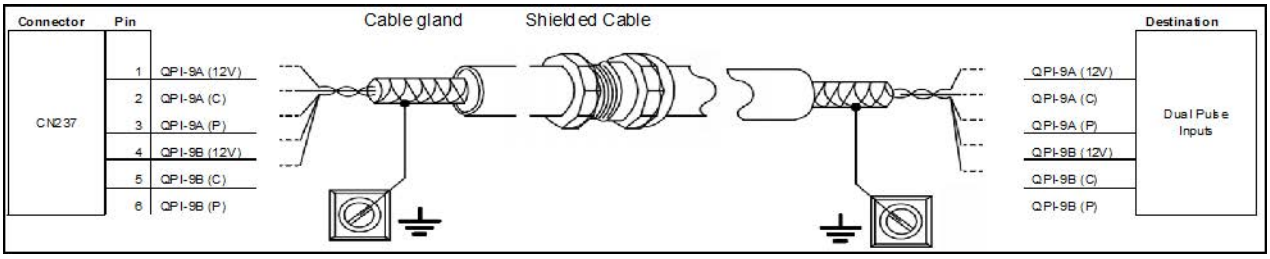


FIGURE 4-27 DC cable 9 (gland 17)

4.7.6.18 AC Cable 6 (Gland 18)

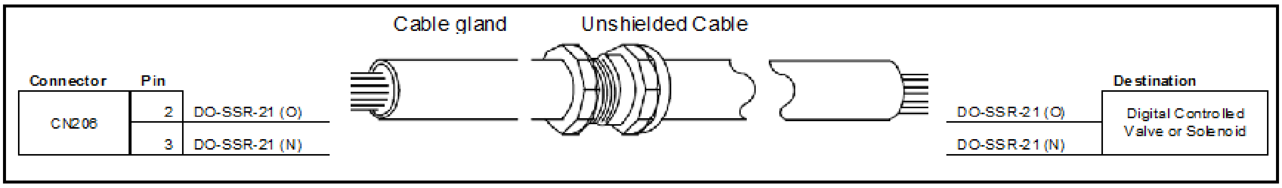


FIGURE 4-28 AC cable 6 (Gland 18)

4.7.6.19 DC Cable 10 (Gland 19)

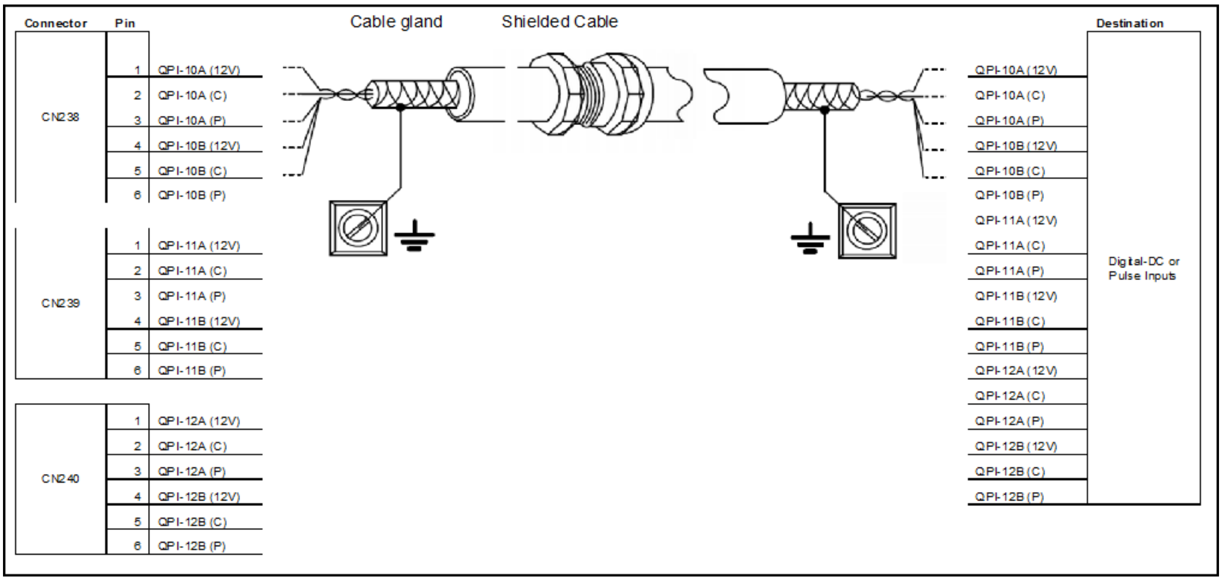


FIGURE 4-29 DC cable 10 (gland 19)

4.7.6.20 DC Cable 11 (Gland 20)

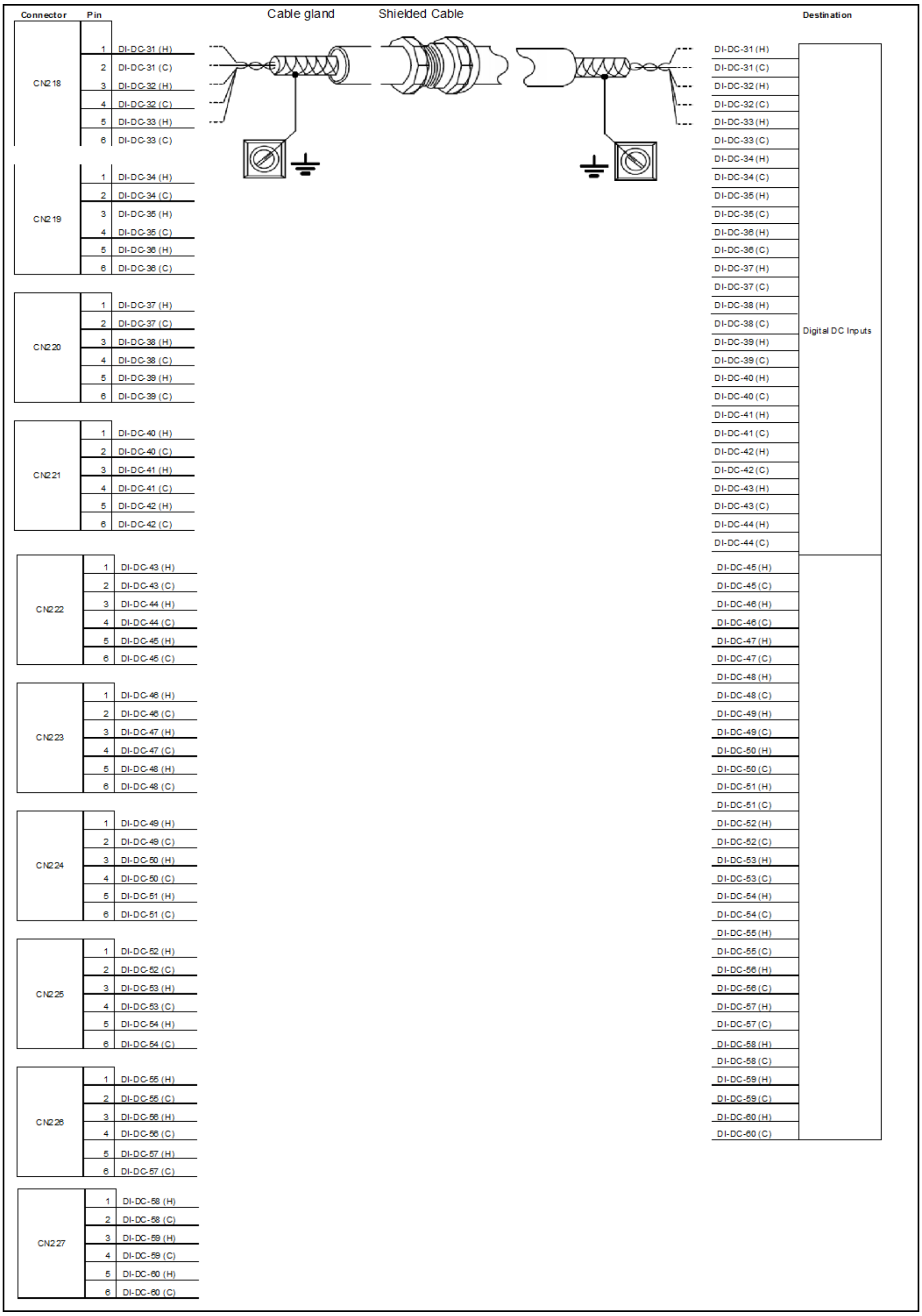


FIGURE 4-30 DC cable 11 (gland 20)

4.7.6.21 AC Cable 7 (Gland 21)

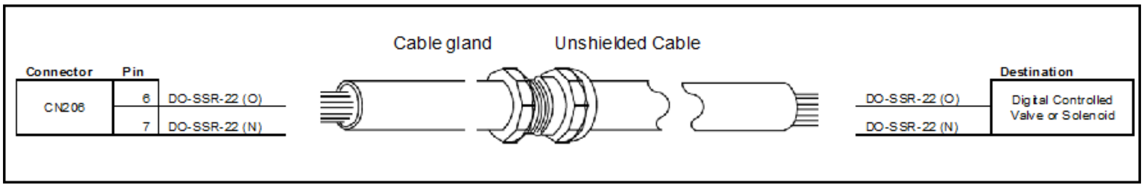


FIGURE 4-31 AC cable 7 (gland 21)

4.7.6.22 AC Cable 8 (Gland 22)

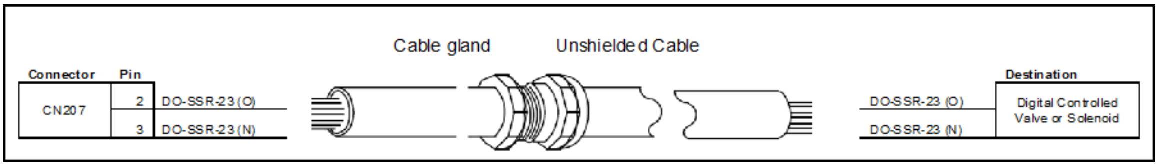


FIGURE 4-32 AC cable 8 (gland 22)

4.7.6.23 Analog Cable 2 (Gland 23)

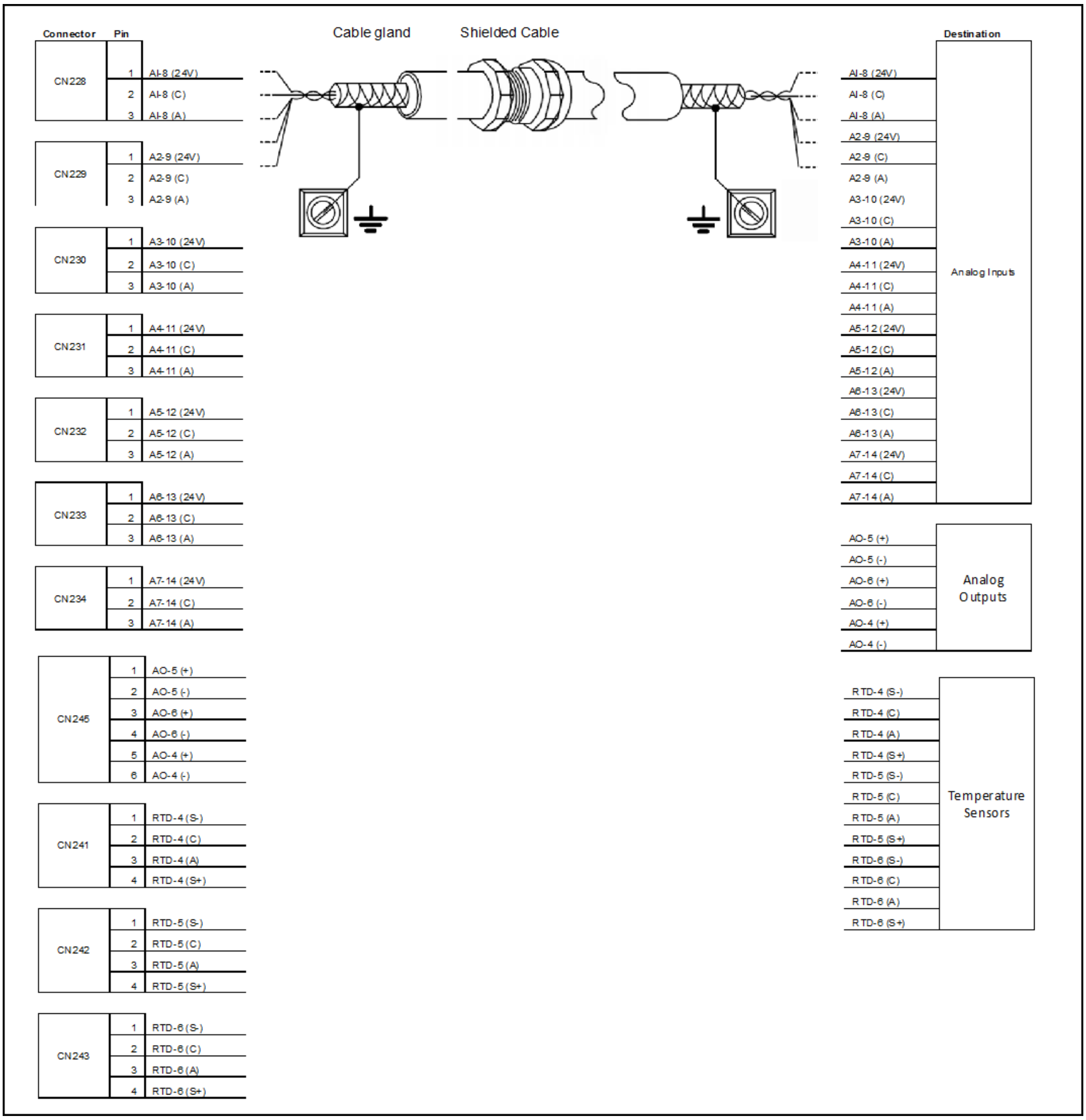


FIGURE 4-33 Analog cable 2 (gland 23)

4.7.6.24 AC Cable 9 (Gland 24)

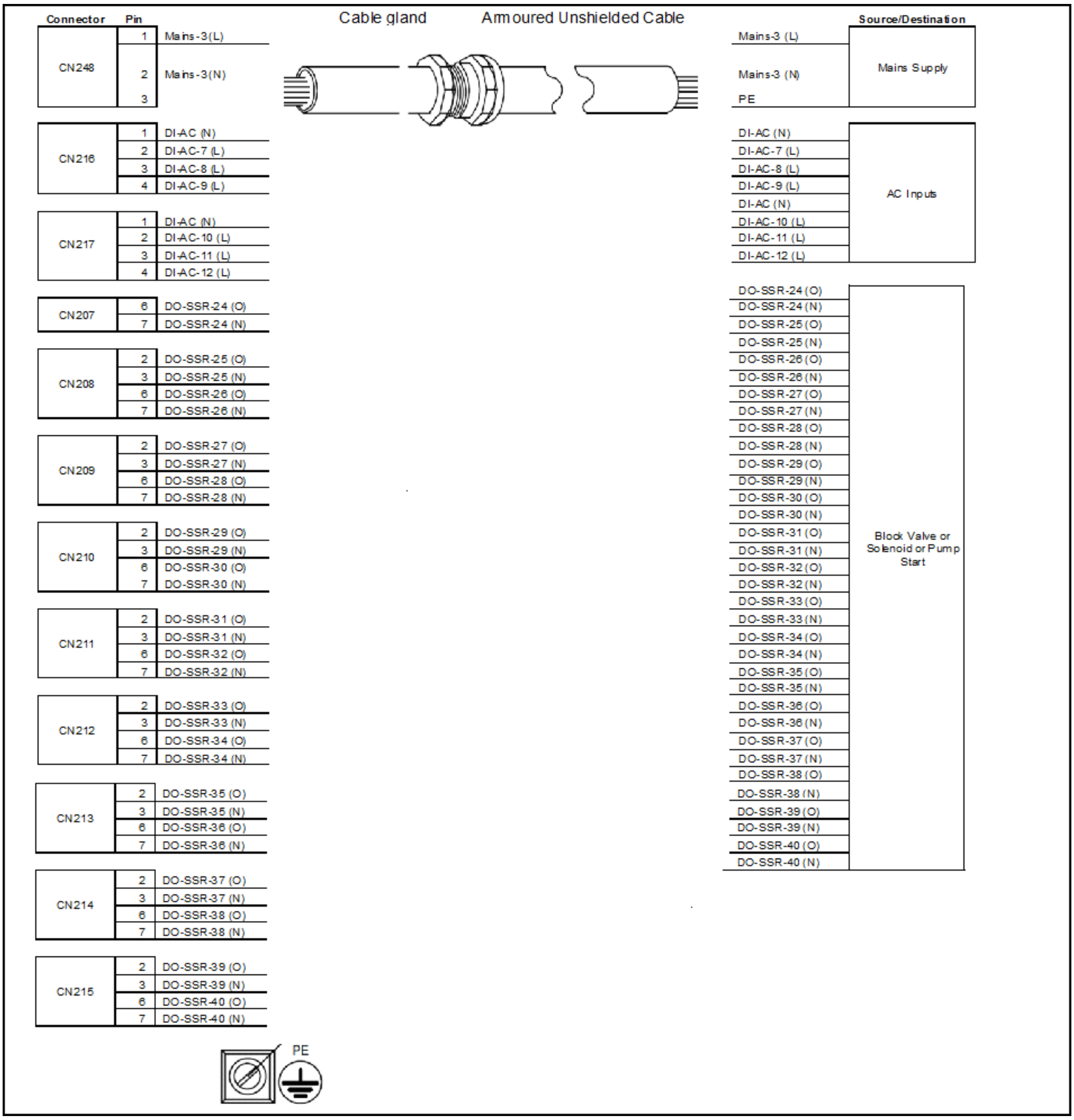


FIGURE 4-34 AC cable 9 (gland 24)

4.7.6.25 AC Cable 10 (Gland 25)

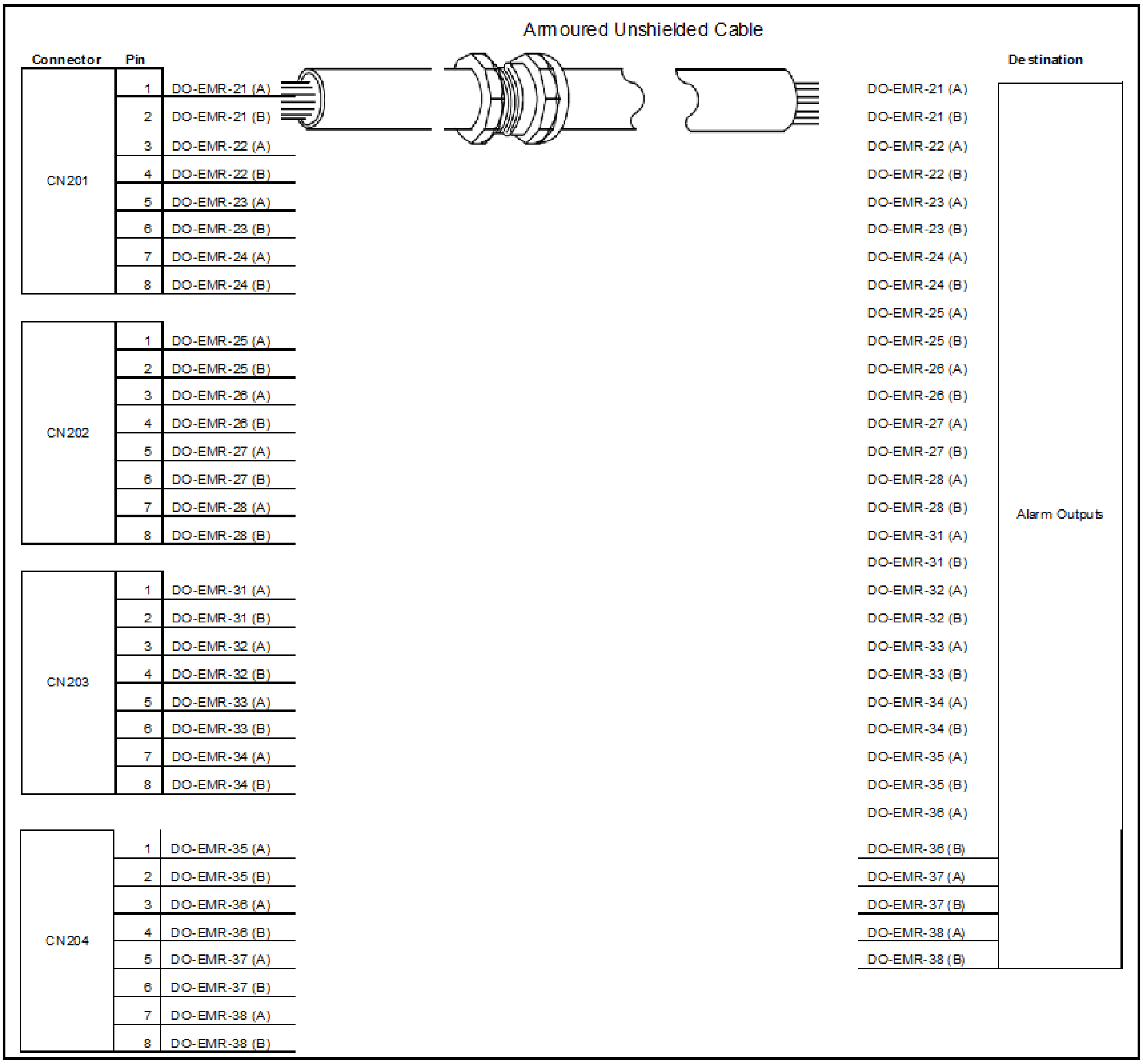


FIGURE 4-35 AC cable 10 (gland 25)

4.7.6.26 DC Cable 12 (Gland 26)

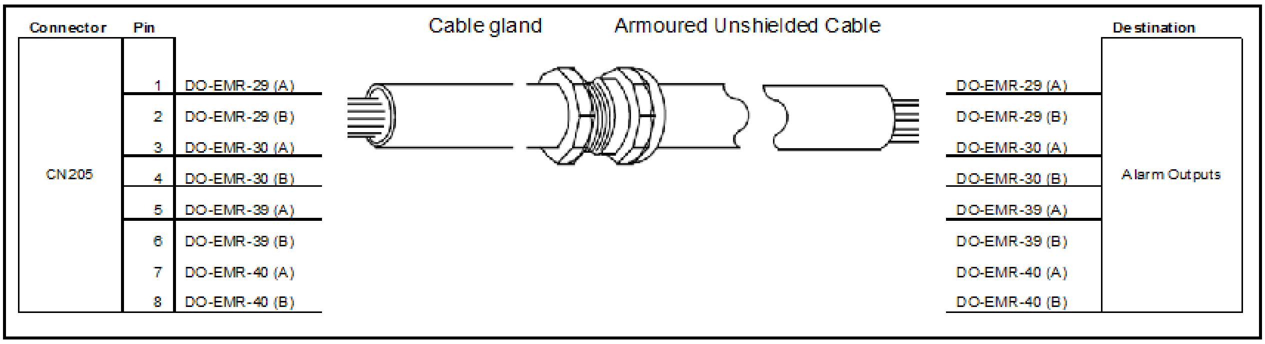
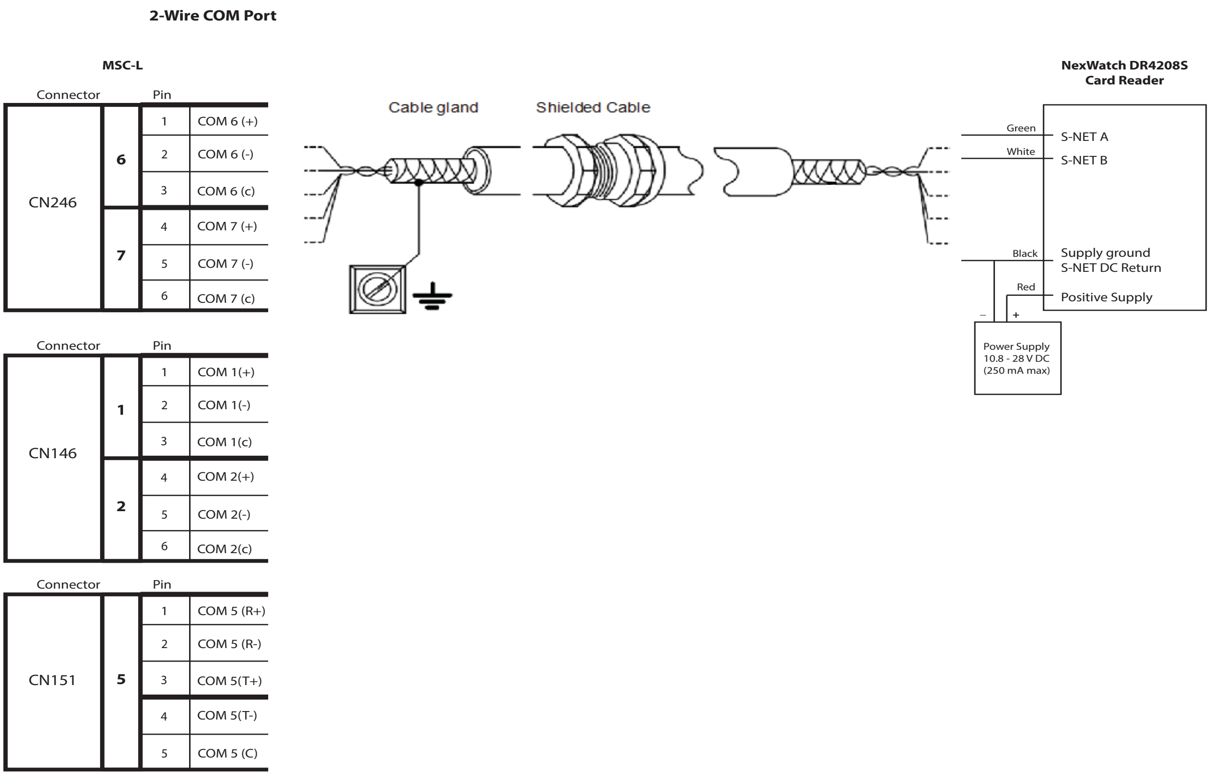


FIGURE 4-36 DC cable 12 (gland 26)

4.7.7 Connecting MSC-L to NexWatch DR4208S Card Reader



4.7.8 ARM-1-BACKPLANE-MSC Terminal Assignment Guide

The following table provides information for the basic function assignment to specific terminals. Majority of the MSC-L 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 Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid
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 Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid
CN-103						

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
1	DO-EMR-11	A	EMR11_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid
8	DO-EMR-14	B	EMR_common	Neutral		
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 Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid
8	DO-EMR-18	B	EMR_common	Neutral		
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 Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid
8	DO-EMR-20	B	EMR_common	Neutral		
CN-106						

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
1	DO-SSR-1	F	SSr1_feed	Feed	High frequency, fast switching AC output control.	Actuator outputs Additive solenoid Additive injection feedback
2	DO-SSR-1	O	SSr1_sw	Signal - Output		
3	DO-SSR-1	N	N	Neutral		
4	DO-SSR-1	L	L	A/C Live		
5	DO-SSR-2	F	SSr2_feed	Feed		
6	DO-SSR-2	O	SSr2_sw	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
7	DO-SSR-2	N	N	Neutral		
8	DO-SSR-2	L	L	A/C Live		
CN-107						
1	DO-SSR-3	F	SSr3_feed	Feed	High frequency, fast switching AC output control.	Actuator outputs Additive solenoid Additive injection feedback
2	DO-SSR-3	O	SSr3_sw	Signal - Output		
3	DO-SSR-3	N	N	Neutral		
4	DO-SSR-3	L	L	A/C Live		
5	DO-SSR-4	F	SSr4_feed	Feed		
6	DO-SSR-4	O	SSr4_sw	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
7	DO-SSR-4	N	N	Neutral		
8	DO-SSR-4	L	L	A/C 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.	Actuator outputs 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 Product block valve 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		
CN-109						
1	DO-SSR-7	F	SSr7_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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 Product block valve 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.	Actuator outputs 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		
6	DO-SSR-10	O	SSr10_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
7	DO-SSR-10	N	N	Neutral		
8	DO-SSR-10	L	L	Live		
CN-111						
1	DO-SSR-11	F	SSr11_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-12	O	SSr12_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
7	DO-SSR-12	N	N	Neutral		
8	DO-SSR-12	L	L	Live		
CN-112						
1	DO-SSR-13	F	SSr13_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-14	O	SSr14_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
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.	Actuator outputs 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		
6	DO-SSR-16	O	SSr16_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
7	DO-SSR-16	N	N	Neutral		
8	DO-SSR-16	L	L	Live		
CN-114						
1	DO-SSR-17	F	SSr17_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-18	O	SSr18_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
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.	Actuator outputs 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		
6	DO-SSR-20	O	SSr20_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Product block valve Additive blocking valve
7	DO-SSR-20	N	N	Neutral		
8	DO-SSR-20	L	L	Live		
CN-116						
1	DI-AC-1, 2, 3	N	AC_NEUTRAL	Neutral	AC input control	Programmable inputs ESD input
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	Programmable inputs ESD input
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		
CN-118						
1	DI-DC-1	H	DC1_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-119						
1	DI-DC-4	H	DC4_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		
CN-120						
1	DI-DC-7	H	DC7_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		
CN-121						
1	DI-DC-10	H	DC10_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		
CN-122						
1	DI-DC-13	H	DC13_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-123						
1	DI-DC-16	H	DC16_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		
CN-124						
1	DI-DC-19	H	DC19_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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	Programmable Inputs ESD input
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		
CN-126						
1	DI-DC-25	H	DC25_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-127						
1	DI-DC-28	H	DC28_hi	Signal - Input	DC input control	Programmable Inputs ESD input
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		
CN-128						
1	AI-1	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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. 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)		
CN-130						
1	AI-3	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. Digital mode for "digital input".
2	AI-3	C	24 V common	Common (passive mode)		
3	AI-3	A	Analog signal	Signal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-131						
1	AI-4	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. Digital mode for "digital input".
2	AI-4	C	24 V common	Common (passive mode)		
3	AI-4	A	Analog signal	Signal - Input (active + passive mode)		
CN-132						
1	AI-5	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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. 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)		
CN-134						
1	AI-7	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
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) Product flow meter (single or dual pulse)
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		
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) Product flow meter (single or dual pulse)
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) Product flow meter (single or dual pulse)
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) Product flow meter (single or dual pulse).
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) Product flow meter (single or dual pulse)
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		
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) Product flow meter (single or dual pulse)
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
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		
CN-142						
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		
CN-143						
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		
CN-144						
1	PO-1	HI	Po1_HI	Feed	Pulse output control	Real time pulse output, factored pulse output. Additive injection feedback, Alarm shutdown, Alarm indication, Pump start, Additive blocking valve
2	PO-1	LO	Po1_LO	Signal - Output		
3	PO-2	HI	Po2_HI	Feed		
4	PO-2	LO	Po2_LO	Signal - Output		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-145						
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 (+)		
4	AO-3	-	AO_b3	Signal - Output (-)		
5	AO-1	+	AO_a1	Signal - Output (+)		
6	AO-1	-	AO_b1	Signal - Output (-)		
CN-146						
1	COM-1	+	RS485_A_CH1	Receive	RS485 communication interface (2-wire)	Preferred interface to: TAS, Fusion4 Portal
2	COM-1	-	RS485_B_CH1	Transmit		
3	COM-1	C	RS485_Common_CH1	0 V		
4	COM-2	-	RS485_A_CH2	Receive		
5	COM-2	+	RS485_A_CH2	Transmit		
6	COM-2	C	RS485_Common_CH2	0 V		
CN-147						
1	ETH-1	T+	ETHER_TXP	Transmit positive	Ethernet communication interface	Preferred interface to: TAS, Fusion4 Portal
2	ETH-1	T-	ETHER_TXN	Transmit negative		
3	ETH-1	R+	ETHER_RXP	Receive positive		
4	ETH-1	R-	ETHER_RXN	Receive negative		
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
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		
CN-150						
1	COM-3	+	RS485_A_CH3	Receive	RS485 communication interface (2-wire)	Preferred interface to: TAS, Fusion4 Portal
2	COM-3	-	RS485_B_CH3	Transmit		
3	COM-3	C	RS485_Common_CH3	0 V		
4	COM-4	+	RS485_A_CH4	Receive		
5	COM-4	-	RS485_B_CH4	Transmit		
6	COM-4	C	RS485_Common_CH4	0 V		
CN-151						
1	COM-5	R+	RS485_A_CH5	Receive positive	RS485 communication interface (4-wire)	Preferred interface to: TAS, Fusion4 Portal
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_Common_CH5	0 V		
CN-152						
1	ETH-2	T+	ETHER_TXP	Transmit positive	Ethernet communication interface	Preferred interface to: TAS, Fusion4 Portal
2	ETH-2	T-	ETHER_TXN	Transmit negative		
3	ETH-2	R+	ETHER_RXP	Receive positive		
4	ETH-2	R-	ETHER_RXN	Transmit negative		

4.7.9 ARM-2-BACKPLANE-MSC Terminal Assignment Guide

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

Majority of the MSC-L 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 Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid
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 Product block valve Deadman callout Deadman bell
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		Secondary interface for: Actuator output Additive solenoid

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-203						
1	DO-EMR-31	A	EMR31_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Product block valve Deadman callout Deadman bell Secondary interface for: Actuator output Additive solenoid
2	DO-EMR-31	B	EMR_common	Neutral		
3	DO-EMR-32	A	EMR32_no	Signal - Output		
4	DO-EMR-32	B	EMR_common	Neutral		
5	DO-EMR-33	A	EMR33_no	Signal - Output		
6	DO-EMR-33	B	EMR_common	Neutral		
7	DO-EMR-34	A	EMR34_no	Signal - Output		
8	DO-EMR-34	B	EMR_common	Neutral		
CN-204						
1	DO-EMR-35	A	EMR35_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Product block valve Deadman callout Deadman bell Secondary interface for: Actuator output Additive solenoid
2	DO-EMR-35	B	EMR_common	Neutral		
3	DO-EMR-36	A	EMR36_no	Signal - Output		
4	DO-EMR-36	B	EMR_common	Neutral		
5	DO-EMR-37	A	EMR37_no	Signal - Output		
6	DO-EMR-37	B	EMR_common	Neutral		
7	DO-EMR-38	A	EMR38_no	Signal - Output		
8	DO-EMR-38	B	EMR_common	Neutral		
CN-205						
1	DO-EMR-29	A	EMR29_no	Signal - Output	Low frequency slow switching AC or DC output control.	Alarm shutdown Alarm indication Pump start Product block valve Deadman callout Deadman bell Secondary interface for: Actuator output Additive solenoid
2	DO-EMR-29	B	EMR_common	Neutral		
3	DO-EMR-30	A	EMR30_no	Signal - Output		
4	DO-EMR-30	B	EMR_common	Neutral		
5	DO-EMR-39	A	EMR39_no	Signal - Output		
6	DO-EMR-39	B	EMR_common	Neutral		
7	DO-EMR-40	A	EMR40_no	Signal - Output		
8	DO-EMR-40	B	EMR_common	Neutral		

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.	Actuator outputs 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		
6	DO-SSR-22	O	SSr22_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
7	DO-SSR-22	N	N	Neutral		
8	DO-SSR-22	L	L	Live		
CN-207						
1	DO-SSR-23	F	SSr23_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-24	O	SSr24_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
7	DO-SSR-24	N	N	Neutral		
8	DO-SSR-24	L	L	Live		
CN-208						
1	DO-SSR-25	F	SSr25_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-26	O	SSr26_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
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.	Actuator outputs 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		
CN-210						
1	DO-SSR-29	F	SSr29_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
CN-211						
1	DO-SSR-31	F	SSr31_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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.	Actuator outputs 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		
6	DO-SSR-34	O	SSr34_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
7	DO-SSR-34	N	N	Neutral		
8	DO-SSR-34	L	L	Live		
CN-213						
1	DO-SSR-35	F	SSr35_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-36	O	SSr36_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
7	DO-SSR-36	N	N	Neutral		
8	DO-SSR-36	L	L	Live		
CN-214						
1	DO-SSR-37	F	SSr37_feed_ac	Feed	High frequency, fast switching AC output control.	Actuator outputs 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		
6	DO-SSR-38	O	SSr38_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
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.	Actuator outputs 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		
6	DO-SSR-40	O	SSr40_sw_ac	Signal - Output		Alarm shutdown Alarm indication Pump start Additive blocking valve
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	Programmable inputs ESD input
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		
CN-217						
1	DI-AC-10, 11, 12	N	AC_NEUTRAL	Neutral	AC input control	Programmable inputs ESD input
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-218						
1	DI-DC-31	H	DC31_hi	Signal - Input	DC input control	Programmable inputs ESD input
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		
CN-219						
1	DI-DC-34	H	DC34_hi	Signal - Input	DC input control	Programmable inputs ESD input
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	Programmable inputs ESD input
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		
CN-221						
1	DI-DC-40	H	DC40_hi	Signal - Input	DC input control	Programmable inputs ESD input
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-222						
1	DI-DC-43	H	DC43_hi	Signal - Input	DC input control	Programmable inputs ESD input
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		
CN-223						
1	DI-DC-46	H	DC46_hi	Signal - Input	DC input control	Programmable inputs ESD input
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	Programmable inputs ESD input
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		
CN-225						
1	DI-DC-52	H	DC52_hi	Signal - Input	DC input control	Programmable inputs ESD input
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-226						
1	DI-DC-55	H	DC55_hi	Signal - Input	DC input control	Programmable inputs ESD input
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		
CN-227						
1	DI-DC-58	H	DC58_hi	Signal - Input	DC input control	Programmable inputs ESD input
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. 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)		
CN-229						
1	AI-9	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-230						
1	AI-10	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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)		
CN-231						
1	AI-11	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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. 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)		
CN-233						
1	AI-13	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. Digital mode for "digital input".
2	AI-13	C	24 V common	Common (passive mode)		
3	AI-13	A	Analog signal	Sgnal - Input (active + passive mode)		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-234						
1	AI-14	24 V	24 V	Power (active mode)	Analog input control	4-20 mA input for temperature measurement. 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)		
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) Product flow meter (single or dual pulse).
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) Product flow meter (single or dual pulse).
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) Product flow meter (single or dual pulse).
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		
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) Product flow meter (single or dual pulse).
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		
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) Product flow meter (single or dual pulse).
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) Product flow meter (single or dual pulse).
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		
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		

Terminal	I/O	Floor plan ID	Signal name	Signal description	Type	Typical functions
CN-244						
1	PO-3	HI	Po3_HI	Feed	Pulse output control	
2	PO-3	LO	Po3_LO	Signal - Output		
3	PO-4	HI	Po4_HI	Feed		
4	PO-4	LO	Po4_LO	Signal - Output		
CN-245						
1	AO-5	+	AO_a5	Signal - Output (+)	Analog output control	
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: TAS Fusion4 Portal Smart Additive
2	COM-6	-	RS485_B_CH6	Transmit		
3	COM-6	C	RS485_Common_CH6	0 V		
4	COM-7	+	RS485_A_CH7	Receive		
5	COM-7	-	RS485_A_CH7	Transmit		
6	COM-7	C	RS485_Common_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: TAS Fusion4 Portal Smart Additive
2	ETH-3	T-	ETHER_TXN	Transmit negative		
3	ETH-3	R+	ETHER_RXP	Receive positive		
4	ETH-3	R-	ETHER_RXN	Receive negative		
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		

CHAPTER 5 OPERATION

5.1 General

5.1.1 Introduction

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

Commissioning the MSC-L is accomplished by configuring entities (or parameters) to the required values. This is performed using the menu options of the MSC-L. See section *5.4 - Menu and Navigation*, for more information.

5.1.2 Text Conventions

In contrast with the explanatory text, all instructions are preceded by a (➔).

All [Entity] and <entity-related> texts 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-L 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.
- The keyboard.

FIGURE 5-1 Service interfaces of the MSC-L

5.3 Service Tools

5.3.1 Fusion4 IR Controller

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

The infrared receiver on the MSC-L 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-L.

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-L uses seven of the Fusion4 IR controller buttons. These buttons (**∧**, **v**, **<**, **>**, **OK**, **ESC**) are provided in bold text in FIGURE 5-2 and are explained in detail in section 5.3.4.1 - Basic Navigation (Fusion4 IR Controller + Fusion4 LAD).

FIGURE 5-2 The key functions of the Fusion4 IR Controller

NOTE:

- 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 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.

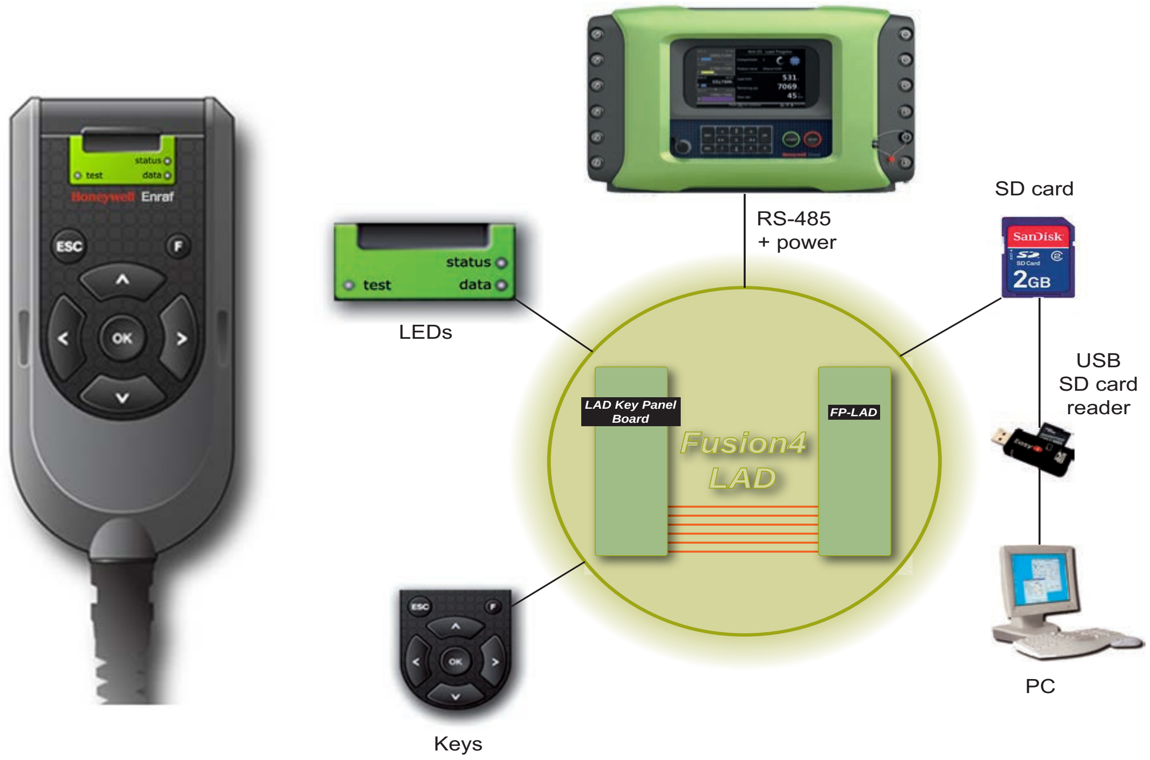


FIGURE 5-3 LAD and its system overview

NOTE: The LAD connection is not recognized by the MSC-L during an active IR Controller session. The LAD must be disconnected and then connected again after the IR Controller session is complete.

5.3.2.2 LAD Application Overview

FIGURE 5-4 LAD application overview

5.3.3 Integrated Keyboard

The keyboard is used for navigating to the user display functions. It also helps in providing inputs for the transaction work flow and the diagnostics functionality.

The EX-IO-HMI-MSC-L board is an interface between the keyboard, the LAD (outside the enclosure) and the HMI board. The keyboard contains the following functions:

1. 16 keypad switches on the MSC-L enclosure. These switches are connected to the enclosure.
2. A switch that is connected to the WnM slider on the MSC-L enclosure.
3. An LAD connector (CN1) where field connections from the external LAD module are connected.
4. A HMI connector (CN2), which is interfaced to the CAN-HMI-MSC board.

See the following figure for more details.

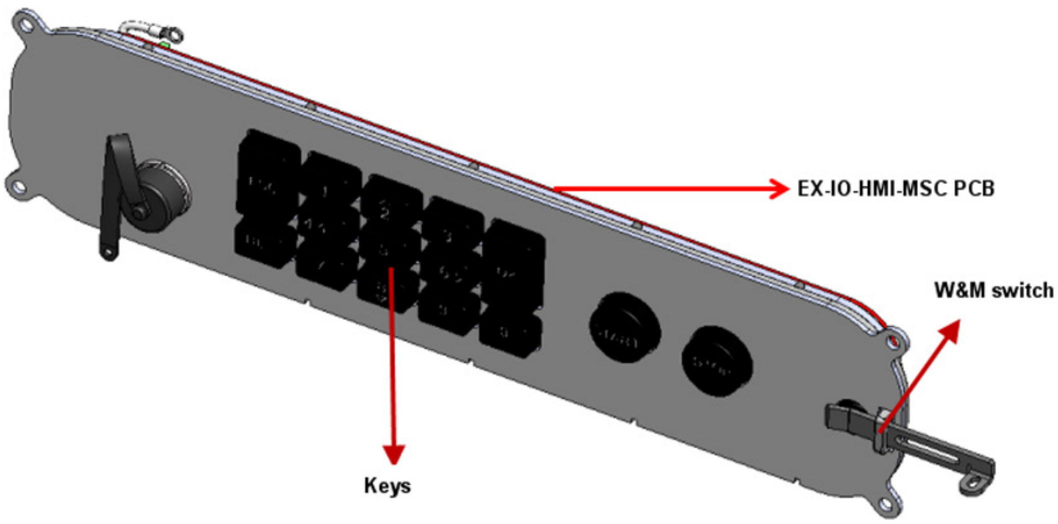


FIGURE 5-5 Keyboard

The following table describes the functionality of the individual keys on the keyboard.

Key name	Image	Description
ESC		Select the ESC key to return to the previous screen. NOTE: Hold the ESC key to enter the Service Technician logon screen.
DEL		Select the DEL key to clear the values entered.
OK		Select the OK key to select the item in focus and confirm the value. NOTE: Hold the OK key to enter the Service Technician logon screen and check the alarms or stream details.
Numeric Keys (0 - 9)		Select any of the numeric keys to enter the numerical values.
START		Select the START key to start a batch after it is setup.
STOP		Select the STOP key to stop all the running batches.
Navigation buttons		Select the navigation buttons to move left, right, up, or down to configure parameter entities in the device.

NOTE: The Negative symbol and decimal points can't be configured through keyboard. Use LAD to configure the same.

5.3.4 Navigation with Fusion4 IR Controller and Fusion4 LAD

5.3.4.1 Basic Navigation (Fusion4 IR Controller + Fusion4 LAD)

The basic navigation of the Fusion4 IR Controller, the Fusion4 LAD, and the Integrated keyboard are identical. See FIGURE 5-6.

Fusion4 IR Controller	Fusion4 LAD	Integrated Keyboard
		
Λ	= Up	
V	= Down	
<	= Left	
>	= Right	
OK	= Select	
ESC	= Back	
DEL (keyboard)	=Clear	

FIGURE 5-6 Basic navigation (Fusion4 IR Controller + Fusion4 LAD + Integrated keyboard)

5.3.4.2 LEDs (Fusion4 IR Controller + Fusion4 LAD)

<table>
<tr><th colspan="2">Fusion4 IR Controller</th><th colspan="2">Fusion4 LAD</th></tr>
<tr><td colspan="2">

</td><td colspan="2">

</td></tr>
<tr><td>Button</td><td>Description</td><td>Button</td><td>Description</td></tr>
<tr><td rowspan="6">send blinking</td><td rowspan="6">Fusion4 IR controller is ready for operation.

NOTE: When the LED is OFF, select the ATTN key on the LAD to “wake up” the Fusion4 IR controller.</td><td>status (dual-color)</td><td>• green = OK
• red = Fault</td></tr>
<tr><td>data (amber)</td><td>ON = data transfer

Note: Do NOT disconnect during data transfer.</td></tr>
<tr><td rowspan="4">test (dual-color)</td><td>• green = mapped I/O function has good health and is active.</td></tr>
<tr><td>• red = mapped I/O is inactive.</td></tr>
<tr><td>• red (blinking) = mapped I/O has bad health.</td></tr>
<tr><td>• off = no I/O mapping exists.</td></tr>
</table>

5.3.4.3 Special Function Key (Only LAD)

• User-defined LAD functions such as transferring transactions to the 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.	

5.3.4.4 SD Card

NOTE: *Format the SD card before using it for the first time. See section 5.19.6 - 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. See FIGURE 5-7.

FIGURE 5-7 SD card location in LAD (lid opened)

- The SD card uses a *FAT file system* to allow interpretability with Microsoft Windows platforms.
- The SD card is used for the 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

5.3.4.4.1 Product Type Selection

The selection of an SD card for the LAD is important. Due to the intrinsically safe design of the 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 cards are recommended by Honeywell Enraf.

Manufacturer	Series	Type	Capacity	Part Number
SanDisk	Industrial	SD	2GB	SDSDAA-002G
Swissbit	S-200	SD	1GB	SFSD1024L4BN2SA-E-D1-131-STD
Pretec	Industrial	SD	1GB	SDS001GSBHP
Transcend	Industrial	SDHC	2GB	TS2GSD80I
STEC	Industrial	SD	1GB	SLSD1GBBSIU

TABLE 6-1 Recommended SD cards

You are allowed to use SD cards not included in TABLE 6-1, but they must conform to the following specifications.

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

NOTE: Honeywell Enraf does NOT provide support for any cards not listed in TABLE 6-1. Contact Honeywell Enraf for more information.

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

5.3.4.4.2 *Directory Structure and File Organization*

FIGURE 5-8 Directory structure and file organization of the MSC-L

5.3.4.4.3 *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 = for Recipes
- File name format for **Transactions** are as follows:
  - <device-type>-<serial number>-<file-id>-<transaction-id>.xml
  - Example: `MSC-L-54639823-T-0123456789.xml`
- File name format for **Calibrations** are as follows:
  - <device-type>-<serial number>-<file-id>-<calibration-id>.xml
  - Example: `MSC-L-54639823-C-0123456789.xml`
- File name format for **Alarm logs** are as follows:
  - <device-type>-<serial number>-<file-id>.xml

- Example: `MSC-L-54639823-A.xml`

- File name format for **Debug logs** are as follows:
  - <device-type>-<serial number>-<file-id>.xml
  - Example: `MSC-L-54639823-D.xml`
- File name format for **Recipes** are as follows:
  - <device-type>-<file-id>-<recipe-name>.xml
  - Example: `MSC-L-R-E20.xml`
- File name format for **Configurations** are as follows:
  - <user defined string>.xml
  - Example: `MY_CONTROLLER_1.xml`

REMARKS:

1. Generic files built/edited in a computer environment can differ from the previous 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-L -LAD interaction.

3. Firmware files MUST be placed in the corresponding folders for the LAD and the MSC-L, otherwise they cannot be selected during the MSC-L-LAD interaction.

5.3.4.5 Language Packs

NOTE: The procedure to build a language pack for the MSC-L will be available in a later release.

5.3.4.5.1 Building a Local Language Pack for the MSC-L

NOTE: The procedure to build a custom language pack for the MSC-L will be available in a later release.

5.3.4.5.2 Configuring a User Display Language for the MSC-L

NOTE: The procedure to configure a user display language for the MSC-L will be available in a later release.

5.4 Menu and Navigation

5.4.1 General

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

The Main Menu consists of colored icons and logically structured sub-menus.

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-L.

- Clean, intuitive, and informative user interface.
- It is not necessary to memorize parameter codes and enumeration value.
- Wizard-based configuration for 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, Fusion4 LAD, and the integrated keyboard.
- 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-L.

- By default, the Diagnostics icon is selected.
- When an entity is selected, a white color focus rectangle appears around it.
- When a single stream is selected, the values for the entities of a single stream are displayed on the screen.
- When a single arm is selected, the values for the entities of a single arm are displayed on the screen.
- When all the streams are selected, the values for the entities are displayed only if the values are the same for all the streams, otherwise '.......' appears for the entities on the screen.

5.4.4 Main Menu

The following table provides detailed information for the main menu items on the MSC-L. For more details on the main menu items, see FIGURE 5-9.

Item	Description
Title bar	The title bar is the horizontal bar at the top of the screen that shows the name or description of the screen. For example, **Main Menu**.

Item	Description
Title Hierarchy	The title hierarchy is an arrangement of a particular set of entities. The entities are separated from each other by a dot (.).
Selected icon (focus rectangle)	The focus rectangle is used as an indicator of the selected entity.
Status bar icons	The status bar icons provides information of the selected icon. It also provides information about the TAS communication, sealing, actual time, and the lock icon.

FIGURE 5-9 Main Menu screens

5.4.5 Stream Selection

5.4.5.1 Product Streams

For some of the entities available in the MSC-L, for example, the <Accumulated totals>, a specific product stream needs to be selected.

When the entity is selected, the respective screen appears, on which you can select the required stream.

See the following screen for an example of the product stream selection.

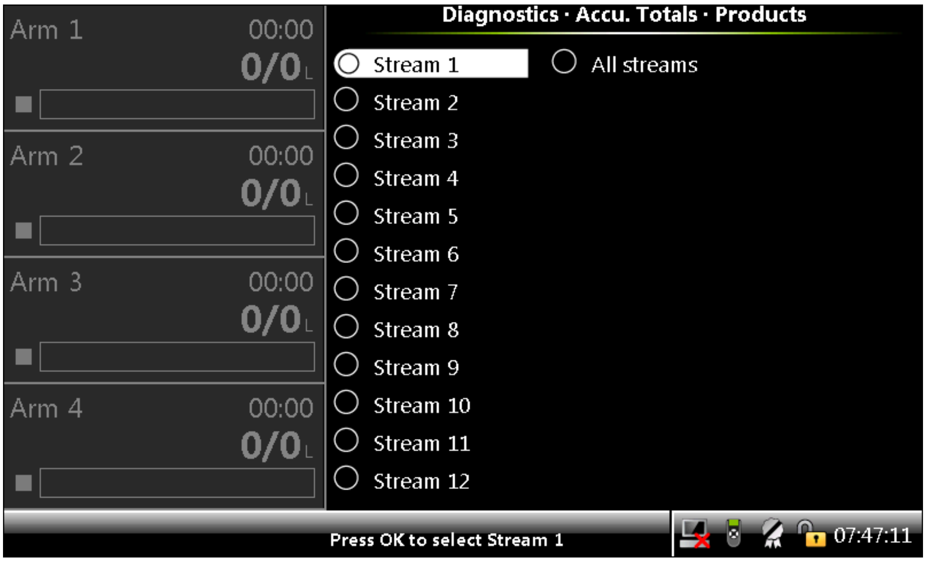


FIGURE 5-10 Product Stream Selection screen

5.4.5.2 Additive Streams

For some of the entities available in the MSC-L, for example, the <Accumulated totals>, a specific stream needs to be selected for the additive stream.

When the entity is selected, the respective screen appears, on which you can select the required stream.

See the following screen for an example of the additive stream selection.

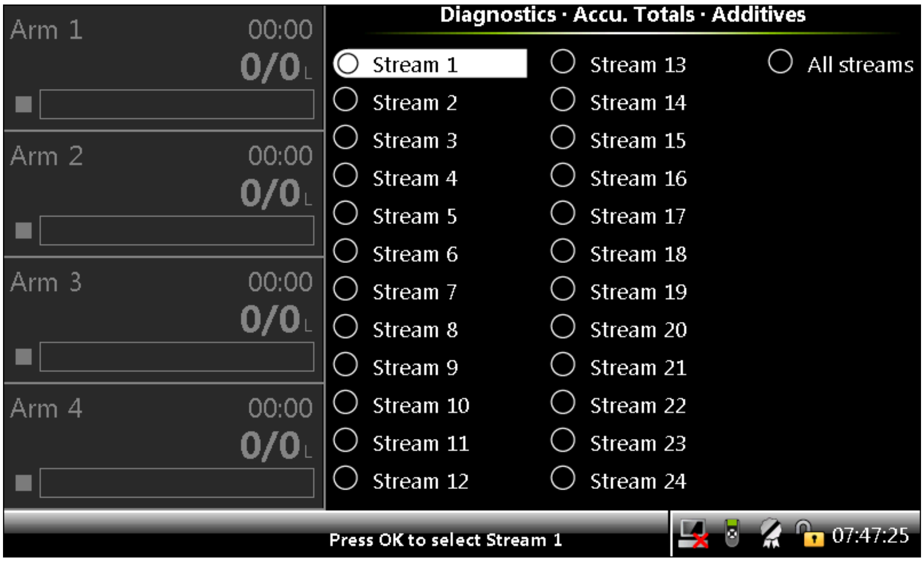


FIGURE 5-11 Additive Stream Selection screen

5.4.6 Arm Selection

For some of the entities available in the MSC-L, for example, the <Arm Configuration>, a specific arm needs to be selected.

When this menu is selected, the respective screen appears, on which you can select the required arm.

See the following screen for an example of the arm selection.

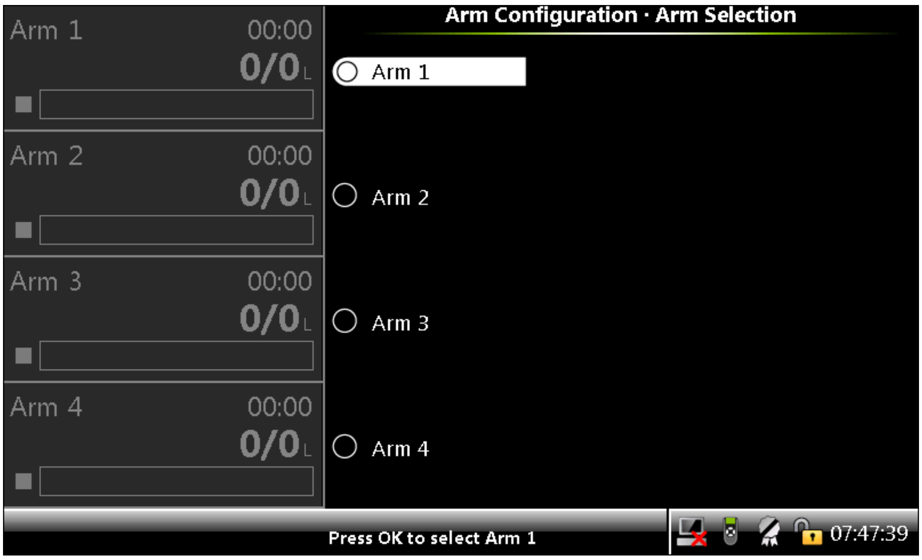


FIGURE 5-12 Arm Selection screen

5.4.7 Text Input Screen

See FIGURE 5-13 for a sample text input screen.

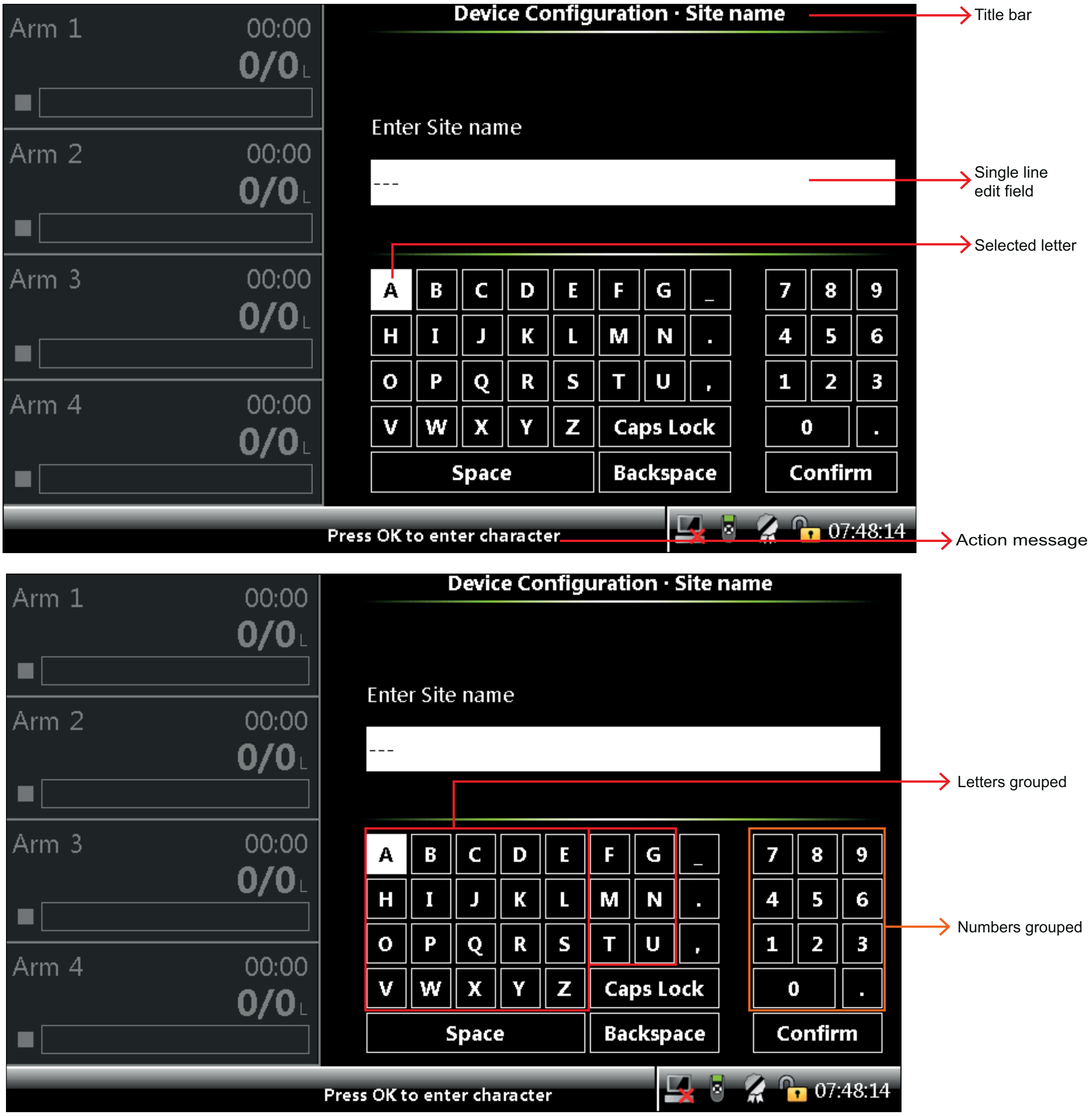


FIGURE 5-13 Text Input screen

5.4.8 Numeric Input Screen

See FIGURE 5-14 for a sample numeric input screen.

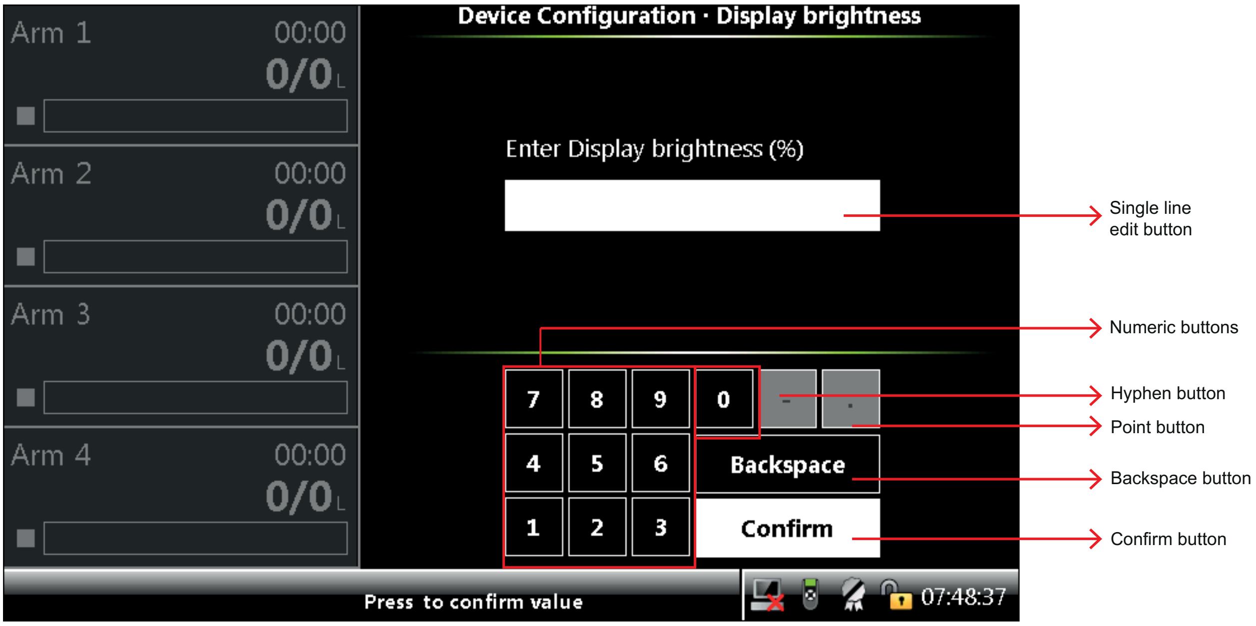


FIGURE 5-14 Numeric Input screen

5.4.9 Enumeration Input Screen

See FIGURE 5-15 for a sample enumeration input screen.

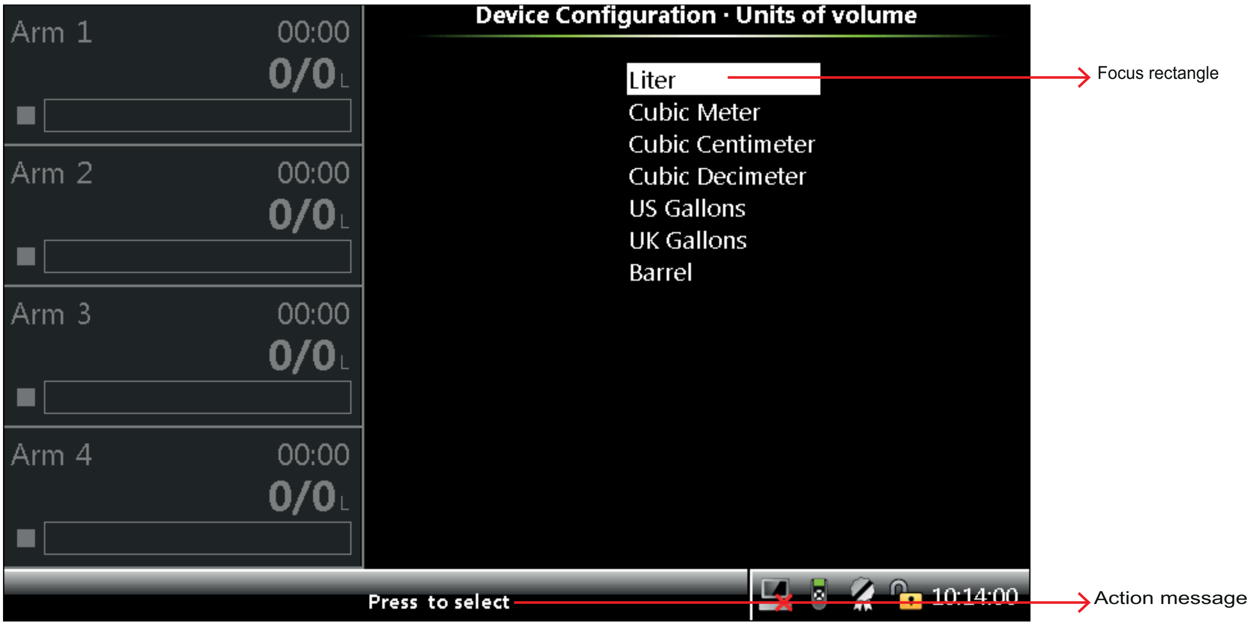


FIGURE 5-15 Enumeration Input screen

5.4.10 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, the LAD or the IR controller).
- Status of TAS.
- Actual time.

Optionally, the status bar also displays a seal icon.

- The seal icon is displayed when the MSC-L is configured as W&M intended and compliant for W&M custody transfer operations. See FIGURE 5-16 for an example of the status bar displaying the seal icon.
- The seal icon is displayed with a black strikethrough when the MSC-L is configured as W&M intended but not compliant for W&M custody transfer operations. See FIGURE 5-17 for an example of the status bar displaying the seal icon with a strikethrough.
- The seal icon is not displayed when the MSC-L is not configured as not intended for W&M custody transfer. See FIGURE 5-18 for an example of the status bar not displaying the seal icon.

FIGURE 5-16 Status bar displaying the seal icon

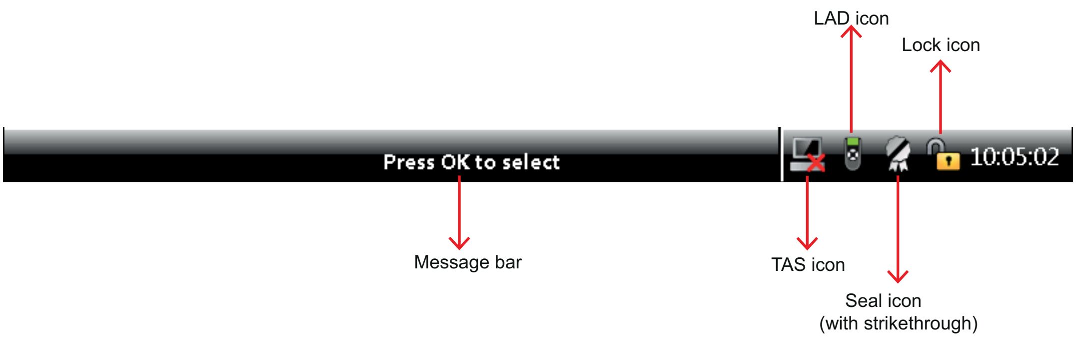


FIGURE 5-17 Status bar displaying the seal icon with a strikethrough

FIGURE 5-18 Status bar without the seal icon

5.5 Device Security

A security level based access controls the activities, which a user can perform using the MSC-L.

The MSC-L user management takes care of the following actions:

- Identify (entering a pin or providing a card).
- Authorize (check pin/card ID against the database and provide access to the system).
- Register (store the latest login date and time).

You can perform the following activities.

- Operational activities (for example, vehicle loading and inspecting the running screens).
- Service activities (for example, Configuration, Monitoring the Alarms).
- Advanced service activities (for example, Upgrade Firmware, Add the users).

Security level is assigned to the users in the database based on the activities which can be performed by that user. There are three security levels SL1, SL2, and SL3.

1. SL1 users generally are truck drivers, bay operators, and so on.
2. SL2 and SL3 users can be managers, service technicians, notified body engineers, and so on.
3. SL3 users can add users into the database. MSC-L provides a default user database with one ADMIN created with security level 3 privileges. The default password is 1234.

5.5.1 Security Levels (SL)

The following table lists the activities which are supported for each security level.

Privilege (activities)	SL 1	SL2	SL3
Loading operations	P	P	P
Monitor alarms	P	P	P
Change configuration	O	P	P
Alarm handling (reset, acknowledge)	O	P	P
Meter calibration	O	P	P
Dashboard	O	P	P
Person database configuration	O	O	P
Upgrade firmware	O	O	P
Restore to factory defaults	O	O	P
Clear all memory	O	O	P
All other activities	O	P	P

NOTE: SL1 contains the lowest level of privileges.

5.5.2 Rules of Navigation

A user with SL1 access can perform loading operations and monitor alarms by navigating through the operational screens by typing the correct password at the password entry prompt.

From anywhere, holding ESC key displays a login prompt. Only a user with level SL2 or higher can go to the Main Menu by typing the correct password when prompted.

A padlock symbol on the bottom right of the status bar indicates the device status. For SL1 it is closed, SL2 and higher it is open. For one arm and two arm systems a person icon with a check is displayed in the left pane.

Each logon event is registered in the events log.

A user with higher security level overwrites the current session. But when the user logs out, the user with lower security level can still access it.

For example, if an SL1 user has entered the system and SL2/SL3 logs in to reset the alarm, then SL2/SL3 escapes from the Main Menu and logs out, yet the SL1 user can access it.

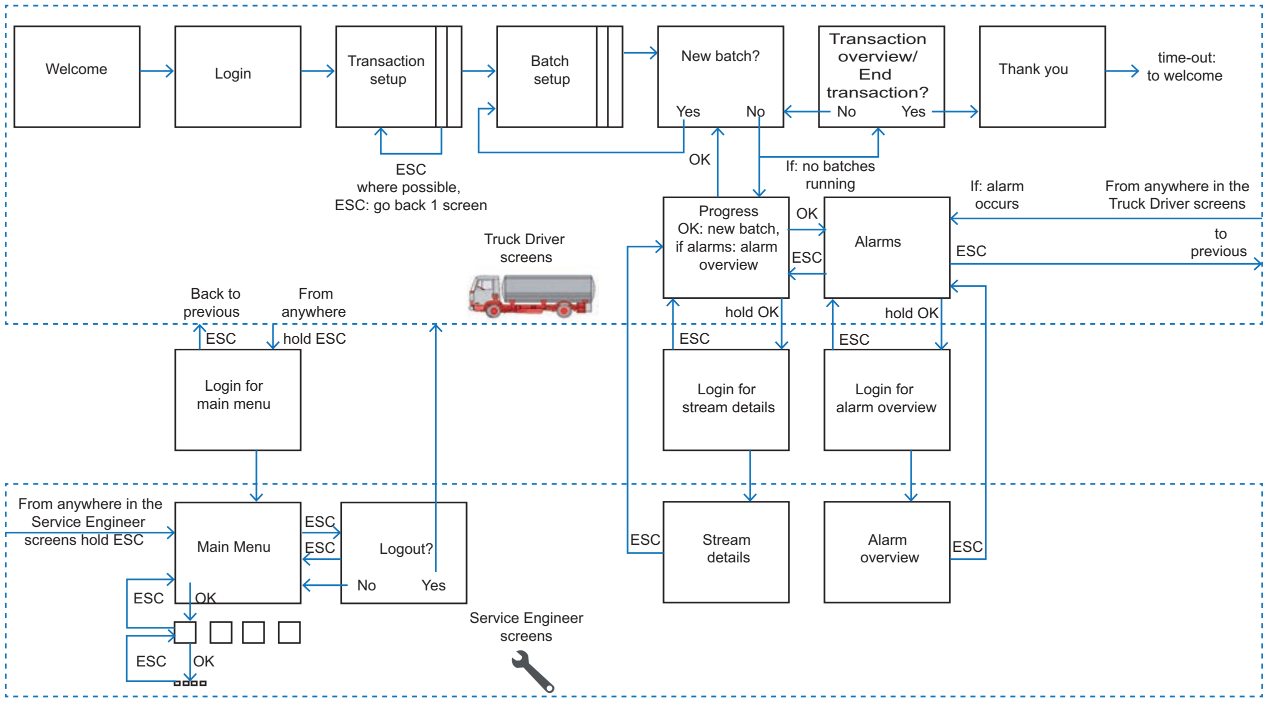


FIGURE 5-19 Rules of Navigation

NOTE: If you forget the password, JP2 of SW1 must be set to ON on the CAN-HMI-MSC (see FIGURE 5-20). Holding ESC key on the keyboard, allows you to *directly login to the Main Menu as a "Power User". The event is registered in the events log.*

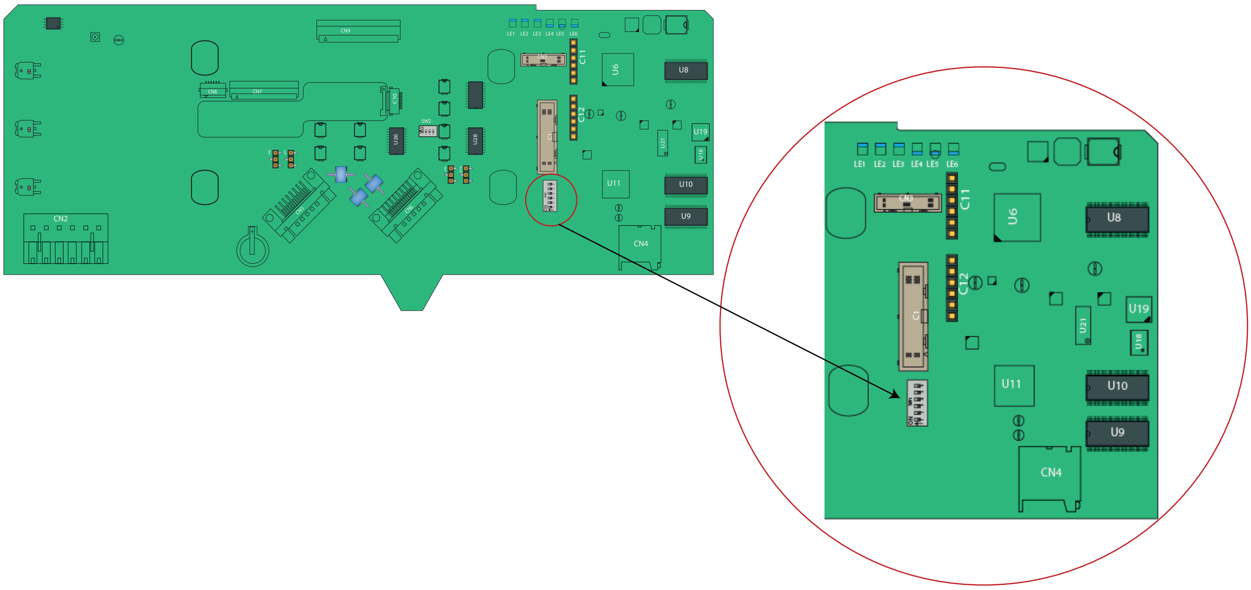


FIGURE 5-20 SW1 on CAN-HMI-MSC board

5.6 Device Commissioning

5.6.1 Using the Menu

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

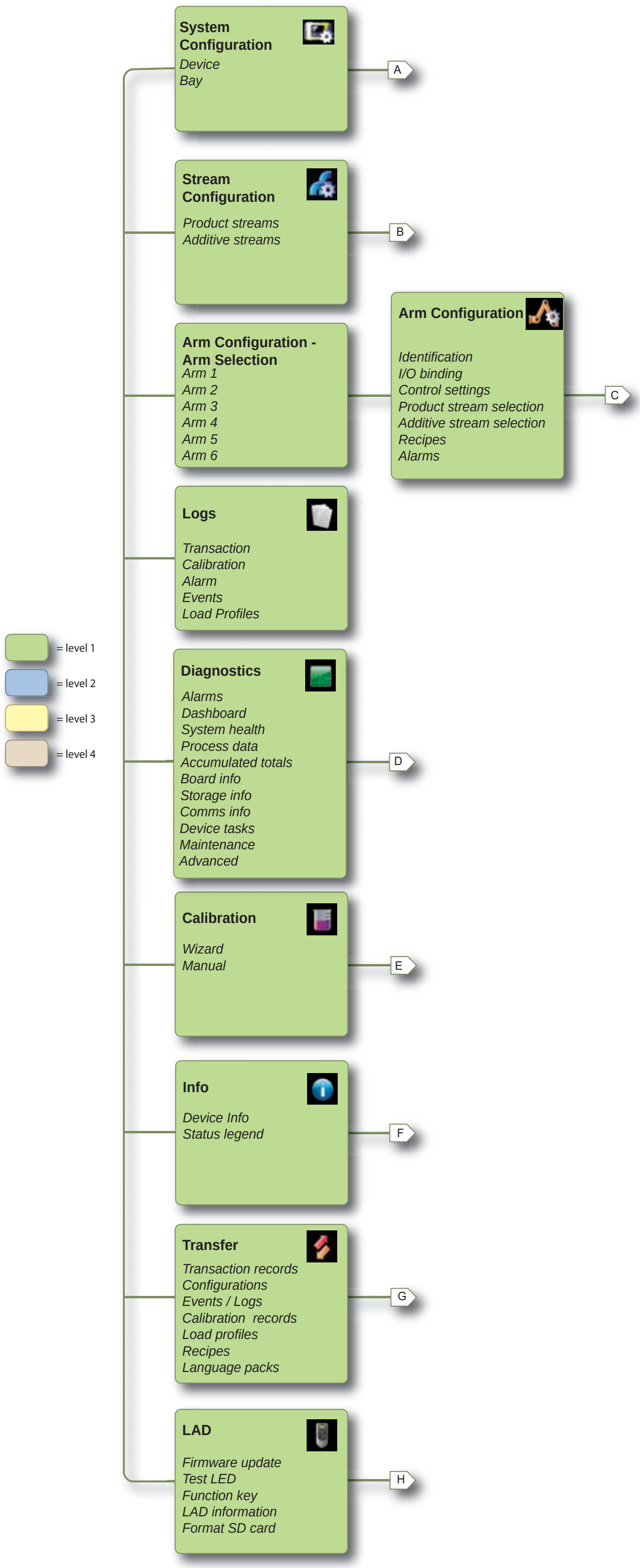
You can select various submenus by using the Fusion4 IR Controller, the Fusion4 LAD, or the keyboard and by starting from the Main Menu.

In this way all entities can be reached and set.

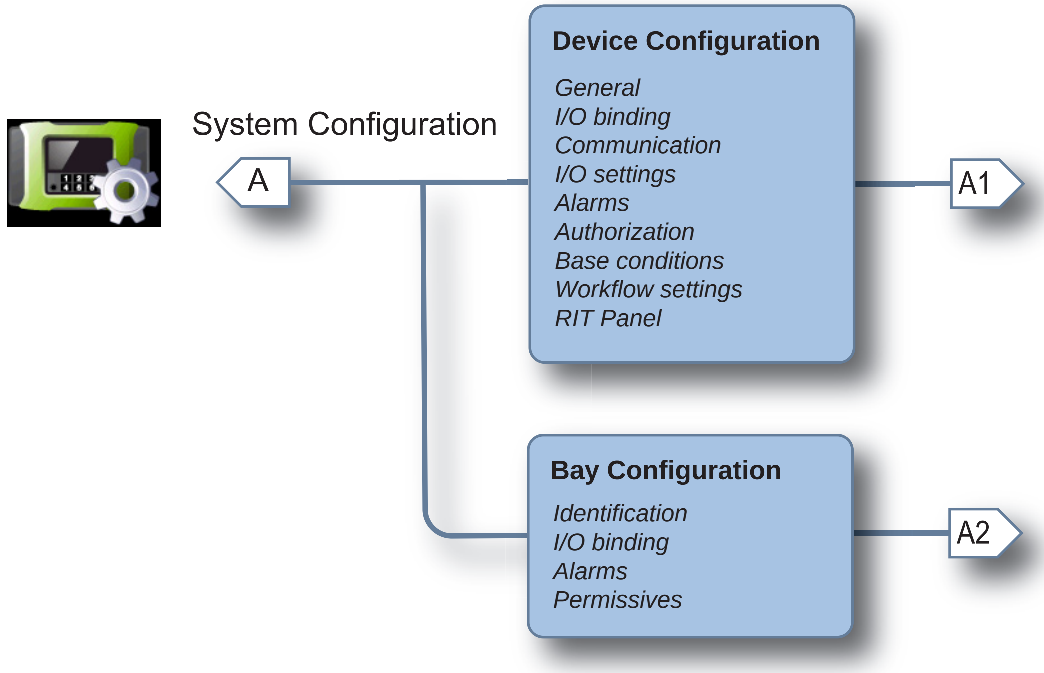
5.6.2 Menu Structure

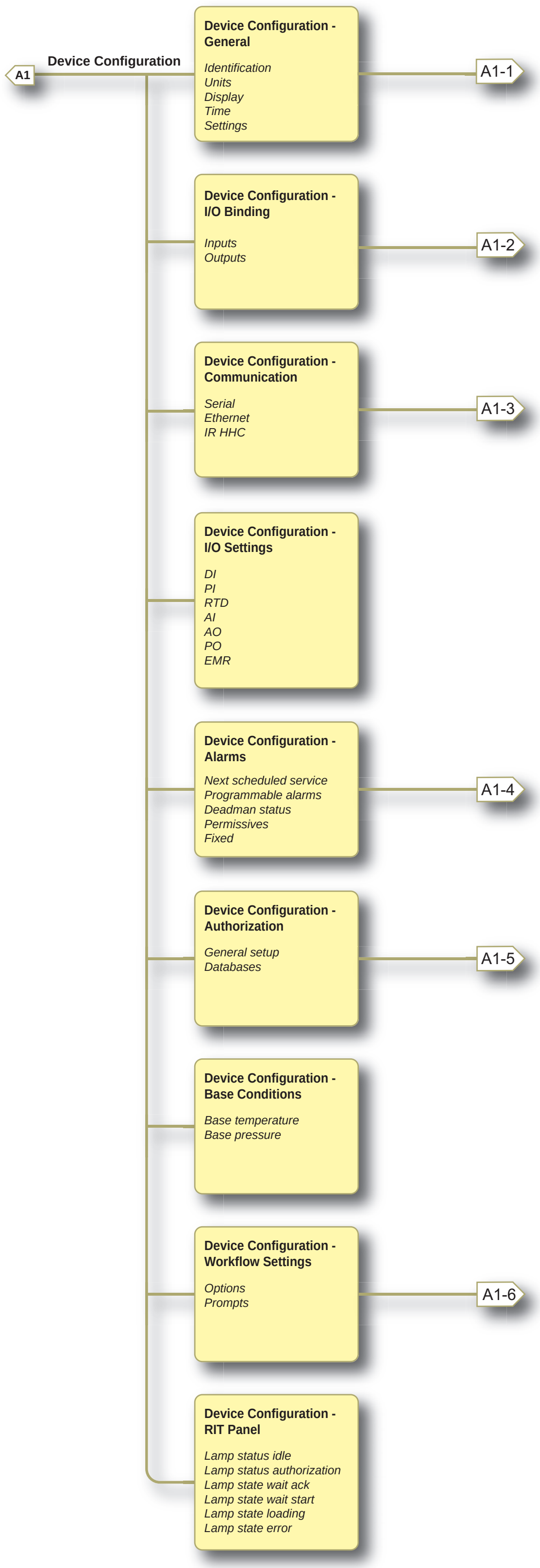
The following images provide an overview of all the entities and the parameters.

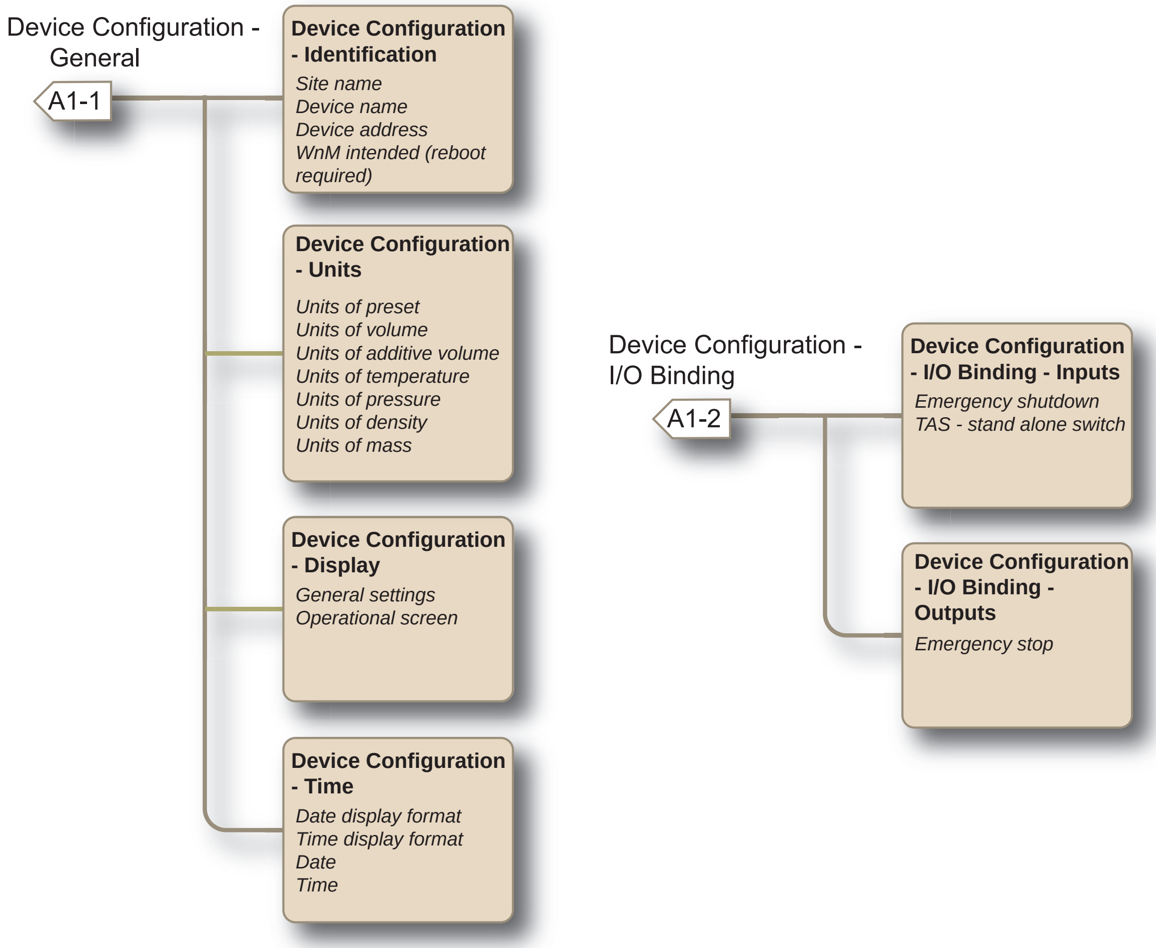
For the complete description of all possible configuration settings, see FIGURE 5-21 - Loading application overview.

