Honeywell

Safety Manager
Release 162

Hardware Reference

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- Original Instructions -

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CHAPTER 1

ABOUT THIS GUIDE

1 About this Guide

The Hardware Reference is intended primarily for the people responsible for and performing tasks related to Safety Manager.

This guide describes the functions of the Safety Builder tool and contains instructions how to use these functions.

1.1 Revision History

Revision	Date	Description
1.1	November 2019	Updated System Interconnection Cables section
1.2	June 2020	Added CPCHAS-0003, IOCHAS-0003S, IOCHAS-0003R and PDB-IO05
1.3	September 2020	Updated TSPKUNI-1624 chapter with TSPKUNI-1624L and TSPKUNI-1624R information.
1.4	October 2020	Updated section TDSI- 1624 and TDSI- 1648
1.5	November 2020	Updated image in section "Earth Leakage Detector terminal (TELD)". Updated section "SICC-0001/Lx"

Revision	Date	Description
1.6	December 2020	Updated minor changes in section "Control Processor Module". Updated "Input Converter Modules", section BSDI-16UNI. Updated sections of Removal of RUSIO-3224 module, Installation of RUSIO-3224 module, Updated, Removal of RUSLS-3224 module, installation of RUSLS-3224 module. Updated Section "BSDOL-04UNI" and removed "The BSDOL-04UNI module can be used in combination with SDOL-0448." Added a note for FS-PDC-MB24-1 power distribution cable. Updated AMP as "A" throughout the document and keeping the document consistent. Added Usage of DCOM 232/485 and DCOM-485. Removed obsolete part FS-PDC-FTA24, moved to Withdrawn Hardware. Updated section "Standards compliance". Updated Technical data table in section "PSU-240516". Updated Technical data table in section "BKM-0001". Updated Technical data table in section "Field Termination Assembly Module".
1.7	March 2021	Updated RUSIO & RUSLS as RUSIO-3224 & RUSLS in chapter Safety Manager Glossary Corrected RUSLS to RUSIO in *RUSIO-3224* under *Universal Safety IO modules* Updated tables of *Recommended wire sizes of PSUs*
1.8	February 2022	Restructured main features in "Power supplies" for consistent. Removed "TSDI-16115U" in section "Field termination assembly module" Updated FA & FC details in "PSU-UNI2450" in section "Power supplies" Added a Note under section 'Analog input ranges for Safety Manager' Replaced all low resolution images with new images. Added a note under the section "Analog input ranges for Safety Manager"

Revision	Date	Description
		below the table ' overview of the analog input ranges for Safety Manager'.
1.9	April 2022	Updated "*AutroSafe Cable Specifications*" in "*Communication cables*". Updated the note in the "Analog input ranges for Safety Manager".
2.0	May 2022	Removed FC and FS prefix codes from chapter names, wherever applicable, for consistency. Removed FS and FC footnotes description, and version# or CC suffix from Type numbers in the Technical data, wherever applicable, as the information is already covered under *General Information*. Removed prefix codes explanation for "FN" and "FE" from *General Information*, as it is not general anymore. Added note for prefix codes "FE" and "FX" in Technical data of "USI-0002" in *Control Processor modules*.
2.1	December 2023	R162.11, Release of the document Removed "FC-RUSFDU-xx" from the Cabinet section

CHAPTER 2

HARDWARE REFERENCE

2 Hardware Reference

The *Hardware Reference* is intended primarily for the people responsible for and performing tasks related to Safety Manager.

This guide provides technical information and specifications for all hardware components used in conjunction with Honeywell SMS's Safety Manager.

Typical readers are hardware engineers, maintenance engineers and assembly personnel.

It is assumed that the reader masters the required skills and knowledge as described herein.

Note:
This guide does not contain information related to other Honeywell Experion™ PKS systems and third-party controllers such as Allen-Bradley, Series 9000, TDC 3000, Data Hiway, UDC, PlantScape, and so on.

For more information about these systems, see the manufacturers book set.

2.1 Content of Hardware Reference

The *Hardware Reference* is a reference guide providing detailed information regarding technical information and specifications for all hardware components used in conjunction with Honeywell SMS's Safety Manager.

A reference guide is a Safety Manager related guide and does not describe tasks in terms of *how* to perform the task in terms of steps to follow. A reference guide can provide input to support decisions required to achieve a certain objective.

Guide	subjects
Hardware Reference	General information
	Handling and ordering spare parts
	Cabinet
	Chassis
	Power supplies
	Control Processor modules
	Input modules
	Input converter modules
	Output modules
	Output converter modules
	Universal Safety IO
	Modules for special functions
	IO Busses
	Field Termination Assembly Module
	System interconnection cables
	Communication cables
	Power distribution
	5 Volt and watchdog distribution

Additionally the following information is presented:

- List of abbreviations
- Safety Manager Glossary

2.1.1 References

The following guides may use this reference guide as a reference source:

Guide	Description
The Overview Guide	This guide describes the general knowledge required, the basic functions of, and the tasks related to Safety Manager.
The Safety Manual	This guide describes the specifications, design guidelines, and safety aspects related to Safety Manager.
The Planning and Design Guide	This guide describes the tasks related to planning and designing a Safety Manager project.
The Troubleshooting and Maintenance Guide	This guide describes the tasks related to troubleshooting and maintaining Safety Manager.
The System Administration Guide	This guide describes the task related to administrating the computer systems used in a Safety Manager project.

2.2 Basic skills and knowledge

Before performing tasks related to Safety Manager you need to:

- Understand basic Safety Manager concepts as explained in the Overview Guide and the Glossary.
- Have a thorough understanding of the Safety Manual.
- Have had appropriate training related to Safety Manager that certifies you for your tasks (see the Planning and Design Guide).

More related information can be found in Prerequisite skills and Training.

2.2.1 Prerequisite skills

When you perform tasks related to Safety Manager, it is assumed that you have appropriate knowledge of:

- Site procedures
- The hardware and software you are working with. These may i.e. be: computers, printers, network components, Controller and Station software.
- Microsoft Windows operating systems.
- Programmable logic controllers (PLCs).
- Applicable safety standards for Process & Equipment Under Control.
- Application design conform IEC 61131-3.
- The IEC 61508 and IEC 61511 standards.

This guide assumes that you have a basic familiarity with the process(es) connected to the equipment under control and that you have a complete understanding of the hazard and risk analysis.

2.2.2 Training

Most of the skills mentioned above can be achieved by appropriate training. For more information, contact your Honeywell SMS representative or see:

- Training Course-list.

2.3 Safety standards for Process & Equipment Under Control (PUC, EUC)

Safety Manager is the logic solver of a Safety Instrumented System (SIS) performing specific Safety Instrumented Functions (SIF) to ensure that risks are kept at predefined levels.

A SIS measures, independently from the Basic Process Control System (BPCS), a couple of relevant process signals like temperature, pressure, level in a tank or the flow through a pipe. The values of these signals are compared with the predefined safe values and, if needed, the SIS gives an alarm or takes action. In such cases the SIS controls the safety of the process and lowers the chance of an unsafe situation.

The logic in Safety Manager defines the response to process parameters.

In this context the following terms are explained in this section:

- Safety Integrity Level (SIL)
- Safety layers of protection
- Equipment Under Control (EUC)
- Process Under Control (PUC)

2.3.1 Safety Integrity Level (SIL)

The IEC 61508 standard specifies 4 levels of safety performance for safety functions. These are called safety integrity levels. Safety integrity level 1 (SIL1) is the lowest level of safety integrity, and safety integrity level 4 (SIL4) the highest level. If the level is below SIL1, the IEC 61508 and IEC 61511 do not apply.

Safety Manager can be used for processing multiple SIFs simultaneously demanding a SIL1 up to and including SIL3.

To achieve the required safety integrity level for the E/E/PE safety-related systems, an overall safety life cycle is adopted as the technical framework (as defined in IEC 61508).

For more information see also:

- Safety layers of protection
- Equipment Under Control (EUC)
- Process Under Control (PUC)

2.3.2 Safety layers of protection

The figure on the next page shows the typical risk reduction methods or safety protection layers used in modern process plants.

Safety Instrumented Systems (SIS) are designed to operate in the prevention and mitigation layers to:

- Prevent a process from entering a dangerous state.
- Mitigate the consequences of entering a dangerous state.

2.3 Safety standards for Process & Equipment Under Control (PUC, EUC)

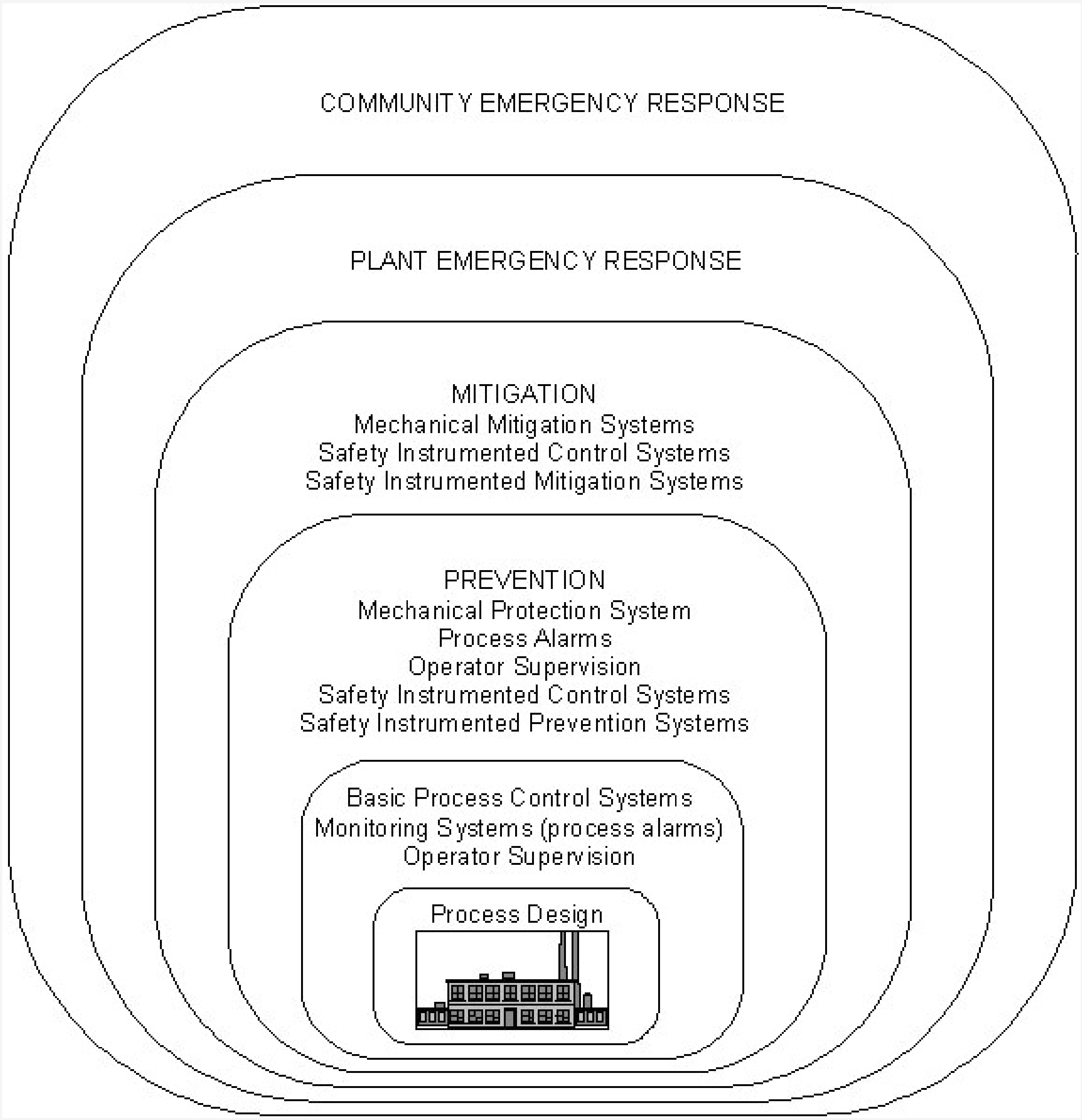


Figure 2-1: The concept of layers of protection

For more information see also:

- Safety Integrity Level (SIL)
- Equipment Under Control (EUC)

- Process Under Control (PUC)

2.3.3 Equipment Under Control (EUC)

Safety-related systems, such as Safety Manager, are designed to prevent the EUC from entering a dangerous state and to mitigate any EUC that has gone into a dangerous state.

For these functions a safety related system can be split in:

- Emergency shutdown systems, operating in the prevention layer of "The concept of layers of protection" on the previous page.
- Fire and gas detection and control systems, operating in the mitigation layer of "The concept of layers of protection" on the previous page.

For more information see also:

- Safety Integrity Level (SIL)
- Safety layers of protection
- Process Under Control (PUC)

2.3.4 Process Under Control (PUC)

PUC is EUC expanded with regulations to prevent the process from running out of control or to mitigate the consequences when it does run out of control.

Where PUC is concerned, Safety Manager monitors the process for abnormal situations. Safety Manager is able to initiate safety actions and process alarms.

Such actions and alarms can be caused by abnormal situations in the:

- Process
- Safety loops
- Safety system itself.

For more information see also

- Safety Integrity Level (SIL)
- Safety layers of protection
- Equipment Under Control (EUC)

CHAPTER 3

GENERAL INFORMATION

3 General information

Note:

A hardware module with same part number but different revision number, will have same form, fit, and function across different releases.The modules with higher revision are backward compatible and can co-exist in a system with different revisions of the same type without any issues. This is a default behavior unless otherwise mentioned.

3.1 Legend of symbols

3.1.1 Legend of symbols

This guide contains layout diagrams and wiring examples. The " Symbols used in this guide" below below explains some specific symbols used in these diagrams.

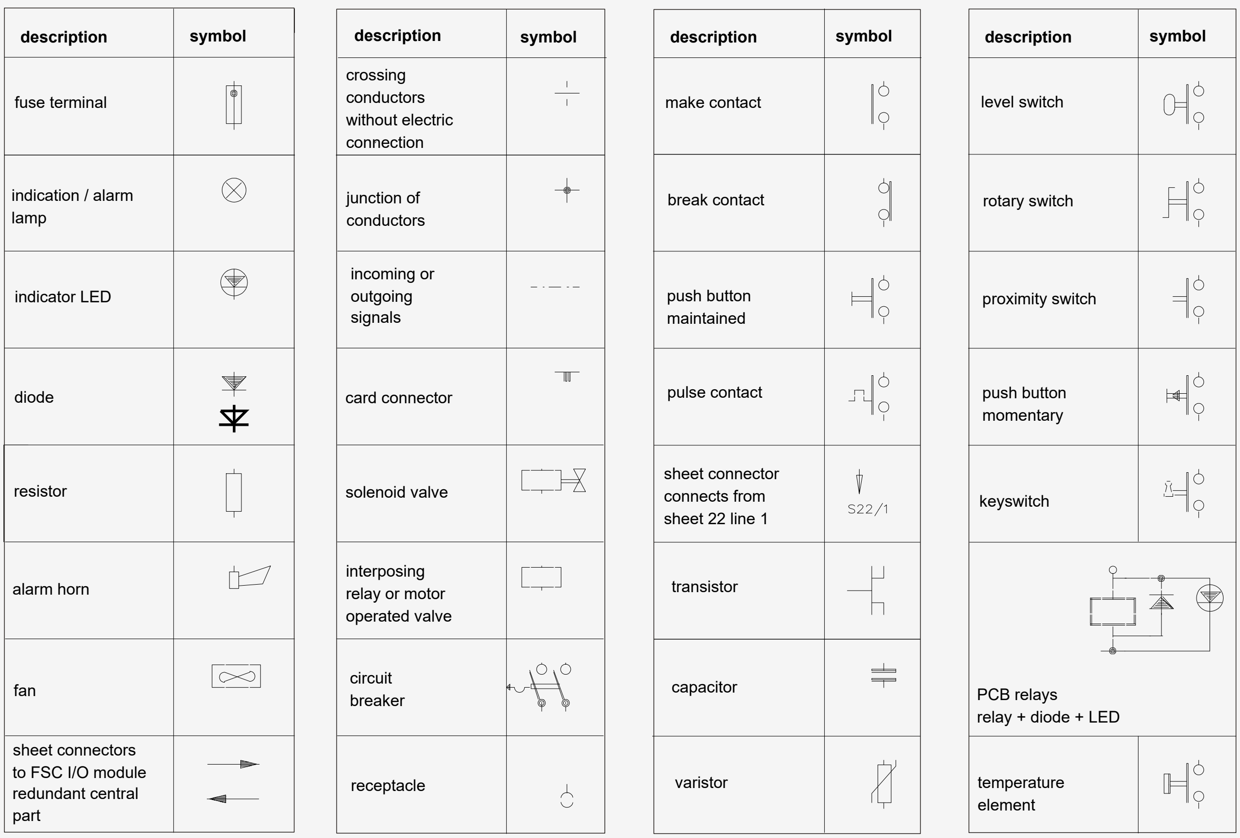


Figure 3-1: Symbols used in this guide

3.2 Safety Manager operating conditions

3.2.1 Safety Manager cabinets

Safety Manager cabinets are generally encased in steel cabinets for mechanical protection of the electronic equipment. Compliance with CE directives further requires Safety Managers to be properly covered.

3.2.2 Safety Manager main components

Safety Manager typically consists of the following main components:

- Cabinet enclosure.
- Power supply system consisting of power supply units (PSUs) generating 24 V DC (and 48 V DC or 110 V DC if needed), main switches and power distribution rails.
- Controller chassis with QPPs, communication modules, 5V supply modules and a Battery and Key switch module.
- Input/output chassis with all input and output modules.
- Field termination assemblies (FTAs) and/or terminals.

3.2.3 Safety Manager operating conditions

Attention:
Below conditions assume that proper airflow is provided (i.e. fans and louvre filters are fitted and operational).

The conditions required for proper Safety Manager operation are as follows:

• Storage temperature:	-40°C-+85°C (-40°F-+185°F)
• Operating temperature:	• Safety Manager cabinet -5°C-70°C (23°F-158°F)[1] • SM remote cabinet -40°C-70°C (-40°F-158°F)[2]
• Relative humidity:	5%-95% (non-condensing)

• Vibration (sinusoidal):	Excitation: sine-shaped with sliding frequency Frequency range: 10-150 Hz Loads: 10 Hz -57 Hz: 0.075 mm 57 Hz -150 Hz: 1 G No. of axes: 3 (x, y, z) Traverse rate: 1 Oct./min.
• Shock:	15 G in 3 axes (shock duration: 11 ms).

1. Measured in the Control Processor modules at 24 V DC supply voltage.
2. Measured in the Universal Safety IO modules at 24 V DC supply voltage.

3.2.4 Supply voltages

The following DC supply voltage ranges apply to ensure correct operation of the Safety Manager modules:

- 110 V DC: +25% / –15%
- 48 V DC: +15% / –15%
- 24 V DC: +30% / –15%

Note:

1. If it cannot be guaranteed that the DC power supplied to Safety Manager remains within the above ranges, additional voltage monitoring is required.
2. It is assumed that the 24Vdc Plant power fed to the Safety Manager Controller is uninterrupted. If not, means should be provided to avoid power dips at the 24Vdc lines to the Safety Manager Controller.
3. When using Plant power, the Plant power supply must fulfill the requirements as laid down in IEC 61010 or IEC 60950.

3.2.5 Safety Manager environment

The most common environment for a Safety Manager cabinet is an air-conditioned equipment/control room.

If the Safety Manager cabinet is to be used in an outdoor environment, special attention should to paid to:

- Minimum and maximum ambient temperatures
- Humidity
- Protection grade (IP grading).

3.3 Standards compliance

This sub section provides a list of the standards Safety Manager complies with.

Safety Manager compliance to standards

Standard	Title	Remarks
IEC 61508, Part 1-7 (2010) (S84.01)	Functional safety of electrical/electronic/ programmable electronic (E/E/PE) safety-related systems.	SFF can be provided uponValues such as Prequest.FD, PFH.
IEC 61511-1 (2004) (S84)	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements	
IEC 62061(2005) + AC (2010) + A1 (2013) + A2 (2015)	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems	
ISO 13849-1 (2015)	Safety of machinery - Safety related parts of control systems. General principles for design	
EN 54 part 2 (2006)	Components of automatic fire detection systems, Introduction.	

3.3 Standards compliance

Standard	Title	Remarks
EN 954-1 (1996)	Safety of Machinery - Safety Related Parts of Control Systems - Part 1. General Principles for Design	
EN 50130-4 (2011) + A1 (2014)	Electromagnetic compatibility - Immunity for requirements for components of fire, intruder and social alarm systems.	
EN 50156-1 (2004)	Electrical equipment of furnaces.	
EN 60204-1 (2006) + A1 (2009) + AC (2010)	Safety of machinery - Electrical equipment of machines - Part 1: General requirements	
IEC 61000-6-2 (2005)	Electromagnetic compatibility – Generic immunity standard: Industrial environment.	
IEC 61010-1 (2010) + Corr. 1 (2011) + Corr. 2 (2013)	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements.	
IEC 61131-2 (2007)	Programmable controllers. Part 2: Equipment requirements and tests.	
IEC 61326-3-1 (2008)	Immunity requirements for safety related systems.	
NFPA 72 (2016)	National Fire Alarm Code Handbook	
NFPA 85	Boiler and Combustions Systems	

Standard	Title	Remarks
(2015)	Hazards Code	
NFPA 86 (2015)	Standard for Ovens and Furnaces	
ANSI/ISA 71.04 (2013)	Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants G3 level: harsh environments	
UL 508	Industrial control equipment, seventeenth edition.	Underwriters Laboratories.
UL 508A (2001)	UL Standard for Safety Industrial Control Panels	Underwriters Laboratories.
FM3600, FM 3611	Electrical equipment for use in Class I, Division 2, Class II, Division 2, and Class III, Division 1 and 2, hazardous locations.	Factory Mutual Research. Applies to the field wiring circuits of the following modules: SDI-1624, SAI-0410, SAI-1620m, SDIL-1608, and SAO-0220m, and installation of the Controller in these environments.
Class I, Division 2, Groups A, B, C & D Class II, Division 2, Groups F & G		
CSA C22.2	Process control equipment. Industrial products.	Canadian Standards Association No. 142.
IEC 60068-1 (2004)	Basic environmental testing procedures.	
IEC 60068-2-1	Cold test. (undervoltage)	Safety Manager; -5°C (23°F)
		SM universal IO module; -40°C (-40°F)

Standard	Title	Remarks
		16 hours; system in operation; reduced power supply voltage:
		(–15%): U=20.4 V DC or (–10%): U=198 V AC.
IEC 60068-2-1	Cold test. (nominal)	Safety Manager; -10°C (14°F)
		SM universal IO module; -45°C (-49°F)
		16 hours; system in operation.
IEC 60068-2-2	Dry heat test.	up to 70°C (158°F)
		16 hours; system in operation; increased power supply voltage:
		(+30%): U=31.2 V DC or (+10%): U=253 V AC.
IEC 60068-2-3	Test Ca: damp heat, steady state.	21 days at +40°C (104°F), 93%
		relative humidity; function test after cooling.
IEC 60068-2-3	Test Ca: damp heat, steady state.	96 hours at +40°C (104°F), 93%
		relative humidity; system in operation.
IEC 60068-2-14	Test Na: change of temperature –	–25°C–+55°C (–13°F–+131°F), 12

Standard	Title	Remarks
	withstand test.	hours, 95% relative humidity, recovery time: max. 2 hours.
IEC 60068-2-30	Test Db variant 2: cyclic damp heat test.	+25°C - +55°C (+77°F -+131°F), 7days, 80-100%
		relative humidity, recovery time: 1 - 2 hours.
IEC 60068-2-6	Environmental testing – Part 2: Tests – Test.	Excitation: sine-shaped with sliding frequency;
	Fc: vibration (sinusoidal).	Safety Manager:
		Frequency range: 10 - 150 Hz. Loads:
		10 - 57 Hz; 0.075 mm.
		57 - 150 Hz; 1 G.
		Duration: 10 cycles (20 sweeps) per axis.
		No. of axes: 3 (x, y, z).
		Traverse rate: 1 oct/min in operation.
IEC 60068-2-27	Environmental testing – Part 2: Tests – Test. Ea: shock.	Half sine shock. 6 shocks per 3 axes (18 in total). Maximum acceleration: 15 G. Shock duration: 11 ms. Safety Manager in operation.

3.4 Key coding

3.4.1 Introduction

A Safety Manager cabinet typically contains two types of modules:

- Control Processor modules (see Control Processor modules)
- IO modules (see Input modules and Output modules).

3.4.1.1 Control Processor modules

Control Processor modules must be placed in pre-defined locations inside the Controller chassis (for more information see Chassis). These locations are identical for all configurations. In some configurations, not all positions need to be filled (dummy casings or a cover plate may be used instead).

3.4.1.2 IO Modules

The locations of the IO modules inside the IO chassis (for more information see Chassis) are not pre-defined. They are defined by the user in the Hardware Configurator option of the Safety Builder software. To ensure proper interfacing with the field devices (wiring, etc.) and to prevent damage to equipment, the IO modules must remain in their designated location. Insertion of a module in a slot that was intended for an other type of IO module, can result in defects to this module and/or the connected field devices. To prevent this, each IO module has two holes in unique positions in its rear connector. Coding pins are inserted at the corresponding locations in the IO backplane connector, so each slot in the IO chassis can only accept the correct type of IO module.

Note:
For key coding, use SOURIAU make 5159.009.17.22 pins and the special insertion tool, type 5159.009.96.

If the coding pins of the module are bent, they must be removed. If you try to bend the pins back to their correct position, they will break and the connector will then need to be replaced.

3.4.2 Connectors

Every IO module has a connector that is plugged into the appropriate chassis connector and a flatcable with connector (on the front side) that must be placed in the bus-print at the front of the IO chassis.

The " IO module connector (left) and IO chassis connector (right)" below on the next page shows the layout of the module connector and chassis connector for IO modules. It clearly indicates the positions for the coding holes (in the module connector) and the coding pins (in the IO backplane connector).

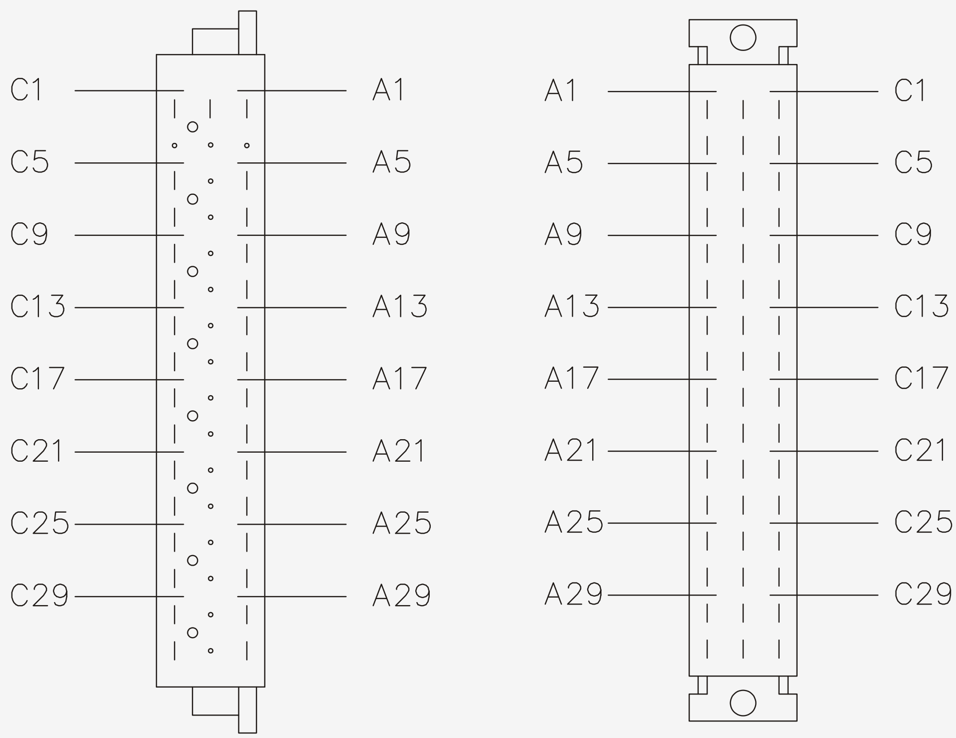


Figure 3-2: IO module connector (left) and IO chassis connector (right)

Safety Manager IO modules are coded with coding system type 5159, make SOURIAU. The below table shows the key coding positions for all key coded modules.

Key coding positions for all possible key coded modules

Module type	Module hole positions		Chassis pin positions	
	Hole 1	Hole 2	Pin 1	Pin 2
Input modules				
SDI-1624	A5	C5	A5	C5
SDI-1648	A13	C29	A13	C29
SAI-0410	A5	C17	A5	C17
SAI-1620m	A5	C25	A5	C25
SDIL-1608	A5	C29	A5	C29
Output modules				
SDO-0824	A9	C9	A9	C9
SAO-0220m	A9	C5	A9	C5
DO-1224	A9	C13	A9	C13
RO-1024	A9	C17	A9	C17
DO-1624	A9	C21	A9	C21
SDO-04110	A13	C25	A13	C25
SDO-0448	A13	C21	A13	C21
SDO-0424	A13	C5	A13	C5
SDOL-0424	A13	C9	A13	C9
SDOL-0448	A17	C9	A17	C9
Various modules[1]				
IO-0001	A5	A7	A5	A7

Module type	Module hole positions		Chassis pin positions	
	Hole 1	Hole 2	Pin 1	Pin 2

1. IO-0002 uses no key coding, but uses different connectors.

3.5 Type number identification

This section describes the identification method for type numbers of Safety Manager products. This method is in line with Honeywell SMS standards. Type number identification is done in such a way that several aspects of a specific product can be recognized. For instance the functionality of the module, how it is connected (terminated) and applicable power details are coded and included in the product type number.

3.5.1 Identification

A type number consists of several coded elements. These elements are pre-defined and controlled by Honeywell SMS product management. Identification of elements is done at two different levels; these levels are listed below.

1. Main elements at type-number level.

   Each type number has three main elements: <Prefix> - <Module> <Suffix>

   Each element represents a distinct aspect of the module.

   For more information, see below Identification of type numbers - main elements.

2. Sub elements at module level.

   A module element consists of several sub elements. Each element represents a distinct aspect of the module.

   For more information, see below Identification of modules - sub elements.

3.5.1.1 Identification of type numbers - main elements

3.5.1.2 Main elements - overview

Main elements of a type-number are: <Prefix> - <Module> <Suffix>

Example

FC - SDI-1624 V1.1 where:

• <Prefix> = FC	for more information see Prefix code - explained,
• <Module> = SDI-1624	typical combination of sub elements; for more information see Identification of modules - sub elements,
• <Suffix> = V1.1	for more information see Suffix code - explained.

3.5.1.3 Prefix code - explained

As a rule, Honeywell SMS products have type numbers that start with a distinct prefix. In this way products related to Safety Manager can always be recognized directly in overall Honeywell SMS product listings.

The prefix codes listed below apply:

<ID>	Value	Explanation
<Prefix>	FS	For non-conformal coated products
	FC	For conformal coated products
	FA	For products that can be connected to devices in explosive atmospheres

A prefix code must be included in the type number wherever a type number is used. However, in some cases the prefix may be excluded if the type number including the prefix becomes too long.

A prefix can be omitted in the following cases:

- type number printed on IO module front,
- type number printed on IO converter modules.

3.5.1.4 Suffix code - explained

The suffix code is to identify changes to Safety Manager products.

The format of the suffix code is as follows:

- “V#.#” (for example: V1.1).

3.6 Fuse derating

“IEC certified fuses can operate continuously at 100% of the temperature derated current. However fuse manufacturers recommend in general to use an additional current derating of 25% for reliable continuous operation. This means that fused relay outputs and fused supply outputs are recommended to be rerated to 75% of the (temperature derated) maximum output current”.

CHAPTER 4

CABINET

4 Cabinet

4.1 General info

This chapter describes standard cabinets that are available for Safety Manager systems.

Using standard cabinets provides several advantages over specifically designed cabinets. Honeywell SMS policy is aimed at delivering standard engineered, tested and certified (modular) concepts to the market for these main reasons:

- Reusing existing concepts saves valuable time (e.g. engineering, testing, certification).
- Individual projects will be delivered at a guaranteed level of quality and in short turn-around times.
- Applying modularity within a proven overall concept provides for flexibility toward customers.

Typically, Safety Manager is installed in a standard cabinet. It is possible to add or rearrange certain components or change their location within the cabinet.

Also, standard Safety Manager remote cabinets are available. Depending on specific application needs one or more types can be opted for.

Should you not wish to follow the standard cabinet layout, then you can only do so after prior consult with Honeywell SMS.

4.2 Rittal TS

4.2.1 Standard Rittal enclosure for Safety Manager

The standard enclosure for Safety Manager is based on two cabinet types available in the Rittal TS 8 series.

Safety Manager enclosures are default equipped with a swing frame, support glands, fans, an enclosure frame with steel doors, louvres and filters, an enclosure light, a thermostat, earthing strips, a mounting plate, gland plates, a rear panel and a roof or bottom plate. Side panels are mounted to the outer walls.

A standard Safety Manager enclosure is painted in RAL 7035, with RAL 7022 for the plinth.

Below sections provide more details related to the Rittal TS series as assembled and delivered by Honeywell SMS.

4.2.2 Cabinet enclosure

Roof	Suitable for mounting the Honeywell SMS fan unit (see section Fans).
	An earth strap makes an earth connection from the roof to the cabinet (connected to the left hand earth bolt on the roof).
	For top cable entry, use one of the following standard Rittal roofs: For TS 8806 cabinet: roof type DK 7826.863, For TS 8808 cabinet: roof type DK 7826.883. These roofs are equipped with a fixed and a sliding part, each with a clamping strip for optimum sealing.
Side wall plates	Mounted to the outer side walls.
Rear wall	Mounted in cabinets with front access only. The standard installed earth potential equalization points are sufficient to ensure proper earth connection.
Bottom plates	Can be moved horizontally when unlocked.
Gland plates	Used for cable entry at the bottom of the cabinet. Earthed to the cabinet frame.

4.2.3 Cabinet access

A Safety Manager cabinet can have front access or combined front and rear access (when it is not placed against a wall). The following table shows the possible configurations for cabinet doors:

	Front door	Rear door	Code in figure below
Front access only	Single, hinged left	-	1000
	Single, hinged right	-	0100
	Double	-	1100
Front and rear access	Single, hinged left	Single, hinged right	1001
	Single, hinged right	Single, hinged left	0110
	Double	Double	1111

Please note the following issues:

- A combination of single (full) door and double (half) doors is not possible.
- Double (half) doors for rear entry can only be selected if double (half) doors are selected for front entry.
- Single (full) rear door, hinged on the left hand side can only be selected if a single (full) front door, hinged on the right hand side is selected.
- Single (full) rear door, hinged on the right hand side can only be selected if a single (full) front door, hinged on the left hand side is selected.

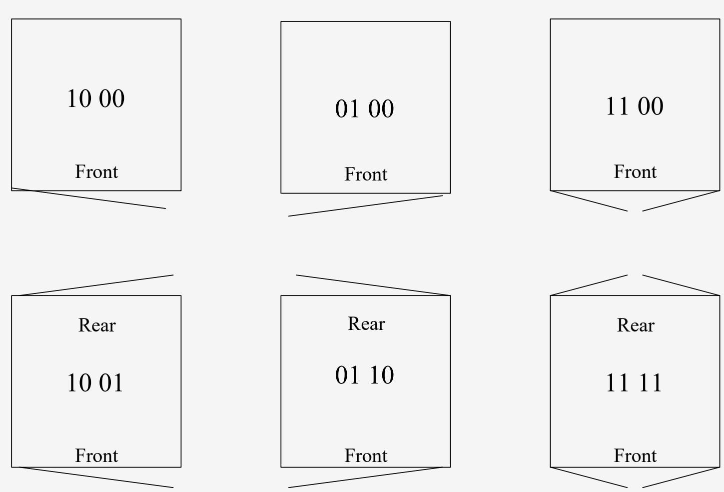


Figure 4-1: Cabinet doors

4.2.4 Cabinet doors

Item	Amount	Remarks
Hinge	4 Per door	130° (internal) door hinges are used.
Comfort handle	1 Per door	
Comfort handle insert (key type)	1 For each door handle	If a push button door lock is required, this will have to be ordered separately.
Earth strap	1 Per door	Mounted on the top side of the door.
Louvres	2 Per front/rear side	See Louvres and filters
Wiring plan pocket (A4)	1	1 Piece per cabinet enclosure, only on front side doors, placed inside the (left hand) door.
Doorstop		Mounted on the inside of a single door (hinged left) to prevent it from colliding with the opened swing frame.

4.2.5 Louvres and filters

In the lower part of the cabinet doors, louvres and filters are mounted to allow for airflow inside the Safety Manager cabinet, in one of two ways:

Single (full) door	Each door is fitted with two louvres with filters. The louvre, including filter, is a Rittal type SK 3323.200.
Double (half) door	Each door is fitted with one louvre with filter. The louvre, including filter, is a Rittal type SK 3323.200.

4.2.6 Cabinet swing frame

The cabinet swing frame, which is always hinged at the left hand side, contains the following Safety Manager components:

Controller chassis	Typically located 3 HE below the top position in the cabinet.
IO chassis	Typically located directly below the Controller chassis.
Bus bar for 24 V power	Typically mounted vertically, right from the various chassis.
Cable tray for vertical bus	Typically mounted vertically, left from the various chassis.
Swing frame stop	Mounted on bottom of swing frame.
Mounting kit	Top and bottom mounting plate for 180 deg. swing frame hinge.
Earth strap	2, One at the top and one at the bottom of the swing frame.
Ergoform S-handle with push lock	No additional swing frame stops are required during normal transportation.
Captive nuts	121 captive nuts, installed on the front and rear side of the swing frame.

It is not necessary for every cabinet to contain a swing frame. When two cabinets are attached mechanically to each other, the:

- Left-hand side cabinet houses the Controller (and contains the swing frame).
- Right-hand side cabinet is meant for marshalling the connections with the field (and doesn't contain a swing frame).

4.2.7 Enclosure light

The Rittal enclosure light (PS 4155.000) has an auto-select input voltage detector (110/230 V AC) and is equipped with a motion sensor. You no longer require an additional door switch. If the shipping section consists of more than one Rittal cabinet enclosure, all cabinets will have an enclosure light. All enclosure lights use the same feeder. The feeder is wired from the first cabinet (with an interconnection cable) to the second and, if applicable, from the second to the third cabinet, etc.

4.2.8 Fans

A pair of fans are mounted in the roof. The following types are available:

- Papst, type 4184NX, operating voltage 24 V DC
- Honeywell SMS fan unit which can be delivered in 3 voltages 24 V DC, 115 V AC, and one for 230 V AC. For a data sheet of the 24 V DC fan unit see FANWR-24R.

FANWR-24R (Preferred)	24Vdc fan unit with readback CC
51199947-275	FAN ASSEMBLY KIT 230VAC EC CC
51199947-175	Fan Assembly Kit, 115VAC, EC, CC

Note:
Fan unit HU-511/HU-611 is withdrawn from service.

The Honeywell SMS fan units consist of a pair of fans. A read-back contact indicates the operational status of the fans.

4.2.9 Thermostat

The thermostat gives an alarm to alert you of temperature increasing inside the Safety Manager cabinet (e.g. when filters are blocked or fans fail). When a Honeywell SMS fan unit is installed, the thermostat is not required.

The Rittal SK 3110.000 thermostat is mounted on the top right-hand side of each Rittal cabinet and is suitable for temperatures ranging from +5°C-+55°C (+41°F-+131°F).

4.2.10 Support structures

A Safety Manager cabinet comes fitted with the following support structures:

Structure	Description
Rittal mounting rails	For non-FTA use. For example: mounting of SIC strain relief brackets and cable trays for communication cables. • Type TS 8612.180 (for 800 mm deep cabinets), • Type TS 8612.160 (for 600 mm deep cabinets).
TS 35 rail	Used for FTAs, terminals, filters, etc.
FTA channels	For FTAs, channels are the preferred solution.
Cable support/ clamp rails	Typically installed at the bottom and/or top, depending on cable entry. Used for securing field cables with cable clamps during on-site cabinet installation. Clamping devices must be able to withstand a 45 kg (100 lbs) pull. If a plinth is factory-mounted and the cabinet has bottom cable entry, the cable support/clamp rail is mounted in the plinth.
Mounting plates	For the mounting of power supply units.

4.2.11 Earthing

Earth rail / potential equalization rail	An earth rail / potential equalization rail is always mounted. The required number of earth rails / potential equalization rails depends on the equipment mounted inside the cabinet enclosure.
protective earth bar	Mechanical items are connected via the Rittal cabinet frame to the protective earth bar. These are mechanical items such as the swing frame, mechanical items in the swing frame, door(s), side wall/plates, roof, bottom plates, the rear wall (if applicable) and all other items requiring a connection to the protective earth bar.
Instrument earth bar	The instrument earth bar is mounted isolated from the cabinet frame and other earth bars.

4.2.12 Ingress Protection (IP) rating

By default, Safety Manager cabinets have an IP rating of IP20 in accordance with DIN VDE 0470.

4.2.13 Electrostatic Discharge (ESD) Bonding point

An ESD bonding point is fixed to the cabinet chassis.

4.2.14 Technical data

Cabinet types	Rittal TS 8806	One of the two standard Rittal cabinet types is used for Safety Manager cabinets.
	Rittal TS 8808	
Approvals	IP 20 / NEMA1	
Color	RAL 7035	Light grey, used for the cabinet enclosure.
	RAL 7022	Dark gray, used for the plinth.
Dimensions Heights do not include the plinth (normally 10 cm / 4 in) and the lifting eye-bolts (5 cm / 2 in).	80 × 60 × 200 cm (31½ × 23½ × 78¾ in) (width × depth × height)	Rittal TS 8806
	80 × 80 × 200 cm (31½ × 31½ × 78¾ in) (width × depth × height)	Rittal TS 8808
Weight	up to 550 kg (1210 lbs)	Weight of cabinet filled with electronics (depends on options used).
Hoisting eye bolts	4	Rittal type PS 4568.000 Placed on the top corners of the cabinet, used for crane

		transportation of the cabinet and for securing the roof to the cabinet.
Plinth	height: 10 cm (4 in)	Standard (factory mounted) the Safety Manager cabinet is supplied with a plinth, unless specified otherwise in the customer requirements.
Leveling feet		If leveling feet are required, use a Rittal standard cabinet without a plinth.

4.3 FANWR-24R

4.3.1 Fan unit 24 V DC with readback

The 24 V DC fan unit (FANWR-24R) consists of two fans and a printed circuit board (PCB) 07209 on a mounting plate.

The external 24 V DC power and readback contact wiring for the fan unit terminates on a 4 pole connector which slots into the fan unit.

Electronics in the fan unit generate the signals to indicate the fan status. If the speed of a fan is above minimum, a green LED next to that fan illuminates to indicate this. If both fans are above minimum speed the readback contact closes.

Finger guards are mounted on both sides of the fans.

The "Layout of the FANWR-24R fan unit and direction of air flow" below shows the direction of airflow and the bottom and side view of the fan unit.

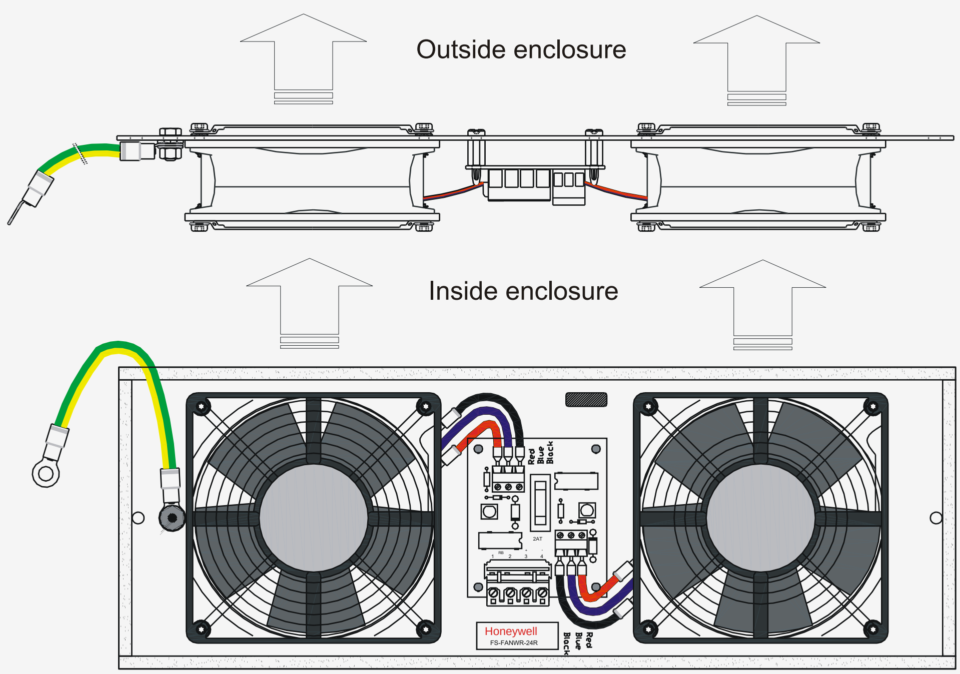


Figure 4-2: Layout of the FANWR-24R fan unit and direction of air flow

4.3.2 Block diagram

The "Functional block diagram of the FANWR-24R fan unit" below shows a functional block diagram of the FANWR-24R fan unit.

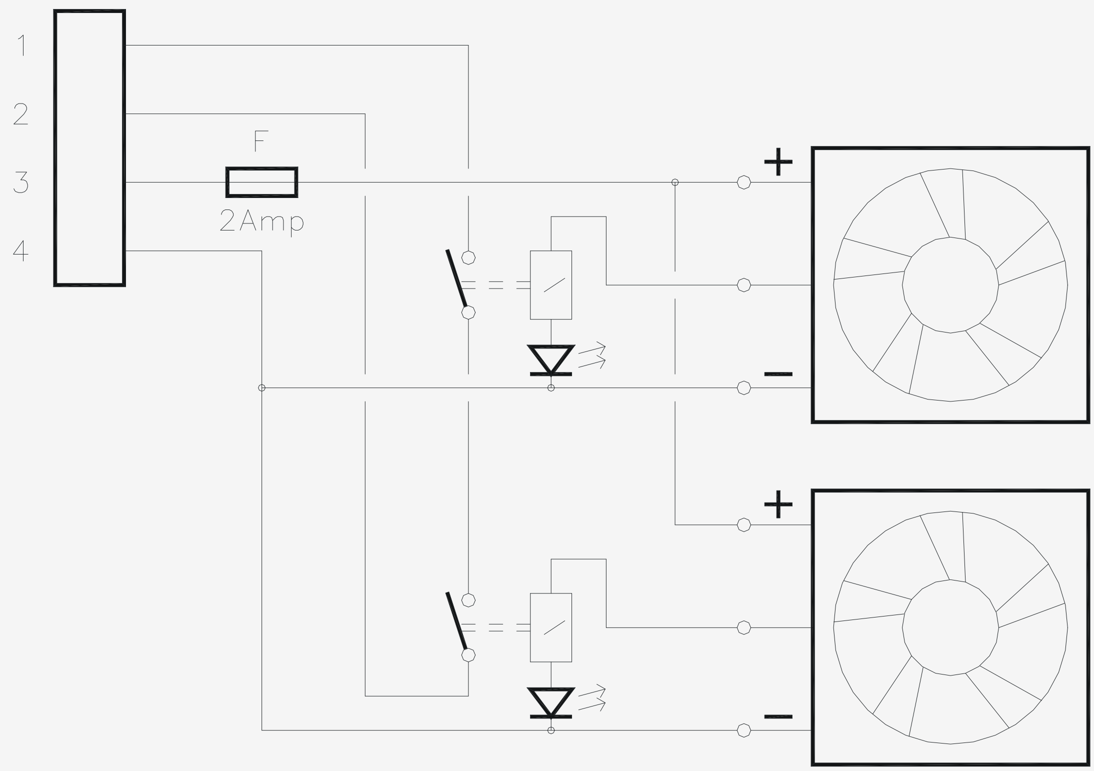


Figure 4-3: Functional block diagram of the FANWR-24R fan unit

4.3.3 Fan status indication

The fan unit is equipped with a potential free readback contact and green LEDs to indicate the fan status.

- The readback contact is closed for about 15 seconds during powerup and when the rotation speed (RPM) of *both* fans is above the minimum speed.
- A LED is on when the rotation speed (RPM) of the *related* fan is above the minimum speed.

4.3.4 Flow rate/Static pressure

The " Flow rate against static pressure (per fan)" below shows the flow rate *per fan* against the static pressure. The grey area indicates the optimum operating range.

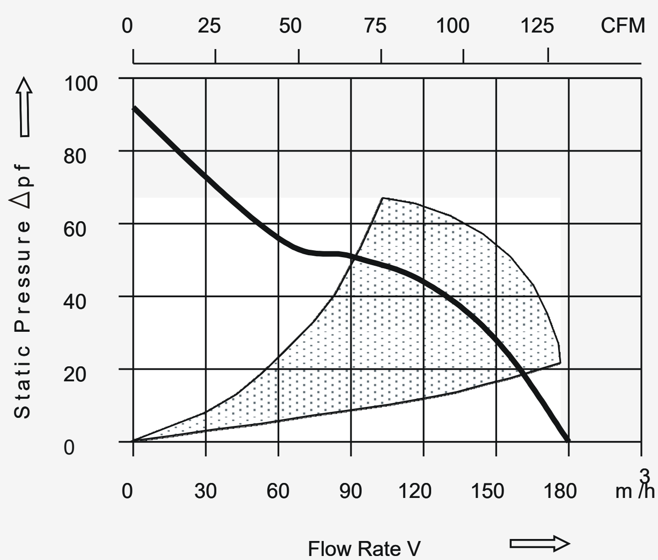


Figure 4-4: Flow rate against static pressure (per fan)

4.3.5 Electrical connections

Attention:
The earth wire of the fan unit must be connected to the enclosure in which the fan unit is mounted.

The fan unit is equipped with a 4 pole screw connector to wire the readback contact and the 24Vdc power.

"Layout of the FANWR-24R fan unit and direction of air flow" on page 43 shows the location of the connector on the fan unit. The "The FANWR-24R fan unit connector details" on the facing page shows the connection details of this connector.

Figure 4-5: The FANWR-24R fan unit connector details

4.3.6 Mounting

Attention:
The airflow through the fan unit should not be obstructed on either side of the unit in order to ensure proper functioning of the fan unit.

The fan unit can be mounted in horizontal or vertical position.

The fan unit needs to be mounted in such a way that the fans and electronics are inside the enclosure. The fan unit will then generate an under pressure inside the enclosure.

The "Cut-out plan of the fan unit including mounting holes" below shows the required cut-out opening of the fan unit and the location of the mounting holes.

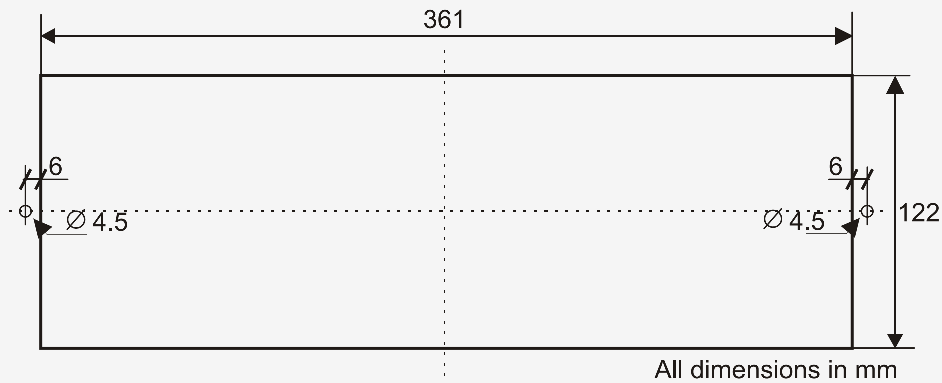


Figure 4-6: Cut-out plan of the fan unit including mounting holes

4.3.7 Technical data

The FS-FANWR-24R has the following specifications:

General	Type numbers	FS-FANWR-24R
	Approvals:	CE; UL; FM
Model and make	Fan make:	Papst
	Model:	4184N/17X (ball bearing)
Power	Finger guard make:	Papst
	Model:	LZ30
Fuse	Power requirements:	24 V DC 9.5 W
	Voltage range:	12-29 V DC No reverse polarity protection
Air flow	(for the complete unit)	360 m^3/hr., 211.8 CFM
Noise	(for the complete unit)	52 dB
Fan speed	Nominal speed:	3.200 RPM
	Minimum speed: (to close readback contact)	1.500 ± 100 RPM
Life cycle		85.000 hrs at 40° C (104° F) 37.500 hrs at 75° C (167° F)
Ingress protection		IP 20
Temperature range		-30° C -+75° C (-22° F to +167° F)
Readback contact	Max. switched voltage:	300 V DC / 240 V AC
	Max switched current:	0.5 A
	Max. switched power:	10 W

Connector	Wire stripping length:	7 mm
	Tightening torque:	0.4-0.5 Nm
	Type of screwdriver:	SD 0.6 X 3.5 -DIN 5264
Physical	Dimensions:	391 × 142 × 51 mm (L × W × D) 15.4 × 5.59 × 2.01 in (L × W × D)
	Weight:	1.7 kg

4.4 MCAR-01

4.4.1 Mounting Carrier (18 inch)

The MCAR-01 is a carrier that can be screwed on any flat surface.

The MCAR-01 can carry one IOTA-R24 assembly. The below figure shows the physical appearance and the coordinates of the four mounting holes.

The MCAR-01 consists of:

- A metal profile
- A plastic cover plate
- A ground rail with 16 ground connection screws
- Two power rails with M5 holes (+24V and 0V)
- Four mounting holes (6.35 mm diameter)

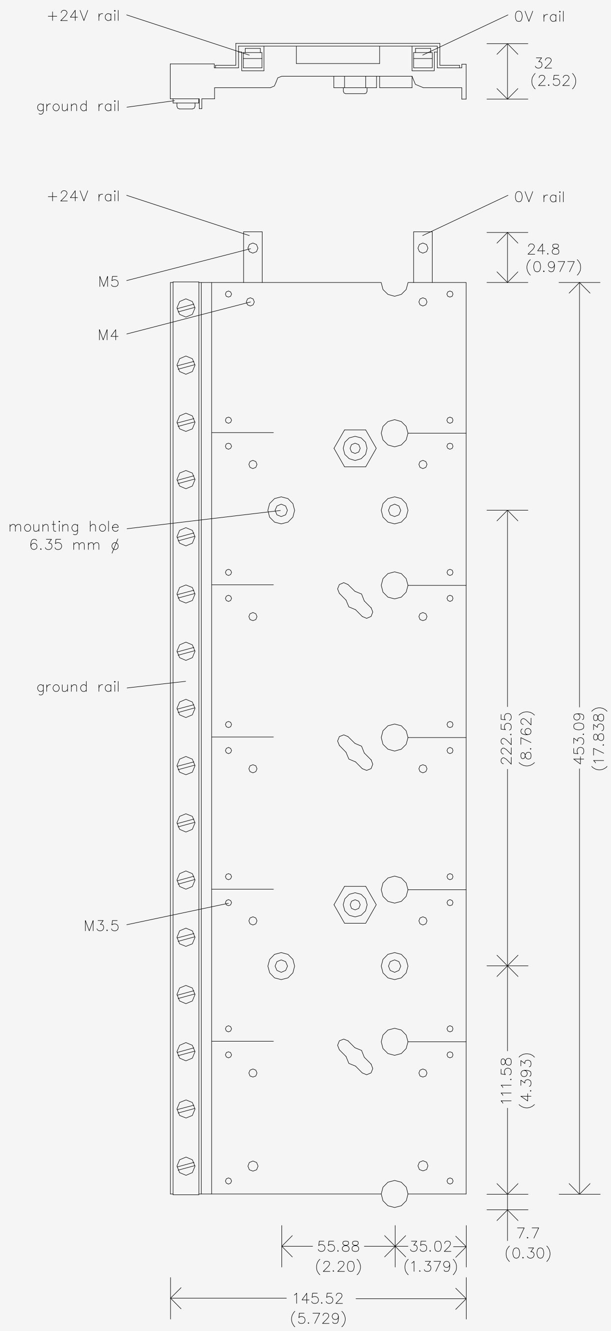


Figure 4-7: Mechanical layout

4.4.2 Mounting an IOTA-R24

The IOTA-R24 is fixed on the MCAR-01 with ten ground screws and two power screws (24V and COM).

24Vdc power must be connected to the MCAR-01 on the power rails using M5 screws.

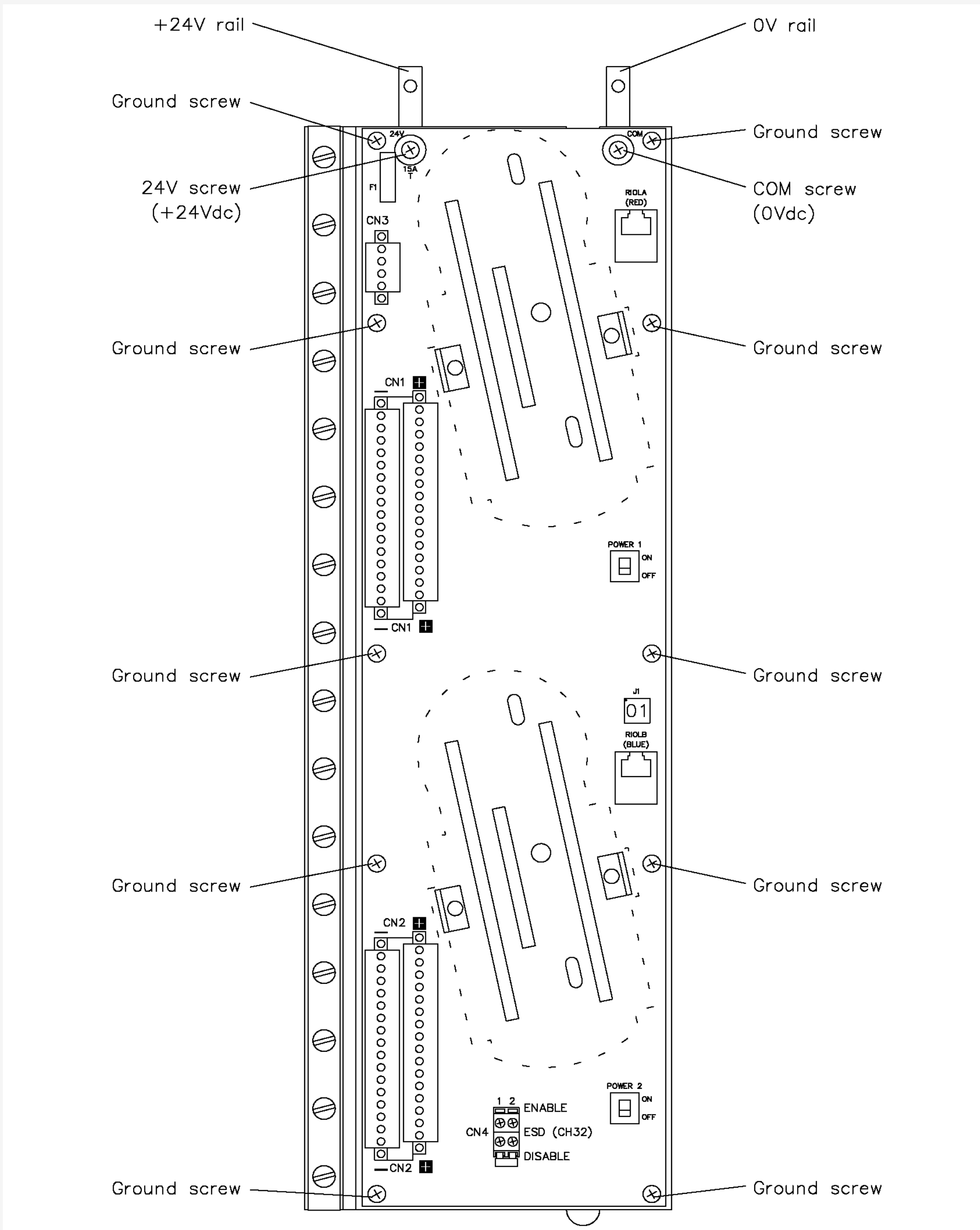


Figure 4-8: MCAR-01 with a mounted IOTA-R24

4.4.3 Mounting an IOTA-NR24

The IOTA-NR24 is fixed on the MCAR-01 with eight ground screws and two power screws (24V and COM).

This leaves room on the MCAR-01 for two 3 inch units or one 6 inch unit.

24Vdc power must be connected to the MCAR-01 on the power rails using M5 screws.

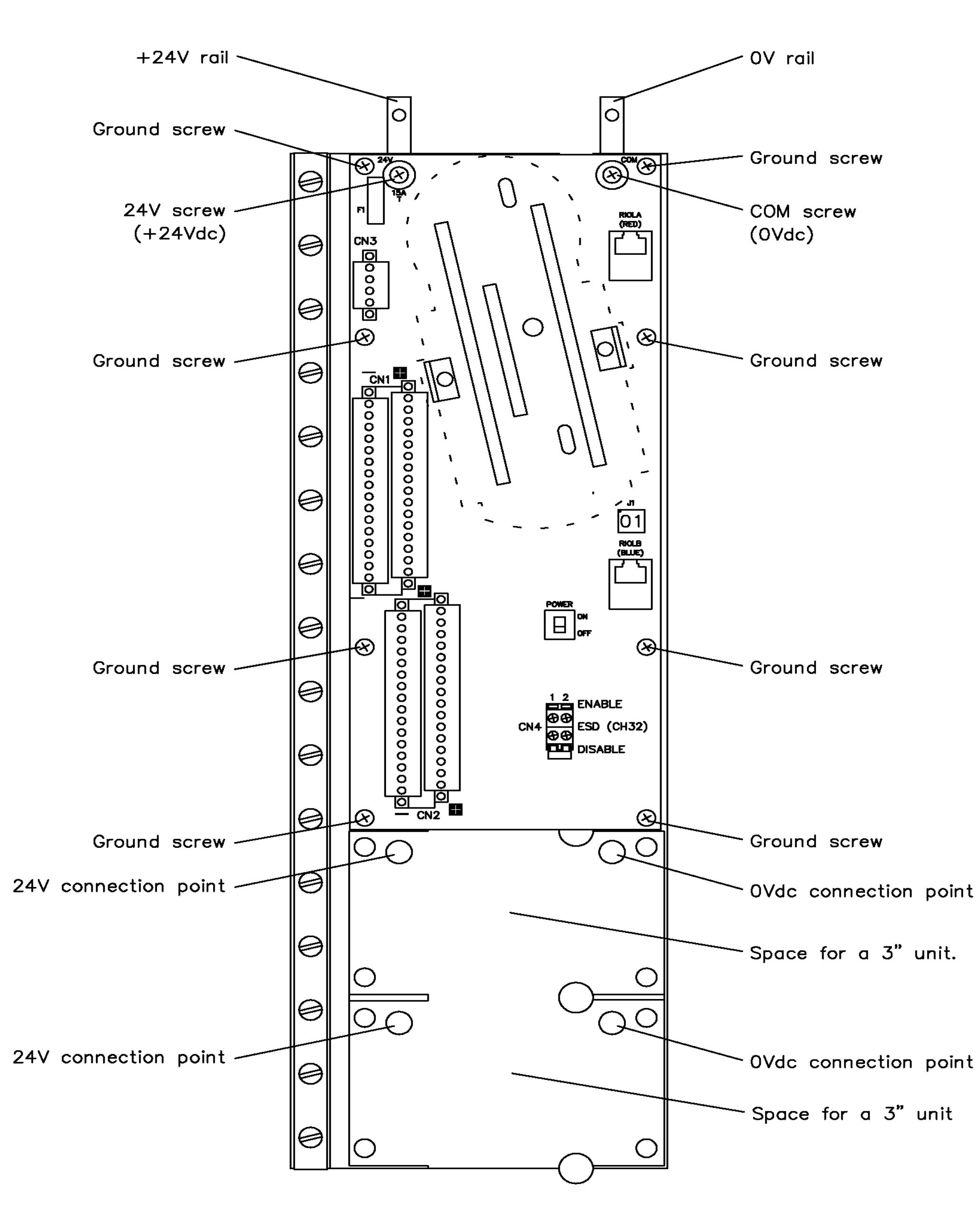


Figure 4-9: MCAR-01 with a mounted IOTA-NR24

4.4.4 Technical data

The MCAR-01 has the following specifications:

General	Type number:	FC-MCAR-01
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL
Power	Supply voltage:	24 V DC -15%..+30%
	Supply current:	none
	Supply rail current:	max. 40 A
Connections	24V supply:	2 x M5
	Ground:	16 x M5
Physical Data	Dimensions (H x W x D):	32 x 145.6 x 478 mm 2.52 x 5.73 x 18.8 in
	Weight:	1.1 kg 2.4 lbs

4.5 MCAR-02

4.5.1 Mounting Carrier (36 inch)

The MCAR-02 is a carrier that can be screwed on any flat surface.

The MCAR-02 can carry two IOTA-R24 assemblies. The below figure shows the physical appearance and the coordinates of the four mounting holes.

The MCAR-02 consists of:

- A Cable Carrier Assembly (CCA)
- A metal profile
- Two plastic cover plates
- A ground rail with 32 ground connection screws
- Two power rails with M5 holes (+24V and 0V)
- Four mounting holes (use screws with a diameter <5.5 mm)

The power rails of two MCAR-02 carriers can be coupled. Use two M5 screws to connect the two power rials of the top carrier with the bottom carrier (through the 5 mm holes).

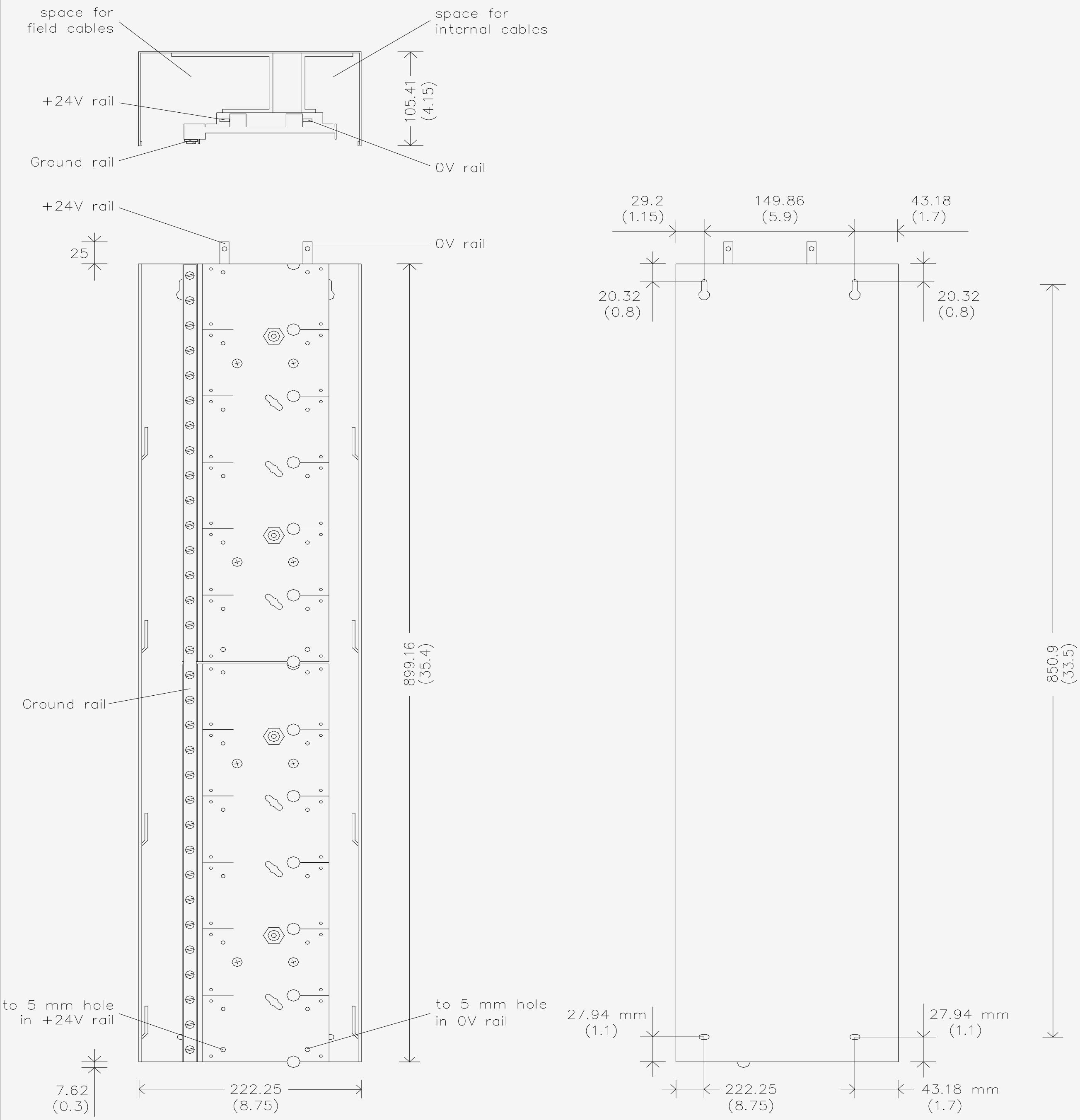


Figure 4-10: MCAR-02 - top, front and rear views

4.5.2 Mounting an IOTA-R24

An IOTA-R24 is fixed on the MCAR-02 with ten ground screws and two power screws (24V and COM).

24Vdc power must be connected to the MCAR-02 on the power rails using M5 screws.

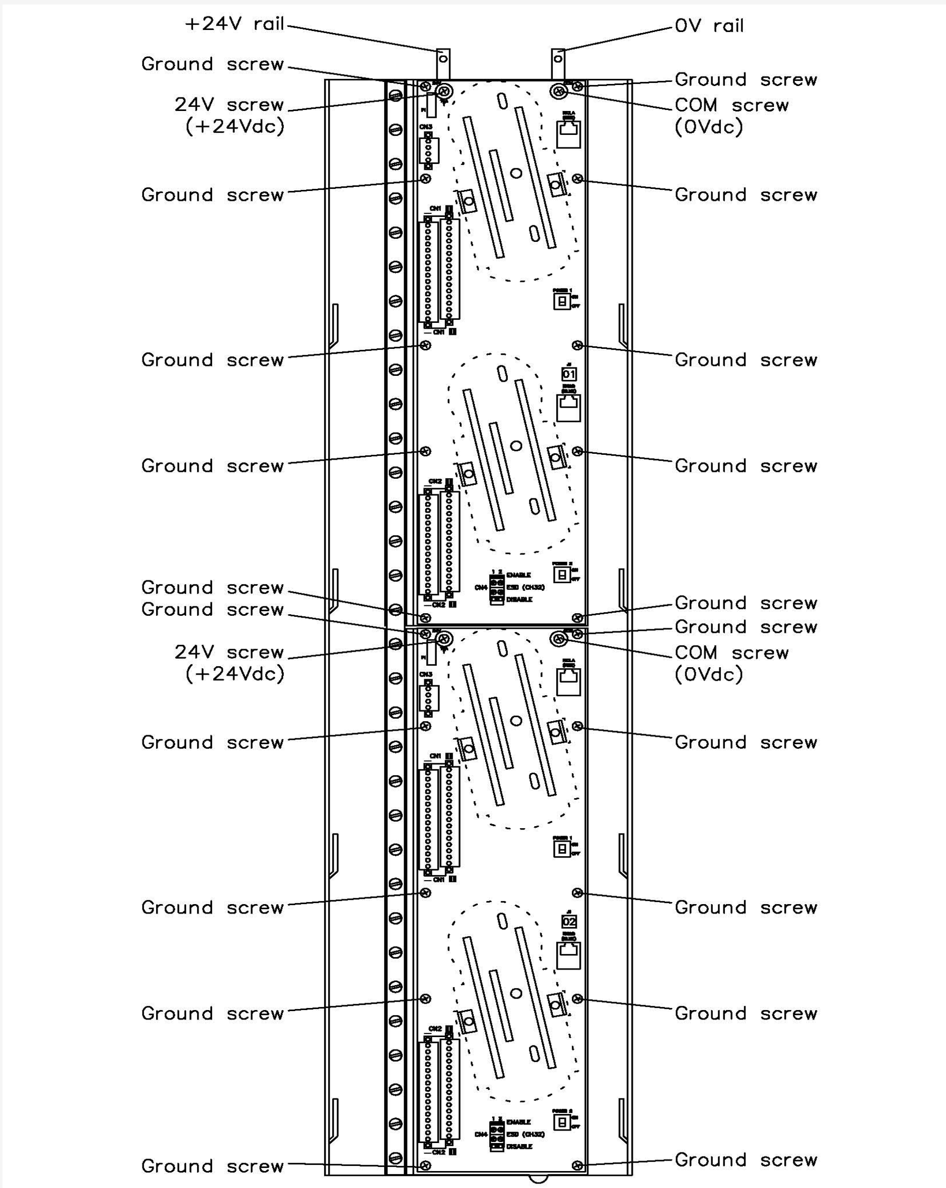


Figure 4-11: MCAR-02 with two mounted IOTA-R24 modules

4.5.3 Mounting IOTA-NR24 units

Up to three (3) IOTA-NR24 units can be fixed on the MCAR-02 with eight ground screws and two power screws (24V and COM) each.

24Vdc power must be connected to the MCAR-02 on the power rails using M5 screws.

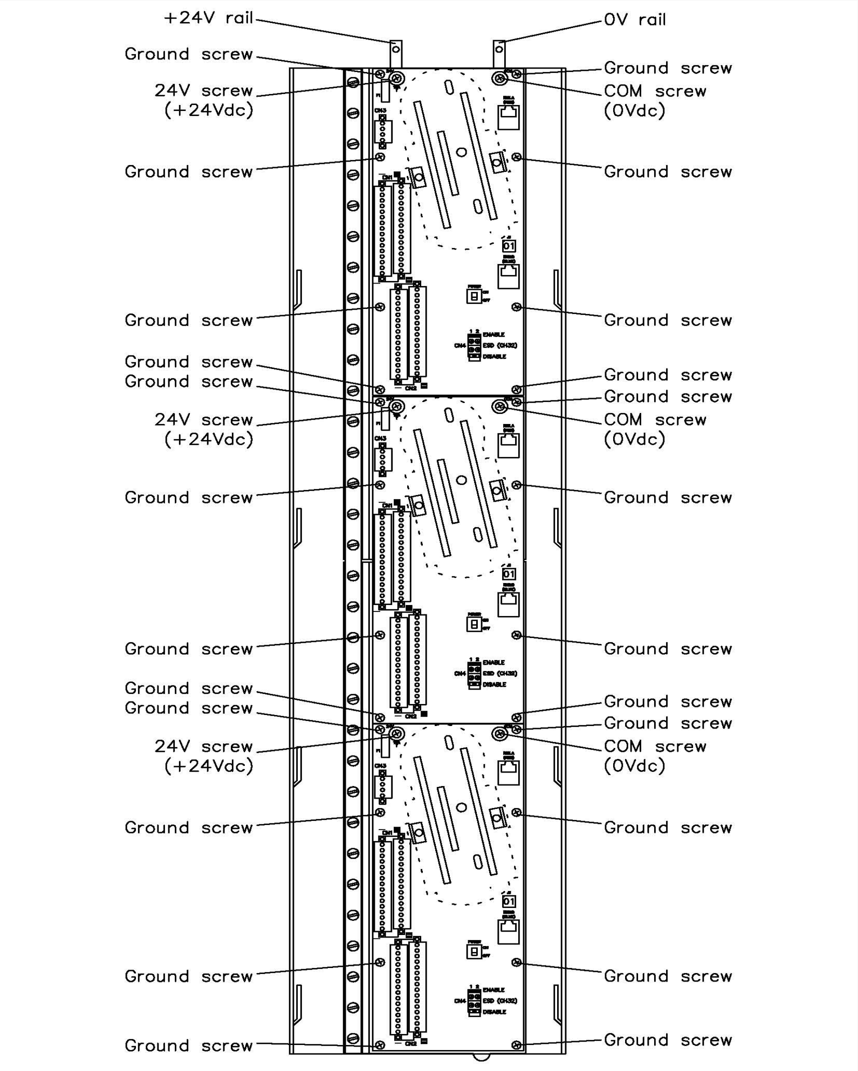


Figure 4-12: MCAR-02 with two mounted IOTA-NR24 modules

4.5.4 Technical data

The MCAR-02 has the following specifications:

General	Type number:	FC-MCAR-02
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL
Power	Supply voltage:	24 V DC -15%..+30%
	Supply current:	none
	Supply rail current:	max. 40 A
Connections	24V supply:	2 x M5 2 x 5mm hole (for coupling of carriers)
	Ground:	32 x M5
Physical Data	Dimensions (H x W x D):	105.4 x 222.3 x 931.8 mm 4.15 x 8.75 x 36.7 in
	Weight:	6.1 kg 13.4 lbs

4.6 MCAR-03

4.6.1 Mounting Carrier (36 inch)

The MCAR-03 is a carrier that can be screwed on any flat surface.

The MCAR-03 can carry two IOTA-R24 assemblies that can each carry two RUSIO-3224 modules. The "MCAR-03 - top and front view" on the next page shows the physical appearance and the coordinates of the four mounting holes.

The MCAR-03 consists of:

- A metal profile
- Two plastic cover plates
- A ground rail with 16 ground connection screws
- Two power rails with M5 holes (+24 V and 0 V)
- Eight mounting holes (6.35 mm diameter)

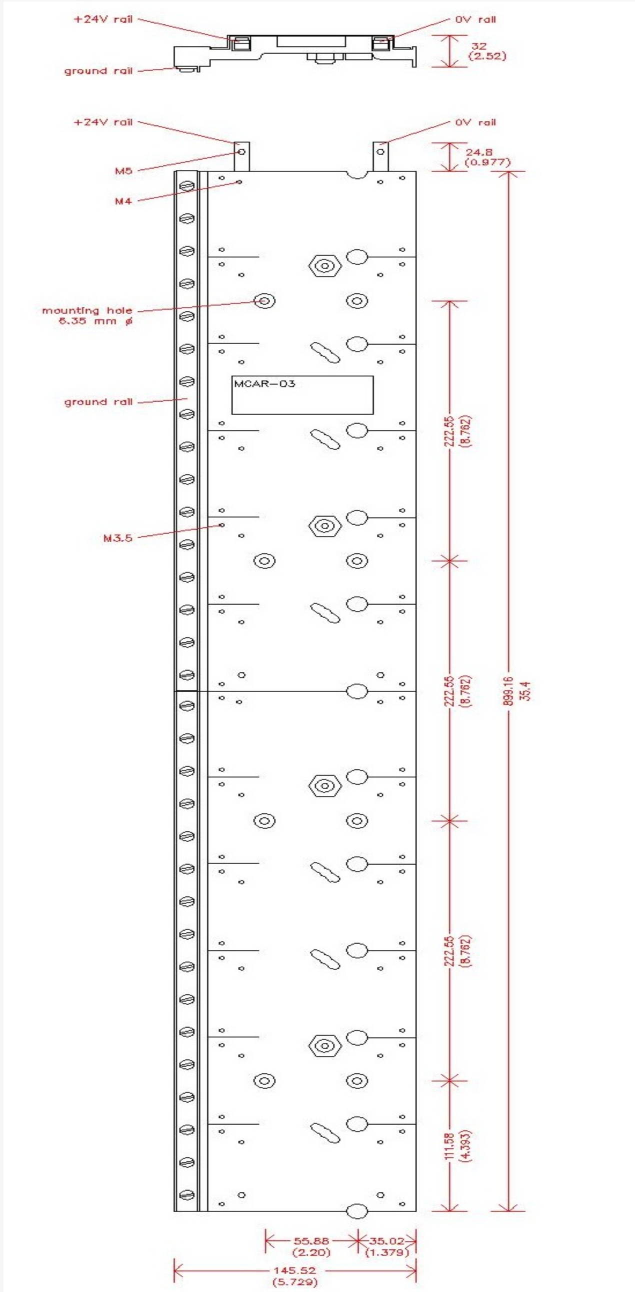


Figure 4-13: MCAR-03 - top and front view

Attention: Be sure that the M12 hex panel nylon locking nuts and accompanying removable boss carrier are not installed on MCAR-03 (for IOTAs TCNT11, TDIO11 and TUIO11).

4.6.2 Mounting an IOTA-R24

Up to two IOTA-R24 units can be fixed on the MCAR-03 with ten ground screws and two power screws (24 V and COM) each.

24 VDC power must be connected to the MCAR-03 on the power rails using M5 screws.

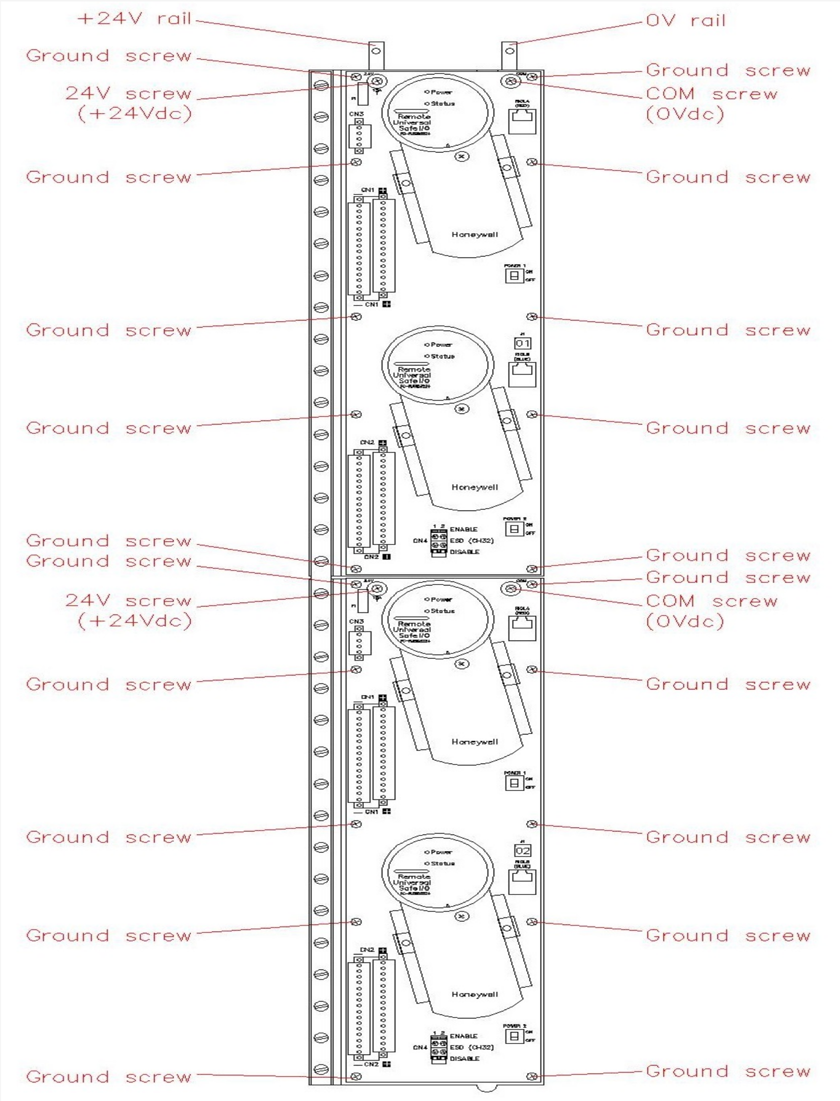


Figure 4-14: MCAR-03 with two mounted IOTA-R24 units

4.6.3 Mounting IOTA-NR24 units

Up to three (3) IOTA-NR24 units can be fixed on the MCAR-03 with 22 ground screws and two power screws (24 V and COM) each. Three PDIO01 modules can be fixed to the IOTA-NR24 units.

24 VDC power must be connected to the MCAR-03 on the power rails using M5 screws.

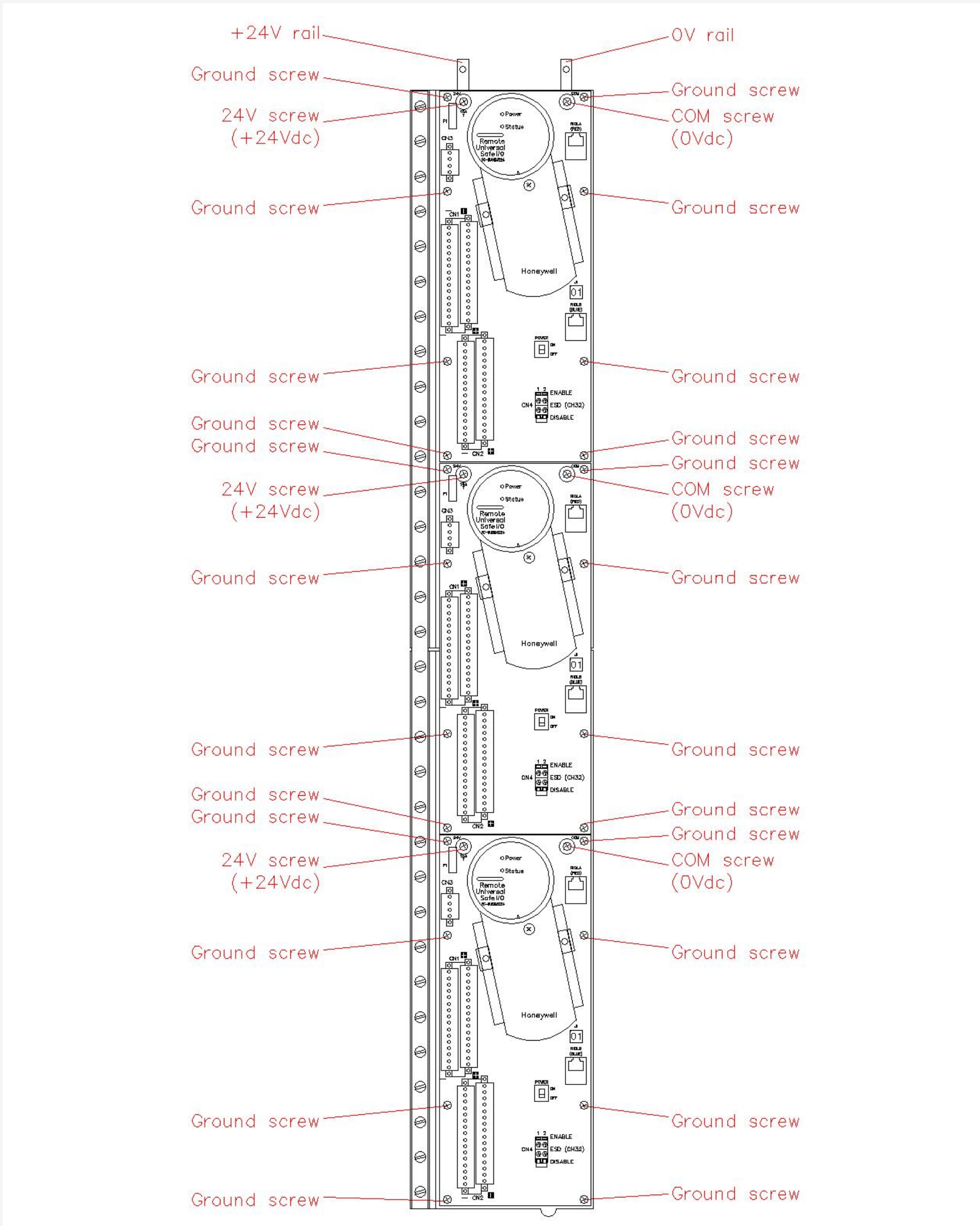


Figure 4-15: MCAR-03 with three mounted IOTA-NR24 modules

4.6.4 Technical data

The MCAR-03 has the following specifications:

General	Type number:	FC-MCAR-03
	Operating temperature:	-40°C to +70 deg°C (-40°F to +158°F)
	Storage temperature:	-40°C to +85°C (-40°F to +185°F)
	Relative humidity:	10.95% (non-condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE, UL
Power	Supply voltage:	24 V DC -15% to +30%
	Supply current:	none
	Supply rail current:	max. 40 A
Connections	24 V supply:	2 x M5
	Ground:	32 x M5
Physical Data	Dimensions (H x W x D):	(32 x 145.6 x 478) mm (2.52 x 5.73 x 18.8) in
	Weight:	1.1 kg 2.4 lbs

CHAPTER 5

CHASSIS

5 Chassis

This chapter describes the following chassis:

Chassis		See
General info about chassis		General info about chassis
Safety Manager		
CPCHAS-0001	Chassis for redundant or non-redundant Controller (Safety Manager)	CPCHAS-0001
IOCHAS-0001S	IO Chassis for non-redundant IO modules (Safety Manager)	IOCHAS-0001S
IOCHAS-0001R	IO chassis for redundant IO modules (Safety Manager)	IOCHAS-0001R
Safety Manager A.R.T.		
CPCHAS-0002	Chassis for redundant Controller (Safety Manager A.R.T.)	CPCHAS-0002
IOCHAS-0002S	IO Chassis for non-redundant IO modules (Safety Manager A.R.T.)	IOCHAS-0002S
IOCHAS-0002R	IO chassis for redundant IO modules (Safety Manager A.R.T.)	IOCHAS-0002R
Safety Manager		
CPCHAS-0003	Chassis for redundant or non-redundant Controller (Safety Manager)	CPCHAS-0003
IOCHAS-0003S	IO Chassis for non-redundant IO modules (Safety Manager)	IOCHAS-0003S
IOCHAS-0003R	IO chassis for redundant IO modules (Safety Manager)	IOCHAS-0003R

5.1 General info about chassis

Safety Manager is installed in a cabinet, as described in Cabinet. A cabinet contains the Control Processor modules and the IO modules, which are placed in several chassis:

- All Control Processor modules are placed in a Control Processor chassis.
- All non-redundant IO modules are placed in one or more IOCHAS-0001S or IOCHAS-0002S or IOCHAS-0003S chassis.
- All redundant IO modules are placed in one or more IOCHAS-0001R or IOCHAS-0002R or IOCHAS-0003R chassis.

A chassis consists of a metal housing, in which the modules, busses and backplanes are placed. The details are described separately for each type of chassis in this chapter.

The housing of a Controller chassis differs from the housing of an IO chassis.

5.2 CPCHAS-0001

Chassis for redundant or non-redundant Controller (Safety Manager)

5.2.1 General

The Controller chassis CPCHAS-0001 is used to contain the Control Processor modules. Each Safety Manager has one Controller chassis. The Controller chassis is generally located at the top position in the cabinet, and the IO chassis at lower positions.

A Controller chassis contains the following components:

- Controller housing
- Controller backplane

5.2.2 Controller housing

The Controller housing has been designed specifically for Safety Manager. It is a 19" housing that is open at the front and covered at the back.

Control Processor modules are placed in the chassis through the front of the housing with the use of module guides, which are located at the bottom and top plate of the housing.

The modules are locked in the chassis with the quarter turn fasteners, located below the module-grips.

The below figure shows the front of a filled redundant Controller chassis.

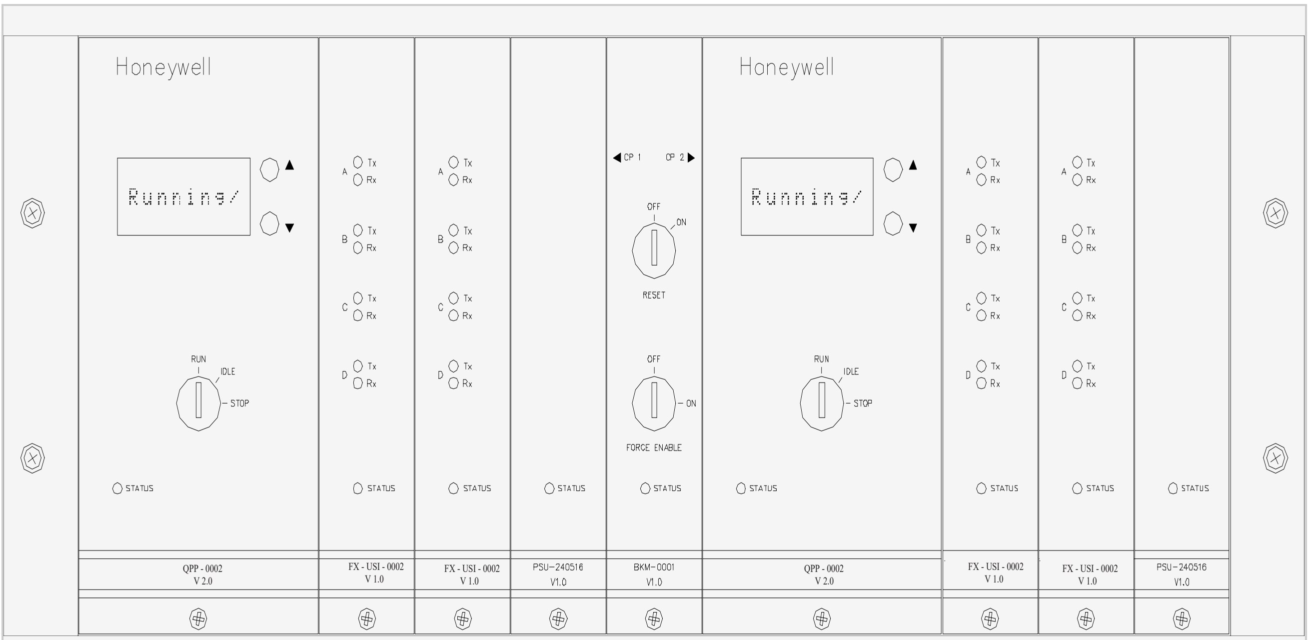


Figure 5-1: Front view of a redundant Controller chassis

The below figure shows the front of a filled non-redundant Controller chassis.

5.2 CPCHAS-0001

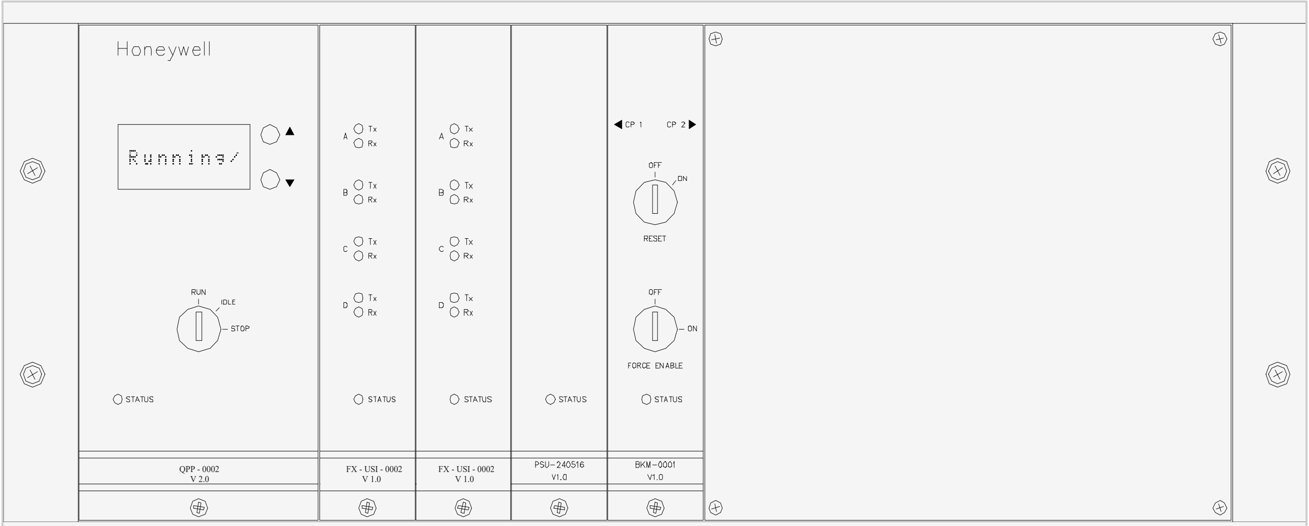


Figure 5-2: Front view of a non-redundant Controller chassis

The back of the housing is covered by a magnetically locked back cover plate, which can be swung upwards to reveal the Controller backplane.

Cables must be tie-wrapped to one of the three horizontal bars at the back of the housing, to lead them towards the side of the chassis.

The top bar is reserved for the 24V-supply and 24V-signal wires/cables.

The middle bar is reserved for the communication cables.

The bottom bar is reserved for the 5V and Watchdog cables (WdPx and 5V-x).

The below figure shows the back of an empty Controller chassis.

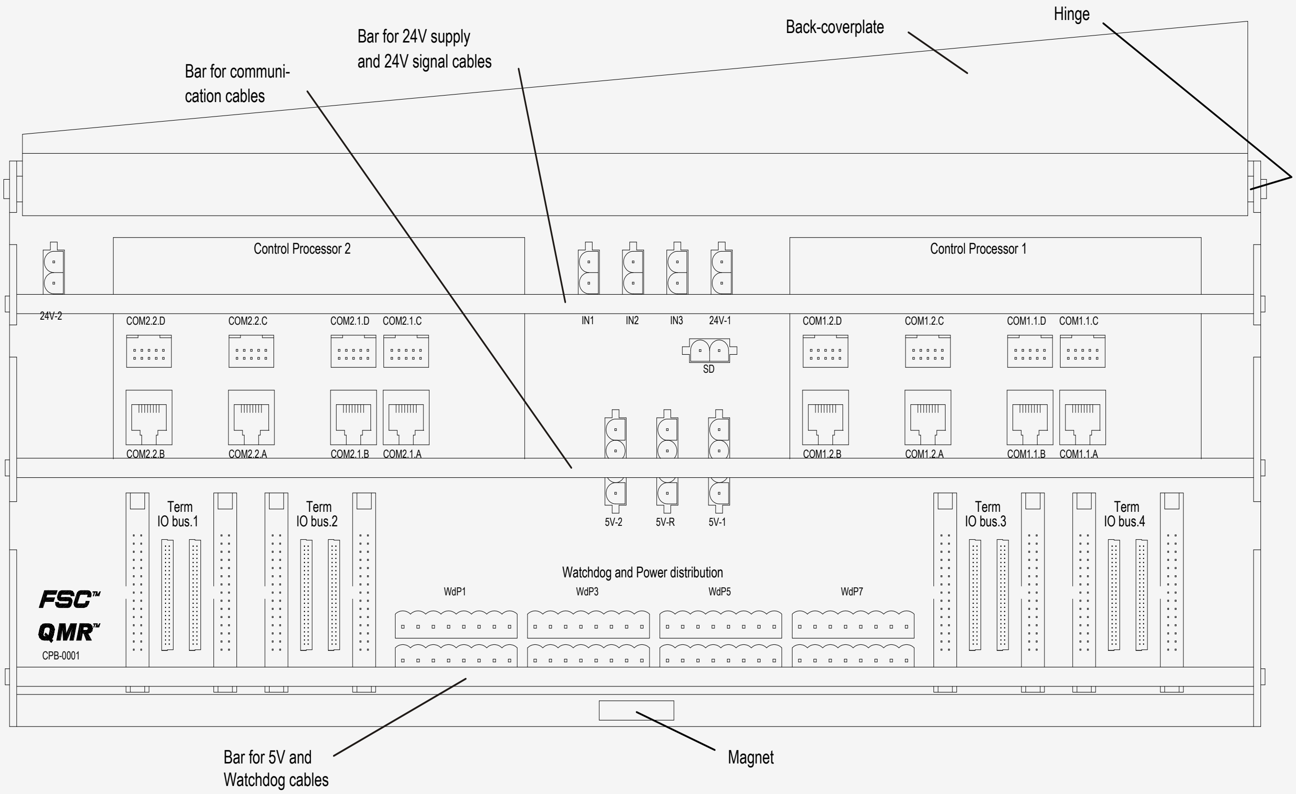


Figure 5-3: Back view of an empty Controller chassis

5.2.3 Location of Control Processor modules

The Controller chassis CPCHAS-0001 contains all Control Processor modules.

The below table shows the location of the Control Processor modules in a non-redundant and a redundant Controller (as seen from the front of the cabinet). As you can see, all Control Processor modules are doubled in a redundant Controller configuration, with the exception of the Battery and Key switch module, which is shared by both Control Processors.

Distribution of the various Control Processor modules in the Controller chassis

Redundant Controller								
Non-Redundant Controller								
C P U 1	C O M 1 .1	C O M 1 .2	P S U 1	B K M	C P U 2	C O M 2 .1	C.O.M.2.2	P S U 2

Legend:		
Item	Description	See
CPU1	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	QPP-0002
COM1.1	the first communication module of the first Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
COM1.2	the second communication module of the first Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
PSU1	the power supply module of the first Control Processor	
	PSU-240516 Power Supply Unit 24/5 V DC, 16A	PSU-240516
BKM	the battery and key switch module of (both) Control Processor(s)	
	BKM-0001 Battery and Key switch Module	BKM-0001
CPU2	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	QPP-0002

Redundant Controller		
Non-Redundant Controller		
COM2.1	the first communication module of the second Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
COM2.2	the second communication module of the second Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
PSU2	the power supply module of the second Control Processor	
	PSU-240516 Power Supply Unit 24/5 V DC, 16A	PSU-240516

In case of a non-redundant Controller, the unused positions in the Controller chassis (CPU2, COM2.1, COM2.2, and PSU2 are covered by an BLIND-CPS plate (see Figure 6-2).

For each Quad Processor Pack, room is provided for two communication modules in the Controller chassis. The below table shows possible locations for different combinations of communication modules.

> **Note:**
> If only one communication module is used in a Control Processor, the module is placed in the COM1 slot (see the below table). A blind communication module (BLIND-COM) should be placed in all unused communication slots.

Possible locations of communication modules in the Controller chassis

Number of modules	COM1 Slot	COM2 Slot
0	BLIND-COM	BLIND-COM
1	USI-0002	BLIND-COM
2	USI-0002	USI-0002

5.2.4 Controller backplane

The Controller backplane is part of the Controller chassis. The front side contains the connectors for the Control Processor modules. The keying pins in the backplane connect the module housings with ground.

The below figure shows the front view of an empty redundant Controller chassis, showing the Controller backplane.

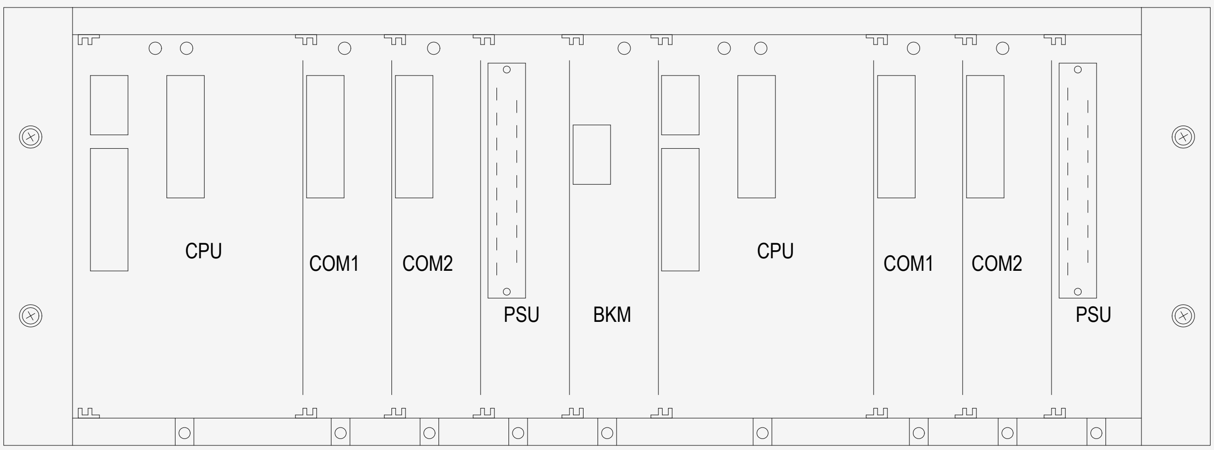


Figure 5-4: Front view of an empty redundant Controller chassis

The back side of the Controller backplane contains all the connectors for signals that go in or out of the (non-)redundant Controller. These connectors are visible when the back cover plate is swung upwards (see Figure 3).

The Controller backplane connects the 5VR output of the PSU of CP1 with the 5VR output of the PSU of CP2.

The resulting 5V-R is used to supply the non-redundant IO.

Thanks to the output diodes in the PSU-240516 (see Figure 2) the 5V-R will be available as long as (at least) one of the PSUs is operating.

The figure on the next page shows the 5V connection of the two PSU-240516 modules on the Controller backplane.

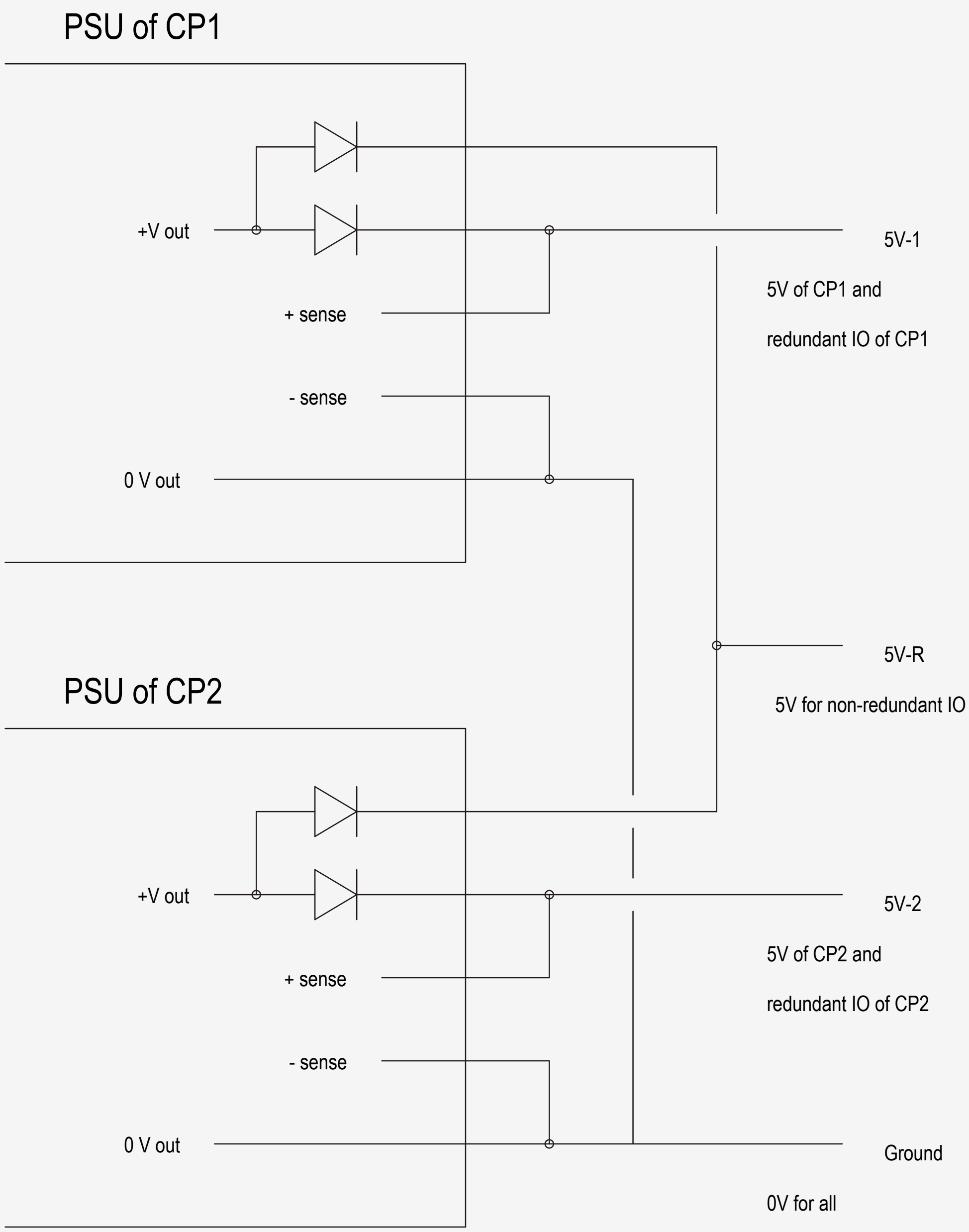
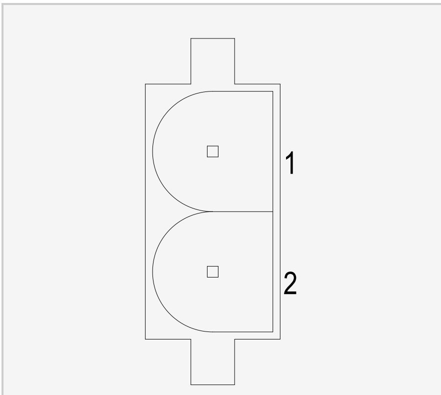


Figure 5-5: 5V PSU-connection on the CP backplane

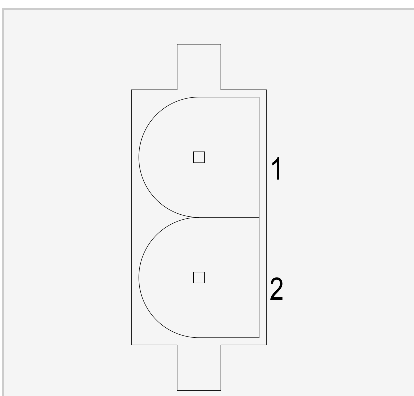
5.2.4.1 Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:



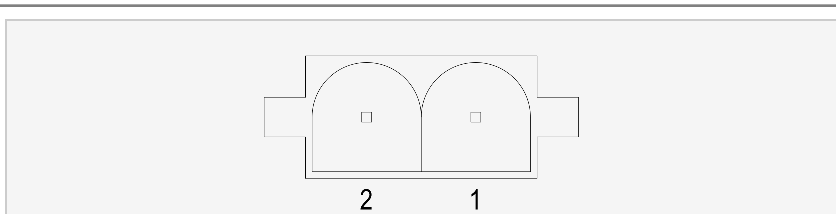
	24V-1	24V-2
1	+24V for CP1	+24V for CP2
2	0V for CP1	0V for CP2

The back view and pin allocation of the IN1, IN2 and IN3 connectors are:



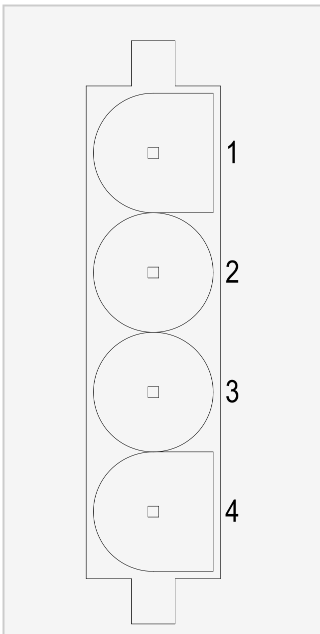
	IN1	IN2	IN3
1	+24V_red	+24V_red	+24V_red
2	input1	input2	input3

The back view and pin allocation of the SD connector is:



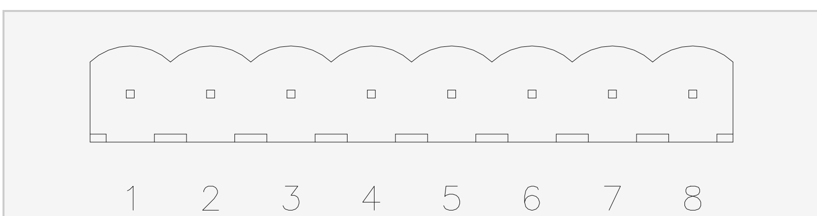
	SD
1	+24V_sd
2	input

The back view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	5V-R	
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

The back view and pin allocation of the eight WdPx connectors are:



	WdPx
1	5V of CP2
2	WD of CP2
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	5V of CP1
8	WD of CP1

5.2.4.2 Connector function

The table on the next page describes the function of the connectors on the back side of the Controller backplane.

Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Control Processor 1	Com1.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com1.1.B	RJ45	
	Com1.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com1.1.D	10-pin male	
	Com1.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com1.2.B	RJ45	
	Com1.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com1.2.D	10-pin male	
Control Processor 2	Com2.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com2.1.B	RJ45	
	Com2.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com2.1.D	10-pin male	
	Com2.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com2.2.B	RJ45	
	Com2.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com2.2.D	10-pin male	

Group	Name	Connector type	Used for
IO bus 1	IO bus1.1	Flat cable connector	first IO bus of Control Processor 1
	IO bus2.1	Flat cable connector	first IO bus of Control Processor 2
	Term IO bus1	2 × 50-pin connector	IO bus terminator for the first IO bus(es) Type: TERM-0001 or TERM-0002, TERM-0001 and TERM-0002 for details.
IO bus 2	IO bus1.2	Flat cable connector	second IO bus of Control Processor 1
	IO bus2.2	Flat cable connector	second IO bus of Control Processor 2
	Term IO bus2	2 × 50-pin connector	IO bus terminator for the second IO bus(es) Type: TERM-0001 or TERM-0002, TERM-0001 and TERM-0002 for details.
IO bus 3	IO bus1.3	Flat cable connector	third IO bus of Control Processor 1
	IO bus2.3	Flat cable connector	third IO bus of Control Processor 2
	Term IO bus3	2 × 50-pin connector	IO bus terminator for the third IO bus(es) Type: TERM-0001 or TERM-0002, TERM-0001 and TERM-0002 for details.
IO bus 4	IO bus1.4	Flat cable connector	fourth IO bus of Control Processor 1
	IO bus2.4	Flat cable connector	fourth IO bus of Control Processor 2
	Term IO bus4	2 × 50-pin connector	IO bus terminator for the fourth IO bus(es) Type: TERM-0001 or TERM-0002, TERM-0001 and TERM-0002 for details.
Watchdog	WdP1	8-pin male	Watchdog and Power to IO chassis 12

Group	Name	Connector type	Used for
and Power[1] distribution		connector	
	WdP2	8-pin male connector	Watchdog and Power to IO chassis 2
	WdP3	8-pin male connector	Watchdog and Power to IO chassis 3
	WdP4	8-pin male connector	Watchdog and Power to IO chassis 4
	WdP5	8-pin male connector	Watchdog and Power to IO chassis 5
	WdP6	8-pin male connector	Watchdog and Power to IO chassis 6
	WdP7	8-pin male connector	Watchdog and Power to IO chassis 7
	WdP8	8-pin male connector	Watchdog and Power to IO chassis 8
Power	24V-1	2-pin male connector	24V for Control Processor 1 (for cable details see PDC-CP24).
	24V-2	2-pin male connector	24V for Control Processor 2 (for cable details see PDC-CP24).
	5V-1	4-pin male connector	5V and Watchdog of Control Processor 1. This connector is used to distribute these signals to other (extension) cabinets using an PDB-IOX05 (for more information see PDB-IOX05).
	5V-2	4-pin male connector	5V and Watchdog of Control Processor 2. This connector is used to distribute these signals to other (extension) cabinets using an PDB-IOX05 (for more information see PDB-IOX05).

Group	Name	Connector type	Used for
	5V-R	4-pin male connector	Redundant 5V and redundant Watchdog. This connector is used to distribute these signals to other (extension) cabinets using an PDB-IOX05 (for more information see PDB-IOX05).
Various	SD	2-pin male connector	Connector for an Emergency Shut Down system. The chassis is delivered with the LINK-SD link placed. This link is required if the Emergency Shut Down function is not used (see also QPP data sheets QPP-0002 and SICP-0002/L3).
	IN1	2-pin male connector	24 Volt non-safety related general purpose input. This input can generate an interrupt (on the rising edge) e.g. for external clock synchronization (see also BKM-0001 and SICP-0002/L3).
	IN2	2-pin male connector	24 Volt non-safety related general purpose input (see also BKM-0001 and SICP-0002/L3).
	IN3	2-pin male connector	24 Volt non-safety related general purpose input (see also BKM-0001 and SICP-0002/L3).

1. Watchdog and 5 Volt of Control Processor 1, Control Processor 2 and the redundant Watchdog and 5 Volt.
2. The chassis numbers mentioned here are defined by jumpers on the IO backplane.

5.2.5 Technical data

General	Type number[1]:	FS-CPCHAS-0001
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	0.05 A
	5V-2:	0.05 A
Dimensions	Height:	4 HE (177 mm, 7 in)
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	5.8 kg, 12.8 lb

Note:

1. Chassis with suffix code V1.1 and higher have an improved cover plate design and reduced power consumption. (Chassis with suffix code V1.0 consume 0.5A per feeder.)

   There are no functional changes.

5.3 IOCHAS-0001S

5.3.1 IO Chassis for non-redundant IO modules (Safety Manager)

The IOCHAS-0001S is a chassis for up to 18 non-redundant IO modules. It consists of the following components:

Components of the IOCHAS-0001S[1] V1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	1	IO Extender module located at slot 21	IO-0001
Blind fronts	2		

Components of the IOCHAS-0001S[1] CCV1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	1	IO Extender module located at slot 21	IO-0001
Blind fronts	2		

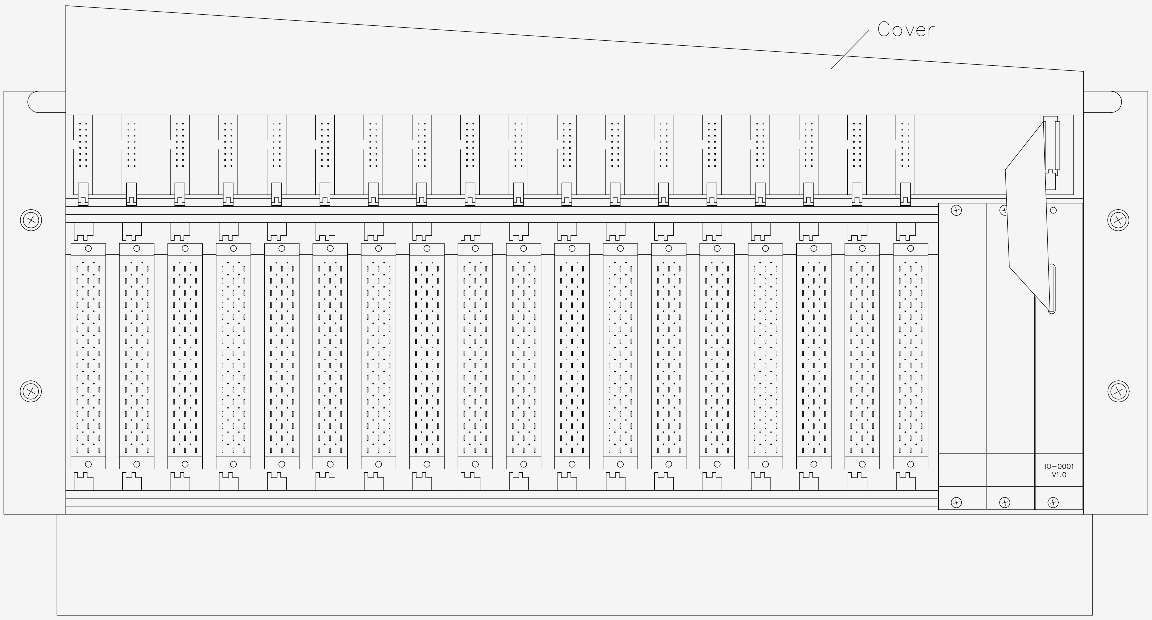


Figure 5-6: Front view of an empty IOCHAS-0001S

The above figure shows the front side of an empty IOCHAS-0001S with the front-cover raised. A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis.

In the IOCHAS-0001S, slots 1 to 18 are available for IO modules.

5.3.2 IO Housing

The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A coverplate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tagnumber assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see the below figure).

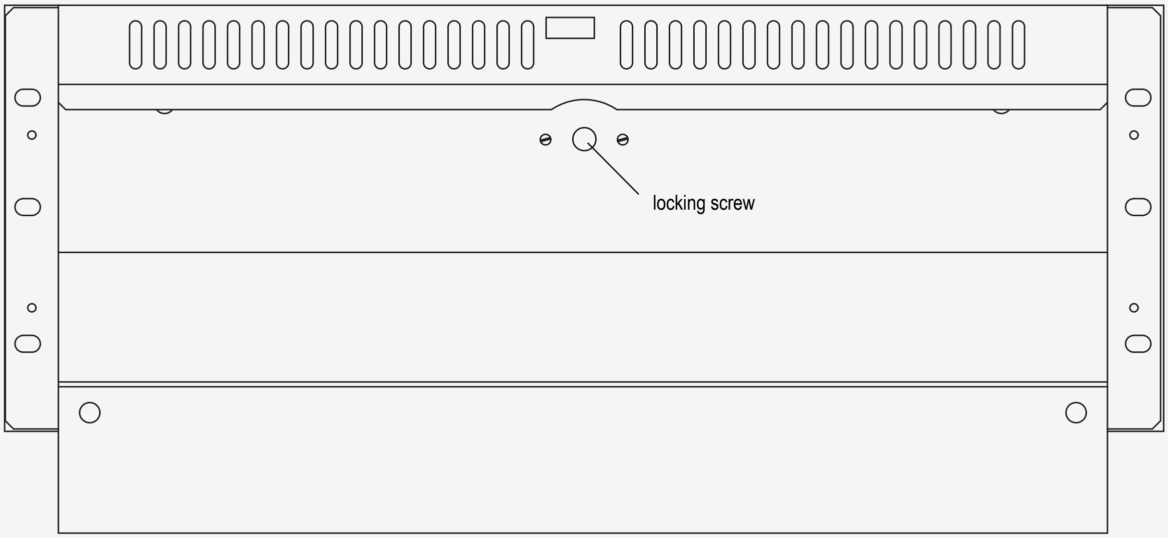


Figure 5-7: Back view of a closed IOCHAS-0001S

Attention:
The IO back cover plate will be completely unattached from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

5.3.3 IO Backplane for non-redundant IO: IOB-0001S

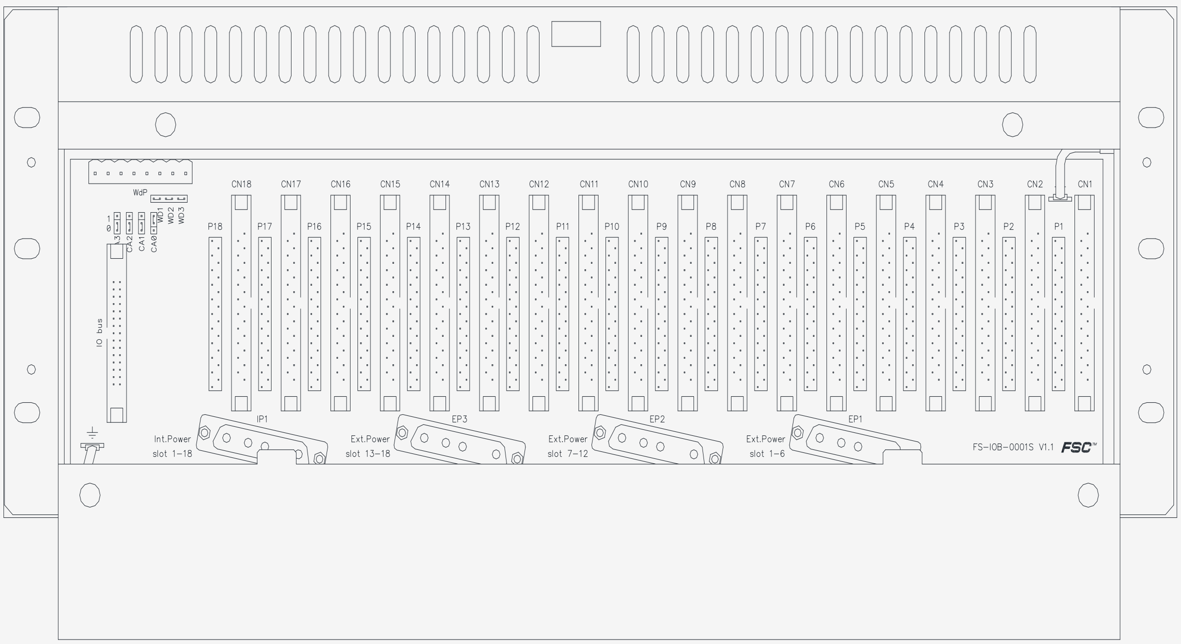


Figure 5-8: Back view of an open IOCHAS-0001S

Connectors on the IOB-0001S

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	Connectors for IO modules, slot 1 to 18	Input modules Output modules
48-pin female chassis connector	1	Connector for IO extender IO-0001, slot 21	IO-0001
Back side			
IO bus	1	Connector for IO bus to Controller chassis.	
CN1 to CN18	18	Connector for system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1 to 18	SICC 0001/LxSICP-0001/Lx
P1 to P18	18	Connector for IO converter modules, slot 1 to 18	Input converter modules Output converter modules
IP1	1	Connector for internal power, slot 1 to 18	Cable: PDC-IOSET, see PDC-IOSET
EP1	1	Connector for external power, slot 1 to 6	Cable: PDC-IOSET, see PDC-IOSET
EP2	1	Connector for external power, slot 7 to 12	Cable: PDC-IOSET, see PDC-IOSET
EP3	1	Connector for external power, slot 13 to 18	Cable: PDC-IOSET, see PDC-IOSET
CA0 to CA3	4	Jumpers for defining the IO chassis address	Address settings

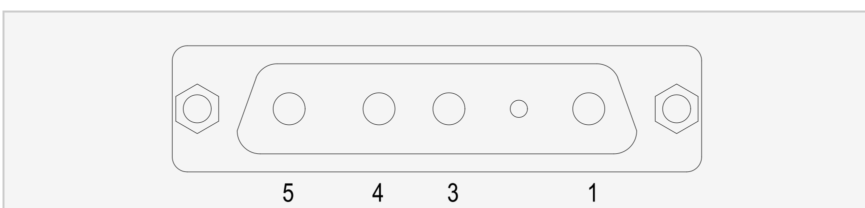
Connector	Amount	Description	See
WdP	1	Connector for watchdog and 5 V power signal, connects to Controller backplane	Refer chassis IO "Back view of an open IOCHAS-0001S" on page 87
			Cable: PDC-IOS05, see PDC-IOS05.
WD1 to WD3[1]	3	Connector to enable external watchdog grouping	See Unit shutdown.

1. On delivery, a triple jumper is placed and no watchdog grouping is used.

   Watchdog grouping can be used for each group (WD1 corresponds to slot 1-6, WD2 to slot 7- 12, WD3 to slot 13-18) by removing the jumper from the WDx connector for that group, and connecting the WDx connector to the watchdog group relais (See Unit shutdown).

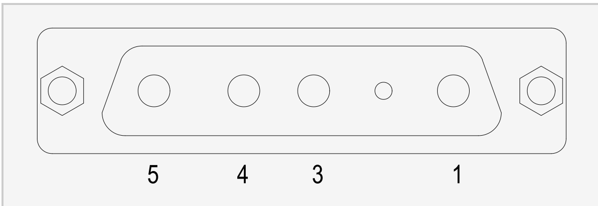
5.3.3.1 Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



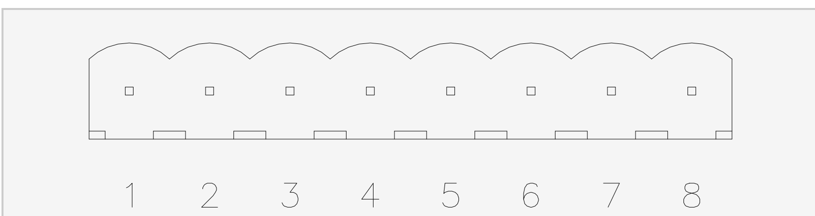
	IP1
1	IP slot 1-9
3	0 V
4	0 V
5	IP slot 10-18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

The back view and pin allocation of the WdP connector is:



	WdP
1	nc
2	nc
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	nc
8	nc

The back view and pin allocation of the WD jumper is:

	WD
1	WDR of CP1 and CP2
2	WD of slot 1, 2, 3, 4, 5 and 6
3	WDR of CP1 and CP2
4	WD of slot 7, 8, 9, 10, 11 and 12
5	WDR of CP1 and CP2
6	WD of slot 13, 14, 15, 16, 17 and 18

The pin allocation of each respective input and output module can be found in the module datasheet.

The below figure shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

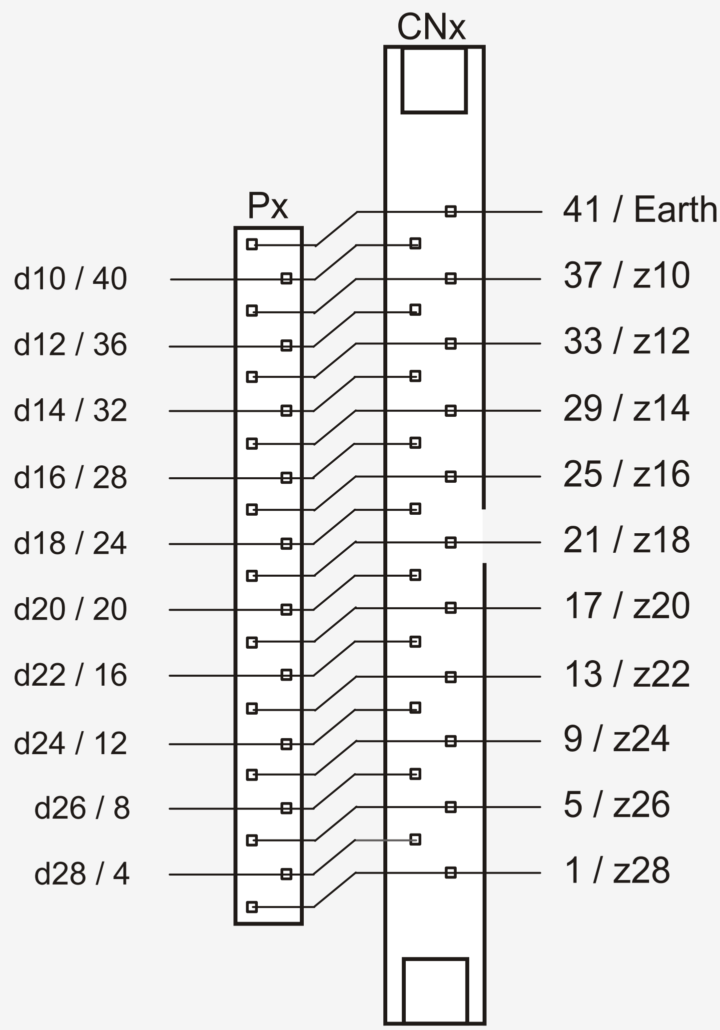


Figure 5-9: Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector

5.3.4 Horizontal IO bus backplane for non-redundant IO

Figure 6-10 shows a front view of a filled IOCHAS-0001S with the cover opened.

Figure 6-11 shows a front view of a filled IOCHAS-0001S with the cover closed.

The below table lists the connectors present on the IOBUS-HBS.

5.3 IOCHAS-0001S

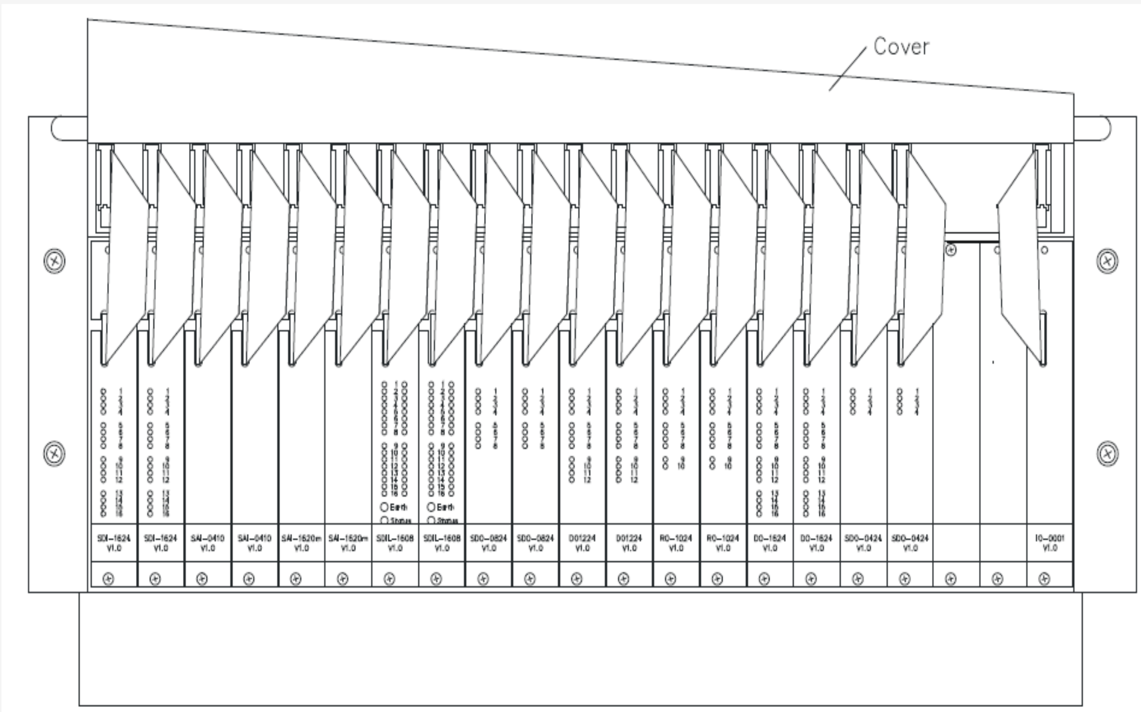


Figure 5-10: Front view of a filled, open IOCHAS-0001S

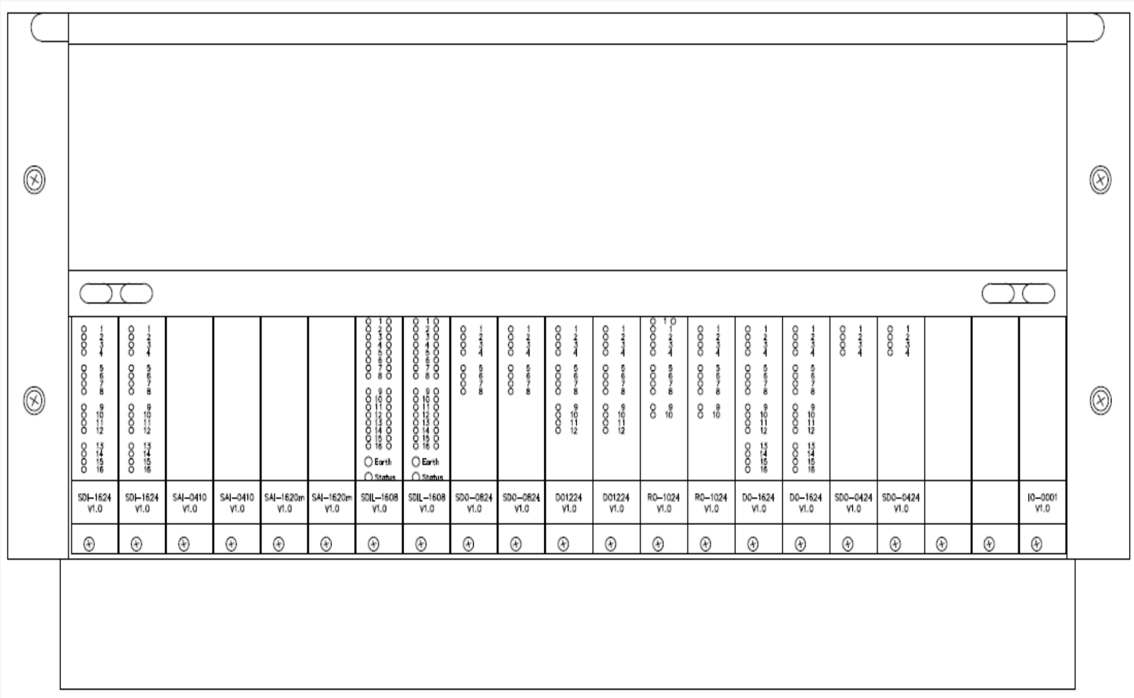


Figure 5-11: Front view of a filled, closed IOCHAS-0001S

Connectors on the Horizontal IO bus backplane

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, located at slot 1 to 18	Input modules Output modules
Flatcable connector	1	Connector for IO extender IO-0001, slot 21	IO-0001
20-pin flatcable assembly	1	Flatcable to the connector on the middle of the IO-0001 module	IO-0001

5.3 IOCHAS-0001S

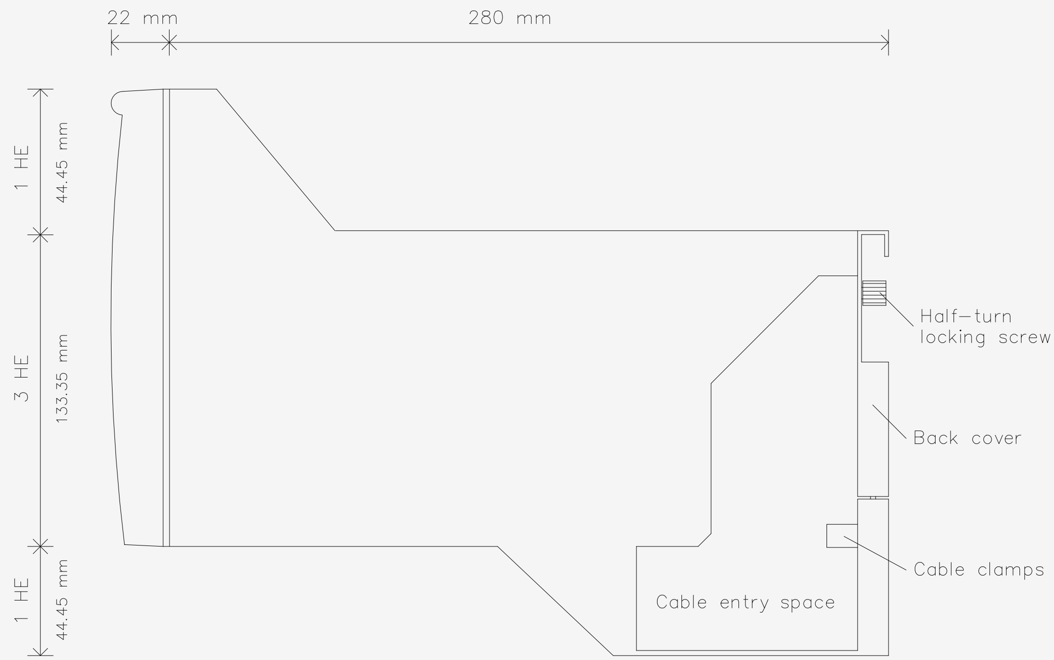


Figure 5-12: Side view of the IOCHAS-0001S

5.3.5 Technical data

General	Type numbers:	FS-IOCHAS-0001S FC-IOCHAS-0001S
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-R:	35 mA (IO-0001 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see "Side view of the IOCHAS-0001S" on the previous page 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8.5 kg

5.4 IOCHAS-0001R

IO chassis for redundant IO modules (Safety Manager)

5.4.1 Description

The IOCHAS-0001R is a chassis for up to 9 pairs of redundant IO modules.

It consists of the following components:

Components of the IOCHAS-0001R[1] V1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	2	IO Extender modules, slot 20 and 21	IO-0001
Blind front	1		

Components of the IOCHAS-0001R[1] CCV1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	2	IO Extender modules, slot 20 and 21	IO-0001
Blind front	1		

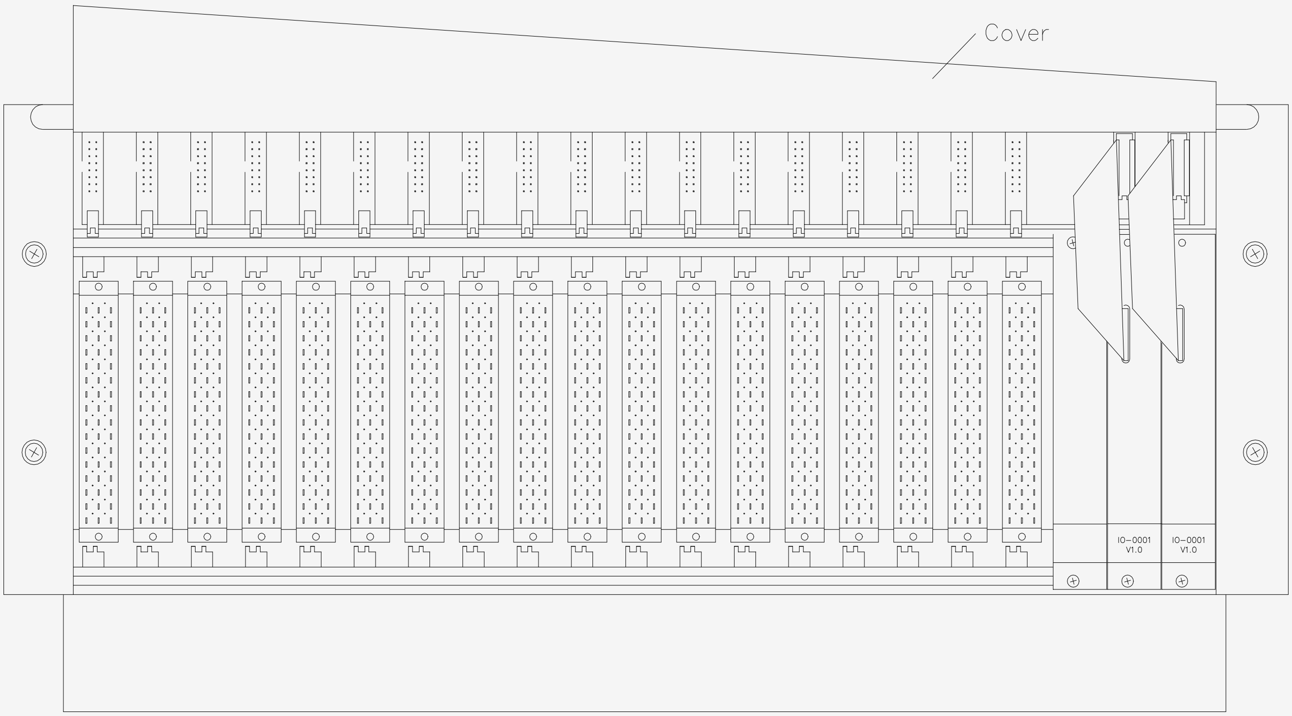


Figure 5-13: Front view of an empty IOCHAS-0001R

The above figure shows the front side of an empty IOCHAS-0001R with the front cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis. In the IOCHAS-0001R, slots 1 to 18 are available for IO modules. They are configured in pairs.

The IO modules in the odd numbered slots (and the IO-0001 in slot 20) are controlled by Control Processor 1.

The IO modules in the even numbered slots (and the IO-0001 in slot 21) are controlled by Control Processor 2.

Slot 19 cannot be used.

Slot 20 and slot 21 contain the IO-0001 modules.

5.4.2 IO Housing

The IO housing is specifically designed for Safety Manager.

5.4 IOCHAS-0001R

It is a 19" based housing.

A cover plate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tag number assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see the below figure).

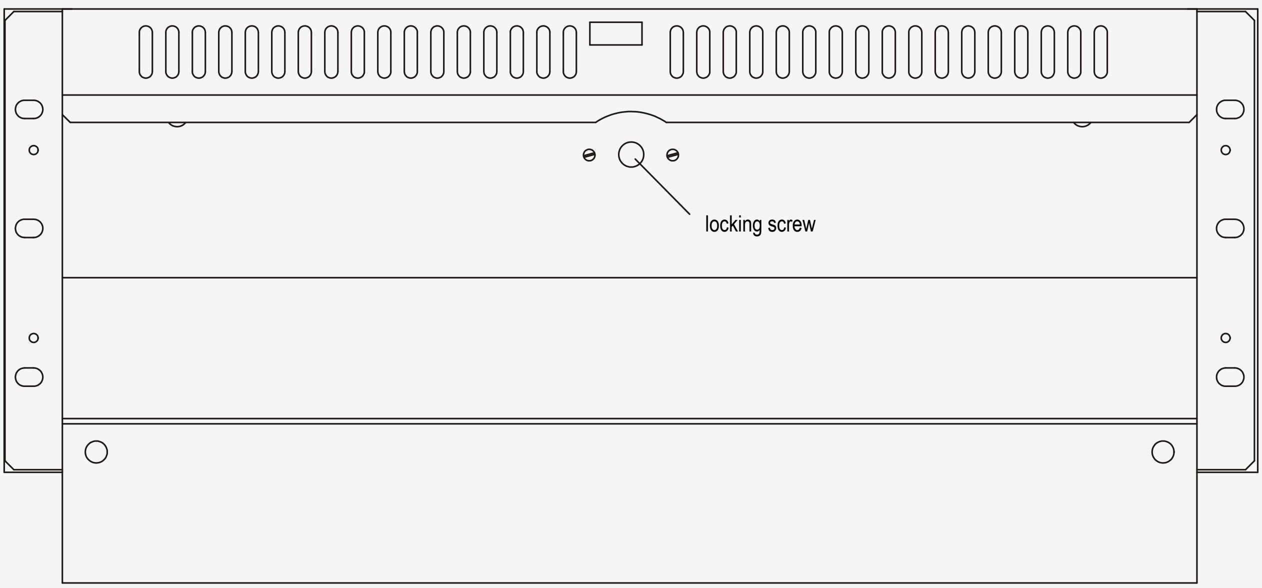


Figure 5-14: Back view of a closed IOCHAS-0001R

Attention:
The IO back cover plate will be completely removed from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

5.4.3 IO Backplane for redundant IO: IOB-0001R

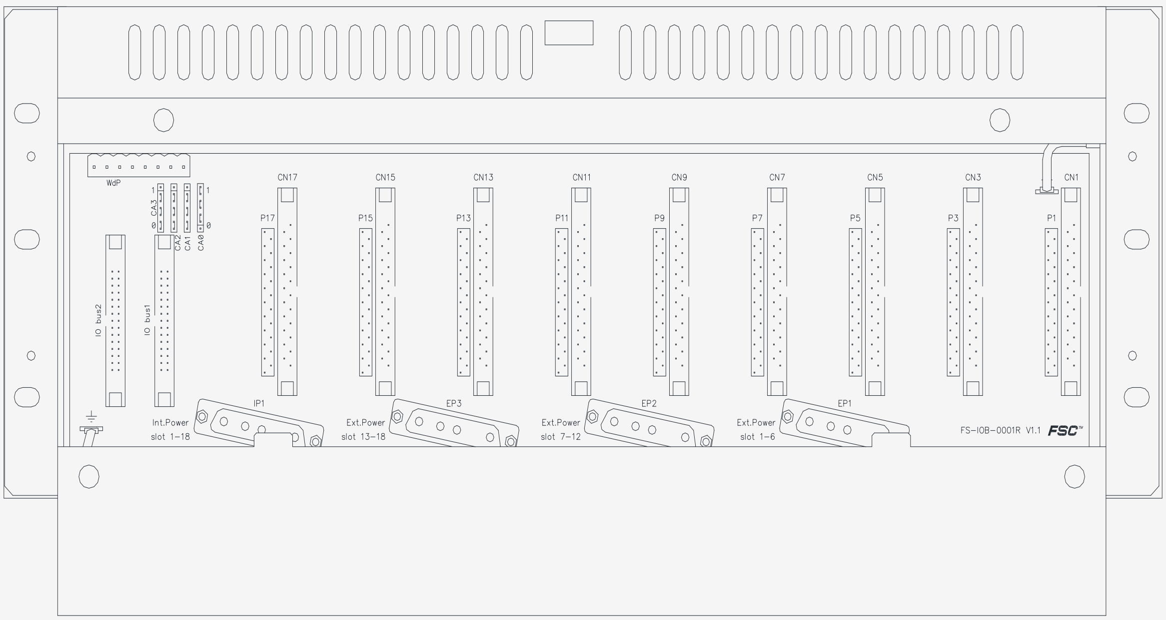


Figure 5-15: Back view of an open IOCHAS-0001R

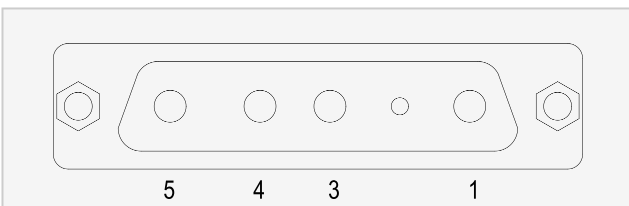
Connectors on the IOB-0001R

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	For IO modules, slot 1 to 18	Input modules Output modules
48-pin female chassis connector	2	For IO extender IO-0001, slot 20 and 21	IO-0001
Back side			
IO bus1	1	Connector for IO bus to Control Processor 1	IOBUS-CPIO
IO bus2	1	Connector for IO bus to Control Processor 2	IOBUS-CPIO
CN1, CN3, CN5, CN7, CN9, CN11, CN13, CN15 and CN17	9	For system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17	SICP-0001/Lx SICP-0001/Lx
P1, P3, P5, P7, P9, P11, P13, P15 and P17	9	For IO converter modules, slot 1, 3, 5, 7, 9, 11, 13, 15, and 17	Input converter modules Output converter modules
IP1	1	For internal power, slot 1 to 18	Cable: PDC-IOSET, see PDC-IOSET
EP1	1	For external power, slot 1 to 6	Cable: PDC-IOSET, see PDC-IOSET
EP2	1	For external power, slot 7 to 12	Cable: PDC-IOSET, see PDC-IOSET
EP3	1	For external power, slot 13 to 18	Cable: PDC-IOSET, see PDC-IOSET

Connector	Amount	Description	See
CA0 to CA3	4	Jumpers for defining the IO chassis address	Address settings
WdP	1	For watchdog and 5 V power signal, connects to Controller backplane	Refer chassis IO "Back view of an open IOCHAS-0001R" on page 100
			Cable: PDC-IOR05, see PDC-IOR05.

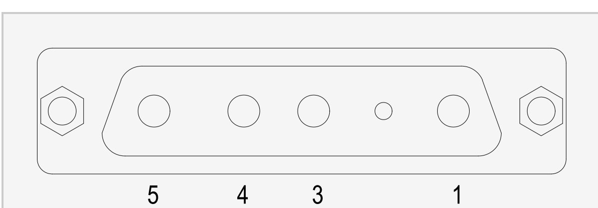
5.4.3.1 Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



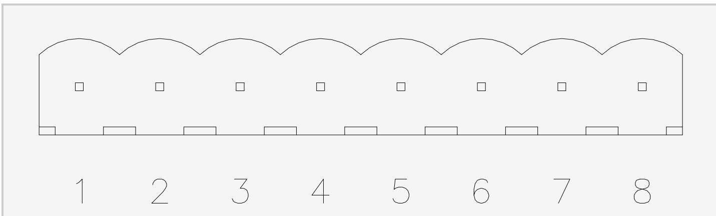
	IP1
1	IP slot 1, 3, 5, 7, 9, 11, 13, 15 and 17
3	0 V
4	0 V
5	IP slot 2, 4, 6, 8, 10, 12, 14, 16 and 18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The back view and pin allocation of the WdP connector is:



	WdP
1	5V of CP2, slot 2, 4, 6, 8, 10, 12, 14, 16, 18 and 21
2	WD of CP2, slot 2, 4, 6, 8, 10, 12, 14, 16 and 18
3	ground
4	nc
5	nc
6	ground
7	5V of CP1, slot 1, 3, 5, 7, 9, 11, 13, 15, 17 and 20
8	WD of CP1, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17

The pin allocation of each respective input and output module can be found in the module datasheet.

The figure on the next page shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

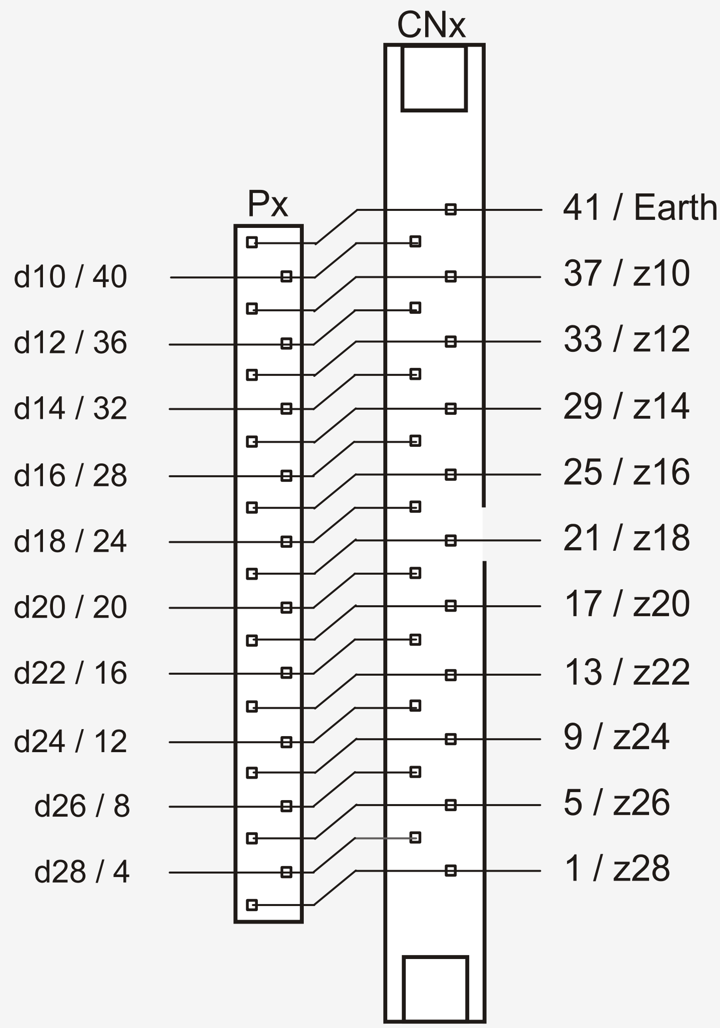


Figure 5-16: Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector

5.4.4 Horizontal IO bus backplane for redundant IO:

Figure 6-17 shows a front view of a filled IOCHAS-0001R with the cover opened.

Figure 6-18 shows a front view of a filled IOCHAS-0001R with the cover closed.

The below table lists the connectors on the IOBUS-HBR.

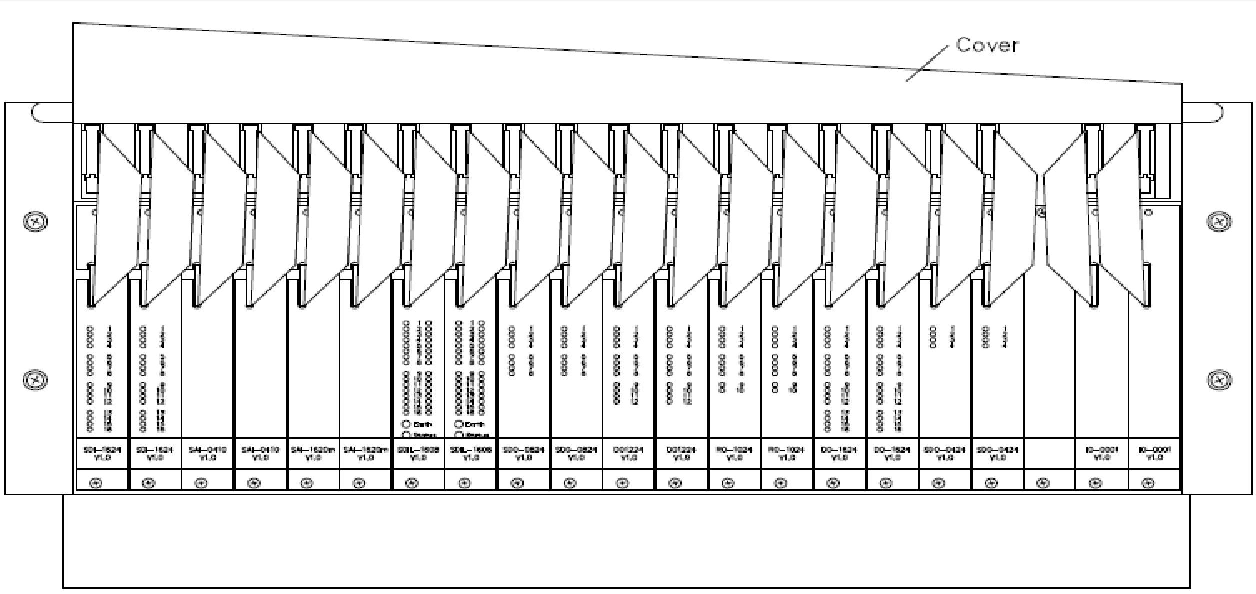


Figure 5-17: Front view of a filled, open IOCHAS-0001R

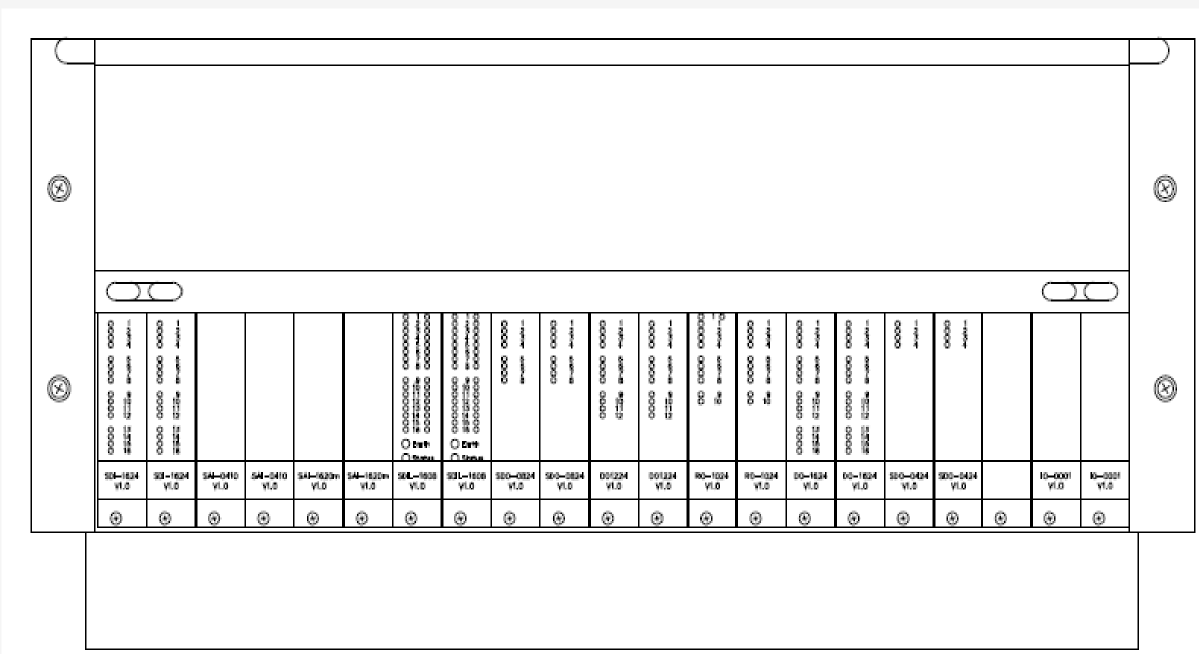


Figure 5-18: Front view of a filled, closed IOCHAS-0001R

Connectors on the Horizontal IO bus backplane

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, slot 1 to 18	Input modules Output modules
Flatcable connector	2	Connector for IO extender IO-0001, slot 20 and 21	IO-0001
10-pin flatcable assembly	2	Flatcables to the connectors on the middle of the IO-0001 modules	IO-0001

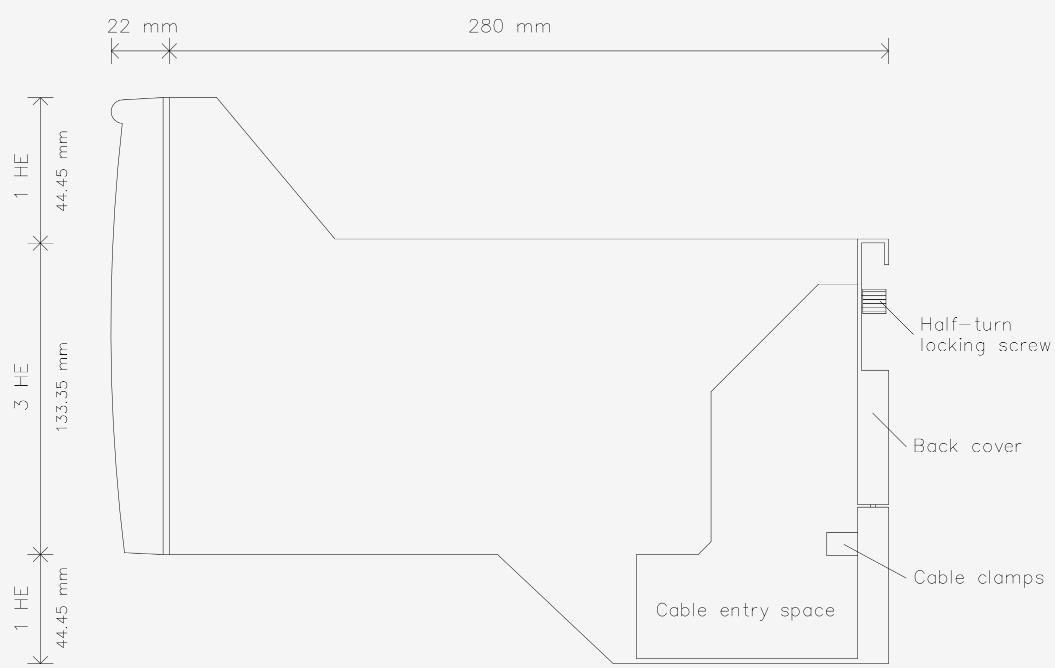


Figure 5-19: Side view of the IOCHAS-0001R

5.4.5 Technical data

General	Type numbers:	FS-IOCHAS-0001R FC-IOCHAS-0001R
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	35 mA (IO-0001 slot 20)
	5V-2:	35 mA (IO-0001 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see "Side view of the IOCHAS-0001R" on page 106 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,5 kg

5.5 CPCHAS-0002

5.5.1 Chassis for redundant Controller (Safety Manager A.R.T.)

The Controller chassis CPCHAS-0002 is used to contain the Control Processor modules. Each Safety Manager has one Controller chassis. The Controller chassis is generally located at the top position in the cabinet, and the IO chassis at lower positions.

A Controller chassis contains the following components:

- Controller housing
- Controller backplane

5.5.2 Controller housing

The Controller housing has been designed specifically for Safety Manager. It is a 19" housing that is open at the front and covered at the back.

Control Processor modules are placed in the chassis through the front of the housing with the use of module guides, which are located at the bottom and top plate of the housing.

The modules are locked in the chassis with the quarter turn fasteners, located below the module-grips.

The below figure shows the front of a filled redundant Controller chassis.

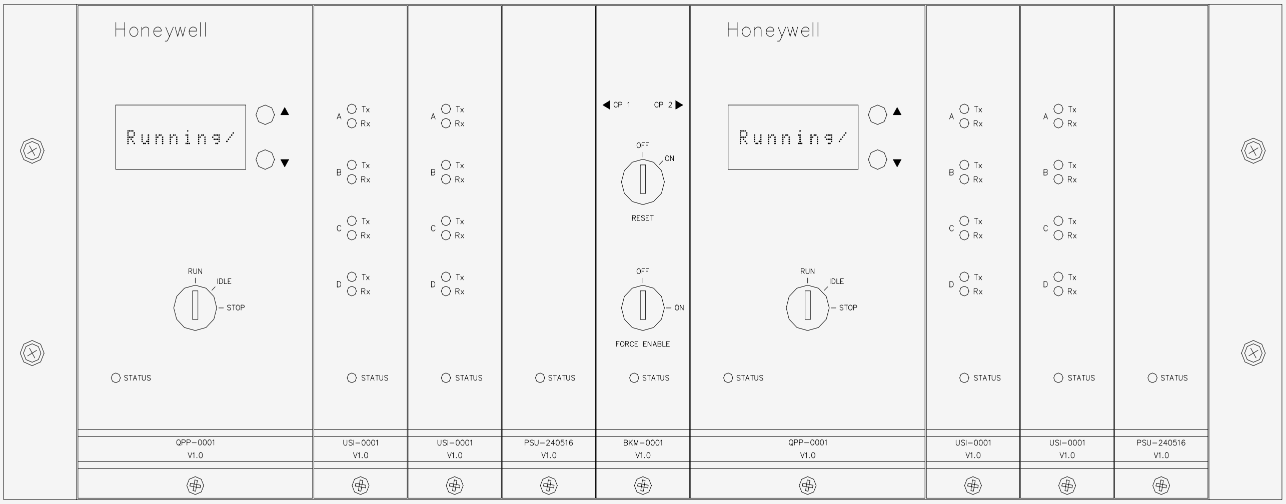


Figure 5-20: Front view of a redundant Controller chassis

The back of the housing is covered by a magnetically locked back cover plate, which can be swung upwards to reveal the Controller backplane.

Cables must be tie-wrapped to one of the three horizontal bars at the back of the housing, to lead them towards the side of the chassis.

The top bar is reserved for the 24V-supply and 24V-signal wires/cables.

The middle bar is reserved for the communication cables.

The bottom bar is reserved for the 5V and Watchdog cables (WdPx and 5V-x).

The figure 6 - 21 shows the back of an empty Controller chassis.

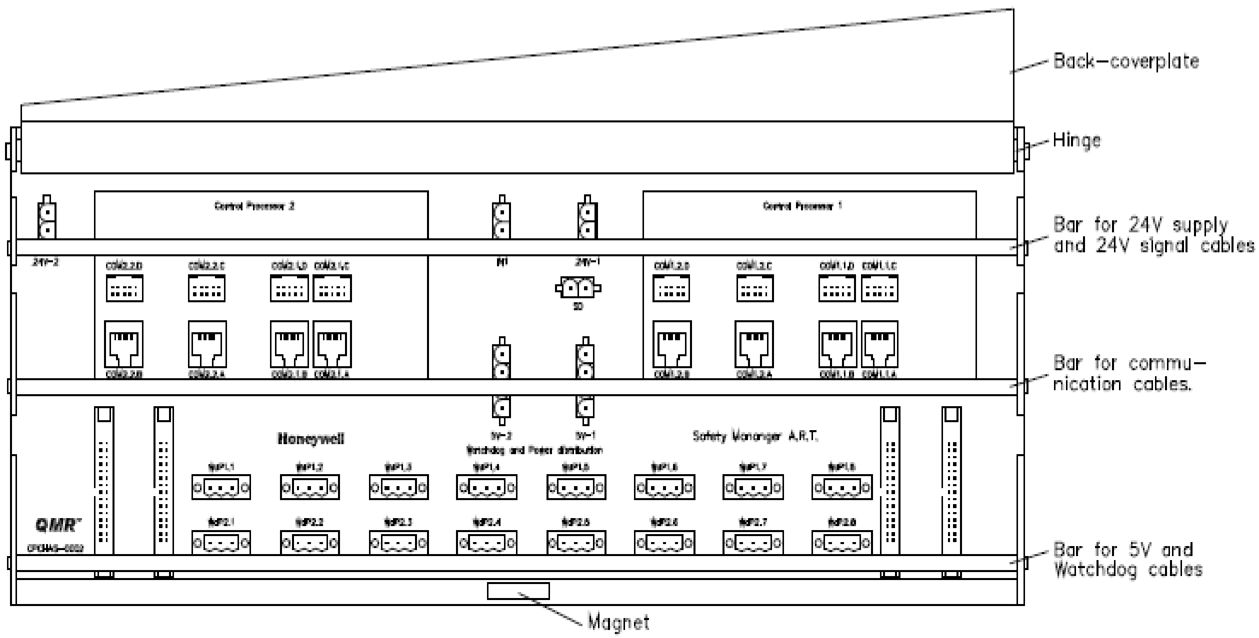


Figure 5-21: Back view of an empty Controller chassis

5.5.3 Location of Control Processor modules

The Controller chassis CPCHAS-0002 contains all Control Processor modules.

The below table shows the location of the Control Processor modules in a redundant Controller (as seen from the front of the cabinet). As you can see, all Control Processor modules are doubled in a redundant Controller configuration, with the exception of the Battery and Key switch module, which is shared by both Control Processors.

Distribution of the various Control Processor modules in the Controller chassis

Redundant Controller								
C P U 1	C O M 1 .1	C O M 1 .2	P S U 1	B K M	C P U 2	C O M 2 .1	C.O.M.2.2	P S U 2

Redundant Controller		
Legend:		
Item	Description	See
CPU1	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	QPP-0002
COM1.1	the first communication module of the first Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
COM1.2	the second communication module of the first Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
PSU1	the power supply module of the first Control Processor	
	PSU-240516 Power Supply Unit 24/5 V DC, 16A	PSU-240516
BKM	the battery and key switch module of (both) Control Processor(s)	
	BKM-0001 Battery and Key switch Module	BKM-0001
CPU2	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	QPP-0002
COM2.1	the first communication module of the second Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
COM2.2	the second communication module of the second Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM

Redundant Controller		
PSU2	the power supply module of the second Control Processor	
	PSU-240516 Power Supply Unit 24/5 V DC, 16A	PSU-240516

For each Quad Processor Pack, room is provided for two communication modules in the Controller chassis. The below table shows possible locations for different combinations of communication modules.

Note:
If only one communication module is used in a Control Processor, the module is placed in the COM1 slot (see the below table). A blind communication module (BLIND-COM) should be placed in all unused communication slots.

Possible locations of communication modules in the Controller chassis

Number of modules	COM1 Slot	COM2 Slot
0	BLIND-COM	BLIND-COM
1	USI-0002	BLIND-COM
2	USI-0002	USI-0002

5.5.4 Controller backplane

The Controller backplane is part of the Controller chassis. The front side contains the connectors for the Control Processor modules. The keying pins in the backplane connect the module housings with ground.

The below figure shows the front view of an empty redundant Controller chassis, showing the Controller backplane.

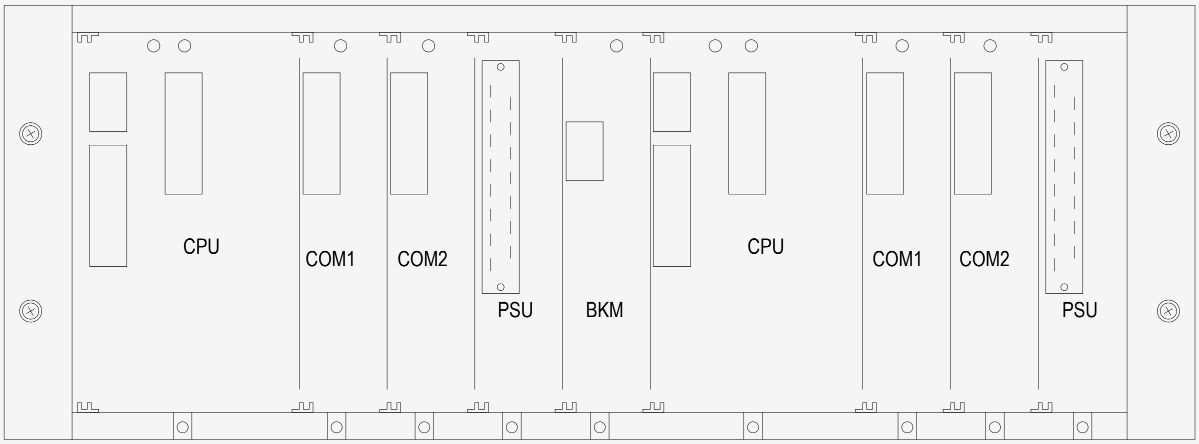
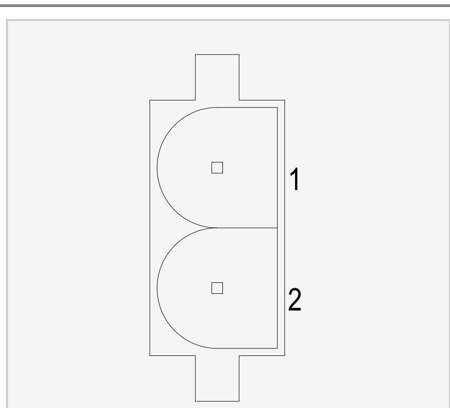


Figure 5-22: Front view of an empty redundant Controller chassis

The back side of the Controller backplane contains all the connectors for signals that go in or out of the Controller. These connectors are visible when the back cover plate is swung upwards (see "Back view of an empty Controller chassis" on page 111).

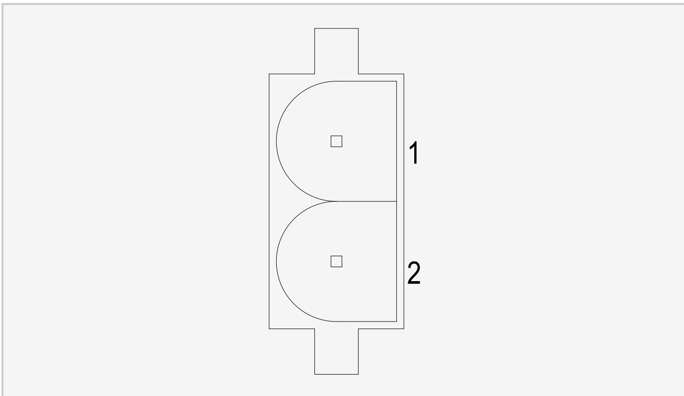
5.5.4.1 Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:



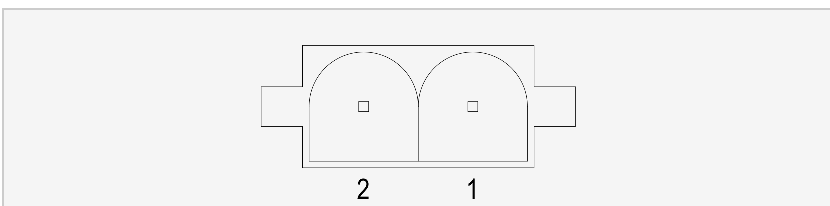
	24V-1	24V-2
1	+24V for CP1	+24V for CP2
2	0V for CP1	0V for CP2

The back view and pin allocation of the IN1 connectors are:



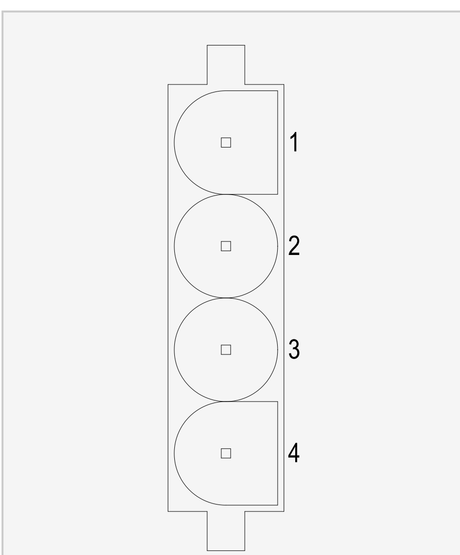
	IN1
1	+24V_red
2	input1

The back view and pin allocation of the SD connector is:



	SD
1	+24V_sd
2	input

The back view and pin allocation of the 5V-2 and 5V-1 connectors are:



	5V-2	5V-1
1	ground	ground
2	WD of CP2	WD of CP1
3	ground	ground
4	5V of CP2	5V of CP1

The back view and pin allocation of the sixteen WdPx connectors are:

		WdP1.x	WdP2.x
	3	WD of CP1	WD of CP2
	2	ground	ground
	1	5V of CP1	5V of CP2

5.5.4.2 Connector function

The below table describes the function of the connectors on the back side of the Controller backplane.

Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Control Processor 1	Com1.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com1.1.B	RJ45	
	Com1.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com1.1.D	10-pin male	
	Com1.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com1.2.B	RJ45	
	Com1.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com1.2.D	10-pin male	

Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Control Processor 2	Com2.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com2.1.B	RJ45	
	Com2.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com2.1.D	10-pin male	
	Com2.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com2.2.B	RJ45	
	Com2.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com2.2.D	10-pin male	
IO bus 1	IO bus1.1	Flat cable connector	first own IO bus of Control Processor 1 and first redundant IO bus of Control Processor 2
	IO bus2.1	Flat cable connector	first own IO bus of Control Processor 2 and first redundant IO bus of Control Processor 1
IO bus 2	IO bus1.2	Flat cable connector	second own IO bus of Control Processor 1 and second redundant IO bus of Control Processor 2
	IO bus2.2	Flat cable connector	second own IO bus of Control Processor 2 and second redundant IO bus of Control Processor 1

Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Watchdog	WdP1.1	3-pin male	Watchdog and Power of CP 1 to IO chassis 1[2]

Group	Name	Connector type	Used for
and Power[1] distribution		connector	

Group	Name	Connector type	Used for
	WdP2.1	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 1
	WdP1.2	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 2
	WdP2.2	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 2
	WdP1.3	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 3
	WdP2.3	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 3
	WdP1.4	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 4
	WdP2.4	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 4
	WdP1.5	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 5
	WdP2.5	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 5
	WdP1.6	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 6
	WdP2.6	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 6
	WdP1.7	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 7
	WdP2.7	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 7

Group	Name	Connector type	Used for
	WdP1.8	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 8
	WdP2.8	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 8
Power	24V-1	2-pin male connector	24V for Control Processor 1 (for cable details see PDC-CPSET.
	24V-2	2-pin male connector	24V for Control Processor 1 (for cable details see PDC-CPSET.
	5V-1	4-pin male connector	5V and Watchdog of Control Processor 1.
			This connector is used to distribute these signals to other (extension) cabinets using a:
			• PDB-CPX05, for more information see PDC-CPX05 or • PDB-ARTX05, for more information see “PDB-ARTX05” on page 727, or • PDB-ARTF05 (for more information see PDB-ARTF05).
	5V-2	4-pin male connector	5V and Watchdog of Control Processor 2.
			This connector is used to distribute these signals to other (extension) cabinets using a:
			• PDB-CPX05, for more information see PDC-CPX05, or • PDB-ARTX05, for more information see “PDB-ARTX05” on page 727, or • PDB-ARTF05 (for more information see PDB-ARTF05).
Various	SD	2-pin male connector	Connector for an Emergency Shut Down system. The chassis is delivered with the LINK-SD link placed. This link is required if the Emergency Shut Down function is not used (see also QPP data sheets QPP-0002 and SICP-0002/L3).

Group	Name	Connector type	Used for
	IN1	2-pin male connector	24 Volt non-safety related general purpose input. This input can generate an interrupt (on the rising edge) e.g. for external clock synchronization (see also BKM-0001 and SICP-0002/L3).

1. Watchdog and 5 Volt of Control Processor 1 and Control Processor 2.
2. The chassis numbers mentioned here are defined by jumpers on the IO backplane.

5.5.5 Technical data

General	Type number:	FS-CPCHAS-0002
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	0.05 A
	5V-2:	0.05 A
Dimensions	Height:	4 HE (177 mm, 7 in)
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	5.8 kg, 12.8 lb

5.6 IOCHAS-0002S

The IOCHAS-0002S is a chassis for up to 18 non-redundant IO modules.

It consists of the following components:

Components of the IOCHAS-0002S

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0002	2	IO Extender modules, slot 20 and 21 (Safety Manager A.R.T.)	IO-0002
Blind front	1	Located at slot 19	

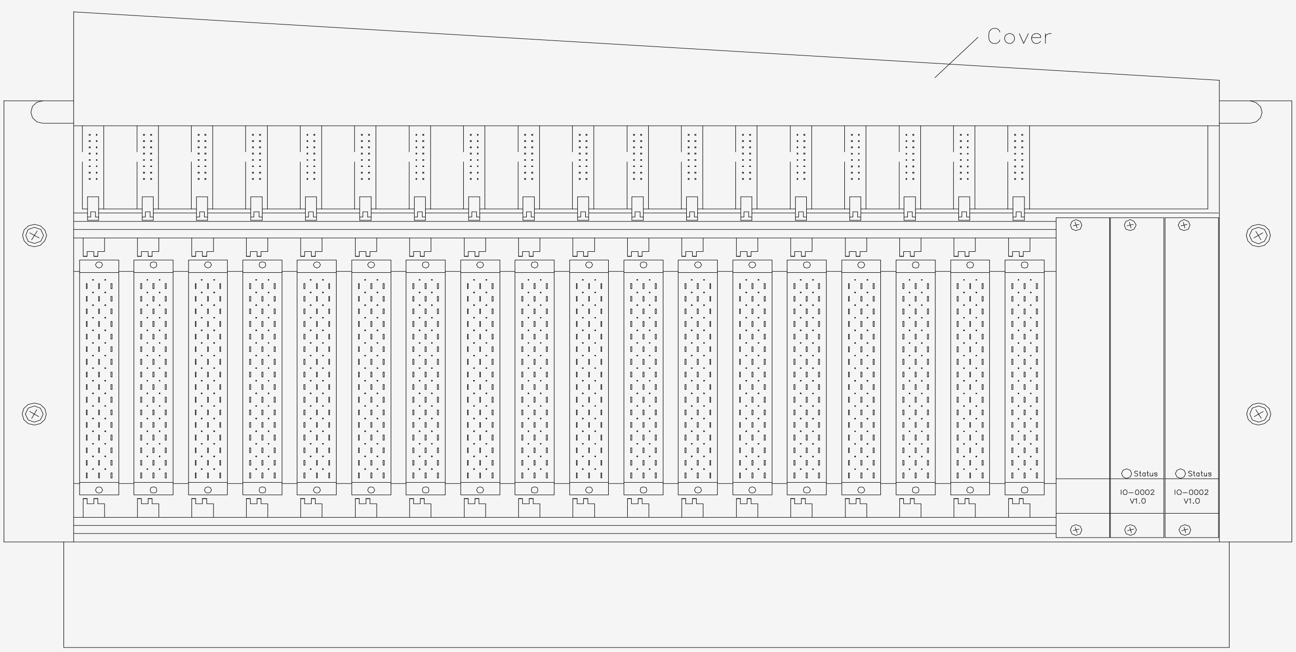


Figure 5-23: Front view of an empty IOCHAS-0002S

The above figure shows the front side of an empty IOCHAS-0002S with the front-cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis.

In the IOCHAS-0002S, slots 1 to 18 are available for IO modules.

Behind the blind front at slot 19, board is located.

Slot 20 and slot 21 contain the IO-0002 modules.

5.6.1 IO Housing

The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A coverplate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tagnumber assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see the below figure).

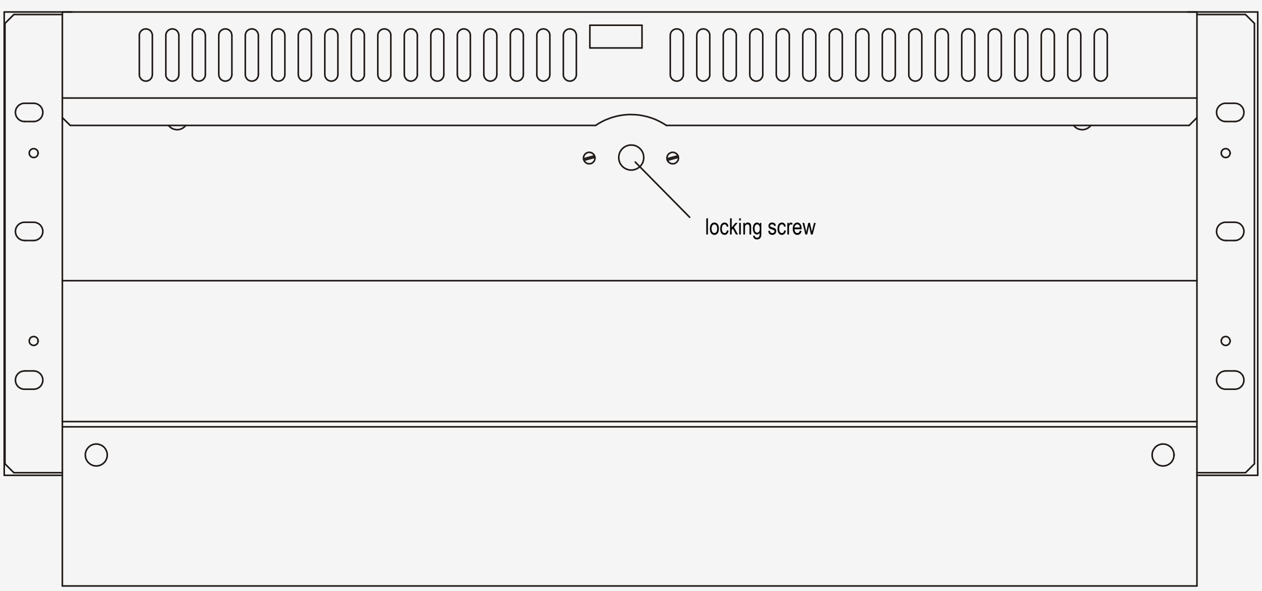


Figure 5-24: Back view of a closed IOCHAS-0002S

Attention:
The IO back cover plate will be completely unattached from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

5.6.2 IO Backplane for non-redundant IO

The front of the backplane is visible in the middle of Figure.

Figure 6-25 shows the back of the IOCHAS-0002S with the back-cover removed.

The below table describes the connectors present.

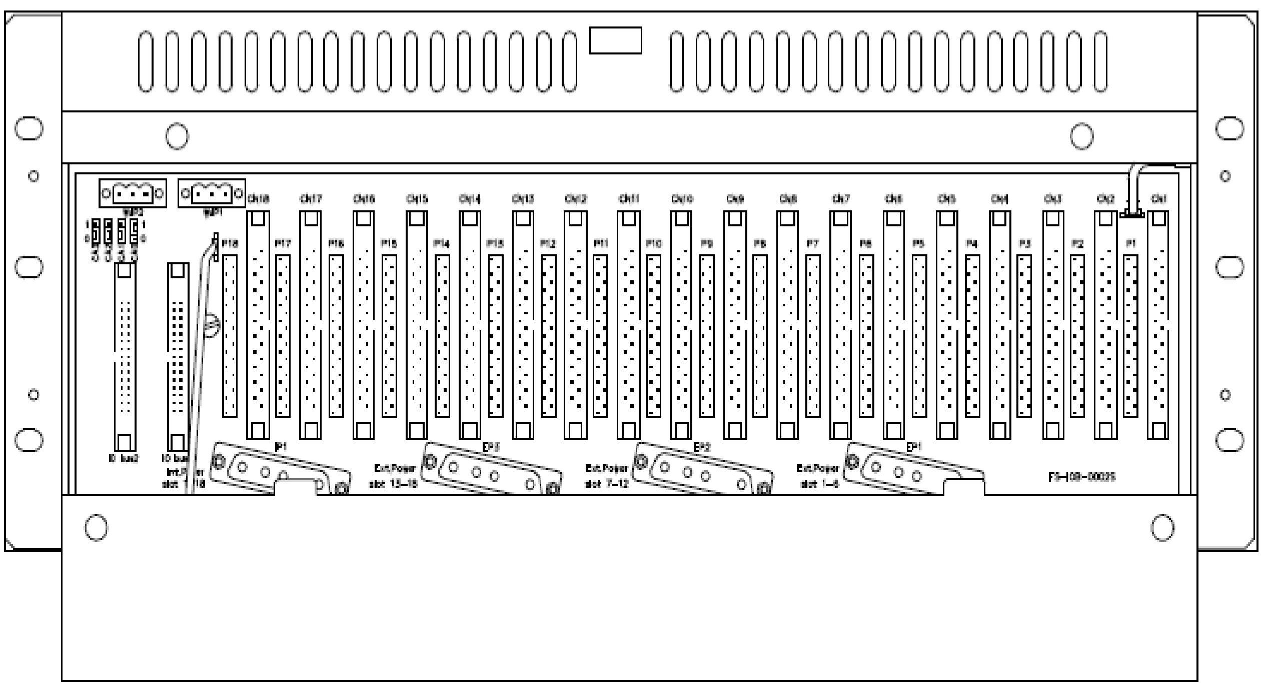


Figure 5-25: Back view of an open IOCHAS-0002S

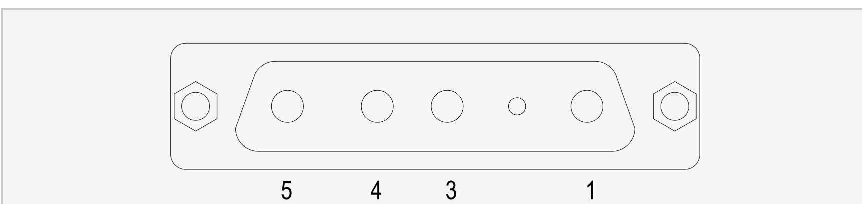
Connectors on the IOB-0002S

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	Connectors for IO modules, slot 1 to 18	Input modules Output modules
55-pin male chassis connector	1	slot 19	Horizontal IO bus transfer board
120-pin female chassis connector	2	For IO extender IO-0002, slot 20 and 21	IO-0002
Back side			
IO bus1	1	Controller for IO bus 1 to controller chassis	
IO bus2	1	Controller for IO bus 2 to controller chassis	
CN1 to CN18	18	Connector for system interconnection cables SICC-0001/Lx or	SICC 0001/LxSICP-0001/Lx
		SICP-0001/Lx, slot 1 to 18	
P1 to P18	18	Connector for IO converter modules, slot 1 to 18	Input converter modules
			Output converter modules
IP1	1	Connector for internal power, slot 1 to 18	Cable: PDC-IOSET, see PDC-IOSET
EP1	1	Connector for external power, slot 1 to 6	Cable: PDC-IOSET, see PDC-IOSET
EP2	1	Connector for external power, slot 7 to 12	Cable: PDC-IOSET, see PDC-IOSET

Connector	Amount	Description	See
EP3	1	Connector for external power, slot 13 to 18	Cable: PDC-IOSET, see PDC-IOSET
CA0 to CA3	4	Jumpers for defining the IO chassis address	Address settings
WdP1	1	Connector for watchdog and 5 V of CP1	Refer chassis IO "Back view of an open IOCHAS-0002S" on page 125
			Cable: PDC-ART05, see PDC-ART05
WdP2	1	Connector for watchdog and 5 V of CP2	Refer chassis IO "Back view of an open IOCHAS-0002S" on page 125
			Cable: PDC-IOR05, see PDC-ART05

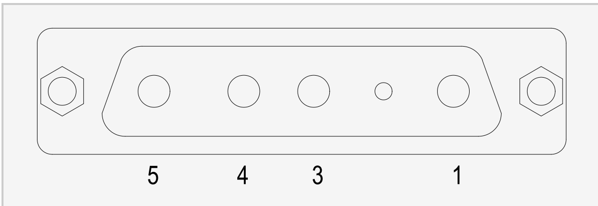
5.6.2.1 Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



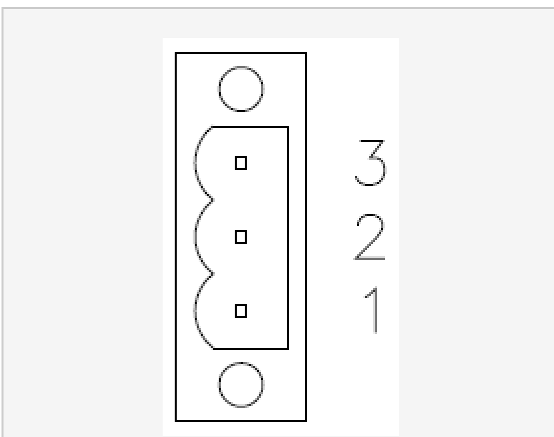
	IP1
1	IP slot 1-9
3	0 V
4	0 V
5	IP slot 10-18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

The back view and pin allocation of the WdPx connector (see below Figure in the table) is:



	WdP1	WdP2
3	WD of CP1	WD of CP2
2	ground	ground
1	5V of CP1	5V of CP2

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 6-26 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

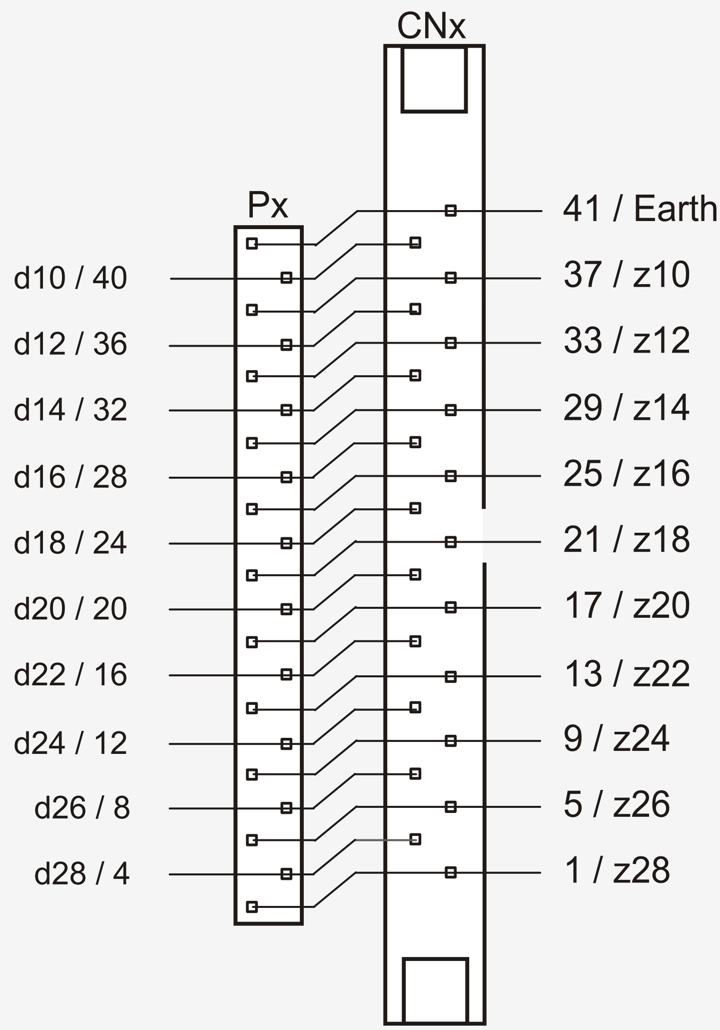


Figure 5-26: Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector

5.6.3 Horizontal IO bus backplane for non-redundant IO

Figure 6-27 shows a front view of a filled IOCHAS-0002S with the cover opened.

Figure 6-28 shows a front view of a filled IOCHAS-0002S with the cover closed.

The below table lists the connectors present.

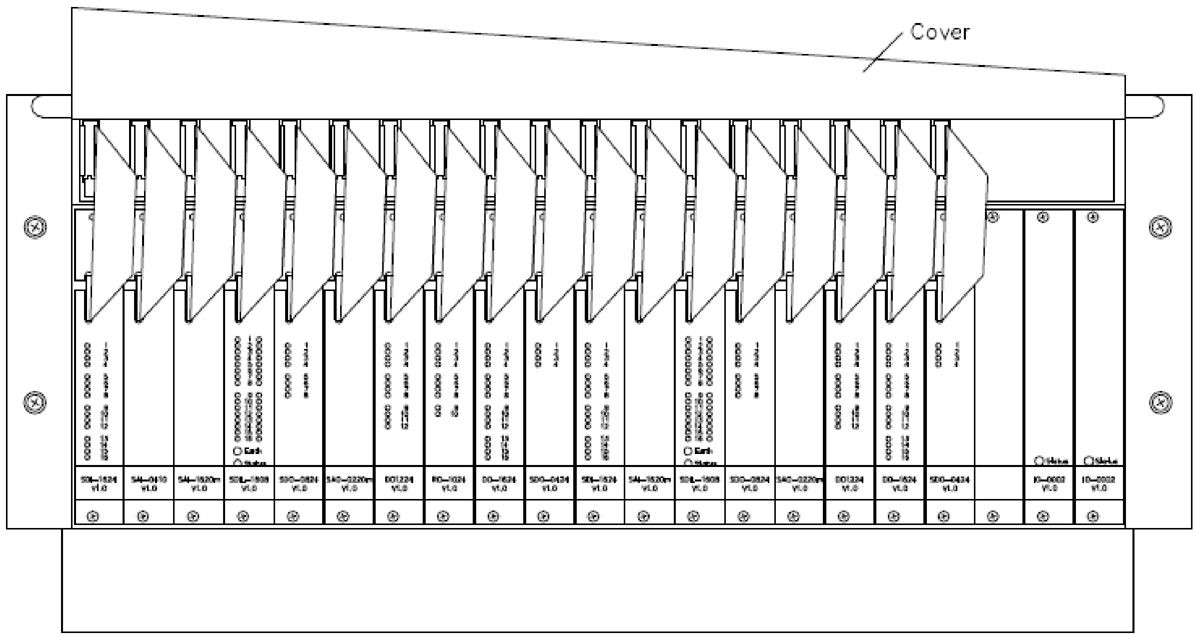


Figure 5-27: Front view of a filled, open IOCHAS-0002S

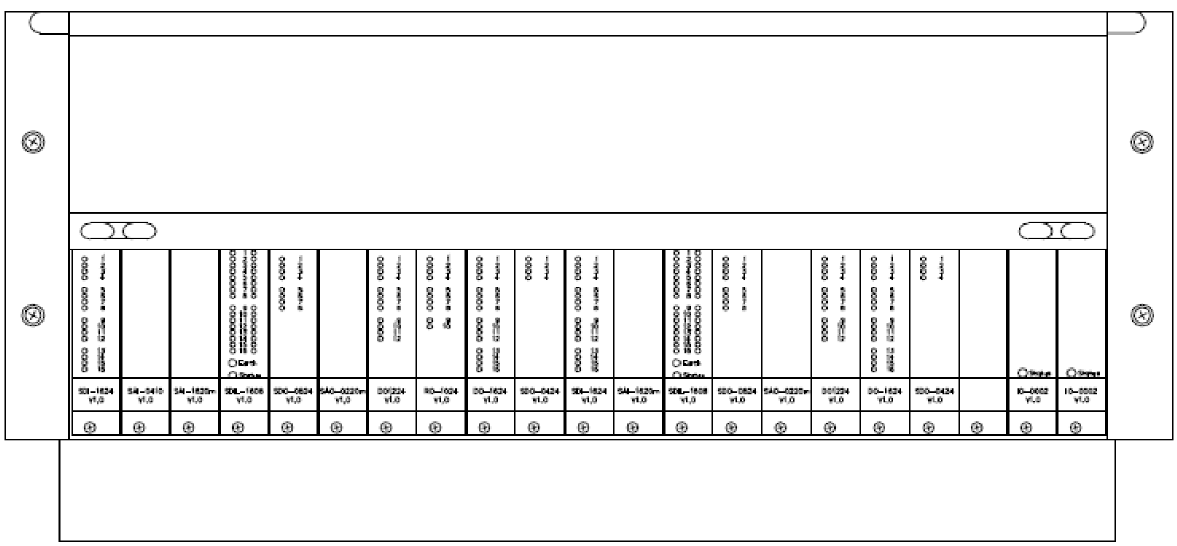


Figure 5-28: Front view of a filled, closed IOCHAS-0002S

Connectors on the Horizontal IO bus backplane

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, located at slot 1 to 18	Input modules Output modules
26-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	“Horizontal IO bus transfer board (Safety Manager A.R.T.): Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A
10-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	“Horizontal IO bus transfer board (Safety Manager A.R.T.): Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A

5.6.4 Horizontal IO bus transfer board

The board transfers the IO bus signals on the backplane to the Horizontal IO bus on the front of the chassis.

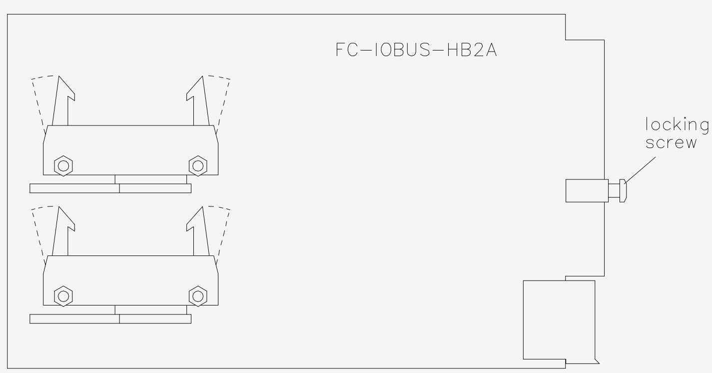


Figure 5-29: Component view of the IOBUS-HB2A board

The board is placed behind the blind front, at slot 19 of the IO chassis.

The board is fixed on the IO backplane with the locking screw (see the above figure).

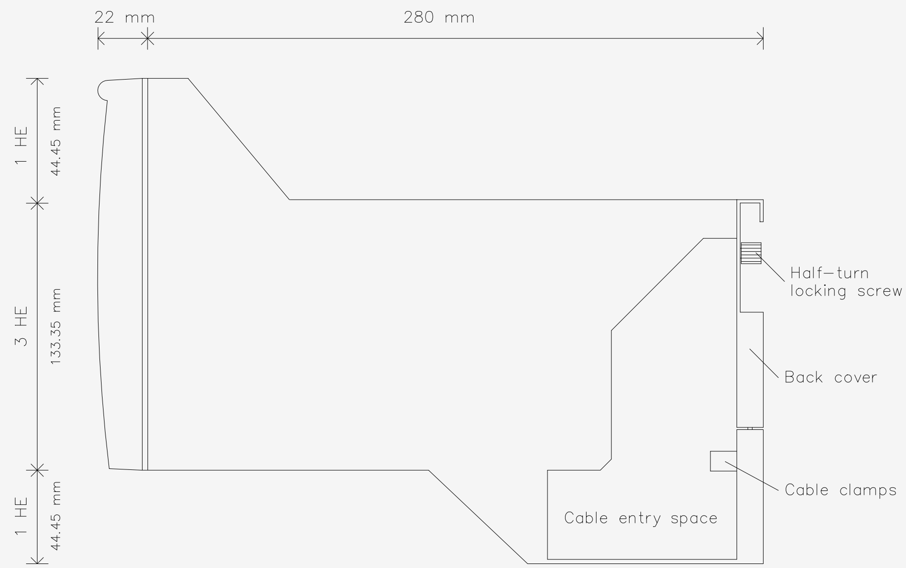


Figure 5-30: Side view of the IOCHAS-0002S

5.6.5 Technical data

General	Type number:	FC-IOCHAS-0002S
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	100 mA (IO-0002 slot 20)
	5V-2:	100 mA (IO-0002 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see "Side view of the IOCHAS-0002S" on the previous page
		44.5 + 133.4 + 44.5 mm
		1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,7 kg, 19.2 lb

5.7 IOCHAS-0002R

The IOCHAS-0002R is a chassis for up to 9 pairs of redundant IO modules.

It consists of the following components:

Components of the IOCHAS-0002R

Component	Amount	Description
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules
IO-0002	2	IO Extender modules, slot 20 and 21 (Safety Manager A.R.T.)
Blind front	1	Located at slot 19

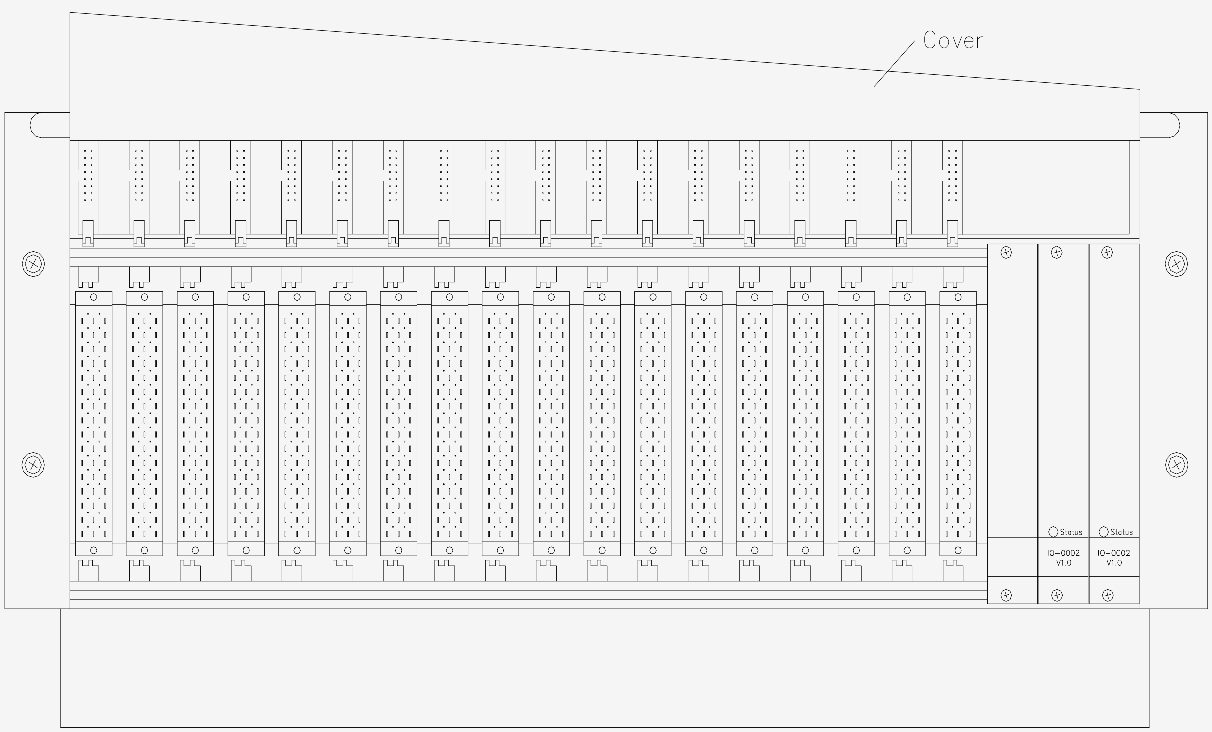


Figure 5-31: Front view of an empty IOCHAS-0002R

The above figure shows the front side of an empty IOCHAS-0002R with the front cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis. In the IOCHAS-0002R, slots 1 to 18 are available for IO modules. They are configured in pairs.

Behind the blind front at slot 19, board is located.

Slot 20 and slot 21 contain the IO-0002 modules.

5.7.1 IO Housing

The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A cover plate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tag number assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see the below figure).

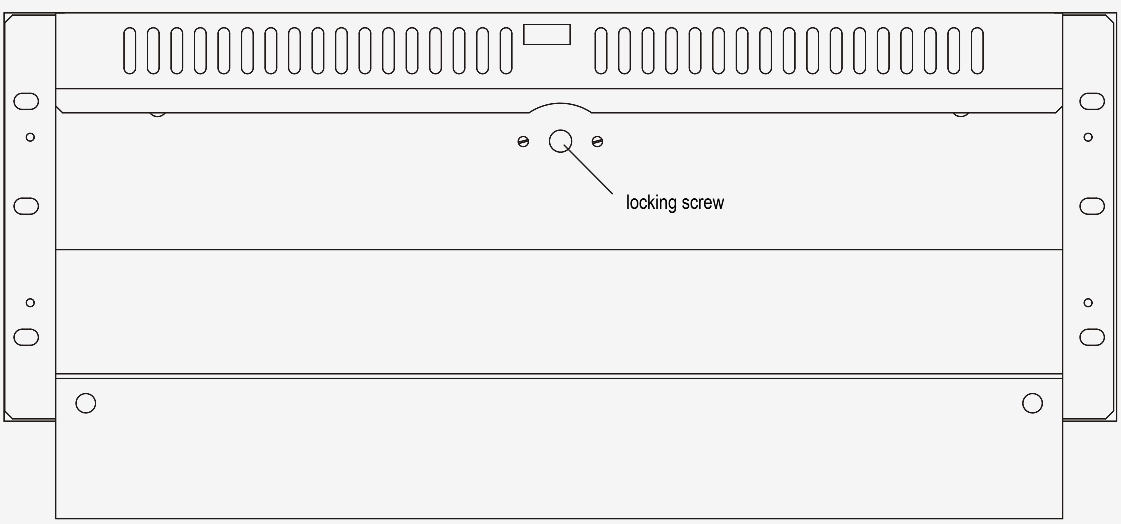


Figure 5-32: Back view of a closed IOCHAS-0002R

Attention:
The IO back cover plate will be completely removed from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

5.7.2 IO Backplane for redundant IO

The front of the backplane is visible in the middle of "Front view of an empty IOCHAS-0002R" on page 134.

Figure 6-33 shows the back of the IOCHAS-0002R with the back-cover removed.

The below table describes the connectors.

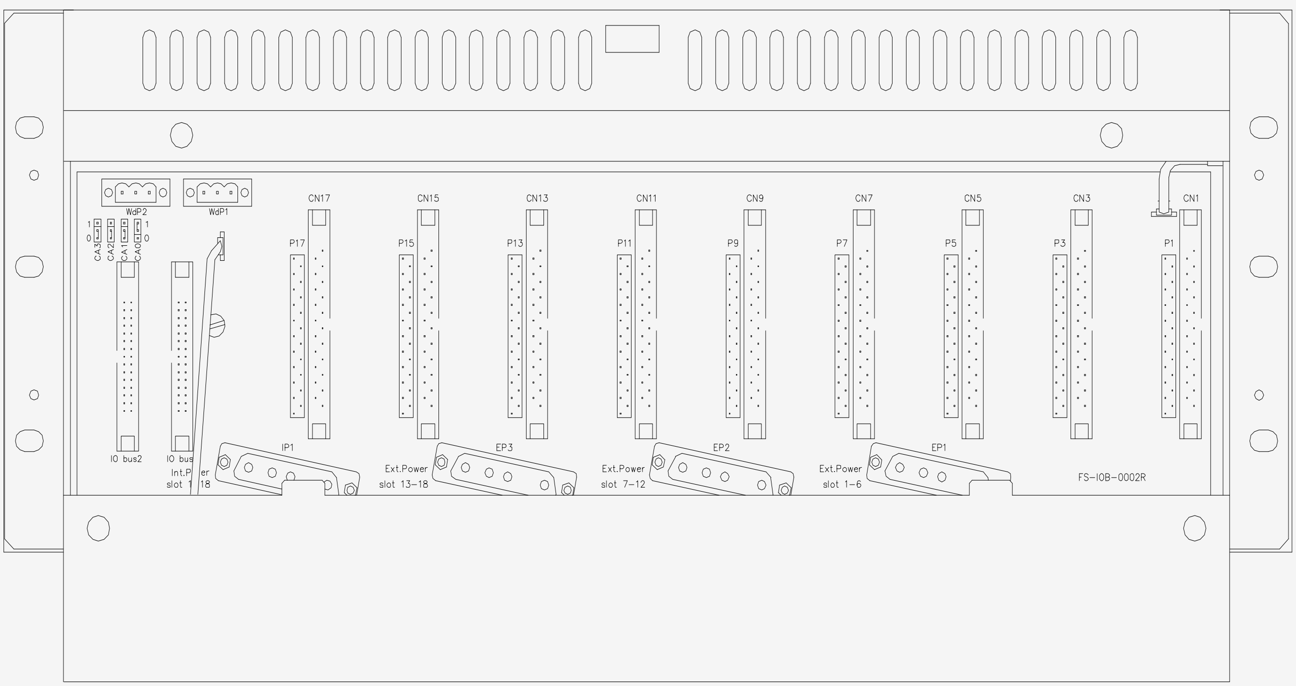


Figure 5-33: back view of an open IOCHAS-0002R

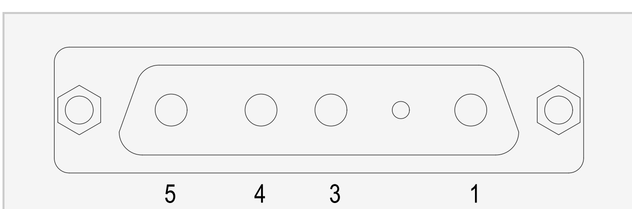
Connectors on the IOB-0002R

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	For IO modules, slot 1 to 18	Input modules
			Output modules
55-pin male chassis connector	1	Slot 19	Horizontal IO bus transfer board
120-pin male chassis connector	2	For IO extender IO-0002, slot 20 and 21	“IO-0002” on page 526
Back side			
IO bus1	1	For IOBUS-CPIO (IO bus 1	IOBUS-CPIO
		to controller chassis)	
IO bus2	1	For IOBUS-CPIO (IO bus 2	IOBUS-CPIO
		to controller chassis)	
CN1, CN3, CN5, CN7, CN9, CN11, CN13, CN15 and CN17	9	For system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17	SICP-0001/Lx SICP-0001/Lx
P1, P3, P5, P7, P9, P11, P13, P15 and P17	9	For IO converter modules, slot 1, 3, 5, 7, 9, 11, 13, 15, and 17	Input converter modules Output converter modules
IP1	1	For internal power, slot 1 to 18	Cable: PDC-IOSET, see PDC-IOSET
EP1	1	For external power, slot 1 to 6	Cable: PDC-IOSET, see PDC-IOSET
EP2	1	For external power, slot 7 to 12	Cable: PDC-IOSET, see PDC-IOSET

Connector	Amount	Description	See
EP3	1	For external power, slot 13 to 18	Cable: PDC-IOSET, see PDC-IOSET
CA0 to CA3	4	Jumpers for defining the IO chassis address	Address settings
WdP1	1	Connector for watchdog and 5 V of CP1	Refer chassis IO "back view of an open IOCHAS-0002R" on page 136
			Cable: PDC-ART05, see PDC-ART05
WdP2	1	Connector for watchdog and 5 V of CP2	Refer chassis IO "back view of an open IOCHAS-0002R" on page 136
			Cable: PDC-IOR05, see PDC-IOR05

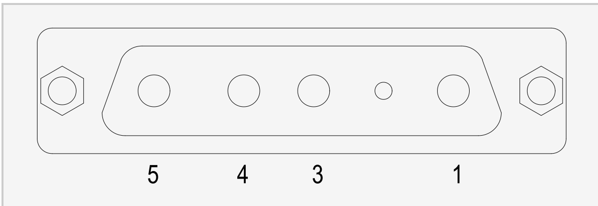
5.7.2.1 Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



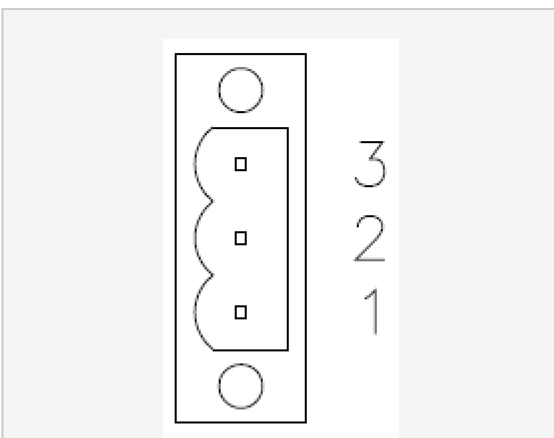
	IP1
1	IP slot 1, 3, 5, 7, 9, 11, 13, 15 and 17
3	0 V
4	0 V
5	IP slot 2, 4, 6, 8, 10, 12, 14, 16 and 18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The back view and pin allocation of the WdPx connector (see "back view of an open IOCHAS-0002R" on page 136) is:



	WdP1	WdP2
3	WD of CP1	WD of CP2
2	ground	ground
1	5V of CP1	5V of CP2

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 6-34 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

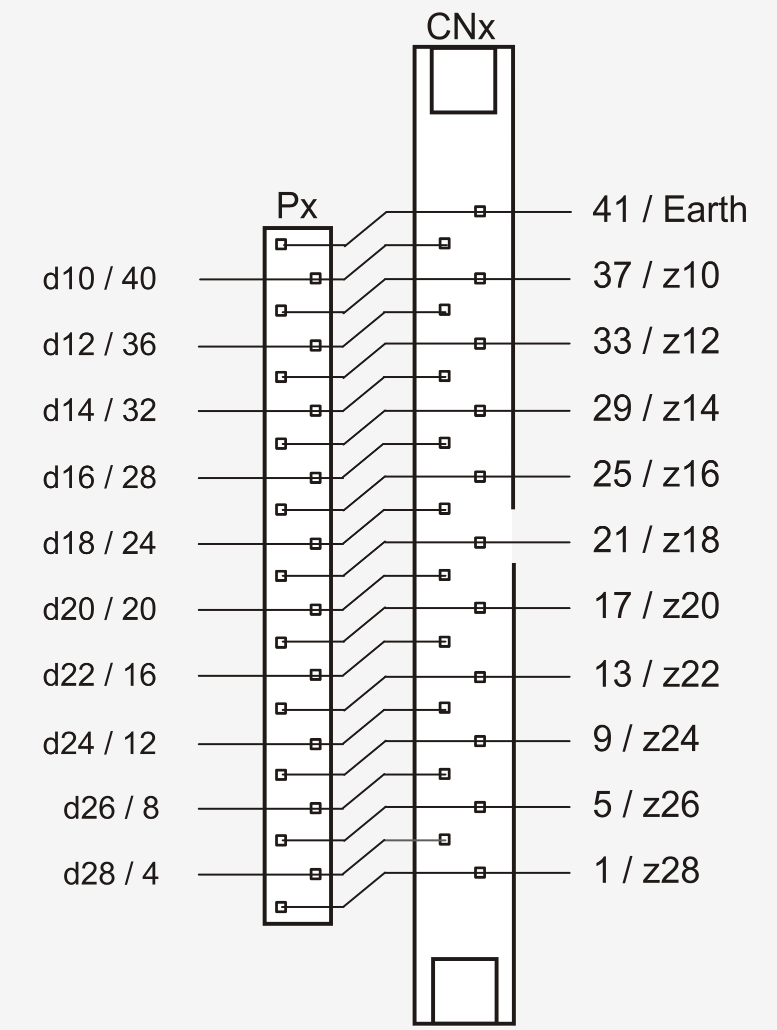


Figure 5-34: Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector

5.7.3 Horizontal IO bus backplane for redundant IO

Figure 6-35 shows a front view of a filled IOCHAS-0002R with the cover opened.

Figure 6-36 shows a front view of a filled IOCHAS-0002R with the cover closed.

The below table lists the connectors.

5.7 IOCHAS-0002R

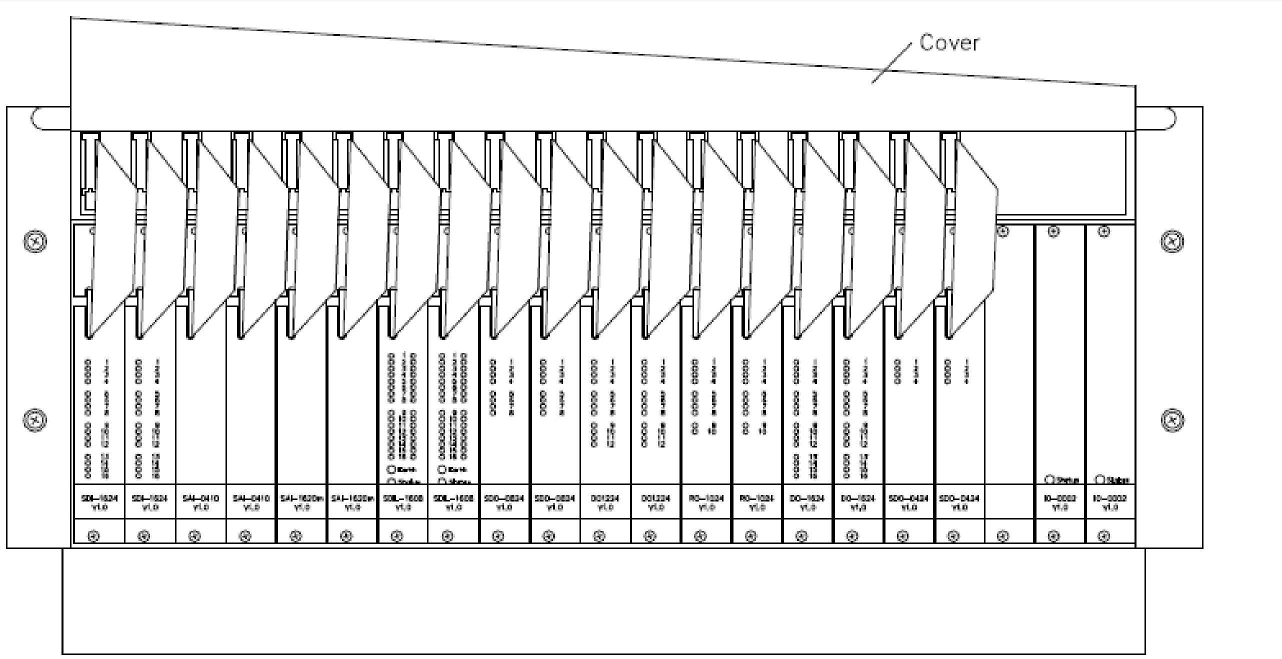


Figure 5-35: Front view of a filled, open IOCHAS-0002R

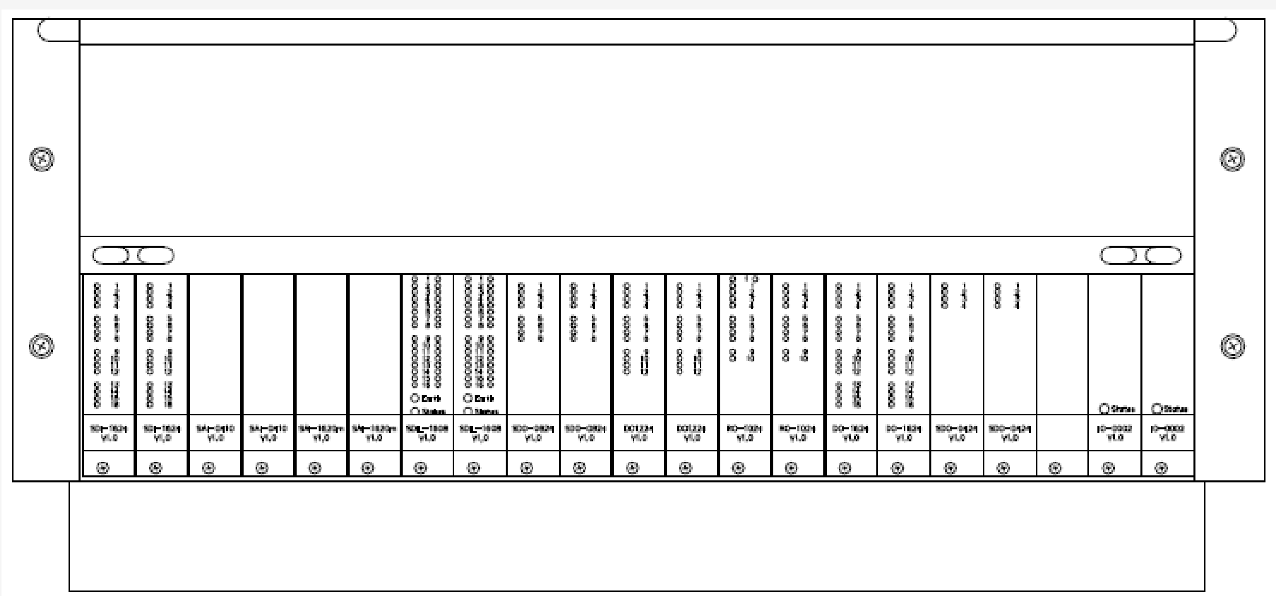


Figure 5-36: Front view of a filled, closed IOCHAS-0002R

Connectors on the IOBUS-HB2R

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, slot 1 to 18	Input modules Output modules
26-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	"Horizontal IO bus transfer board (Safety Manager A.R.T.): Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A
10-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	"Horizontal IO bus transfer board (Safety Manager A.R.T.): Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A

5.7.4 Horizontal IO bus transfer board

The board transfers the IO bus signals on the backplane to the Horizontal IO bus on the front of the chassis.

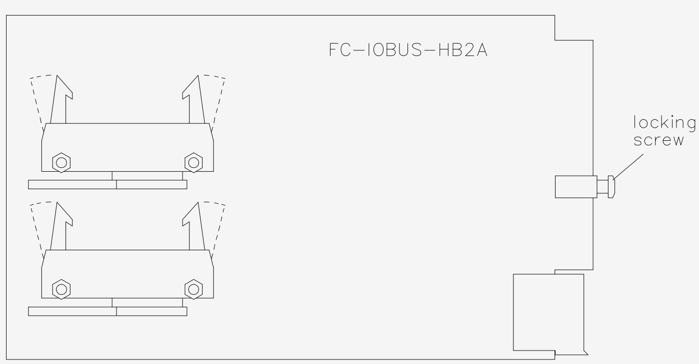


Figure 5-37: Component view of the IOBUS-HB2A board

The board is placed behind the blind front, at slot 19 of the IO chassis.

The board is fixed on the IO backplane with the locking screw (see the above figure).

5.7 IOCHAS-0002R

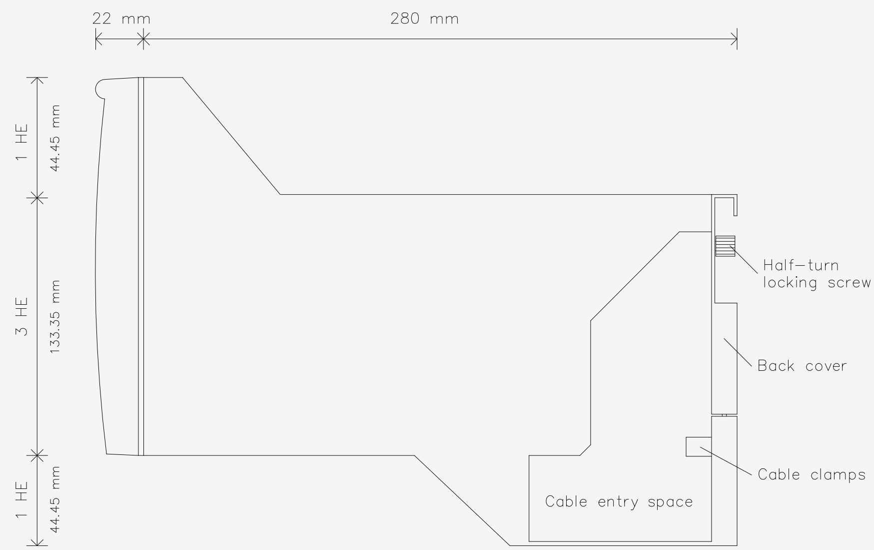


Figure 5-38: Side view of the IOCHAS-0002R

5.7.5 Technical data

General	Type number:	FC-IOCHAS-0002R
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	100 mA (IO-0002 slot 20)
	5V-2:	100 mA (IO-0002 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see "Side view of the IOCHAS-0002R" on the previous page
		44.5 + 133.4 + 44.5 mm
		1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,7 kg, 19.2 lb

5.8 CPCHAS-0003

Chassis for redundant or non-redundant Controller (Safety Manager)

5.8.1 General

The Controller chassis CPCHAS-0003 is used to contain the Control Processor modules. Each Safety Manager has one Controller chassis. The Controller chassis is generally located at the top position in the cabinet, and the IO chassis at lower positions.

A Controller chassis contains the following components:

- Controller housing
- Controller backplane

> **Note:**
> CPCHAS-0003 is a replacement for CPCHAS-0001.

5.8.2 Controller housing

The Controller housing has been designed specifically for Safety Manager. It is a 19" housing that is open at the front and covered at the back.

Control Processor modules are placed in the chassis through the front of the housing with the use of module guides, which are located at the bottom and top plate of the housing.

The modules are locked in the chassis with the quarter turn fasteners, located below the module-grips.

The below figure shows the front of a filled redundant Controller chassis.

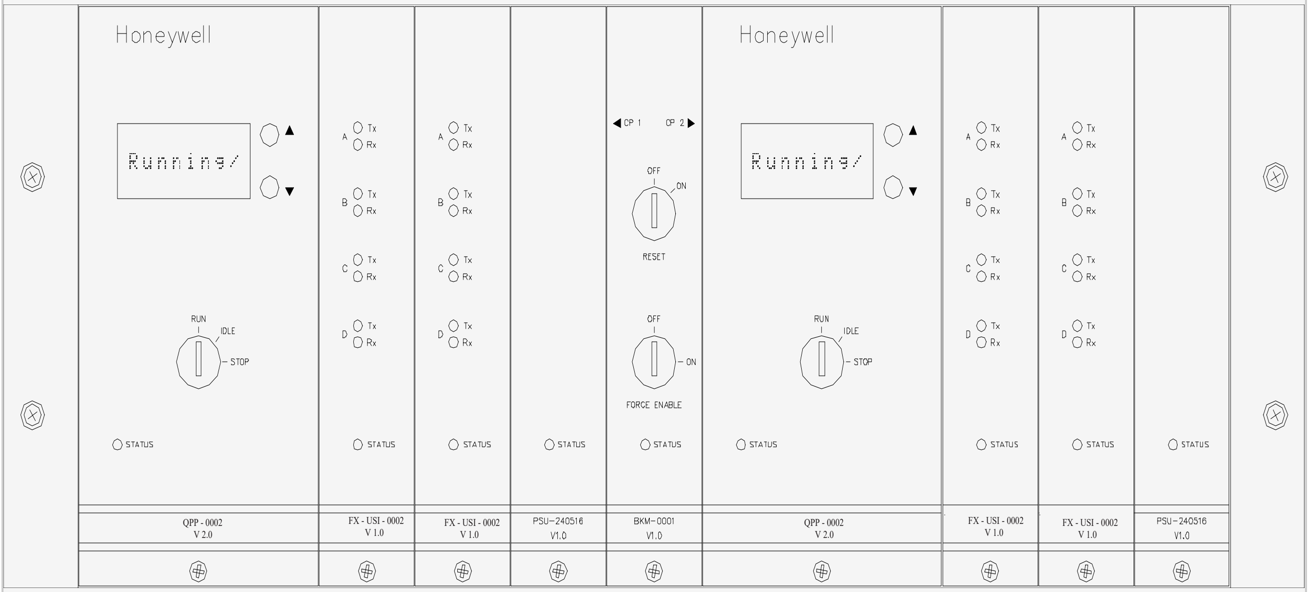


Figure 5-39: Front view of a redundant Controller chassis

The below figure shows the front of a filled non-redundant Controller chassis.

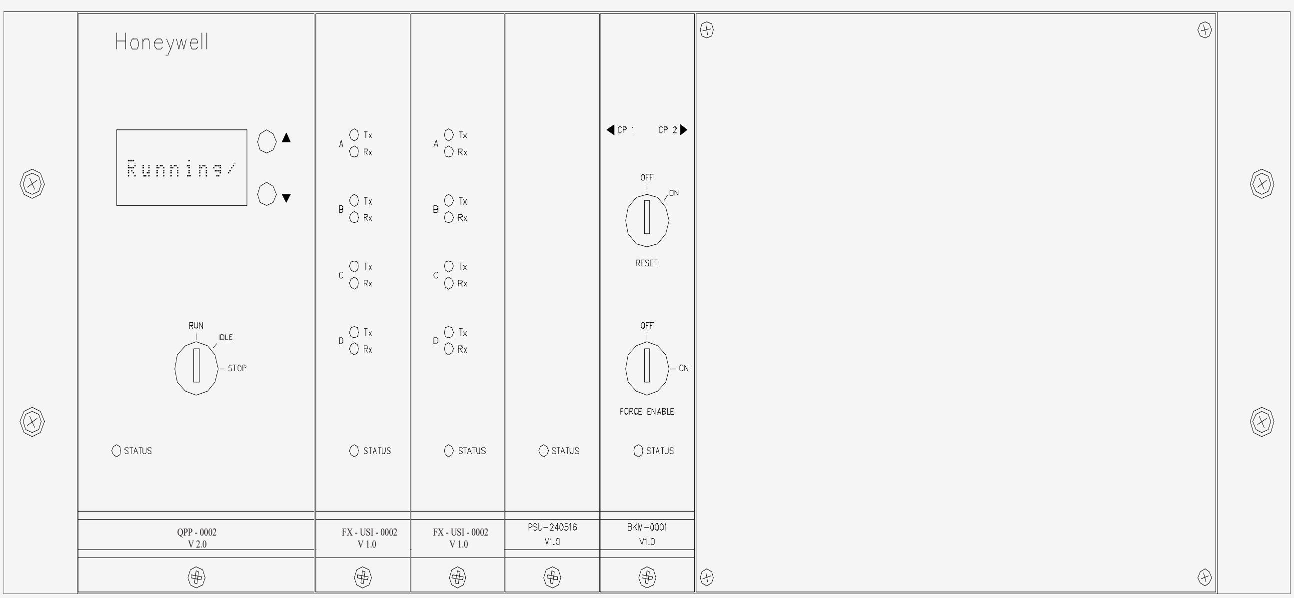


Figure 5-40: Front view of a non-redundant Controller chassis

The below figure shows the back of an empty Controller chassis.