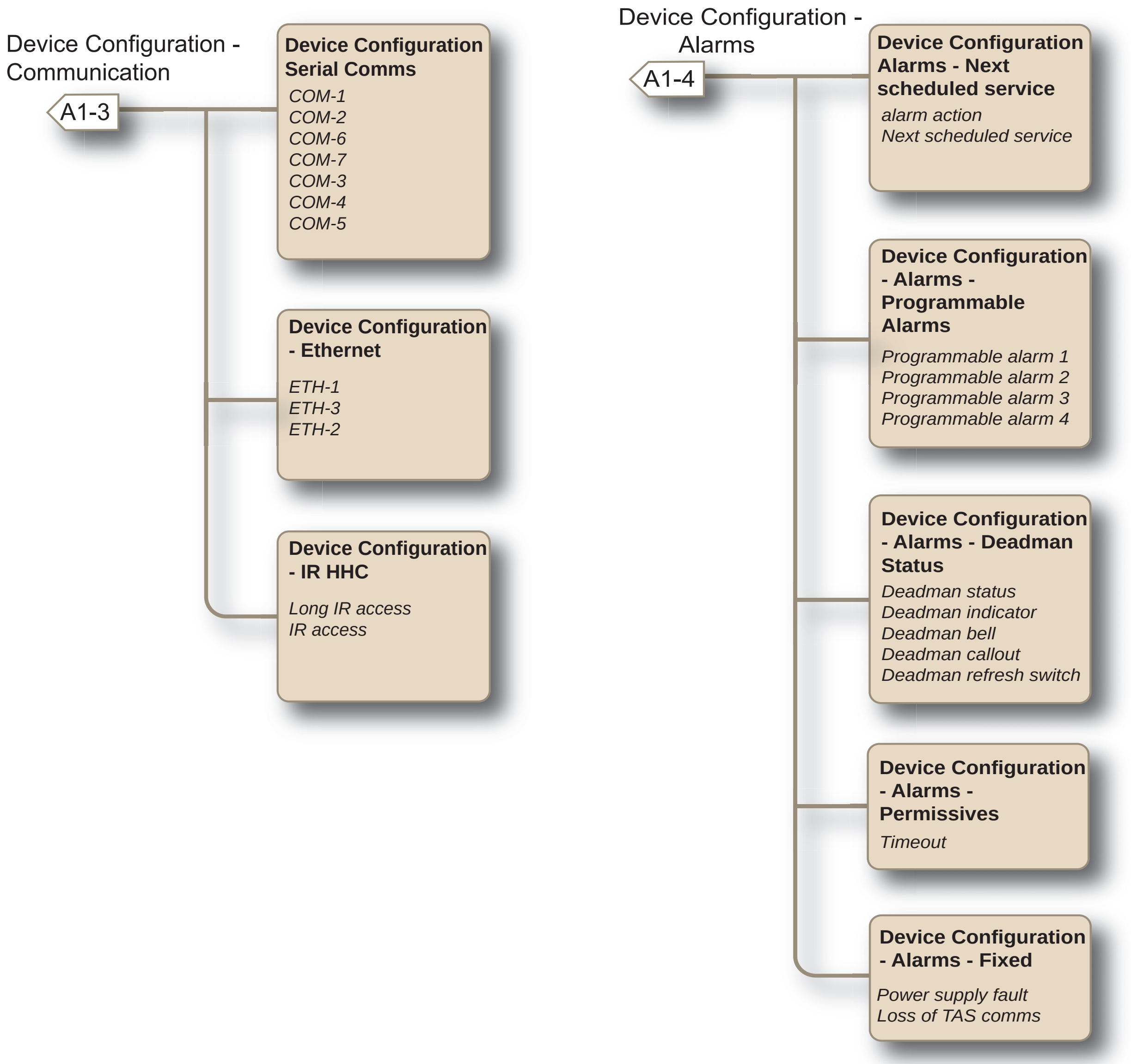

System Configuration
Device
Bay
A
Stream Configuration
Product streams
Additive streams
B
Arm Configuration - Arm Selection
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
Arm Configuration
Identification
I/O binding
Control settings
Product stream selection
Additive stream selection
Recipes
Alarms
C
Logs
Transaction
Calibration
Alarm
Events
Load Profiles
= level 1
= level 2
= level 3
= level 4
Diagnostics
Alarms
Dashboard
System health
Process data
Accumulated totals
Board info
Storage info
Comms info
Device tasks
Maintenance
Advanced
D
Calibration
Wizard
Manual
E
Info
Device Info
Status legend
F
Transfer
Transaction records
Configurations
Events / Logs
Calibration records
Load profiles
Recipes
Language packs
G
LAD
Firmware update
Test LED
Function key
LAD information
Format SD card
H

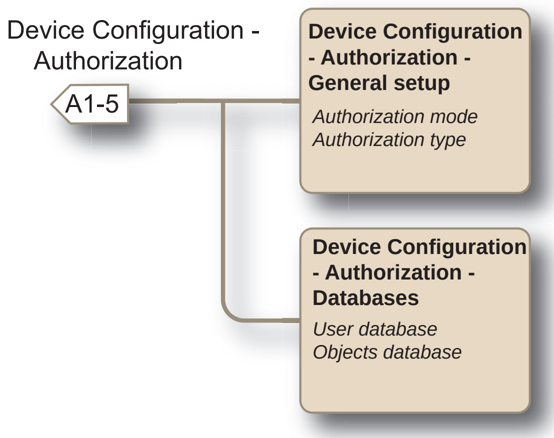
5.6.2.1 System Configuration

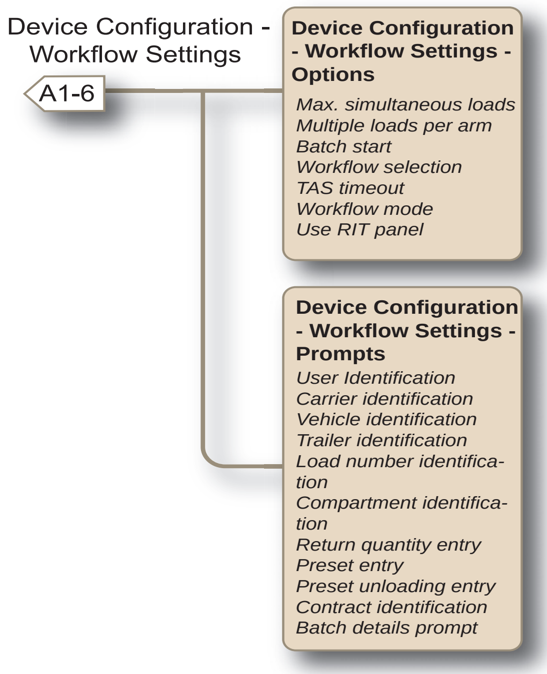


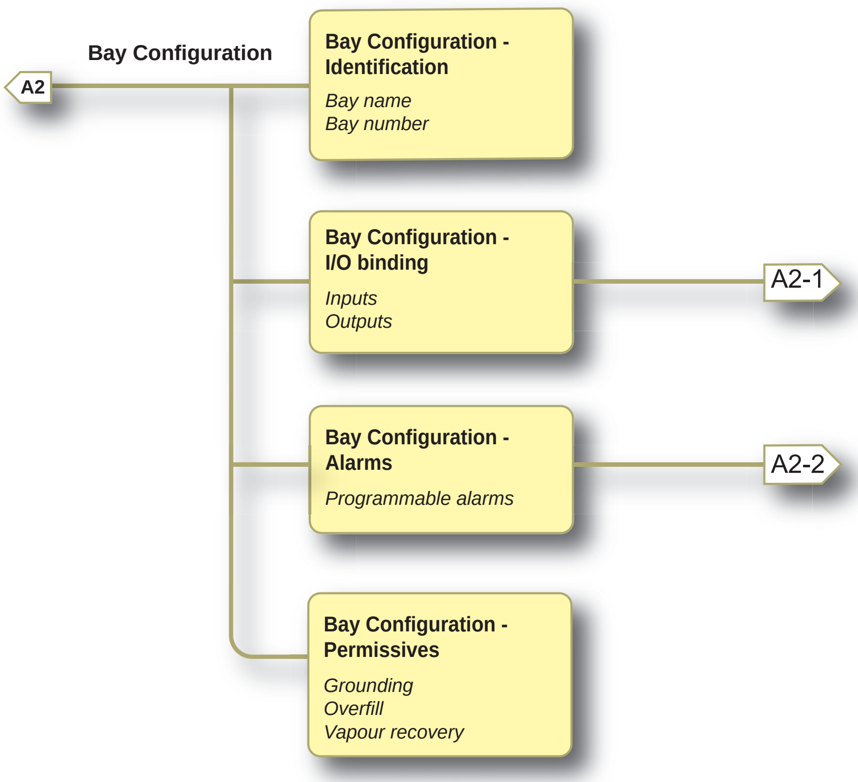

A1
Device Configuration
Device Configuration - General
Identification
Units
Display
Time
Settings
A1-1
Device Configuration - I/O Binding
Inputs
Outputs
A1-2
Device Configuration - Communication
Serial
Ethernet
IR HHC
A1-3
Device Configuration - I/O Settings
DI
PI
RTD
AI
AO
PO
EMR
Device Configuration - Alarms
Next scheduled service
Programmable alarms
Deadman status
Permissives
Fixed
A1-4
Device Configuration - Authorization
General setup
Databases
A1-5
Device Configuration - Base Conditions
Base temperature
Base pressure
Device Configuration - Workflow Settings
Options
Prompts
A1-6
Device Configuration - RIT Panel
Lamp status idle
Lamp status authorization
Lamp state wait ack
Lamp state wait start
Lamp state loading
Lamp state error

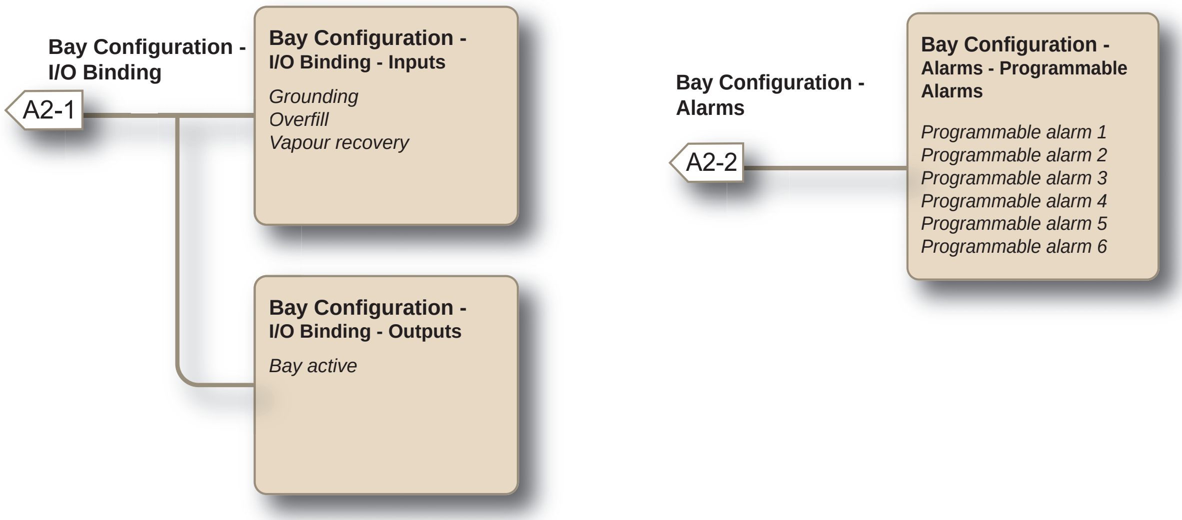

Device Configuration - General
A1-1
Device Configuration - Identification
Site name
Device name
Device address
WnM intended (reboot required)
Device Configuration - Units
Units of preset
Units of volume
Units of additive volume
Units of temperature
Units of pressure
Units of density
Units of mass
Device Configuration - Display
General settings
Operational screen
Device Configuration - Time
Date display format
Time display format
Date
Time
Device Configuration - I/O Binding
A1-2
Device Configuration - I/O Binding - Inputs
Emergency shutdown
TAS - stand alone switch
Device Configuration - I/O Binding - Outputs
Emergency stop


Device Configuration -
Communication
A1-3
Device Configuration
Serial Comms
COM-1
COM-2
COM-6
COM-7
COM-3
COM-4
COM-5
Device Configuration
- Ethernet
ETH-1
ETH-3
ETH-2
Device Configuration
- IR HHC
Long IR access
IR access
Device Configuration -
Alarms
A1-4
Device Configuration
Alarms - Next
scheduled service
alarm action
Next scheduled service
Device Configuration
- Alarms -
Programmable
Alarms
Programmable alarm 1
Programmable alarm 2
Programmable alarm 3
Programmable alarm 4
Device Configuration
- Alarms - Deadman
Status
Deadman status
Deadman indicator
Deadman bell
Deadman callout
Deadman refresh switch
Device Configuration
- Alarms -
Permissives
Timeout
Device Configuration
- Alarms - Fixed
Power supply fault
Loss of TAS comms


Device Configuration - Authorization
A1-5
Device Configuration - Authorization - General setup
Authorization mode
Authorization type
Device Configuration - Authorization - Databases
User database
Objects database

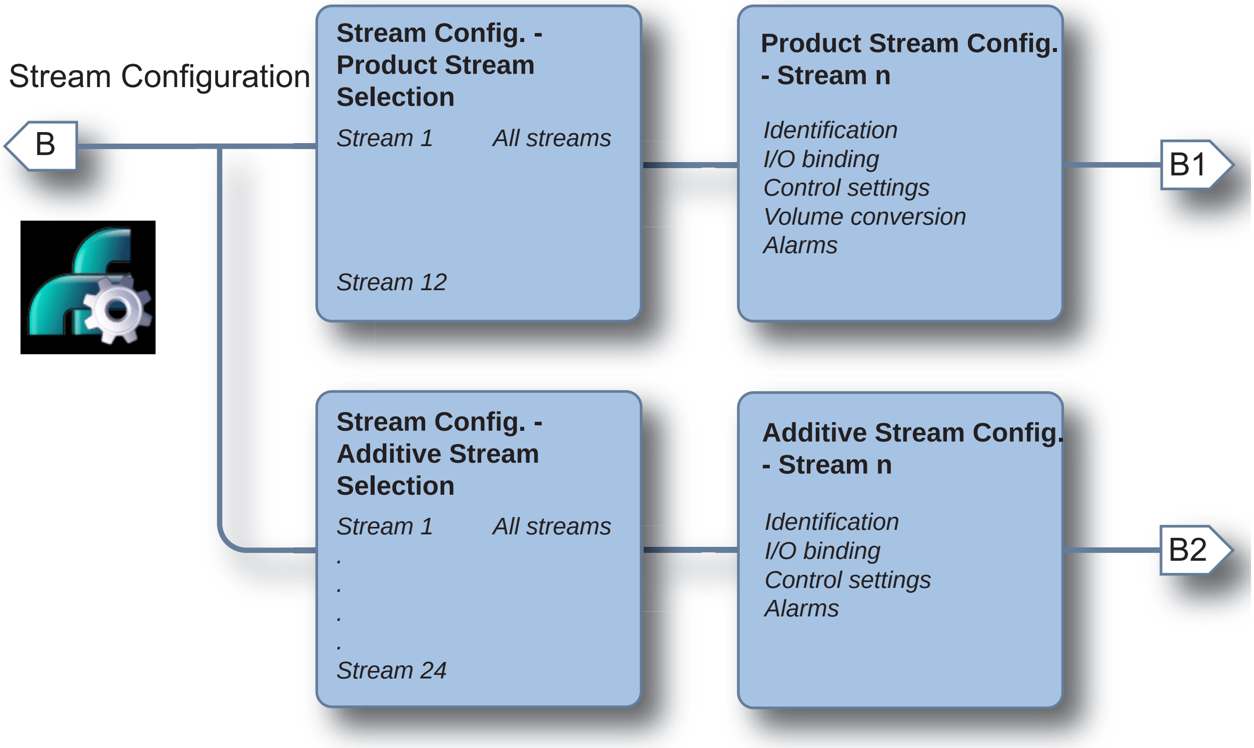

Device Configuration - Workflow Settings
A1-6
Device Configuration - Workflow Settings - Options
Max. simultaneous loads
Multiple loads per arm
Batch start
Workflow selection
TAS timeout
Workflow mode
Use RIT panel
Device Configuration - Workflow Settings - Prompts
User Identification
Carrier identification
Vehicle identification
Trailer identification
Load number identification
Compartment identification
Return quantity entry
Preset entry
Preset unloading entry
Contract identification
Batch details prompt

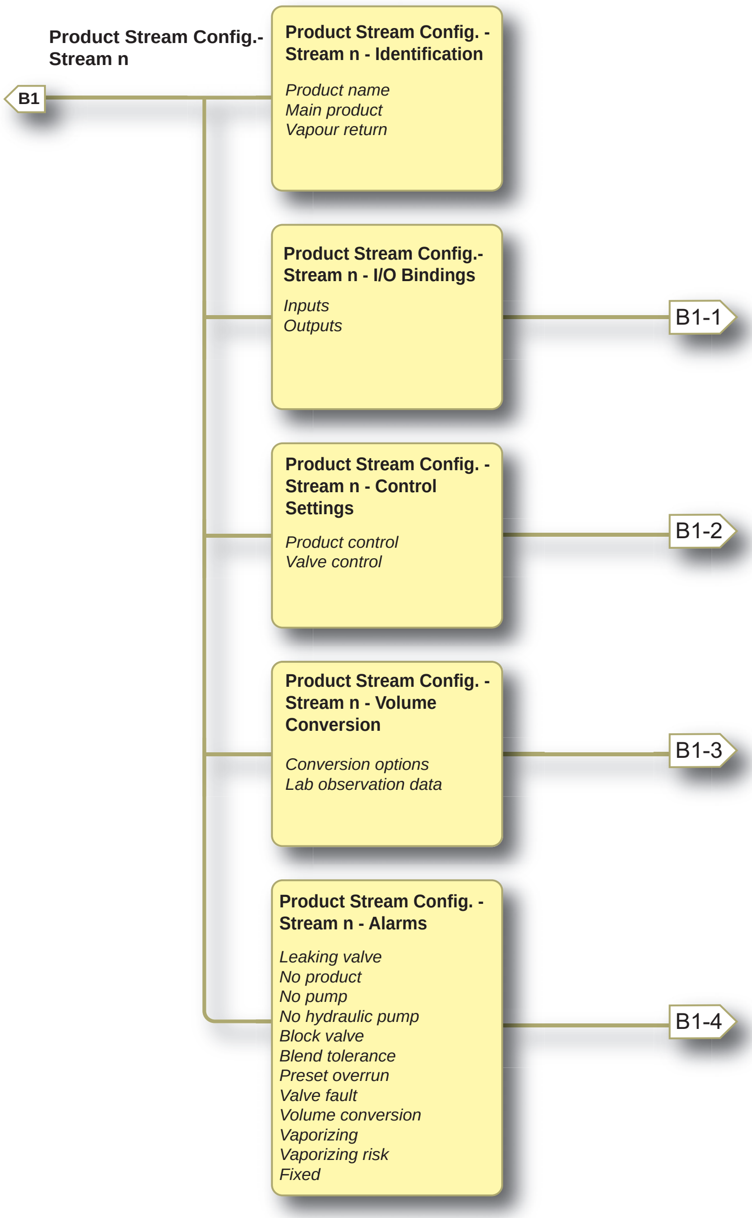

Bay Configuration
A2
Bay Configuration - Identification
Bay name
Bay number
Bay Configuration - I/O binding
Inputs
Outputs
A2-1
Bay Configuration - Alarms
Programmable alarms
A2-2
Bay Configuration - Permissives
Grounding
Overfill
Vapour recovery

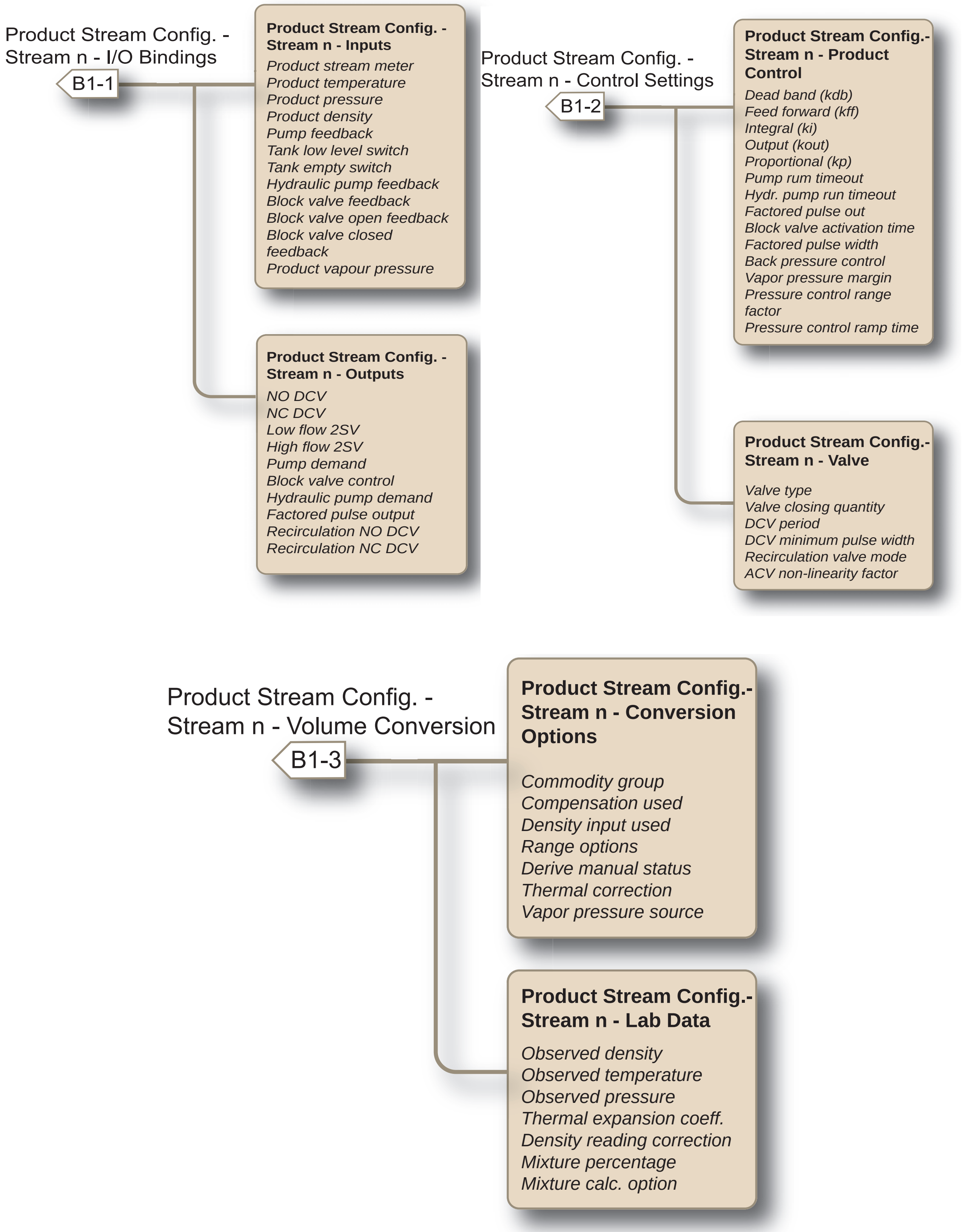


For information regarding the parameter and entity details, see section 5.9 - LPG Loading Application Overview.

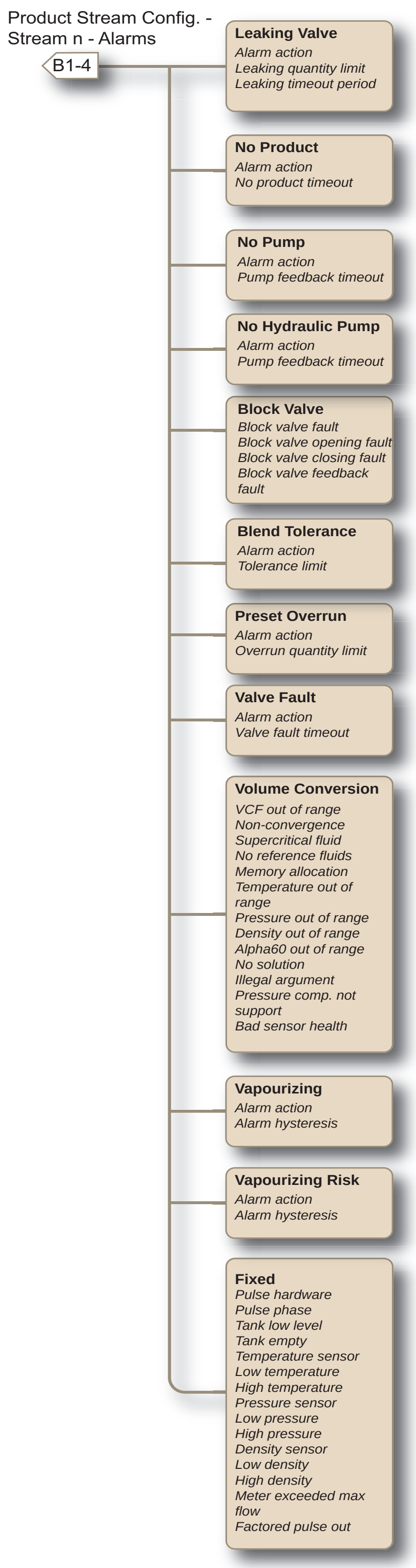
5.6.2.2 Stream Configuration

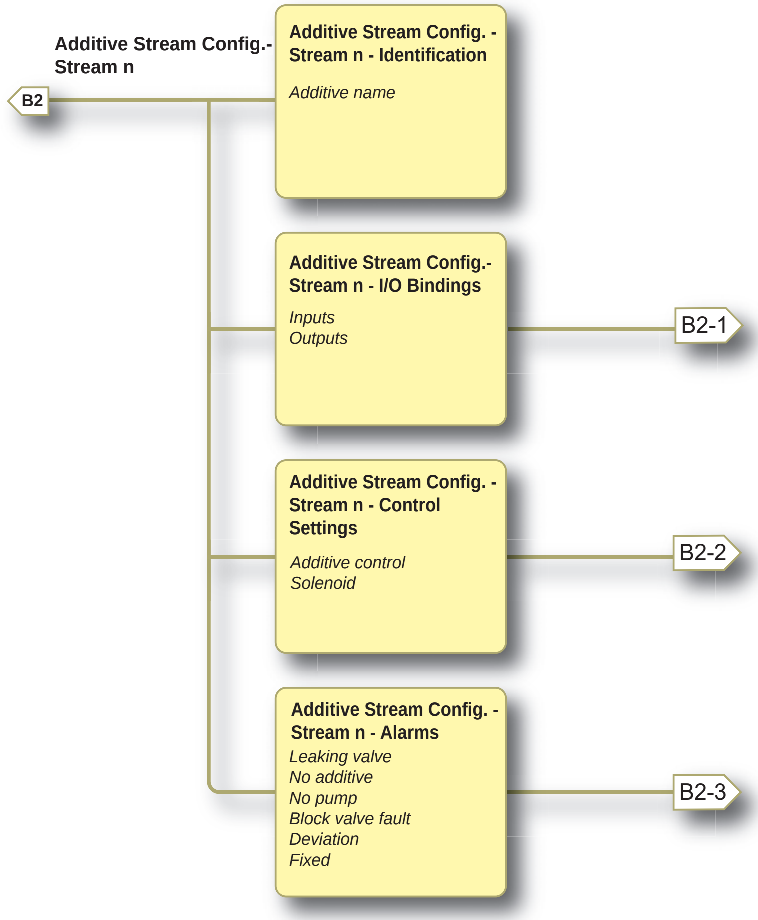


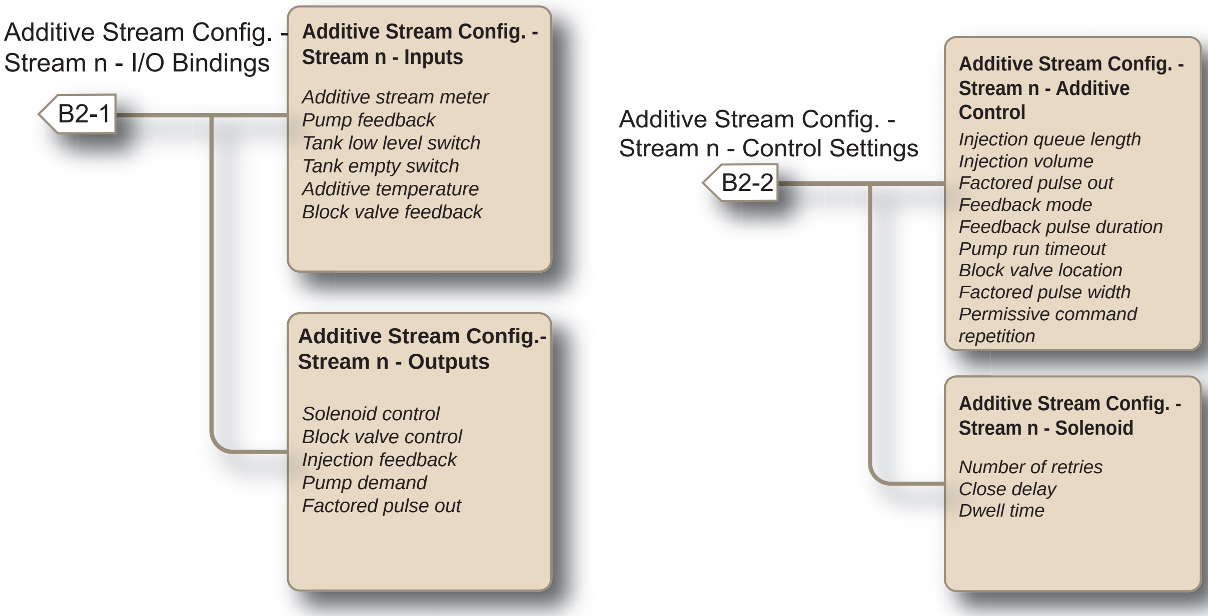

Product Stream Config.-
Stream n
B1
Product Stream Config. -
Stream n - Identification
Product name
Main product
Vapour return
Product Stream Config.-
Stream n - I/O Bindings
Inputs
Outputs
B1-1
Product Stream Config. -
Stream n - Control
Settings
Product control
Valve control
B1-2
Product Stream Config. -
Stream n - Volume
Conversion
Conversion options
Lab observation data
B1-3
Product Stream Config. -
Stream n - Alarms
Leaking valve
No product
No pump
No hydraulic pump
Block valve
Blend tolerance
Preset overrun
Valve fault
Volume conversion
Vaporizing
Vaporizing risk
Fixed
B1-4

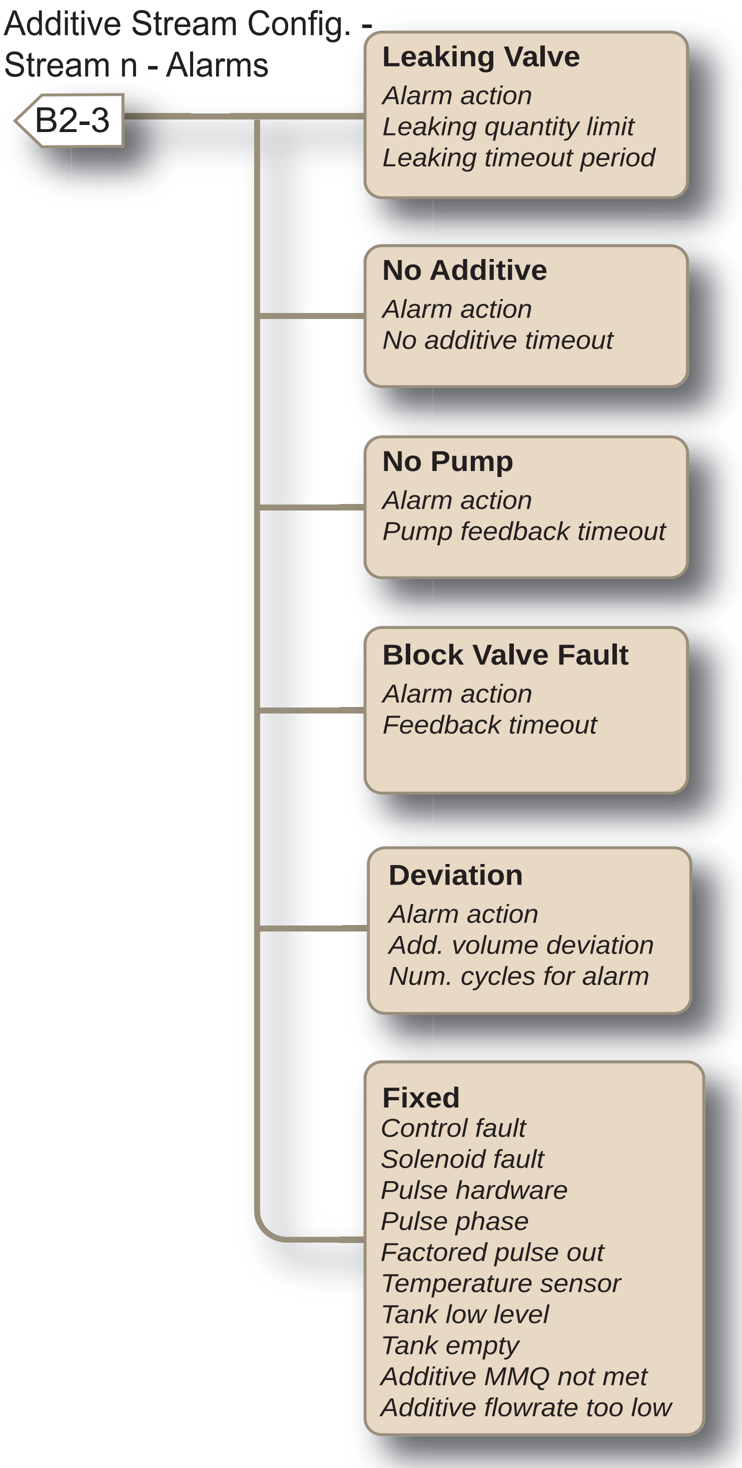


Product Stream Config. - Stream n - I/O Bindings
B1-1
Product Stream Config. - Stream n - Inputs
Product stream meter
Product temperature
Product pressure
Product density
Pump feedback
Tank low level switch
Tank empty switch
Hydraulic pump feedback
Block valve feedback
Block valve open feedback
Block valve closed feedback
Product vapour pressure
Product Stream Config. - Stream n - Outputs
NO DCV
NC DCV
Low flow 2SV
High flow 2SV
Pump demand
Block valve control
Hydraulic pump demand
Factored pulse output
Recirculation NO DCV
Recirculation NC DCV
Product Stream Config. - Stream n - Control Settings
B1-2
Product Stream Config.- Stream n - Product Control
Dead band (kdb)
Feed forward (kff)
Integral (ki)
Output (kout)
Proportional (kp)
Pump rum timeout
Hydr. pump run timeout
Factored pulse out
Block valve activation time
Factored pulse width
Back pressure control
Vapor pressure margin
Pressure control range factor
Pressure control ramp time
Product Stream Config.- Stream n - Valve
Valve type
Valve closing quantity
DCV period
DCV minimum pulse width
Recirculation valve mode
ACV non-linearity factor
Product Stream Config. - Stream n - Volume Conversion
B1-3
Product Stream Config.- Stream n - Conversion Options
Commodity group
Compensation used
Density input used
Range options
Derive manual status
Thermal correction
Vapor pressure source
Product Stream Config.- Stream n - Lab Data
Observed density
Observed temperature
Observed pressure
Thermal expansion coeff.
Density reading correction
Mixture percentage
Mixture calc. option


Product Stream Config. - Stream n - Alarms
B1-4
Leaking Valve
Alarm action
Leaking quantity limit
Leaking timeout period
No Product
Alarm action
No product timeout
No Pump
Alarm action
Pump feedback timeout
No Hydraulic Pump
Alarm action
Pump feedback timeout
Block Valve
Block valve fault
Block valve opening fault
Block valve closing fault
Block valve feedback fault
Blend Tolerance
Alarm action
Tolerance limit
Preset Overrun
Alarm action
Overrun quantity limit
Valve Fault
Alarm action
Valve fault timeout
Volume Conversion
VCF out of range
Non-convergence
Supercritical fluid
No reference fluids
Memory allocation
Temperature out of range
Pressure out of range
Density out of range
Alpha60 out of range
No solution
Illegal argument
Pressure comp. not support
Bad sensor health
Vapourizing
Alarm action
Alarm hysteresis
Vapourizing Risk
Alarm action
Alarm hysteresis
Fixed
Pulse hardware
Pulse phase
Tank low level
Tank empty
Temperature sensor
Low temperature
High temperature
Pressure sensor
Low pressure
High pressure
Density sensor
Low density
High density
Meter exceeded max flow
Factored pulse out

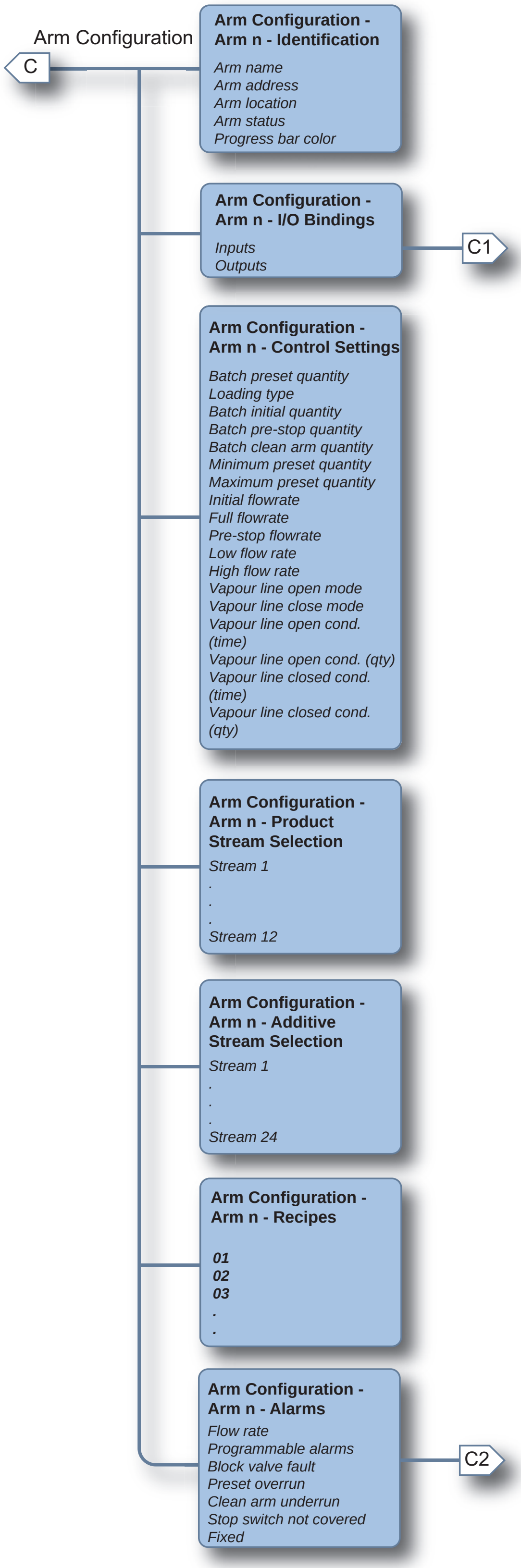

Additive Stream Config.-
Stream n
B2
Additive Stream Config. -
Stream n - Identification
Additive name
Additive Stream Config.-
Stream n - I/O Bindings
Inputs
Outputs
B2-1
Additive Stream Config. -
Stream n - Control
Settings
Additive control
Solenoid
B2-2
Additive Stream Config. -
Stream n - Alarms
Leaking valve
No additive
No pump
Block valve fault
Deviation
Fixed
B2-3

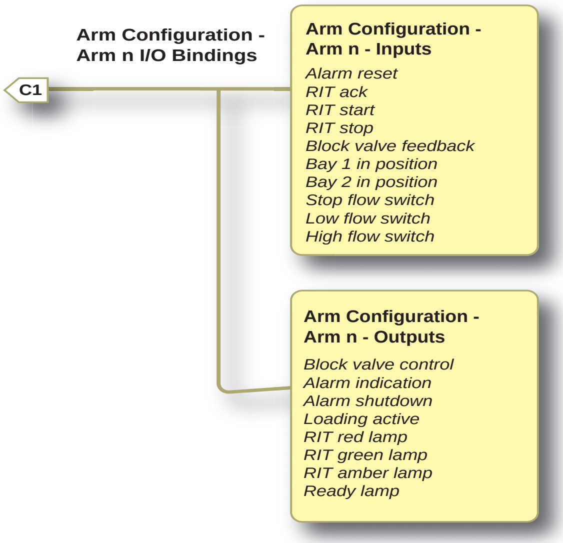

Additive Stream Config. -
Stream n - I/O Bindings
B2-1
Additive Stream Config. -
Stream n - Inputs
Additive stream meter
Pump feedback
Tank low level switch
Tank empty switch
Additive temperature
Block valve feedback
Additive Stream Config.-
Stream n - Outputs
Solenoid control
Block valve control
Injection feedback
Pump demand
Factored pulse out
Additive Stream Config. -
Stream n - Control Settings
B2-2
Additive Stream Config. -
Stream n - Additive
Control
Injection queue length
Injection volume
Factored pulse out
Feedback mode
Feedback pulse duration
Pump run timeout
Block valve location
Factored pulse width
Permissive command
repetition
Additive Stream Config. -
Stream n - Solenoid
Number of retries
Close delay
Dwell time

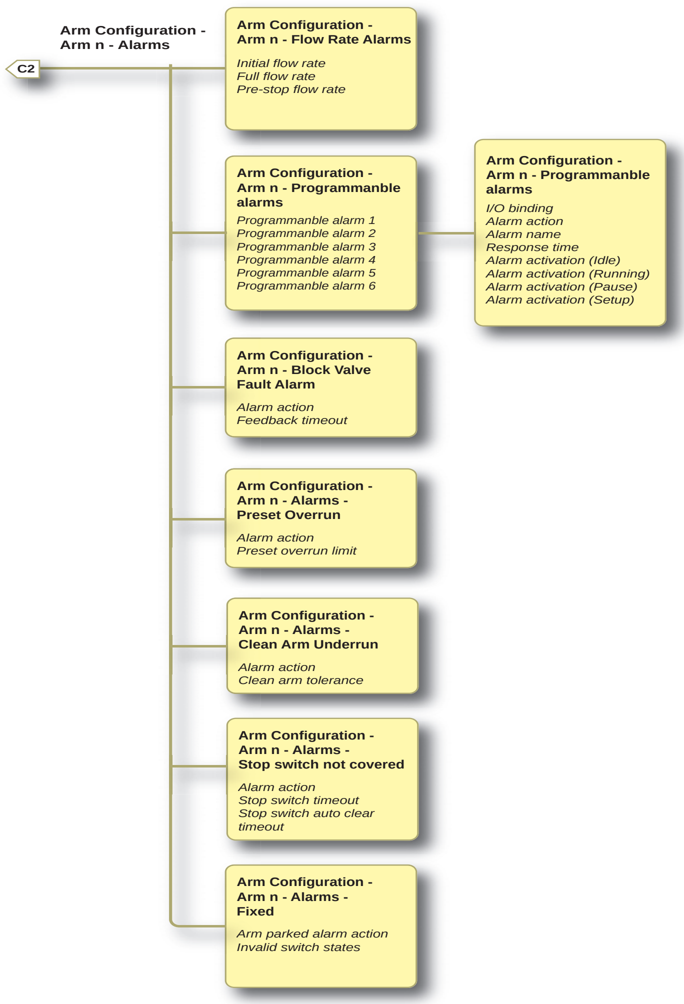


For information regarding the parameter and entity details, see section 5.12 - Stream Configuration.

5.6.2.3 Arm Configuration

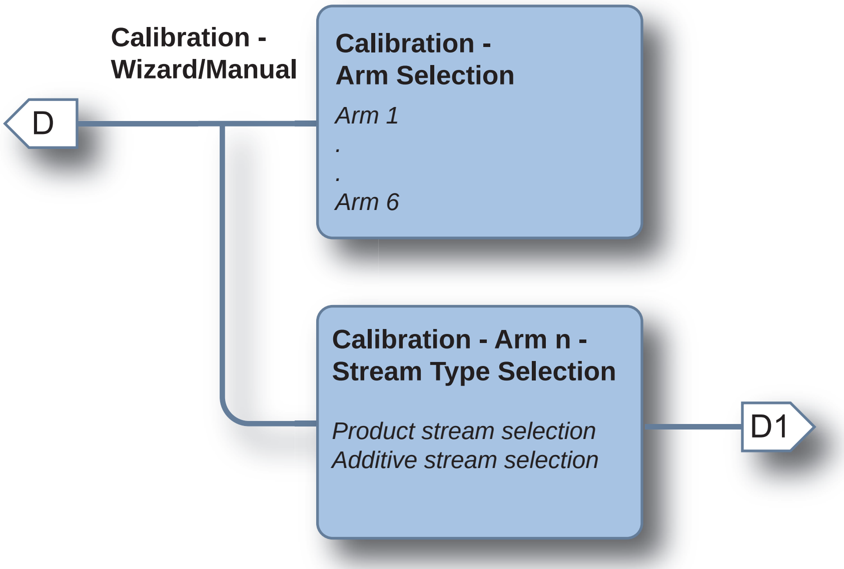


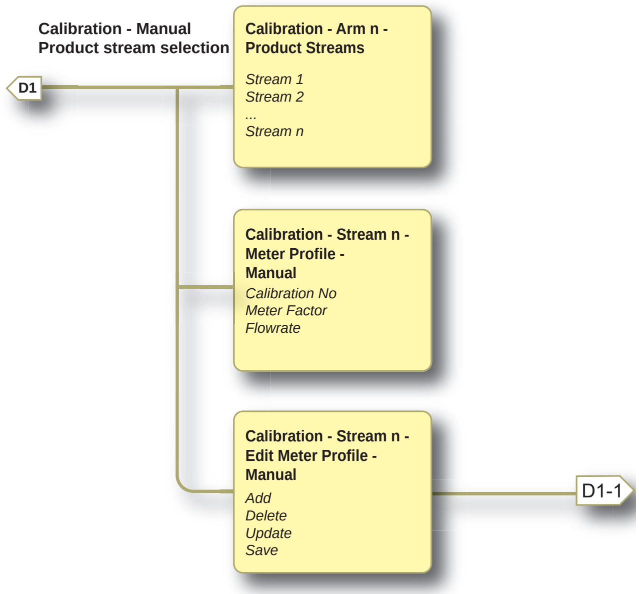


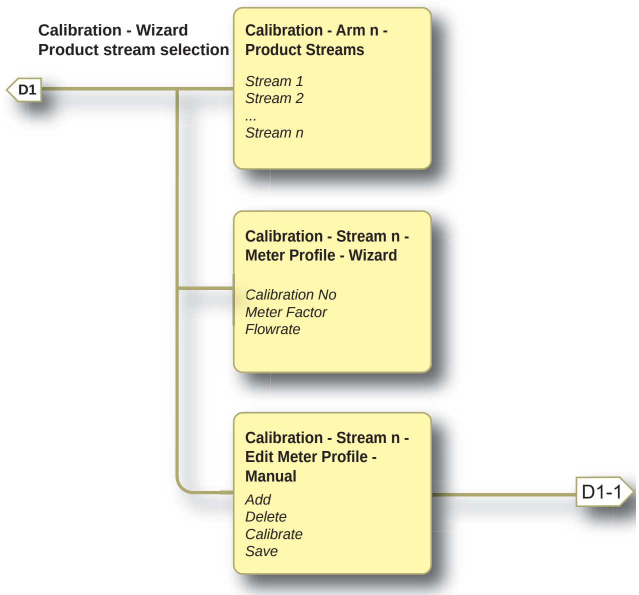


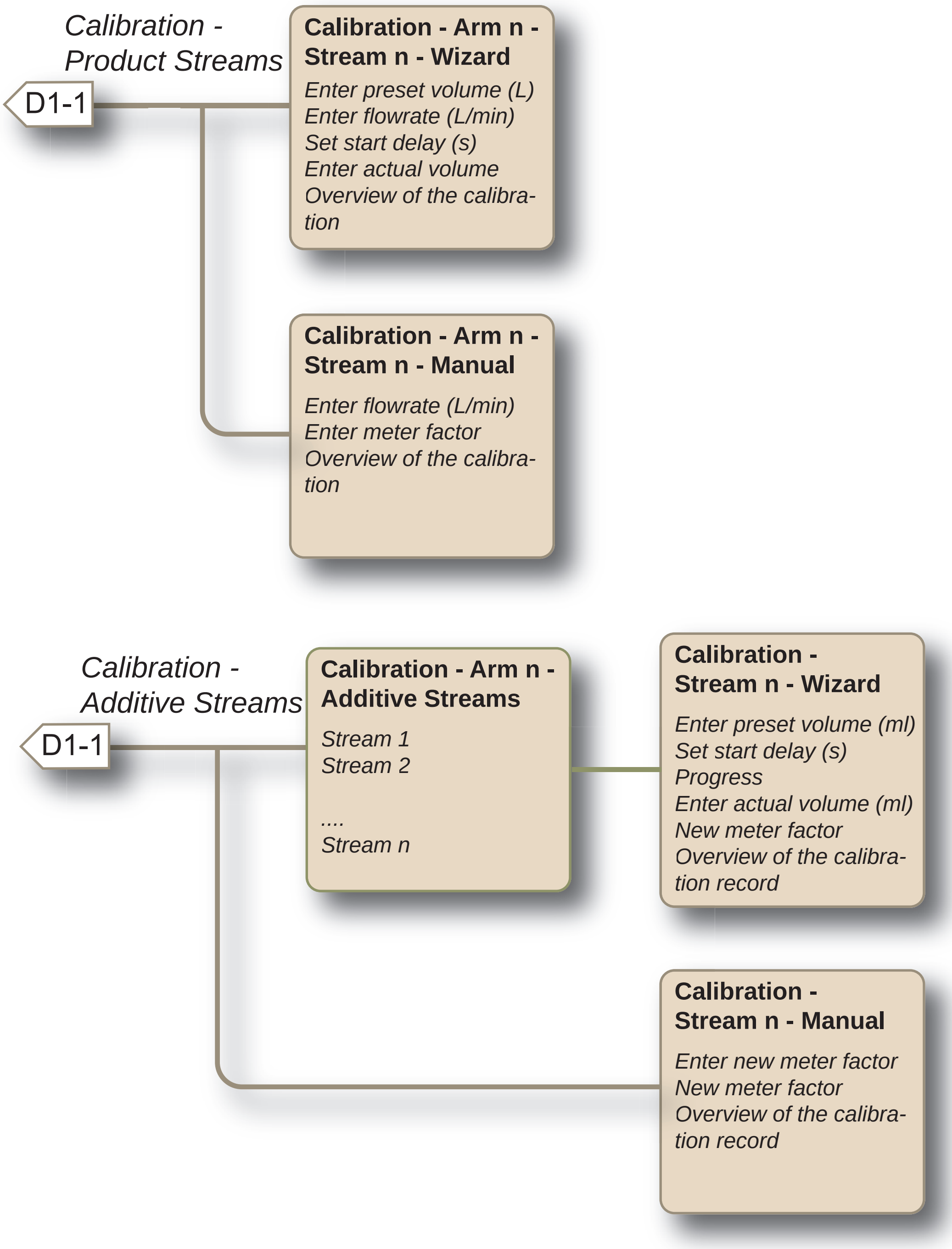
For information regarding the parameter and entity details, see section 5.13 - Arm Configuration.

5.6.2.4 Calibration



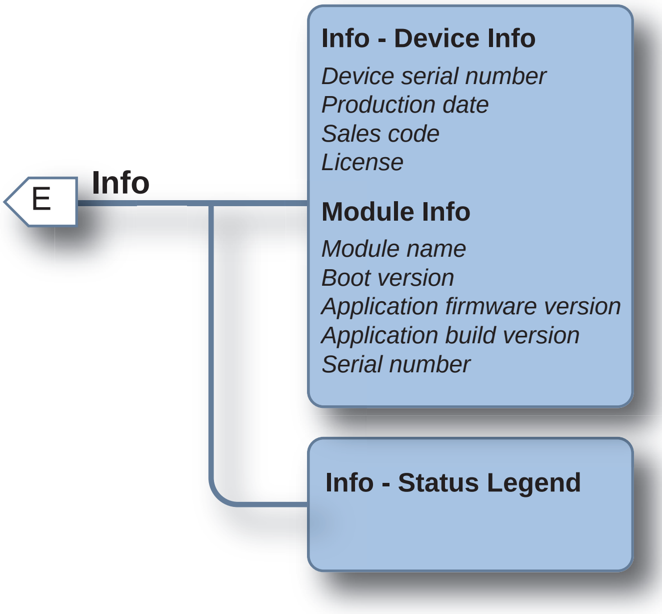






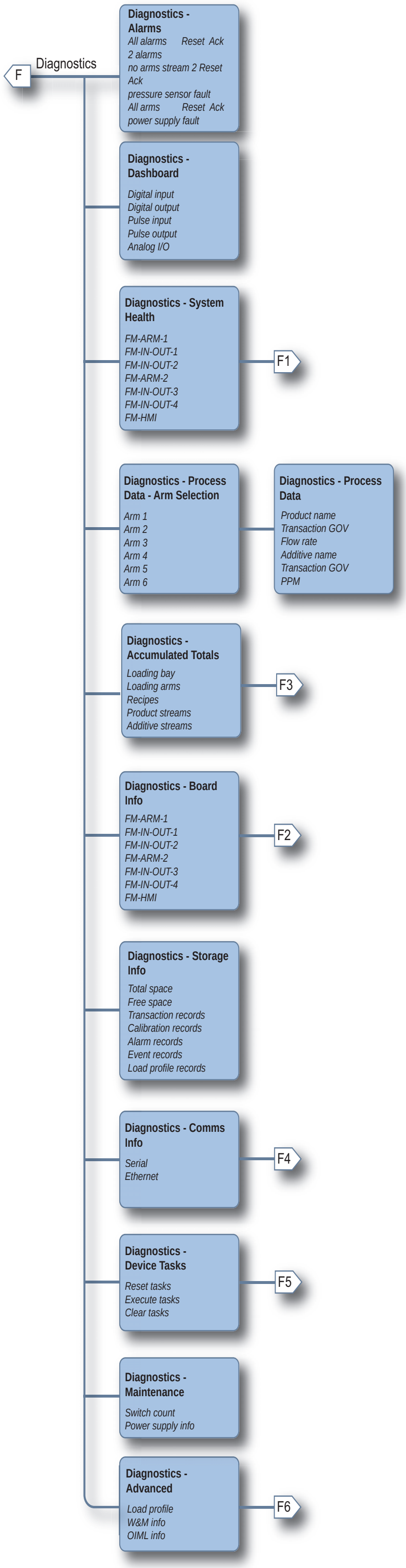
For information regarding the parameter and entity details, see section 5.16 - Calibration.

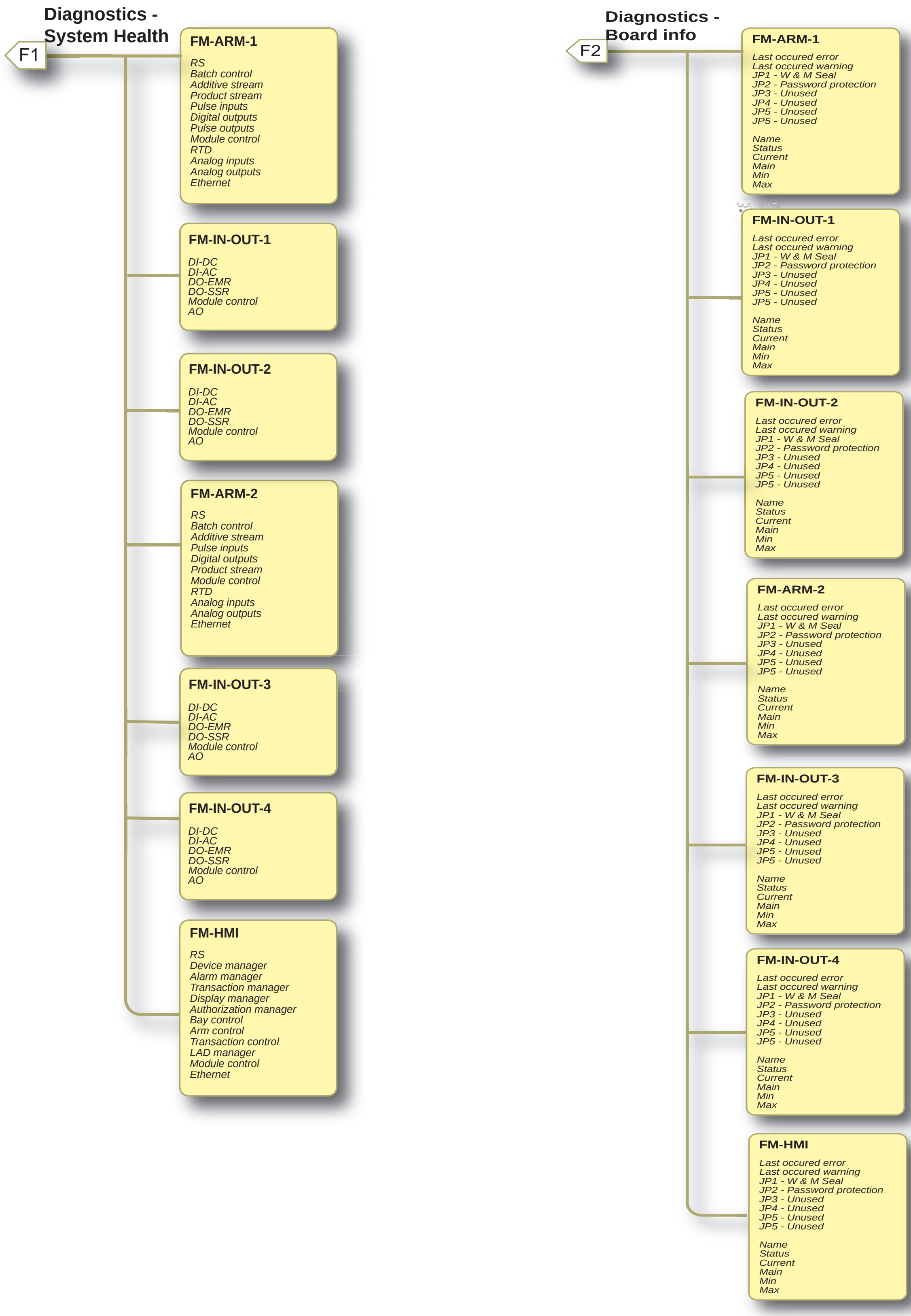
5.6.2.5 Info (Device Information)

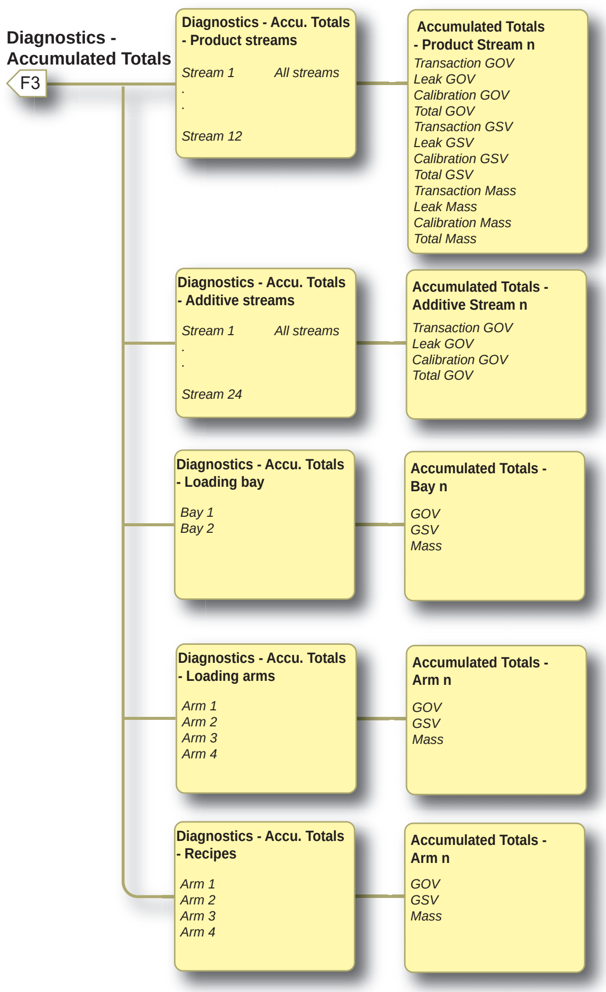


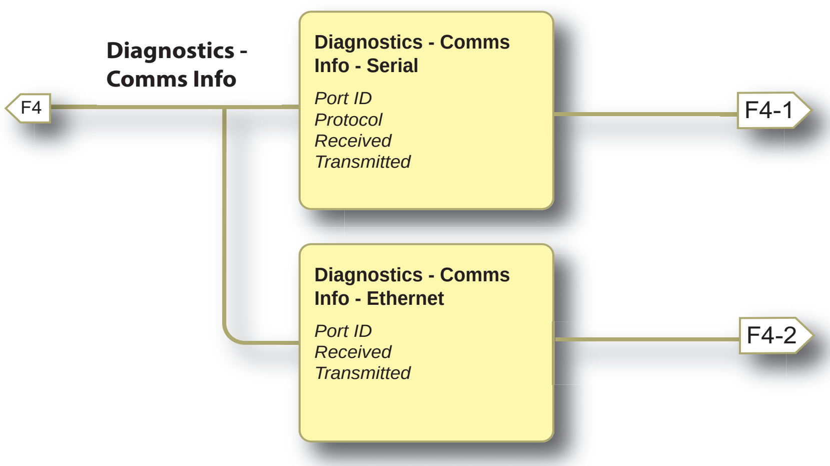
For information regarding the parameter and entity details, see section 5.17 - Info (Device Information).

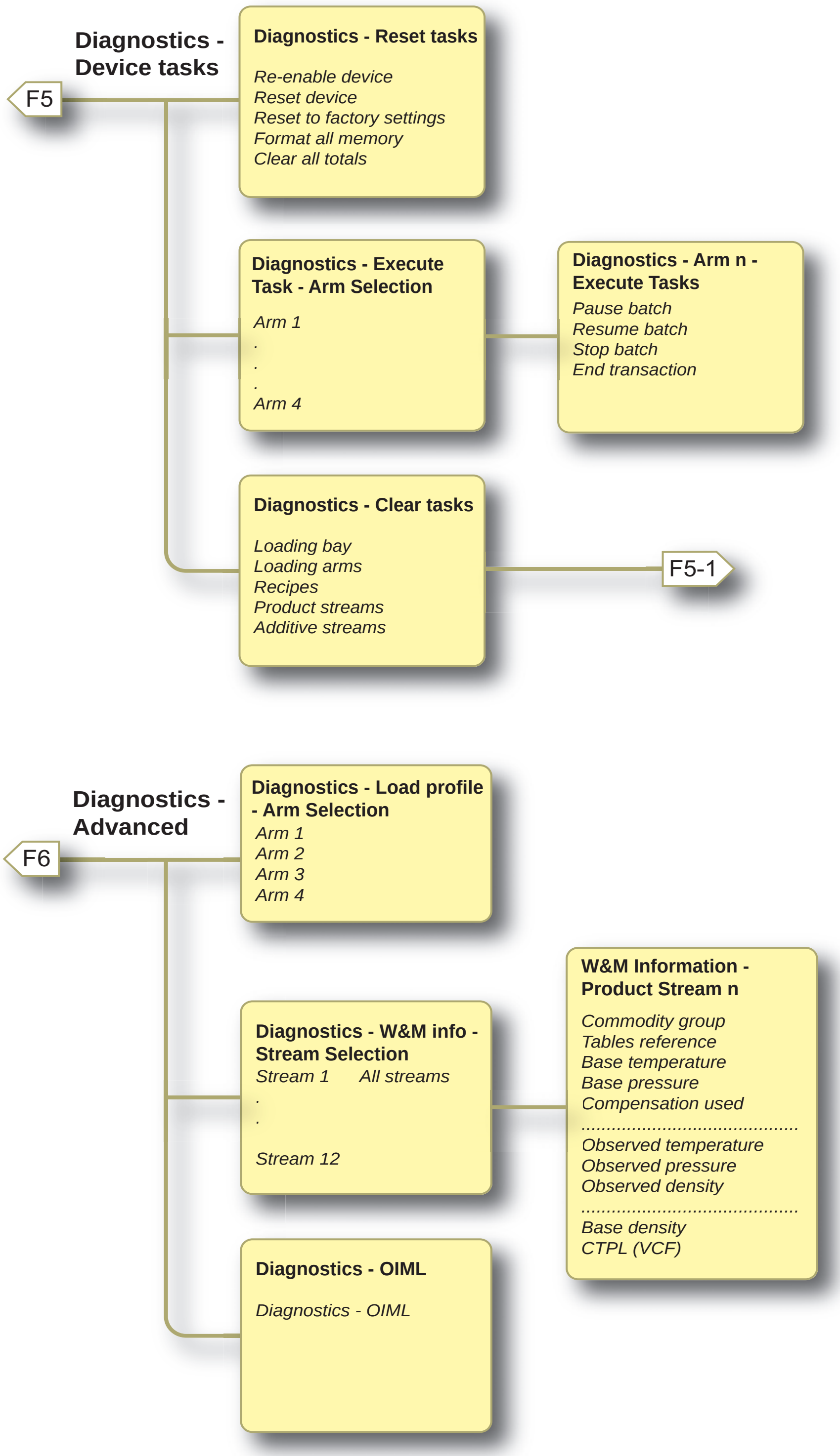
5.6.2.6 Diagnostics

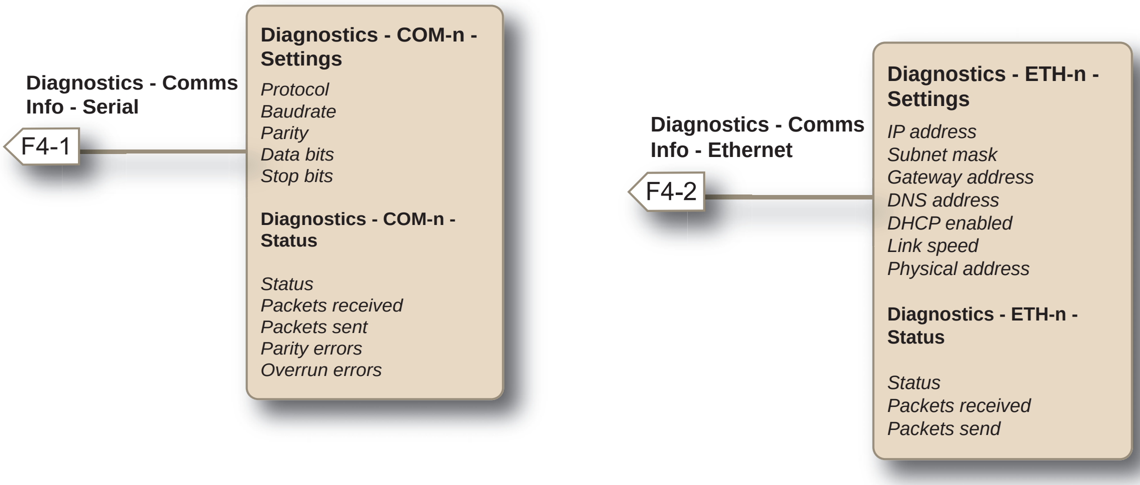



Diagnostics - System Health
F1
FM-ARM-1
RS
Batch control
Additive stream
Product stream
Pulse inputs
Digital outputs
Pulse outputs
Module control
RTD
Analog inputs
Analog outputs
Ethernet
FM-IN-OUT-1
DI-DC
DI-AC
DO-EMR
DO-SSR
Module control
AO
FM-IN-OUT-2
DI-DC
DI-AC
DO-EMR
DO-SSR
Module control
AO
FM-ARM-2
RS
Batch control
Additive stream
Pulse inputs
Digital outputs
Product stream
Module control
RTD
Analog inputs
Analog outputs
Ethernet
FM-IN-OUT-3
DI-DC
DI-AC
DO-EMR
DO-SSR
Module control
AO
FM-IN-OUT-4
DI-DC
DI-AC
DO-EMR
DO-SSR
Module control
AO
FM-HMI
RS
Device manager
Alarm manager
Transaction manager
Display manager
Authorization manager
Bay control
Arm control
Transaction control
LAD manager
Module control
Ethernet
Diagnostics - Board info
F2
FM-ARM-1
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max
FM-IN-OUT-1
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max
FM-IN-OUT-2
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max
FM-ARM-2
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max
FM-IN-OUT-3
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max
FM-IN-OUT-4
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max
FM-HMI
Last occured error
Last occured warning
JP1 - W & M Seal
JP2 - Password protection
JP3 - Unused
JP4 - Unused
JP5 - Unused
JP5 - Unused
Name
Status
Current
Main
Min
Max


Diagnostics - Accumulated Totals
F3
Diagnostics - Accu. Totals - Product streams
Stream 1
All streams
Stream 12
Accumulated Totals - Product Stream n
Transaction GOV
Leak GOV
Calibration GOV
Total GOV
Transaction GSV
Leak GSV
Calibration GSV
Total GSV
Transaction Mass
Leak Mass
Calibration Mass
Total Mass
Diagnostics - Accu. Totals - Additive streams
Stream 1
All streams
Stream 24
Accumulated Totals - Additive Stream n
Transaction GOV
Leak GOV
Calibration GOV
Total GOV
Diagnostics - Accu. Totals - Loading bay
Bay 1
Bay 2
Accumulated Totals - Bay n
GOV
GSV
Mass
Diagnostics - Accu. Totals - Loading arms
Arm 1
Arm 2
Arm 3
Arm 4
Accumulated Totals - Arm n
GOV
GSV
Mass
Diagnostics - Accu. Totals - Recipes
Arm 1
Arm 2
Arm 3
Arm 4
Accumulated Totals - Arm n
GOV
GSV
Mass

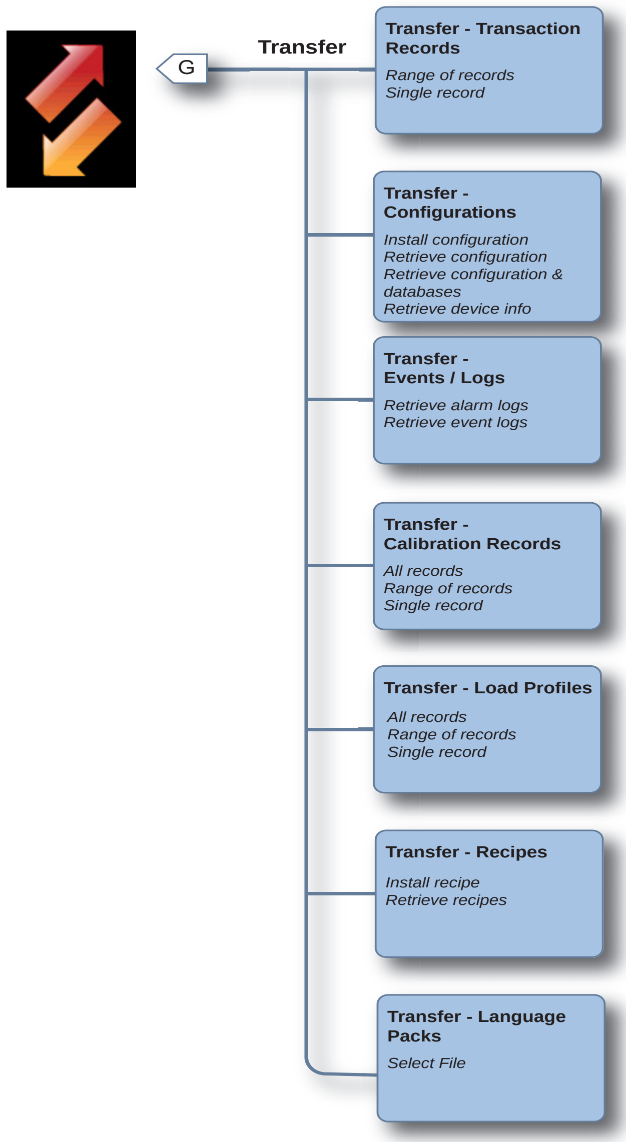

Diagnostics - Comms Info
F4
Diagnostics - Comms Info - Serial
Port ID
Protocol
Received
Transmitted
F4-1
Diagnostics - Comms Info - Ethernet
Port ID
Received
Transmitted
F4-2


Diagnostics - Device tasks
F5
Diagnostics - Reset tasks
Re-enable device
Reset device
Reset to factory settings
Format all memory
Clear all totals
Diagnostics - Execute Task - Arm Selection
Arm 1
.
.
.
Arm 4
Diagnostics - Arm n - Execute Tasks
Pause batch
Resume batch
Stop batch
End transaction
Diagnostics - Clear tasks
Loading bay
Loading arms
Recipes
Product streams
Additive streams
F5-1
Diagnostics - Advanced
F6
Diagnostics - Load profile - Arm Selection
Arm 1
Arm 2
Arm 3
Arm 4
Diagnostics - W&M info - Stream Selection
Stream 1 All streams
.
.
Stream 12
W&M Information - Product Stream n
Commodity group
Tables reference
Base temperature
Base pressure
Compensation used
Observed temperature
Observed pressure
Observed density
Base density
CTPL (VCF)
Diagnostics - OIML
Diagnostics - OIML



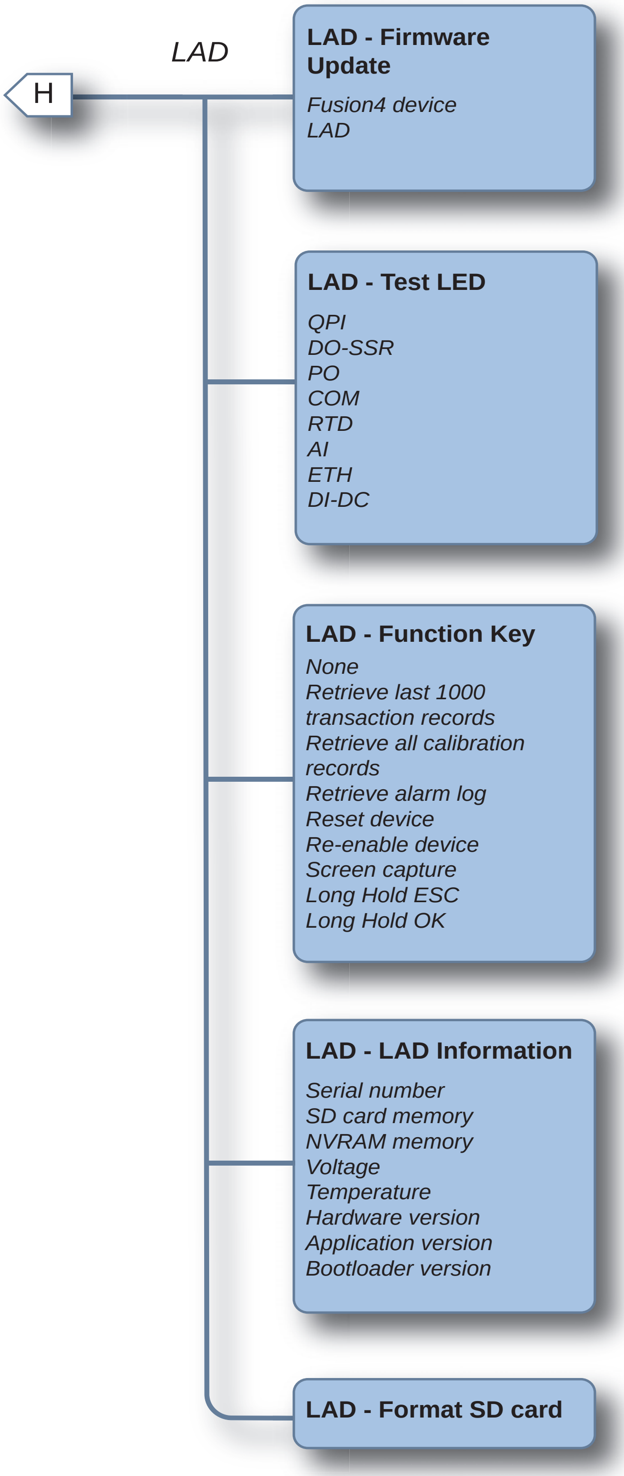
For information regarding the parameter and entity details, see section 5.15 - Diagnostics.

5.6.2.7 Transfer



For information regarding the parameter and entity details, see section 5.18 - Transfer.

5.6.2.8 LAD Functions



For information regarding the parameter and entity details, see section NOTE: - The language settings are applicable at a workflow level and are available for use after restarting the MSC-L device..

5.7 Loading Application Overview

The typical usage of the MSC-L is for normal loading and the other specific application types are described in the next chapters.

NOTE: *FIGURE 5-21 illustrates the loading application for each stream. This overview is also applicable for 6 Arms.*

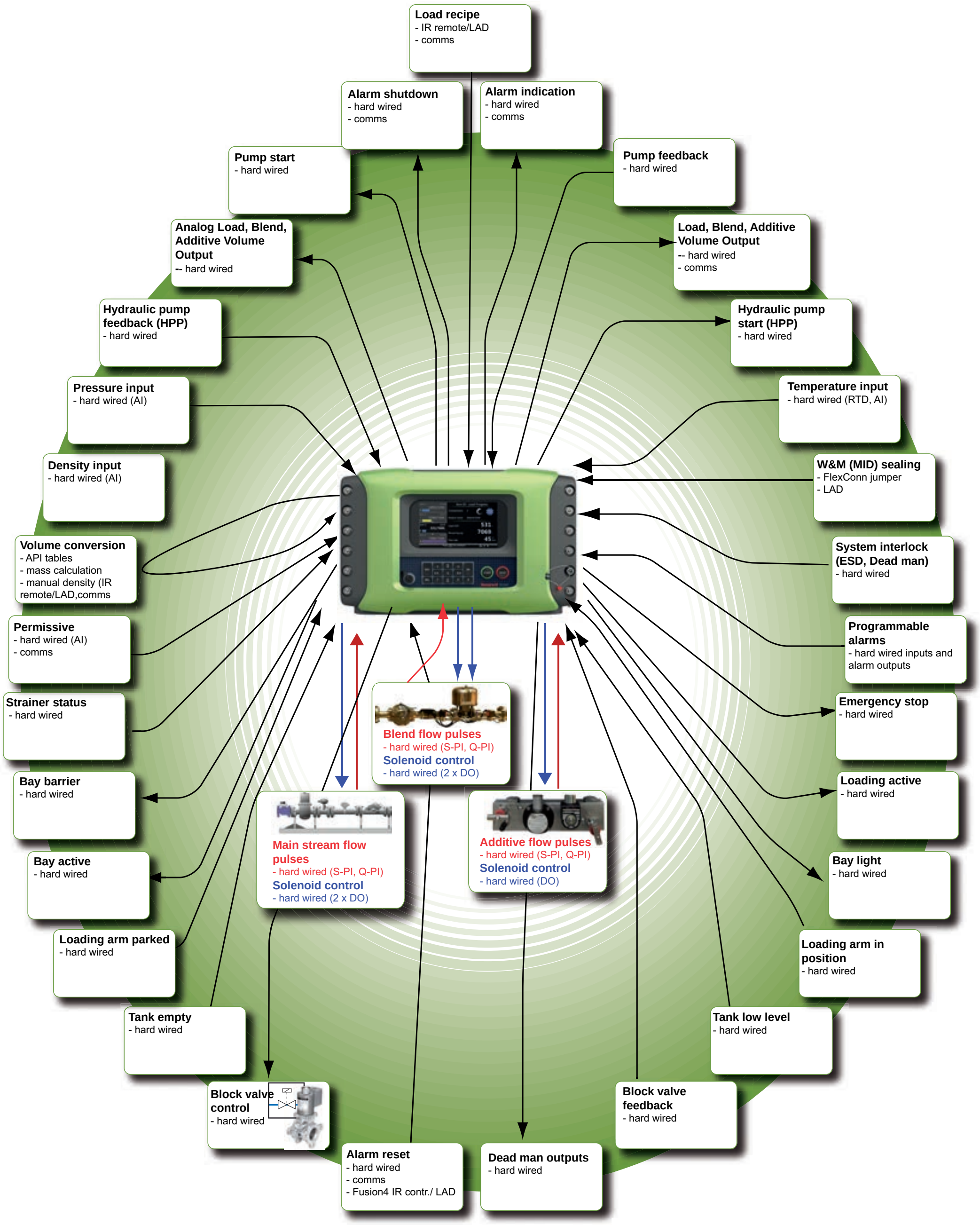


FIGURE 5-21 Loading application overview

5.8 Unloading Application Overview

The Fusion4 MSC-L supports unloading (offloading) application.The unloading assemblies cover a range of requirements, starting with simple single-unit, standalone unloading skids for the emptying of road tankers and transferring product from vehicle to site storage.

The MSC-L have a configuration parameter to configure the device for unloading with preset or unloading without preset.

These systems can be fully automated with dual redundancy, integrating multiple functions into the offloading process such as de-aeration, denaturing, additivation or blending. Multiple metering technologies can be utilized in these systems including positive displacement and Coriolis for custody transfer, with both local and remote data reconciliation. Ethanol and biodiesel offloading can be facilitated from both road tanker and rail car, as can LPG.

During unloading operation, the MSC-L controls the centrifugal pump, flow meter, direct control valve, high flow switch, low flow switch, stop flow switch, and dry run switch. Refer to the figure 5-22 for unloading product flow.

NOTE: when a centrifugal pump is used the flow rate may be adjusted by using a digital control valve. But, when a positive displacement valve is used the flow rate may not be controlled by a DCV. However, by configuring a two stage valve, the two provided control signal may be used by device external to the MSC-L to derive the proper frequency to control the pump.

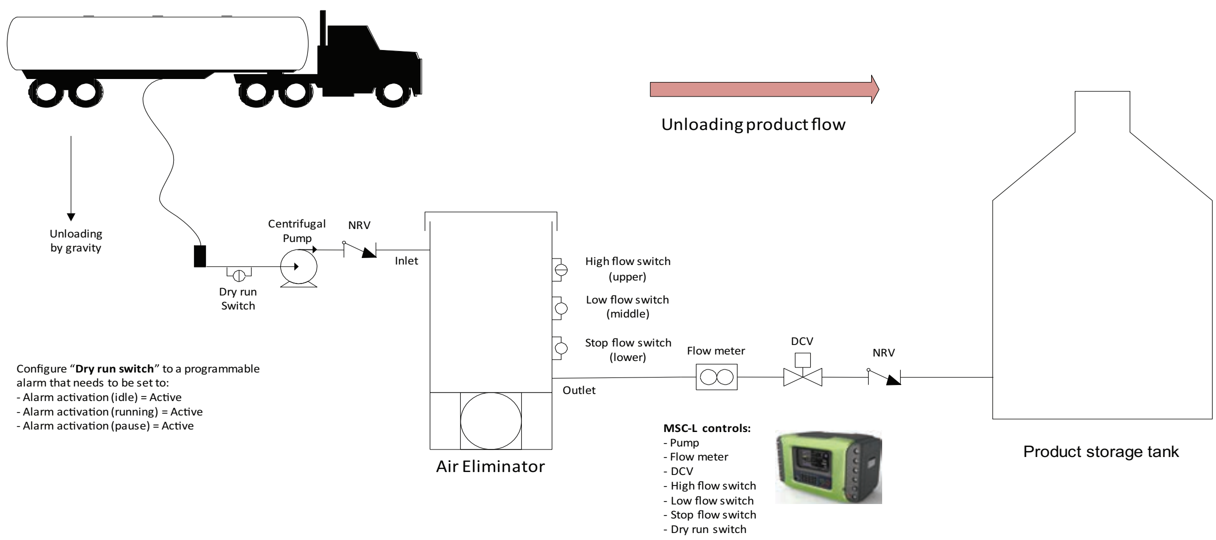


FIGURE 5-22 Unloading application overview

To configure a MSC-L device for unloading the product:

1. Enable [Back Pressure Control].

   Stream Configuration . Product streams . Stream n . Control settings . Product control . [Back Pressure Control] = <Enable>

2. Configure [Vapour pressure margin], [Pressure control range factor] and [Pressure control ramp time]

   Stream Configuration . Product streams . Stream n . Control Settings . Product Control . [Vapour pressure margin]

   Stream Configuration . Product streams . Stream n . Control Settings . Product Control . [Pressure control range factor]

   Stream Configuration . Product streams . Stream n . Control Settings . Product Control . [Pressure control ramp time]

3. Configure LPG as the commodity that's delivered through a product stream.

   Stream Configuration . Product streams . Stream n . Volume conversion . Conversion options . [Commodity group] = <TP27-07 (NGL & LPG)>

4. Select <Temperature & pressure> as the type of compensation used during the calculation of GSV and mass.

   Stream Configuration . Product streams . Stream n . Volume conversion . Conversion options . [Compensation used] = <Temperature & pressure>

5. Select the [Vapour pressure source].

   Stream Configuration . Product streams . Stream n . Volume conversion . Conversion options . [Vapour pressure source] = <Calculated> or <Measured>

   If [Vapour pressure source] is configured as <Measured>, then additional configuration item needs to be set:

   Stream Configuration . Product streams . Stream n . I/O bindings . Inputs . [Product vapour pressure] = <AI-x>

NOTE: *The chosen AI will be used with vapour pressure sensor and should be configured accordingly.*

6. Enable mass loading and configure the mass flow rate.

NOTE: *The vapour return line can only be used with a mass flow meter to measure the quantity correctly. This means that only loading by mass is supported when using a vapour return line.*

   System Configuration . Device . I/O Settings . PI . QPI-xx . [Meter Type] = <Mass>

System Configuration . Device . I/O Settings . PI . QPI-xx . [Minimum linear flow rate] = <0.0 kg/min>.

NOTE: *The vapour return line is not a controlled stream, but only monitored.*

System Configuration . Device . Workflow Settings . Options [Multiple loads per arm] = <Disabled>

System Configuration . Device . Workflow Settings . Promts [Preset unloading entry] = <Mandatory or Disabled>

NOTE: *The Preset unloading entry can be set either to Mandatory or Disabled depends on choice made for operation.*

7. Enable Vapour return

   Stream Configuration . Product streams . Stream x . Identification . [Vapour return] = <ENABLE>

8. Configure alarms

   Stream Configuration . Product streams . Stream x . Alarms . No Product . [Alarm action] = <Disabled>.

   Arm Configuration . Arm x . Alarms . Stop switch not covered. [Stop flow switch auto clear time out] = <10 s>.

   Arm Configuration . Arm x . Alarms . Fixed. [Invalid switch states] = <Display pause>.

NOTE: *A regular stream is used as vapour return line, which means that all features that are part of a stream can be used, like the block valve.*

9. Configure a loading arm

   Arm Configuration . Arm X . Control Settings . [Loading type] = <Unloading>

   Arm Configuration . Arm X . Control Settings . [Low flow rate] = <300 l/min>

   Arm Configuration . Arm X . Control Settings . [High flow rate] = <1800 l/min>

   Arm Configuration . Arm X . I/O binding. [Stop flow switch] = <Enable>

   Arm Configuration . Arm X . I/O binding. [Low flow switch] = <Enable>

   Arm Configuration . Arm X . I/O binding. [High flow switch] = <Enable>

10. Select a recipe

    Arm Configuration . Arm x . Recipes

NOTE: *Add the vapour return line as blend 1 in the recipe to enable the feature.*

5.9 LPG Loading Application Overview

Fusion4 MSC-L supports Liquefied Petroleum Gas (LPG) road loading. Liquefied petroleum gas or liquid petroleum gas (LPG or LP gas), also referred to as simply propane (C_3H_8) or butane (C_4H_{10}), or a mixture of those 2 propane and butane are flammable mixtures of hydrocarbon gases used as fuel in heating appliances, cooking equipment and vehicles.

MSC-L also supports loading a blend of propane and butane which may be required over changing climatic conditions. A typical blend can include 60-70% butane and 30-40% propane along with additives (odorants like ethanethiol,l ethyl mercaptan) for leak detection. LPG has a boiling point that depends on the vapour pressure, the temperature and the composition of it. LPG evaporates quickly at normal temperature and pressures so it must be kept pressurized, and a MSC-L device helps you to control the vapour pressure.

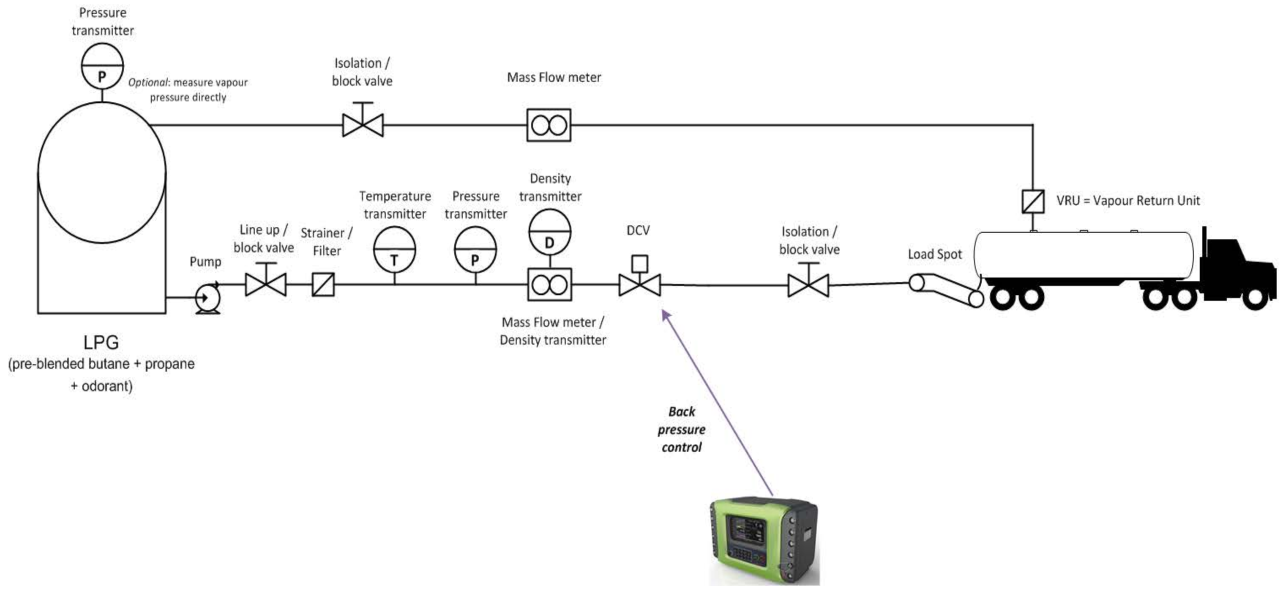


FIGURE 5-23 Application overview - LPG loading

The pressure in the delivery line is monitored/controlled to be above the vapour pressure to avoid LPG vaporization and, where possible, to optimize truck loading time. Fusion4 MSC-L supports configuration with independent external “back pressure” regulator valve (not shown) as well as configuration where the ‘normal’ flow control valve (DCV) is used to prevent from LPG vaporizing by reducing prescribed flow rate when pressure approaches vapour pressure.

FIGURE 5-24 LPG running screen

NOTE: *If external "back pressure" regulator valve is to be used, configure "Vapour pressure source" to "Externally controlled" and "Vapour pressure margin" to match the setting of the external pressure regulator valve. In this case Fusion4 MSC-L back pressure control will be disabled and "Vapour pressure margin" (together with delivery line pressure) will be used to derive vapour pressure.*

When Fusion4 MSC-L is configured to perform back pressure control, "Vapour pressure margin" functions as a safety margin, while "Pressure control range factor" parameter is used to adjust "Maximum limit point" and provides means to adjust range where "back pressure control" is active.