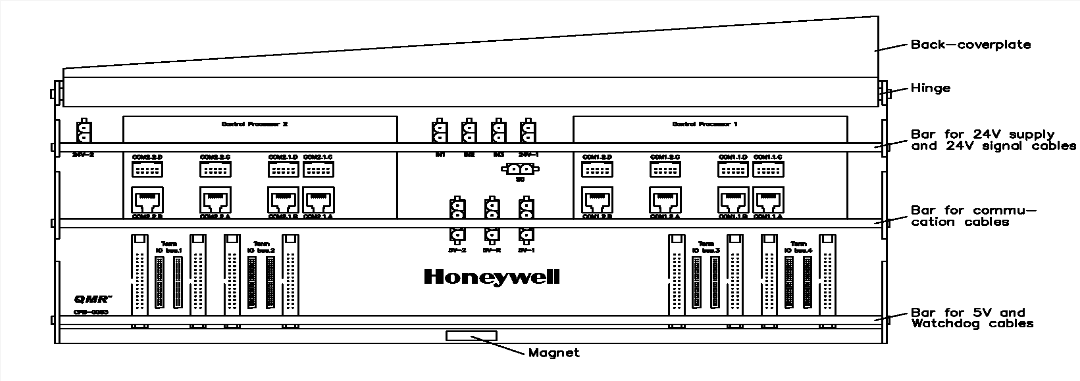


Figure 5-41: Back view of an empty Controller chassis

The back of the housing is covered by a magnetically locked back cover plate, which can be swung upwards to reveal the Controller backplane.

Cables must be tie-wrapped to one of the three horizontal bars at the back of the housing, to lead them towards the side of the chassis.

The top bar is reserved for the 24V-supply and 24V-signal wires/cables.

The middle bar is reserved for the communication cables.

The bottom bar is reserved for the 5V and Watchdog cables (5V-x).

5.8.3 Location of Control Processor modules

The Controller chassis CPCHAS-0003 contains all Control Processor modules.

The table in the next page shows the location of the Control Processor modules in a non-redundant and a redundant Controller (as seen from the front of the cabinet). As can be seen, all Control Processor modules are doubled in a redundant Controller configuration, with the exception of the Battery and Key switch module, which is shared by both Control Processors.

Distribution of the various Control Processor modules in the Controller chassis

Redundant Controller								
Non-Redundant Controller								
C P U 1	C O M 1 .1	C O M 1 .2	P S U 1	B K M	C P U 2	C O M 2 .1	C.O.M.2.2	P S U 2

Legend:		
Item	Description	See
CPU1	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	QPP-0002
COM1.1	the first communication module of the first Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
COM1.2	the second communication module of the first Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
PSU1	the power supply module of the first Control Processor	
	PSU-240516 Power Supply Unit 24/5 V DC, 16A	PSU-240516
BKM	the battery and key switch module of (both) Control Processor(s)	
	BKM-0001 Battery and Key switch Module	BKM-0001
CPU2	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	QPP-0002

Redundant Controller		
Non-Redundant Controller		
COM2.1	the first communication module of the second Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
COM2.2	the second communication module of the second Control Processor	
	USI-0002 Universal Safety Interface, or	FX-USI-0002
	BLIND-COM Dummy Communication Module	BLIND-COM
PSU2	the power supply module of the second Control Processor	
	PSU-240516 Power Supply Unit 24/5 V DC, 16A	PSU-240516

In case of a non-redundant Controller, the unused positions in the Controller chassis (CPU2, COM2.1, COM2.2, and PSU2 are covered by an BLIND-CPS plate (see Figure 6-40).

For each Quad Processor Pack, room is provided for two communication modules in the Controller chassis. The below table shows possible locations for different combinations of communication modules.

> **Note:**
> If only one communication module is used in a Control Processor, the module is placed in the COM1 slot (see the below table). A blind communication module (BLIND-COM) should be placed in all unused communication slots.

Possible locations of communication modules in the Controller chassis

Number of modules	COM1 Slot	COM2 Slot
0	BLIND-COM	BLIND-COM
1	USI-0002	BLIND-COM
2	USI-0002	USI-0002

5.8.4 Controller backplane

The Controller backplane is part of the Controller chassis. The front side contains the connectors for the Control Processor modules. The keying pins in the backplane connect the module housings with ground.

Figure 6-42 below shows the front view of an empty redundant Controller chassis, showing the Controller backplane.

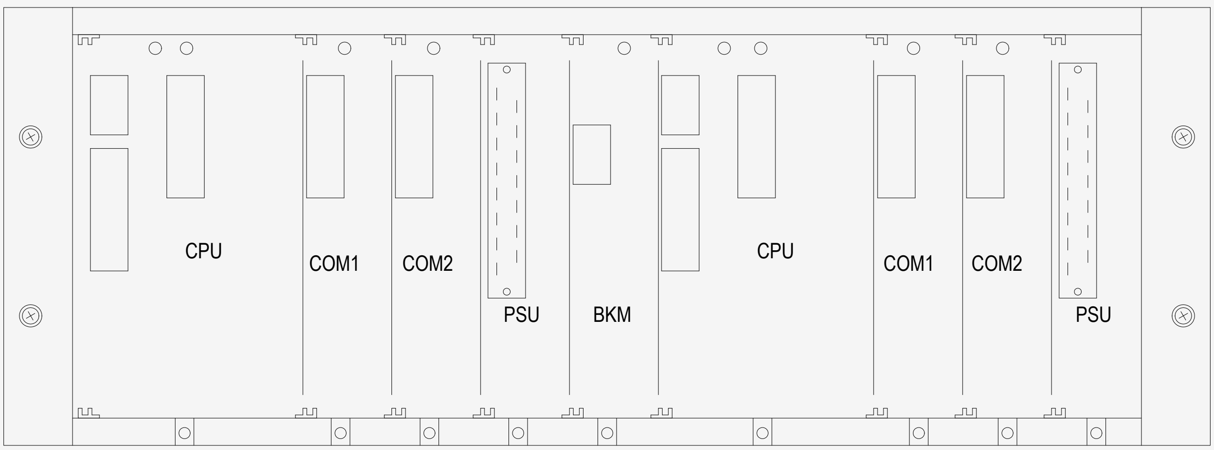


Figure 5-42: Front view of an empty redundant Controller chassis

The back side of the Controller backplane contains all the connectors for signals that go in or out of the (non-)redundant Controller. These connectors are visible when the back cover plate is swung upwards.

The Controller backplane connects the 5VR output of the PSU of CP1 with the 5VR output of the PSU of CP2.

The resulting 5V-R is used to supply the non-redundant IO.

Thanks to the output diodes in the PSU-240516 (see Figure 6-43 on the next page) the 5V-R will be available as long as (at least) one of the PSUs is operating.

Figure 6-43 shows the 5V connection of the two PSU-240516 modules on the Controller backplane.

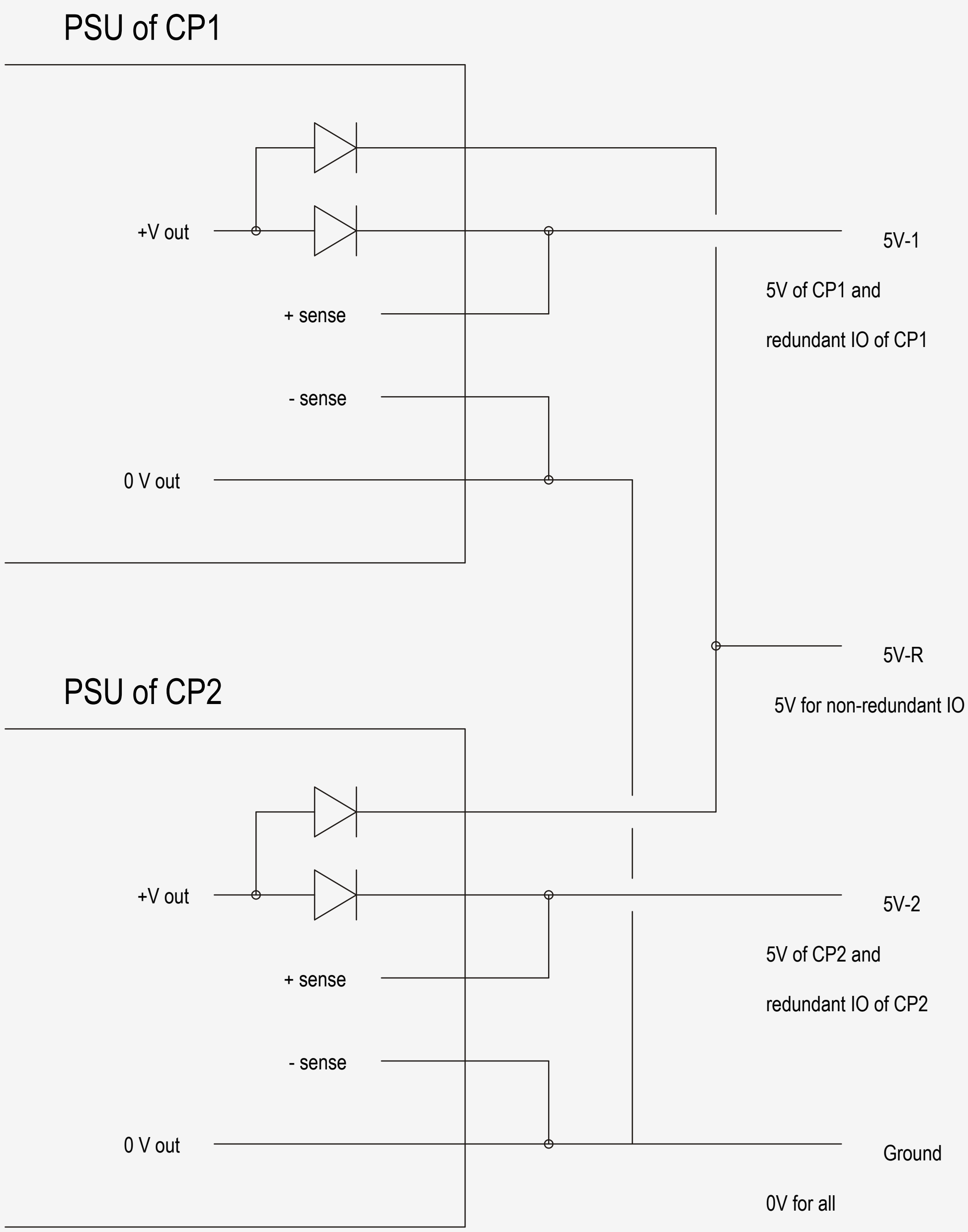
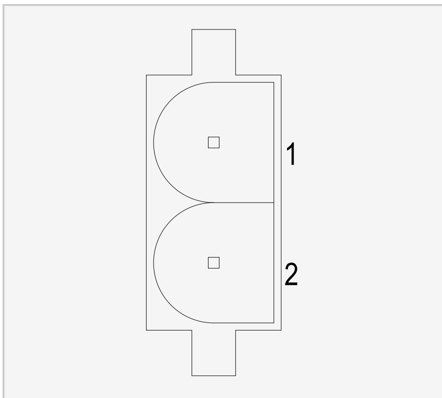


Figure 5-43: 5V PSU-connection on the CP backplane

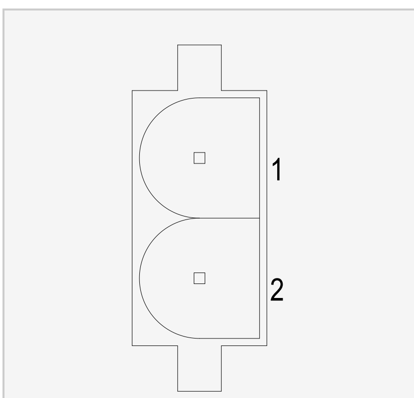
5.8.4.1 Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:



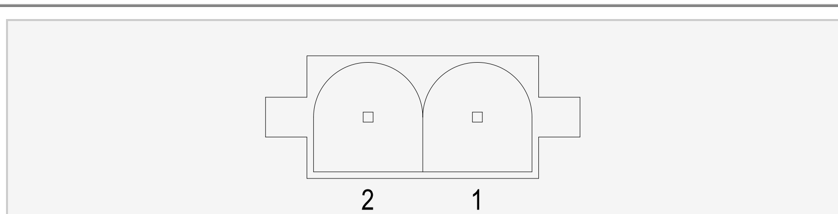
	24V-1	24V-2
1	+24V for CP1	+24V for CP2
2	0V for CP1	0V for CP2

The back view and pin allocation of the IN1, IN2 and IN3 connectors are:



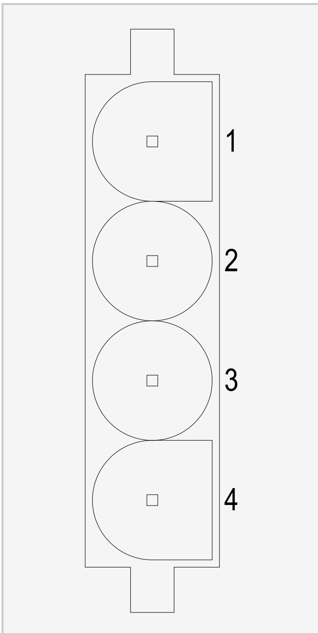
	IN1	IN2	IN3
1	+24V_red	+24V_red	+24V_red
2	input1	input2	input3

The back view and pin allocation of the SD connector is:



	SD
1	+24V_sd
2	input

The back view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	5V-R	5V-1
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

5.8.4.2 Connector function

The below table describes the function of the connectors on the back side of the Controller backplane.

Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Control Processor 1	Com1.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com1.1.B	RJ45	
	Com1.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com1.1.D	10-pin male	
	Com1.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com1.2.B	RJ45	
	Com1.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com1.2.D	10-pin male	
Control Processor 2	Com2.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com2.1.B	RJ45	
	Com2.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com2.1.D	10-pin male	
	Com2.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com2.2.B	RJ45	
	Com2.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com2.2.D	10-pin male	
IO bus 1	IO bus1.1	Flat cable connector	first IO bus of Control Processor 1
	IO bus2.1	Flat cable connector	first IO bus of Control Processor 2
	Term IO	2 × 50-pin	IO bus terminator for the first IO bus(es) Type: TERM-0001 or

Group	Name	Connector type	Used for
	bus1	connector	TERM-0002 for details.
IO bus 2	IO bus1.2	Flat cable connector	second IO bus of Control Processor 1
	IO bus2.2	Flat cable connector	second IO bus of Control Processor 2
	Term IO bus2	2 × 50-pin connector	IO bus terminator for the second IO bus(es) Type: TERM-0001 or TERM-0002 for details.
IO bus 3	IO bus1.3	Flat cable connector	third IO bus of Control Processor 1
	IO bus2.3	Flat cable connector	third IO bus of Control Processor 2
	Term IO bus3	2 × 50-pin connector	IO bus terminator for the third IO bus(es) Type: TERM-0001 or TERM-0002 for details.
IO bus 4	IO bus1.4	Flat cable connector	fourth IO bus of Control Processor 1
	IO bus2.4	Flat cable connector	fourth IO bus of Control Processor 2
	Term IO bus4	2 × 50-pin connector	IO bus terminator for the fourth IO bus(es) Type: TERM-0001 or TERM-0002 for details.
Power	24V-1	2-pin male connector	24V for Control Processor 1 (for cable details see PDC-CP24).
	24V-2	2-pin male connector	24V for Control Processor 2 (for cable details see PDC-CP24).
	5V-1	4-pin male connector	5V and Watchdog of Control Processor 1. This connector is used to distribute these signals to the IO chassis (for more information see chapter 20 - 5 Volt_and_watchdog_distribution).

Group	Name	Connector type	Used for
	5V-2	4-pin male connector	5V and Watchdog of Control Processor 2. This connector is used to distribute these signals to the IO chassis (for more information see chapter 20 - 5 Volt_and_watchdog_distribution).
	5V-R	4-pin male connector	Redundant 5V and redundant Watchdog. This connector is used to distribute these signals to the non-redundant IO chassis (for more information see chapter 20 - 5 Volt_and_watchdog_distribution).
Various	SD	2-pin male connector	Connector for an Emergency Shut Down system. The chassis is delivered with the LINK-SD link placed. This link is required if the Emergency Shut Down function is not used (see also QPP data sheets QPP-0002 and SICP-0002/L3).
	IN1	2-pin male connector	24 Volt non-safety related general purpose input. This input can generate an interrupt (on the rising edge) e.g. for external clock synchronization (see also BKM-0001 and SICP-0002/L3).
	IN2	2-pin male connector	24 Volt non-safety related general purpose input (see also BKM-0001 and SICP-0002/L3).
	IN3	2-pin male connector	24 Volt non-safety related general purpose input (see also BKM-0001 and SICP-0002/L3).

1. Watchdog and 5 Volt of Control Processor 1, Control Processor 2 and the redundant Watchdog and 5 Volt.
2. The chassis numbers mentioned here are defined by jumpers on the IO backplane.

5.8.5 Technical data

General	Type number:	FS-CPCHAS-0003
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	0.05 A
	5V-2:	0.05 A
	5V-R:	0.05 A
Dimensions	Height:	4 HE (177 mm, 7 in)
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	5.8 kg, 12.8 lb

5.9 IOCHAS-0003S

Note: IOCHAS-0003S is a replacement for IOCHAS-0001S.

5.9.1 IO Chassis for non-redundant IO modules (Safety Manager)

The IOCHAS-0003S is a chassis for up to 18 non-redundant IO modules. It consists of the following components:

Components of the IOCHAS-0003S V1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	1	IO Extender module located at slot 21	IO-0001
Blind fronts	2		

Table 2. Components of the IOCHAS-0003S CCV1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	1	IO Extender module located at slot 21	IO-0001
Blind fronts	2		

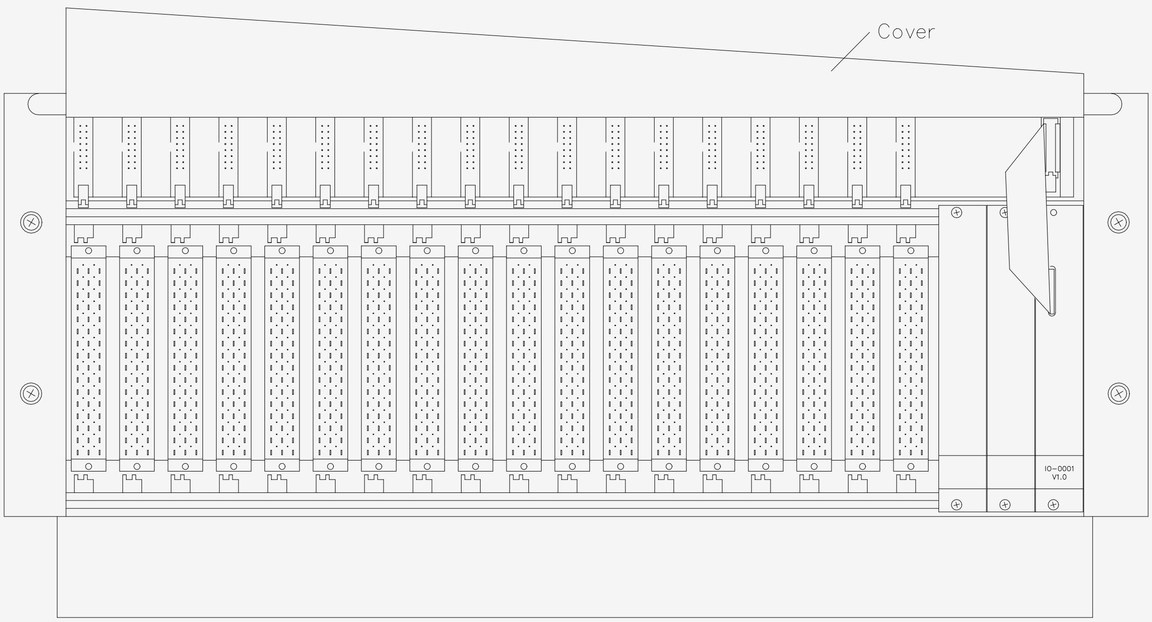


Figure 5-44: Front view of an empty IOCHAS-0003S

The above figure shows the front side of an empty IOCHAS-0003S with the front-cover raised. A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis.

In the IOCHAS-0003S, slots 1 to 18 are available for IO modules.

5.9.2 IO Housing

The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A coverplate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tagnumber assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see the below figure).

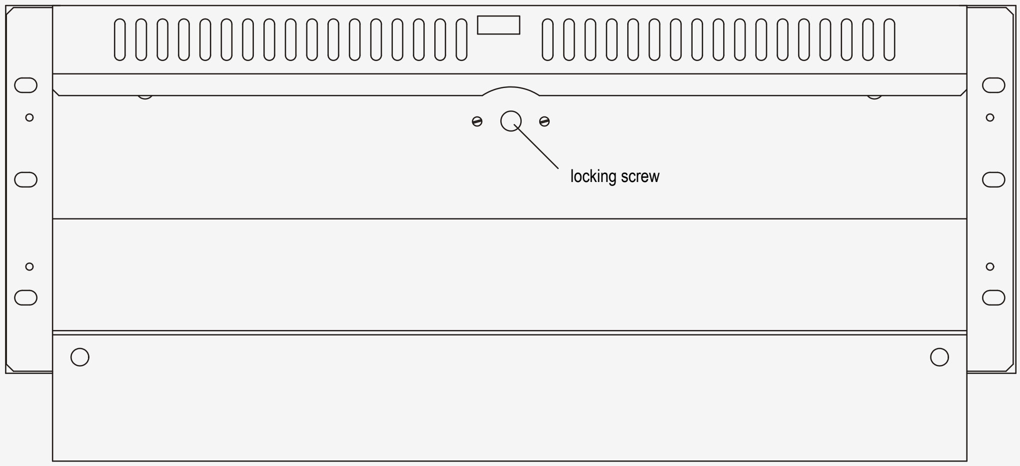


Figure 5-45: Back view of a closed IOCHAS-0003S

Attention:
The IO back cover plate will be completely unattached from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

5.9.3 IO Backplane for non-redundant IO: IOB-0003S

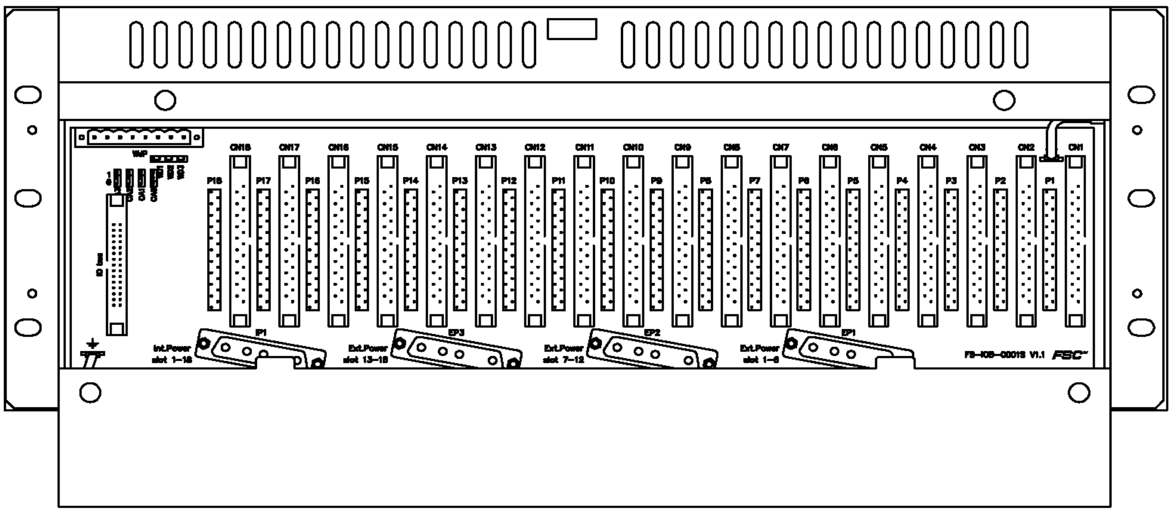


Figure 5-46: Back view of an open IOCHAS-0003S

Connectors on the IOB-0003S

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	Connectors for IO modules, slot 1 to 18	Input modules Output modules
48-pin female chassis connector	1	Connector for IO extender IO-0001, slot 21	IO-0001
Back side			
IO bus	1	Connector for IO bus to Controller chassis.	
CN1 to CN18	18	Connector for system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1 to 18	SICC 0001/LxSICP-0001/Lx
P1 to P18	18	Connector for IO converter modules, slot 1 to 18	Input converter modules Output converter modules
IP1	1	Connector for internal power, slot 1 to 18	Cable: PDC-IOSET, see PDC-IOSET
EP1	1	Connector for external power, slot 1 to 6	Cable: PDC-IOSET, see PDC-IOSET
EP2	1	Connector for external power, slot 7 to 12	Cable: PDC-IOSET, see PDC-IOSET
EP3	1	Connector for external power, slot 13 to 18	Cable: PDC-IOSET, see PDC-IOSET
CA0 to CA3	4	Jumpers for defining the IO chassis address	Address settings

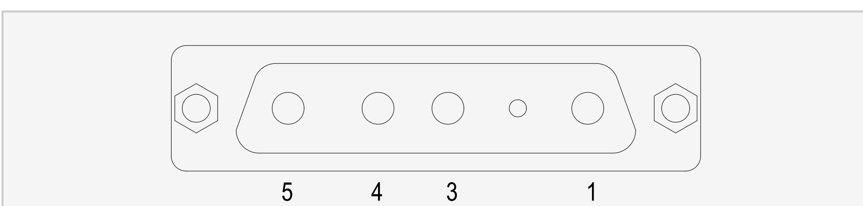
Connector	Amount	Description	See
WdP	1	Connector for watchdog and 5 V power signal, connects to Controller backplane	Refer chassis IO"Back view of an open IOCHAS-0003S" on page 161
			Cable: PDC-IOS05, see PDC-IOS05.
WD1 to WD3[1]	3	Connector to enable external watchdog grouping	See Unit shutdown.

1. On delivery, a triple jumper is placed and no watchdog grouping is used.

   Watchdog grouping can be used for each group (WD1 corresponds to slot 1-6, WD2 to slot 7- 12, WD3 to slot 13-18) by removing the jumper from the WDx connector for that group, and connecting the WDx connector to the watchdog group relais (See Unit shutdown).

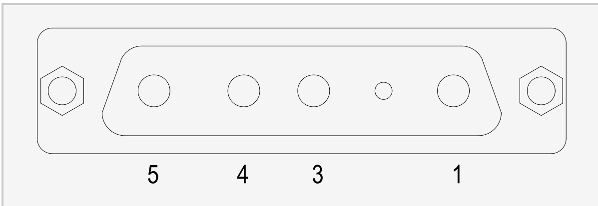
5.9.3.1 Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



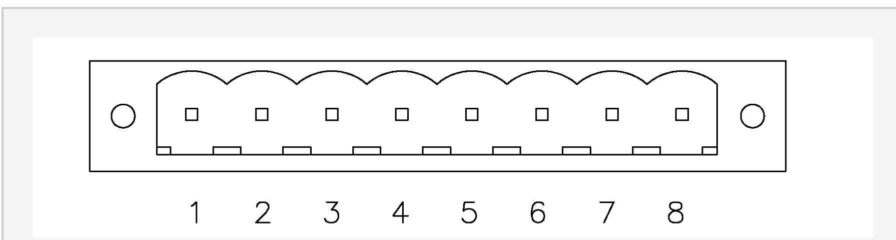
	IP1
1	IP slot 1-9
3	0 V
4	0 V
5	IP slot 10-18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

The back view and pin allocation of the WdP connector is:



	WdP
1	nc
2	nc
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	nc
8	nc

The back view and pin allocation of the WD jumper is:

	WD
1	WDR of CP1 and CP2
2	WD of slot 1, 2, 3, 4, 5 and 6
3	WDR of CP1 and CP2
4	WD of slot 7, 8, 9, 10, 11 and 12
5	WDR of CP1 and CP2
6	WD of slot 13, 14, 15, 16, 17 and 18

The pin allocation of each respective input and output module can be found in the module datasheet.

The below figure shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

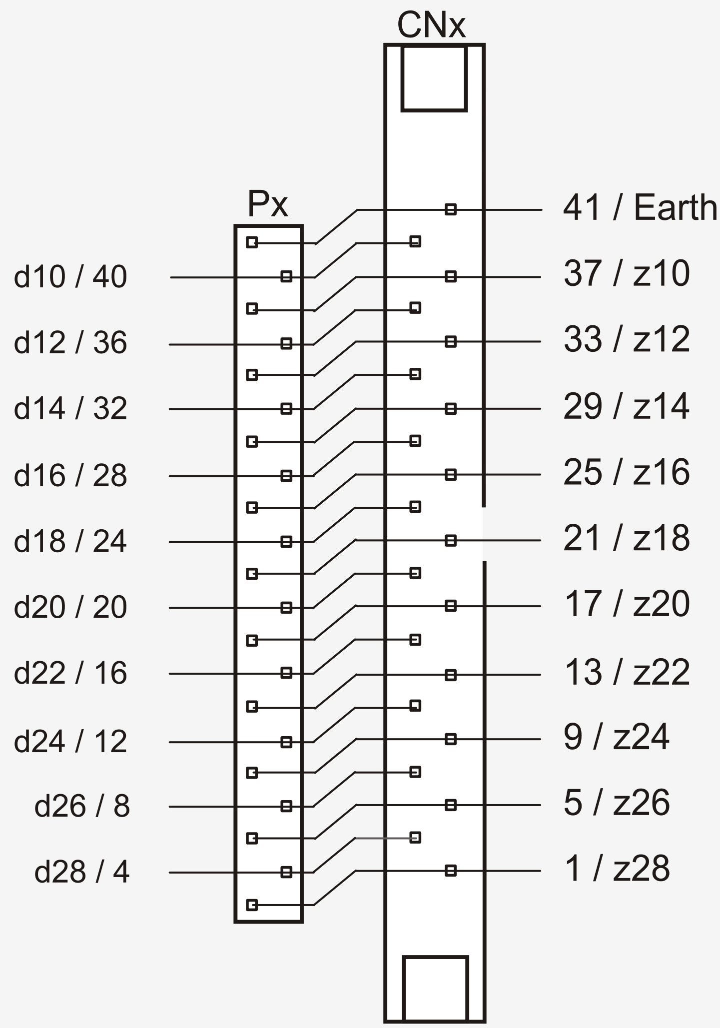


Figure 5-47: Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector

5.9.4 Horizontal IO bus backplane for non-redundant IO

Figure 6-48 shows a front view of a filled IOCHAS-0003S with the cover opened.

Figure 6-49 shows a front view of a filled IOCHAS-0003S with the cover closed.

The below table lists the connectors present on the IOBUS-HBS.

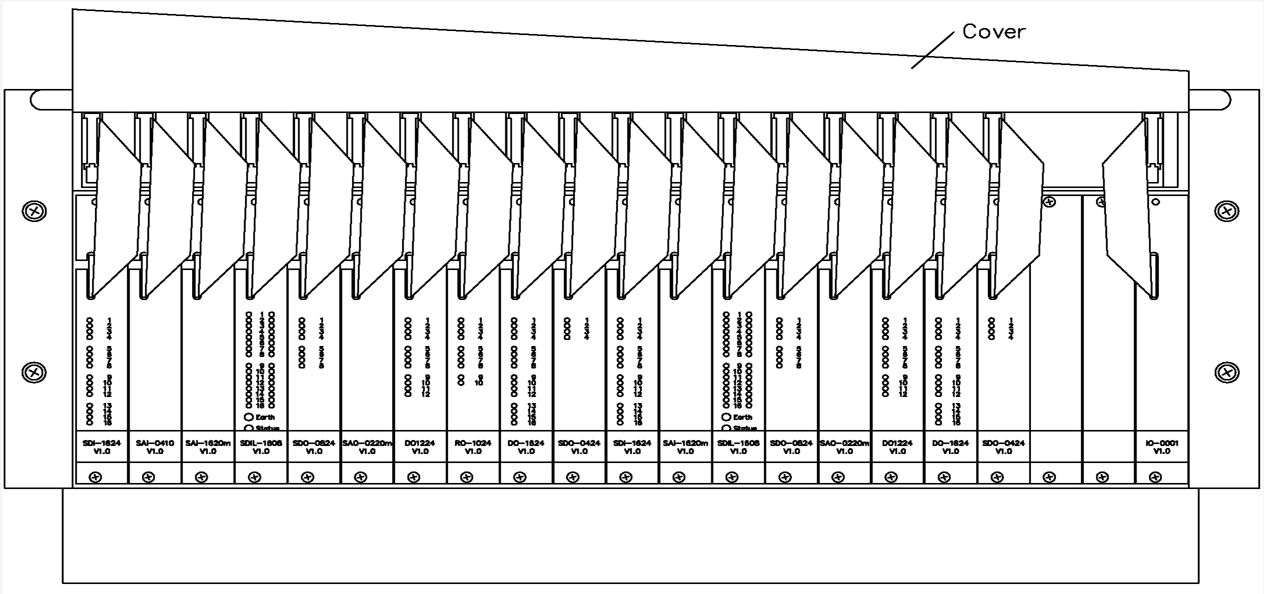


Figure 5-48: Front view of a filled, open IOCHAS-0003S

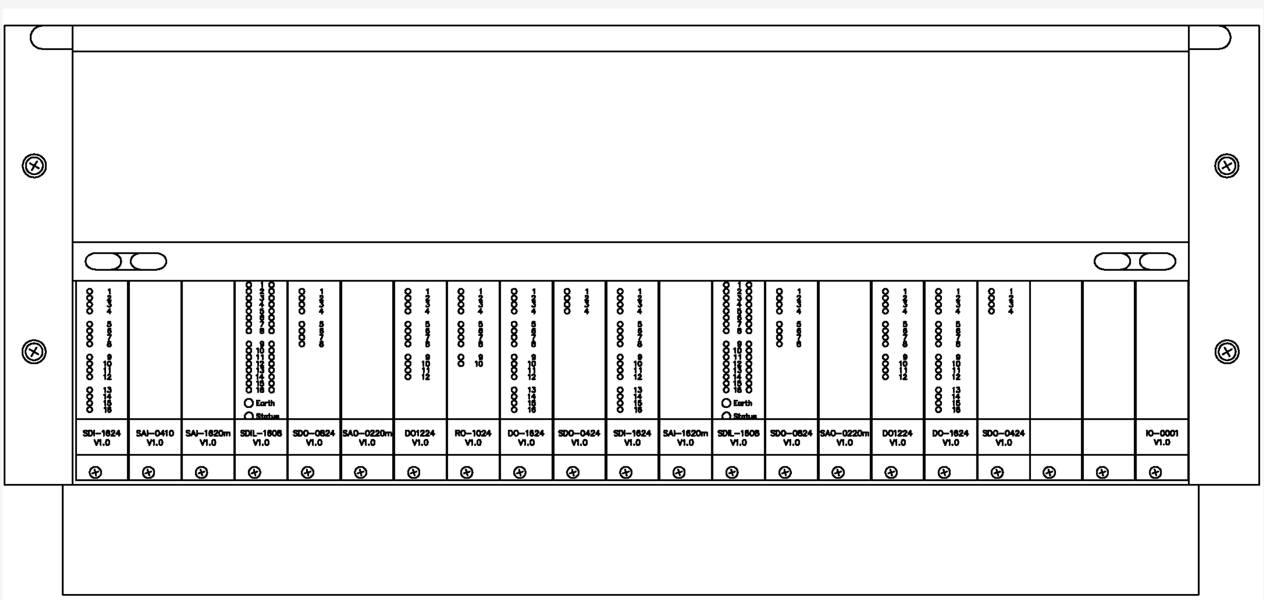


Figure 5-49: Front view of a filled, closed IOCHAS-0003S

Connectors on the Horizontal IO bus backplane

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, located at slot 1 to 18	Input modules Output modules
Flatcable connector	1	Connector for IO extender IO-0001, slot 21	IO-0001
20-pin flatcable assembly	1	Flatcable to the connector on the middle of the IO-0001 module	IO-0001

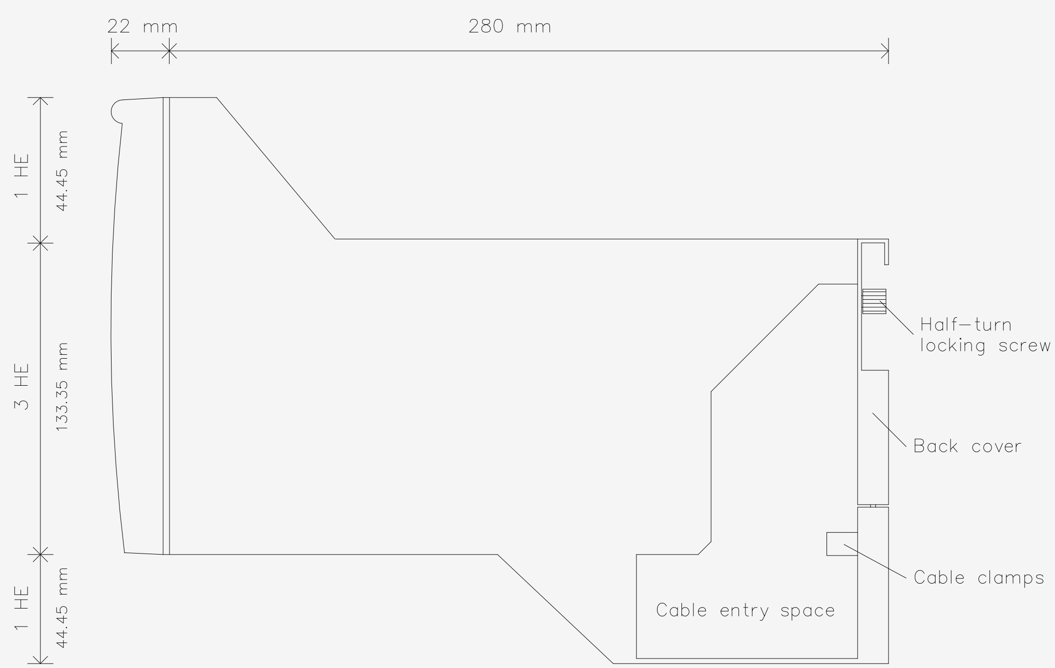


Figure 5-50: Side view of the IOCHAS-0003S

5.9.5 Technical data

General	Type number:	FC-IOCHAS-0003S
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-2:	100 mA (IO-0001 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see the above figure 6-50
		44.5 + 133.4 + 44.5 mm
		1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,7 kg, 19.2 lb

5.10 IOCHAS-0003R

IO chassis for redundant IO modules (Safety Manager)

Note: IOCHAS-0003R is a replacement for IOCHAS-0001R.

5.10.1 Description

The IOCHAS-0003R is a chassis for up to 9 pairs of redundant IO modules.

It consists of the following components:

Components of the IOCHAS-0003R V1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	2	IO Extender modules, slot 20 and 21	IO-0001
Blind front	1		

Components of the IOCHAS-0003R CCV1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	IO Housing
IO-0001	2	IO Extender modules, slot 20 and 21	IO-0001
Blind front	1		

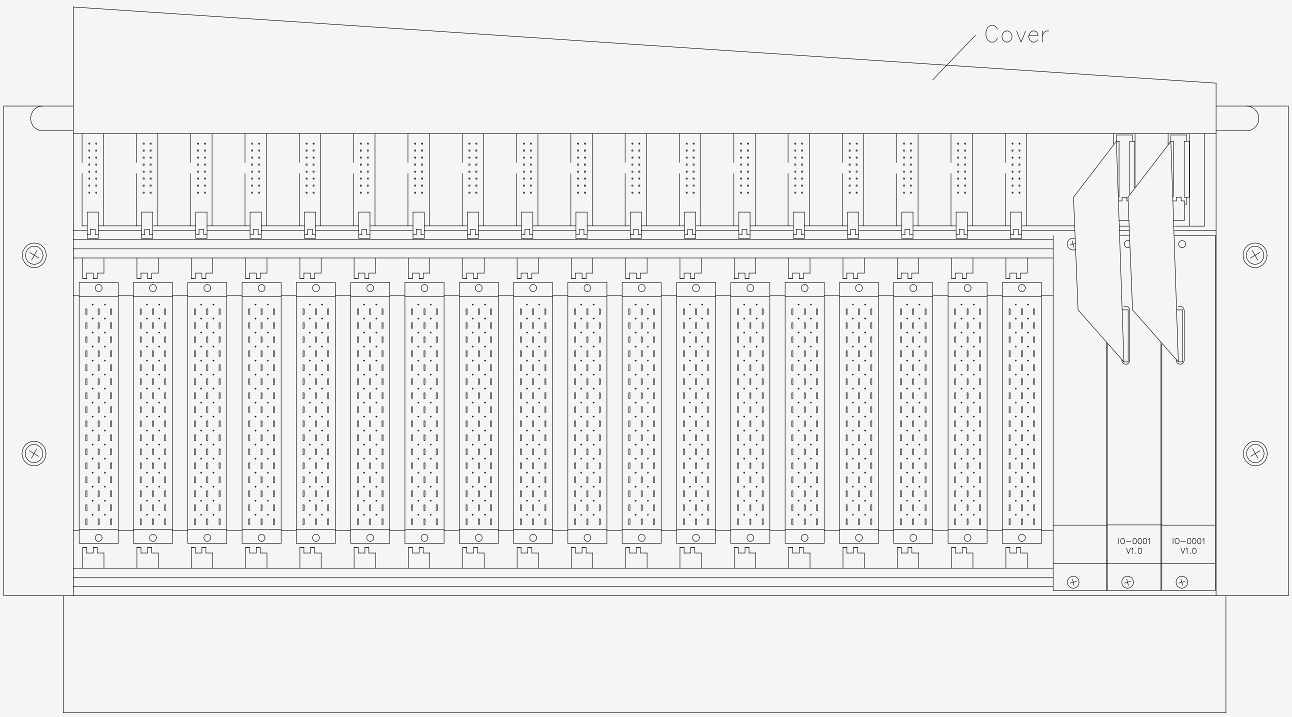


Figure 5-51: Front view of an empty IOCHAS-0003R

The above figure shows the front side of an empty IOCHAS-0003R with the front cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis. In the IOCHAS-0003R, slots 1 to 18 are available for IO modules. They are configured in pairs.

The IO modules in the odd numbered slots (and the IO-0001 in slot 20) are controlled by Control Processor 1.

The IO modules in the even numbered slots (and the IO-0001 in slot 21) are controlled by Control Processor 2.

Slot 19 cannot be used.

Slot 20 and slot 21 contain the IO-0001 modules.

5.10.2 IO Housing

The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A cover plate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tag number assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see the below figure).

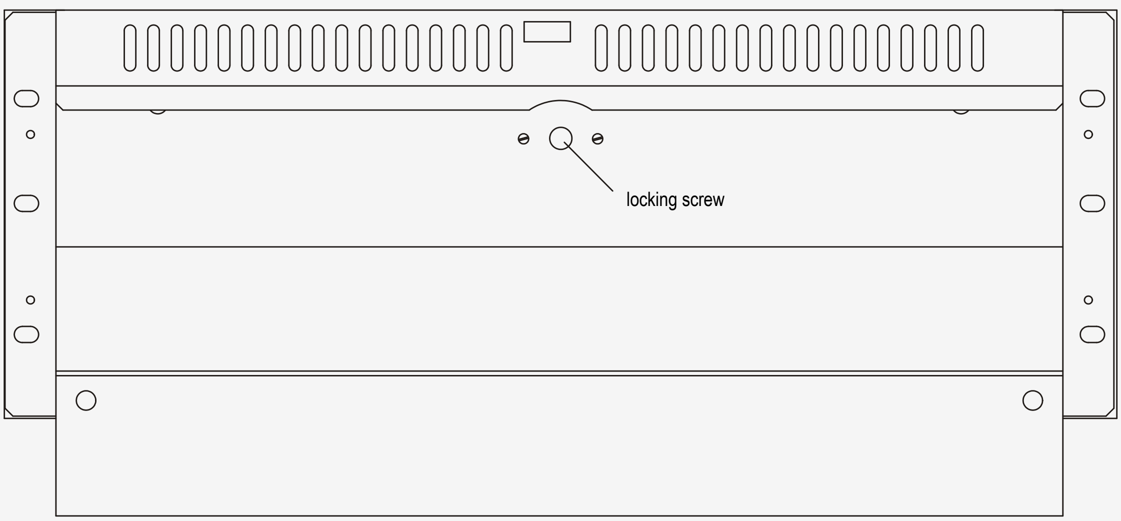


Figure 5-52: Back view of a closed IOCHAS-0003R

Attention:
The IO back cover plate will be completely removed from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

5.10.3 IO Backplane for redundant IO

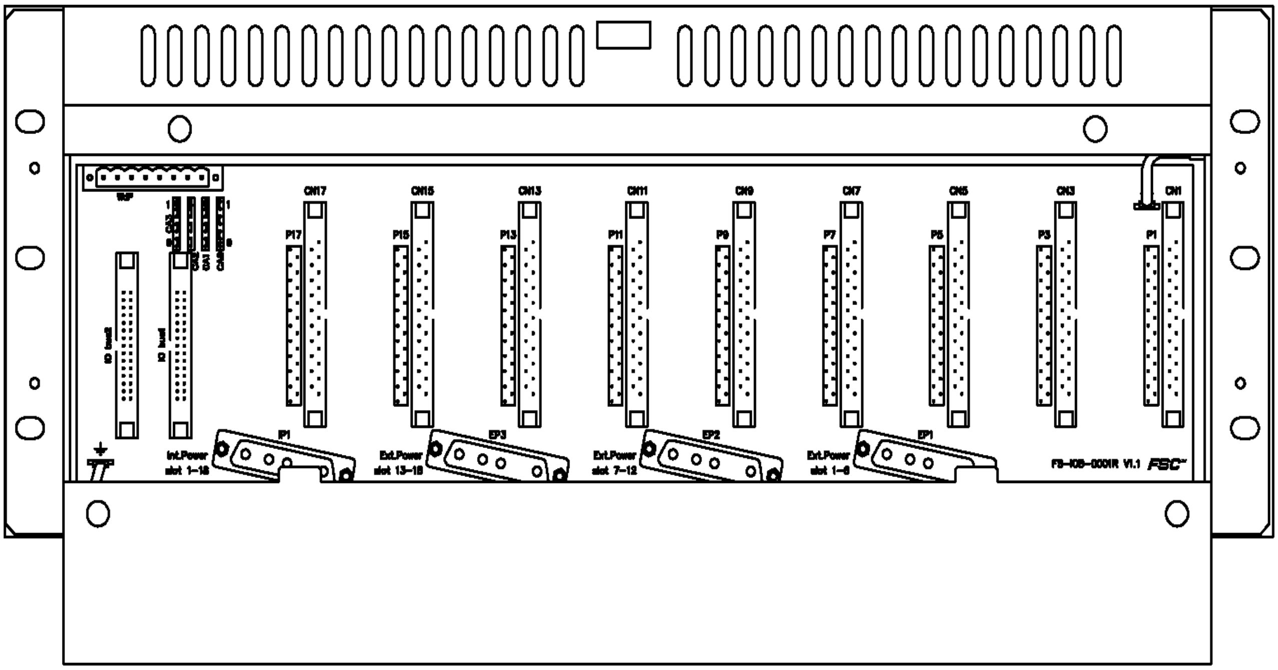


Figure 5-53: back view of an open IOCHAS-0003R

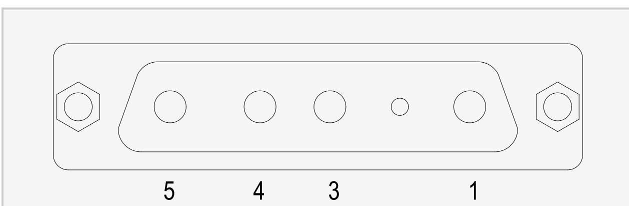
Connectors on the IOB-0003R

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	For IO modules, slot 1 to 18	Input modules Output modules
48-pin female chassis connector	2	For IO extender IO-0001, slot 20 and 21	IO-0001
Back side			
IO bus1	1	Connector for IO bus to Control Processor 1	IOBUS-CPIO
IO bus2	1	Connector for IO bus to Control Processor 2	IOBUS-CPIO
CN1, CN3, CN5, CN7, CN9, CN11, CN13, CN15 and CN17	9	For system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17	SICP-0001/Lx SICP-0001/Lx
P1, P3, P5, P7, P9, P11, P13, P15 and P17	9	For IO converter modules, slot 1, 3, 5, 7, 9, 11, 13, 15, and 17	Input converter modules Output converter modules
IP1	1	For internal power, slot 1 to 18	Cable: PDC-IOSET, see PDC-IOSET
EP1	1	For external power, slot 1 to 6	Cable: PDC-IOSET, see PDC-IOSET
EP2	1	For external power, slot 7 to 12	Cable: PDC-IOSET, see PDC-IOSET
EP3	1	For external power, slot 13 to 18	Cable: PDC-IOSET, see PDC-IOSET
CA0 to CA3	4	Jumpers for defining the IO chassis	Address settings

Connector	Amount	Description	See
		address	
WdP	1	For watchdog and 5 V power signal, connects to Controller backplane	Refer chassis IO"back view of an open IOCHAS-0003R" on page 173
			Cable: PDC-IOR05, see PDC-IOR05.

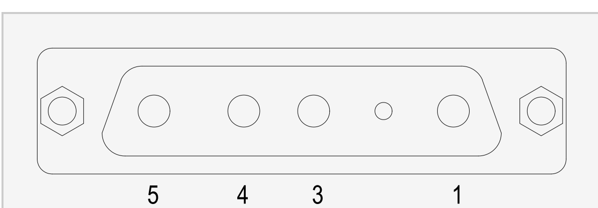
5.10.3.1 Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



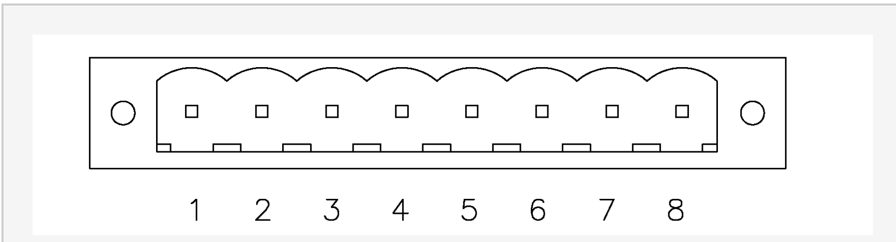
	IP1
1	IP slot 1, 3, 5, 7, 9, 11, 13, 15 and 17
3	0 V
4	0 V
5	IP slot 2, 4, 6, 8, 10, 12, 14, 16 and 18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The back view and pin allocation of the WdP connector is:



	WdP
1	5V of CP2, slot 2, 4, 6, 8, 10, 12, 14, 16, 18 and 21
2	WD of CP2, slot 2, 4, 6, 8, 10, 12, 14, 16 and 18
3	ground
4	nc
5	nc
6	ground
7	5V of CP1, slot 1, 3, 5, 7, 9, 11, 13, 15, 17 and 20
8	WD of CP1, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 6-54 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

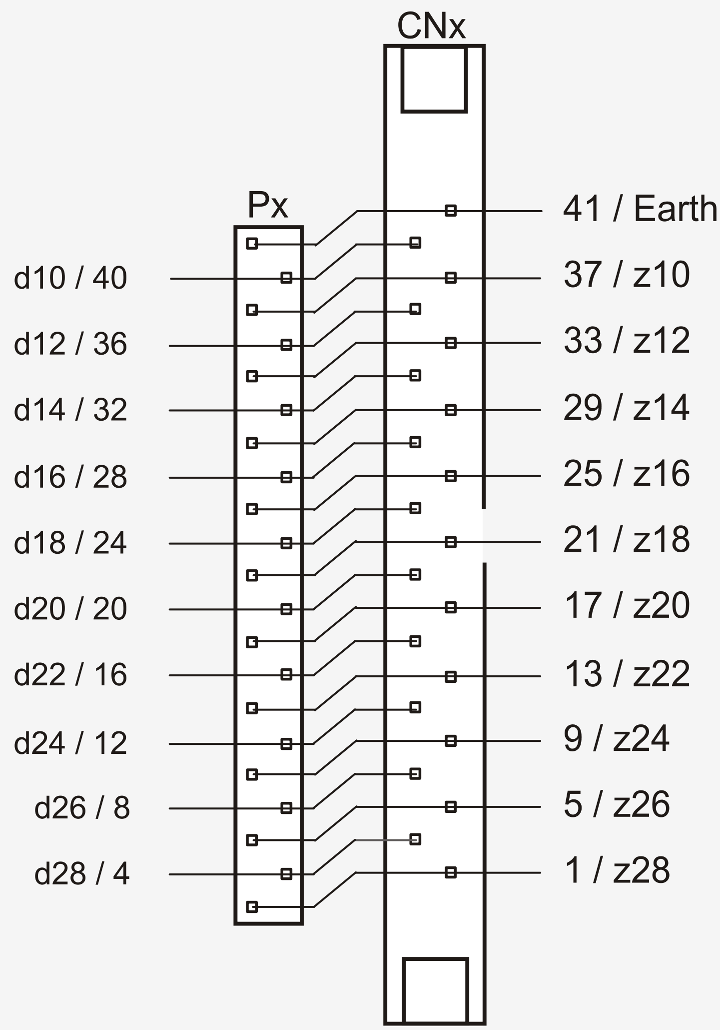


Figure 5-54: Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector

5.10.4 Horizontal IO bus backplane for redundant IO

Figure 6-55 shows a front view of a filled IOCHAS-0003R with the cover opened.

Figure 6-56 shows a front view of a filled IOCHAS-0003R with the cover closed.

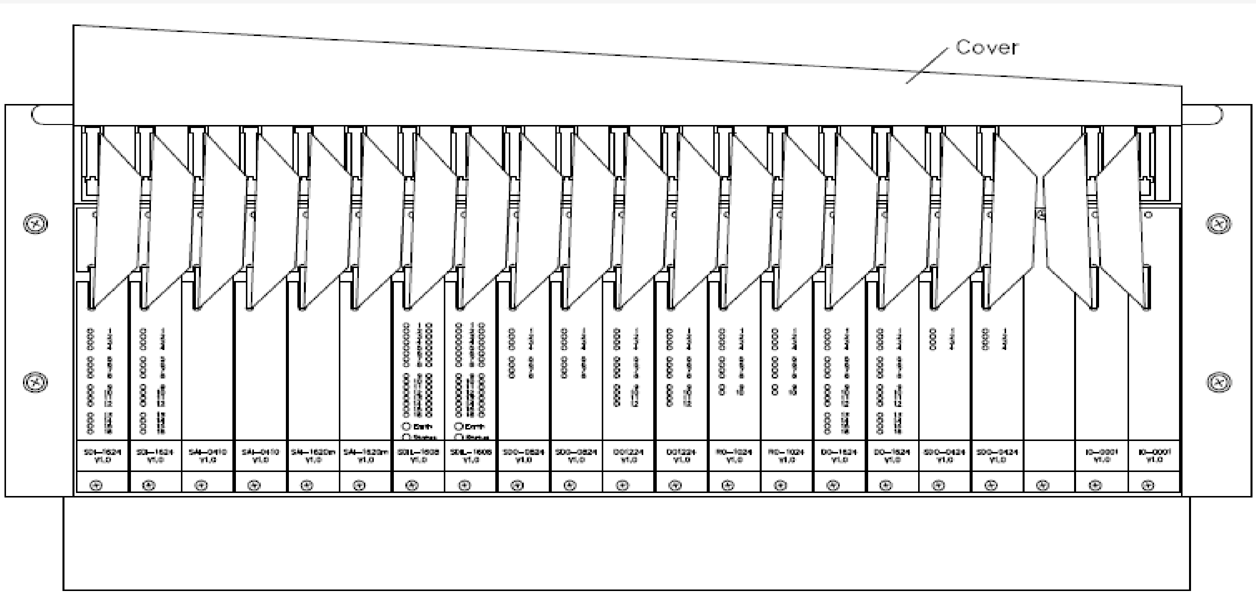


Figure 5-55: Front view of a filled, open IOCHAS-0003R

The below table lists the connectors on the IOBUS-HBR.

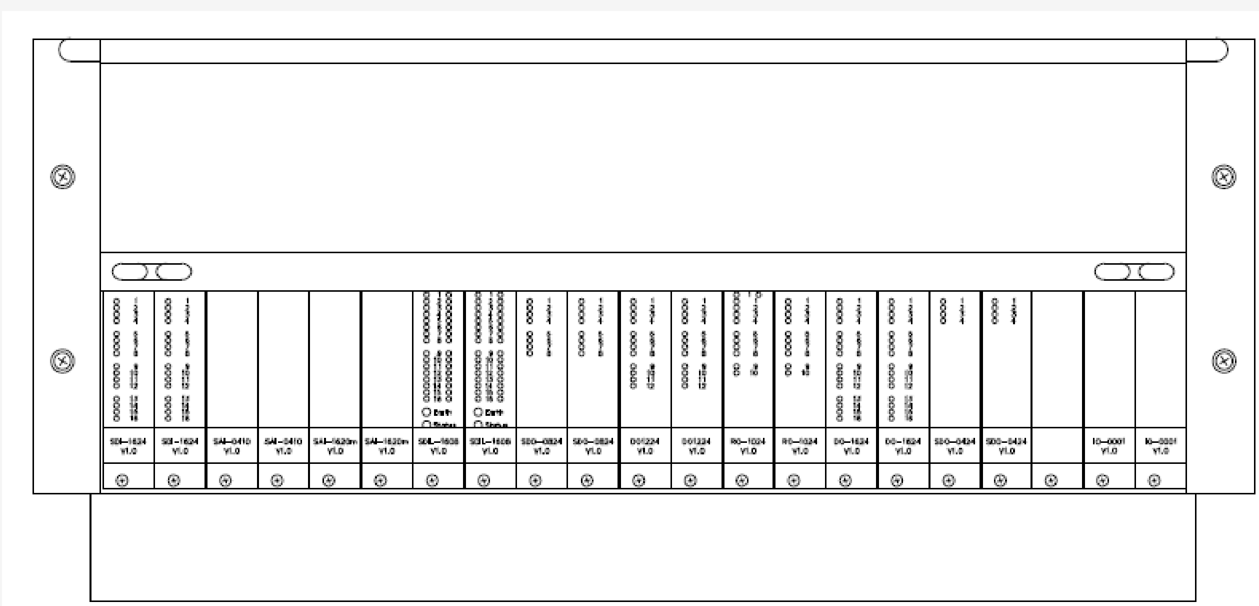


Figure 5-56: Front view of a filled, closed IOCHAS-0003R

Connectors on the Horizontal IO bus backplane

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, slot 1 to 18	Input modules Output modules
Flatcable connector	2	Connector for IO extender IO-0001, slot 20 and 21	IO-0001
10-pin flatcable assembly	2	Flatcables to the connectors on the middle of the IO-0001 modules	IO-0001

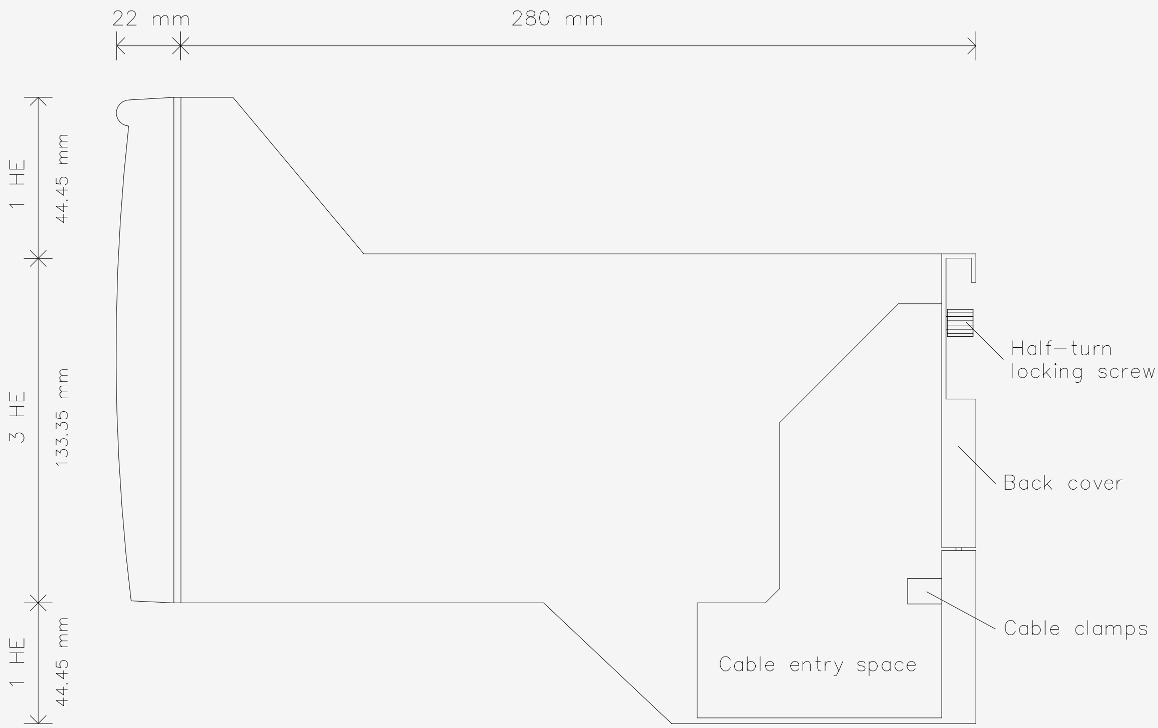


Figure 5-57: Side view of the IOCHAS-0003R

5.10.5 Technical data

General	Type numbers:	FC-IOCHAS-0003R
	Approvals:	CE, UL, CSA, TUV, FM
Power consumption	5V-1:	35 mA (IO-0001 slot 20)
	5V-2:	35 mA (IO-0001 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see "Side view of the IOCHAS-0003R" on the previous page 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,5 kg

CHAPTER 6

POWER SUPPLIES

6 Power supplies

This chapter describes the different types of power supplies and power feeders that can be used with the Safety Manager.

The following power supplies on AC plant power are described:

Power supply	See
PSUNI2424	PSUNI2424
PSU-UNI2450U	PSU-UNI2450U
PSU-UNI4825U	PSU-UNI4825U
PSU-UNI6020U	PSU-UNI6020U
PSU-UNI11011U	PSU-UNI11011U
PSU-UNI12010U	PSU-UNI12010U
RUSPSU-R	RUSPSU-R
RUSPSU-S	RUSPSU-S
PSU-UNI2412	PSU-UNI2412U
PSUTA-0001	PSUTA-0001
QUINT4-PS/1AC/24DC/20	QUINT4-PS/1AC/24DC/20
QUINT4-PS/1AC/24DC/20/+	QUINT4-PS/1AC/24DC/20/+

The following power feeders on DC plant power are described:

Power feeder	See
FDOVP-2450	FDOVP-2450
FEEDER-24R	FEEDER-24R
FEEDER-48R	FEEDER-48R

6.1 General info about power supplies

Power supplies are used to convert different V AC input voltages to a specific V DC output voltage, which is used by Safety Manager.

The below table shows all suitable power supplies and their input and output voltages.

Power supplies and their input and output voltages

Power supply	Input feeder	Output feeder
PSU-UNI2450	110-240 V AC	24 V DC, 50 A
PSU-UNI4825U	110-240 V AC	48 V DC, 25 A
PSU-UNI6020U	110-240 V AC	60 V DC, 20 A
PSU-UNI11011U	110-240 V AC	110 V DC, 11 A

The below table also shows the available power feeders required to process DC plant power. They can be wired identical to the power supplies.

Power feeders and their input and output voltages

Feeder type	Input feeder	Output feeder
FEEDER-24R	24 V DC	24 V DC, 63 A
FEEDER-48R	48 V DC	48 V DC, 63 A

In addition to these, Power Supply Unit PSU-240516 is located in the Controller chassis. It is described in the chapter about Control Processor modules, in section PSU-240516.

6.1.1 Power supply configurations

Note:
For more information and calculation examples see Power concept.

6.1.1.1 Non-redundant power supply units (N configuration)

In this configuration the number of PSUs chosen matches the required power. If the system has a non-redundant Controller there may be no need for redundancy in the PSU configuration.

AC power feeders supply the power for the entire Safety Manager system. To limit the load on the feeder, you are advised to put no more than 2 power supplies on one feeder.

This configuration has the following characteristics:

- The PSU(s) deliver(s) sufficient power for Safety Manager.
- A failure in one of the PSUs may lead to a system stop with undefined results.
- A failure in the mains power leads to a system stop with undefined results.

See "Power Supply Units configurations (2 examples for each configuration)" on the facing page for details.

6.1.1.2 Redundant power supply units (N+1 configuration)

If the system has a redundant Controller, it is recommended to have a PSU configuration that is tolerant to a PSU failure. In the N+1 configuration one extra PSU is placed besides the PSU(s) necessary to deliver the required power.

AC power feeders supply the power for the entire Safety Manager system. To limit the load on the feeder, you are advised to put no more than 2 power supplies on one feeder.

This configuration has the following characteristics:

- The PSUs can supply more power than the Safety Manager system requires.
- System continues normal operation when one PSU fails (single-fault tolerant).
- System continues normal operation upon a failure in the power mains.

See "Power Supply Units configurations (2 examples for each configuration)" on the facing page for details.

6.1.1.3 Fully redundant power supply units (Nx2 configuration)

If the system has a redundant Controller, it is recommended to have a PSU configuration that is tolerant of a PSU or mains failure. In the Nx2 configuration the required PSU capacity is doubled. The the second part is connected to an independent power feeder system.

AC power feeders supply the power for the entire Safety Manager system. To limit the load on the feeder, you are advised to put no more than 2 power supplies on one feeder.

This configuration has the following characteristics:

- The PSUs can deliver twice the power required by the Safety Manager system.
- System continues normal operation when one PSU fails (single-fault tolerant).
- System continues normal operation upon a failure in the power mains.

See "Power Supply Units configurations (2 examples for each configuration)" below for details.

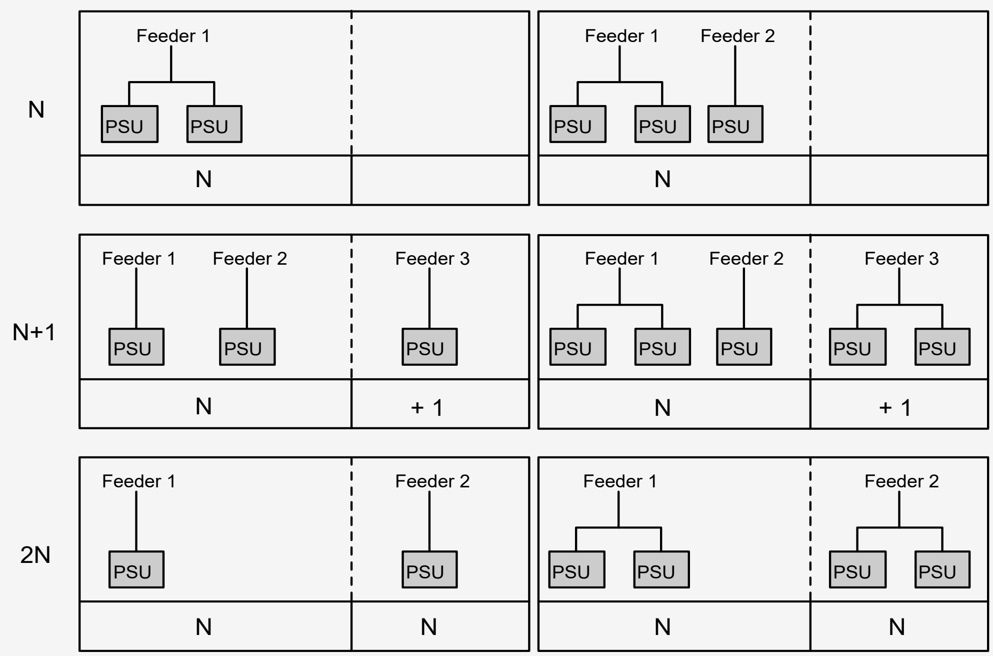


Figure 6-1: Power Supply Units configurations (2 examples for each configuration)

6.1.2 Power feeder configurations

If a customer provides DC power feeder(s) for the Safety Manager system, power supply units (PSUs) may not have to be installed. However the Honeywell SMS Feeder Unit 24V or Feeder Unit 48V is installed.

If a customer provides one DC power feeder cable for the entire Safety Manager system, a single failure in the mains power leads to a system stop with undefined results.

Redundant DC power feeders are normally supplied with the Safety Manager system. In this case, de coupling diodes have to be used.

The Honeywell SMS Feeder Units already contain de coupling diodes.

6.2 PSUNI2424

The PSUNI2424 power supply is CE and UL approved for connection to industrial installations for use in process and safety controllers.

The power supply is a switched-mode AC to DC power supply with a high efficiency (87% with 230VAC input and 24A output) and supports a wide input voltage range between 100VAC and 240VAC. The output is SELV certified according the EN60950 standard.

The power supplies is certified for use in SIL3 applications where the output voltage needs to be guaranteed below 31VDC. This is done by using a dual independent over voltage protection supporting the IEC 61508 architectural constrains. In combination with an increase immunity for external EM-disturbances.

The power supplies can be connected in parallel up to eight power supplies to support higher output currents. The alarm outputs can be daisy-chained.

6.2.1 Main Features

Main features:

- Dual built-in over-voltage protection, supporting SIL3 applications (IEC 61508).
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- DC under-voltage alarm (<23.5V).
- AC under-voltage alarm (<80V).
- The power supplies can be connected in parallel up to eight power supplies to support higher output currents.
- Wide temperature range: -40°C to 70°C.
- Optimum protection against continuous overload and short-circuiting.
- >50ms holdup time.
- FAN alarm.
- Reduced FAN speed to reduce wear out in typical applications.
- Increased EMC immunity to support alarm systems (EN50130-4).
- 50A/200ms peak current for clearing fuses.
- Inrush current limited (<60A); Supports 10A type C circuit breakers.

The LEDs on the front panel indicate the following status:

"AC In" (Green LED)	on	AC input is within the specified range
	off	AC input is lost (for any reason)
"Status" (Green LED)	on	Power supply output is within specified voltage, temperature and current limits
	off	a. If DC output voltage is out of spec (on anode side of isolating ORing diode) b. If a greater current than specified is being pulled from the power supply and/or c. If the power supply has reached temperatures above specified limits d. OVP has activated or e. If AC input is under voltage
	flashing	One or both of the fans failed

6.2.2 Hardware control features

The PSUNI2424 power supply has the following hardware control features:

- Power switch
- An alarm contact

Each of these features is discussed in more detail below.

6.2.2.1 Power switch

It allows you to switch off the PSUNI2424 operation before you disconnect it.

Attention:
Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

6.2.2.2 Alarm contact

The PSUNI2424 has an alarm contact used for monitoring the module health status.

The "Alarm contact state with output voltage above 23.5 V DC " below shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 23.5 V DC.

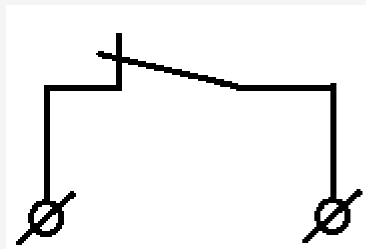


Figure 6-2: Alarm contact state with output voltage above 23.5 V DC

6.2.3 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see "Vertical mounting of the PSUNI2424 power supply" on the facing page).

Note:
Vertical mounting is preferred for optimal cooling.

The absolute minimum spacing between two blade mounted units is 12.5 mm (0.5 in).

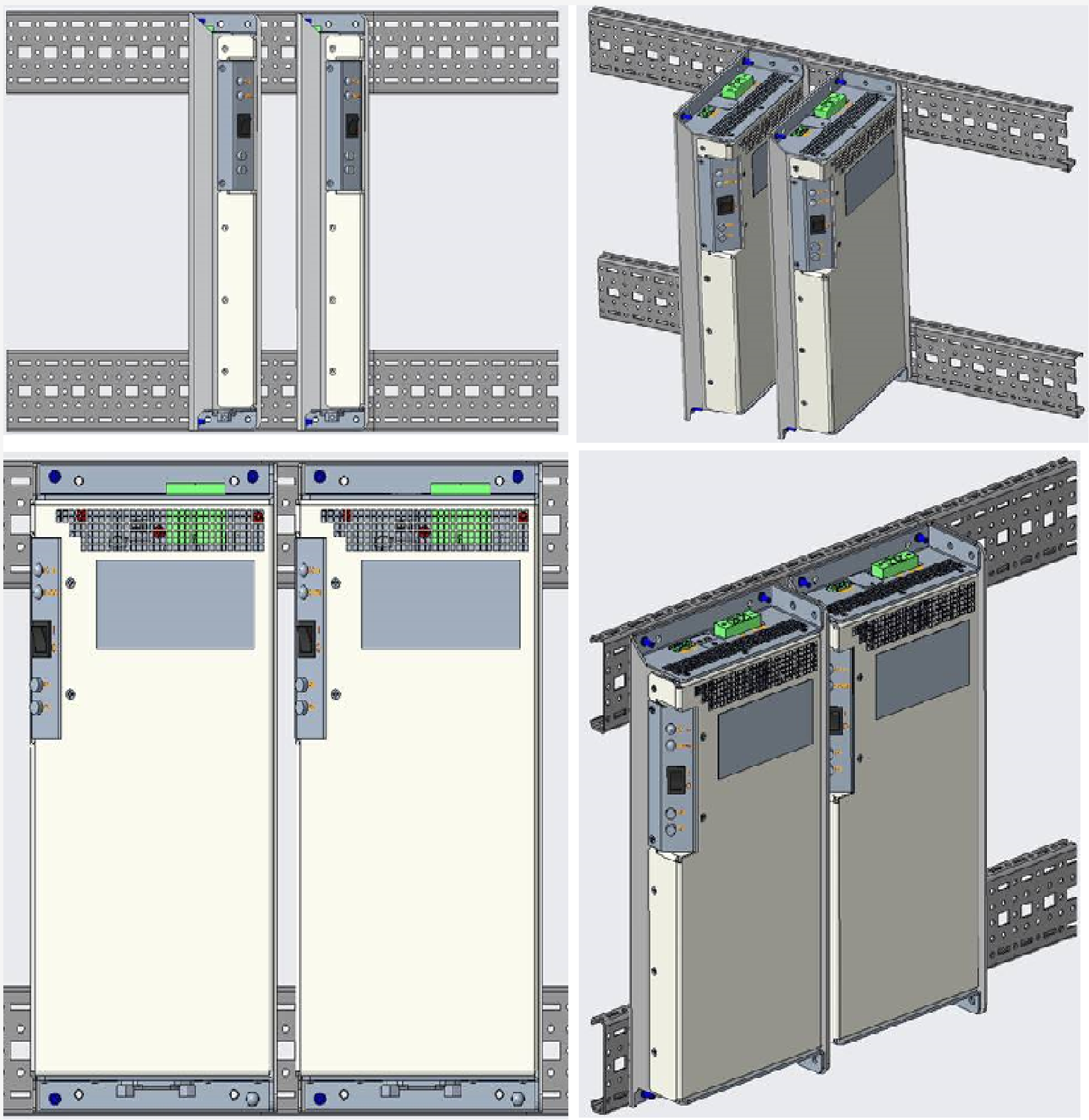


Figure 6-3: Vertical mounting of the PSUNI2424 power supply

6.2.3.1 Mounting holes

The below figure depicts the mounting details of PSUNI2424 power supply.

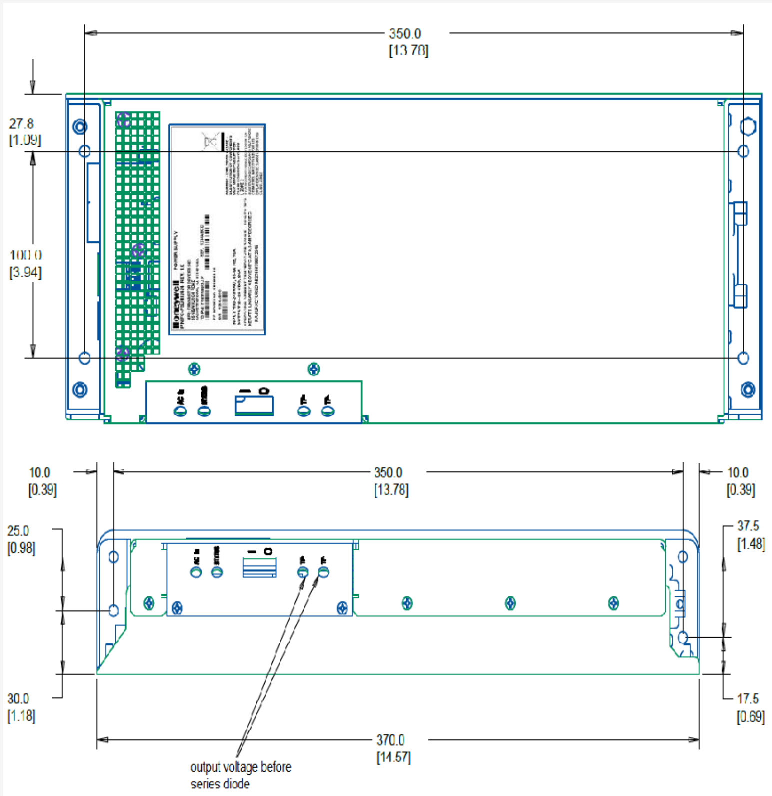


Figure 6-4: Mounting holes of the PSUNI2424 power supply

Note:
The dimensions are in mm / [inch].

6.2.3.2 AC Input

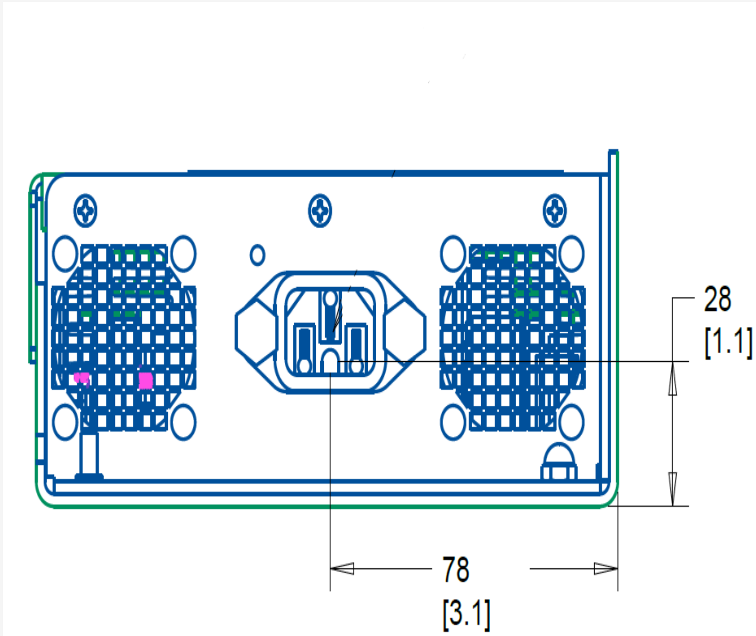


Figure 6-5: AC Input

Note:
The dimensions are in mm / [inch].

6.2.3.3 DC and alarm output

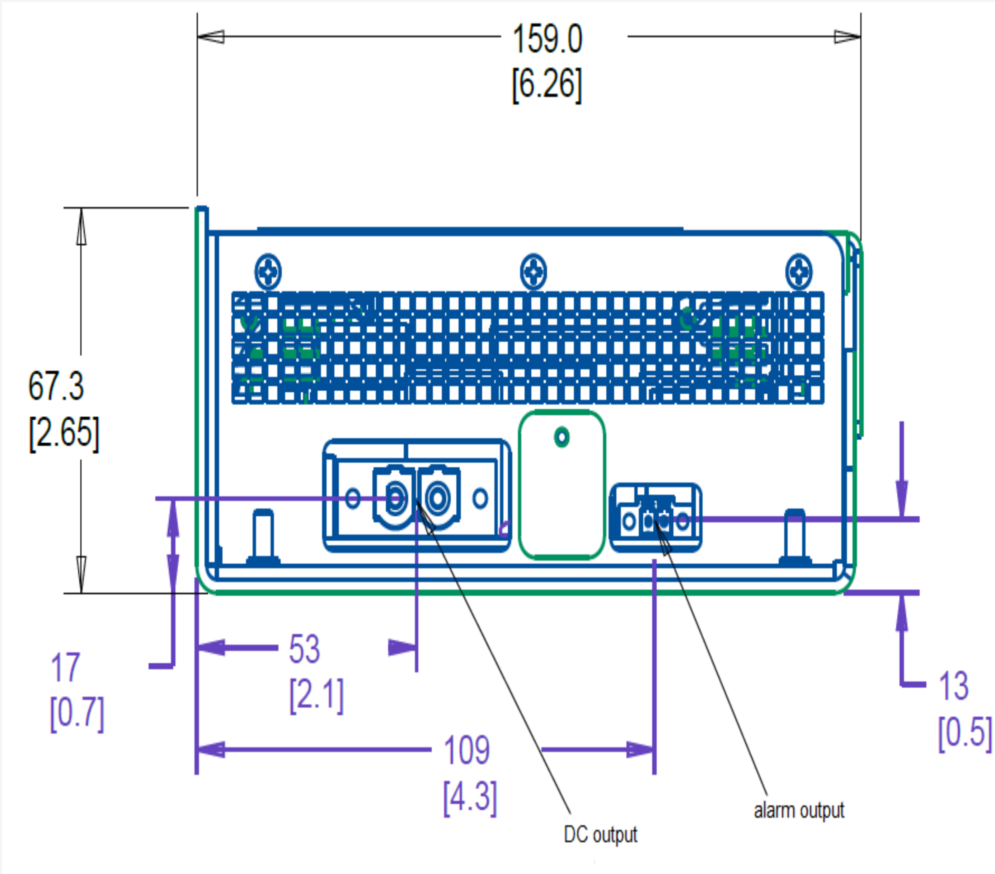


Figure 6-6: DC and alarm output

Note:
The dimensions are in mm / [inch].

6.2.3.4 Controller power supply configuration

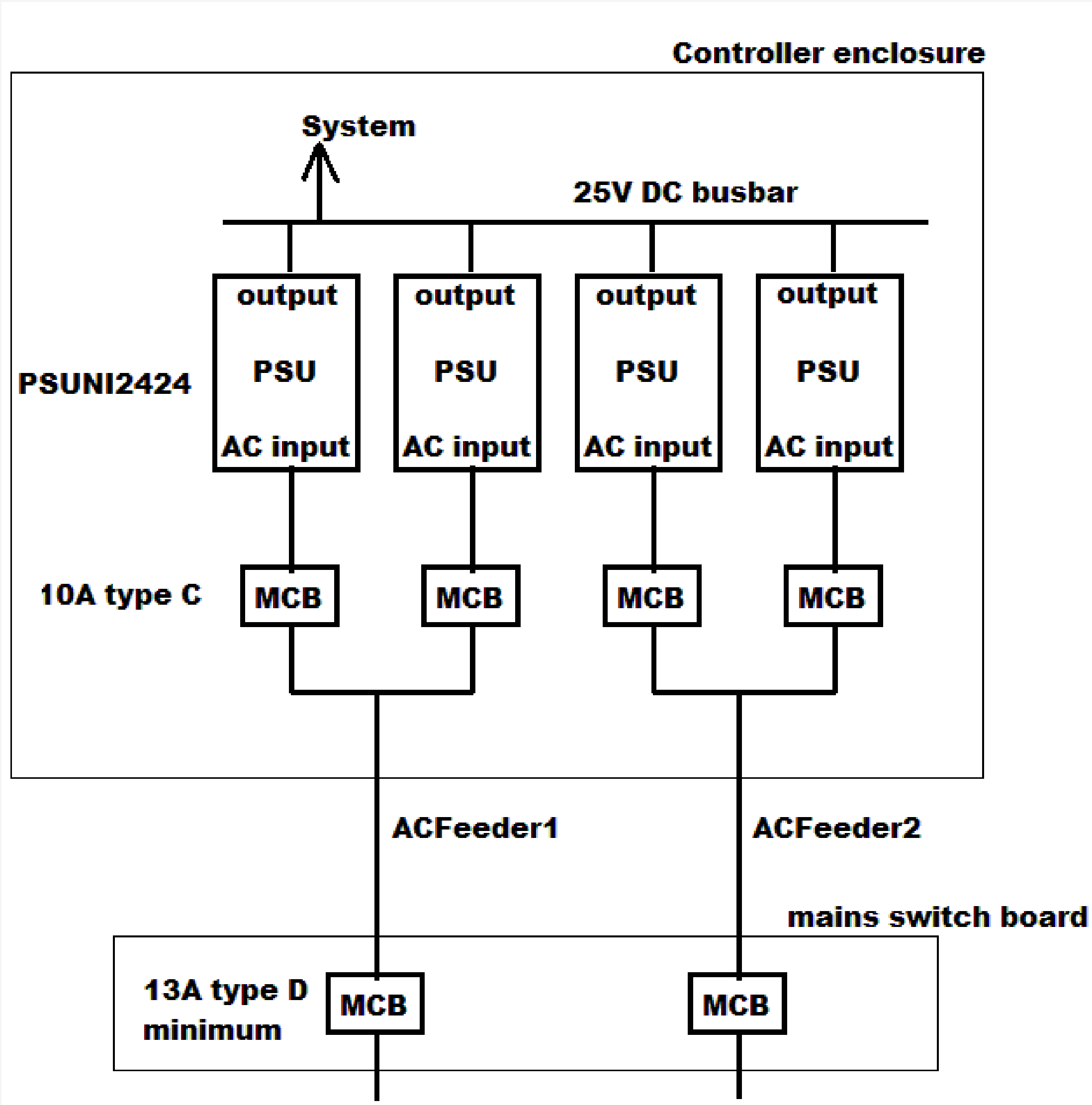


Figure 6-7: Controller power supply configuration

The mains switch board mini circuit breaker or fuse needs to support 120 A inrush current. It is supported with 13 A type D circuit breaker or higher.

6.2.3.5 Output derating curves

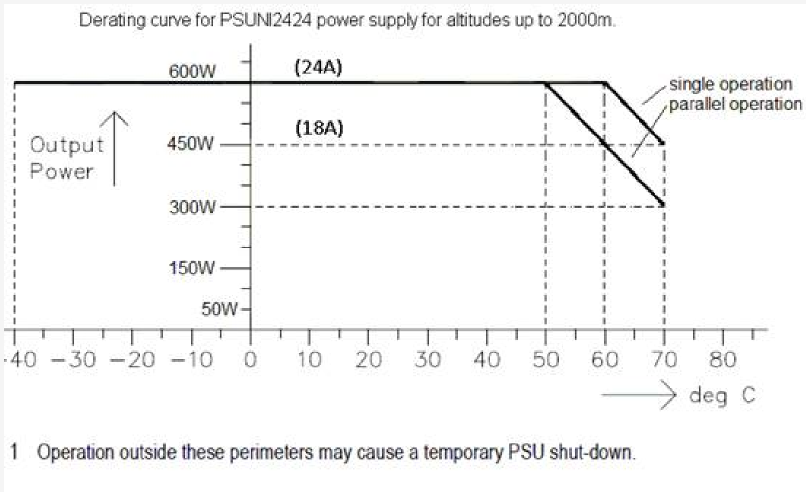


Figure 6-8: Output derating curve

Output derating should start 10°C earlier when DC outputs are connected in parallel to support higher currents.

6.2.4 Electrical connection

1. AC Mating Connector: PX0597, BULGIN C15 IEC
   AC Mating Cable: 80042 EcoFlex, 3x 16AWG
2. DC Mating Connector: 1967456 PC 16/2-stf-10,16, Phoenix, Contact
   DC Mating Cable: HV8-55-0 AND HV8-55-2, PowerFlex 1000, 8AWG
3. Alarm Mating Connector: 1827703 MC 1,5/2-STF-3,81
   20-24AWG Alarm wire
4. Each power supply unit AC input requires to have in series an external 10A circuit breaker type C or 10A class CC fuse.

Note:
The AC cable (2m in length - open end) and DC cable (1.8m in length with METHOD D-TAB-200-JCK-8-S DC bus bar connector) and alarm mating connector are included in the shipment box when

ordering the PSUNI2424 module.

6.2.5 Technical Data

The PSUNI2424 power supply unit has the following specifications:

General	Type number:	FC-PSUNI2424
	Approvals:	CE; cUL (60950). CID2 T4 and Zone2 (+61010-1) certifications are pending for the PSUNI2424. DC output is SELV certified. The OVP is SIL3 certified keeping DC output voltages below 31V (according IEC 61508). EMC standards: EN61131-2, EN50130-4 and EN61000-6-7.
Power	Output power:	600W
	Input power:	115VAC: 712W; 230VAC: 691W typical 85VAC: 750W; 220VAC: 720W maximum
	Power efficiency:	100VAC: 80% @ 6A and 84.5% @ 12-24A 230VAC: ; 82% @ 6A and 87% @ 12-24A
	Power factor:	100VAC: >0.99@6-24A 230VAC: >0.88 @ 6A and 0.98 @ 24A
	Input frequency range:	45-66Hz
Physical	Dimensions:	370 x 159 x 67.3mm (W × H × D)
	Weight:	2.9kg
Environment	Storage temperature:	-40°C to 85°C Keep below 40°C for long term storage.

	Operating temperature:	-40°C to 70°C
	Maximum temperature change:	3°C/minute
	Humidity:	5% to 95% RH non-condensing. Derating RH above 40°C
	Pollution degree:	PD2 maximum(IEC60664-1)
	Altitude:	0-2000m above sea level
Input	Input voltage:	100-120 / 220-240VAC nominal (Operational between 85 – 265VAC)
	Inrush and re-rush current:	<60A; supports using 10A type C circuit breaker EMI filter with 2uF between the input lines
	Input current:	• 115VAC: 6.2A • 230VAC: 3.1A At rated DC output load
	Internal fusing:	10A fuse for each AC leg line
	External Protection[1]:	Fuse: 10A class CC or MCB: 10-13A type C(EN60898-1)
	Installations	Industrial installations only. OVC II up to 2000m
Output	Output voltage:	25.7V no load and 25.1V with 24A static load;

		24.5-26.5V with 24A dynamic load.
	Ripple	20-40mV typical (HART compliant)
	Noise:	<100mV LL and <700mV LE
	Output current:	0-24A continuously; 50A for 200ms typical for clearing fuses
	Load sharing:	< 10% difference at full load
	Electronic current limiter:	34A typical (27A-42A) after 200ms
	Derating output current:	Single operation: 24A with -0.6A/°C above 60°C up to 2000m altitude Parallel operation: 24A with -0.6A/°C above 50°C upto 2000m altitude
	Hold-up time:	50ms; Rest EN61000-4-11 level 3
Alarm output	Type:	Solid-state output (Opto-FET) isolated up to 500VAC
		Activated when power supply status is okay (FAN speed okay and output voltage >23.5V)
	Nominal voltage:	31V maximum (33V TVS protected inside)
	Nominal Current:	40mA maximum non inductive
	Voltage drop:	<0.2V at 7mA
	Short circuit protection:	Yes (Trips within 1second at 0.5A – self restoring)
FAN speed:	0% below -10°C and	

	50% above -10°C and 100% above 80-85°C heatsink temperature	
Isolation	Input to output:	3750VAC/1min (8mm creepage)
	Input to case:	2210VAC/1min; Transient limited by 3000V spark gap and 300VAC varistor in series; 100% tested at 2300VDC
	Output to case:	1500VDC/1min; Transient limited by 320VAC varistor; <50M Ohm at 250VDC

Note:

1. One double pole external circuit breaker per power supply unit is mandatory, for electrical safety reasons.

6.3 PSU-UNI2450U

6.3.1 25—28 V DC Power supply (1200 W) – UL508 approved

The PSU-UNI2450U power supply is a UL approved switched-mode DC power supply with a high efficiency (>85% at 187 V AC and >80% at 93, 5 V AC). It accepts a wide range of input voltages to provide 25 V DC and 48 A output or 28 V DC and 43 A output.

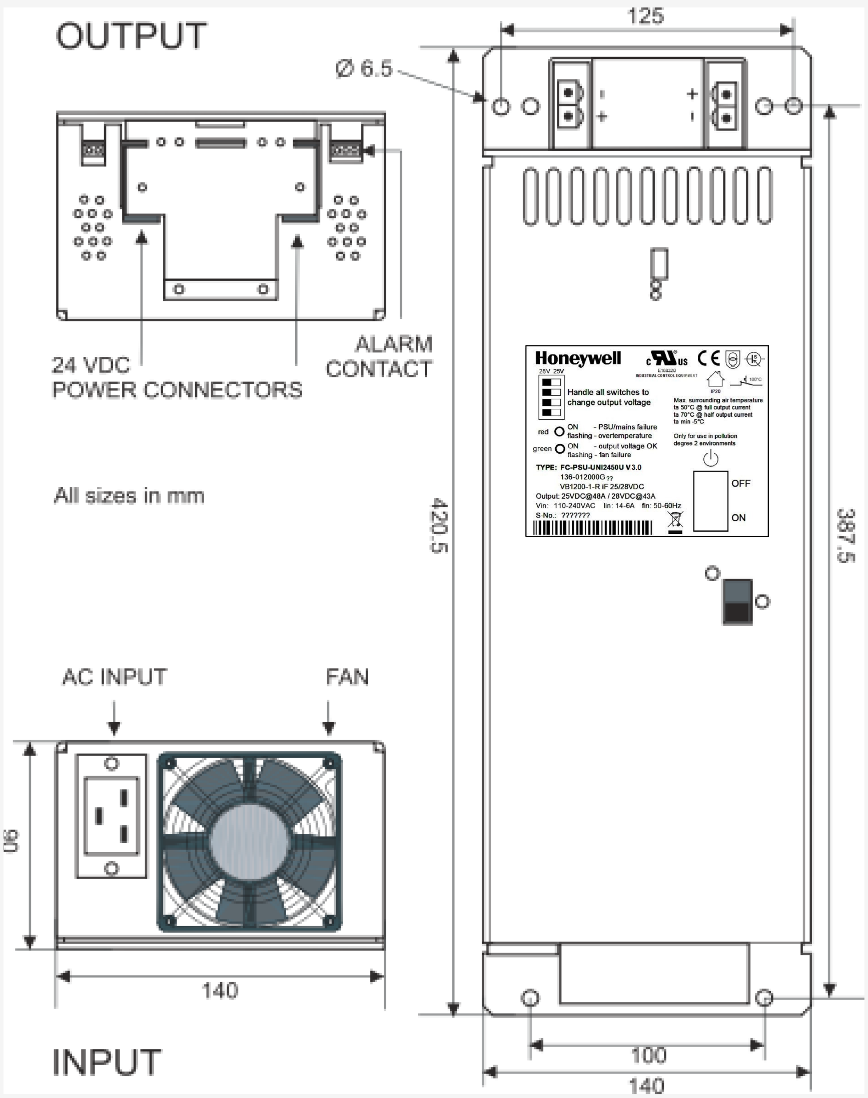


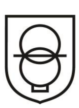
Figure 6-9: Top, bottom and front view of the PSU-UNI2450U power supply

6.3.2 Main features

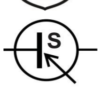
The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the IEC 61508 standard.
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- Under-voltage alarm (<22 V).
- An output diode for parallel operation.
- For FC-PSU-UNI2450U, temperature range: -5°C to 70°C.
- For FA-PSU-UNI2450U, Wide temperature range: -40°C to 70°C.
- Optimum protection against continuous overload and short-circuiting.
- 100ms holdup time.
- FAN alarm.
- For FA-PSU-UNI2450U Hazloc Certified (IECEx. ATEX. CID2).
- UL 508 approved (file no. E168320) and also EN 61558-2-16 compliant.
- The FA-Version is additionally ATEX, IECEx, and CSA approved for explosive atmospheres zone 2.

Explanation of symbols:

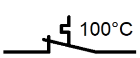


Safety isolating transformer, short-circuit proof.



Switch mode power supply unit.

For indoor use only, protection class IP20.



Contains 100°C temperature switch with automatic switch-on after cooling down.

The LEDs on the front panel indicate the following status:

Green LED	On	PSU in operation; output OK
	Off	PSU swithed off
	Fflashing	Fan does not reach required speed
Red LED	On	PSU/MAINS failure, or in stand-by mode
	Off	No failure
	Flashing	Temperature too high

Attention:
The LEDs of the PSUs are the only indicators that determine the health/functioning of the PSU. Therefore, it is recommended to visually check LEDs of the PSUs during regular inspection.

Attention:
The unit (FA and FC variant) contain temperature switches (minimum switch OFF temperature is 100°C). After reaching the lowest temperature of the hysteresis the unit will switch ON automatically.

Caution:
The unit (FA and FC variant) is conditionally short-circuit proof, not permanent short-circuit proof.

6.3.3 Hardware control features

The PSU-UNI2450U power supply has the following hardware control features:

- Power switch
- An output adjustment selector switch (25 V DC or 28 V DC)
- An alarm contact

6.3.3.1 Power switch

Attention:
Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI2450U before you disconnect it.

With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

6.3.3.2 Output adjustment selector switch

Attention:
Only change the dip-switch settings when the power supply has been switched off.

To adjust the output to 28 V DC (e.g. for UPS applications), *all four* dip-switches in the PSU front need to be set in their left position, as shown in the below figure.

Default factory setting of the dip-switch is 25 V DC.

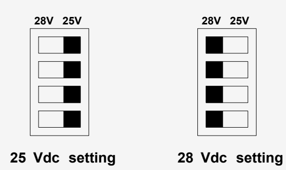


Figure 6-10: Dip-switch setting to set output voltage

6.3.3.3 Alarm contact

The PSU-UNI2450U has an alarm contact used for voltage monitoring.

The below figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 22Vdc, and fan reached required speed.

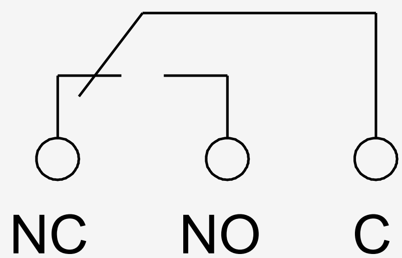


Figure 6-11: Alarm contact state with output voltage above 22 V DC

6.3.4 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see the below figure).

Note:
Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

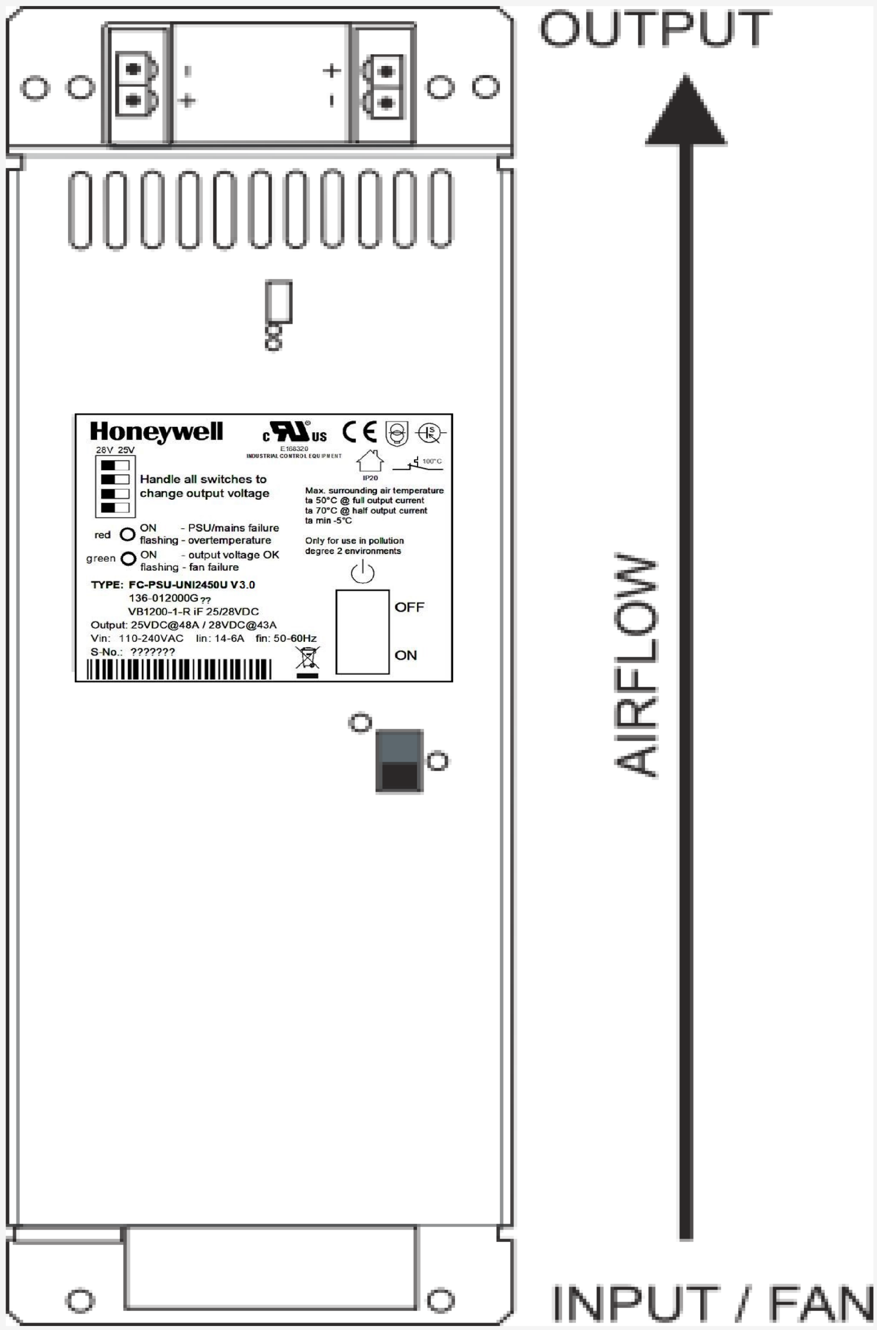


Figure 6-12: Vertical mounting of the PSU-UNI2450U power supply

The below figure shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

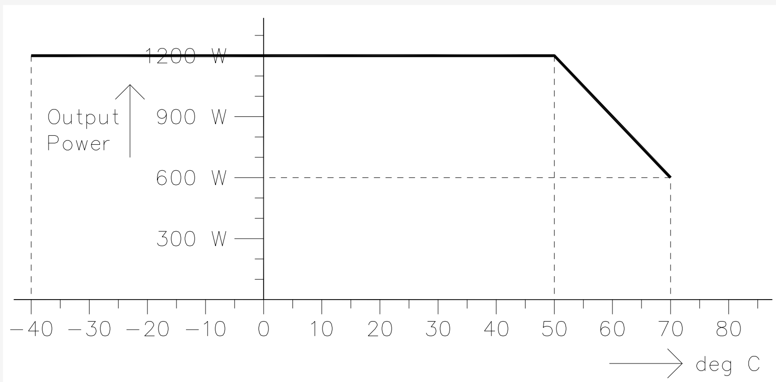


Figure 6-13: Derating curve[1] for the PSU-UNI2450U power supply.

1. Operation outside these perimeters may cause a temporary PSU shut-down.

6.3.5 Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector. A cable is included to connect the PSU to the mains.
- The DC output uses 2 internally mounted male output connectors, type Phoenix PCV6-16/2-G1F-10,16 with locking nuts. A dual cable set is included to transfer the load to the main power rail. For more information see MB-0001.

> **Note:**
> Both the connectors of output cable set do not contain a separate strain relief. Protect the cable from tension and twisting in the end application.

- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

The below figure shows the connections and connector lay-out on the output side of the PSU-UNI2450U.

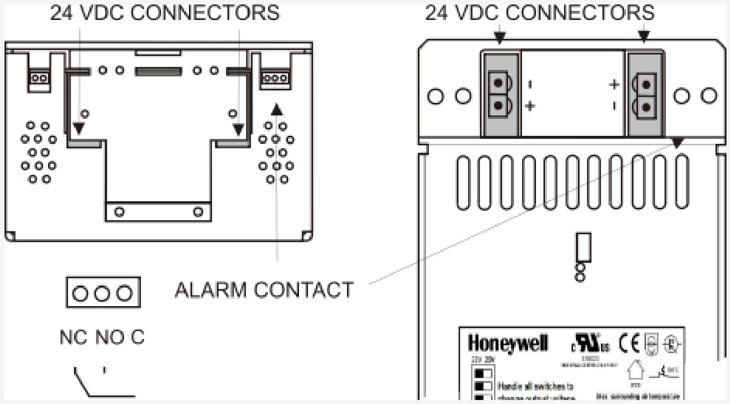


Figure 6-14: Connections on the output side of the PSU-UNI2450U[1]

1. Note that both 24 V DC connectors are wired in parallel; there is no separation diode inbetween.

The below table shows the recommended wire sizes for the power supply's input and output wiring.

Recommended wire sizes for the PSU-UNI2450U power supply

INPUT	OUTPUT	
110 –240 V AC	25 V DC	Voltage drop (with dual output cable, length 1.8 m)
2.5 mm^2; (AWG 14)	2 sets of black and red wires - 8.3 mm^2; (AWG 8)	192 mV/m at 48 A

Spare part list

Spare parts	Article numbers
Retaining clip for IEC 60230 C19 connector	Bulgin article number: KT0012
Input cable including IEC 60230 C19 connector	Honeywell article number: 148-020002C
Output cable including both connectors	Honeywell article number: 148-020003L

6.3.6 Technical data

The FC-PSU-UNI2450U power supply unit has the following specifications:

General	Type number:	FC-PSU-UNI2450U
	Version[3]:	V2.1, V3.0
	Approvals:	TUV; CE cULus
Power	Power requirements:	110-240 V AC
		(operating limits: 93-253 V AC)
	Power consumption at no load:	13 W
	Power factor:	Close to 1
	Input frequency range	47- 63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D)
		16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	-25 °C to +85 °C (-13 °F to +185 °F)
	Operating temperature:	-5 °C to +70 °C (23°F to +158°F)
		(see Figure 2 for derating of output current as a function of ambient temperature)

Input	Inrush current:	< 15A
	Input power:	• < 1400 VA (rated voltage 220-240 V AC) • < 1500 VA (rated voltage 110-120 V AC)
	Input current:	• < 7.5 A (rated voltage 220-240 V AC) • < 16 A (rated voltage 110-120 V AC)
Output	Output voltage:	25 V DC or 28 V DC; dual overvoltage protection
	Ripple and noise:	< 40 mVpp
	Output current (25 V DC):	48 A at -5 °C to +50 °C (23 °F to +122 °F)
	Output current (28 V DC):	43 A at -5 °C to +50 °C (23 °F to +122 °F)
	Derating output current:	Starting at 50 °C (122 °F): 30 W/°C
		(see "Derating curve1 for the PSU-UNI2450U power supply." on page 207 for derating curve)
	Hold-up time:	100 ms at full load
	Output voltage setting:	25 V DC
	Efficiency:	• >85% (rated voltage 220-240 V AC) • >80% (rated voltage 110-120 V AC)
Isolation	Input to output:	3750 V_{rms} (1 min.)[1]
	Input to case:	2500 V_{rms} (1 min.)[1]
	Output to case:	500 V DC

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16 A with retaining clip
	DC output:	2 x Phoenix PCV6-16/2-G1F-10,163
		With locking screws
	Cable connector	Phoenix PC 16/2-STF-10,16[2]
	• Min. wire size	0.75 mm^2
	• Max. wire size	16 mm^2
	• Strip length	12 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	Cable connector	Phoenix MC 1,5/3-ST-3,81
	• Min. wire size	0.14 mm^2
	• Max. wire size	1.5 mm^2
	• Strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 22 V DC.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 27 V (30 V for 28 V mode) in case of malfunction of the normal regulation.

Note:

1. For type test only.
2. Both the connectors of output cable set do not contain a separate strain relief. Protect the cable from tension and twisting in the end application.
3. From V3.0 the Alarm contact reports fan failure.

The FA-PSU-UNI2450U power supply unit has the following specifications:

General	Type number[1]:	FA-PSU-UNI2450U
	Version [4]:	V2.1, V3.0
	Approvals[2]:	TUV; CE cULus; CSA; ATEX; IECEx
		Ex signature: Ex nA nC IIC T4 Gc IECEx cert. No: EPS 17.0044X CSA Signature: Ex nA nC IIC T4 Gc Class 1, Division 2, Groups ABCD T4
Power	Power requirements:	110—240 V AC
		(operating limits: 93-253 V AC)
	Power consumption at no load:	13 W
	Input frequency range	47-63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D)
		16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	-25 °C to +85 °C (-13 °F to +185 °F)
	Operating temperature:	-40 °C to +70 °C (-40 °F to +158 °F)
		(see Figure 2 for derating of output current as a function of ambient temperature)

Input	Inrush current:	< 15A
	Input power:	• <1400VA (rated voltage 220-240 Vac) • <1500VA (rated voltage 110-120 Vac)
	Input current:	• <7.5A (rated voltage 220-240 Vac) • <16A (rated voltage 110-120 Vac)
Output	Output voltage:	25 V DC or 28 V DC; dual overvoltage protection
	Ripple and noise:	< 40 mVpp
	Output current (25 V DC):	48 A at -40 °C to +50 °C (-40 °F to +122 °F)
	Output current (28 V DC):	43 A at -40 °C to +50 °C (-40 °F to +122 °F)
	Derating output current:	Starting at 50 °C (122 °F): 30 W/°C
		(see "Derating curve1 for the PSU-UNI2450U power supply." on page 207 for derating curve)
	Hold-up time:	100 ms at full load
	Output voltage setting:	25 V DC
	Efficiency at 230 V AC:	>87%
Isolation	Input to output:	3750 V_{rms} (1 min.)
	Input to case:	2500 V_{rms} (1 min.)
	Output to case:	500 V DC
Connectors	AC input:	IEC 60320 C20 inlet type socket, 16 A with retaining clip
	DC output:	2 x Phoenix PCV6-16/2-G1F-10,16 with locking screws
	cable connector	Phoenix PC 16/2-STF-10,16[3]

	• Min. wire size	0.75 mm^2
	• Max. wire size	16 mm^2
	• Strip length	12 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• Min. wire size	0.14 mm^2
	• Max. wire size	1.5 mm^2
	• Strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 22 V DC.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 27 V (30 V for 28 V mode) in case of malfunction of the normal regulation.

Note:

1. FA-type modules can be used to connect to devices in explosive atmospheres, conform to the applicable ATEX / IECEx guidelines.
2. In case the FA-PSU-UNI2450U is applied for ATEX / IECEx certified projects, the end user shall ensure that it is placed in an IP54 compliant enclosure.
3. Both the connectors of output cable set do not contain a seperate strain relief. Protect the cable from tension and twisting in the end application.
4. From V3.0 the Alarm contact reports fan failure.

6.4 PSU-UNI4825U

6.4.1 48 V DC Power supply (1200 W) – UL508 approved

The PSU-UNI4825U power supply is a UL approved switched-mode DC power supply with a high efficiency (>85% at 187 V AC and >80% at 93, 5 V AC). It accepts a wide range of input voltages to provide 48 V DC and 25 A output.

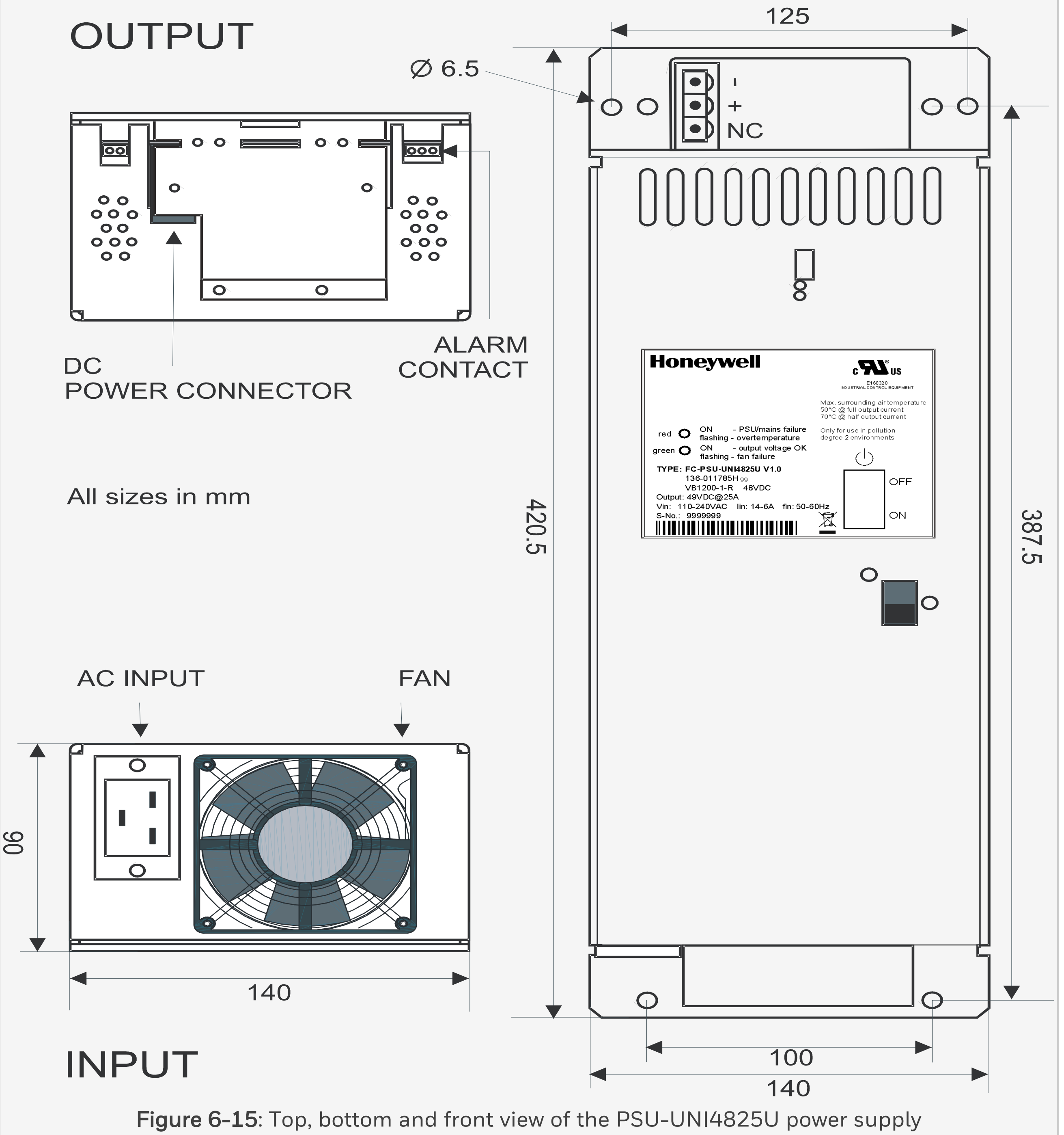


Figure 6-15: Top, bottom and front view of the PSU-UNI4825U power supply

6.4.2 Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards.
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- DC under-voltage alarm (<44 V).
- An output diode for parallel operation.
- Optimum protection against continuous overload and short-circuiting.
- 100 ms holdup time.

The LEDs on the front panel indicate the following status:

Green LED	On	PSU in operation; output OK
	Off	PSU swithed off
	Flashing	Fan does not reach required speed
Red LED	On	PSU/MAINS failure, or in stand-by mode
	Off	No failure
	Flashing	Temperature too high

Attention:
The LEDs of the PSUs are the only indicators that determine the health/functioning of the PSU. Therefore, it is recommended that during regular inspection, LEDs of the PSUs are checked visually.

6.4.3 Hardware control features

The PSU-UNI4825U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

6.4.3.1 Power switch

Attention:
Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI4825U before you disconnect it.

With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

6.4.3.2 Alarm contact

The PSU-UNI4825U has an alarm contact used for voltage monitoring.

The below figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 44Vdc.

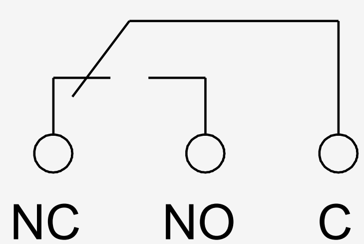


Figure 6-16: Alarm contact state with output voltage above 44 V DC

6.4.4 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see the below figure).

Note:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

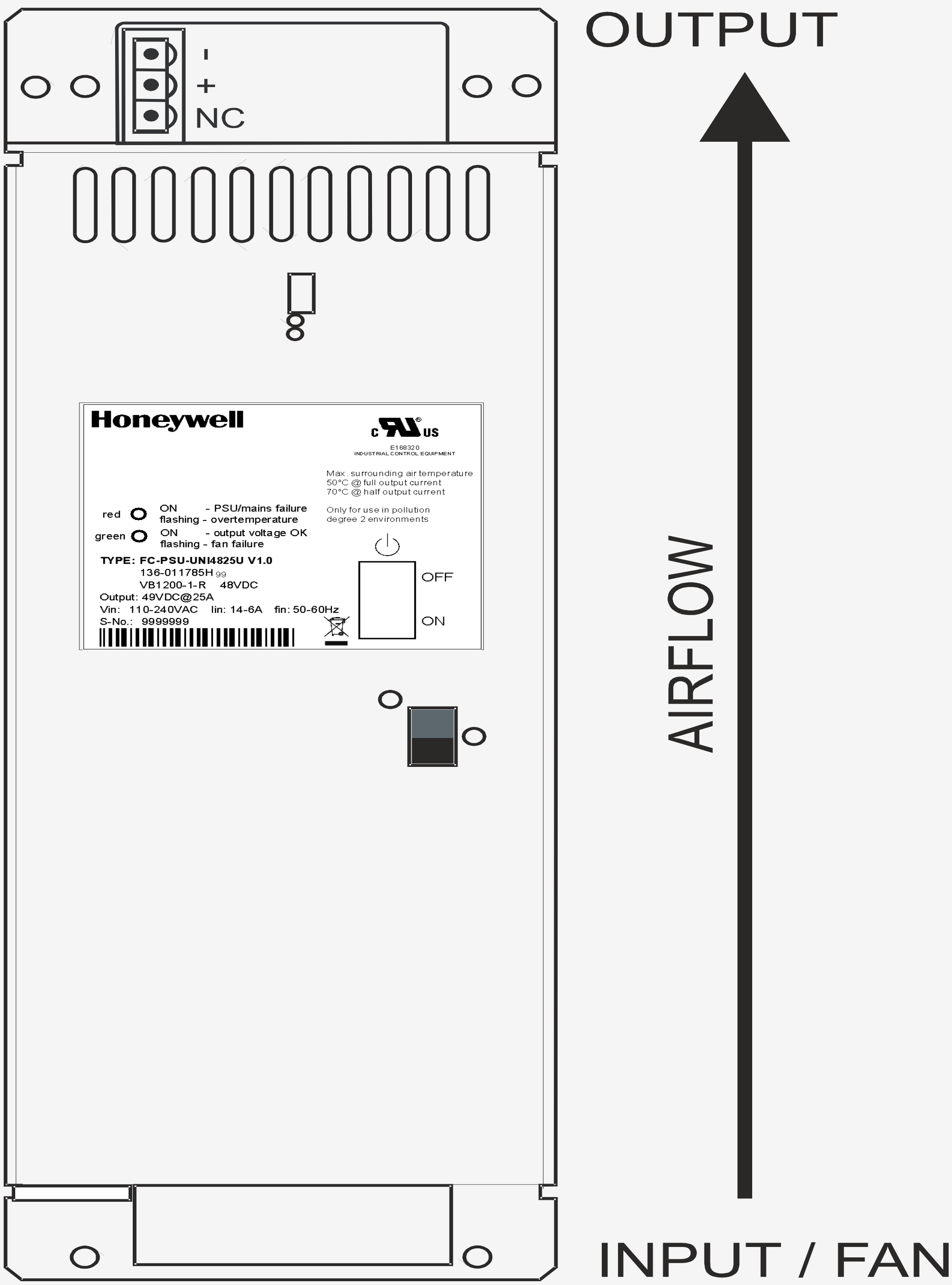


Figure 6-17: Vertical mounting of the PSU-UNI4825U power supply

The below figure shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

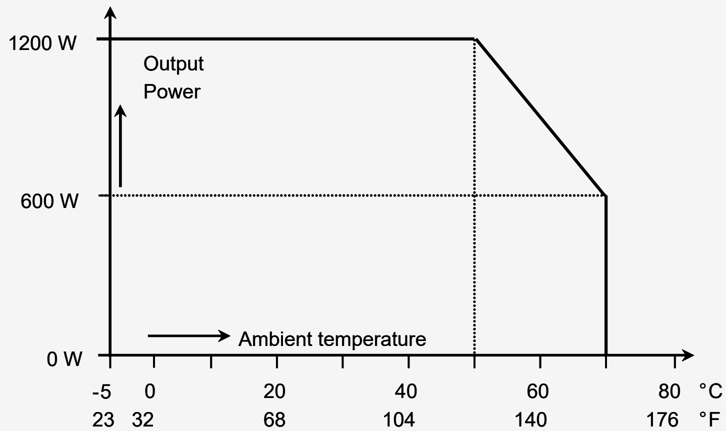


Figure 6-18: Derating curve[1] for the PSU-UNI4825U power supply.

1. Operation outside these perimeters may cause a temporary PSU shut-down.

6.4.5 Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.

  A cable is included to connect the PSU to the mains.
- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

The below figure shows the connections and connector lay-out on the output side of the PSU-UNI4825U.

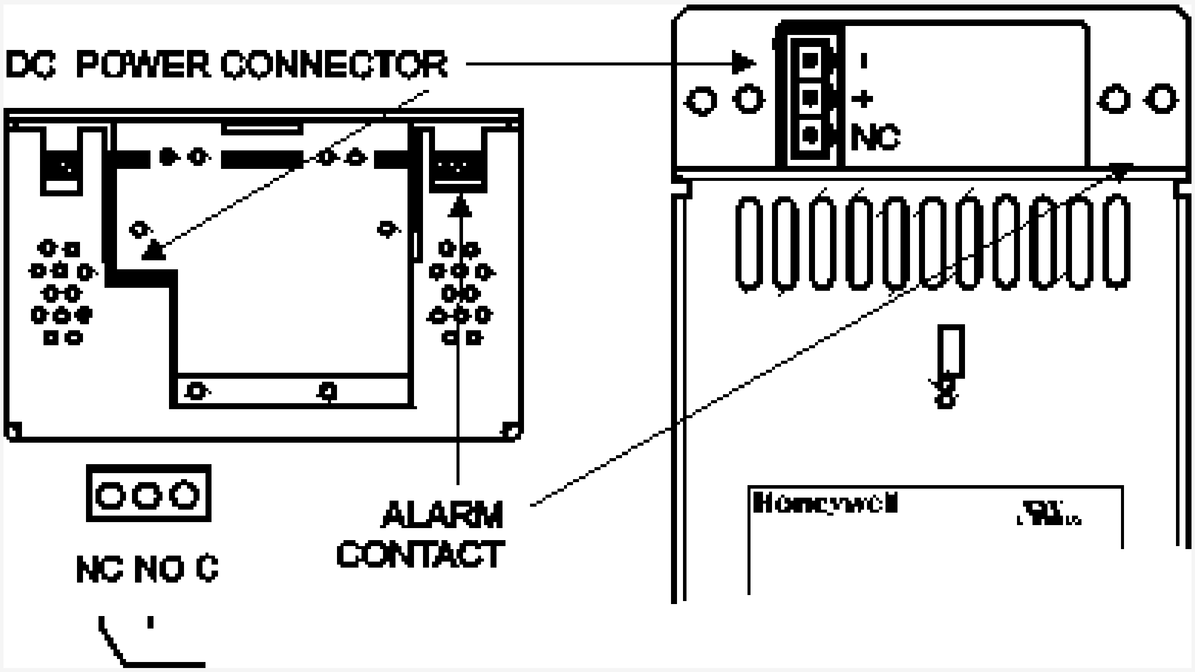


Figure 6-19: Connections on the output side of the PSU-UNI4825U

The below table shows the recommended wire sizes for the power supply's input and output wiring.

Recommended wire sizes for the PSU-UNI4825U power supply

INPUT	OUTPUT	
110 –240 V AC	48 V DC	Voltage drop (with output cable, length 1.8 m)
2.5 mm^2; (AWG 14)	1 set of black and red wire - 8.3 mm^2; (AWG 8)	200 mV/m at 25A

6.4.6 Technical data

The PSU-UNI4825U power supply unit has the following specifications:

General	Type number:	FC-PSU-UNI4825U
	Approvals:	CE; TUV; UL508; CSA
Power	Power requirements:	110-240 V AC
		(operating limits: 93-253 V AC)
	Power consumption at no load:	13 W
	Power factor:	close to 1
	Input frequency range	47-63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D)
		16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) - including the cable set
Environment	Storage temperature:	-25°C-+85°C (-13°F-+185°F)
	Operating temperature:	-5°C-+70°C (23°F-+158°F)
		(see "Derating curve1 for the PSU-UNI4825U power supply." on page 221 for derating of output current as a function of ambient temperature)

Input	Inrush current:	< 15A
	Input power:	• < 1400VA (rated voltage 220-240 V AC) • < 1500VA (rated voltage 110-120 V AC)
	Input current:	• < 7.5A (rated voltage 220-240 V AC) • < 16A (rated voltage 110-120 V AC)
Output	Output voltage:	48 V DC; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (48 V DC):	25 A at –5°C-+50°C (23°F-+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C
		(see "Derating curve1 for the PSU-UNI4825U power supply." on page 221 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	48 V DC
	Efficiency:	• > 85% (rated voltage 220-240 V AC) • > 80% (rated voltage 110-120 V AC)
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 V DC

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	cable connector	Phoenix PC 5/3-STF-7,62
	• Min. wire size	0.2 mm^2
	• Max. wire size	6 mm^2
	• Strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• Min. wire size	0.14 mm^2
	• Max. wire size	1.5 mm^2
	• Strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 44 V DC.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 54 V in case of malfunction of the normal regulation.

6.5 PSU-UNI6020U

6.5.1 60 V DC Power supply (1200 W) – UL508 approved

The PSU-UNI6020U power supply is a UL approved switched-mode DC power supply with a high efficiency (>85% at 187 V AC and >80% at 93, 5 V AC). It accepts a wide range of input voltages to provide 60 V DC and 20 A output.

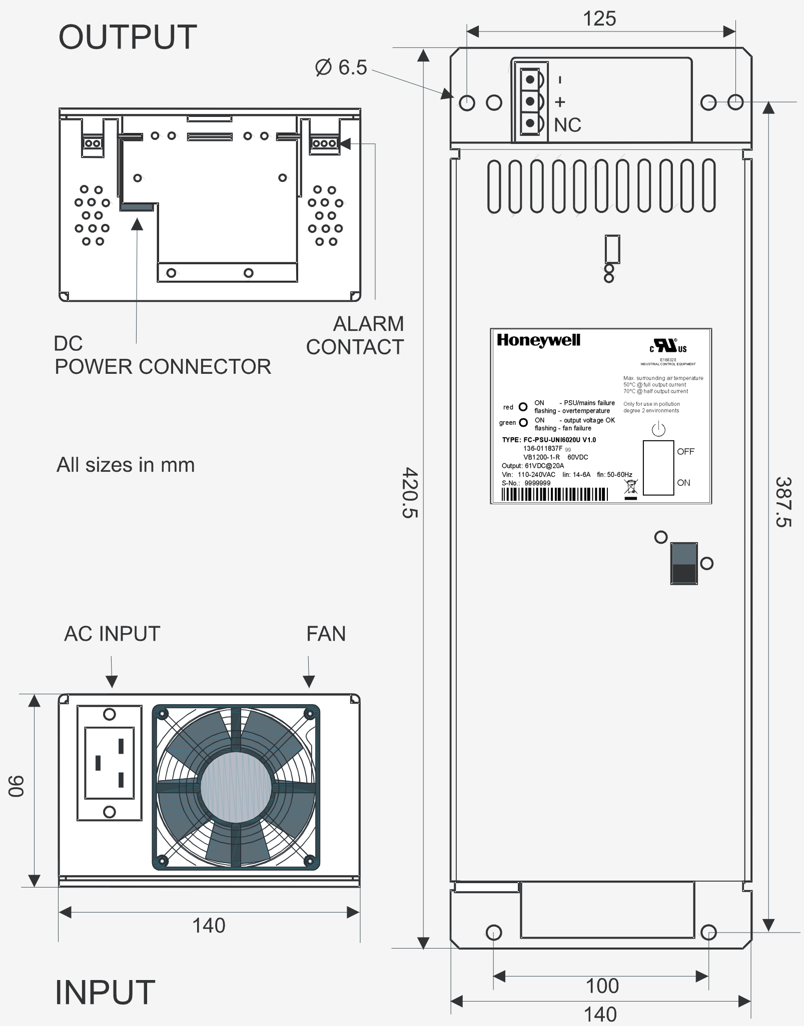


Figure 6-20: Top, bottom and front view of the PSU-UNI6020U power supply

6.5.2 Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards.
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- Under-voltage alarm (<54 V).
- An output diode for parallel operation.
- Optimum protection against continuous overload and short-circuiting.
- 100ms holdup time.

The LEDs on the front panel indicate the following status:

Green LED	On	PSU in operation; output OK
	Off	PSU swithed off
	Flashing	Fan does not reach required speed
Red LED	On	PSU/MAINS failure, or in stand-by mode
	Off	No failure
	Flashing	Temperature too high

Attention:
The LEDs of the PSUs are the only indicators that determine the health/functioning of the PSU. Therefore, it is recommended that during regular inspection, LEDs of the PSUs are checked visually.

6.5.3 Hardware control features

The PSU-UNI6020U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

6.5.3.1 Power switch

> **Attention:**
> Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI6020U before you disconnect it.

With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

6.5.3.2 Alarm contact

The PSU-UNI6020U has an alarm contact used for voltage monitoring.

The below figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 54Vdc.

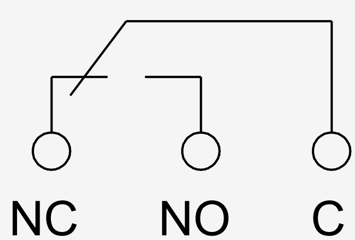


Figure 6-21: Alarm contact state with output voltage above 54 V DC

6.5.4 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see the below figure).

Note:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

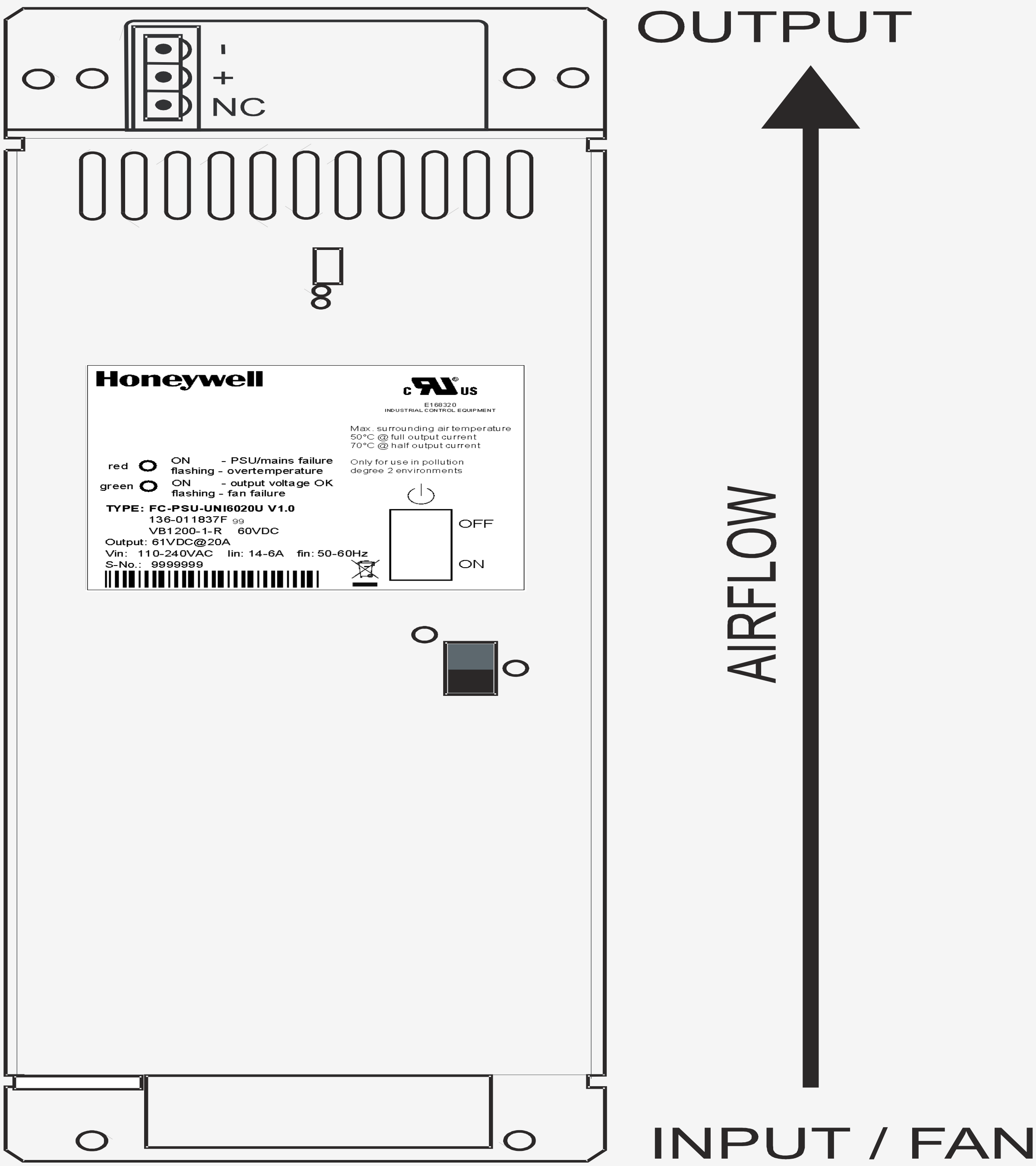


Figure 6-22: Vertical mounting of the PSU-UNI6020U power supply

The below figure shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

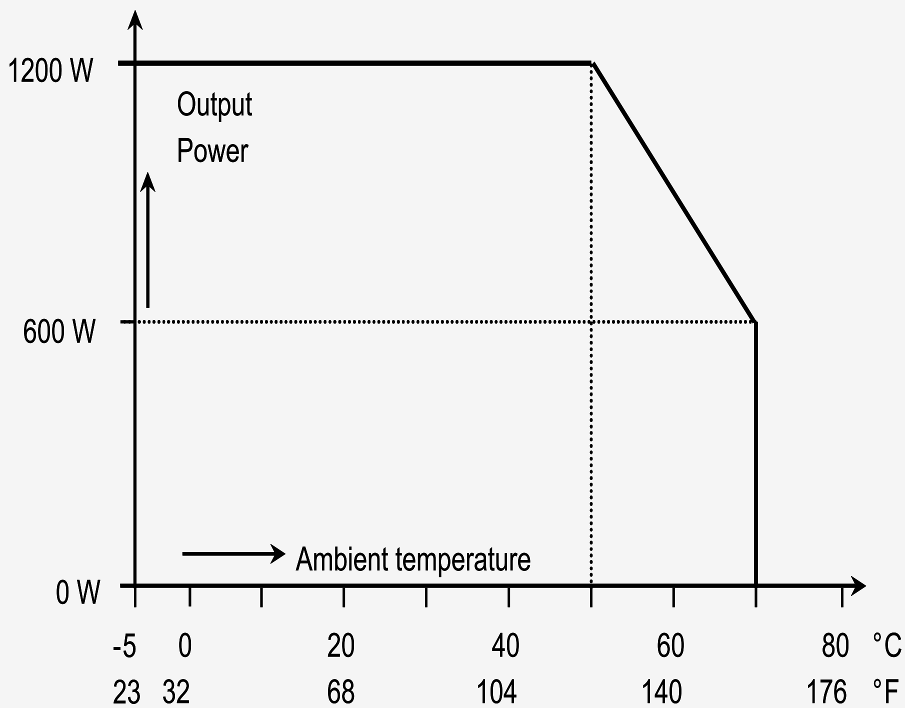


Figure 6-23: Derating curve[1] for the PSU-UNI6020U power supply.

1. Operation outside these perimeters may cause a temporary PSU shut-down.

6.5.5 Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.

  A cable is included to connect the PSU to the mains.

- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

The below figure shows the connections and connector lay-out on the output side of the PSU-UNI6020U.

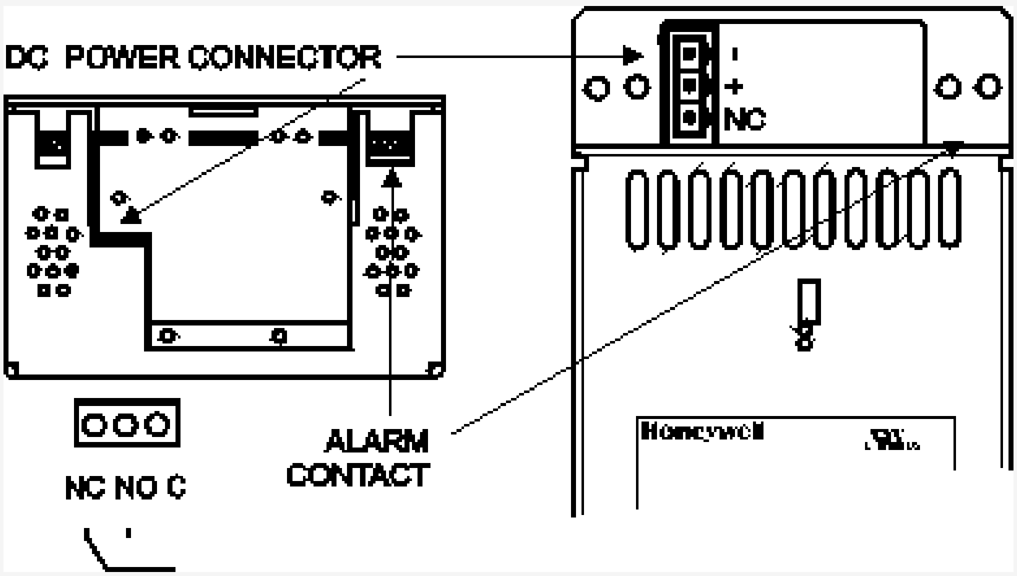


Figure 6-24: Connections on the output side of the PSU-UNI6020U

The below table shows the recommended wire sizes for the power supply's input and output wiring.

Recommended wire sizes for the PSU-UNI6020U power supply

INPUT	OUTPUT	
110 –240 V AC	60 V DC	Voltage drop (with output cable, length 1.8 m)
2.5 mm^2; (AWG 14)	1 set of black and red wire - 8.3 mm^2; (AWG 8)	160 mV/m at 20 A

6.5.6 Technical data

The PSU-UNI6020U power supply unit has the following specifications:

General	Type number:	FC-PSU-UNI6020U
	Approvals:	CE; TUV; UL508; CSA
Power	Power requirements:	110-240 V AC
		(operating limits: 93-253 V AC)
	Power consumption at no load:	13 W
	Power factor:	close to 1
	Input frequency range	47-63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D)
		16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	-25°C-+85°C (-13°F-+185°F)
	Operating temperature:	-5°C-+70°C (23°F-+158°F)
		(see "Derating curve1 for the PSU-UNI6020U power supply." on page 231 for derating of output current as a function of ambient temperature)

Input	Inrush current:	< 15 A
	Input power:	• < 1400VA (rated voltage 220-240 V AC) • < 1500VA (rated voltage 110-120 V AC)
	Input current:	• < 7.5A (rated voltage 220-240 V AC) • < 16A (rated voltage 110-120 V AC)
Output	Output voltage:	60 V DC; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (60 V DC):	20 A at -5°C-+50°C (23°F-+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C
		(see "Derating curve1 for the PSU-UNI6020U power supply." on page 231 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	60 V DC
	Efficiency	• > 85% (rated voltage 220-240 V AC) • > 80% (rated voltage 110-120 V AC)
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 V DC

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	cable connector	Phoenix PC 5/3-STF-7,62
	• Min. wire size	0.2 mm^2
	• Max. wire size	6 mm^2
	• Strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	Cable connector	Phoenix MC 1,5/3-ST-3,81
	• Min. wire size	0.14 mm^2
	• Max. wire size	1.5 mm^2
	• Strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 54 V DC.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 70 V in case of malfunction of the normal regulation.

6.6 PSU-UNI11011U

6.6.1 110 V DC Power supply (1200 W) – UL508 approved

The PSU-UNI11011U power supply is a UL approved switched-mode DC power supply with a high efficiency (>85% at 187 V AC and >80% at 93, 5 V AC). It accepts a wide range of input voltages to provide 111 V DC and 11 A output.

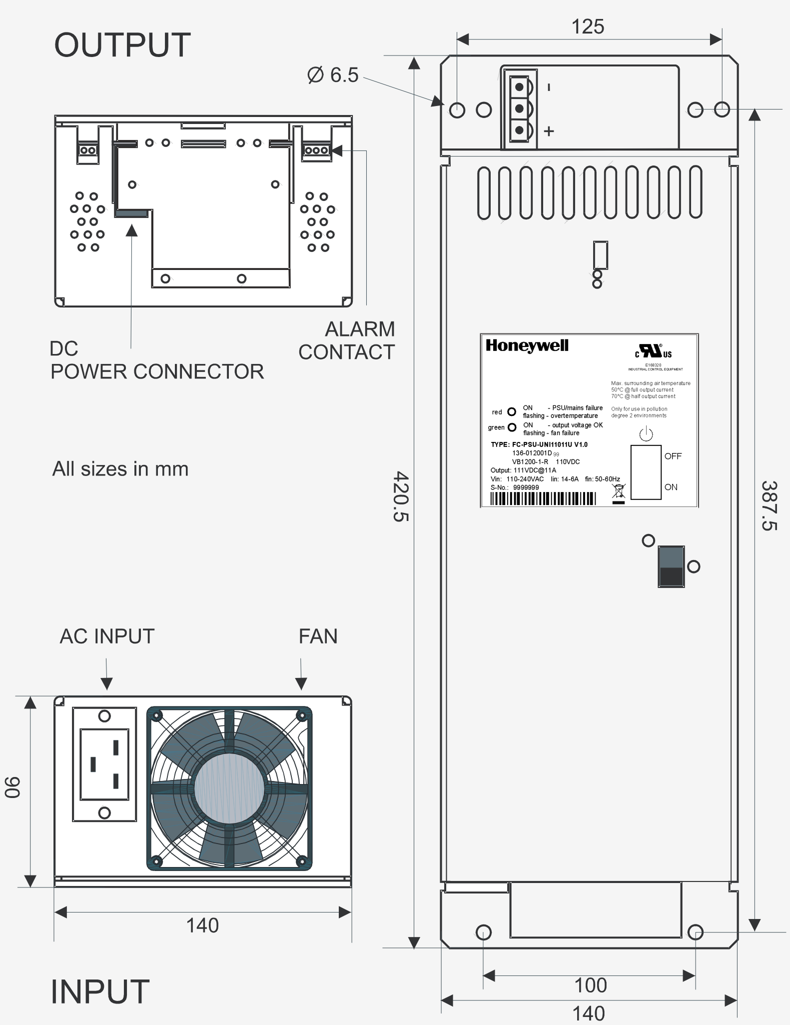


Figure 6-25: Top, bottom and front view of the PSU-UNI11011U power supply

6.6.2 Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards.
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- DC under-voltage alarm (<100 V).
- An output diode for parallel operation.
- Optimum protection against continuous overload and short-circuiting.
- 100ms holdup time.

The LEDs on the front panel indicate the following status:

Green LED	On	PSU in operation; output OK
	Off	PSU swithed off
	Flashing	Fan does not reach required speed
Red LED	On	PSU/MAINS failure, or in stand-by mode
	Off	No failure
	Flashing	Temperature too high

Attention:
The LEDs of the PSUs are the only indicators that determine the health/functioning of the PSU. Therefore, it is recommended that during regular inspection, LEDs of the PSUs are checked visually.

6.6.3 Hardware control features

The PSU-UNI11011U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

6.6.3.1 Power switch

Attention:
Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI11011U before you disconnect it.

With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

6.6.3.2 Alarm contact

The PSU-UNI11011U has an alarm contact used for voltage monitoring.

The below figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 100Vdc.

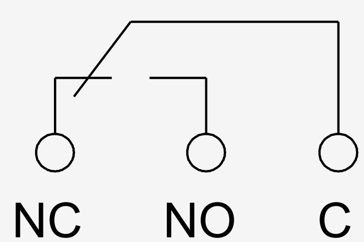


Figure 6-26: Alarm contact state with output voltage above 100Vdc

6.6.4 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see the below figure).

Note:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

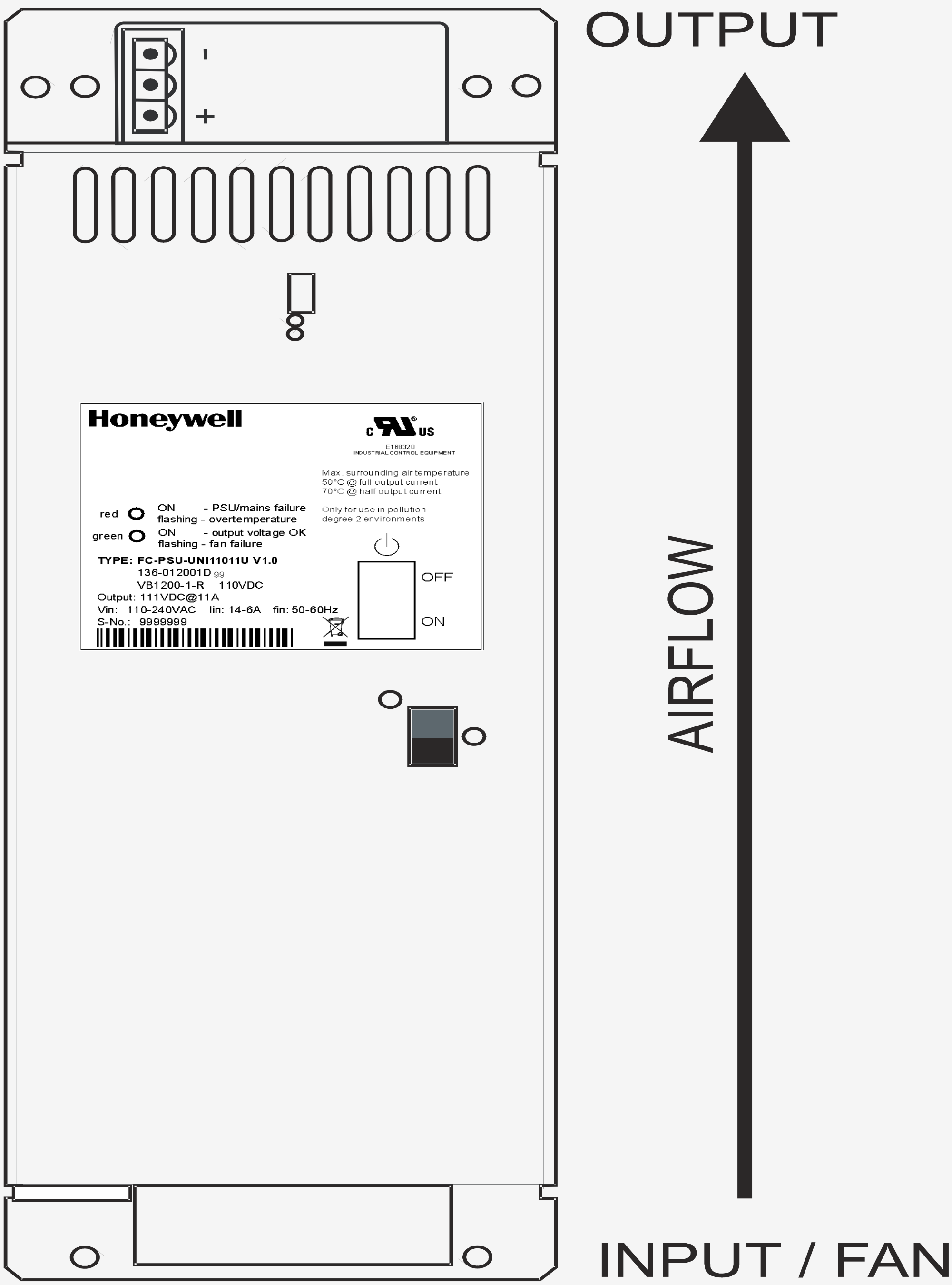


Figure 6-27: Vertical mounting of the PSU-UNI11011U power supply

The below figure shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

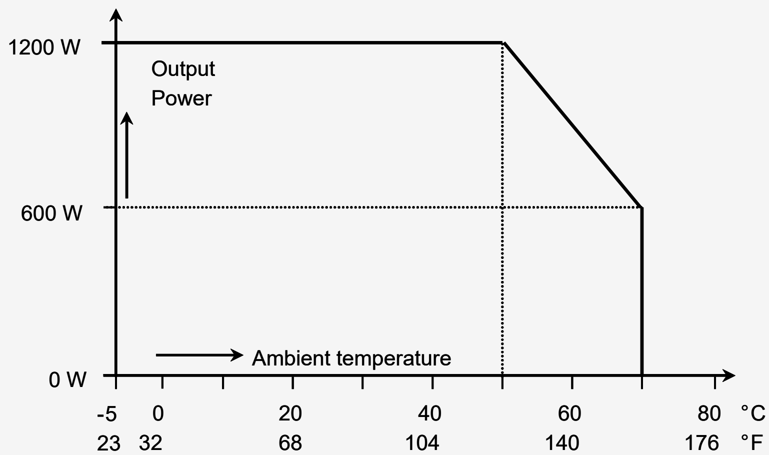


Figure 6-28: Derating curve[1] for the PSU-UNI11011U power supply.

1. Operation outside these perimeters may cause a temporary PSU shut-down.

6.6.5 Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.

  A cable is included to connect the PSU to the mains.

- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

The below figure shows the connections and connector lay-out on the output side of the PSU-UNI11011U.

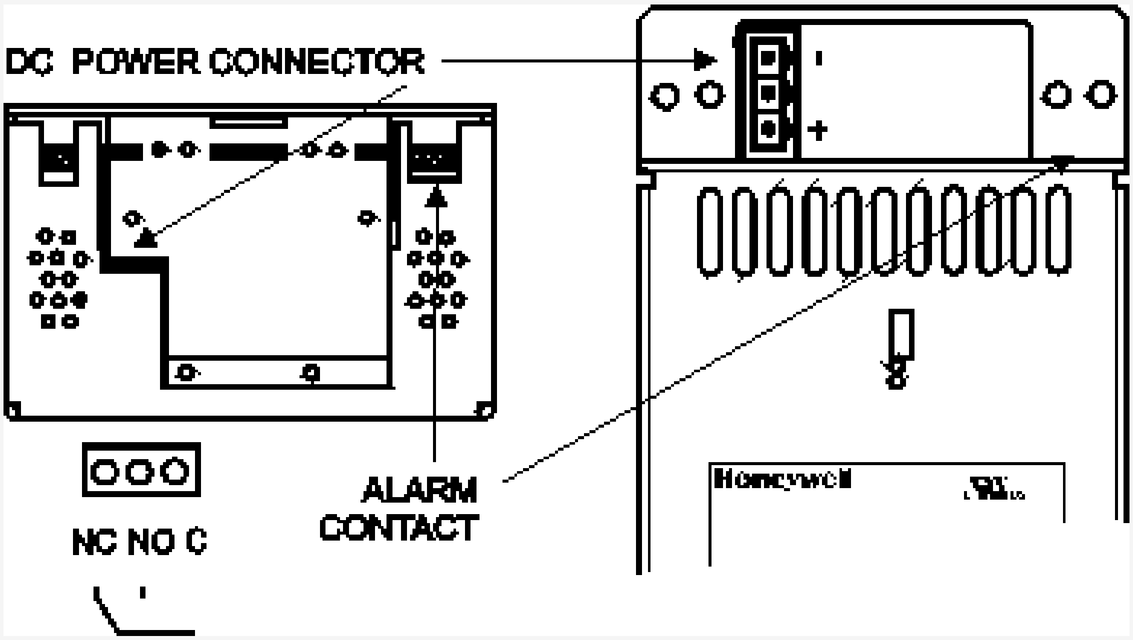


Figure 6-29: Connections on the output side of the PSU-UNI11011U

The below table shows the recommended wire sizes for the power supply's input and output wiring.

Recommended wire sizes for the PSU-UNI11011U power supply

INPUT	OUTPUT	
110 –240 V AC	111 V DC	Voltage drop (with output cable, length 1.8 m)
2.5 mm^2; (AWG 14)	1 set of black and red wire - 8.3 mm^2; (AWG 8)	88 mV/m at 11A

6.6.6 Technical data

The PSU-UNI11011U power supply unit has the following specifications:

General	Type number:	FC-PSU-UNI11011U
	Approvals:	CE; TUV; UL508; CSA
Power	Power requirements:	110-240 V AC
		(operating limits: 93-253 V AC)
	Power consumption at no load:	13 W
	Power factor:	close to 1
	Input frequency range	47-63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D)
		16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – cable set included
Environment	Storage temperature:	-25°C-+85°C (-13°F-+185°F)
	Operating temperature:	-5°C-+70°C (23°F-+158°F)
		(see "Derating curve1 for the PSU-UNI11011U power supply." on page 241 for derating of output current as a function of ambient temperature)

Input	Inrush current:	< 15A
	Input power:	• < 1400VA (rated voltage 220-240 V AC) • < 1500VA (rated voltage 110-120 V AC)
	Input current:	• < 7.5A (rated voltage 220-240 V AC) • < 16A (rated voltage 110-120 V AC)
Output	Output voltage:	111 V DC; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (111 V DC):	11 A at –5°C-+50°C (23°F-+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C
		(see "Derating curve1 for the PSU-UNI11011U power supply." on page 241 for derating curve)
	Hold-up time:	Typically 100ms at 100% load
	Output voltage setting:	111 V DC
	Efficiency:	• > 85% (rated voltage 220-240 V AC) • > 80% (rated voltage 110-120 V AC)
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 V DC

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	Cable connector	Phoenix PC 5/3-STF-7,62
	• Min. wire size	0.2 mm^2
	• Max. wire size	6 mm^2
	• Strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	Cable connector	Phoenix MC 1,5/3-ST-3,81
	• Min. wire size	0.14 mm^2
	• Max. wire size	1.5 mm^2
	• Strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 99 V DC.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately
		120 V in case of malfunction of the normal regulation.

6.7 PSU-UNI12010U

6.7.1 120 V DC Power supply (1200 W) – UL508 approved

The PSU-UNI12010U power supply is a UL approved switched-mode DC power supply with a high efficiency (>85% at 187 V AC and >80% at 93, 5 V AC). It accepts a wide range of input voltages to provide 120 V DC and 10 A output.

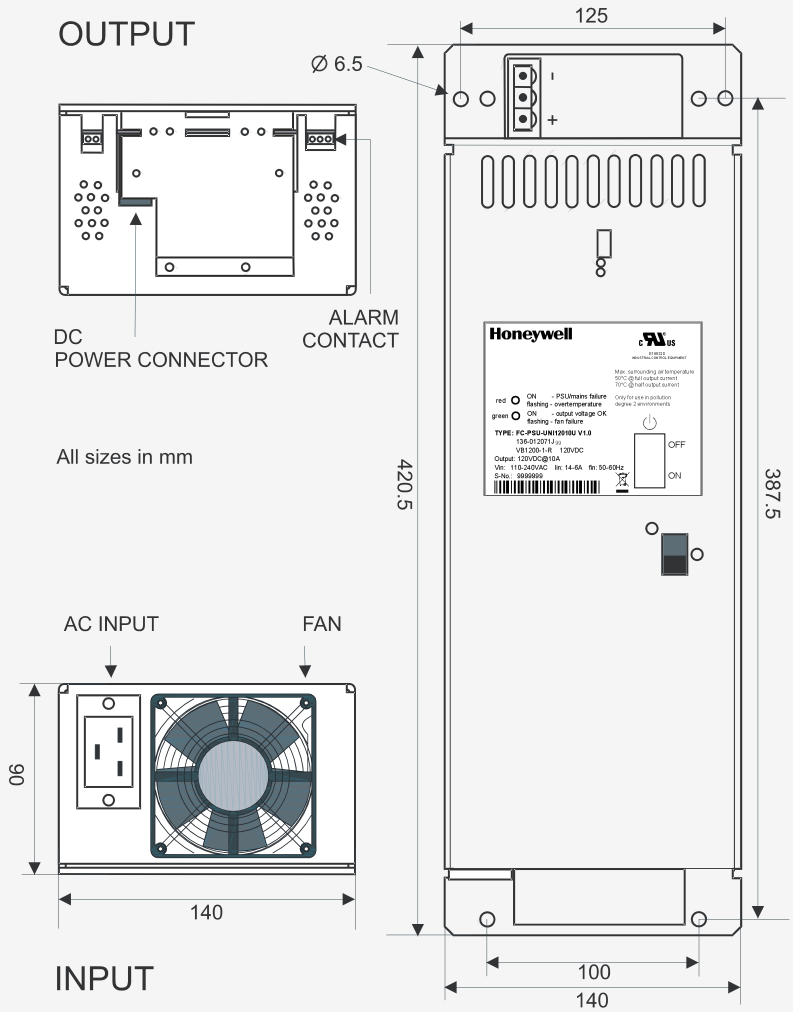


Figure 6-30: Top, bottom and front view of the PSU-UNI12010U power supply

6.7.2 Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards.
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- DC under-voltage alarm (<100 V).
- An output diode for parallel operation.
- Optimum protection against continuous overload and short-circuiting.
- 100ms holdup time.

The LEDs on the front panel indicate the following status:

Green LED	On	PSU in operation; output OK
	Off	PSU swithed off
	Flashing	Fan does not reach required speed
Red LED	On	PSU/MAINS failure, or in stand-by mode
	Off	No failure
	Flashing	Temperature too high

Attention:
The LEDs of the PSUs are the only indicators that determine the health/functioning of the PSU. Therefore, it is recommended that during regular inspection, LEDs of the PSUs are checked visually.

6.7.3 Hardware control features

The PSU-UNI12010U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

6.7.3.1 Power switch

Attention:
Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI12010U before you disconnect it.

With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

6.7.3.2 Alarm contact

The PSU-UNI12010U has an alarm contact used for voltage monitoring.

The below figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 100Vdc.

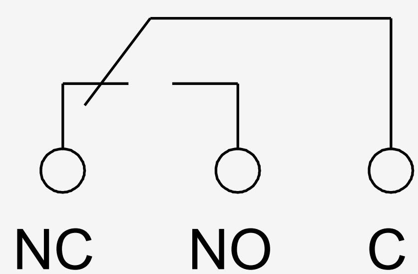


Figure 6-31: Alarm contact state with output voltage above 100Vdc

6.7.4 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see the below figure).

Note:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

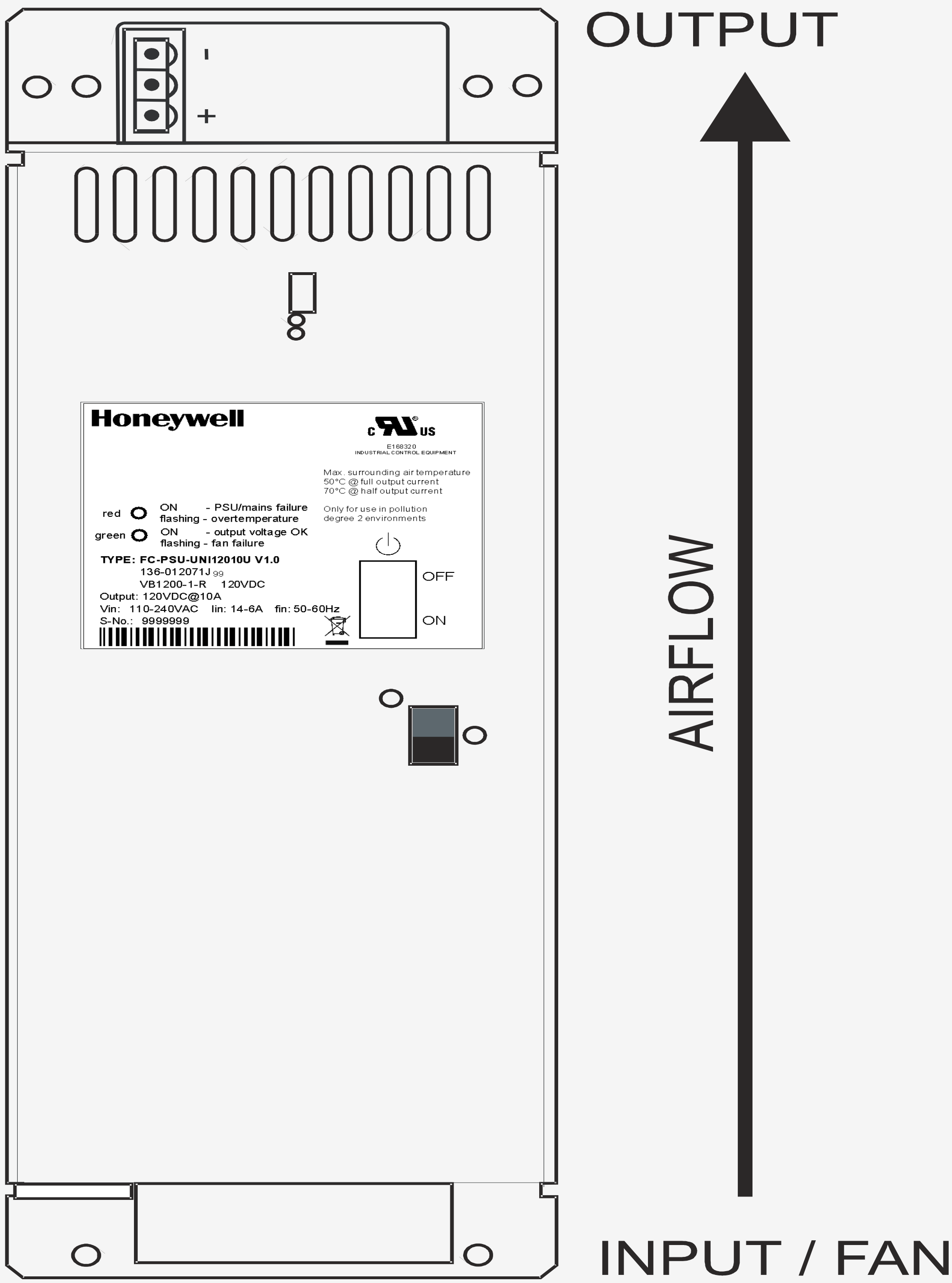


Figure 6-32: Vertical mounting of the PSU-UNI12010U power supply

The below figure shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

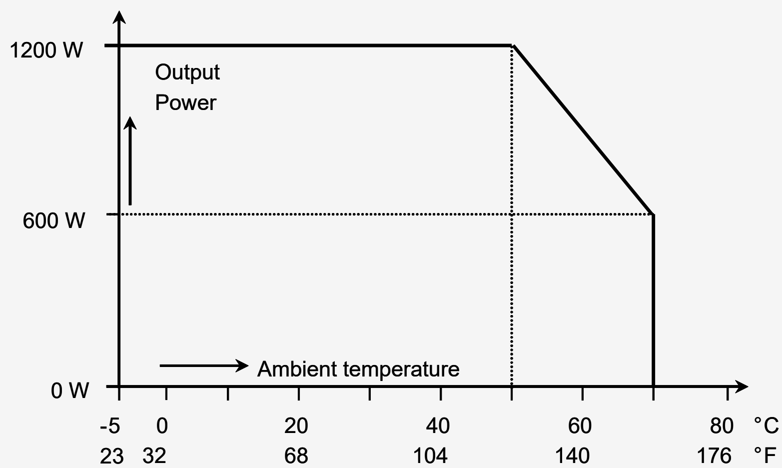


Figure 6-33: Derating curve[1] for the PSU-UNI12010U power supply.

1. Operation outside these perimeters may cause a temporary PSU shut-down.

6.7.5 Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.

  A cable is included to connect the PSU to the mains.

- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

The below figure shows the connections and connector lay-out on the output side of the PSU-UNI12010U.

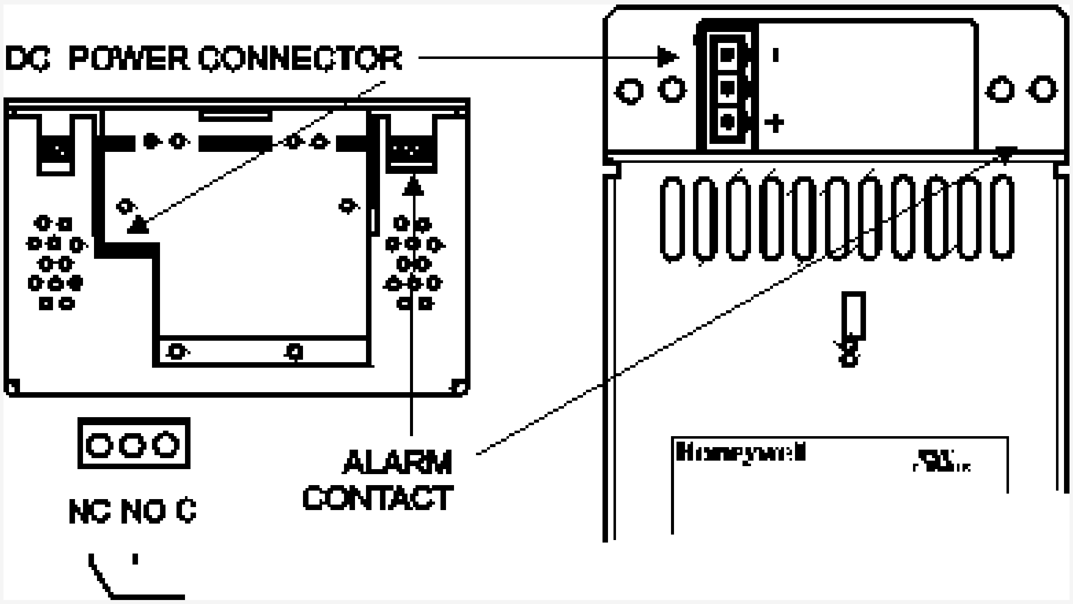


Figure 6-34: Connections on the output side of the PSU-UNI12010U

The below table shows the recommended wire sizes for the power supply's input and output wiring.

Recommended wire sizes for the PSU-UNI12010U power supply

INPUT	OUTPUT	
110 –240 V AC	120 V DC	Voltage drop (with output cable, length 1.8 m)
2.5 mm^2; (AWG 14)	1 set of black and red wire - 8.3 mm^2; (AWG 8)	88 mV/m at 10A

6.7.6 Technical data

The PSU-UNI12010U power supply unit has the following specifications:

General	Type number:	FC-PSU-UNI12010U
	Approvals:	CE; TUV; UL508; CSA
Power	Power requirements:	110-240 V AC
		(operating limits: 93-253 V AC)
	Power consumption at no load:	13 W
	Power factor:	close to 1
	Input frequency range	47-63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D)
		16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – cable set included
Environment	Storage temperature:	-25°C-+85°C (-13°F-+185°F)
	Operating temperature:	-5°C-+70°C (23°F-+158°F)
		(see "Derating curve1 for the PSU-UNI12010U power supply." on page 251 for derating of output current as a function of ambient temperature)

Input	Inrush current:	< 15A
	Input power:	• < 1400VA (rated voltage 220-240 V AC) • < 1500VA (rated voltage 110-120 V AC)
	Input current:	• < 7.5A (rated voltage 220-240 V AC) • < 16A (rated voltage 110-120 V AC)
Output	Output voltage:	120 V DC; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (111 V DC):	10 A at -5°C-+50°C (23°F-+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C
		(see "Derating curve1 for the PSU-UNI12010U power supply." on page 251 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	120 V DC
	Efficiency:	• > 85% (rated voltage 220-240 V AC) • > 80% (rated voltage 110-120 V AC)
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 V DC

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	Cable connector	Phoenix PC 5/3-STF-7,62
	• Min. wire size	0.2 mm^2
	• Max. wire size	6 mm^2
	• Strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	Cable connector	Phoenix MC 1,5/3-ST-3,81
	• Min. wire size	0.14 mm^2
	• Max. wire size	1.5 mm^2
	• Strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 108 V DC.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately
		132 V in case of malfunction of the normal regulation.

6.8 FEEDER-24R

6.8.1 24 V DC Feeder unit redundant

The 24 V DC Feeder unit redundant (FEEDER-24R) consists of a melamine plate on which a redundant feeder unit is installed.

The 24 V DC feeder unit is completely assembled and pre wired. Only cabling to the input and output terminals and readback contact need to be connected.

The complete 24 V DC feeder unit is protected by removable perspex cover plates.

6.8.2 Wiring details

The below figure shows the schematic wiring diagram for both feeders as they are installed on the 24 V DC feeder unit redundant (FEEDER-24R).

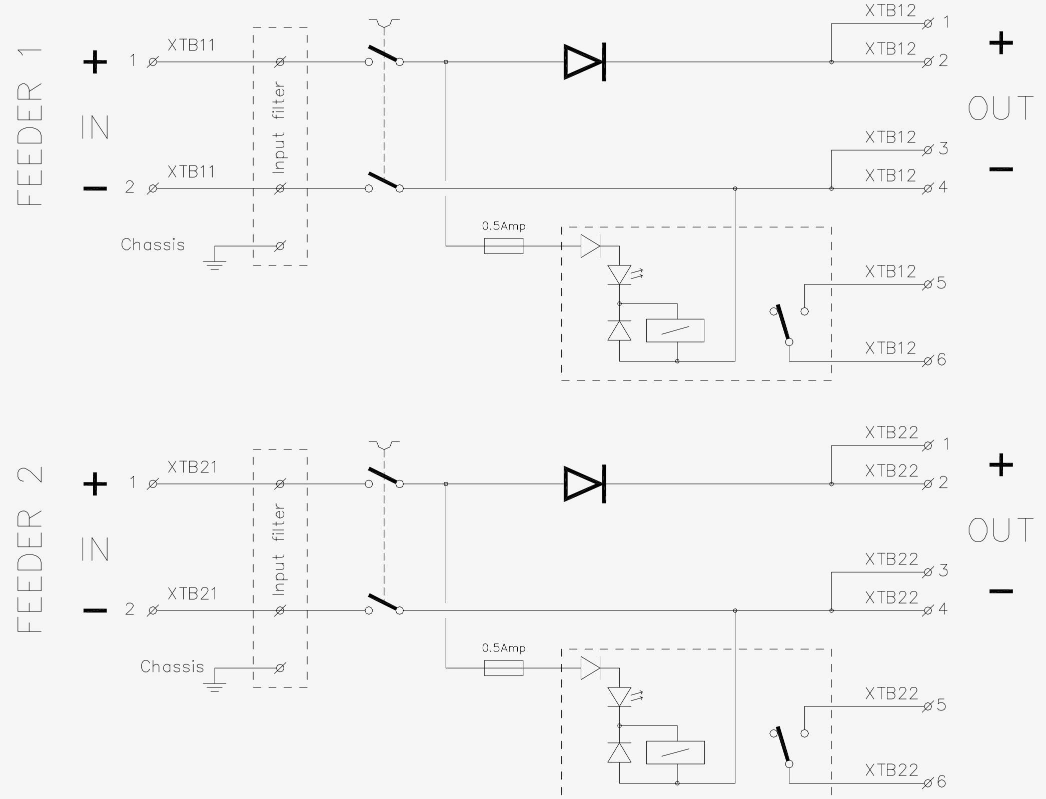


Figure 6-35: Schematic wiring diagram

6.8.3 Layout

The below figure shows the layout of the 24 V DC feeder unit FEEDER-24R with the location of all components.

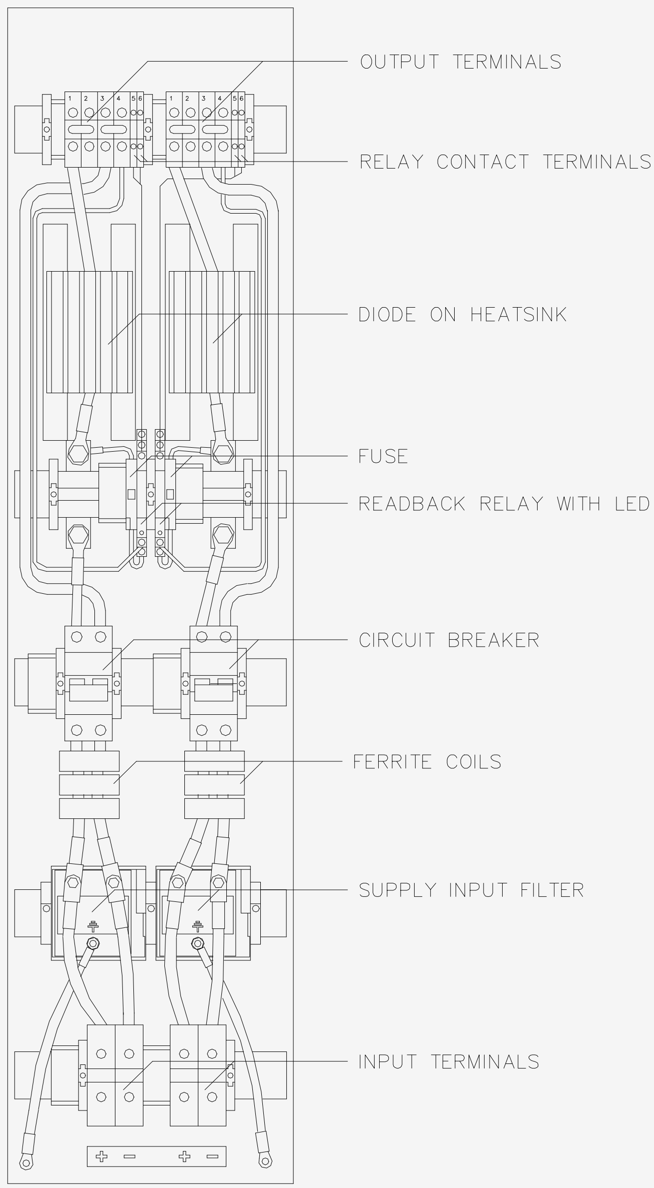


Figure 6-36: Layout of the 24 V DC Feeder unit redundant

6.8.4 Input terminals

Note:

The maximum allowed wire size is 95 mm^2.

For each 24 V DC input feeder 2 Weidmuller WDU 70N/35 terminals are mounted at the bottom of the redundant feeder unit.

The below figure shows the 24 V DC input terminal details.

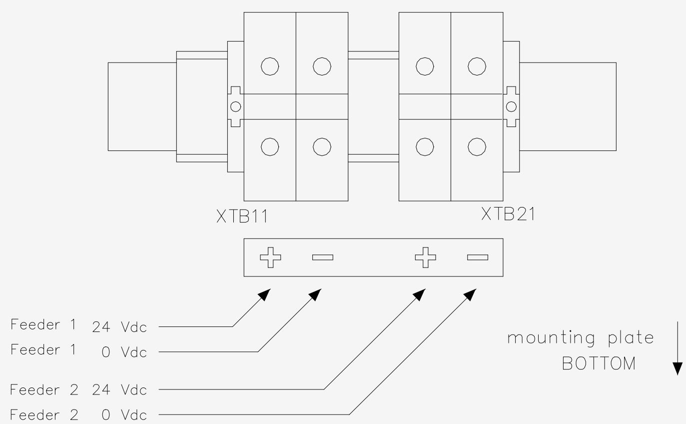


Figure 6-37: 24 V DC input terminal details

6.8.5 Supply input filter

For each 24 V DC input feeder a supply input filter (Honeywell SMS model FS-SIF-24) is installed. For more information see the respective data sheets, to open click SIF-X.

6.8.6 Circuit breaker

Tip:

If desired it is possible to have the default circuit breaker replaced by an approved type with a *lower* rating.

This must be identified before hand by the cabinet integrator or the end-user.

For each 24 V DC input feeder an ABB double pole circuit breaker is installed. The standard installed double pole circuit breaker is rated for 63 A.

6.8.7 Diode

For each 24 V DC input feeder a diode with heat sink is installed.

Each diode:

- is capable of handling 130A throughput current (2.5kA peak current),
- can sustain a reverse voltage of 1.2 kV,
- has a forward voltage drop of ≤ 1.5V.

6.8.8 Output terminals

Note:
The maximum allowed wire size is 16 mm^2.

For each 24 V DC output 2 Weidmuller WDU 16 terminals are mounted.

The below figure shows the 24 V DC output terminal details. *Terminal 3 is not to be used*. The shaded terminal blocks have a different function.

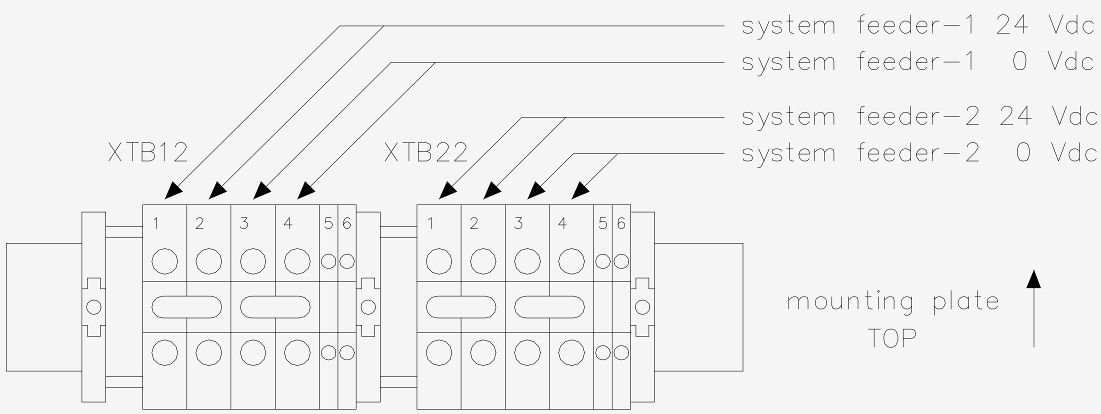


Figure 6-38: 24 V DC output terminal details

6.8.9 Readback relay terminals

For each 24 V DC input feeder a readback contact is available to indicate the feeder status. The below figure shows the readback contact terminal details.

- When 24 V DC is supplied to the 24 V DC input terminals, the (NO) contact will be closed. This contact is a potential free contact.
- Each relay has a green indication LED. When 24 V DC is supplied to the feeder terminals, the LED will be on.
- The relays can be extracted from their terminal socket and be replaced with an identical spare part.

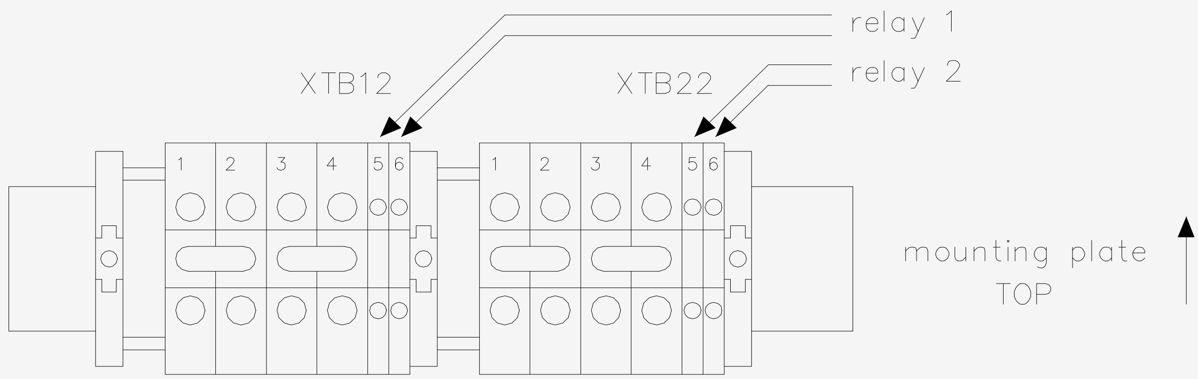


Figure 6-39: Readback contact terminal details

6.8.10 Fuse

A fused terminal is installed in the coil circuit to protect the readback relay. This fused terminal is equipped with a 0.5 A fuse slow blow.

6.8.11 Mounting details

Note:
The 24 V DC Feeder unit redundant (FEEDER-24R) should be mounted in vertical position to ensure that the heat sink of the diode has sufficient airflow.

The below figure left shows the measurements and the mounting hole locations of the of the 24 V DC feeder unit (FEEDER-24R).

The below figure right shows the location of the perspex covers that can be (dis-)mounted for easy access to labels and terminals. The covers must be placed and locked with plastic moulded nuts after assembly of the unit.

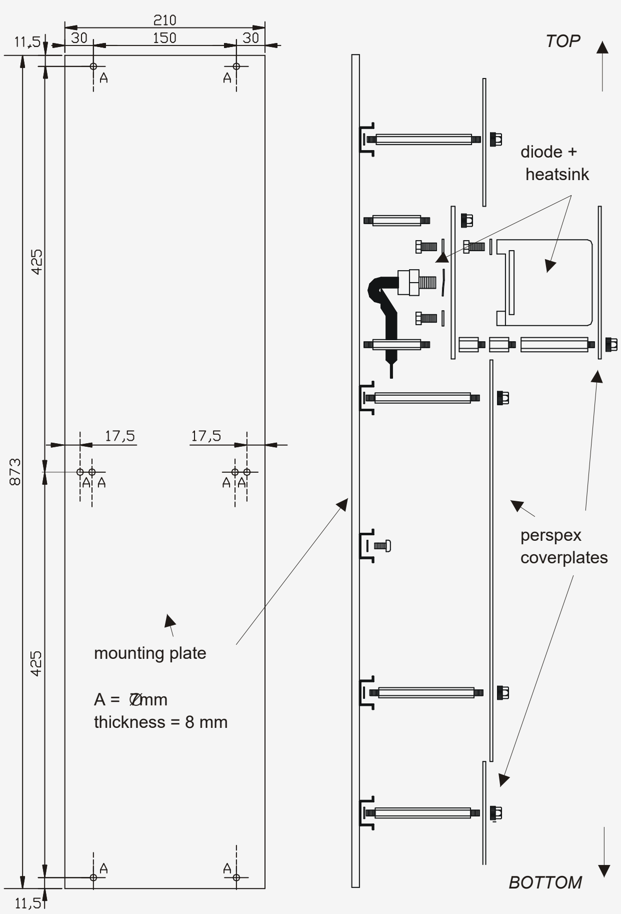


Figure 6-40: Mounting plan and measurements of the FEEDER-24R

6.8.12 Technical data

The FEEDER-24R redundant power feeder unit has the following specifications:

General	Type number[1]:	FS-FEEDER-24R
	Approvals:	CE
Input terminals	Make:	Weidmuller
	Type:	WDU 70N/35
	Maximum cable size:	95 mm^2 (AWG 3/0)
	Tightening torque, min:	10 Nm
Output terminals	Make:	Weidmuller
	Type:	WDU 16
	Maximum cable size:	16 mm^2 (AWG 6)
Fuse	Fuse rating:	500 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2501
	Derating curve:	Linear from 0.5 A at 25 dC to 0.35 A at 70 dC module ambient
Relay	Coil current:	6.6 mA at 24 V DC
	Maximum switching power	250 V AC / 6 A
	Minimum switching power	12 V / 10 mA
	Terminal wire size	≥ 0.5 mm^2 (AWG 30)
		≤ 4 mm^2 (AWG 12)

Diode	Peak reverse voltage:	1.2 kV
	Maximum continues current:	130 A
	Peak current:	2.5 kA
	Voltage drop:	≤ 1.5 V
Physical	Space requirements:	873 x 210 x 190 mm (H xW xD)
		34.4 x 8.3 x 7.5 in (H xW xD)
	Weight:	8.8 kg (19.4 lb.)

Note:

1. V1.0 has a different output terminal configuration:
    - terminal 1: system feeder 24 V DC,
    - terminal 2: system feeder 0 V DC,
    - terminals 11 and 14: relay contact.

6.9 FEEDER-48R

6.9.1 48 V DC Feeder unit redundant

The 48 V DC Feeder unit redundant (FEEDER-48R) consists of a melamine plate on which a redundant feeder unit is installed.

The 48 V DC feeder unit is completely assembled and pre wired. Only cabling to the input and output terminals and readback contact need to be connected.

The complete 48 V DC feeder unit is protected by removable perspex cover plates.

6.9.2 Wiring details

The below figure shows the schematic wiring diagram for both feeders as they are installed on the 48 V DC feeder unit redundant (FEEDER-48R).

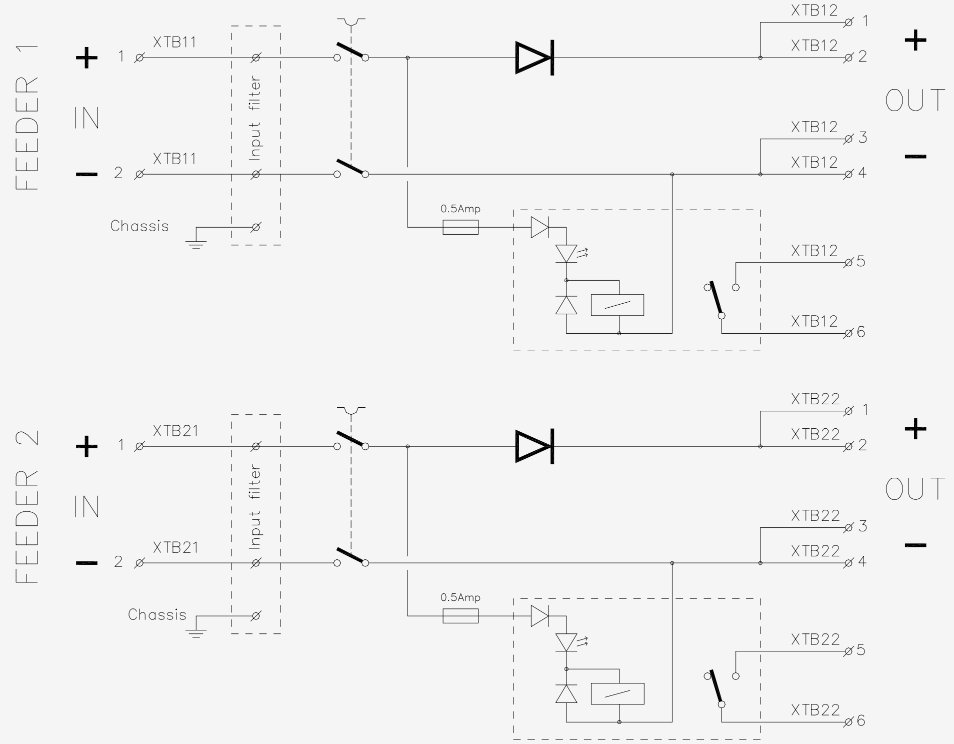


Figure 6-41: Schematic wiring diagram

6.9.3 Layout

The below figure shows the layout of the 48 V DC feeder unit FEEDER-48R with the location of all components.

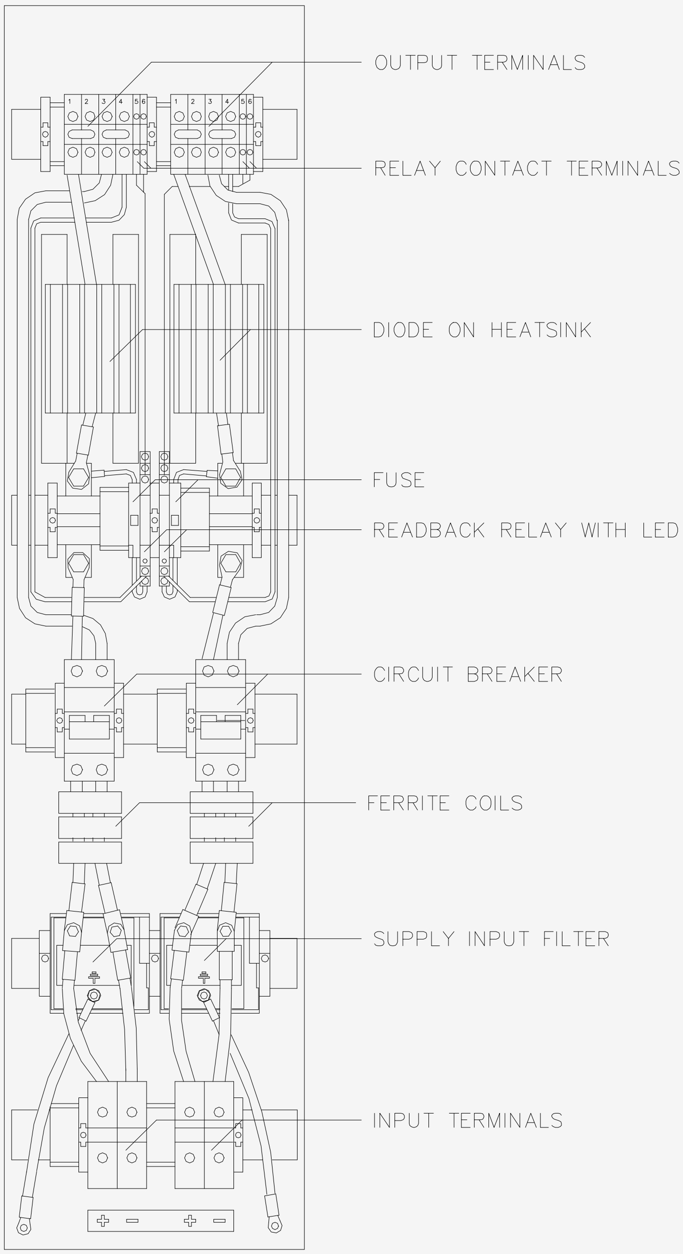


Figure 6-42: Layout of the 48 V DC Feeder unit redundant

6.9.4 Input terminals

> **Note:**
> The maximum allowed wire size is 95 mm^2.

For each 48 V DC input feeder 2 Weidmuller WDU 70N/35 terminals are mounted at the bottom of the redundant feeder unit.

The below figure shows the 48 V DC input terminal details.

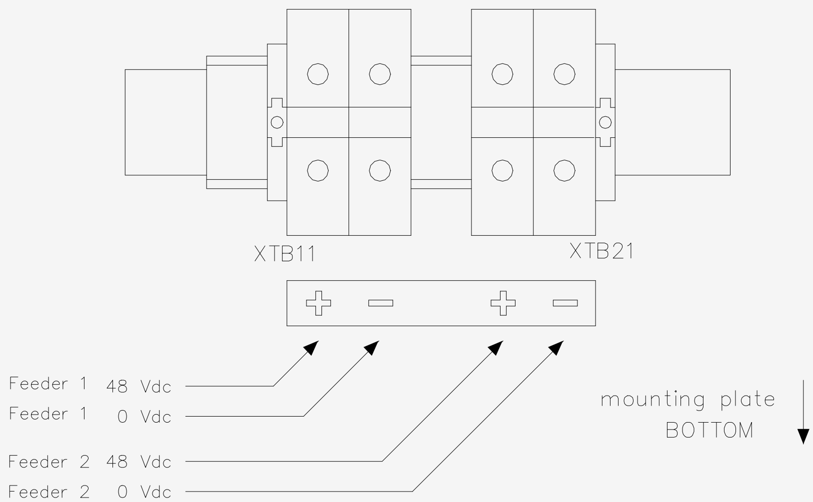


Figure 6-43: 48 V DC input terminal details

6.9.5 Supply input filter

For each 48 V DC input feeder a supply input filter (Honeywell SMS model FS-SIF-48) is installed. For more information see the respective data sheets, to open click SIF-X.

6.9.6 Circuit breaker

> **Tip:**
> If desired it is possible to have the default circuit breaker replaced by an approved type with a *lower* rating.
>
> This must be identified before hand by the cabinet integrator or the end-user.

For each 48 V DC input feeder an ABB double pole circuit breaker is installed. The standard installed double pole circuit breaker is rated for 63A.

6.9.7 Diode

For each 48 V DC input feeder a diode with heat sink is installed.

Each diode:

- is capable of handling 130A throughput current (2.5kA peak current)
- can sustain a reverse voltage of 1.2 kV,
- has a forward voltage drop of ≤ 1.5V.

6.9.8 Output terminals

> **Note:**
> The maximum allowed wire size is 16 mm^2.

For each 48 V DC output 2 Weidmuller WDU 16 terminals are mounted.

The below figure shows the 48 V DC output terminal details. *Terminal 3 is not to be used*. The shaded terminal blocks have a different function.

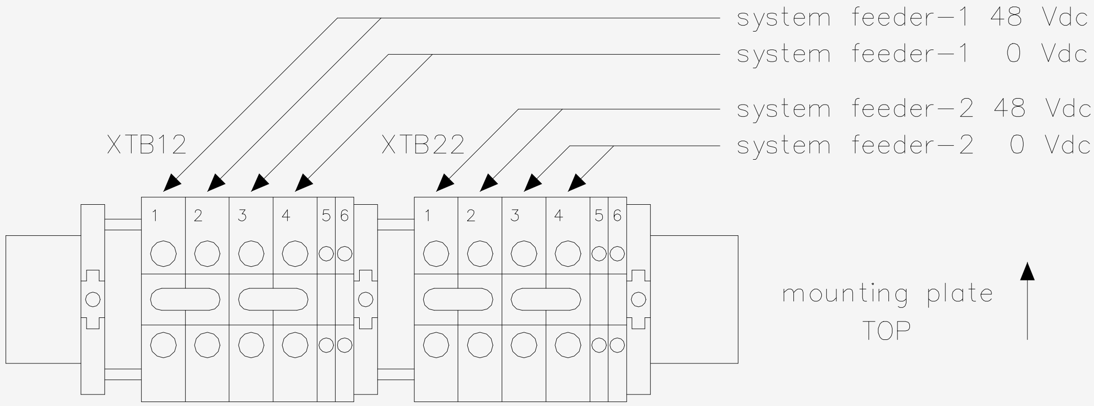


Figure 6-44: 48 V DC output terminal details

6.9.9 Readback relay terminals

For each 48 V DC input feeder a readback contact is available to indicate the feeder status. The below figure shows the readback contact terminal details.

- When 48 V DC is supplied to the 48 V DC input terminals, the (NO) contact will be closed. This contact is a potential free contact.
- Each relay has a green indication LED. When 48 V DC is supplied to the feeder terminals, the LED will be on.
- The relays can be extracted from their terminal socket and be replaced with an identical spare part.

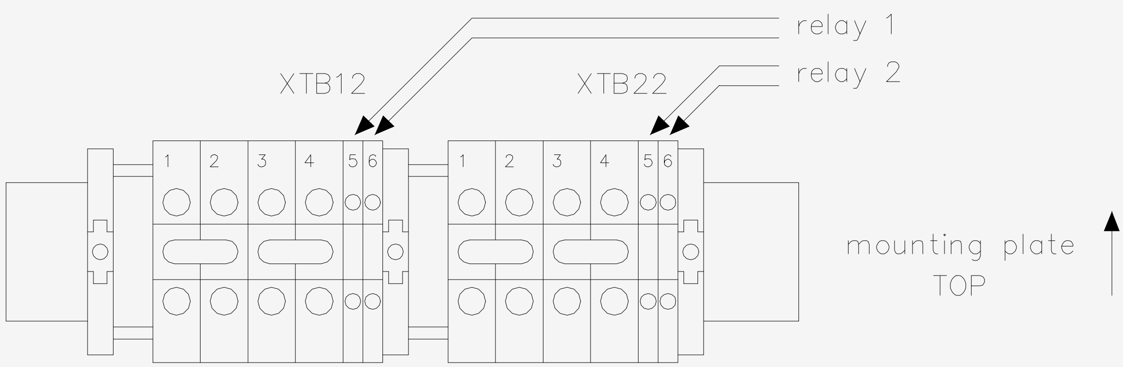


Figure 6-45: Readback contact terminal details

6.9.10 Fuse

A fused terminal is installed in the coil circuit to protect the readback relay. This fused terminal is equipped with a 0.5 A fuse slow blow.

6.9.11 Mounting details

Note:
The 48 V DC Feeder unit redundant (FEEDER-48R) should be mounted in vertical position to ensure that the heat sink of the diode has sufficient airflow.

The below figure left shows the measurements and the mounting hole locations of the of the 48 V DC feeder unit (FEEDER-48R).

The below figure right shows the location of the perspex covers that can be (dis-)mounted for easy access to labels and terminals. The covers must be placed and locked with plastic moulded nuts after assembly of the unit.

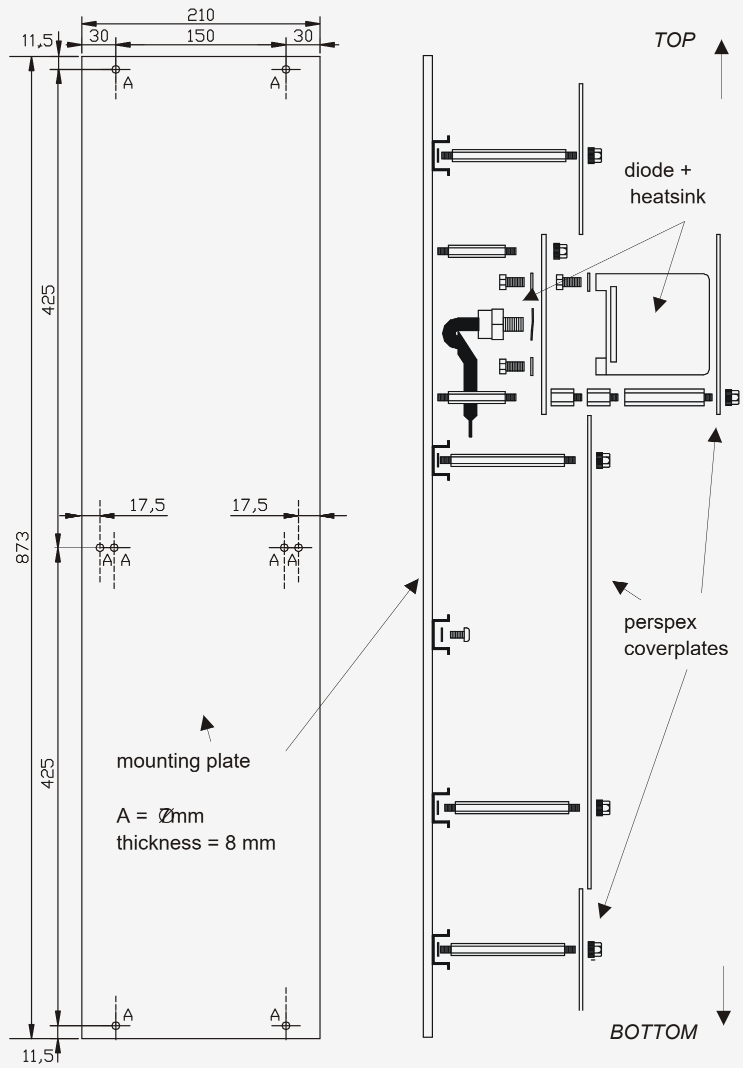


Figure 6-46: Mounting plan and measurements of the FEEDER-48R

6.9.12 Technical data

The FEEDER-48R redundant power feeder unit has the following specifications:

General	Type number[1]:	FS-FEEDER-48R
	Approvals:	CE
Input terminals	Make:	Weidmuller
	Type:	WDU 70N/35
	Maximum cable size:	95 mm^2 (AWG 3/0)
	Tightening torque, min:	10 Nm
Output terminals	Make:	Weidmuller
	Type:	WDU 16
	Maximum cable size:	16 mm^2 (AWG 6)
Fuse	Fuse rating:	500 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2501
	Derating curve:	Linear from 0.5 A at 25 dC to 0.35 A at 70 dC module ambient
Relay	Coil current:	4 mA at 48 V DC
	Maximum switching power	250 V AC / 6 A
	Minimum switching power	12 V / 10 mA
	Terminal wire size	≥0.5 mm^2 (AWG 30)
		≤ 4 mm^2 (AWG 12)

Diode	Peak reverse voltage:	1.2 kV
	Maximum continues current:	130 A
	Peak current:	2.5 kA
	Voltage drop:	≤ 1.5 V
Physical	Space requirements:	873 x 210 x 190 mm (HxWxD)
		34.4 x 8.3 x 7.5 in (HxWxD)
	Weight:	8.8 kg (19.4 lb.)

Note:

1. V1.0 has a different output terminal configuration:
   - terminal 1: system feeder 48 V DC,
   - terminal 2: system feeder 0 V DC,
   - terminals 11 and 14: relay contact.

6.10 FDOVP-2450

24 V DC Feeder and Over-voltage protection unit.

6.10.1 Description

The FDOVP-2450 feeder and over-voltage protection unit protects the system 24Vdc power against overvoltage from the incoming 24Vdc feeder. A 24Vdc feeder line is connected with the FDOVP-2450. The FDOVP-2450 is connected with the 24Vdc supply rail. The FDOVP-2450 can handle upto 50 A.

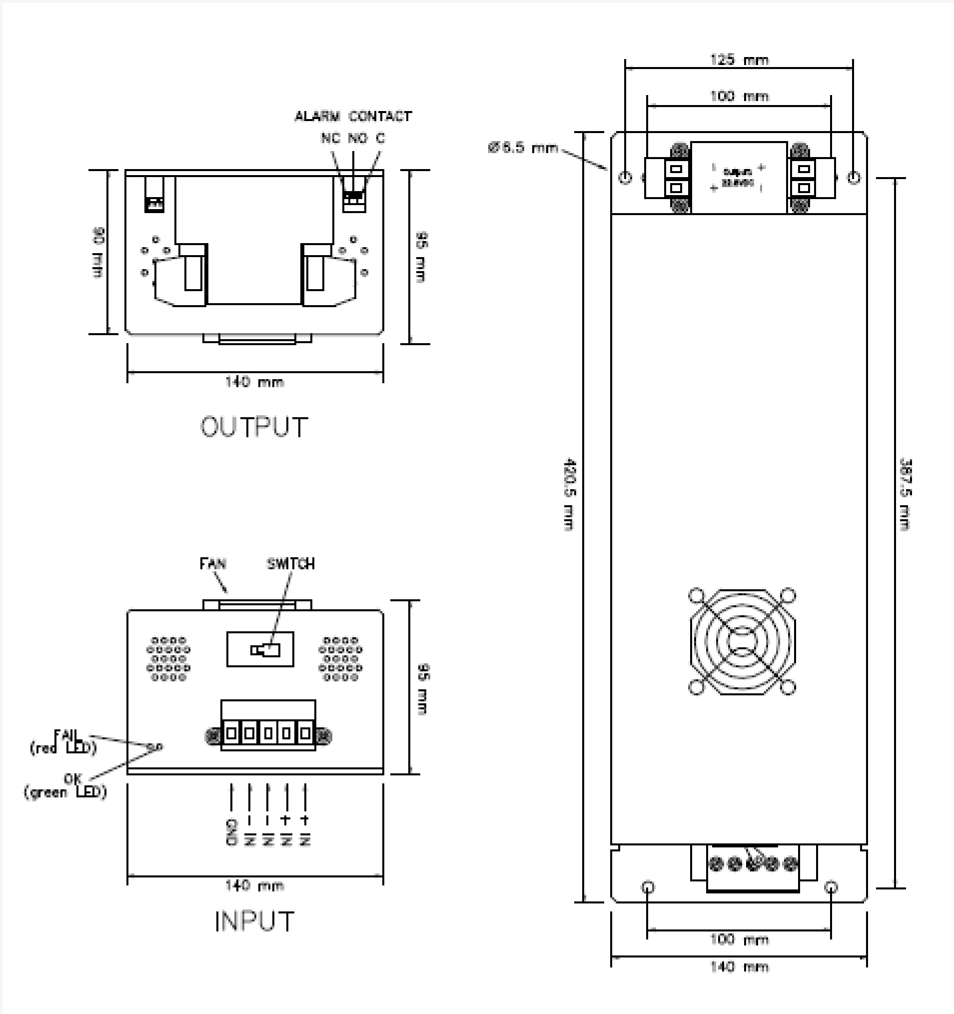


Figure 6-47: Top, Bottom and Front View of FDOVP-2450 unit

6.10.2 Main features

The main features of the FDOVP-2450 unit include:

- Dual built-in over-voltage protection, to comply with the functional safety
- ON/OFF circuit-breaker switch
- an output diode for parallel operation

- an alarm contact (isolated change-over contact)
- requirements of the DIN V 19250 and VDE V 0801 standards
- no galvanic isolation (with direct pass thru of the minus signal)

The LEDs on the bottom-side panel indicate the following status:

- green LED on: OK
- red led on: FAIL input voltage to low or OVP activated
- both LEDs off: No incoming power available (or circuit breaker switched off)

The over-voltage protection function has a latching behavior. That means after an over-voltage detection, the FDOVP-2450 will stay open untill the incoming voltage drops very low or the (circuit-breaker) switch is cycled (open_wait_close).

The FAN is only activated when cooling of the unit is required.

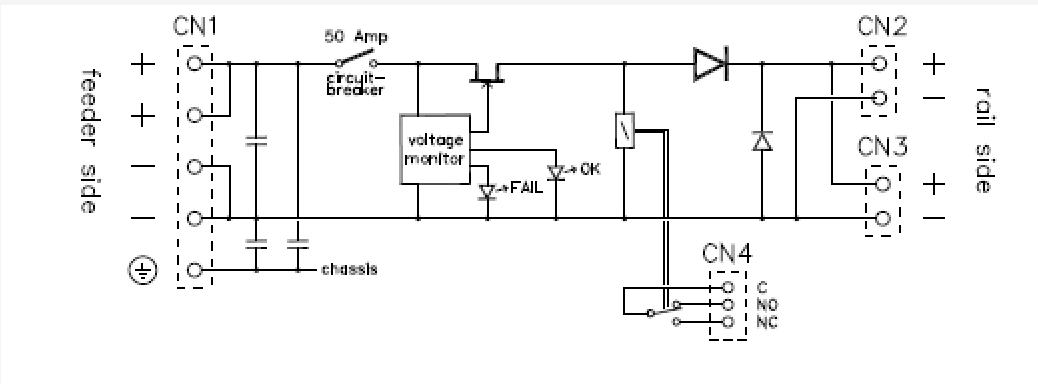


Figure 6-48: FDOVP-2450 Block Diagram

6.10.3 Circuitbreaker Switch

The circuit-breaker switch will open if the current thru the FDOVP-2450 exceeds 50 A.

Attention:
The circuit-breaker switch must be switched off before the power connections (CN1, CN2 and CN3) are placed or removed.

6.10.4 Alarm contact

The FDOVP-2450 has an alarm contact to indicate the unit status.

The indicated contact position (NO open and NC closed) is the situation with an operating unit (relay activated).

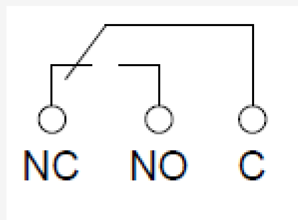


Figure 6-49: Alarm state with output voltage

6.10.5 Electrical connections

The following connection details apply to the over-voltage protection unit.

- The feeder input (CN1) uses a 5-pole connector type PCV6-16/5-G1F-10,16 with locking nuts.
- The feeder outputs (CN2,CN3) uses 2-pole connectors type PCV6-16/2-G1F-10,16 with locking nuts.
  Cables of type PDC-PSU24 are available.
- The alarm wires are connected to a 3 pole female screw socket connector (CN4), make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into the male connector next to the output connectors.

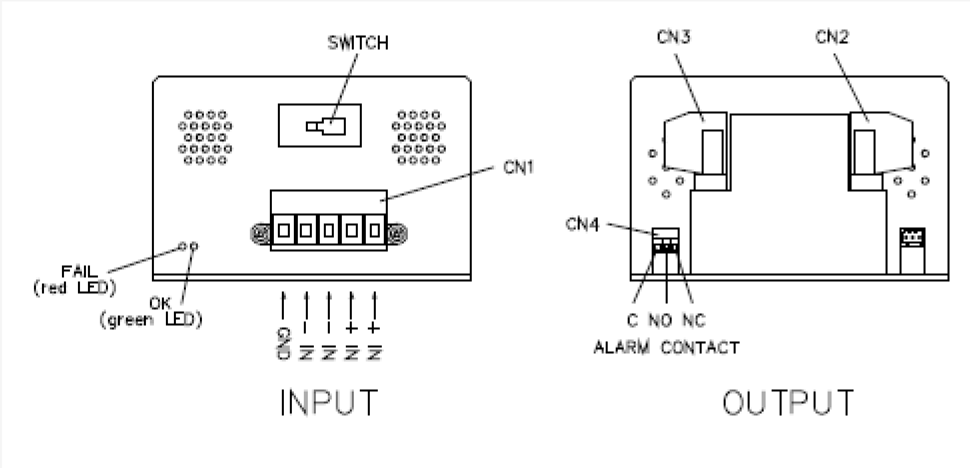


Figure 6-50: FDOVP-2450 Unit - Connector positions

The advised wire size for the feeder and the output connections is 2 x 2 x 8.3mm^2(AWG 8) or thicker.

6.10.6 Technical Data

The FDOVP-2450 unit has the following specifications:

General	Type number:	FC-FDOVP-2450
	Approvals :	CE; UL; CSA
OVP Trip	Input voltage :	30.5-32 V DC
Feeder Input	Input voltage :	18-31.2 V DC absolute maximum: 100 V DC
	Current consumption at no load :	< 120mA (no FAN) typical: 100 mA at 25 V DC
Voltage drop	Input to Output:	0.8 .. 1.2 V at 50 A
Physical	Module dimensions :	420.5 × 140 × 95 mm (L × W × H) 16.6 × 5.5 × 3.7 in (L × W × H)
	Weight:	2.7 kg (5.95 lb)
Environment	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
	Operating temperature:	–5°C—+70°C (–23°F—+158°F)
Isolation	In/Out to case:	500 V DC

Connectors	Feeder input (CN1) :	Phoenix PCV6-16/5-G1F-10,16 (5 pole)
	Cable connector:	Phoenix PC 16/5-STF-10,16
	• min. wire size	0.75 mm²
	• max. wire size	16 mm²
	• strip length	12 mm (0.47 in)
	Output (CN2,CN3) :	2 x Phoenix PCV6-16/2-G1F-10,16 (2 pole)
	Cable connector:	Phoenix PC 16/2-STF-10,16
	• min. wire size	0.75 mm²
	• max. wire size	16 mm²
	• strip length	12 mm (0.47 in)
	Alarm (CN4) :	Phoenix MC 1,5/3-G-3,81 (3 pole)
	Cable connector:	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm²
	• max. wire size	1.5 mm²
	• strip length	7 mm (0.28 in)
Alarm contact	Contact rating :	100 mA / 30 V DC

6.11 RUSPSU-R

6.11.1 Redundant Power Supply assembly 24 V DC, 12 A

The RUSPSU-R is a power supply assembly providing a redundant 25Vdc, 12 A supply voltage (out of a 120Vac or 230Vac line power).

The RUSPSU-R consists of:

- one PSUTA-0001 (see PSUTA-0001)
- and two PSU-UNI2412 power supply units (see PSUTA-0001)

The RUSPSU-R is usable in SIL 3 applications.

The below figure shows the physical appearance of the RUSPSU-R.

> **Attention:**
> The switch must be in ⏻ stand-by position prior to insertion or removal of the power supply.

6.11 RUSPSU-R

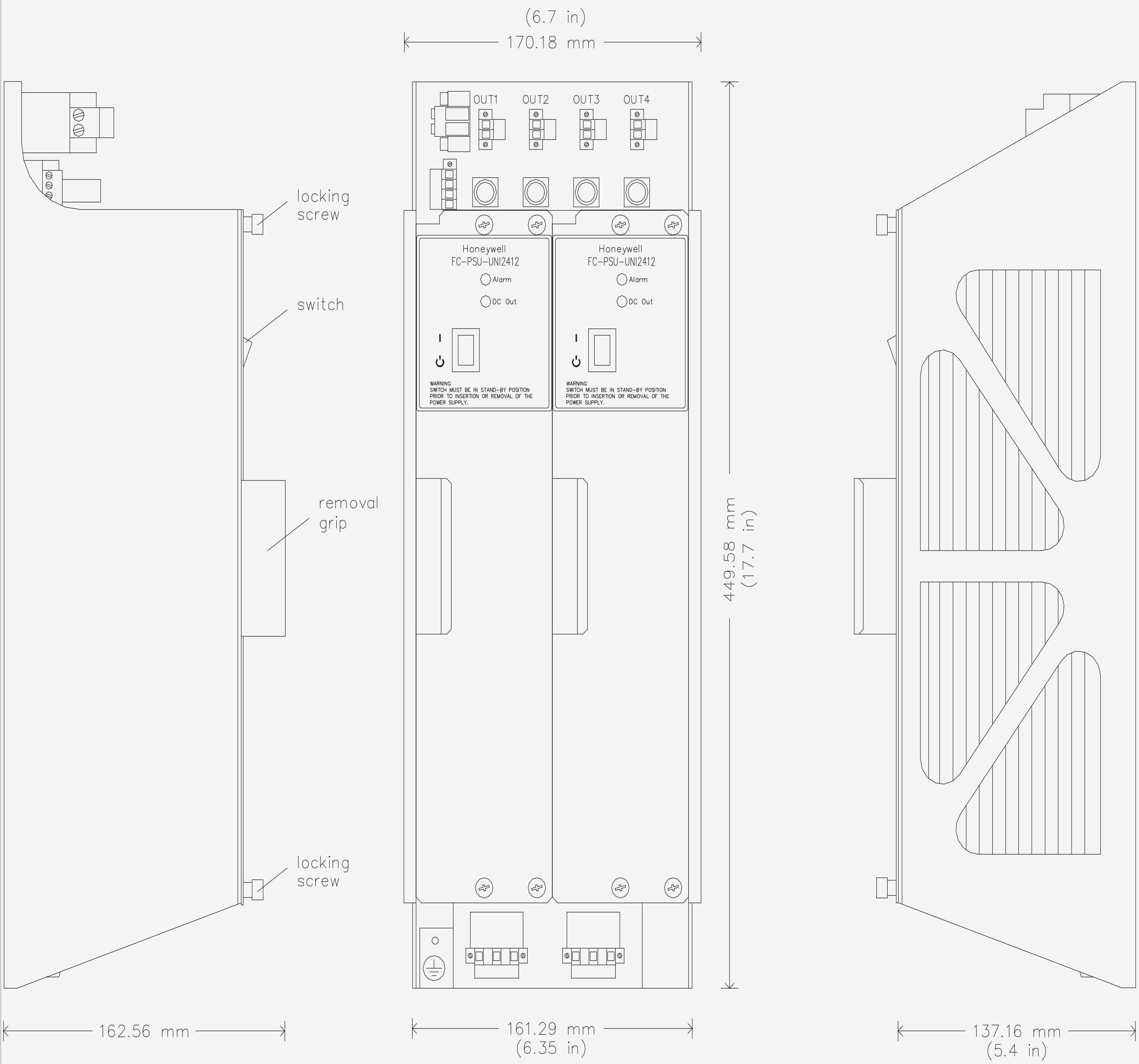


Figure 6-51: RUSPSU-R - mechanical layout

6.11.2 Connections

The connection diagram of the RUSPSU-R power supply assembly is as follows:

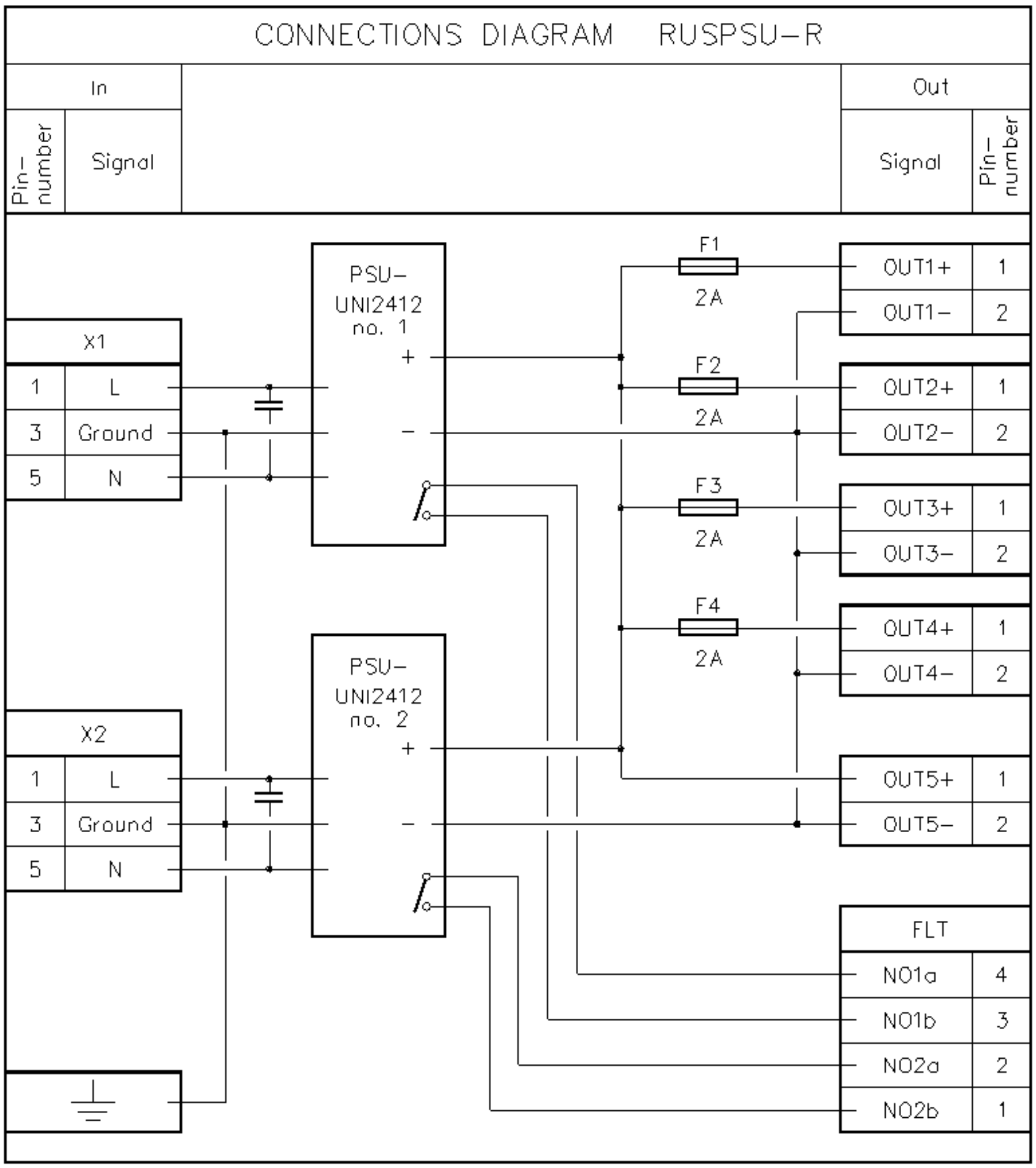


Figure 6-52: RUSPSU-R power supply assembly

6.11.3 Technical data

The RUSPSU-R power supply assembly has the following specifications:

General	Type number:	FC-RUSPSU-R
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL; TUV; IECEx pending
Power IN	Supply voltage:	102..132 V AC or 196 .. 253 V AC
	Frequency:	47 .. 63 Hz
	Connector name:	X1, X2
Power OUT	Output voltage:	25 V DC nominal
	Output current:	0 .. 12 A (redundant)
	Connector name:	OUT1, OUT, OUT3, OUT4 (2 A fused)
	Connector name:	OUT5 (0 .. 12 A)
Alarm contact	Voltage	0 .. 30 V AC or V DC
	Current:	0 .. 65 mA (non-inductive)
	Connector name:	FLT
Physical Data	Dimensions (H x W x D):	447.04 x 157.48 x 162.56 mm
		17.6 x 6.2 x 6.4 in
	Weight:	8.6 kg
		18.9 lbs

6.12 RUSPSU-S

6.12.1 Non-redundant Power Supply assembly 24 V DC, 12 A

The RUSPSU-S is a power supply assembly providing a 25Vdc, 12 A supply voltage (out of a 120Vac or 230Vac line power).

The RUSPSU-S consists of:

1. one PSUTA-0001 (see PSUTA-0001) with a PSU-blind coverplate.
2. one PSU-UNI2412 power supply units (see PSUTA-0001).

The RUSPSU-S is usable in SIL 3 applications.

The below figure shows the physical appearance of the RUSPSU-S.

Attention:
The switch must be in ⏻ stand-by position prior to insertion or removal of the power supply.

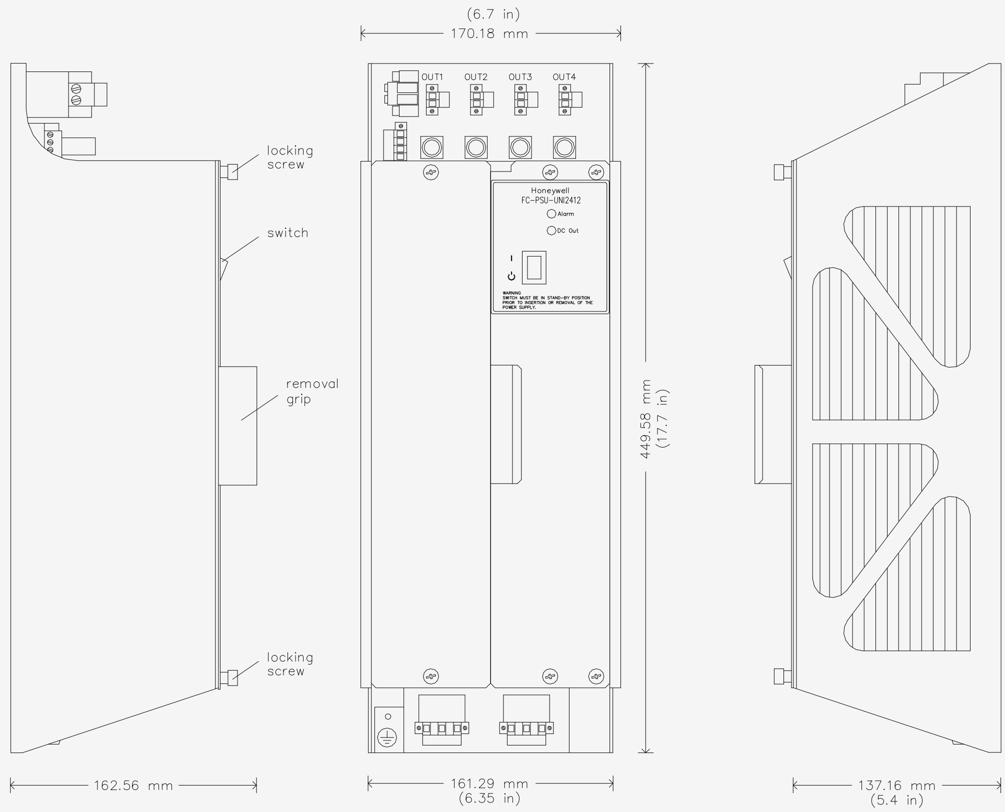


Figure 6-53: RUSPSU-S - mechanical layout

6.12.2 Connections

The connection diagram of the RUSPSU-S power supply assembly is as follows:

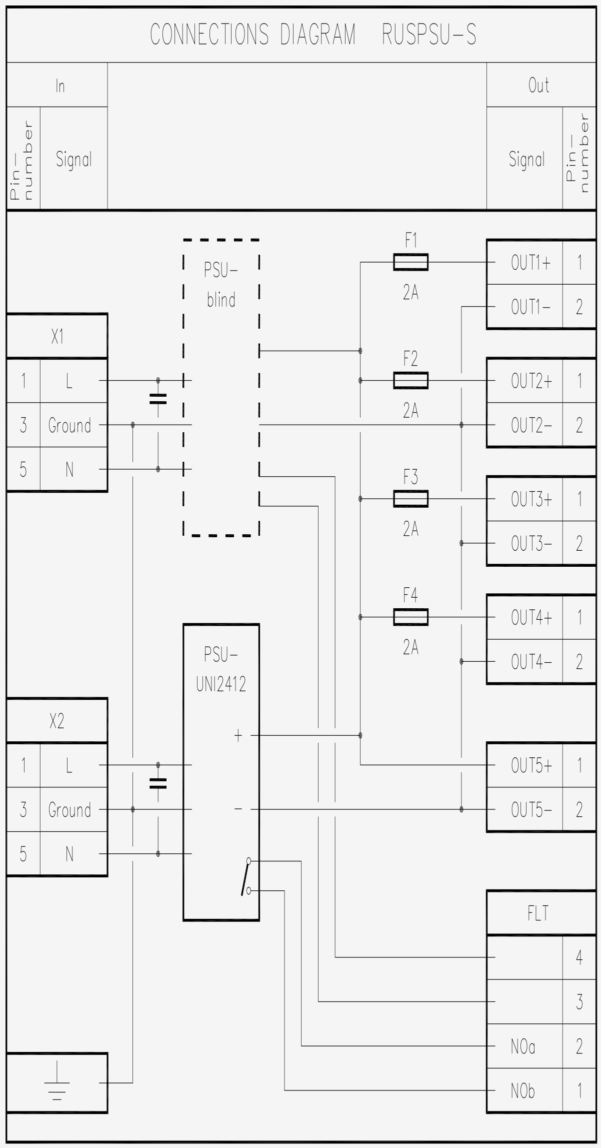


Figure 6-54: Connection diagram

6.12.3 Technical data

The RUSPSU-S power supply assembly has the following specifications:

General	Type number:	FC-RUSPSU-S
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL; TUV; IECEx pending
Power IN	Supply voltage:	102..132 V AC or 196 .. 253 V AC
	Frequency:	47 .. 63 Hz
	Connector name:	X2
Power OUT	Output voltage:	25 V DC nominal
	Output current:	0 .. 12 A
	Connector name:	OUT1, OUT, OUT3, OUT4 (2 A fused)
	Connector name:	OUT5 (0 .. 12 A)
Alarm contact	Voltage	0 .. 30 V AC or V DC
	Current:	0 .. 65 mA (non-inductive)
	Connector name:	FLT
Physical Data	Dimensions (H x W x D):	447.04 x 157.48 x 162.56 mm
		17.6 x 6.2 x 6.4 in
	Weight:	5.2 kg
		11.5 lbs

6.13 PSU-UNI2412U

6.13.1 Power Supply unit 24 V DC, 12 A

The PSU-UNI2412U power supply unit is capable to supply up to 12A (out of a 115Vac or 230Vac line power) at 25Vdc nominal.

The two fault tolerant design makes it usable in SIL 3 applications.

Due to its two fault design the unit covers the SIL 3 safety integrity for the supply of all IO point connected Safety Integrity Functions (SIFs).

The below figure shows the physical appearance of the PSU-UNI2412U.

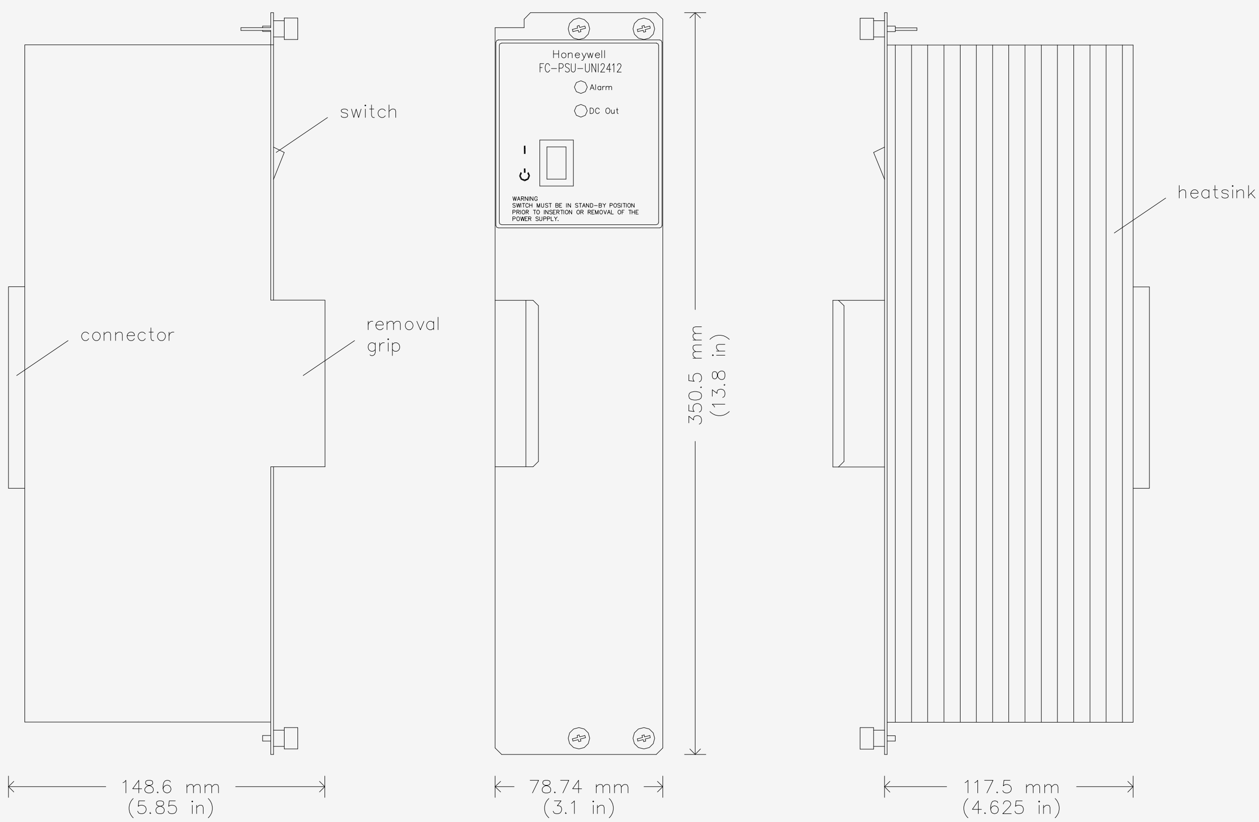


Figure 6-55: PSU-UNI2412U - mechanical layout

Configuration details:

- The PSU-UNI2412U must be placed in a PSUTA-0001 Power Supply Carrier

  (see "PSUTA-0001" on page 299).
- An RUSPSU-R offers a redundant 25Vdc 12 A supply

  (see "RUSPSU-R" on page 284).
- An RUSPSU-S offers a non-redundant 25Vdc 12 A supply

  (see "RUSPSU-S" on page 289).

6.13.2 Hardware control features

The below figure shows detailed views of the power and health and status indications of the unit.

The PSU-UNI2412U power supply has the following hardware control features:

- An ON/Standby switch
- Two LEDs for status indication,

  one for Alarm and one for DC Out indications
- Output over voltage protection (OVP)
- An alarm contact (for status)

Each of these features is discussed in more detail below.

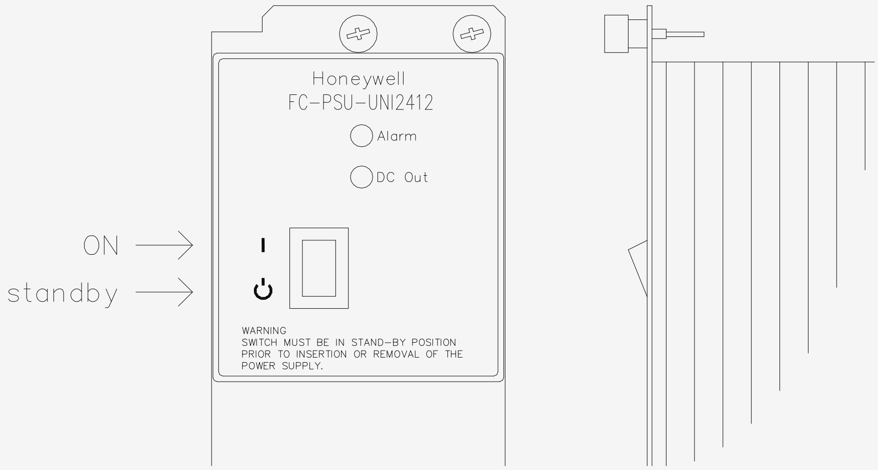


Figure 6-56: PSU-UNI2412U - detailed views

6.13.2.1 ON/Standby switch

The ON/Standby switch has two positions. The side view on the above figure shows the stand-by position.

Attention:

The switch must be in ⏻ stand-by position prior to insertion or removal of the power supply.

6.13.2.2 Status indications

The Alarm LED is:

- Off when the unit is OK or has no power (on AC input)
- Red when the unit is powered (on AC input) but the 25V output is not OK (e.g. because the switch is in the stand-by position)
- Red and blinking when the internal temperature > 90°C

The DC Out LED is:

- green when the 25V output voltage is OK (>22V)
- off when the 25V output voltage is lost

6.13.2.3 Over voltage protection

If an output overvoltage (OVP) is detected, the unit switches off.

An OVP reset requires interruption of the input AC line power, preferrably with the switch in the stand-by position.

6.13.2.4 Alarm contact

The alarm contact is closed when the 25V output is OK (>22V).

6.13.2.5 Temperature derating

The maximum PSU ambient temperature at full load may not exceed 60°C. At tempeartures above 60°C, a derating of 0.6 A per°C must be applied. The below figure shows the effects of temperature derating on the output current.

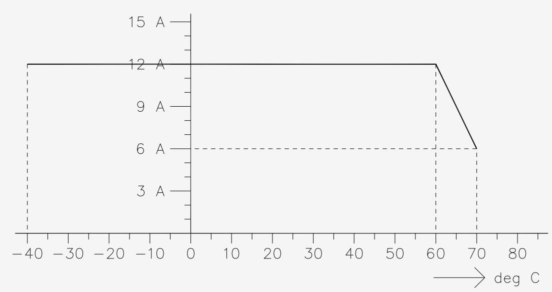


Figure 6-57: Derating curve for the PSU-UNI2412U power supply.