The "Minimum limit point" is a calculated pressure value where it is considered that the product may start vaporizing. The flow must completely stop at this pressure level:

Minimum limit point = 1.0 * Vapour pressure (measured) + Vapour pressure margin

Minimum limit point = 1.1 * Vapour pressure (calculated)+ Vapour pressure margin

NOTE: *The additional 10% 'safety' margin applies in the case of 'Calculated' vapour pressure to cater for potential errors disclosed in MPMS 11.2.5 standard (used for deriving vapour pressure).*

The “Maximum limit point” is the point where “back pressure control” starts throttling down flow rate. This point is above the “Minimum limit point” and it can be adjusted via “Pressure control range factor” parameter:

Maximum limit point = Minimum limit point * (1.0 + Pressure control range factor)

NOTE: *If the product vapour pressure (required for back pressure control) cannot be determined for some reason, for example in case of ‘Calculated’ vapour pressure configuration and VCF calculations raising exception, the flow rate target will be adjusted to zero for safety reasons.*

Back pressure control is implemented by applying a 'Setpoint Adjustment Factor' (calculated) to the product flow rate setpoint. When target setpoint is switched and if back pressure control is active, the effective setpoint will be gradually changing (converging) from previous value to a new value during the configured 'Pressure control ramp time' interval, therefore smoothing out flow/pressure dynamics. An example of Load Profile showing ‘ramping’ up when back pressure control is active is shown in the figure below.

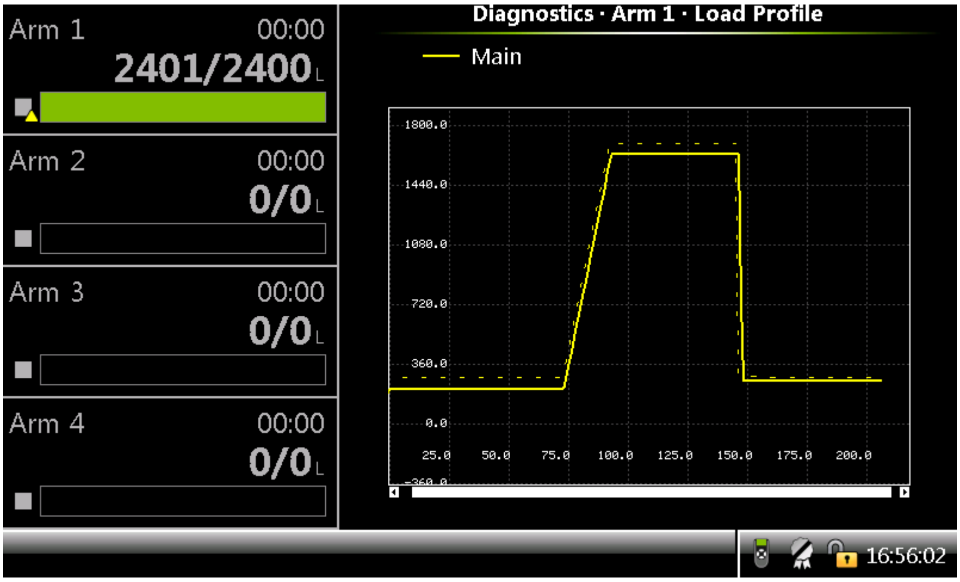


FIGURE 5-25 Load Profile showing ‘ramping’ up when back pressure control is active

For safety reasons, Fusion4 MSC-L features a number of alarms. Relevant alarms can be configured and triggered if the flow rate is reduced below meter’s “Minimum linear flow rate”. There are also configurable pressure alarms that warn you about dropping pressure conditions. MSC-L devices also support configurable pressure alarm hysteresis in order to avoid oscillation of an alarm around the alarm threshold.

To configure a MSC-L device for LPG loading with no external 'back pressure' regulator valve:

1. Enable [Back Pressure Control].

   Stream Configuration . Product streams . Stream n . Control settings . Product control . [Back Pressure Control] = <Enable>

2. Configure [Vapour pressure margin], [Pressure control range factor] and [Pressure control ramp time]

   Stream Configuration . Product streams . Stream n . Control Settings . Product Control . [Vapour pressure margin]

   Stream Configuration . Product streams . Stream n . Control Settings . Product Control . [Pressure control range factor]

   Stream Configuration . Product streams . Stream n . Control Settings . Product Control . [Pressure control ramp time]

3. Configure LPG as the commodity that's delivered through a product stream.

   Stream Configuration . Product streams . Stream n . Volume conversion . Conversion options . [Commodity group] = <TP27-07 (NGL & LPG)>

4. Select <Temperature & pressure> as the type of compensation used during the calculation of GSV and mass.

   Stream Configuration . Product streams . Stream n . Volume conversion . Conversion options . [Compensation used] = <Temperature & pressure>

5. Select the [Vapour pressure source].

   Stream Configuration . Product streams . Stream n . Volume conversion . Conversion options . [Vapour pressure source] = <Calculated> or <Measured>

   If [Vapour pressure source] is configured as <Measured>, then additional configuration item needs to be set:

   Stream Configuration . Product streams . Stream n . I/O bindings . Inputs . [Product vapour pressure] = <AI-x>

NOTE: The chosen AI will be used with vapour pressure sensor and should be configured accordingly.

6. Enable mass loading and configure the mass flow rate.

NOTE: The vapour return line can only be used with a mass flow meter to measure the quantity correctly. This means that only loading by mass is supported when using a vapour return line.

   System Configuration . Device . I/O Settings . PI . QPI-xx . [Meter Type] = <Mass>

System Configuration . Device . I/O Settings . PI . QPI-xx . [Minimum linear flow rate] = <0.0 kg/min>.

NOTE: The vapour return line is not a controlled stream, but only monitored.

7. Enable Vapour return

   Stream Configuration . Product streams . Stream x . Identification . [Vapour return] = <ENABLE>

8. Configure alarms

   Stream Configuration . Product streams . Stream x . Alarms . No Product . [Alarm action] = <Disabled>.

NOTE: A regular stream is used as vapour return line, which means that all features that are part of a stream can be used, like the block valve.

9. Configure a loading arm

   Arm Configuration . Arm x . Control Settings . [Loading type] = <Straight with VRU>

10. Select a recipe

    Arm Configuration . Arm x . Recipes

NOTE: Add the vapour return line as blend 1 in the recipe to enable the feature.

5.10 Dual Bay Loading Application Overview

5.10.1 About Dual Bay Loading

Fusion4 MSC-L has a dual bay loading feature. This feature enables multiple users to use the load computer at the same time to load two different trucks simultaneously; where for each bay/ truck, a transaction is running/active.

A single operator or a maximum of two truck drivers can use an HMI and an MSC-L device to perform dual bay loading. However, the two truck drivers must sequentially operate the device (entering the input data, setting up batches, and so on). Since multiple batches can be started at the same time, two transactions run in parallel/simultaneously.

A dual loading bay supports fixed arms and swing arms. A swing arm can be used on both bays by swinging the arm from one bay to another. A fixed arm that is fixed to one side of the bay can also be used to realize dual bay loading. A maximum of 4 arms are supported; where the arms are either swing arms or fixed arms or a mix of them.

Dual bay loading can be done stand alone or remotely by Terminal manager.

5.10.2 MSC-L Licenses

Following are the licenses for MSC-L to enable dual bay loading:

- MSC-L 1D
- MSC-L 2D
- MSC-L 3D
- MSC-XL1
- MSC-XL2
- MSC-XL3
- MSC-XL4

NOTE: *You cannot perform dual bay loading if the license is for 5 or 6 arms.*

5.10.3 Dual Bay Loading using MSC-L

The following figure represents the dual bay loading operations using MSC-L.

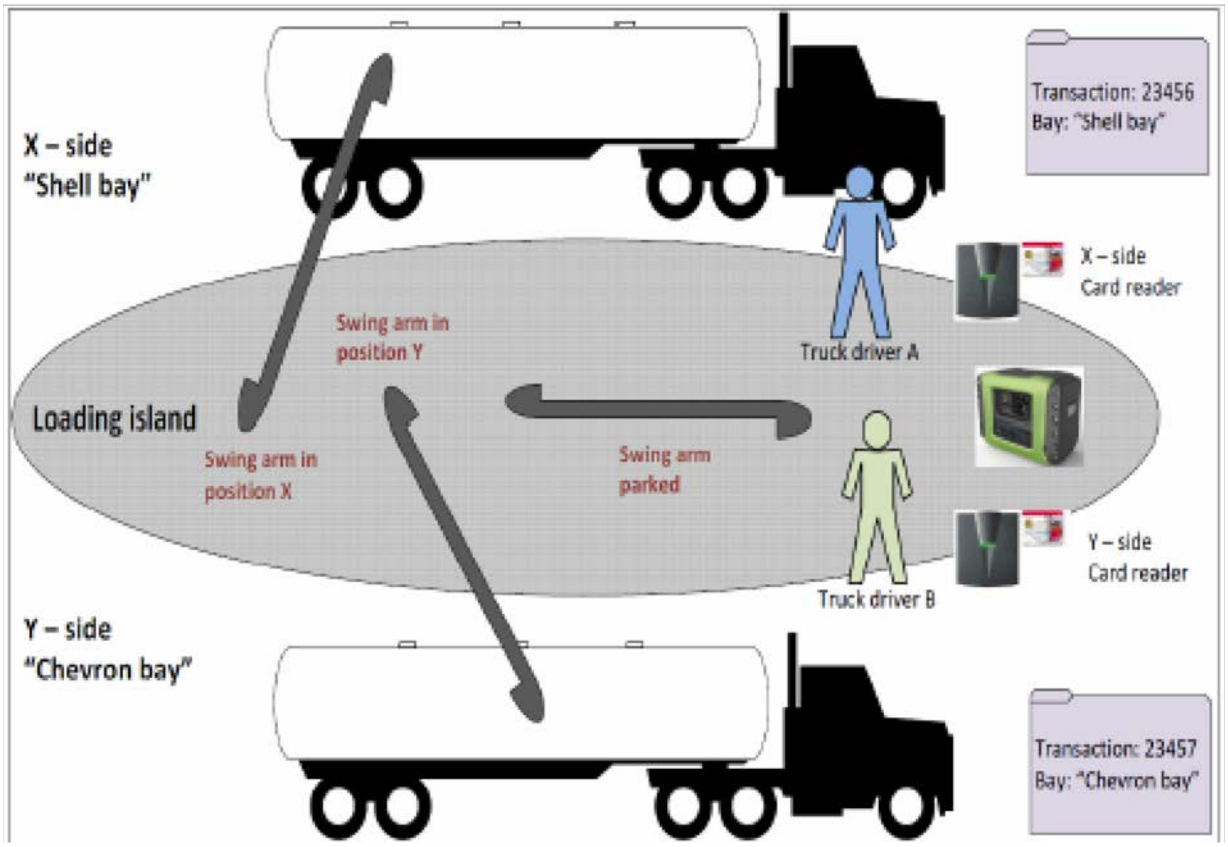


FIGURE 5-26 Dual Bay Loading using MSC-L

5.10.4 Authorization Modes supported for Dual Bay Loading

The following modes of authorization are supported for dual bay loading:

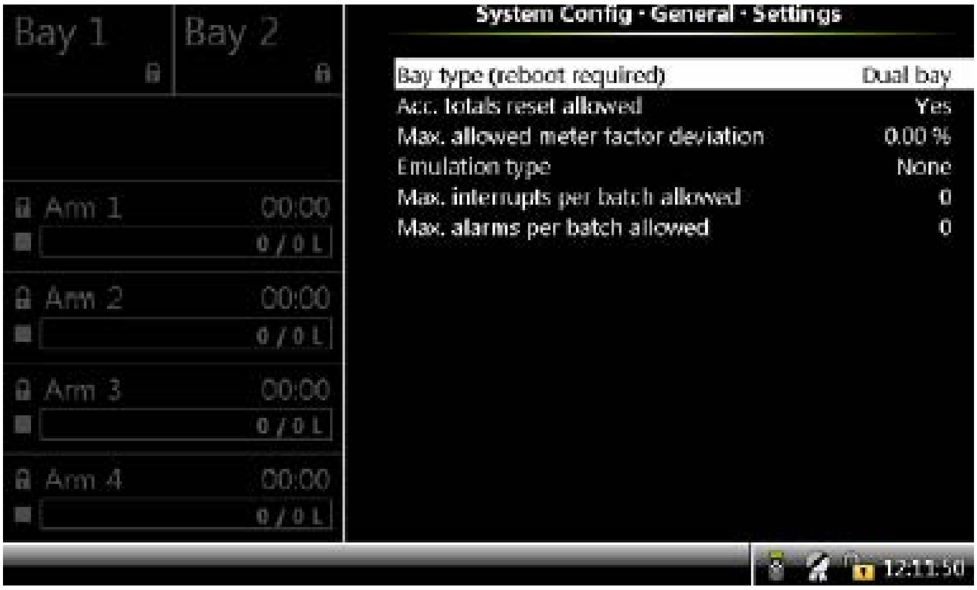
- Two card readers - a card reader for each bay
- A common card reader for both the bays
- A PIN per user entered using the MSC-L keyboard

5.10.5 Dual Bay Configuration

The following section describes the configurations required for dual bay loading.

To configure dual bay, perform the following:

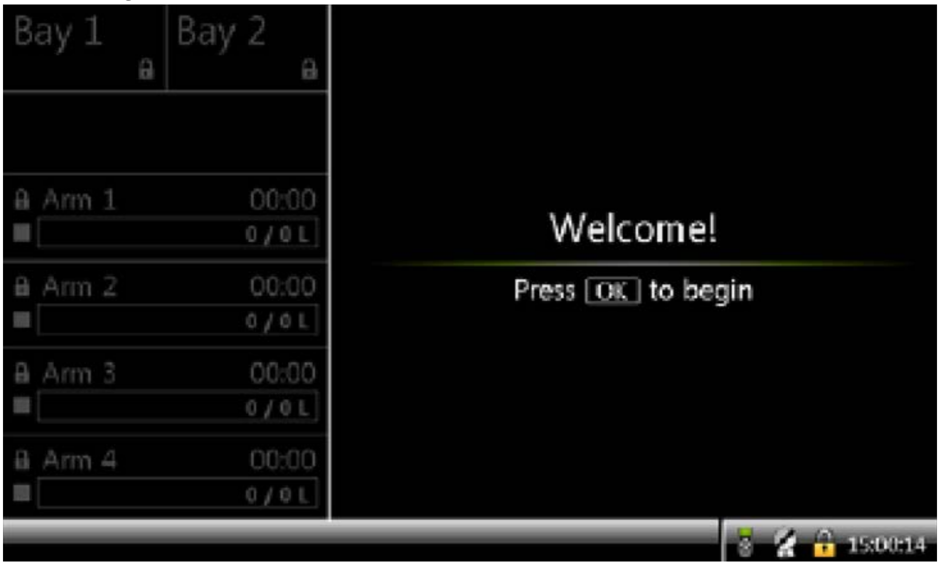
1. On the System Configuration. General screen, select <Settings>.
2. On the System Configuration. General. Settings screen, select Bay type (reboot required).



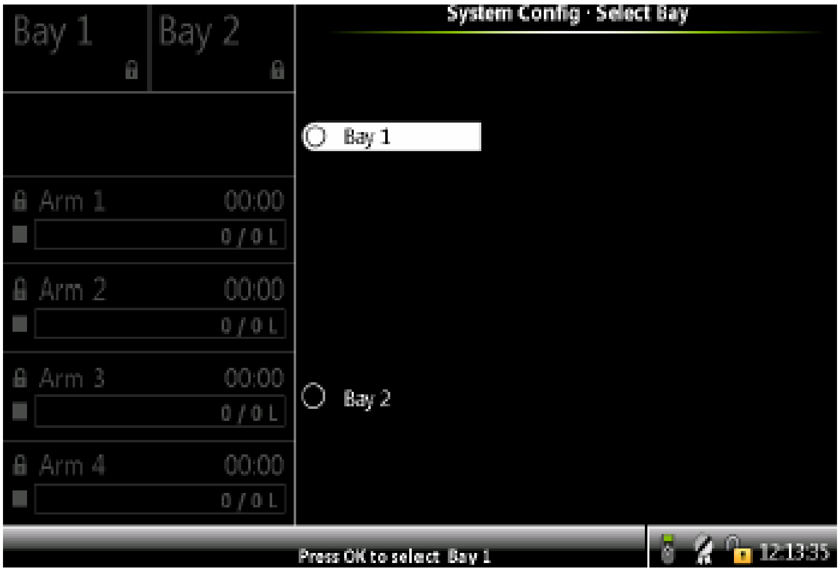
For more information on the entities, refer to chapter 5.8.1.1.5 "System Config . Device . Settings".

The following screen appears.

3. Select the bay type as Dual Bay.
4. After you change the bay type, restart the device manually for the changes to take effect.



After the device is restarted, the two bays are displayed in the user interface.



5. Select the required bay.
6. Press OK to select the required bay, and continue configuring the bay.
7. On the System Configuration . Bay <number> . Bay screen, select Identification.

8. Select System Configuration. COM-<number>. Authorization. The following screen appears.

9. On the System Configuration. COM-<number>. Authorization screen, select Loading Bay.
   The following screen appears.

10. On the System Configuration . COM-<number>. Loading Bay screen, select one of the following:
    - Bay 1: If the integrated card reader is applicable only for Bay 1.
    - Bay 2: If the integrated card reader is applicable only for Bay 2.
    - None: If the integrated card reader is common to both Bay 1 and Bay 2.
11. Select Main menu . Arm Configuration . Arm <number>.

12. On the Arm Configuration . Arm <number> screen, select Identification.
    The following screen appears.

13. On the Arm Configuration . Arm <number> . <Identification> screen, select Arm Location.
    The following screen appears.

14. On the Arm Config. Arm <number>. Arm Location screen, select one of the following:
    - Bay 1: If the selected arm is associated to Bay 1
    - Bay 2: If the selected arm is associated to Bay 2.
    - None: If the selected arm is a swing arm.

NOTE: f any arm is selected as a swing arm, then perform steps 15 to 17.

15. Select Main menu . Arm Configuration . Arm <number>. I/O bindings. Inputs. The following screen appears.

16. On the Arm Configuration . Arm <number> . I/O bindings. Inputs screen, select Bay 1 in position.
The following screen appears.

17. Select the required I/O binding for the selected bay.

If Bay 1 in position is Active, then the arm is in position at Bay 1; else, the arm is not in position at Bay 1. Similarly, if Bay 2 in position is Active, then the arm is in position at Bay 2; else, the arm is not in position at Bay 2.

The following table describes the various arm statuses based on the values configured for Bay 1 in position is Active and Bay 1 in position is Active parameters.

Bay 1 in position	Bay 2 in position	Arm Status
Active	Active	This scenario cannot occur. An alarm “Swing arm invalid position” is displayed
Not Active	Active	Loading can begin at Bay 2
Active	Not Active	Loading can begin at Bay 1
Not Active	Not Active	The loading arm is parked or in transition.

18. On the Diagnostics screen, select <Accumulated totals>. The Diagnostics . Accumulated Totals screen appears.

19. On the Diagnostics. Accumulated Totals screen, select <Loading bay>.
    The following screen appears.

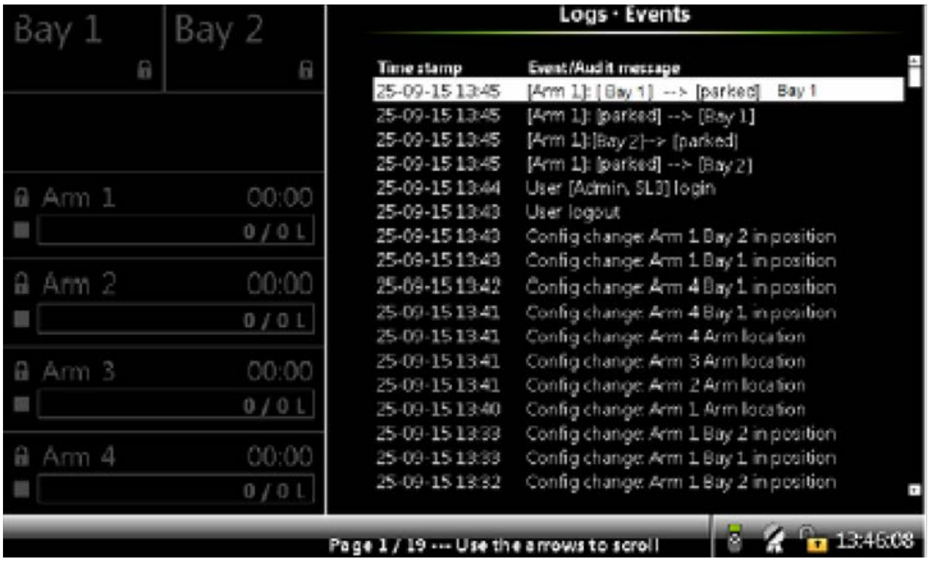
20. On the Diagnostics. Accumulated Totals . Loading bay screen, select Bay 1.
    The following screen appears.

The following details are displayed.

- GOV: The Gross Observed Volume of the product.
- GSV: The Gross Standard Volume of the product.
- Mass: The mass of the product.

21. On the Main Menu screen, select <Logs>. The Logs screen appears.

22. On the Logs screen, select <Events> and then select <OK> on the IR controller or the LAD. The Logs. Event Log screen appears.



All the event logs are displayed.

The configurations required for the dual bay loading are successfully completed.

5.10.6 Dual Bay Loading Operations

Fusion4 MSC-L has a dual bay loading mechanism. Dual bay loading enables multiple users to use the load computer at the same time.

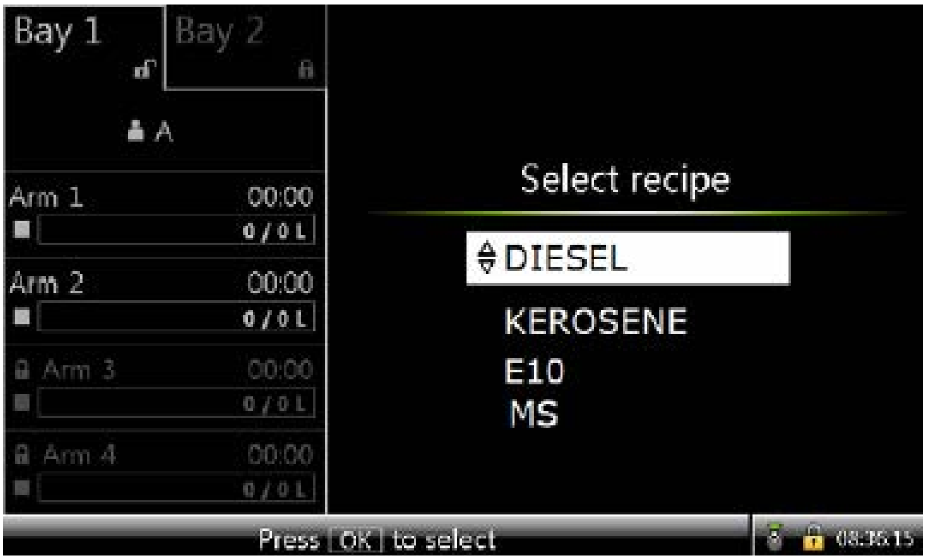
NOTE: *You cannot perform dual bay loading if the license is for 5 to 6 arms.*

To perform dual bay loading:

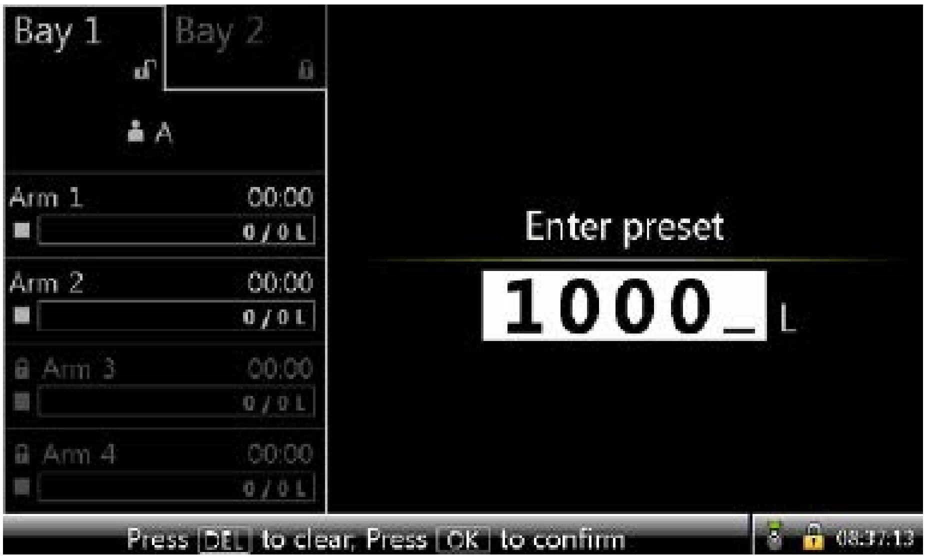
1. On the MSC-L Welcome screen, press OK. The Select bay screen appears.

2. Select the required bay and then press OK. The Select arm screen appears.

3. Select the arm that must be used for loading and then press OK. The Select recipe screen appears.



4. Select the recipe that must be loaded and then press OK. The Enter preset screen appears.



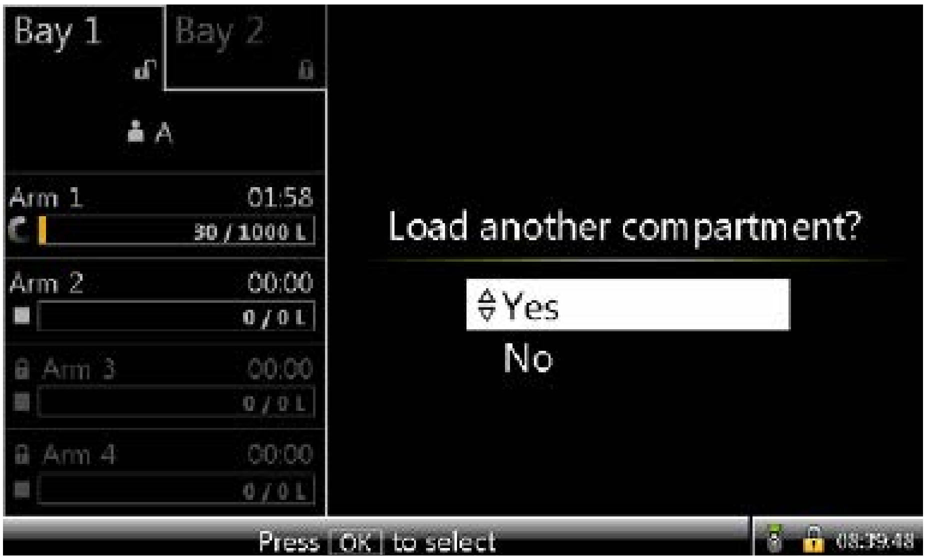
5. Enter the quantity of the product that must be loaded into the compartment and then press OK. The following screen appears.

The following details are displayed on the right pane.

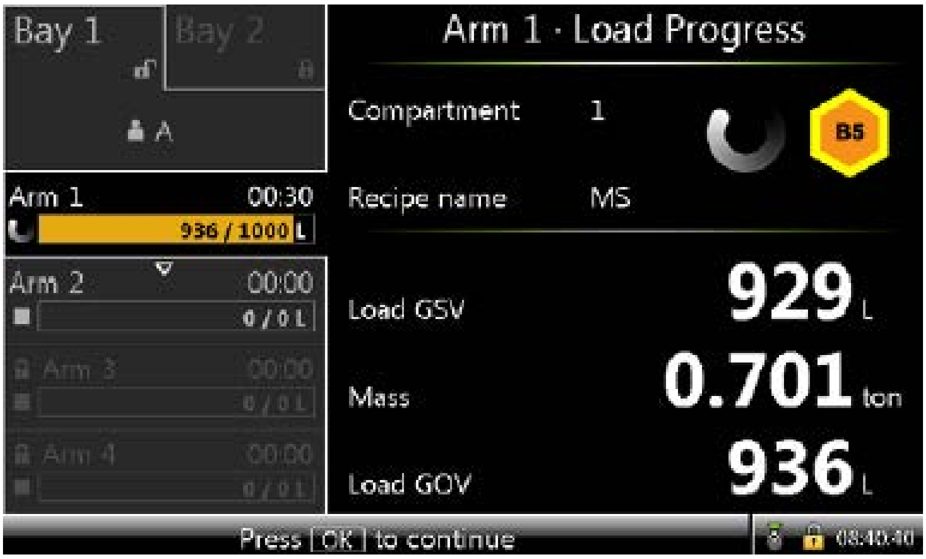
- Recipe name: The name of the product that is being loaded into the compartment.
- Compartment: The compartment to which the product is being loaded.
- Arm name: The name of the arm that is being used for loading the product.
- Preset: The quantity of the product to be loaded.

6. Press Confirm. The following screen appears.

7. Press Start. The loading starts and the following screen appears.



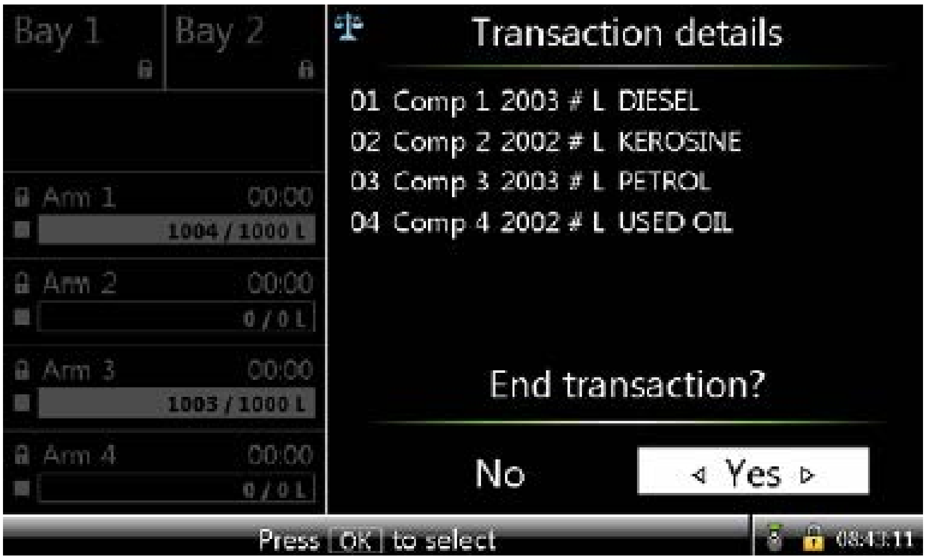
8. If you want to load another compartment, press Yes. Repeat steps from 2 to 7.
   Or
   If you do not want to load another compartment, press No.
9. Select the loading bay and then press OK. The following screen appears.



The following details are displayed on the right pane.

- Compartment: The compartment to which the product is being loaded.
- Recipe name: The name of the product that is being loaded into the compartment.
- Load GSV: The gross standard volume of the product loaded.
- Mass: The mass of the product loaded.

″ Load GOV: The gross observed volume of the product loaded. After the transaction is complete, the Transaction details screen appears.



10. If you want to end the transaction, press Yes. The transaction is successfully completed.

NOTE:

- Permissives per bay: Grounding, Overfill, Vapor (DI).
- Transaction records are created simultaneously per bay.
- Fusion4 Portal prints the first finished transaction first.
- The workflow is identical for each bay. However, the workflow is executed independent from each other.
- The STOP button on the keyboard pauses all running arms on both bays with the ability to stop or resume the arms per “HMI bay focus”.

5.11 System Configuration

To perform the System Configuration

1. On the **Main Menu** screen, select the **System Configuration** icon.

The **System Configuration** screen appears, which displays the functions available for system configuration.

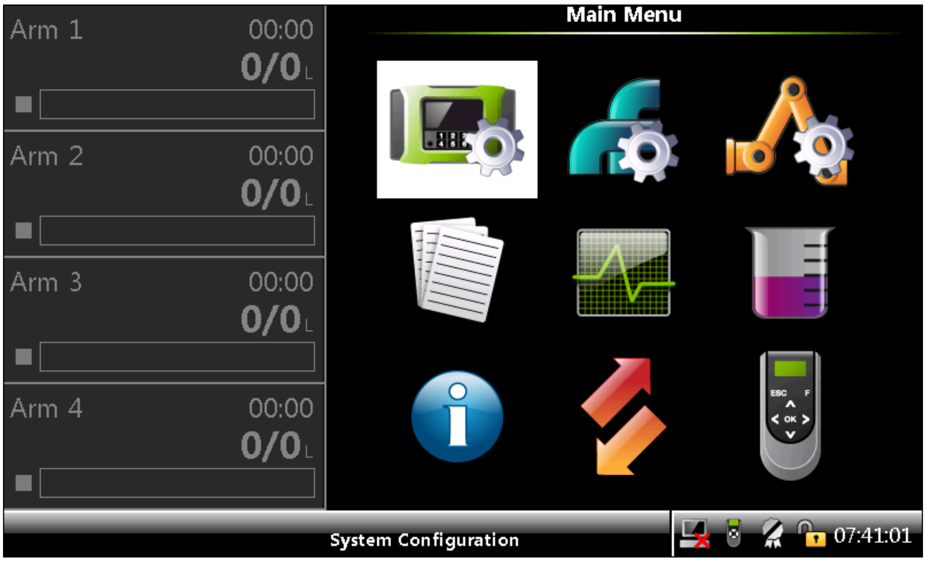
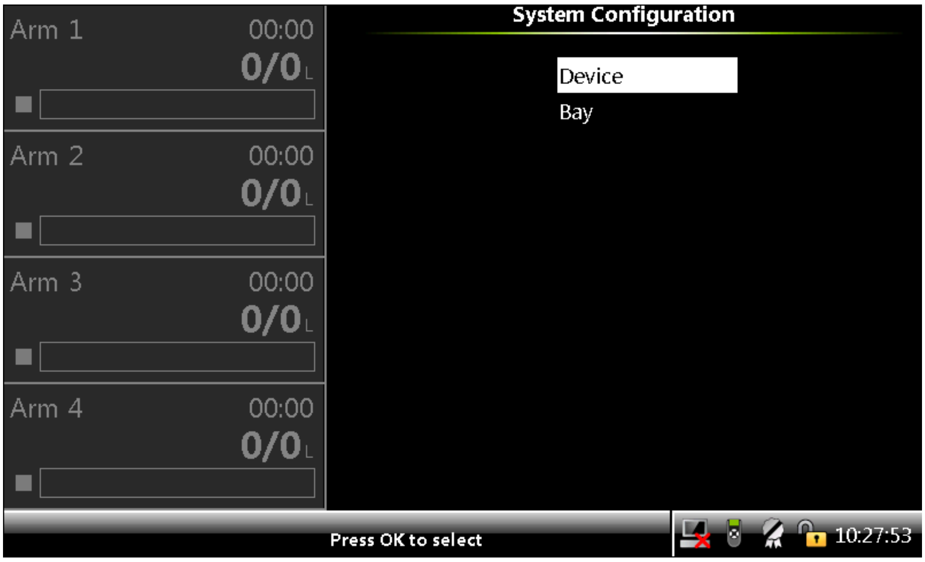


FIGURE 5-27 System Configuration icon

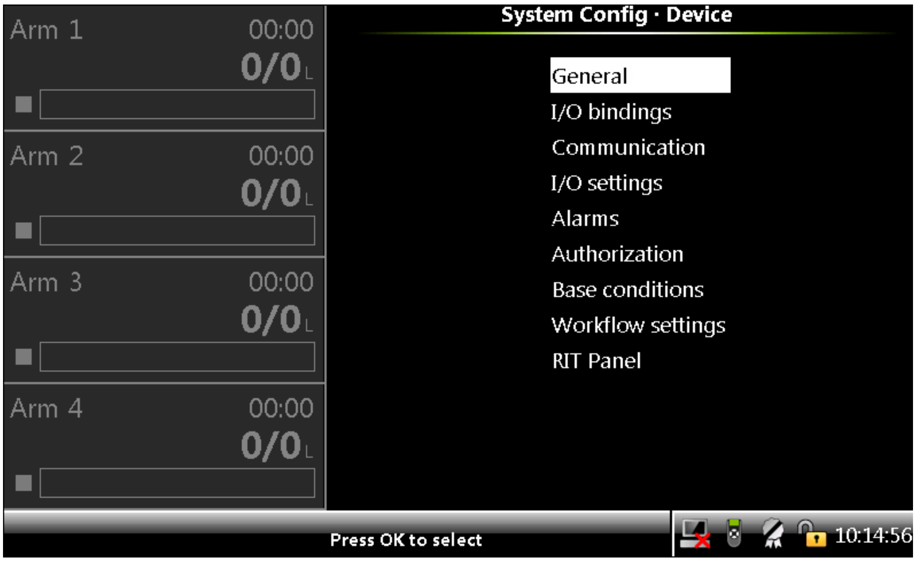
2. On the **System Configuration** screen, select either <Device> or <Bay> to configure the MSC-L.



5.11.1 Device Configuration

- On the **System Configuration** screen, select <Device>.

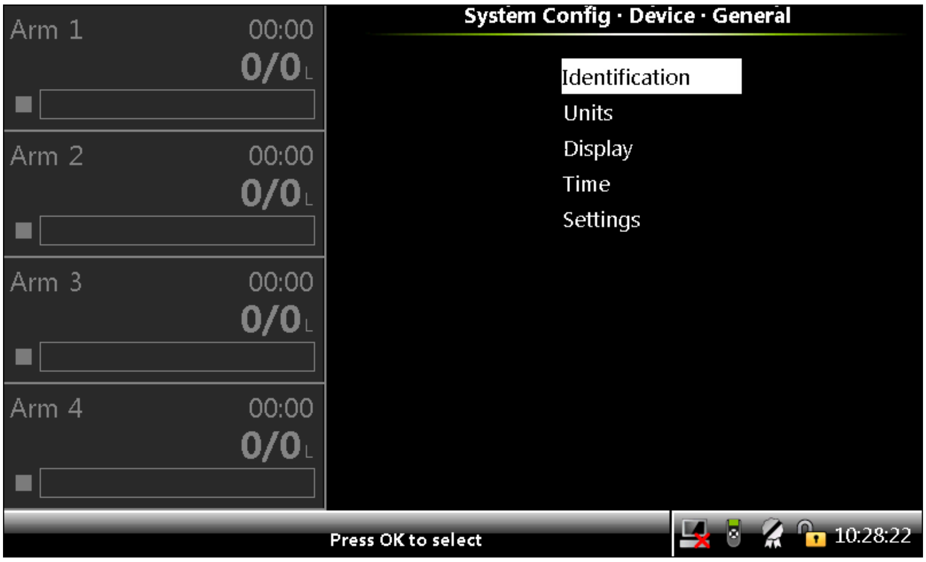
The **System Config . Device** screen appears, which displays the functions available for the device configuration.



5.11.1.1 Device Configuration . General

1. On the **Device Configuration** screen, select <General>.

   The **System Config . Device . General** screen appears.



2. On the **System Config . Device . General** screen, select each entity to configure the MSC-L.

5.11.1.1.1 *System Config . General Identification*

The **System Config . Device . General** screen, select <Identification>. The following entities are displayed on the **System Config . General . Identification** screen.

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-L. This entity specifies a unique identification of the device by a text string.	A text string of maximum 8 characters.
[Device Address]		
[WnM intended (reboot required)]	This entity denotes if the MSC-L is W&M intented. Note: You need to restart the MSC-L after changing the entity.	<True> - W&M compliant (default) <False> - Not W&M compliant
[Application Type]	Fusion 4 MSC-XL6	

5.11.1.1.2 *System Config . General . Units*

On the **System Config . Device . General** screen, select <Units>. The following entities are displayed on the **System Config . General . Units** screen.

Entity	Description	Value range
[Units of preset]	With this entity you can select the engineering units for preset.	<GOV> (default) <GSV> <Mass>
[Units of volume]	With this entity you can select the engineering units for volume.	<Liter> (default) <Cubic Meter> <Cubic Centimeter> <Cubic Decimeter> <US Gallons> <Gallons Imperial> <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> <PSI large <Bar>

Entity	Description	Value range
[Units of density]	With this entity you can select the engineering units for density.	<Kilogram per Cubic Meter> (default) <Degrees API> <Pounds per Cubic Feet> <Relative Density at 60 F> <Kilogram per liter>
[Units of mass]	With this entity you can select the engineering units for mass.	<Kilogram> (default) <Metric ton> <Pound> <Long ton (UK) <Short ton (US)

The following table lists the units that are displayed on the device screen.

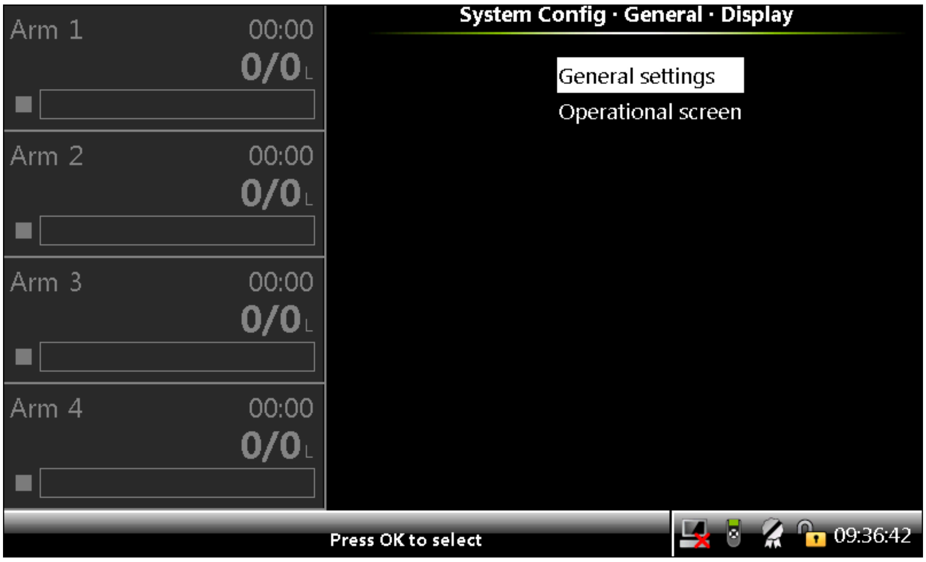
Description	Name	Unit	Range min	Range max	Format
Transaction volume (General + MSC-L BoL)	Liter Cubic meter Cubic centimeter Cubic decimeter US Gallons Gallons imperial Barrel	L m^3 cm^3 dm^3 gal gal bbl	0 0 0 0 0 0 0	999999.99 999.99999 999999990 999999.99 99999.999 99999.999 9999.9999	6 [ds] 2 3 [ds] 5 9 6[ds]2 5[ds]3 5[ds]3 4[ds]4
Transaction volume (MSC-L running / idle screens)	Liter Cubic meter Cubic centimeter Cubic decimeter US Gallons Gallons imperial Barrel	L m^3 cm^3 dm^3 gal gal bbl	0 0 0 0 0 0 0	99999999 99999.999 99999999000 99999999 9999999.9 9999999.9 999999.99	8 5[ds]3 11 8 7[ds]1 7[ds]1 6[ds]2
Accumulated total volume	Liter Cubic meter Cubic centimeter Cubic decimeter US Gallons Gallons imperial Barrel	L m^3 cm^3 dm^3 gal gal bbl	0 0 0 0 0 0 0	99999999 99999.999 99999999000 99999999 9999999.9 9999999.9 999999.99	8 5[ds]3 11 8 7[ds]1 7[ds]1 6[ds]2
Transaction additive volume	Milliliter Cubic centimeter	ml cc	0 0	999999.99 999999.99	6[ds]2 6[ds]2
Accumulated total additive volume	Liter Cubic meter Cubic centimeter Cubic decimeter US Gallons Gallons imperial Barrel	L m^3 cm^3 dm^3 gal gal bbl	0 0 0 0 0 0 0	99999.999 99.999999 99999999 99999.999 99999.999 99999.999 999.99999	5[ds]3 2[ds]6 8 5[ds]3 5[ds]3 5[ds]3 3[ds]5
Mass	Kilogram Metric ton Pound Long ton (UK) Short ton (US)	kg ton lb long ton US ton	0 0 0 0 0	999999.99 999.99999 999999.99 999.99999 999.99999	6[ds]2 3[ds]5 6[ds]2 3[ds]5 3[ds]5

Description	Name	Unit	Range min	Range max	Format
Temperature	Celsius Fahrenheit	°C °F	-300.00 -400.0	300.00 572.0	3[ds]2 3[ds]1
Density	Kilogram per cubic meter Degrees API Pounds per cubic feet Relative density at 60°F Kilogram per Liter (MSC)	kg/m^3 °API lb/ft^3 RD60 kg/L	0 -50.0 0 0 0	9999.9 600.0 999.99 9.9999 9.9999	4[ds]1 3[ds]1 3[ds]2 1[ds]4 1[ds]4
Pressure	Bar Pascal Kilo Pascal PSI RANGE 100 (SSC) PSI RANGE 1000 (SSC) PSI (MSI)	bar Pa kPa psi_r100 psi_r1000 psi	0 0 0 0 0 0	999.99 99999000 99999 999.9999 999.999 999.9999	3[ds]2 8 5[ds]0 3[ds]4 3[ds]3 3[ds]4
Ratio	Percentage Parts per million	% ppm	0.00 0	99.99 999999	2 [ds] 2 6
Expansion coefficient	Inverse Fahrenheit Inverse Celsius	10^{-7}/°F 10^{-7}/°C	00000 00000	99999 99999	5 5
Flow rate	Liter per minute Cubic meter per minute Cubic centimeter per minute Cubic decimeter per minute US Gallons per minute Gallons imperial per minute Barrel per minute	L/min m^3/min cm^3/min dm^3/min gal/min gal/min bbl/min	0 0 0 0 0 0 0	999999.99 999.99999 999999990 999999.99 99999.999 99999.999 9999.9999	6 [ds] 2 3 [ds] 5 9 6[ds]2 5[ds]3 5[ds]3 4[ds]4
Additive Flow rate	Milliliter per minute Cubic centimeter per minute	ml/min cc/min	0 0	999999.99 999999.99	6[ds]2 6[ds]2

5.11.1.1.3 System Config . General . Display

1. On the **System Config . Device** . **General** screen, select <Display>.

The **System Config . General . Display** screen appears.



2. On the **System Config . General . Display** screen, select each entity to configure the display for the MSC-L.

5.11.1.1.3.1 System Config . Display . General Settings

On the **System Config . General . Display** screen, select <General settings>. 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 the 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> <Thai> <Local Language>

5.11.1.1.3.2 System Config . Display. Operational Screen

On the **System Config . General . Display** screen, select <Operational screen>. The following entities are displayed.

Entity	Description	Value range
[Dynamic label 1], [Dynamic label 2], and [Dynamic label 3]	With this entity you can select the values which are required to appear on the Load progress screen.	<Preset > <Load GOV> <Load GSV> <Remaining time> <Flow rate> <Mass> <Accumulated GOV> <Accumulated GSV> <Accumulated mass> <Remaining quantity> <Temperature> <Pressure> <Density> <Main GOV> <Blend 1 GOV> <Blend 2 GOV> <Blend 3 GOV> <Main GSV> <Blend 1 GSV> <Blend 2 GSV> <Blend 3 GSV> <Main ratio> <Blend 1 ratio> <Blend 2 ratio> <Blend 3 ratio> <Main mass> <Blend 1 mass> <Blend 2 mass> <Blend 3 mass> <Additive 1 PPM> <Additive 2 PPM> <Additive 3 PPM> <Base temperature> <Base pressure> <Vapour return>

5.11.1.1.4 *System Config . General . Time*

On the **System Config . Device . General** screen, select <Time>. The following entities are displayed.

Entity	Description	Value range
[Date display format]	With this entity you can select the format of the date. Note: The local site time must be configured (synchronized) in the MSC-L, to have all the transactions and the alarms being timestamped correctly in the local time. The MSC-L does not support Daylight Saving Time.	<DD-MM-YY> (default) <MM-DD-YY> <YY-MM-DD> <DD-MM-YYYY> <MM-DD-YYYY> <DD/MM/YYYY> <MM/DD/YYYY> Note: Only the first three selections are completely visible on the MSC-L screen.
[Time display format]	With this entity you can select the format of the time.	<12-hour> <24-hour> (default) Note: Only the 24-hour selection is completely visible on the MSC-L screen.
[Date]	With this entity you can select the actual date that is used for time stamping of transactions, calibrations, and alarms.	<Year> <Month> <Day> Note: By default, the current date appears. To change the default date, enter the year, month, and day.
[Time]	With this entity you can select the actual time that is used for time stamping of transactions, calibrations, and alarms.	<Hour> <Minute> <Second> Note: By default, the current time appears. To change the default time, enter the hour, minute, and second.

5.11.1.1.5 *System Config . Device . Settings*

On the **System Config . Device . General** screen, select <Settings>. The following entities are displayed.

Entity	Description	Value range
[Bay type (reboot required)]	With this entity you can select the necessary bay	<Single bay> <Dual bay>.
[Acc. totals reset allowed]	With this entity you can enable / disable the ability to reset accumulator totals	<No> (default) <Yes>.

Entity	Description	Value range
[Max. allowed meter factor deviation]	With this entity you can select the maximum deviation between any two adjacent meter factors. During product meter calibration (manual or wizard), the configured meter factor deviation is checked between the adjacent meter-factors. If the meter factor deviation is set to 0%, it means there is no deviation check required. This entity has a W&M seal protection.	<+/- 0.0%> (default)
[Emulation Type]	With this entity you can configure the type of device that you want to emulate.	<None> (default) <1010BJ> <1010CJ> <1010CB> <1010RT> <Accuload>
[Max. interrupts per batch allowed]	With this entity you can configure that maximum number of batch interruptions.	
[Max. alarms per batch allowed]	With this entity you can configure that maximum number of alarms that can be configured for a batch.	

To emulate a 1010 device, the [Emulation Type] selected here must be relevant to the Serial Port configured in the **System Config . COM-n screen**. Refer to chapter 5.11.1.3.1.1 "Setup"

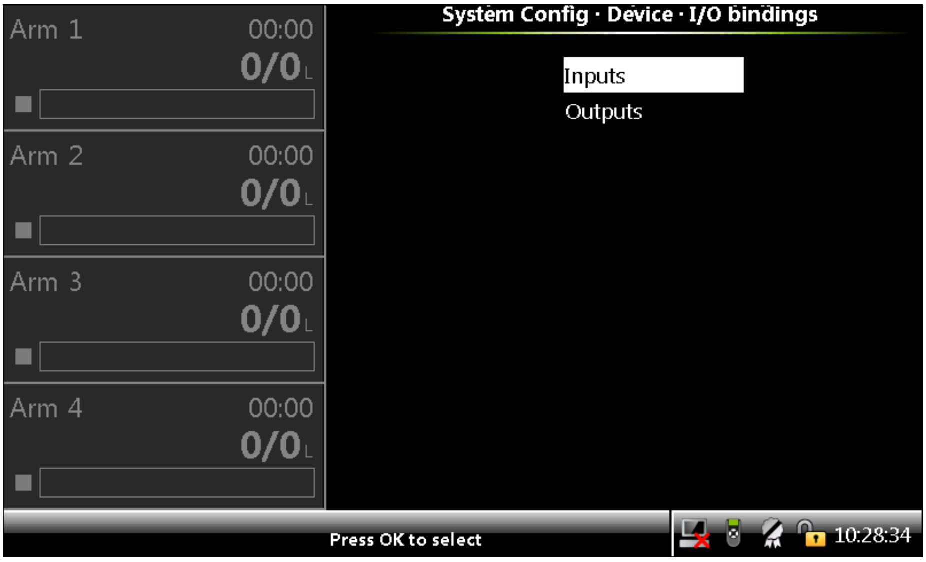
Refer to the table below to select the appropriate communication protocol over the a Serial COM interface to emulate a device.

Emulation Type	Communication protocol
1010BJ 1010CJ 1010CB	SLIP
Accuload	Minicomp Host
Accuload	Terminal Host

5.11.1.2 System Config . Device . I/O Binding

1. On the **System Configuration** screen, select <I/O binding>.

The **System Config . Device . I/O Binding** screen appears.



2. On the **Device Configuration . I/O Binding** screen, select each entity to configure the MSC-L.

5.11.1.2.1 System Config . I/O bindings . Inputs

On the **System Config . Device . I/O Binding** screen, select <Inputs>. The following entity is displayed.

Entity	Description	Value range
[Emergency shutdown]	With this entity you can select the physical input of the emergency shutdown input.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None. The default value is <None>.
[TAS - stand alone switch]	With this entity users can select work flow to be local (Enable) or remote (Disabled)	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None. The default value is <None>.

5.11.1.2.2 System Config . I/O bindings . Outputs

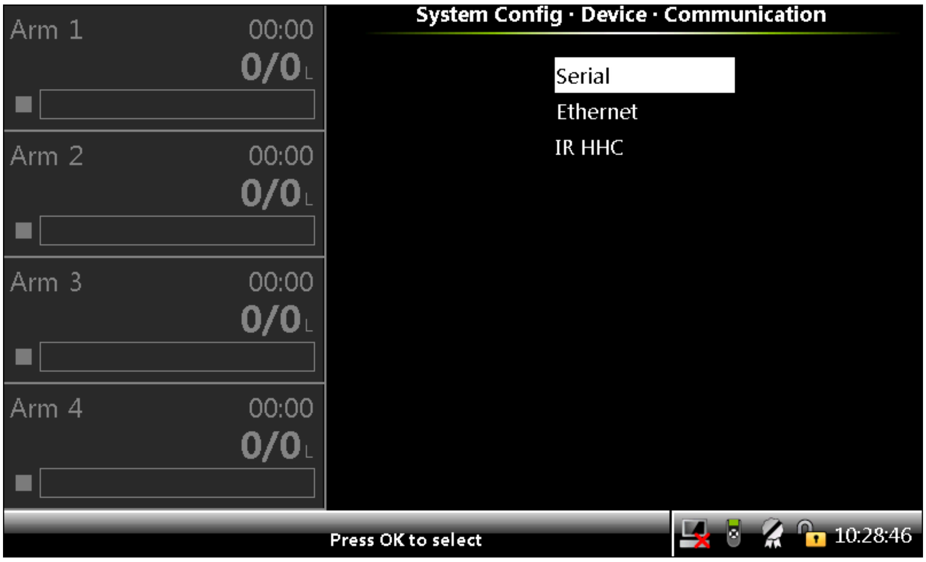
On the **System Config . Device . I/O Binding** screen, select <Outputs>. The following entity is displayed.

Entity	Description	Value range
[Emergency stop]	With this entity you can select the physical output of the emergency stop.	Any of the unused DO-SSR, DO-EMR, PO, or None. The default value is <None>.

5.11.1.3 System Config . Device . Communication

1. On the **System Config . Device** screen, select <Communication>.

The **System Config . Device . Communication** screen appears.



2. On the **System Config . Device . Communication** screen, select each entity.

The Serial, Ethernet, or IR HHC communication entities can be configured.

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

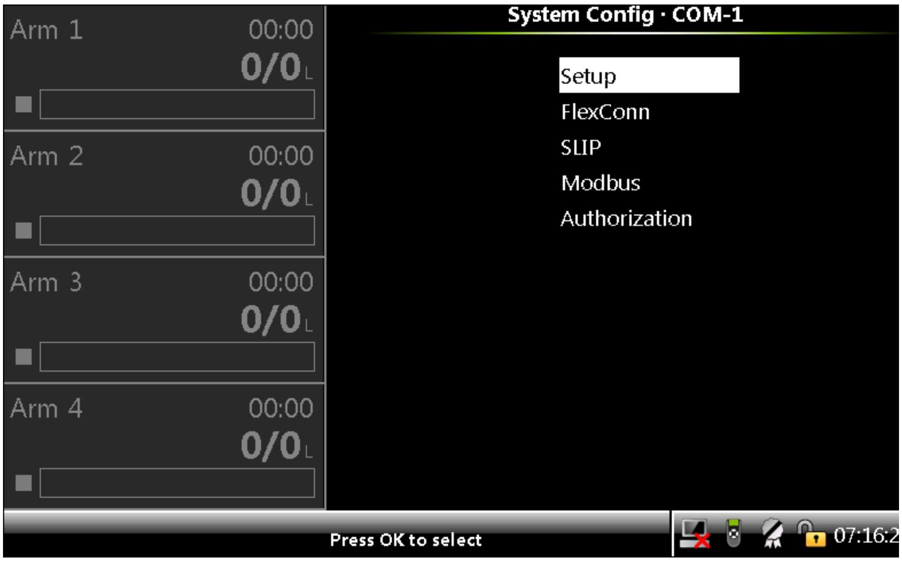
- Up to seven 485 communication ports.
- Up to three Ethernet ports.

5.11.1.3.1 *Serial*

1. On the **System Config . Device . Communication** screen, select <Serial>.

   The **System Config . Communication . Serial** screen appears and displays 5 COM ports.

Select a COM port and the **System Config . COM-n** screen appears.



The following sections provide the entities that are available for the Serial communication.

5.11.1.3.1.1 Setup

On the **System Config . COM-n** screen, select <Setup>.

The **System Config . COM-n . Setup** screen appears with the following entities.

Entity	Description	Value range
[Communication protocol]	With this entity you can select the protocol for the communication port.	<FlexConn> (default) <Modbus RTU> <Snet> <Nedap CR/LF> <SLIP> <Minicomp Host> <Terminal Host>
[Baudrate]	With this entity you can select baud rate for the communication port.	<Baudrate 1200> <Baudrate 2400> <Baudrate 4800> <Baudrate 9600> (default) <Baudrate 19200> <Baudrate 38400> <Baudrate 57600> <Baudrate 115200> <Baudrate 128000>
[Parity]	With this entity you can set the parity for the communication port.	<Odd> <Even> <None> (default)

Entity	Description	Value range
[Stop bits]	With this entity you can configure the number of stop bits for the communication port.	<One> (default) <Two>
[Turn around delay]	With this entity you can enter the time between when the request is received from the master and the moment the answer is sent (ms).	<0> ms ... <1000> ms (default = <100> ms)
[Write access password]	This configuration entity defines the write access password that external applications must use before they are allowed to write to the FlexConn entities.	Alphanumeric string of maximum 6 characters. (Default = ENRAF2)

NOTE: If the communication protocol selected is SLIP make sure that the emulation type selected is 1010BJ, 1010CJ, or 1010CB.

NOTE: If the communication protocol selected is Terminal Host or Minicomp Host, make sure that the emulation type selected is Accuload.

5.11.1.3.1.2 FlexConn

On the **System Config . COM-n** screen, select <FlexConn>.

The **System Config . COM-n . FlexConn** screen appears with the following entities.

Entity	Description	Value range
[FlexConn address]	With this entity you can enter the device address for the FlexConn protocol.	<0>...<1900> (default = <0>)
[Datastream max gap time]	With this entity you can enter the time-out between the characters in one single record (ms).	<0>...<10000> (default = <1000> ms)

5.11.1.3.1.3 SLIP

On the **System Config . COM-n** screen, select <SLIP>.

The **System Config . COM-n . SLIP** screen appears with the following entities.

Entity	Description	Value range
[Slip unit address]	With this entity you can enter the starting unit address. This entity is only applicable in case the protocol is Slip	default = <123>
[No. of 1020 devices]	With this entity you can select No. of devices connected to MSC-L	default = <1>

5.11.1.3.1.4 Modbus

On the **System Config . COM-n** screen, select <Modbus>.

The **System Config . COM-n . Modbus** screen appears with the following entities.

Entity	Description	Value range
[Modbus byte order]	With this entity you can select the byte order used for the data when Modbus protocols are used.	<Little endian> (default) <Big endian>

5.11.1.3.1.5 Authorization

On the **System Config . COM-n** screen, select <Authorization>.

The **System Config . COM-n . Authorization** screen appears with the following entities.

Entity	Description	Value range
[Database selection]	With this entity you can select the authorization database used to authorize users or objects connected to this device.	<User> (default) <Object> <Users and objects>
[Attribute]	Applicable if the database selected is <object>. With this entity you can add an attribute to the selected object.	
[Loading bay]	With this entity you can enable the required loading bay	<Bay1> (default) <Bay2> <None>

5.11.1.3.2 Ethernet

The following table lists the entities available for the Ethernet communication on the **System Config . ETH-n** screen.

Entity	Description	Value range
[DHCP status]	With this entity you can enable the DHCP to use a dynamic IP address.	<Disabled> (default) <Enabled>
[DNS server IP address]	With this entity you can configure the DNS server IP address.	default = <0.0.0.0>
[Static IP address]	With this entity you can assign static IP address to the MSC-L when the DHCP is disabled.	default = <192.168.1.100>
[Gateway IP address]	With this entity the default gateway IP address can be entered.	default = <0.0.0.0>
[Subnet mask]	With this entity the subnet mask can be entered.	default = <255.255.0.0>
[Modbus byte order]	With this entity you can select the byte representation of the information retrieved by the modbus protocol: • Little endian: the LSB is sent first. • Big endian: the MSB is sent first.	<Little endian> (default) <Big endian>
[FlexConn address]	With this entity, the unit address for flexcon protocol can be entered.	<0 to 999> (default = <0>)

Entity	Description	Value range
[FlexConn TCP port]	With this entity you can configure the port used to communicate over Fleconn TCP port	<55598>
[Write Access password]	With this entity, password used to enable the write protected entities	<******>

5.11.1.3.3 *IR HHC*

The following table lists the entities available for the IR HHC communication on the **System Config . Communication . IR HHC** screen.

Entity	Description	Value range
[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].	<Long IR disabled> <Long IR enabled> (default)
[IR access]	With this entity you can enable the IR interface, if it is turned off.	<IR disabled> (default) <IR enabled>

NOTE: In a few installations of Honeywell Enraf 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.

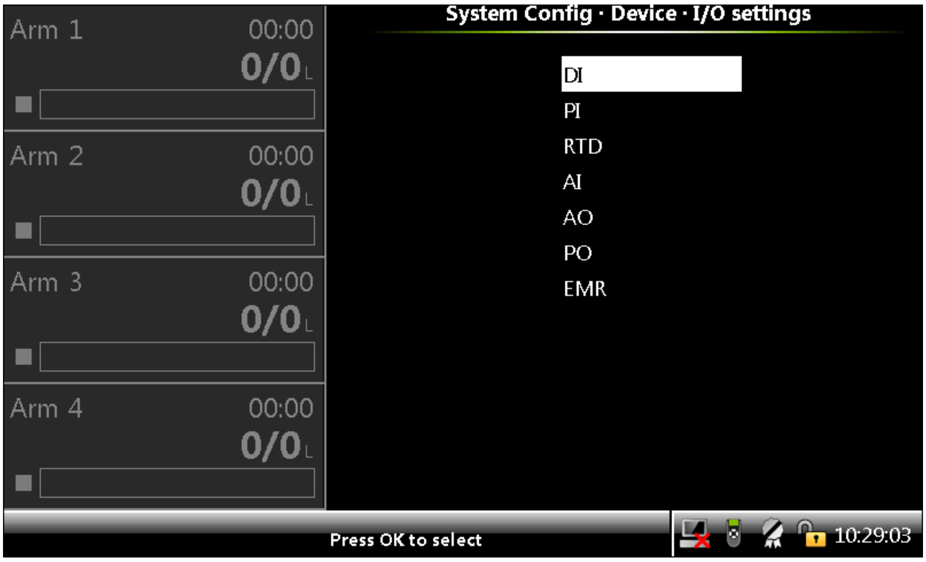
Note that this is an EXTREMELY rare possibility.

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-L. Using an extended login character sequence raises the odds of a random pattern of interference matching the correct login sequence to astronomical levels.

5.11.1.4 System Config . Device. I/O Settings

1. On the **System Config . Device** screen, select <I/O settings>.

The **System Config . Device . I/O Settings** screen appears.

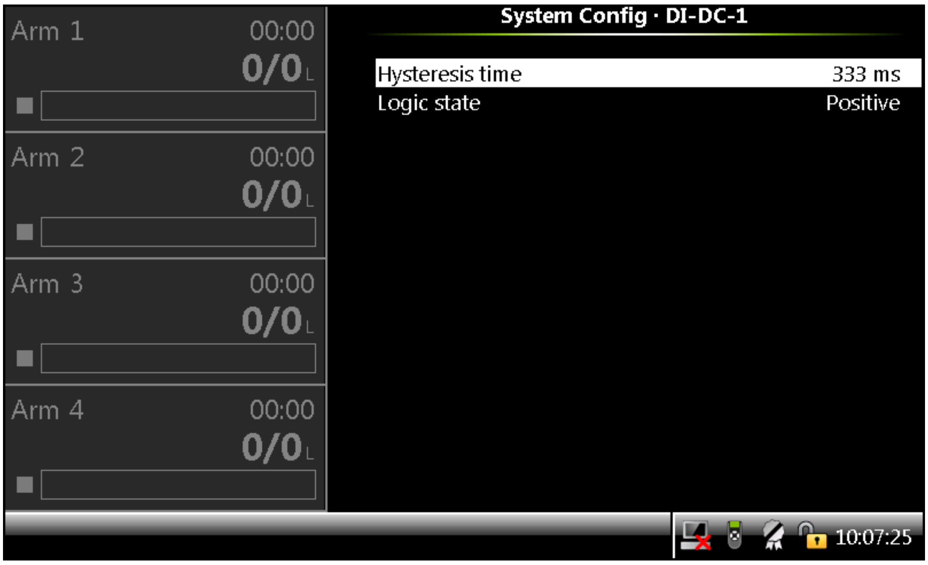


2. On the **System Config . I/O Settings** screen, select the available entities.

Entity	Available I/Os
[DI]	DI-DC-n, DI-AC-n
[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
[EMR]	DO-EMR-n

5.11.1.4.1 DI (for both AC# and DC#)

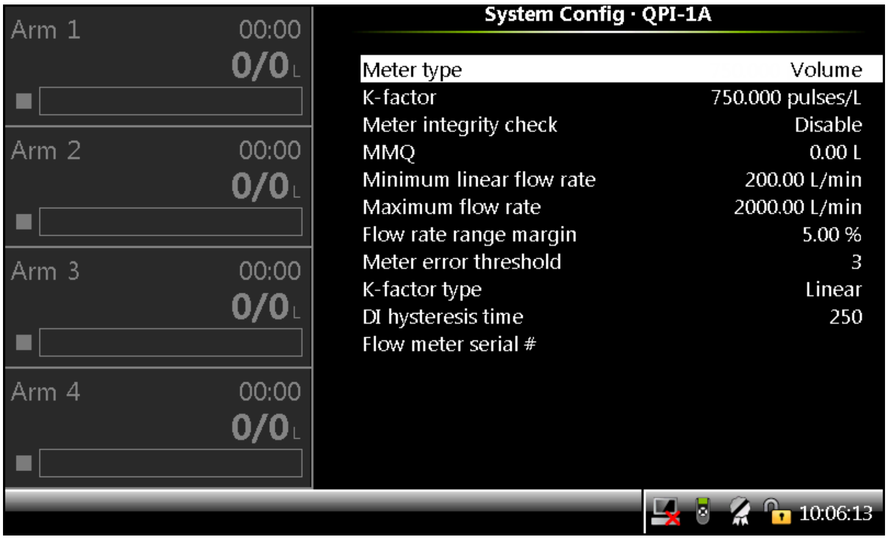
On the **System Config . Device . I/O settings** screen, select the available Digital Inputs (DIs), and then select a DI. The following entities are displayed on the **System Config . DI-DC-1** screen.



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)
[Logic State]	With this entity you can configure the active input signal to low or high	<Negative> <Positive>

5.11.1.4.2 PI

On the **System Config . Device . I/O Settings** screen, select the available Pulse Inputs (PIs), and then select a QPI-n(A/B). The following entities are displayed on the **System Config . QPI-nA** screen.

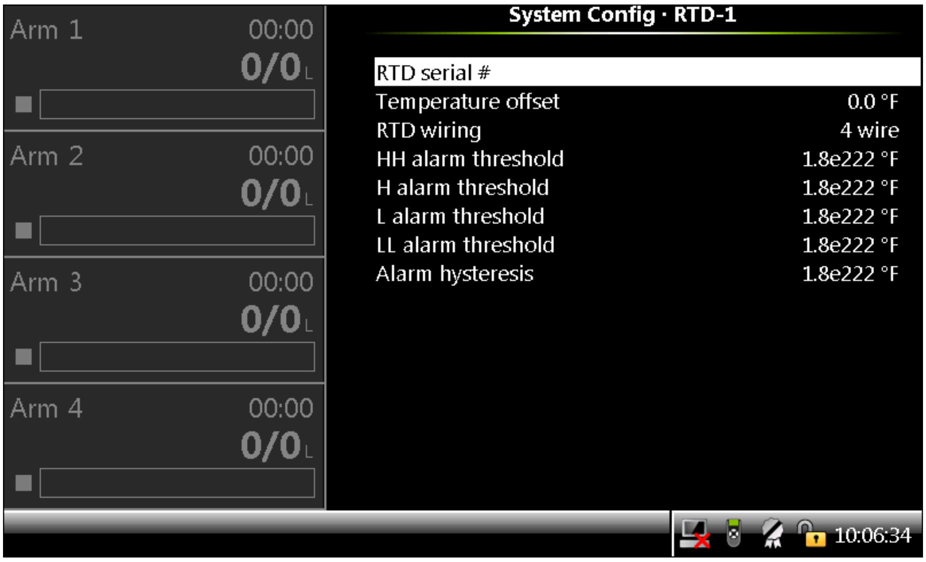


Entity	Description	Value range
[Meter type]	With this entity you can select type of meter connected to a stream.	<Volume> (default) <Mass>
[K-factor]	With this entity you can set the K-factor of the flow meter supplied by the vendor, in pulses per [Units of volume] or [Units of mass].	The K-factor must be the number of pulses per liter (gallon), regardless of the configured unit of volume selection. (default = <750.000 pulses/L>)
[Meter integrity check]	With this entity you can select the pulse type of the flow meter.	<Enable> = dual pulse (quad) <Disable> = single pulse (default)
[Pulse phase relationship]	With this entity you can select pulse phase difference which is considered to be correct for flow meter. When set to forward, only forward gives no alarm and all other result gives pulse phase alarm.	<inverted> <reverse> <forward>
[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 flow rate]	With this entity you can program the minimum linear flowrate for the flow meter installed.	default = <200.00> L/min
[Maximum flow rate]	With this entity you can set the maximum allowed flow rate.	default = <2000.00> L/min

Entity	Description	Value range
[Flow rate range margin]	With this entity you can set a band around the minimum linear meter flow and the maximum meter flow that ensures a certain amount of margin is used above the minimum and under the maximum flow rates. The margin is defined as the percentage of the range between the minimum linear meter flow rate and the maximum meter flow rate and is applied to both limits. That is, the range of the meter is effectively reduced by twice the amount of the factor in terms of the loading profile.	default = <5.00> %
[Meter error threshold]	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. Missing pulses that occur when the pulse input frequency is below the meter cutoff frequency are not counted towards the pulse hardware alarm. A quad pulse phase error also increments the pulse hardware error count.	default = <3>
[K-factor type]	With this entity you can specify if the meter is configured to use a linear or non-linear K-factor. This setting affects the calculation of the effective K-Factor entity.	<Linear> (default) <Non-Linear>
[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.	

5.11.1.4.3 RTD

On the **System Config . Device . I/O settings** screen, select an available RTD. The following entities are displayed on the **System Config . RTD-n** screen.

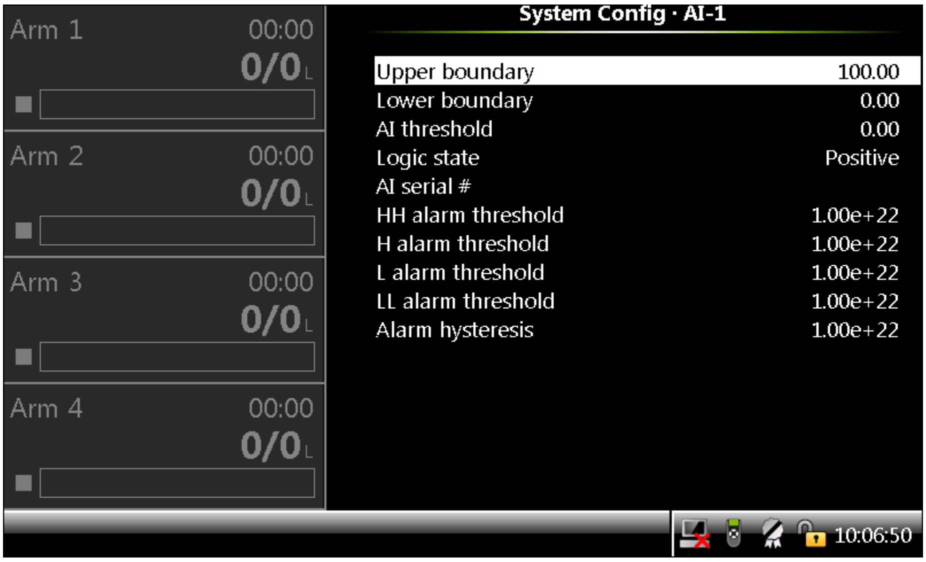


Entity	Description	Value range
[RTD serial #]	With this entity you can enter the serial number of the connected PT100 temperature probe.	Alphanumeric string of maximum 8 characters.
[Temperature offset]	With this entity you can insert a certified thermometer near the RTD and adjust the MSC-L to read the same temperature. The temperature offset is for calibration of the RTD.	default = 0.00 °C
[RTD wiring]	With this entity you can set the wiring configuration of the RTD.	<3 wire> <4 wire> (default) <Unknown>

Entity	Description	Value range
[HH alarm threshold]	With this entity you can set the high high temperature alarm threshold. When exceeded, a temperature alarm occurs.	NOTE: 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]	With this entity you can set the hysteresis around the alarm levels. This hysteresis is used for avoiding alarm ON/OFF-toggling situations at an alarm level. • A High (High) alarm occurs when the value becomes higher than [HH/H Alarm Threshold]. • A Low (Low) alarm occurs when the value becomes lower than [LL/L Alarm Threshold]. • 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].	

5.11.1.4.4 AI

On the **System Config . I/O settings . AI** screen, select the available Analog Inputs (AIs). The following entities are displayed on the **System Config.AI-n** screen.

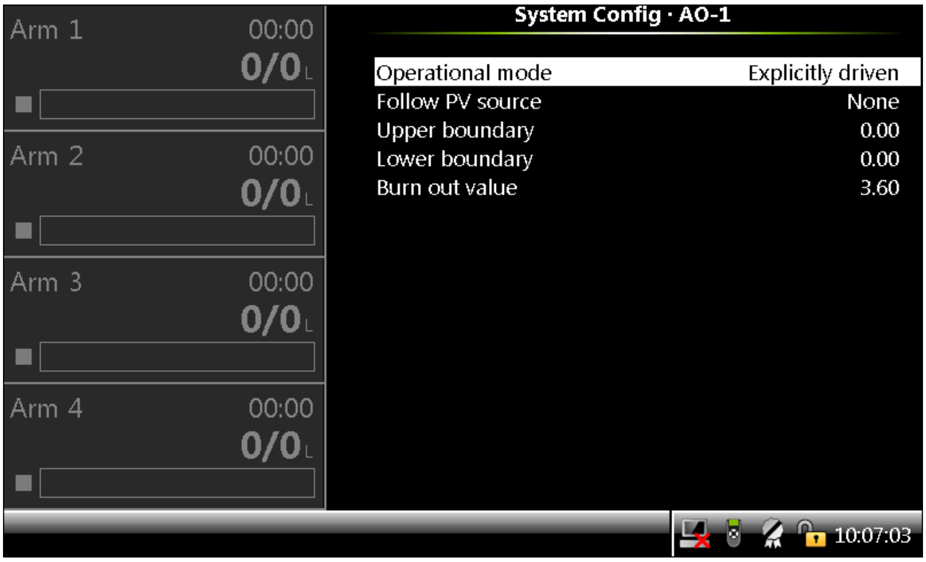


Entity	Description	Value range
[PV value @20mA]	With this entity the process value at 20 mA can be configured.	default = 100.00
[PV value @4mA]	With this entity the process value at 4 mA can be configured.	default = 0.00
[AI threshold]	With this entity the analog input threshold value defines the range 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. • <Positive>: 0 or inactive from 4-[AI threshold] mA and 1 or active from [AI threshold] to 20 mA. • <Negative>: 1 or active from 4-[AI threshold] mA and 0 or inactive from [AI threshold] to 20 mA.	<Negative> (default) <Positive>
[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.	NOTE: The entity is blank (empty) by default.
[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]	With this entity you can set the hysteresis around the alarm levels. This hysteresis is used for avoiding alarm ON/OFF toggling situations at an alarm level. • A high (high) alarm occurs when the value becomes higher than [HH/H Alarm Threshold]. • A low (low) alarm occurs when the value becomes lower than [LL/L Alarm Threshold]. • 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].	

5.11.1.4.5 AO

On the **System Config . Device . I/O Settings** screen, select the available Analog Outputs (AOs). The following entities are displayed on the **System Config . AO-n** screen.

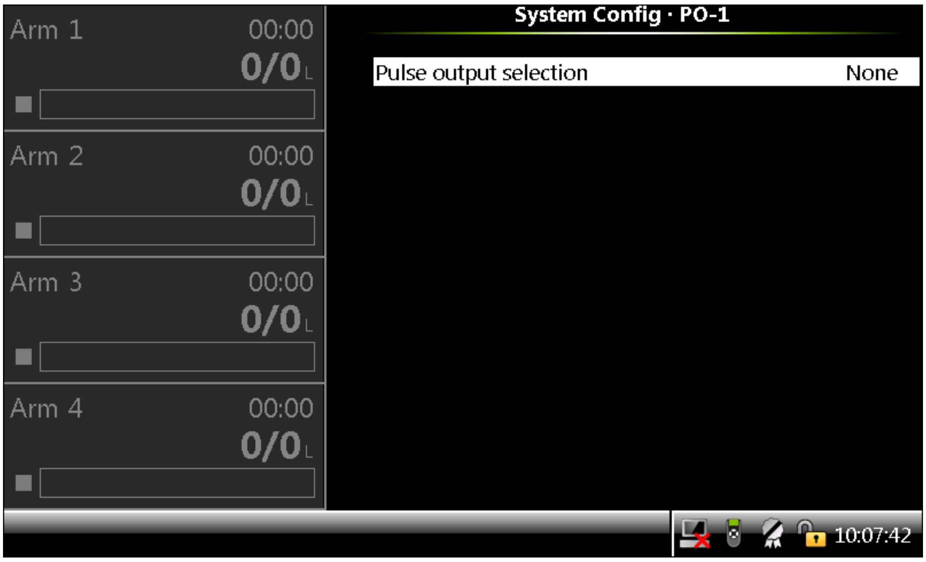


Entity	Description	Value range
[Operational mode]	With this entity you can select between two modes for the analog output.	<Explicitly driven> (default) - The output value is set by the application (for example, valve control). <Follow PV> - The output reflects one of the Primary Values measured by the MSC-L. <Calibrate Low> <Calibrate High>
[Follow PV source]	With this entity you can select the process variable to be mapped on the analog output (4-20 mA).	<None> (default) <Batch GOV> <Batch GSV> <Batch mass> <Batch Flowrate> <Batch instant. temp> <Batch instant. pressure> <Batch instant. density>
[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]. Note: The Lower boundary values are set as per the units selected in the [PV address] *entity.*

Entity	Description	Value range
[Burn out value]		default = 3.60

5.11.1.4.6 PO

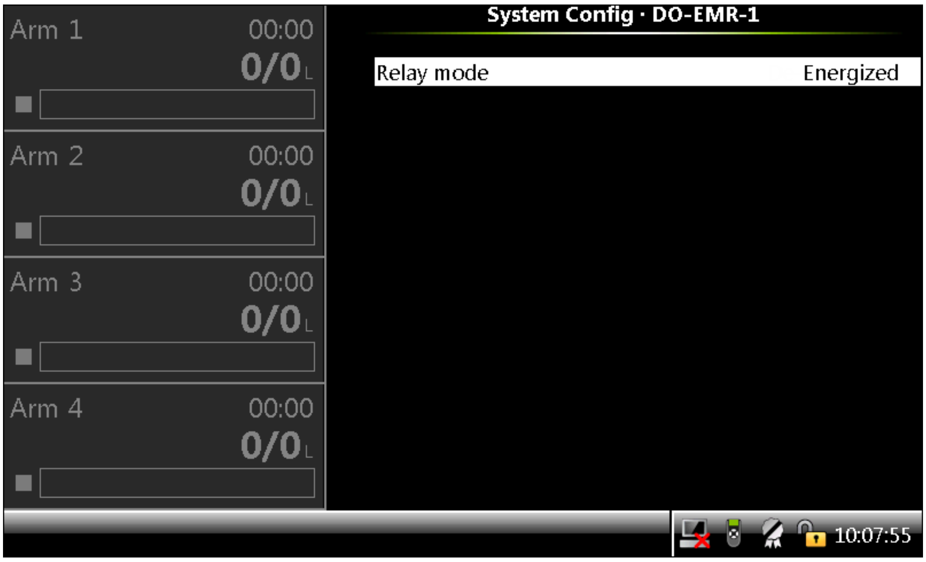
On the **System Config . Device . I/O Settings** screen, select the available Pulse Outputs (POs). The following entities are displayed on the **System Config . PO-n** screen.



Entity	Available I/Os
[Pulse output selection]	None, any of the QPIs, FPO default = None

5.11.1.4.7 *EMR*

On the **System Config . Device . I/O Settings** screen, select the available EMRs. The following entities are displayed on the **System Config . DO-EMR-n** screen.

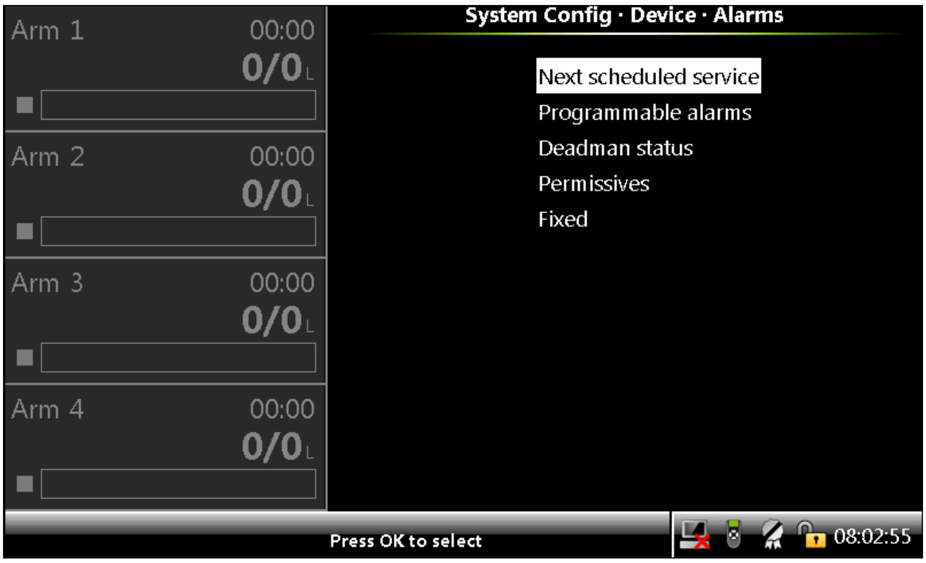


Entity	Description	Value range
[Relay mode]	With this entity you can configure the default mode of the EMR output.	<Energized> <De-energized> (default)

5.11.1.5 System Config . Device . Alarms

1. On the **System Config . Device** screen, select <Alarms>.

   The **System Config . Device . Alarms** screen appears.



Alarms can have the following alarm actions.

- <Disabled>:
  The alarm is ignored.
- <Display>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
- <Display shutdown>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is stopped.
- <Display pause>:
  - The alarm is shown on the display.
  - The alarm-indication output set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is paused.

2. On the **System Config . Alarms** screen, select each entity to configure the alarms.

5.11.1.5.1 *System Config . Alarms . Next scheduled service*

On the **System Config . Device . Alarms** screen, select <Next scheduled service>. The following entities are displayed on the **System Config . Alarms . Next scheduled service** screen.

Entity	Description	Value range
[alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> (default) <Display shutdown> <Display pause>
[Next scheduled service]	With this entity you can select the date when the next service activities should take place for the MSC-L. It is handled similar to an alarm and can be configured to a required alarm behavior (Disable, Display, Display shutdown, or Display pause).	<Year> <Month> <Day> Note: By default, 01-01-25 appears. However, to change the default date enter the year, month, and day.

5.11.1.5.2 *System Config . Alarms . Programmable Alarms*

On the **System Config . Device . Alarms** screen, select <Programmable alarms>. The following entities are displayed on the **System Config . Alarms . Programmable Alarms** screen.

The MSC-L contains four device programmable alarms [Programmable alarm 1], [Programmable alarm 2], [Programmable alarm 3], and [Programmable alarm 4].

When any of the device programmable alarm arises, the MSC-L stops or pauses all the running batches based on the configuration. To clear the programmable alarm, the programmable input must be connected/ disconnected based on the expected input state configured. Then, the alarm disappears and the MSC-L resumes. However, it is not required to reset the condition with normal alarms.

NOTE: *You can configure Emergency Stop as the MSC-L programmable alarm.*

Entity	Description	Value range
[IO binding]	With this entity you can select the physical input source for the programmable alarm function.	Any of the unused QPI-n, AI-n, DI-AC-n, DI-DC-n, or None. The default value is <None>.
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Alarm name]	With this entity you can configure the name of the alarm.	A maximum of 32 alphanumeric characters are allowed for configuration.
[Response time]	With this entity you can set the time in seconds, which is the time required for the input to change from one state to other.	<0> s ... <255> s (default = <0> s)
[Alarm activation (Idle)]	With this entity you can set the state of the input when the MSC-L is in idle state for the alarm function. The MSC-L state is in idle when the transactions are not started for loading process. <None>: The alarm is ignored. <Active>: Alarm occurs when the input state is active. <Deactive>: Alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>
[Alarm activation (Running)]	With this entity you can set the state of the input when the MSC-L is in running state for the alarm function. After successful authorization and permissives gets connected to start a loading process, the MSC-L is in the running state and continues to be in this state till all the permissives are disconnected after the transactions are complete. • <None>: The alarm is ignored. • <Active>: The alarm occurs when the input state is active. • <Deactive>: The alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>

5.11.1.5.3 System Config . Alarms . Deadman

1. On the **System Config . Device . Alarms** screen, select <Deadman>.

The **System Config . Alarms . Deadman** screen appears. The deadman function of the MSC-L allows the loading process to be monitored to ensure the operator's attention and safety during the loading operation.

2. On the **System Config . Alarms . Deadman** screen, the following entities are displayed.

5.11.1.5.3.1 Deadman Status

Entity	Description	Value range
[Deadman status]	With this entity you can <Enable> or <Disable> deadman alarm function. If enabled, the operator/driver must repeatedly (within the settable timeout period) press a key on the keyboard of the MSC-L or press deadman refresh switch to prevent the deadman function from being triggered.	<Enable> <Disable> (default)

5.11.1.5.3.2 Deadman Indicator

Entity	Description	Value range
[Output]	With this entity you can select the physical output for the deadman indicator function.	Any of the unused DO-SSR, DO-EMR, PO, or None. The default value is <None>.
[Timeout]	With this entity you can set the time in seconds in which the operator must press a key or refresh the deadman switch in an interval of [Deadman indicator timeout] to prevent the deadman indicator (warning) lamp from being activated and deadman bell (siren) start the beep.	<10> s ... <999> s (default = <150> s)

5.11.1.5.3.3 Deadman bell

Entity	Description	Value range
[Output]	With this entity you can select the physical output for the deadman bell function.	Any of the unused DO-SSR, DO-EMR, PO, or None. The default value is <None>.
[Timeout]	With this entity you can set the time in seconds in which after the deadman indicator output activates, the operator must press a key or deadman switch refresh to prevent the batch from being paused and deadman bell activate continuously.	<10> s ... <999> s (default = <30> s)

5.11.1.5.3.4 Deadman callout

Entity	Description	Value range
[Output]	With this entity you can select the physical output for the deadman callout function.	Any of the unused DO-SSR, DO-EMR, PO, or None. The default value is <None>.
[Timeout]	With this entity you can set the time in seconds in which after the batch pauses the operator must press a key or deadman switch refresh to prevent the batch to stop and the deadman callout out output activates. If the batch is stopped by the activation of the deadman callout, the deadman alarm raises.	<10> s ... <999> s (default = <30> s)

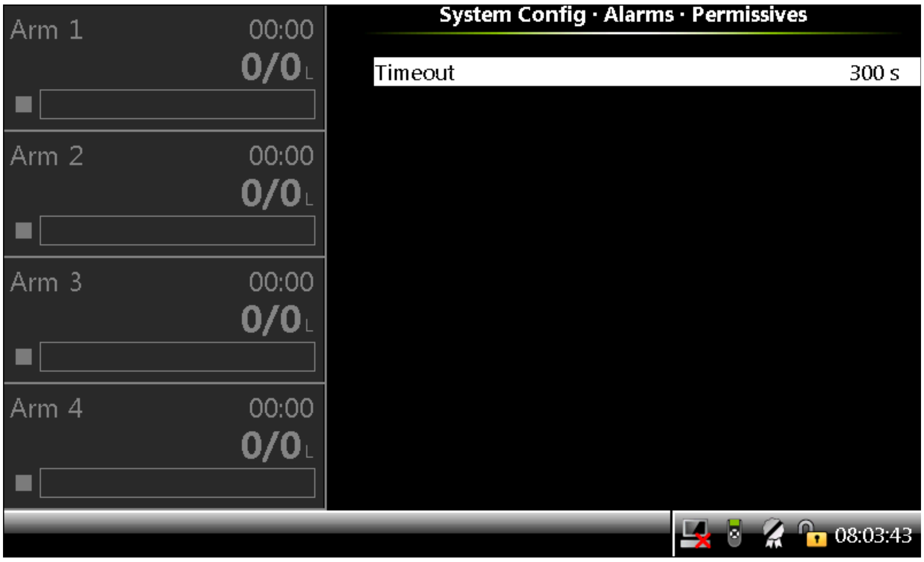
5.11.1.5.3.5 Deadman refresh switch

Entity	Description	Value range
[Deadman refresh switch]	With this entity you can select the physical input source for the deadman refresh function.	Any of the unused DO-SSR, DO-EMR, PO, or None. The default value is <None>.

5.11.1.5.4 System Config . Alarms . Permissives

1. On the **System Config . Device . Alarms** screen, select <Permissives>.

   The **System Config . Alarms . Permissives** screen appears.