6.13.3 Technical data

The PSU-UNI2412U power supply unit has the following specifications:

General	Type number:	PSU-UNI2412U
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)[1]
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10 .. 95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL; TUV; IECEx pending
	Efficiency:	> 85%
	Power Factor correction:	Yes
	Inrush current:	35A peak, measured at 60Hz 254 V AC
	Holdup time:	> 100ms (Vout > 22.5V; full load)
Power IN	Supply voltage:	102..132 V AC or 196 .. 253 V AC
	Frequency:	47 .. 63 Hz
	Connector name:	X2
Power OUT	Output voltage:	25 V DC nominal
		between 24.3 .. 25.5 V DC at output currents between 0.36 .. 12 A
	Output current:	0 .. 12 A
	OVP trip level:	28V

Alarm contact	Voltage	0 .. 30 V AC or V DC
	Current:	0 .. 65 mA (non-inductive)
Physical Data	Dimensions (H x W x D):	350.5 x 78.74 x 148.6 mm
		13.8 x 3.1 x 5.85 in
	Weight:	3.5 kg
		7.7 lbs

Note:

1. Full output current can be supplied between -40 .. +60°C; at higher temperatures derating applies. For details refer to Temperature derating.

6.14 PSUTA-0001

6.14.1 Power supply carrier 0001

The PSUTA-0001 is a Power Supply Unit Termination Assembly, and it can be equipped with one of the configurations listed below:

- Two PSU-UNI2412 power supply units (refer to RUSPSU-R).
- One PSU-UNI2412 and a PSU dummy (refer to RUSPSU-S).

For physical representations of the PSUTA-0001 see the below figure.

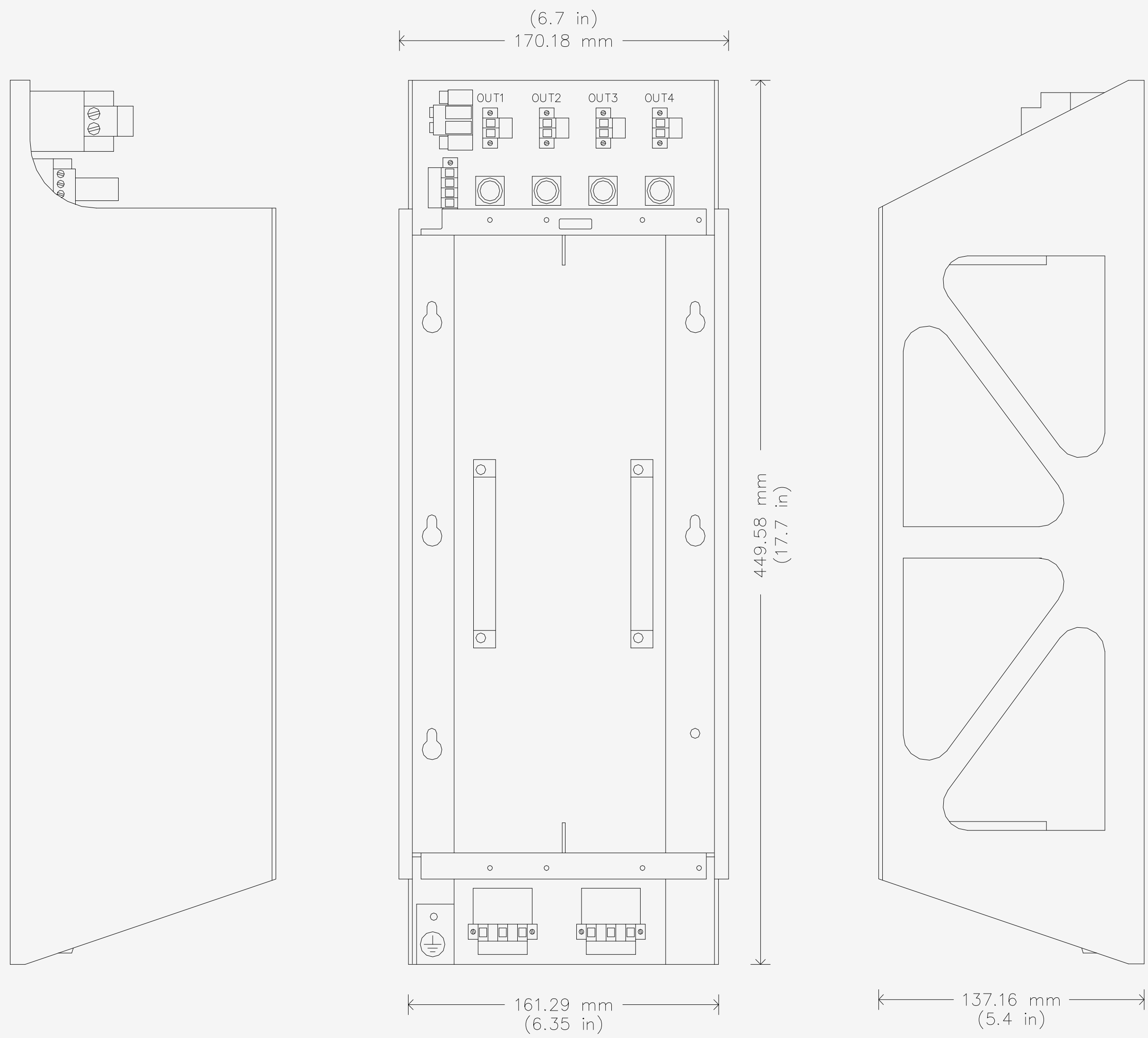


Figure 6-58: Mechanical layout

The PSUTA-0001 consists of:

- A metal frame
- A PCB
- Two (AC) power input connectors
- One ground connection point (M4 thread)
- Two connectors for PSU-UNI2412 power supply units
- One 25Vdc power output connector
- Four fused 25Vdc output connectors
- One FLT (fault) output contacts connector

6.14.2 Pin allocation

6.14.2.1 POWER IN connectors

See the figure below for a top, side & bottom view of the POWER IN connectors.

The two (110Vac or 230Vac) POWER IN connectors (X1 and X2) are situated on the lower side of the PCB.

The pin assignment of connectors X1 and X2 is:

- Pin 5: Neutral (N)
- Pin 3: Ground
- Pin 1: Line (L)

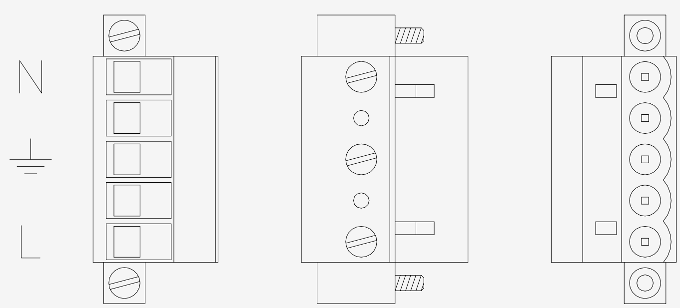


Figure 6-59: POWER IN connectors X1 and X2

On the left of the POWER IN connectors you will find the primary Ground connection point (with M4 thread).

6.14.2.2 Fused 25Vdc out connectors

The below figure shows the top, side & bottom view of the (2 A fused) 25Vdc out connectors.

The 25Vdc out connectors are situated on the upper side of the PCB.

There are four of these 25Vdc out connectors (OUT1, OUT2, OUT3 and OUT4).

1. The pin marked "+" is pin 1; it has a fused +25Vdc connection.
2. The pin marked "-" is pin 2; it has an unfused connection with 0Vdc.

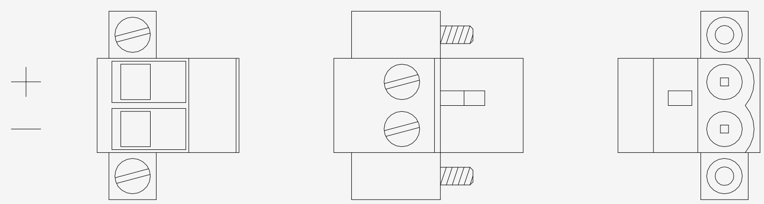


Figure 6-60: Fused 25Vdc out connectors OUT1 thru OUT4

6.14.2.3 Main 25Vdc out connectors

The belwo figure shows the top, side & bottom view of the main 25Vdc out connector.

The main 25Vdc out connector (OUT5) is situated on the upper side of the PCB.

- The pin marked "+" is pin 1. It is connected with +25Vdc.
- The pin marked "-" is pin 2. It is connected with 0Vdc.

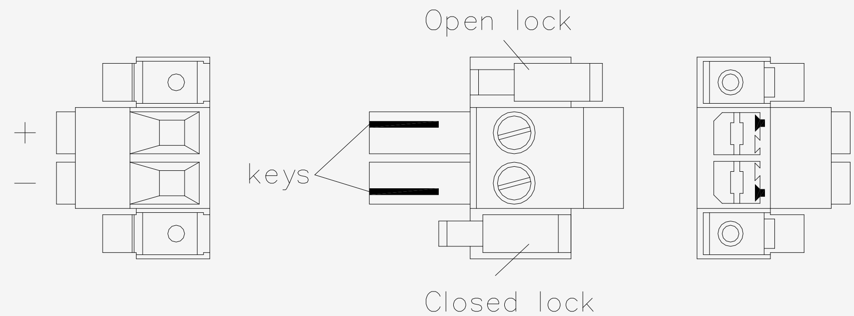


Figure 6-61: Main 25Vdc out connector OUT5

The two (red) locking slides of the cable-connector in the above figure keep the cable-connector locked on the PSUTA-0001.

6.14.2.4 Fault connector

The below figure shows the top, side & bottom view of the Fault connector.

The Fault connector (FLT) is situated on the upper side of the PCB.

The Fault connector combines the contacts of the Power-OK relays of PSU1 and PSU2. These contacts are only closed if the PSU is OK and powered up.

The Power-OK contact of PSU1 is connected between pins 1 and 2 of the Fault connector.

The Power-OK contact of PSU2 is connected between pins 3 and 4 of the Fault connector.

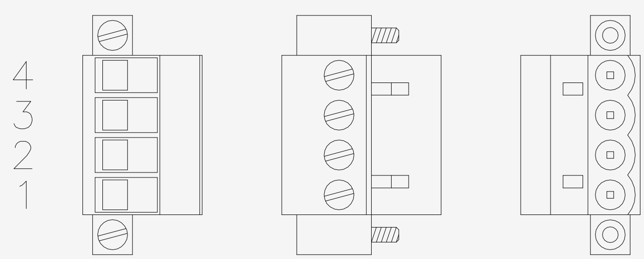


Figure 6-62: Fault connector FLT

6.14.3 Fuses

> **Caution:**
> For continued protection against risk of fire, replace only with same type and rating of fuse.

Fuse replacement is only allowed under no load condition.

Two examples of how to achieve this are listed below:

- Remove or disconnect the field load.
- Put the switch(es) of the (both) PSU in ⏻ stand-by position.

6.14.4 Mounting

The PSUTA-0001 can be screwed on a flat surface. The below figure shows the coordinates of the (six) screw holes. Relevant details are:

- The screw shaft can be up to 5 mm
- The screw head can be up to 11 mm

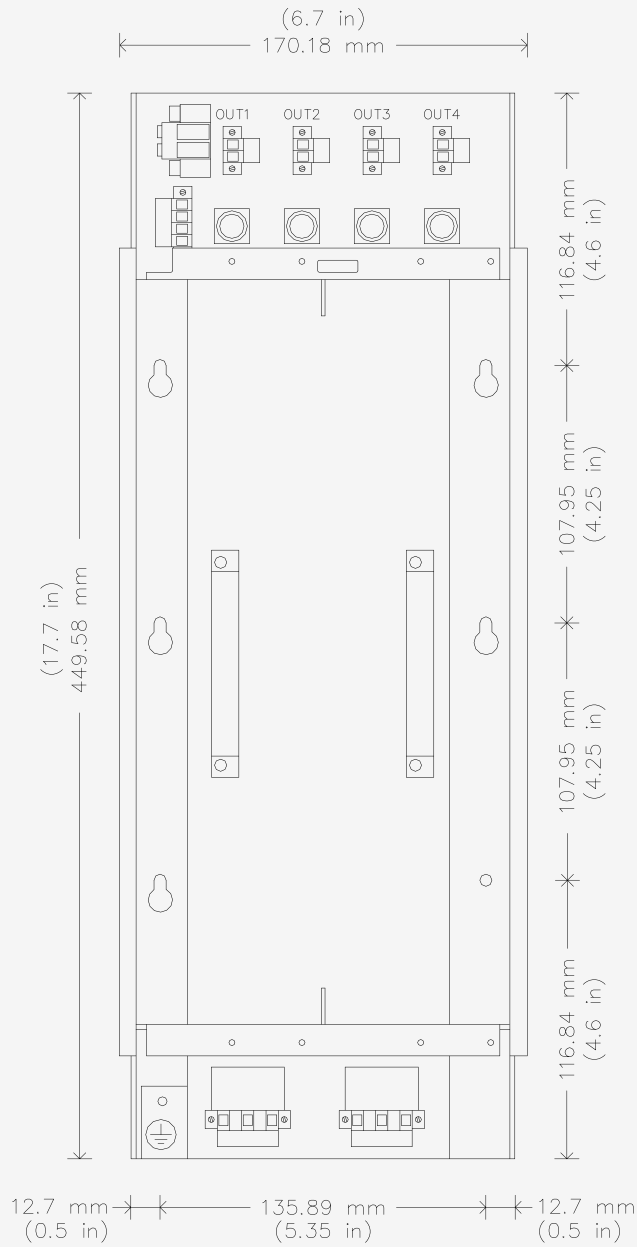


Figure 6-63: Top view with mounting hole coordinates

6.14.5 Connections

The below figure shows the connection diagram of the PSUTA-0001.

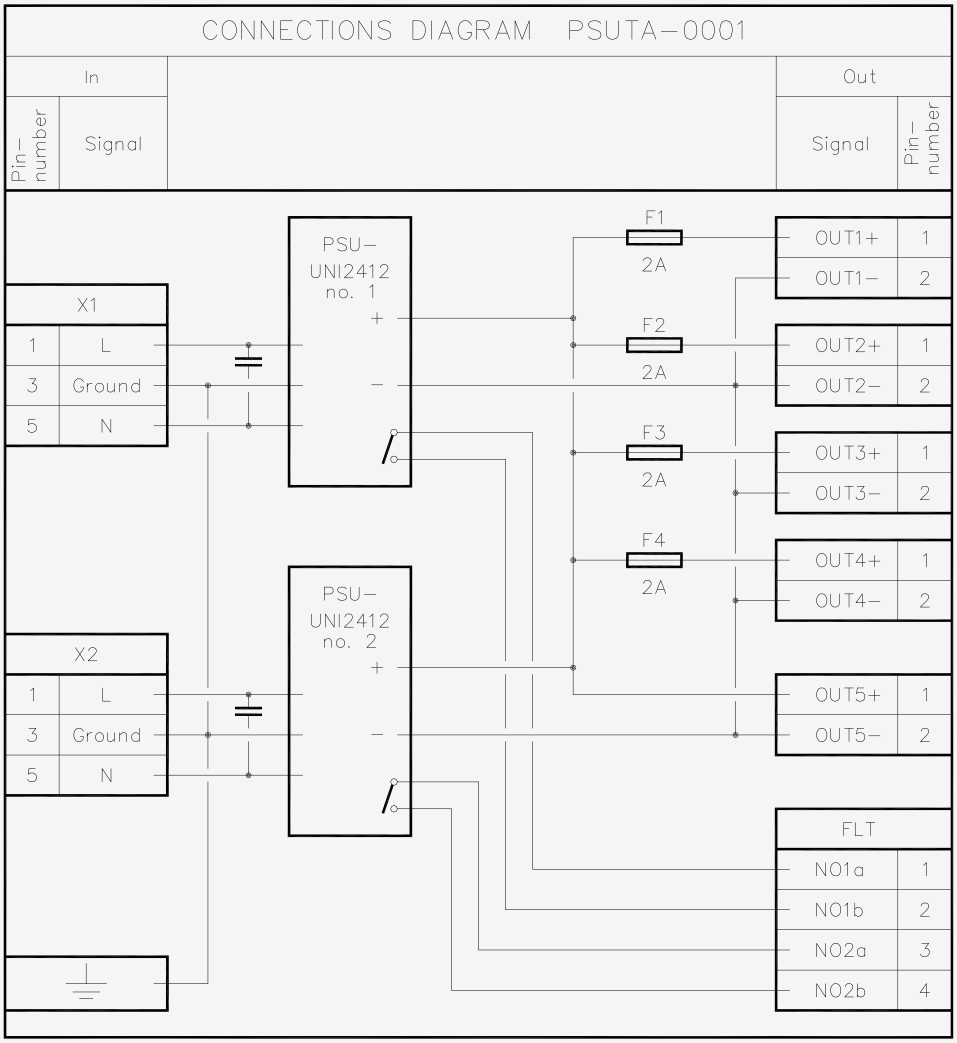


Figure 6-64: Connection diagram

6.14.6 Technical data

The PSUTA-0001 has the following specifications:

General	Type number:	FC-PSUTA-0001
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL; TUV; IECEx pending
Power IN	Supply voltage:	0 .. 260 V AC
	Supply current:	none
Power OUT	Output voltage:	25 V DC nominal
	Output current OUT1..4:	max. 2 A
	Output current OUT5:	max. 12 A
	FLT:	
	• Voltage:	max. 30 V AC or 36 V DC
	• Current:	max. 0.5 A

Fuse	Fuse rating:	2 A
	Fuse dimensions:	6.3x32 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	63 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2527
	Derating curve:	1.4 A

Connectors	Power IN:	5 pole header (3 pins used)
	• Make and type:	Weidmuller: BLZ 5.08/5F SN SW
	Ground:	M4 thread (approx. 10 mm)
	25V supply fused:	2 pole header
	• Make and type:	Weidmuller: BLZ 5.08/2F SN SW
	25V supply main:	2 pole header with keying
	• Make and type:	Weidmuller: BVZ 7.62HP/02F SN (conn.) Weidmuller: BV/SV7.62HP KO (keys)
	FLT:	4 pole header
	• Make and type:	Weidmuller: BLZ 5.08/4F SN SW
Physical Data	Dimensions (H x W x D):	137.2 x 157.5 x 447 mm
		5.4 x 6.2 x 17.6 in
	Weight:	3.2 kg
		7.0 lbs

6.15 QUINT4-PS/1AC/24DC/20 (51454943-100)

The power supply is a switched-mode AC to DC power supply with a high efficiency (94% with 230 V AC input and 20 A output) and supports a wide input voltage range between 100 V AC and 240 V AC.

The QUINT4-PS/1AC/24DC/20 (51454943-100) is certified for use in SIL3 applications where the output voltage needs to be guaranteed below 31 V DC. This is done by using a dual independent over voltage protection established by connecting QUINT4-PS/1AC/24DC/20 (51454943-100) in series with QUINT4-S-ORING/12-24DC/1X40/+ (51454944-100). In combination with an increase immunity for external EM-disturbances

The power supplies can be connected in parallel to support higher output currents. The alarm outputs can be daisy-chained.

6.15.1 Alarm Contact

The QUINT4-PS/1AC/24DC/20 (51454943-100) has an alarm contact used for monitoring the module health status.

The Figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 23.5 V DC.

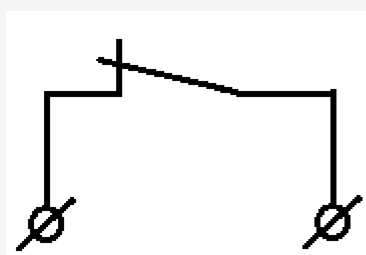


Figure 6-65: Alarm contact state with output voltage above 23.5 V DC

6.15.2 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power inputs facing downwards.

Note:
Vertical mounting is preferred for optimal cooling.

6.15.3 Controller Power Supply Configuration

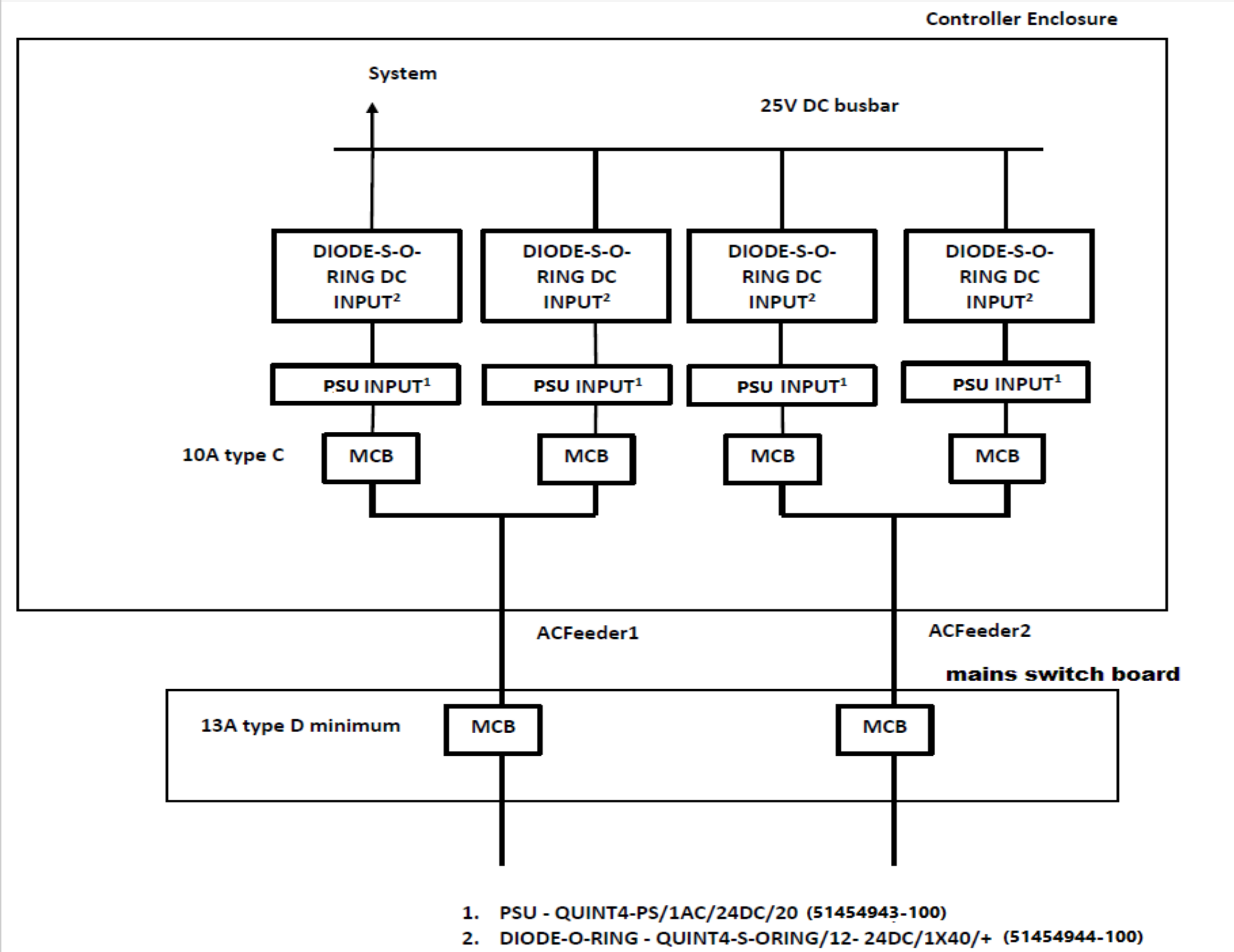


Figure 6-66: Controller Power Supply Configuration

The mains switch board mini circuit breaker or fuse needs to support 120 A inrush current. It is supported with 13 A type D circuit breaker or higher.

6.15.4 Technical Data

Refer to https://www.phoenixcontact.com/us/products/2904602 and https://www.phoenixcontact.com/us/products/2907753 for technical data on QUINT4-PS/1AC/24DC/20 (51454943-100) and QUINT4-S-ORING/12-24DC/1X40/+ (51454944-100) respectively.

6.15.5 Settings

Make sure you have the correct settings on the QUINT4(+) as described here:

PSU default settings to check (default)

- Output undervoltage level: 90% (is 22.5V)
- Output characteristic curve: U/I Advanced

PSU settings to check/change (not default)

- Parallel operation: No -> Yes (For better load sharing; output voltage lowers with current)
- DC output voltage: 24V ->25V (To compensate for the 0.5V maximum voltage drop at 20A, having the parallel operation mode enabled.)

Advised PSU settings to check/change (not default)

- Lock the NFC with a password: No -> Yes
- Disable the front buttons: No -> Yes

> **Note:**
> The settings for the QUINT4(+) can be changed in 2 different ways:
>
> - Using the Phoenix TWN4 MIFARE NFC USB ADAPTER and PC software
> - Using an android phone with NFC capability and the Phoenix App
>
> For details about how to change/update these settings, refer to the Phoenix Contact product website.

6.16 QUINT4-PS/1AC/24DC/20/+ (50151665-001)

The power supply is a switched-mode AC to DC power supply with a high efficiency (>97% with 230 V AC input and 24 A output) and supports a wide input voltage range between 100 V AC and 240 V AC.

The QUINT4-PS/1AC/24DC/20/+ (50151665-001) is certified for use in SIL3 applications where the output voltage needs to be guaranteed below 31 V DC (integrated with O-Ring). This is done by using a dual independent over voltage protection supporting the IEC 61508 architectural constrains. In combination with an increase immunity for external EM-disturbances.

The power supplies can be connected in parallel to support higher output currents. The alarm outputs can be daisy-chained.

6.16.1 Alarm Contact

The QUINT4-PS/1AC/24DC/20/+ (50151665-001) has an alarm contact used for monitoring the module health status.

The Figure shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 23.5 V DC.

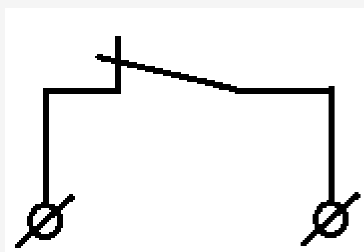


Figure 6-67: Alarm contact state with output voltage above 23.5 V DC

6.16.2 Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power inputs facing downwards.

> **Note:**
> Vertical mounting is preferred for optimal cooling.

6.16.3 Controller power supply configuration

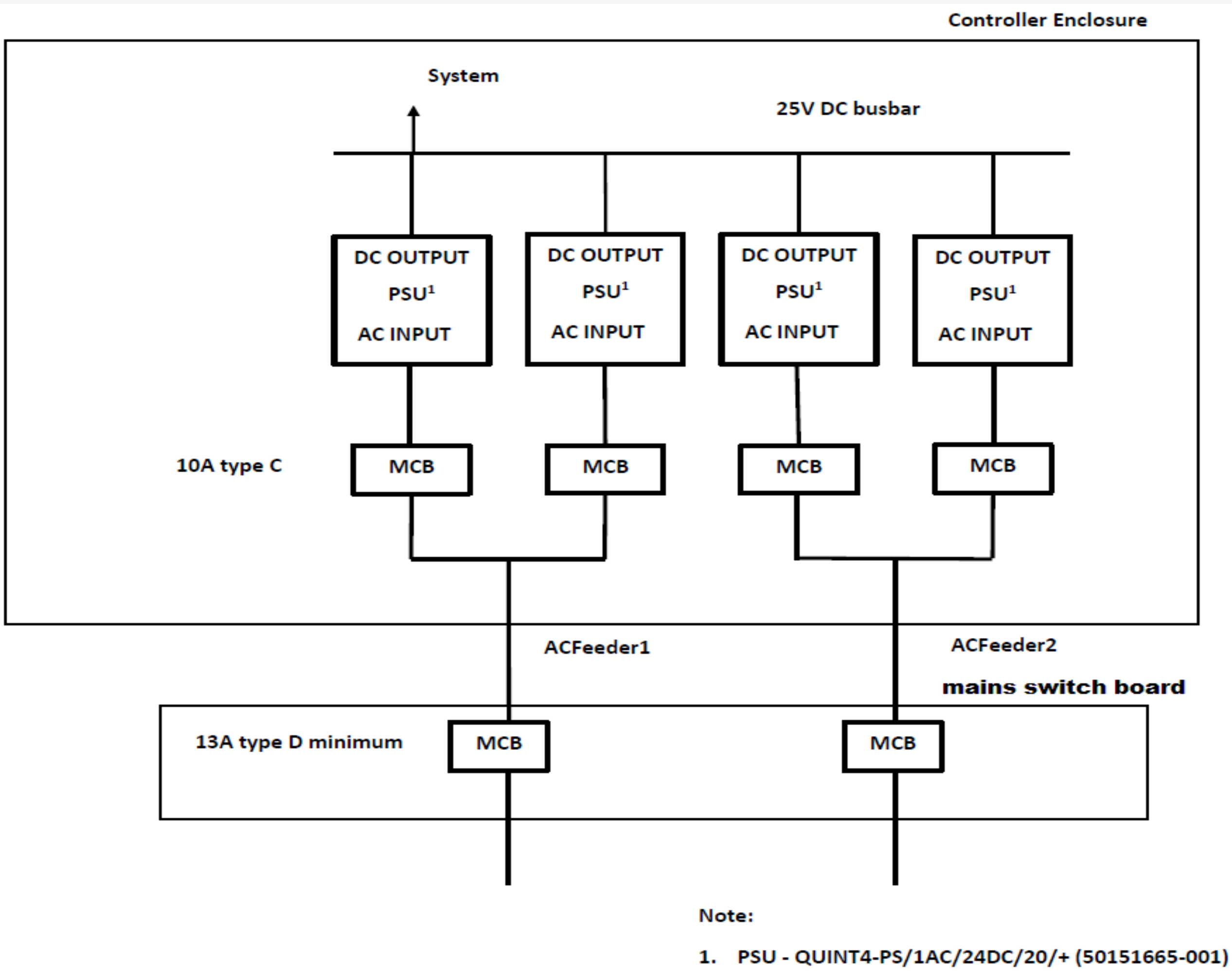


Figure 6-68: controller power supply configuration

The mains switch board mini circuit breaker or fuse needs to support 120 A inrush current. It is supported with 13 A type D circuit breaker or higher.

6.16.4 Technical Data

Refer to https://www.phoenixcontact.com/us/products/2904617 for technical data on QUINT4-PS/1AC/24DC/20/+ (50151665-001).

6.16.5 Settings

Make sure you have the correct settings on the QUINT4(+) as described here:

PSU default settings to check (default)

- Output undervoltage level: 90% (is 22.5V)
- Output characteristic curve: U/I Advanced

PSU settings to check/change (not default)

- Parallel operation: No -> Yes (For better load sharing; output voltage lowers with current)
- DC output voltage: 24V ->25V (To compensate for the 0.5V maximum voltage drop at 20A, having the parallel operation mode enabled.)

Advised PSU settings to check/change (not default)

- Lock the NFC with a password: No -> Yes
- Disable the front buttons: No -> Yes

Note:
The settings for the QUINT4(+) can be changed in 2 different ways:

- Using the Phoenix TWN4 MIFARE NFC USB ADAPTER and PC software
- Using an android phone with NFC capability and the Phoenix App

For details about how to change/update these settings, refer to the Phoenix Contact product website.

CHAPTER 7

CONTROL PROCESSOR MODULES

7 Control Processor modules

This chapter describes the following Control Processor modules:

Module	
USI-QPP-0002	Quad Processor Pack
BLIND-COM	Dummy communication module
BKM-0001	Battery and Key switch Module
PSU-240516	Power Supply Unit 24/5 V DC, 16 A

7.1 General info about Control Processor modules

Each Safety Manager Control Processor module is located in a pre-determined slot in the Controller chassis (see section CPCHAS-0002). Connectors and earth/keying pins in the backplane ensure they can only be placed in the slot reserved for that type of Control Processor module (see the below figure).

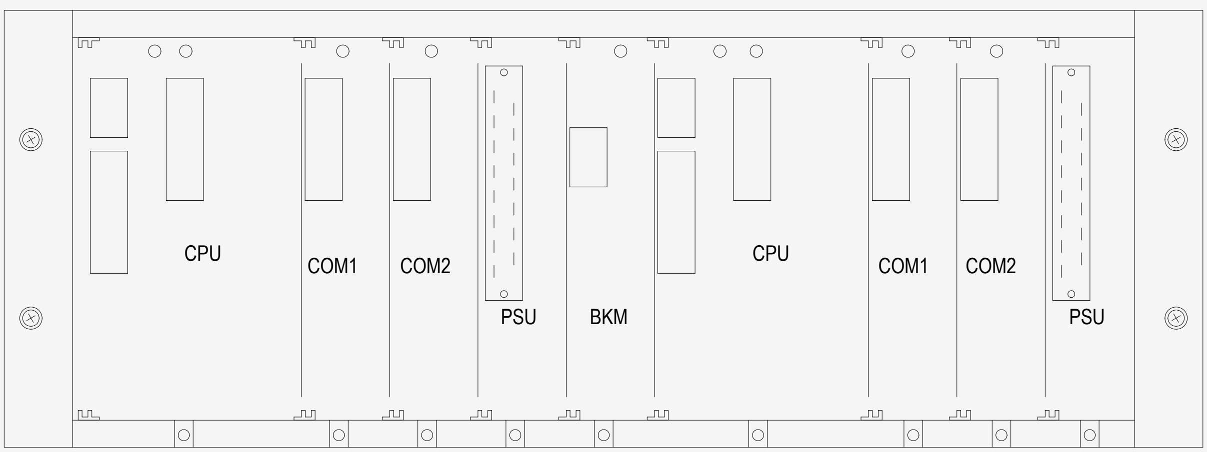


Figure 7-1: Front view of an empty Controller chassis

All connections and communication from and to Control Processor modules run via the Controller backplane (see section Controller backplane CPB-0001).

Available Control Processor modules and their functionality

Control Processor module		Functionality

QPP-0002	Quad Processor Pack	• Two -synchronous- processors
		• Flash memory for system and application program
		• RAM with battery backup (battery located in BKM-0001)
		• Data comparators for the processors and their memory
		• A redundant communication link with the other Control Processor
		• Data exchange with its communication modules
		• Watchdog (fully testable) with:
		    • Minimum and maximum execution time monitor
		    • Memory error handler
		    • 1oo2D functionality
		    • 24V and 5V monitoring
		    • Emergency Shut Down Input (24V)
		    • Two outputs (for non-redundant resp. redundant IO)
		• Four IObus drivers
		• Diagnostics display
		• Temperature monitors
		• Real time clock

USI-0002	Universal Safety Interface	• Two 10/100 Mb Ethernet channels • Two general purpose SCC channels
BKM-0001	Battery and Key switch	• Backup batteries for CP1 and CP2

Control Processor module		Functionality
	Module	• Reset key switch • Force Enable key switch • Three general purpose inputs (24 V DC)

PSU-240516	Power Supply Unit 24/5 V DC, 16 A	• Dual 5 V supply (out of 24 V DC) for:
		  • Control Processor and redundant IO
		  • Non-redundant IO

7.2 QPP-0002

7.2.1 Quad Processor Pack

The Quad Processor Pack (QPP-0002) is the second generation (enhanced performance) processing module of Safety Manager and is located in the Controller chassis (see section CPCHAS-0001 or CPCHAS-0002 or CPCHAS-0003).

The QPP-0002 is backwards compatible with, and a one-on-one spare part for the QPP-0001, when installed in Safety Managers running R121 firmware or higher.

> **Attention:**
> You can only remove or replace the QPP-0002 module safely when the key switch is in *STOP*!

A non-redundant Controller contains one QPP-0002 module, a redundant Controller contains two QPP-0002 modules.

The slot of the Quad Processor Packs within the Controller chassis is pre-determined (see Location of Control Processor modules).

The Quad Processor Pack (QPP-0002) is the heart of Safety Manager. It controls all system operations. The QPP-0002 module reads the IO input signals and executes the Controller File as created by the user in graphical Functional Logic Diagrams (FLDs). The results of the Controller File are then transmitted to the output interfaces. In Safety Manager configurations with a redundant Controller, the two QPP-0002 modules synchronize their operation through a dedicated redundant communication link between the two Control Processors. Continuous testing of the Safety Manager hardware by the QPP-0002 module ensures safe control of the process as well as extensive system and process equipment diagnostics.

The QPP-0002 module has two processors and two memory sets. Hardware data-comparators compare every read and write action of the processors, and trip the watchdog if any difference in the data is detected. Additional test hardware enables full testing of the QPP-0002 module to achieve diagnostic coverage higher than 99%. This allows one QPP-0002 module to run applications up to and including SIL3 without time limitation. Redundant Controller configurations result in a 2oo4D voting architecture.

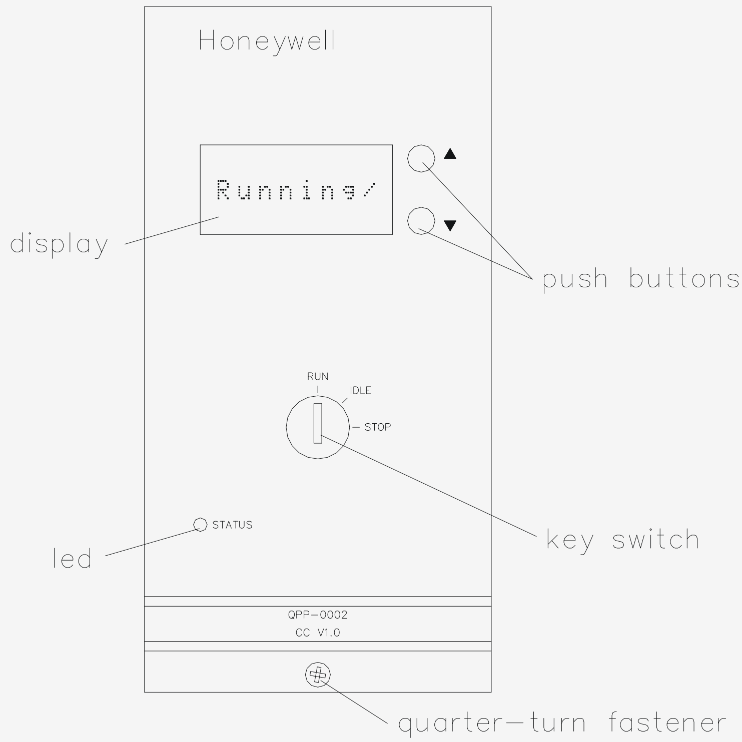


Figure 7-2: the front view of the QPP-0002

The QPP-0002 has the following components:

- Two processors running synchronously
- Flash memory for system and application program
- Flash memory for backup of system and application program
- RAM with battery backup (battery located in BKM-0001)
- A redundant communication link with the other Control Processor
- RAM for the redundant communication link data
- Data comparators for the processors and their memory
- Data exchange with its communication modules
- Watchdog (fully testable) with:

- Minimum and maximum execution time monitor
- Memory error handler
- 1oo2D functionality
- 24V and 5V monitoring
- Emergency Shut Down Input (24V)
- Two outputs (for non-redundant resp. redundant IO)
- Four IObus drivers
- Diagnostics display
- Temperature monitors
- Real time clock

7.2.2 Processors

The QPP-0002 module has two processors running synchronously during process control. During an (application-) download they may get out of sync, but after the download they will re-synchronize.

The processors run the system program (including extensive self tests and diagnostic routines) and the application program.

7.2.3 Memory

The QPP-0002 module has the following on-board memory:

- 2 × 2 Mbyte flash for the system and application program.
- 2 × 256 kbyte SRAM with battery backup (for IO, markers, counters, timers and registers).
- 2 × 512 kilobyte SRAM for data-exchange with the other Control Processor.
- 1 x 16 Mbyte flash for backup of system and application program.

The flash contents can be updated without removing the QPP-0002 from the Controller chassis.

7.2.4 User interface

The QPP-0002 module has the following features for indicating the Controller status and allowing the user to start, stop, reset, power-up and power-down the Control Processor:

- User Interface Display
- Processor Status Key Switch
- Status LED

7.2.5 User interface display

Note:
The information on the user display may vary depending on the software version installed in the QPP.

The QPP module has a user interface display that informs the user of the status of the Control Processor and all the IO related to it.

The eight-digit display shows one message at a time, and the user can scroll between messages with the use of the buttons on the right-hand side of the display (see the below figure).

Many messages, like diagnostic messages, are divided into sub-messages, called stages (see the below table). The user interface display automatically scrolls through these stages within the current message.

When left alone for 30 seconds, the user interface display returns to the default status message.

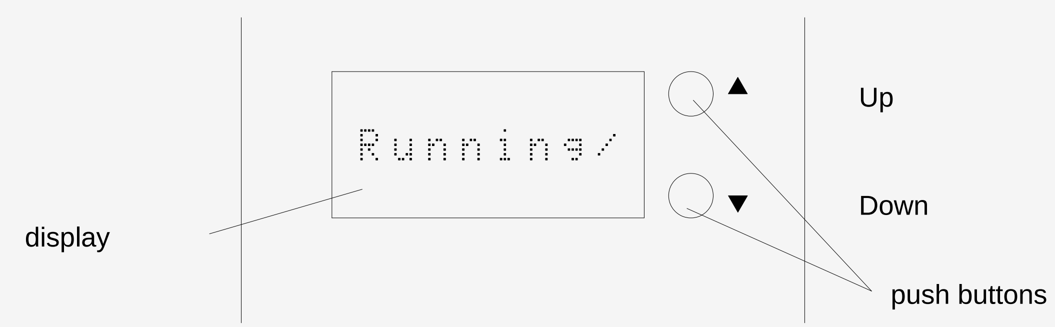


Figure 7-3: the user interface display of the QPP-0002

Messages displayed by the User Interface Display of the QPP module

Scroll	Message	Description
↑ Up Down ↓	Fail	Shows the number of diagnostic messages (N)
	Frc	Shows the number of forced points
	IP 2B IP 2A IP 1B IP 1A	Shows the details for the selected COM port. If a COM port is configured the display shows: IP address (in two steps); Gateway; Gateway IP address (in two steps). If a COM port is not configured the display shows: Not Config.; Gateway Not Config. (in two steps).
	Sys	Shows the Controller node number
	Vb	Shows the battery voltage for this Control Processor in Volts
	Vcc	Shows the 5VDC PSU output voltage for this Control Processor in Volts
	Tmp	Shows the temperature for this Control Processor
	Date	Shows the actual date
	Time	Shows the actual time
	R #version no.#	Shows the software version number
	Default status message[1]	For details see Table 2.
↑ Up Down	Diagnostic message N	Shows the diagnostic messages that apply for this Controller. If there are no messages the display shows “Fail 0”.

<table>
<tr><th>Scroll</th><th colspan="2">Message</th><th>Description</th></tr>
<tr><td rowspan="4">↓</td><td colspan="2"></td><td rowspan="4">If there are multiple messages the last 32 messages are displayed in chronological order. The last message is shown first.

Select a message with the scroll buttons. When releasing a scroll button on a diagnostic message the display scrolls:
• the fault location in two steps (chassis and slot),
• the faulty module in the next step (module ID)
• the message body in two steps (Message 1 & 2)
• the error code in the next step (Error #)

After completing this cycle the display returns to the default status message.</td></tr>
<tr><td>↓</td><td>1. Chass
2. Slot
3. Module ID
4. Message 1
5. Message 2
6. sError #</td></tr>
<tr><td colspan="2">Diagnostic message N-1</td></tr>
<tr><td>↓</td><td>1. Chass
2. Slot
3. Module ID
4. Message 1
5. Message 2
6. Error #</td></tr>
<tr><td colspan="4">1. When selecting another display message with the scroll buttons, the display will always return to this message after a time-out.</td></tr>
</table>

Table 2. Possible default status messages

Status	Message[1]	Alternating with
Busy with power-on checks	*PowerUp*	
Busy synchronizing	*Sync*	
Busy loading	*Loading*	
Waiting for download to start	*Waiting*	
Waiting for download to start	*Waiting*	with Flt
Key in *IDLE*: CP halted	*Halt*	
Key in *RUN*: CP halted due to faults	*Halt*	with Flt
Key in *RUN*: CP ready to start	*CPReady*	
Running with faults	*Running*	with Flt
Running no faults	*Running*	
Loading other CP, or loading own USI	*Sending*	

1. A continuously rotating bar or a flashing star on the display indicates that the QPP is operational.

7.2.6 Processor status key switch

The QPP-0002 module contains a processor status key switch that enables the user to change the Control Processor status. This key is different from the keys of the key switches on the BKM-0001 module.

The below table shows the possible statuses of the Processor Status Key Switch.

Table 1. Positions of the processor status key switch

Processor status key	Description
RUN	The Control Processor executes (or is ready to execute) the Application File.
IDLE	The execution of the application program is ended by the processors. The current application and memory contents are not affected by the IDLE state. The Control Processor is available for loading software. The watchdog outputs are de-activated by the processor.
STOP	The Control Processor is in Hardware Reset. It is not executing any program. The watchdog outputs are de-activated. The IObus drivers are de-energized.

7.2.7 Status LED

The QPP-0002 has one STATUS LED on the front side of the module.

The below table shows the possible states of this STATUS LED.

Table 1. LED indicators of the QPP-0002 module

LED	Status	Description
STATUS	Off	The power to the module is down or the Processor Status Key Switch is set to STOP.
	Red	One or more hardware errors detected on the module.
	Green	No hardware errors detected on the module.

7.2.8 SD input

The QPP-0002 has a (24 V DC) emergency Shut Down input.

A low level on the emergency Shut Down input will de-energize the watchdog outputs independently from the processor. The SD input is available on the Controller backplane and requires a normally closed (field-)contact.

The SD input is common for both Control Processors. The +24 V_SD-output is supplied by both QPP-0002 modules, but the input stays operational even if one of the QPP-0002 modules has no 24 V DC supply, or is removed.

- If the SD function is used you should connect an external potential free SD contact via the SICP-0002/L3 (see SICP-0002/L3).
- If the SD function is not used an SD link is required (default placed on the CP backplane).

This SD input is 24 V DC and galvanically isolated from the internal 5 V DC (see the below figure).

Note:
The resistor R on the 24 V input circuit of the SD input in the below figure limits the short-circuit current (to 0 V) of the +24 V_sd signal.

The external potential free SD switch is connected via a SICP-0002/L3 cable. For more details see SICP-0002/L3 and CPCHAS-0001 or CPCHAS-0003.

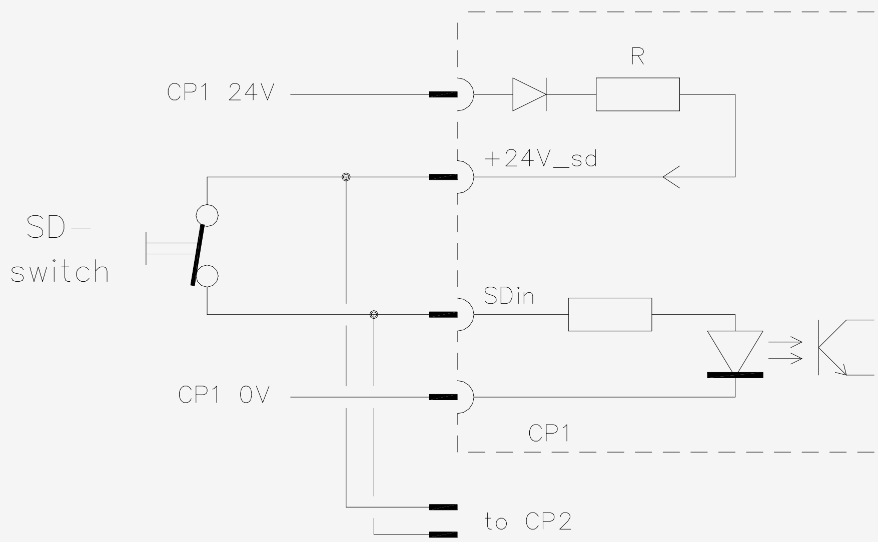


Figure 7-4: SD input schematic

7.2.9 Watchdog functionality

The Watchdog function in the QPP-0002 monitors the operation and the operating condition of the processors. The processor operation is monitored by verifying whether the processors execute all the tasks within a pre-calculated time frame, which depends on the configuration. The monitored operating conditions include the data integrity of the processor memory, the (5 V) processor supply voltage and the (24 V) IO supply voltage (both undervoltage and overvoltage). If the Watchdog detects a fault in the operation of the QPP-0002 or its operating conditions, it will deactivate its outputs and thus deactivates the safety-critical outputs of Safety Manager, independent of the QPP-0002 status.

The watchdog module monitors system parameters including:

- The application loop maximum execution time. This in order to detect if the process is executing its program correctly and is not looping (hang-up).
- The application loop minimum execution time. This in order to detect if the processor is executing its program correctly and is not skipping program parts.

- Data (-bus) differences. This will detect memory errors and processor defects.
- 5 V DC level. Overvoltage and undervoltage detection (5 V DC ± 5%).
- 24 V DC level. Overvoltage and undervoltage detection (24 V DC –20%, +35%).
- SD input signal level.

The watchdog also includes the following features:

- A 1oo2D functionality.

  The processor has the capability to de-energize the watchdog of the other (redundant) processor in the Controller chassis.
- A (second) watchdog-output for the non-redundant IO modules. This output is connected in parallel with the (second) output of the other processor in the Controller chassis. The output is used to energize the watchdog input of non-redundant IO chassis and will stay ‘high’ as long as at least one of the processors keeps its (second) output high. If a fault is detected in a module in the non-redundant IO section, the processors can switch off this ‘second’ watchdog-output and keep the redundant IO modules online.

In order to be able to test all watchdog functions, the watchdog module is duplicated. The outputs are switched in parallel (‘wired OR’ function) to enable a trip of one section without losing the watchdog signal to the IO.

The below figures show the watchdog section and watchdog outputs schematics.

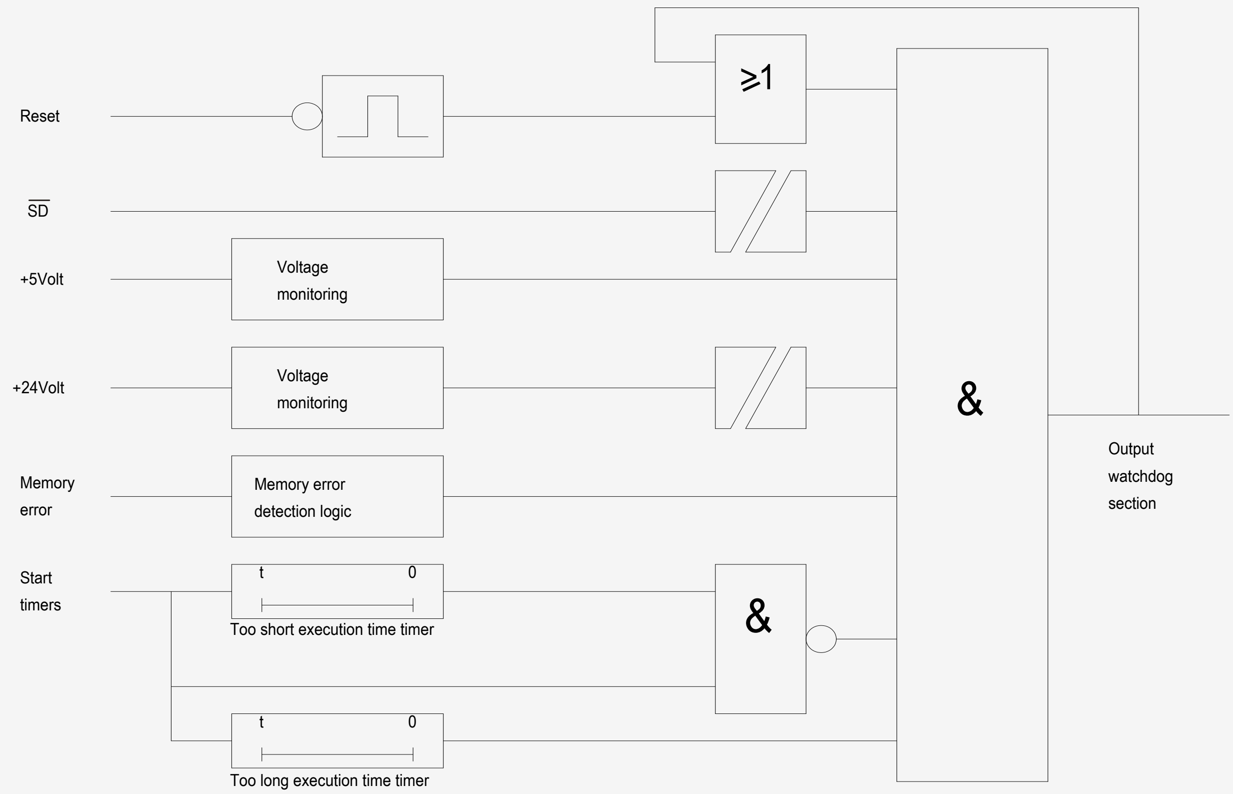


Figure 7-5: Watchdog section schematic

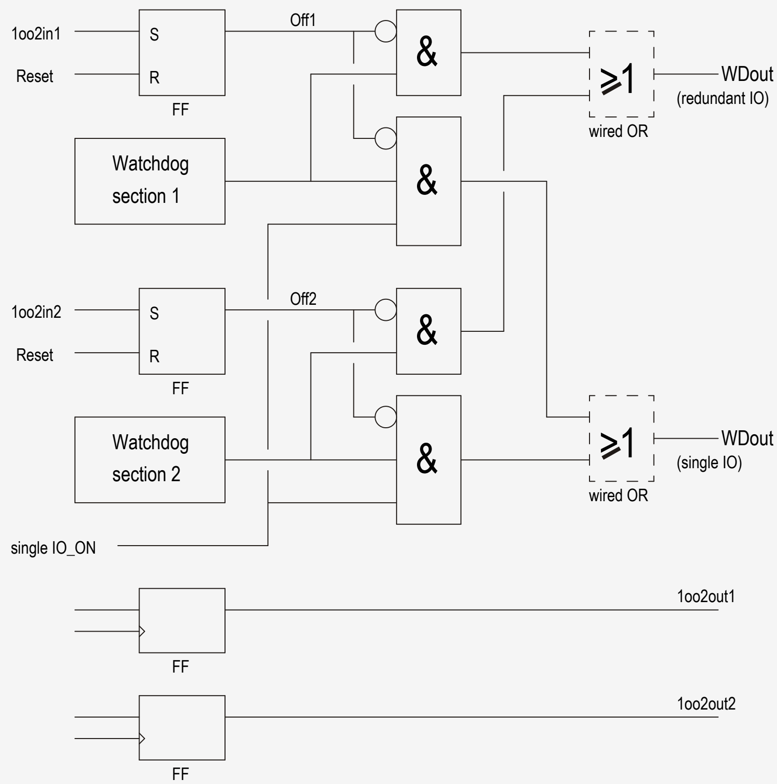


Figure 7-6: Watchdog outputs schematic

The lower two flip-flops in the above figure latch the (outgoing 1oo2D) commands to de-energize the watchdog (parts) of the (redundant) processor. These outputs of the (redundant) processor are connected to the (1oo2D) inputs of this watchdog ('1oo2in1' and '1oo2in2' in the above figure).

Each WD_{out} output can drive 750mA.

7.2.10 Diagnostics

The following diagnostics are performed by the QPP-0002 module:

- QPP-0002 generates an alarm and event when battery voltage drops below the data retention voltage. The "data retention voltage" is defined as the absolute minimum voltage needed for a device to correctly maintain the contents of their RAM circuits. This voltage is standard 2.0 V.
- QPP-0002 generates an alarm and event when the battery lifetime expires.
- The 5 V DC voltage 'too high' or 'too low' will be alarmed.

The 24 V DC voltage ‘too high’ or ‘too low’ will be alarmed.

- The diagnostics on the hardware comparators will detect “stuck-at” and “shorts between inputs and outputs of the comparators”.
- The fault reaction to faults detected in the temperature monitoring function will result in an alarm, unless the temperature measured by the other Control Processor differs less then 3 degrees Celsius from a shutdown limit. In the latter case, an automatic shutdown of the Control Processor is initiated.
- Faults detected in the 10 ms base timer function result in automatic Control Processor shutdown.
- The fault reaction on a hardware failure detected by the hardware comparators of the application processor will result in an alarm to the safety processor, which initiates a Control Processor shutdown.

The following diagnostics are defined for the BKM-0001 (most electronics for execution of these functions are located on the QPP-0002):

- The BKM-0001 is not placed.
- Battery voltage is out of range (too high, too low and open circuit).
- The safety processor will have the capability and possibility to indicate a faulty battery status on the status LED of the BKM-0001.

7.2.11 Technical data

General	Type number:	FC-QPP-0002
	Operating temperature:	
	• outside module temperature:	-5°C-+70°C (+23°F-+158°F)
	• inside module temperature:	-5°C-+85°C (+23°F-+185°F)
	Storage temperature:	-40°C-+85°C (-40°F-+185°F)
	Relative humidity:	10-95% (non condensing)
	Approvals:	CE, UL, CSA, TUV, FM
Power	24 V supply voltage:	24 V DC -15%-+30%
	24 V supply current:	max. 25 mA
	5 V supply voltage:	5 V DC ± 5%
	5 V supply current:	max 1.2 A
+24 V_sd	Output supply voltage:	15-31 V DC
	Output resistance:	approx. 1.1 kΩ
	Short circuit proof:	continuous
SD input	Voltage (high):	15-32 V DC
	Voltage (low):	<4 V (reverse polarity protected)
	Input current:	approx. 8mA at 24 V DC
WD_{out} output	Output current:	750mA per output
Physical	Dimensions: (H × W× D)	176 × 88.5 × 212 mm
		6.93 × 3.48 × 8.35 in
	Weight:	1,3 kg

7.3 USI-0002

7.3.1 Universal Safety Interface

The USI-0002 communication module handles Ethernet and Serial communication with external devices, e.g. Experion™ PKS and Safety Builder. It is located in the Controller chassis (see section CPCHAS-0001 or CPCHAS-0002 or CPCHAS-0003).

The below figure shows the front view of the USI-0002 module.

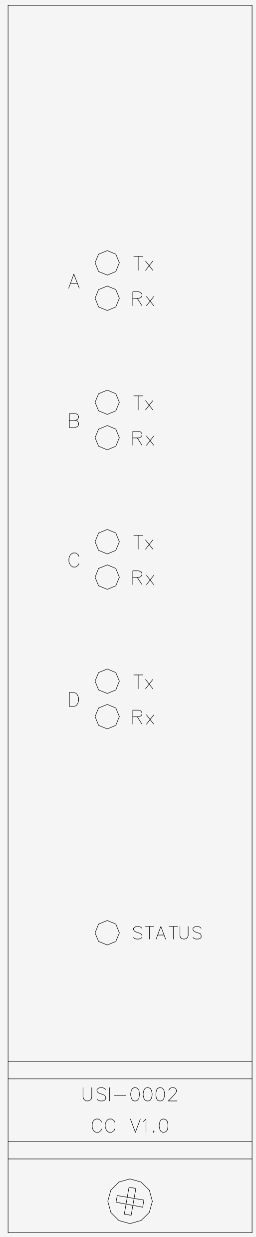


Figure 7-7: Front view of the USI-0002 module

The main function of communication modules is handling the communication to and from external devices and other Safety Managers. The USI-0002 has four (4) independent communication channels. See the below table for the relevant details.

Table 1. The communication channels of the USI-0002 module

<table>
<tr><th>Channel</th><th>Description</th><th>Connector</th><th>Connects to</th><th>Communication cable</th></tr>
<tr><td>A</td><td rowspan="2">10/100 Mb Ethernet[1]
Communication Channels</td><td rowspan="2">RJ45</td><td rowspan="2">SDW-550-EC</td><td rowspan="2">CCI-HSE-01, CCI-HSE-02</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="2">General purpose Serial
Communication Channels</td><td rowspan="2">10-pins
AMP</td><td rowspan="2">DCOM-232/485
DCOM-485[2]</td><td rowspan="2">CCI-UNI-02
CCI-UNI-04</td></tr>
<tr><td>D</td></tr>
<tr><td colspan="5">1. The Ethernet interfaces are auto-ranging, they automatically select between 10 and 100 Mb. It is highly recommended to configure the port to fixed 100MB/Full duplex.
2. Required for FSC-SM SafeNet with baud rate of 1M/2M Manchester coded.</td></tr>
</table>

Furthermore, the USI-0002 communication module acts as hardware firewall, protecting the safety functions within Safety Manager. It has:

- enhanced protective capability,
- high internal memory for running multiple demanding communication protocols in parallel.

The module consists of the following items:

- A Motorola 8270 communication processor.
- EEPROM to store specific module data, such as the two MAC-addresses and the hardware revision number.
- 8 Mbyte Flash memory to store the system and application program. The flash content is copied to SRAM at startup and is executed from there. The flash content can be updated without removing the USI-0002 from the Controller chassis.
- 8 Mbyte Local SRAM (with Error Detecting and Correcting logic) for system and application program and information.

- 256 kilobyte shared RAM for data exchange between the USI-0002 and the Control Processor.
- Two dual-speed fast ethernet transceivers
- Two general purpose serial communication controller channels.

7.3.2 LED Indicators

The below table lists LEDs that are visible at the front side of the USI-0002 module.

LED indicators of the USI-0002 module

LED	Status	Description
Tx N[1]	Green	Data is being transmitted on channel N[1].
	Off	No data is being transmitted on channel N[1].
Rx N[1]	Green	Data is being received on channel N[1].
	Off	No data is being received on channel N[1].
STATUS[2]	Green	No hardware errors are detected in the module.
	Red	One or more hardware errors are detected in the module.
	Off	Power down or booting

1. N = 1, 2, 3 or 4.
2. When the QPP Key switch is in the stop position, the FX-USI-0002 status LED is off. In this same situation, the status LED of other USI types is Green.

7.3.3 Reset mechanism

The USI-0002 module resets hardware via the following mechanisms:

- Power-up or power-dip.
- If the Quad Processor Pack (key switch) goes in 'STOP' mode.
- If the Quad Processor Pack generates a COMmunication RESet.

The communication *channels* are reset (go offline) if:

- the module resets, or
- the dedicated watchdog times out.

> **Note:**
> A dedicated watchdog has been added to prevent a possible communication lock-out on the communication lines, if the processor on the USI-0002 gets a fatal error (e.g. program hang-up or loss of clock).

7.3.4 Hot swap

The USI-0002 module has 'hot swap' features.

This means that the module may be placed or removed in a running system. The application program will not be interrupted by these actions.

7.3.5 Additional specifications

The USI-0002 module has a galvanic isolation of:

- ≥ 2.5 kVdc between the 5 V DC and the Ethernet signal.
- ≥ 1.5 kVdc between the Ethernet signal and the casing of the USI-0002.
- ≥ 1.5 kVdc between the 5 V DC and the casing of the USI-0002.

If a memory error in the USI-0002 module is detected, the Quad Processor Pack will get an interrupt.

The USI-0002 module has a power-up self-test (diagnostics) phase for testing of the following components:

- Processor address- and data registers
- Local RAM
- Shared RAM
- Exception Handling
- Software integrity

Power-up self-tests are required to reduce the risk of defective hardware or corrupted software being used.

7.3.6 Technical data

The USI-0002 has the following specifications.

General	Type number[1, 2]:	FX-USI-0002
	Operating temperature:	-5°C - +70°C (+23°F - +158°F)
	Storage temperature:	-40°C - +85°C (-40°F - +185°F)
	Relative humidity:	10 - 95% (non condensing)
	Approvals:	CE, TUV, UL, CSA, FM
Power	5 V supply voltage:	5 V DC ± 5%
	5 V supply current:	max 1.2A
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D)
		6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0.7 kg

Note:

1. FE-USI-0002 and FX-USI-0002 support the EUCN protocol.
2. FX-USI-0002 can replace FC-USI-0001, FC-USI-0002, and FE-USI-0002 from Safety Manager R140 and higher.

7.4 BLIND-COM

7.4.1 Dummy communication module

The dummy communication module (BLIND-COM) is placed in COM slots of the Controller chassis that are not used for actual communication modules (USI-0002).

The purpose of this module is to create a closed and grounded EMC-shield at the front of the Controller chassis.

The below figure shows the front view of the BLIND-COM.

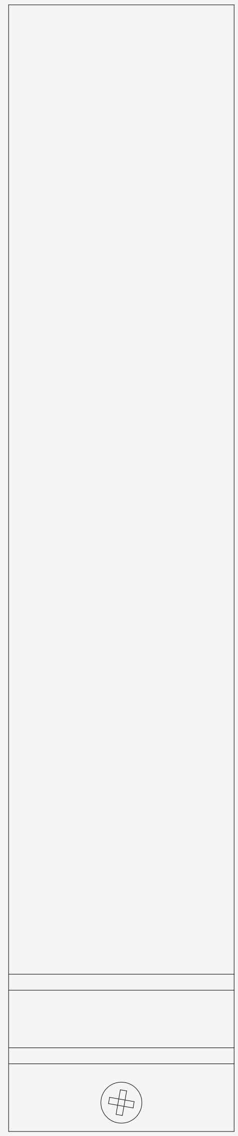


Figure 7-8: Front view of the BLIND-COM

7.4.2 Technical data

The BLIND-COM has the following specifications:

General	Type number:	FS-BLIND-COM
	Operating temperature:	-40°C - +85°C (-40°F - +185°F)
	Storage temperature:	-40°C - +85°C (-40°F - +185°F)
Power	None	
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D)
		6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0.5 kg

7.5 BKM-0001

7.5.1 Battery and Key switch Module

The Battery and Key switch Module (BKM-0001) is located in the Controller chassis (see section CPCHAS-0001 or CPCHAS-0002 or CPCHAS-0003).

There is only one BKM-0001, even in a redundant Controller chassis.

The BKM-0001 contains the following items:

- Two batteries (one for each Control Processor)
- Force Enable key switch
- Reset key switch

The below figure shows the front view of the BKM-0001 module.

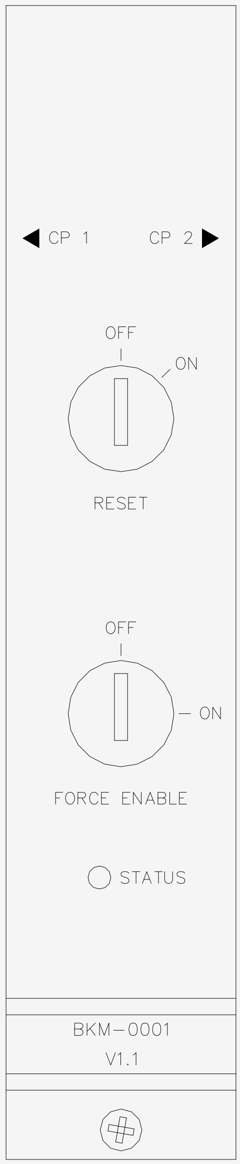


Figure 7-9: The front view of the BKM-0001 module

The BKM-0001 module may be placed or removed in a running system. The application program will not be interrupted by these actions.

Note:
Version 1.0 modules have a darker blue front plate.

> **Attention:**
> Removal of the BKM-0001 module should only be done with its Force Enable key switch in the 'OFF' position. Extraction of the BKM-0001 module will always remove all forces.

7.5.2 Batteries

The BKM-0001 module contains non-rechargeable (lithium) batteries that supply the back-up power to maintain the diagnostic messages, the real time clock on the QPP modules and FTE IP addresses, in case of a power outage.

As the batteries are not recharged, the used back-up time is accumulating. *The total back-up time of the lithium cells is approximately 3 months*.

If the system is switched off for a longer period (and during transport), the batteries can be switched off with the battery switch on the module.

It is recommended to replace the batteries every five years and after every substantial discharge period.

Replacing the batteries requires no special tools.

The side plate of the BKM-0001 module has an opening to enable battery replacement and battery-switch operation (see the below figure).

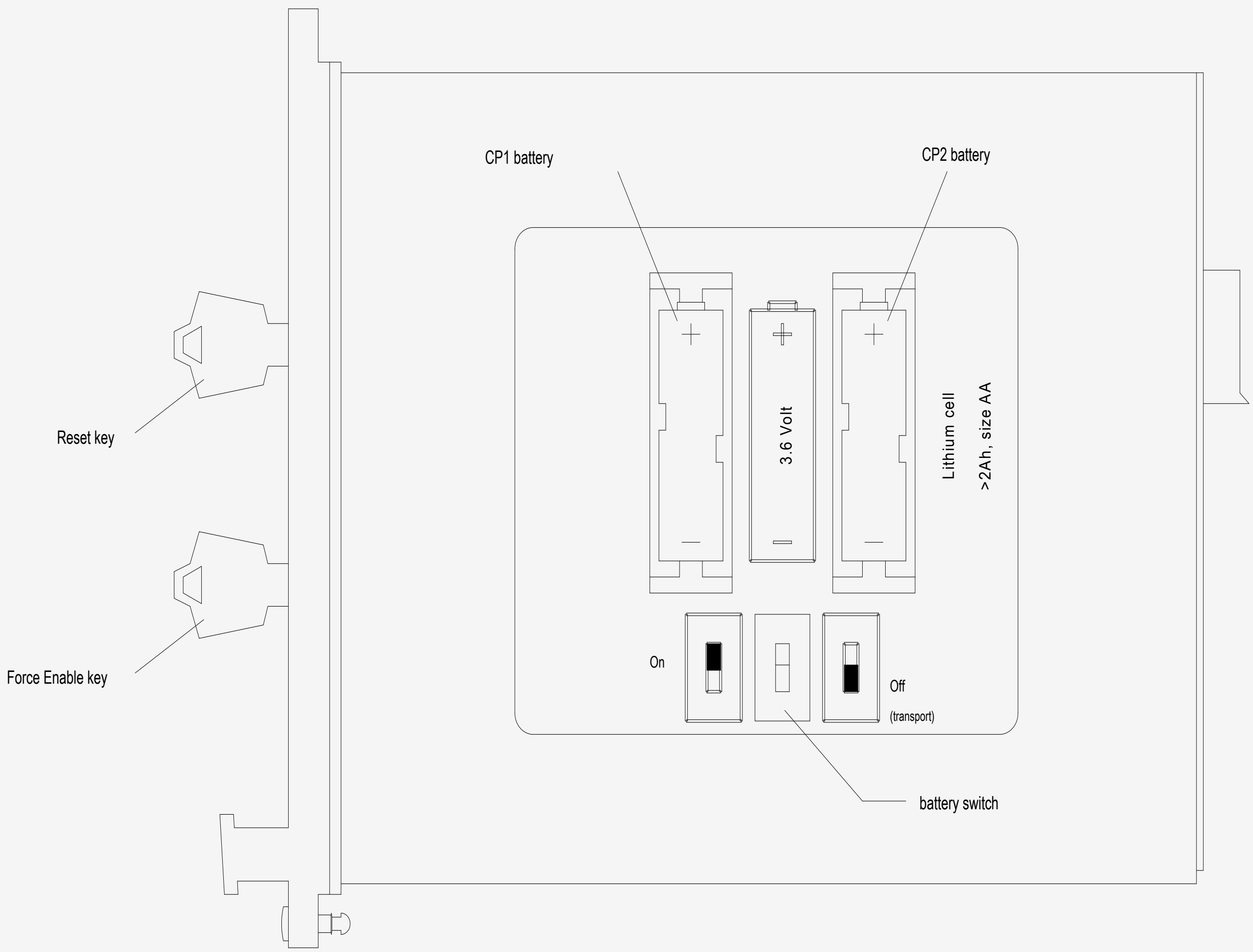


Figure 7-10: Side view of the BKM-0001

When the batteries are disconnected (battery switch in the OFF position) the status LED will stay red.

7.5.3 Reset key switch

The Reset key switch is used for emptying the diagnostics database and resetting (starting) the watchdog. Its default position is the OFF position, to which it will automatically return after setting it in the ON position. You can only remove the key in the OFF (vertical) position.

The key required for the Reset key switch is a different key than the one for the Force Enable key switch.

Reset key switch state	Function
OFF	No action
ON	• The Watchdog signal is reset for both Control Processors. • The actual diagnostics will be moved to historical diagnostics database for both Control Processors.

7.5.4 Force Enable key switch

The Force Enable key switch is used for enabling or disabling software-controlled forcing of input and output signals. The key is removable in both positions.

The key required for the Force Enable key switch is a different key than the one for the Reset key switch.

Force Enable key switch state	Function
OFF	Software-controlled forcing of input and output signals is not possible. All active forces are removed.
ON	Software-controlled forcing of input and output signals is possible.

7.5.5 Status LED

The below table lists the possible LED status indications that are visible at the front side of the BKM-0001 module.

Table 1. LED indicators of the BKM-0001 module

LED	Status	Description
STATUS	off	The power to the module is down.
	Red	The battery switch is in OFF position. One (or both) battery voltage(s) are too low (or fuse is blown)
	Green	No battery error is detected.

7.5.6 Additional functionality

The diagnostics for the BKM-0001 include:

- BKM-0001 not placed.
- Battery voltage out of ranges (too high, too low and open circuit).

7.5.7 Technical data

The BKM-0001 has the following specifications:

General[1]	Type numbers:	FS-BKM-0001
		FC-BKM-0001
	Operating temperature:	-5°C - +70°C (+23°F - +158°F)
	Storage temperature:	-40°C - +85°C (-40°F - +185°F)
	Relative humidity:	10-95% (non condensing)
	Approvals:	CE, TUV, UL, CSA, FM
Power	24 V supply voltage:	24 V DC –15%-+30%
	24 V supply current:	Max. 20 mA (out of each 24 V DC) typ. 7 mA (shared load on 24 V DC)
	5 VR supply voltage:	5 V DC ± 10%
	5 VR supply current:	Max. 10 mA
+24V_red	Output supply voltage:	14-31 V DC
	Output resistance:	Approx. 2 × 1.1 kΩ (parallel)
	Short circuit proof:	Continuous
Battery	Make[2]:	SAFT
	Type[2]:	LS14500CFG
	Material:	Lithium Thionyl Chloride
	Voltage:	Nominal 3.6 V
	Capacity:	> 2 Ah

	Size:	AA
	Operating temperature:	-40°C - +85°C (-40°F-+185°F)
Physical	Dimensions:	176 x 35.2 x 224 mm (H x W x D) 6.93 x 1.4 x 8.81 in (H x W x D)
	Weight:	660 g

Note:

1. Version 1.0 modules have a darker blue front plate.
2. Use of specified make and type numbers is necessary to maintain UL approval.

7.6 PSU-240516

7.6.1 Power Supply Unit 24/5 V DC, 16 A

The PSU-240516 power supply unit converts incoming 24 V DC to (local) 5 V DC and (redundant) 5 V DC, and is located in the Controller chassis (see CPCHAS-0001 or CPCHAS-0002 or CPCHAS-0003).

The below figure shows the front view of the PSU-240516 module.

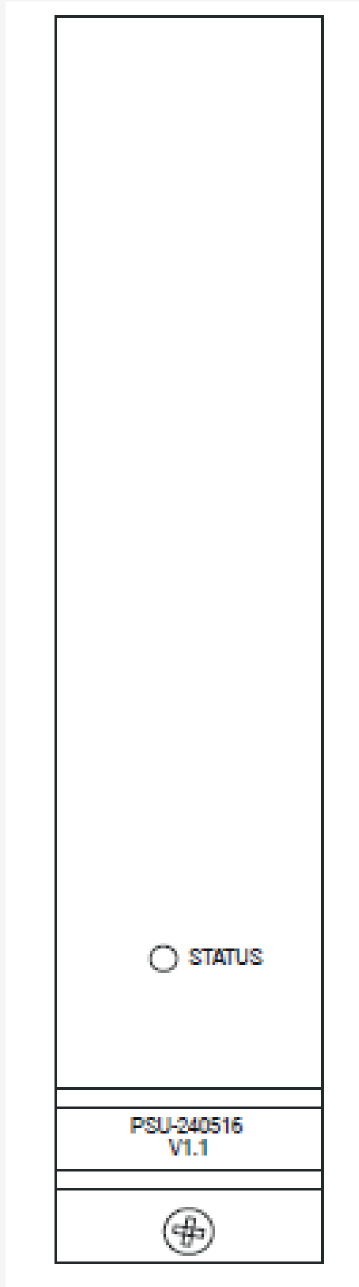


Figure 7-11: Front view of the PSU-240516 module

The (local) 5 V DC output (5V1 resp. 5V2) supplies 5 V to its Control Processor and the redundant IO modules of its Control Processor. The (redundant) 5 V DC output (5VR) shares the 5 V load of the non-redundant IO modules with the PSU-240516 of the other Control Processor. All 5 V supply signals are available on the WdPx connectors of the Controller backplane.

The PSU-240516 module has two independent overvoltage protection circuits. This makes the module suitable for safe applications without maintenance checks on regular intervals.

The below figure shows a schematic diagram of the PSU-240516.

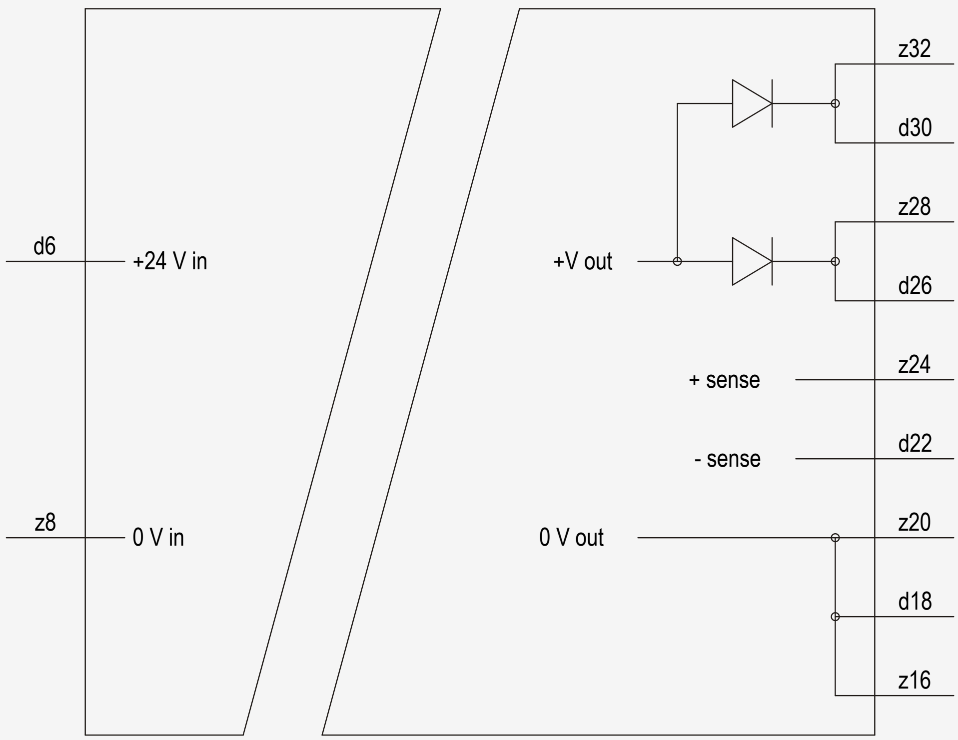


Figure 7-12: Schematic diagram of the PSU-240516

7.6.2 Pin allocation

The back view and pin allocation of the PSU-240516 module are as follows:

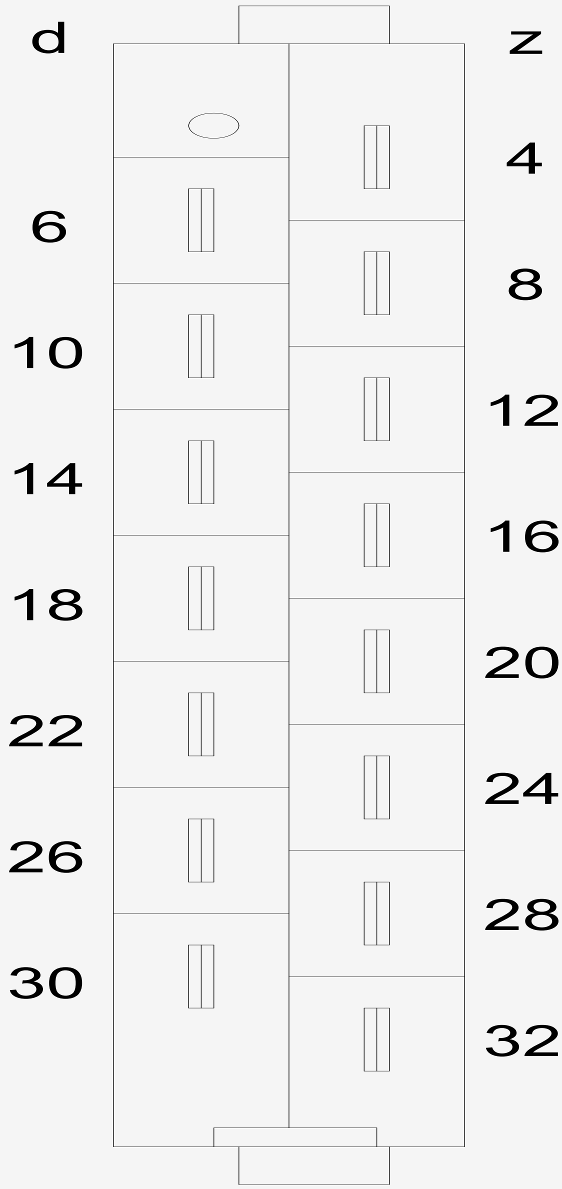


Figure 7-13: Back view and pin allocation of the PSU-240516 module

d6	Supply 24 V DC in
d10	
d14	
d18	Supply 0 V DC out
d22	- sense
d26	Supply 5 V DC out (5Vx)
d30	Supply 5 V DC out (5VR)
z4	Earth
z8	Supply 0 V DC in
z12	
z16	Supply 0 V DC out
z20	Supply 0 V DC out
z24	+ sense
z28	Supply 5 V DC out (5Vx)
z32	Supply 5 V DC out (5VR)

7.6.3 Status LED

The below table lists the possible LED status indications that are visible at the front side of the PSU-240516 module.

Table 1. LED indicators of the PSU-240516 module

LED	Status	Description
STATUS	Off	The (24 V DC) power on the module is down or too low.
	Red	The 5 V DC output level is too low.
	Green	The 5 V DC output level is within range.

7.6.4 Additional functionality

The PSU-240516 module has a galvanic isolation of:

- ≥ 2.5 kVdc between the 24 V DC input and the 5 V DC outputs.
- ≥ 1 kVdc between the 24 V DC and the casing of the PSU-240516.
- ≥ 1.5 kVdc between the 5 V DC outputs and the casing of the PSU-240516.

7.6.5 Technical data

The PSU-240516 has the following specifications.

General	Type numbers[1]:	FS-PSU-240516 FC-PSU-240516
	Operating temperature:	-5°C-+70°C (+23°F-+158°F)
	Storage temperature:	-40°C-+85°C (-40°F-+185°F)
	Relative humidity:	10-95% (non condensing)
	Approvals:	CE, TUV, UL, CSA, FM
Power	24 V supply voltage:	24 V DC -15%-+30%
	24 V supply current:	< 6 A at 24 Vin (16 A load)
		< 7 A at 20.4 Vin (16 A load)
	Inrush current:	< 5 A at 24 Vin
	5 V_load:	min. 0.5 A
		max. 16 A
	5 VR_load:	min. 0.5 A
		max. 16 A
	Hold-up time:	< 1ms
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D)
		6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0.85 kg

Note:

1. Modules with suffix code V1.1 contain modified components. There are no functional changes.

7.7 Controller power supply configuration

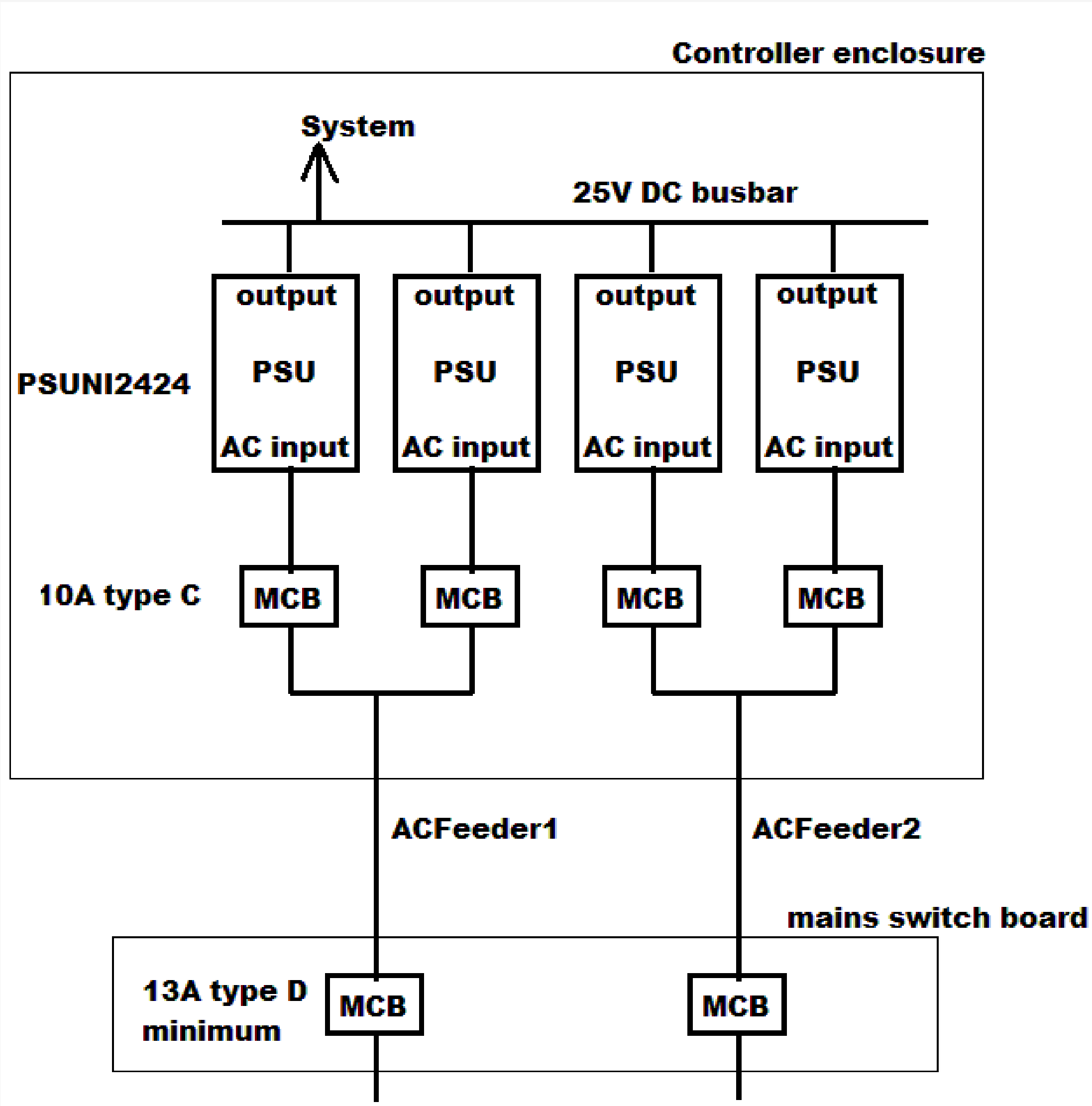


Figure 7-14: Controller power supply configuration

The mains switch board mini circuit breaker or fuse needs to support 120 A inrush current. It is supported with 13 A type D circuit breaker or higher.

CHAPTER 8

INPUT MODULES

8 Input modules

This chapter describes the input modules that are available for Safety Manager.

The following input modules are described:

SDI-1624	Safe digital input module (24 V DC, 16 channels)
SDI-1648	Safe digital input module (48 V DC, 16 channels)
SAI-0410	Safe analog input module (4 channels)
SAI-1620m	Safe high-density analog input module (16 channels)
SDIL-1608	Safe loop-monitored digital input module with earth fault monitor (16 channels)

For related input converter modules, see Input converter modules.

For related FTAs, seeField Termination Assembly Module.

8.1 General info about input modules

8.1.1 General

All input modules are standard European size (100 × 160 mm) instrument modules. The width of the module front is 4 TE = 4 HP (20.32 mm, 0.8 in), which is one slot in a standard 19 inch IO chassis.

Each input module is connected to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR) via a flatcable, which extends from the module front.

Digital input modules have status LEDs for each input channel. The LEDs are located in the module front, below the flat cable.

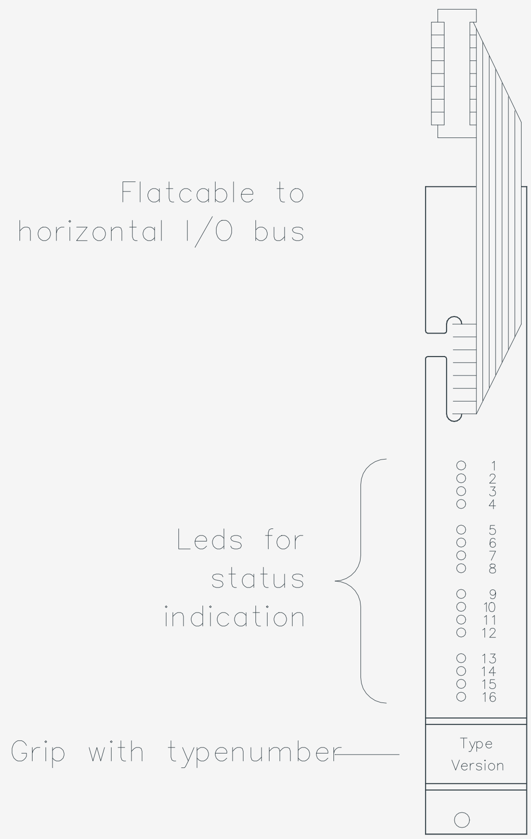


Figure 8-1: Front of a digital input module

There are digital input modules for 24 V DC, 48 V DC and Namur signals. The modules are powered with 5 V DC for circuits associated with the horizontal bus logic, and with 24 V DC or 48 V DC for the circuits associated with the input signals.

There are analog inputs for 0-20 mA, 0-5 V and 0-10 V field signals. These field signals can be converted to the required input voltage of the input modules (such as 0-2 V or 0-4 V) by using an FTA or an input converter module.

8.1.2 Input Modules

Input modules have galvanic isolation between 5 V DC circuitry and field inputs. They are fitted with a male connector according to DIN 41612, type F, with the d, (b) and z rows in use.

The following items terminate on the chassis connector:

- 5 V DC internal power supply
- 24 V DC or 48 V DC internal power supply
- 24 V DC or 48 V DC external power supply (if needed)
- Wiring for the input signals

The 5 V DC signals are physically separated from the IO connections and supply.

The following DC supply voltage ranges apply to ensure correct operation of the Safety Manager modules:

- 110 V DC: +25% / -15%
- 48 V DC: +15% / -15%
- 24 V DC: +30% / -15%

Note:

1. If it cannot be guaranteed that the DC power supplied to Safety Manager remains within the above ranges, additional voltage monitoring is required.
2. It is assumed that the 24Vdc Plant power fed to the Safety Manager Controller is uninterrupted. If not, means should be provided to avoid power dips at the 24Vdc lines to the Safety Manager Controller.
3. When using Plant power, the Plant power supply must fulfill the requirements as laid down in IEC 61010 or IEC 60950.

8.1.3 Address

The address of an input module is determined by the modules slot in the IO chassis. This means that input modules have no jumpers or switches for setting the address. Each input module can be replaced by any module of the same type.

8.1.4 Replacing an input module

Input modules can be replaced with power switched on. Depending on the input signal function and the system IO configuration, process operation may be affected.

When removing an input module, first disconnect the flat cable from the horizontal IO bus (IOBUS-HBS or IOBUS-HBR), loosen the screws, and carefully slide the module out of the chassis.

When placing an input module into the chassis, carefully push it into the slot until it is flush with the chassis, fasten the screws, then connect the flatcable to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR).

8.2 SDI-1624

8.2.1 Safe digital input module (24 V DC, 16 channels)

The safe digital input module SDI-1624 has sixteen 24 V DC digital input channels. The input stage of the module is of a 'fail-to-safe' nature. This means that a component failure results in a de-energized input signal to the processor, which is the safe condition in a normally energized system.

The remaining logic circuitry on the module is completely covered by the self-test functions of the system. Within the configured Diagnostic Test Interval, the modules are tested for:

- Ability to receive logic level '0' signals
- Ability to receive logic level '1' signals
- Crosstalk between inputs

The 24 V DC out pin is a current limited output, intended for energizing the (redundant) inputs via a field contact.

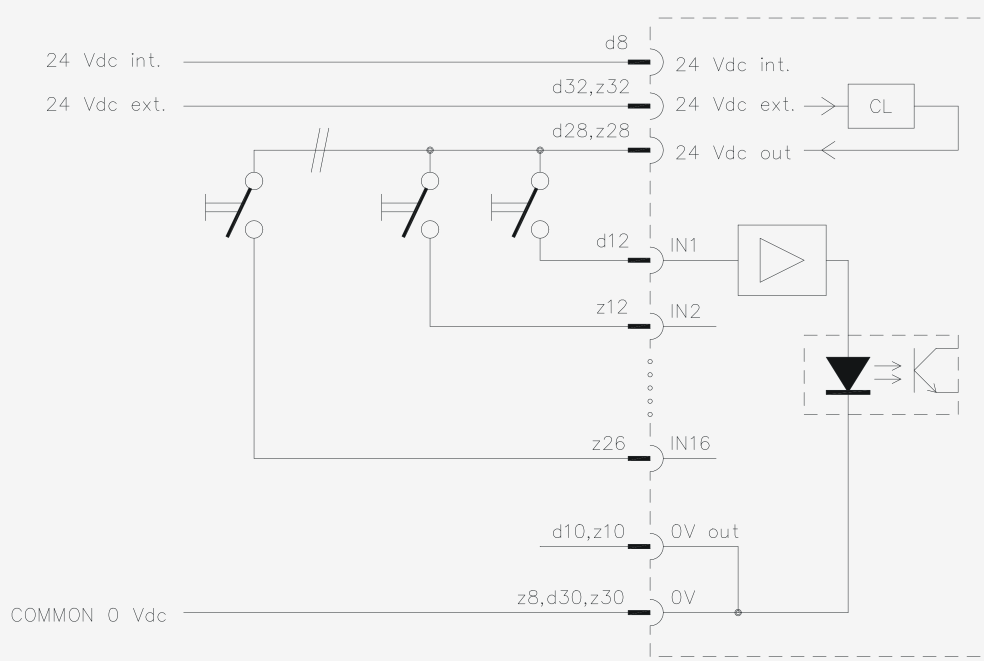


Figure 8-2: Schematic diagram for connection of inputs to the SDI-1624 module

8.2.2 Pin allocation

The following overview contains the back view and pin allocation of the SDI-1624 module connector:

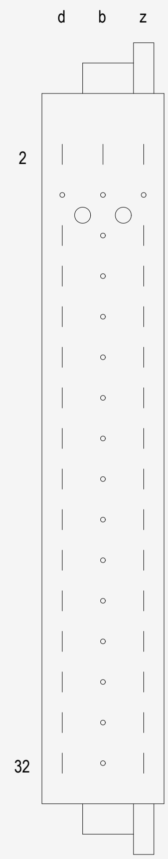


Figure 8-3: Back view and pin allocation of the SDI-1624 module connector

d2	
d4	–
d6	
d8	Supply 24 V DC int.
d10	0 V DC out
d12	IN 1
d14	IN 3
d16	IN 5
d18	IN 7
d20	IN 9
d22	IN 11
d24	IN 13
d26	IN 15
d28	24 V DC ext. out
d30	Supply 0 V DC
d32	Supply 24 V DC ext.
b2	GND
z2	5 V DC
z4	-
z6	
z8	Supply 0 V DC
z10	0 V DC out

z12	IN 2
z14	IN 4
z16	IN 6
z18	IN 8
z20	IN 10
z22	IN 12
z24	IN 14
z26	IN 16
z28	24 V DC ext. out
z30	Supply 0 V DC
z32	Supply 24 V DC ext.

8.2.3 Connection examples

The figures below show a number of connection examples for the safe digital input module SDI-1624.

> **Note:**
> The 24 V DC (internal) supply must be connected to prevent fault detection during self-test.

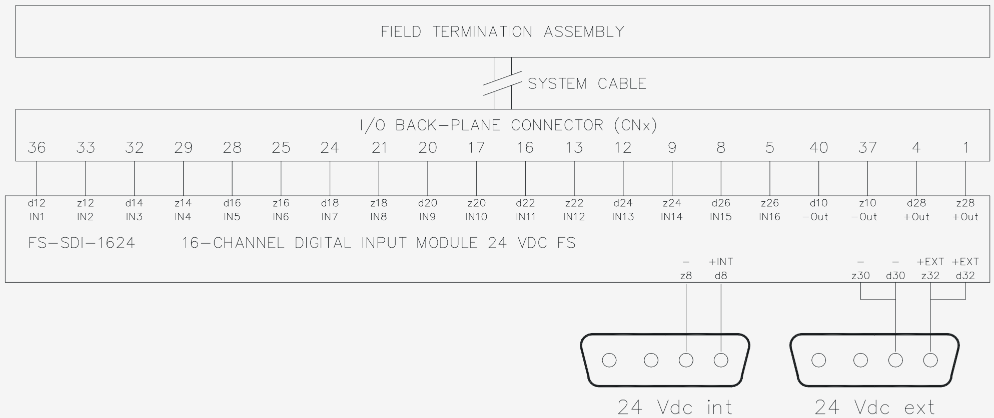


Figure 8-4: Connection example of SDI-1624 module to FTA for both non-redundant and redundant IO configurations

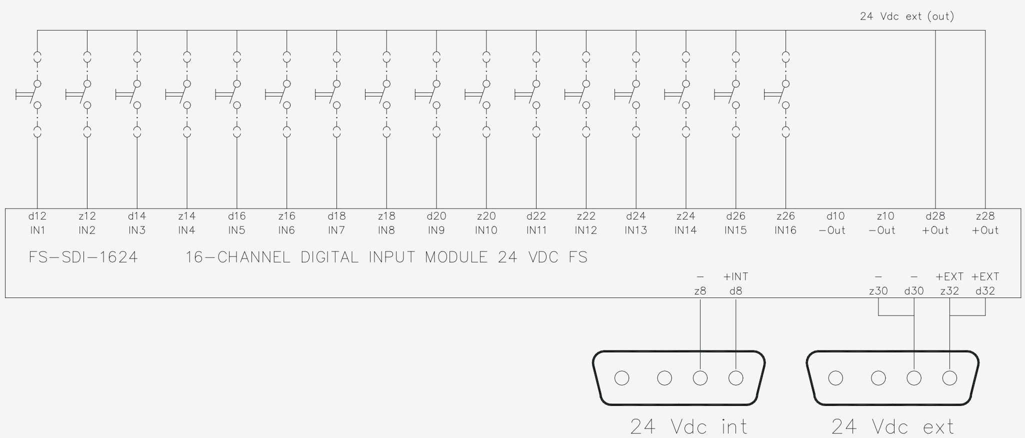


Figure 8-5: IO connection example of SDI-1624 module for non-redundant IO configurations

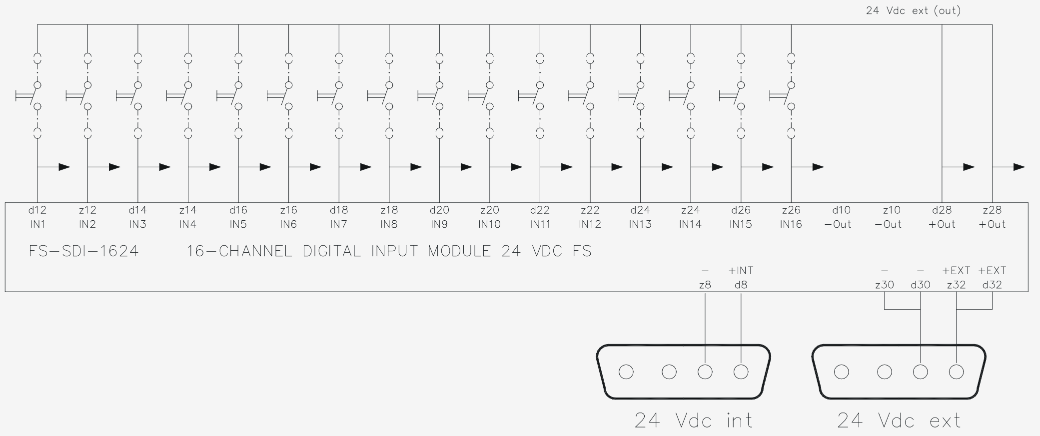


Figure 8-6: IO connection example of SDI-1624 module for redundant IO configurations

8.2.4 Hazardous locations (FM 3611)

The SDI-1624 module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see Safety Manager FM approval PM.MAN.6348. (This document is available on request)

8.2.5 24 V DC Output current limiting

The 24 V DC Out provides power to the switching elements. This transistor output has an electronic current-limiting circuit. If the output is overloaded or shorted, it goes into current limit for a brief period of time (several milliseconds), supplying *at least* the specified maximum current. If the overload or short-circuit persists, the output switches off for several hundred milliseconds, and tries again.

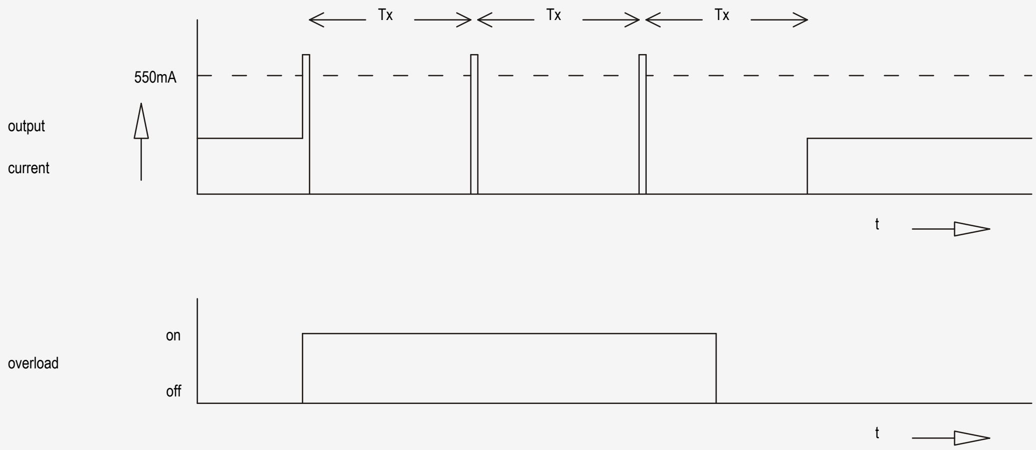


Figure 8-7: 24V output overload / short-circuit behavior

8.2.6 Technical data

The SDI-1624 module has the following specifications:

General	Type numbers:	FS-SDI-1624
		FC-SDI-1624
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 8 mA
		24 V DC int., 110 mA
		24 V DC ext., 110 mA (input currents)
	Ripple content (on 5 V DC):	< 0.5 Vp-p (0-360 Hz)
Input	Number of input channels:	16
	Maximum input voltage:	36 V DC
	Input current:	7 mA at 24 V DC
	Maximum load capacitance:	100 nF
	Input HIGH:	> 15 V DC
	Input LOW:	< 9 V DC (I < 2 mA)
	Input delay:	Typically 10 ms
Output	Type	24 V DC solid state, short circuit proof
	Maximum current	450 mA (see the figure above)
	Max. load capacitance	32 μF
	Voltage drop	< 1.5 V at 450 mA

Key coding	(See section Key coding)	
	Module connector code:	
	• Holes	A5, C5
	Chassis connector code:	
	• Large pins	A5, C5

8.3 SDI-1648

8.3.1 Safe digital input module (48 V DC, 16 channels)

The safe digital input module SDI-1648 has sixteen 48 V DC digital input channels. The input stage of the module is of a ‘fail-to-safe’ nature. This means a component failure will result in a de-energized input signal to the processor, which is the safe condition in a normally energized system.

The remaining logic circuitry on the module is completely covered by the self-test functions of the system.

Within the configured Diagnostic Test Interval, the modules are tested for:

- Ability to receive logic level ‘0’ signals
- Ability to receive logic level ‘1’ signals
- Crosstalk between inputs

The 48 V DC out pin is a current limited output intended for energizing the (redundant) inputs via a field contact.

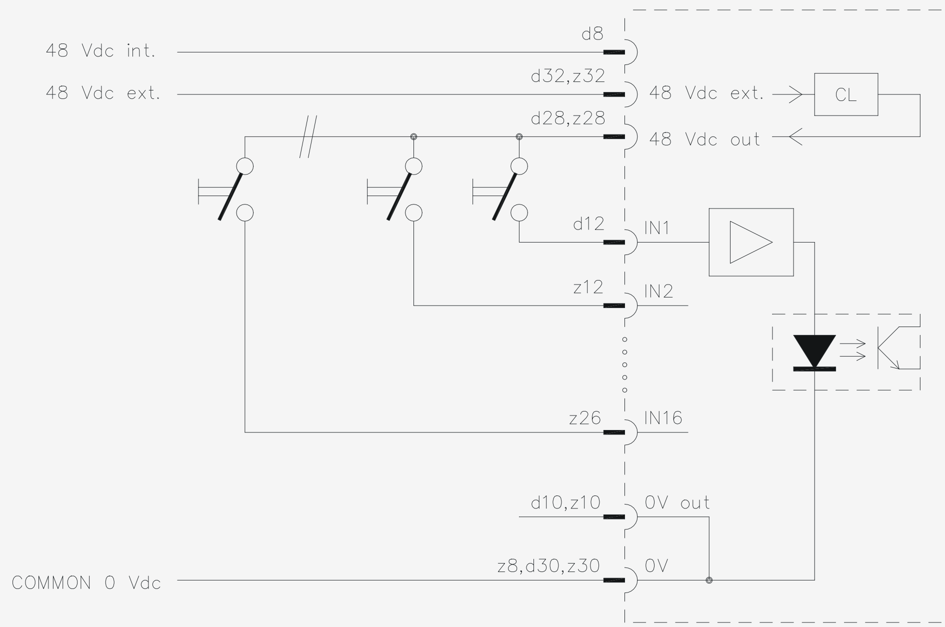


Figure 8-8: Schematic diagram for connection of inputs to the SDI-1648 module

8.3.2 Pin allocation

The following overview contains the back view and pin allocation of the SDI-1648 module connector:

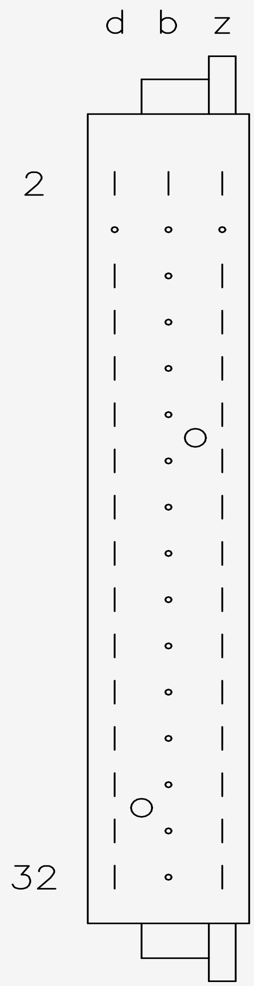


Figure 8-9: Back view and pin allocation of the SDI-1648 module connector

d2	
d4	-
d6	
d7	
d8	Supply 48 V DC int.
d10	0 V DC out
d12	IN 1
d14	IN 3
d16	IN 5
d18	IN 7
d20	IN 9
d22	IN 11
d24	IN 13
d26	IN 15
d28	48 V DC ext. out
d30	Supply 0 V DC
d32	Supply 48 V DC ext.
b2	GND
z2	5 V DC
z4	-
z6	
z8	Supply 0 V DC

z10	0 V DC out
z12	IN 2
z14	IN 4
z16	IN 6
z18	IN 8
z20	IN 10
z22	IN 12
z24	IN 14
z26	IN 16
z28	48 V DC ext. out
z30	Supply 0 V DC
z32	Supply 48 V DC ext.

8.3.3 Connection examples

The figures below show a number of examples of connections for the safe digital input module SDI-1648.

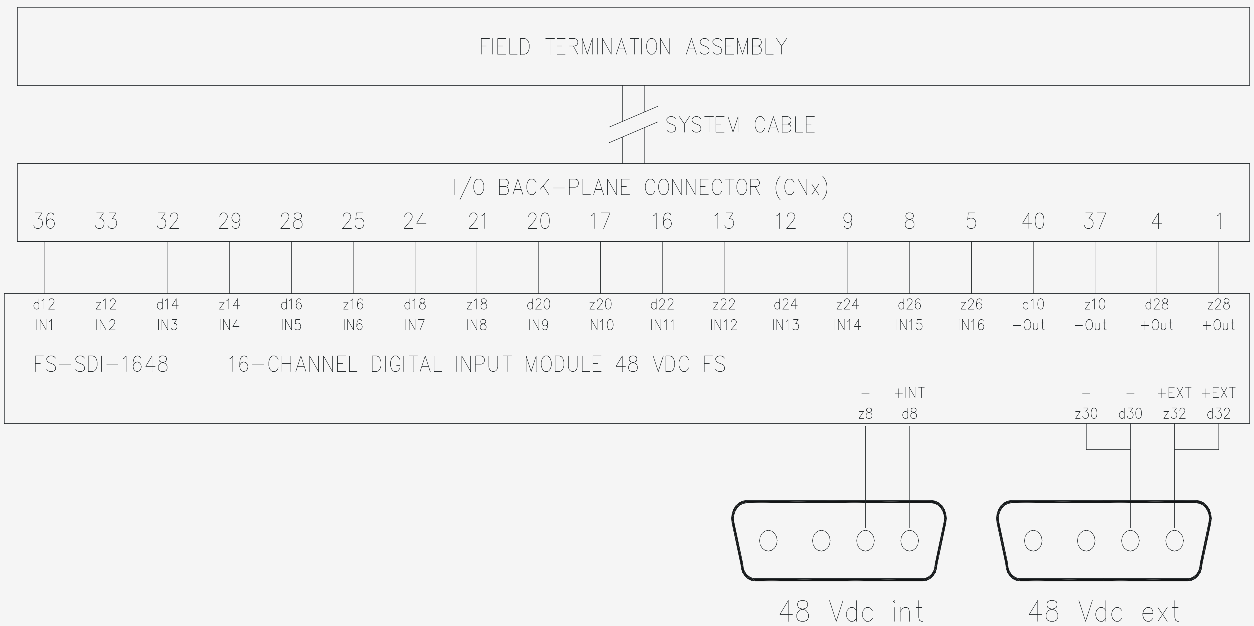


Figure 8-10: Connection example of SDI-1648 module to FTA for both non-redundant and redundant IO configurations

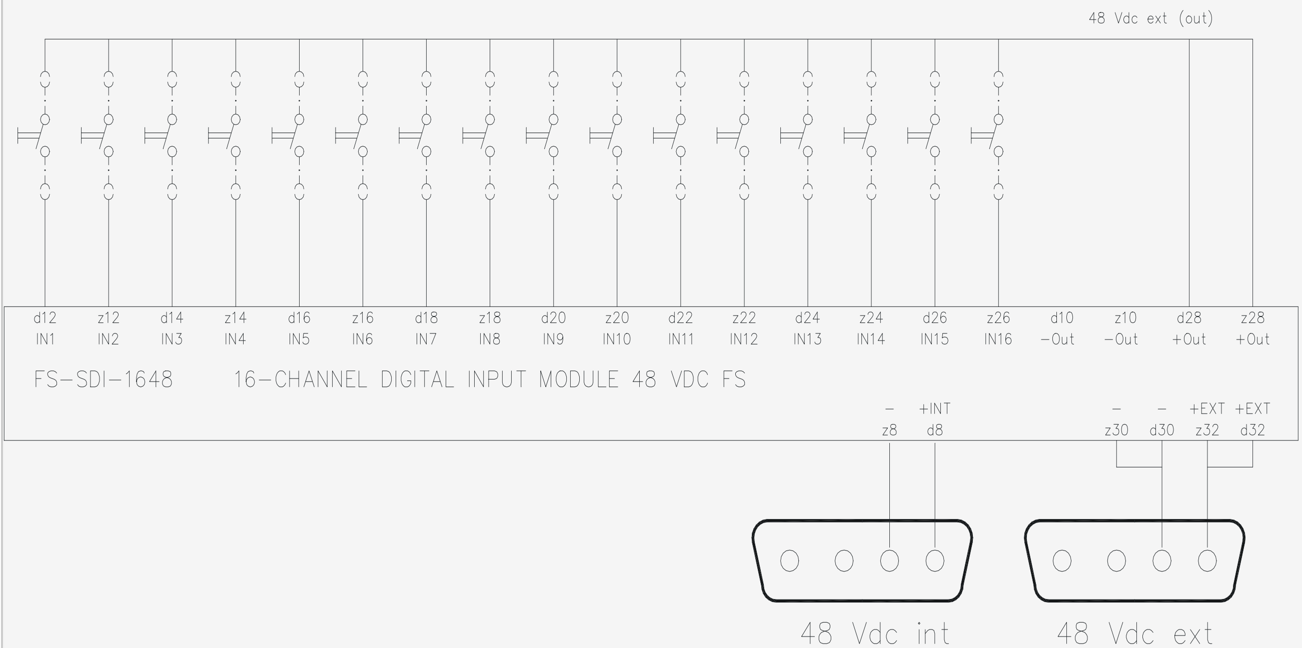


Figure 8-11: IO connection example of SDI-1648 module for non-redundant IO configurations

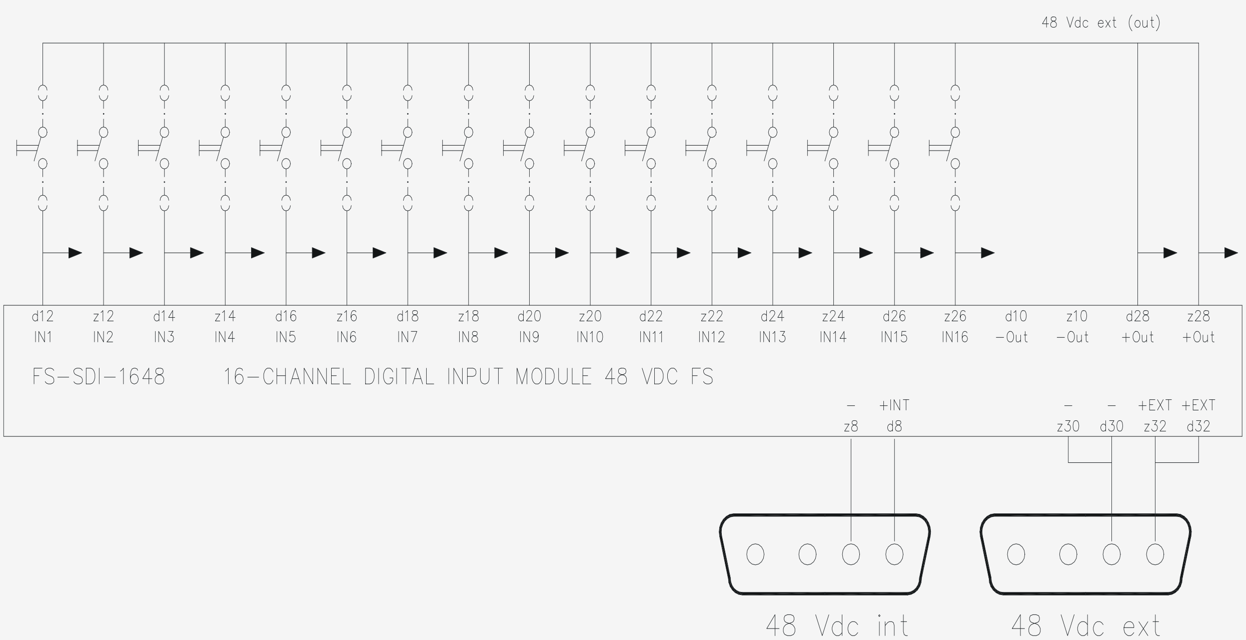


Figure 8-12: IO connection example of SDI-1648 module for redundant IO configurations

Note:
The 48 V DC (internal) supply must be connected to prevent fault detection during self-test.

8.3.4 48 V DC output current limiting

The 48 V DC Out provides power to the switching elements. This transistor output has an electronic current-limiting circuit. If the output is overloaded or shorted, it goes into current limit for a brief period of time (several milliseconds), supplying *at least* the specified maximum current. If the overload or short-circuit persists, the output switches off for several hundred milliseconds, and tries again.