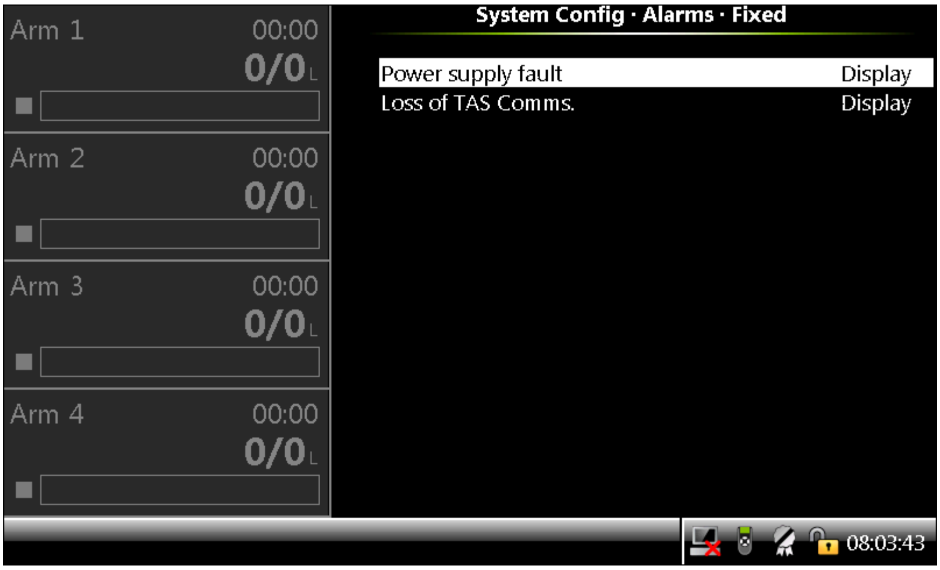
2. On this screen the following entity is displayed.

Entity	Description	Value range
[Timeout]	With this entity you can configure the permissive timeout.	<10> s ... <999> s (default = <300> s)

5.11.1.5.5 System Config . Alarms . Fixed

1. On the **System Config . Device . Alarms** screen, select <Fixed>.

   The **System Config . Alarms . Fixed** screen appears.



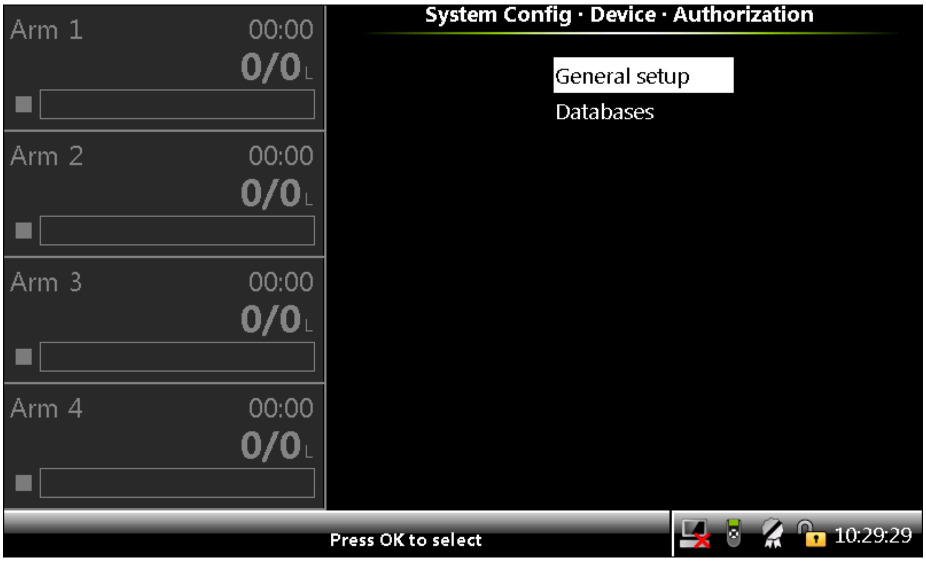
2. On this screen the following entity is displayed.

Entity	Description	Value range
[Power supply fault]	With this entity you can configure an alarm that is triggered when there is a power supply fault.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[Loss of TAS Comms.]	With this entity you can configure an alarm that is triggered when there is a loss in TAS Comms.	<Disabled> (default) <Display> <Display shutdown> <Display pause>

5.11.1.6 System Config . Device . Authorization

- On the **System Config . Device** screen, select <Authorization>.

The **System Config . Device . Authorization** screen appears.



5.11.1.6.1 *System Config . Authorization. Setup*

On the **System Config . Device . Authorization** screen, select <General setup>. The following entities are displayed on the **System Config . Authorization . Setup** screen.

Entity	Description	Value range
[Authorization mode]	With this entity the authorization for the MSC-L is provided. With this entity you can configure the authorization modes for users, carriers, vehicles, trailers and contracts. <User> <Carrier> <Vehicle> <Trailer> <Contract>	<No verification> <Local verification> (default) <Remote verification>

Entity	Description	Value range
[Authorization type]	With this entity you can configure the authorization mechanism for users, carriers, vehicles, trailers or contracts. <User> <Carrier> <Vehicle> <Trailer> <Contract> This configuration defines the input device for all the authorization screens used in the workflow. PIN indicates a value entered directly by the user through the MSC-L keyboard. NexWatch and Nedap refer to two different types of external reader devices. When configured for NextWatch or Nedap the user must present a card/RFID tag to the reader as a means of entering the authorization data.	<None> <PIN> (default) <NexWatch> <Nedap>

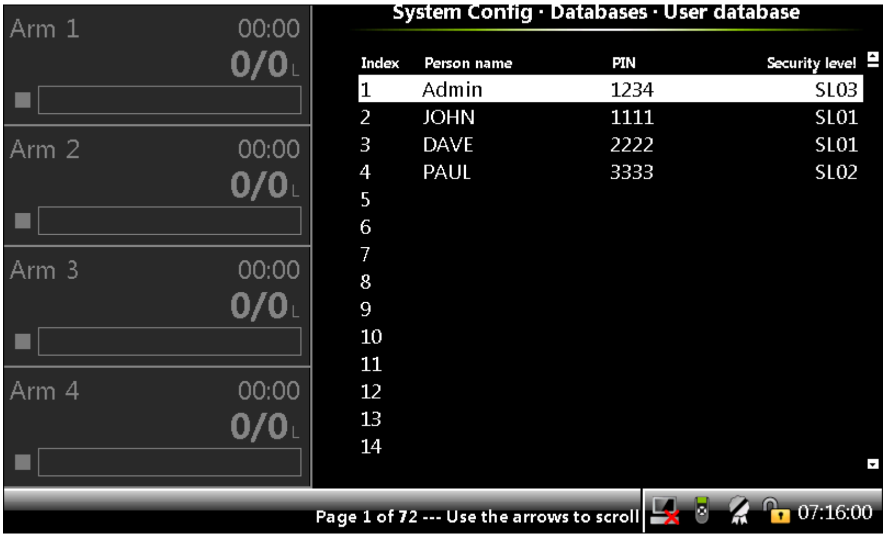
5.11.1.6.2 *System Config . Authorization. Databases*

1. On the **System Config . Device . Authorization** screen, select <Databases>. The **System Config . Authorization . Databases** screen appears with the following entities.

5.11.1.6.2.1 User Database

1. On the **System Config . Authorization . Databases** screen, select <User database>.

The **System Config . Databases . User database** screen appears, which displays the Index, Person name, PIN, and Security level.



2. Select any one of the databases and then select <OK> on the IR controller or the LAD.

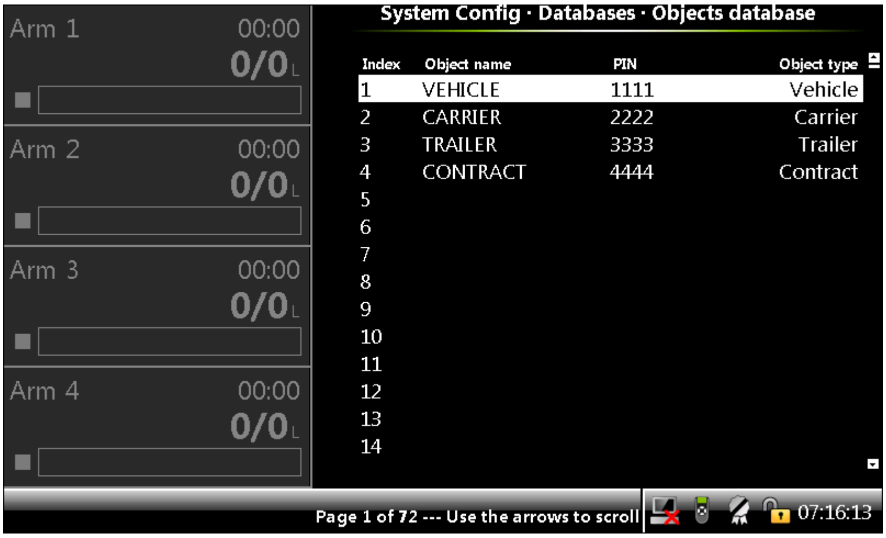
   The **System Config . User database . Change database** screen appears, on which the user database details can be entered.

Entity	Description	Value range
[Name]	With this entity you can configure the name of the user.	A text string of maximum 16 characters.
[PIN]	With this entity you can configure the password associated with the user account.	A numeric string of maximum 10 digits.
[Security Level]	With this entity you can configure the security level associated with the user account.	<Security level 1> <Security level 2> <Security level 3>

5.11.1.6.2.2 Objects Database

1. On the **System Config . Authorization . Databases** screen, select <Objects database>.

The **System Config . Databases . Objects database** screen appears, which displays the Index, Object name, PIN, and Object Type.



2. Select any one of the databases and then select <OK> on the IR controller or the LAD.

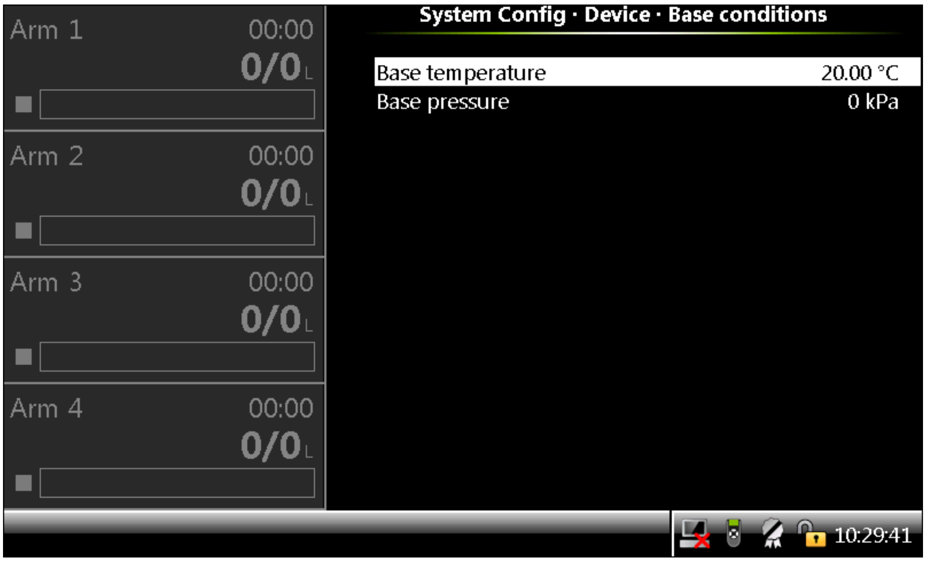
   The **Device Configuration . Change DB** screen appears, on which the objects database details can be entered.

Entity	Description	Value range
[Name]	With this entity you can configure the name of the object.	A text string of maximum 16 characters.
[PIN]	With this entity you can configure the password associated with the object.	A numeric string of maximum 10 digits.
[Object Type]	With this entity you can configure the attibute of the object.	<Unknown> <Vehicle> <Carrier> <Trailer> <Contract>

5.11.1.7 Device Configuration . Base Conditions

1. On the **System Configuration . Device** screen, select <Base conditions>.

The **System Config . Device . base conditions** screen appears.



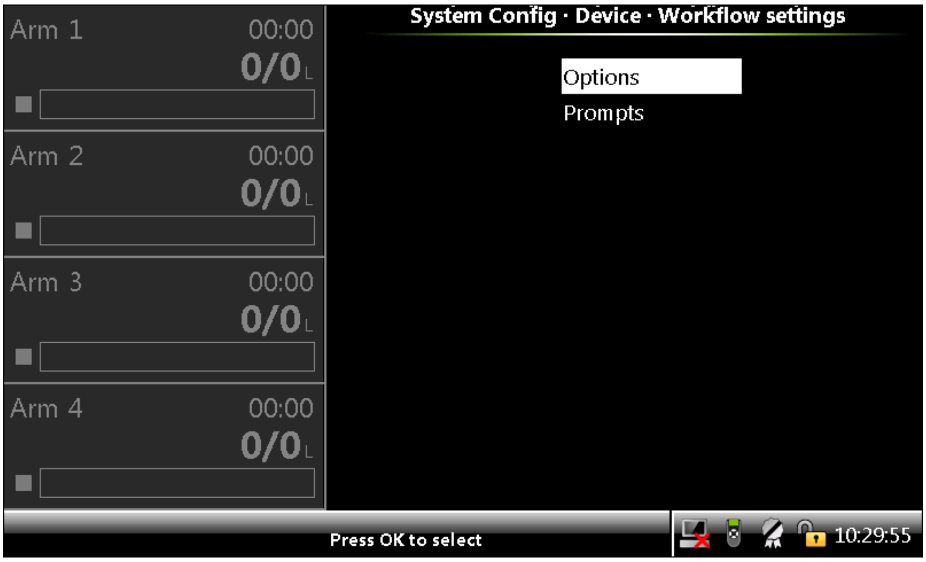
2. On the **System Config . device .base conditions** screen, select each entity to configure the MSC-L.

Entity	Description	Value range
[Base temperature]	With this entity you can configure the temperature at which the standardize volume is calculated.	[Value] default = 15 [Units] <Degrees Celsius> (default) <Degrees Fahrenheit>
[Base pressure]	With this entity you can configure the pressure at which the standardize volume is calculated.	[Value] default = <0> [Units] <Pascal> <Kilo Pascal> (default) <Pounds per Square Inch> <PSI large> <Bar>

5.11.1.8 Device Configuration . Workflow Settings

1. On the **System Config . Device** screen, select <Workflow settings>.

The **System config . device . Workflow settings** screen appears.



2. On the **System config . device . Workflow settings** screen, select each entity to configure the MSC-L.

5.11.1.8.1 *System Config . Options*

On the **System Config . Device . Workflow settings** screen, select <Options>. The following entities are displayed.

Entity	Description	Value range
[Max. simultaneous loads]	Allows you to configure the maximum number of batches that can be loaded simultaneously using different arms.	default = <0>
[Multiple loads per arm]	Allows you to enable or disable the functionality to perform multiple batches on an arm in the same transaction.	<Enable> (default) <Disable>
[Batch start]	When configured as remote, the batch can be started remotely through TAS. When configured as local, the batch can only be started using the START key.	<Local> (default) <Remote>

Entity	Description	Value range
[Workflow Selection]	This configuration selects which workflow is started when the device is powered up. The MSC-L can support two independent workflow configurations (Default and Custom). One of these two configurations (Default) is programmed in the factory and contains sufficient functionality to perform compartment loading without any TAS interaction. The MSC-L prompting configuration settings enable and disable certain specific prompts used in this default workflow. The custom workflow can be initialized by first changing the workflow selection setting to custom and then applying a custom workflow XML file through the LAD. The device must be restarted for this workflow to take effect. After changing the workflow selection setting, the device should always be reset to restart the desired workflow. Refer to 5.11.1.8.1.1 to run local and remote loading in MSC-L for 1010BJ and 1010RT emulation.	<Default> (default) <Custom>
[TAS timeout]	With this entity you can select the TAS request timeout duration.	<10s> (default)
[Workflow Mode]	Select this entity to operate MSC-L in either standalone or operate with TAS <Local> MSC-L device will operate in standalone mode <Remote with Local fallback> MSC-L will be controlled by TAS, and in case of communication failure, it will switch back to stand alone operation <Remote only> MSC-L will always be controlled by TAS When using emulation type as Accuload, make sure that the [Workflow Mode] is <Remote only>.	<Local> (default) <Remote with Local fallback> <Remote>
[Use RIT Panel]	With this entity you can enable or disable the RIT panel	<Enable> <Disable> (default)

5.11.1.8.1.1 Workflow Installation and Configuration settings for MSC-L 1010BJ and 1010RT Emulation

To configure a MSC-L device to run Local and Remote loading, you should install two workflows as given below:

1. 1010BJLocal.xml / 1010RTLocal.xml workflow to run in local mode.
2. 1010BJRemote.xml / 1010RTRemote.xml workflow to run in remote mode.

Main Menu. Device. Workflow settings. Options. Workflow selection = < Default>

Install 1010BJLocal.xml / 1010RTLocal.xml workflow.

To Install 1010BJLocal.xml / 1010RTLocal.xml:

Transfer. Install configuration. <1010BJLocal.xml / 1010RTLocal.xml>

NOTE: *After installation device reboot automatically.*

Main Menu. Device. Workflow settings. Options. Workflow selection = < Custom>

Install 1010BJRemote.xml / 1010RTRemote.xml workflow.

To Install 1010BJRemote.xml / 1010RTRemote.xml:

Transfer. Install configuration. <1010BJRemote.xml / 1010RTRemote.xml>

NOTE: *After installation device reboot automatically.*

Main Menu. Device. Workflow settings. Options. Workflow selection = < Default>

Main Menu | Device | Workflow settings | Options | Workflow mode = < Remote>

Reboot the device manually, after the configuration settings are done.

5.11.1.8.2 *System Config . Prompts*

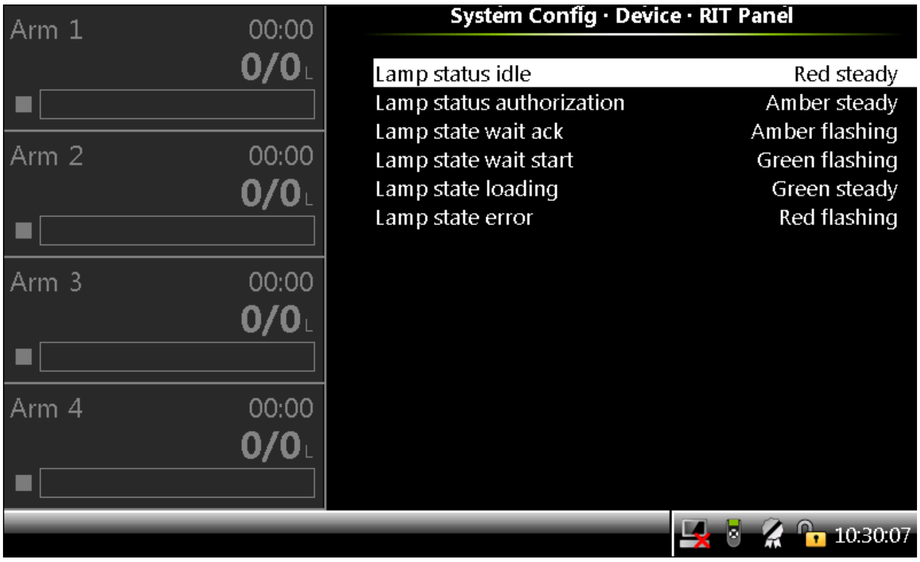
On the **System Config . Device . Workflow settings** screen, select <Prompts>. The following entities are displayed.

Entity	Description	Value range
[User identification]	Alllows you to enable or disable the user identification prompt	<Disabled> <Optional> <Mandatory>
[Carrier identification]	Alllows you to enable or disable the carrier identification prompt.	<Disabled> <Optional> <Mandatory>
[Vehicle identification]	Allows you to enable or disable the vehicle identification prompt.	<Disabled> <Optional> <Mandatory>
[Trailer identification]	Allows you to enable or disable the trailer identification prompt.	<Disabled> <Optional> <Mandatory>
[Load number identification]	Allows you to enable or disable the load number prompt.	<Disabled> <Optional> <Mandatory>
[Compartment identification]	Allows you to enable or disable the compartment number prompt.	<Disabled> <Optional> <Mandatory>
[Return quantity entry]	Allows you to enable or disable the return quantity prompt.	<Disabled> <Optional> <Mandatory>
[Preset entry]	Allows you to enable or disable the preset entry prompt.	<Disabled> <Optional> <Mandatory>
[Preset unloading entry]	Allows you to enable or disable the preset unloading entry promt.	<Disabled> <Optional> <Mandatory>
[Contract identification]	Allows you to enable or disable the contract identification prompt.	<Disabled> <Optional> <Mandatory>
[Batch details promt]	Allows you to enable or disable the Batch details promt.	<Enable> <Disable>

5.11.1.9 Device Configuration . RIT Panel

1. On the **System Config . Device** screen, select <RIT Panel>.

The **System Config . Device . RIT Panel** screen appears.



2. On the **System Config . Device . RIT Panel** screen, select each entity to configure the MSC-L.

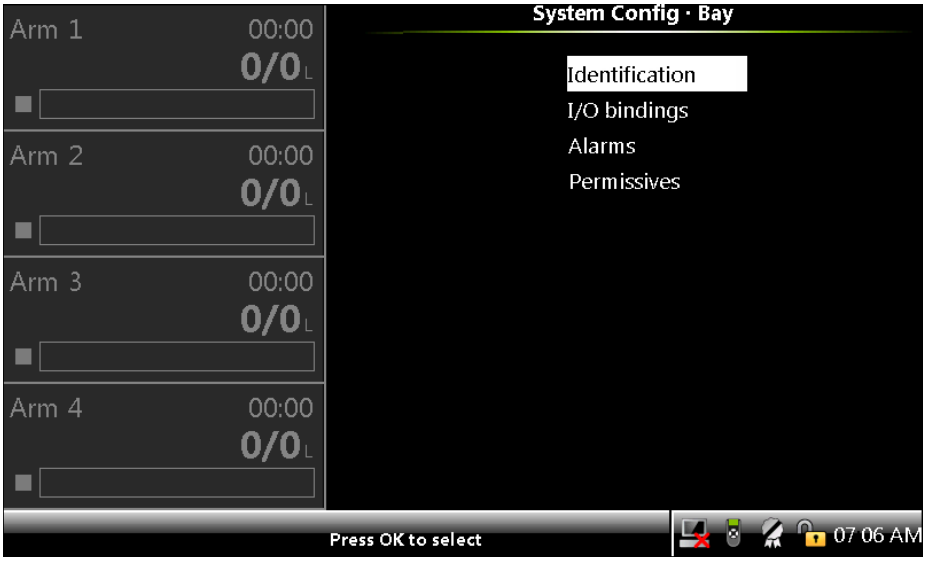
Entity	Description	Value range
[Lamp status idle]	With this entity you can select the lamp status on the Remote Interaction Terminal, when idle.	<All off> <Red steady> (default) <Red flashing> <Amber steady> <Amber flashing> <Green steady> <Green flashing>
[Lamp status authorization]	With this entity you can select the lamp status on the Remote Interaction Terminal during authorisation.	<All off> <Red steady> <Red flashing> <Amber steady> (default) <Amber flashing> <Green steady> <Green flashing>
[Lamp state wait ack]	With this entity you can select the lamp status on the Remote Interaction Terminal, when waiting for acknowledgement.	<All off> <Red steady> <Red flashing> <Amber steady> <Amber flashing> (default) <Green steady> <Green flashing>

Entity	Description	Value range
[Lamp state wait start]	With this entity you can select the lamp status on the Remote Interaction Terminal, when waiting for start.	<All off> <Red steady> <Red flashing> <Amber steady> <Amber flashing> <Green steady> <Green flashing> (default)
[Lamp state loading]	With this entity you can select the lamp status on the Remote Interaction Terminal, when loading.	<All off> <Red steady> <Red flashing> <Amber steady> <Amber flashing> <Green steady> (default) <Green flashing>
[Lamp state error]	With this entity you can select the lamp status on the Remote Interaction Terminal, when in an error.	<All off> <Red steady> <Red flashing> (default) <Amber steady> <Amber flashing> <Green steady> <Green flashing>

5.11.2 Bay Configuration

On the **System Configuration** screen, select <Bay>.

The **System Config . Bay** screen appears, which displays the functions available for device configuration.



5.11.2.1 System Config . bay . Identification

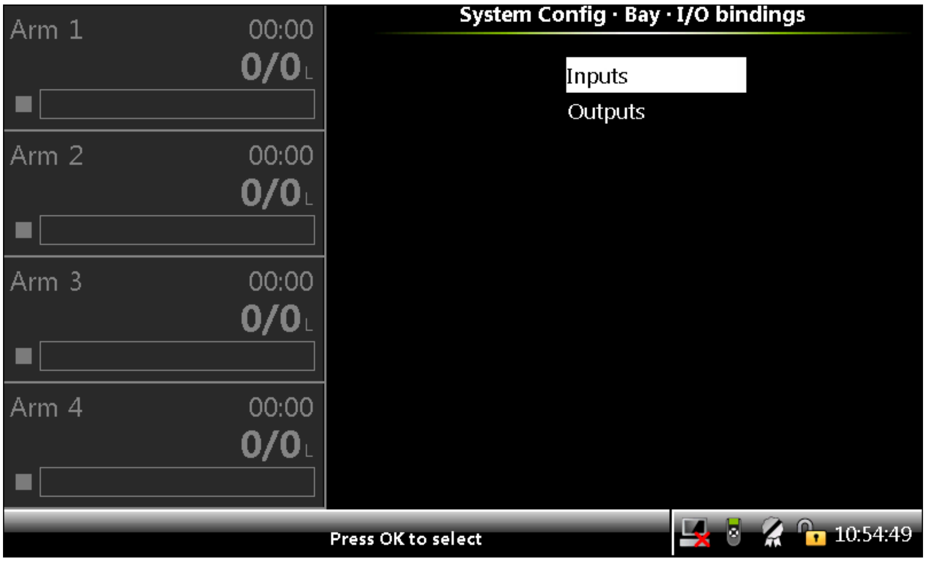
- On the **System Config . Bay** screen, select <Identification>.

The following entities are displayed on the **System Config . Bay . Identification** screen.

Entity	Description	Value range
[Bay name]	With this entity you can configure the name of the bay.	A text string of maximum 20 characters. Use maximum 7 characters to view the complete name on the MSC-L screen.
[Bay number]	With this entity you can assign a unique number that can be used to identify the bay.	A numeric string of maximum 20 characters. Use maximum 7 characters to view the complete name on the MSC-L screen.

5.11.2.2 Bay Configuration . I/O Binding

1. On the **System Config . Bay** screen, select <I/O binding>. The **System Config . Bay . I/O bindings** screen appears.



2. On the **System Config . Bay . I/O bindings** screen, select each entity to configure the MSC-L.

5.11.2.2.1 Bay Configuration . I/O Binding . Inputs

On the **Bay Configuration . I/O binding** screen, select <Inputs>. The following entities are displayed on the **Bay Configuration . I/O Binding . Inputs** screen.

Entity	Description	Value range
[Grounding]	With this entity you can configure the physical source for the grounding input.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None. The default value is <None>.
[Overfill]	With this entity you can configure the physical source for overfill protection input.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None. The default value is <None>.

Entity	Description	Value range
[Vapour recovery]	With this entity you can configure the physical source for the vapour recovery input.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None. The default value is <None>.

5.11.2.2.2 *Device Configuration . I/O Binding . Outputs*

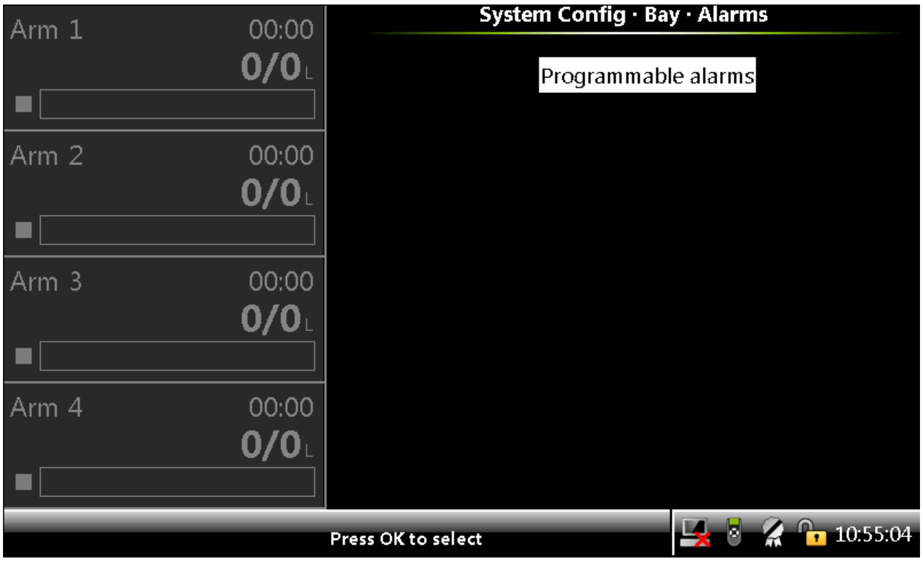
On the **Bay Configuration . I/O binding** screen, select <Outputs>. The following entities are displayed on the **Bay Configuration . I/O Binding Outputs** screen.

Entity	Description	Value range
[Bay active]	With this entity you can configure the output, which indicates the bay active.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None. The default value is <None>.

5.11.2.3 Bay Configuration . Alarms

1. On the **System Config . Bay** screen, select <Alarms>.

   The **System Config . Bay . Alarms** screen appears.



Alarms can have the following alarm actions.

- <Disabled>:
  The alarm is ignored.
- <Display>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
- <Display shutdown>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is stopped.

- <Display pause>:
  - The alarm is shown on the display.
  - The alarm-indication output set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is paused.

2. On the **System Config . Bay . Alarms** screen, select each entity to configure the alarms.

5.11.2.3.1 *System Config . Alarms . Programmable alarms*

On the **System Config . Bay . Alarms** screen, select <Programmable alarms>. The following entities are displayed.

The MSC-L contains five bay programmable alarms [Programmable alarm 1], [Programmable alarm 2], [Programmable alarm 3], [Programmable alarm 4], [Programmable alarm 5], and Programmable alarm 6].

When any of the device programmable alarm arises, the MSC-L stops or pauses all the running batches based on the configuration. To clear the programmable alarm, the programmable input must be connected/ disconnected based on the expected input state configured. Then, the alarm disappears and the MSC-L resumes again. However, it is not required to reset the condition with normal alarms.

NOTE: You can configure Emergency Stop as the MSC-L programmable alarm.

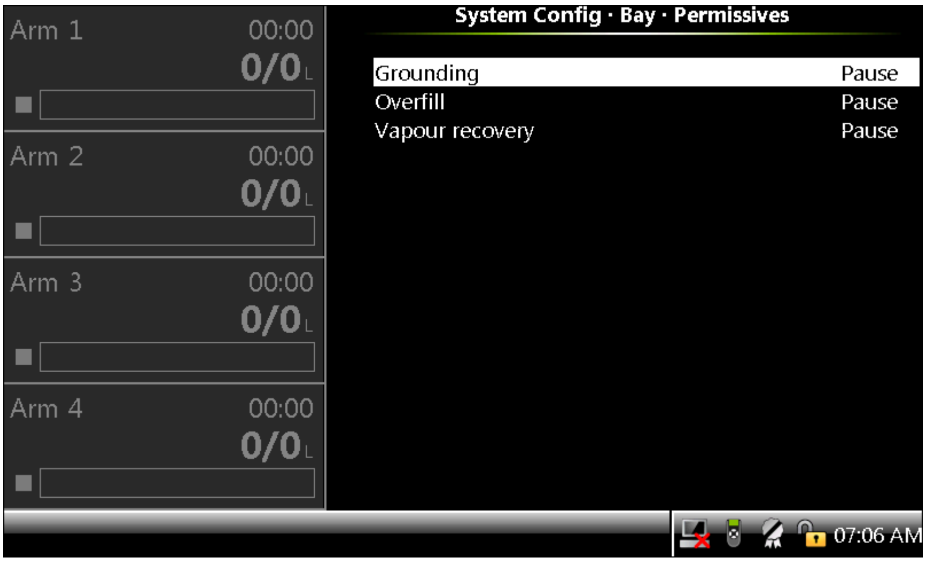
Entity	Description	Value range
[IO binding]	With this entity you can select the physical input source for the programmable alarm function.	Any of the unused QPI-n, AI-n, DI-AC-n, DI-DC-n, or None. The default value is <None>.
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Alarm name]	With this entity you can configure the name of the alarm.	A maximum of 32 alphanumeric characters are allowed for configuration.
[Response time]	With this entity you can set the time in seconds, which is the time required for the input to change from one state to other.	<0> s ... <255> s (default = <0> s)

Entity	Description	Value range
[Alarm activation (Idle)]	With this entity you can set the state of the input when the MSC-L is in idle state for the alarm function. The MSC-L state is idle when the transactions are not started for loading process. • <None>: The alarm is ignored. • <Active>: The alarm occurs when the input state is active. • <Deactive>: The alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>
[Alarm activation (Running)]	With this entity you can set the state of the input when the MSC-L is in running state for the alarm function. After successful authorization and permissives gets connected to start a loading process, the MSC-L is in the running state and continues to be in this state till all the permissives are disconnected after the transactions are complete. • <None>: The alarm is ignored. • <Active>: The alarm occurs when the input state is active. • <Deactive>: The alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>

5.11.2.4 System Config . Bay . Permissives

1. On the **System Config . Bay** screen, select <Permissives>.

   The **System Config . Bay . Permissives** screen appears.



2. On this screen the following entities are displayed.

Entity	Description	Value range
[Grounding]	With this entity you can configure the action taken when the grounding input is detached.	<Pause> (default) <Shutdown> <Timeout> <Manual Reset>
[Overfill]	With this entity you can configure the action taken when the overfill input is detached.	<Pause> (default) <Shutdown> <Timeout> <Manual Reset>
[Vapour recovery]	With this entity you can configure the action taken when the vapour recovery input is detached.	<Pause> (default) <Shutdown> <Timeout> <Manual Reset>

The various permissive types and the associated actions are described as follows:

1. **Pause**: If the physical input associated with the permissive is disconnected during loading, all the batches running on this bay are paused. If the input is reconnected then the alarm is auto cleared and the batch can be resumed.
2. **Shutdown**: If the physical input associated with the permissive is disconnected during loading, all the batches running on the bay are terminated. The alarm is auto cleared after the transaction is terminated.
3. **Timeout**: If the physical input associated with the permissive is disconnected during loading, all the batches running on this bay are paused. If the input is reconnected within the timeout configured from the device configuration, the alarm is auto cleared and the batches can be resumed. If the input is not reconnected during the timeout, the transaction running on that bay is terminated and the alarm auto clears.
4. **Manual Reset**: If the physical input associated with the permissive is disconnected during loading, all the batches running on this bay are paused. If the input is reconnected within the timeout configured from the device configuration, the alarm is auto cleared and the batches can be resumed. If the input is not reconnected during the timeout, the transaction running on that bay is terminated and alarm needs to reset manually.

The logic of the used overfill system on top-loading might impair the expected logic of the overfill permissive in the MSC-L.

5.12 Stream Configuration

To perform the Stream Configuration

1. On the **Main Menu** screen, select the **Stream Configuration** icon.

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

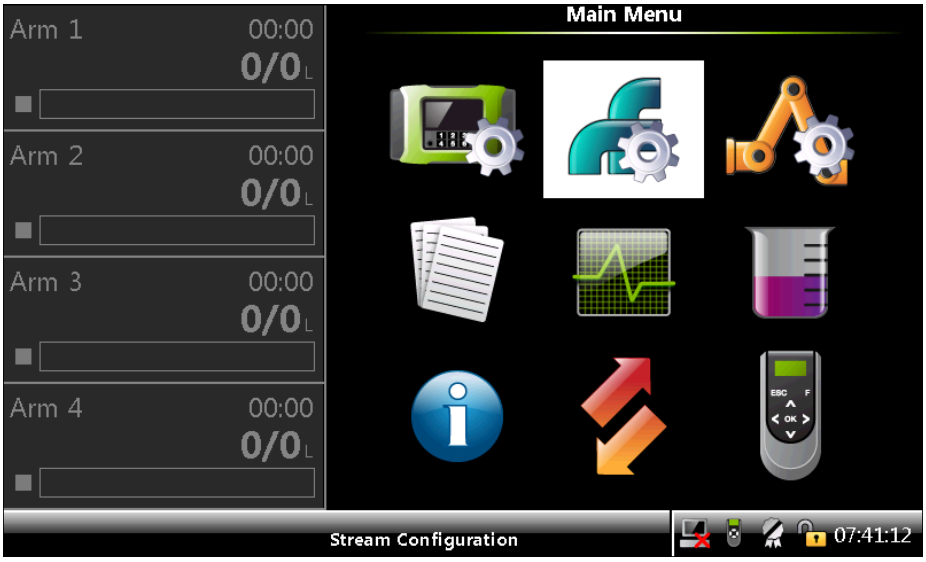
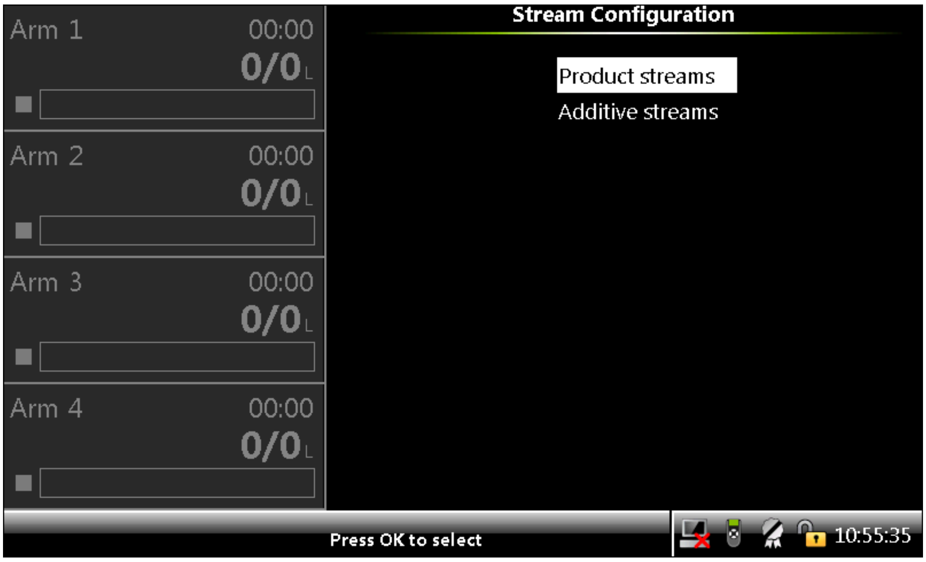


FIGURE 5-28 Stream Configuration icon

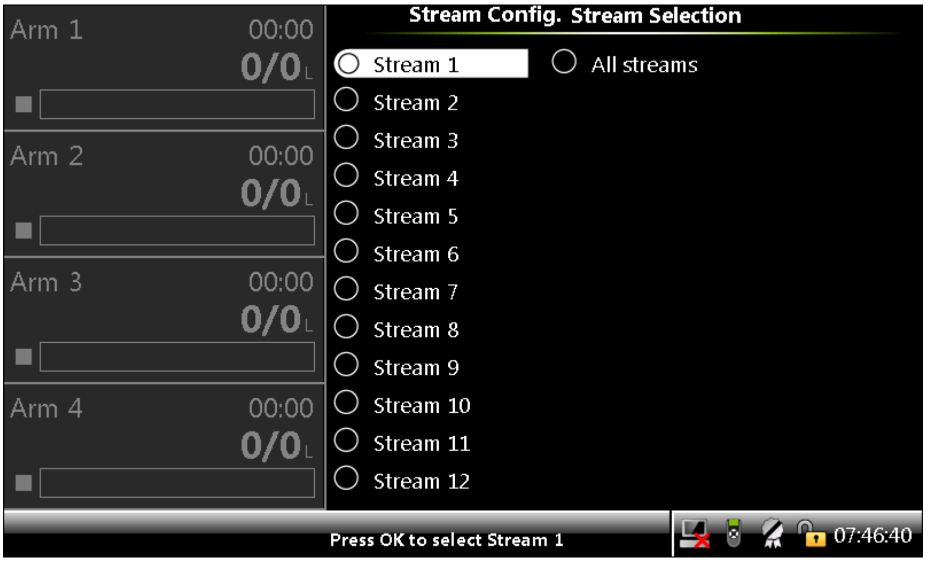
2. On the **Stream Configuration** screen, select **Product streams** or **Additive streams**.



5.12.1 Stream Configuration . Product Streams

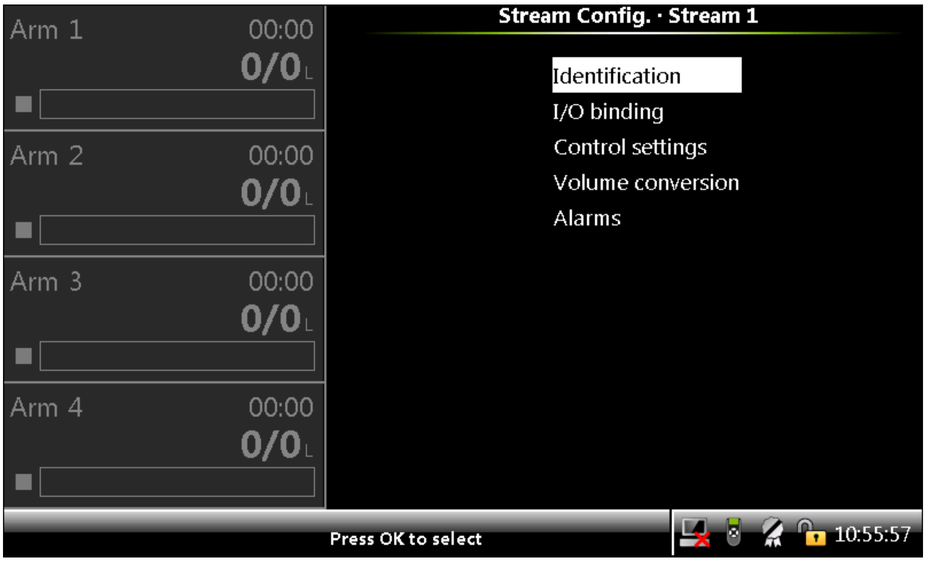
1. On the **Stream Configuration** screen, select **Product streams**.

The **Stream Config. Stream Selection** screen appears.



2. Select the required stream or all the streams.

The **Stream Config . Stream n** screen appears.



5.12.1.1 Stream Config. . Stream n . Identification

On the **Stream Config . Stream n** screen, select <Identification>.

The **Stream Config . . Stream n . Identification** screen appears with the following entities.

Entity	Description	Value range
[Product name]	With this entity you can enter the name of the wild stream product. The Product name appears on the running screens.	A text string of maximum 20 characters can be entered. Use maximum of 12 characters to view the complete name on the MSC display screen. The default value is <Stream n>.
[Main product]	With this entity you can enable or disable loading the main product.	<Enable> <Disable> (default)
[Vapour return]	With this entity you can enable or disable vapour recovery.	<Enable> <Disable> (default)

5.12.1.2 Stream Config . Stream n . I/O Bindings

On the **Stream Config . Stream n** screen, select <I/O binding>.

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-L.

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

To configure Input/Output entities

? On the **Main Menu** screen, select the **Stream Configuration** icon.

The **Stream Configuration** screen appears.

? On the **Stream Configuration** screen, select **Product streams**.

The **Stream Config. - Stream Selection** screen appears.

? On the **Stream Config. - Stream Selection** screen, select any one of the stream or all the streams.

The **Stream Config . Stream n** screen appears.

? On the **Stream Config . Stream n** screen, select <I/O binding>.

? Select <Inputs> or <Outputs> and then select <OK> on the Fusion4 IR controller, Fusion4 LAD, or the integrated keyboard.

A specific entity, for example [Pump feedback], [Pump demand], 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 Electromechanical Relay), and so on.

5.12.1.2.1 The I/O Bindings . Input Parameters

NOTE: The default value for the Input entities are None.

NOTE: When the temperature and/or pressure correction is used, link them as below for the W&M compliance.

- *Select the I/O binding for the Product Temperature as RTD input (4-wire).*
- Select the I/O binding for the Product Pressure as AI (4-20 mA).
- *Select the I/O binding for the Product Density as AI (4-20 mA) or use the lab density*.

Entity	Description	Can be linked to...
[Product stream meter]	With this entity you can select the physical source for the product stream meter function.	Any of the unused QPI-1A to QPI-6B (for product streams 1 to 6). Any of the unused QPI-7A to QPI-12B (for product streams 7 to 12).
[Product temperature]	With this entity you can select the physical source for the product stream temperature function.	RTD-1, RTD-2, RTD-3, RTD-4, RTD-5, RTD-6, 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, None
[Product pressure]	With this entity you can select the physical source for the product stream pressure function.	AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, I-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, None
[Product density]	With this entity you can select the physical source for the product stream density function.	AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, I-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, None
[Pump feedback]	With this entity you can select the physical source for the pump feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Tank low level switch]	With this entity you can select the physical source for the tank low level function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Tank empty switch]	With this entity you can select the physical source for the tank empty function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Hydraulic pump feedback]	With this entity you can select the physical source for the hydraulic pump feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Block valve feedback]	With this entity you can select the physical source for the block valve feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Block valve open feedback]	With this entity you can select the physical source for the block valve open feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Block valve closed feedback]	With this entity you can select the physical source for the block valve closed feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Product vapor pressure]	With this entity you can select the physical source for the product stream vapour pressure function.	AI-1, AI-2, AI-3, AI-4, AI-5, AI-6, AI-7, I-8, AI-9, AI-10, AI-11, AI-12, AI-13, AI-14, None

5.12.1.2.1.1 Pump Feedback

- If the [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).

5.12.1.2.1.2 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 must provide a simple form contact closure upon detection of a low level (in excess of some low point) in the supply tank. Consideration must 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 must 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-L *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.

5.12.1.2.1.3 Tank Empty Switch

If the *tank-empty condition* exists, the MSC-L *cannot operat*e 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-L resumes to normal use. It is not required to reset the condition with normal alarms.

5.12.1.2.1.4 Hydraulic Pump Feedback

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

5.12.1.2.2 The I/O Bindings . Output Parameters

NOTE: The default value for all the Output entities are None.

Entity	Description	Can be linked to...
[NO DCV]	With this entity you can select the physical source for the DCV function.	Any of the unsed DO-EMR-n, DO-SSR-n, PO-n, or None.
[NC DCV]	With this entity you can select the physical source for the DCV function.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Low flow 2SV]	With this entity you can select the output used in a two stage value to enable low product flow (output is also enabled in high flow stage).	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[High flow 2SV]	With this entity you can select the output used in a two stage value to enable high product flow.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Pump demand]	With this entity you can select the physical source for the pump demand function.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Block valve control]	With this entity you can select the physical source for the block valve control function.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Hydraulic pump demand]	With this entity you can select the physical source for the hydraulic pump demand function.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Factored pulse output]	With this entity you can select the physical source for the factored pulse output.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Recirculation NO DCV]	With this entity you can select the physical source for recirculation NO DCV.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.
[Recirculation NC DCV]	With this entity you can select the physical source for recirculation NO DCV.	Any of the unused DO-EMR-n, DO-SSR-n, PO-n, or None.

5.12.1.2.2.1 Pump Demand

- Product stream pump demand output should be driven high when the batch starts (if the [Pump demand] I/O binding is defined).
- The pump is de-activated when the batch stops and [Pump run timeout] is elapsed.

5.12.1.2.2.2 Block Valve Control

- If the [Block valve] I/O binding is defined, then the block valve output should be active when the batch starts.
- If the block valve should remain active until the product stream stops or pauses.

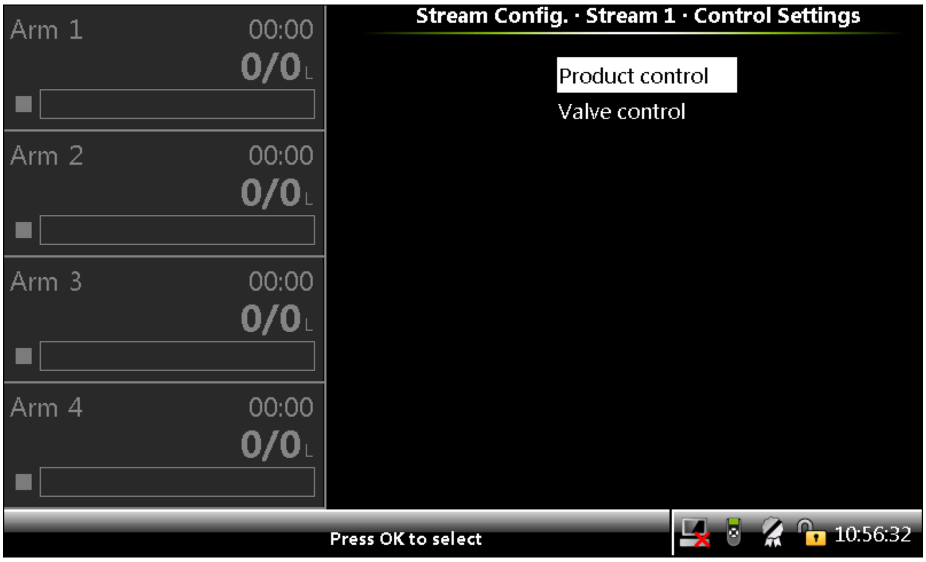
5.12.1.2.2.3 Hydraulic Pump Demand

- Product stream hydraulic pump demand output should be driven high when the batch starts (if the [Hydraulic pump demand] I/O binding is defined).
- The hydraulic pump is de-activated when the batch stops and [Hydraulic pump run timeout] elapses.

5.12.1.3 Stream Config. . Stream n . Control Settings

On the **Stream Config . Stream n** screen, select <Control settings>.

The **Stream Config . Stream n . Control Settings** screen is displayed with the following entities.



5.12.1.3.1 *Product Control*

On the **Stream Config . Stream n . Control Settings** screen, select <Product control>.

The **Stream Config . Stream n . Product Control** screen is displayed with the following entities.

Entity	Description	Value range
[Dead band (kdb)]	With this entity you can configure the allowed flow deviation from the target flow. When the actual flow is less than the [Dead band] limit, the control output from the controller is locked. Changes are not made to the product stream control valve. This value effectively establishes the dead band in which the product stream flow can deviate without correction. The dead band defines this value.	default = 15 litres
[Feed forward (kff)]	This entity is used only for non-DCV type valves.	default = 0.00
[Integral (ki)]	With this entity the Integral part of the PI(D) controller can be set.	default = 0.00
[Output (kout)]	With this entity the collaboration with the [-1, 1] limiter is used for setting the operational range of the controller.	default = 100.00

Entity	Description	Value range
[Proportional (kp)]	With this entity the gain of the proportional part of the PI(D) controller can be set.	default = 1.00
[Pump run timeout]	With this entity you can enter the time in minutes between the last injection and the additive pump stop.	<1> min ... <255> mins (default = <10> mins)
[Hydr. pump run timeout]	With this entity you can enter the time in minutes between stopping the blend stream flow and closing the hydraulic pump.	<1> min... <255> minutes (default = <10> mins)
[Factored pulse out]	With this entity you can select the amount of pulses for each unit of the product volume dispensed.	<1 Pulse / Unit> (default) <10 Pulses / Unit> <100 Pulses / Unit> <1000 Pulses / Unit>
[Block valve activation time]	With this entity you can configure the time that the MSC-L waits after the activation of block valve before controlling the DCV. This entity is used only if the block valve feedback is not configured.	<0> sec ... <999> secs (default = <0> sec)
[Factored pulse width]	With this entity you can select the width of the factored pulse output.	<1> msec... <500> msec (default = <1> msec)
[Back pressure control]	With this entity you can enable back pressure control.	<Enable> <Disable> (default)
[Vapour pressure margin]	With this entity, you can adjust “Minimum limit point” to provide a ‘safety’ margin above derived vapour pressure. **Note**: In case of “Externally controlled” vapour pressure, this parameter is used to derive vapour pressure from observed product pressure.	(default = <1> Bar) Units <Pascal> <Kilo Pascal> <Pounds per Square Inch> <PSI large> <Bar>
[Pressure control range factor]	With this entity you can adjust ‘Maximum limit point’ to change the pressure range where ‘back pressure control’ is active	Value = <0.20> ... <5.00> (default = <1.00>)
[Pressure control ramp time]	With this entity you can configure a pressure control ramp time interval that helps in smoothing out the flow/ pressure dynamics.	<0> sec ... <60> sec (default = <10> sec)

5.12.1.3.2 Valve Control

On the **Stream Config . Stream n . Control Settings** screen, select <Valve control>.

The **Stream Config . Stream n . Valve** screen is displayed with the following entities.

Entity	Description	Value range
[Valve type]	With this entity you can select an entity for configuring the valve type.	<None> (default) <DCV> <Two stage valve> <Simulated DCV>
[Valve closing quantity]	You can use the valve closing entity to over-run the preset value. In the next batches, the DCV and block values are closed at the set valve closing quantity. This is to ensure that the configured is met.	default = <0>
[DCV period]	With this entity you can configure the time in between DCV output updates.	<100> msec ... <1000> msec (default = <300> msec)
[DCV minimum pulse width]	With this entity you can configure the minimal time in between solenoid changes.	<50> msec... <950> msec (default = <50> msec)
[Recirculation Valve mode]	With this entity you can configure the recirculation valve mode	<Inverse DCV> <Follow DCV>

NOTE: *For accurate DCV control performance, it is recommended to configure the Digital Outputs (DO's) locally. That is, use the SSR's for valve control on the CAN-ARM-MSC board where the flow meter is configured to the Pulse Input(s) (PI).*

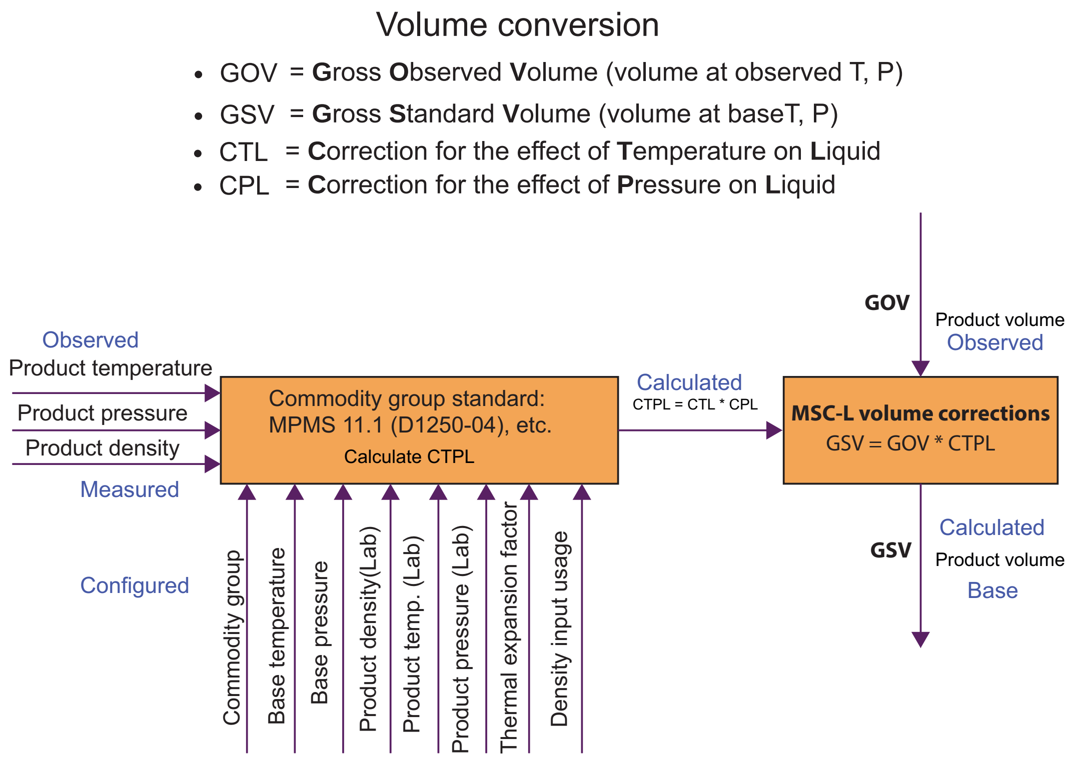
5.12.1.4 Volume Conversion

5.12.1.4.1 Volume Conversion Essential Information

The MSC-L volume conversions are meant for the conversion of the measured Gross Observed Volume (GOV) to the Gross Standard Volume (GSV).

The GSV is defined at base (reference) conditions for temperature and pressure, and hence it is suitable for highly accurate custody transfer of various products.

NOTE: *Configured/observed pressures are gauge pressures, i.e. pressures above standard atmospheric pressure of 101.325 kPa, so it is important that gauge (not absolute) pressure transmitters are used as pressure sensors. Also, in case of NGL and LPG (TP27-07 commodity group), configured base pressure is the pressure above product vapour* *pressure as it is typically stated for custody transfer purposes.*



The MSC-L implements volume conversions for the product groups (commodity groups) as follows:

- A = Crude oil
- B = Refined products
- C = Special applications (thermal expansion factor needed)
- D = Lubricating oils
- E = NGL and LPG
- FAME = Fatty Acid Methyl Esters
- Petroleum to CNP6-70
- Ethanol mix to NBR 5992:2008 / 15639:2008
- Ethanol to MPMS 11.3.3

The volume conversion is implemented according to procedures (calculations) prescribed in various current standards.

Standard	Description
API MPMS 11.1 (2004)	Temperature and Pressure Volume Correction Factors for Generalized Crude Oils Refined Products and Lubricating Oils (Adjunct to: ASTM D 1250-04) NOTE: designated as "D1250-04" in MSC-L user interface

Standard	Description
API MPMS 11.2.4 (2007)	Temperature Correction for the Volume of NGL and LPG Tables 23E 24E 53E 54E 59E and 60E (GPA Technical Publication TP-27) NOTE: designated as "TP27-07" in MSC-L user interface
EN 14214 (2008)	Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines NOTE: designated as "EN14214-08" in MSC-L user interface
API MPMS 11.2.2	Compressibility Factors for Hydrocarbons: 0.350-0.637 Relative Density (60°F/60°F) and -50°F to 140°F Metering Temperature
API MPMS 11.2.5	Simplified Vapour Pressure Correlation for Commercial NGLs
CNP Resolution No. 6-70, Tables I and II	Conversion of Observed Density to Density at 20 °C and Volume Correction to 20 °C NOTE: Designated as "CNP6-70 (Petroleum)" in MSC-L user interface
NBR 5992:2008 / 15639:2008	Ethanol and its mixtures with water NOTE: Designated as "NBR15639-08 (Ethanol Mix)" in MSC-L user interface
API MPMS 11.3.3	Ethanol Density and Volume Correction Factors NOTE: Designated as "MPMS 11.3.3 (Pure/Fuel Ethanol)" in MSC-L user interface
API MPMS 9.1 / ASTM D1298-12b	Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method NOTE: designated as "D1298-12B" in MSC-L user interface

The following table provides convenient reference to the historical 'Tables' designations in respect to the current standards' procedures.

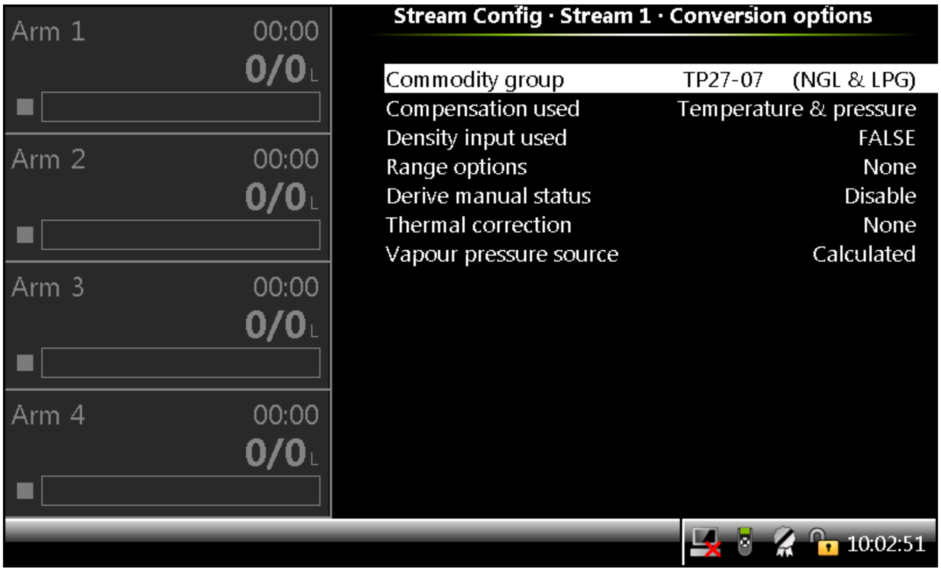
Standard	Procedure Paragraph in Current Standard	Historical Table Designation
API MPMS 11.1	11.1.6.1	6/24 A, B, C & D
API MPMS 11.1	11.1.6.2	5/23 A, B & D
API MPMS 11.1	11.1.7.1	54/60 A, B, C & D
API MPMS 11.1	11.1.7.2	53/59 A, B & D
API MPMS 11.2.4	5.1	23/24 E
API MPMS 11.2.4	5.2	53/54 E
API MPMS 11.2.4	5.3	59/60 E

Since the procedures from the same standard can be differentiated by stipulated base (reference) temperature, this allows MSC-L to engage the appropriate procedure based on the configured base (reference) temperature without any additional inputs from the end users.

MSC-L directly applies appropriate procedures from standards for cases where configured base conditions (temperature and pressure) match the ones referenced in the chosen standard (commodity group), otherwise a generic 2-step approach is used: procedures from the chosen standard are used first to convert from observed to referenced conditions and then from referenced conditions to configured base conditions.

To cater for various practical scenarios, MSC-L offers efficient and flexible configuration options (all are individual per product stream, except "base conditions") including:

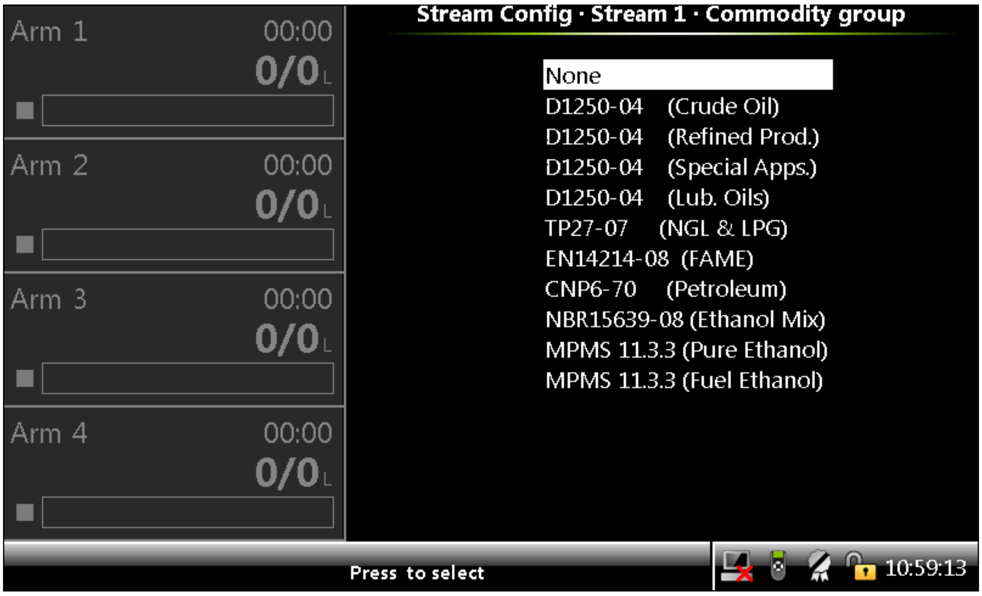
- Base (reference) temperature and pressure (these parameters are 'device' based, that is same for all product streams)
- Commodity group (in connection with related standard)
- Compensation type (None, Temperature, or Temperature and Pressure)
- Density input usage option (determines whether density sensor at metering conditions or laboratory density data is used)
- Range options (allows for wider range than stipulated by standards)
- Laboratory observation data



Temperature effects are catered for all commodity groups by standards' procedures (calculations), while pressure effects are catered for different standardized commodity groups as follows:

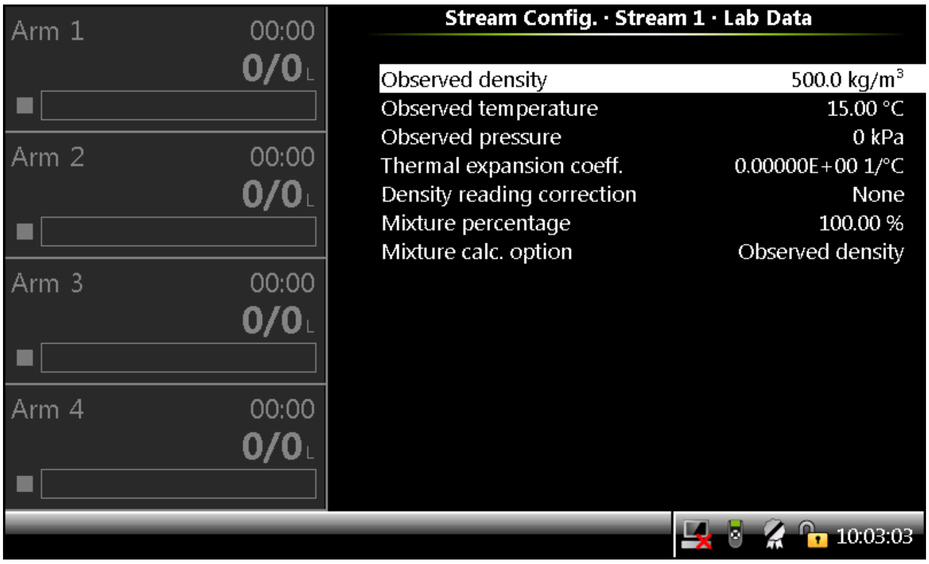
- D1250-04 (MPMS 11.1) - by standard itself

- TP27-07 (MPMS 11.2.4) - by additionally applying CPL factor based on MPMS 11.2.2 and vapour pressure (MPMS 11.2.5 is used if vapour pressure source is set to ‘Calculated’)
- CNP6-70 - by additionally applying CPL factor based on MPMS 11.2.1M (utilizing D1250-04 procedures)
- Other commodity groups - pressure compensation not supported



If density sensor is not used, then laboratory observation density is used to derive density at base conditions and, conveniently this laboratory data can represent conditions different from base conditions. Laboratory data parameters also include thermal expansion coefficient which is required for commodity group C (Special Apps.).

The “Density reading correction” parameter can be set for convenient entering of laboratory observed density as direct reading from a glass hydrometer (D1298-12B). The “Mixture percentage” and “Mixture calc. option” parameters allow for mixture percentage (either by mass or by volume) to be used instead of laboratory observed density in case of NBR15639-08 commodity group (ethanol mixture with water).



Product mass is determined by multiplying volume and density at metering conditions.

$M = V_m * \rho_m$

5.12.1.4.2 *Volume Conversion Calculation Details*

5.12.1.4.2.1 MPMS 11.1 (D1250-04), Commodity Groups A, B, D

Valid ranges for this commodity groups are specified in MPMS 11.1 in paragraph 11.1.2.3 as follows:

11.1.2.3 Temperature, Pressure, and Density Limits

The limits on this Standard are defined in a mixture of terms of customary and metric units. The following table shows the defining limits and their associated units. These values are shown in ***bold italics***. Also shown in the table are the limits converted to their equivalent units (and, in the case of the densities, other base temperatures).

	Crude Oil	Refined Products	Lubricating Oils
Density, kg/m³ @ 60°F	***610.6 to 1163.5***		***800.9 to 1163.5***
Relative Density @ 60°F	0.61120 to 1.16464		0.80168 to 1.1646
API Gravity @ 60°F	100.0 to -10.0		45.0 to -10.0
kg/m³ @ 15°C	611.16 to 1163.79	611.16 to 1163.86	801.25 to 1163.85
kg/m³ @ 20°C	606.12 to 1161.15	606.12 to 1160.62	798.11 to 1160.71
Temperature, °C	***-50.00 to 150.00***		
°F	-58.0 to 302.0		
Pressure, psig	***0 to 1,500***		
kPa (gauge)	0 to 1.034×10^4		
bar (gauge)	0 to 103.4		
α_{60}, per °F	***230.0×10^{-6} to 930.0×10^{-6}***		
per °C	414.0×10^{-6} to 1674.0×10^{-6}		

5.12.1.4.2.2 MPMS 11.1 (D1250-04), Commodity Group C (Special Applications)

For volume conversion, this commodity group requires knowledge of the thermal expansion factor α_{60}. The product density data is not necessary for volume conversion for cases where compensation for pressure effects is not required, but the density is still needed for product mass determination. It is recommended always to configure appropriate product density (or use the density sensor).

Valid ranges for this commodity group are specified in MPMS 11.1 (see table above).

5.12.1.4.2.3 MPMS 11.2.4 (TP27-07), Commodity Group E (NLG & LPG)

The calculation of the pressure conversion factor is not included directly into the MPMS 11.2.4 (TP27-07) procedures, therefore MPMS 11.2.2 and product vapour pressure are used in addition for calculating the compressibility of the fluid. Iterative process is used in this case to establish density at reference conditions, which in turn is used to derive CTPL (VCF).

The product vapour pressure source can be configured as:

- Calculated – using MPMS 11.2.5 standard
- Measured – directly measured by configured pressure sensor
- Externally controlled – in this case the product pressure Pm is controlled externally to be above equilibrium (vapour) pressure Pe by fixed safety margin Ps, therefore Pe = Pm - Ps

NOTE: In configurations where compensation for pressure effects is used together with density input (or laboratory pressure is non-zero) and such compensation is not an integral part of the commodity group standard (currently it applies to TP27-07 and CNP6-70 commodity groups), some combinations of measured parameters (typically at high pressures) can have multiple theoretical solutions for the product density at base conditions. In such case, MSC-L will resolve to one of these roots – typically such roots would be close to each other having minor effect on overall CTPL (VCF) calculation results.

Sometimes the containment vessel for the product contains means of altering the vapour pressure in the vessel to some value other than the equilibrium pressure (Pe) at the metering temperature (Tm). The difference between the calculated equilibrium pressure at the observed temperature and the actual measured pressure (Pm) in the vessel results in a pressure difference (ΔP) that is then used for calculating the compressibility factor (Fp) of the product at the observed conditions using MPMS 11.2.2. Finally, the compressibility factor and the pressure differential between the observed pressure and the equilibrium vapour are used for calculating the CPL for blend product.

Table of valid ranges for this commodity group as stipulated in MPMS 11.2.4:

Fluid Property	Minimum value	Maximum value
Temperature, °F	-50.8	+199.4
Temperature, °C	-46	+93
60.0°F relative density	0.3500	0.6880
Density at 15.0°C, kg/m^3	351.7	687.8
Density at 20.0°C, kg/m^3	331.7	683.6

CAUTION! *Compensation for pressure effects should be used above 10 bar product pressure.*

When density sensor input is used, not all sets of observation values may result in a proper calculation values bound by stipulated ranges. This is the expected behaviour for these calculations (an exception is raised if a proper value cannot be calculated).

5.12.1.4.2.4 EN14214 (2008), Commodity Group FAME (Fatty Acid Methyl Esters)

There is currently no compensation for pressure effects for this commodity group.

Table of valid ranges for this commodity group:

Fluid Property	Minimum value	Maximum value
Temperature, °C	+20.0	+60.0
Density at 15.0°C, kg/m^3	860	900

5.12.1.4.2.5 CNP6-70, Commodity Group Petroleum (Brazilian Standard)

The calculation of the pressure conversion factor is not included directly into the CNP6-70 Tables, therefore MPMS 11.2.1M (utilizing D1250-04 procedures) is used in addition for calculating the compressibility of the fluid. Iterative process is used in this case to establish density at reference conditions, which in turn is used to derive CTPL (VCF).

Table of valid ranges for this commodity group:

Fluid Property	Minimum value	Maximum value
Temperature, °C	-50.0 (-60.0 Ext.)	+200.0 (+240.0 Ext.)
Density at 20.0°C, kg/L	0.500 (0.450 Ext.)	1.100 (1.250 Ext.)

NOTE: *Temperature range depends on density as determined by CNP6-70 Tables I and II.*

5.12.1.4.2.6 NBR15639 (2008), Commodity Group Alcohol (Ethanol Mixture with Water)

There is currently no compensation for pressure effects for this commodity group.

Table of valid ranges for this commodity group:

Fluid Property	Minimum value	Maximum value
Temperature, °C	-20.0 (-30.0 Ext.)	+40.0 (+50.0 Ext.)
Density at 20.0°C, kg/m^3	789.23	998.20

5.12.1.4.2.7 MPMS 11.3.3 (2011), Commodity Group Pure and Denatured Fuel Ethanol

For volume conversion, this commodity group is treated as Commodity Group C (Special Applications) with prescribed thermal expansion factor $\alpha60$ for pure and denatured fuel ethanol. The product density data is not necessary for volume conversion for cases where compensation for pressure effects is not required, but the density is still needed for product mass determination. It is recommended always to configure appropriate product density (or use the density sensor).

Valid ranges for this commodity group are specified in MPMS 11.1 (see table at 5.9.1.4.2.1).

Table of prescribed thermal expansion factors for this commodity group:

Fluid Type	SI Units	US Units
Pure Ethanol	0.001078 1/°C	0.000599 1/°F
Denatured Fuel Ethanol	0.001085 1/°C	0.000603 1/°F

5.12.1.4.2.8 Volume Conversion Terms

ρ_{lab}	product (lab sample) density
T_{ab}	product (lab sample) temperature
P_{lab}	product (lab sample) pressure
$\alpha 60$	product thermal expansion factor at 60 °F
ρ_m	product (metering conditions) density (measured or calculated)
T_m	product (metering conditions) temperature
P_m	product (metering conditions) pressure
V_m	product (metering conditions) volume
ρ_b	product (base conditions) density
T_b	product (base conditions) temperature
P_b	product (base conditions) pressure
V_b	product (base conditions) volume
M	product mass
P_e	product equilibrium vapour pressure
F_p	product compressibility factor
$CTL_{A\text{-}B}$	temperature correction factor from conditions A to conditions B
$CPL_{A\text{-}B}$	pressure correction factor from conditions A to conditions B
$CTPL_{A\text{-}B}$	temperature and pressure correction factor from conditions A to conditions B

5.12.1.4.2.9 Calculation of Gross Standard Volume

The calculation of the Gross Standard Volume (GSV) is performed incrementally by performing a volume-conversion calculation on an incremental measured product stream volume. The volume-converted values of these incremental product stream observed volumes are then added together to generate the running accumulative GSV value.

The gross standard volume after N number of incremental calculation intervals is provided by the following formula.

$$GSV_{transaction} = \sum_{i=1}^{N} VCF_i (GOV_i - GOV_{i-1})$$

The GOV_i represents the total accumulative gross observed volume after i calculation intervals. GOV_0 is always 0.

5.12.1.4.3 *Stream Config. Stream n . Volume Conversion*

On the **Stream Config . Stream n** screen, select <Volume conversion>.

The **Stream Config . Stream n . Volume Conversion** screen appears with the following entities.

5.12.1.4.3.1 Conversion Options

On the **Stream Config . Stream n . Volume Conversion** screen, select <Conversion options>.

The **Stream Config. Stream n . Conversion Options** screen is displayed with the following entities.

Entity	Description	Value range
[Commodity group]	With this entity you can select the commodity group of the product in compliance with the specific applicable standard.	<None> <D1250-04 (Crude oil)> <D1250-04 (Refined Prod.)> (default) <D1250-04 (Special Apps.)> <D1250-04 (Lub. Oils)> <TP27-07 (NGL & LPG)> <EN14214-08 (FAME)> <CNP6-70> (Petroleum) <NBR15639-08> (Ethanol Mix) <MPMS 11.3.3> (Pure Ethanol) <MPMS 11.3.3> (Fuel Ethanol) <D4311-15> (dsp halt)
[Compensation used]	With this entity you can select the type of compensation used during the calculation of GSV and mass (pressure compensation is not applicable for the FAME commodity group).	<None> (default) <Temperature> <Temperature & pressure>
[Density input used]	With this entity you can select whether the density sensor input at metering conditions is used for volume conversion calculations (instead of laboratory observed density value).	<False> (default) <True>
[Range options]	With this entity you can select the options enabled when using the VCF table. The extended temperature, pressure and range give the ability to do the volume conversion over a broader range than covered by the earlier versions of the standard. For instance at locations where it is very cold, like Alaska. When <None> is selected and the application goes beyond the normal range, an error occurs.	<None> (default) <Extended range>

Entity	Description	Value range
[Derive manual status]	With this entity you can select if the manual status of the density is propagated in the GSV and Mass. <Disable>: Manual status does not appear in the status of the GSV and Mass (default setting). <Enable>: Manual status appears in the status of the GSV and Mass.	<Enable> <Disable> (default)
[Thermal correction]	With this entity you can select if the thermal correction as per Annex A.3 of NBR15639-08 should apply to VCF calculation. This setting is applicable only to NBR15639-08 (Ethanol Mix) commodity group and can be chosen if/ where required by this standard. NOTE: this correction is presumably might be used to compensate for thermal expansion of stainless steel meters.	<None> (default) <NBR15639-08 (A.3)>
[Vapor pressure source]	With this entity you can configure how the vapour pressure will be derived, i.e. calculated per MPMS 11.2.5, directly measured by dedicated vapour pressure sensor, or calculated as “Product pressure” – “Vapour pressure margin” in case of externally controlled pressure. Currently this is only relevant to TP27-07 (NGL & LPG) commodity group.	<Calculated> (default) <Measured> <Externally controlled>

5.12.1.4.3.2 Lab Observation Data

On the **Stream Config . Stream n . Volume Conversion** screen, select <Lab observation data>.

The **Stream Config. Stream n . Lab Data** screen is displayed with the following entities.

Entity	Description	Value range
[Observed density]	With this entity you can enter the density of the product stream as it is measured in a lab.	<Value> <Units> (default = <1000.0> kg/m3)
[Observed temperature]	With this entity you can enter the temperature of the lab sample used for determining the product stream observed density.	<Value> <Units> (default = <15.00> °C)
[Observed pressure]	With this entity you can enter the pressure of the lab sample used for determining the product stream observed density.	<Value> <Units> (default = <0> kPa)

Entity	Description	Value range
[Thermal expansion coeff.]	With this entity you can enter the expansion coefficient used during the volume conversion. This is only applicable for Special application commodity group.	<Value> <Units> default = <0.00000E+00> 1/°C
[Density reading correction]	With this entity you can select if the density reading correction should apply to [Observed density] parameter. Set this parameter to <D1298-12B> if [Observed density] was entered as a direct reading of glass hydrometer complying with D1298-12B standard.	<None> (Default) <D1298-12B>
[Mixture percentage]	With this entity you can enter the product stream mixture percentage (either by mass or by volume) as it is measured in a lab. Currently this is only relevant to NBR15639-08 (Ethanol Mix) commodity group, providing that [Mixture calc. option] parameter set to either <Percentage (by mass)> or <Percentage (by volume)>.	<0...100%> <100%> (Default)
[Mixture calc. option]	With this entity you can select the lab observation data to be used for VCF calculations for mixtures. Currently this is only relevant to NBR15639-08 (Ethanol Mix) commodity group.	<Observed density> (Default) <Percentage (by mass)> <Percentage (by volume)>

Entity	Range
[Observed density units]	<Kilogram per Cubic Meter> <Degrees API> <Pounds per Cubic Feet> <Relative Density at 60 F> <Kilogram per liter>
[Observed temperature]	<Degrees Celsius> <Degrees Fahrenheit>
[Observed pressure] -> <Units>	<Pascal> <Kilo Pascal> <Pounds per Square Inch> <PSI large> <Bar>

NOTE: The pressure should be entered as a gauge pressure.

5.12.1.5 Stream Config . Stream n . Alarms

On the **Stream Config . Stream n** screen, select <Alarms>.

Alarms can have the following alarm actions.

- <Disabled>:
  - The alarm is ignored.
- <Display>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
- <Display shutdown>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is stopped.
- <Display pause>:
  - The alarm is shown on the display.
  - The alarm-indication output set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is paused.

5.12.1.5.0.1 Leaking Valve

On the **Stream Config . Stream n . Alarms** screen, select <Leaking valve>.

The **Stream Config. . Stream n . Leaking Valve** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Leaking quantity limit]	With this entity you can configure the amount of product volume that needs to be measured within the [Product Leaking volume timeout period] to raise an alarm, when the stream is idle.	<0.0> L ... <999> L (default = <0.00> L)
[Leaking timeout period]	With this entity you can configure the time within which amount more than [Product Leaking volume limit] needs to be measured to raise an alarm, when the stream is idle.	<1> s ... <99> s (default = <5> s)

5.12.1.5.0.2 No Product

On the **Stream Config . Stream n . Alarms** screen, select <No product>.

The **Stream Config. . Stream n . No Product** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[No product timeout]	With this entity you can set the time in seconds in which product stream pulses should be received when the device is permitted. After this time no product pulse stream pulse is received, an alarm occurs depending on [Alarm action].	<1> s ... <255> s (default = <5> s)

5.12.1.5.0.3 No Pump

On the **Stream Config . Stream n . Alarms** screen, select <No pump>.

The **Stream Config. . Stream n . No Pump** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Pump feedback timeout]	With this entity you can set the time in seconds in which the product stream pump must give feedback to the MSC-L. If no pump feedback is received in [Pump feedback timeout], an alarm occurs depending on [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.1.5.0.4 No Hydraulic Pump

On the **Stream Config . Stream n . Alarms** screen, select <No hydraulic pump>.

The **Stream Config. . Stream n . No Hydraulic Pump** screen is displayed with the following entities.

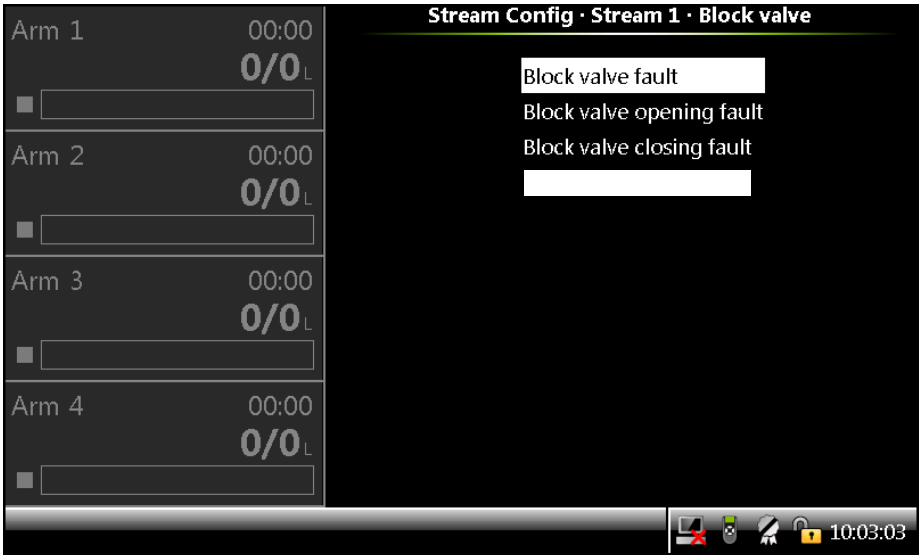
Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>

Entity	Description	Value range
[Pump feedback timeout]	With this entity you can set the time in seconds in which the product stream hydraulic pump must give feedback to the MSC-L. If no hydraulic pump feedback is received in [Pump feedback timeout], an alarm occurs depending on the [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.1.5.0.5 Block Valve

On the **Stream Config . Stream n . Alarms** screen, select <Block valve>.

The **Stream Config . Stream n . Block valve** screen appears.



5.12.1.5.0.5.1 Block Valve fault

On the **Stream Config . Stream n . Block valve** screen, select <Block valve fault>.

The **Stream Config. . Stream n . Block Valve fault** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause>
[Feedback timeout]	With this entity you can set the time in seconds in which the product stream block valve must give feedback to the MSCL. If no feedback is received in [feedback timeout] an alarm occurs depending on [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.1.5.0.5.2 Block valve opening fault

On the **Stream Config . Stream n . Block valve** screen, select <Block valve opening fault>.

The **Stream Config. . Stream n . Block valve opening fault** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause>
[Feedback timeout]	With this entity you can set the time in seconds in which the product stream block valve must give feedback to the MSCL. If no feedback is received in [feedback timeout] an alarm occurs depending on [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.1.5.0.5.3 Block valve closing fault

On the **Stream Config . Stream n . Block valve** screen, select <Block valve closing fault>.

The **Stream Config. . Stream n . Block valve closing fault** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause>
[Feedback timeout]	With this entity you can set the time in seconds in which the product stream block valve must give feedback to the MSCL. If no feedback is received in [feedback timeout] an alarm occurs depending on [Alarm action].	

5.12.1.5.0.5.4 Block valve feedback fault

On the **Stream Config . Stream n . Block valve** screen, select <Block valve feedback fault>.

The **Stream Config. . Stream n . Block valve feedback fault** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause>

Entity	Description	Value range
[Feedback timeout]	With this entity you can set the time in seconds in which the product stream block valve must give feedback to the MSCL. If no feedback is received in [feedback timeout] an alarm occurs depending on [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.1.5.0.6 Blend Tolerance

On the **Stream Config . Stream n . Alarms** screen, select <Blend Tolerance>.

The **Stream Config. . Stream n . Blend Tolerance** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[Tolerance limit]	With this entity you can configure the blend tolerance percentage that the MSC-L raises. • blend tolerance low alarm if the blend ratio between delivered product quantity with delivered batch quantity is less than [blend tolerance limit]. • blend tolerance high alarm if the blend ratio between delivered product quantity with delivered batch quantity is greater than [blend tolerance limit].	<0> % ... <10> % (default = <5> %)

5.12.1.5.0.7 Preset overrun

On the **Stream Config . Stream n . Alarms** screen, select <Preset overrun>.

The **Stream Config. . Stream n . Preset overrun** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)

Entity	Description	Value range
[Overrun volume limit]	With this entity you can configure the overrun volume limit. The MSC-L raises Exceeds overrun limit alarm if the product quantity delivered exceeded the preset quantity by the configured [overrun volume limit].	default = 0.00 L

5.12.1.5.0.8 Valve Fault

On the **Stream Config . Stream n . Alarms** screen, select <Valve fault>.

The **Stream Config. . Stream n . Valve Fault** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Valve fault timeout]	With this entity you can set the time in seconds in which the product stream valve must close after sending the signals close to the product stream valve. If product stream valve did not close within [Valve fault timeout] an alarm occurs depending on the [Alarm action].	<1> s ... <99> s (default = <5> s)

5.12.1.5.0.9 Volume Conversion

On the **Stream Config . Stream n . Alarms** screen, select <Volume conversion>.

The **Stream Config. .Stream n . Volume Conversion** screen is displayed with the following entities.

Entity	Description	Value range
[Vcf out of range]	With this entity you can configure the [VCF out of range] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Non-convergence]	With this entity you can configure the [Non-convergence] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Supercritical fluid]	With this entity you can configure the [Supercritical fluid] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)

Entity	Description	Value range
[No reference fluids]	With this entity you can configure the [No reference fluids] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Memory allocation]	With this entity you can configure the [Memory allocation] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Temperature out of range]	With this entity you can configure the [Temperature out of range] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Pressure out of range]	With this entity you can configure the [Pressure out of range] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Density out of range]	With this entity you can configure the [Density out of range] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Alpha60 out of range]	With this entity you can configure the [Alpha60 out of range] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[No solution]	With this entity you can configure the [No solution] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Illegal argument]	With this entity you can configure the [Illegal argument] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Pressure comp. not support]	With this entity you can configure the [Pressure comp. not support] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Bad sensor health]	With this entity you can configure the [Bad sensor health] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)

5.12.1.5.0.10 Vaporizing

On the **Stream Config . Stream n . Alarms** screen, select <Vaporizing>.

The **Stream Config. . Stream n . Vaporizing** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause>
[Alarm hysteresis]		<0...10%> (default = <5> %)

5.12.1.5.0.11 Vaporizing risk

On the **Stream Config . Stream n . Alarms** screen, select <Vaporizing risk>.

The **Stream Config. . Stream n . Vaporizing risk** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause>
[Alarm hysteresis]		<0....10%> (default = <5> %)

5.12.1.5.0.12 Fixed

On the **Stream Config . Stream n . Alarms** screen, select <Fixed>.

The **Stream Config. . Stream n . Fixed** screen is displayed with the following entities.

Entity	Description	Value range
[Pulse hardware]	With this entity you can configure the [Pulse hardware] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Pulse phase]	With this entity you can configure the [Pulse phase] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)

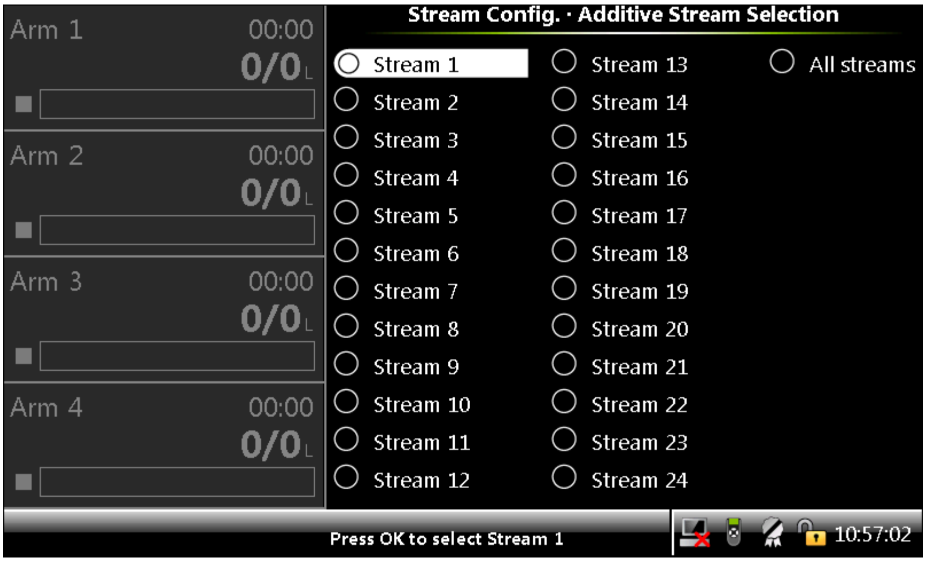
Entity	Description	Value range
[Tank low level]	With this entity you can configure the [Tank low level] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Tank empty]	With this entity you can configure the [Tank empty] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Temperature sensor]	With this entity you can configure the [Temperature sensor] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Low temperature]	With this entity you can configure the [Low temperature] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[High temperature]	With this entity you can configure the [High temperature] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Pressure sensor]	With this entity you can configure the [Pressure sensor] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Low pressure]	With this entity you can configure the [Low pressure] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[High pressure]	With this entity you can configure the [High pressure] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Density sensor]	With this entity you can configure the [Density sensor] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Low density]	With this entity you can configure the [Low density] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)

Entity	Description	Value range
[High density]	With this entity you can configure the [High density] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Meter exceeded max flow]	With this entity you can configure the [Flow rate exceed meter limit] alarm behavior in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Factored pulse out]	With this entity you can configure the [Factored pulse out] alarm behavior in case this particular alarm occurs.	<Disabled> <Displayed> <Display shutdown> <Display pause> (default)

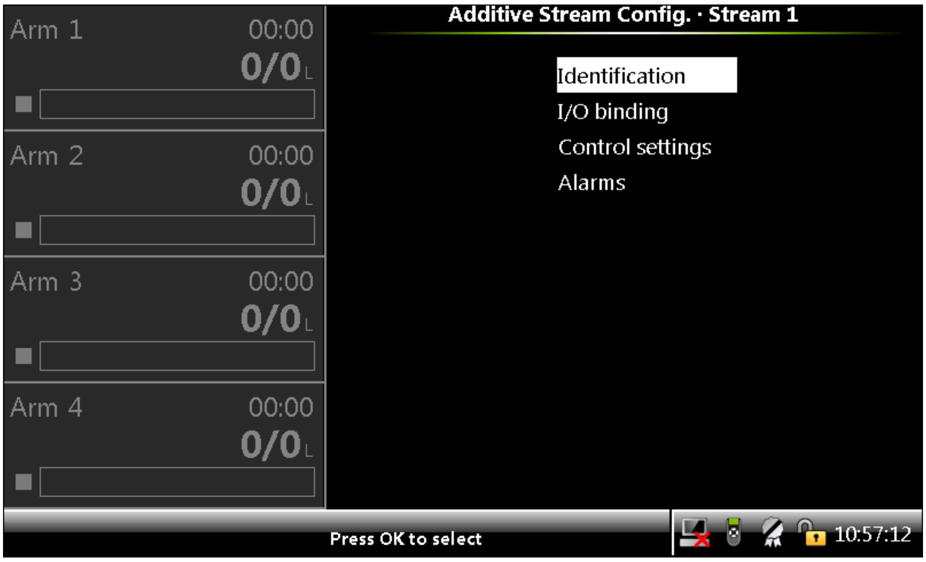
5.12.2 Stream Configuration . Additive streams

1. On the **Stream Configuration** screen, select **Additive streams**.

   The **Stream Config . Additive Stream Selection** screen appears.



2. Select any one of the stream or all the streams. The **Additive Stream Config . Stream n** screen appears.



5.12.2.1 Additive Stream Config. . Stream n . Identification

On the **Additive Stream Config . Stream n** screen, select <Identification>.

The **Additive Stream Config . Stream n . Identification** screen is displayed with the following entities.

Entity	Description	Value range
[Additive name]	With this entity you can enter the name of the additive product.	A text string of maximum 20 characters. Use maximum 7 characters to view the complete name on the MSC-L display screen.

5.12.2.2 Additive Config. Stream n . I/O Bindings

On the **Additive Stream Config . Stream n** screen, select <I/O binding>.

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-L.

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

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

- Additive stream meter
- Pump feedback
- Additive temperature

- Solenoid control
- Block valve
- Injection feedback
- Pump start
- Factored pulse out

To configure Input/Output entities

? On the Main Menu screen, select the **Stream Configuration** icon.

The **Stream Configuration** screen appears.

? On the **Stream Configuration** screen, select **Additive streams**.

The **Stream Config. . Additive Stream Selection** screen appears.

? On the **Stream Config. . Additive Stream Selection** screen, select any one of the stream or all the streams.

The **Additive Stream Config . Stream n** screen appears.

? On the **Additive Stream Config . Stream n** screen, select <I/O binding>.

? Select <Inputs> or <Outputs> and then select <OK> on the Fusion4 IR controller, Fusion4 LAD, or the integrated keyboard.

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

5.12.2.2.1 *The I/O Bindings . Input Parameters*

NOTE: The default value for all the Input entities are None.

Entity	Description	Can be linked to...
[Additive stream meter]	With this entity you can select the physical pulse input for an additive pulse input.	Any of the unused QPI-1A to QPI-6B (for additive streams 1 to 12). Any of the unused QPI-7A to QPI-12B (for product streams 13 to 24).
[Pump feedback]	With this entity you can select physical source for the pump feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI - n, AI-n, or None.
[Tank low level switch]	With this entity you can select the physical source for the tank low level function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Tank empty switch]	With this entity you can select the physical source for the tank empty function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.
[Additive temperature]	With this entity you can select the physical source for the additive stream temperature measurement.	RTD-1, RTD-2, RTD-3, RTD-4, RTD-5, RTD-6, 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, None
[Block valve feedback]	With this entity you can select the physical source for the block valve feedback function.	Any of the unused DI-DC-n, DI-AC-n, QPI-n, AI-n, or None.

5.12.2.2.1.1 Pump Feedback

- If the [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).

5.12.2.2.1.2 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 the 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 the 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-L *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.

5.12.2.2.1.3 Tank Empty Switch

If the *tank-empty condition* exists, the MSC-L *cannot operat*e 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-L resumes to normal use. It is not required to reset the condition with normal alarms.

5.12.2.2.2 The I/O Bindings . Output Parameters

NOTE: The default value for all the Output entities are None.

Entity	Description	Can be linked to...
[Solenoid control]	With this entity you can select the physical source for the additive solenoid control function.	Any of the unused DO-SSR-n, DO-EMR-n, PO-n, or None.

Entity	Description	Can be linked to...
[Block valve control]	With this entity you can select the physical source for the block valve control function.	Any of the unused DO-SSR-n, DO-EMR-n, PO-n, or None.
[Injection feedback]	With this entity you can select the physical source for the injection feedback function.	Any of the unused DO-SSR-n, DO-EMR-n, PO-n, or None.
[Pump demand]	With this entity you can select the physical source for the pump demand function.	Any of the unused DO-SSR-n, DO-EMR-n, PO-n, or None.
[Factored pulse out]	With this entity you can select the physical source for the factored pulse out function.	PO-1, PO-2, PO-3, PO-4, or None

5.12.2.2.2.1 Solenoid Control

If a running batch contains additives, the particular additive solenoid must be opened and closed when an additive injection is triggered (solenoid open/close is signalled).

5.12.2.2.2.2 Block Valve Control

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

5.12.2.2.2.3 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 the 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 is 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.

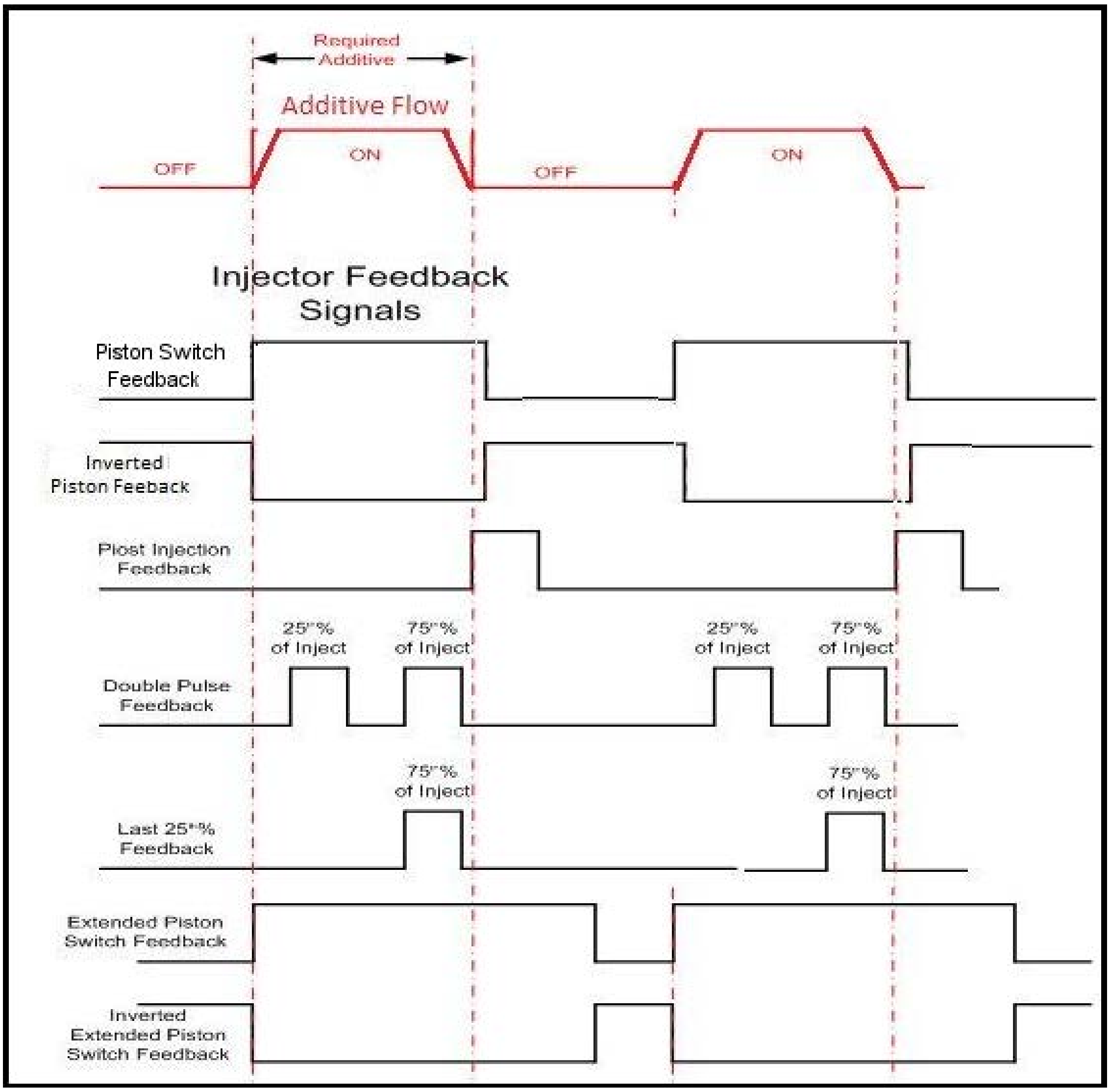


FIGURE 5-29 Injector feedback signals

5.12.2.2.2.4 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 on 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.

5.12.2.3 Additive Stream Config. . Stream n . Control Settings

On the **Additive Stream Config . Stream n** screen, select <Control settings>.

The **Additive Stream Config . Stream n . Control Settings** screen is displayed with the following entities.

5.12.2.3.1 Additive Control

On the **Additive Stream Config . Stream n . Control Settings** screen, select <Additive control>.

The **Additive Stream Config . Stream n . Additive Control** screen is displayed with the following entities.

Entity	Description	Value range
[Injection queue length]	With this entity you can configure the inject queue length. 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.	<0> ... <10> (default = <0>)
[Injection volume]		
[Factored pulse out]	With this entity you can select the amount of pulses for each unit of additive volume dispensed.	<1 Pulse / Unit> (default) <10 Pulses / Unit> <100 Pulses / Unit> <1000 Pulses / Unit> <1 Pulse / 10 Units> <1 Pulse / 100 Units> <1 Pulse / 1000 Units>

Entity	Description	Value range
[Feedback mode]	With this entity you can select the type of feedback for each injection.	<None> (default) <end sensor piston emul.> <Piston switch> <inv.end-sensor piston emul.> <Inverted piston switch> <mid-stroke piston emul.> <Post injection> <Double pulse> <Last 25%> <Ext. piston switch> <Inv. ext. piston switch>
[Feedback pulse duration]	With this entity you can enter the duration of the feedback pulse in ms.	<0> ms ... <1000> ms (default = <500> ms)
[Pump run timeout]	With this entity you can enter the time in minutes between the last injection and the additive pump stop.	<1> min ... <255> mins (default = <10> mins)
[Block valve location]	With this entity you can configure the physical position of the block valve pertaining to the additive meter.	<Upstream from meter> (default) <Downstream from meter>
[Factored pulse width]		

5.12.2.3.2 *Solenoid*

On the **Additive Stream Config. - Stream n- Control Settings** screen, select <Solenoid>.

The **Additive Stream Config. - Stream n - Solenoid** screen is displayed with the following entities.

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)

Entity	Description	Value range
[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 nonzero, 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)

5.12.2.4 Additive Stream Config. Stream n . Alarms

On the **Additive Stream Config. . Stream n** screen, select <Alarms>.

The **Additive Stream Config . Stream n . Alarms** screen is displayed.

Alarms can have the following alarm actions.

- <Disabled>:
  - The alarm is ignored.
- <Display>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
- <Display shutdown>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is stopped.
- <Display pause>:
  - The alarm is shown on the display.
  - The alarm-indication output set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is paused.

5.12.2.4.1 Leaking Valve

On the **Additive Stream Config . Stream n . Alarms** screen, select <Leaking valve>.

The **Additive Stream Config. . Stream n . Leaking Valve** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Leaking volume limit]	With this entity you can set the maximum amount of additive volume measured [Leaking timeout period] before a leaking valve alarm is generated. If this limit is exceeded, an alarm occurs depending on the [Alarm action].	<0> ml ... <999> ml (default = <100.00> ml)
[Leaking timeout period]	With this entity you can set the time in seconds in which the [Leaking volume limit] is checked.	<1> s ... <99> s (default = <60> s)

5.12.2.4.2 *No Additive*

On the **Additive Stream Config . Stream n . Alarms** screen, select <No additive>.

The **Additive Stream Config. . Stream n . No Additive** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[No additive timeout]	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].	<1> s ... <9> s (default = <2> s)

5.12.2.4.3 *No Pump*

On the **Additive Stream Config . Stream n . Alarms** screen, select <No pump>.

The **Additive Stream Config. . Stream n . No Pump** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[Pump feedback timeout]	With this entity you can set the time in seconds in which the additive pump must provide a feedback to the MSC. If the feedback from the pump is not received in [Pump feedback timeout], then an alarm occurs depending on the [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.2.4.4 *Block Valve Fault*

On the **Additive Stream Config . Stream n . Alarms** screen, select <Block valve fault>.

The **Additive Stream Config. . Stream n . Block Valve Fault** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[Feedback timeout]	With this entity you can set the time in seconds in which the additive pump must providea feedback to the MSC. If the feedback from the pump is not received in [Feedback timeout], then an alarm occurs depending on the [Alarm action].	<1> s ... <255> s (default = <15> s)

5.12.2.4.5 *Deviation*

On the **Additive Stream Config . Stream n . Alarms** screen, select <Deviation>.

The **Additive Stream Config. . Stream n . Deviation** screen is displayed with the following entities.

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display> (default) <Display shutdown> <Display pause>

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>)

5.12.2.4.6 Fixed

On the **Additive Stream Config . Stream n . Alarms** screen, select <Fixed>.

The **Additive Stream Config. . Stream n . Fixed** screen is displayed with the following entities.

Entity	Description	Value range
[Control fault]	With this entity you can configure the [Control fault] alarm in case this particular alarm occurs.	<Disabled> <Display> (default) <Display shutdown> <Display pause>
[Solenoid fault]	With this entity you can configure the [Solenoid fault] alarm in case this particular alarm occurs.	<Disabled> <Display> (default) <Display shutdown> <Display pause>
[Pulse hardware]	With this entity you can configure the [Pulse hardware] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Pulse phase]	With this entity you can configure the [Pulse phase] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Factored pulse out]	With this entity you can configure the [Factored pulse out] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Temperature sensor]	With this entity you can configure the [Temperature sensor] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>

Entity	Description	Value range
[Tank low level]	With this entity you can configure the [Tank low level] alarm in case this particular alarm occurs.	<Disabled> <Display> (default) <Display shutdown> <Display pause>
[Tank empty]	With this entity you can configure the [Tank empty] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Additive MMQ not met]	With this entity you can configure the [Additive MMQ not met] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Additive flowrate too low]	With this entity you can configure the [Additive flowrate too low] alarm in case this particular alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>

5.13 Arm Configuration

To perform the Arm Configuration

1. On the **Main Menu** screen, select the **Arm Configuration** icon.

   The **Arm Configuration . Arm Selection** screen appears.

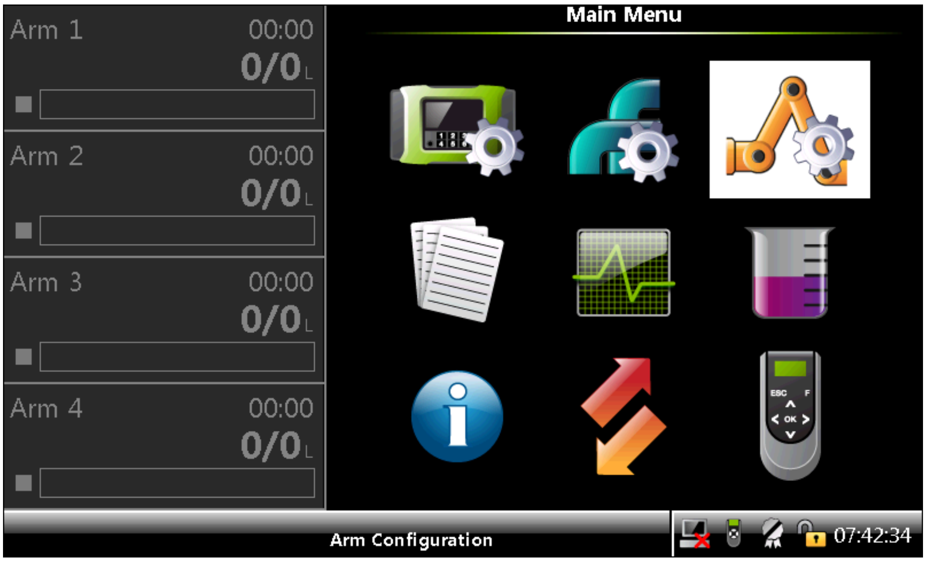


FIGURE 5-30 Arm Configuration icon

2. On the **Arm Configuration . Arm Selection** screen, select the required arm. For example, Arm 1.

The **Arm Configuration . Arm n** screen appears with the following entities.

5.13.1 Arm Configuration . Arm n . Identification

On the **Arm Configuration . Arm1** screen, select <Identification>.

The **Arm Configuration . Arm1 . Identification** screen is displayed with the following entity.

Entity	Description	Value range
[Arm name]	With this entity you can enter the name of the loading arm. The Arm name appears on the running screens.	A text string of maximum 20 characters. Use maximum 7 characters to view the complete name on the MSC-L screen.
[Arm address]	With this entity you can enter and assign a reference number to the arm.	default = <123>
[Arm location]	With this entity you can select the location of the arm whether in Bay 1 or Bay 2 or its a swing arm	<Bay 1> <Bay 2> <None>
[Arm status]	With this entity you can configure the arm to operational/enabled or Disabled	<Enable> <Disable>
[Progress bar color]	With this entity you can configure the color to be used on a loading arm progress bar. Note: The Progress bar color is located on the loading arm progress tab.	<Black> <White> <Gray> <Yellow> <Mid Blue> <Light Blue> <Purple> <Green> (default) <Dark Green> <Brown> <Red> <Pink> <Gold>

5.13.2 Arm Configuration . Arm n . I/O Bindings

On the **Arm Configuration . Arm1** screen, select <I/O binding>.

The **Arm Configuration . Arm1 . I/O Bindings** screen is displayed with the following entities.

5.13.2.1 The I/O Bindings . Input Parameters

NOTE: The default value for all the Input entities are None.

Entity	Description	Can be linked to...
[Alarm reset]	With this entity you can select the physical source for the alarm reset function.	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[RIT ack]	With this entity you can select the physical source for the RIT acknowledgment function.	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[RIT start]	With this entity you can select the physical source for the RIT start function.	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[RIT stop]	With this entity you can select the physical source for the RIT stop function.	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[Block valve feedback]	With this entity you can select the physical source for the block valve feebdackfunction.	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[Bay 1 in position]	With this entity you can select the physical source for the arm for Bay1	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[Bay 2 in position]	With this entity you can select the physical source for the arm for Bay2	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[Stop flow switch]	With this entity you can select the physical source for the Stop flow switch function	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[Low flow switch]	With this entity you can select the physical source for the Low flow switch function	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.
[high flow switch]	With this entity you can select the physical source for the High flow switch function	Any one of unused Pulse Inputs (QPI), Analog Inputs (AI-n), Digital Inputs DC (DI-DC-n), Digital Inputs AC (DI-AC-n), or None.

5.13.2.2 The I/O Bindings . Output Parameters

NOTE: The default value for all the Output entities are None.

Entity	Description	Can be linked to...
[Block valve control]	With this entity you can select the physical output for the block valve control function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.
[Alarm indication]	With this entity you can select the physical output for the alarm indication function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.
[Alarm shutdown]	With this entity you can select the physical output for the alarm shutdown function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.

Entity	Description	Can be linked to...
[Loading active]	With this entity you can select the physical output for the loading active function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.
[RIT red lamp]	With this entity you can select the physical output for the RIT red lamp function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.
[RIT green lamp]	With this entity you can select the physical output for the RIT green lamp function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.
[RIT amber lamp]	With this entity you can select the physical output for the RIT amber lamp function.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.
[Ready lamp]	With this entity you can select the physical output which conveys whether the load is ready to start, when all permissive are met.	Any one of unused Digital Outputs (DO-SSR-n or DO-EMR-n), Pulse Outputs (PO-n), or None.

5.13.3 Arm Configuration . Arm n . Control Settings

On the **Arm Configuration . Arm n** screen, select <Control settings>.

The **Arm Configuration . Arm n . Control Settings** screen is displayed with the following entities.

Entity	Description	Value range
[Batch preset quantity]	With this entity the total final required GOV of the blended product is obtained. This value is either entered directly by the user or supplied externally by the TAS.	default = <0.00> L
[Loading type]	With this entity you can select the blend type for the loading process, as well as use it for unloading purposes.	<Ratio> (default) <Side stream> <Unloading> <Straight with VRU>
[Batch initial quantity]	With this entity you can determine the amount of product that must be delivered into the compartment at the Initial Flow Rate to ensure that the risk of static discharge is eliminated.	<0> L to <1000000> L (default = <300> L)
[Batch pre-stop quantity]	With this entity you can determine the volume before the end of the batch at which the flow rate must be adjusted to dispense the exact quantity requested.	<0> L to <1000000> L (default = <300> L)

Entity	Description	Value range
[Batch clean arm quantity]	With this entity the amount of the unblended main product at the end of a batch can be determined. The flow rate to obtain this volume is not defined, though it is still restricted due to the limitations mentioned previously. However, blending during delivering the clean arm volume is not permitted.	<0> L to <1000000> L (default = <300> L)
[Minimum preset quantity]	With this entity the minimum preset quantity can be configured. Presets entered below this value are not accepted for a valid batch.	default = <0> L
[Maximum preset quantity]	With this entity the maximum preset quantity can be configured. Presets entered above this value are not accepted for a valid batch.	default = <30000> L
[Initial flowrate]	With this entity the rate at which the final product is initially filled into the container until the delivered volume is greater than the Initial Volume is determined.	<1> L/min to <1000000> L/min (default = <300> L/min)
[Full flowrate]	With this entity the target flow rate of the final product when it is neither in Initial or pre-stop states is determined.	<1> L/min to <1000000> L/min (default = <1800> L/min)
[Pre-stop flowrate]	With this entity the target flow rate of the final product when the amount of delivered product is greater than the following (Batch Preset Volume - Pre-stop Volume) is determined.	<1> L/min to <1000000> L/min (default = <300> L/min)
[Low flow rate]	With this entity you can select the low flow rate for the product to be delivered.	<1> L/min to <1000000> L/min (default = <300> L/min)
[High flow rate]	With this entity you can select the high flow rate for the product to be delivered.	<1> L/min to <1000000> L/min (default = <1800> L/min)
[Vapour line open mode]	With this entity you can select block valve control open mode with main line.	<Direct> <Before time> <After time> <After quantity>
[Vapour line close mode]	With this entity you can select block valve control close mode with main line.	<Direct> <Before time> <After time> <After quantity>
[Vapour line open cond. (time)]	With this entity you can configure block valve control open condition time.	<0 s>
[Vapour line open cond. (qty)]	With this entity you can configure block valve control open condition quantity.	<0.00%>

Entity	Description	Value range
[Vapour line close cond. (time)]	With this entity you can configure block valve control close condition time.	<0 s>
[Vapour line close cond. (qty)]	With this entity you can configure block valve control close condition quantity.	<0.00%>

With the [High flow rate] entity a second full flow rate can be configured. This flow rate is used during the “Full flow” loading phase. This entity relates to the [High flow switch] in the I/O binding.

When the input is active, the [High flow rate] is used during the “Full flow” loading phase.

When the input is not active the [Full flow rate] is used during the “Full flow” loading phase.

When no I/O binding is configured always the [Full flow rate] will be used during the “Full flow” loading phase.

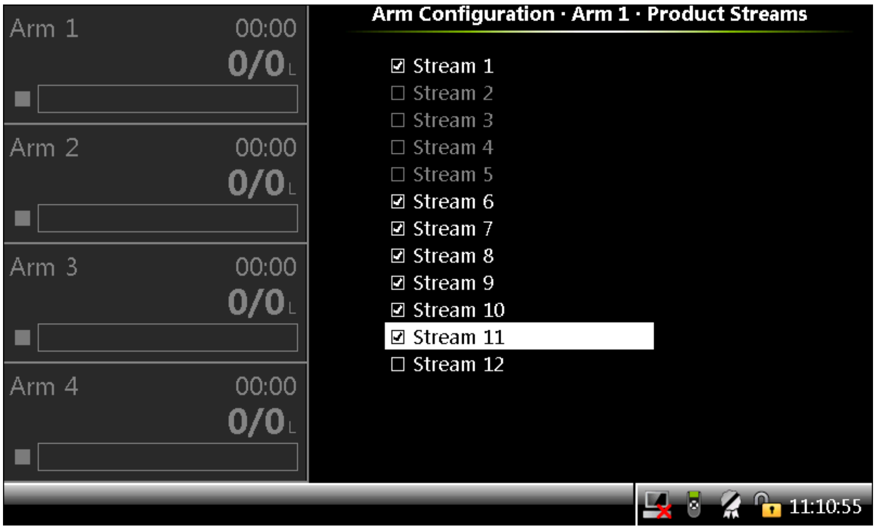
For a correct configuration the [Full flow rate] must be set to a higher value than the [High flow rate].

In case also the [Stop flow switch] and the [Low flow switch] I/O binding are configured those three switched will be used for unloading operation controlling the air eliminator.

5.13.4 Arm Configuration . Arm n . Product Streams

1. On the **Arm Configuration . Arm n** screen, select <Product stream selection>.

   The **Arm Configuration . Arm n . Product Streams** screen appears.



2. Select the required stream and press <OK>. The checkbox is enabled.

   To clear the checkbox, press <OK> again.

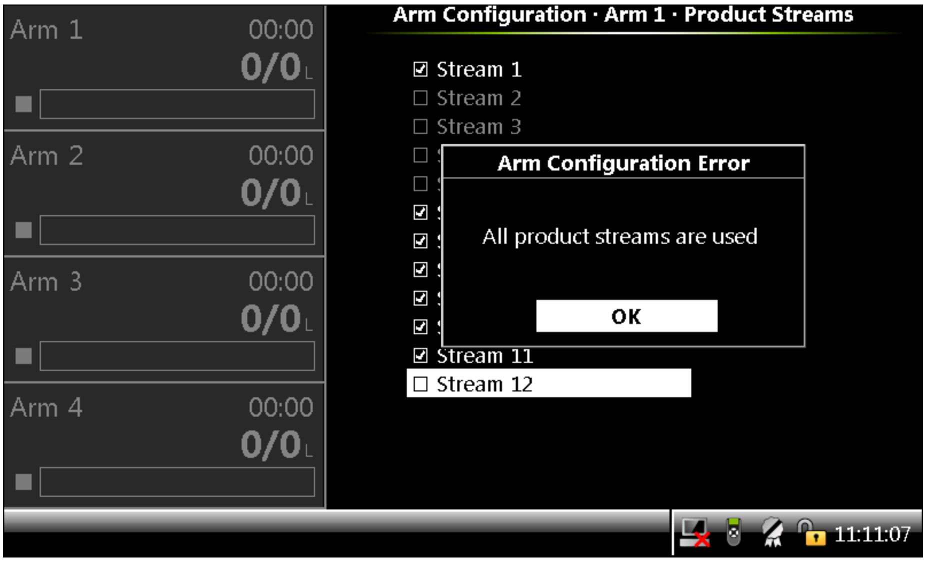
NOTE: *Streams that are bound to the Arm selected have the checkbox enabled.*

Streams that are bound to another arm are dimmed.

One Arm can have maximum of 7 product streams. If you try to assign more than 7 streams to an arm, then an error message appears mentioning that all product streams are used.

These streams are not physical streams but abstract placeholders which can configure a stream. Each stream must also have an associated flow meter.

CAUTION! *Be aware that the stream configuration is limited by the remaining free pulse inputs. In the MSC-L there are always un-configured and not allocated streams left.*



5.13.5 Arm Configuration . Arm n . Additive Streams

1. On the **Arm Configuration . Arm1** screen, select <Additive stream selection>.

   The **Arm Configuration . Arm1 . Additive Streams** screen appears.

2. Select the required stream and press <OK>. The checkbox is enabled.

   To clear the checkbox, press <OK> again.

NOTE: *Streams that are bound to the Arm have the checkbox enabled.*

Streams that are bound to another arm are dimmed.

One Arm can have maximum of 12 additive streams. If you try to assign more than 12 streams to an arm, then an error message appears.

These streams are not physical streams but abstract placeholders to be able to configure a stream. Each stream must also have an associated flow meter.

CAUTION

CAUTION! Be aware that the stream configuration is limited by the remaining free pulse inputs. In the MSC-L there are always un-configured and not allocated streams left.

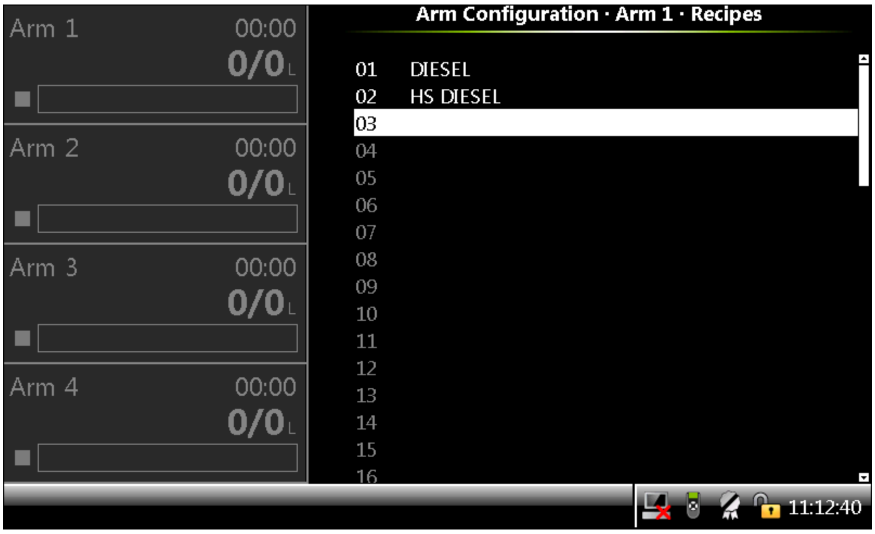
5.13.6 Arm Configuration . Arm n . Recipes

1. On the **Arm Configuration . Arm n** screen, select <Recipes>.

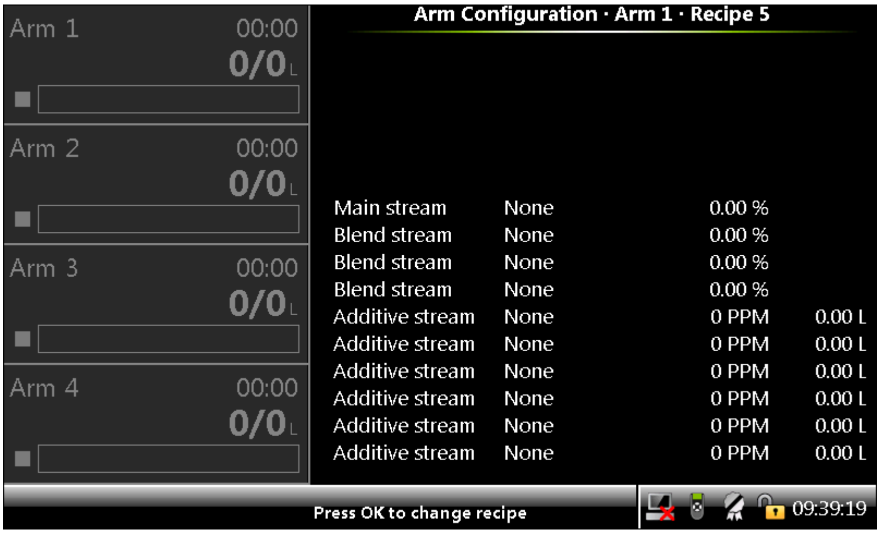
   The **Arm Configuration . Arm n . Recipes** screen appears with the configured recipes. 50 recipes can be configured for each arm.

2. Select the required recipe number and press <OK> to view the recipe.

   The **Arm Configuration . Arm n . Recipes** screen appears.



3. Press <OK> to change the recipe.



When configuring the recipe, make sure of the following:

- The recipe can contain up to four products and up to six additive streams (arm can be bound to more streams but a batch running on the arm can only have upto four products and six additives).
- An Arm can have a maximum of 50 recipes.
- The sum of all product stream blend ratios must be 100%.
- The product and additive streams must be bound to an Arm using the product stream selection and the additive streams selection menus.
- The recipe is validated in the following scenarios.
  - The product/additive stream selection is changed.
  - The recipe is installed.
  - The configuration is installed.

4. Enter the recipe name, hazardous material classification, and the symbol. The information selected appears on the running screen.
   - The product symbols available are as follows:
     - 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*.

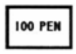
Description	Menu text displayed	Symbol
High-grade unleaded gasoline	HGU gasoline	
Mid-grade unleaded gasoline	MGU gasoline	
Low grade unleaded gasoline	LGU gasoline	

Description	Menu text displayed	Symbol
Ultra low sulfer diesel	ULS diesel	
Low sulfer diesel	LS diesel	
High sulfer diesel	HS diesel	
Low sulfer no. 1 fuel oil	LS no. 1 fuel oil	
High sulfer no. 1 fuel oil	HS no. 1 fuel oil	
Low sulfer no. 2 fuel oil	LS no. 2 fuel oil	
High sulfer no. 2 fuel oil	HS no. 2 fuel oil	
Ultra low sulfer kerosene	ULS kerosene	
Low sulfer kerosene	LS kerosene	
High sulfer 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	
B20 (20% Bio blended diesel)	API B20	

Description	Menu text displayed	Symbol
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)*.

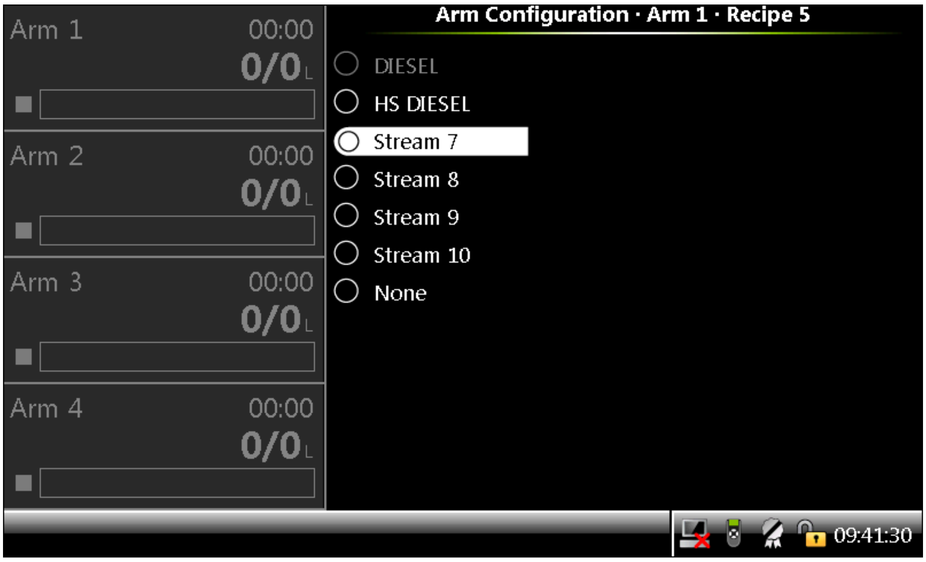
Description	Menu text displayed	Symbol
Lead Replacement Petrol	Lead repl. petrol	
Premium unleaded Petrol (95 octane)	PU petrol	
Super unleaded petrol (97 octane)	SU petrol	
E5 (5% ethanol, 95% petrol)	EU E5	
E10 (10% ethanol, 90% petrol)	EU E10	
E20 (20% ethanol, 80% petrol)	EU E20	
DERV	DERV	
B5 (5% FAME, 95% diesel)	EU B5	
B10 (10% FAME, 90% diesel)	EU B10	
B20 (20% FAME, 80% diesel)	EU B20	
Gas oil (marked heating oil)	Gas Oil	

Description	Menu text displayed	Symbol
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	
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	

NOTE: These streams are not physical streams but abstract placeholders which can configure a stream. Each stream must also have an associated flow meter.

5. Enter the product % for main stream.

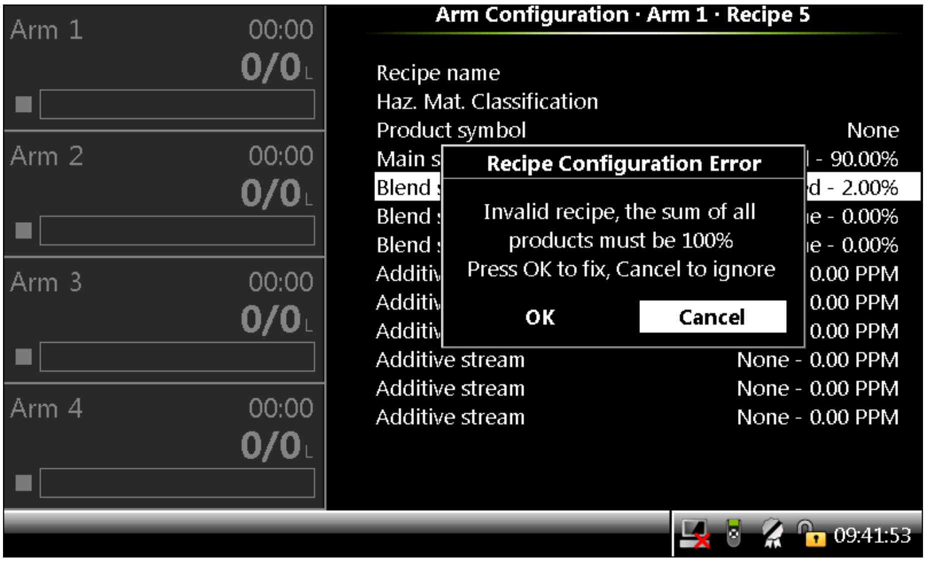
The **Arm Configuration . Arm n . Recipe n** stream selection screen appears, which allows you to select one of the streams bound to the arm as the main stream.



6. Enter the product % for remaining streams.

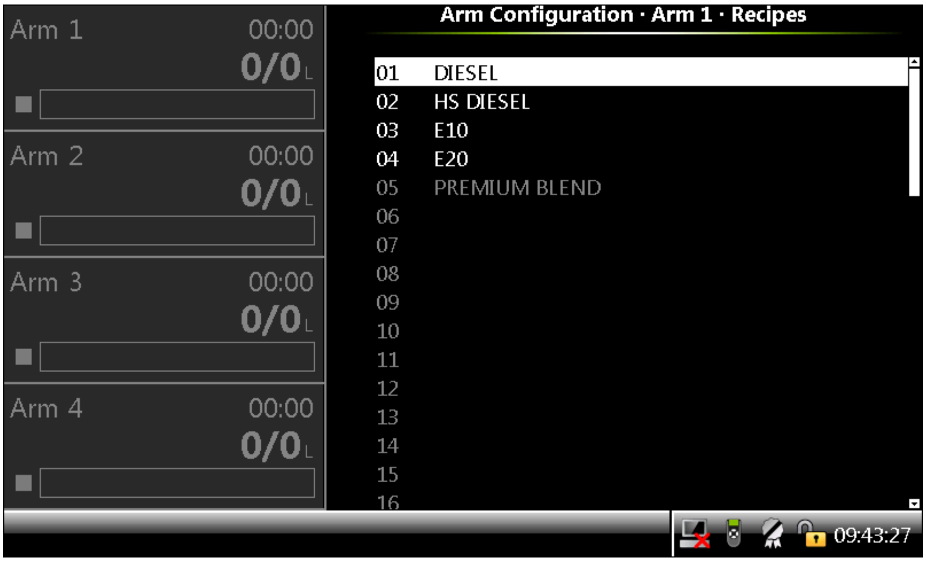
   The stream that contains the product % as zero is not used during a batch when the recipe is selected for loading.

7. Enter the additive value as PPM.
8. Enter the pacing volume.
9. Press <ESC> when all the entities are complete.
10. Check the values entered for all the entities.
    - If the values entered are correct, the recipe is validated and saved.
    - If the values entered are incorrect, then a message appears informing you to correct the recipe.



11. Press <OK> to correct the recipe or <Cancel> to retain the values entered.
12. If <Cancel> is selected, then the invalid recipe is dimmed.

NOTE: *Invalid recipes are dimmed in the configuration and cannot be selected for loading.*



5.13.7 Arm Configuration . Arm n . Alarms

On the **Arm Configuration . Arm n** screen, select <Alarms>.

The **Arm Configuration . Arm n . Alarms** screen is displayed.

Alarms can have the following alarm actions.

- <Disabled>:

  - The alarm is ignored.
- <Display>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
- <Display shutdown>:
  - The alarm appears on the display.
  - The alarm-indication output is set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is stopped.
- <Display pause>:
  - The alarm is shown on the display.
  - The alarm-indication output set to ON.
  - The alarm-shutdown output is set to ON.
  - Running batch is paused.

5.13.7.1 Flow Rate

5.13.7.1.1 Initial Flow . Alarms

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[Alarm start delay]	With this entity you can configure a delay after which the MSC-L starts monitoring the initial flow rate alarm.	<0> s ... <255> s (default = <5> s)
[Low percentage]	With this entity you can configure the low percentage value for monitoring the initial flowrate alarm. The initial flowrate low alarm is raised if the actual flowrate during the initial flow stage is below the configured initial flowrate by low percentage value.	<1.0> % ... <99.99> % (default = <5.0> %)
[High percentage]	With this entity you can configure the high percentage value for monitoring the initial flowrate alarm. The initial flowrate high alarm is raised if the actual flowrate during the initial flow stage is above the configured initial flowrate by high percentage value.	<1.0> % ... <99.99> % (default = <5.0> %)

5.13.7.1.2 Full Flow . Alarms

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display > <Display shutdown> <Display pause>
[Alarm start delay]	With this entity you can configure a delay after which the MSC-L starts monitoring the full flow rate alarm, after the load profile enters the full flow state.	<0> s ... <255> s (default = <5> s)
[Low percentage]	With this entity you can configure the low percentage value for monitoring full flowrate alarm. The full flowrate low alarm is raised if the actual flowrate during the full flow stage is below the configured full flowrate by low percentage value.	<1.0> % ... <99.99> % (default = <5.0> %)
[High percentage]	With this entity you can configure the high percentage value for monitoring the full flowrate alarm. The full flowrate high alarm is raised if the actual flowrate during the full flow stage is above the configured full flowrate by high percentage value.	<1.0> % ... <99.99> % (default = <5.0> %)

5.13.7.1.3 *Pre-stop Flow . Alarms*

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> (default) <Display> <Display shutdown> <Display pause>
[Alarm start delay]	With this entity you can configure a delay after which the MSC-L starts monitoring the full flow rate alarm after the load profile enters from full flow state to pre stop state.	<0> s ... <255> s (default = <5> s)
[Low percentage]	With this entity you can configure the low percentage value for monitoring the prestop flowrate alarm. The Prestop flowrate low alarm is raised if the actual flowrate during the prestop stage is below the configured prestop flowrate by low percentage value.	<1.0> % ... <99.99> % (default = <5.0> %)
[High percentage]	With this entity you can configure the high percentage value for monitoring the prestop flowrate alarm. The Prestop flowrate low alarm is raised if the actual flowrate during the prestop stage is above the configured prestop flowrate by high percentage value.	<1.0> % ... <99.99> % (default = <5.0> %)

5.13.7.2 Programmable Alarms

Entity	Description	Value range
[IO binding]	With this entity you can select the physical input source for the programmable alarm function.	Any of the unused QPI-n, AI-n, DI-AC-n, DI-DC-n, or None. The default value is <None>.
[Alarm action]	With this entity you can configure the alarm behavior, in case this particular alarm occurs.	<Disabled> <Display > <Display shutdown> <Display pause> (default)
[Alarm name]	With this entity you can configure the name of the alarm.	A maximum of 32 alphanumeric characters are allowed for configuration.
[Response time]	With this entity you can set the time in seconds, which is the time required for the input to change from one state to other.	<0> s ... <255> s (default = <0> s)

Entity	Description	Value range
[Alarm activation (Idle)]	With this entity you can set the state of the input when the MSC-L is in idle state for the alarm function. The MSC-L state is in idle when the transactions are not started for loading process. • <None>: The alarm is ignored. • <Active>: The alarm occurs when the input state is active. • <Deactive>: The alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>
[Alarm activation (Running)]	With this entity you can set the state of the input when the MSC-L is in running state for the alarm function. After successful authorization and permissives gets connected to start a loading process, the MSC-L is in the running state and continues to be in this state till all the permissives are disconnected after the transactions are complete. • <None>: The alarm is ignored. • <Active>: The alarm occurs when the input state is active. • <Deactive>: The alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>
[Alarm activation (Pause)]	With this entity you can set the state of the input when the arm/batch is in pause state for the alarm function. • <None>: The alarm is ignored. • <Active>: The alarm occurs when the input state is active. • <Deactive>: The alarm occurs when the input state is deactive.	<None> (default) <Active> <Deactive>

5.13.7.3 Block Valve Fault

Entity	Description	Value range
[Alarm Action]	With this entity you can configure the alarm behavior, in case this alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Feeback timeout]	With this entity you can configure the time within which a feedback should be received from the block valve.	<1> sec to <999> sec (default = <10> secs)

5.13.7.4 Preset Overrrun

Entity	Description	Value range
[Alarm Action]	With this entity you can configure the alarm behavior, in case this alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Preset overrun limit]	With this entity you can configure the overrun limit. If the delivered batch quantity exceeds this quantity, an alarm is raised.	default = <5.00> L

5.13.7.5 Clean Arm Underrun

Entity	Description	Value range
[Alarm Action]	With this entity you can configure the alarm behavior, in case this alarm occurs.	<Disabled> <Display> <Display shutdown> (default) <Display pause>
[Clean arm underrun]	The measured clean arm volume is less than the specified clean arm volume minus the clean arm tolerance.	default = <5.00> L

5.13.7.6 Stop Switch not covered

Entity	Description	Value range
[Alarm action]	With this entity you can configure the alarm behavior, in case this alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Stop switch timeout]	With this entity you can configure the time within which a feedback should be received from the Stop/Low/High flow rate switches	<0-65535s> <10s> (default)
[Stop switch auto clear timeout]	With this entity you can reset the Stop switch not covered alarm and continue unloading the truck until its empty.	<0-65535s> <10s> (default)

5.13.7.7 Fixed

Entity	Description	Value range
[Arm parked alarm action]	With this entity you can configure the alarm behavior, in case this alarm occurs.	<Disabled> <Display> <Display shutdown> <Display pause> (default)
[Invalid switch states]	With this entity you can configure the alarm behavior, in case switch states of Stop flow switch, Low flow switch and High flow switch are invalid.	<Disabled> <Display> <Display shutdown> <Display pause> (default)

5.14 Logs

To perform the Logs functions

- On the **Main Menu** screen, select the <Logs> icon.

  The **Logs** screen appears, in which the various logs maintained in the non-volatile memory can be viewed.

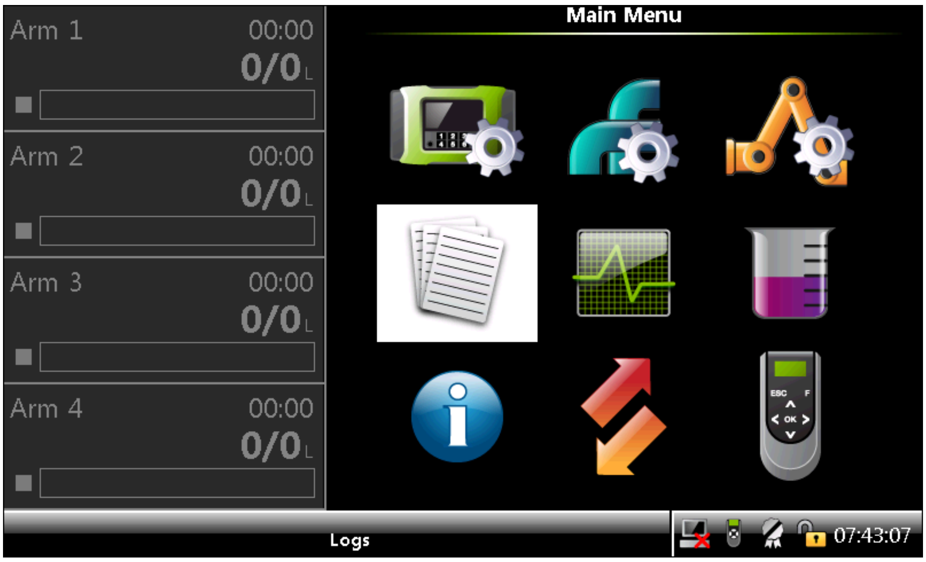


FIGURE 5-31 Logs icon

On 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-L is 10,000 records.
- Calibration logs: Displays the product meter factor and additive meter factor calibrations over time for all the available calibration records. The storage space for the calibration logs in the MSC-L is 1200 records.
- Alarm logs: Displays a chronological list of 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-L is 2000 records.
- Events logs: Displays a log of important device events. The storage space for the event logs in the MSC-L is 1000 records.
- Load Profiles: Displays a log containing a list of Load Profile batches processed over time. The storage space for the Load Profile logs in the MSC-L is 100 records.

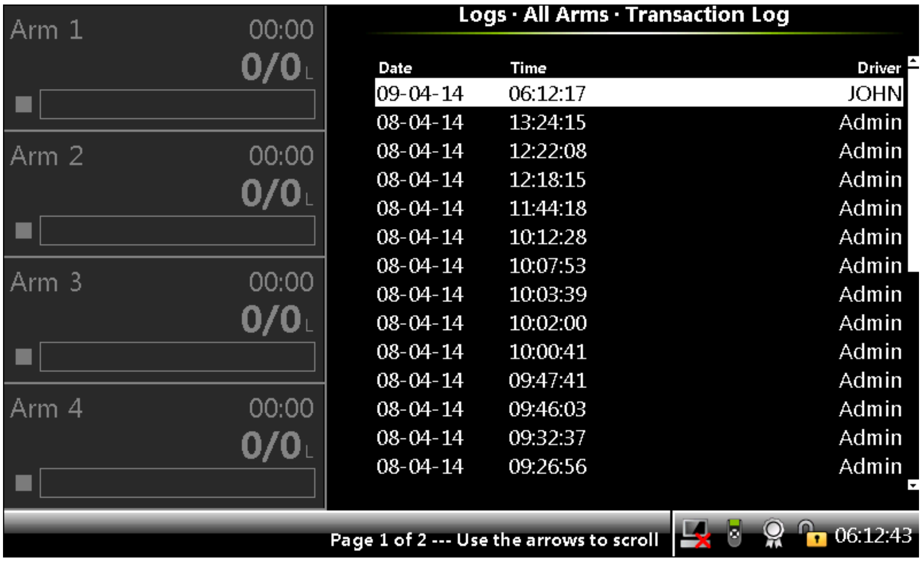
When the log record is full, the oldest one is automatically deleted and overwritten. Then, the transaction cannot be retrieved through the Fusion4 Portal or the LAD.

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.*

5.14.1 Transaction

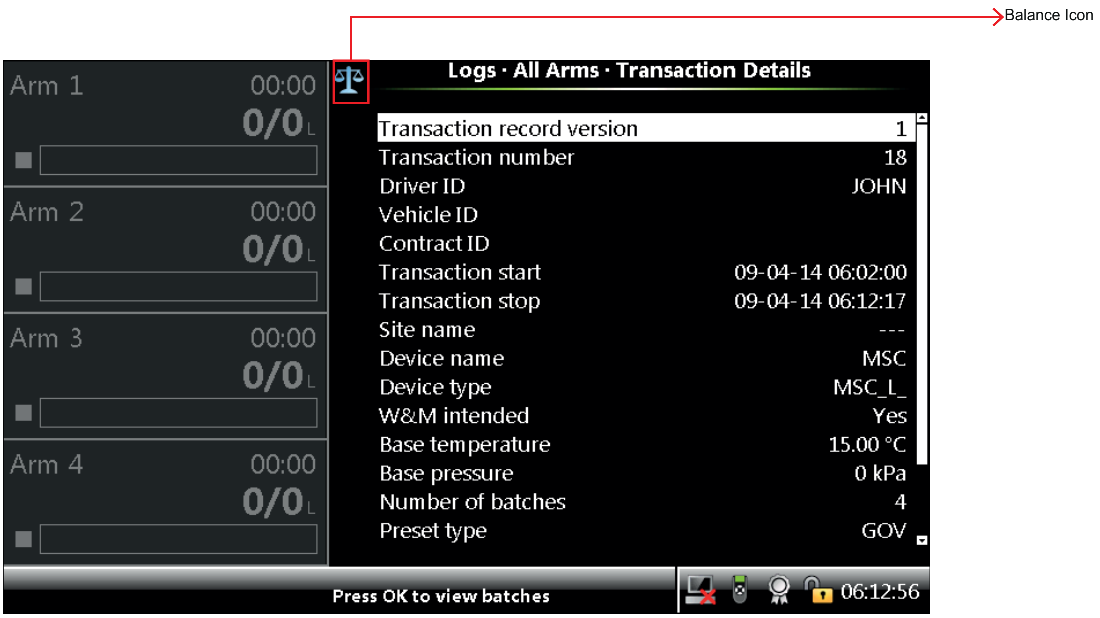
1. On the **Logs** screen, select <Transaction> and then select <OK> on the IR controller, the LAD, or the keyboard.

The **Logs . All Arms . Transaction Log** screen appears, which displays all the transaction records.



2. Select any one of the transactions and then select <OK> on the IR controller or the LAD.

   The **Logs . All Arms . Transaction Details** screen appears, which displays the transaction header details.



Following are the transaction details that appear on the **Logs . All Arms . Transaction Details** screen.

- Transaction record version
- Transaction number
- Driver ID

- Vehicle ID
- Contract ID
- Transaction start
- Transaction stop
- Site name
- Device name
- Device type
- W&M intended
- Base temperature
- Base pressure
- Number of batches
- Preset type
- Bay number
- Communication mode
- User language

A Balance icon is displayed on the screens of the MSC-L which are intended for W&M custody transfer.

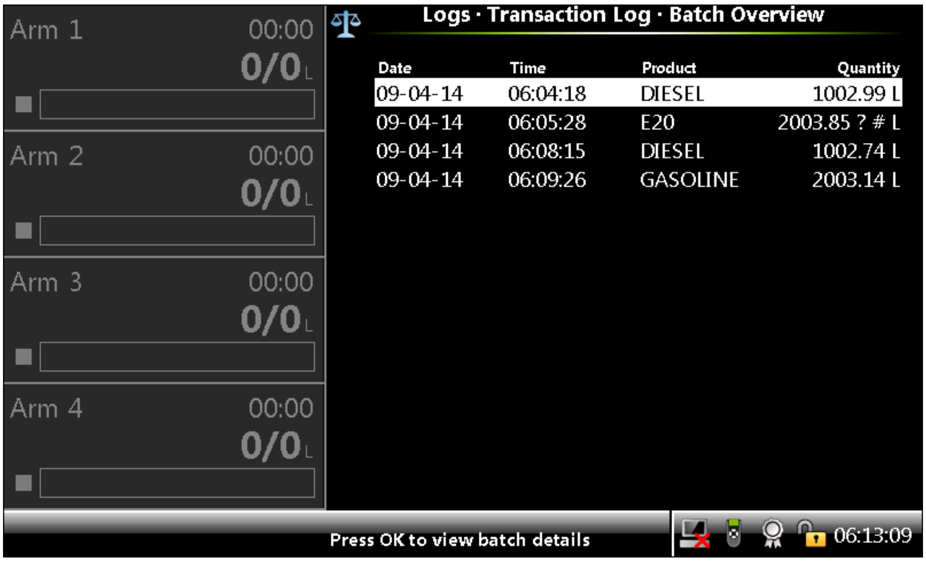
The **Transaction Details** screen is a W&M intended screen. It displays the balance icon as shown in the figure above.

The screen displays the complete transaction data with the multiple batches and the transaction attributes including GOV, GSV, base conditions, and mass.

To view transactions from the transaction log, the security level of the user must be SL2 or higher.

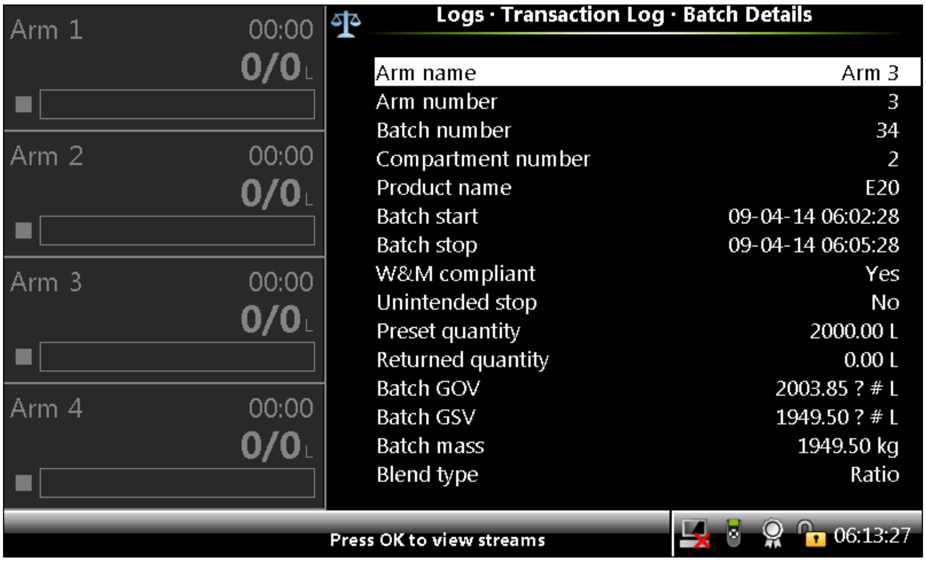
? Press <OK> to view batches.

The **Logs . Transaction Log . Batch Overview** screen appears.



? Press <OK> to view the batch details.

The **Logs . Transaction Log . Batch Details** screen appears.

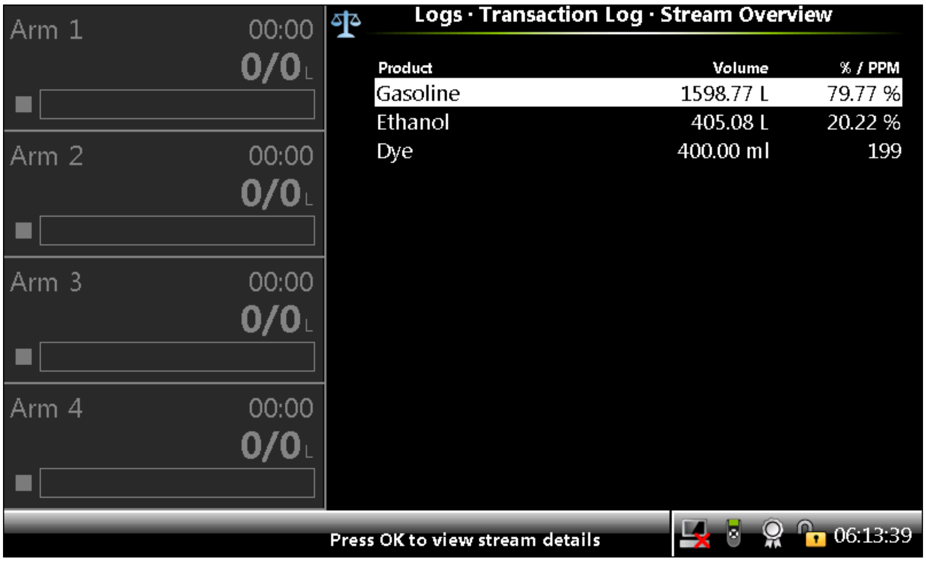


Following are the batch details that appear on the **Logs . Transaction Log . Batch Details** screen.

″ Arm name
″ Arm number
″ Batch number
″ Compartment number
″ Product name
″ Batch start
″ Batch stop
″ W&M compliant
″ Unintended stop
″ Preset volume
″ Returned quantity
″ Batch GOV
″ Batch GSV
″ Batch mass
″ Blend type

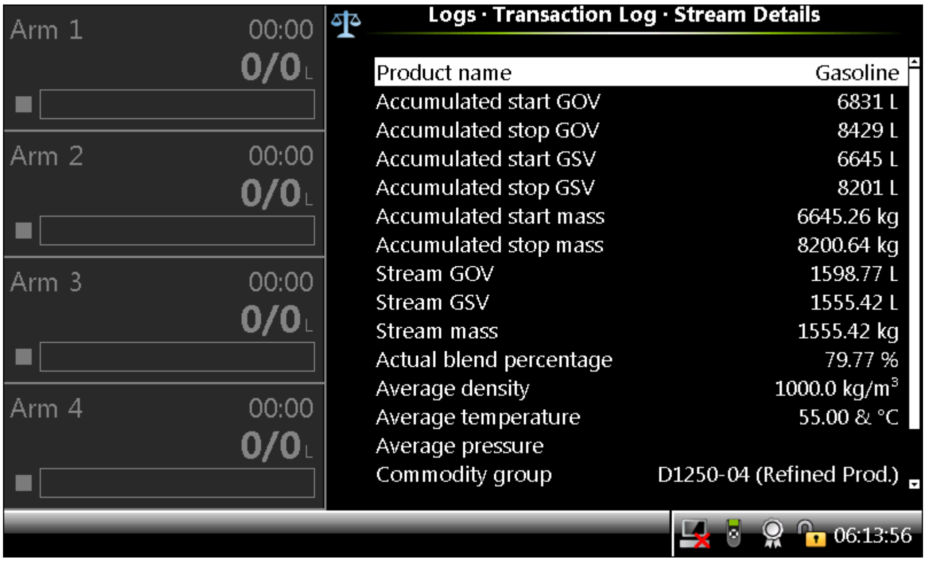
? Press <OK> to view batches.

The **Logs . Transaction Log . Stream Overview** screen appears.



? Select the required stream and Press <OK> to view the stream details.

If the selected stream is a product stream, then **Logs . Transaction Log . Stream Details** screen appears.

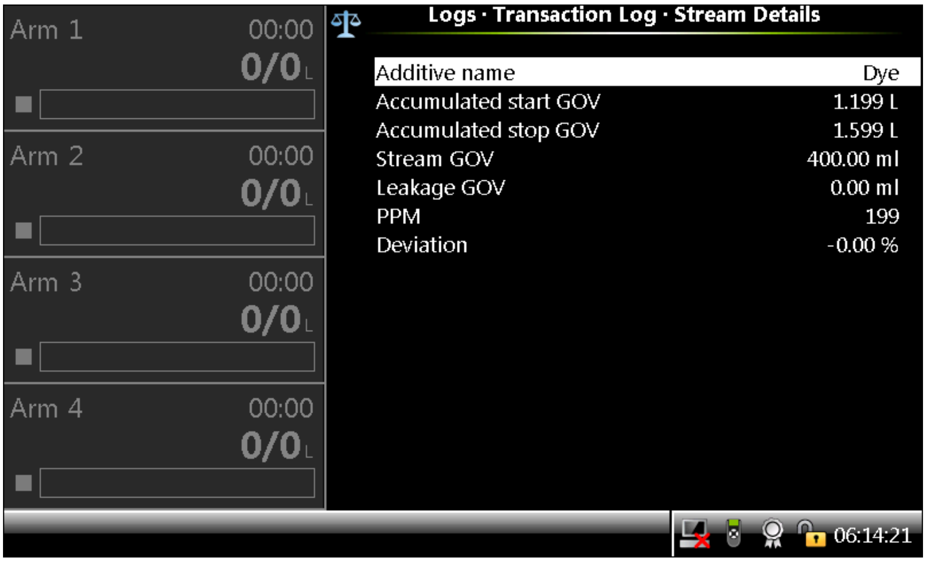


Following are the stream details that appear on the **Logs . Transaction Log . Stream Details** screen for a product stream.

- Product name
- Accumulated start GOV
- Accumulated stop GOV
- Accumulated start GSV
- Accumulated stop GSV
- Accumulated start mass

- Accumulated stop mass
- Stream GOV
- Stream GSV
- Stream mass
- Actual blend percentage
- Average density
- Average temperature
- Average pressure
- Returned quantity
- Commodity Group
- Temperature Compensation

? If the selected stream is an additive stream, then **Logs . Transaction Log . Stream Details** screen appears.



Following are the stream details that appear on the **Logs . Transaction Log . Stream Details** screen for an additive stream.

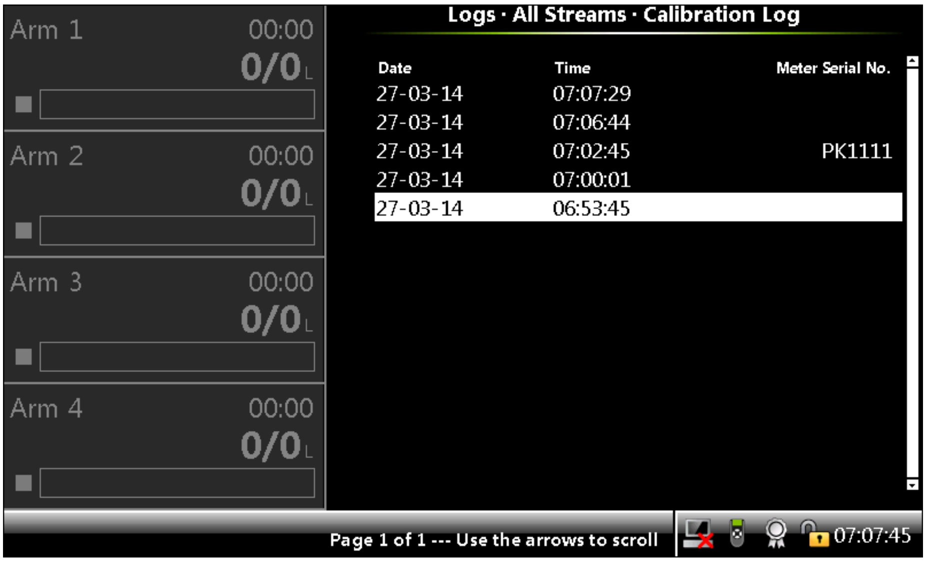
- Additive Name
- Accumulated Start GOV
- Accumulated Stop GOV
- Stream GOV
- Leakage GOV
- PPM
- Deviation

5.14.2 Calibration

1. On the **Logs** screen, select <Calibration> and then select <OK> on the IR controller or the LAD.

The **Logs . All Streams . Calibration Log** screen appears, which displays the sequence of additive meter factor calibrations over time.

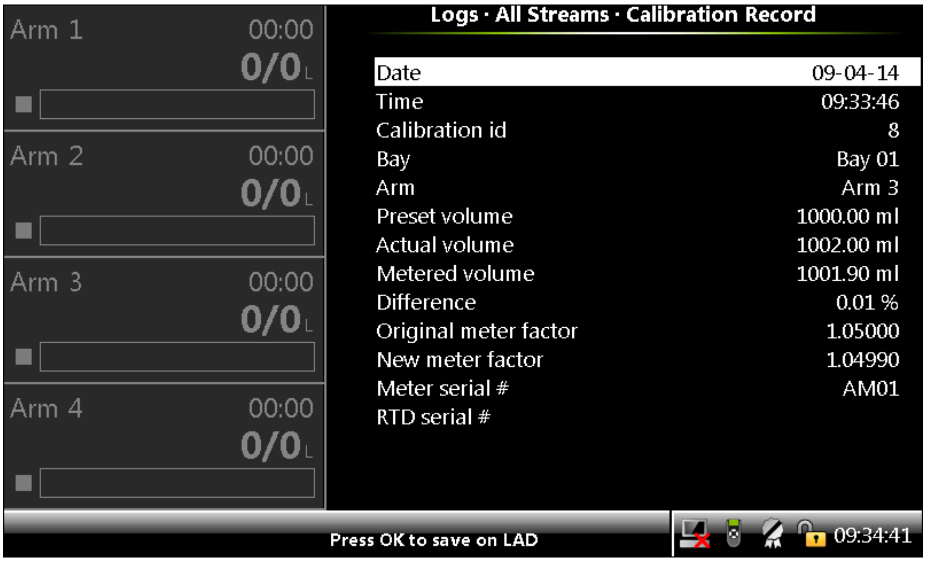
2. On the **Logs . All Streams . Calibration Log** screen, select any one of the transactions and then select <OK> on the IR controller or the LAD.



3. Perform one of the following:

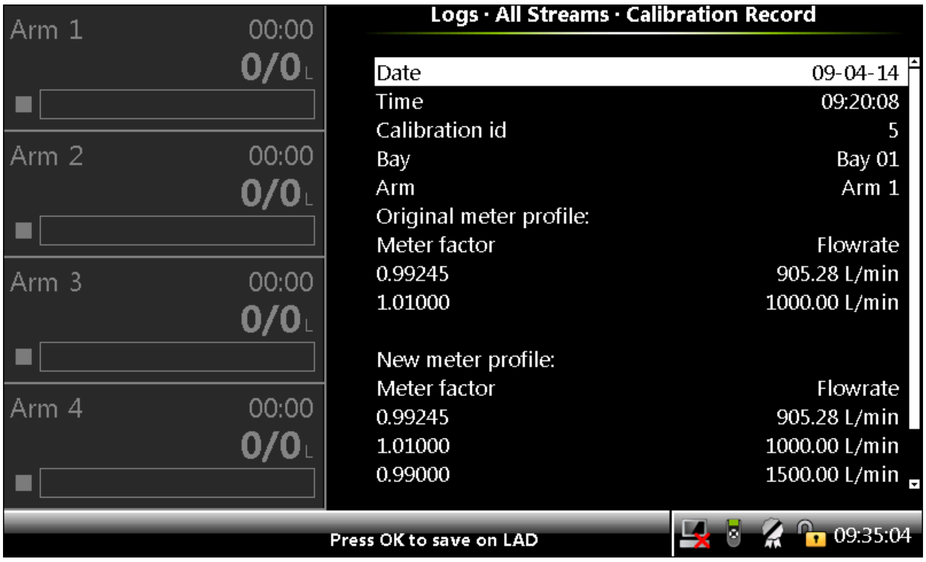
- Select the calibration log for an additive stream.

  The **Logs . All Streams . Calibration Record** screen appears, which displays the data of the flow meter calibration process. It contains the current and the new meter factor value so that the precision of the flow meter can be checked.



- Select the calibration log for a product stream.

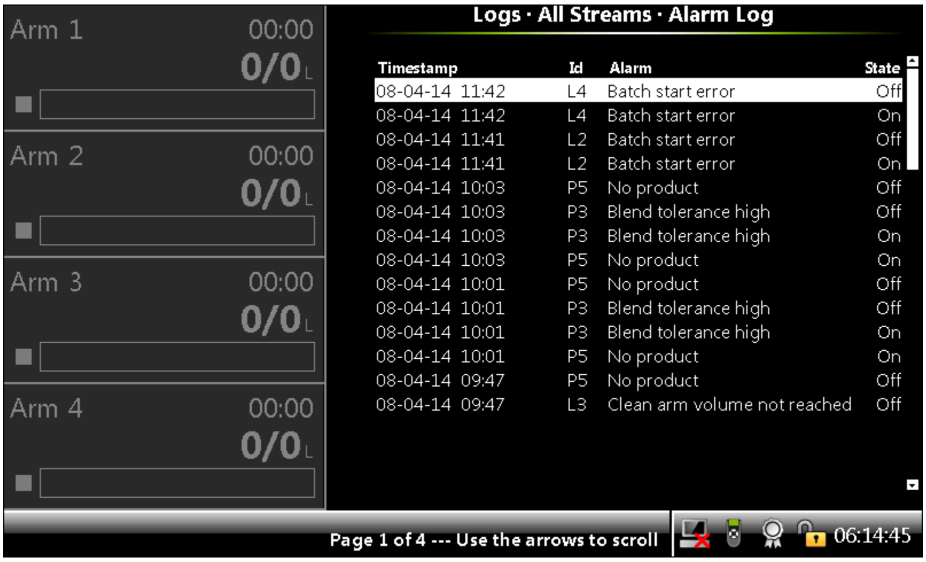
The **Logs . All Streams . Calibration Record** screen appears, which displays the data of the flow meter calibration process. It contains the current and the new meter factor value so that the precision of the flow meter can be checked.



5.14.3 Alarm

On the **Logs** screen, select <Alarm> and then select <OK> on the IR controller or the LAD.

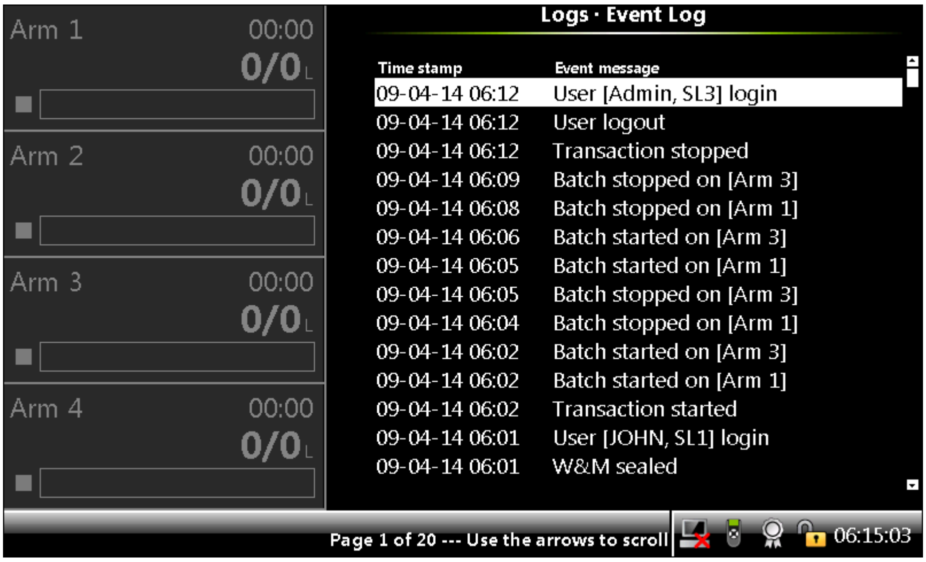
The **Logs . All Streams . Alarm Log** screen appears, which displays all the activated alarms with the date and time the alarm is recorded in the device.



5.14.4 Events

- On the **Logs** screen, select <Events> and then select <OK> on the IR controller or the LAD.

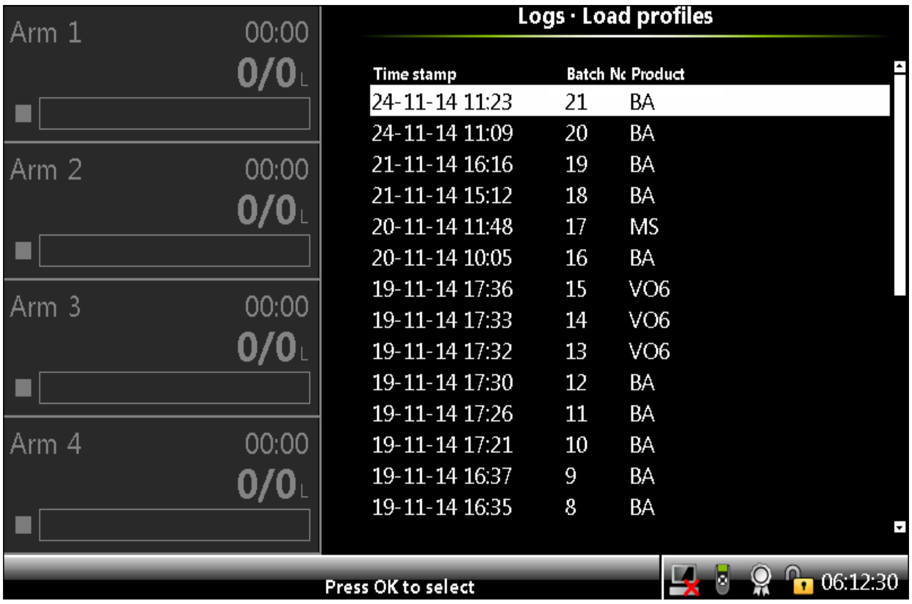
  The **Logs . Event Log** screen appears, which displays all the event logs.



5.14.5 Load Profiles

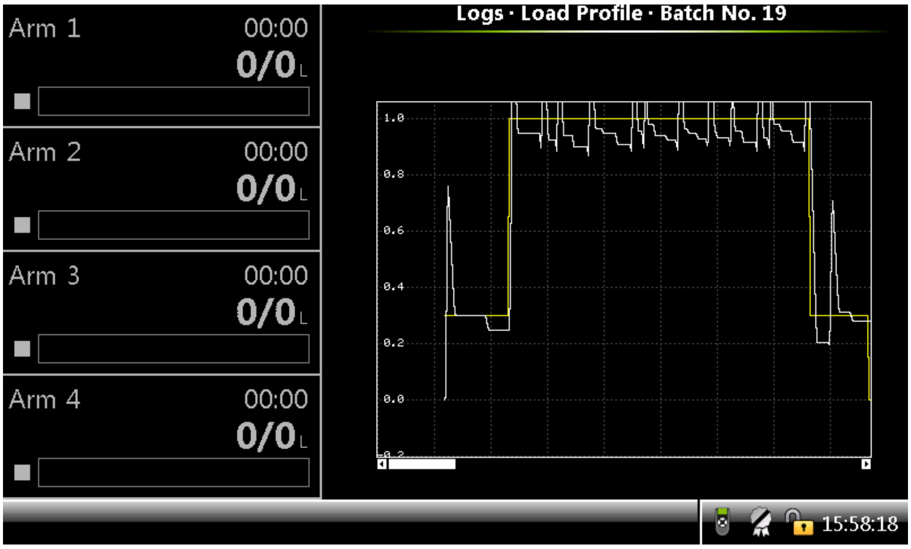
- On the **Logs** screen, select <Load Profiles> and then select <OK> on the IR controller or the LAD.

  The **Logs Load profiles** screen appears, which displays a list of Load Profile batches.



Use the LAD controller to navigate through the list, select a batch and then select <OK>.

The **Logs Load profile batch** screen appears, which displays a profile graph showing the target and actual flow rates of the currently selected batch



5.15 Diagnostics

To perform Diagnostics functions

- On the **Main Menu** screen, select the **Diagnostics** icon.

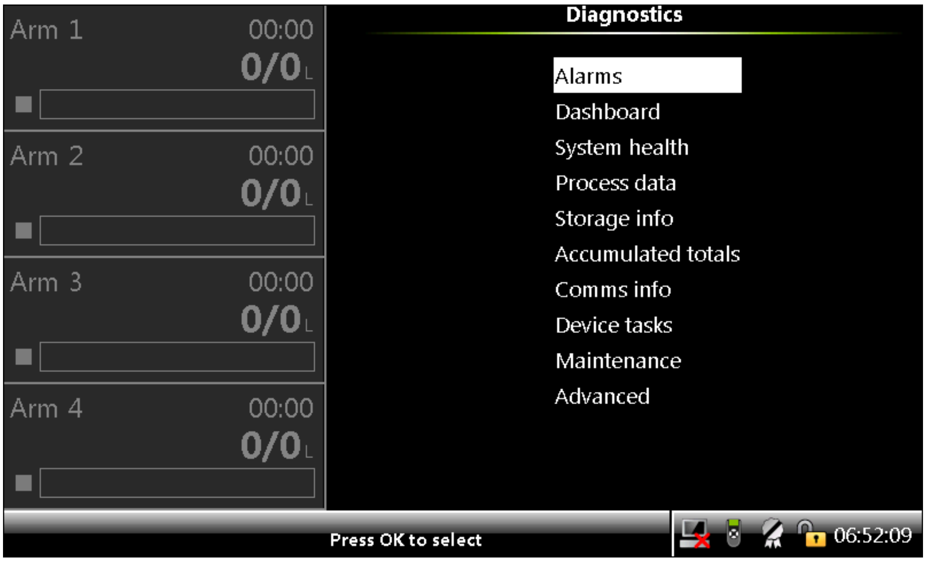
The **Diagnostics** screen appears.

FIGURE 5-32 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 system health overview.
- 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 equipment. This function is extremely useful for commissioning the device.
- Provides the internal memory usage overview.

On the **Diagnostics** screen, you can view the diagnostics of the following features.

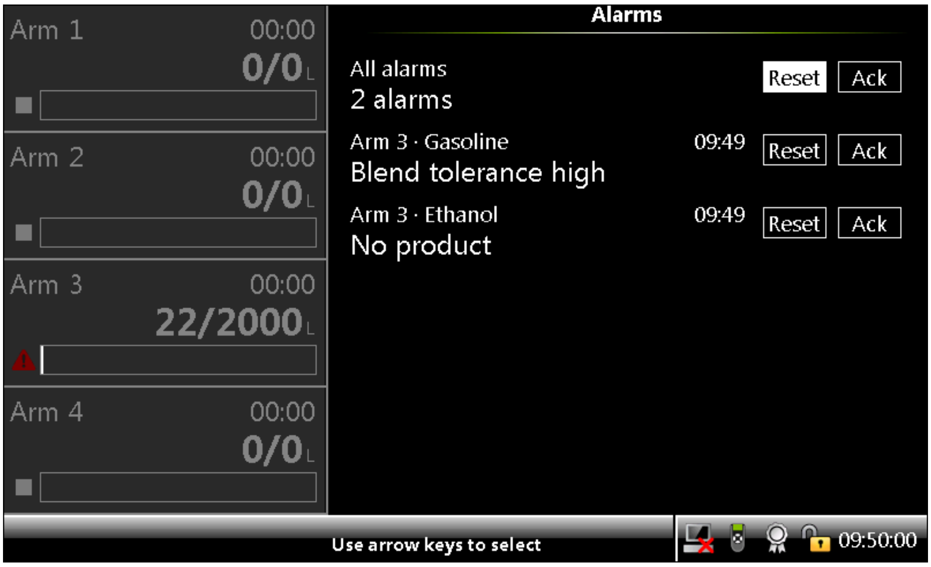


- Alarms - Provides the options to reset and acknowledge the alarms.
- Dashboard - Provides an overview of all the I/O functions.
- System health - Provides an overview of the system health.
- Process data - Provides an overview of the process data such as accumulated totals, flow rate, temperature, 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.
- Accumulated totals - Provides an overview of the accumulated totals of the product streams and additive streams.
- 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.
- Advanced - Provides the Load profile, W&M info, and OIML information.

5.15.1 Alarms

On the Diagnostics screen, select <Alarms> to reset or acknowledge the alarms.

The **Diagnostics . Alarms** screen appears, which displays the alarms available. The alarms can be reset or acknowledged.

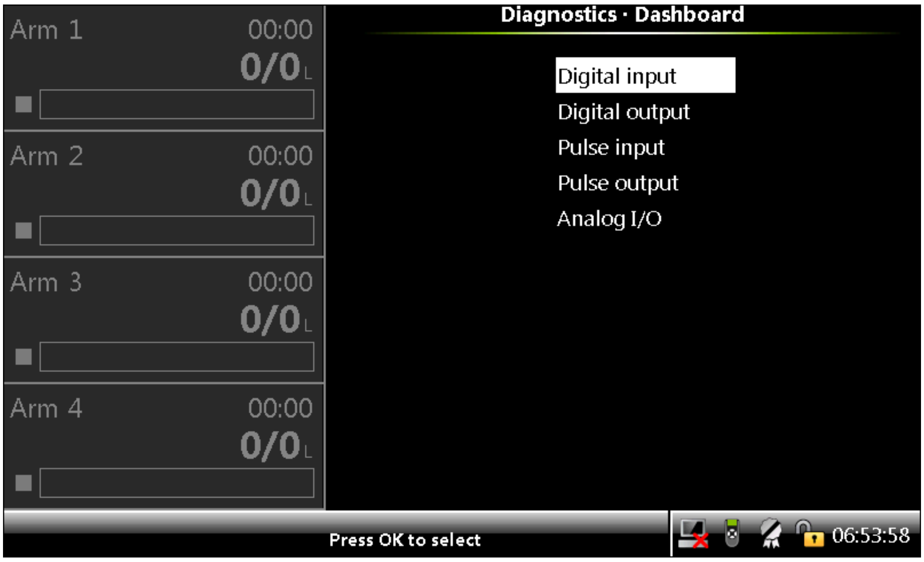


Alarms can be reset or acknowledged individually by scrolling to each of them. All alarms can be reset or acknowledged together also.

5.15.2 Dashboard

On the **Diagnostics** screen, select <Dashboard> to view the state or value of all the available I/O blocks in the MSC-L.

The **Diagnostics . Dashboard** screen appears, which displays the following input/output features.



NOTE: *You can activate or de-activate the individual output for testing by selecting the output and then selecting <OK> on the IR controller or the LAD.*

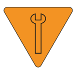
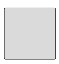
Activating the output energises the actual field equipment connected.

NOTE: The content of the following sections may differ depending on the particular Model that is bought.

5.15.2.0.1 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.

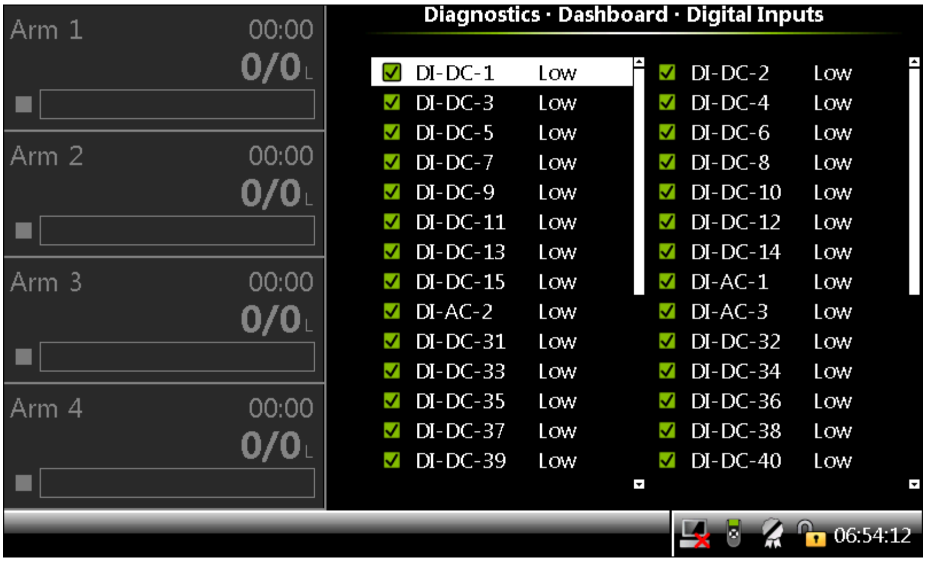
The following table lists the icons on the **Diagnostics . Dashboard** screen.

Icon	Description
	Maintenance is required
	Out of specification
	Check the function
	Failure
	Diagnostics is active
	Diagnostics is passive

5.15.2.0.2 Digital Input

On the **Diagnostics . Dashboard** screen, select <Digital input>.

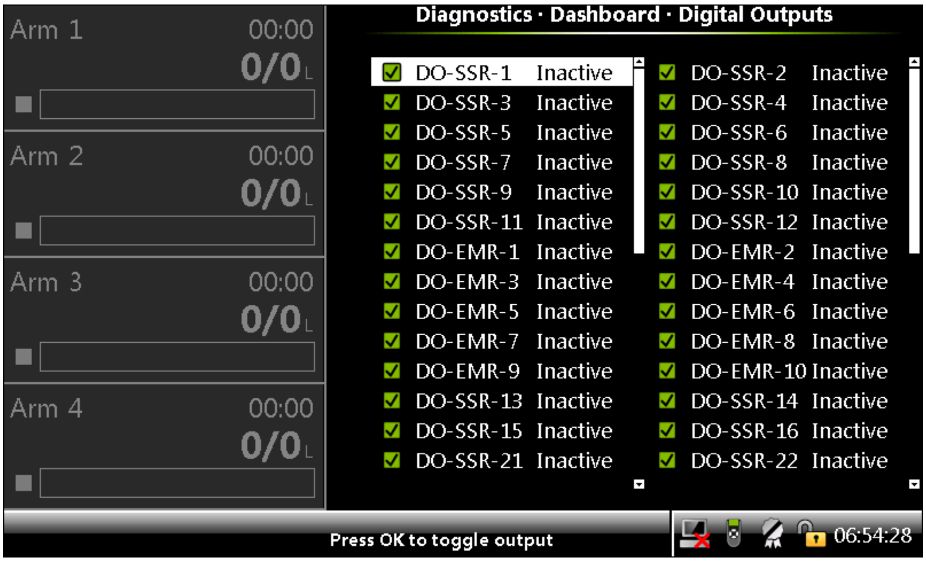
The **Diagnostics . Dashboard . Digital Inputs** screen appears, which displays the state or value of all the available Digital input blocks.



5.15.2.1 Digital Output

On the **Diagnostics . Dashboard** screen, select <Digital output>.