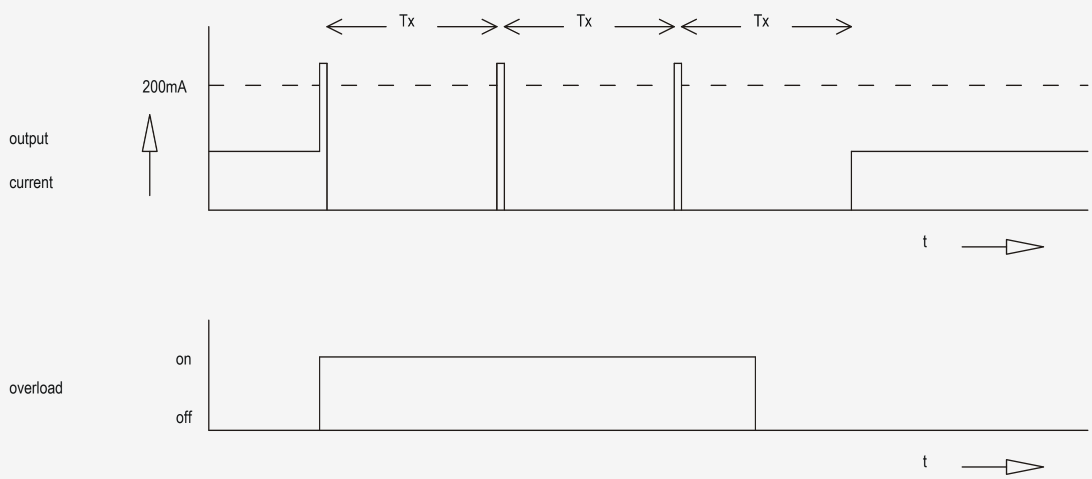


Figure 8-13: 48V output overload / short-circuit behavior

8.3.5 Technical data

The SDI-1648 module has the following specifications:

General	Type numbers:	FS-SDI-1648
		FC-SDI-1648
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 8 mA
		48 V DC int., 45 mA
		48 V DC ext., 75 mA (input currents)
	Ripple content (on 5 V DC):	< 0.5 Vp-p (0-360 Hz)
Input	Number of input channels:	16
	Maximum input voltage:	70 V DC
	Input current:	4 mA at 48 V DC
	Maximum load capacitance:	100 nF
	Input HIGH:	> 30 V DC
	Input LOW:	< 16 V DC (I < 1.1 mA)
	Input delay:	typically 10 ms
Output	Type	48 V DC solid state, short circuit proof
	Maximum current	200 mA Figure 1
	Max. load capacitance	20 µF
	Voltage drop	< 1.5 V at 200 mA

Key coding	(See section Key coding)	
	Module connector code:	
	• Holes	A13, C29
	Chassis connector code:	
	• Large pins	A13, C29

8.4 SAI-1620m

8.4.1 Safe high-density analog input module (16 channels)

The analog input module SAI-1620m has sixteen analog inputs (0-4 V) and an external voltage readback input (0-4 V). The sixteen channels are safe (safety class SIL3, in compliance with IEC 61508) and have an isolated analog 0 V common to all sixteen channels.

The field signals for the analog inputs of the SAI-1620m module need to be converted from 0-20 mA to a level suitable for the SAI-1620m module.

You can perform this conversion in two ways:

- On the field termination assembly module TSAI-1620m, TSHART-1620m, TSGAS-1624 or TSFIRE-1624
- Analog input conversion module BSAI-1620mE, located on programming connector (P_x) on the back of the IO backplane in the 19-inch chassis.

Analog input signals, such as thermocouple or PT-100, can only be used after conversion to 0(4)—20 mA with a dedicated converter (and a TSAI-1620m or BSAI-1620mE module).

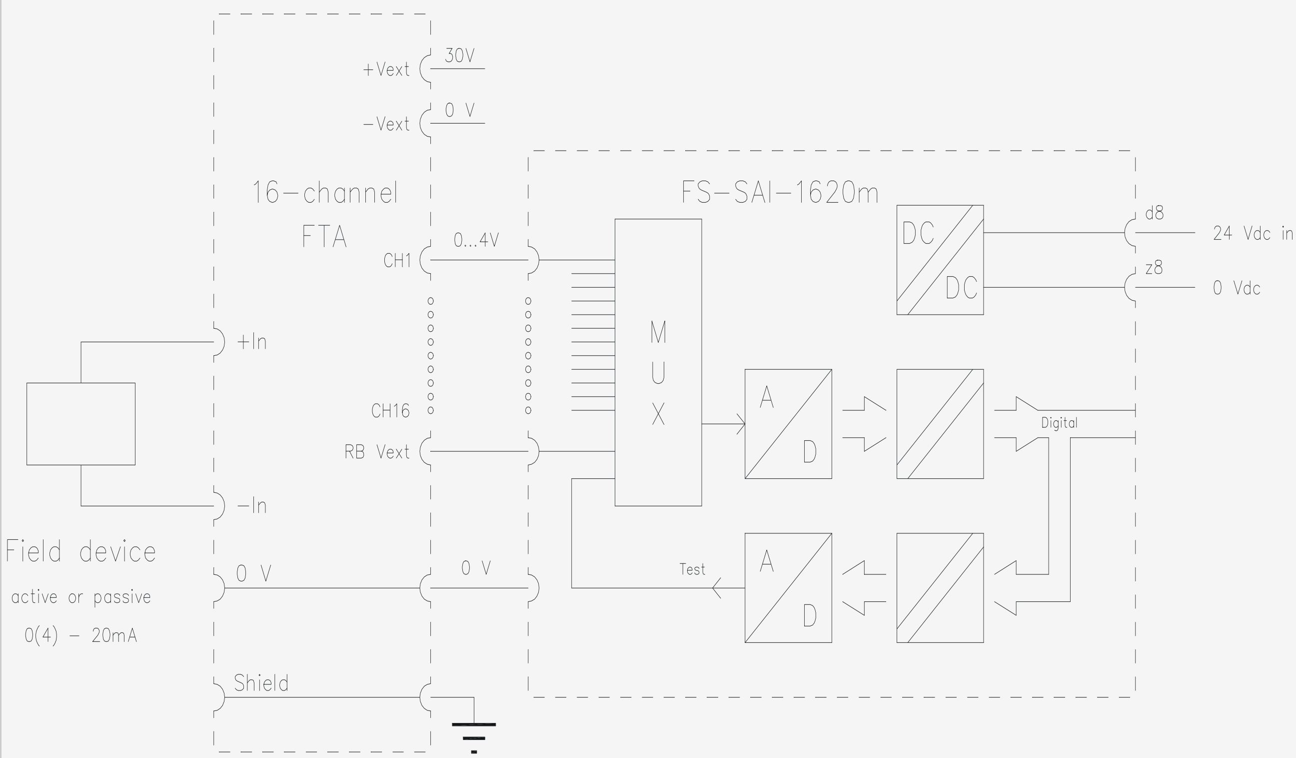


Figure 8-14: Schematic diagram for connection of inputs to SAI-1620m module

The self-test of the module, which is controlled by the Safety Manager Controller, checks:

- Absolute accuracy
- Correct conversion over the full range
- Crosstalk between inputs
- Channel input filters
- Internal supply voltages

8.4.2 Pin allocation

The following overview contains the back view and pin allocation of the SAI-1620m module connector:

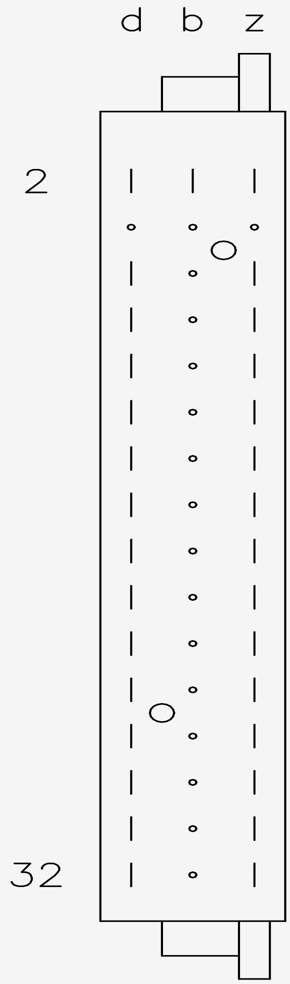


Figure 8-15: Back view and pin allocation of the SAI-1620m module connector

d2	
d4	-
d6	
d8	Int. 24 V DC supply
d10	Analog ground
d12	IN 1
d14	IN 3
d16	IN 5
d18	IN 7
d20	IN 9
d22	IN 11
d24	IN 13
d26	IN 15
d28	Analog ground
d30	
d32	
b2	GND
z2	5 V DC
z4	-
z6	
z8	Int. 0 V DC supply
z10	Analog ground

z12	IN 2
z14	IN 4
z16	IN 6
z18	IN 8
z20	IN 10
z22	IN 12
z24	IN 14
z26	IN 16
z28	Readback external power
z30	
z32	

8.4.3 Connection examples

The below figures show typical connection examples for the SAI-1620m module.

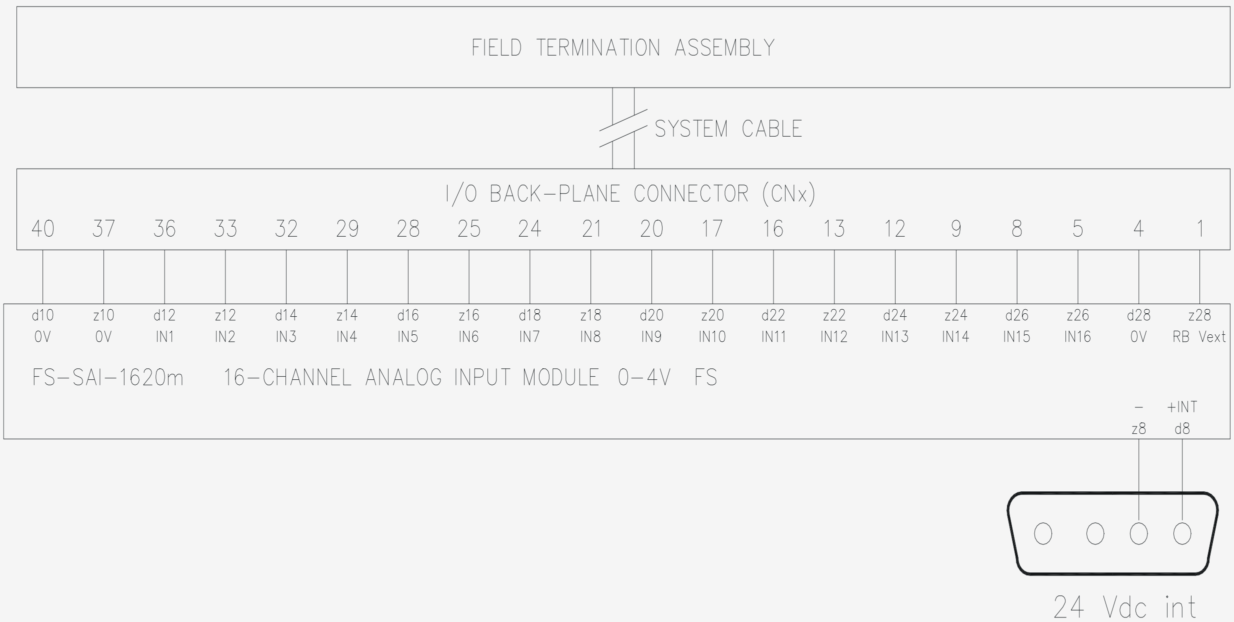


Figure 8-16: Connection example of SAI-1620m module to FTA

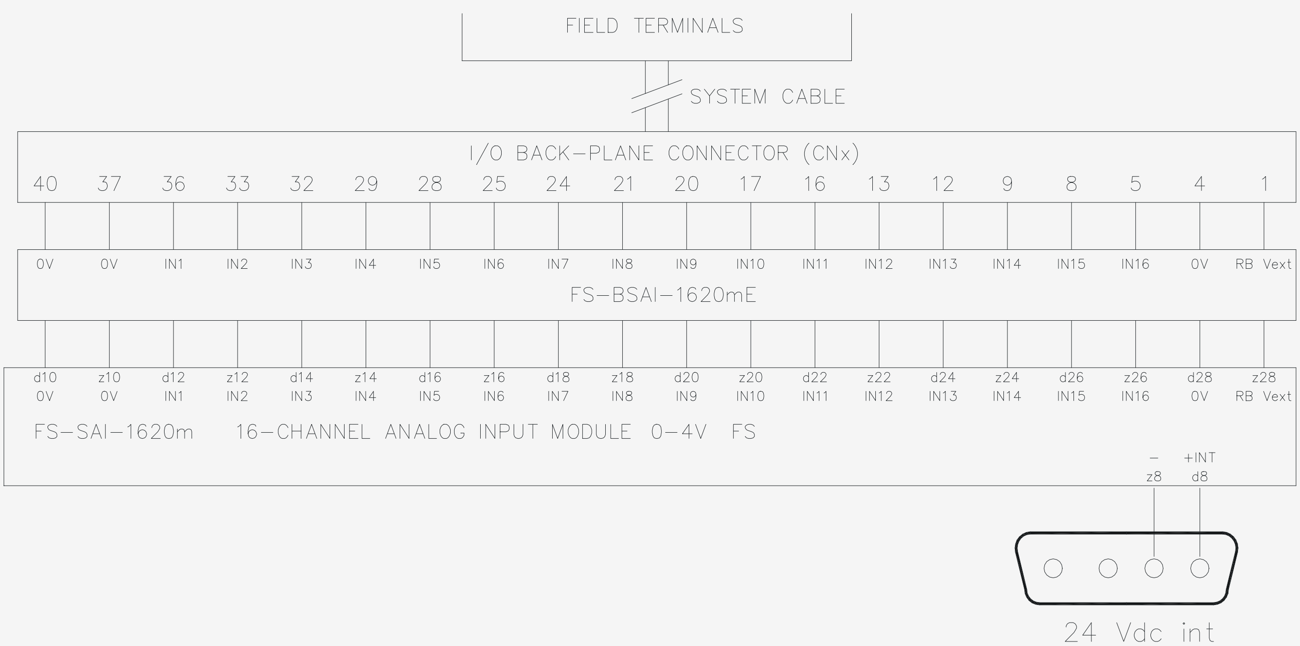


Figure 8-17: Connection example of SAI-1620m module with signal converter BSAI-1620mE

8.4.4 Hazardous locations (FM 3611)

The SAI-1620m module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see Safety Manager FM approval PM.MAN.6348.

8.4.5 Technical data

The SAI-1620m module has the following specifications:

General	Type numbers:	FS-SAI-1620m
		FC-SAI-1620m
		FA-SAI-1620m
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 35 mA
		24 V DC, 35 mA
Input	Number of input channels:	16
	Input range:	0-4.1 V
	Input resistance:	> 1 MΩ
	Maximum load capacitance:	100 nF
	A/D converter:	12-bit
	A/D converter inaccuracy:	± 1 LSB
	Module inaccuracy:	< 0.25%
	Absolute max. input signal:	± 36 V DC
	Cross talk between channels:	> 60 dB[3]
	External voltage read back:	
	• Range	0-4.1 V
	• Input resistance	Typically 1 MΩ

Key coding	(See section Key coding)	
	Module connector code:	
	• Holes	A5, C25
	Chassis connector code:	
	• Large pins	A5, C25

8.5 SAI-0410

8.5.1 Safe analog input module (4 channels)

The safe analog input module SAI-0410 has four 0-2 V analog input channels. The analog inputs have a common 0 V connection, but are galvanically isolated from the 24 V DC and 5 V DC.

Analog inputs can be used either actively (with each input having a separate 26 V DC > 20 mA short-circuit protected output) or passively (the supply being directly connected to the transmitter).

The SAI-0410 input stage has a high input impedance. It can therefore connect two SAI-0410 modules in parallel. The inputs require an analog input converter module BSAI-04x or BSDIL-0426 (see section BSAI-04x + BSDIL-0426).

> **Note:**
> Inputs require an analog converter module (BSAI-04x or BSDIL-0426). The SAI-0410 module can therefore only be used in combination with an IO backplane in the chassis.

The analog input module scans analog inputs, 26 V output voltages, the internal supply voltages, and a reference voltage generated by a D/A converter. This D/A converter generates several reference voltages, which are used to test the analog input module completely. The self-test includes a leakage test of the input filter, as this could influence the accuracy of the analog input value.

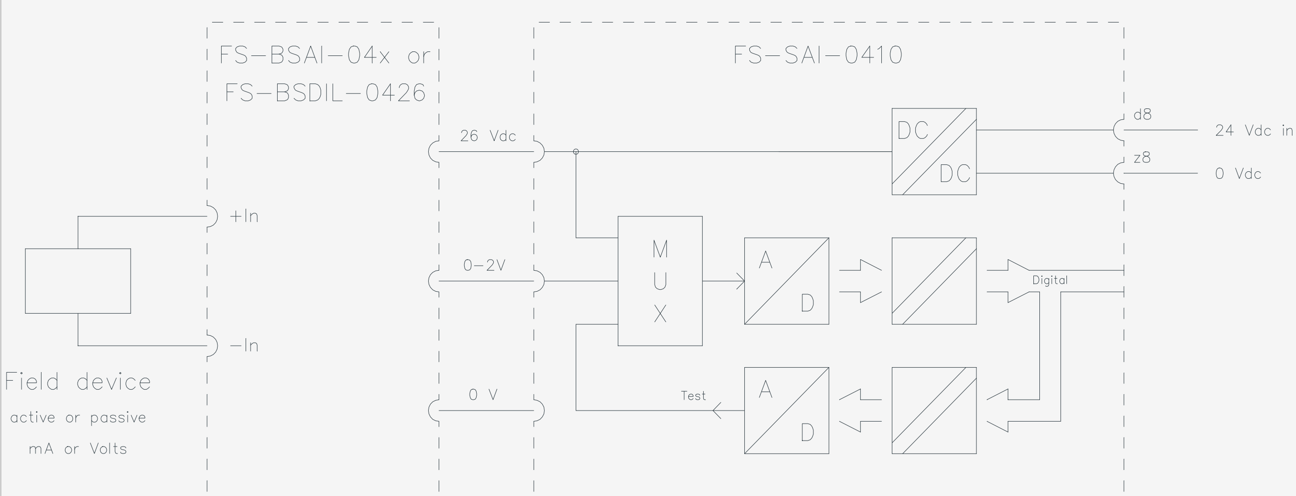


Figure 8-18: Schematic diagram for connection of inputs to the SAI-0410 module

Within the configured Diagnostic Test Interval, the analog inputs are tested for:

- Absolute accuracy
- Correct conversion over full range
- Cross talk between inputs
- Output voltage of the 26 V DC outputs

The 26 V DC outputs are generated by the DC/DC converter and stabilized at 26 V DC. They are therefore not affected by the voltage of the incoming 24 V DC.

Note:
The available output current is at least 21 mA. If the transmitters require a higher supply current, the input channels must be used in passive mode (= external supply).

8.5.2 Analog input ranges for Safety Manager

The below table provides an overview of the analog input ranges for Safety Manager, and of the way SAI-0410 module can be used for each range.

Table 1. Overview of analog inputs for Safety Manager

0(4)-20 mA	Internal power	SAI-0410 + BSAI-0420mI
0(4)-20 mA	External power	SAI-0410 + BSAI-0420mE
0(1)-5 V	External power	SAI-0410 + BSAI-0405E
0(2)-10 V	External power	SAI-0410 + BSAI-0410E
Loop-monitored digital input		SAI-0410 + BSDIL-0426

Other analog input signals, such as thermocouple or PT-100, can only be used after conversion to one of the analog input ranges that Safety Manager can handle.

Note:
The FSC system supports the 0(4)-20 mA, 0(1)-5 V and 0(2)-10 V configurations for module type SAI-0410. Safety Manager supports only 0(1)-5 V and 0(2)-10 V configurations for module type SAI-0410. For FSC to Safety Manager migration and module type SAI-0410 that has 0(4)-20 mA signals configured on it, the migration fails as it is not supported.

Solution:

- In the point configurator, change these points to 0(1)-5 V or 0(2)-10 V.
- The analog input range remains the same, SAI-0410 + BSAI-0420mI or SAI-0410 + BSAI-0420mE.

The Safety Manager does not find any difference because the range setting module will convert the field signal to the correct voltage the AI module uses. The system uses the scan value (0-4095 row count value) before it converts to the configured engineering units.

8.5.3 Pin allocation

The following overview contains the back view and pin allocation of the SAI-0410 module connector:

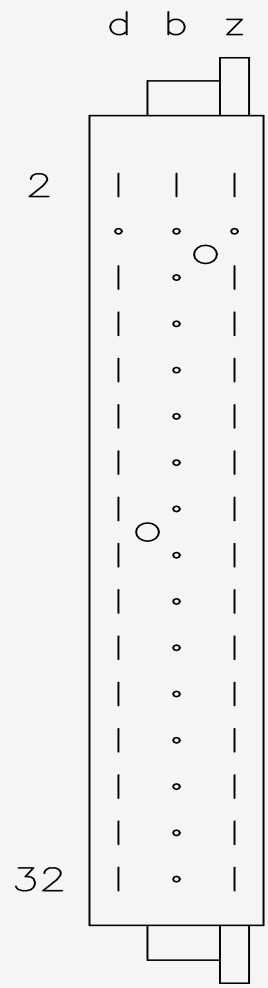


Figure 8-19: Back view and pin allocation of the SAI-0410 module connector

d2	
d4	-
d6	
d8	Supply 24 V DC int.
d10	(IN1-)
d12	26 V DC 1
d14	0 V 1
d16	IN 2
d18	(IN 2+)
d20	(IN 3-)
d22	26 V DC 3
d24	0 V 3
d26	IN 4
d28	(IN 4+)
d30	
d32	
b2	GND
z2	5 V DC
z4	-
z6	
z8	Supply 0 V DC
z10	(IN 1+)

z12	IN 1
z14	0 V 2
z16	26 V DC 2
z18	(IN 2-)
z20	(IN 3+)
z22	IN 3
z24	0 V 4
z26	26 V DC 4
z28	(IN 4-)
z30	
z32	

8.5.4 Connection examples

The below figure shows a connection example for the SAI-0410 safe analog input module.

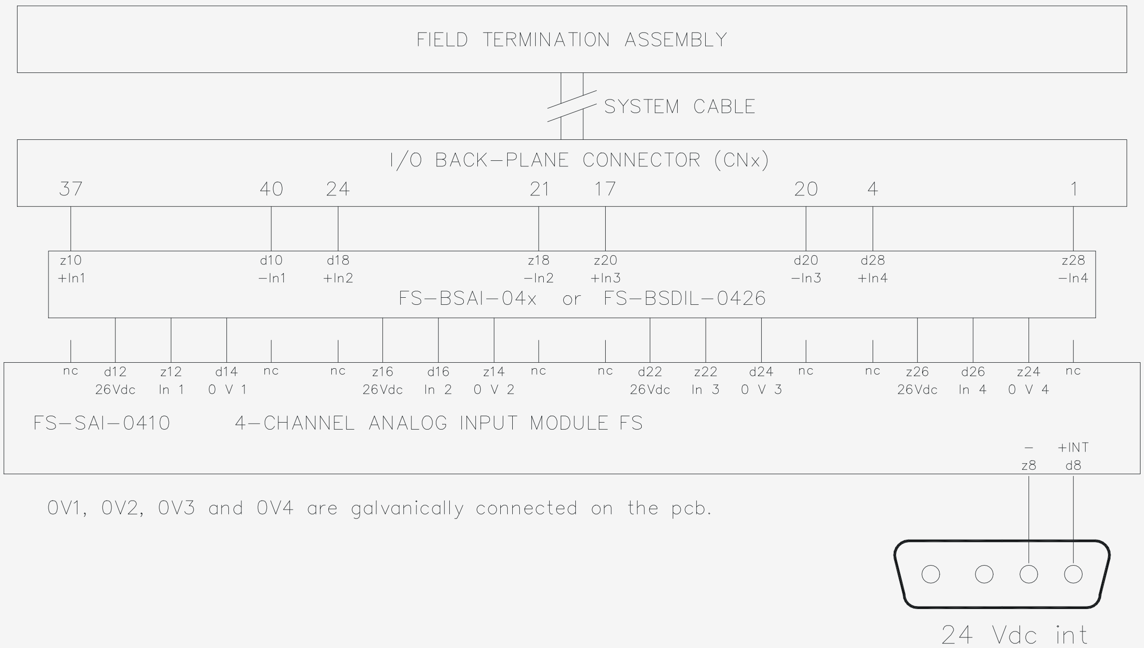


Figure 8-20: Connection example of SAI-0410 module to FTA for both non-redundant and redundant IO configurations

8.5.5 Hazardous locations (FM 3611)

The SAI-0410 module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see Safety Manager FM approval PM.MAN.6348.

8.5.6 Technical data

The SAI-0410 module has the following specifications:

General	Type numbers:	FS-SAI-0410
		FC-SAI-0410
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 30 mA
		24 V DC, 175 mA +25 mA for each active input
Input	Number of input channels:	4
	Input specification (V):	0-2 V DC
	Input resistance:	> 100 kΩ
	Maximum load capacitance:	100 nF
	Loop powering:	26 V DC (±1 V for 0.2 mA < I < 20 mA), short-circuit protected
	Loop current limit:	> 21 mA solid state
	A/D converter:	12-bit
	Inaccuracy:	≤ 0.75%
	Absolute max. input signal:	± 5 V DC
Key coding	(See section Key coding)	
	Module connector code:	
	• Holes	A5, C17
	Chassis connector code:	
	• Large pins	A5, C17

8.6 SDIL-1608

8.6.1 Safe loop-monitored digital input module with earth fault monitor (16 channels)

The SDIL-1608 digital input module has sixteen channels for either loop- monitored loops or status signals derived from proximity switches, as set in DIN (NAMUR). The module also supports monitoring of earth faults that occur within these sixteen loops.

The SDIL-1608 module can be used in applications up to SIL 3, in compliance with IEC 61508.

The power for the connected field devices is supplied by an on-board DC/DC converter common to all sixteen channels.

LEDs on the front of the module indicate the status of the channel, loop and module diagnostics.

The input of proximity switch signals to the SDIL-1608 module needs to be converted to a level that is suitable for the SDIL-1608 module. To enable this conversion, you need to place the signal converter module BN-1608 or BSN-1608 on programming connector Px on the back of the IO backplane in the IO chassis.

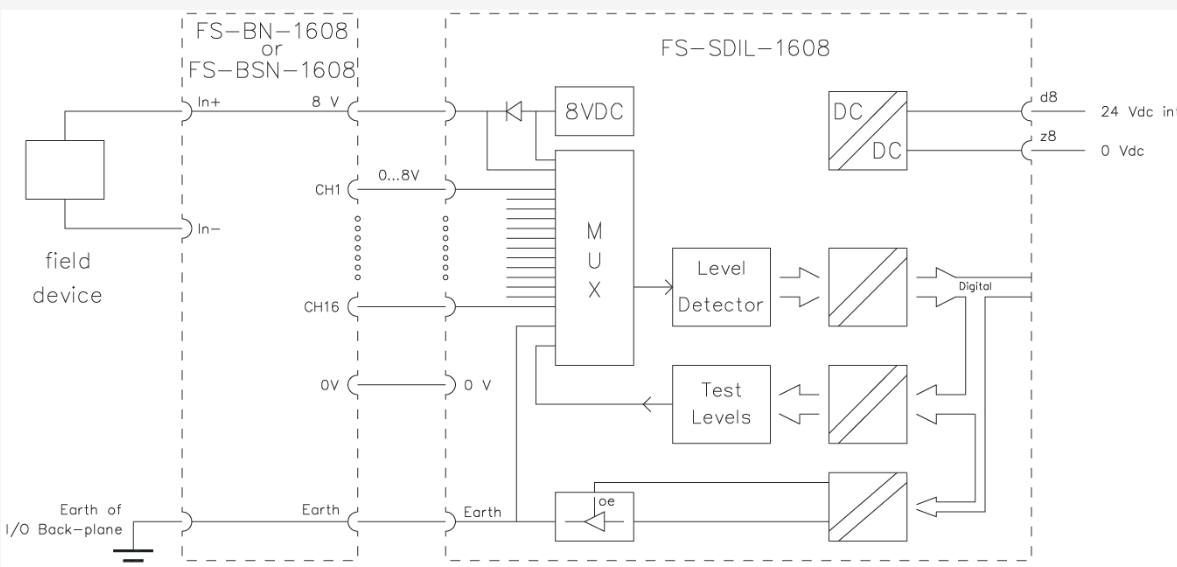


Figure 8-21: Schematic diagram for connection of inputs to SDIL-1608 module

8.6.2 Self-test

The self-test of the module, which is controlled by the Safety Manager Controller, includes:

- Functional tests of the various trip levels applied
- Channel independence
- Monitoring of supply voltage to input devices
- Earth connection
- Used supply voltages

8.6.3 Field devices

Different types of field devices can be connected to the SDIL-1608 channels, depending on the signal converter that is used, as shown in the below table.

Connection of field devices

Type of field signal	Used converter type	
	BN-1608	BSN-1608
Dry contacts with line monitoring function[1]	Yes	Yes
Dry contacts without line monitoring function	Yes	Yes[2]
Proximity switches according to DIN (NAMUR), for example Pepperl+Fuchs (P+F) N-series	Yes	No
Pepperl+Fuchs (P+F) SN-series safe proximity switches (ferrometal sensing)[3]	No	Yes
Pepperl+Fuchs (P+F) S1N-series safe proximity switches (non-ferrometal sensing)***	No	Yes

1. This requires a line terminator with a 10 kΩ resistor and a 1 kΩ resistor ±10%, 0.25 W (see Figure 2).
2. Max. 8 channels per BSN-1608 converter may be used for dry contacts without line-monitoring function.
3. The combination of safe sensors with the safe input module SDIL-1608 meets the safety integrity requirements in IEC 61508.

8.6.4 Earth fault monitor

For proper operation of the earth fault monitor, you need to ensure there is an earth connection for pin z28 of the SDIL-1608 module and the monitor software has been activated.

The earth fault monitor uses floating field sensors to check for and indicate a connection between any of the 2x16 input wires and earth. In zener-barrier applications, the earth fault monitor checks for and indicates a loss of connection between the ‘8 V DC’ of the SDIL-1608 module and earth.

8.6.5 LED indicators

The module front has a number of LED indicators that indicate the status of the channel, loop and module.

Each channel has two LEDs to indicate its status.

- The green channel LED shows the channel status is high (ON) or low (OFF).
- The red channel LED shows a fault occurred in the channel, or if a lead breakage or short circuit was found (ON).

For inputs without active line monitors, these two LEDs are always off.

The below tables shows the status indications of the green and red channel LEDs for different field situations.

The bi-colored earth LED indicates whether the earth connection test is OK (green), false (red) or disabled (OFF).

The bi-colored status LED indicates whether the module is OK (green) or faulty/not running (red).

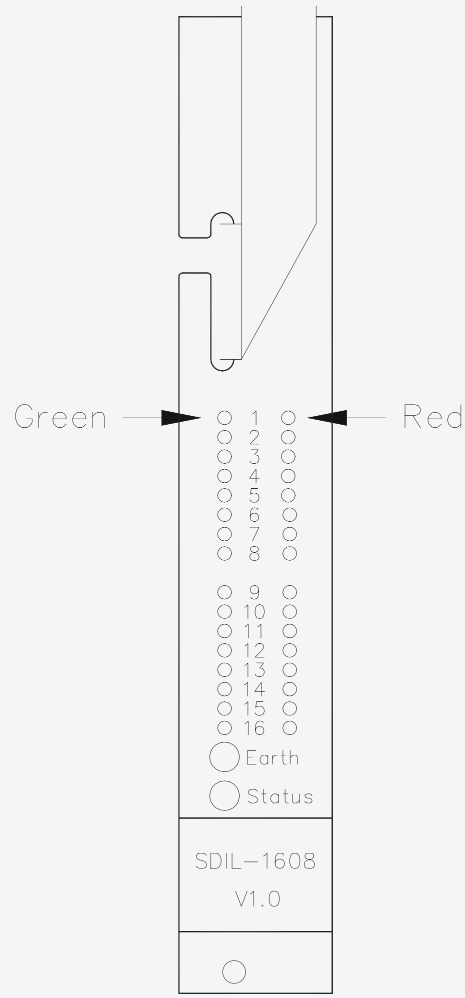


Figure 8-22: Module front

Table 1. Status LED behavior for line-monitored inputs

Field status	Green channel LED	Red channel LED
Normal	See the below table	ON/OFF[1]
Lead breakage	OFF	ON
Short circuit	ON	ON

1. OFF if no channel fault has been detected since the last fault reset.

   ON if a channel fault has been detected since the last fault reset.

	field situation	green channel LED	loop monitored
IN+ IN− DIN 19234 NAMUR	sensor I < 1.2mA	OFF	YES
IN+ IN− DIN 19234 NAMUR	sensor I > 2.1mA	ON	
IN+ IN− P+F SN sensor	sensor covered (safe state)	OFF	YES
IN+ IN− P+F SN sensor	sensor uncovered (active state)	ON	
IN+ IN− P+F S1N sensor	sensor uncovered (safe state)	OFF	YES
IN+ IN− P+F S1N sensor	sensor covered (active state)	ON	
1K 10K IN+ IN−	switch open	OFF	YES
1K 10K IN+ IN−	switch closed	ON	
1K 10K IN+ IN−	switch open	OFF	YES
1K 10K IN+ IN−	switch closed	ON	
IN+ IN−	switch open	OFF	NO
IN+ IN−	switch closed	ON	
IN+ IN− Spare	any	OFF	NO

Figure 8-23: Green channel LED behavior

8.6.6 Hazardous locations (FM 3611)

The SDIL-1608 module can be used for hazardous zones in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG).

Its non-incentive field device may reside in Division 2 area but module, FTA and converter must reside in a non-hazardous area. For more details, see Safety Manager FM approval PM.MAN.6348.

8.6.7 Maximum output load

The power for the connected field devices is supplied by an on-board DC/DC converter, common to all sixteen channels.

The below figure shows the derating curve of the total 8V output load versus the ambient temperature and (24 V DC) supply voltage level.

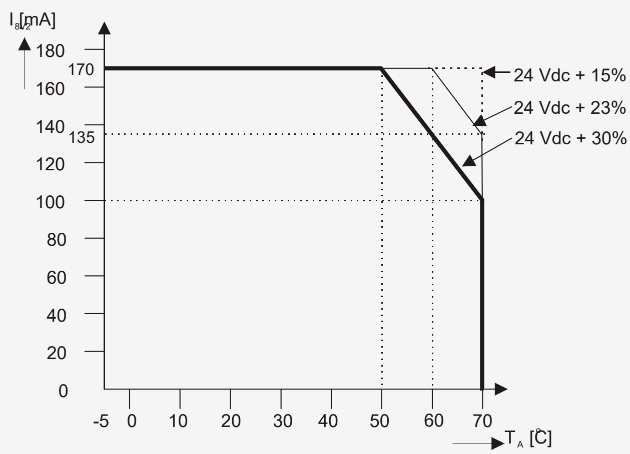


Figure 8-24: Derating curve (8V output load current vs. ambient temperature) for the SDIL-1608

8.6.8 Connection examples

The below figure shows a typical connection example for SDIL-1608.

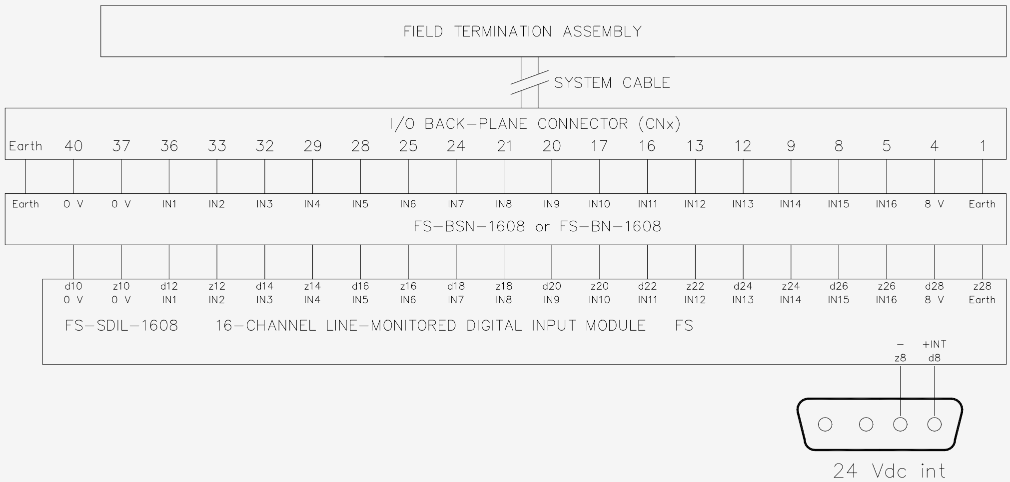


Figure 8-25: Connection example of SDIL-1608 module with signal converter BN-1608

8.6.9 Pin allocation

The following overview contains the back view and pin allocation of the SDIL-1608 module connector:

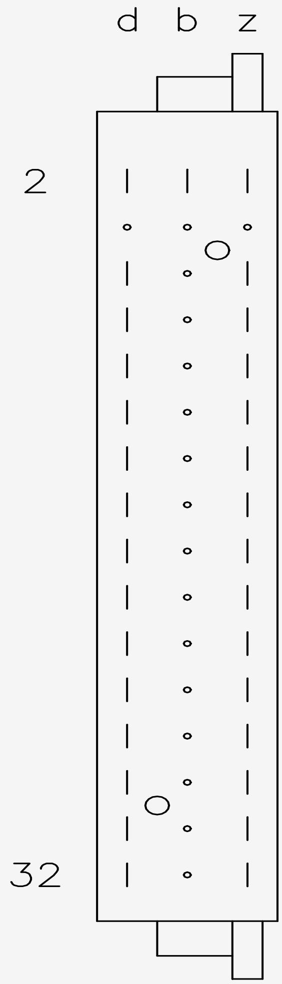


Figure 8-26: Back view and pin allocation of the SDIL-1608 module connector

d2	
d4	-
d6	
d8	Int. 24 V DC supply
d10	0 V DC Out
d12	IN 1
d14	IN 3
d16	IN 5
d18	IN 7
d20	IN 9
d22	IN 11
d24	IN 13
d26	IN 15
d28	8 V DC Out
d30	
d32	
b2	GND
z2	5 V DC
z4	-
z6	
z8	Int. 0 V DC supply
z10	0 V DC Out

z12	IN 2
z14	IN 4
z16	IN 6
z18	IN 8
z20	IN 10
z22	IN 12
z24	IN 14
z26	IN 16
z28	Earth
z30	
z32	

8.6.10 Technical data

The SDIL-1608 module has the following specifications:

General	Type numbers:	FS-SDIL-1608
		FC-SDIL-1608
		FA-SDIL-1608
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 160 mA
		24 V DC, 110 mA
Input	The following specifications are all in combination with BN-1608.	
	Number of input channels:	16
	Input type:	According to DIN (= NAMUR)
	Switch level:	1.4-1.9 mA
	Hysteresis:	0.2 mA ± 0.05 mA
	Input filter:	First order, low pass 100 Hz
	Field wire resistance:	Max. 50 Ω
	8 V loop supply:	
	output voltage	7.9-8.7 V
	output current	170 mA (short-circuit proof)[3]
	Maximum load capacitance:	100 nF

Earth	Connection monitor:	1
	Input resistance:	Typically 0.5 MW (–40V < U < 40V)
	Test current:	Typically 0.5 mA
	Output voltage:	Typically 0.5 V DC
	Field fault voltage:	Max. 250 V AC
Key coding	(See section Key coding)	
	Module connector code:	
	• Holes	A5, C29
	Chassis connector code:	
	• Large pins	A5, C29

CHAPTER 9

INPUT CONVERTER MODULES

9 Input converter modules

This chapter describes the input converter modules that are available for Safety Manager.

The following input converter modules are described:

Input converter module	
BSAI-04x + BSDIL-0426	Analog input converter modules for use with SAI-0410
BSAI-1620mE	Analog input converter module, 0-25 mA to 0-4.1 V (16 channels)
BSDI-16UNI	Converter module for normally open digital inputs with ELD function (16 channels)
BN-1608	Digital converter module for NAMUR Signals (16 channels)
BSN-1608	Digital converter module for Safety sensor signals (16 channels)

For related input modules, see Input modules.

9.1 General info about input converter modules

An input converter module converts input field signals to values appropriate for the Safety Manager input module being used. Converting input field signals can also be done on the FTA (see General info about Termination Assembly modules).

The converter modules described here are “B” type converters, meaning they are placed on an IO programming connector on the IO backplane in the IO chassis.

The below table shows all available input converter modules and the input modules for which they are used.

Table 1. input converter modules and their corresponding input modules

Input converter module	Input module
BSAI-0420mI BSAI-0420mE BSAI-0405E BSAI-0410E BSDIL-0426	SAI-0410
BSAI-1620mE	SAI-1620m
BSDI-16UNI	SDI-1624 SDI-1648
BN-1608	SDIL-1608
BSN-1608	SDIL-1608

The below figure shows a part of the back of a non-redundant IO chassis with input converters in slots P1, P4, P6 and P7.

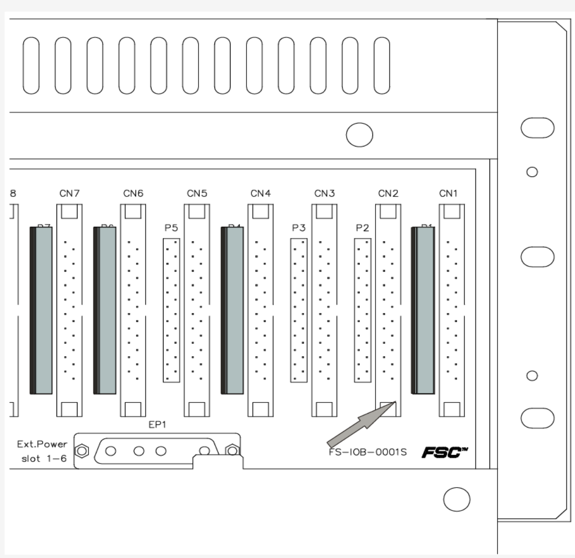


Figure 9-1: Detail of the back of a non-redundant IO chassis

The below figure shows a part of the back of a redundant IO chassis with input converters in slots P1 and P7.

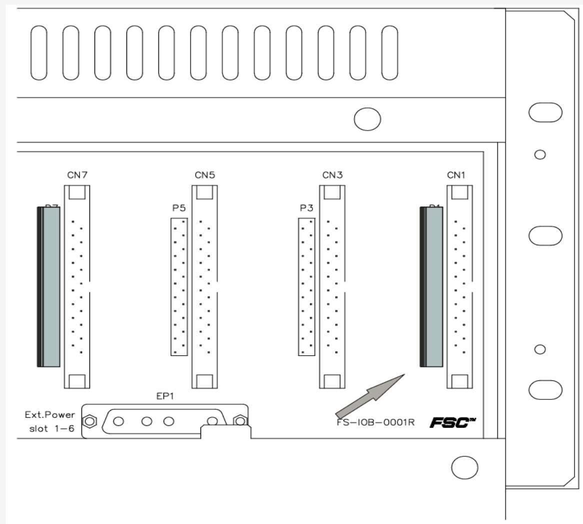


Figure 9-2: Detail of the back of a redundant IO chassis

9.2 BSAI-04x + BSDIL-0426

9.2.1 Analog input converter modules for use with SAI-0410

The analog inputs of an SAI-0410 module require an BSAI-04x or BSDIL-0426 analog input converter module to convert field signals into 0-2 V signals for the SAI-0410 module.

The following analog input converters are available for the SAI-0410:

- “BSAI-0420mI”
- “BSAI-0420mE”
- “BSAI-0405E”
- “BSAI-0410E”
- “BSDIL-0426”

The BSAI-04x or BSDIL-0426 module is placed on a programming connector (Px) on the back of the IO backplane in the 19-inch chassis.

Redundant modules require only one BSAI-04x or BSDIL-0426 module.

9.3 BSAI-0420mI

9.3.1 Safe analog input converter module, 0(4)—20 mA Internal power

The BSAI-0420mI analog input converter converts four 0(4)-20 mA field signals to 0-2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0420mI module links the 26 V DC power to the field.

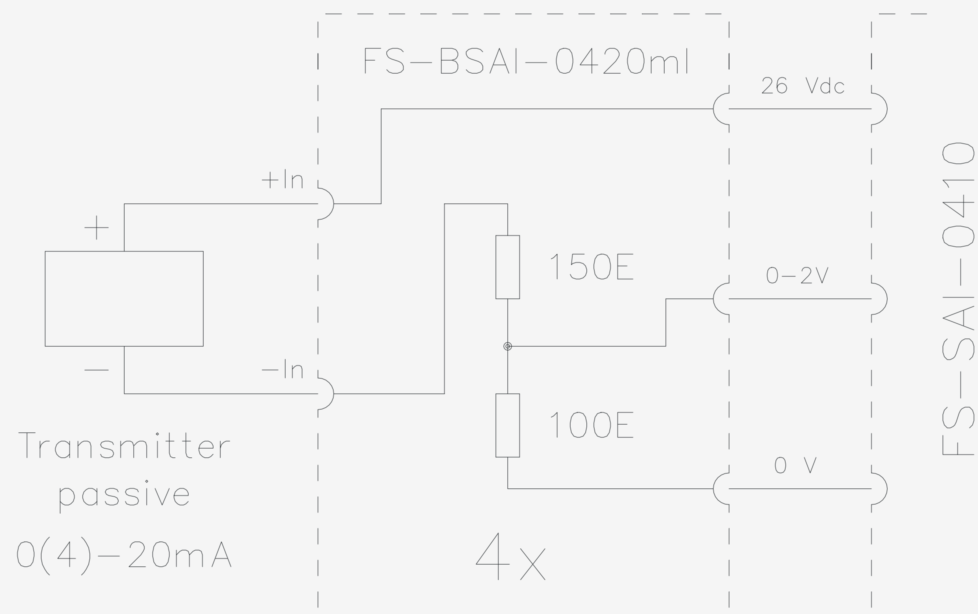


Figure 9-3: Schematic diagram of BSAI-0420mI module

9.3.2 Technical data

The BSAI-0420mI module has the following specifications:

General	Type numbers:	FS-BSAI-0420mI
		FC-BSAI-0420mI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	26 V DC (supplied by SAI-0410 module)
Input	Number of input channels:	4
	Input current:	0(4)-20 mA
	Maximum loop resistance:	800 Ω
	Input resistance:	250 Ω 0.1%
	Transmitter voltage:	21 V DC (± 1 V at 20 mA)
	Loop current limit:	> 20 mA solid state
	Absolute max. current:	50 mA
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.4 BSAI-0420mE

9.4.1 Safe analog input converter module, 0(4)—20 mA External power

The BSAI-0420mE analog input converter module converts four 0(4)-20 mA field signals to 0-2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0420mE module does not supply energy to the field.

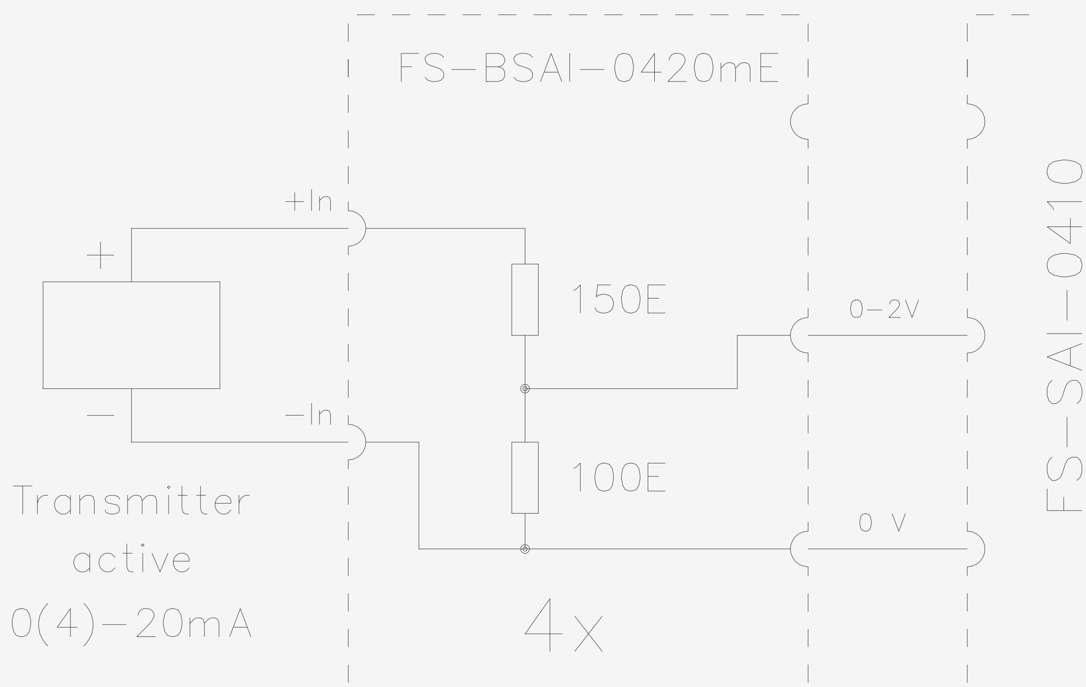


Figure 9-4: Schematic diagram of BSAI-0420mE module

9.4.2 Technical data

The BSAI-0420mE module has the following specifications:

General	Type numbers:	FS-BSAI-0420mE
		FC-BSAI-0420mE
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Input	Number of input channels:	4
	Input current:	0(4)-20 mA
	Input resistance:	250 Ω 0.1%
	Absolute max. input signal:	± 50 mA
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.5 BSAI-0405E

9.5.1 Safe analog input converter module, 0(1)—5 V DC External power

The BSAI-0405E analog input converter module converts four 0(1)-5 V DC field signals to 0-2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0405E module does not supply energy to the field.

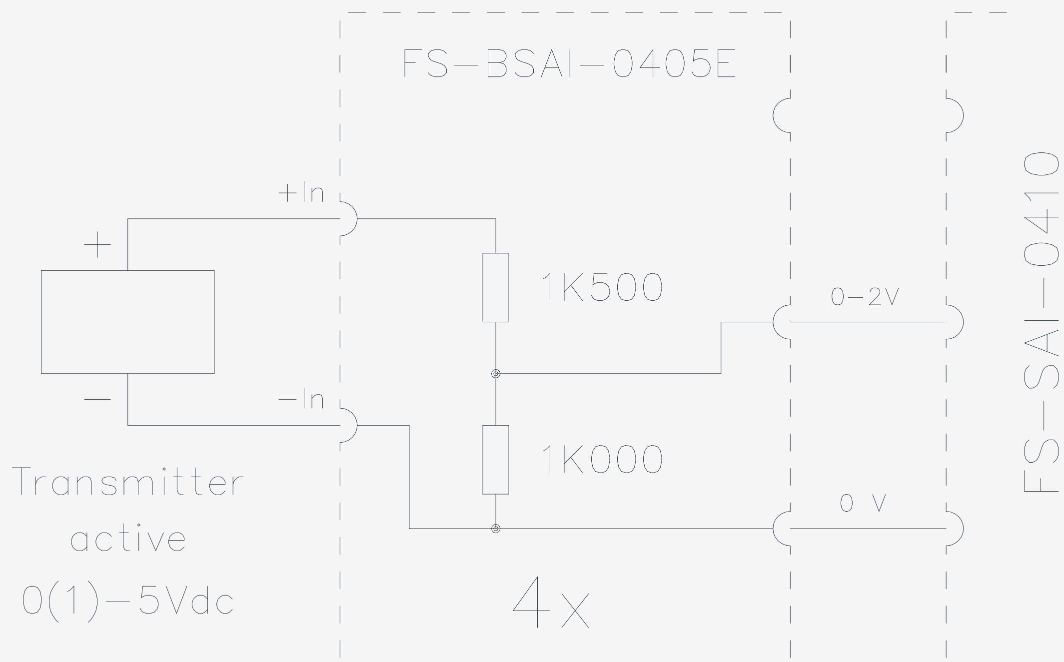


Figure 9-5: Schematic diagram of BSAI-0405E module

9.5.2 Technical data

The BSAI-0405E module has the following specifications:

General	Type numbers:	FS-BSAI-0405E
		FC-BSAI-0405E
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Input	Number of input channels:	4
	Input voltage:	0(1)-5 V DC
	Input resistance:	2.5 kΩ 0.1%
	Absolute max. input signal:	± 12.5 V DC
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.6 BSAI-0410E

9.6.1 Safe analog input converter module, 0(2)—10 V DC External power

The BSAI-0410E analog input converter module converts four 0(2)-10 V DC field signals to 0-2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0410E module does not supply energy to the field.

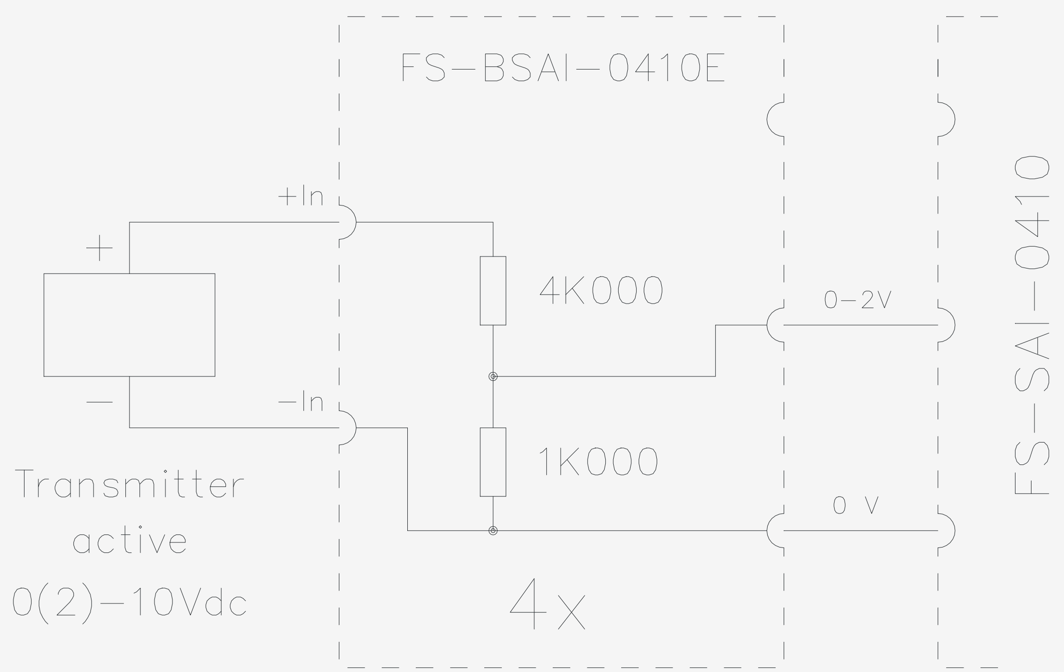


Figure 9-6: Schematic diagram of BSAI-0410E module

9.6.2 Technical data

The BSAI-0410E module has the following specifications:

General	Type numbers:	FS-BSAI-0410E
		FC-BSAI-0410E
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Input	Number of input channels:	4
	Input voltage:	0(2)-10 V DC
	Input resistance:	5 kΩ 0.1%
	Absolute max. input signal:	± 25 V DC
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.7 BSDIL-0426

9.7.1 Safe analog input converter module for loop-monitored digital signals

The BSDIL-0426 analog input converter module converts four field contacts with suitable resistors to 0-2 V signals for a (redundant pair of) SAI-0410 module(s).

The field resistors must be at least 0.25 W, 10%, and should be placed as close to the actual field contact as possible.

The BSDIL-0426 module supplies the 26 V DC power to the field.

The actual 'loop-monitored' digital input result is obtained by assigning a functional block to this input (in the application program).

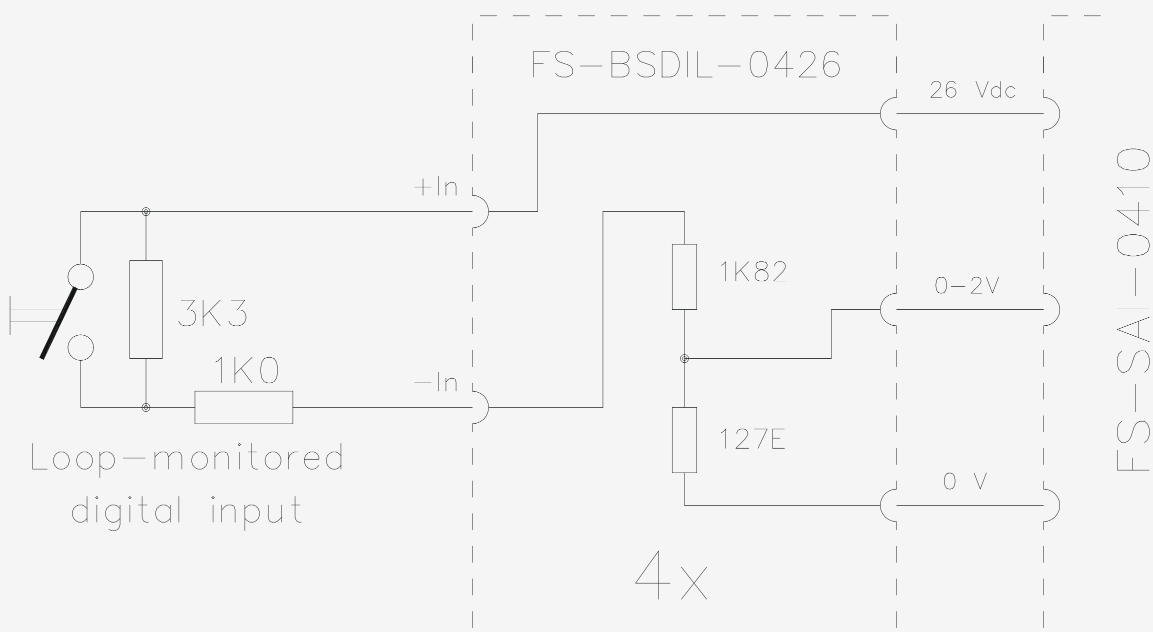


Figure 9-7: Schematic diagram of BSDIL-0426 module

9.7.2 Technical data

The BSDIL-0426 module has the following specifications:

General	Type numbers:	FS-BSDIL-0426
		FC-BSDIL-0426
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	26 V DC (supplied by SAI-0410 module)
Input	Number of input channels:	4
	Lead breakage voltage:	Approximately 26 V DC
	Input resistance:	Approximately 2 kΩ
	Short-circuit current:	Approximately 13 mA
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.8 BSAI-1620mE

9.8.1 Analog input converter module, 0—25 mA to 0—4.1 V (16 channels)

The analog input converter module BSAI-1620mE converts sixteen 0(4)-20 mA field signals to 0(0.66)-3.3 V signals for the safe high-density analog input module SAI-1620m.

The BSAI-1620mE is not used if the 0-20 mA field signals to 0 -3.3 V conversion is already done elsewhere (e.g. by the FTA on the rail).

All inputs are passive and have a common 0 V connection. The converter module BSAI-1620mE has been prepared for external power read-back. This only requires one extra resistor of 9.09 kΩ (1%) to rescale the voltage range (0 - 41 V).

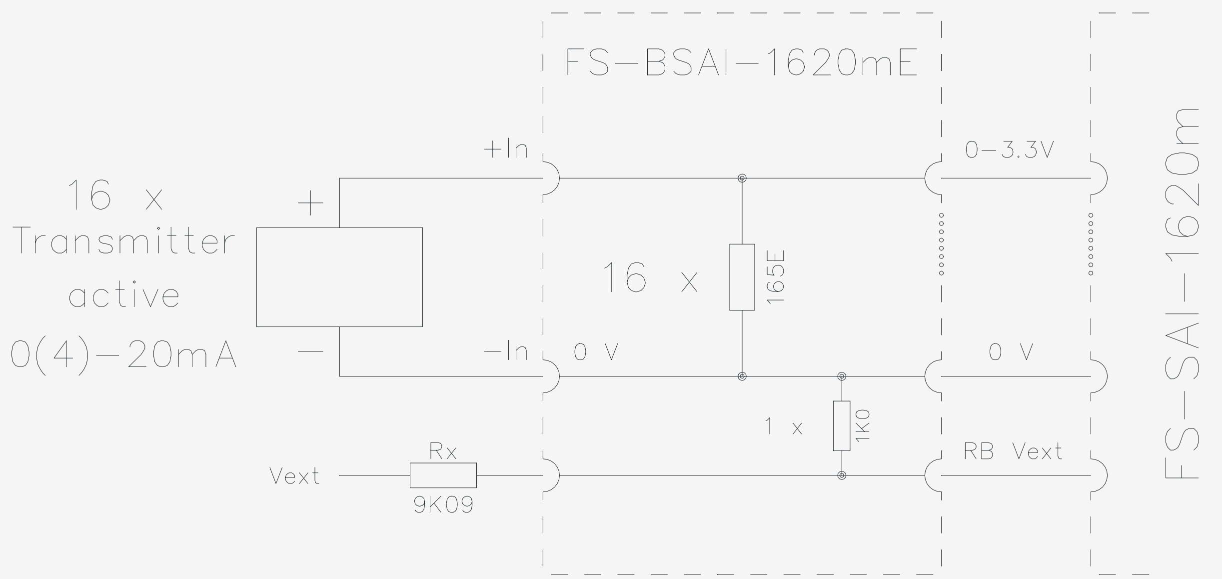


Figure 9-8: Schematic diagram

9.8.2 Technical data

The BSAI-1620mE module has the following specifications:

General	Type numbers:	FS-BSAI-1620mE
		FC-BSAI-1620mE
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Analog input	Number of input channels:	16
	Input current:	0(4)-20 mA (full scale = 25 mA)
	Input resistance:	165 Ω 0.1%
	Absolute max. input current:	50 mA
Read back input	R_x resistor:	9.09 kΩ 1%, 0.6 W
	Input voltage (Vext):	0-41 V
	Input resistance (Vext):	10.1 kW 1%
	Absolute maximum (Vext):	80 V
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.9 BSDI-16UNI

9.9.1 Converter module for normally open digital inputs with ELD function (16 channels)

The BSDI-16UNI converter module for normally open (NO) digital inputs with an earth leakage detector terminal (TELD) on the supply, provides sixteen transient voltage suppressor diodes for the input channels of a SDI-1624 or SDI-1648 digital input module.

The diodes enable earth fault detection by the module in case of earth faults at the input wires of an input signal with an open field contact. Earth faults at the power supply or to input wires of inputs signals with closed field contacts are already detected by the module without the use of the BSDI-16UNI module.

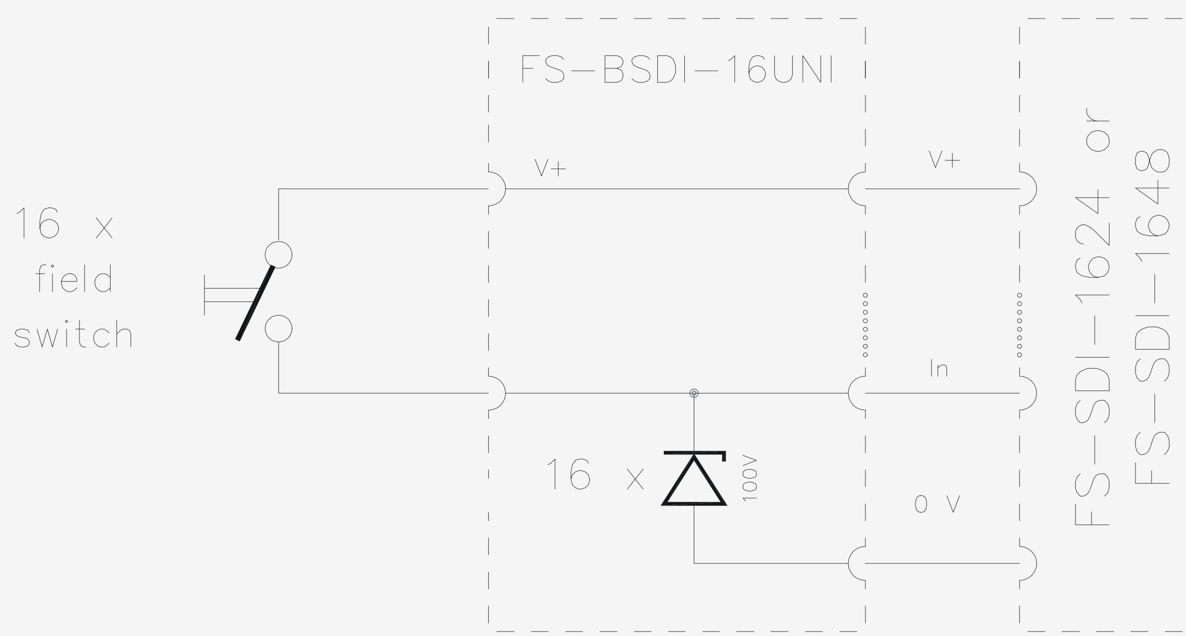


Figure 9-9: Schematic diagram

9.9.2 Technical data

The BSDI-16UNI module has the following specifications:

General	Type numbers:	FS-BSDI-16UNI
		FC-BSDI-16UNI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	None
Digital input	Number of input channels:	16
	Input voltage:	Max. 90 V
	Reverse current:	Max. 200 mA
	Reverse voltage drop:	< 1 V
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.10 BN-1608

9.10.1 Digital converter module for NAMUR Signals (16 channels)

The NAMUR signal converter module BN-1608 converts sixteen NAMUR field signals to 0-8 V signals for the safe line-monitored digital input module SDIL-1608.

All inputs are passive and have a common 8 V connection.

The BN-1608 module connects the earth pin of the SDIL-1608 module with the earth of the IO backplane.

- If earth fault monitoring is used (*floating* selected in Safety Builder Module properties -Advanced) the (single) 100kΩ resistor between 0V and earth increases the maximum allowed cable length of the module.
- If earth connection monitoring is used (*grounded* is selected in Safety Builder Module properties - Advanced) there is no cable length limit.
- If earth monitoring is disabled (*not monitored* selected in Safety Builder Module properties - Advanced) there is no cable length limit.

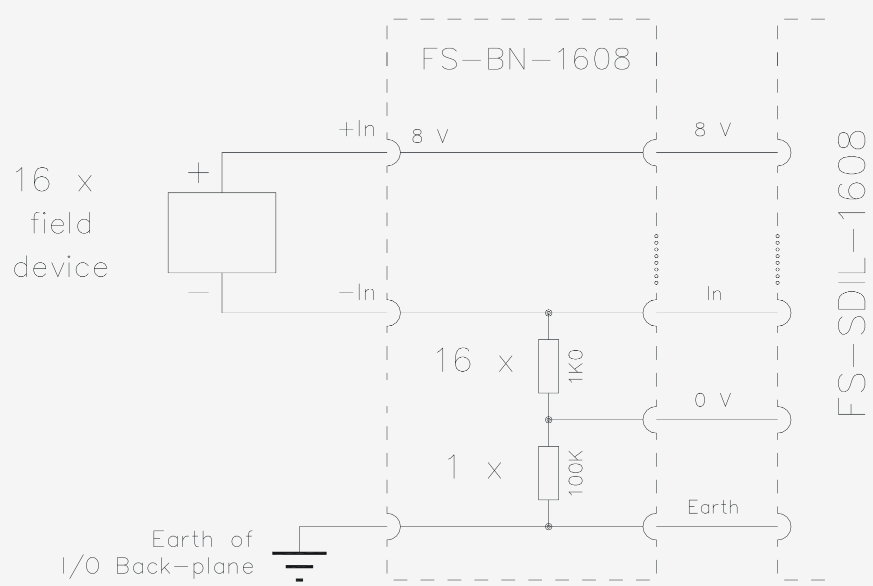


Figure 9-10: Schematic diagram

9.10.2 Technical data

The BN-1608 module has the following specifications:

General	Type numbers:	FS-BN-1608
		FC-BN-1608
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	None
Analog input	Number of input channels:	16
	Input current:	0-8 mA
	Input resistance:	1 kΩ 1%
	Absolute max. input current:	20 mA
Cable capacitance	(total of all connected cables)	< 16 µF 2
Earth resistor	Resistance:	100 kΩ 1% 2
	Maximum dissipation:	0.6 W
Physical	Dimensions:	58.5 × 28.5 × 9mm
		(2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

9.11 BSN-1608

9.11.1 Digital converter module for Safety sensor signals (16 channels)

The Safety sensor signal converter module BSN-1608 converts sixteen Pepperl+Fuchs (P+F) Safety sensor signals to 0-8 V signals for the safe line-monitored digital input module SDIL-1608. All inputs are passive and have a common 8 V connection.

The BSN-1608 module connects the earth pin of the SDIL-1608 module to the earth of the IO backplane.

- If earth fault monitoring is used (*floating* selected in Safety Builder Module properties -Advanced) the (single) 100kΩ resistor between 0V and earth increases the maximum allowed cable length of the module.
- If earth connection monitoring is used (*grounded* is selected in Safety Builder Module properties - Advanced) there is no cable length limit.
- If earth monitoring is disabled (*not monitored* selected in Safety Builder Module properties - Advanced) there is no cable length limit.

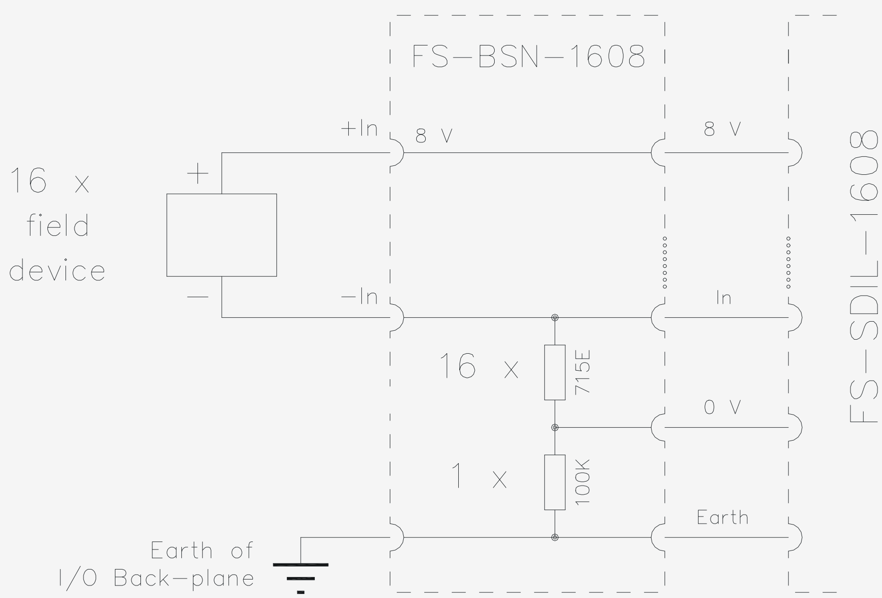


Figure 9-11: Schematic diagram

9.11.2 Technical data

The BSN-1608 module has the following specifications:

General	Type numbers:	FS-BSN-1608
		FC-BSN-1608
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	None
Analog input	Number of input channels:	16
	Input current:	0–11 mA
	Input resistance:	715 Ω 1%
	Absolute max. input current:	25 mA
Cable capacitance	(total of all connected cables)	< 16 µF 2
Earth resistor	Resistance:	100 kΩ 1% 2
	Maximum dissipation:	0.6 W
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

CHAPTER 10

OUTPUT MODULES

10 Output modules

This chapter describes the output modules that are available for Safety Manager.

The following output modules are described:

output module	
SDO-0824	Safe digital output module (24 V DC, 0.55 A, 8 channels)
SAO-0220m	Safe analog output module (0(4)-20 mA, 2 channels)
DO-1224	Non-safe digital output module (24 V DC, 0.55 A, 12 channels)
RO-1024	Non-safe relay output module (contacts, 10 channels)
DO-1624	Non-safe digital output module (24 V DC, 0.1 A, 16 channels)
SDO-04110	Safe digital output module (110 V DC, 0.32 A, 4 channels)
SDO-0448	Safe digital output module (48 V DC, 0.75 A, 4 channels)
SDO-0424	Safe digital output module (24 V DC, 2 A, 4 channels)
SDOL-0424	Safe loop-monitored digital output module (24 V DC, 1 A, 4 channels)
SDOL-0448	Safe loop-monitored digital output module (48 V DC, 500mA, 4 channels)

For related output converter modules, see Output converter modules.

For related FTAs, see Field Termination Assembly Module.

10.1 General information about output modules

All output modules are European standard size (100 × 160 mm) instrument modules. The width of the module front is 4 TE = 4 HP (20.32 mm, 0.8 in), which is one slot in a standard 19-inch IO chassis.

Each output module is connected to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR) via a flat cable, which extends from the module front. Digital output modules have status LEDs for each channel. The LEDs are placed in the module front, below the flatcable.

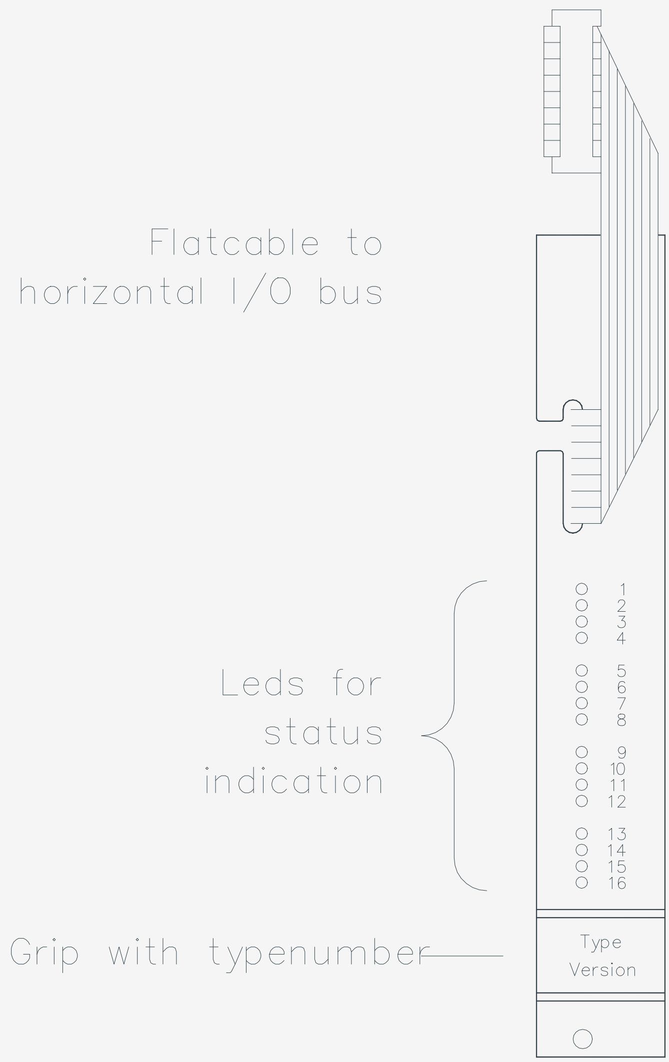


Figure 10-1: Front of a digital output module

There are digital output modules for 24 V DC, 48 V DC and 110 V DC signals. The modules are powered with 5 V DC for circuits associated with the horizontal bus logic, and with 24 V DC, 48 V DC or 110 V DC for the circuits associated with the output signals.

There is an analog output module for 0-20 mA field signals.

The output modules are fitted with a male connector according to DIN 41612, type F, with the d, (b) and z rows used.

The following items are terminated on the chassis connector:

- The internal power supply of 5 V DC,
- The internal control input for the secondary means of de-energization (WD input),
- The internal and external power supply of 24 V DC or other supply voltages (48 V DC or 110 V DC), and
- The wiring for the output signals.

All output modules have galvanic isolation between the 5 V DC circuitry and the output circuitry for separation between the processor and field section.

If indicated, the output modules are ‘fail-to-safe’. This means that in case of a component failure of the output module the outputs can still be switched off. The safe property of output modules is mainly achieved through self-test routines and additional (test) circuits on the module.

The fail-to-safe output modules have a secondary means of de-energization via the watchdog (WD) inputs (5 V DC level). This makes it possible to de-energize an output irrespective of the horizontal IO bus (IOBUS-HBS or IOBUS-HBR) control signals. This results in a de-energized output signal to the process, which is the safe condition in a normally energized system. The safety-relevant circuitry of the module is completely covered by the self-test functions of the system.

10.1.1 Secondary means of de-energization

All safe output modules have a secondary means of de-energization (SMOD) included to ensure ‘single fault tolerance for safety’. With this SMOD any failing output channel can be isolated from the equipment under control (EUC).

Each safe output module has one or two ‘group-SMODs’, controlling 2 or 4 channels, and rated to switch the combined load of all channels of the group.

The group SMOD is tested by the processor (QPP) and controlled by both the QPP and the watchdog:

- If the functional test of an output is diagnosed as faulty (fail to open), the QPP will switch off the corresponding SMOD, thereby isolating the faulty output from the EUC.
- If the functional test of the SMOD is diagnosed as faulty (fail to open), the QPP will switch off the corresponding channel outputs, thereby isolating the faulty SMOD from the EUC.

The series connection of a SMOD and the channel output, combined with full functional testing, creates ‘single fault tolerance for safety’.

Software driven full functional testing is executed by the QPP and the actual readback status is compared with the expected value. Any discrepancy found will result in safety corrective actions, meaning isolation of the fault from the EUC and notification of the operator while saving data in the diagnostics file and recording the event in the SOE.

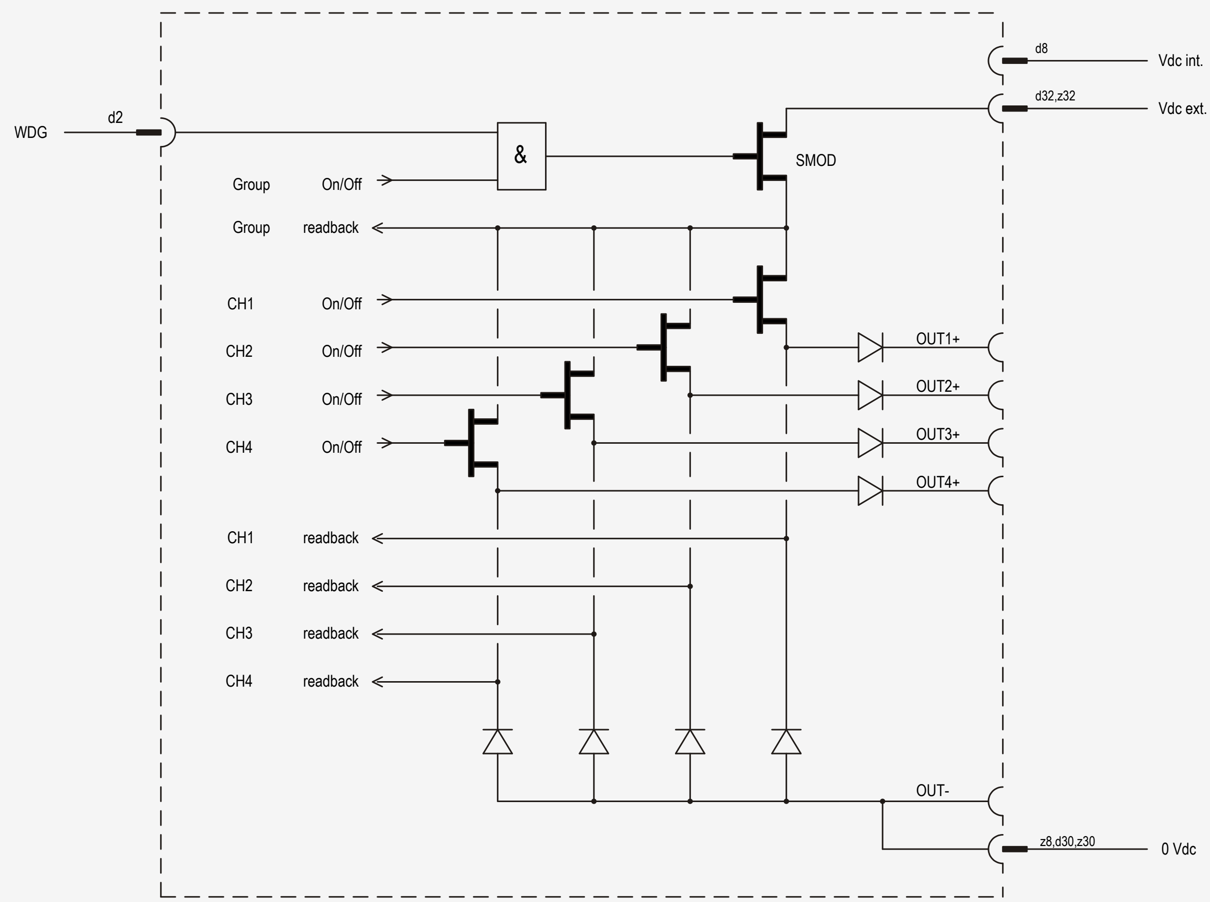


Figure 10-2: Schematic diagram of a SMOD with 4 channels

The following DC supply voltage ranges apply to ensure correct operation of the Safety Manager modules:

- 110 V DC: +25% / -15%
- 48 V DC: +15% / -15%
- 24 V DC: +30% / -15%

Note:

1. If it cannot be guaranteed that the DC power supplied to Safety Manager remains within the above ranges, additional voltage monitoring is required.
2. It is assumed that the 24Vdc Plant power fed to the Safety Manager Controller is uninterrupted. If not, means should be provided to avoid power dips at the 24Vdc lines to the Safety Manager Controller.
3. When using Plant power, the Plant power supply must fulfill the requirements as laid down in IEC 61010 or IEC 60950.

10.1.2 Address

The address of an output module is determined by the modules slot number in the IO chassis. This means the output modules have no jumpers or switches for setting the address. Each output module can be replaced by any module of the same type.

10.1.3 Replacing an output module

All output modules can be replaced with the power switched on. Depending on the output signal function and the system IO configuration, process operation may be affected.

When removing an output module, first disconnect the flat cable from the horizontal IO bus (IOBUS-HBS or IOBUS-HBR), loosen the screws, then carefully pull the module from the chassis.

When placing an output module, carefully push the module into the chassis until it is flush with the chassis, fasten the screws, then connect the flat cable to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR).

10.1.4 Output load current limiting and supply voltage

The digital outputs with transistor outputs are provided with an electronic current-limiting circuit. If the output is overloaded or shorted, it goes in current limit for a brief period of time (several milliseconds), supplying *at least* the specified maximum output current. If the overload or short-circuit persists, the output switches off.

Safety-related outputs will then generate a Safety Manager system fault, and remain de-energized until a fault reset is given.

Non-safety-related outputs switch on again after a delay of several hundreds of milliseconds (see the below figure). A system fault is only generated if the output is a safe type.

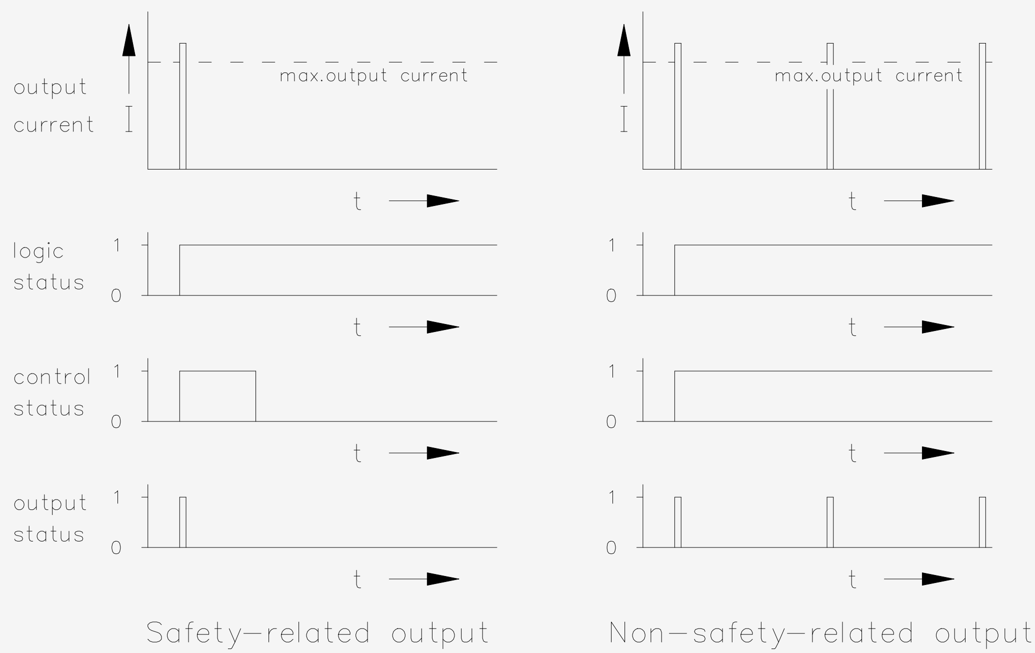


Figure 10-3: Output overload / short-circuit behavior

The specified maximum output current is independent of the supply voltage. The load current usually changes in a linear fashion with the supply voltage (I = V/R). To calculate the maximum permissible load of a channel, we must take into account the maximum supply voltage we expect.

To do this, we can use the following formula:

$$I_{nl} = I_m \frac{V_n}{V_m}$$

where:

V_n = nominal supply voltage (usually 24 V DC)

I_{nl} = nominal load current

V_m = expected maximum supply voltage

I_m = maximum output current (see module specification)

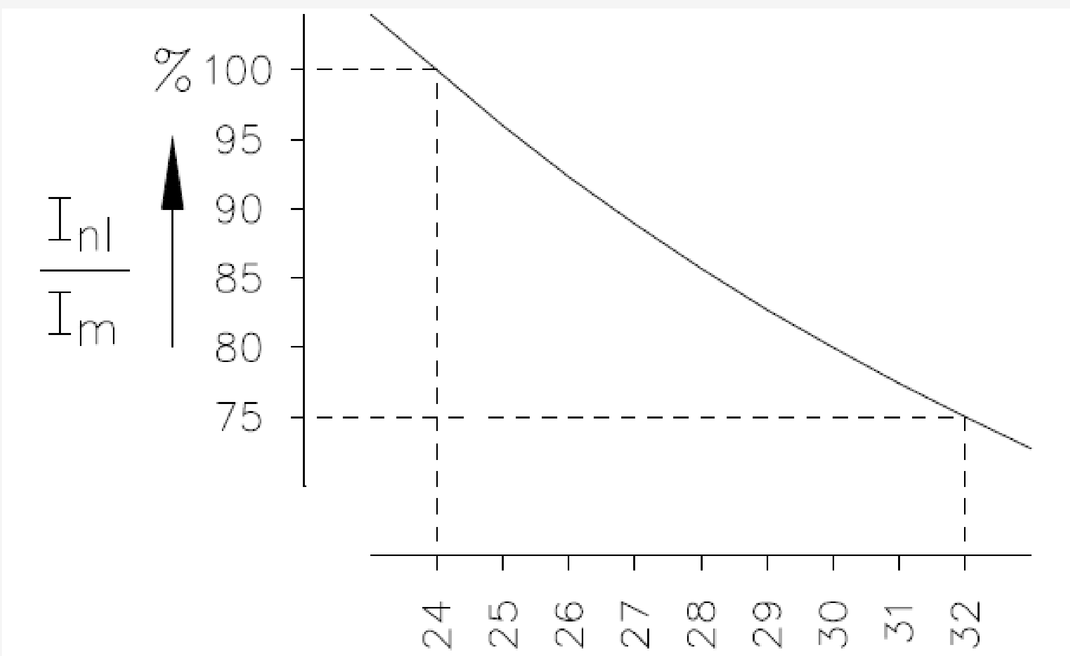


Figure 10-4: Maximum current derating vs. expected maximum supply voltage

10.1.4.1 Example:

We have a SDO-0824 module and we expect a maximum supply voltage of 30 V. The maximum output current of each channel is 550 mA. The current derating factor is 80% (see the above figure). The maximum nominal load current is then 80% * 550 mA = 440 mA (= 10.56 W).

10.2 SDO-0824

10.2.1 Safe digital output module (24 V DC, 0.55 A, 8 channels)

The safe digital output module SDO-0824 has eight 24 V DC, 550 mA output channels to drive loads up to 13 W.

These loads may be resistive (for example lamps) or inductive (for example solenoids). For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

During the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize
- Ability to de-energize the group (via secondary means)
- Crosstalk between outputs
- Functioning of the suppression diodes

The outputs are split into two groups of four outputs each. Each group has its own secondary means of de-energizing.

The secondary means of de-energizing (SMOD) enables the watchdog and the processor to de-energize the outputs, irrespective of the result of the application function.

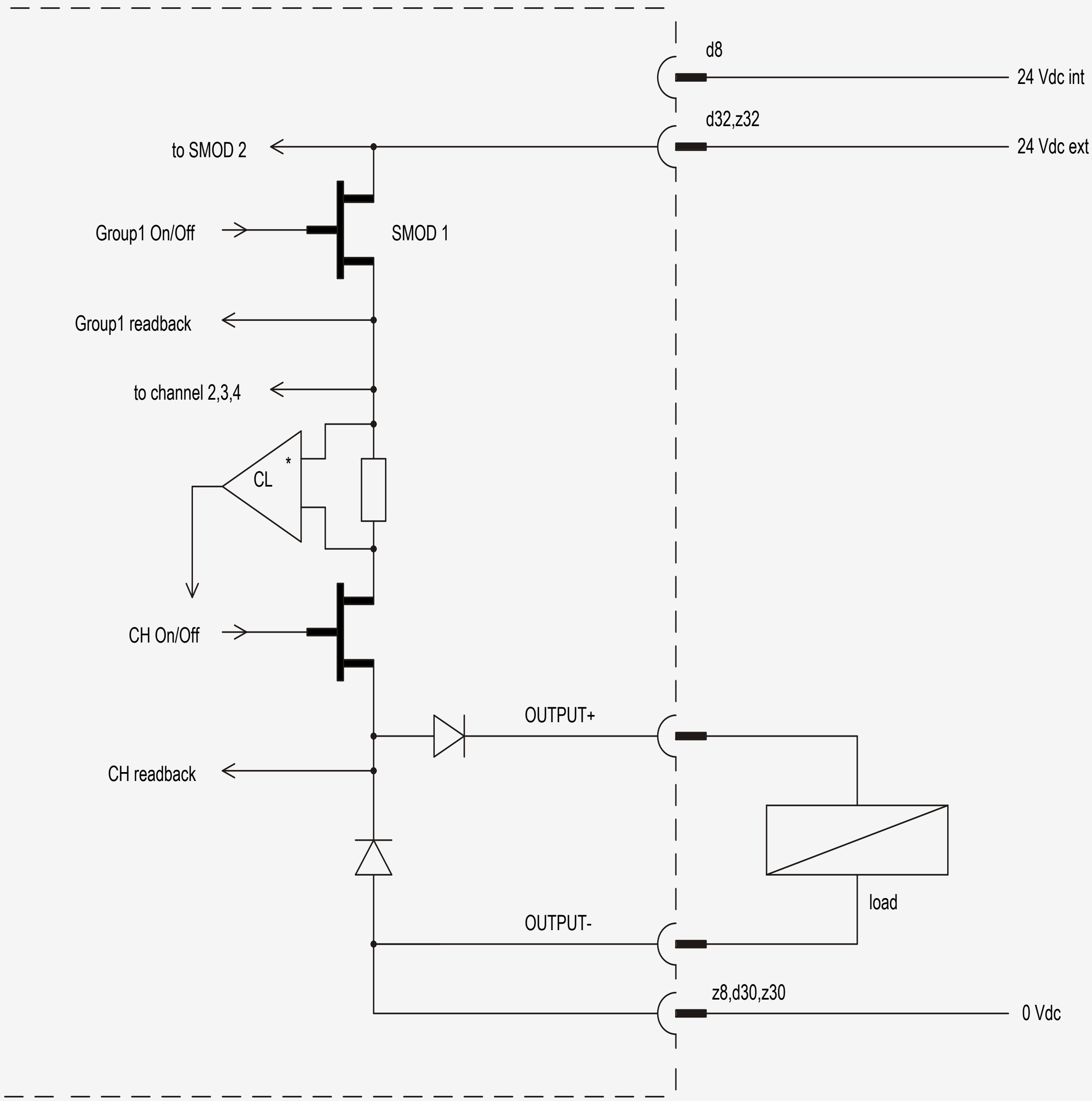


Figure 10-5: Schematic diagram for connection of one output to the SDO-0824 module
*Current Limiting circuit

10.2.2 Pin allocation

The back view and pin allocation of the SDO-0824 module connector are as follows:

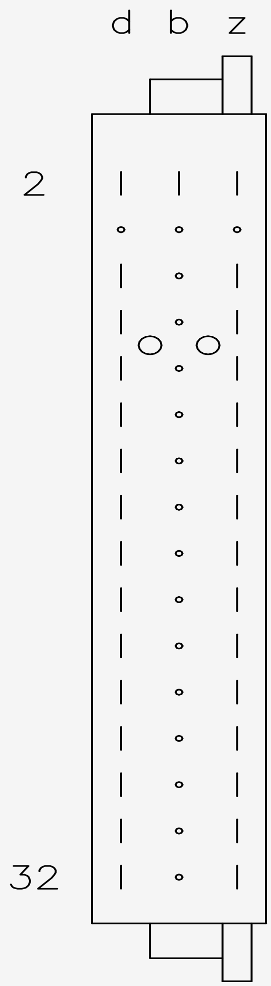


Figure 10-6: Back view and pin allocation of the SDO-0824 module connector

d2	WDG
d4	-
d6	
d8	Supply 24 V DC int.
d10	(0 V DC)
d12	OUT 1+
d14	OUT 2+
d16	OUT 3+
d18	OUT 4+
d20	OUT 5+
d22	OUT 6+
d24	OUT 7+
d26	OUT 8+
d28	(0 V DC)
d30	Supply 0 V DC
d32	Supply 24 V DC ext.
b2	GND
z2	VCC
z4	-
z6	
z8	Supply 0 V DC
z10	(0 V DC)

z12	OUT 1-
z14	OUT 2-
z16	OUT 3-
z18	OUT 4-
z20	OUT 5-
z22	OUT 6-
z24	OUT 7-
z26	OUT 8-
z28	(0 V DC)
z30	Supply 0 V DC
z32	Supply 24 V DC ext.

10.2.3 Connection examples

The next figures show a number of connection examples for the safe digital output module SDO-0824.

Attention:
The 24 V DC internal and external power supplies must be connected to prevent fault detection during the self-test of the output module (pins d8, z8, d30/z30 and d32/z32).

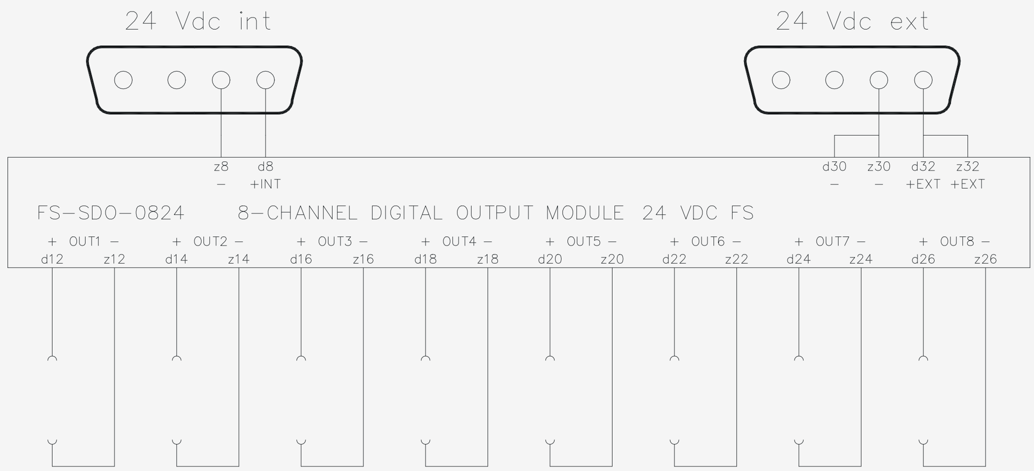


Figure 10-7: Connection example of SDO-0824 module to FTA for both non-redundant and redundant IO configurations

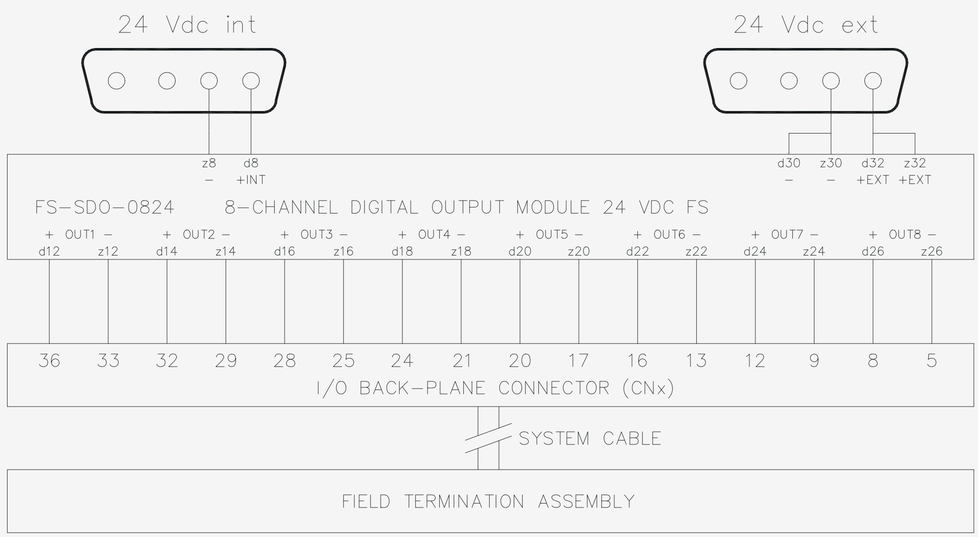


Figure 10-8: IO connection example of SDO-0824 module for non-redundant IO configurations

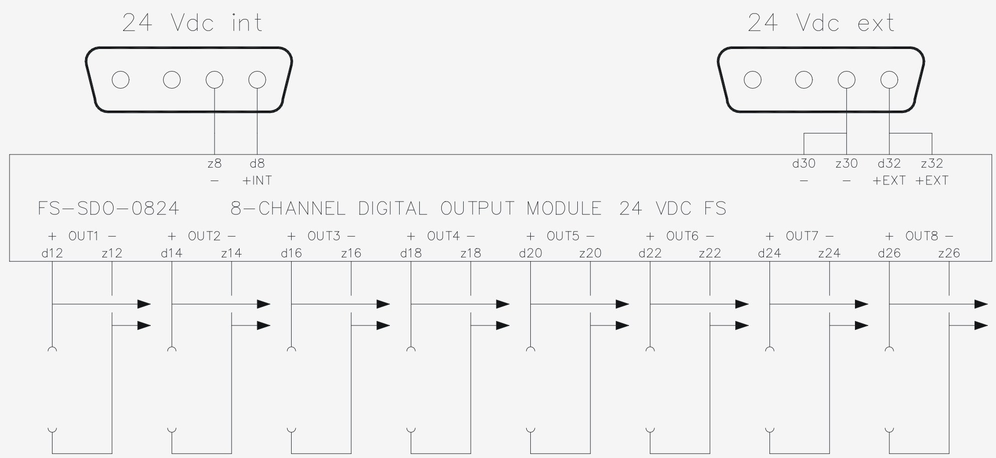


Figure 10-9: IO connection example of SDO-0824 module for redundant IO configurations

10.2.4 Maximum output load

The below figure shows the maximum channel load versus the ambient temperature.

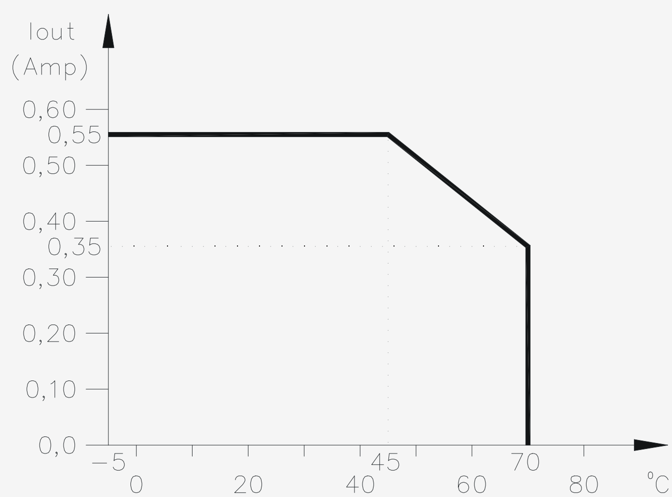


Figure 10-10: Derating curve (channel load vs. ambient temperature) for an SDO-0824

10.2.5 Technical data

The SDO-0824 module has the following specifications:

General	Type numbers:	FS-SDO-0824
		FC-SDO-0824
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 25 mA
		24 V DC internal, 25 mA
		24 V DC external, 70 mA (without output load)
Output	Number of output channels:	8
	Output specification:	24 V DC solid-state source, short-circuit proof
	Maximum current:	550 mA
	Maximum lamp load:	120 mA (2.9 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 2.0 V DC at 500 mA
	Off current:	< 0.1 mA
	WDG input current:	8 mA
Key coding	(See section Key coding)	
	Module code:	
	• Holes	A9, C9
	Chassis code:	
	• Large pins	A9, C9

10.3 SAO-0220m

10.3.1 Safe analog output module (0(4)—20 mA, 2 channels)

The safe analog output module SAO-0220m has two 0(4)-20 mA output channels for analog control applications. The load may only be resistive or capacitive. Inductive loads will cause the analog output module to be reported faulty. The two analog outputs are galvanically isolated from the 24 V DC and the 5 V DC. The 0 V 1 (d14) pin and 0 V 2 (d20) pin are interconnected on the module.

Each analog output channel consists of a 12-bit D/A converter for the output value and an A/D converter which reads the output value. By using the A/D converter, it is possible to check the correct functioning of the output channel.

Within the configured Diagnostic Test Interval, the analog outputs are tested for:

- Correct output value (current value ± 5%)
- Ability to de-energize
- Cross talk between analog outputs

Each analog output has a secondary means of de-energizing (SMOD). This enables the watchdog and the processor to de-energize the outputs, irrespective of the result of the application value.

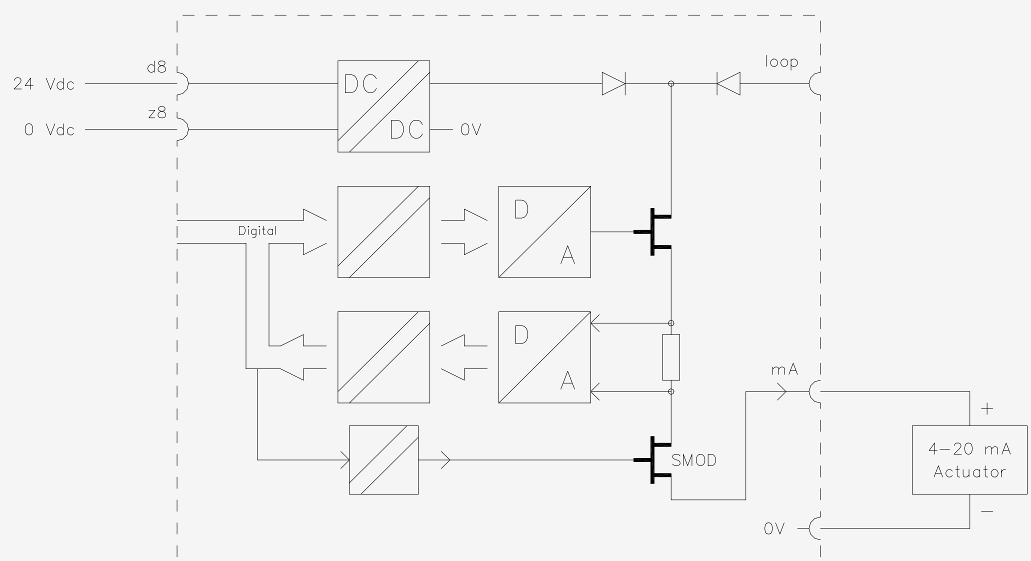


Figure 10-11: Schematic diagram for connection of the SAO-0220m module as an active output

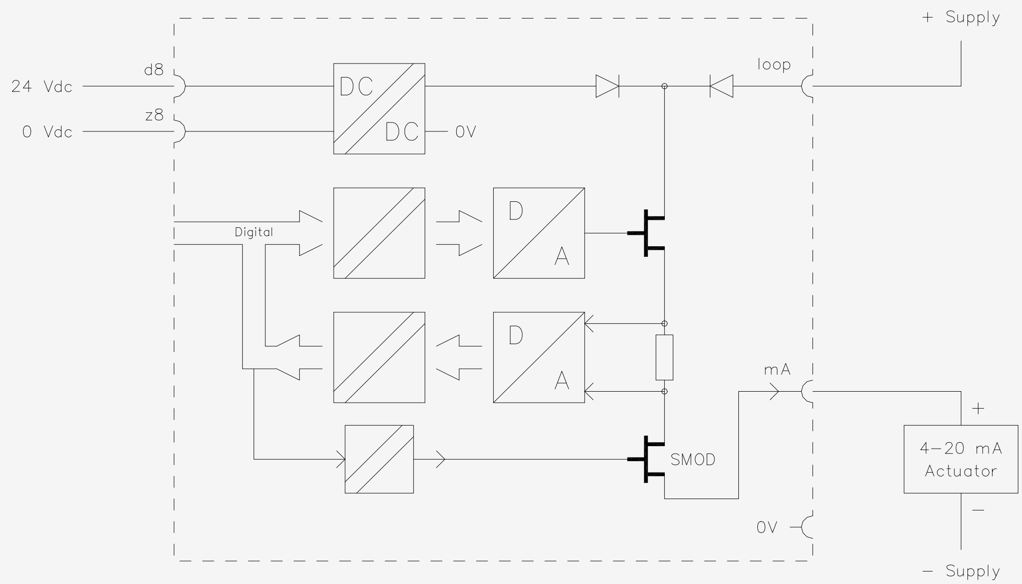


Figure 10-12: Schematic diagram for connection of the SAO-0220m module as a passive output

10.3.2 Redundant analog out

As of release 120 of Safety Builder, Safety Manager supports redundant analog outputs.

Attention:
Due to the nature of the self test procedure a fault detected on a *redundant* analog output channel may cause a dip in the output before Safety Manager switches over to the healthy channel.

10.3.3 Pin allocation

The back view and pin allocation of the SAO-0220m module connector are as follows:

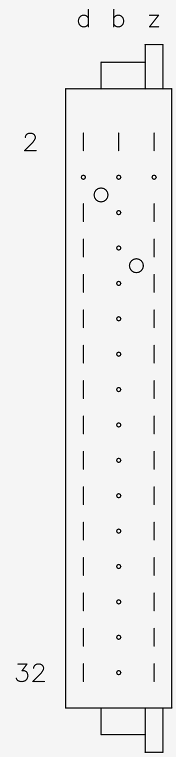


Figure 10-13: Back view and pin allocation of the SAO-0220m module connector

d2	WDG
d4	–
d6	
d8	Supply 24 V DC int.
d10	
d12	
d14	0 V 1
d16	mA 1
d18	
d20	0 V 2
d22	mA 2
d24	
d26	
d28	
d30	
d32	
b2	GND
z2	VCC
z4	–
z6	
z8	Supply 0 V DC
z10	

z12	
z14	
z16	Loop 1
z18	
z20	
z22	Loop 2
z24	
z26	
z28	
z30	
z32	

10.3.4 Connection examples

The figures below show a number of connection examples for the safe analog output module SAO-0220m.

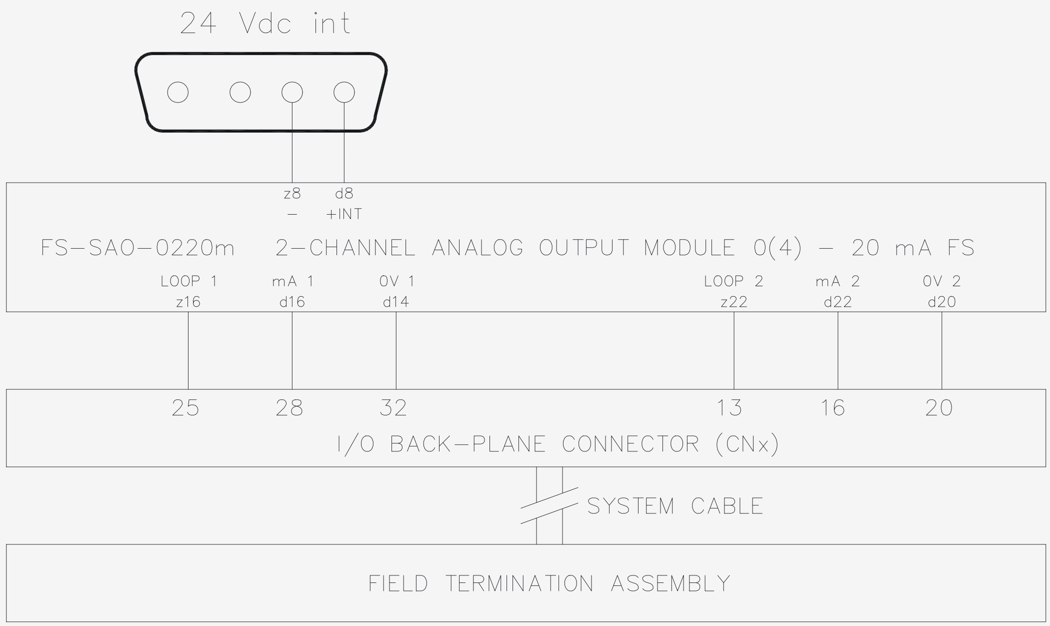


Figure 10-14: Connection example of SAO-0220m module to FTA for non-redundant IO configurations

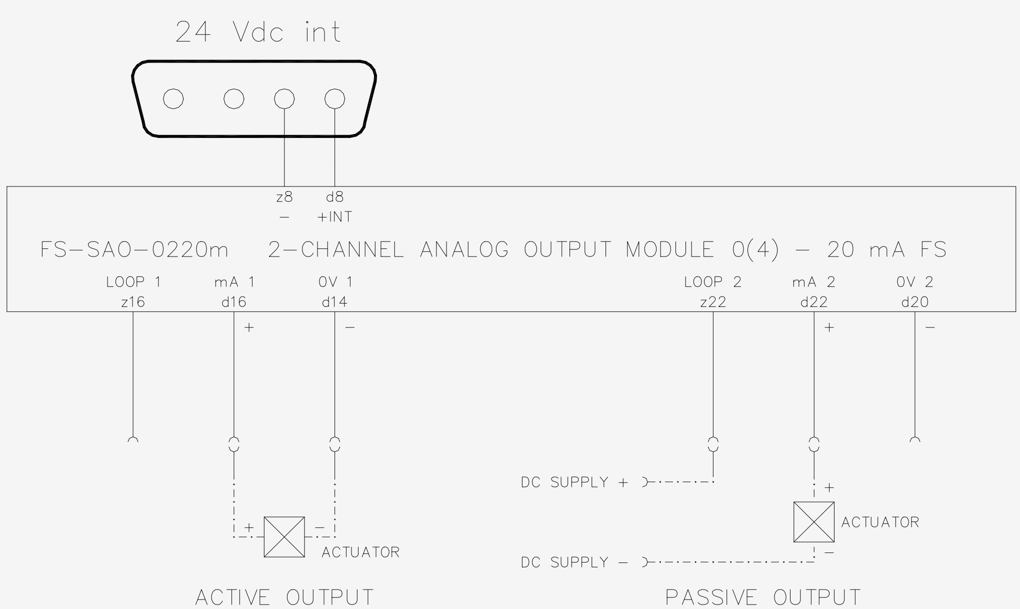


Figure 10-15: IO connection example for SAO-0220m module for non-redundant IO configurations (one channel active, one channel passive)

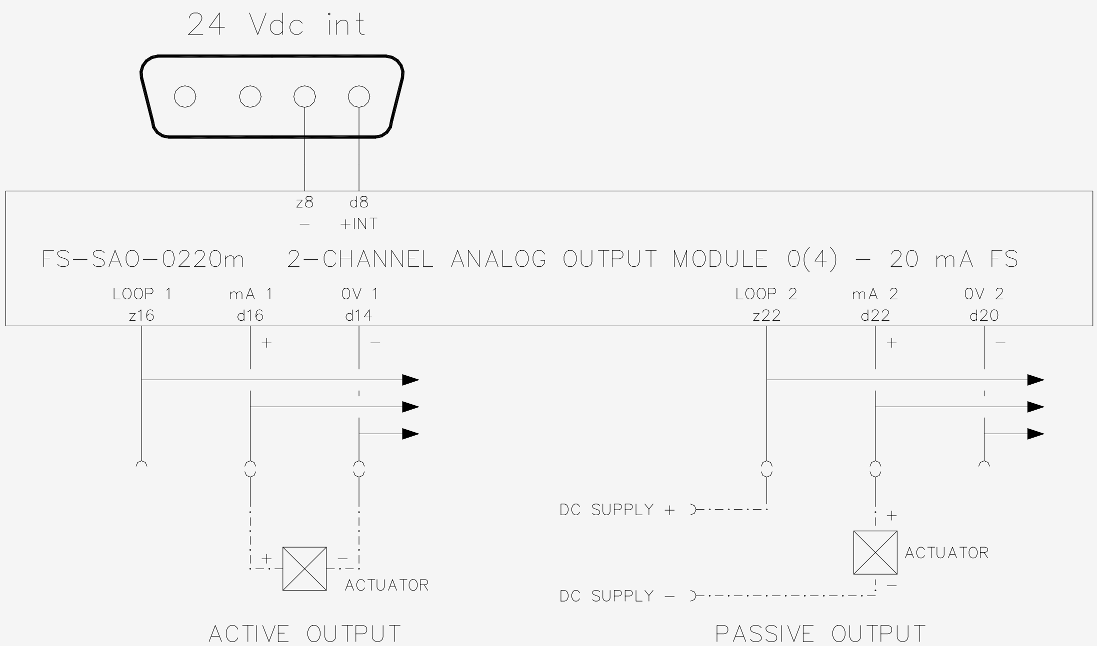


Figure 10-16: IO connection example for SAO-0220m module for redundant IO configurations (one channel active, one channel passive)

Note:

The 24 V DC (internal) supply must be connected to prevent fault detection during self-test.

Unused outputs must be shorted to prevent fault detection during the self-test of the module. For the FTA (TSAO-0220m), you need to link terminal 2 with 3 (for channel 1) respectively terminal 6 with 7 (for channel 2)

10.3.5 Hazardous locations (FM 3611)

The SAO-0220m module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see Safety Manager FM approval PM.MAN.6348.

10.3.6 Technical data

The SAO-0220m module has the following specifications:

General	Type numbers:	FS-SAO-0220m
		FC-SAO-0220m
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 30 mA
		24 V DC, 65 mA +30 mA for each active output
Output	Number of output channels:	2 (Galvanically isolated from supply voltage; 0V 1 and 0V 2 interconnected)
	Output specification (mA):	Active or passive, 0-20 / 4-20 mA
	D/A converter:	12-bit
	Off current:	< 0.05 mA
	Maximum load capacitance:	100 nF
	Loop powering (active):	Maximum loop resistance: 600 Ω
		Maximum output voltage: 30 V DC
	External powering (passive):	Maximum: 40 V DC
		Minimum voltage drop: ≤ 7.5 V
	WDG input current:	0.5 mA
Key Coding	(See section Key coding)	
	Module code:	
	• Holes	A9, C5
	Chassis code:	
	• Large pins	A9, C5

10.4 DO-1224

10.4.1 Non-safe digital output module (24 V DC, 0.55 A, 12 channels)

The DO-1224 digital output module has twelve non-safe 24 V DC, 550 mA output channels to drive loads up to 13 W.

These loads may be resistive (such as lamps) or inductive (such as solenoids). For inductive loads, a suppression diode is included on each output. The outputs are not tested and can therefore *not* be used for safe applications.

The outputs are also controlled by the watchdog. This means the outputs are de-energized if the system shuts down and the watchdog switches off.