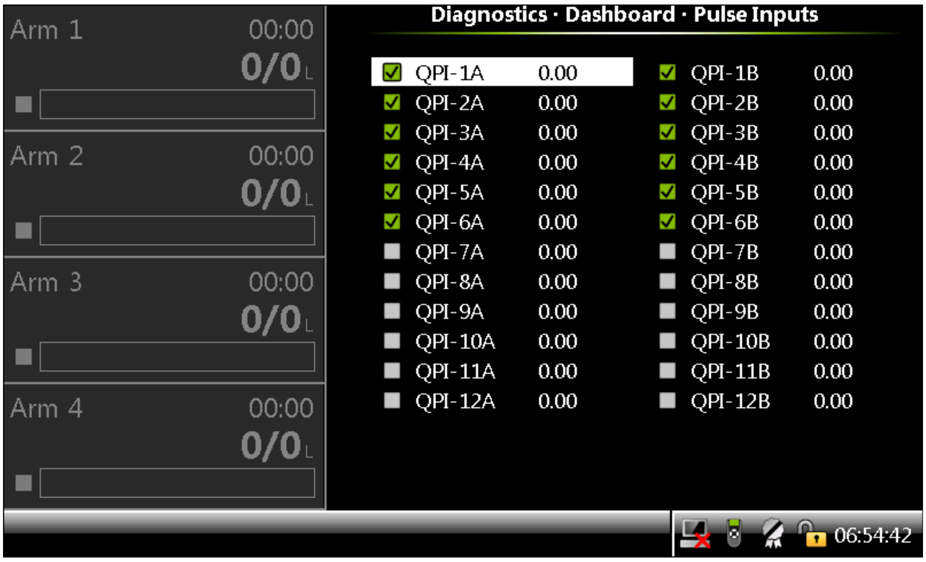
The **Diagnostics . Dashboard . Digital Outputs** screen appears, which displays the state or value of all the available Digital output blocks.



5.15.2.2 Pulse Input

On the **Diagnostics . Dashboard** screen, select <Pulse input>.

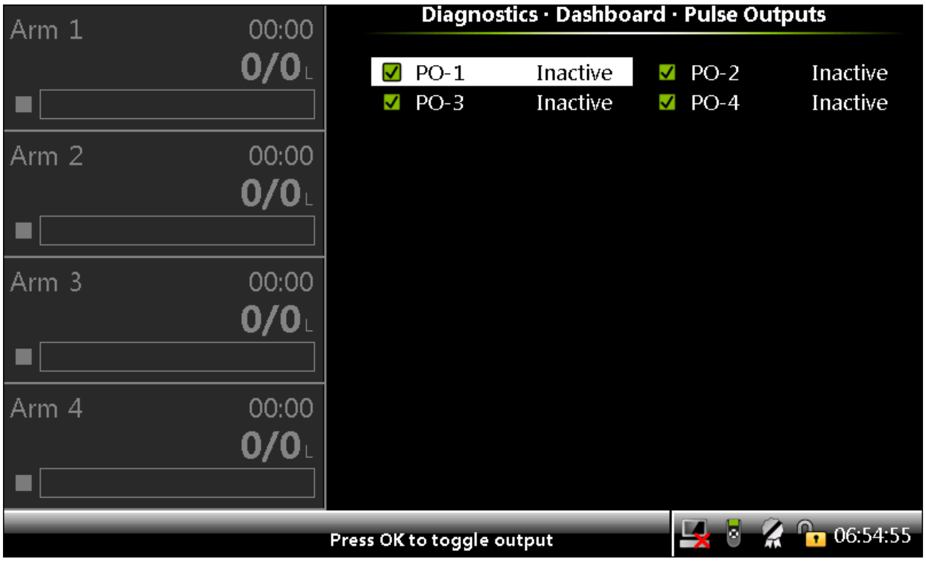
The **Diagnostics . Dashboard . Pulse Inputs** screen appears, which displays the state or value of all the available Pulse input blocks.



5.15.2.3 Pulse Output

On the **Diagnostics . Dashboard** screen, select <Pulse output>.

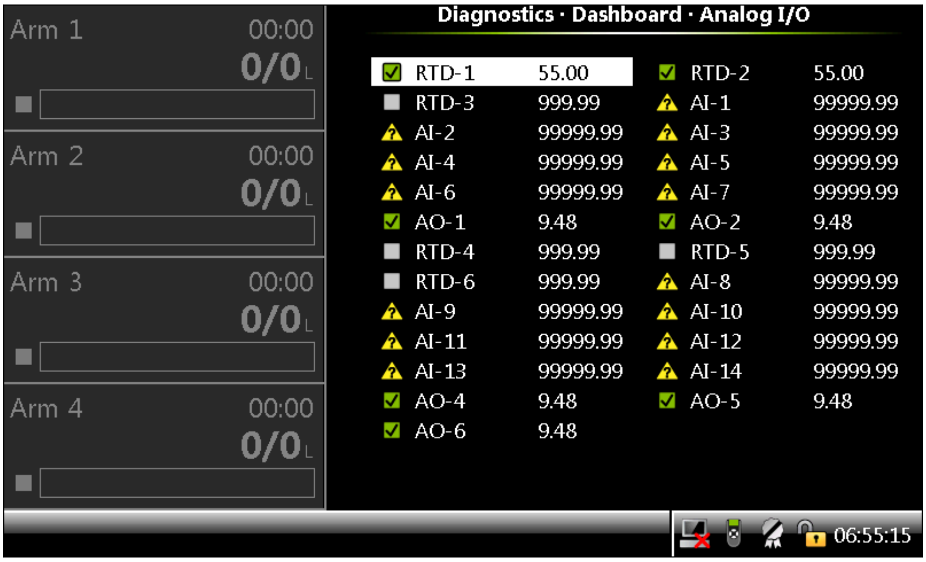
The **Diagnostics . Dashboard . Pulse Outputs** screen appears, which displays the state or value of all the available Pulse output blocks.



5.15.2.4 Analog I/O

On the **Diagnostics . Dashboard** screen, select <Analog I/O>.

The **Diagnostics . Dashboard . Analog I/O** screen appears, which displays the state or value of all the available Analog I/O blocks.

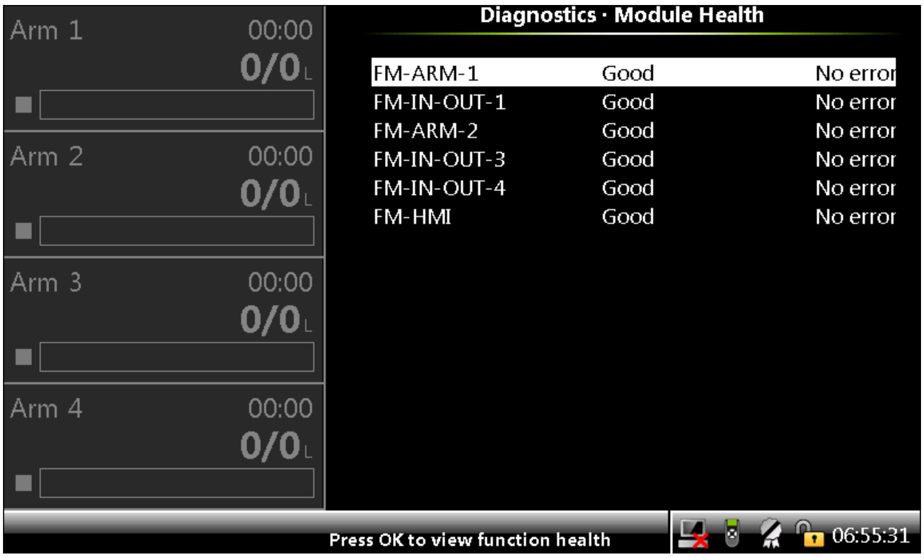


5.15.3 System Health

NOTE: The content of the Diagnostics - System Health may differ depending on the particular Model that is bought.

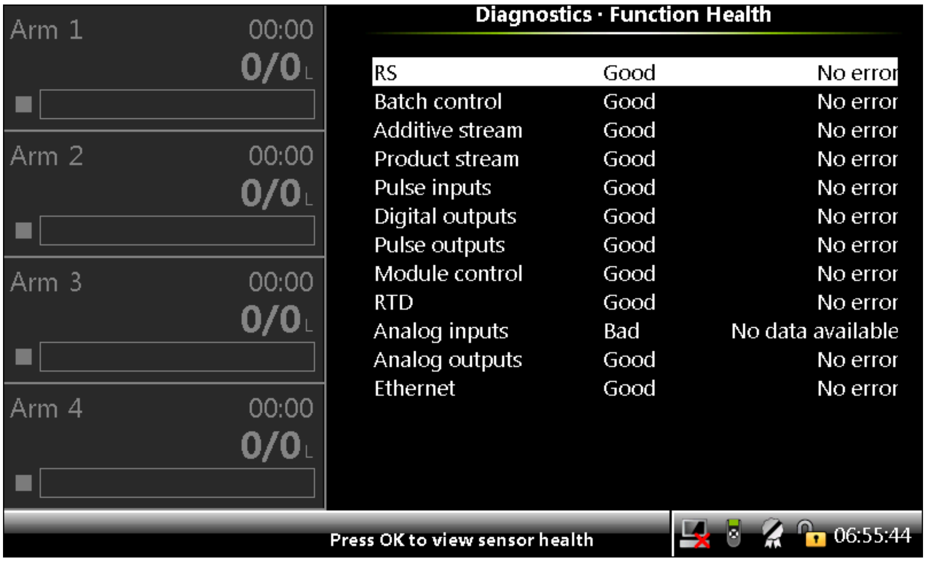
On the **Diagnostics** screen, select <System health>.

The **Diagnostics** . **Module Health** screen appears, which displays the health of the boards available in the MSC-L.



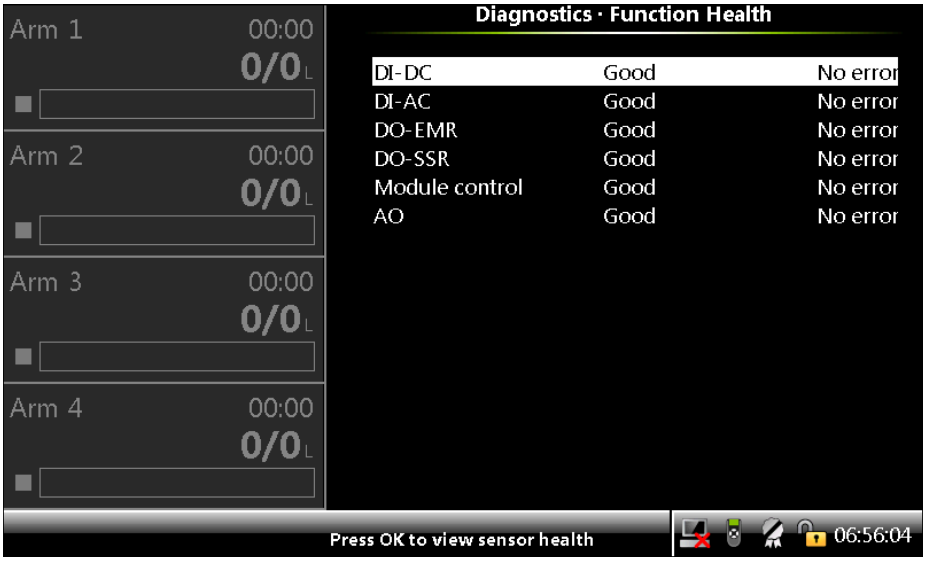
1. On the **Diagnostics - Module Health** screen, select <FM-ARM-n>.

The **Diagnostics . Function Health** screen appears, which displays the details of the ARM board.

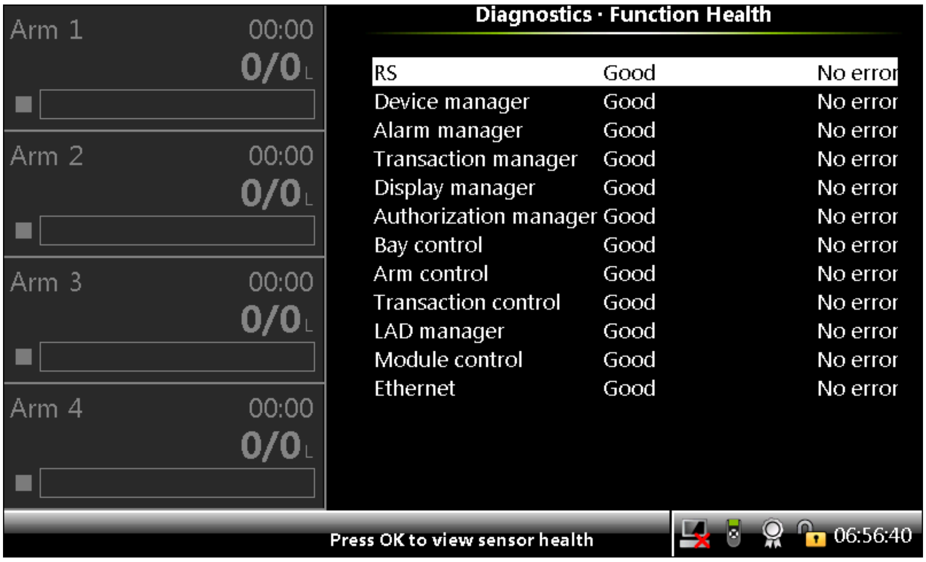


2. On the **Diagnostics . Module Health** screen, select <FM-IN-OUT-n>.

   The **Diagnostics . Function Health** screen appears, which displays the details of the IN-OUT board.



3. On the **Diagnostics . Module Health** screen, select <FM-HMI>.The **Diagnostics . Function Health** screen appears, which displays the details of the HMI board.



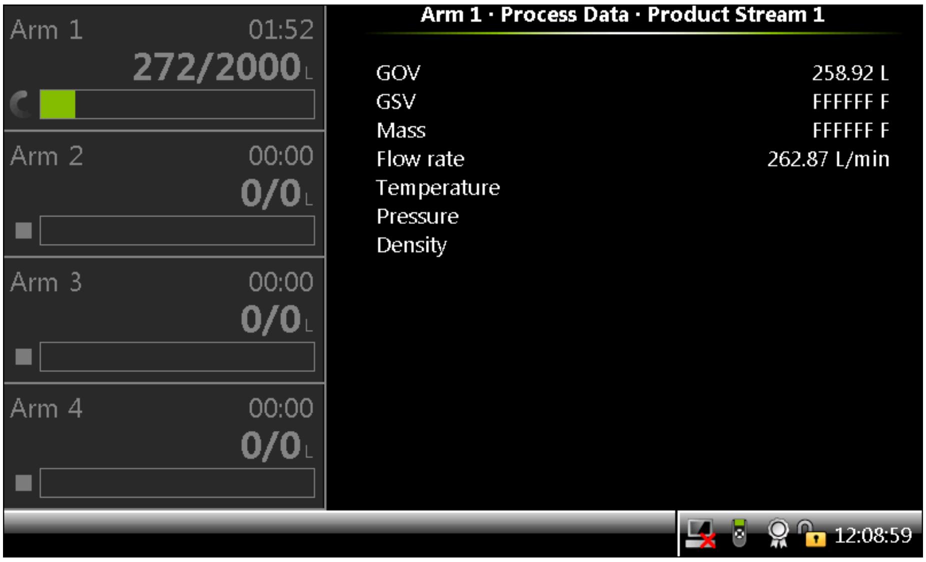
5.15.4 Process Data

1. On the **Diagnostics** screen, select <Process data>.

   The **Arm Selection** screen appears.

2. Select one arm to view the process data.

   The **Arm n . Process Data . Product Stream n** screen appears, which displays the batch related run time data.



5.15.5 Storage Info

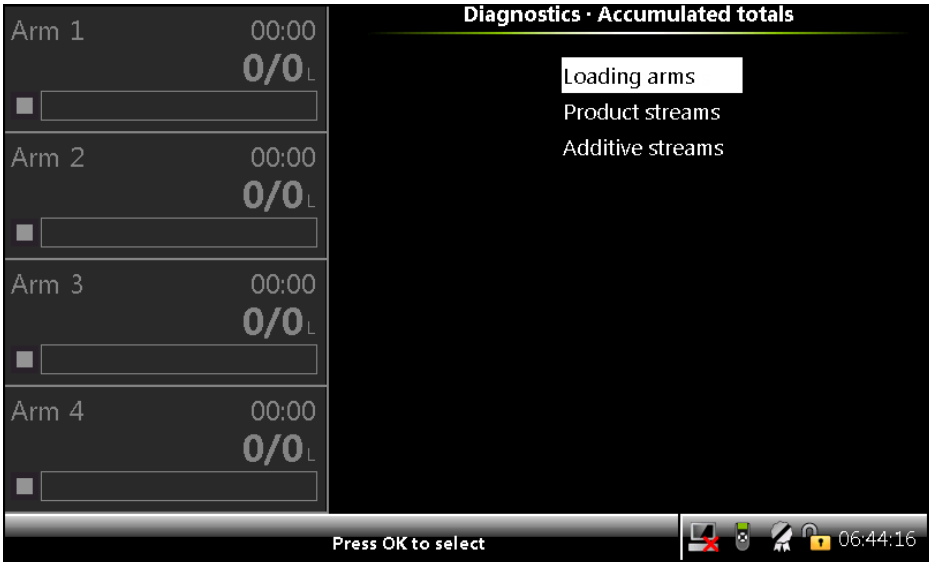
On the **Diagnostics** screen, select <Storage info>.

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.

5.15.6 Accumulated Totals

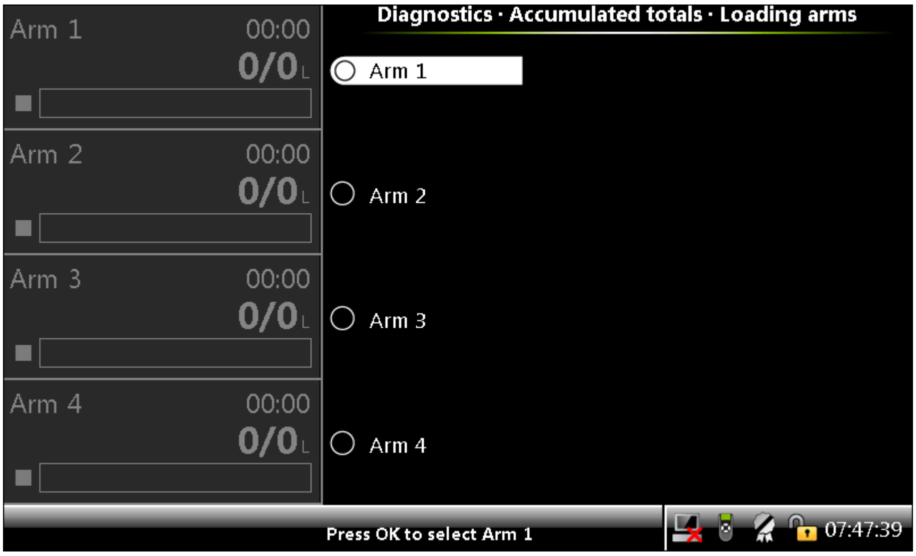
1. On the **Diagnostics** screen, select <Accumulated totals>.

   The **Diagnostics . Accumulated Totals** screen appears.

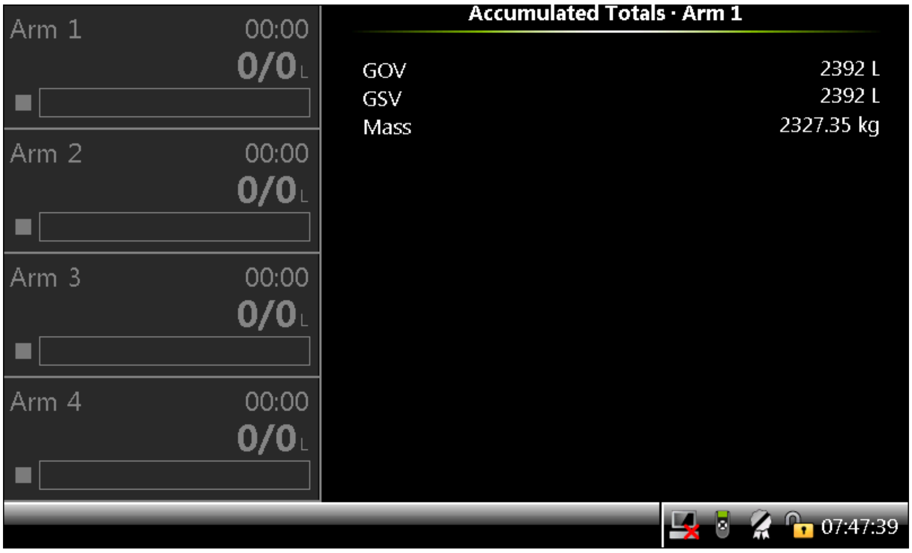


2. Select <Loading Arms>.

The **Diagnostics . Accumulated totals . Loading arms** screen. appears. Select the appropriate arm.



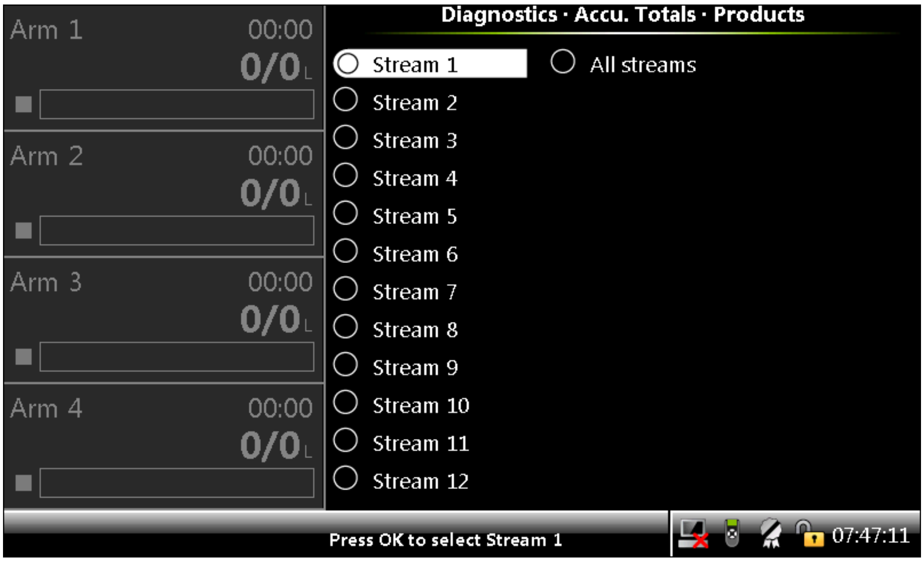
The **Accumulated Totals . Arm n** screen appears



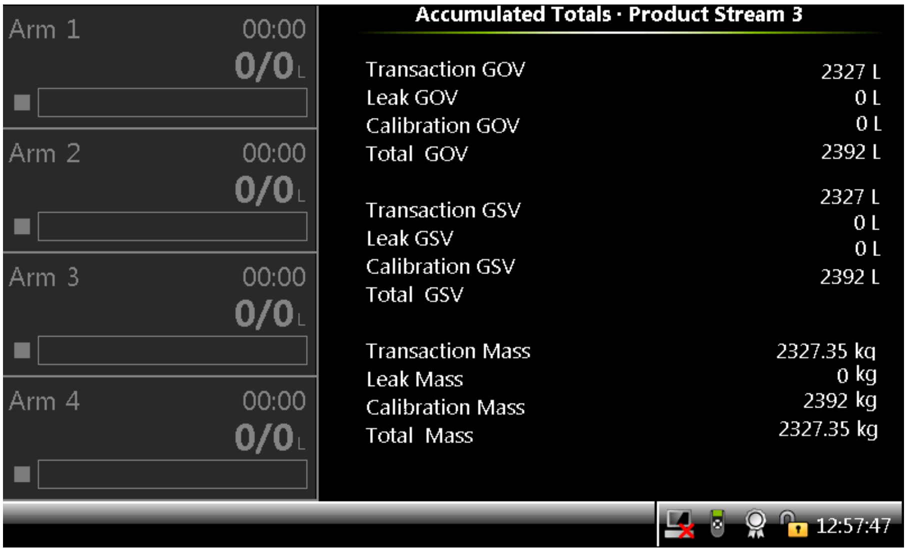
3. Select <Product streams>.

   The **Diagnostics. Accu totals. Products** screen appears.

Select the appropriate stream.



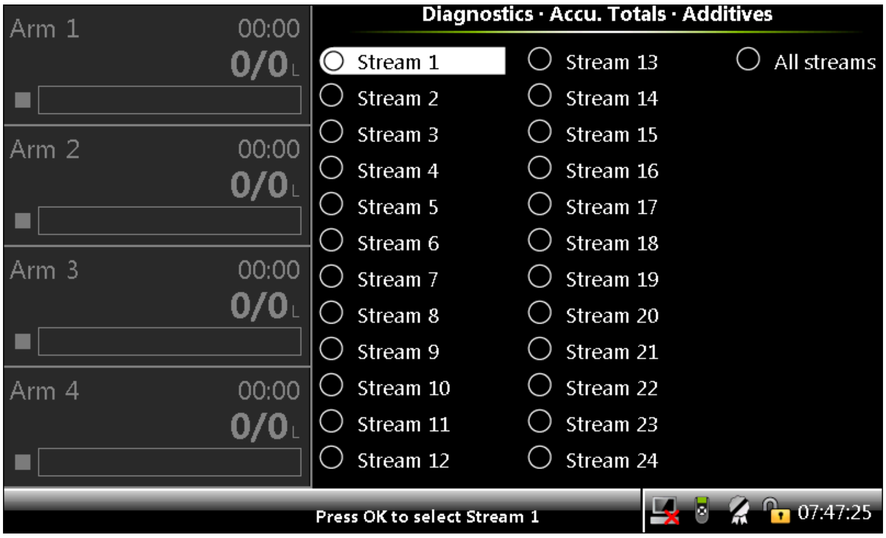
The **Accumulated Totals . Product Stream n** screen appears.



4. Select <Additive streams>.

   The **Diagnostics. Accu totals. Additives** screen appears.

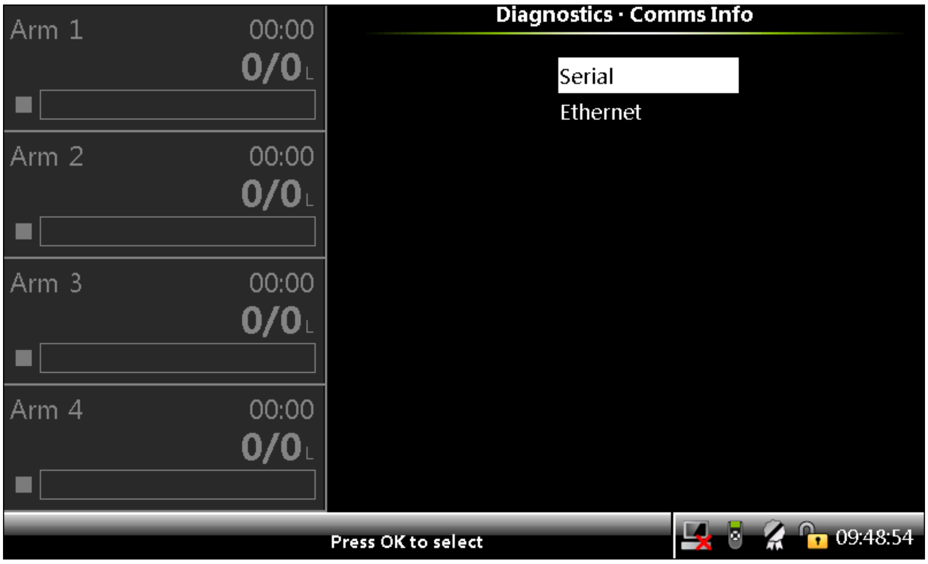
Select the appropriate stream.



The **Accumulated Totals . Additive Stream n** screen appears.

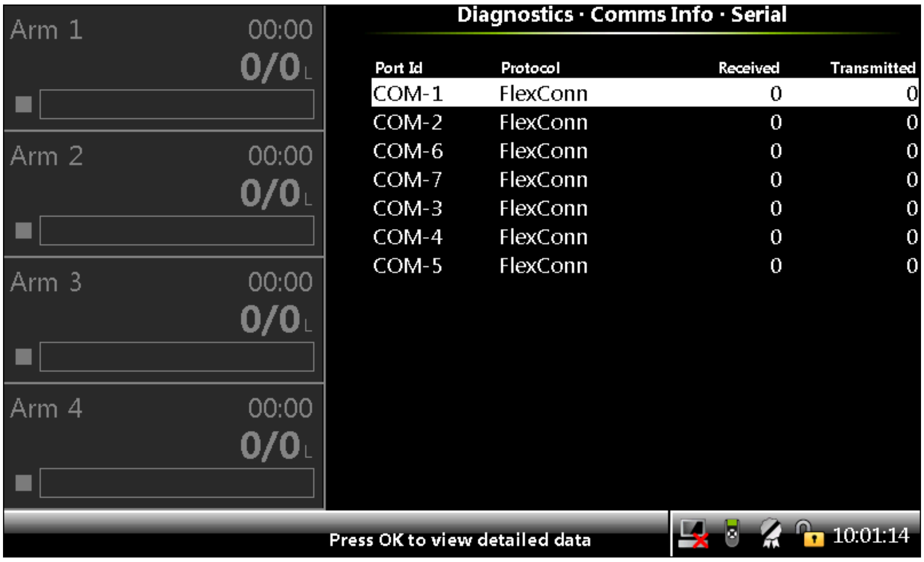
5.15.7 Comms Info

1. On the **Diagnostics** screen, select <Comms info> to view the serial and ethernet details.



2. On the **Diagnostics . Comms Info** screen, select <Serial>.

   The **Diagnostics . Comms Info . Serial** screen appears, which displays the serial communication details.



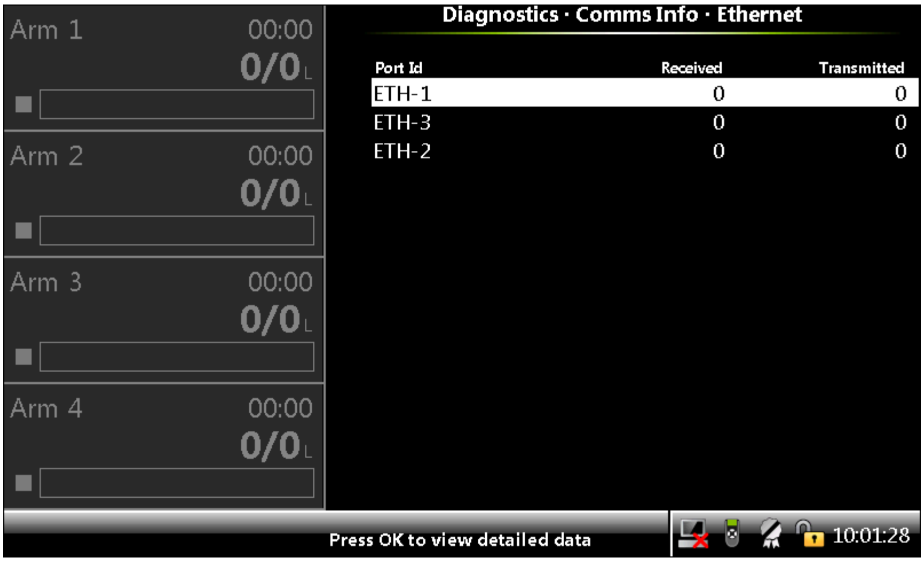
3. On the **Diagnostics . Comms Info . Serial** screen, select any one of the serial ports to view the details of the communication settings and the status.

   ″ 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.

4. On 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.



5. On 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-n . Settings** screen appears, which displays the details of the ethernet settings.
   - The **Diagnostics . ETH-n . Status** screen appears, which displays the number of packets that are received and transmitted.

5.15.8 Device Tasks

1. On the **Diagnostics** screen, select <Device tasks>.

The **Diagnostics . Device Tasks** screen appears, which displays the options to reset tasks, execute tasks, and clear tasks.

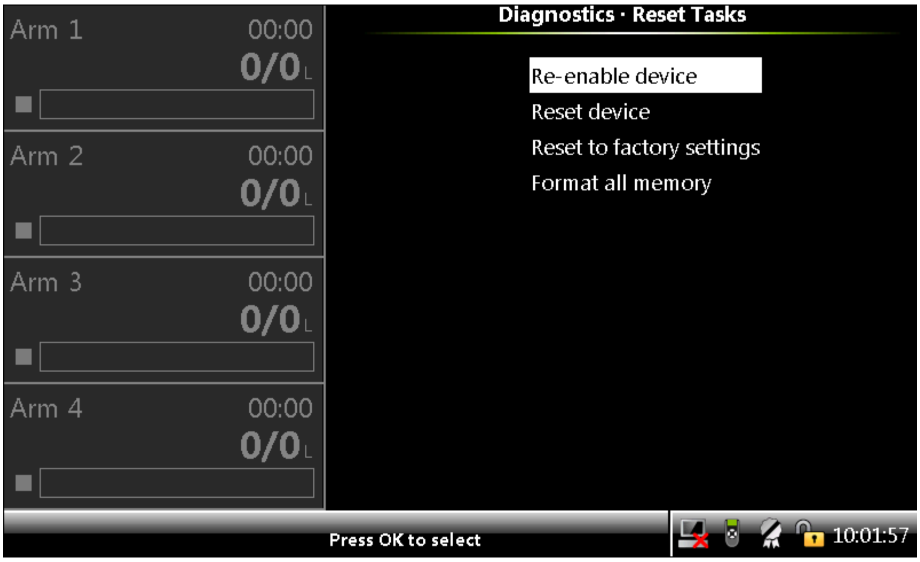
5.15.8.1 Reset Tasks

1. On 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-L.
   - Reset device - Allows you to reset the MSC-L.
   - Reset to factory settings - Allows you to reset to the default configuration settings.

- Format all memory - Allows you to reset to the default configuration settings and reset to the default calibration settings. For example, K-factors and clear/remove logs.



5.15.8.2 Execute Tasks

1. On the **Diagnostics . Device Tasks** screen, select <Execute tasks>.

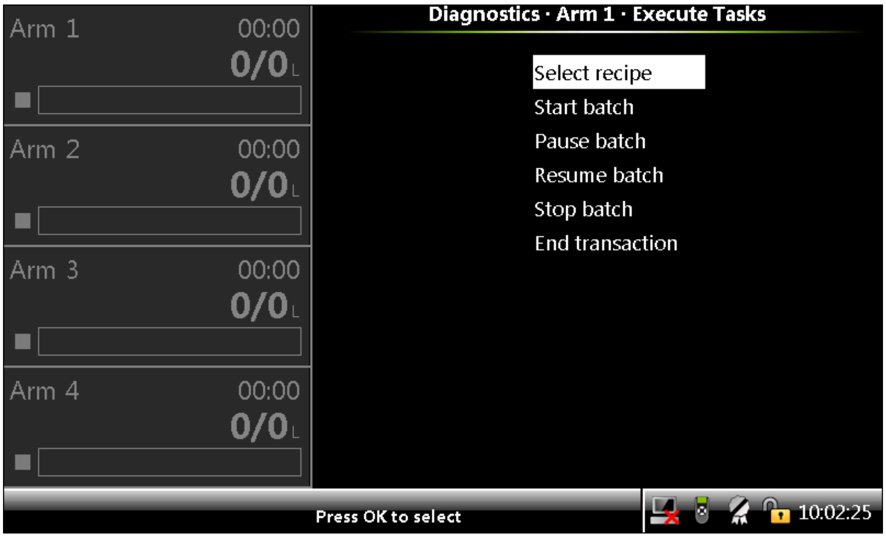
   The **Diagnostics . Execute Task. Arm Selection** screen appears.

2. Select <OK> on the IR controller or LAD to select any one of the stream or all the streams.

   The **Diagnostics . Arm n . Execute Tasks** screen appears, which simulates the following actions by Comms.

   - Select recipe
   - Start batch

- Pause batch
- Resume batch
- Stop batch
- End transaction



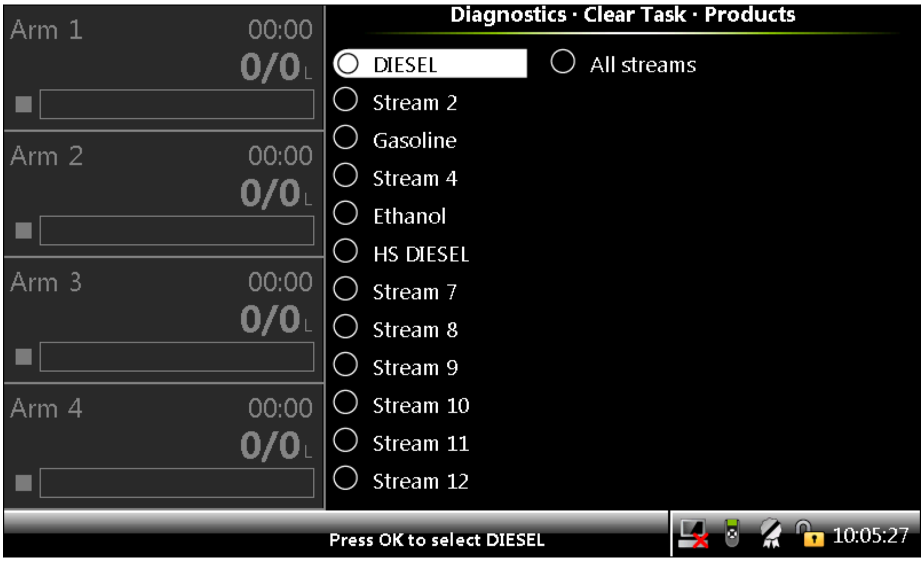
5.15.8.3 Clear Tasks

1. On the **Diagnostics . Device Tasks** screen, select <Clear tasks>.

   The **Diagnostics . Stream n . Clear Tasks** screen appears.

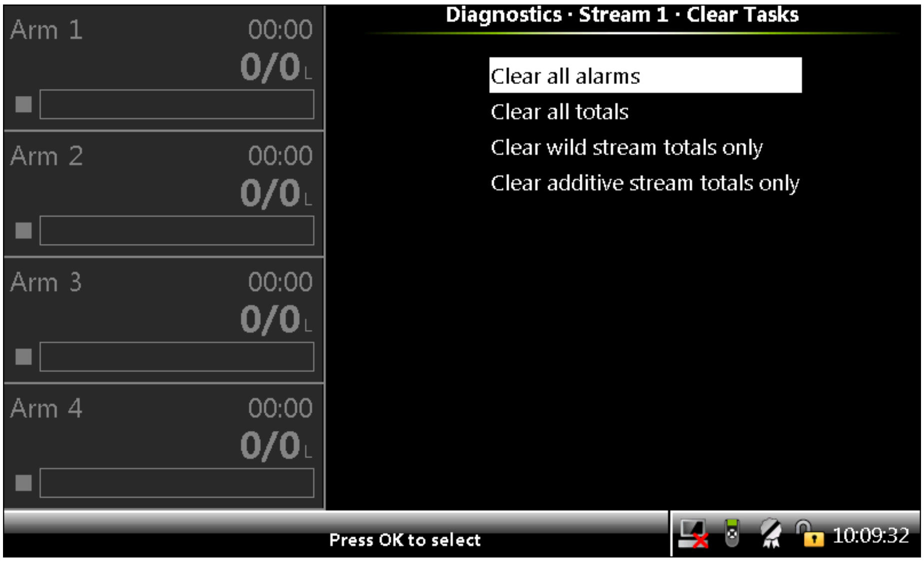
2. Select <Product Streams>.

The **Diagnostics . Clear Task . Products** screen appears. Select the appropriate stream.



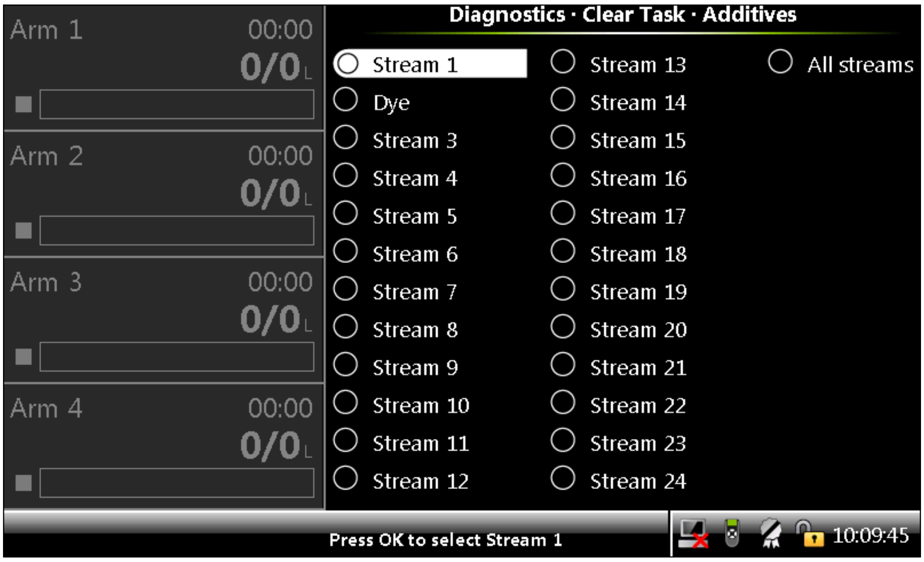
The **Diagnostics . Stream n . Clear Tasks** screen appears, which displays the following options to clear the tasks selected for the stream.

- 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.



3. Select <Additive Streams>.

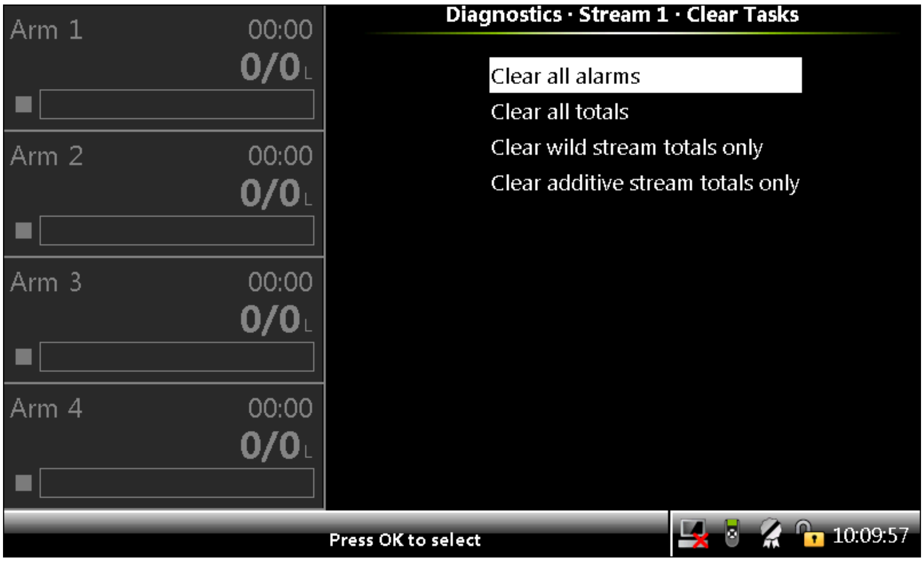
The **Diagnostics . Clear Task . Additives** screen appears. Select the appropriate stream.



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.

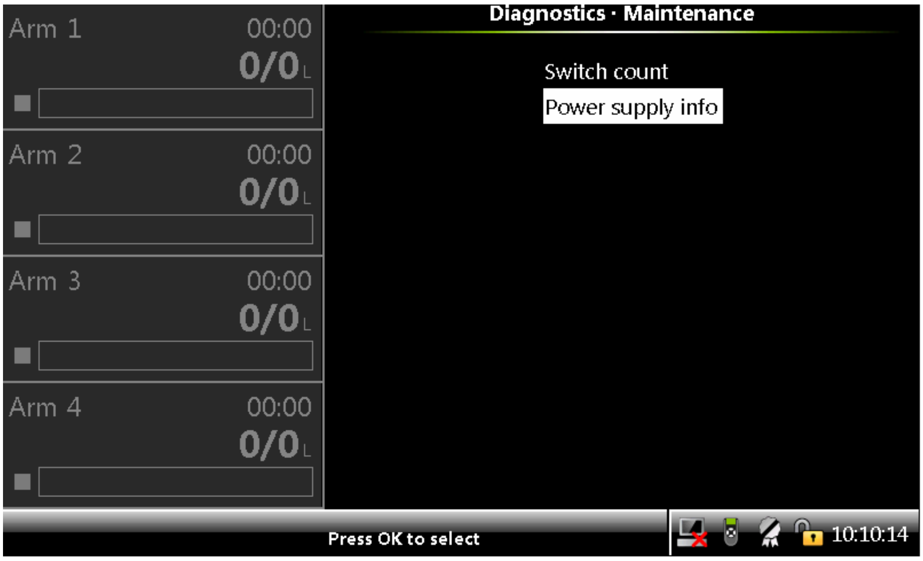
Clear additive stream totals only - Clears the additive stream totals.



5.15.9 Maintenance

1. On the **Diagnostics** screen, select <Maintenance>.

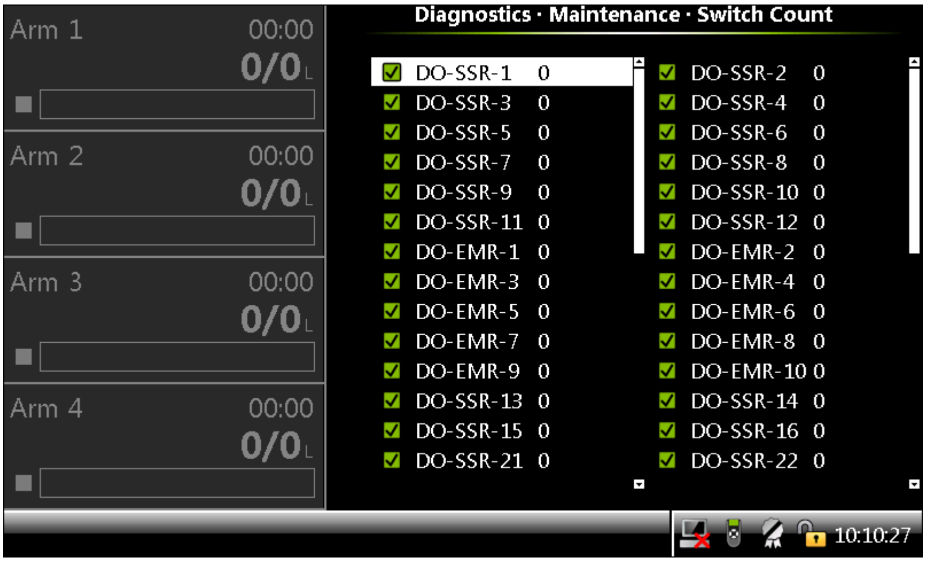
The **Diagnostics . Maintenance** screen appears, which displays the option to view the switch counts.



2. On the **Diagnostics . Maintenance** screen, select <Switch count>.

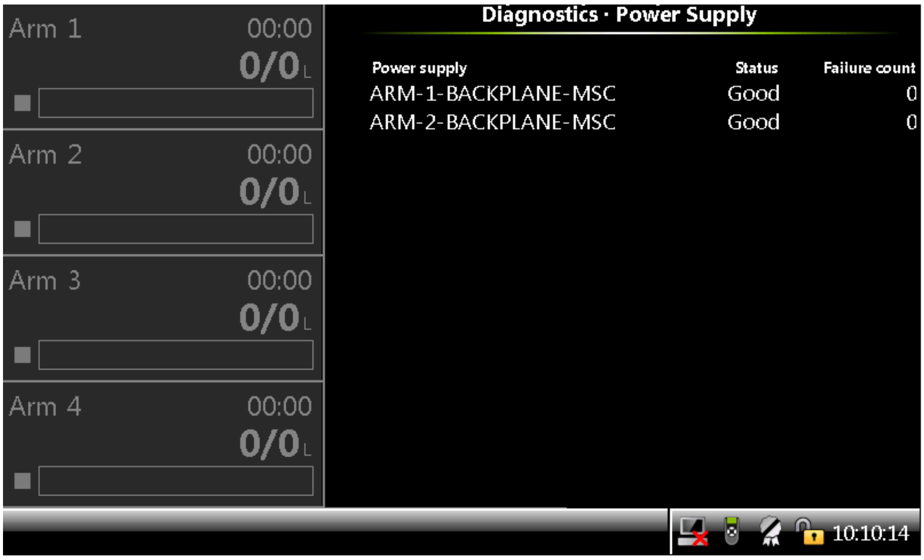
   The **Diagnostics . Maintenance . Switch Count** screen appears, which displays the switch count that maintains the number of times the digital output is switched ON or OFF.

   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).



3. On the **Diagnostics . Maintenance** screen, select <Power supply info>.

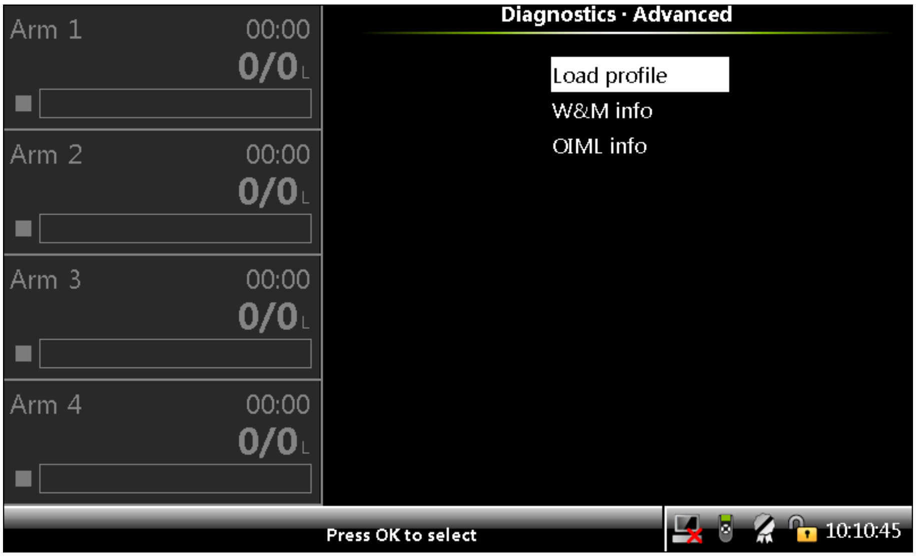
The **Diagnostics Power Supply** screen appears which status the power supply status of the arm boards.



5.15.10 Advanced

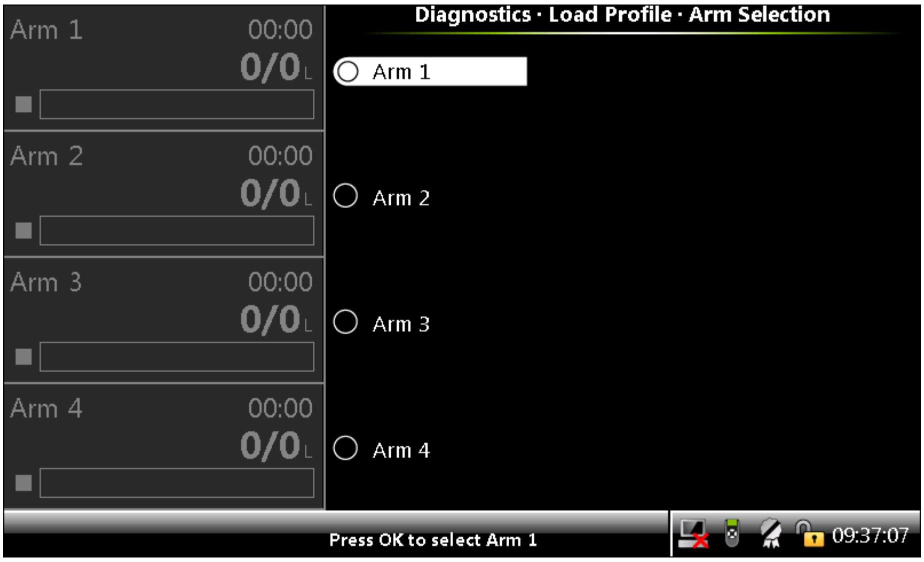
1. On the Diagnostics screen, select <Advanced>.

The **Diagnostics . Advanced** screen appears.

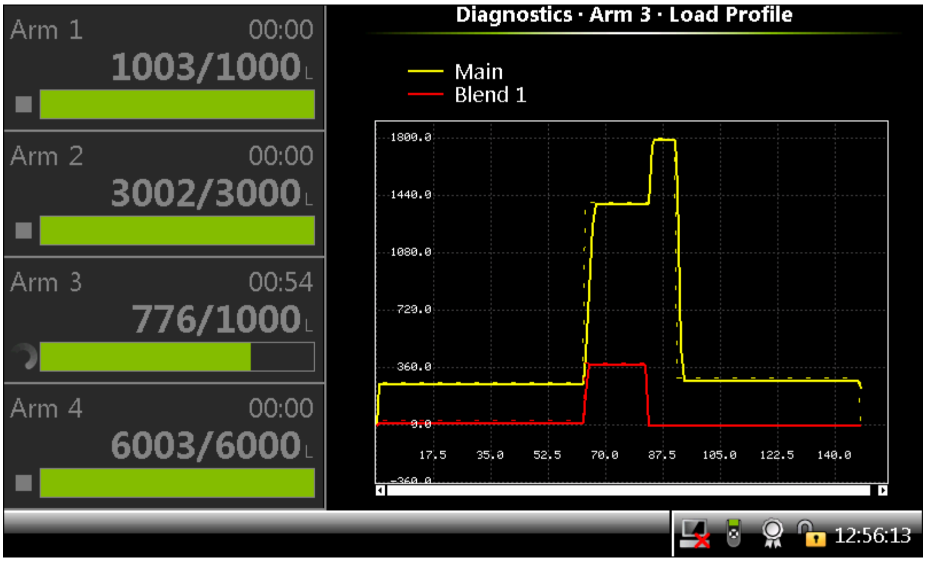


2. Select <Load profile>.

The **Diagnostics. Load Profile . Arm Selection** screen appears. Select the appropriate arm.



The **Load profile** diagnostic screen appears, which displays the target and actual flow rates of a currently active batch.

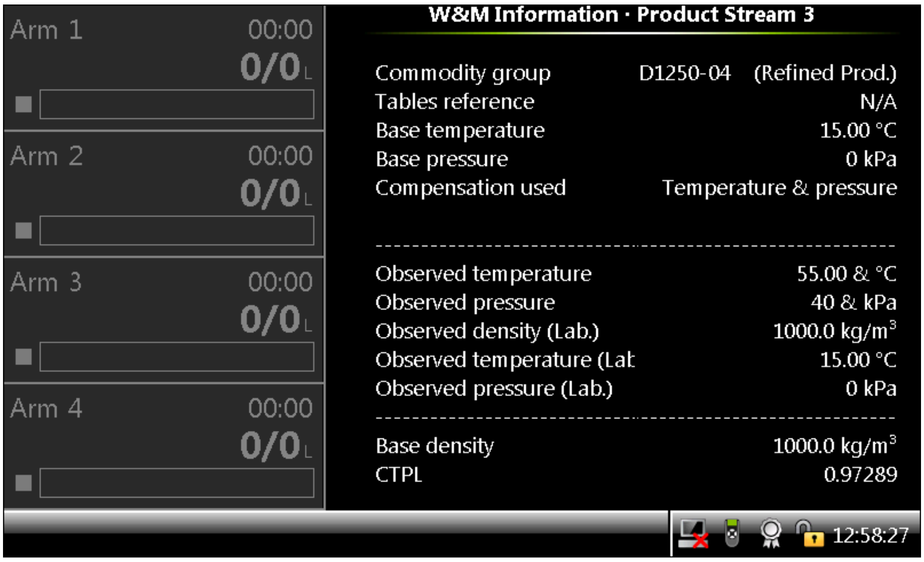


3. Select <W&M info>.

   The **Diagnostics . W&M Info . Stream Selection** screen appears.

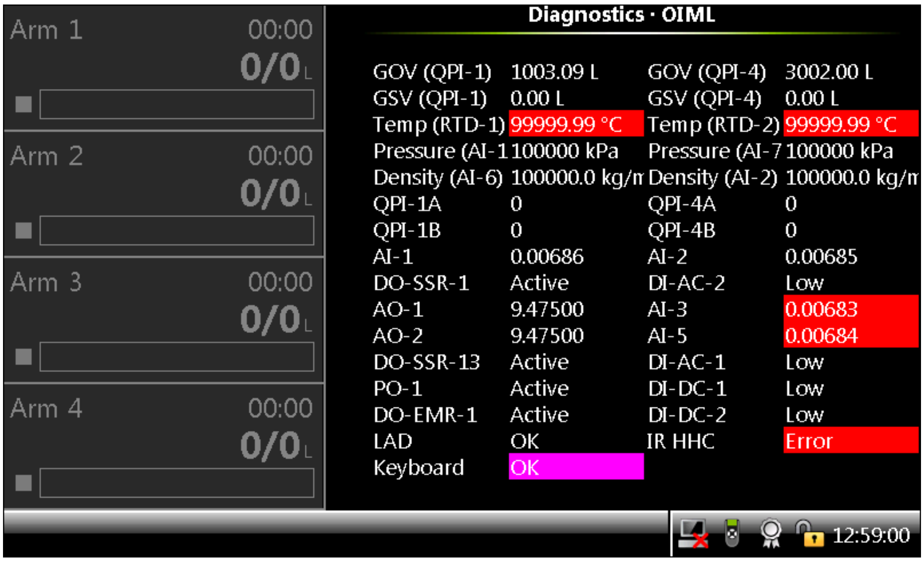
   Select the required stream.

The **W&M Information . Product Stream n** screen appears., which displays the intermediate volume conversion calculations values.



4. Select <OIML info>.

The **Diagnostics . OIML screen** appears. These values are used only during OIML testing.



5.16 Calibration

5.16.1 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 FIGURE 5-33) with the displayed value on the MSC-L display, which is the result of the value returned from the flow meter.

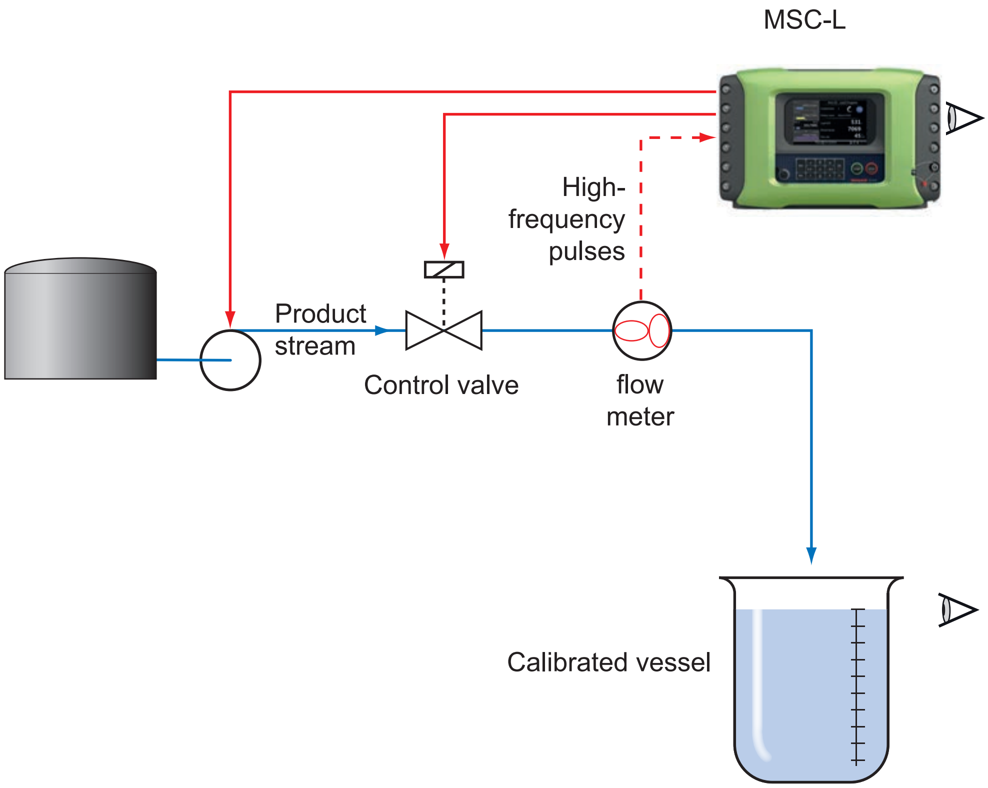


FIGURE 5-33 Calibrating the flow meter for the Product Stream

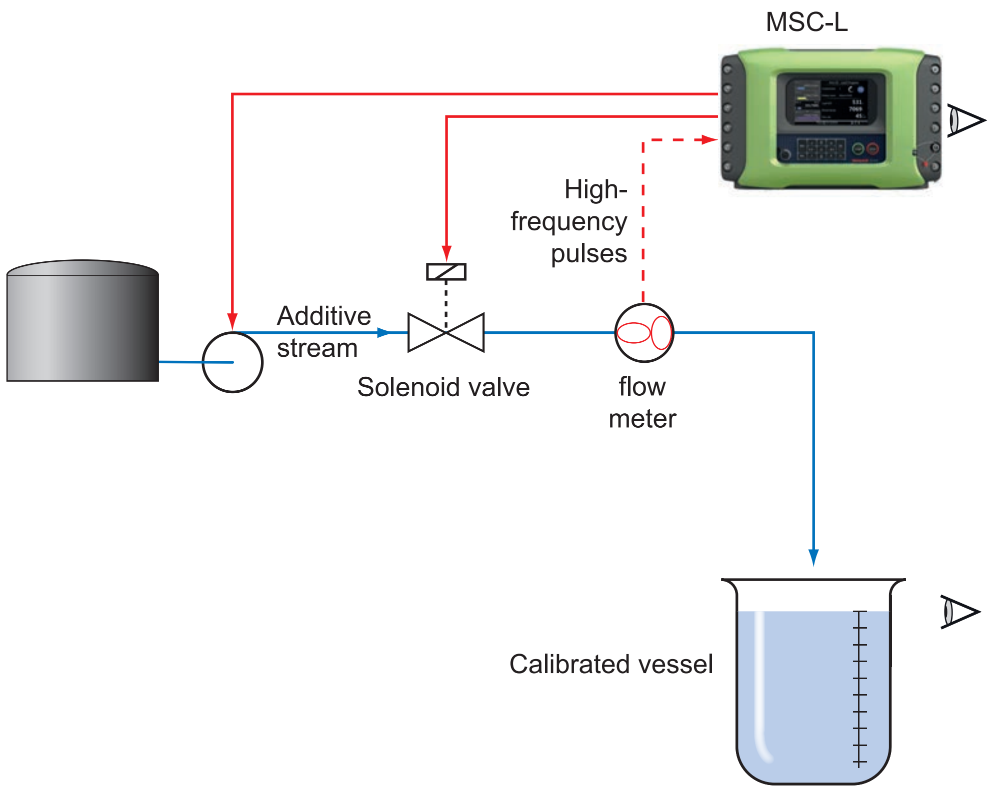


FIGURE 5-34 Calibrating the flow meter for an Additive Stream

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 = Number of pulses/(K-factor * meter factor).

5.16.2 Calibration Menu Choice

1. On the **Main Menu** screen, select the **Calibration** icon to perform the calibration process.

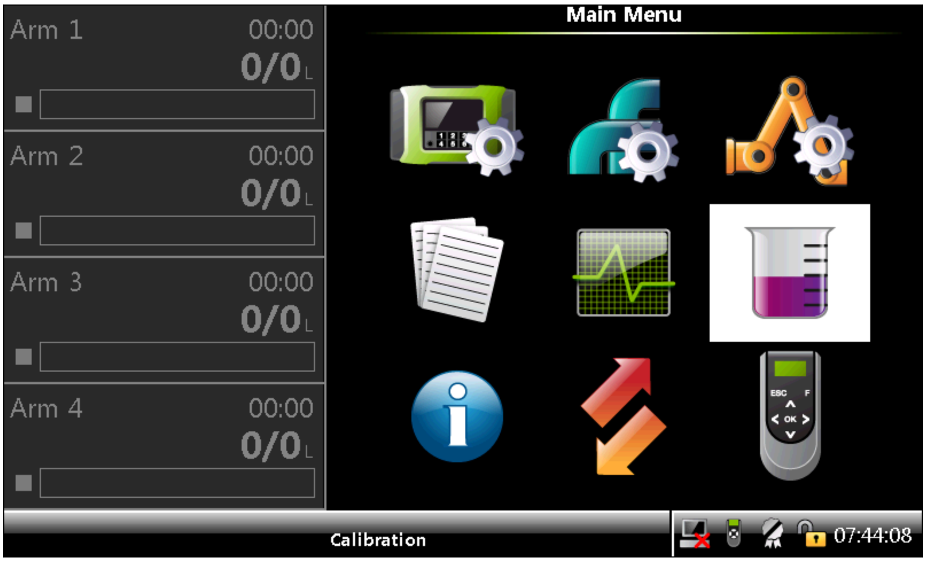


FIGURE 5-35 Calibration icon

2. On 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.

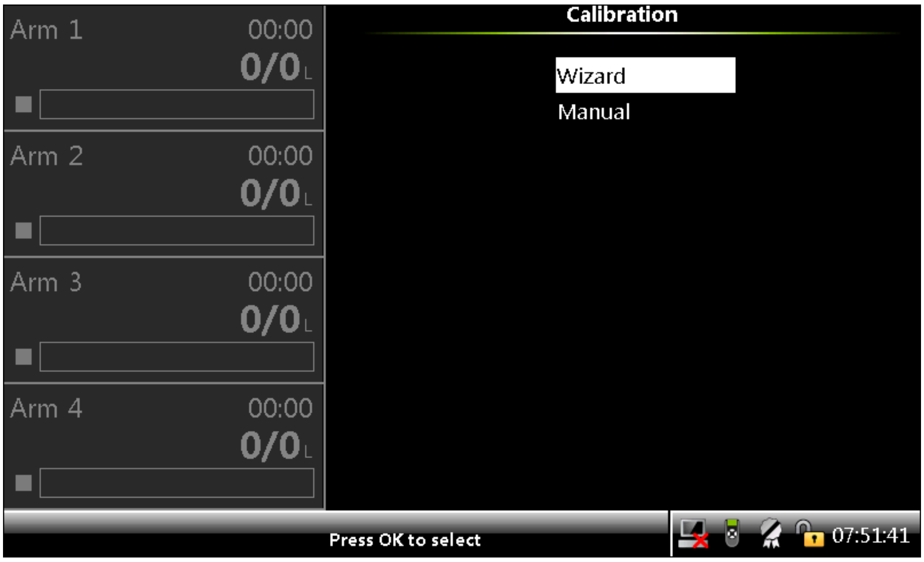
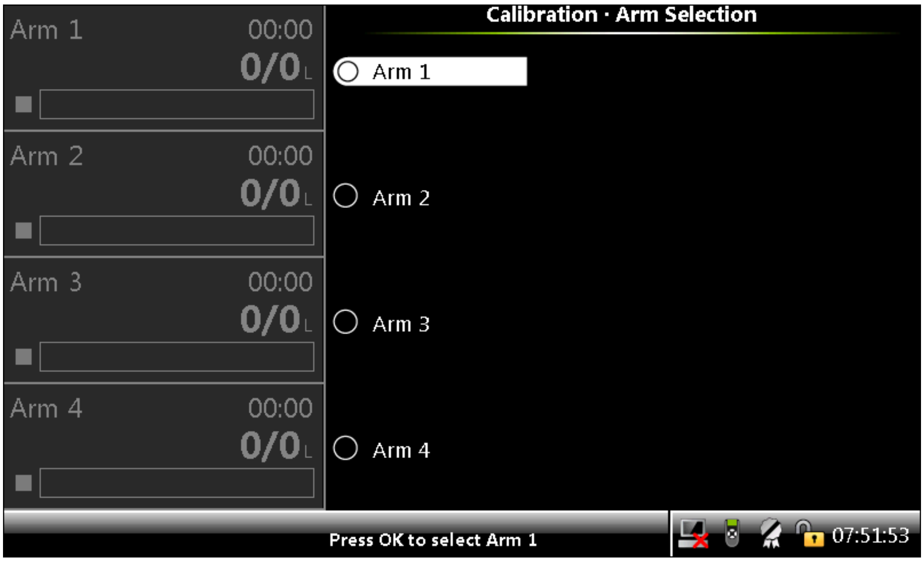


FIGURE 5-36 Calibration menu choices

5.16.3 Manual Calibration

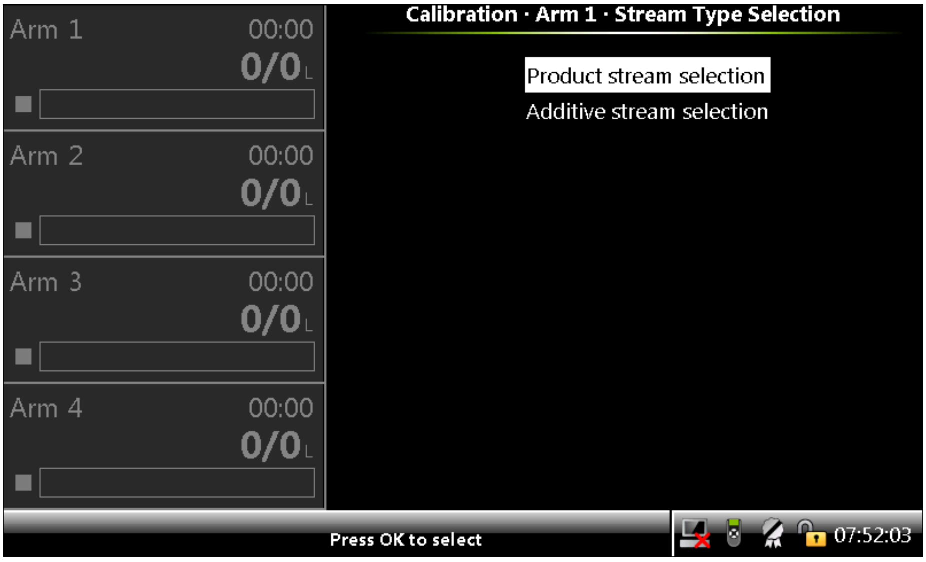
1. On the **Calibration** screen, select <Manual> calibration.

   The **Calibration. Arm Selection** screen appears.



2. Select any one of the arms. For example, Arm1.

The **Calibration . Arm n . Stream Type Selection** screen appears.



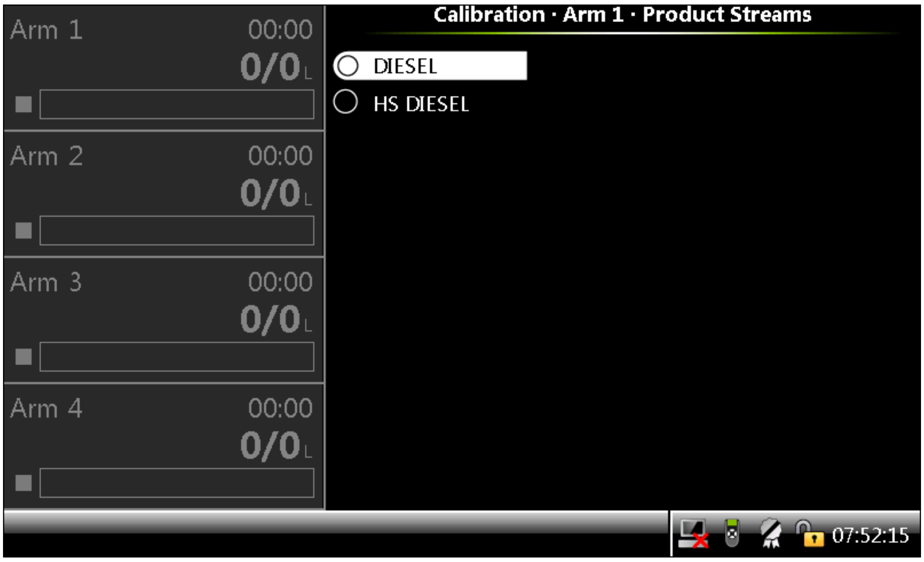
3. On the **Calibration . Arm n . Stream Type Selection** screen, select <Product stream selection> or <Additive stream selection>, to calibrate the product stream or additive stream accordingly.

   See the following sections for more information.

5.16.3.1 Product Stream Selection

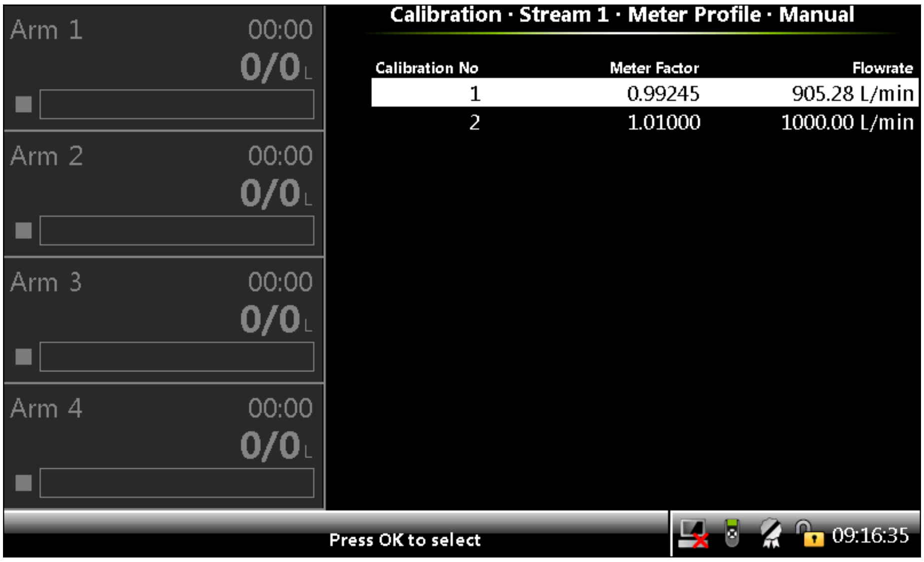
1. On the **Calibration . Arm n . Stream Type Selection** screen, select <Product stream selection>.

   The **Calibration . Arm n . Product Streams** screen appears.



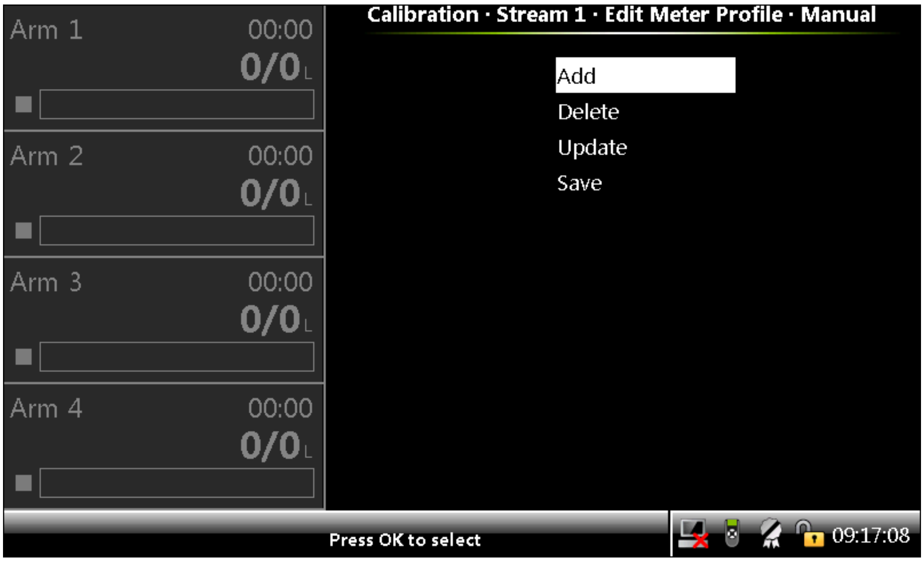
2. Select any one of the streams. For example, Stream 1.

The **Calibration . Stream n . Meter Profile . Manual** screen appears.



3. Select <OK> on the IR controller or LAD to select the calibration point.

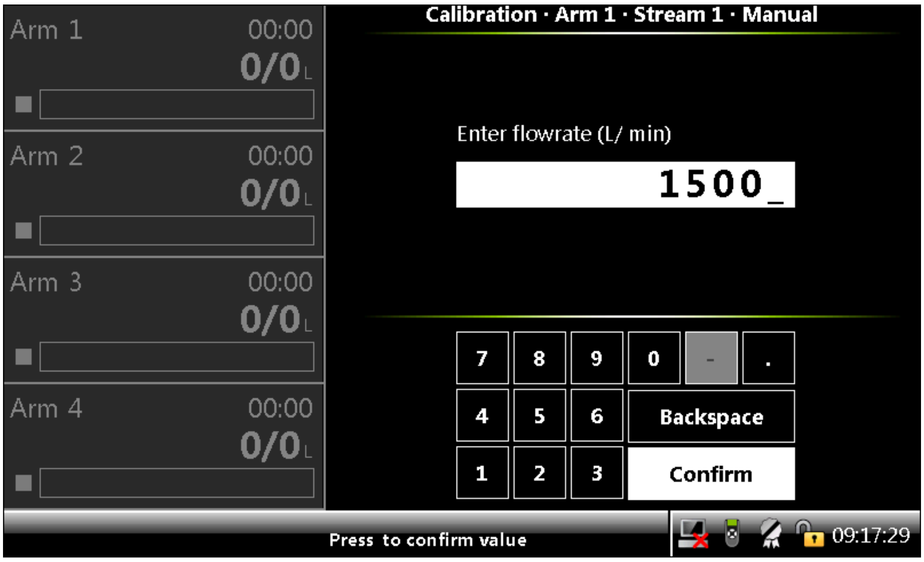
   The **Calibration . Stream n . Edit Meter Profile . Manual** screen appears.



The following functions can be performed for the calibration.

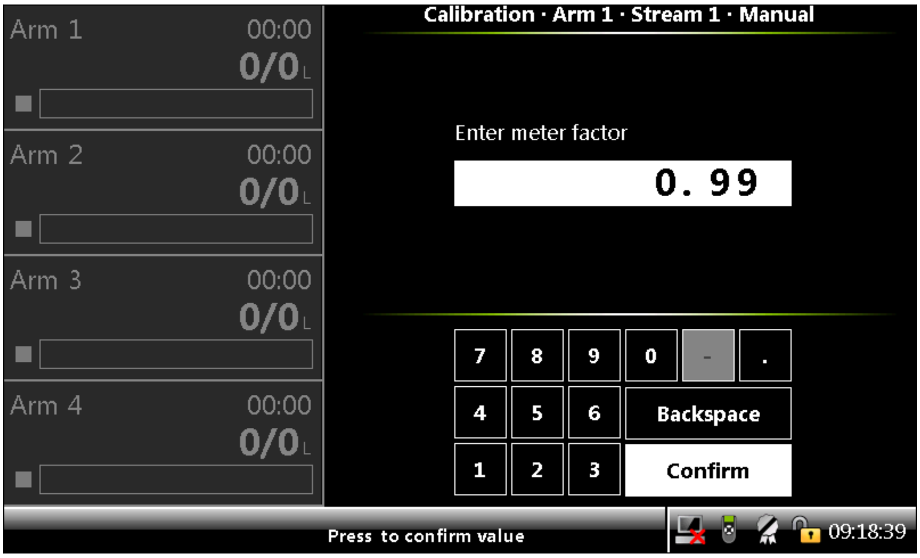
- Add - Adds a new calibration point to the meter profile.
- Delete - Deletes the selected calibration point.
- Update - Updates the selected calibration point.
- Saves - Saves the meter profile (generates Calibration Log record).

4. If the Add function is selected, then the C**alibration . Arm n . Stream n . Manual** screen appears, on which the flow rate must be entered.



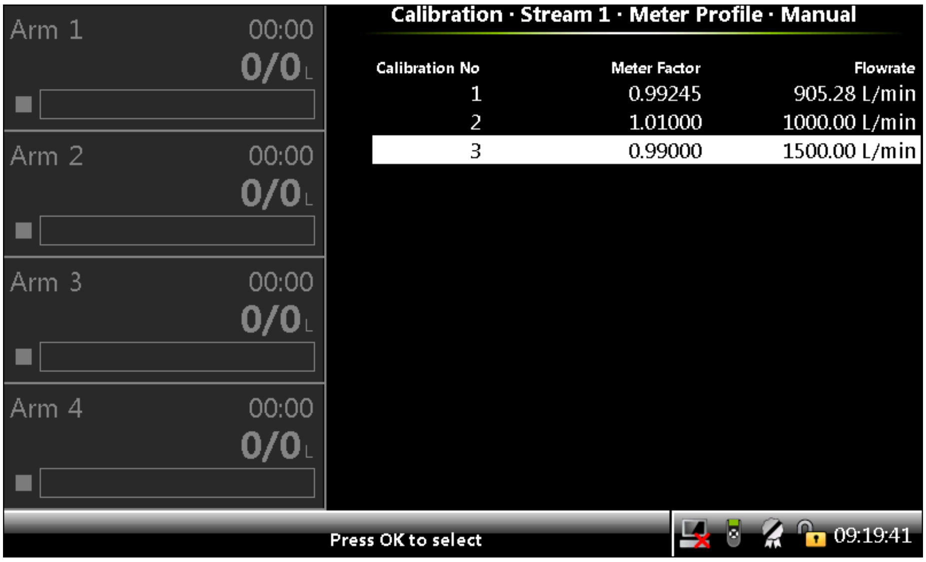
5. Enter the flow rate and then select <Confirm>.

   The **Calibration. Arm n. Stream n - Manual** screen appears, on which the meter factor must be entered.



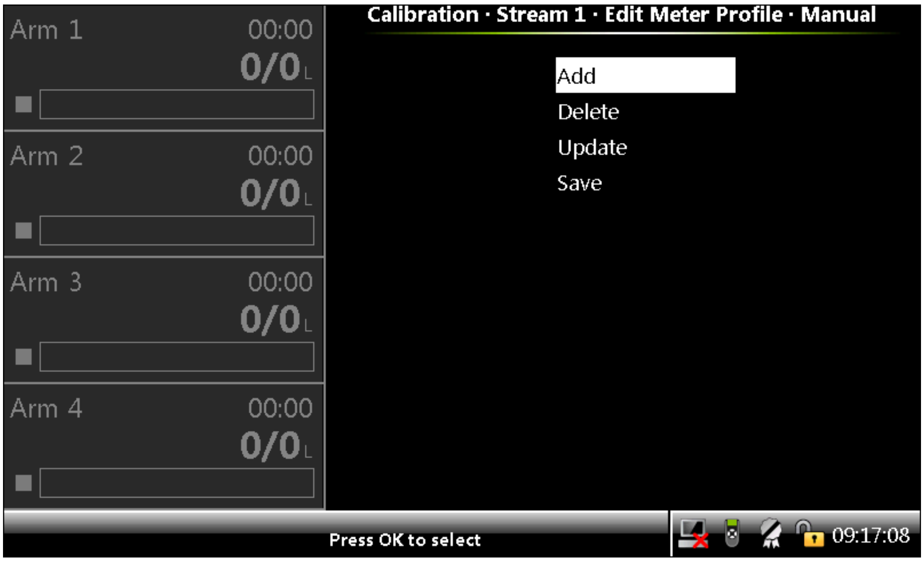
6. Enter the meter factor and then select <Confirm>.

The **Calibration . Stream n . Meter Profile . Manual** screen appears, which displays the Calibration No, Meter Factor, and the Flowrate.



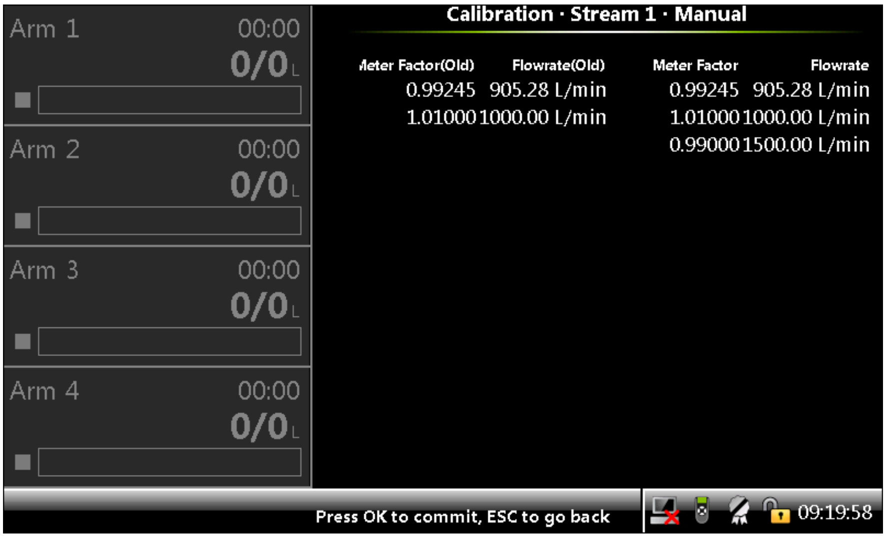
7. Select <OK> on the IR controller or LAD to save the calibration point.

   The **Calibration . Stream n . Edit Meter Profile . Manual** screen appears.



8. Select <Save> and then select <OK> on the IR controller or LAD.

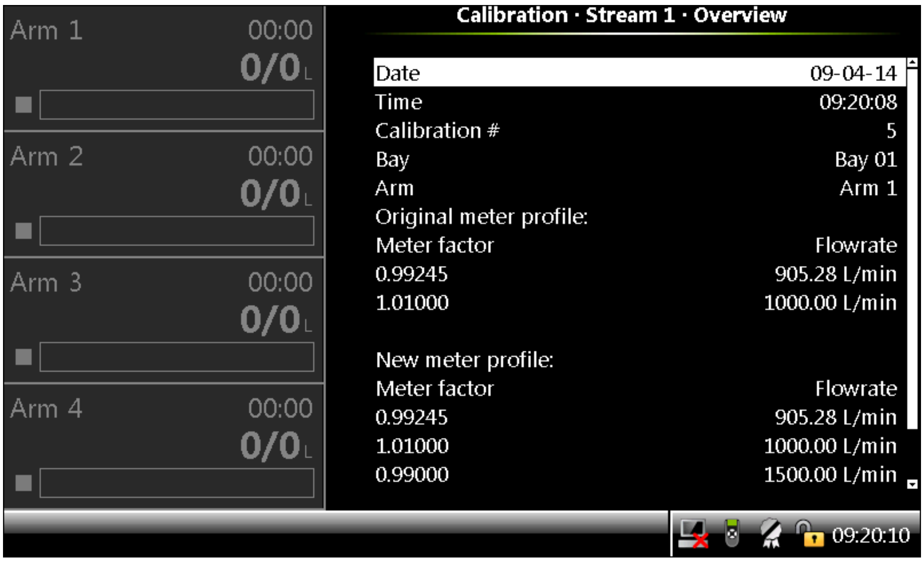
The **Calibration . Stream n . Manual** screen appears, which displays the Meter Factor(old), Flowrate(old), Meter Factor, and Flowrate.



9. Select <OK> on the IR controller or LAD to commit the calibration or <ESC> to terminate the calibration.

   If <OK> is pressed then the **Calibration . Stream n . Overview** screen appears, which displays the calibration details.

10. Select <OK> on the IR controller or LAD to exit to the **Main Menu**.

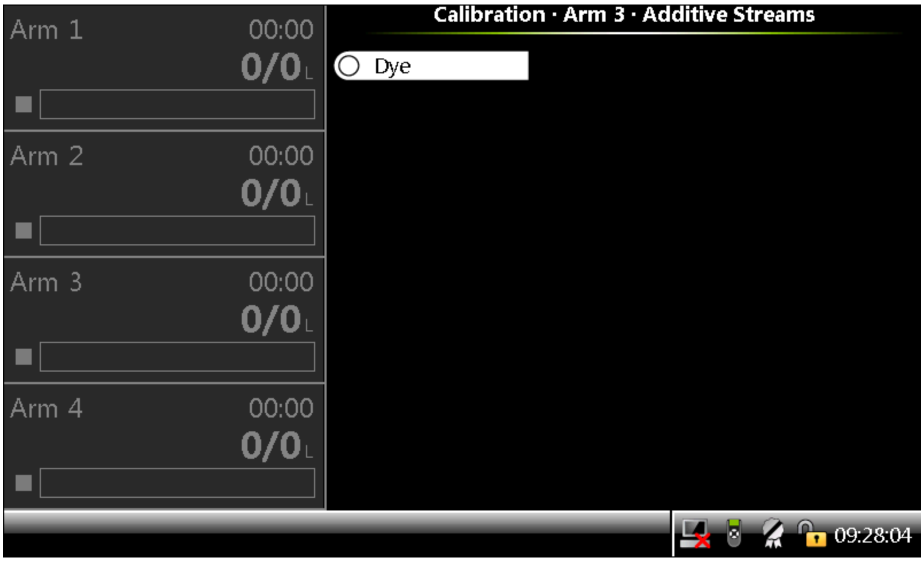


*NOTE: Select **<ESC>** to restore the old meter factor.*

5.16.3.2 Additive Stream Selection

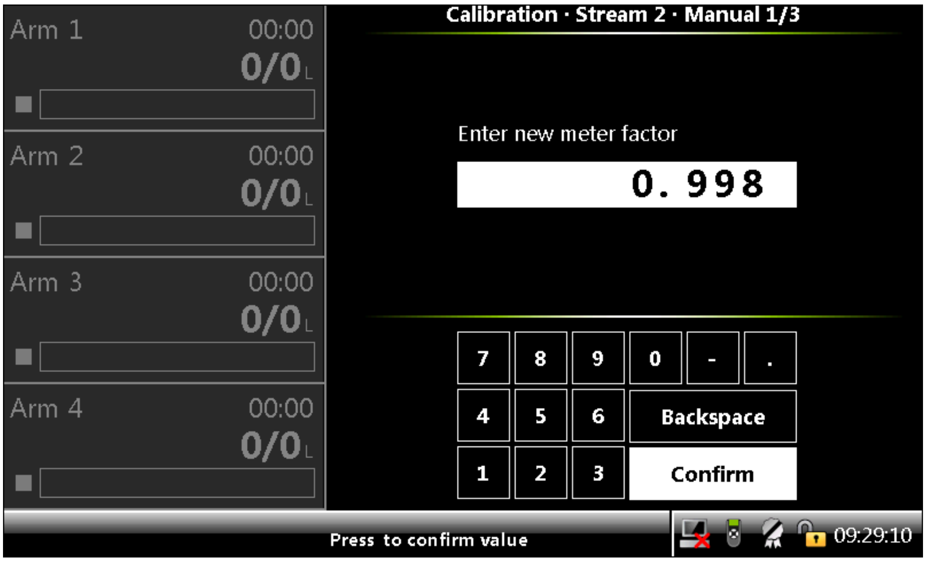
1. On the **Calibration . Arm n . Stream Type Selection** screen, select <Additive stream selection>.

The **Calibration . Arm n . Additive Streams** screen appears.



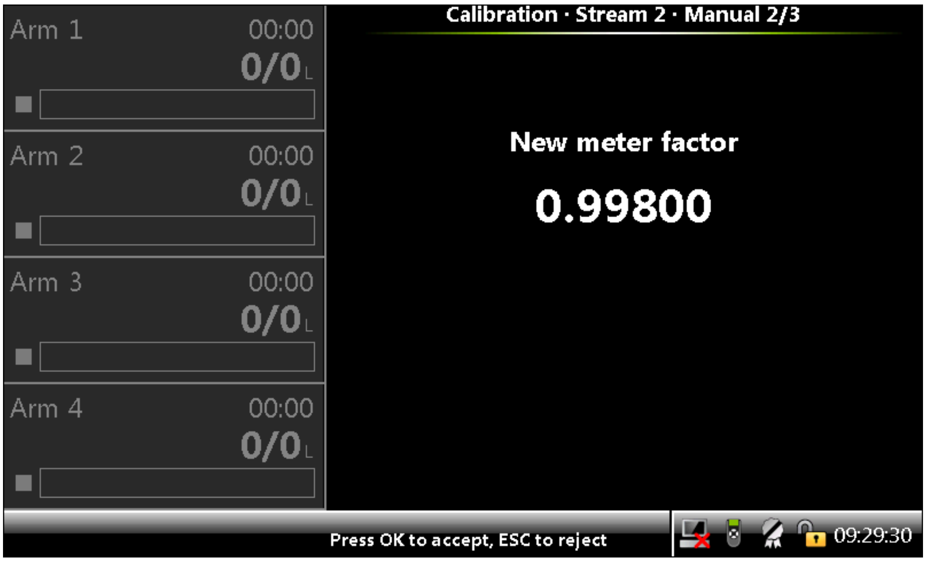
2. Select any one of the streams. For example, Stream 1.

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



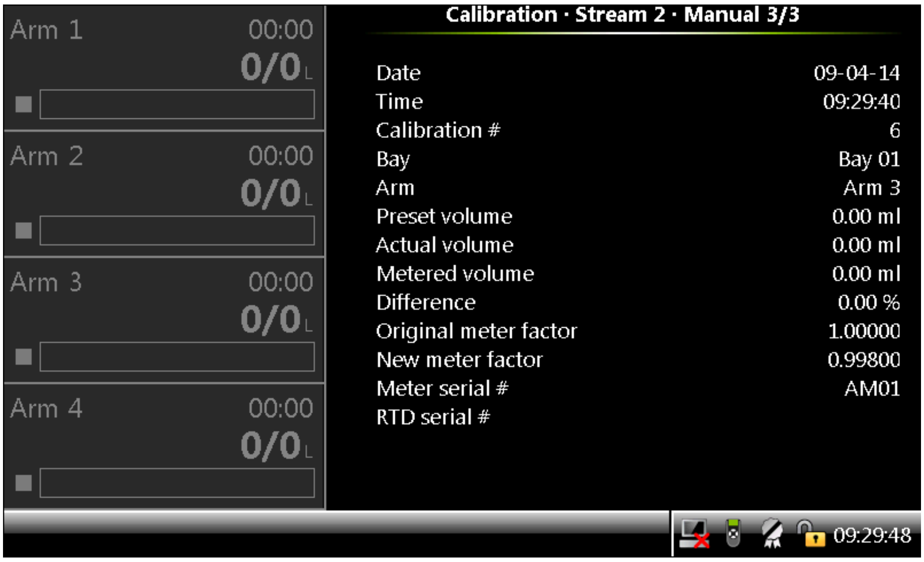
3. On the **Calibration . Stream n . Manual 1/3** screen, enter the new meter factor and then select <Confirm>.

   The **Calibration . Stream n . Manual 2/3** screen appears, which displays the new meter factor.



4. On 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.

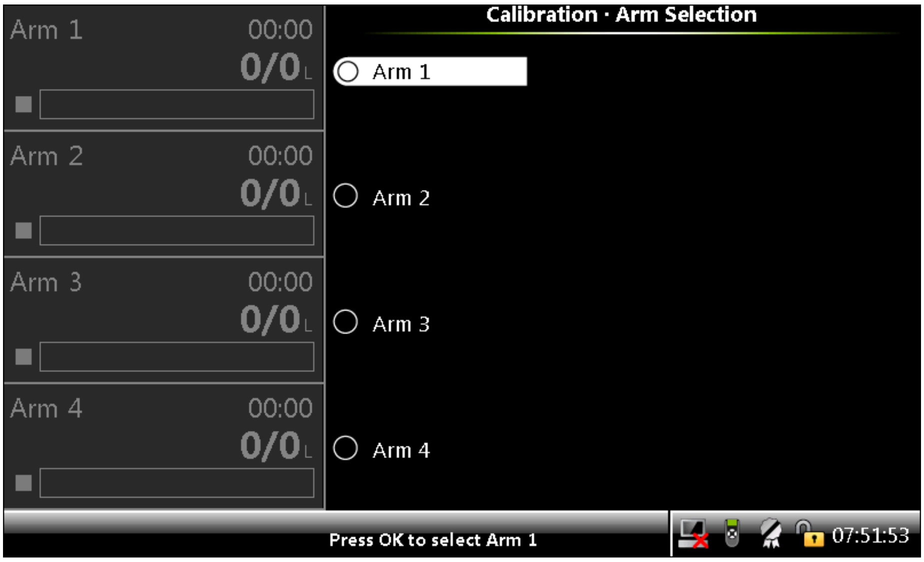
5.16.4 Wizard Calibration

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.

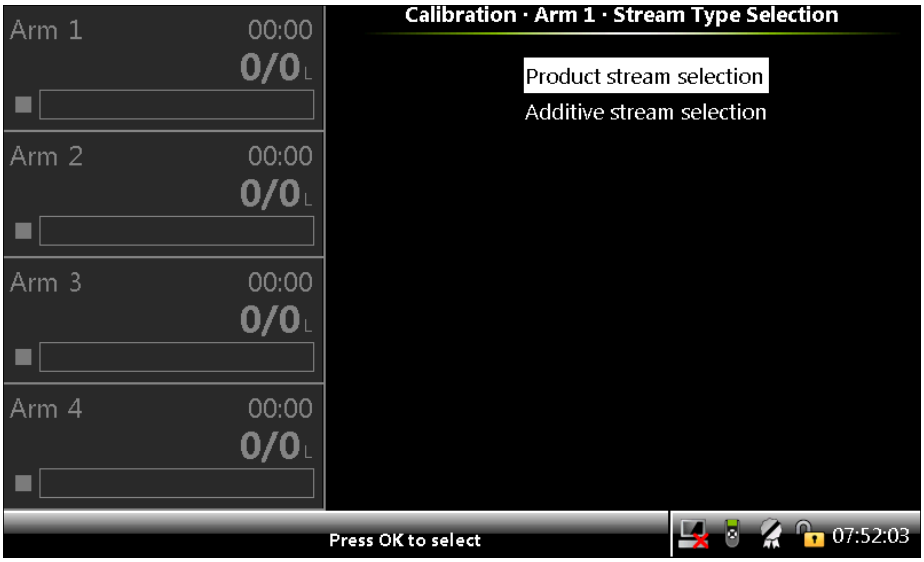
1. On the **Calibration** screen, select <Wizard> calibration and then select <OK> on the IR controller or LAD.

   The **Calibration . Arm Selection** screen appears.



2. Select any one of the arms. For example, Arm1.

   The **Calibration . Arm n . Stream Type Selection** screen appears.



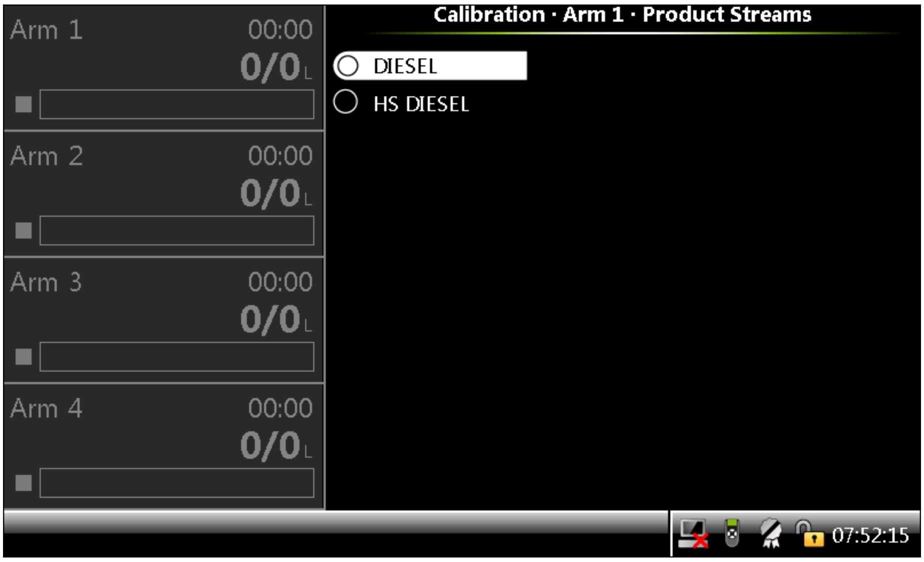
3. On the **Calibration . Arm n . Stream Type Selection** screen, select <Product stream selection> or <Additive stream selection>, to calibrate the product stream or additive stream accordingly.

   See the following sections for more information.

5.16.4.1 Product Stream Selection

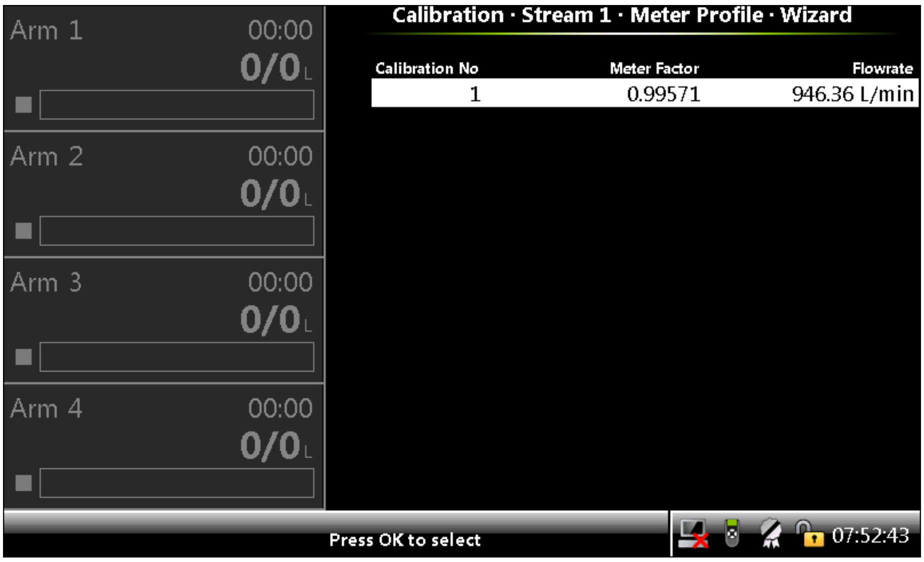
1. On the **Calibration . Arm n . Stream Type Selection** screen, select <Product stream selection>.

   The **Calibration . Arm n . Product Streams** screen appears.



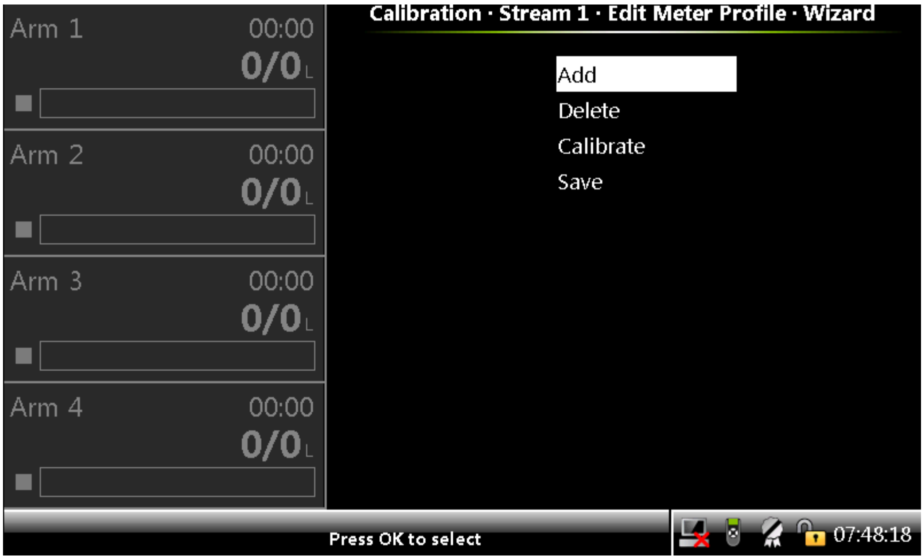
2. Select any one of the streams. For example, Stream 1.

   The **Calibration . Stream n . Meter Profile . Wizard** screen appears, which displays the Calibration No, Meter Factor, and the Flowrate.



3. Select <OK> on the IR controller or LAD to select the calibration point.

   The **Calibration . Stream n . Edit Meter Profile . Wizard** screen appears when a calibration record is selected.

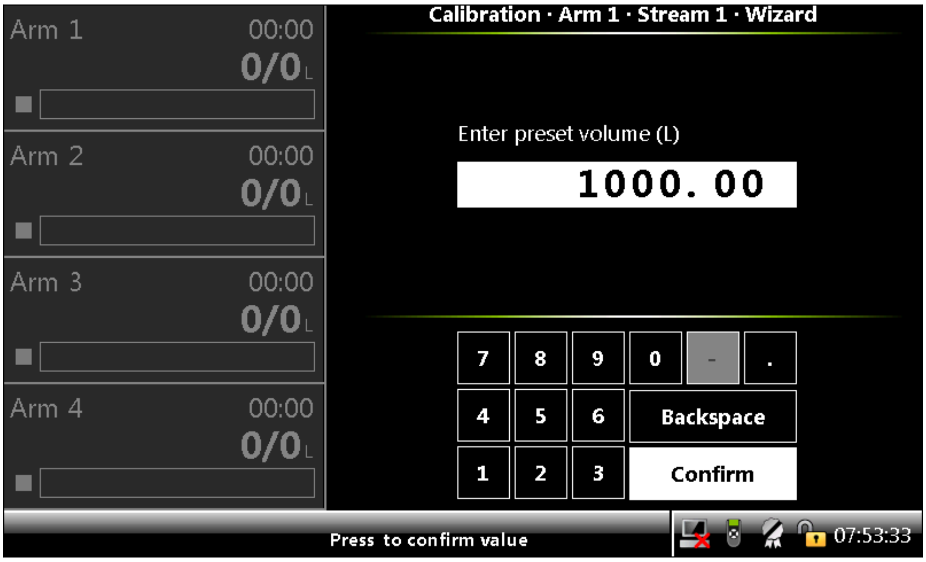


   The following functions can be performed.

   - Add - Adds a new calibration point to the meter profile.
   - Delete - Deletes the selected calibration point.
   - Calibrate - Re-calibrates the selected calibration point.
   - Saves - Saves the meter profile (generates Calibration Log record).

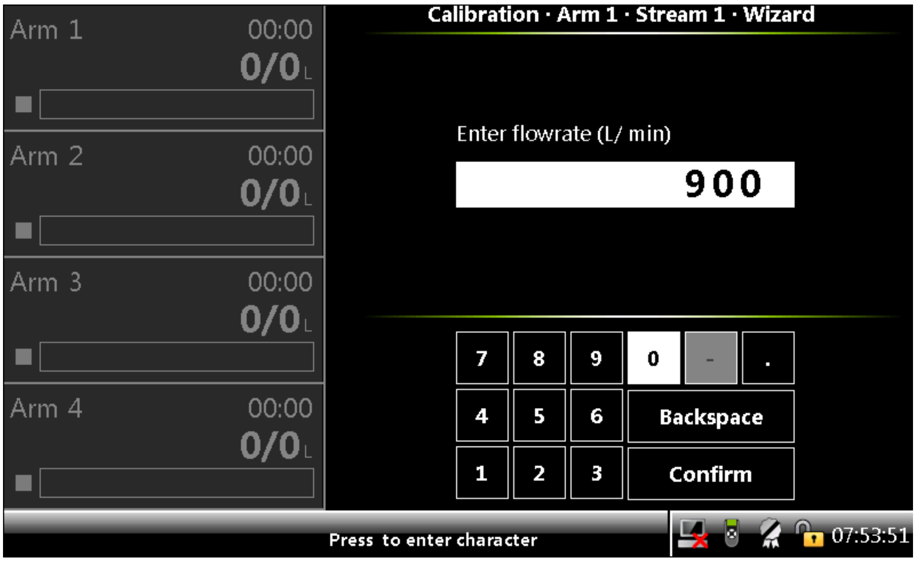
NOTE: *While adding a new calibration point, the initial meter factor is considered to be 1.*

4. If the Add function is selected, then the **Calibration . Arm n . Stream n . Wizard** screen appears, on which the preset volume must be entered.



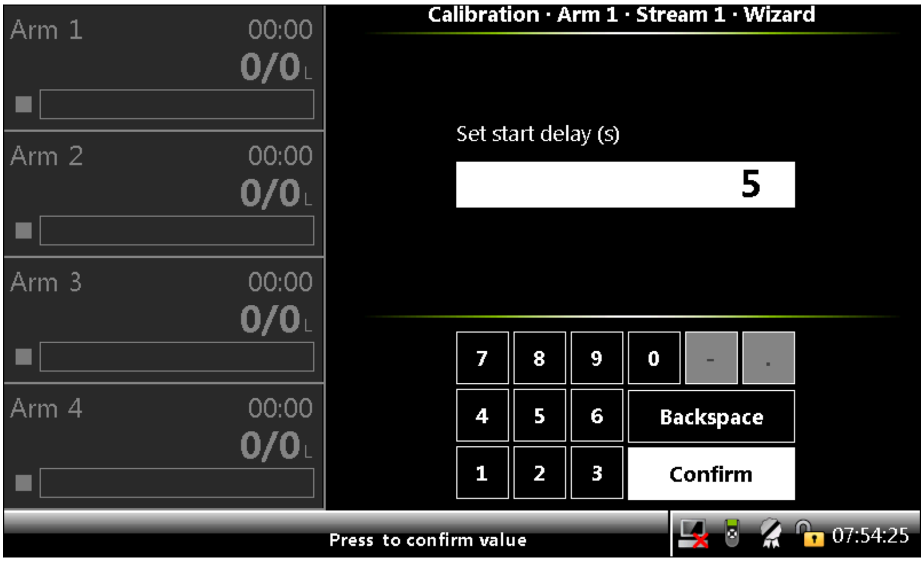
5. Enter the preset volume and then select <Confirm>.

   The **Calibration . Arm n . Stream n . Wizard** screen appears, on which the flowrate must be entered.



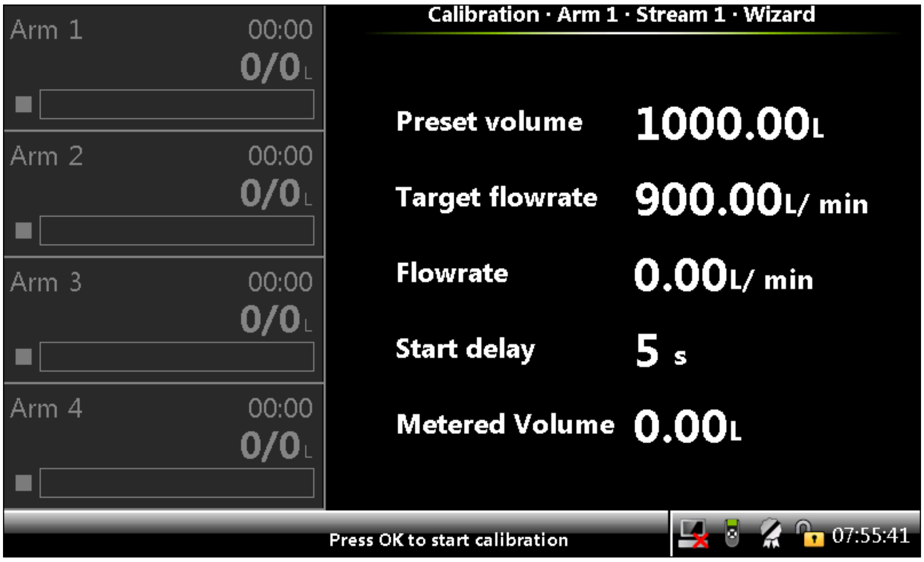
6. Enter the flowrate and then select <Confirm>.

   The **Calibration . Arm n . Stream n . Wizard** screen appears, on which the start delay time in seconds must be entered. A suitable delay time must be entered so that you can move to another place (for example, to observe the result) until the process continues.



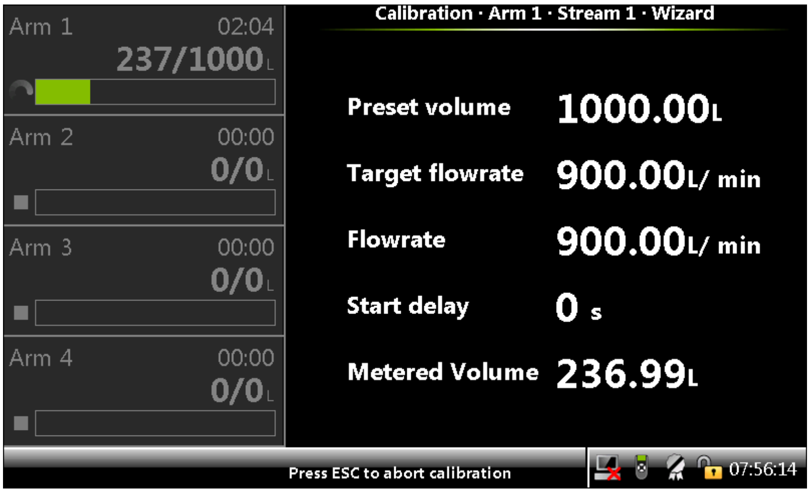
7. Enter the start delay in seconds and then select <Confirm>.

   The **Calibration . Arm n . Stream n. Wizard** screen appears with the Preset volume, Flowrate, Start delay time in seconds, and the Metered Volume.

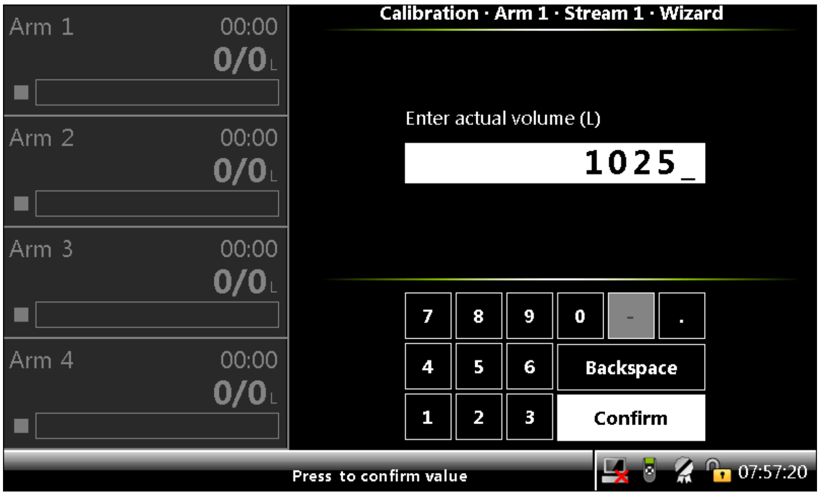


8. Select <OK> on the IR controller or LAD to start the calibration.

   The countdown of the delay time starts. After the expiration of the delay time, the calibration process starts.

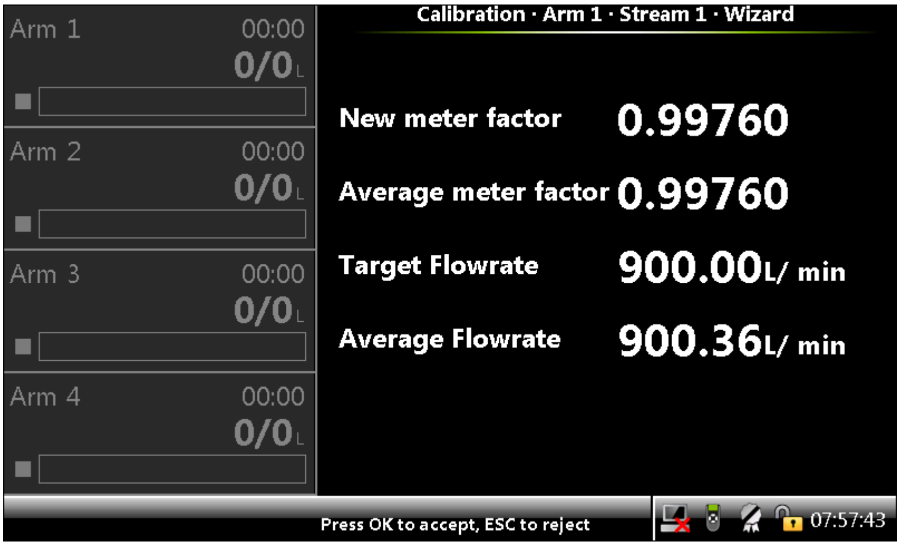


9. When the preset volume is loaded completely the **Calibration . Arm n . Stream n . Wizard** screen appears, on which the actual volume must be entered.



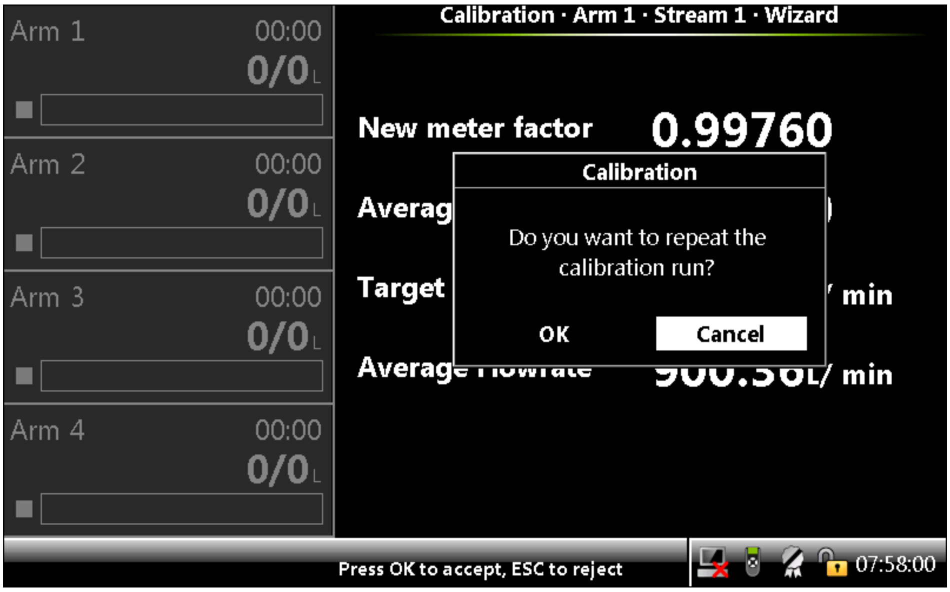
10. Enter the actual volume and then select <Confirm>.

    The **Calibration. Arm n . Stream n . Wizard** screen appears, on which the new calculated meter factor appears.



11. Select <OK> on the IR controller or LAD to accept the new meter factor or <ESC> to reject the meter factor.

    If <OK> is selected, then a message appears informing if you want to repeat the calibration runs.

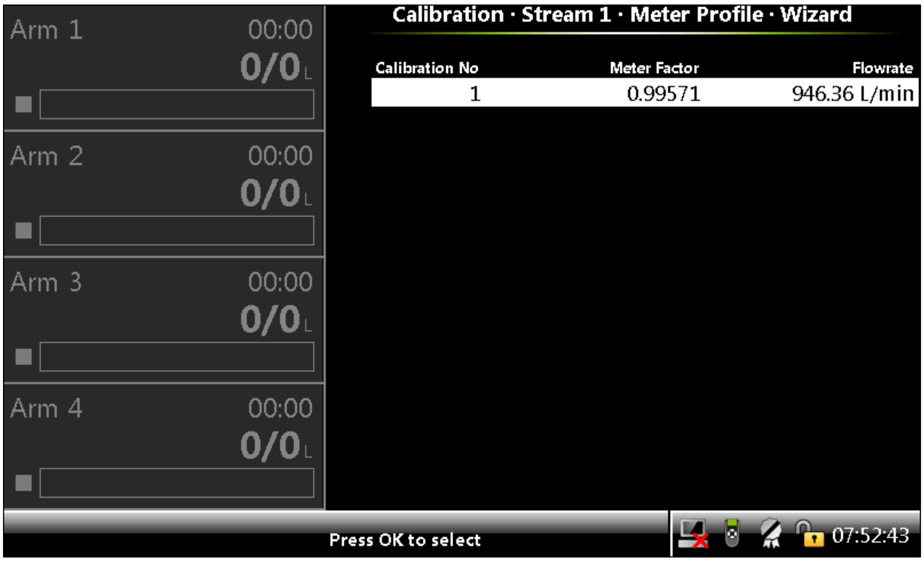


12. Following options can be performed.
    - Select <OK> on the IR controller or LAD to repeat calibration on the same flow rate.

NOTE: *Maximum of 5 calibrations can be performed for a single flow rate.*

- Select <Cancel> to terminate the operation.

The **Calibration . Stream n . Meter Profile Wizard** screen appears, which displays the latest calibrated point with the new meter factor.

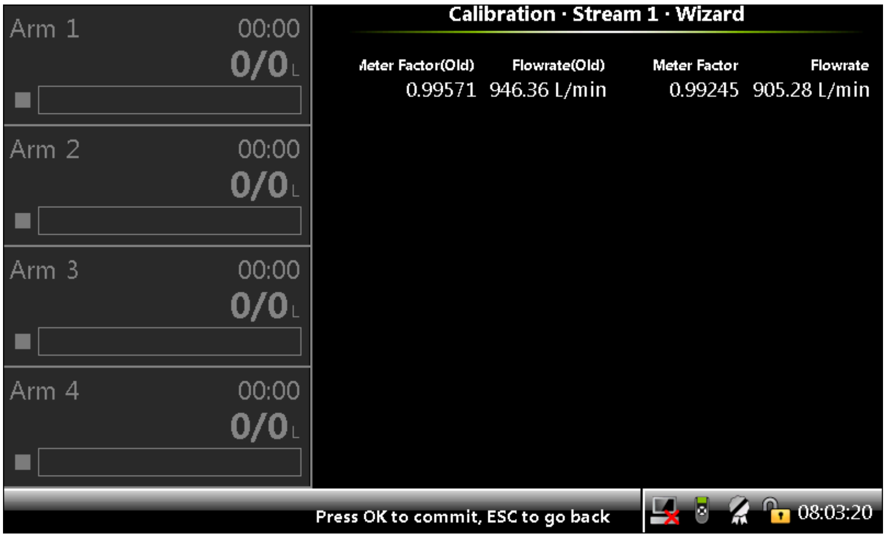


13. Select <OK> on the IR controller or LAD.

    The **Calibration . Stream n . Edit Meter Profile Wizard** screen appears, on which the options to save or delete the calibration point are available.

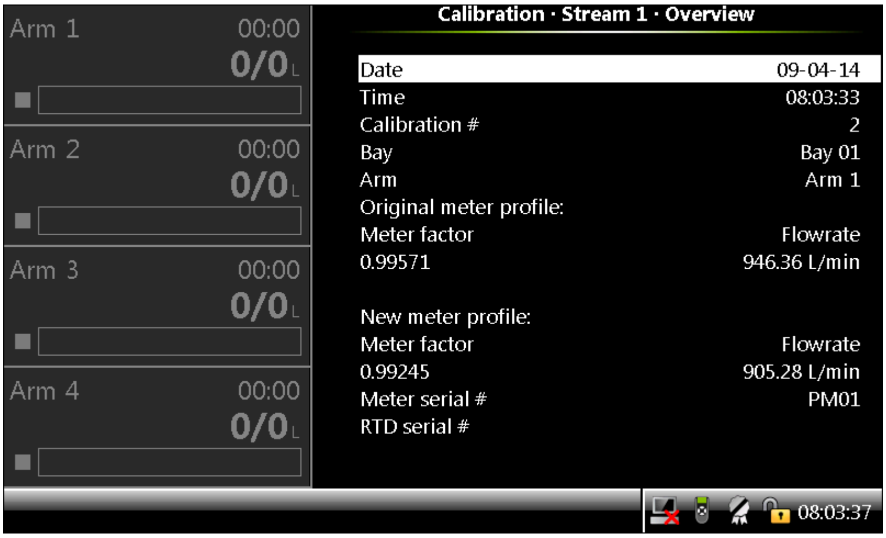
14. Select <OK> on the IR controller or LAD to save the calibration point.

    The **Calibration . Stream n . Wizard** screen appears, which displays the Meter Factor(old), Flowrate(old), Meter Factor, and Flowrate.



15. Select <OK> to commit the calibration point.

    The **Calibration . Stream n. Overview** screen appears.



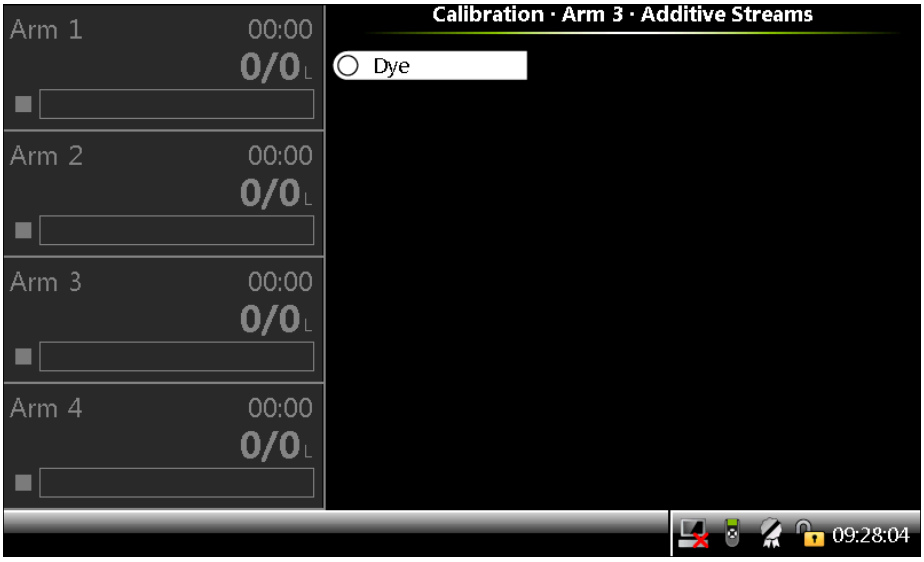
NOTE: Select <ESC> to restore the old values.

16. Select <OK> to go back to the **Main Menu**.

5.16.4.2 Additive Stream Selection

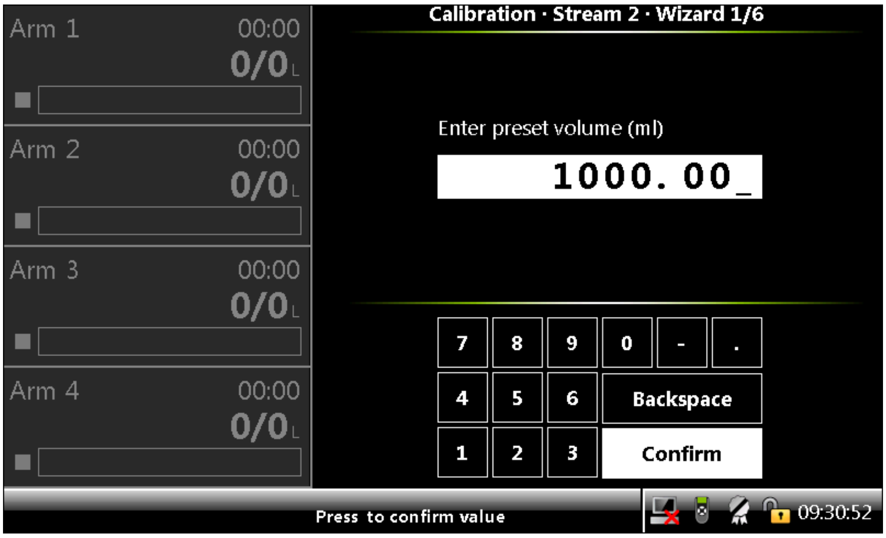
1. On the **Calibration . Arm n . Stream Type Selection** screen, select <Additive stream selection>.

The **Calibration . Arm n . Additive Streams** screen appears.



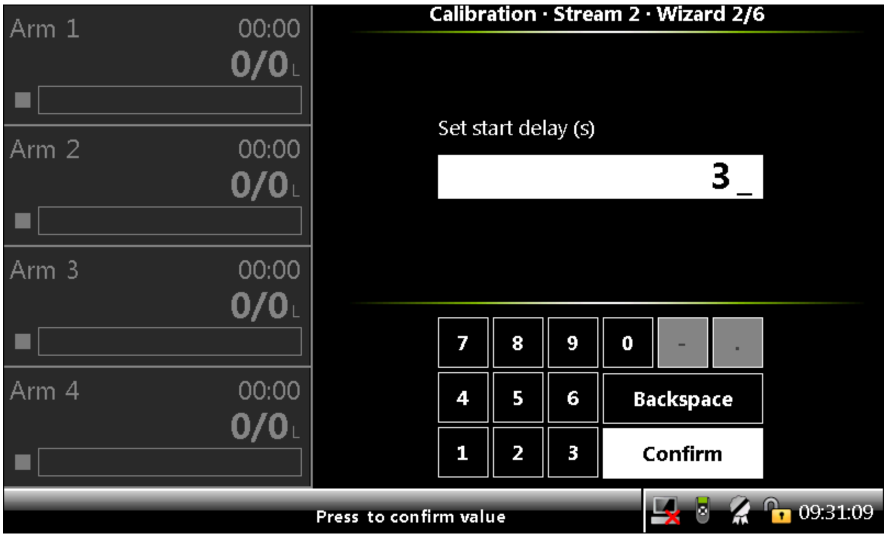
2. Select any one of the streams. For example, Stream 1.

   The **Calibration . Stream n . Wizard 1/6** screen appears, on which the preset volume must be entered.



3. On the **Calibration . Stream n . Wizard 1/6** screen, enter the preset volume that the MSC-L must inject for the calibration process and then select <Confirm>.

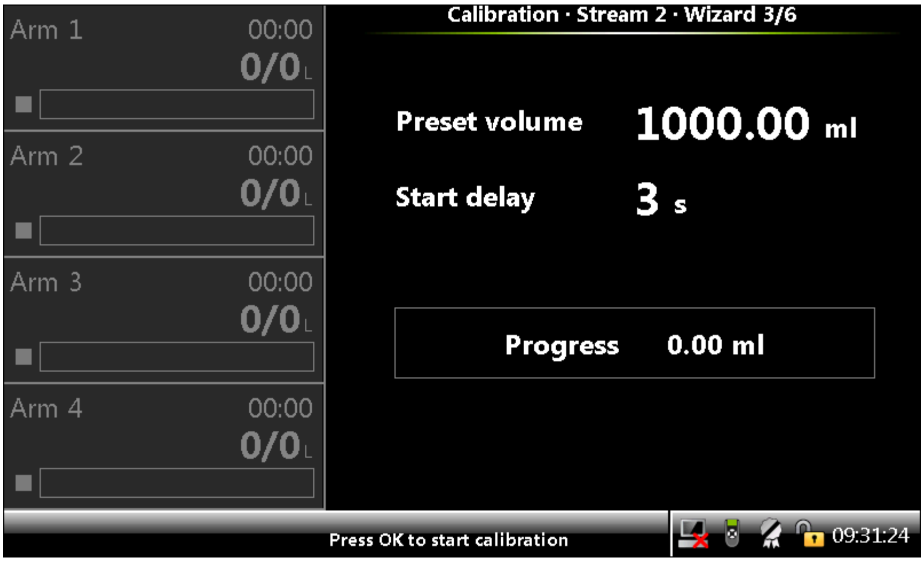
   The **Calibration . Stream n . Wizard 2/6** screen appears, on which the delay time must be entered.



4. 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.

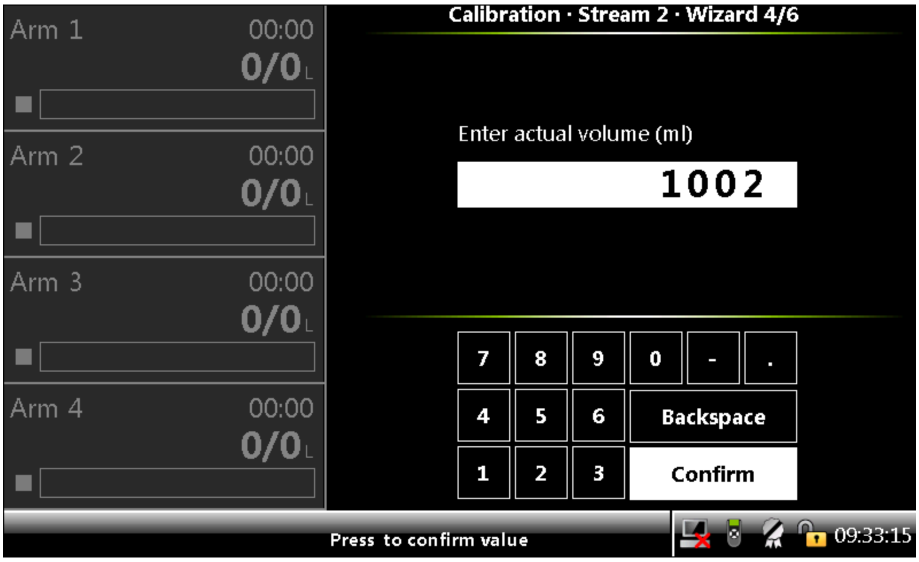


5. Check the Progress bar to monitor the calibration progress.
6. Select <OK> on the IR controller or LAD.

   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.

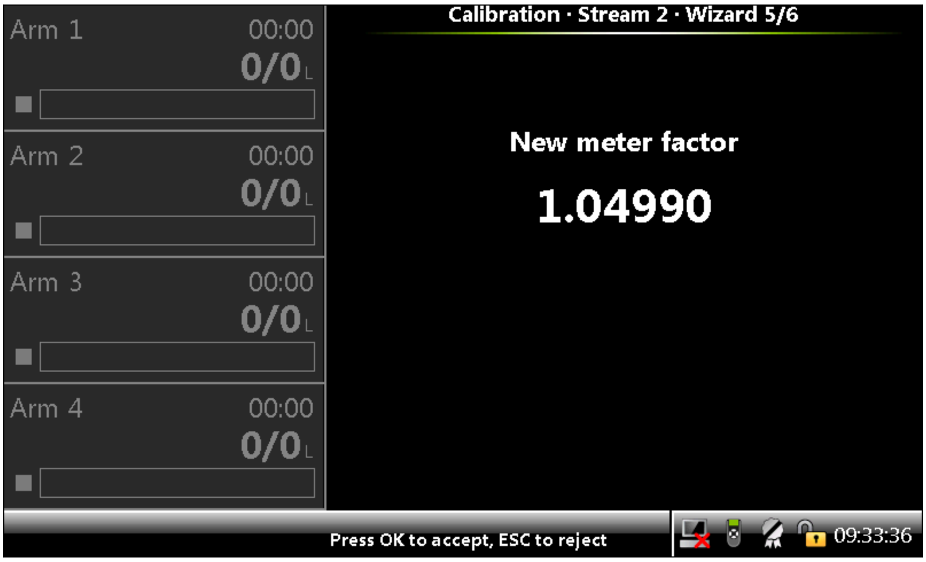
7. After the process is completed, the **Calibration . Stream n . Wizard 4/6** screen appears, on which the actual measured volume must be entered.



8. 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-L measured, a new meter factor is calculated.

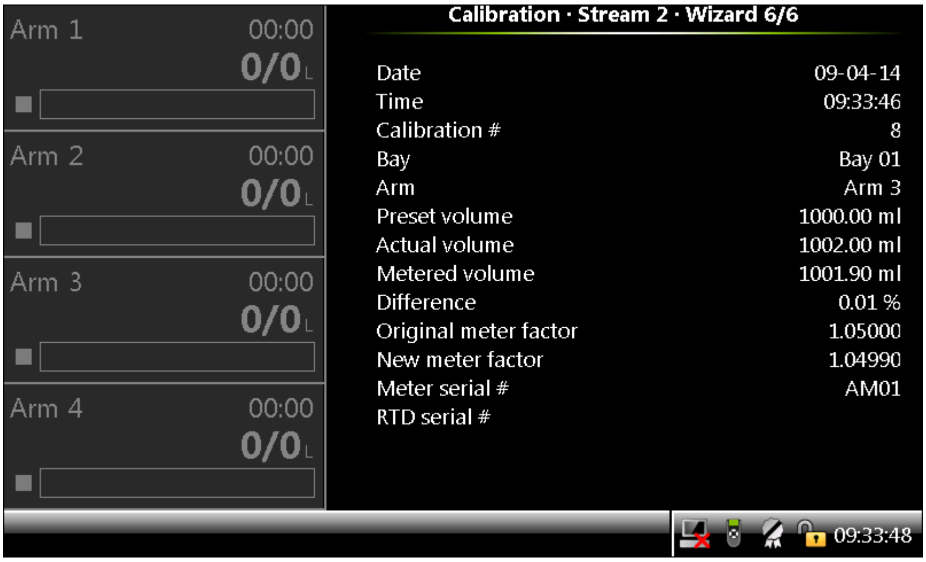
   The **Calibration . Stream n . Wizard 5/6** screen appears, which displays the new meter factor.



9. 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.

5.17 Info (Device Information)

5.17.1 Device Information

To view the Device Information

- On the **Main Menu** screen, select the **Info** icon to view the device and the module information.

  The **Device Info** screen appears, which displays the Device information and the Module information.

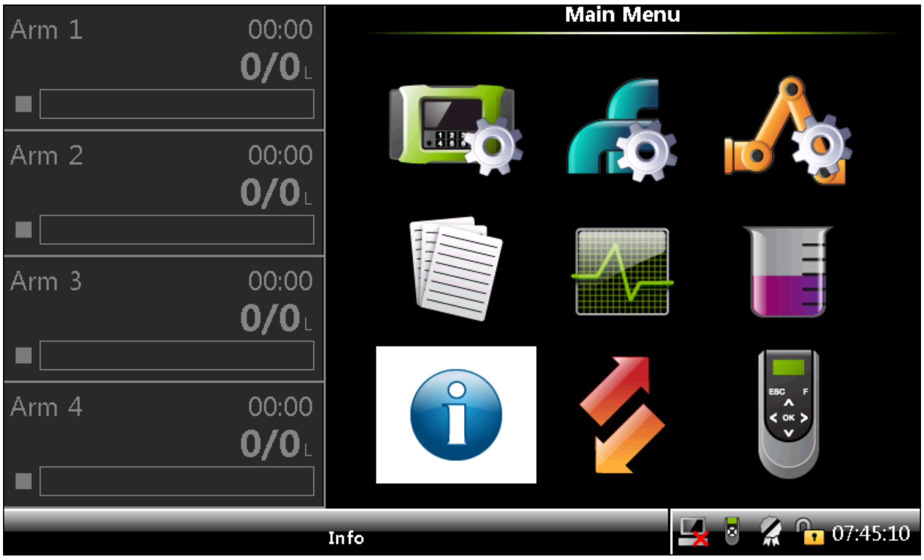


FIGURE 5-37 Info icon

The Device Info section displays the important information about the device, which includes the following:

- Device serial number
- Production date
- Sales code
- License

NOTE: All the above device information is programmed by Honeywell Enraf 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

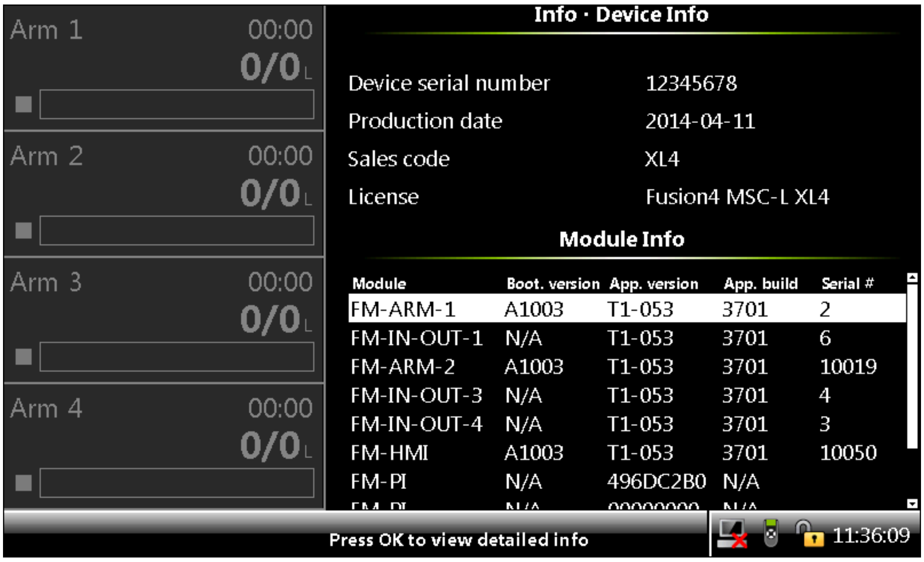
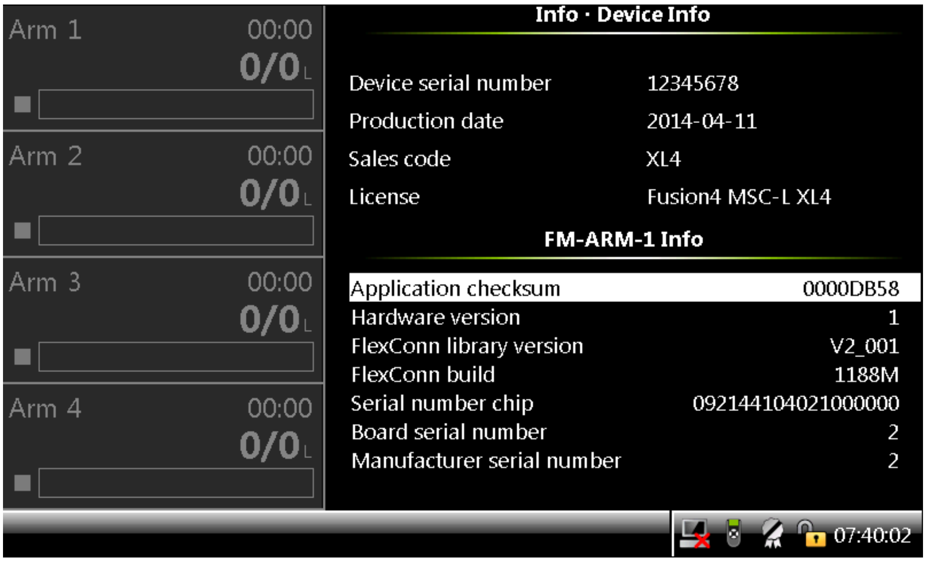


FIGURE 5-38 Device Info/Module Info screen

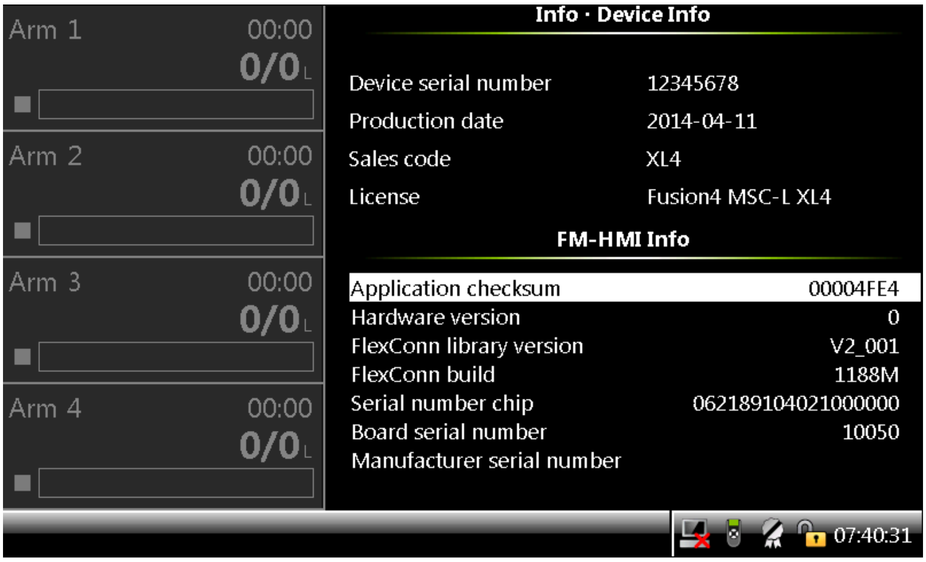
- Select **FM-ARM-n**.

  The following **FM-ARM-n Info** appears.



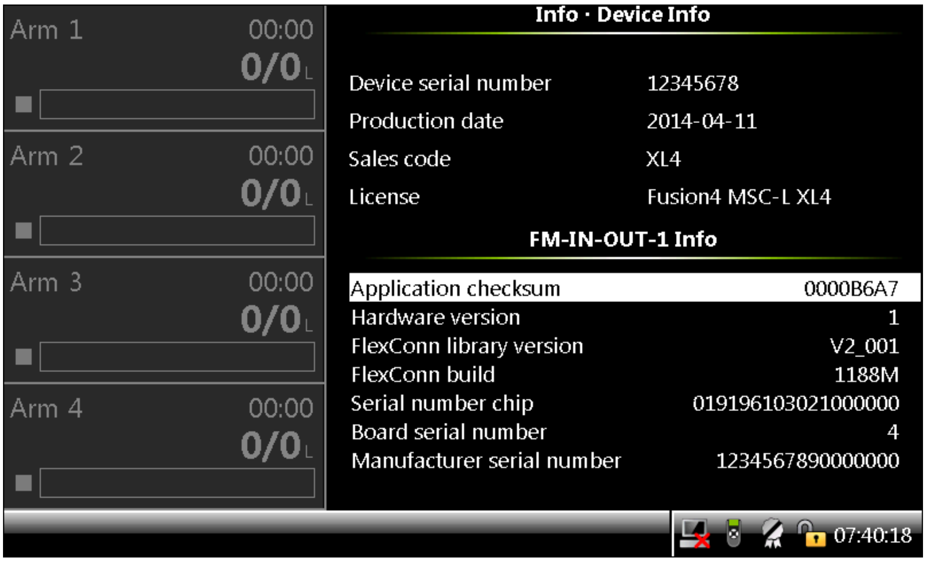
- Select **FM-HMI-n**.

The following **FM-HMI-n Info** appears.



- Select **FM-IN-OUT-n**.

  The following **FM-IN-OUT-n Info** appears.



The MSC-L software version format is explained in the following figure.

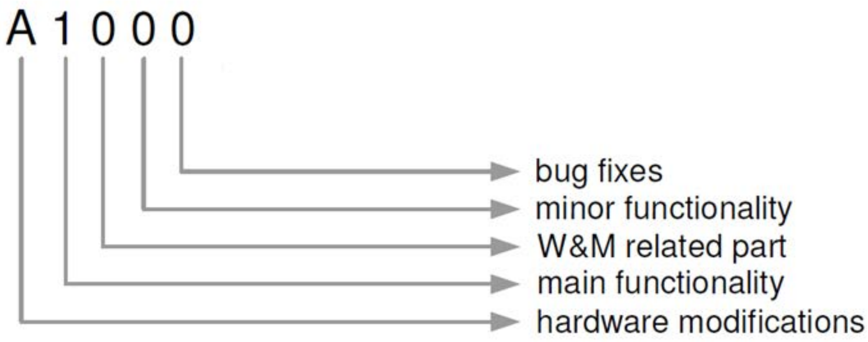


FIGURE 5-39 Software version format

To have W&M compliant MSC-L, check that the firmware versions are the certified software versions as mentioned in the following table.

The version can be checked in the **Info. Device Info** screen.

Board	Firmware	Software version
CAN-HMI-MSC	FM-HMI	A<N><N>xx
CAN-ARM-MSC	FM-ARM	A<N><N>xx
CAN-ARM-MSC	FM-PI	A<N><N>xx
CAN-IN-OUT-MSC	FM-IN-OUT	Not legally relevant

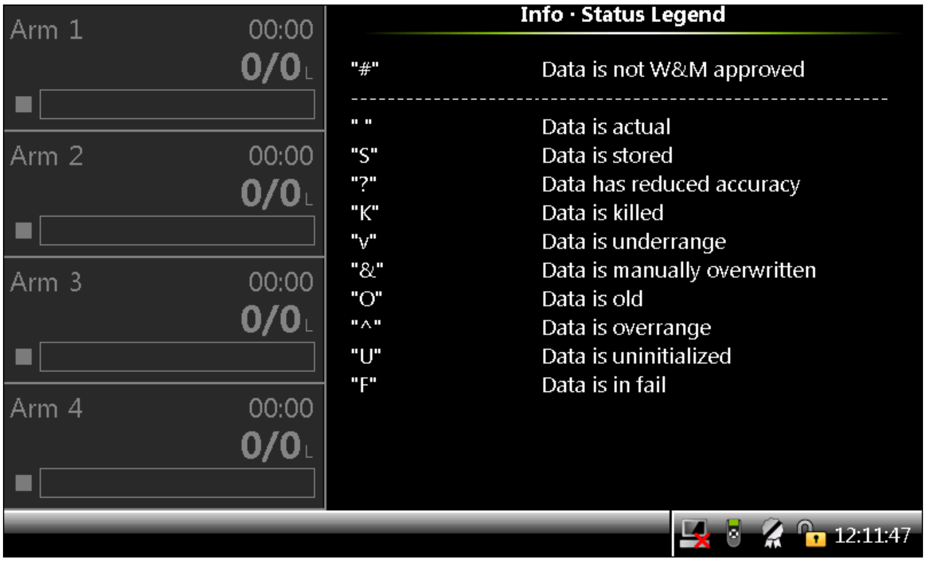
NOTE: NN is the version mentioned in the W&M certificate.

5.17.2 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

Status Character	Category
F	Data is in Fail



5.18 Transfer

NOTE: *The Transfer functions are available only when LAD is connected to the MSC-L.*

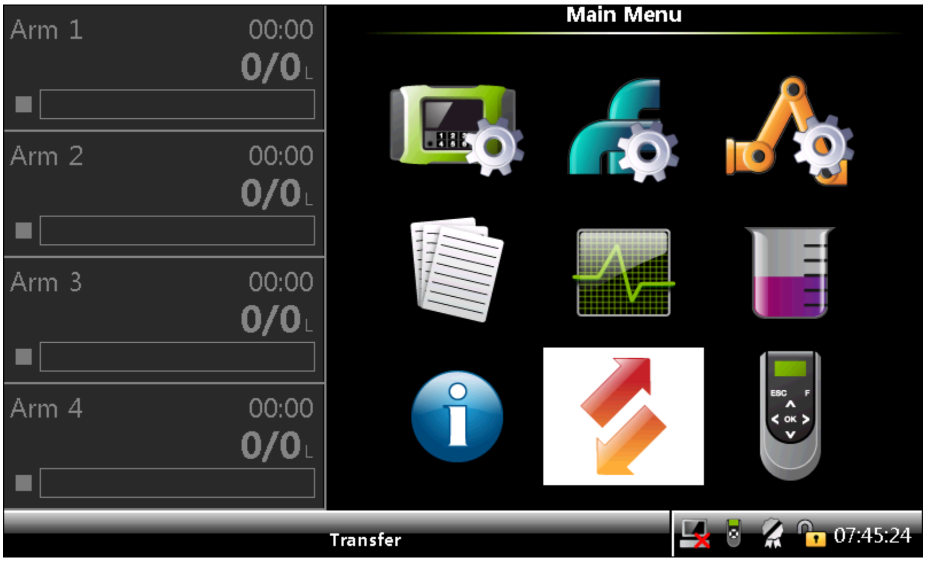


FIGURE 5-40 Transfer icon

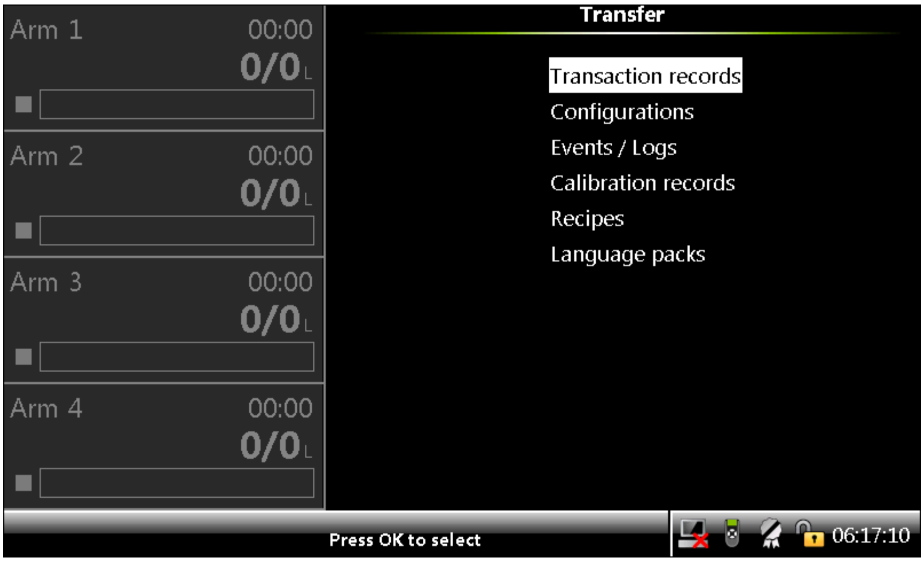
Using the Transfer menu, the following types of records can be transferred between the MSC-L and the LAD.

- Transaction records
- Configurations
- Events / Logs
- Calibration records
- Recipes
- Language packs

5.18.1 General

- On 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-L and the LAD.



The following figure describes the data-transfer directions.

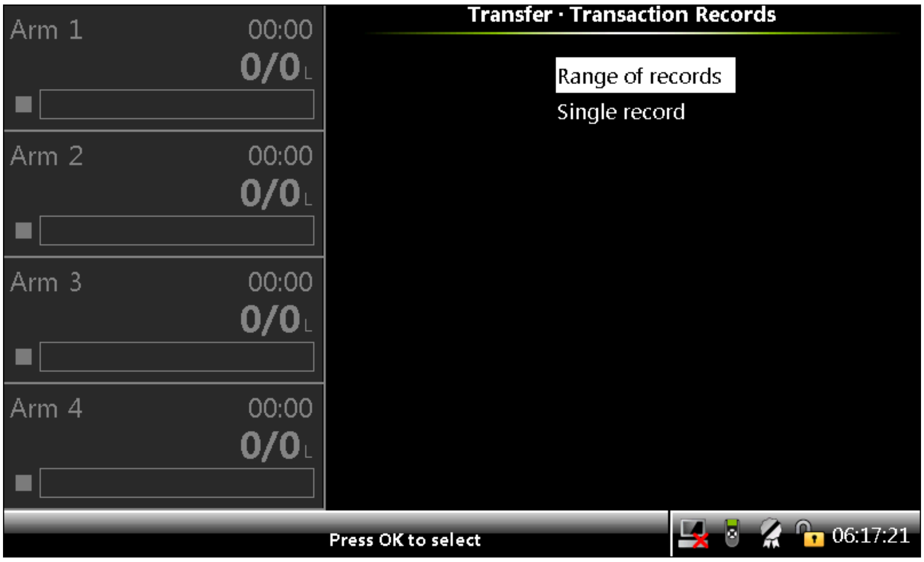
FIGURE 5-41 Data-transfer directions

5.18.2 Retrieving Transaction Records

The MSC-L 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.

On 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 for copying a transaction record to the LAD.*

Maximum 10, 000 transactions can reside in the transaction memory of the MSC-L. The oldest transaction is overwritten after 10,000 transactions.You must settle all transactions before the oldest one is automatically deleted and overwritten. You are responsible for the settlement of the transactions within 3 months. Once the transactions are overwritten, then these transactions cannot be retrieved by the Fusion4Portal or the LAD.

The transaction and batch details explained in the following sections are retrieved as a single record.

5.18.2.1 Transaction Details

Transaction Record Parameter	Description
MSC-L Transaction Header	
Transaction Record Version	The version of this transaction record.
Transaction Number	The number of this transaction record.
Device Type	This describes the type of Fusion4 device the transaction record comes from.
Number of Batches	The number of batches in this transaction.
W&M Intended Transaction	If the device is configured as W&M intended during the complete transaction.
Base Temperature	Reference temperature that a user defines for volume correction.
Base Pressure	Reference pressure that a user defines for volume correction.
Units of Temperature	The engineering units associated with all temperature measurements in this record.
Units of Density	The engineering units associated with all density measurements in this record.
Units of Pressure	The engineering units associated with all pressure measurements in this record.
Site Name	The name of the site where the transaction happened.
Transaction Start Time	The time at which the transaction began (sampled from RTC entity).
Transaction Start Date	The date when the transaction began (sampled from RTC entity).
Transaction Stop Time	The time at which the transaction ended (sampled from RTC entity).
Transaction Stop Date	The date when the transaction ended (sampled from RTC entity).
Preset Type	This specifies if the preset value is expressed as volume or mass value.
Bay Number	The number of the bay the device is installed in.
Communications Mode	It expresses if the transaction is done in Local (No Communications) or Remote (Communications to TAS) Mode.
User Language	The language used by operator during transaction.
Contract ID	A string that represents the Contract or Order Number
Vehicle ID	A string that uniquely identifies the vehicle used in the transaction.

Transaction Record Parameter	Description
Batch Details	
Batch Number	The batch number associated with the current batch record.
Batch Start Time	The time at which the batch began (sampled from RTC entity).
Batch Start Date	The date when the batch began (sampled from RTC).
Batch Stop Time	The time at which the batch ended (sampled from RTC entity).
Batch Stop Date	The date when the batch ended (sampled from RTC).
Arm Name	The name of ARM used for dispensing the blended product.
Arm Number	The number of the arm used for bringing the batch.
Blend Type	Specifies the type of blend (none, ratio, or side stream).
Batch Recipe Definition	The recipe used during the batch (name, blend %, API symbol).
W&M Compliant Batch	If the device was W&M compliant during the complete batch.
Unintended Stop	if the batch stopped unexpectedly during the load.
Compartment Number	The trailer compartment associated with this batch.
Returned Quantity	The amount of product in the compartment at the start of the batch.
Preset Volume	When used with a preset, this value defines the preset quantity for the batch. If not used in preset mode, then this value is 0.
Product Stream Details	
Batch Product Name	The name of product.
Batch Product Calibration Number	A counter incremented each time flow meter calibration is performed.
Batch Product Gross Observed Volume	The total observed volume of the product dispensed during the batch.
Batch Product Gross Standard Volume	The total gross standard volume (net) of the product dispensed during the batch.
Batch Product Mass	The total mass of the product stream for the batch.
Actual Blend Percentage	The actual percentage of the product in the finished product.
Batch Product Start Accumulated Gross Observed Volume	The gross observed accumulated volume at the start of the batch for the stream.

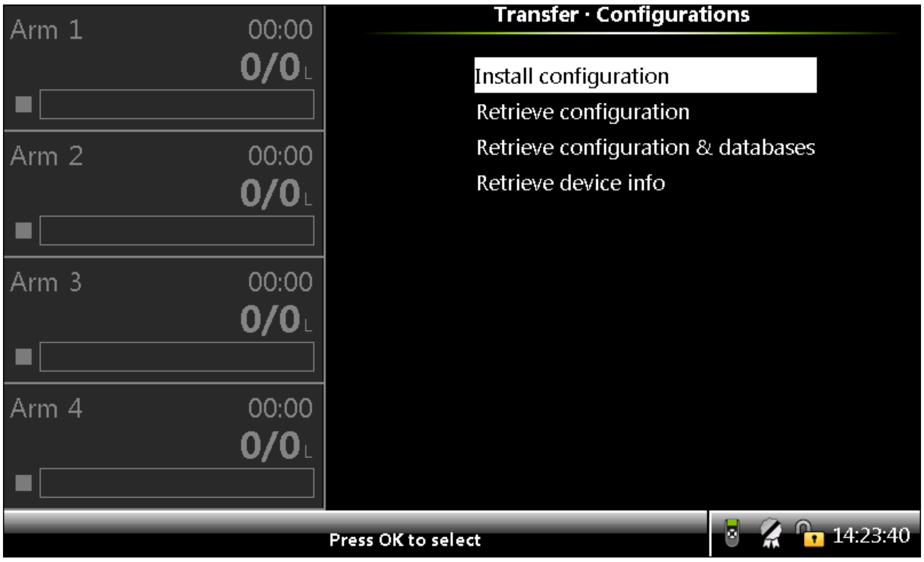
Transaction Record Parameter	Description
Batch Product Stop Accumulated Gross Observed Volume	The gross observed accumulated volume at the end of the batch for the stream.
Batch Product Start Accumulated Gross Standard Volume	The gross standard (net) accumulated volume at the start of the batch for the stream.
Batch Product Stop Accumulated Gross Standard Volume	The gross standard (net) accumulated volume at the end of the batch for the stream.
Batch Product Start Accumulated Mass	The arm accumulated mass at the start of the batch.
Batch Product Stop Accumulated Mass	The arm accumulated mass at the end of the batch.
Batch Product Average Temperature	The average or observed stream temperature during the batch.
Batch Product Average Pressure	The average or observed stream pressure during the batch.
Batch Product Average Density	The average or observed stream density during the batch.
Commodity Group	The commodity group of the product.
Temperature Compensation Used	Expresses if the temperature compensation is used for calculating the batch product gross standard volume.
Batch Product Pressure Compensation Used	Expresses if the pressure compensation is used for calculating the batch product gross standard volume.
Additive Stream Details	
Batch Additive Name	The name of additive injected into the load stream.
Batch Additive Calibration Number	A counter incremented each time the flow meter calibration is performed.
Batch Additive Gross Observed Volume	The total additive observed volume dispensed during the batch.
Batch Additive Gross Observed Leakage Volume	The total additive observed leakage volume that occurred during the batch.
Batch Start Additive Accumulated Gross Observed Volume	The additive gross accumulated volume at the start of the batch.
Batch Stop Additive Accumulated Gross Observed Volume	The additive gross accumulated volume at the end of the batch.
Additive PPM	The actual calculated parts per million of additive in the final product.

Transaction Record Parameter	Description
Additive Percent Deviation	The percentage additive deviation from the accumulative target additive injection volume

5.18.3 Configurations

On 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**.

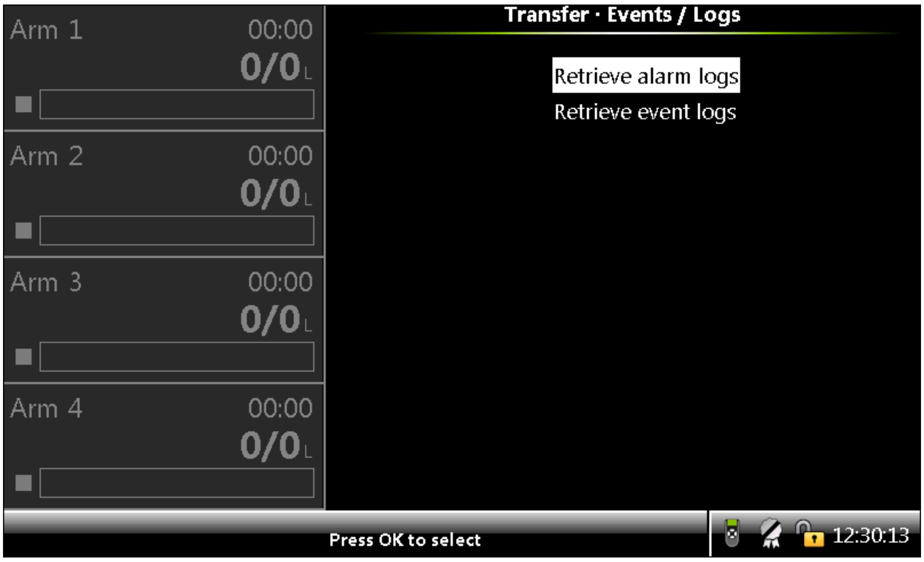
- <Install configuration> - Select this option to install the configuration present on the SD card.
- <Retrieve configuration> - Select this option to save the present configuration on the SD card.
- <Retrieve configuration & darabases> - Select this option to save the present configuration along with the authorization database on the SD card.
- <Retrieve device info> - Select this option to save the preset configuration information on the SD card.

NOTE: A warning message appears when the device is W&M sealed and a configuration file is installed.

5.18.4 Events / Logs

On the **Transfer** screen, select <Events / Logs> to retrieve the events and logs from the MSC-L.

The **Transfer . Events / Logs** screen appears, which displays the options to retrieve the events and logs from the MSC-L.



The following entities are available on the **Transfer . Events / Logs** screen.

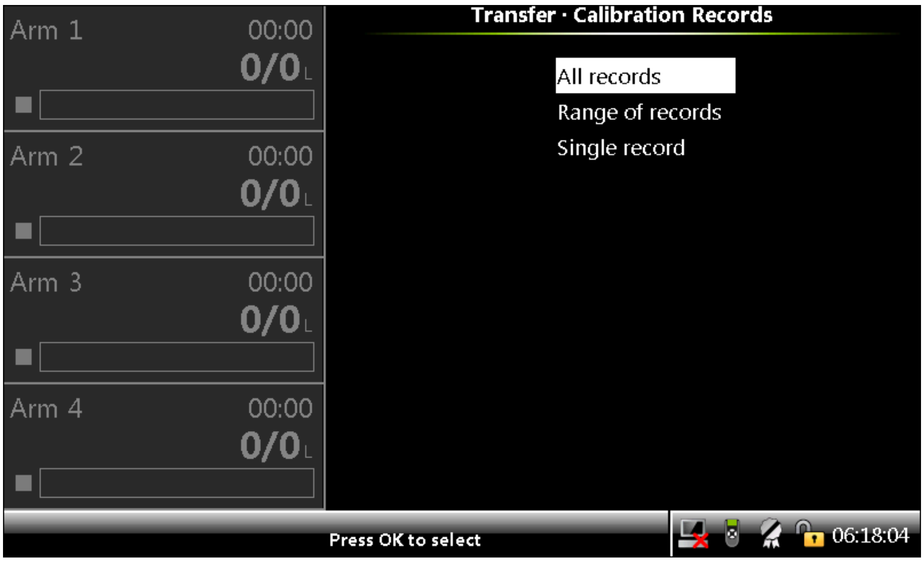
- <Retrieve alarm logs> - Select this option to retrieve the alarm logs.
- <Retrieve event logs> - Select this option to retrieve the event logs.

These logs are saved on the SD card inside the LAD device.

5.18.5 Calibration Records

On 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 required range of calibration logs from the available records.
- Single record - This option allows you to retrieve the calibration of a single record available on the device.

5.18.6 Recipes

On 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.

5.18.7 Language Packs

The language packs contain the local translations of the parameters and entities displayed on the screen of the MSC-L.

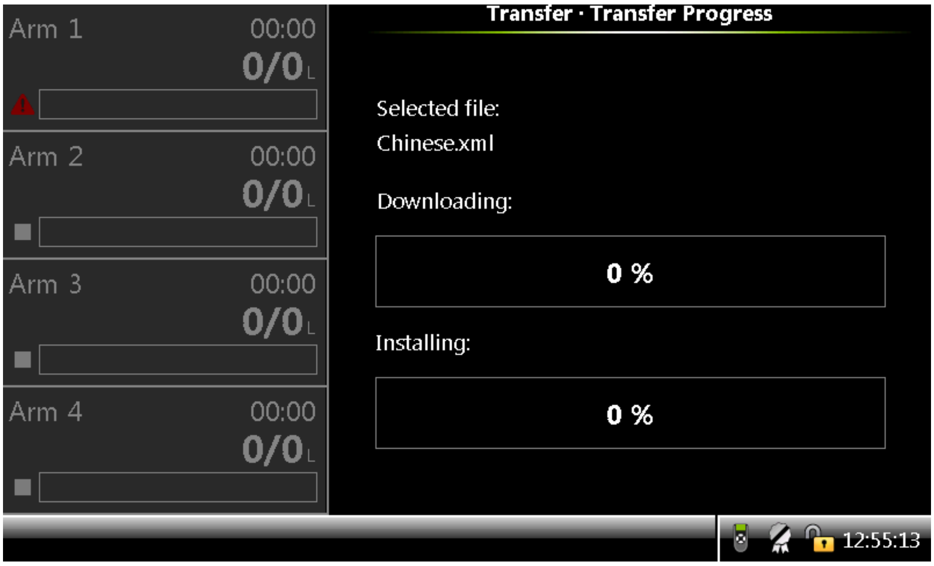
? Copy the language pack xml file to *'Honeywell\MSC-L\Generic\Language packs'* path located in the SD card of the LAD.

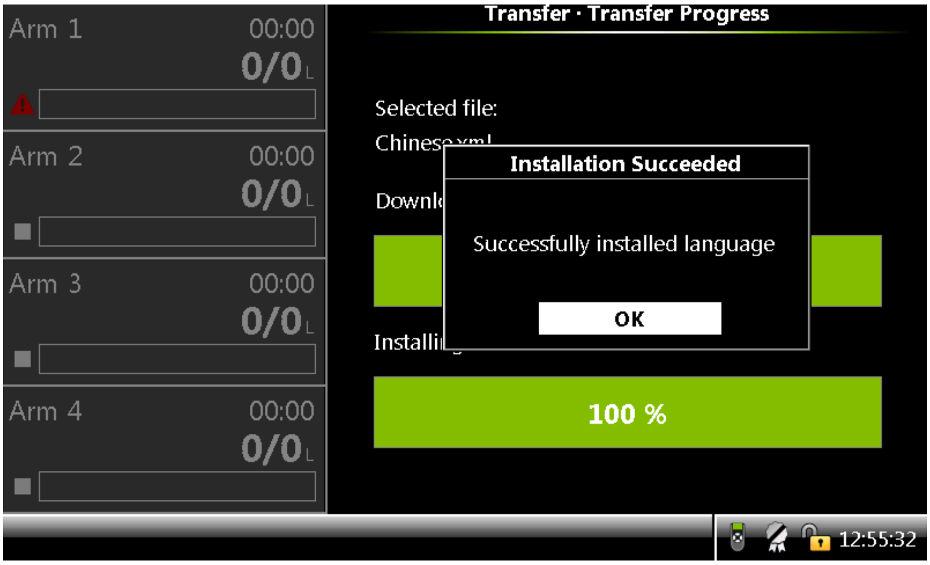
? On the **Transfer** screen, select <Language packs> to install the language file stored in the LAD.

The **Select File** screen appears.

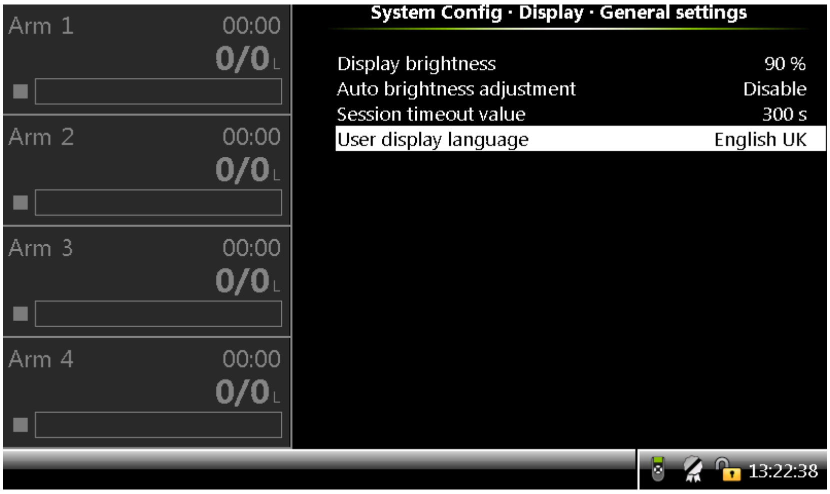
? Browse and select the language pack

? The **Transfer Progress** screen appears, displaying the language pack installation progress.





To select language preferences, go to **System Configuration**, **Device**, **General**, **Display**, **General Settings**, and then select the required language from <User display language>



NOTE: The language settings are applicable at a workflow level and are available for use after restarting the MSC-L device.

5.19 LAD Functions

NOTE: The LAD functions are available only when the LAD is connected to the MSC-L.

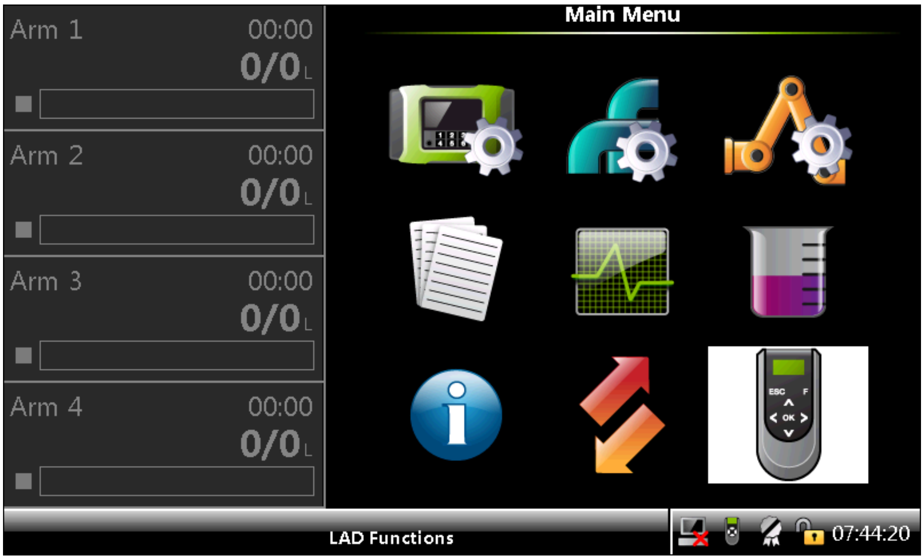


FIGURE 5-42 LAD icon

The LAD functions provide the following functionalities.

- Facility to download the firmware in the MSC-L and the LAD.
- Facility to navigate the screen.
- Configuration of the Test LED.
- Configuration of the LAD’s special function key.
- Information about the LAD.
- Facility to format the SD card.

5.19.1 General

- On the **Main Menu** screen, select the **LAD** icon.

The **LAD** function screen appears, which displays the various LAD functions and their activities.

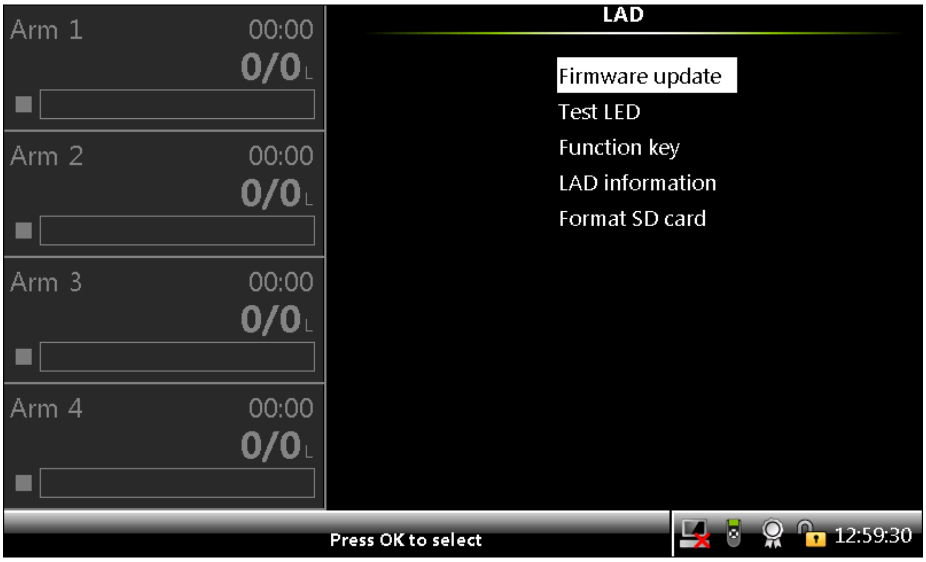


FIGURE 5-43 LAD functions

5.19.2 Firmware Update

NOTE: *Remove the old files that are available in* `Honeywell\MSC-L\Generic\Firmware\` *directory from previous upgrades before updating the files.*

To update the firmware using the LAD

1. Replace the following updated firmware files in the `Honeywell\MSC-L\Generic\Firmware\` directory.
   - FM-HMI-FC-FPGA.bin
   - FM-HMI-FC-IMG.bin
   - FM-IN-OUT-APP.bin (optional)
   - FM-ARM-FC-APP.bin
   - FM-HMI-FC-APP.bin

The FM-IN-OUT-APP.bin file is only required if the CAN-IN-OUT-MSC card is installed in the device.

2. Connect the LAD to the MSC-L and make sure that the SD card is inserted in the LAD before connecting.

   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.

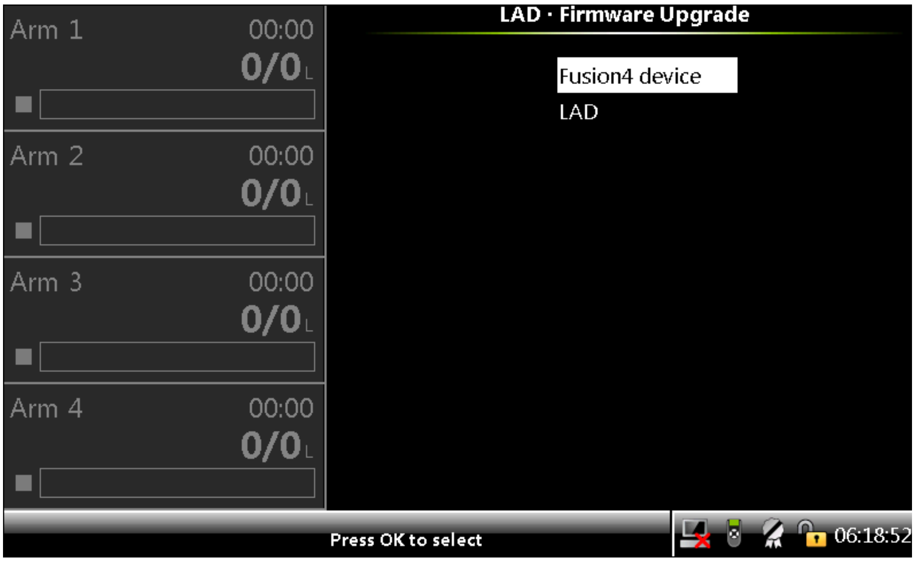
NOTE:

- Update the firmware only when the device is not being used.

- Do not insert or remove the SD card when the LAD is connected to the device and do not remove the LAD when an upgrade file is downloading.
- Do not perform the update procedure during a power outage, as this can cause problems and/or make the device unusable.

3. On 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.



4. Select <Fusion4 device> to update the files.

   The **Select File** screen appears.

5. On 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 the 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.bin
   - The total time for the firmware update file is 3.5 minutes approximately.

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.

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: *Update the files in the above sequence, unless mentioned in the release notes.*

NOTE: *Sometimes it is observed that after new firmware upgrade or license changed, the workflow behaves incorrectly. If this happens, the device has to be formatted for complete memory and install workflow again.*

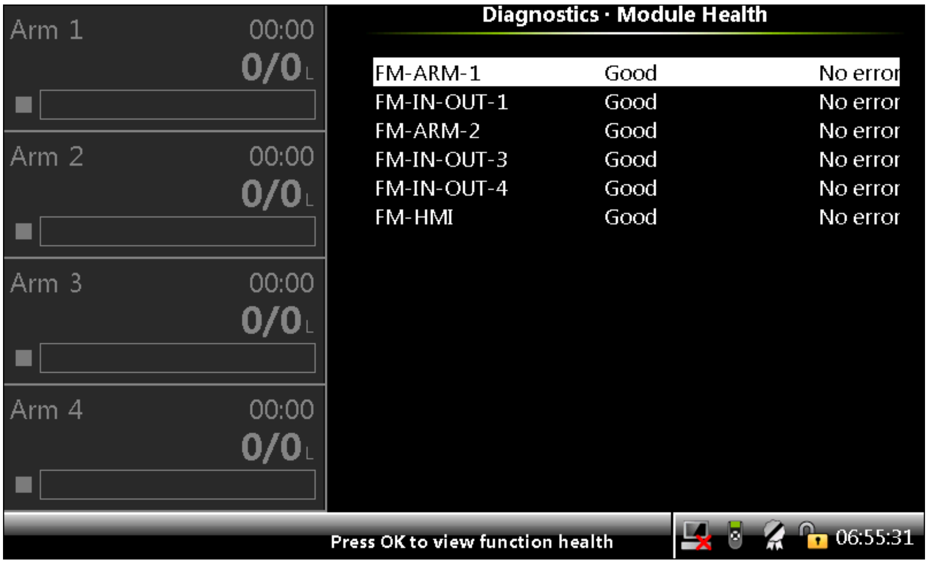
NOTE: *Make sure that format memory clear all configurtion data and all logs.*

5.19.2.1 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 on the **Device/ Module Info** screen.
2. Verify the parameter settings to check if they are the same as they were in the previous old firmware.

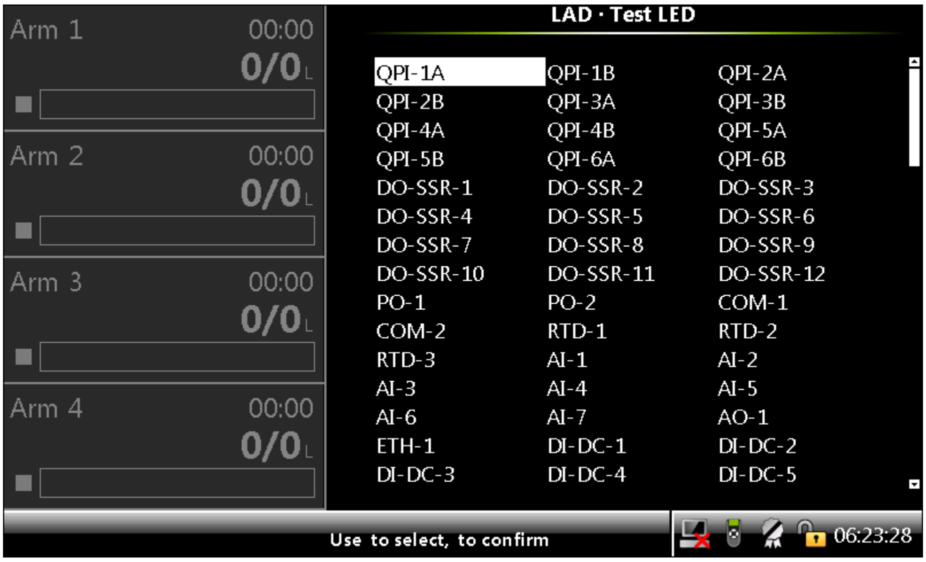
3. On the **Diagnostic** screen, select <System health> on any one of the boards and then select <OK> on the IR controller or the LAD. The test "Good/No Error" must appear on the screen, as shown in the **Diagnostic - Module Health** screen.