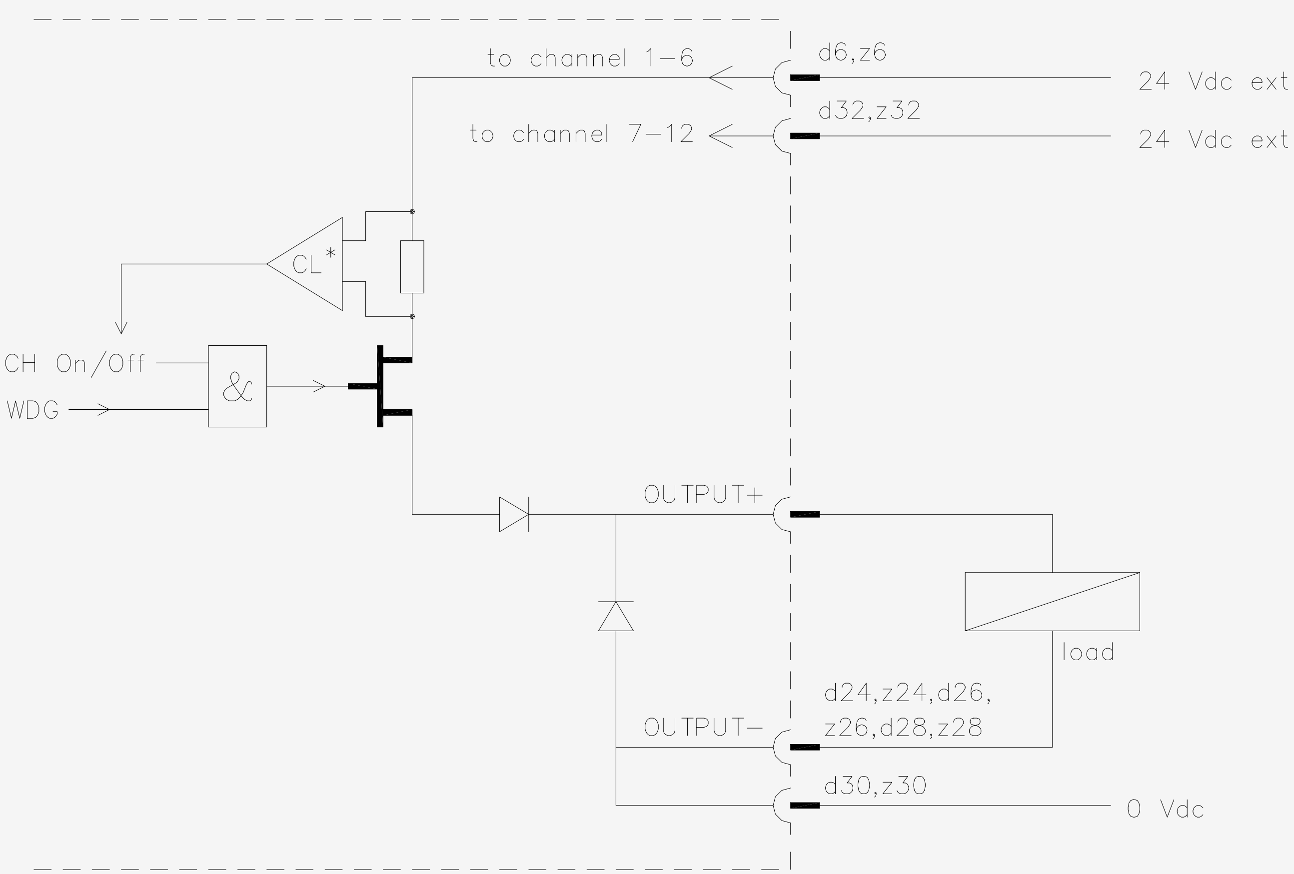


Figure 10-17: Schematic diagram for connection of one output to the DO-1224 module

*Current Limiting circuit

10.4.2 Pin allocation

The back view and pin allocation of the DO-1224 module connector are as follows:

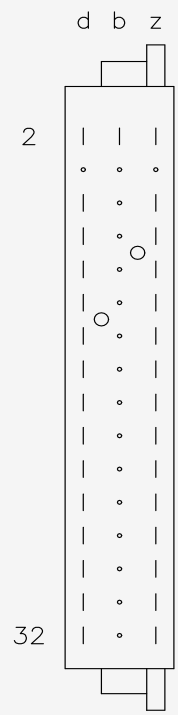


Figure 10-18: Back view and pin allocation of the DO-1224 module connector

d2	WDG
d4	-
d6	Supply 24 V DC ext.
d8	
d10	
d12	OUT 1
d14	OUT 3
d16	OUT 5
d18	OUT 7
d20	OUT 9
d22	OUT 11
d24	0 V DC out
d26	0 V DC out
d28	0 V DC out
d30	Supply 0 V DC
d32	Supply 24 V DC ext.
b2	GND
z2	VCC
z4	-
z6	Supply 24 V DC ext.
z8	
z10	

z12	OUT 2
z14	OUT 4
z16	OUT 6
z18	OUT 8
z20	OUT 10
z22	OUT 12
z24	0 V DC out
z26	0 V DC out
z28	0 V DC out
z30	Supply 0 V DC
z32	Supply 24 V DC ext.

10.4.3 Connection examples

The figures below show a number of examples of connections for the digital output module DO-1224.

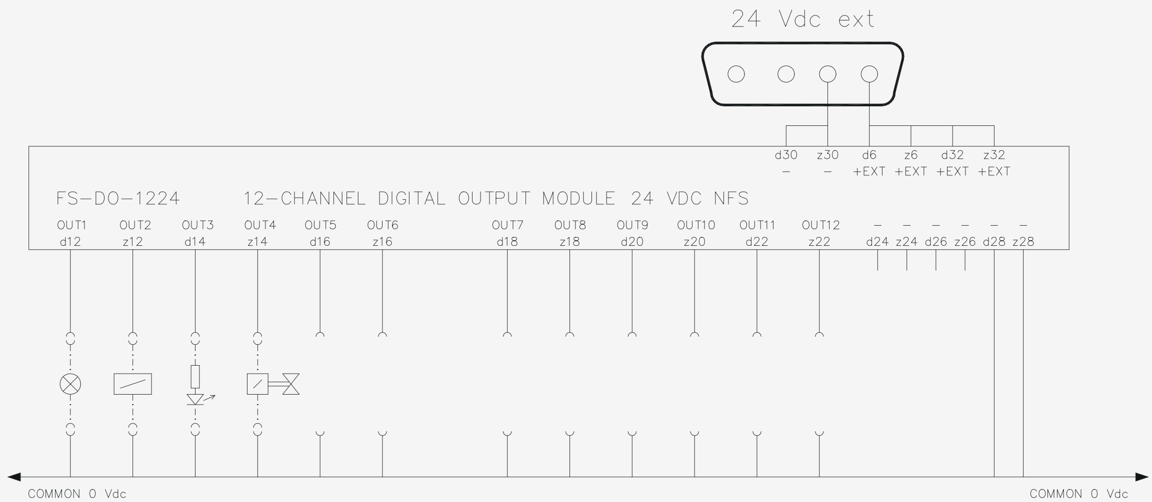


Figure 10-19: Connection example of DO-1224 module to FTA for both non-redundant and redundant IO configurations

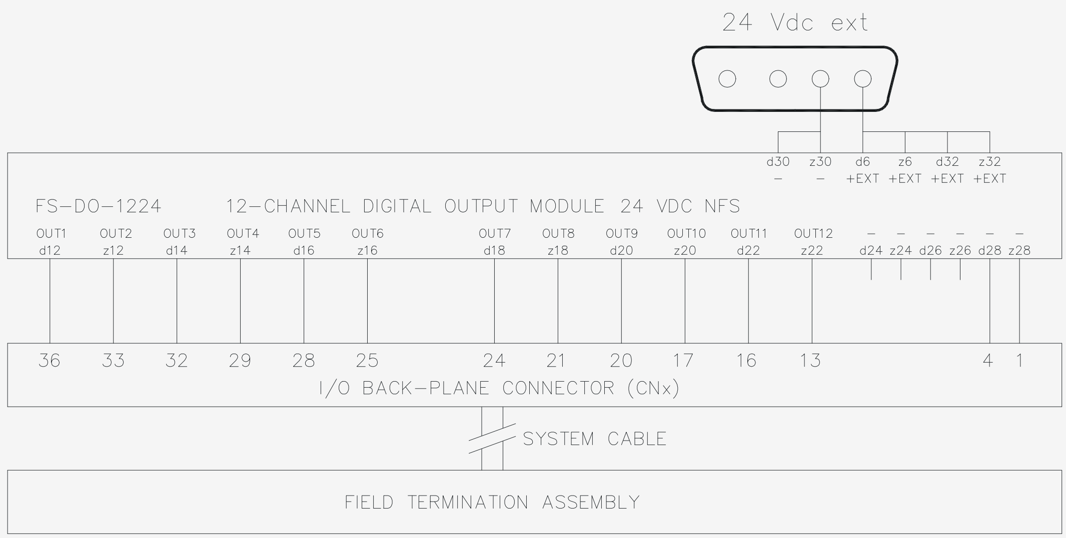


Figure 10-20: IO connection example for DO-1224 module for non-redundant IO configurations

10.4 DO-1224

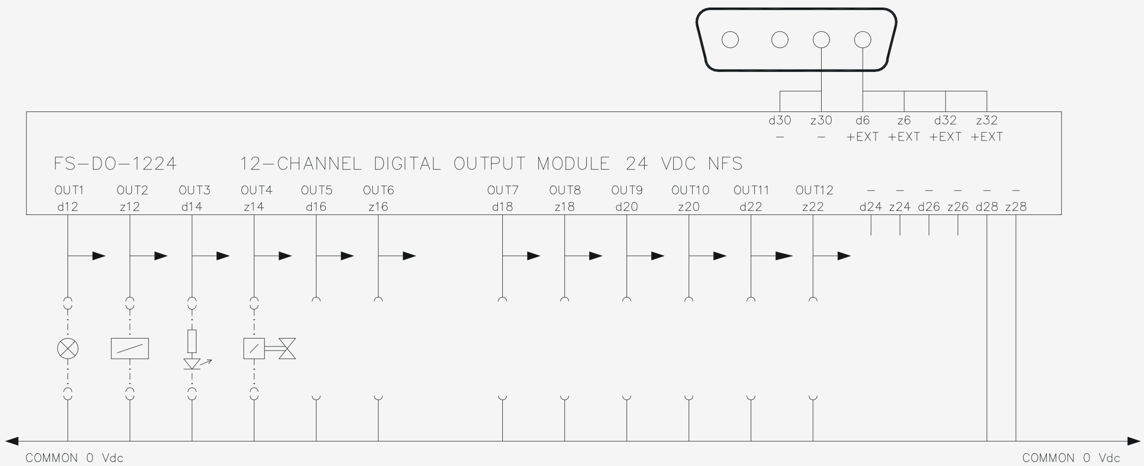


Figure 10-21: IO connection example for DO-1224 module for redundant IO configurations

10.4.4 Technical data

The DO-1224 module has the following specifications:

General	Type numbers:	FS-DO-1224
		FC-DO-1224
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 25 mA
		24 V DC, 2*30 mA (without output load)
Output	Number of output channels:	12 (2 groups of 6)
	Output specification:	24 V DC solid-state source, short-circuit proof
	Maximum current:	550 mA
		(see section General information about output modules)
	Maximum lamp load:	275 mA (6.6 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 1.5 V DC at 500 mA
	Off current:	< 0.1 mA
	WDG input current:	0.06 mA
Key coding	(See section Key coding)	
	Module code:	
	• Holes	A9, C13
	Chassis code:	
	• Large pins	A9, C13

10.5 RO 1024

The relay output module RO-1024 has ten potential-free relay contact non-safe output channels to drive loads up to 70 W.

These loads may be resistive (such as lamps) or inductive (such as solenoids). For inductive loads, a suppression diode must be mounted externally. The outputs are not tested and may therefore *not* be used for safe applications.

The maximum voltage on the relay contacts may be 36 V DC to meet IEC 61010-1.

The outputs are also controlled by the watchdog. This means the relays de-energize if the system shuts down and the watchdog switches off.

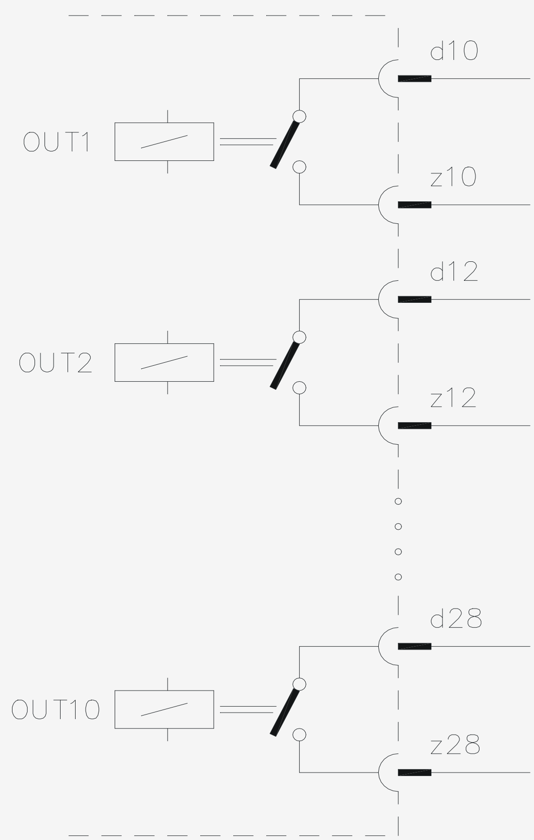


Figure 10-22: Schematic diagram for RO-1024 module

10.5.1 Pin allocation

The back view and pin allocation of the RO-1024 module connector are as follows:

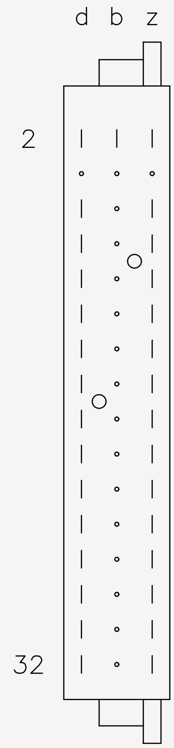


Figure 10-23: Back view and pin allocation of the RO-1024 module connector

d2	WDG
d4	-
d6	
d8	Supply 24 V DC
d10	Common 1
d12	Common 2
d14	Common 3
d16	Common 4
d18	Common 5
d20	Common 6
d22	Common 7
d24	Common 8
d26	Common 9
d28	Common 10
d30	
d32	
b2	GND
z2	VCC
z4	-
z6	
z8	Supply 0 V DC
z10	Normally open 1

z12	Normally open 2
z14	Normally open 3
z16	Normally open 4
z18	Normally open 5
z20	Normally open 6
z22	Normally open 7
z24	Normally open 8
z26	Normally open 9
z28	Normally open 10
z30	
z32	

10.5.2 Connection examples

The figures below show a number of connection examples for the relay output module RO-1024.

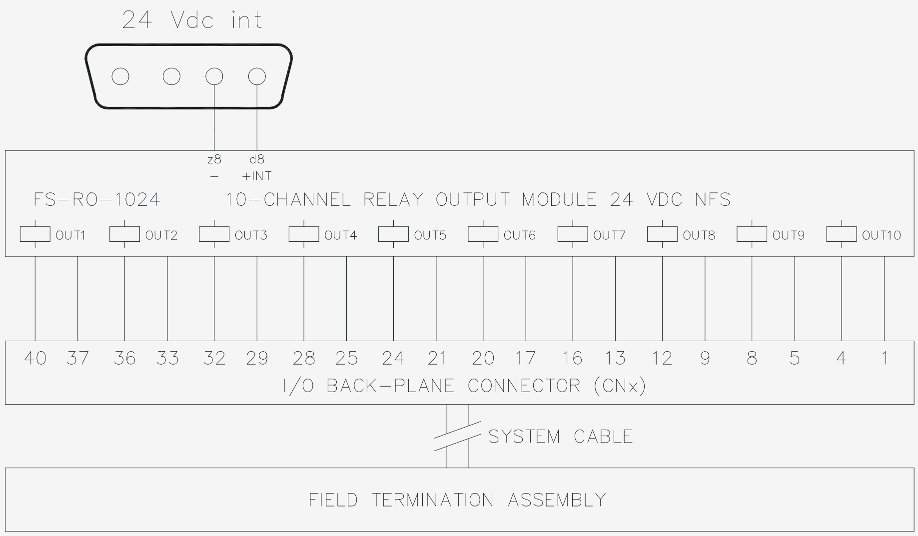


Figure 10-24: Connection example of RO-1024 module to FTA for both non-redundant and redundant IO configurations

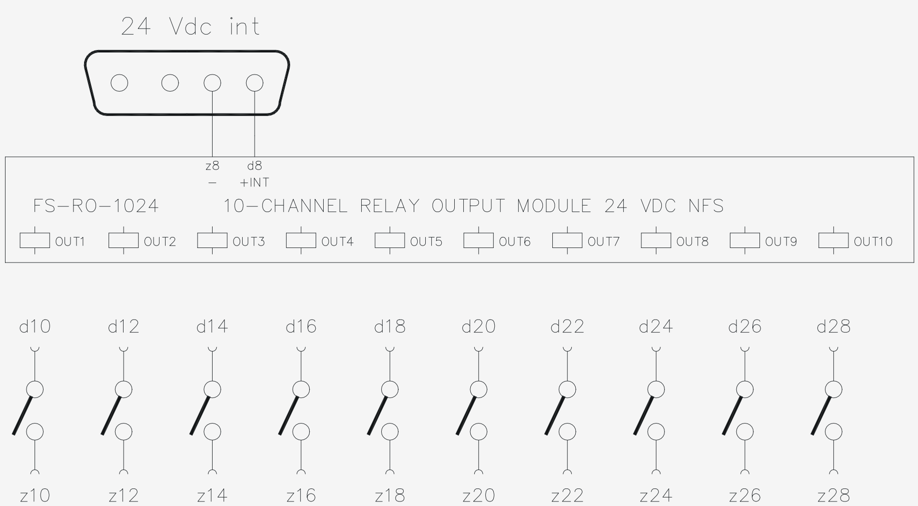


Figure 10-25: IO connection example for RO-1024 module for non-redundant IO configurations

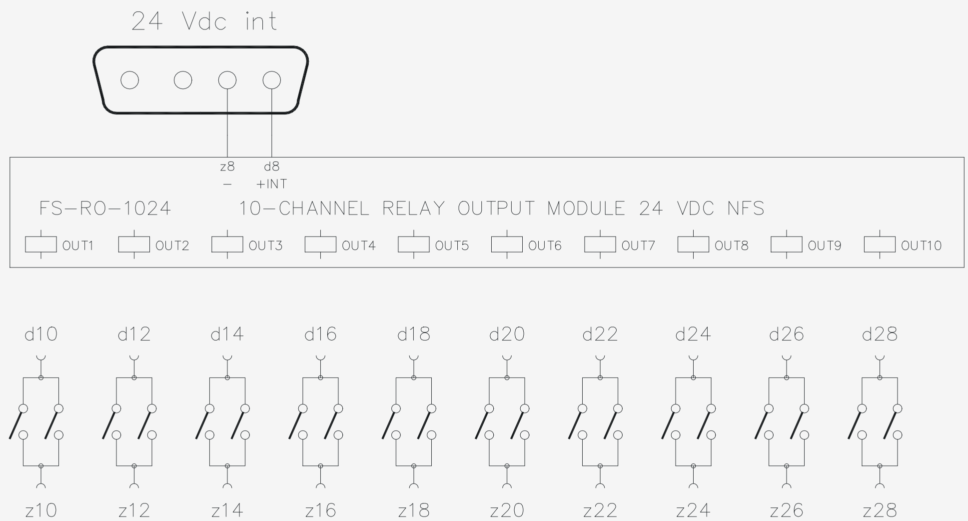


Figure 10-26: Figure 3. IO connection example for RO-1024 module for redundant IO configurations

10.5.3 Technical data

The RO-1024 module has the following specifications:

General	Type numbers:	FS-RO-1024
		FC-RO-1024
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 25 mA
		24 V DC, 120 mA
Output	Number of output channels:	10
	Output specification:	Relay contact
	Maximum current:	2 A
	Maximum load capacitance:	100 nF
	Maximum voltage:	30 V AC /36 V DC - IEC 61010-1 (1990), over
		voltage category 3, Table D.12
	WDG input current	4 mA
Relay contact	Expected electrical life:	
	• Resistive load	1,000,000 switch operations
	• AC inductive load (Pf 0.4)	100,000 switch operations
	Maximum switched power:	100 W / 1000 VA
	Contact material:	Gold flash over silver alloy

Key coding	(See section Key coding)	
	Module code:	
	• Holes	A9, C17
	Chassis code:	
	• Large pins	A9, C17

10.6 DO-1624

10.6.1 Non-safe digital output module (24 V DC, 0.1 A, 16 channels)

The digital output module DO-1624 has sixteen 24 V DC, 100 mA non-safe output channels to drive loads up to 2.5 W. These loads may be resistive (such as LEDs) or inductive (such as relays).

For inductive loads, a suppression diode is included on each output. The outputs are not tested and may therefore *not* be used for safe applications.

The outputs are also controlled by the watchdog. This means that the outputs are de-energized if the system shuts down and the watchdog switches off.

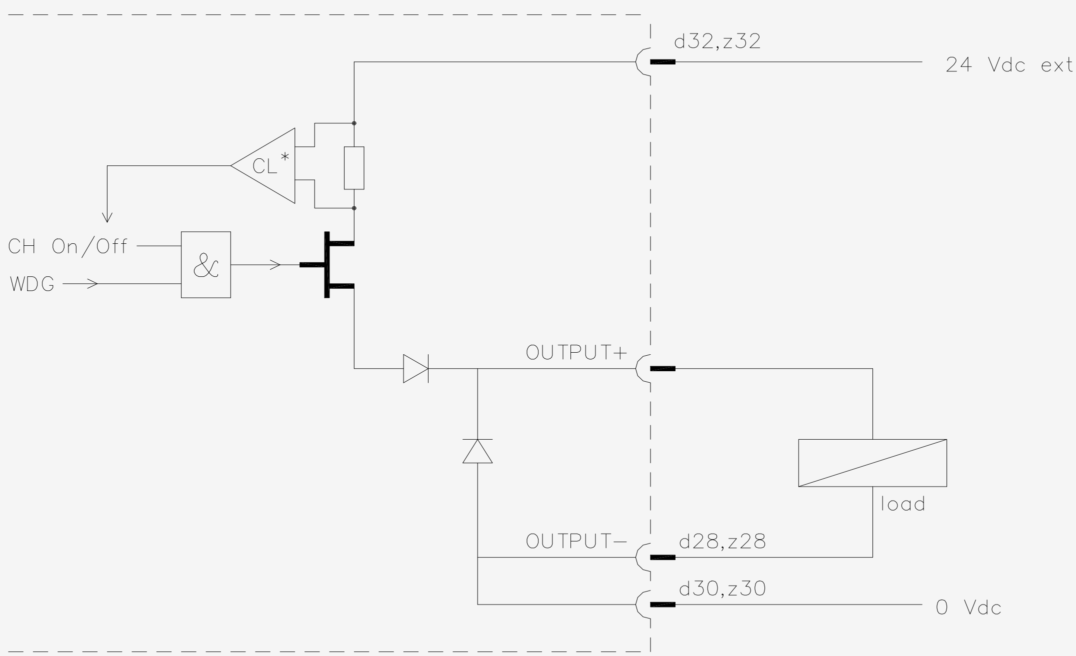


Figure 10-27: Schematic diagram for connection of one output to the DO-1624 module
*Current Limiting circuit

10.6.2 Pin allocation

The back view and pin allocation of the DO-1624 module connector are as follows:

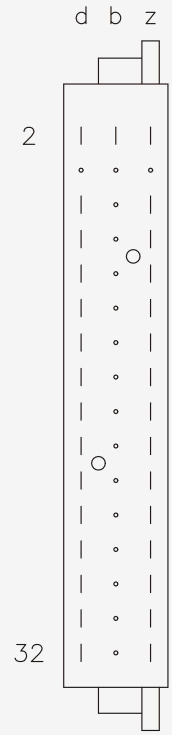


Figure 10-28: Back view and pin allocation of the DO-1624 module connector

d2	WDG
d4	-
d6	
d8	
d10	
d12	OUT 1
d14	OUT 3
d16	OUT 5
d18	OUT 7
d20	OUT 9
d22	OUT 11
d24	OUT 13
d26	OUT 15
d28	0 V DC out
d30	Supply 0 V DC
d32	Supply 24 V DC
b2	GND
z2	VCC
z4	-
z6	
z8	
z10	

z12	OUT 2
z14	OUT 4
z16	OUT 6
z18	OUT 8
z20	OUT 10
z22	OUT 12
z24	OUT 14
z26	OUT 16
z28	0 V DC out
z30	Supply 0 V DC
z32	Supply 24 V DC

10.6.3 Connection examples

The figures below show a number of connection examples for the digital output module DO-1624.

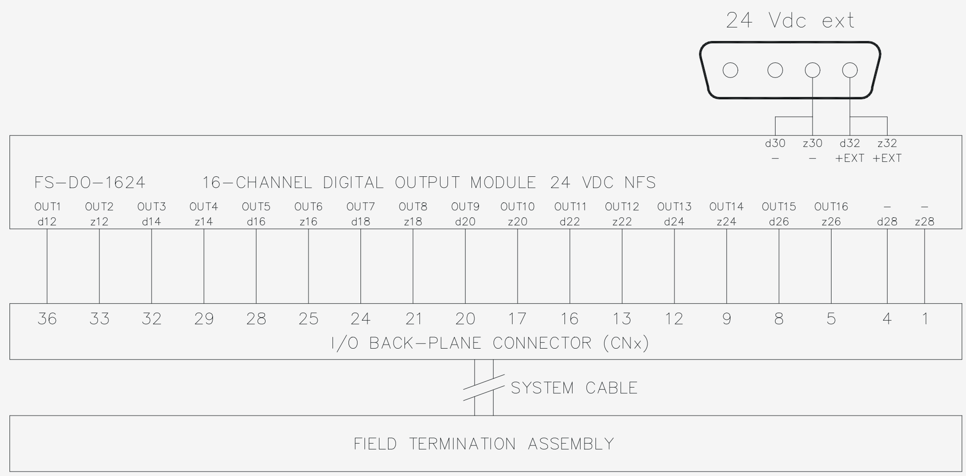


Figure 10-29: Connection example of DO-1624 module to FTA for both non-redundant and redundant IO configurations

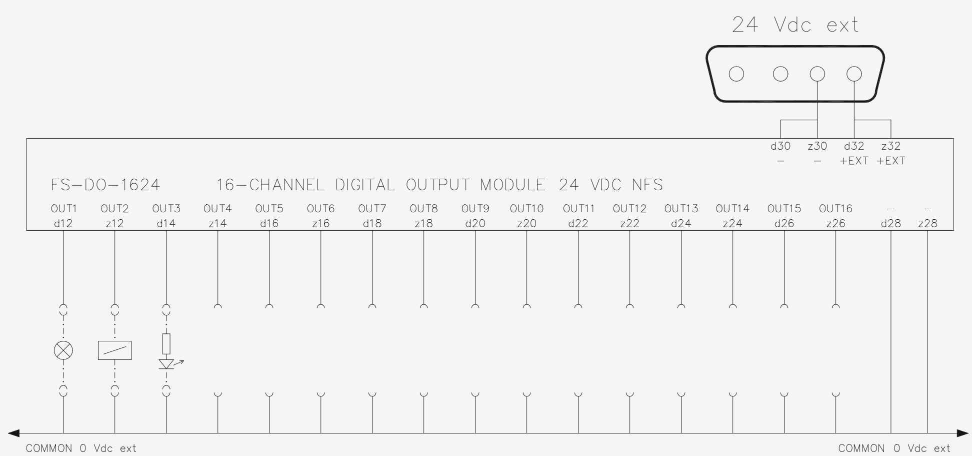


Figure 10-30: IO connection example for DO-1624 module for non-redundant IO configurations

10.6 DO-1624

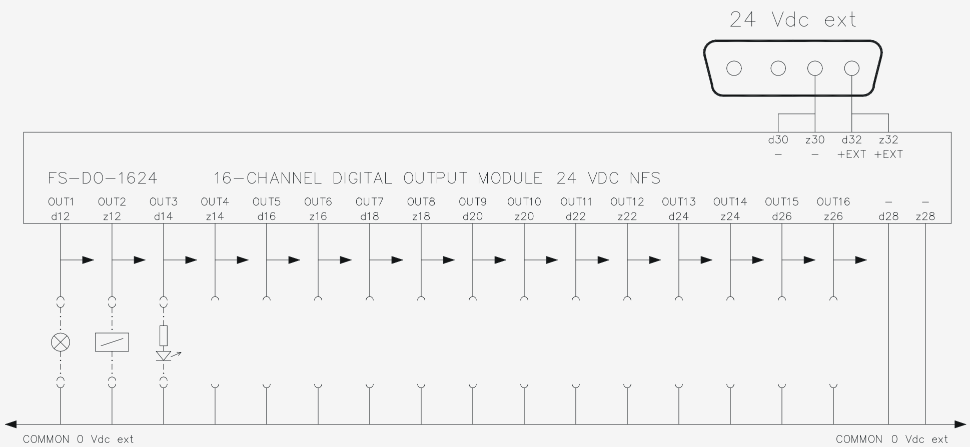


Figure 10-31: IO connection example for DO-1624 module for redundant IO configurations

10.6.4 Technical data

The DO-1624 module has the following specifications:

General	Type numbers:	FS-DO-1624
		FC-DO-1624
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 35 mA
		24 V DC, 85 mA (without output load)
Output	Number of output channels:	16
	Output specification:	24 V DC solid-state source, short-circuit proof
	Maximum current:	100 mA
		(see section General information about output modules)
	Maximum lamp load:	50 mA (1.2 W)
	Maximum load capacitance:	1 μF
	Voltage drop:	< 1.2 V DC at 100 mA
	Off current:	< 0.1 mA
	WDG input current:	4 mA
Key coding	(See section Key coding)	
	Module code:	
	• Holes	A9, C21
	Chassis code:	
	• Large pins	A9, C21

10.7 SDO-04110

10.7.1 Safe digital output module (110 V DC, 0.32 A, 4 channels)

The safe digital output module SDO-04110 has four 110 V DC, 325 mA output channels to drive loads up to 35 W. These loads may be resistive (for example LEDs) or inductive (for example solenoids).

For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

Within the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Crosstalk between outputs
- Functioning of the suppression diodes

The outputs have secondary means of de-energizing (SMOD). The watchdog and the processor can de-energize outputs, irrespective of the application function result.

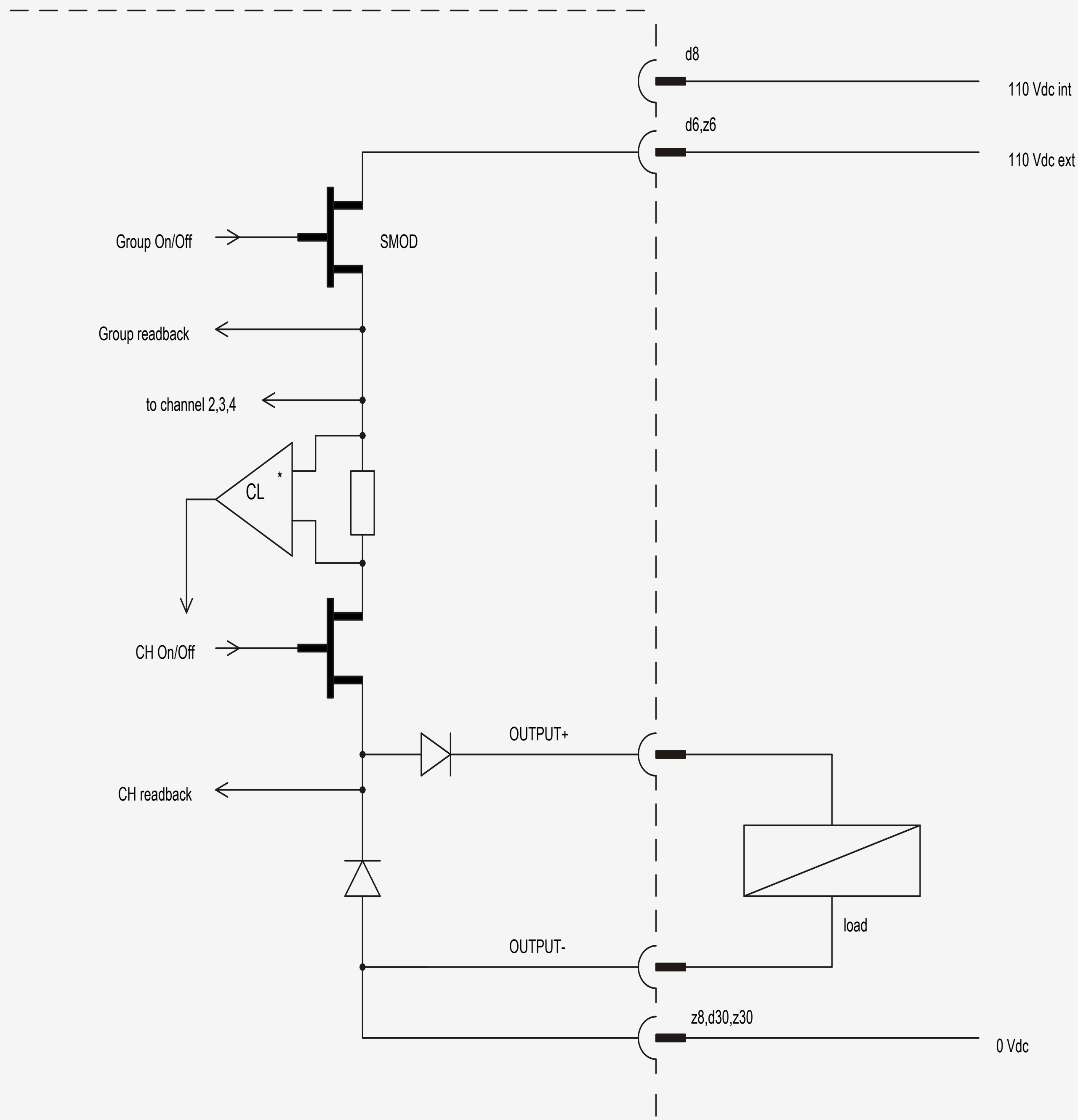


Figure 10-32: Schematic diagram for connection of one output to the SDO-04110 module

*Current Limiting circuit

10.7.2 Pin allocation

The back view and pin allocation of the SDO-04110 module connector are as follows:

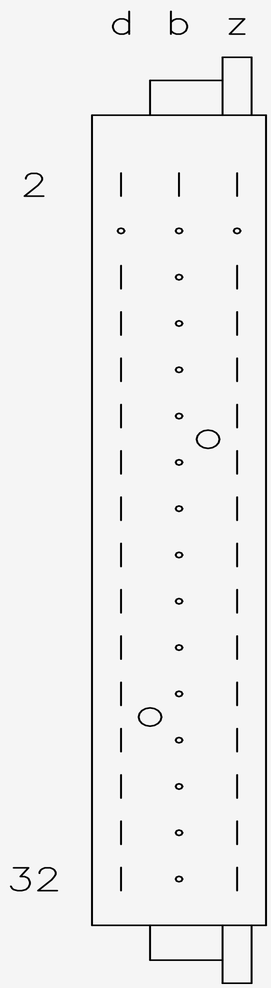


Figure 10-33: Back view and pin allocation of the SDO-04110 module connector

d2	WDG
d4	–
d6	Supply 110 V DC ext.
d8	Supply 110 V DC int.
d10	(0 V DC)
d12	(0 V DC)
d14	OUT 1+
d16	(0 V DC)
d18	OUT 2+
d20	(0 V DC)
d22	OUT 3+
d24	(0 V DC)
d26	OUT 4+
d28	(0 V DC)
d30	Supply 0 V DC
d32	
b2	GND
z2	VCC
z4	–
z6	Supply 110 V DC ext.
z8	Supply 0 V DC
z10	(0 V DC)

z12	(0 V DC)
z14	OUT 1–
z16	(0 V DC)
z18	OUT 2–
z20	(0 V DC)
z22	OUT 3–
z24	(0 V DC)
z26	OUT 4–
z28	(0 V DC)
z30	Supply 0 V DC
z32	

10.7.3 Connection examples

The figures below show a number of connection examples for the safe digital output module SDO-04110.

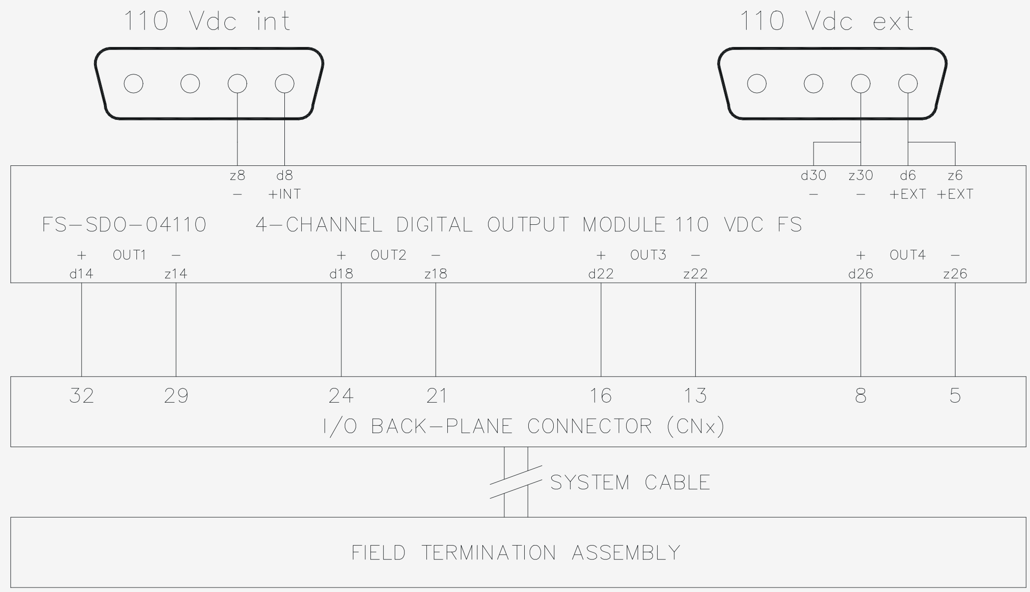


Figure 10-34: Connection example of SDO-04110 module to FTA for both non-redundant and redundant IO configurations

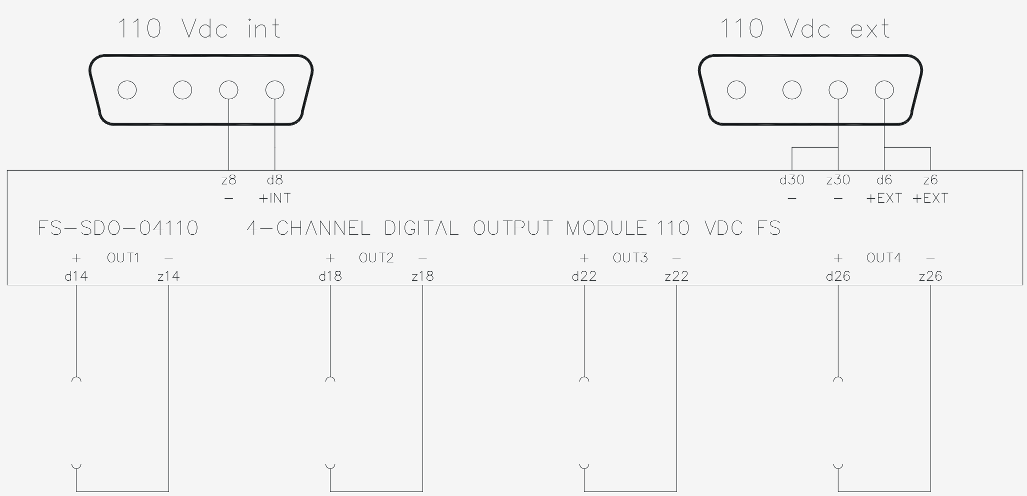


Figure 10-35: IO connection example for SDO-04110 module for non-redundant IO configurations

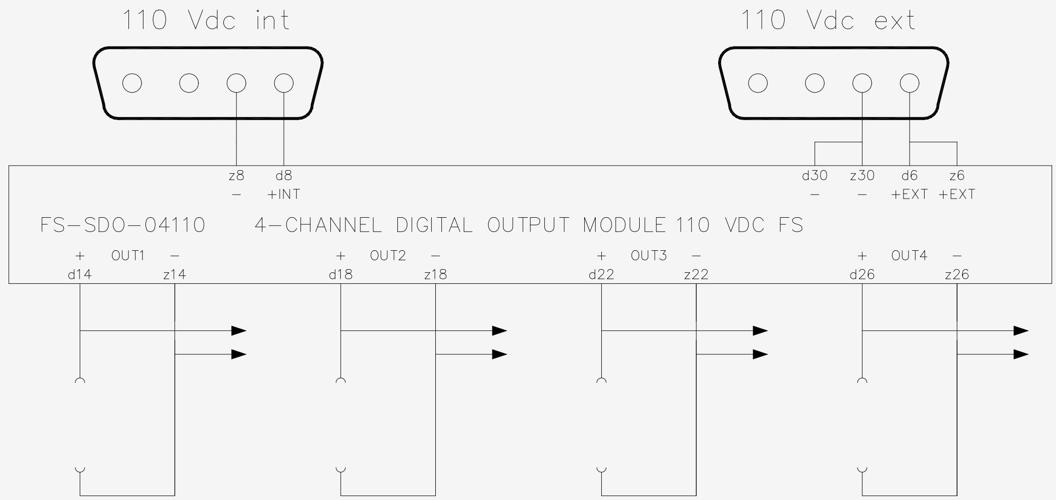


Figure 10-36: IO connection example for SDO-04110 module for redundant IO configurations

Note:

The 110 V DC internal and external power supplies must be connected to prevent fault detection during self-test of the output module (pins d6/z6, d8, z8, d30/z30).

10.7.4 Technical data

The SDO-04110 module has the following specifications:

General	Type numbers:	FS-SDO-04110
		FC-SDO-04110
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Supply voltage:	110 V DC, -15%-+25%
	Power requirements:	5 V DC, 25 mA
		110 V DC internal, 10 mA
		110 V DC external, 20 mA (without output load)
Output	Number of output channels:	4
	Output specification:	110 V DC solid-state source, short-circuit proof
	Maximum current:	325 mA
		(see section General information about output modules)
	Maximum l load:	55 mA (6 W)
	Maximum load capacitance:	1 μF
	Voltage drop:	< 2.5 V DC at 300 mA
	Off current:	< 0.1 mA
	WDG input current:	5 mA

Key coding	(See section Key coding)	
	Module code:	
	• Holes	A13, C25
	Chassis code:	
	• Large pins	A13, C25

10.8 SDO-0448

10.8.1 Safe digital output module (48 V DC, 0.75 A, 4 channels)

The safe digital output module SDO-0448 has four 48 V DC, 750 mA output channels to drive loads up to 36 W. These loads may be resistive (such as LEDs) or inductive (such as solenoids).

For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

Within the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Crosstalk between outputs
- Functioning of the suppression diodes

The outputs have secondary means of de-energizing (SMOD). This enables the watchdog and the processor to de-energize the outputs irrespective of the result of the application function.

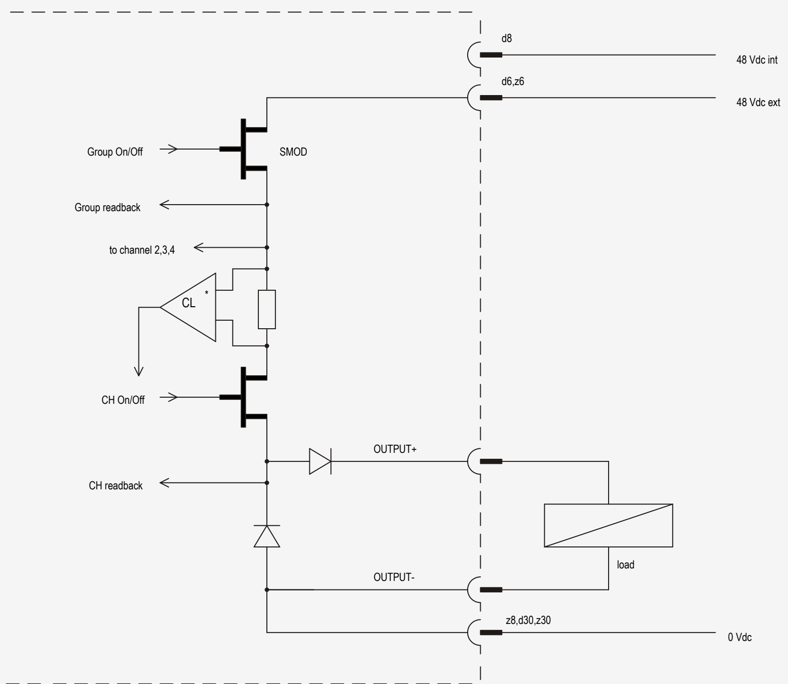


Figure 10-37: Schematic diagram for connection of one output to the SDO-0448 module

*Current Limiting circuit

10.8.2 Pin allocation

The back view and pin allocation of the SDO-0448 module connector are as follows:

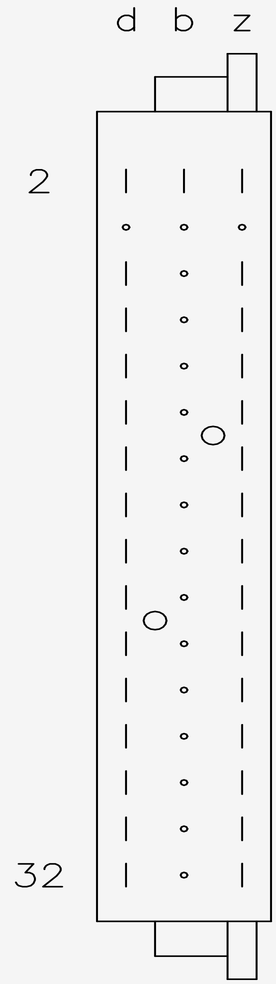


Figure 10-38: Back view and pin allocation of the SDO-0448 module connector

d2	WDG
d4	-
d6	Supply 48 V DC ext.
d8	Supply 48 V DC int.
d10	(0 V DC)
d12	(0 V DC)
d14	OUT 1+
d16	(0 V DC)
d18	OUT 2+
d20	(0 V DC)
d22	OUT 3+
d24	(0 V DC)
d26	OUT 4+
d28	(0 V DC)
d30	Supply 0 V DC
d32	
b2	GND
z2	VCC
z4	-
z6	Supply 48 V DC ext.
z8	Supply 0 V DC
z10	(0 V DC)

z12	(0 V DC)
z14	OUT 1-
z16	(0 V DC)
z18	OUT 2-
z20	(0 V DC)
z22	OUT 3-
z24	(0 V DC)
z26	OUT 4-
z28	(0 V DC)
z30	Supply 0 V DC
z32	

10.8.3 Connection examples

The figures below show a number of connection examples for the safe digital output module SDO-0448.

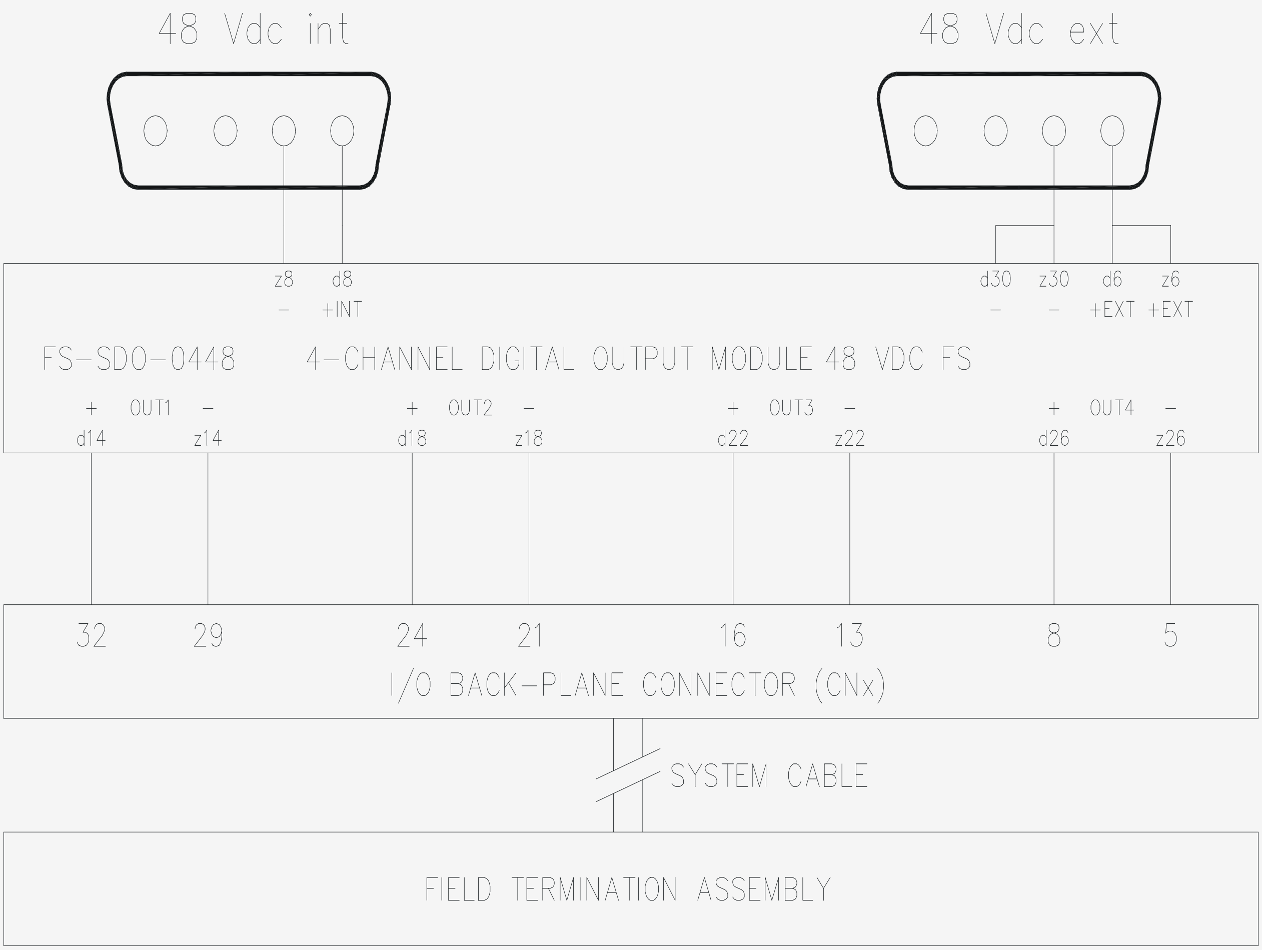


Figure 10-39: Connection example of SDO-0448 module to FTA for both non-redundant and redundant IO configurations

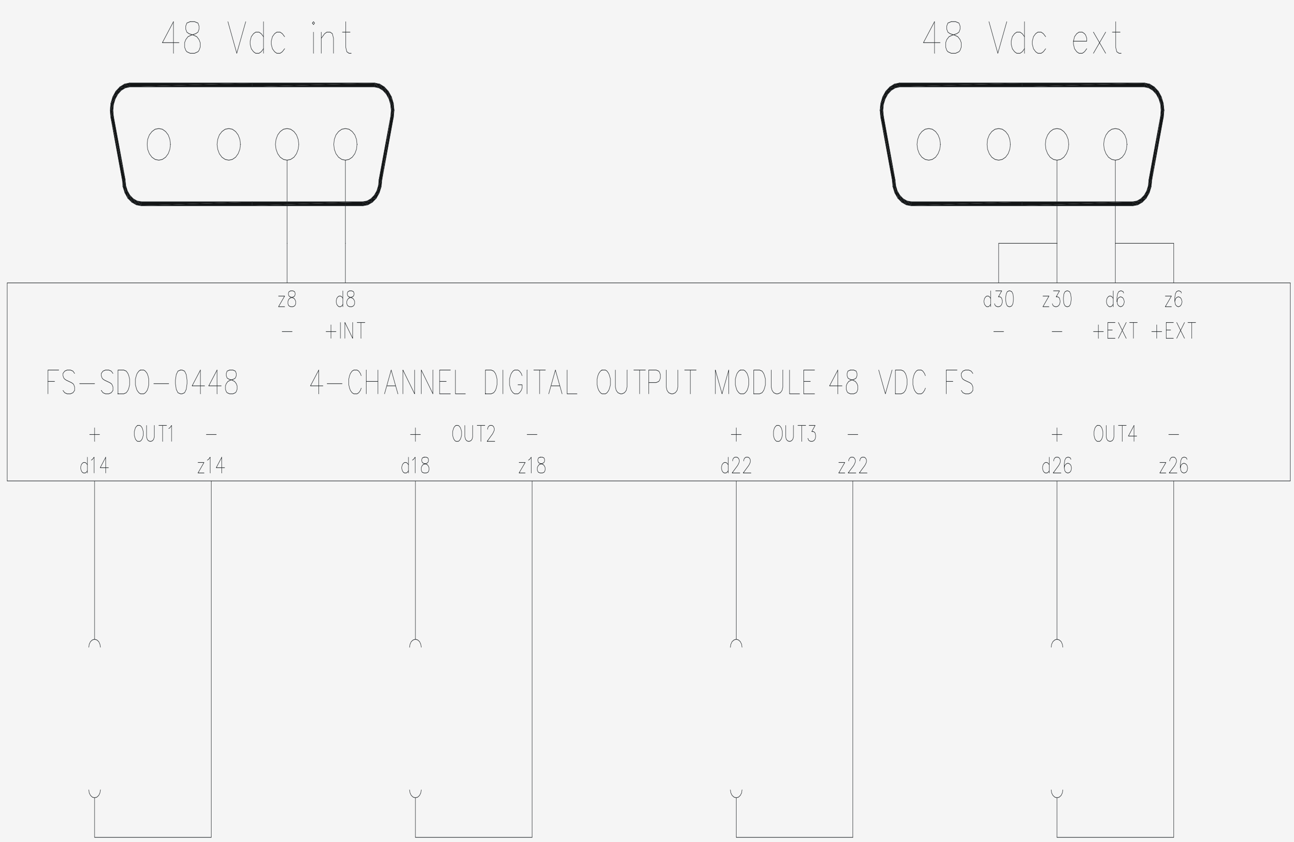


Figure 10-40: IO connection example for SDO-0448 module for non-redundant IO configurations

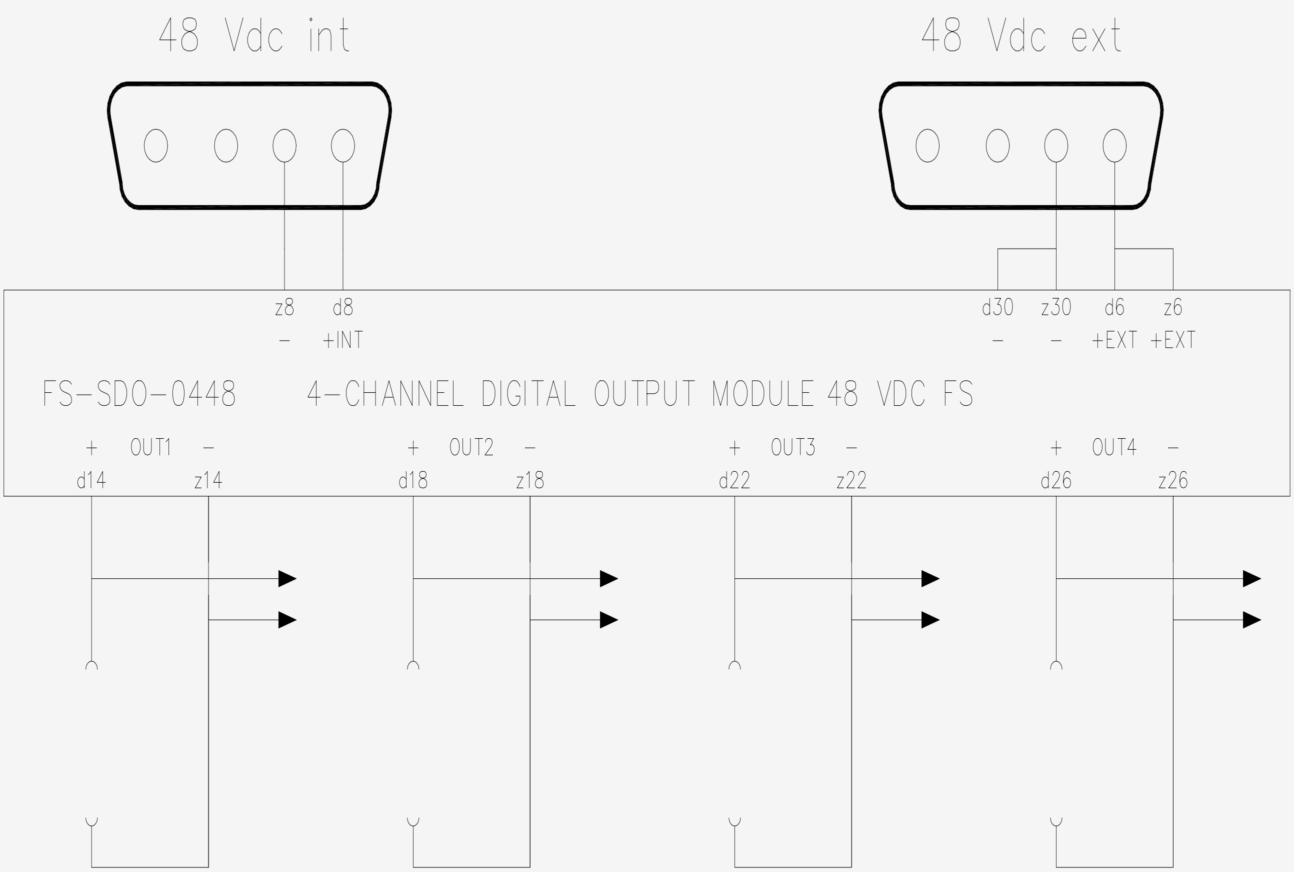


Figure 10-41: IO connection example for SDO-0448 module for redundant IO configurations

Note:

The 48 V DC internal and external power supplies must be connected to prevent fault detection during self-test of the output module (pins d6/z6, d8, z8, d30/z30).

10.8.4 Technical data

The SDO-0448 module has the following specifications:

General	Type numbers:	FS-SDO-0448
		FC-SDO-0448
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Supply voltage:	48 V DC ± 15%
	Power requirements:	5 V DC, 25 mA
		48 V DC internal, 20 mA
		48 V DC external, 20 mA (without output load)
Output	Number of output channels:	4
	Output specification:	48 V DC solid-state source, short-circuit proof
	Maximum current:	750 mA
		(see section General information about output modules)
	Maximum lamp load:	125 mA (6 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 2.1 V DC at 750 mA
	Off current:	< 0.1 mA
	WDG input current:	5 mA
Key coding	(See section Key coding)	
	Module code:	
	• Holes	A13, C21
	Chassis code:	
	• Large pins	A13, C21

10.9 SDO-0424

10.9.1 Safe digital output module (24 V DC, 2 A, 4 channels)

The safe digital output module SDO-0424 has four 24 V DC, 2 A output channels to drive loads up to 50 W. The maximum module load is 6 A.

These loads may be resistive (such as lamps) or inductive (such as solenoids). For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

Within the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize the output,
- Ability to de-energize the group (via secondary means),
- Crosstalk between outputs, and
- Functioning of the suppression diodes.

The external 24 V DC supply is split into two groups of two outputs each. Each group has its own secondary means of de-energizing.

A secondary means of de-energizing (SMOD) enables the watchdog and the processor to de-energize the outputs, irrespective of the result of the application function.

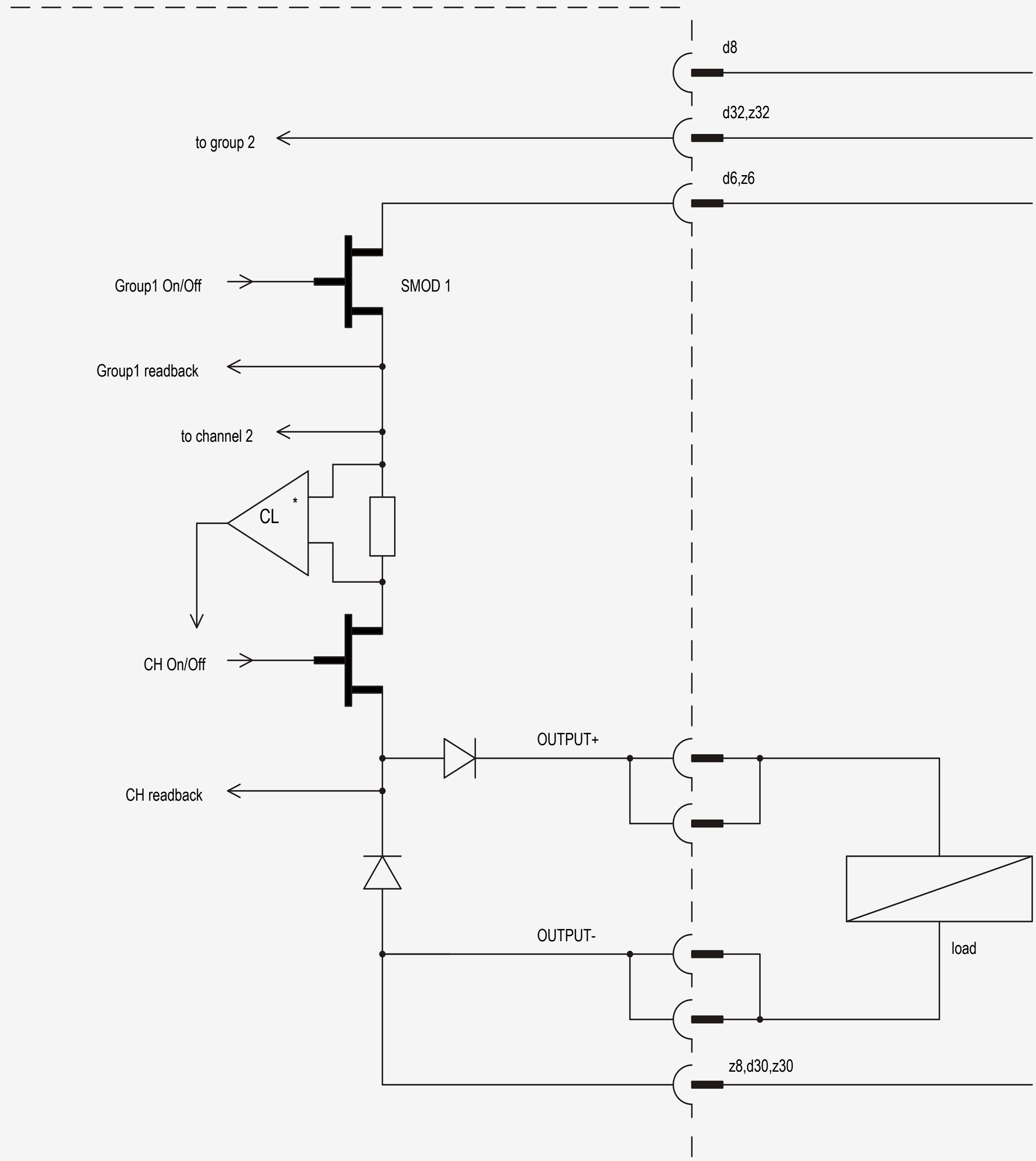


Figure 10-42: Schematic diagram for connection of one output to the SDO-0424 module
*Current Limiting circuit

10.9.2 Pin allocation

The back view and pin allocation of the SDO-0424 module connector are as follows:

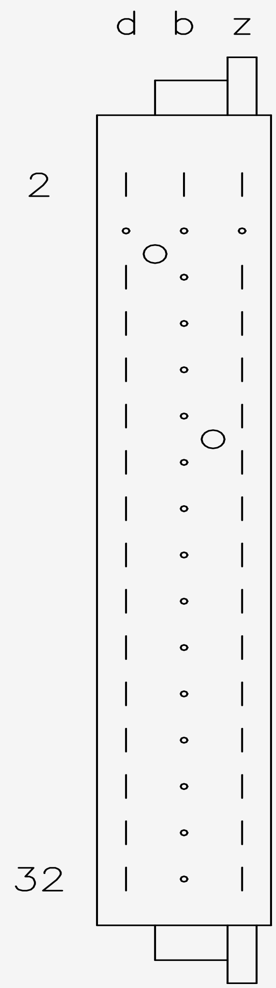


Figure 10-43: Back view and pin allocation of the SDO-0424 module connector

d2	WDG
d4	–
d6	Supply 24 V DC ext.
d8	Supply 24 V DC int.
d10	
d12	OUT 1+
d14	OUT 1+
d16	OUT 2+
d18	OUT 2+
d20	OUT 3+
d22	OUT 3+
d24	OUT 4+
d26	OUT 4+
d28	(0 V DC)
d30	Supply 0 V DC
d32	Supply 24 V DC ext.
b2	GND
z2	VCC
z4	–
z6	Supply 24 V DC ext.
z8	Supply 0 V DC
z10	

z12	OUT 1–
z14	OUT 1–
z16	OUT 2–
z18	OUT 2–
z20	OUT 3–
z22	OUT 3–
z24	OUT 4–
z26	OUT 4–
z28	(0 V DC)
z30	Supply 0 V DC
z32	Supply 24 V DC ext.

10.9.3 Connection examples

The figures below show a number of connection examples for the safe digital output module SDO-0424.

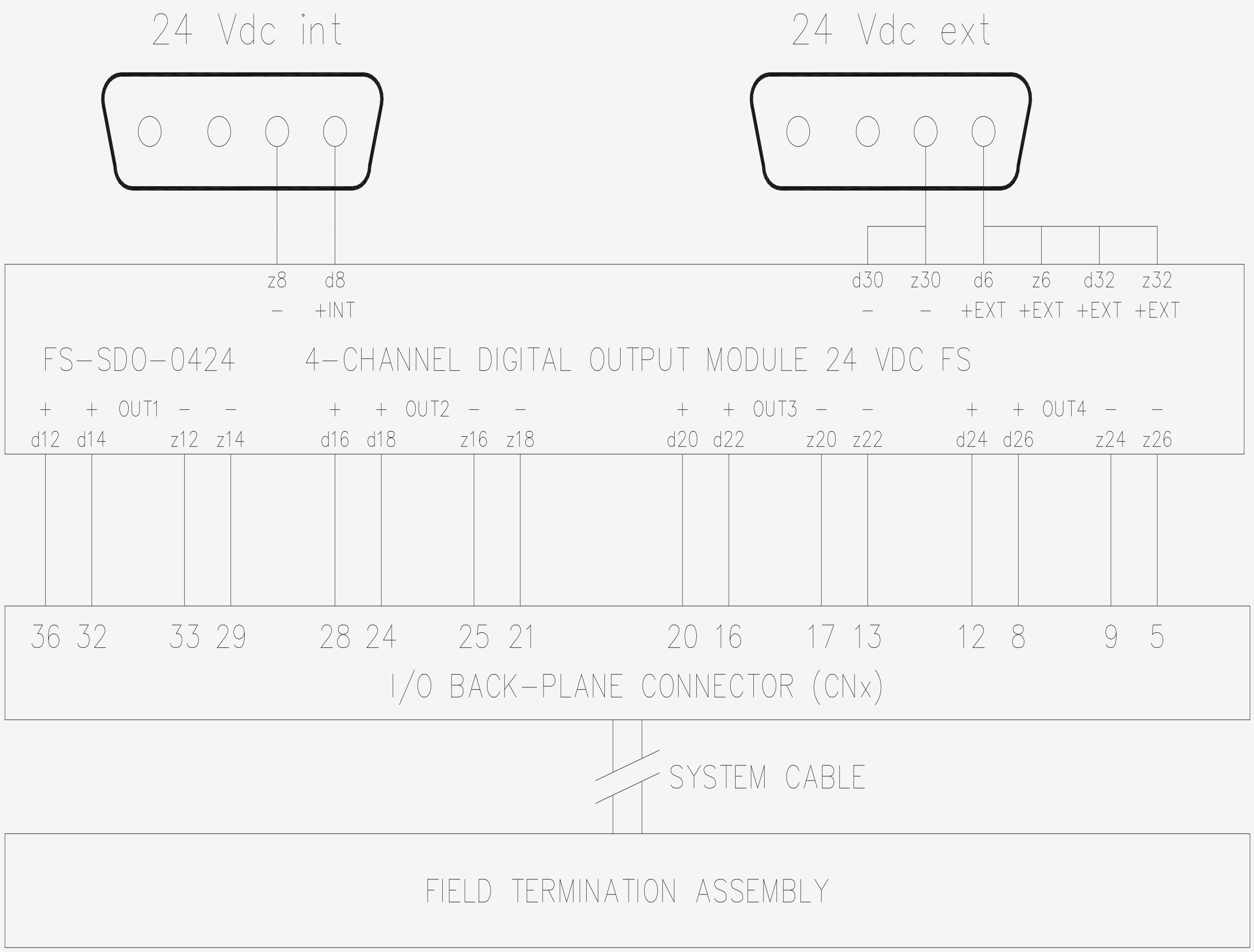


Figure 10-44: Connection example of SDO-0424 module to FTA for both non-redundant and redundant IO configurations

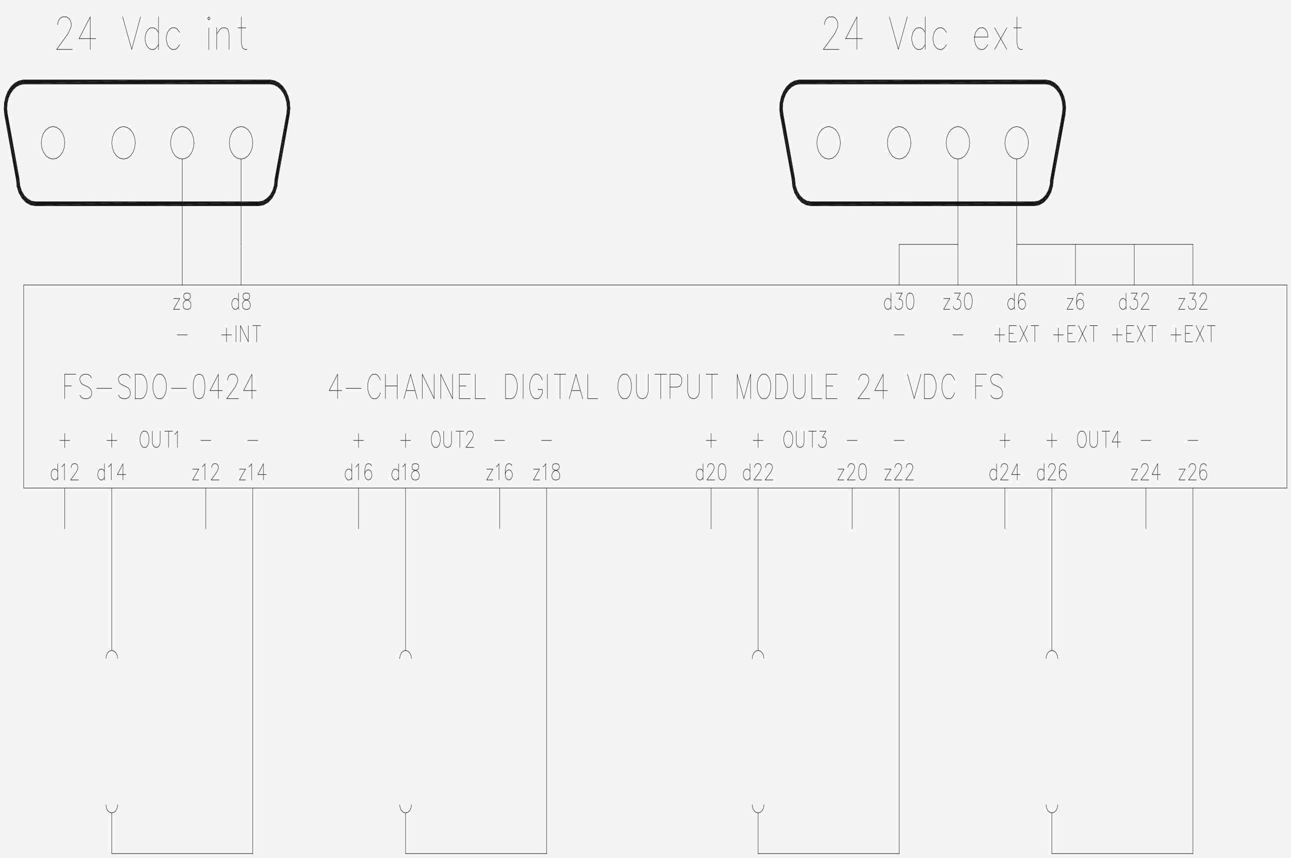


Figure 10-45: IO connection example for SDO-0424 module for non-redundant IO configurations

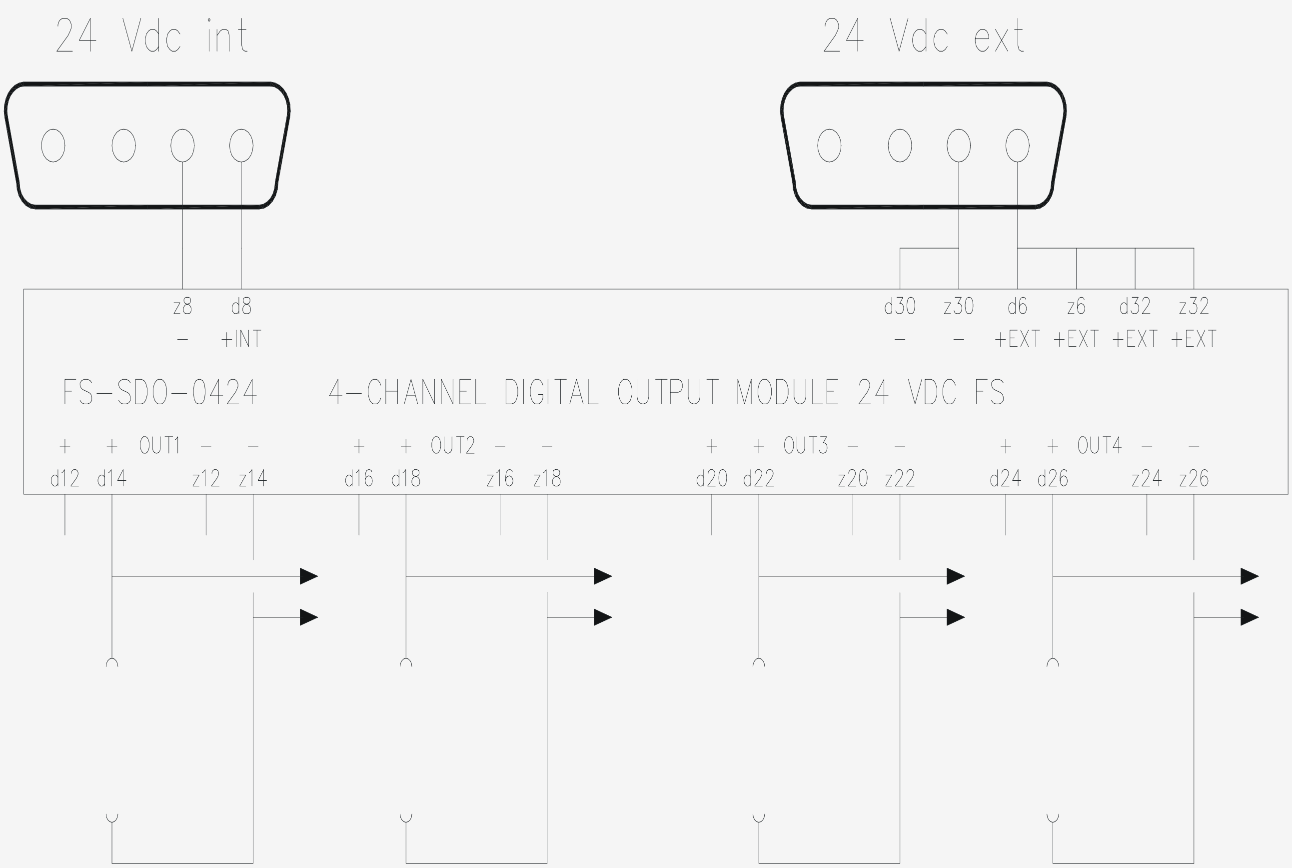


Figure 10-46: IO connection example for SDO-0424 module for redundant IO configurations

Note:

The 24 V DC internal and external power supplies must be connected to both output groups to prevent fault detection during self-testing of the output module (pins d6/z6, d8, d30/z30 and d32/z32).

10.9.4 Technical data

The SDO-0424 module has the following specifications:

General	Type numbers:	FS-SDO-0424
		FC-SDO-0424
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 12 mA
		24 V DC internal, 35 mA
		24 V DC external, 50 mA (without output load)
Output	Number of output channels:	4 (2 groups of 2)
	Output specification:	24 V DC solid-state source, short-circuit proof
	Maximum channel current:	2 A
		(see General information about output modules)
	Maximum total module load:	6 A (module dissipation limit)
	Maximum lamp load:	417 mA (10 W)
	Maximum load capacitance:	1 μF
	Voltage drop:	< 1.3 V DC at 2 A
	Off current:	< 0.1 mA
	WDG input current:	8 mA
Key coding	(See section Key coding)	
	Module code:	
	• Holes	A13, C5
	Chassis code:	
	• Large pins	A13, C5

10.10 SDOL-0424

10.10.1 Safe loop-monitored digital output module (24 V DC, 1 A, 4 channels)

The safe loop-monitored digital output module SDOL-0424 has four 24 V DC, 1 A loop-monitored output channels to drive loads up to 24 W. The maximum module load is 3.6 A. These loads may be resistive or inductive. For inductive loads, a suppression diode is included on each output.

The outputs, including the suppression diode, the lead breakage detection and short-circuit detection, are fully tested and may therefore be used for safe applications.

The outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Cross talk between outputs
- Function of the suppression diodes
- Lead breakage in the (external) output wiring
- Short circuit of the outputs

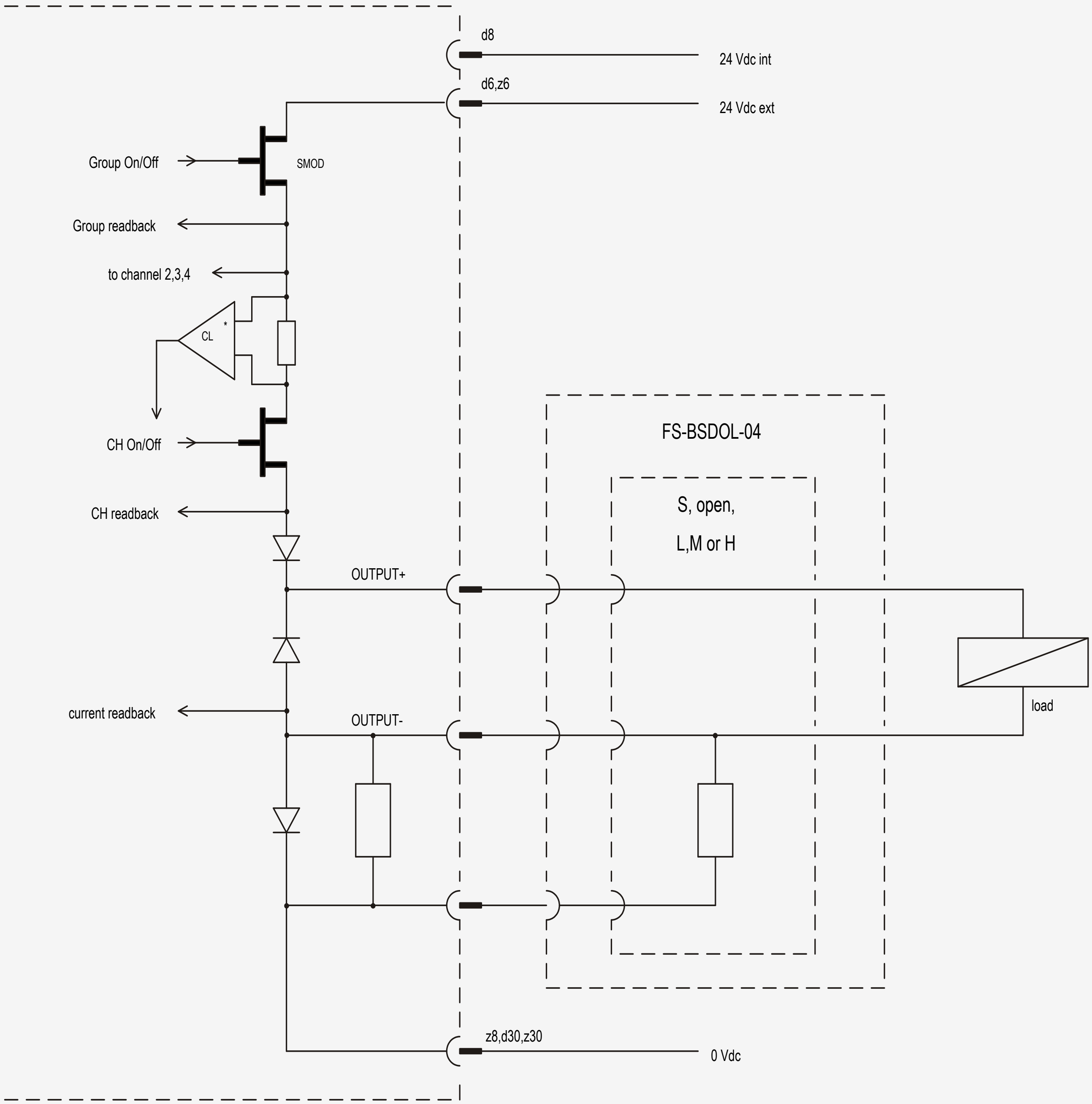


Figure 10-47: Schematic diagram for connection of one output to the SDOL-0424 module
*Current Limiting circuit

The outputs have secondary means of de-energizing (SMOD). This enables the watchdog and/or the processor to de-energize the outputs irrespective of the result of the application function.

Note:
The SDOL-0424 module can only be used in combination with an IO backplane, since the outputs require an BSDOL-04UNI module.

10.10.2 Loop monitoring

All outputs are monitored for lead breakage and short circuit. To get a rough lead breakage current setting, the current sense level must be programmed (see the below table). A BSDOL-04UNI module consists of a BSDOL-01 section, placed on the IO-backplane program connector PX and sixteen (4xS, 4xL, 4xM, 4xH) range setting sub-modules.

Table 1. Selection of range-setting module

LOAD		Range-setting module
Spare channel		Sub-module “S”
0.1-0.39 W	4-16 mA	None
0.4-1.1 W	17-47 mA	Sub-module “L”
1.2-4.7 W	48-199 mA	Sub-module “M”
≥ 4.8 W	≥ 200 mA	Sub-module “H”

Attention:
The second fault timer is started when only one Control Processor is running and the non-redundant SDOL-0424 has an open loop fault.

10.10.3 LEDs

The SDOL-0424 module has one LED for each channel; four in total.

If a channel is Off, its corresponding LED is off and gives short intermittent flashes. These indicate the lead breakage tests are being performed.

If a channel is On and the configuration is non-redundant, its corresponding LED is on and gives (very) short periodic flashes, which are hardly visible to the naked eye. These indicate the internal switch-off self-tests are being performed.

If a channel is On and the configuration is redundant, its corresponding LEDs appear to flash intermittently. This happens because the module in Control Processor 2 switches off briefly to allow the module in Control Processor 1 to perform its self-test. After the self-test of the module in Control Processor 1 has been completed, the module in Control Processor 2 switches on again (this may take some time) and the module in Control Processor 1 switches off to allow the module in Control Processor 2 to perform its self-test, etc. Due to this, it looks as if the channel LEDs of both modules flash intermittently. The LED flash speed may vary, depending on the application cycle time and configuration of Diagnostic Test Interval.

10.10.4 Pin allocation

The back view and pin allocation of the SDOL-0424 module connector are as follows:

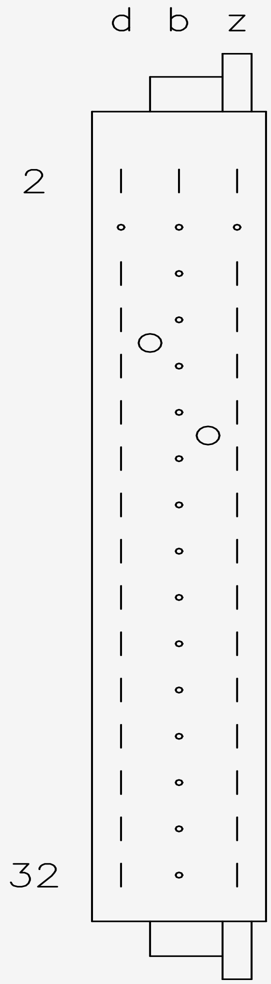


Figure 10-48: Back view and pin allocation of the SDOL-0424 module connector

d2	WDG
d4	–
d6	Supply 24 V DC ext.
d8	Supply 24 V DC int.
d10	
d12	(0 V DC)
d14	OUT 1+
d16	0 V DC
d18	OUT 2+
d20	0 V DC
d22	OUT 3+
d24	0 V DC
d26	OUT 4+
d28	0 V DC
d30	Supply 0 V DC
d32	
b2	GND
z2	VCC
z4	–
z6	Supply 24 V DC ext.
z8	Supply 0 V DC
z10	

z12	(0 V DC)
z14	OUT 1–
z16	0 V DC
z18	OUT 2–
z20	0 V DC
z22	OUT 3–
z24	0 V DC
z26	OUT 4–
z28	0 V DC
z30	Supply 0 V DC
z32	

10.10.5 Connection examples

The figure below shows a connection example for the safe digital output module SDOL-0424.

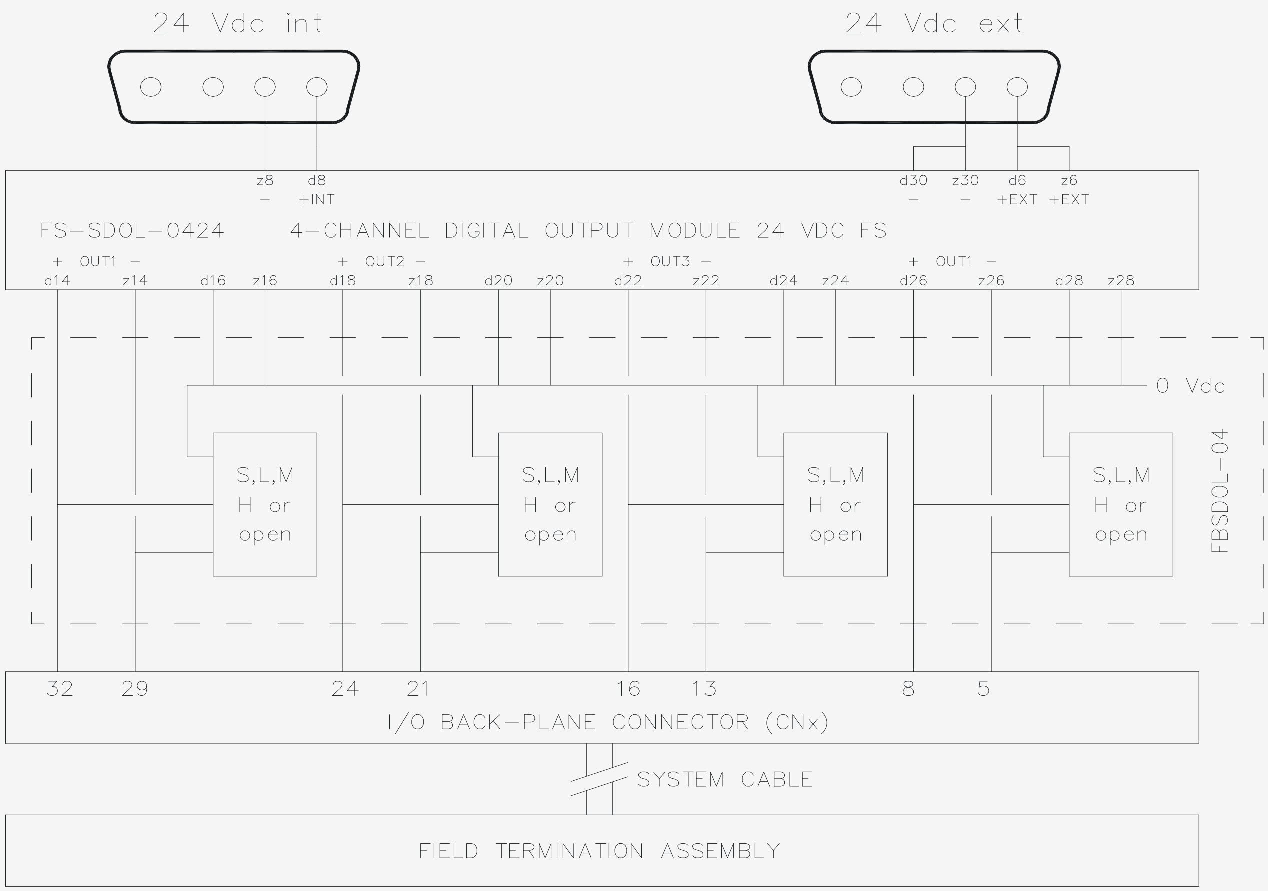


Figure 10-49: Connection example of SDOL-0424 module to FTA for both non-redundant and redundant IO configurations

Note:

The 24 V DC internal power supply (d8 and z8) must be connected to prevent fault detection during the self-test of the output module. The external power supply (d6/z6 and d30/z30), as well as (dummy) loads on all channels, must be connected to prevent fault detection during the lead breakage test of the output module.

10.10.6 Technical data

The SDOL-0424 module has the following specifications:

General	Type numbers:	FS-SDOL-0424
		FC-SDOL-0424
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 15 mA
		24 V DC internal, 50 mA
		24 V DC external, 15 mA (without output load)
Output	Number of output channels:	4
	Output specification:	24 V DC solid-state source, short circuit proof
	Maximum channel current:	1 A
	Maximum total module load:	3.6 A (module dissipation limit)
	Maximum load inductance:	0.5 H
	Maximum load capacitance:	1 µF
	Top of overload detection:	> 10 Ω
	Cold resistance lamp:	> 20 Ω
	Voltage drop:	< 1.3 V at 1 A
	Off current:	< 0.1 mA
	Current sense voltage drop:	< 1 V at 1 A
	WDG input current:	4 mA

Key coding	(See section Key coding)	
	Module code:	
	• Holes	A13, C9
	Chassis code:	
	• Large pins	A13, C9

10.11 SDOL-0448

10.11.1 Safe loop-monitored digital output module (48 V DC, 500mA, 4 channels)

The safe loop-monitored digital output module SDOL-0448 has four 48 V DC, 500mA loop-monitored output channels to drive loads up to 24 W. These loads may be resistive or inductive. For inductive loads, a suppression diode is included on each output.

The outputs, including the suppression diode, the lead breakage detection and short-circuit detection, are fully tested and may therefore be used for safe applications.

The outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Cross talk between outputs
- Function of the suppression diodes
- Lead breakage in the (external) output wiring
- Short circuit of the outputs

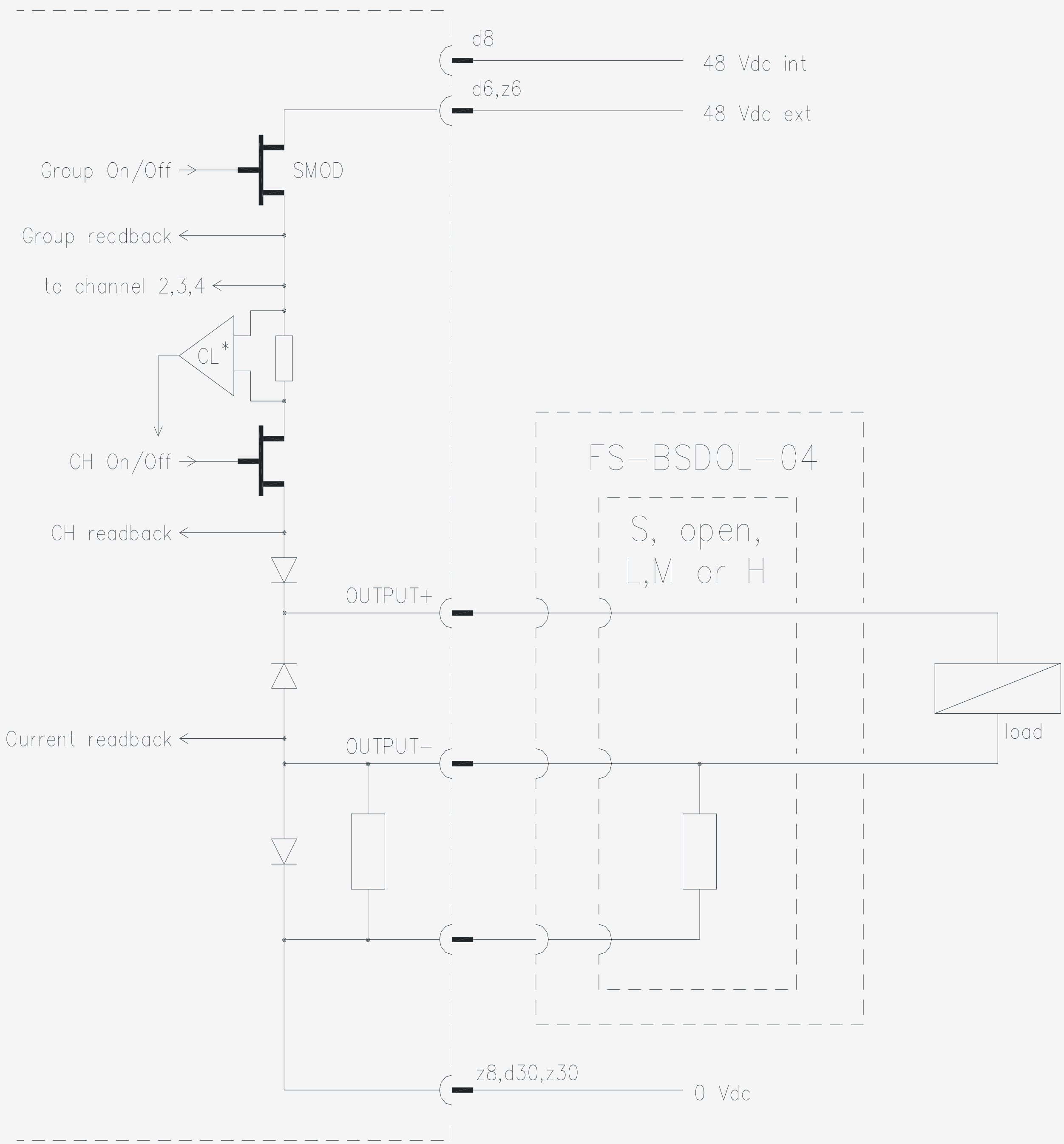


Figure 10-50: Schematic diagram for connection of one output to the SDOL-0448 module

*Current Limiting circuit

The outputs have secondary means of de-energizing (SMOD). This enables the watchdog and/or the processor to de-energize the outputs irrespective of the result of the application function.

Note:
The SDOL-0448 module can only be used in combination with an IO backplane, since the outputs require an BSDOL-04UNI module.

10.11.2 Loop monitoring

All outputs are monitored for lead breakage and short circuit. To get a rough lead breakage current setting, the current sense level must be programmed (see the below table). A BSDOL-04UNI module consists of a BSDOL-01 section, placed on the IO-backplane program connector PX and sixteen (4xS, 4xL, 4xM, 4xH) range setting sub-modules.

Table 1. Selection of range-setting module

LOAD		Range-setting module
Spare channel[1]		Sub-module “S”
0.2-0.8 W	4-16 mA	None
0.9-2.2 W	17-47 mA	Sub-module “L”
2.3-9.5 W	48-199 mA	Sub-module “M”
≥ 9.6W	≥ 200 mA	Sub-module “H”

1. To reduce power consumption and heat dissipation it is advised to keep spare channels *Off*.

10.11.3 LEDs

The SDOL-0448 module has one LED for each channel; four in total.

If a channel is Off, its corresponding LED is off and gives short intermittent flashes. These indicate the lead breakage tests are being performed.

If a channel is On and the configuration is non-redundant, its corresponding LED is on and gives (very) short periodic flashes, which are hardly visible to the naked eye. These indicate the internal switch-off self-tests are being performed.

If a channel is On and the configuration is redundant, its corresponding LEDs appear to flash intermittently. This happens because the module in Control Processor 2 switches off briefly to allow the module in Control Processor 1 to perform its self-test. After the self-test of the module in Control Processor 1 has been completed, the module in Control Processor 2 switches on again (this may take some time) and the module in Control Processor 1 switches off to allow the module in Control Processor 2 to perform its self-test, etc. Due to this, it looks as if the channel LEDs of both modules flash intermittently. The LED flash speed may vary, depending on the application cycle time and configuration of Diagnostic Test Interval.

10.11.4 Pin allocation

The back view and pin allocation of the SDOL-0448 module connector are as follows:

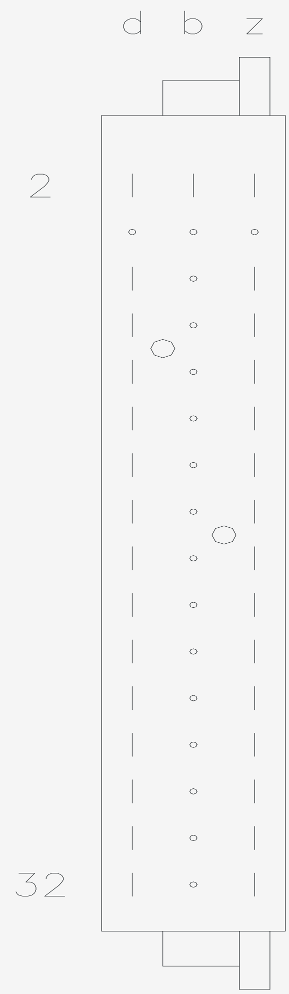


Figure 10-51: Back view and pin allocation of the SDOL-0448 module connector

d2	WDG
d4	–
d6	Supply 48 V DC ext.
d8	Supply 48 V DC int.
d10	
d12	(0 V DC)
d14	OUT 1+
d16	0 V DC
d18	OUT 2+
d20	0 V DC
d22	OUT 3+
d24	0 V DC
d26	OUT 4+
d28	0 V DC
d30	Supply 0 V DC
d32	
b2	GND
z2	VCC
z4	–
z6	Supply 48 V DC ext.
z8	Supply 0 V DC
z10	

z12	(0 V DC)
z14	OUT 1–
z16	0 V DC
z18	OUT 2–
z20	0 V DC
z22	OUT 3–
z24	0 V DC
z26	OUT 4–
z28	0 V DC
z30	Supply 0 V DC
z32	

10.11.5 Connection examples

The figure below shows a connection example for the safe digital output module SDOL-0448.

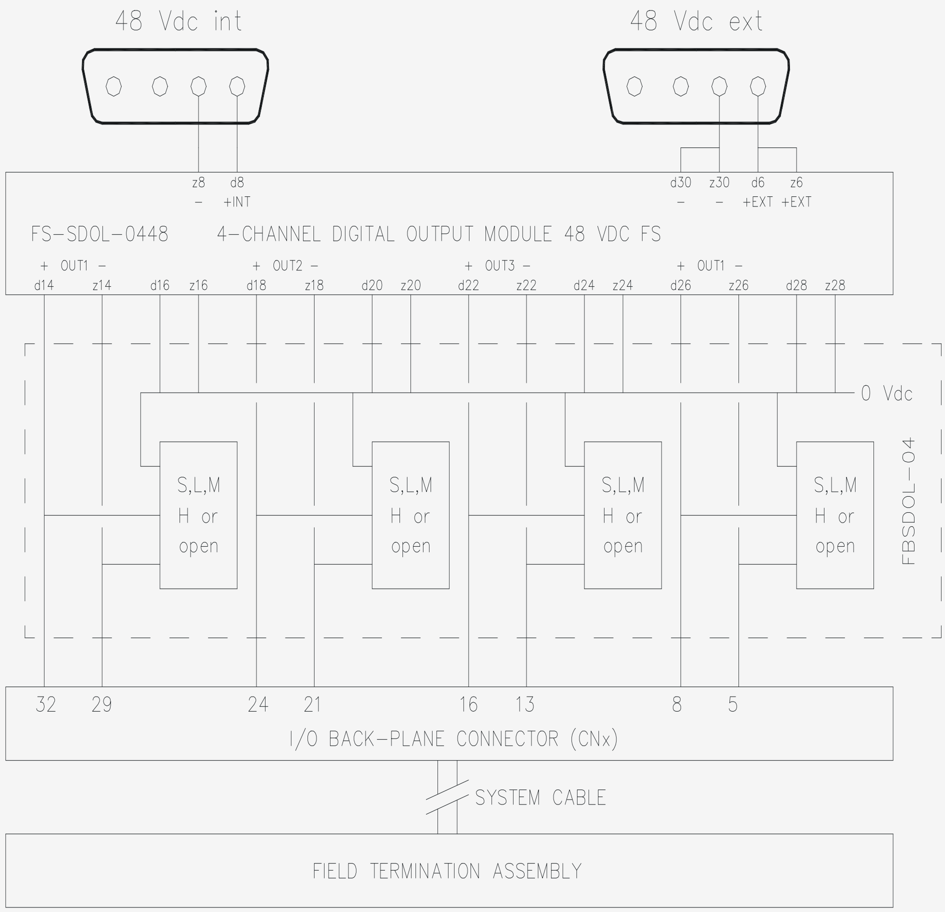


Figure 10-52: Connection example of SDOL-0448 module to FTA for both non-redundant and redundant IO configurations

Note:

The 48 V DC internal power supply (d8 and z8) must be connected to prevent fault detection during the self-test of the output module. The external power supply (d6/z6 and d30/z30), as well as (dummy) loads on all channels, must be connected to prevent fault detection during the lead breakage test of the output module.

10.11.6 Technical data

The SDOL-0448 module has the following specifications:

10.11 SDOL-0448

General	Type numbers:	FS-SDOL-0448
		FC-SDOL-0448
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 15 mA
		48 V DC internal, 25 mA
		48Vdc external, 15 mA (without output load)
Output	Number of output channels:	4
	Output specification:	48 V DC solid-state source, short circuit proof
	Maximum channel current:	0.5 A (see section General information about output modules)
	Maximum load inductance:	1 H
	Maximum load capacitance:	0.5 µF
	Top of overload detection:	> 50 Ω
	Cold resistance lamp:	> 90 Ω
	Voltage drop:	< 1.5 V at 0.5A
	Off current:	< 0.1 mA
	Current sense voltage drop:	< 1 V at 0.5A
	WDG input current:	4 mA

Key coding	(See section Key coding)	
	Module code:	
	• Holes	A17, C9
	Chassis code:	
	• Large pins	A17, C9

CHAPTER 11

OUTPUT CONVERTER MODULES

11 Output converter modules

This chapter describes the output converter modules that are available for Safety Manager.

The following output converter modules are described:

Output converter module	
BSDOL-04UNI	Range setting module
setting “S”	
setting “L”	
setting “M”	
setting “H”	

For related output modules, see Output modules.

11.1 General info about output converter modules

An output converter module converts (output) load ranges to values that can be used by Safety Manager output module signals.

The converter modules described here are “B” type converters, meaning they are placed on an IO programming connector on the IO backplane in the IO chassis.

The below table shows the available output converter modules and the output modules for which they are used.

Table 1. output converter modules and their corresponding output modules

Output Converter Module	Output Module
BSDOL-04UNI	SDOL-0424

The below figure shows a part of the back of a non-redundant IO chassis with input converters in slots P1, P4, P6 and P7.

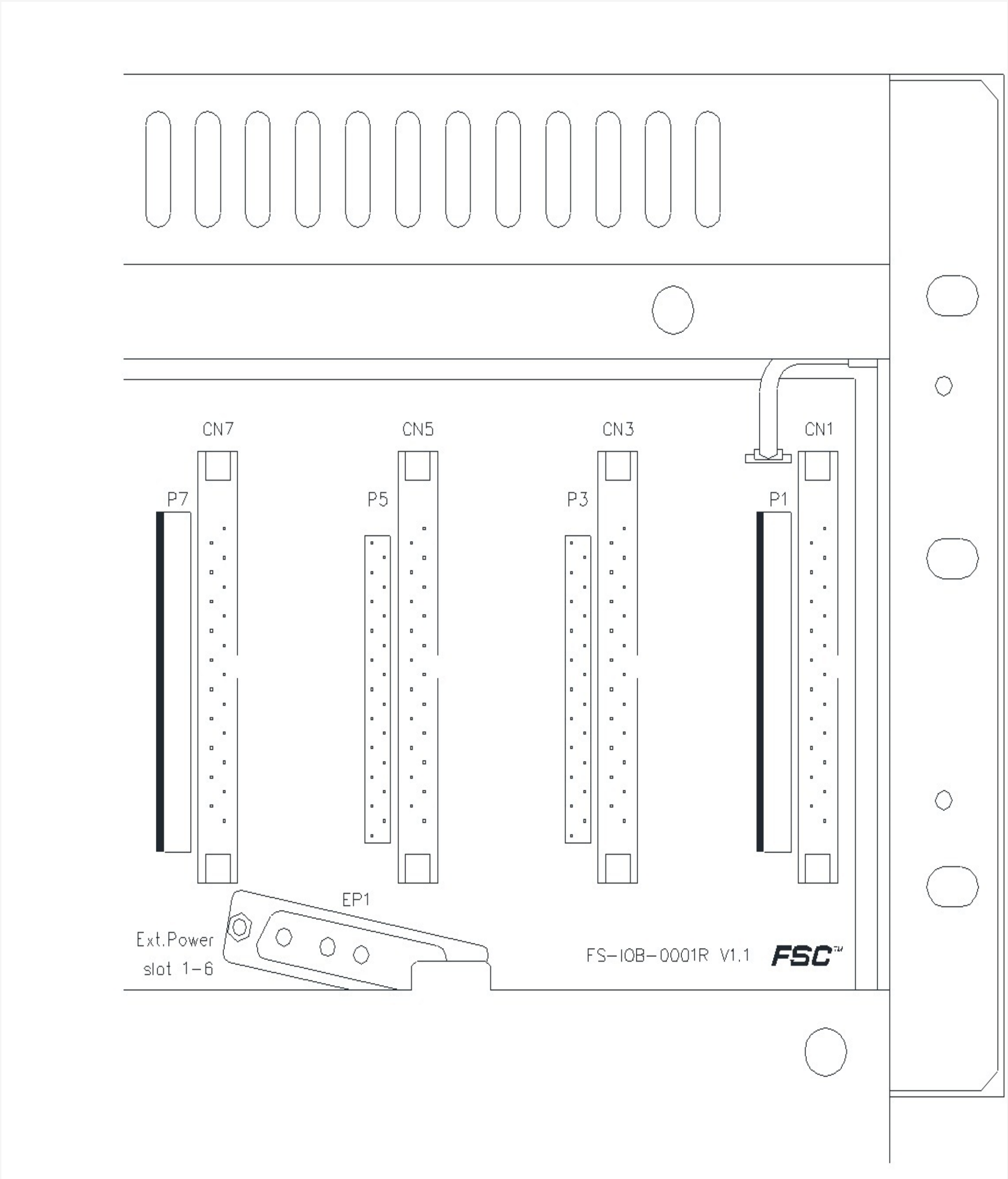


Figure 11-1: Detail of the back of a non-redundant IO chassis

The below figure shows a part of the back of a redundant IO chassis with output converters in slots P1 and P7.

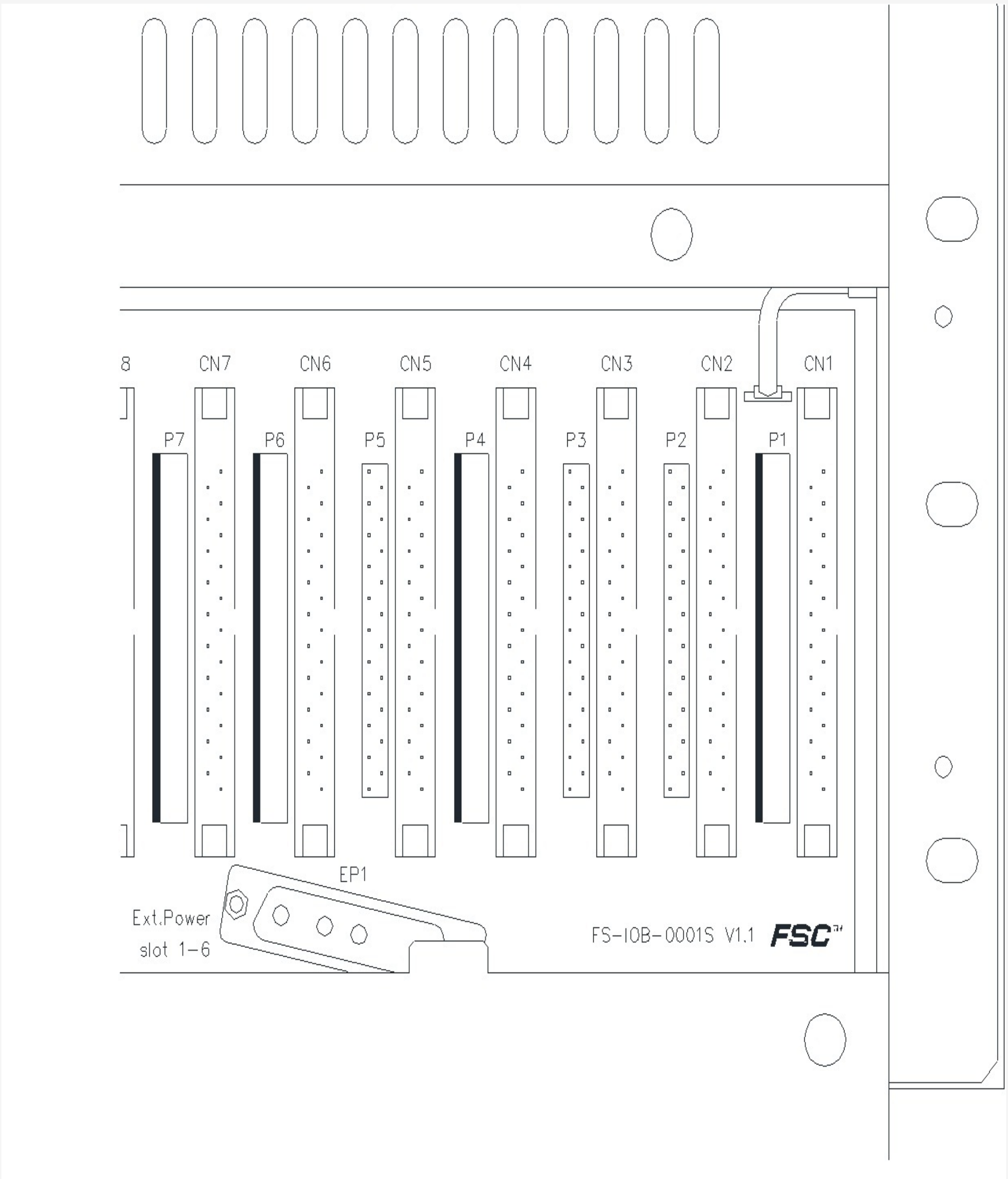


Figure 11-2: Detail of the back of a redundant IO chassis

11.2 BSDOL-04UNI

11.2.1 Range setting module

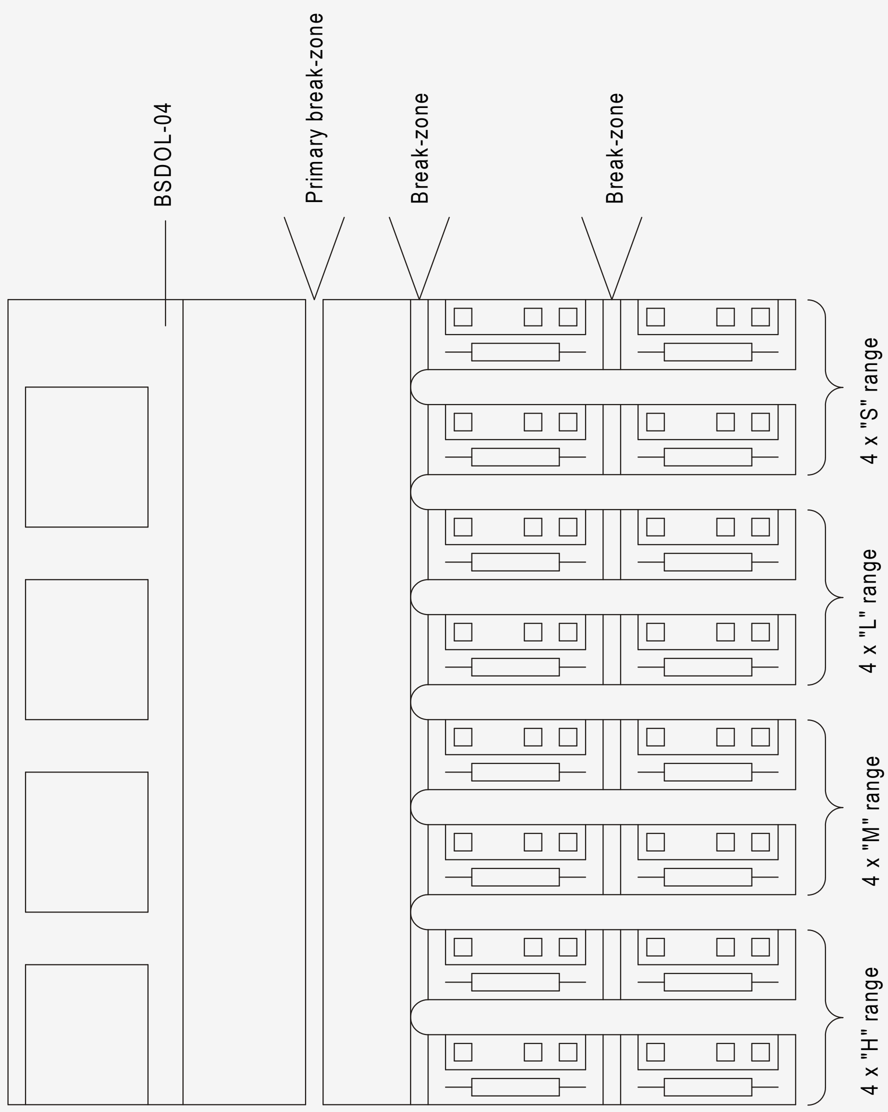


Figure 11-3: Front view of the BSDOL-04UNI

The BSDOL-04UNI module is a module with break-off sections (see the above figure):

- The main section (BSDOL-04), which must be placed on the programming connector (Px) on the IO backplane. Offers 4 range settings positions for channel 1 through 4 (see the table below).

- 16 Range setting sub-modules (4x type S, 4x type L, 4x type M, 4x type H), which must be placed on the 4 positions in the BSDOL-04 (= main section).

The below table shows the possible range settings for the BSDOL-04UNI module.

Table 1. Possible BSDOL-04UNI range settings

Range setting	Range	Description
S	-	The BSDOL-04UNI “S” range setting is used for spare channels of SDOL-04x modules to prevent lead breakage detection on those channels and has a 4.7 kΩ (dummy load) resistor.
L	17-47 mA	The BSDOL-04UNI “L” range setting module is used for SDOL-04x channels with loads between 17 and 47 mA and has a 33 Ω resistor to set the current sense level.
M	48-199 mA	The BSDOL-04UNI “M” range setting module is used for SDOL-04x channels with loads between 48 and 199 mA and has a 10 Ω resistor to set the current sense level.
H	≥ 200 mA	The BSDOL-04UNI “H” range setting module is used for SDOL-04x channels with loads of 200 mA or higher and has a 2.2 Ω resistor to set the current sense level.

Note:
When the BSDOL-04UNI module is placed on the IO backplane, the top position corresponds to channel 1, the second position to channel 2, and so on.

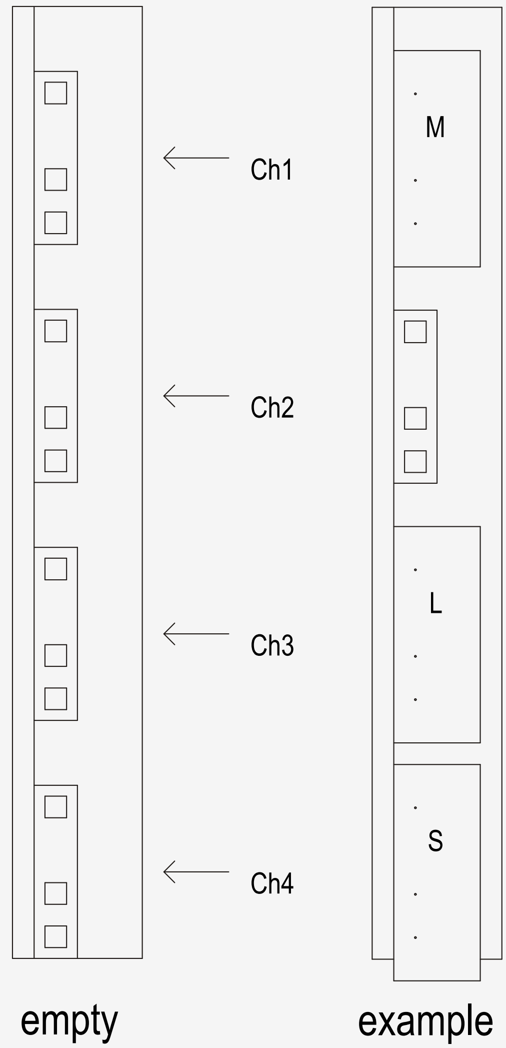


Figure 11-4: Rear view of an BSDOL-04UNI on an IO backplane

The ‘example’ in the above figure shows:

- Channel 1: setting for a 48-199 mA load
- Channel 2: setting for a 4-16 mA load
- Channel 3: setting for a 17-47 mA load
- Channel 4: spare

The ‘empty’ BSDOL-04UNI at the left side in the above figure is actually set for 4-16 mA load on all four channels.