5.19.3 Test LED and LAD Information Submenus

On 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-L.



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 then select <OK>. The Test

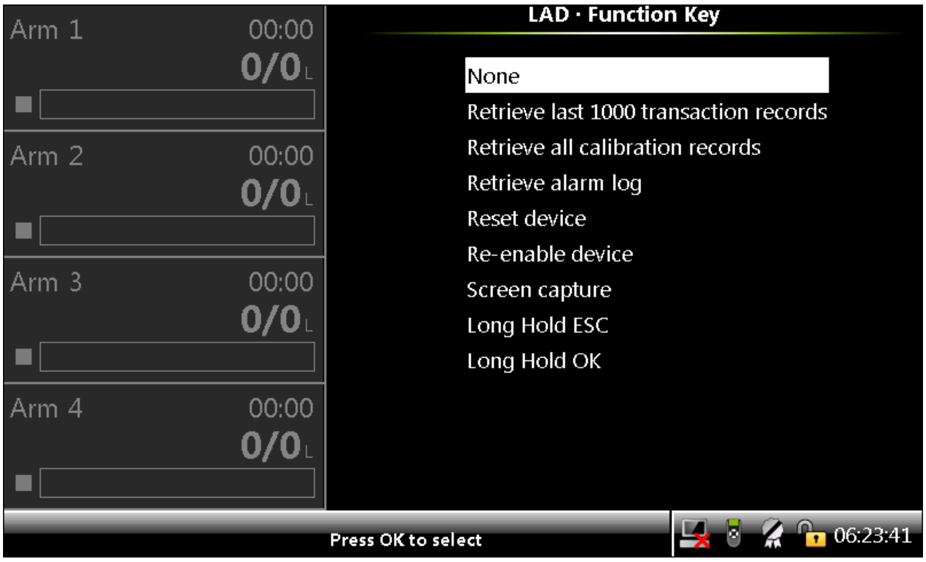
LED is red if the health of the assigned I/O is bad, and is green if the health of the assigned I/O is good.

5.19.4 Function Key

On the **LAD** screen, select <Function key> to specify the functions that can be programmed to the function “F” key on the LAD. This helps you to achieve a quicker operation of the MSC-L.

The **LAD . Function Key** screen appears, which specifies the functions that can be programmed.

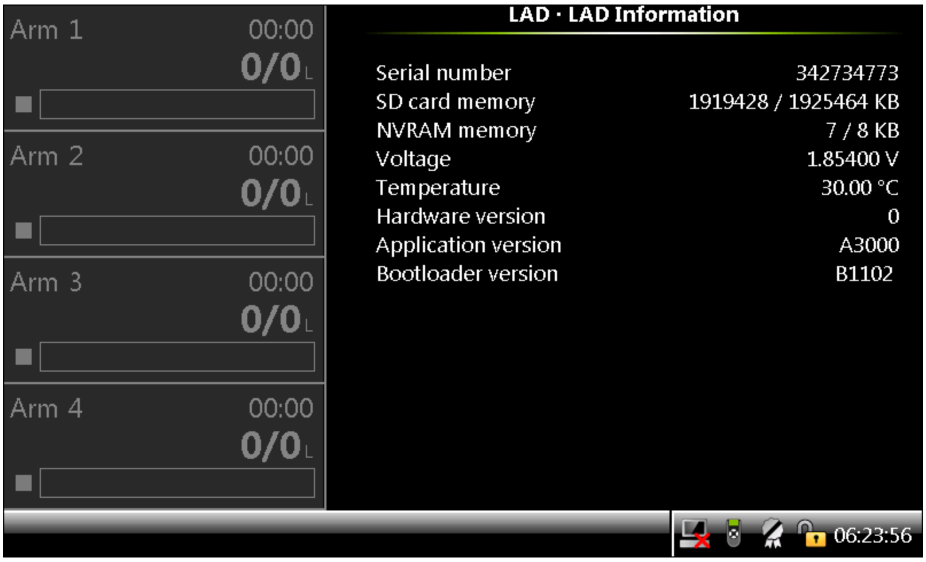
The configuration is saved on the LAD. Changes made to the function key is applicable for other Fusion4 devices also.



5.19.5 LAD Information

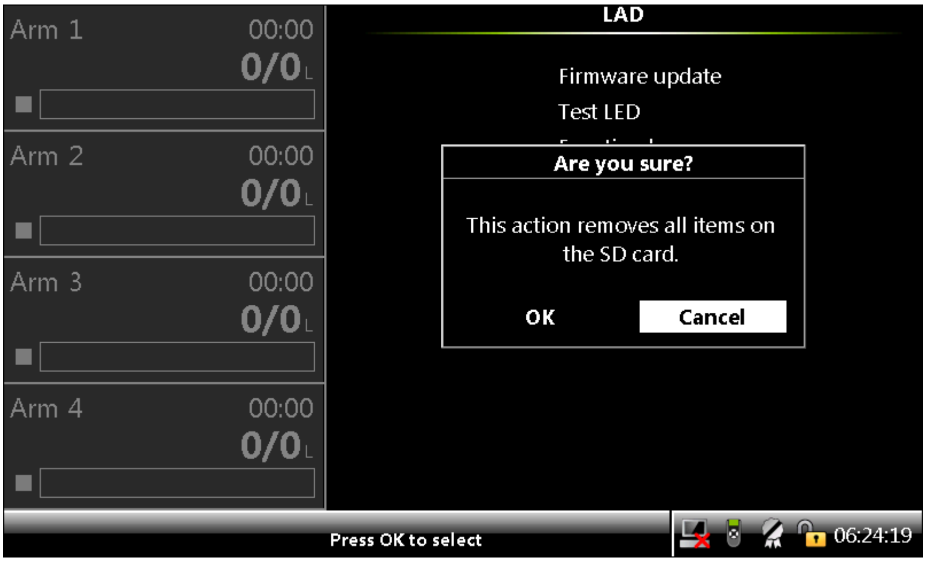
On the **LAD** screen, select <LAD information>.

The **LAD . LAD Information** screen appears which displays the relevant LAD information and diagnostics of LAD.



5.19.6 Format SD Card

1. On the **LAD** screen, select <Format SD card> to format the SD card of the LAD. The confirmation dialog box appears.



CAUTION! *All content is erased if you select* ***OK****.*

2. 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.

5.20 Truck Driver Operations

5.20.1 Overview

A truck driver can perform loading operations by navigating through the various screens designed for truck loading. FIGURE 5-44 provides an overview of the truck loading operations.

NOTE: The screens displayed in grey are optional.

The vehicle authorization prompts can be enabled or disabled from the workflow options on the device configuration menus. The permissive connect screens appear only if the respective I/O bindings are configured on the Bay I/O Bindings menu.

NOTE: This navigation is the factory default navigation, which is available when using the MSC-L is stand-alone and is not controlled by the TAS. The data entered on a few screens are validated and the invalid entry can result in errors.

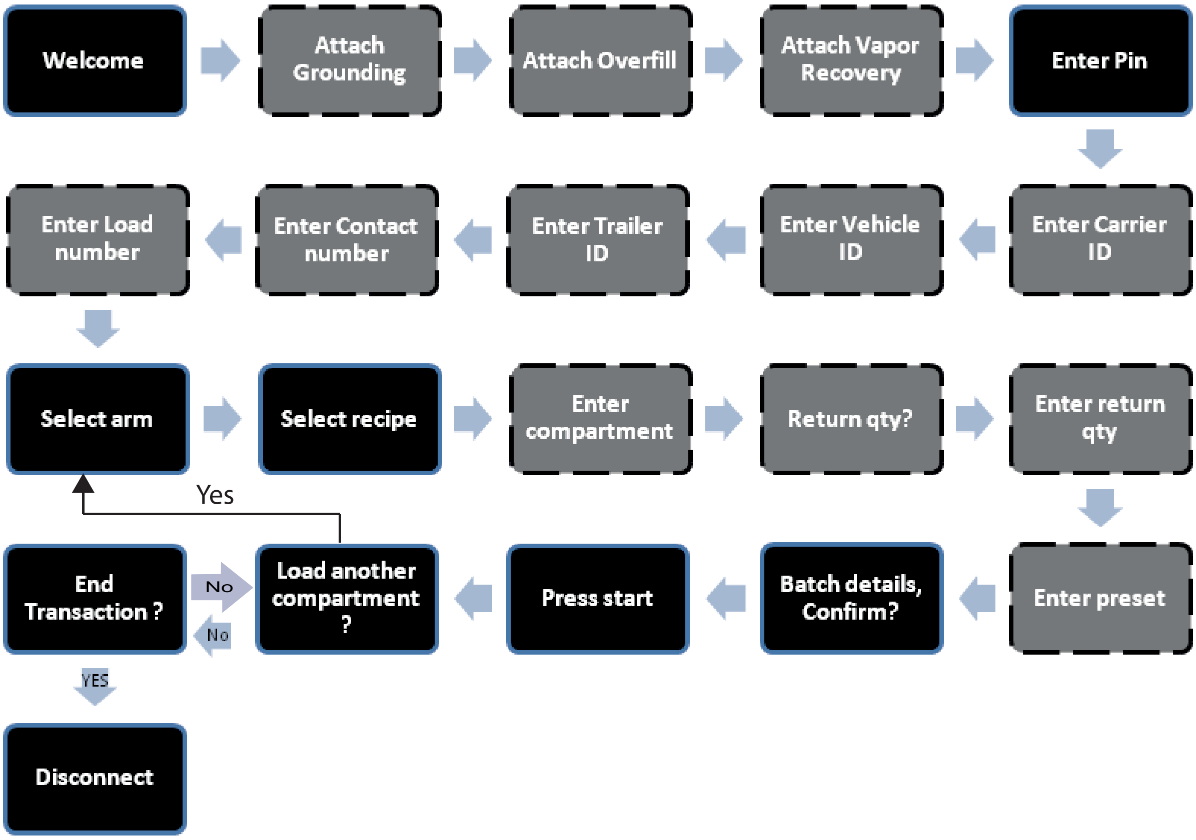
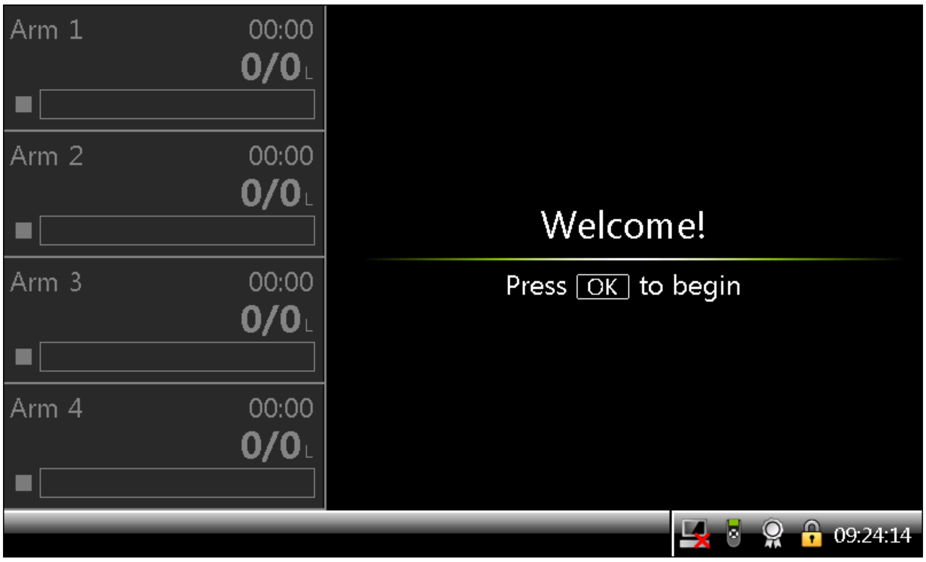


FIGURE 5-44 Sequence of Truck driver operations

5.20.2 Default standalone MSC-L workflow

NOTE: *This procedure is applicable in standalone mode and is not controlled by the TAS.*

1. When the MSC-L displays the **Welcome!** screen, press **OK** on the keyboard.



If permissives are configured, then permissive connect screen appears for each of the permissive similar to the grounding.

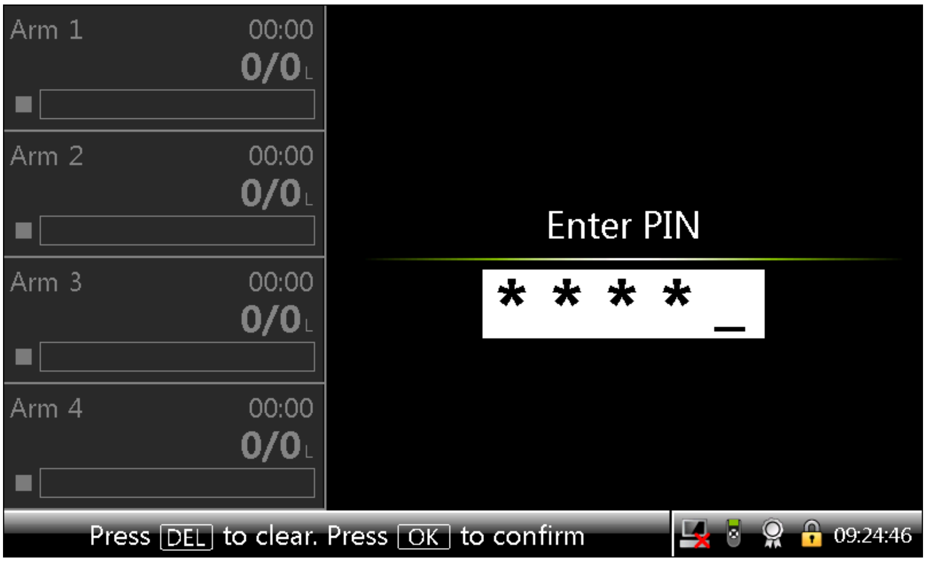
The **Enter Pin** screen appears only if the permissives are connected.

2. On the **Enter Pin** screen, enter the truck driver password using the keyboard.

   Press **OK** on the keyboard to confirm the password.

NOTE: The password is validated against the local database or the remote database based on the configuration.

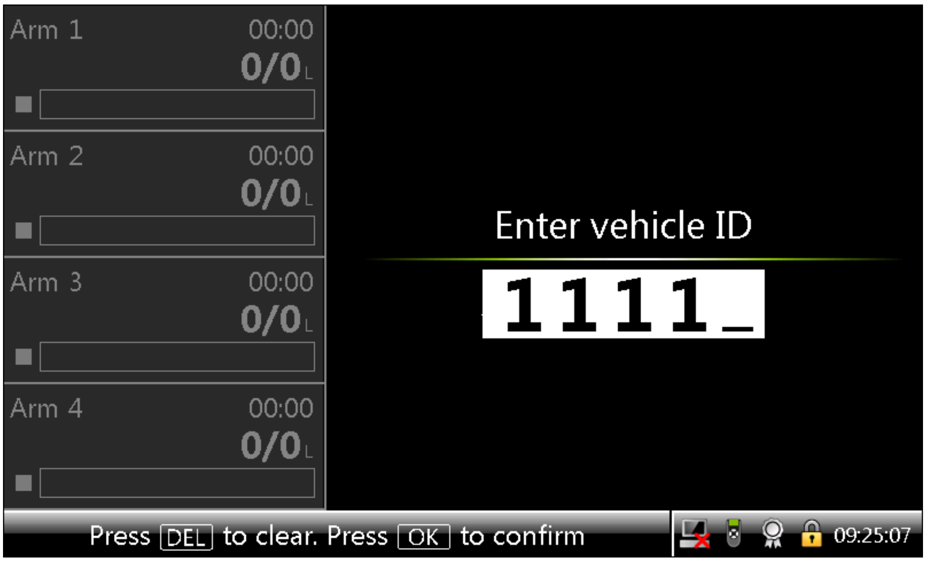
If the password entered is not valid, then an error message is displayed.



NOTE: *Asterisks (*) appear as you type each character of your password.*

If the vehicle/carrier/trailer/contract identification is enabled, then you can enter the respective IDs. These IDs are validated against the local or the remote database based upon your device authorization settings.

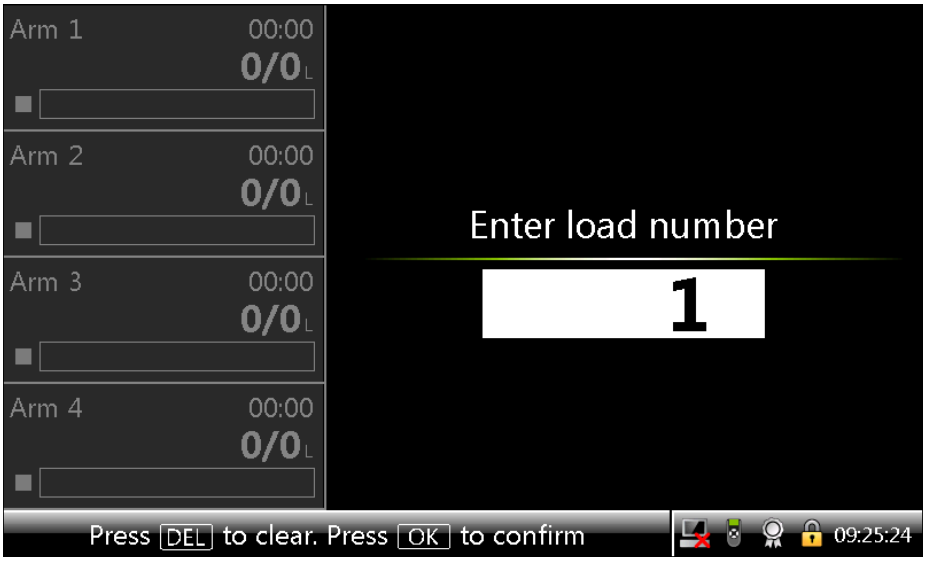
3. Enter the ID on the vehicle ID screen.



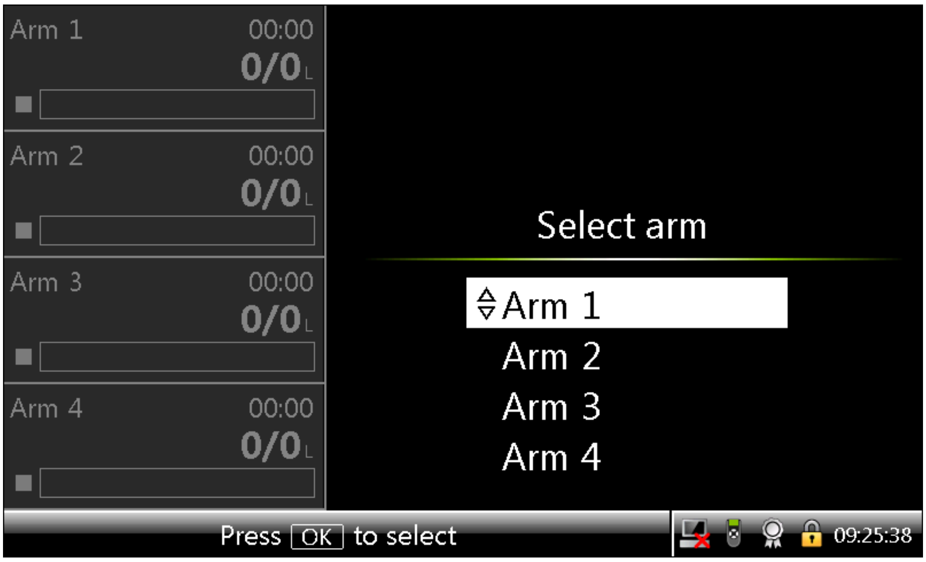
4. Enter the following attributes using the keyboard to perform the transaction setup.

NOTE: *Press the ESC key on the keyboard to return to the previous screen.*

5. If the load number prompt is enabled, enter the load number when prompted.

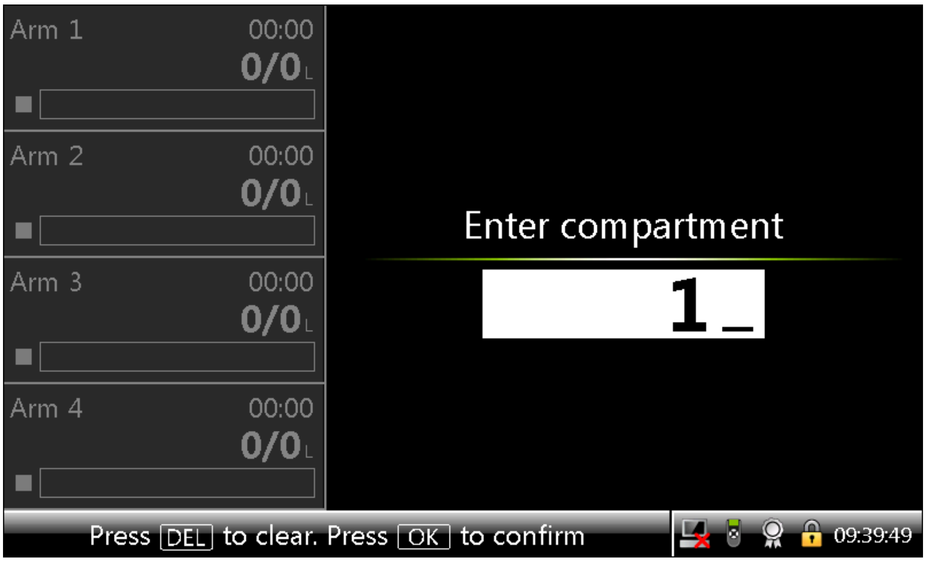


6. Select the Arm in which you want to perform the batch. For example ARM 1.

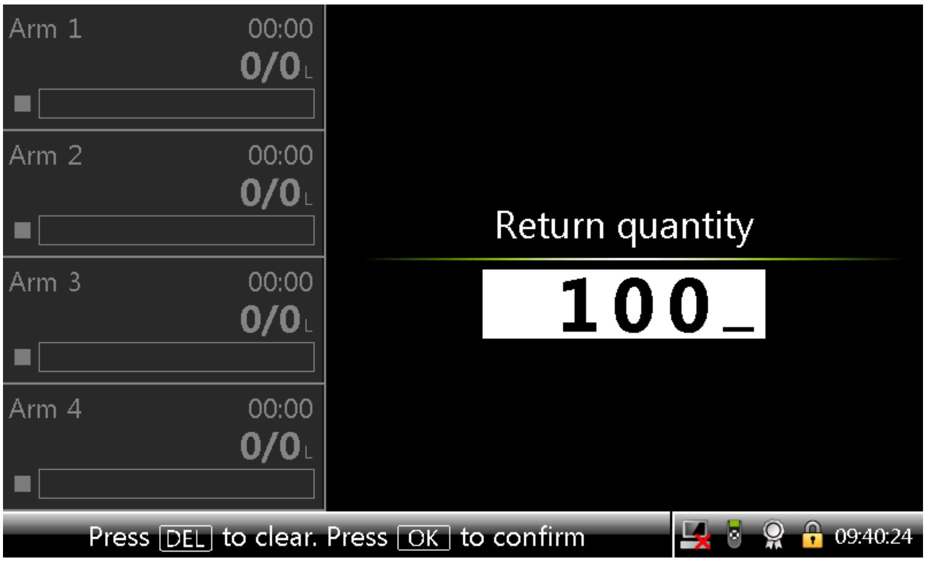


7. Select the recipe from the list of configured recipes.

8. If compartment prompt is enabled, enter the appropriate compartment number.



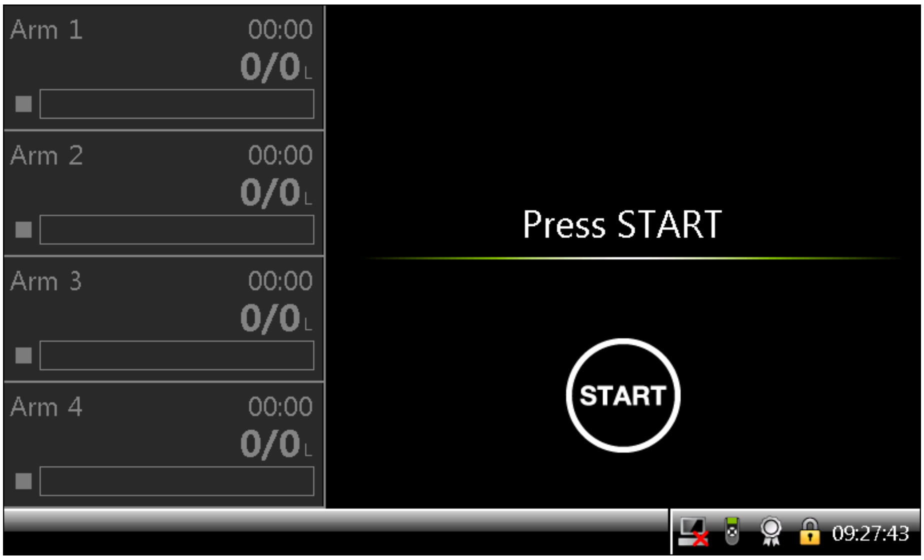
9. If return quantity prompt is enabled, enter the return quantity.



10. If prompt is enabled, enter the preset as per the configured preset type (liters, gallons, kilograms, and so on).

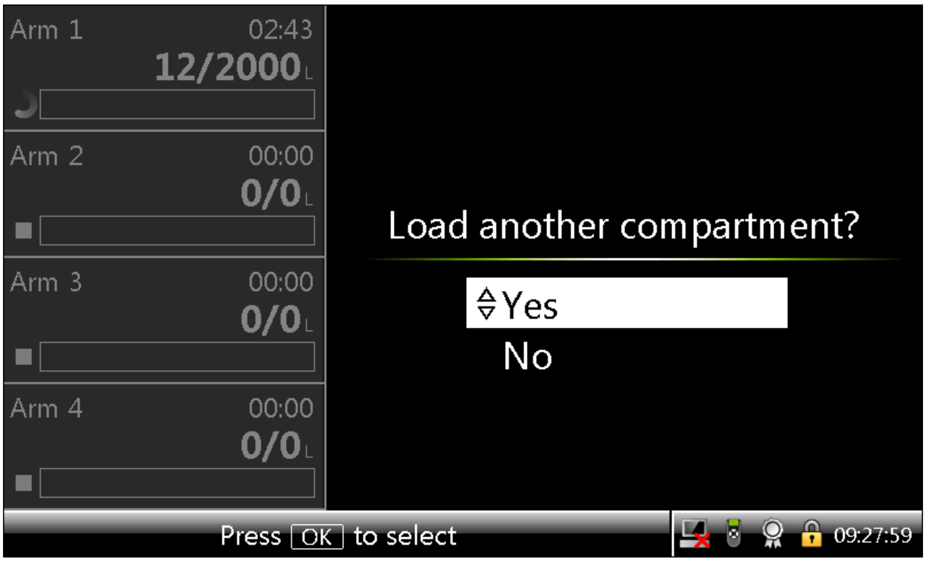
If the batch is executable to load, then the batch details screen appears with the recipe name, compartment, arm name, and preset value. If not, an error message appears.

11. Select <Confirm> to perform the batch or select <Cancel> to cancel the batch.
12. If confirmed, press the **Start** button on the keyboard to commence the batch.



The load another compartment prompt appears only if another batch can begin (that is, there is an idle arm and the maximum number of simultaneous batches has not been reached.) If a new batch cannot be planned then the running screen appears.

A message appears prompting you if another batch needs to be loaded.

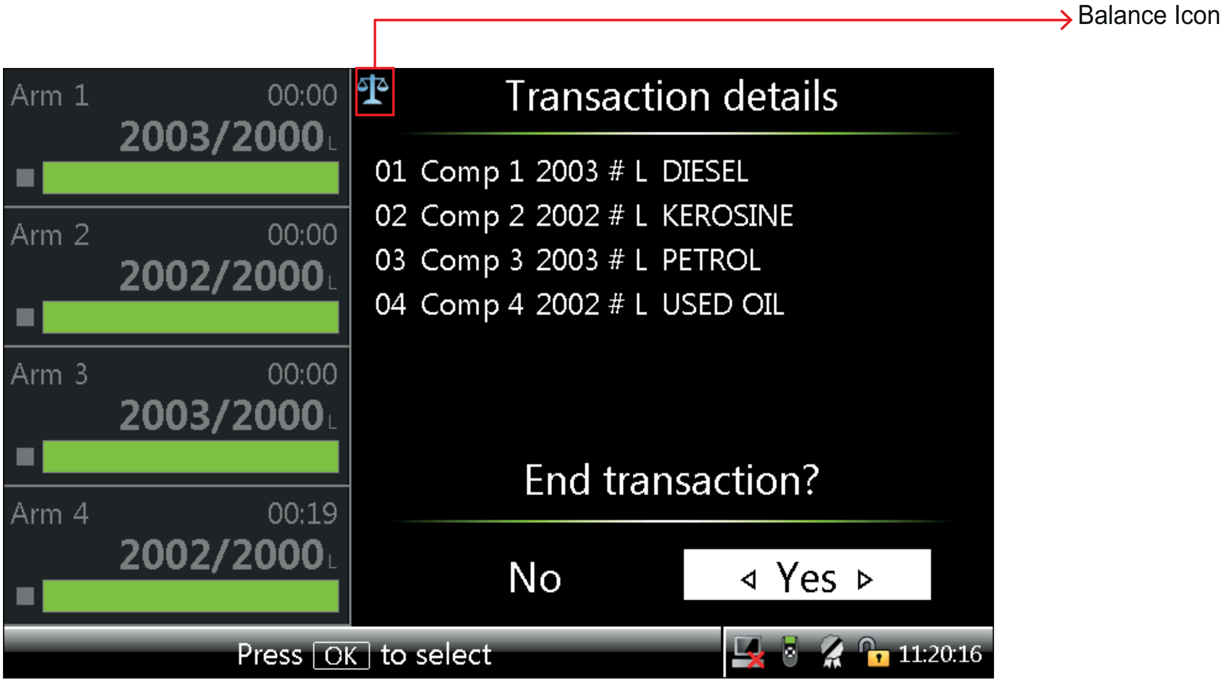


13. Perform any one of the following:

- Select <Yes> if you want to load another compartment.

  The selected arm screen appears. After entering all the details, another batch can be started.

- Select <No> to go back to one of the following screens.
  - Running screen (if there are batches still in progress).
  - Transaction Overview screen (if there are no batches in progress).



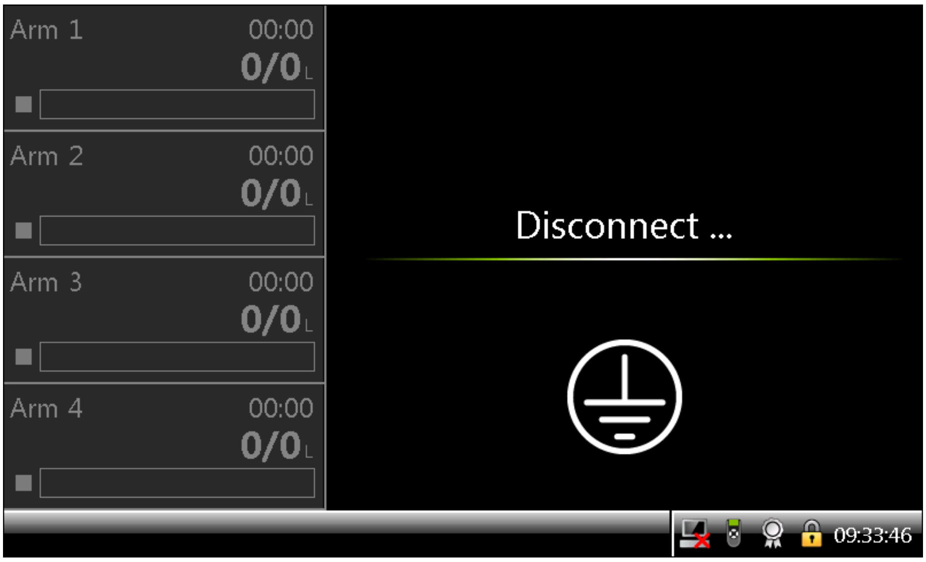
A Balance icon is displayed on the screens of the MSC-L which are intended for W&M custody transfer.

The **Transaction details** screen is a W&M intended screen. It displays the balance icon as displayed in the figure above.

The screen displays all the batches in the GOV when the preset type is configured as the Load control on the GOV. The **Transaction details** screen can be viewed by the truck driver or the operator having security level SL1 or higher.

14. Perform any one of the following:
- Select <No> to load another batch.
- Select <Yes> if you want to end the transaction.

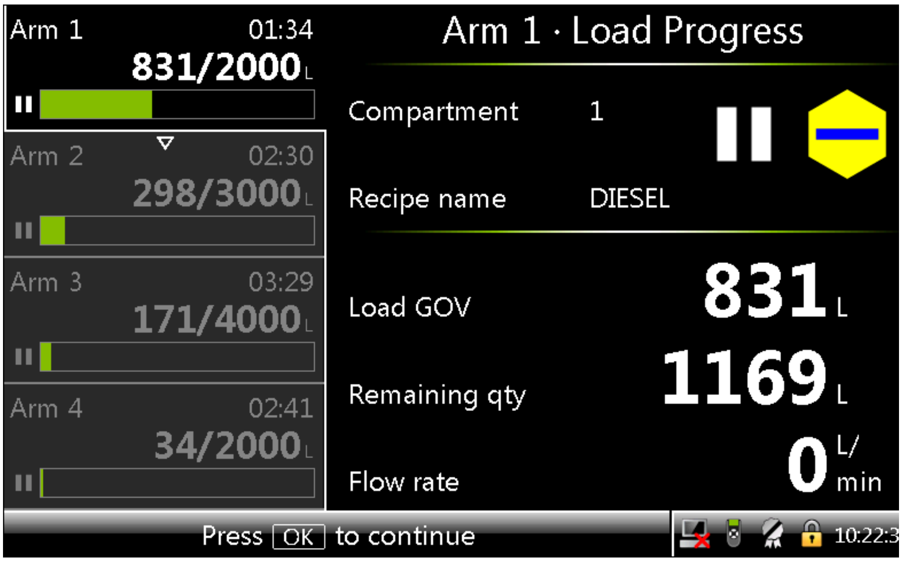
A **Disconnect** screen appears where it is expected to disconnect the permissives like grounding, overfill, and so on.



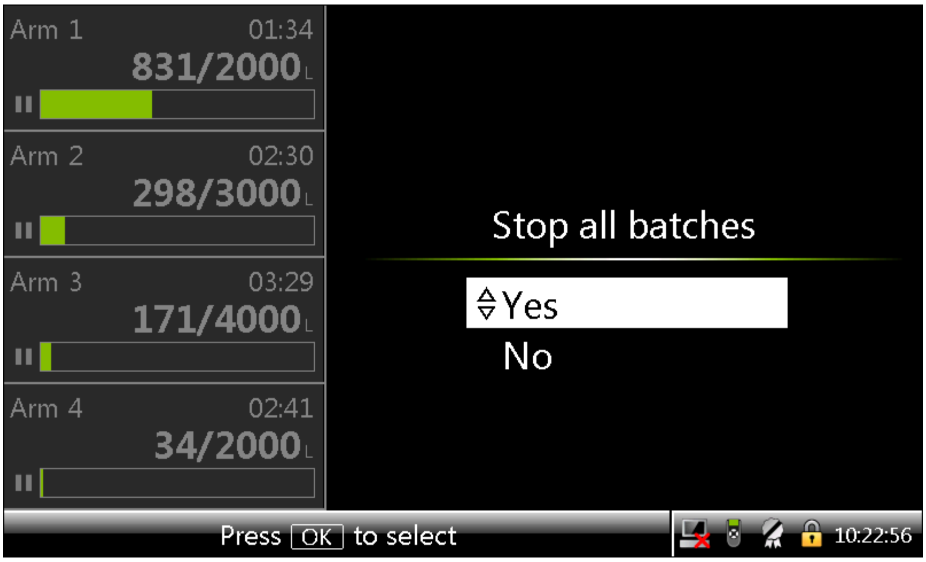
5.20.3 STOP Key Operations

When the arm is loading the STOP key on the keyboard can be used to pause the running batches.

After the STOP key is pressed, all the running batches are in a paused state as seen in the following figure.



To stop or resume the batches, press the OK key, which displays a prompt as follows.



Perform one of the following on the Stop all batches screen.

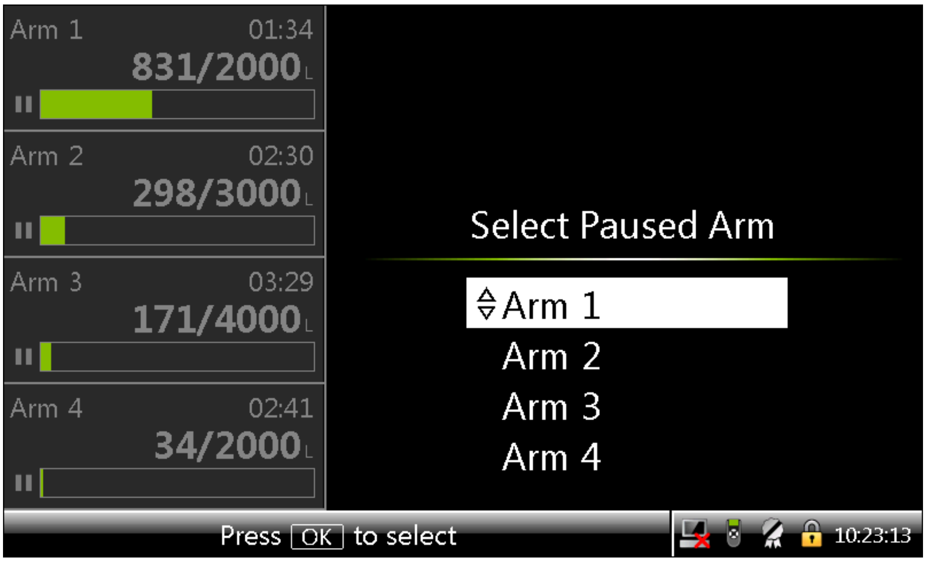
- Select <Yes> if you want to stop all the batches. All the batches are stopped and a prompt is displayed to load another compartment.

Perform one of the following on the load compartment screen.

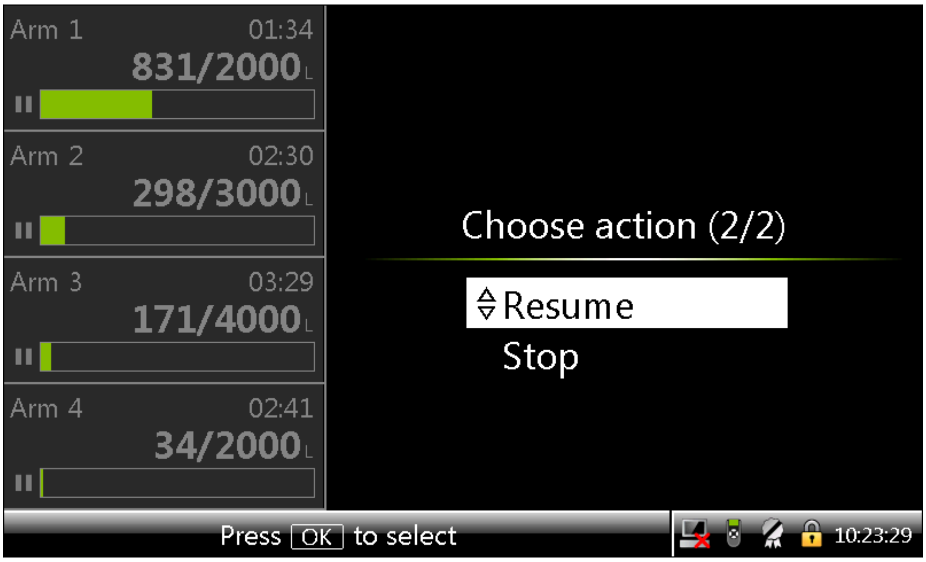
- Select <Yes> to start a batch on another arm.
- Select <No> to end the transaction.

A transaction details screen is displayed and the transaction is ended.

- Select <No> if you want to resume the batches. A screen is displayed with a list of paused arms. You must first pick a paused arm before choosing the action to perform on it..



Select the arm that needs to resumed and press OK. A screen is displayed that allows you to select the desired action.



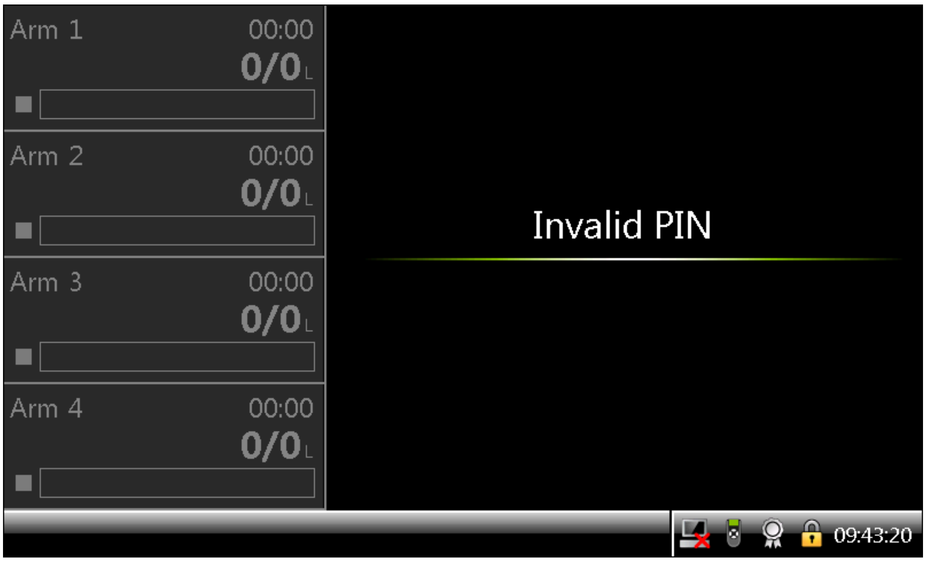
Perform one of the following:

- Select <Resume> to restart the arm and a screen is displayed with a list to select the remaining paused arms. Choose the action for the other arms.
- Select <Stop> to stop the selected paused arm if there are no more paused arms then the **Load another compartment** screen appears.

5.20.4 Error Scenarios

5.20.4.1 Invalid Pin

If the entered pin is not available in the database, then an invalid PIN message is displayed.

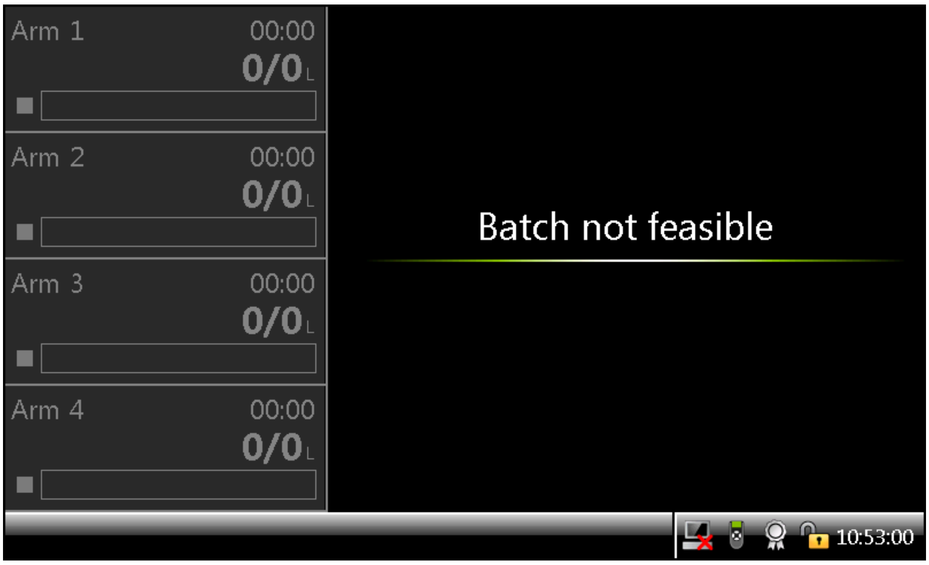


5.20.4.2 Invalid Preset

If a valid preset is not entered, then an error message is displayed.

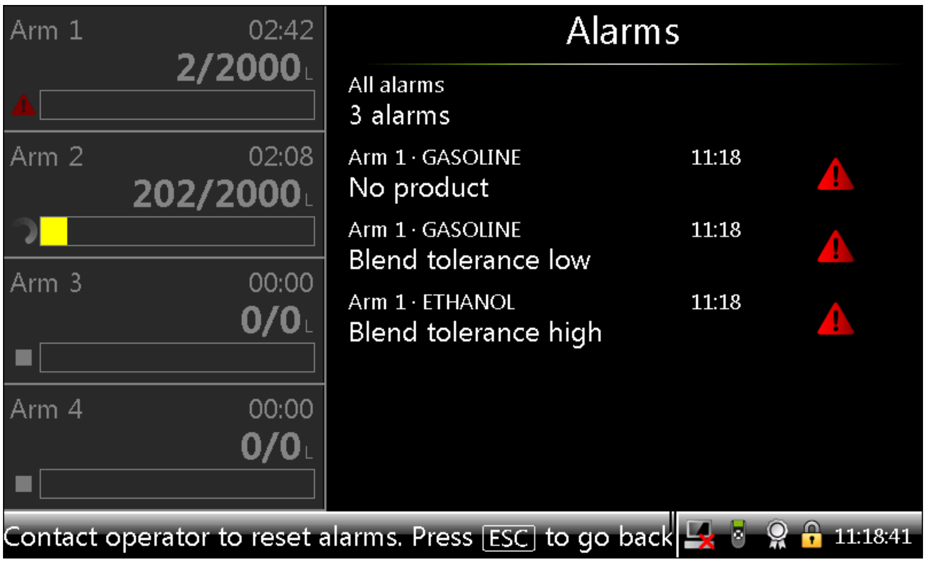
5.20.4.3 Batch not Feasible

If the batch validation fails, for example, if the meter configuration and stream configuration do not match, then after the **Batch details** screen batch not feasible message appears.



5.20.4.4 Batch stopped due to an Alarm

If an alarm with action display pause or display shutdown occurs on the device, the bay, the arm, or the stream, then the loading batch is paused/stopped, with the display listing the alarms that have occurred. An SL2 user or higher can clear the alarms so that new batches can be started on that arm.

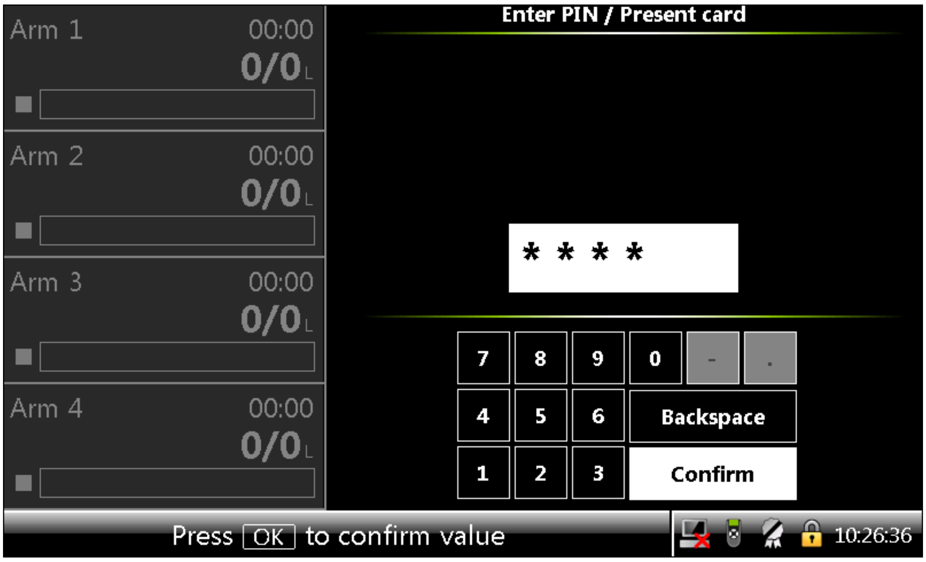


5.21 Service Technician Operations

A service technician generally performs the service activities (for example, Configuration and Monitoring the Alarms). The advanced service activities (for example, Upgrade Firmware and Add the users) are also sometimes performed by the service technician.

A user must be created in the user database with service level SL2 or SL3 based on the activities that need to be performed.

Holding the <ESC> key on the keyboard anytime during the operation, displays the log on screen. If the correct password or PIN is entered, then the Main Menu is displayed.



NOTE: You are automatically logged out in the following scenarios:

If the time-out is reached and there are no transactions running.
The LAD is not connected.

*Session time-out can be configured from **Device Configuration. General Settings**.*

5.21.1 Configuration Options

A service technician has various options that can be used for configuring the MSC-L as follows:

- User Interface: Fusion4 LAD, Fusion4 IR interface or keyboard.
- Configuration file: Fusion4 LAD can be used for downloading the configuration file.
- Fusion4 Portal: The MSC-L can be interfaced to Fusion4 Portal on the RS-485 or the Ethernet ports.

5.21.2 Configuration Order

When the MSC-L is configured for a specific application, it is important to follow a particular order. This is to ensure that the MSC-L can perform the loading activities as required.

A loading arm can have product streams and additive streams. Each of the logical streams contain a flow meter and a control valve/solenoid to control the flow of the product or the additive. The arm is physically on a bay and both the arms and the bays are logically part of the MSC-L. See FIGURE 5-45 for the configuration order.

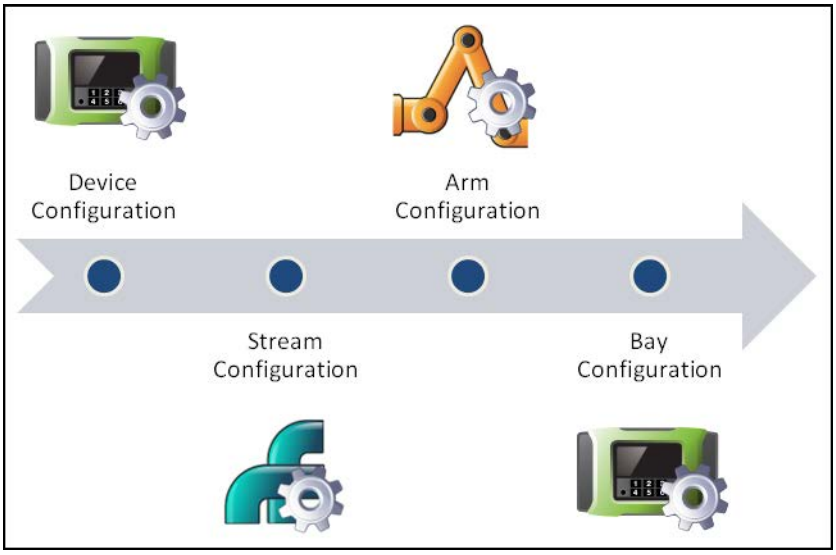


FIGURE 5-45 Configuration order

1. Device Configuration: Includes configuration of the MSC-L level permissive like ESD, device level alarms, I/O settings for various I/Os including the pulse inputs, and so on.

   See 5.11.1 - Device Configuration, for more information regarding the configuration of the parameters and the entities.

2. Stream Configuration: Includes the configuration of I/O bindings for flow meter, actuator (DCV), solenoid and various control settings for the streams. For example, the maximum flow rates, minimum flow rates, stream level alarms, and so on.

   See 5.12 - Stream Configuration, for more information regarding the configuration of the parameters and the entities.

3. Arm Configuration: Includes assigning streams to an arm, configuring recipe, arm level control parameters, arm alarms, and so on.

   See 5.13 - Arm Configuration, for more information regarding the configuration of the parameters and the entities.

4. Bay Configuration: Includes configuring bay permissive. For example, overfill, bay alarms, and so on.

   See 5.11.2 - Bay Configuration, for more information regarding the configuration of the parameters and the entities.

5.21.3 Configuration File

You can configure the MSC-L using user interface; but it can be time consuming.

Retrieving and installing the configuration file using the Fusion4 LAD is a time saving option that can be used effectively in situations where there are multiple MSC-L devices with similar configurations.

Following are the XML based configuration file features.

- Retrieved and installed through the Fusion4 LAD.
- Prepared/modified offline (safe area).
- Contains all the configuration entities in the device except for the following:
  - The workflow
  - The authorization databases
  - Recipes

See FIGURE 5-46 for the contents of the configuration file.


```
<FLEXCONN_ENTITY name="Permissive" board="20" function="4" entity="1031" index="11" datatype="0" size="10" comment="">65535-321-1-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="Permissive" board="20" function="4" entity="1031" index="12" datatype="0" size="10" comment="">65535-321-1-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="1" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="2" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="3" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="4" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="5" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="6" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="7" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="8" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="9" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="10" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="11" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="System interlock" board="20" function="4" entity="1045" index="12" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="Alarm reset" board="20" function="4" entity="1035" index="1" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="Alarm reset" board="20" function="4" entity="1035" index="2" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
<FLEXCONN_ENTITY name="Alarm reset" board="20" function="4" entity="1035" index="3" datatype="0" size="10" comment="">0-0-0-0-0</FLEXCONN_ENTITY>
```


FIGURE 5-46 Configuration file

The following table provides the description of the fields in the configuration file.

Field	Description
Name	The name of the entity as it appears on the MSC-L.
Content	The description of the enumeration options, otherwise empty.
Value	The value of the entity.

For details regarding the installation or retrieving a configuration, refer to the section Transfer 5.18.3 - Configurations.

5.21.4 Recipe Transfer using the Fusion4 LAD

The recipes are an important part of the MSC-L configuration.

The recipes can be retrieved or installed using the Fusion4 LAD.

- The recipes are saved with the configured recipe name on the Fusion4 LAD.
- The recipe is validated after installation.
  - The sum of all product stream blend ratios must be 100 %.
  - The product and additive streams must be bound to the ARM.
- The Fusion4 LAD provides an easy mechanism to transfer the recipes between the devices.

5.22 Running Screens

5.22.1 Loading Progress

During an active transaction with batches running on the arms, the **Arm n . Load Progress** screen appears.

See FIGURE 5-47 for a sample of a loading progress, when the default language selected in the <User display language> is <English UK> and the Progress bar is green.

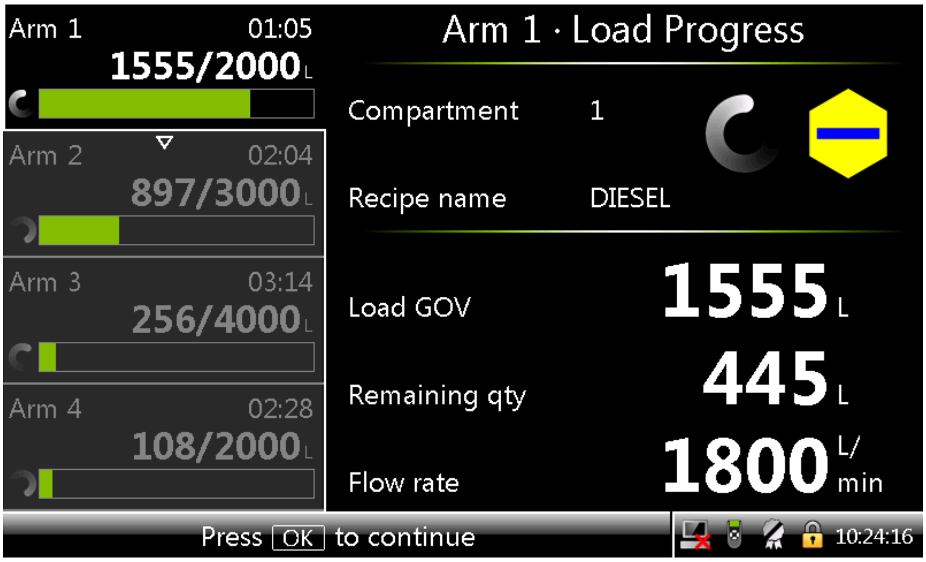


FIGURE 5-47 Loading progress for the default language

See FIGURE 5-48 for a sample of a loading progress, when the default language selected in the <User display language> is <English UK> and the Progress bar color is white.

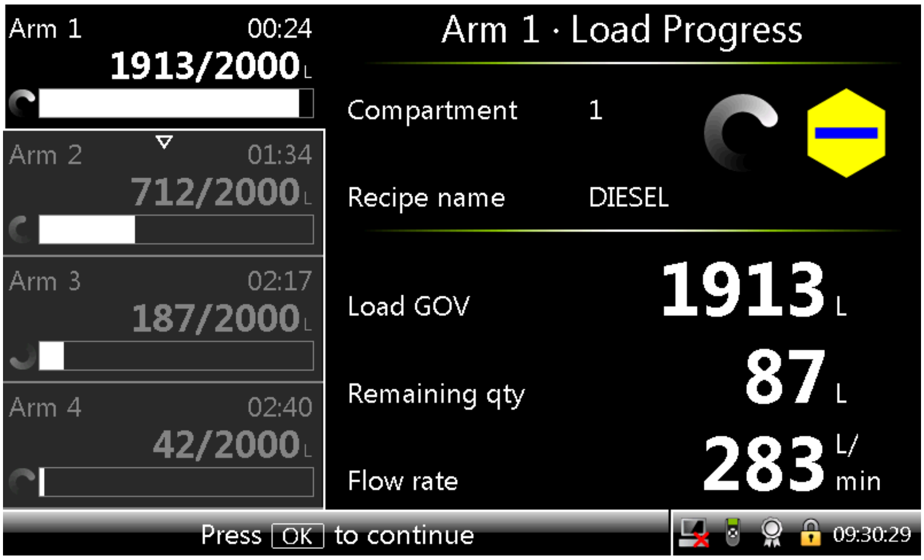


FIGURE 5-48 Loading progress for the default language with progress bar color white

See FIGURE 5-49 for a sample of a loading progress, when the default language selected in the <User display language> is <English UK> and different colors are selected for the arms.

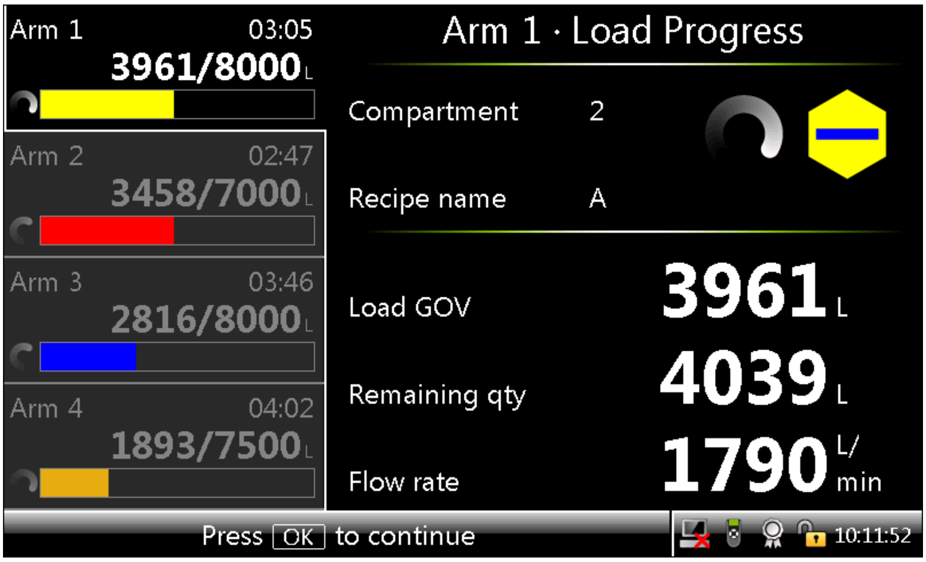


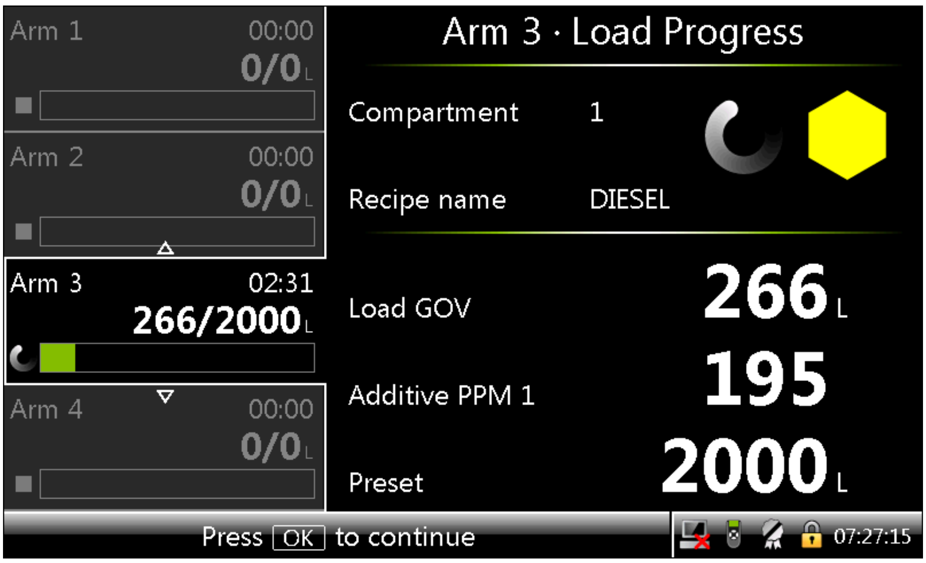
FIGURE 5-49 Loading progress for the default language with different colors for the arms

The following table describes the operational data on the Load Progress screen.

Acronym used on the Load Progress screen	Description
Compartment	Displays the Compartment ID entered.
Arm name	Displays the name of the Arm that is selected.
Recipe name	Displays the name of the Recipe that is selected.
Load GOV	Displays the GOV of the finished product being loaded.
Remaining qty	Displays the remaining quality of the finished product that is yet to be loaded.
Flow rate	Displays the actual flow rate.

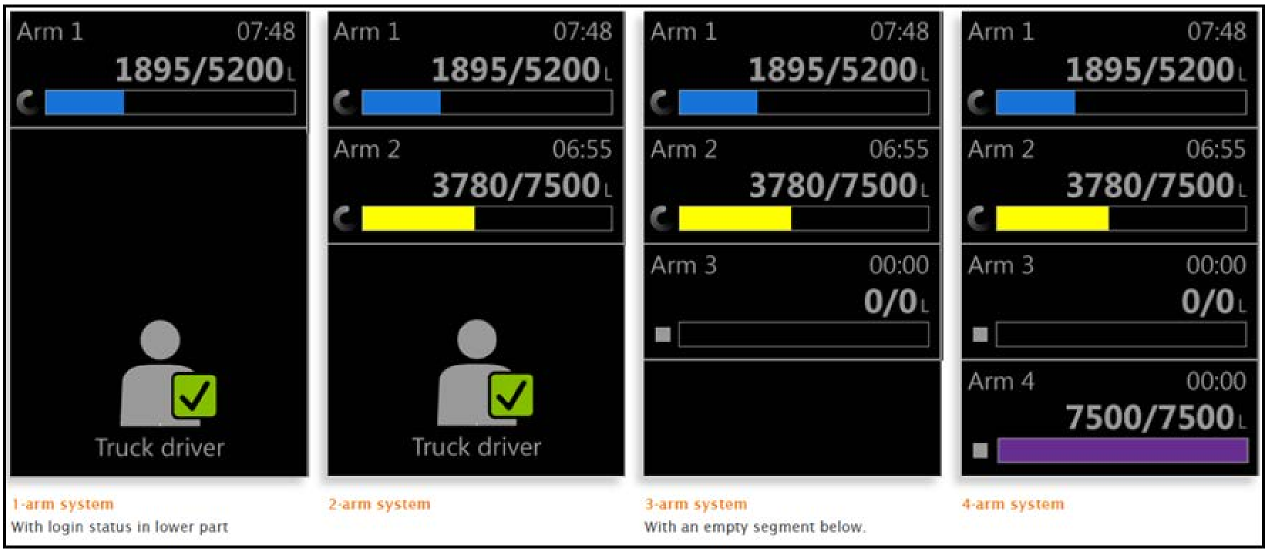
The Load GOV, the Remaining qty, and the Flow rate are the default labels. These labels can be configured to display some other parameters from the 5.11.1.1.3.2 - System Config . Display. Operational Screen menu.

Following is a sample screen where the operational label 2 and 3 are configured as Additive ppm 1 and Preset.



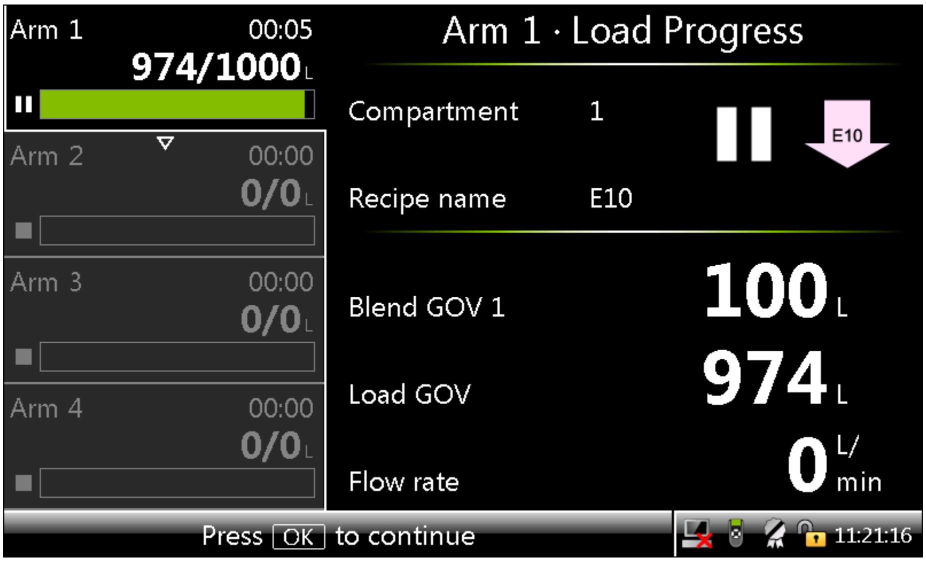
5.22.2 Left Arm Pane

The left pane displays the status of the arms. Based on the license used, the number of arms displayed in the left pane varies.



The state of the arm is also indicated by the running, stop, or the pause symbol.

Following is a sample screen, which shows the paused batch.



5.23 W&M Compliance

W&M compliance of the MSC-L is based on the following criteria.

- Configuration of the W&M Intended entity
- Sealing
- Device Health

Following sections explain the criteria in more details.

5.23.1 W&M Intended

For the MSC-L to be intended for W&M custody transfer, the configuration entity W&M intended should be set to <True>.

See section 5.11.1.1.1 - System Config . General 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).

5.23.2 W&M Sealing

The MSC-L can be W&M sealed in the following two ways.

1. Using a board jumper/switch on every Flexconn board in the MSC-L.

   The MSC-L W&M relevant configuration and the MSC-L relevant firmware is sealed when the jumper is set to ON.

The MSC-L W&M relevant configuration and the MSC-L 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.*

2. Using a switch on the keyboard of the MSC-L.

   The MSC-L W&M relevant configuration and the MSC-L relevant firmware is sealed when this switch is activated.

   When the switch is deactivated, the MSC-L W&M relevant configuration and the relevant firmware is not sealed.

NOTE: *In case the W&M keyboard switch is used for sealing, the board W&M jumpers/switches must be set to OFF. The device can be sealed by the service technician or the notified body engineer.*

The MSC-L can be physically sealed as shown in the following figure.

5.23.3 Device Health

For the MSC-L 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.

5.23.4 MSC-L W&M compliance

The MSC-L is compliant for W&M custody transfer if all the following criteria are met.

- The W&M Intended is set to <True>.
- The MSC-L is W&M sealed - either the jumper in ON or the switch is activated.
- The device health is good.

CHAPTER 6 ALARM HANDLING

6.1 General

You can set various alarm configurations using the MSC-L menu. Also, the active alarms and alarm logs can be viewed through the MSC-L menu.

6.2 Basic Concepts

An alarm is an indication that an undesired situation has occurred. In MSC-L, the following collection of information is associated with an alarm.

- Name
- Scope
- State
- Action
- Date
- Time

6.2.1 Alarm Name

The alarm name is used for describing the situation in which the alarm has occurred.

6.2.2 Alarm Scope

Conceptually, an MSC-L device has loading bays. A bay has multiple loading arms and loading arms have zero or more streams associated with them. They are referred to as scope type.

There are five scope types in the MSC-L as follows:

- Device
- Bay (or transaction)
- Loading arm (or batch)
- Product stream
- Additive stream

On the alarm log screen, the emphasized first character of the alarm chapter is used for indicating the chapter to which the alarm belongs to.

Consider the example of an Tank empty alarm on product stream 3. The scope type is a Product stream. But this information is not enough to uniquely identify the source of the alarm. The index of the product stream, 3 in this case is missing.

In general, the scope of an alarm is the scope type together with the index within that scope type. The index for each scope type always starts from one.

6.2.3 Alarm State

An alarm can be in one of following possible states.

- Inactive
- Asserted
- Acknowledged

In the MSC-L, an alarm is either active or inactive.

An inactive alarm is in the inactive state. An active alarm is either in the asserted state or the acknowledged state. The difference between the asserted and acknowledged state is only in the way alarm outputs are driven.

6.2.4 Alarm Action

The way the system responds to an activated alarm depends on the Alarm Action of that alarm.

There are four possible alarm actions.

- Disabled
- Display
- Pause & Display
- Shutdown & Display

An alarm with Disabled alarm action is ignored. It is a way to tell the system that all alarming for that particular alarm is disabled.

A Display only alarm is an alarm that does not affect the loading operations that are happening using the MSC-L. The alarms are only displayed on the alarm screens and included in the alarm log.

Unlike a Display alarm, both Pause & Display and Shutdown & Display are considered a critical alarm. A critical alarm affects the loading of the batch it applies to. A batch is affected by an alarm in the following scenarios:

- If the alarm is a loading arm alarm of the arm that serves that batch.
- If it is a stream (product or additive) alarm that is associated with the loading arm that serves the batch.
- If it is a bay alarm of the bay that serves the batch.
- If it is a device alarm.

The difference between a Shutdown & Display alarm and a Pause & Display alarm is that the Shutdown & Display alarm terminates the affected batch(es) and that the Pause & Display alarm pauses the affected batch(es).

NOTE: *Active stream alarms that are not associated with any arm have no effect on batches and do not drive alarm indication and/or alarm shutdown outputs.*

6.2.5 Date & Time

The Date and Time associated with an alarm indicates the most recent date and time at which the alarm is activated. In the alarm log it is the date and time at which the state of the alarm is changed.

6.3 Alarm Severity

The alarm severity is a concept that applies to loading arms. The alarm severity of a loading arm is the highest severity of the active alarms that affects the loading arm. The alarm severity is further explained in the following example.

6.3.1 Setup

Consider the MSC-L that is set-up as follows:

- Three product streams P1, P2, and P3.
- Three loading arms L1, L2, and L3.
- One Device alarm D
- Two product stream alarms PS1 and PS2.

6.3.2 Configuration

The streams are configured as follows:

- P1 is associated to L1
- P2 is associated to L2
- P3 is not being associated to any arm

The alarms are configured as follows:

- D, a Device alarm with alarm action Display.
- PS1, a Product stream alarm on product stream 1 with alarm action Display.
- PS3, a Product stream alarm on product stream 3 with alarm action Pause & Display.

6.3.3 Scenario

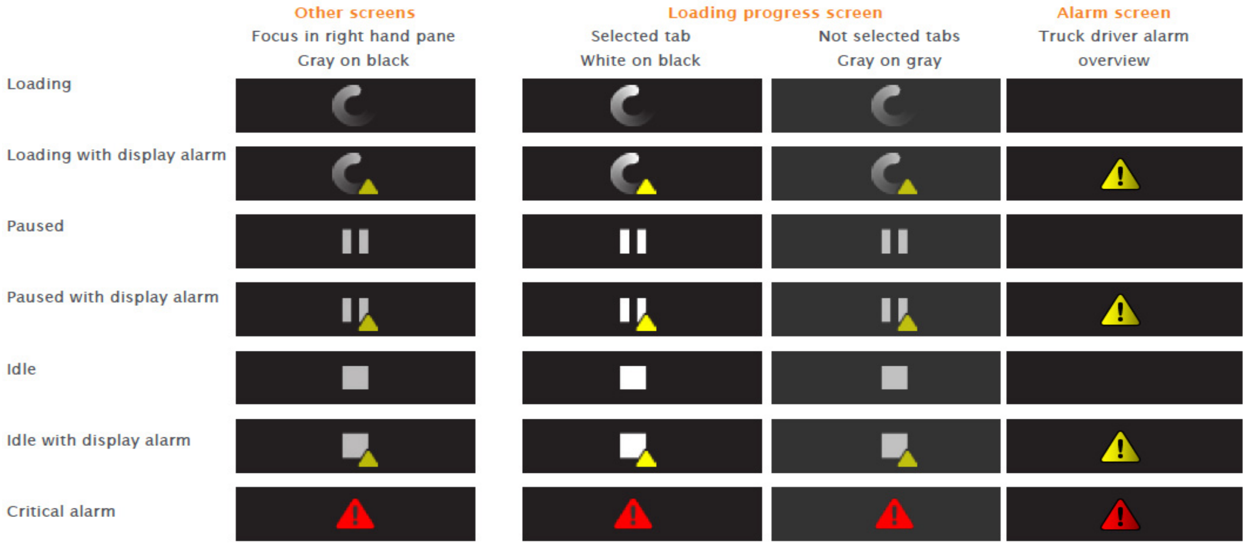
For the above set-up and configuration, assume a sequence of alarm state changes and observe how it affects the severity is for each of the loading arms. The initial alarm state of each of the alarms is inactive.

Alarm Change	Severity		
	L1	L2	L3

Alarm Change	Severity		
1. Initial	None	None	None
2. D is activated	Display	Display	Display
3. PS1 is activated	Display	Display	Display
4. D is deactivated	Display	None	None
5. PS3 is activated	Display	None	None
6. PS1 action changed to shutdown	Display	None	None
7. PS1 is deactivated	None	None	None
8. PS1 is activated	Shutdown	None	None
9. PS3 is associated to L3	This is not allowed in the MCL. Deactivate first or reboot after.		

1. Initially there are no active alarms available, hence the severity is None for all the loading arms.
2. A device alarm applies to all arms. Hence, when D is activated, the alarm action of D - Display, applies to all the loading arms.
3. Then PS1 is activated, which brings L1 to Display severity. The difference is not seen, because the arm already was at the Display severity.
4. If the Device alarm D is deactivated, then it is removed from all the loading arms. But, since there is still one active alarm Display severity on the product stream 1, it affects the loading arm L1. Hence, L1 will have Display severity.
5. Now if PS3 is activated, it does not affect any loading arm as stream P3 is not associated to any loading arm. However, this alarm appears in the alarm screens and in the alarm log.
6. If the alarm action for PS1 is changed from Display to Shutdown & Display, there is no effect at this point. This is because, the alarm action used in the MSC-L is only sampled at the time the alarm is activated.
7. If PS1 is deactivated, it removes the last activated Display alarm for L1 and hence L1 changes to Alarm severity None.
8. If PS1 is activated, then it uses the configured Shutdown & Display alarm action, and brings the alarm severity of L1 to Shutdown & Display.
9. If a stream has an active alarm then it is not allowed to associate the stream to a loading arm or to dissociate from a loading arm. You need to try and clear the alarms first or reboot the MSC-L after the faulty (re) configuration is made.

The loading progress bars at the left side of the screen display an icon which indicates the state of the loading arms. The state of the loading arm is a combination of the loading state (idle, running, and so on) and the alarm severity of the loading arm. From that icon the highest severity among the active alarms associated with the loading arm can be read.



6.4 Alarm Output Configuration

In the MSC-L two different alarm output bindings per loading arm can be configured. These are:

- 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.

The alarm shutdown output of a loading arm activates when the alarm severity of that loading arm becomes critical. A critical severity is a severity that is equal to either Pause & Display or Shutdown & Display.

The reverse is also possible. If the alarm severity of the loading arm becomes non-critical then the alarm shutdown for that loading arm is deactivated. The severity is non-critical when it is not critical, so it is either None or Display.

The (de)activation of the alarm indication output is dependent on the number of unacknowledged active alarms that affect the loading arm. When the number changes from zero to a number larger than zero, the alarm indication output is activated. When the number changes from a number larger than zero to zero, then the alarm indication output is deactivated.

6.5 Operations on alarms

A number of operations can be performed on alarms. Not all operations are directly accessible. However, they are explained in the following sections to give a clear understanding of the way alarms work.

6.5.1 Raising

For each alarm, a specific raise conditions is periodically checked. If the raise condition is met, then a RaiseAlarm operation is performed. A RaiseAlarm operation activates the alarm if the alarm is not active yet.

6.5.2 Clearing

Clearing is performed through user interaction. On the alarm screen (or through external interfaces), an individual alarm is selected and a ClearAlarm operation may be requested for that alarm. The ClearAlarm operation causes the alarm to be deactivated. However, if the raise conditions for that alarm are still met, the effect of the ClearAlarm operation is immediately overwritten by the RaiseAlarm operation.

Some alarms, such as the Tank Low Level alarm, perform automatic clearing. For such alarms, there is a raise condition and a clear condition that is periodically checked. When the clear condition is met a ClearAlarm operation is performed and the alarm is deactivated. In case of the Tank Low Level alarm, the clear condition is the complement of the raise condition, but this is not so in general.

6.5.3 Resetting

Resetting an alarm is a user operation. An individual alarm is selected and a ResetAlarm operation is requested to reset the alarm. For most of the alarms the ResetAlarm directly translates to performing a ClearAlarm operation. But this is not true in general.

An alarm may have some state associated with it. When the raise condition is based on this state, then only clearing the alarm causes the alarm to be raised immediately again, even if the situation is such that you do not expect that alarm to come back again. For example, the 'Pulse hardware error' alarm maintains a counter that counts the number of erroneous pulses. If the ResetAlarm operation does not clear that counter but only clears the alarm, then the value of the counter causes a new RaiseAlarm operation, even if there are no new pulse errors detected.

6.5.4 Acknowledging

Acknowledging an alarm is a user operation. An individual alarm is selected and an AcknowledgeAlarm operation is requested to acknowledge an alarm. This operation has no effect on clearing/raising alarms but only moves an alarm from the Asserted state to the Acknowledged state. This affects only on the alarm indication output.

6.5.5 Resetting all alarms

Resetting all alarms performs a ResetAlarm operation on all currently active (asserted and acknowledged) alarms.

6.5.6 Acknowledging all alarms

Acknowledging all alarms performs an AcknowledgeAlarm operation on all currently asserted alarms.

NOTE: The Service Due Reminder alarm has a different 'Reset' operation implemented. In the MSC-L user interface the Reset button for this alarm is replaced by an Off button. Press the Off button to switch off the alarm. Switching off the alarm brings the Alarm Action temporarily to the Disabled alarm state. When the system is rebooted or when the alarm is reconfigured, the Alarm Action is set back to the configured Alarm Action.

To avoid accidently disabling of this alarm, resetting all the alarms performs an ordinary reset on the Service Due Reminder alarm, causing it to become asserted immediately after again.

6.6 Active Alarms

The Active alarms screen displays all active and acknowledged alarms. See FIGURE 6-1.

FIGURE 6-1 Active Alarms

To change the state of the alarm to <ACKNOWLEDGED>, on the Active alarm screen, perform the following:

- Scroll to the particular alarm, select <Ack> and then press <OK> on the IR controller, the LAD, or the keyboard to acknowledge the alarm. The state of the alarm changes to <ACKNOWLEDGED> and a new alarm log item is created.
  OR
- Scroll to **All alarms**, select <Ack> and then press <OK> on the IR controller, the LAD, or keyboard to acknowledge all the alarms. The state of all the active alarms changes to <ACKNOWLEDGED> and new alarm log items are created.

To change the state of the alarm to <ALARM_INACTIVE>, on the Active alarm screen, perform the following:

- Scroll to the particular alarm, select <Reset> and then press <OK> on the IR controller, the LAD, or the keyboard to reset the alarm. The state of all the alarms changes to <ALARM_INACTIVE> and a new alarm log item is created.
  OR
- Scroll to the top, to all the alarms, select <Reset> and then press <OK> on the IR controller, the LAD, or keyboard to reset the

alarms. The state of all the active alarms changes to <ALARM_INACTIVE> and a new alarm log item is created.

To reset all alarms through hardware, the entity [I/O binding alarm reset input] must be configured accordingly. This allows you to reset all alarms on a particular arm.

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 the device.

6.7 Alarm Logs

Any alarm-state change that occurs is logged with a timestamp.

Alarms can have the following three states.

- Inactive (default)
- Active
- Acknowledged

On the **Alarm log** screen, all the alarm states that are changed can be examined.

6.8 List of all alarms

This section lists the alarms and their cause for the Device, Bay, Arm, Product stream, and Additive stream alarms.

6.8.1 Device Alarms

Alarm	Cause
Service due reminder	The [Next scheduled service] date has expired.
Programmable input 1.4	The programmable input state (active/de-active) does not match with the expected input state.
Deadman	The operator does not press any key or the deadman refresh switch in the deadman callout time and the timer expires.
Power failure	This transaction is not completed due to a power failure.
Emergency stop	The emergency stop signal is active.
NEDAP communication failure	The communication with the Nedap Reader is lost.
NEDAP battery Low	The Nedap reader reports a low battery status.
Nexwatch communication failure	The communication with the Nexwatch reader is lost.
A task called BlockTask()	An internal software error occurred inside the device. A reboot is required

6.8.2 Bay Alarms

Alarm	Cause
Programmable input 1..6	The programmable input state (active/de-active) does not match with the expected input state.
Transaction start error	The new transaction cannot be started. *NOTE: The transaction cannot be managed/controlled due to the internal MSC-L fatal fault. For example, missing or failing hardware components.*
Transaction stop error	The running transaction cannot be stopped. *NOTE: The transaction cannot be managed/controlled due to the internal MSC-L fatal fault. For example, missing or failing hardware components.*
Max. #batches exceeded	No new batch can be started because the maximum number of batches within a transaction is reached.
Grounding [Pause]	The grounding permissive is detached.
Grounding [Shutdown]	The grounding permissive is detached.
Overfill [Pause]	The overfill protection permissive is detached.
Overfill [Shutdown]	The overfill protection permissive is detached.
Vapor Recovery [Pause]	The vapor recovery permissive is detached.
Vapor Recovery [Shutdown]	The vapor recovery permissive is detached.

NOTE: The Grounding [Pause], Grounding [Shutdown], Overfill [Pause], Overfill [Shutdown], Vapor Recovery [Pause], and Vapor Recovery [Shutdown] *alarms come in pairs and each pair is used to implement a single permissive.*

6.9 Arm Alarms

Alarm	Cause
Initial flow rate low	The flow rate during the initial flow stage is below the arm initial flow rate by the [Low percentage] after the [Alarm start delay] elapsed.
Initial flow rate high	The flow rate exceeds the arm initial flow rate by the [High percentage] and the [Alarm start delay] elapsed.
Full flow rate low	The full flow rate is below the arm full flow rate by the [Low percentage] and the [Alarm start delay] elapses.
Full flow rate high	The flow rate exceeds the arm full flow rate by the [High percentage] and the [Alarm start delay] elapses.
Pre-stop flow rate low	The flow rate during the pre-stop flow stage is below the arm pre-stop flow rate by the [Low percentage] and the [Alarm start delay] elapses.
Pre-stop flow rate high	The flow rate during the pre-stop flow rate exceeds the arm pre-stop flow rate by the [High percentage] and the [Alarm start delay] elapses.
Programmable input 1..6	The programmable input state (active/de-active) does not match with the expected input state.
Block valve fault	No valve feedback is detected.
Arm exceeds overrun limit	The measured volume exceeds the preset and the configured overrun limit.
Clean arm volume not reached	The measured clean arm volume is less than the specified clean arm volume minus the clean arm tolerance.
Arm parked	The arm parked input is detached.
Batch initialization error	A problem inside the device prohibits the batch to be initialized.
Calibration batch initialization error	A problem inside the device prohibits the calibration batch to be initialized.
Batch start error	A problem inside the device prohibits the batch to be started.
Calibration batch start error	A problem inside the device prohibits the calibration batch to be started.
Batch stop error	A problem inside the device prohibits the batch to be stopped.
Calibration batch stop error	A problem inside the device prohibits the calibration batch to be stopped.
Batch pause error	A problem inside the device prohibits the batch to be paused.
Batch resume error	A problem inside the device prohibits the batch to be resumed.

6.10 Product Stream Alarms

Alarm	Cause
Leaking valve	The volume accumulated on the product stream meter exceeds the [Leaking Volume Limit] entity within the [Leaking Timeout period] when the stream is idle.
No product	No product flow is detected from the product stream meter within the [no product timeout] period.
No pump	The pump feedback signal is not detected within the [pump feedback timeout]. It is only possible if the I/O binding for the pump is ON/OFF and the pump indications are configured.
No hydraulic pump	The feedback signal is not detected within the [hydraulic pump feedback timeout]. It is only possible if the I/O binding for hydraulic pump is ON/OFF and the hydraulic pump indication is configured.
Block valve fault	The block valve feedback signal is not detected within the [block valve feedback timeout]. It is only possible if the I/O binding for the block valve is ON/OFF and the block valve indications are configured.
Blend tolerance low	The blend ratio between the delivered product quantity with the delivered batch quantity is less than the blend ratio specified in the recipe by [blend tolerance limit].
Blend tolerance high	The blend ratio between the delivered product quantity with the delivered batch quantity is more than the blend ratio specified in the recipe by [blend tolerance limit].
Stream exceeds overrun limit	The product quantity delivered exceeds the preset quantity by the configured [overrun volume limit].
Valve fault	The product stream valve is not closed in the [Valve fault timeout] entity after sending the signal to close the product stream valve.
VCF out of range	The calculated VCF is out of range during the volume correction calculation used in the MSC-L.
VCF non convergence	The Non convergence error occurs during the volume correction calculation used in the MSC-L.
VCF supercritical fluid	The Superficial fluid error occurs during the volume correction calculation used in the MSC-L.
VCF no reference fluid	No reference fluid error occurs during the volume correction calculation used in the MSC-L.
VCF memory allocation	Memory Allocation error occurs during the volume correction calculation used in the MSC-L.
VCF temperature out of range	The temperature sensor output is out of range during the volume correction calculation used in the MSC-L.
VCF pressure out of range	The pressure sensor output is out of range during the volume correction calculation used in the MSC-L.
VCF density out of range	The density sensor output is out of range during the volume correction calculation used in the MSC-L.
VCF alpha60 out of range	The Alpha60 out of Range error occurs during the volume correction calculation used in the MSC-L.

Alarm	Cause
VCF no solution	The No Solution error occurs during the volume correction calculation used in the MSC-L.
VCF illegal argument	The Illegal argument error occurs during the volume correction calculation used in the MSC-L.
VCF pressure compensation not supported	The Pressure Compensation not supported error occurs during the volume correction calculation used in the MSC-L.
VCF bad sensor health	The Bad sensor health error occurs during the volume correction calculation used in the MSC-L.
Pulse hardware fault	The pulse input module detects the following error conditions. • Reading information from the Pulse Input processor. • Pulse overflow errors. • BAD health of the pulse input function.
Pulse phase fault	The dual pulse inputs are out of phase. It is only possible if the MSC-L is configured for quad pulse.
Tank low level	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.
Tank empty	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.
Temperature sensor fault	Temperature sensor fault is detected on the temperature sensor on the product stream.
Low temperature	The instantaneous temperature is less than the configured limits.
High temperature	The instantaneous temperature is greater than the configured limits.
Pressure sensor	The pressure sensor fault is detected on the pressure sensor on the product stream.
Low pressure	The instantaneous pressure is less than the configured limits.
High pressure	The instantaneous pressure is greater than the configured limits.
Density sensor fault	The density sensor fault is detected on the density sensor on the product stream.
Low density	The instantaneous density is less than the configured limits.
High density	The instantaneous density is greater than the configured limits.
Flowrate exceeded meter limit	The flow rate exceeds the configured meter limits.
VCF invalid reference condition	Invalid reference condition error occurs during the volume correction calculation used in the MSC-L

Alarm	Cause
VCF invalid temperature scale	Invalid temperature scale error occurs during the volume correction calculation used in the MSC-L.
VCF invalid commodity group	Invalid commodity group error occurs during the volume correction calculation used in the MSC-L.
VCF invalid table	Invalid table error occurs during the volume correction calculation used in the MSC-L
VCF invalid flow meter health	Invalid flow meter health error occurs during the volume correction calculation used in the MSC-L.
VCF rounding error	Invalid rounding error occurs during the volume correction calculation used in the MSC-L.
Factored pulse out fault	The configured number of pulses cannot be generated on the pulse output.

6.11 Additive Stream Alarms

Alarm	Cause
Leaking valve	Volume accumulated on the additive stream meter within the [leaking timeout period] is more than the [leaking Volume limit] (when the stream is idle or in between injections.)
No additive	The [number of retries] * [no additive timeout] is elapsed after the additive pulses stop during a batch. As soon as the additive solenoid opens, the timer [no additive timeout] starts.
No pump	The pump feedback signal is not detected within the [pump feedback timeout]. It is only possible if the I/O binding for the pump is ON/OFF and the pump indications are configured.
Block valve fault	The block valve feedback signal is not detected within the [block valve feedback timeout]. It is only possible if the I/O binding for the block valve is ON/OFF and the block valve indications are configured.
Low volume deviation	The average of the additive injection volume calculated over the configured number of cycles is lower than the additive deviation percentage. The alarm is evaluated after every injection. With the entity [Additive volume deviation], the acceptable deviation can be set. 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.
High volume deviation	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. With the entity [Additive volume deviation], the acceptable deviation can be set. 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.
Control fault	The MSC-L is not configured appropriately and does not have sufficient time to handle all the inject triggers. *NOTE: The maximum number of triggers that can be stored inside the buffer is 10.*
Solenoid fault	The system cannot activate or deactivate the solenoid. (This is an internal firmware control failure).
Pulse hardware fault	The pulse input module detects the following error conditions. • Reading information from the Pulse Input processor. • Pulse overflow errors. • BAD health of the pulse input function.
Pulse phase fault	The dual pulse input are out of phase. It is only possible if the MSC-L is configured for quad pulse.

Alarm	Cause
Factored pulse out fault	The configured number of pulses cannot be generated on the pulse output.
Temperature error	The temperature sensor fault is detected on the temperature sensor on the product stream.
Tank low level	The 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.
Tank empty	The 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.

6.12 Dual Bay Alarms

Alarm	Cause
Swing arm invalid position	Both [Bay 1 in position] and [Bay 2 in position] read an active signal.
Swing arm invalid transition	The arm changes its position while the arm is not idle. This alarm is not configurable and always terminates the batch.

For More Information
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