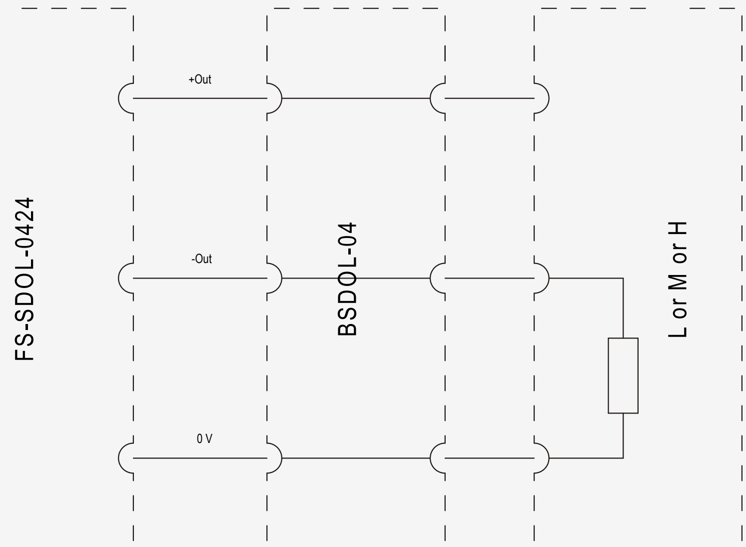


Figure 11-5: Schematic diagram for a channel with range setting sub-module

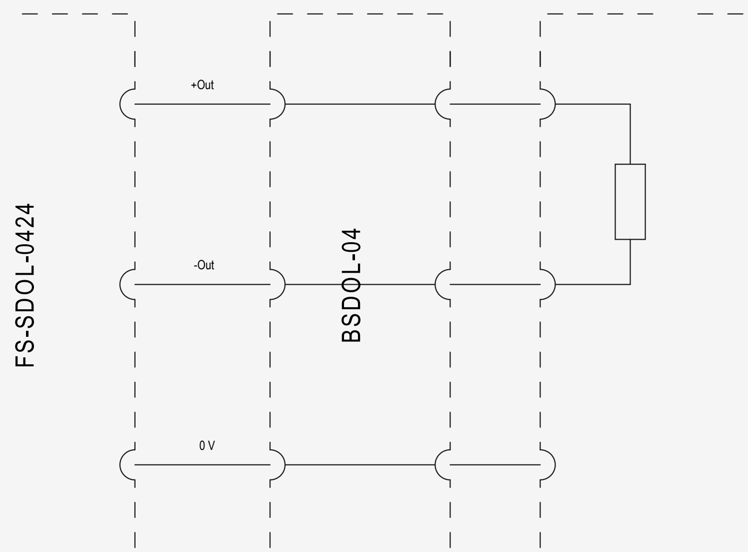


Figure 11-6: Schematic diagram for a spare channel

11.2.2 Technical data

The BSDOL-04UNI module has the following specifications:

11.2 BSDOL-04UNI

General	Type numbers:	FS-BSDOL-04UNI
		FC-BSDOL-04UNI
	Approvals:	CE, TUV, UL, CSA, FM
	Number of channels:	4
Power	Power requirements:	
	“S”	5 mA from 24 Vext. of SDOL-0424
	“L”, M” and “H”	None
	Load range:	
	“S”	None
	None	4-16 mA
		0.1-0.39W at 24 V DC (SDOL-0424)
	“L”	17-47 mA
		0.4-1.1 W at 24 V DC (SDOL-0424)
		0.8-2.3 W at 48 V DC (SDOL-0448)
	“M”	48-199 mA
		1.2-4.7 W at 24 V DC (SDOL-0424)
		2.4-9.5 W at 48 V DC (SDOL-0448)
	“H”	≥ 200 mA
		≥ 4.8 W at 24 V DC (SDOL-0424)
		≥ 9.6 W at 48 V DC (SDOL-0448)

Physical	Dimensions:	
	BSDOL-04UNI BSDOL-04 Range setting sub-module	58.5 × 54.5 × 12.5mm (2.3 × 2.15 × 0.5 in) 58.5 × 21 × 9mm (2.3 × 0.825 × 0.35 in) 13.5 × 5.1 × 12.5mm (.525 × 0.2 × 0.5 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

CHAPTER 12

SM UNIVERSAL IO MODULES

12 Universal Safety IO

This chapter describes the Universal Safety IO modules that are available for Safety Manager. These are:

output module	
RUSIO-3224	Universal Safe IO device (32 channels, 24 V DC)
RUSLS-3224	Universal Safe Logic Solver (32 channels, 24 V DC)

12.1 RUSIO-3224

12.1.1 Universal Safe IO device (32 channels, 24 V DC)

The RUSIO-3224 module has 32 universal safe IO channels with configurable channel function; configuration is done in Safety Builder.

The RUSIO-3224 module can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

It requires two RUSIO-3224 modules to achieve a redundant configuration.

All channels are powered out of the 24 V DC supply.

Each channel can be configured as:

- Digital input (with or without loop monitoring)
- Digital output (with loop monitoring
- Analog input (0-20 mA or 4-20 mA active)
- Analog output (0-20 mA or 4-20 mA active)

The RUSIO-3224 module supports two (100Mbaud) ethernet links to communicate with a Safety Manager Controller.

The RUSIO-3224 module has a housing that is in line with the patented Series C design of Honeywell. It needs to be placed on an IO Termination Assembly (IOTA).

The below figure shows physical appearance of the RUSIO-3224 module.

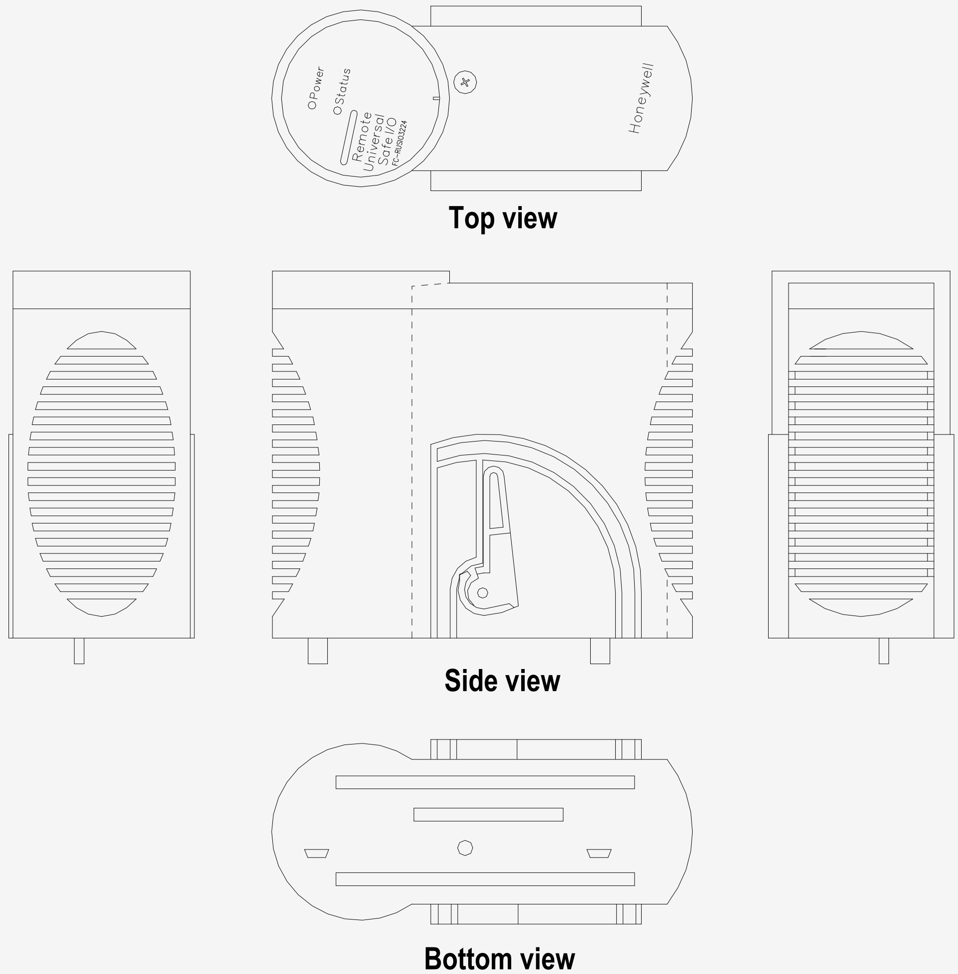


Figure 12-1: RUSIO-3224 module - top, side and bottom view

The RUSIO-3224 module has the following features:

- 32 universal IO channels that can be configured to control DI, AI, DO, AO
- Any type of IO field signal has only to be connected to the two connections of the applicable universal channel on the IOTA
- Proven-in-use redundant processor concept that complies with the SIL 3 safety requirements in single channel operation
- A dedicated communication link between these processors
- A redundant communication link with the partner module (in redundant configuration)

- An Ethernet-based Safety Manager Universal I/O link to the Safety Manager Controller in the network via dedicated switches; the Safety Manager Universal I/O link uses a dedicated protocol
- Monitoring the temperature of the electronics
- A configurable ESD function via channel 32 for dedicated safety related functions
- Function-tested watchdogs that: monitor and/or handle:
    - monitor cycle time and supply voltage
    - handle the ESD function and memory errors
- LED indicators at the front of the module for power and health status indication
- Real-time clock for Sequence Of Event (SOE) time stamping with a resolution of 1 msec

The RUSIO-3224 module functions as a Safety Manager universal IO module within the Safety Manager concept. It executes:

- The input scan of the process variables
- All functional tests of its hardware
- Data exchange with its partner module
- Data exchange via the Safety Manager Universal I/O link with the Safety Manager Controller that executes the application logics
- Update the outputs and thus the process

The FLASH nature of the memory allows for on line upgrading within the TÜV-approved concept of both the system software as well as the channel configuration.

12.1.2 Power and status indications

The RUSIO-3224 module has two LEDs; one for power indication and one for status indication (see the below figure).

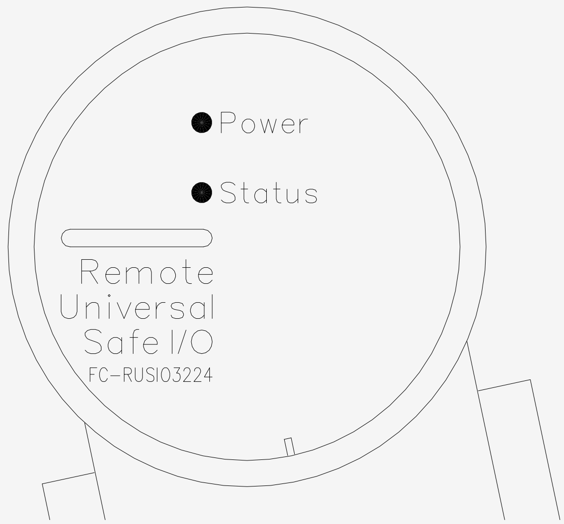


Figure 12-2: RUSIO-3224 module - power and status indications

The table below specifies the applicable indications:

LED indication		Status
Power LED	Green, steady	Power to the module is switched on
	Off	Power to the module is switched off
Status LED	Green, steady	Running without hardware fault
	Red, steady	Running with hardware fault(s)
	Green, flashing, toggle 1 Hz	Idle without hardware fault
	Red, flashing, toggle 1 Hz	Idle with hardware fault(s)
	Red, flashing, toggle 4 Hz	Application / firmware loading
	Off	Module has stopped

12.1.3 ESD function

The RUSIO-3224 module has one channel that can be configured as Emergency ShutDown (ESD) input; this is channel 32. To configure channel 32 as ESD input in Safety Builder, the two pins fork on the CN4 terminals on the IOTA must be in the ENABLE position (connecting pins 1 and 2).

Channel 32 must be configured for the ESD function in the software also, in order to execute the proper tests for the ESD channel.

When the (field) switch on the ESD input opens, the Safety Manager universal IO watchdogs switch off and all digital outputs of the connected RUSIO-3224 module(s) will go off and remain off. There is *no* software action required to do this; also there is no software action that can prevent this.

See detail A of the "ESD input of a Safety Manager universal IO channel" below for a block diagram of this ESD input.

See detail B of the "ESD input of a Safety Manager universal IO channel" below for the ESD input field connection.

The ESD input is line monitored (for short circuit in the field wires).

Place the (1 kOhm) line termination resistor on (or near) the switch.

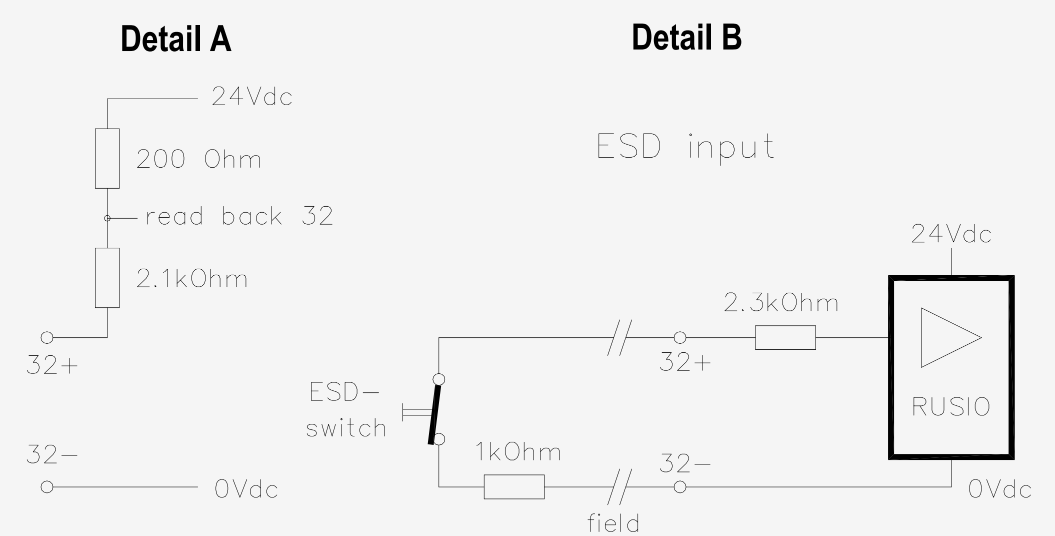


Figure 12-3: ESD input of a Safety Manager universal IO channel

Connecting multiple ESD-inputs of RUSIO-3224 modules with one switch requires a 7.5 Volt zener, see the "ESD switch to multiple Safety Manager universal IO modules" on the next page.

All RUSIO-3224 modules involved must be supplied out of the same 24 V DC (power rail).

A 1 Watt zenerdiode - like the 1N4737A or the BZV85-C7V5 - can handle upto 10 ESD inputs of (redundant) RUSIO-3224 modules.

A 5 Watt zenerdiode - like the 1N5343B - can handle upto 50 ESD inputs of (redundant) RUSIO-3224 modules.

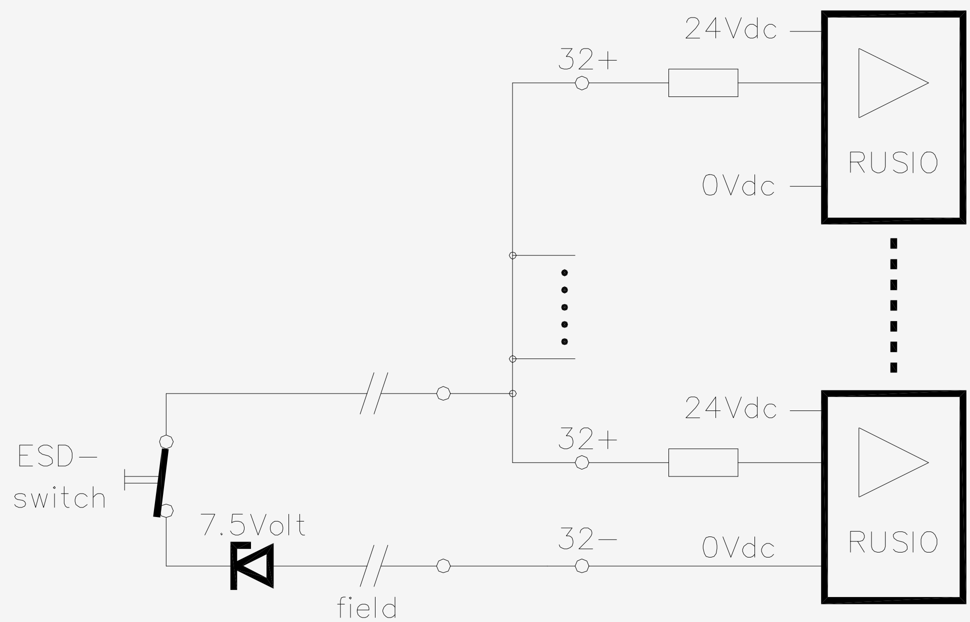


Figure 12-4: ESD switch to multiple Safety Manager universal IO modules

12.1.3.1 Technical Data for an ESD input

Open voltage:	24 V DC -20% ... +30%
Closed contact current:	7 mA ± 5% (at 24 V DC)
Switch resistor (single):	1 kOhm ± 5% >0.25 W
Switch zener (multiple):	7.5 Volt
Open contact current:	< 4 mA ± 5%
Short circuit detection:	field resistance < 500 Ohm ± 50%
ESD to outputs off delay:	10 ms ± 30%

12.1.4 IO channels

The RUSIO-3224 module has 32 remote universal safe IO channels.

One RUSIO-3224 module can be placed on a non-redundant IOTA to establish 32 non-redundant channels. Two RUSIO-3224 modules can be placed on one redundant IOTA to establish 32 redundant universal safe IO channels.

Each channel has two screw positions for the connection of field wires on the IOTA. No additional connections for field devices are required.

Positions 1+ through 32+ are the signal connections; one for each of the channels.

Positions 1- through 32- are (all) directly connected with the 0Volt supply connection.

All channels are 24Vdc sourcing (“active”).

Each channel can be configured as (line monitored) input or output. Some channels have additional configuration features. In the next topics the features and specific technical data of the various configurations are described. The topic titles reflect the function that a channel will have once it is configured.

12.1.4.1 Line-monitored digital input

The line-monitored input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of the "Line-monitored digital input of a Safety Manager universal IO channel" below for a block diagram of this Safety Manager universal IO channel configuration.

A line-monitored digital input requires two resistors in the field, near the switching element.

For Normally Closed (field-)contacts, these resistors must be connected in parallel, close to the switch. See detail B of the "Line-monitored digital input of a Safety Manager universal IO channel" below.

For Normally Open (field-)contacts, these resistors must be connected in series, close to the switch. See detail C of the "Line-monitored digital input of a Safety Manager universal IO channel" below.

Lead-breakage or short circuit in the wires to the switching element will be detected and result in a warning by the RUSIO-3224.

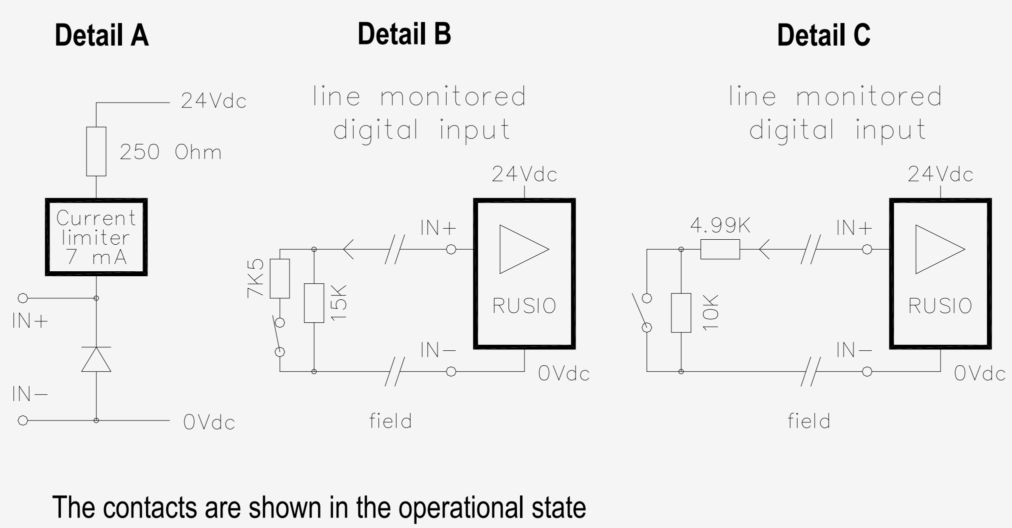


Figure 12-5: Line-monitored digital input of a Safety Manager universal IO channel

Technical data for a line-monitored digital input

All channels	Open voltage:	24 V DC -20% ... +30%
	Short circuit current:	7 mA ± 5%
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Open contact:	15 kOhm ± 5% >0.1 W
	Closed contact:	5 kOhm ± 5% >0.25 W
	Short circuit detection:	I > 6.3 mA ± 5%
	Closed contact detection:	2.8 mA < I < 6.3 mA ± 5%
	Open contact detection:	0.7 mA < I < 2.1 mA ± 5%
	Lead breakage detection:	I < 0.7 mA ± 5%
	Input filter:	first-order low-pass 100 Hz
	Maximum field capacitance:	100 nF

12.1.4.2 Non line-monitored digital input

The non line-monitored input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of the below figure for a block diagram of this Safety Manager universal IO channel configuration.

A non line-monitored digital input has a switching element in the field; see detail B of the below figure.

This input has no short circuit or lead breakage detection.

> **Attention:**
> Channels configured as non line-monitored digital inputs may not be used as part of a safety loop.

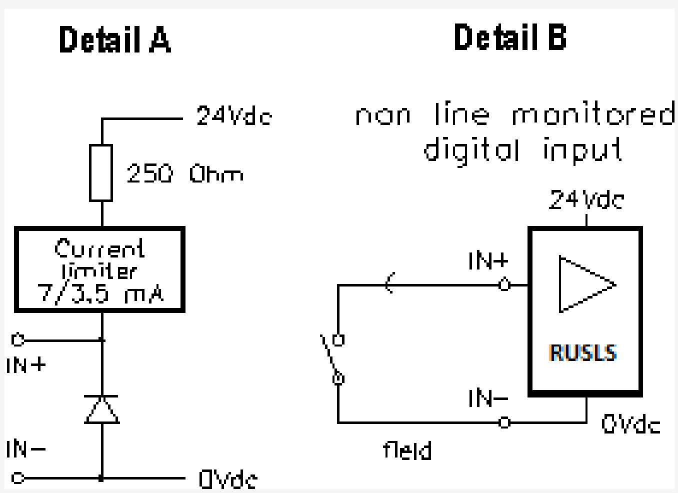


Figure 12-6: Non line-monitored digital input of a Safety Manager universal IO channel

Technical data for a non line-monitored digital input

All channels	Open voltage:	24 V DC -20% ... +30%
	Closed contact current:	7 mA ± 5%, after open state detection
		3.5 mA ± 5%, after closed state detection
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Closed contact detection:	I > 2.8 mA ± 5%
	Open contact detection:	I < 2.1 mA ± 5%
	Input filter:	first-order low-pass 100 Hz
	Maximum field capacitance:	100 nF

12.1.4.3 Analog input 0-20mA and 4-20mA

The analog input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of the below figure for a block diagram of this Safety Manager universal IO channel configuration.

An analog input is typically connected with a sensor in the field.

That sensor can also be a smoke or fire detector.

See details B and C of the below figure for examples.

A latching smoke or fire detector can be reset by the RUSIO-3224 module without extra components or wires.

It is possible to connect multiple smoke or fire detectors (up to 6) on one channel. Line monitoring and sensor state must be handled in the function block. For a wiring example see detail C of the below figure.

An analog input can be configured for 0-20mA or 4-20mA and is always active (internally sourced out of the 24Vdc supply).

Short circuit in the wires to the sensor will be detected and result in a warning by the RUSIO-3224.

If the input is configured for 4-20mA, then lead breakage of the wires will also be detected and result in a warning by the RUSIO-3224 module.

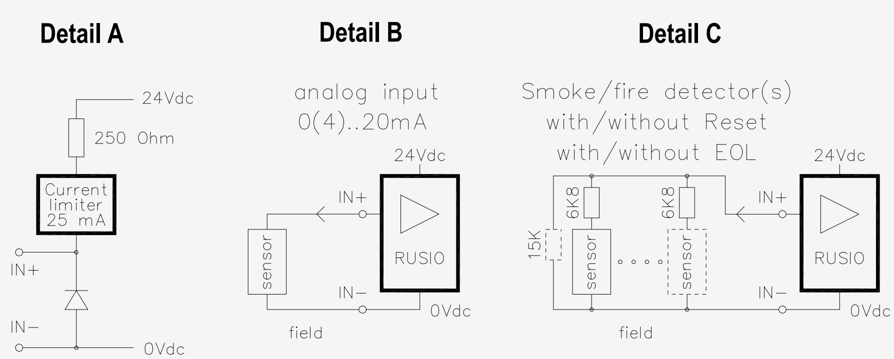


Figure 12-7: Analog input of a Safety Manager universal IO channel

A passive analog Safety Manager universal IO input 0-20mA or 4-20mA can only be created if the current source is isolated. See detail A of the below figure for a block diagram of this Safety Manager universal IO input.

Passive analog Safety Manager universal IO inputs use a V+ pin of CN3 on the IOTA. See detail B of the below figure for an example.

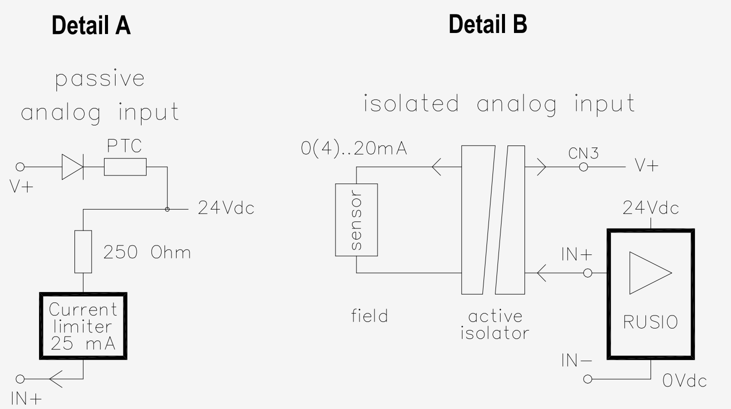


Figure 12-8: Passive analog input of a Safety Manager universal IO channel

Technical data for an analog input

Open voltage:	24 V DC -20% ... +30%
Field voltage:	> 15 V DC (at 0 ... 24 mA)
Short circuit current:	24.5 mA ± 0.5 mA
Input range:	0-20mA or 4-20mA
Input impedance:	typically 250 Ohm
A-D conversion:	16 bit
Typical Inaccuracy	< 0.05%
Worst Case Inaccuracy for 25 degree C	< 0.15%
Worst Case Inaccuracy over full temperature range	< 0.2%
Safety-related inaccuracy:	< 1% of full scale
Input filter:	first-order low-pass 100 Hz
Maximum field capacitance:	100 nF

Attention:

- For HART enabled points, the analog transmitter must be configured to operate within the range 2.5 - 22.5 mA. The HART communication will not work if operated outside this range.

  The alarm settings for the HART communication also do not work if operated outside this range. In addition, HART communication can be delayed when the analog signal changes from normal operation to alarm state.

  - If the alarms on HART devices are communicated by HART messages, alarms are reported as long as the PV value is within the 2.5 and 22.5 mA range.
  - If the field device changes the PV value to a value outside the operational range of 4-20 mA so that the alarm value is in between 2.5 and 22.5 mA, HART communication is still possible. However, as HART messages are not used to indicate an alarm this is not a must.

Note:
When using the PV value to indicate an alarm, it is recommended to configure the alarm value between 2.5 and 4 mA or between 20 to 22.5 mA to avoid unwanted disturbance.

- All active field devices shall be galvanically separated (isolated) from live voltages. Live voltages are voltages higher than 30Vac or 40Vdc.
- Drawing more than 24 mA will cause extra heat dissipation in the housing of the RUSIO-3224 module. For more information refer to Temperature derating.

12.1.4.4 Digital output

The digital output of the RUSIO-3224 module consists of a (0.5 A current limited) output with a Secondary Means Of De-energisation (SMOD) FET output.

Each output has a SMOD to enable switching off the channel, even if the channel FET fails. See detail A of the below figure for an example.

The output driver limits the output (short circuit) current and switches off the output if an overload condition lasts too long.

All digital outputs of a RUSIO-3224 are off when its IO watchdog is tripped.

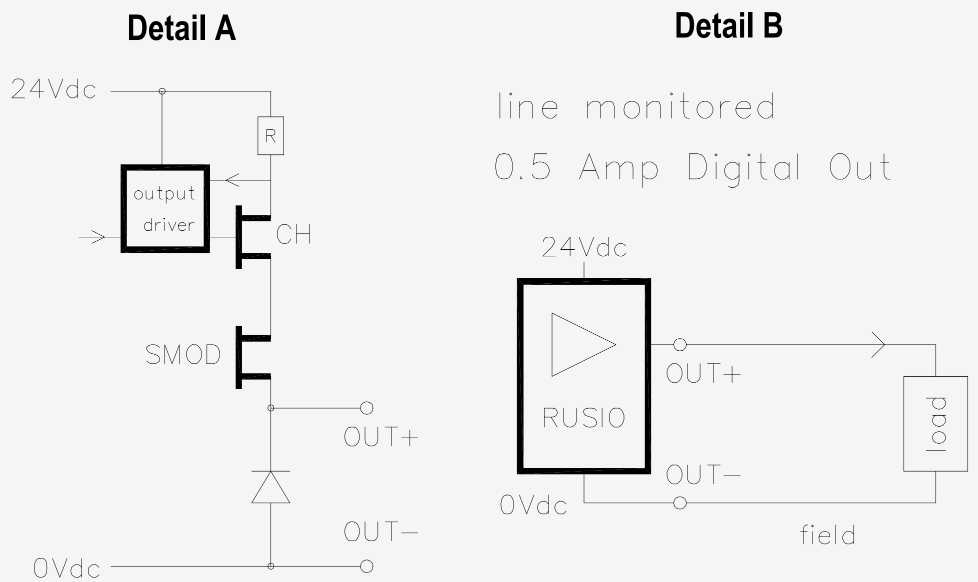


Figure 12-9: (Single) digital output of a Safety Manager universal IO channel

Lead breakage detection in the (field-) wiring is achieved by sourcing a small current (< 0.7 mA) into the field. Failure to conduct this current indicates lead breakage.

Loads of more than 0.5A are supported with the multiple output option.

Sets of two or four outputs can be configured as a multiple output, respectively capable of sourcing up to 1 A or 2 A.

A 2 pins fork with a pitch of 5.08mm (or a 4 pins fork with a pitch of 5.08mm) can be used to interconnect the multiple outputs. See details A and B of the below figure for examples.

The field + wire must be connected with one of the OUT+ pins (together with the fork). Any one of the OUT- pins can be used to connect the field return wire.

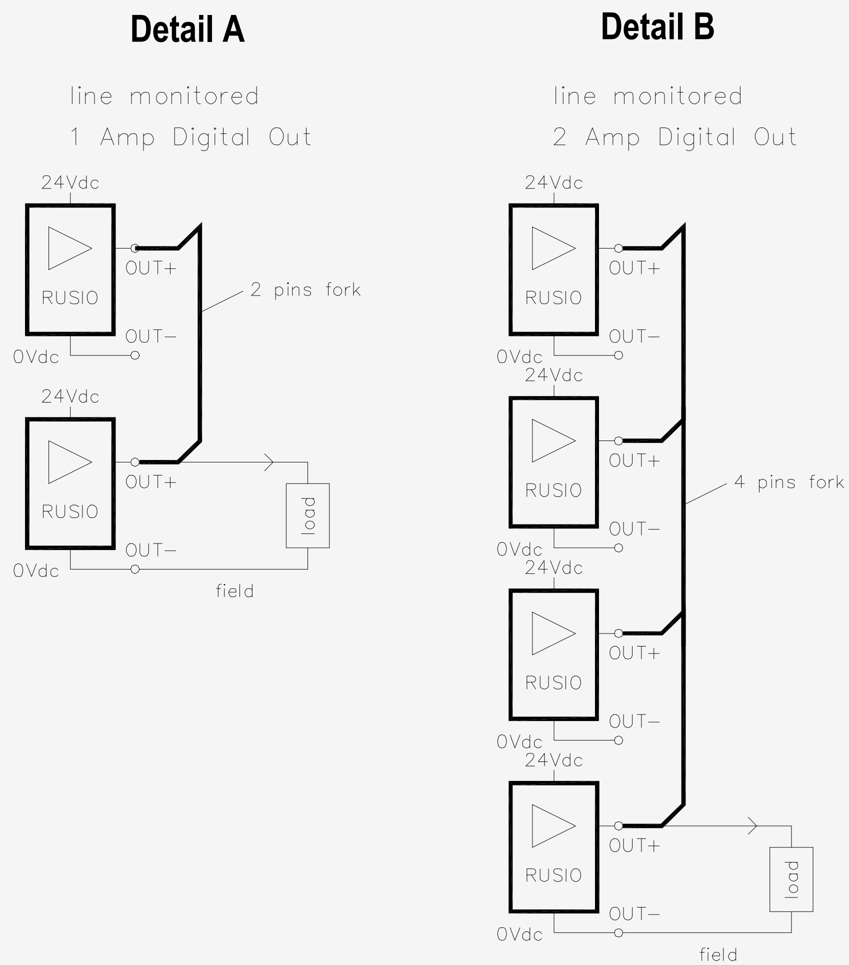


Figure 12-10: Multiple digital output connection of a Safety Manager universal IO channel

Technical data for a digital output

Output:	24 V DC solid-state source
	short circuit proof
Maximum resistive load:	500 mA
	For more details see, • Open loop detection for de-energized Universal I/O line-monitored digital output channels • General information about output modules
Maximum tungsten-lamp load:	125mA (3 W)
Minimum load:	1 mA
Maximum field capacitance:	1 µF For details, see Open loop detection for de-energized Universal I/O line-monitored digital output channels
Maximum inductive load	10 H
Voltage drop:	< 1.5 V (at 500 mA)
Off current:	< 0.1 mA
Two pins fork:	Weidmuller, LPA QB 2
Four pins fork:	Weidmuller, LPA QB 4

12.1.4.5 Analog output 0-20mA and 4-20mA

The analog output of the RUSIO-3224 module consists of a 250 Ohm readback resistor, a current control circuit with output FET (AO) and a SMOD FET. See detail A of the below figure for a block diagram of this Safety Manager universal IO output. Each output has a SMOD to enable switching off the channel, even if the channel FET fails. See details A of the below figure for an example.

An analog output is typically connected with an 0-20mA or 4-20mA analog actuator in the field. See detail B of the below figure for an example.

An analog output can be configured for 0-20mA or 4-20mA and is always active. This means that the RUSIO-3224 module provides the required power.

Short circuit in the wires to the load will not be detected.

If the output is configured for 4-20mA, than lead breakage of the wires will be detected and result in a warning by the RUSIO-3224 module.

Isolated analog output signals require an (Ex-)analog isolator module. See detail C of the below figure for an example of how to connected such an output.

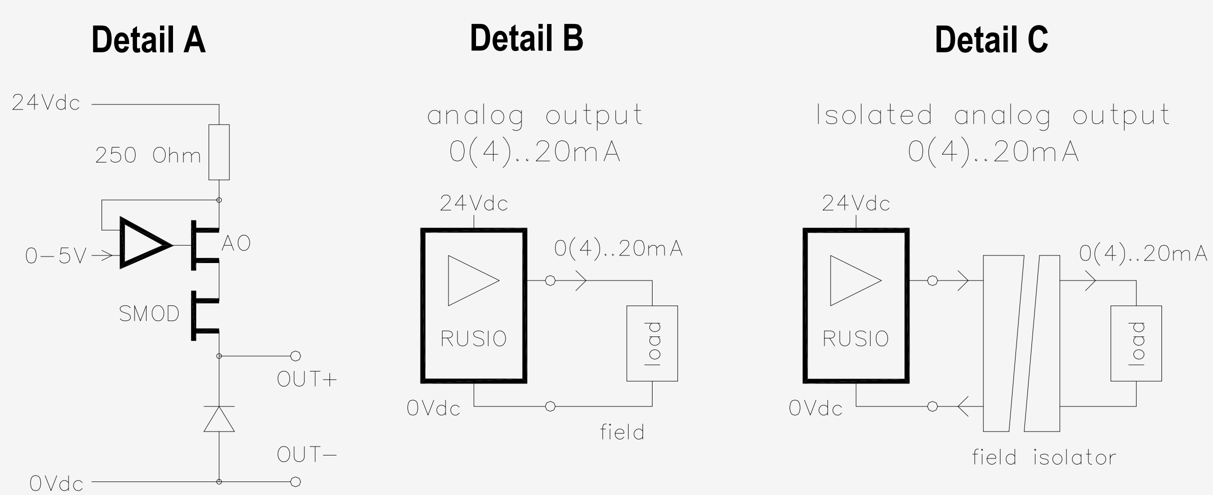


Figure 12-11: Analog output of a Safety Manager universal IO channel

Technical Data for an analog output

Open voltage:	24 V DC -20% ... +30%
Output current:	0 - 23 mA
Field (loop) resistance:	max. 500 Ohm
Maximum field capacitance:	100 nF
D-A conversion:	12 bit
Inaccuracy:	< 0.5% of full scale
Safety-related inaccuracy	< 1% of full scale

12.1.5 Temperature derating

This sub section addresses ‘outside module temperature’. The maximum outside module temperature must be limited depending on the internal dissipation.

Attention:

1. Airflow in / through the module is assumed to be natural convection.
2. Make sure that RUSIO-3224 modules are installed in the correct position. A RUSIO-3224 module must be mounted in upright position (refer to the "RUSIO-3224 module installation position" below).

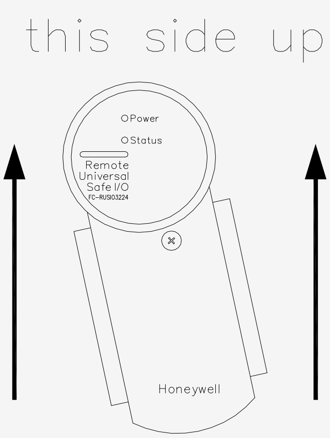


Figure 12-12: RUSIO-3224 module installation position

To determine the maximum acceptable outside module temperature for a typical configuration do the steps below. Relevant details are given in separate topics.

Outline of the procedure	For details see
Perform the Internal dissipation calculation. 1. Determine which supply voltage applies to your configuration: • 25 V or less • more than 25 V or unknown 2. Select the applicable reference table. 3. Determine and record the actual configuration data. 4. Calculate the totals per dissipation contributor. 5. Add the totals of the previous step to determine the internal dissipation.	Internal dissipation calculation
Determine the maximum acceptable outside module temperature. Use the applicable derating curve, based on the supply voltage: • 25V or less: use the derating curve in "Module derating with a supply voltage of 25 V default" on page 583. • more than 25V or unknown: use the derating curve in "Module derating with a supply voltage of 31.2 V" on page 585.	"Module derating with a supply voltage of 25 V default" on page 583 "Module derating with a supply voltage of 31.2 V" on page 585

Tip:
You can make a print of the applicable calculation table to make annotations of your specific configuration(s). Make sure to fill in the table for the applicable supply voltage.

12.1.5.1 Internal dissipation calculation

To calculate the maximum outside module temperature, you need the configuration. The maximum dissipation caused by the logic of the RUSIO-3224 module is a fixed value. Other dissipation contributions depend on the channel configuration. The maximum dissipation per channel type depends on the applicable supply voltage.

Select the appropriate table to carry out the calculation, based on the supply voltage:

- 25 V or less: 25 V (default) - as displayed in the Dissipation calculation - supply voltage 25 V table,
- more than 25 V or unknown: 31.2 V (maximum) - as displayed in the Dissipation calculation - supply voltage more than 25 V table.

Table 1. Dissipation calculation - supply voltage 25 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSIO [1]	0.49		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335		
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

Table 2. Dissipation calculation - supply voltage more than 25 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSIO [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1. Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

12.1.5.2 Temperature derating curves (25 V supply voltage)

The below figure shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 25 V supply voltage.

An example calculation for this supply voltage is given in the below table.

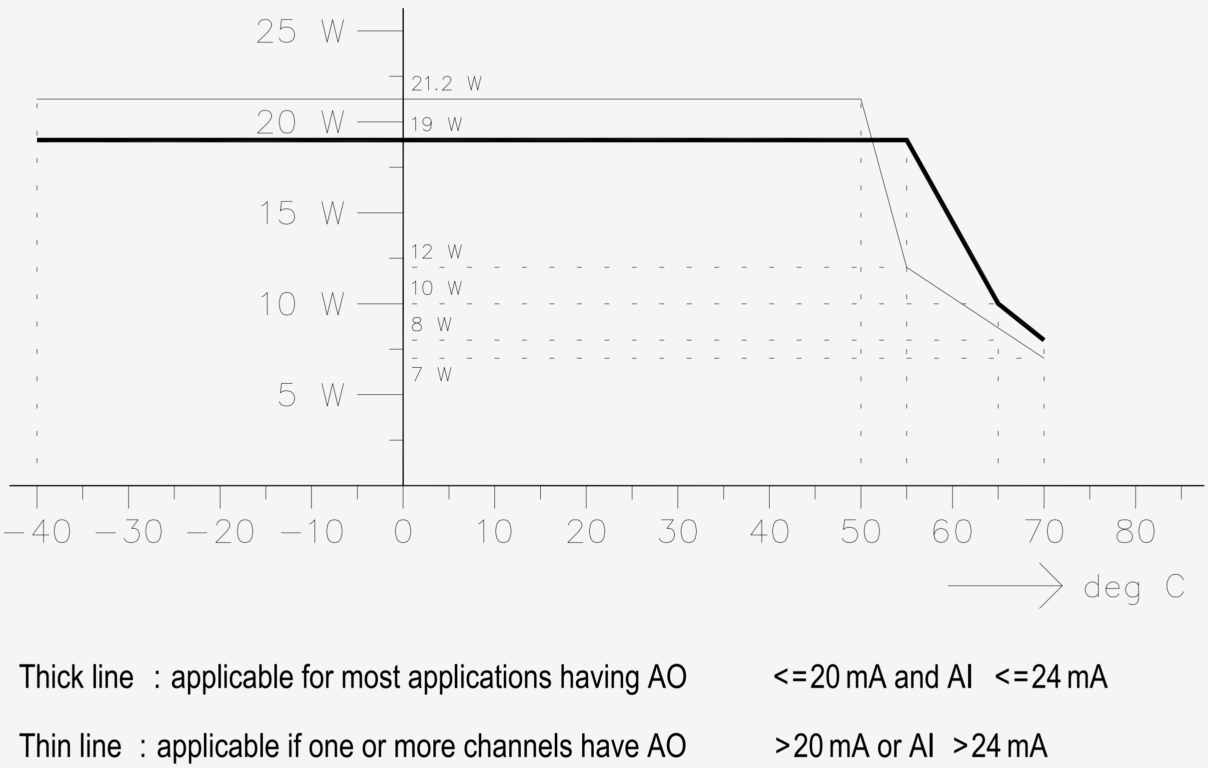


Figure 12-13: Module derating with a supply voltage of 25 V default

The below table shows a calculation example using the table for a 25 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in the below figure the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 70°C, with the High temperature shutdown of the module set at 90°C.

Note:

The maximum outside temperature limit can be improved with forced airflow.

Table 3. Example: dissipation calculation – supply voltage 25 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	10	0.1
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	10	1.5
AI; > 24 mA; Current limited by RUSIO [1]	0.49		
DO; <0.3 A	0.115	10	1.15
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335	2	0.67
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			7.92
Max. outside module temperature [°C]			+70

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

12.1.5.3 Temperature derating curves (31.2V supply voltage)

The below figure shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 31.2V supply voltage.

An example calculation for this supply voltage is given in the below table.

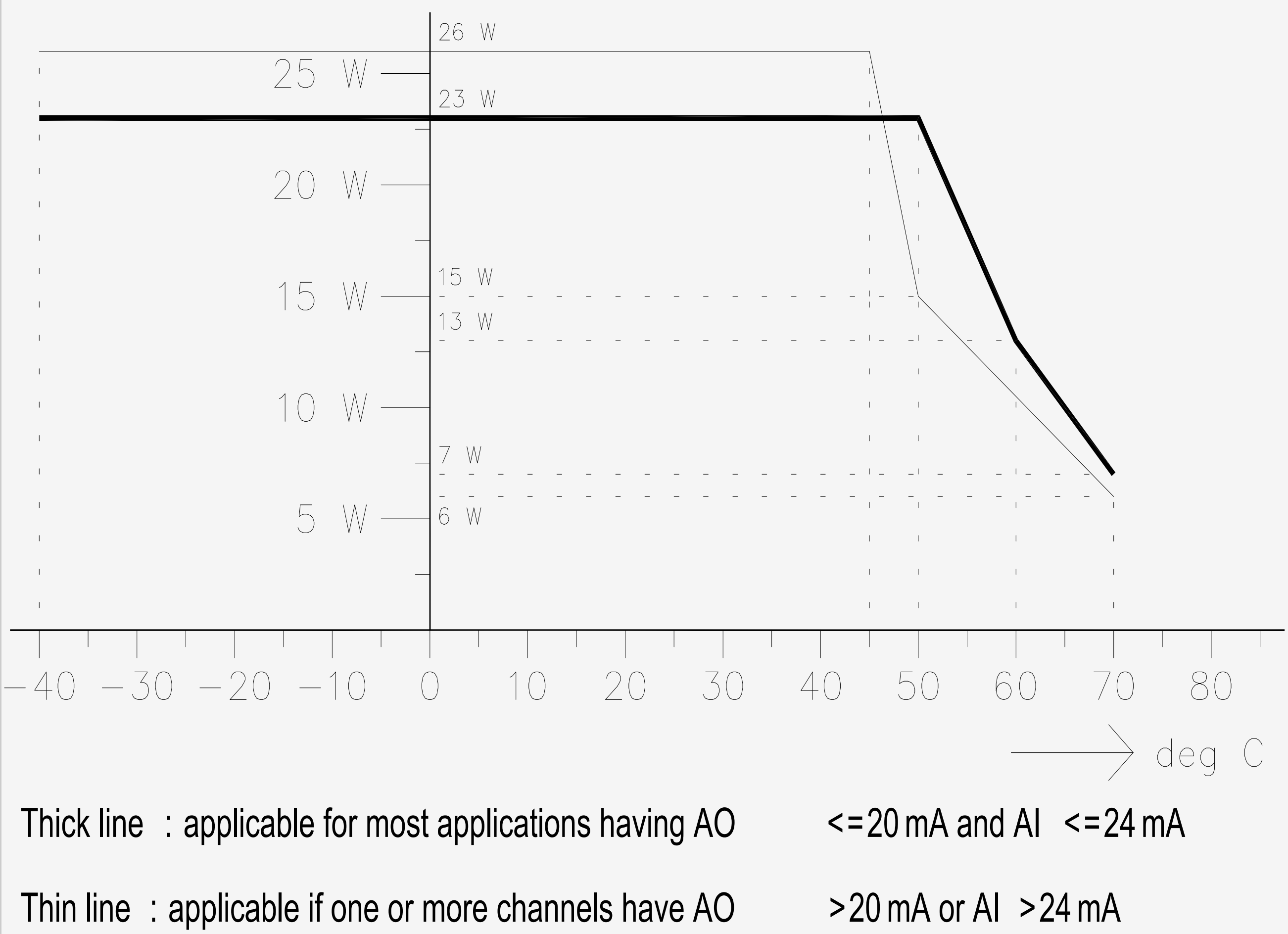


Figure 12-14: Module derating with a supply voltage of 31.2 V

The below table shows a calculation example using the table for a 31.2 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in "Module derating with a supply voltage of 31.2 V" above the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 65°C, with the High temperature shutdown of the module set at 90°C.

> **Note:**
> The maximum outside temperature limit can be improved with forced airflow.

Table 4. Example: dissipation calculation - supply voltage 31.2 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	2	0.02
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	21	1.05
AI; > 24 mA; Current limited by RUSIO [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305	9	2.75
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			9.32
Max. outside module temperature [°C]			65

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

12.1.6 Power supply ripple (24 V DC supply voltage)

The Safety Manager with Universal IO can tolerate a distortion or ripple on the 24 V DC power supply as defined in the following graph.

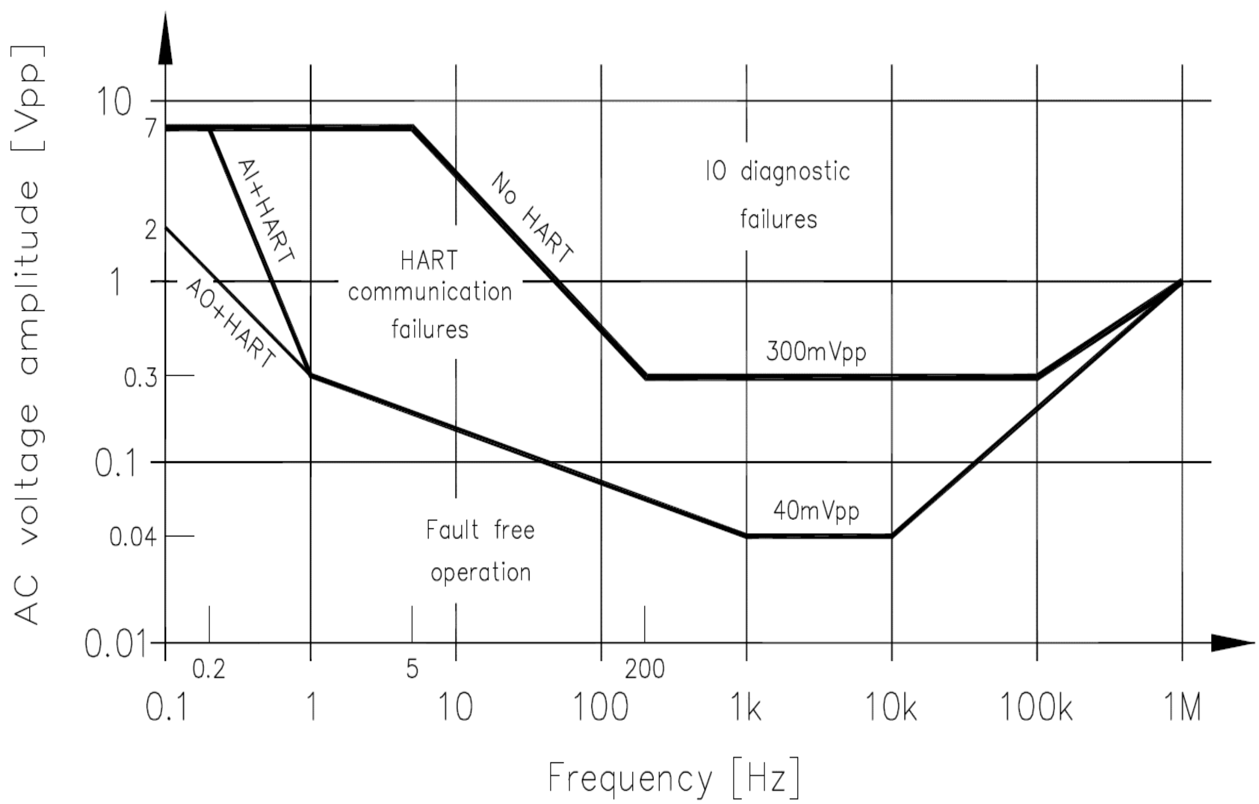


Figure 12-15: Distortion or ripple on the 24 V DC power supply graph

12.1.7 Module handling replacement

This sub section describes the procedures for removal and installation of a RUSIO-3224 module. See the below figure for relevant details.

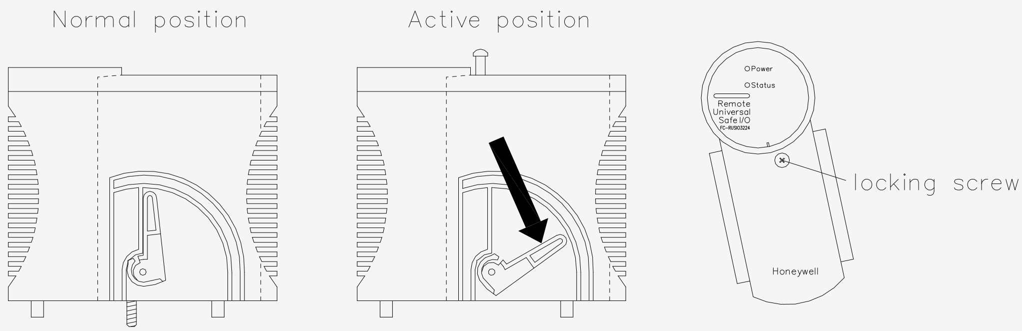


Figure 12-16: Module handling - removal lever

12.1.7.1 Removal of a RUSIO-3224 module

Do these steps in the order given to remove the subject RUSIO-3224 module:

1. On the IOTA, set the applicable switch (POWER 1 or POWER 2) to OFF. The Power LED (green) must go off.
2. Completely loosen the locking screw.
3. Press both (removal) levers at the sides of the module down *at the same time*. See Active Position in the "Module handling - removal lever" above.
4. Remove the module from the IOTA.
5. Put the (removal) levers back in the upright (normal) position.

12.1.7.2 Installation of a RUSIO-3224 module

Do these steps in the order given to install the subject RUSIO-3224 module:

1. On the IOTA, make sure that the applicable switch (POWER 1 or POWER 2) is set to OFF.
2. On the module to be installed, make sure that the (removal) levers are in the upright (normal) position.
3. Hold the module in the correct position on the IOTA and carefully push it down on the corresponding connectors.
4. Tighten the locking screw.

5. On the IOTA, set the applicable switch (POWER 1 or POWER 2) to ON. The Power LED (green) must go on.

12.1.8 Technical data

The RUSIO-3224 module has the following specifications:

General	Type number:	FC-RUSIO-3224
	Operating temperature:	
	• outside module temperature:	-40°C ... +70°C (-40°F ... +158°F)
	• inside module temperature:	-40°C ... +90°C (-40°F ... +194°F)
	Storage temperature:	-40°C ... +85°C (-40°F ... +185°F)
	Relative humidity:	10 ... 95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE, UL, TÜV
Power	Supply voltage:	24 V DC -15% ... +30%
	Supply current:	max 300mA (without field load)
IO	Number of channels:	32
	Channel type:	Universal safe (software configurable)
	• Digital in	max. 32 (with or without line-monitoring)
	• ESD in	max. 1 (with line-monitoring)
	• Analog in	max. 32 (with or without line-monitoring)
	• Digital out	max. 32 (with or without line-monitoring) max. combined load: 9 A
	• Analog out	max. 16 (with or without open loop detection)
	Maximum field capacitance	100 nF (for AI / DI / AO channels)
		1 µF (for DO channels)

12.1 RUSIO-3224

Physical Data	Dimensions (H x W x D):	145 x 165.1 x 72.4 mm
		5.7 x 6.5 x 2.85 in
	Weight:	0.66 kg
		1.45 lbs

12.2 RUSLS-3224

12.2.1 Universal Safe Logic Solver (32 channels, 24 V DC)

The RUSLS-3224 module has 32 universal safe IO channels with configurable channel function; configuration is done in Safety Builder.

The user can assign execution of application logics to the RUSLS-3224 module for one or more related FLDs; this is called logic solving. Configuration of logic solving is done in Safety Builder.

The RUSLS-3224 module can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

It requires two RUSLS-3224 modules to achieve a redundant configuration.

All channels are powered out of the 24Vdc supply.

Each channel can be configured as:

- Digital input (with or without loop monitoring)
- Digital output (with loop monitoring)
- Analog input (0-20mA or 4-20mA active)
- Analog output (0-20mA or 4-20mA active)

The RUSLS-3224 module supports two (100Mbaud) ethernet links to communicate with a Safety Manager Controller.

The RUSLS-3224 module has a housing that is in line with the patented Series C design of Honeywell. It needs to be placed on an IO Termination Assembly (IOTA).

The below figure shows physical appearance of the RUSLS-3224 module.

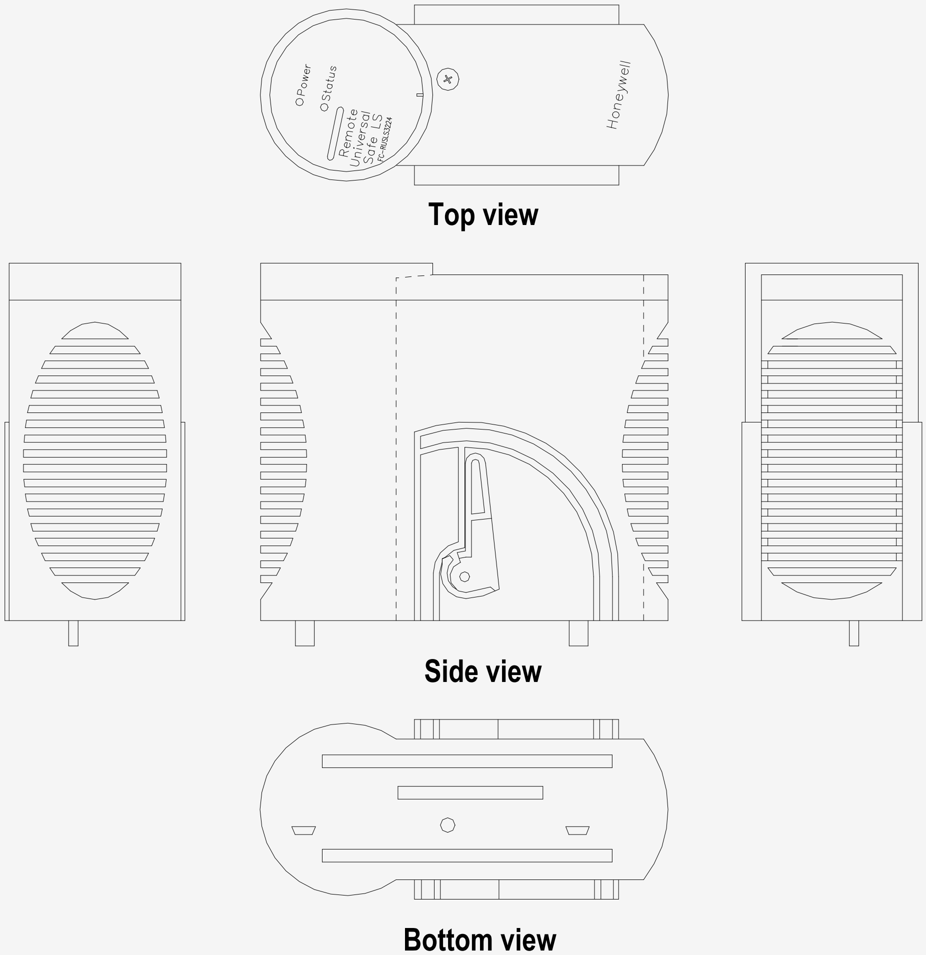


Figure 12-17: RUSLS-3224 module - top, side and bottom view

The RUSLS-3224 module has the following features:

- 32 universal IO channels that can be configured to control DI, AI, DO, AO
- Any type of IO field signal has only to be connected to the two connections of the applicable universal channel on the IOTA
- Proven-in-use redundant processor concept that complies with the SIL 3 safety requirements in single channel operation
- Logic solving that enables localized safeguarding of equipment under control (EUC)
- Redundant memory for system and application programs

- A dedicated communication link between these processors
- A redundant communication link with the partner module (in redundant configuration)
- An Ethernet-based Safety Manager Universal I/O link to the Safety Manager Controller in the network via dedicated switches; the Safety Manager Universal I/O link uses a dedicated protocol
- Monitoring the temperature of the electronics
- A configurable ESD function via channel 32 for dedicated safety related functions
- Function-tested watchdogs that: monitor and/or handle:
  - Monitor cycle time and supply voltage
  - Handle the ESD function and memory errors
- LED indicators at the front of the module for power and health status indication
- Real-time clock for Sequence Of Event (SOE) time stamping with a resolution of 1 msec

The RUSLS-3224 module functions as a local Logic Solver and as a Safety Manager universal IO module within the Safety Manager concept. It executes:

- The input scan of the process variables
- All functional tests of its hardware
- Data exchange with its partner module
- The application logics of those FLDs within that are assigned to the module, independently
- Data exchange via the Safety Manager Universal I/O link with the Safety Manager Controller that executes the application logics of those FLDs that are not assigned to the module
- Update the outputs and thus the process

The FLASH nature of the memory allows for on line upgrading within the TÜV-approved concept of both the system software as well as the channel configuration and [parts of] the application program.

12.2.2 Power and status indications

The RUSLS-3224 module has two LEDs; one for power indication and one for status indication (see the below figure).

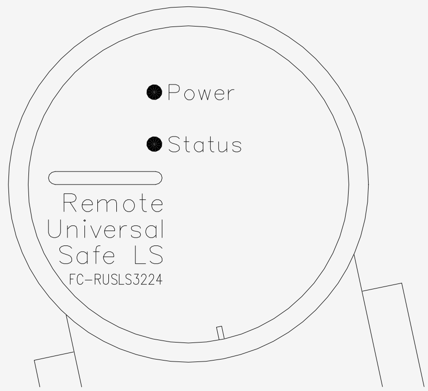


Figure 12-18: RUSLS-3224 module - power and status indications

The table below specifies the applicable indications:

LED indication		Status
Power LED	Green, steady	Power to the module is switched on
	Off	Power to the module is switched off
Status LED	Green, steady	Running without hardware fault
	Red, steady	Running with hardware fault(s)
	Green, flashing, toggle 1 Hz	Idle without hardware fault
	Red, flashing, toggle 1 Hz	Idle with hardware fault(s)
	Red, flashing, toggle 4 Hz	Application / firmware loading
	Off	Module has stopped

12.2.3 Logic solving

The RUSLS-3224 module is capable of logic solving. Logic solving by the module enables localized safeguarding of equipment under control (EUC). This is achieved by the execution of the application logic (FLDs) that is assigned to the module. Configuration of *Remote Universal Safe Logic Solving* is done in Safety Builder; for relevant details see the *Software Reference*.

Localized safeguarding offers distinct benefits. A major advantage is that logic solving by the RUSLS-3224 module is unaffected when:

- communication with Safety Manager is lost,
- Safety Manager experiences a shutdown.

> **Attention:**
> A prerequisite for localized safeguarding is that the applicable FLDs only use IOTA resident IO.

Another advantage of localized safeguarding is that it saves execution capacity within the Control Processor of Safety Manager, potentially decreasing its application cycle time.

Execution capacity for localized safeguarding mainly depends on the number of points configured on FLDs that are assigned to the module. Absolute limitations are listed below:

Type	Base	Maximum number
Markers	-	512
Bytes registers	-	256
Counters	-	16
Timers	10 msec	4
	100 msec	32
	1 sec	32
	1 min	16

12.2.4 ESD function

The RUSLS-3224 module has one channel that can be configured as Emergency ShutDown (ESD) input; this is channel 32. To configure channel 32 as ESD input in Safety Builder, the two pins fork on the CN4 terminals on the IOTA must be in the ENABLE position (connecting pins 1 and 2).

Channel 32 must be configured for the ESD function in the software also, in order to execute the proper tests for the ESD channel.

When the (field) switch on the ESD input opens, the Safety Manager universal IO watchdogs switch off and all digital outputs of the connected RUSLS-3224 module(s) will go off and remain off. There is *no* software action required to do this; also there is no software action that can prevent this.

See detail A of the below figure for a block diagram of this ESD input.

See detail B of the below figure for the ESD input field connection.

The ESD input is line monitored (for short circuit in the field wires).

Place the (1kOhm) line termination resistor on (or near) the switch.

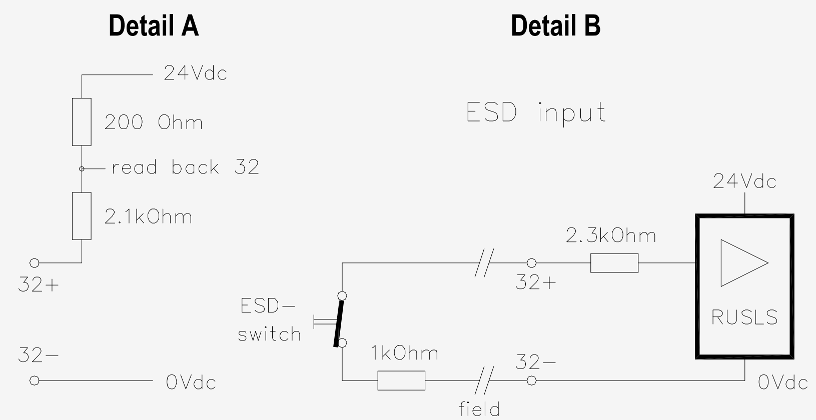


Figure 12-19: ESD input of a Safety Manager universal IO channel

Connecting multiple ESD-inputs of RUSLS-3224 modules with one switch requires a 7.5Volt zener, see the below figure.

All RUSLS-3224 modules involved must be supplied out of the same 24Vdc (power rail).

A 1 Watt zenerdiode - like the 1N4737A or the BZV85-C7V5 - can handle upto 10 ESD inputs of (redundant) RUSLS-3224 modules.

A 5 Watt zenerdiode - like the 1N5343B - can handle upto 50 ESD inputs of (redundant) RUSLS-3224 modules.

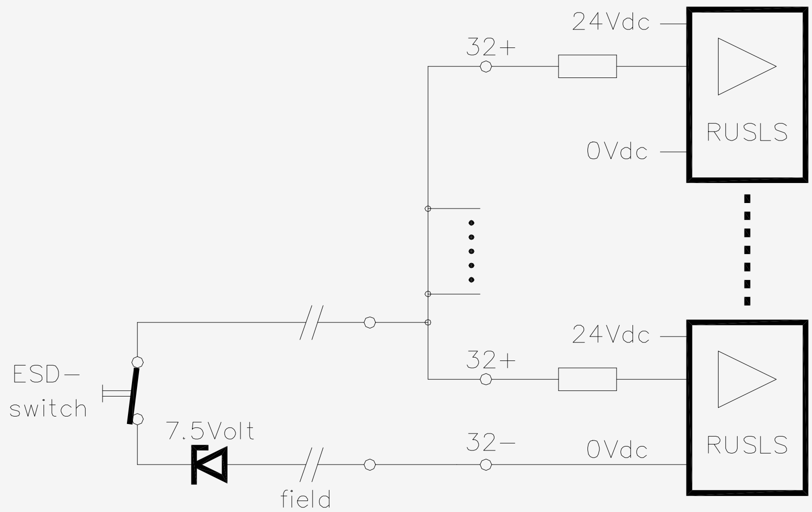


Figure 12-20: ESD switch to multiple Safety Manager universal IO modules

12.2.4.1 Technical Data for an ESD input

Open voltage:	24 V DC -20% ... +30%
Closed contact current:	7 mA ± 5% (at 24Vdc)
Switch resistor (single):	1 kOhm ± 5% >0.25W
Switch zener (multiple):	7.5 Volt
Open contact current:	< 4 mA ± 5%
Short circuit detection:	field resistance < 500 Ohm ± 50%
ESD to outputs off delay:	10 ms ± 30%

12.2.5 IO channels

The RUSLS-3224 module has 32 remote universal safe IO channels.

One RUSLS-3224 module can be placed on a non-redundant IOTA to establish 32 non-redundant channels. Two RUSLS-3224 modules can be placed on one redundant IOTA to establish 32 redundant universal safe IO channels.

Each channel has two screw positions for the connection of field wires on the IOTA. No additional connections for field devices are required.

Positions 1+ through 32+ are the signal connections; one for each of the channels.

Positions 1- through 32- are (all) directly connected with the 0Volt supply connection.

All channels are 24Vdc sourcing (“active”).

Each channel can be configured as (line monitored) input or output. Some channels have additional configuration features. In the next topics the features and specific technical data of the various configurations are described. The topic titles reflect the function that a channel will have once it is configured.

12.2.5.1 Line-monitored digital input

The line-monitored input of the RUSLS-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of the "Line-monitored digital input of a Safety Manager universal IO channel" on the facing page for a block diagram of this Safety Manager universal IO channel configuration.

A line-monitored digital input requires two resistors in the field, near the switching element.

For Normally Closed (field-)contacts, these resistors must be connected in parallel, close to the switch. See detail B of the "Line-monitored digital input of a Safety Manager universal IO channel" on the facing page.

For Normally Open (field-)contacts, these resistors must be connected in series, close to the switch. See detail C of the "Line-monitored digital input of a Safety Manager universal IO channel" on the facing page.

Lead-breakage or short circuit in the wires to the switching element will be detected and result in a warning by the RUSLS-3224.

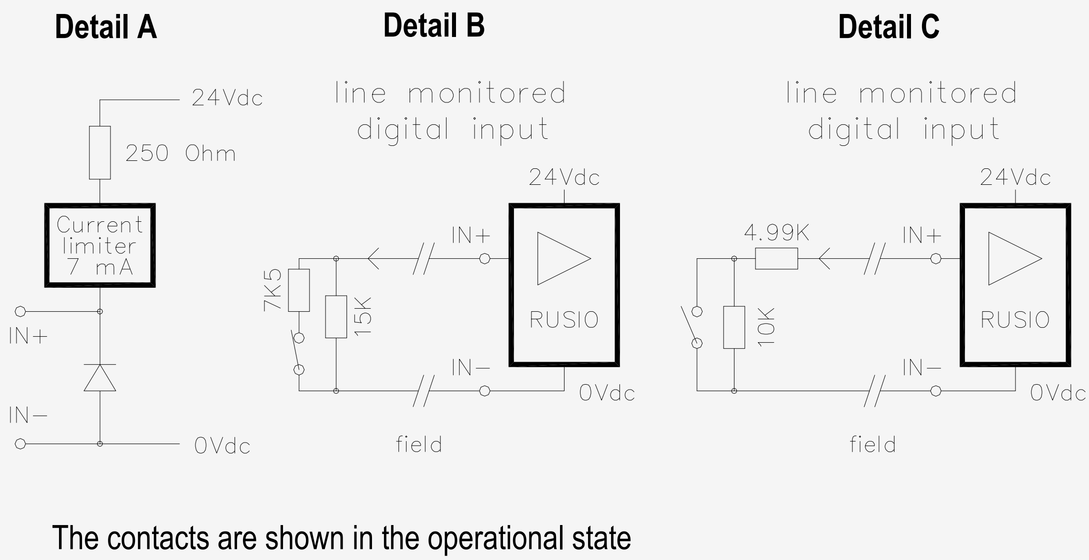


Figure 12-21: Line-monitored digital input of a Safety Manager universal IO channel

Technical data for a line-monitored digital input

All channels	Open voltage:	24 V DC -20% ... +30%
	Short circuit current:	7 mA ± 5%
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Open contact:	15 kOhm ± 5% >0.1 W
	Closed contact:	5 kOhm ± 5% >0.25 W
	Short circuit detection:	I > 6.3 mA ± 5%
	Closed contact detection:	2.8 mA < I < 6.3 mA ± 5%
	Open contact detection:	0.7 mA < I < 2.1 mA ± 5%
	Lead breakage detection:	I < 0.7 mA ± 5%
	Input filter:	first-order low-pass 100 Hz
	Maximum field capacitance:	100 nF

12.2.5.2 Non line-monitored digital input

The non line-monitored input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of the below figure for a block diagram of this Safety Manager universal IO channel configuration.

A non line-monitored digital input has a switching element in the field; see detail B of the below figure.

This input has no short circuit or lead breakage detection.

Attention:
Channels configured as non line-monitored digital inputs may not be used as part of a safety loop.

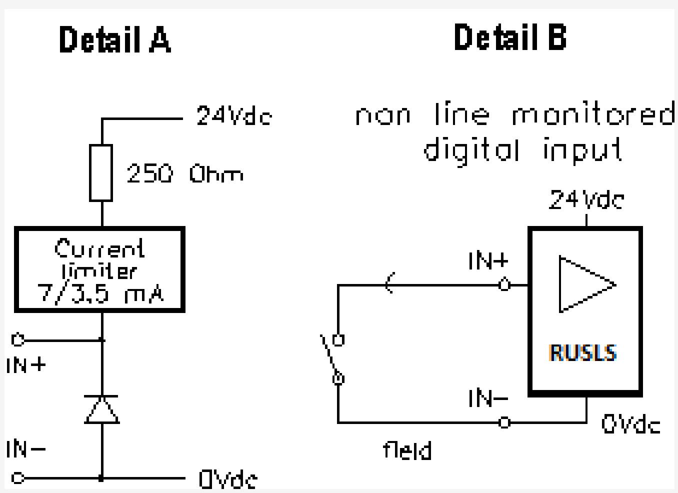


Figure 12-22: Non line-monitored digital input of a Safety Manager universal IO channel

Technical data for a non line-monitored digital input

All channels	Open voltage:	24 V DC -20% ... +30%
	Closed contact current:	7 mA ± 5%, after open state detection
		3.5 mA ± 5%, after closed state detection
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Closed contact detection:	I > 2.8 mA ± 5%
	Open contact detection:	I < 2.1 mA ± 5%
	Input filter:	first-order low-pass 100 Hz
	Maximum field capacitance:	100 nF

12.2.5.3 Digital output

The digital output of the RUSLS-3224 module consists of a (0.5 A current limited) output with a Secondary Means Of De-energisation (SMOD) FET output.

Each output has a SMOD to enable switching off the channel, even if the channel FET fails. See detail A of the below figure for an example.

The output driver limits the output (short circuit) current and switches off the output if an overload condition lasts too long.

All digital outputs of a RUSLS-3224 are off when its IO watchdog is tripped.

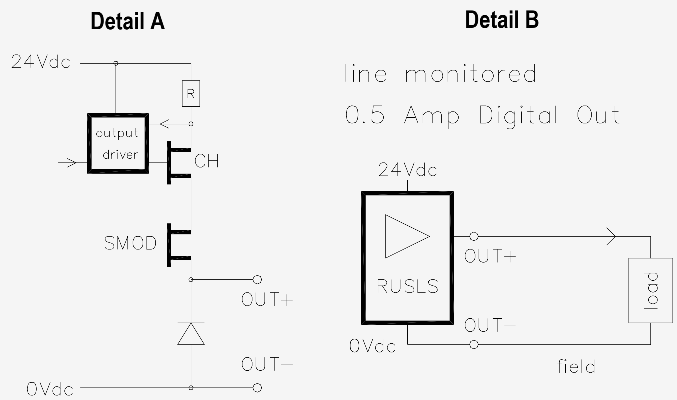


Figure 12-23: (Single) digital output of a Safety Manager universal IO channel

Lead breakage detection in the (field-) wiring is achieved by sourcing a small current (< 0.7 mA) into the field. Failure to conduct this current indicates lead breakage.

Loads of more than 0.5A are supported with the multiple output option.

Sets of two or four outputs can be configured as a multiple output, respectively capable of sourcing up to 1 A or 2 A.

A 2 pins fork with a pitch of 5.08mm (or a 4 pins fork with a pitch of 5.08mm) can be used to interconnect the multiple outputs. See details A and B of the below figure for examples.

The field + wire must be connected with one of the OUT+ pins (together with the fork). Any one of the OUT- pins can be used to connect the field return wire.

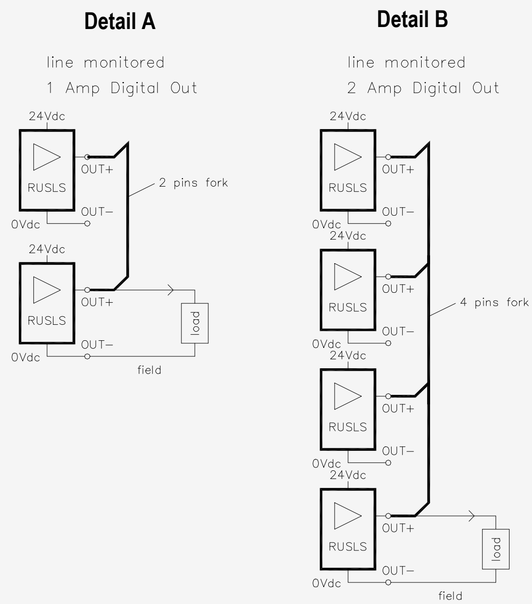


Figure 12-24: Multiple digital output connection of a Safety Manager universal IO channel

Technical data for a digital output

Output:	24 V DC solid-state source
	short circuit proof
Maximum resistive load:	500 mA
	For more details see, • Open loop detection for de-energized Universal I/O line-monitored digital output channels • General information about output modules
Maximum tungsten-lamp load:	125mA (3 W)
Minimum load:	1 mA
Maximum field capacitance:	1 µF For details, see Open loop detection for de-energized Universal I/O line-monitored digital output channels
Maximum inductive load	10 H
Voltage drop:	< 1.5 V (at 500 mA)
Off current:	< 0.1 mA
Two pins fork:	Weidmuller, LPA QB 2
Four pins fork:	Weidmuller, LPA QB 4

12.2.5.4 Analog output 0-20mA and 4-20mA

The analog output of the RUSLS-3224 module consists of a 250 Ohm readback resistor, a current control circuit with output FET (AO) and a SMOD FET. See detail A of the below figure for a block diagram of this Sm universal IO output. Each output has a SMOD to enable switching off the channel, even if the channel FET fails. See details A of the below figure for an example.

An analog output is typically connected with an 0-20mA or 4-20mA analog actuator in the field. See detail B of the below figure for an example.

An analog output can be configured for 0-20mA or 4-20mA and is always active. This means that the RUSLS-3224 module provides the required power.

Short circuit in the wires to the load will not be detected.

If the output is configured for 4-20mA, then lead breakage of the wires will be detected and result in a warning by the RUSLS-3224 module.

Isolated analog output signals require an (Ex-)analog isolator module. See detail C of the below figure for an example of how to connected such an output.

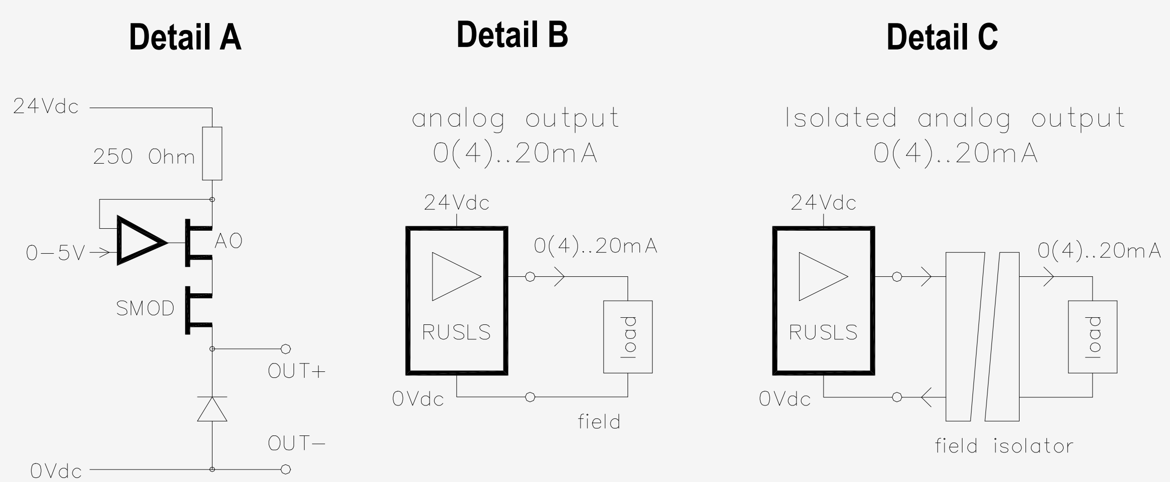


Figure 12-25: Analog output of a Safety Manager universal IO channel

Technical data for an analog output

Open voltage:	24 V DC -20% ... +30%
Output current:	0 - 23 mA
Field (loop) resistance:	max. 500 Ohm
D-A conversion:	12 bit
Inaccuracy:	< 0.5% of full scale
Safety-related inaccuracy	< 1% of full scale

12.2.6 Temperature derating

This sub section addresses ‘outside module temperature’. The maximum outside module temperature must be limited depending on the internal dissipation.

Attention:

1. Airflow in / through the module is assumed to be natural convection.
2. Make sure that RUSLS-3224 modules are installed in the correct position. A RUSLS-3224 module must be mounted in upright position (refer to the "RUSLS-3224 module installation position" on the facing page).

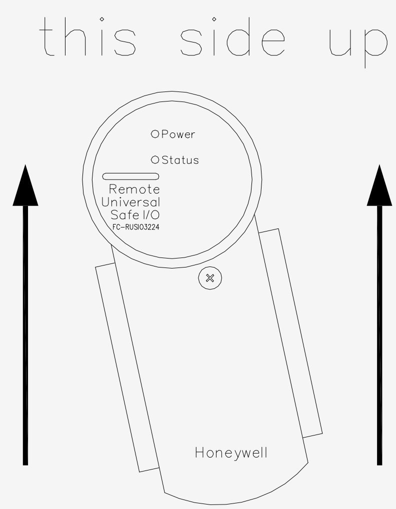


Figure 12-26: RUSLS-3224 module installation position

To determine the maximum acceptable outside module temperature for a typical configuration do the steps below. Relevant details are given in separate topics.

Outline of the procedure	For details see
Perform the Internal dissipation calculation. 1. Determine which supply voltage applies to your configuration: • 25 V or less, • more than 25 V or unknown. 2. Select the applicable reference table 3. Determine and record the actual configuration data. 4. Calculate the totals per dissipation contributor. 5. Add the totals of the previous step to determine the internal dissipation.	Internal dissipation calculation
Determine the maximum acceptable outside module temperature. Use the applicable derating curve, based on the supply voltage: • 25 V or less: use the derating curve in "Module derating with a supply voltage of 25 V default" on page 615. • More than 25 V or unknown: use the derating curve in "Module derating with a supply voltage of 31.2 V" on page 617.	"Module derating with a supply voltage of 25 V default" on page 615 "Module derating with a supply voltage of 31.2 V" on page 617

Tip:
You can make a print of the applicable calculation table to make annotations of your specific configuration(s). Make sure to fill in the table for the applicable supply voltage.

12.2.6.1 Internal dissipation calculation

To calculate the maximum outside module temperature, you need the configuration. The maximum dissipation caused by the logic of the RUSLS-3224 module is a fixed value. Other dissipation contributions depend on the channel configuration. The maximum dissipation per channel type depends on the applicable supply voltage.

Select the appropriate table to carry out the calculation, based on the supply voltage:

- 25 V or less: 25 V (default) - shown in the below table,
- More than 25 V or unknown: 31.2 V (maximum) - shown in the below table.

Table 1. Dissipation calculation - supply voltage 25 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSLS [1]	0.49		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335		
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

Table 2. Dissipation calculation - supply voltage 31.2 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSLS [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

12.2.6.2 Temperature derating curves (25 V supply voltage)

The below figure shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 25 V supply voltage.

An example calculation for this supply voltage is given in the below table.

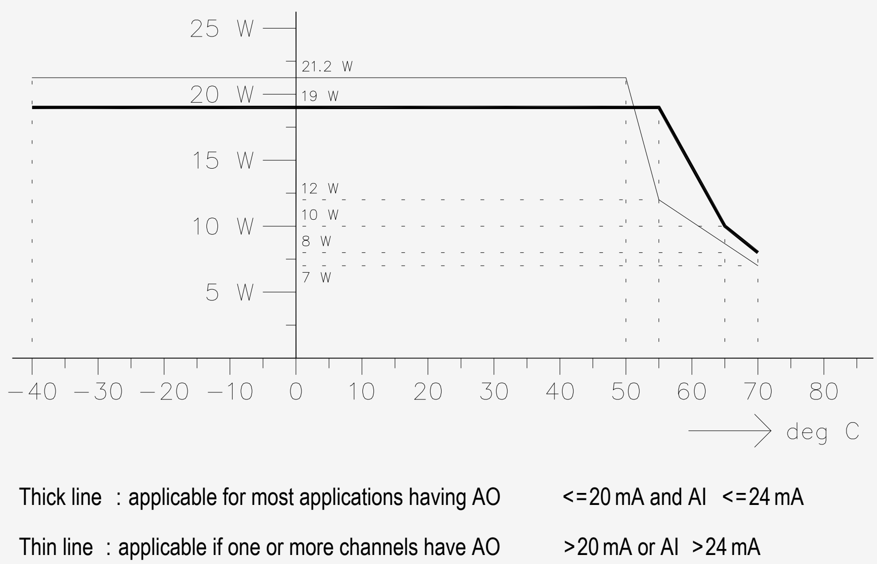


Figure 12-27: Module derating with a supply voltage of 25 V default

The below table shows a calculation example using the table for a 25 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in the "Module derating with a supply voltage of 25 V default" above the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 70°C, with the High temperature shutdown of the module set at 90°C.

Note:
The maximum outside temperature limit can be improved with forced airflow.

Table 3. Example: dissipation calculation - supply voltage 25 V

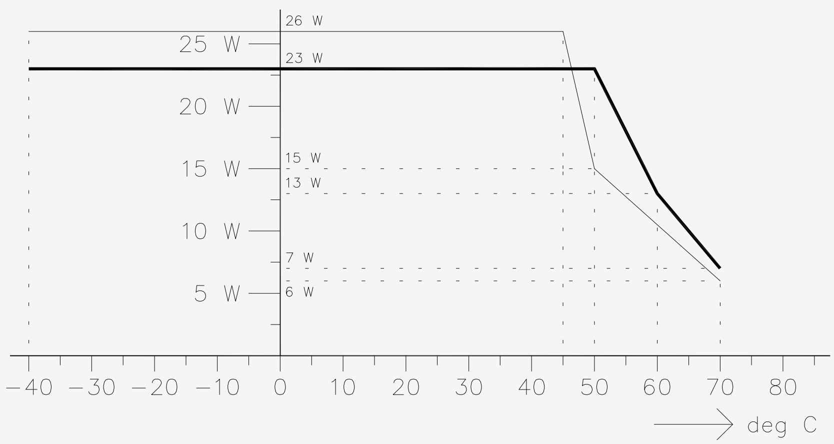
Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	10	0.1
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	10	0.5
AI; > 24 mA; Current limited by RUSLS [1]	0.49		
DO; <0.3 A	0.115	10	1.15
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335	2	0.67
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			7.92
Max. outside module temperature [°C]			70

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

12.2.6.3 Temperature derating curves (31.2 V supply voltage)

The below figure shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 31.2 V supply voltage.

An example calculation for this supply voltage is given in the below table.



Thick line : applicable for most applications having AO <=20 mA and AI <=24 mA

Thin line : applicable if one or more channels have AO >20 mA or AI >24 mA

Figure 12-28: Module derating with a supply voltage of 31.2 V

The below table shows a calculation example using the table for a 31.2 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in the above figure the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 65°C, with the High temperature shutdown of the module set at 90°C.

> **Note:**
> The maximum outside temperature limit can be improved with forced airflow.

Table 4. Example: dissipation calculation - supply voltage 31.2 V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	2	0.02
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	21	1.05
AI; > 24 mA; Current limited by RUSLS [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305	9	2.75
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			9.32
Max. outside module temperature [°C]			65

1. Analogue input currents above 24 mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24 mA, e.g. 3.5 mA for sensor fault conditions to minimize the Safety Manager universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

12.2.7 Power supply ripple (24 V DC supply voltage)

The Safety Manager with Universal IO can tolerate a distortion or ripple on the 24 V DC power supply as defined in the following graph.

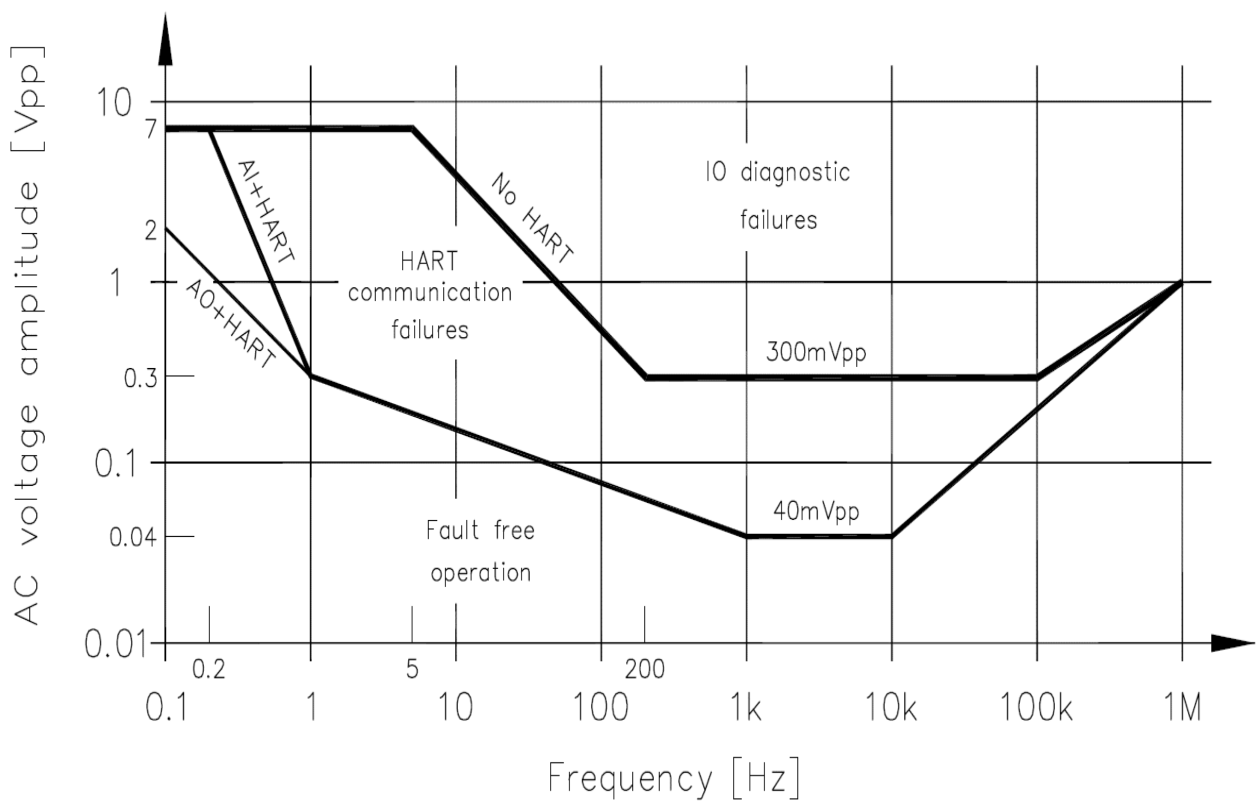


Figure 12-29: Distortion or ripple on the 24 V DC power supply graph

12.2.8 Module handling replacement

This sub section describes the procedures for removal and installation of a RUSLS-3224 module. See the below figure for relevant details.

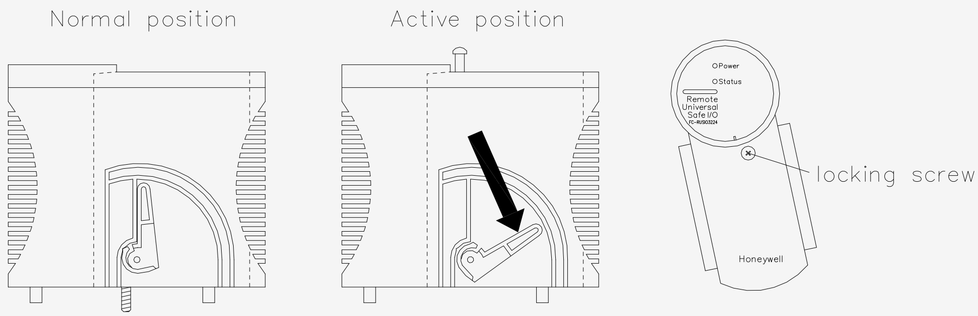


Figure 12-30: Module handling - removal lever

12.2.8.1 Removal of a RUSLS-3224 module

Do these steps in the order given to remove the subject RUSLS-3224 module:

1. On the IOTA, set the applicable switch (POWER 1 or POWER 2) to OFF. The Power LED (green) must go off.
2. Completely loosen the locking screw.
3. Press both (removal) levers at the sides of the module down *at the same time*. See Active Position in the above figure.
4. Remove the module from the IOTA.
5. Put the (removal) levers back in the upright (normal) position.

12.2.8.2 Installation of a RUSLS-3224 module

Do these steps in the order given to install the subject RUSLS-3224 module:

1. On the IOTA, make sure that the applicable switch (POWER 1 or POWER 2) is set to OFF.
2. On the module to be installed, make sure that the (removal) levers are in the upright (normal) position.
3. Hold the module in the correct position on the IOTA and carefully push it down on the corresponding connectors.
4. Tighten the locking screw.
5. On the IOTA, set the applicable switch (POWER 1 or POWER 2) to ON. The Power LED (green) must go on.

12.2.9 Technical data

The RUSLS-3224 module has the following specifications:

General	Type number:	FC-RUSLS-3224
	Operating temperature:	
	• outside module temperature:	–40°C ... +70°C (–40°F ... +158°F)
	• inside module temperature:	–40°C ... +90°C (–40°F ... +194°F)
	Storage temperature:	–40°C ... +85°C (–40°F ... +185°F)
	Relative humidity:	10 ... 95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE, UL, TÜV
Power	Supply voltage:	24 V DC -15% ... +30%
	Supply current:	max 300mA (without field load)
IO	Number of channels:	32
	Channel type:	Universal safe (software configurable)
	• Digital in	max. 32 (with or without line-monitoring)
	• ESD in	max. 1 (with line-monitoring)
	• Analog in	max. 32 (with or without line-monitoring)
	• Digital out	max. 32 (with or without line-monitoring) max. combined load: 9 A
	• Analog out	max. 16 (with or without open loop detection)

Physical Data	Dimensions (H x W x D):	145 x 165.1 x 72.4 mm
		5.7 x 6.5 x 2.85 in
	Weight:	0.66 kg
		1.45 lbs

12.3 Open loop detection for de-energized Universal I/O line-monitored digital output channels

Open loops are detected for de-energized Universal I/O line-monitored digital output channels, when there is a high capacitance but low field current. To avoid this, a maximum resistance value can be used depending on the field device capacitance, field wire capacitance, and the Universal I/O supply voltage.

The following table lists the maximum resistance values to be used based on the capacitance and the Universal I/O supply voltage.

21.2 Volt		
Capacitance	Resistance	Current
nF	KOhm	mA
0	23	0.92
47	22	0.96
100	15	1.41
220	8	2.65
470	4	5.30
1000	2	10.60

12.3 Open loop detection for de-energized Universal I/O line-monitored digital output channels

24 Volt		
Capacitance	Resistance	Current
nF	KOhm	mA
0	26	0.92
47	25	0.96
100	18	1.33
220	10	2.40
470	5	4.80
1000	2	12.00

31.2 Volt		
Capacitance	Resistance	Current
nF	KOhm	mA
0	34	0.92
47	33	0.95
100	23	1.36
220	13	2.40
470	7	4.46
1000	3	10.40

The following figure is the graphical representation of the same.

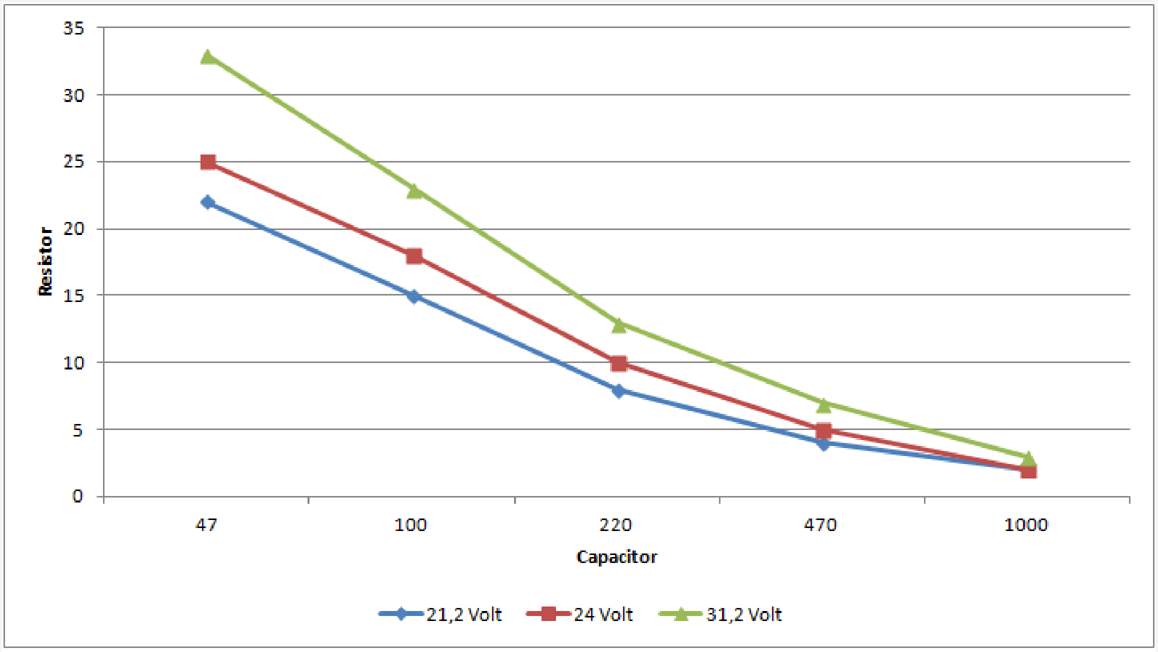


Figure 12-31: Maximum resistance values to be used based on capacitance and the Universal I/O supply voltage

Depending on the field device capacitance, field wire capacitance, and the Universal I/O supply voltage, a maximum resistance value can be used as shown in the graph. However, it is recommended that you choose the value that covers the 21.2V range.

Attention:

A minimum of 1 mA must run through the DO channel.

The following graph illustrates the graphical representation of the maximum current to be used based on the capacitance and supply voltage. For proper open-loop detection, the Universal I/O channel load-current should not exceed the maximum values depicted in the figure.

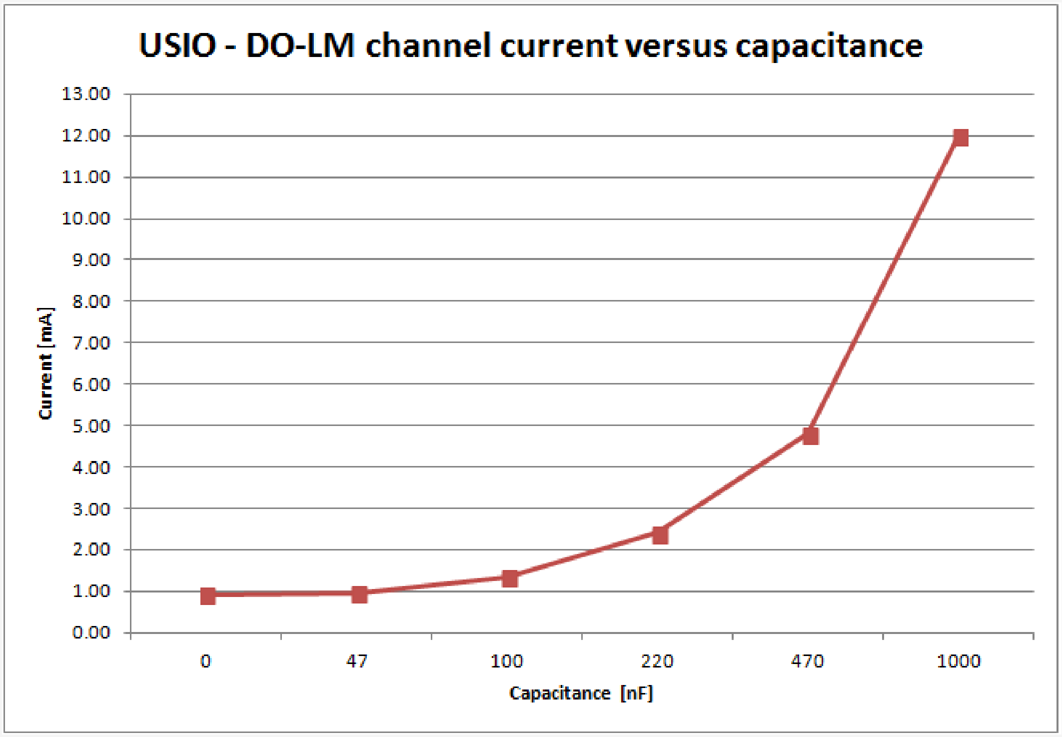


Figure 12-32: Current versus capacitance

13 Modules for special functions

This chapter describes about the number of modules for special functions that are available in addition to the modules for processors, and the input and output converter modules for Safety Manager.

13.1 10310/2/1

13.1.1 Earth leakage detector (ELD)

The 10310/2/1 module is an earth leakage detector (ELD) for 24 V DC systems. It has a manually operated self-test and earth connection monitor (switch 2 in 'TEST' position).

The ELD can be used to monitor:

- 24 V DC, 48 V DC and/or 60 V DC systems, or
- 110 V DC systems.

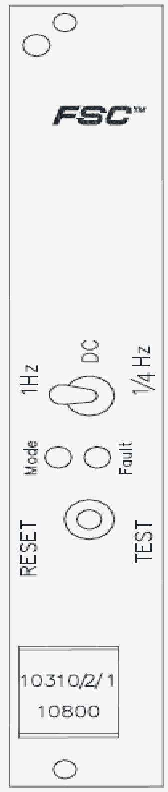


Figure 13-1: Front View

The ELD module connects earth level with -12 V DC (referenced to the 0 V connection of the 24, 48, 60 and/or 110 V DC supply). This connection is:

- Continuous (switch 1 in 'DC' position), or
- Interrupting at 1 Hz (switch 1 in '1 Hz' position), or
- Interrupting at 0.25 Hz (switch 1 in '1/4 Hz' position).

With switch 1 in the '1 Hz' or '1/4 Hz' position, the green 'MODE' LED on the module front flashes at the selected connection frequency.

Switch 1 is normally used in the 'DC' position.

The '1 Hz' position should only be used to accommodate for solenoids or relays that could stay energized by the negative earth voltage. The '1/4 Hz' position can be used for locating earth faults. Locating earth faults requires a current clamp (e.g. the DCM300E digital clamp from AVO International).

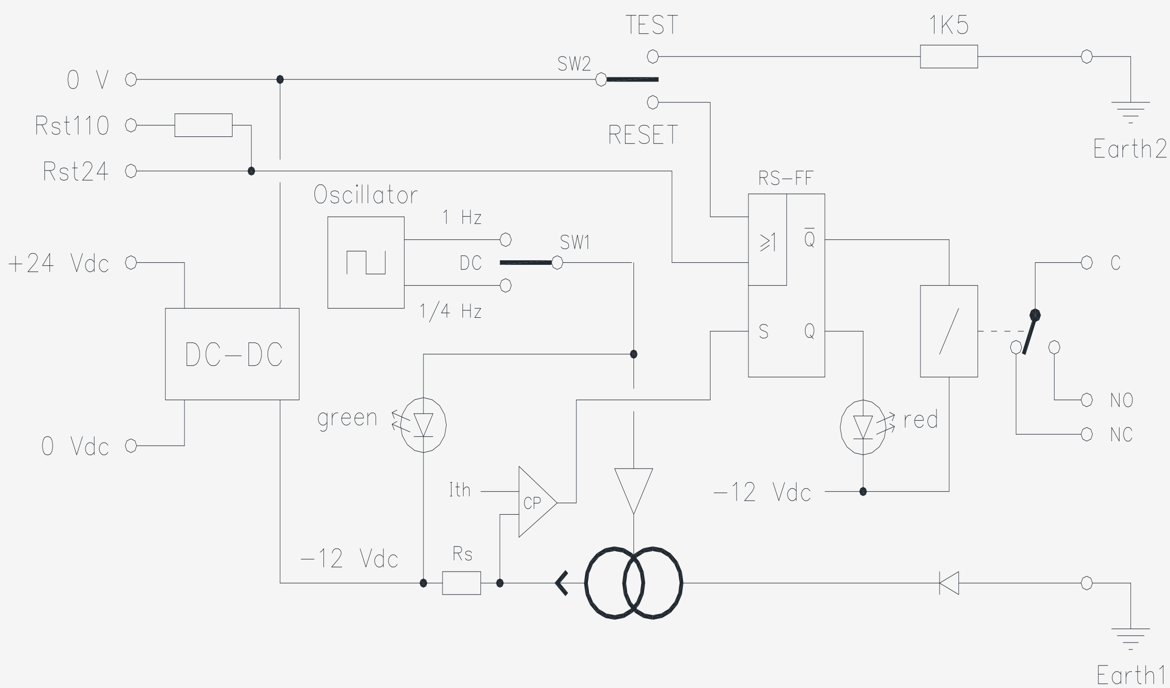


Figure 13-2: Block Diagram of 10310/2/1 ELD

An earth fault sets the flip-flop (FF), and de-energizes the relay. The flip-flop remains set until a reset is given. This can be done in three ways:

- Manually (by setting switch 2 to 'RESET' position), or
- By a high level at the Rst24 input, or
- By a high level at the Rst110 input.

The ELD module can be tested by connecting a 1.5 kOhm resistor between 0 V and earth. This should set the flip-flop. A 1.5 kOhm resistor in the ELD with its own connection to earth (on the Earth2 pin) allows testing of the ELD and the earth connection (switch 2 in 'TEST' position). A disconnected Earth1-to-Earth2 link will block the flip-flop set action (because no earth current is flowing).

13.1.2 Earth fault for digital inputs

An earth fault to an input wire with an open field contact (10101/2/.) can only be detected if the 10101/A/1 digital input reverse diode module is used. For details refer to this module's data sheet.

13.1.3 Connection examples

The figures below show two connection examples of the 10310/2/1 ELD module.

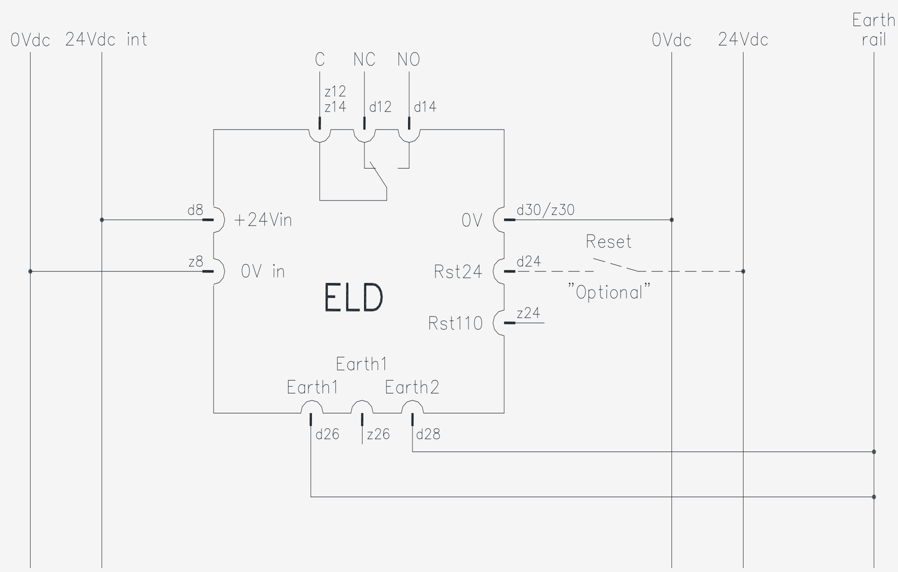


Figure 13-3: 24 V DC with 48 V DC or 60 V DC monitoring

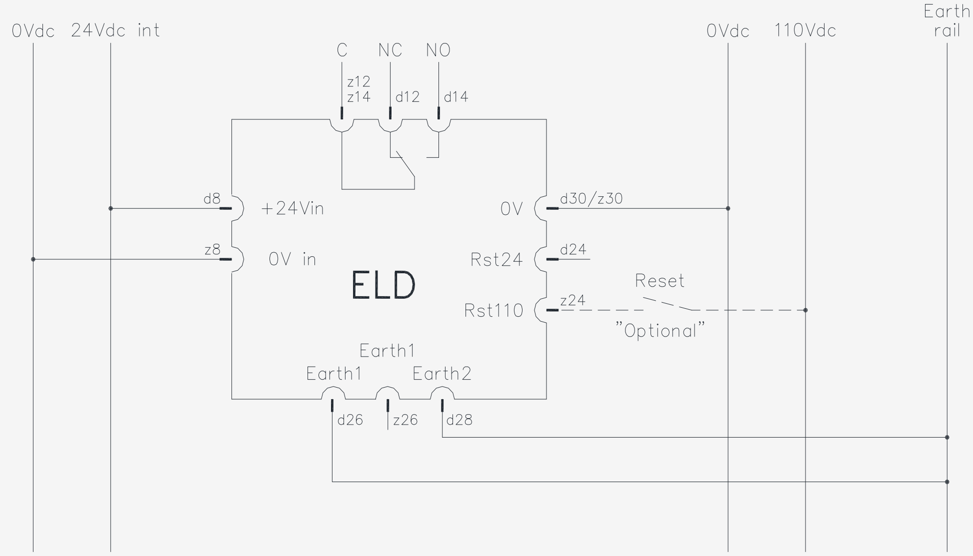


Figure 13-4: ELD with single earth wire

13.1.4 Pin Allocation

The back view and pin allocation of the 10310/2/1 module connector are as follows:

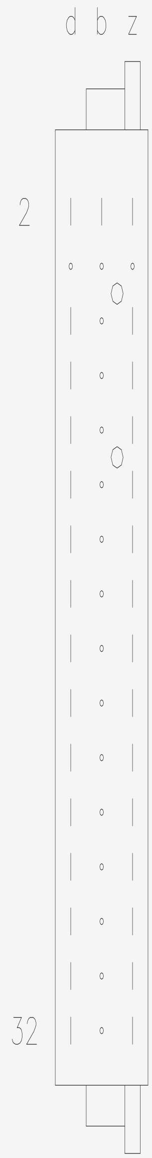


Figure 13-5: Back view and pin allocation of the 10310/2/1 module connector

13.1.5 Technical data

The 10310/2/1 module has the following specifications:

13.1 10310/2/1

General	Type number: Approvals:	10310/2/1 10800 CE, UL
Power	Supply voltage:	24 V DC (max. 30 V DC)
	Supply current:	max. 60 mA
	Rst24 input voltage:	18...70 V DC
	Rst110 input voltage:	40...130 V DC
	Rst24 input current:	1.1 mA at 24 V DC
	Rst110 input current:	2.5 mA at 110 V DC
Earth	Earth voltage:	-12 V DC (no earth fault)
	Earth fault threshold:	-30...+125 V DC (earth fault)
	Max. earth current:	5.5 mA (± 1 mA) 25.0 mA (± 5 mA)
Output contact	Max. output voltage: Max. output current:	115 V DC 2 A
Relay contacts	Initial contact resistance:	
	Max. current: Max. switched voltage: Max. switched load:	30 mOhm 5A 250 V DC / 250 V AC 100 W / 1000 VA
	Expected life:	
	• Electrical • Mechanical	100,000 switch operations 200,000,000 switch operations

Key coding	(See ‘Key coding’ data sheet)	
	Module code:	
	• Holes	A5, A11
	Rack code:	
	• Large pins	A5, A11

13.2 Watchdog Repeater (WDR)

13.2.1 10302/1/1

13.2.1.1 Description

The watchdog repeater 10302/1/1 is a module that monitors the 5 Vdc and 24 Vdc supplied to the I/O modules. The watchdog output of the watchdog repeater is connected to the watchdog input of those output modules whose power supply (5 Vdc and/or 24 Vdc) is monitored.

A watchdog repeater is required in the following cases:

- In multiple-PSU configurations, for each subsequent 24 Vdc to 5 Vdc power supply unit, e.g. PSU 2, 3, 4.
- If the 24 Vdc is supplied via an M24-20 HE or M24-12 HE power supply.
- If the 24 Vdc is supplied via a power supply which can provide supply voltages that exceed 31.0 Vdc. (The maximum output voltage of the 24 Vdc supply must be less than 37 Vdc under any single or double fault condition of the 24 Vdc power supply unit.)
- If the required watchdog current exceeds 900 mA.
- In configurations which combine redundant and non-redundant I/O, in order to create the watchdog output for the output modules of the non-redundant I/O part.
- In configurations with redundant Central Parts and non-redundant I/O, in order to monitor the 5 Vdc power supply (if no 5 Vdc monitoring is done).

The watchdog repeater requires a horizontal bus connection. This means that space must be reserved in the I/O racks (positions 1 to 18). A watchdog repeater must always be placed in the I/O section whose output modules are monitored by that watchdog repeater. This means that watchdog repeaters in configurations with multiple (redundant) I/O sections may not be installed in such a way that they control the "other" I/O section.

The watchdog repeater may be exchanged with the power supply switched on, but the Central Part will shut down, or both Central Parts will shut down if used in a configuration with redundant Central Parts and non-redundant I/O.

The watchdog repeater is fitted with a male connector according to DIN 41612, type F, with the 'd' and 'z' rows used.

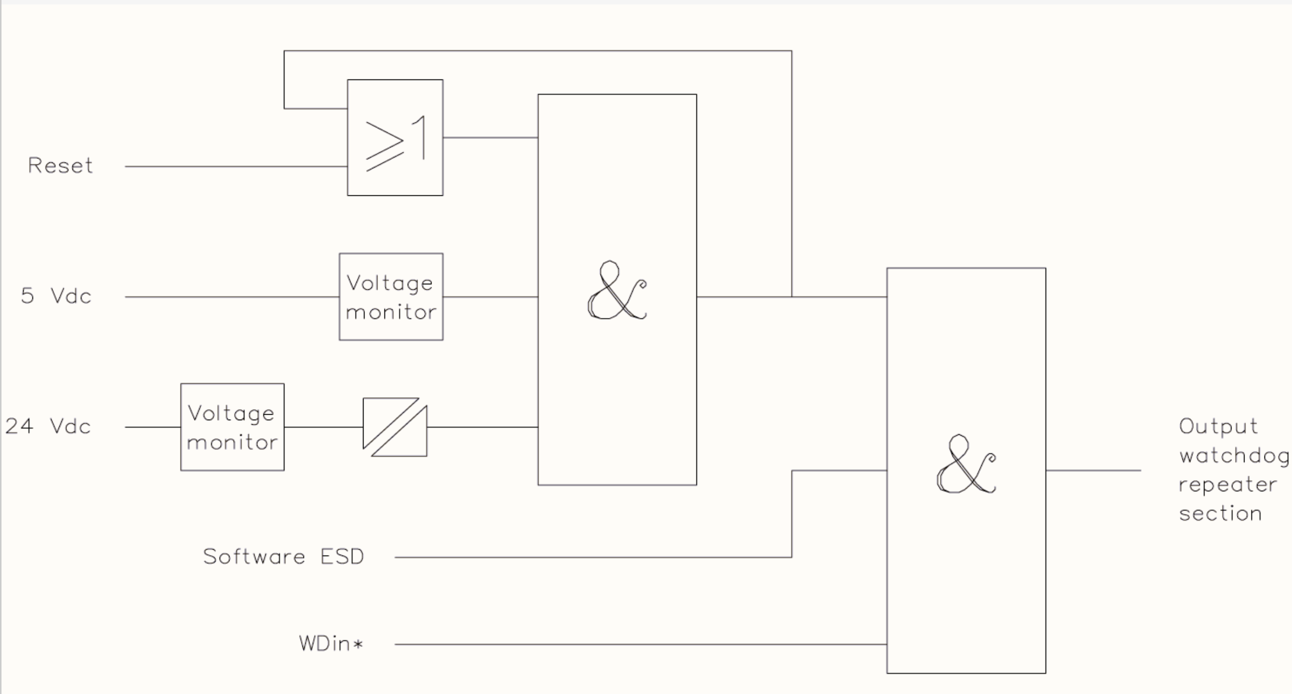


Figure 13-6: Logic Diagram of 10302/1/1 WDR

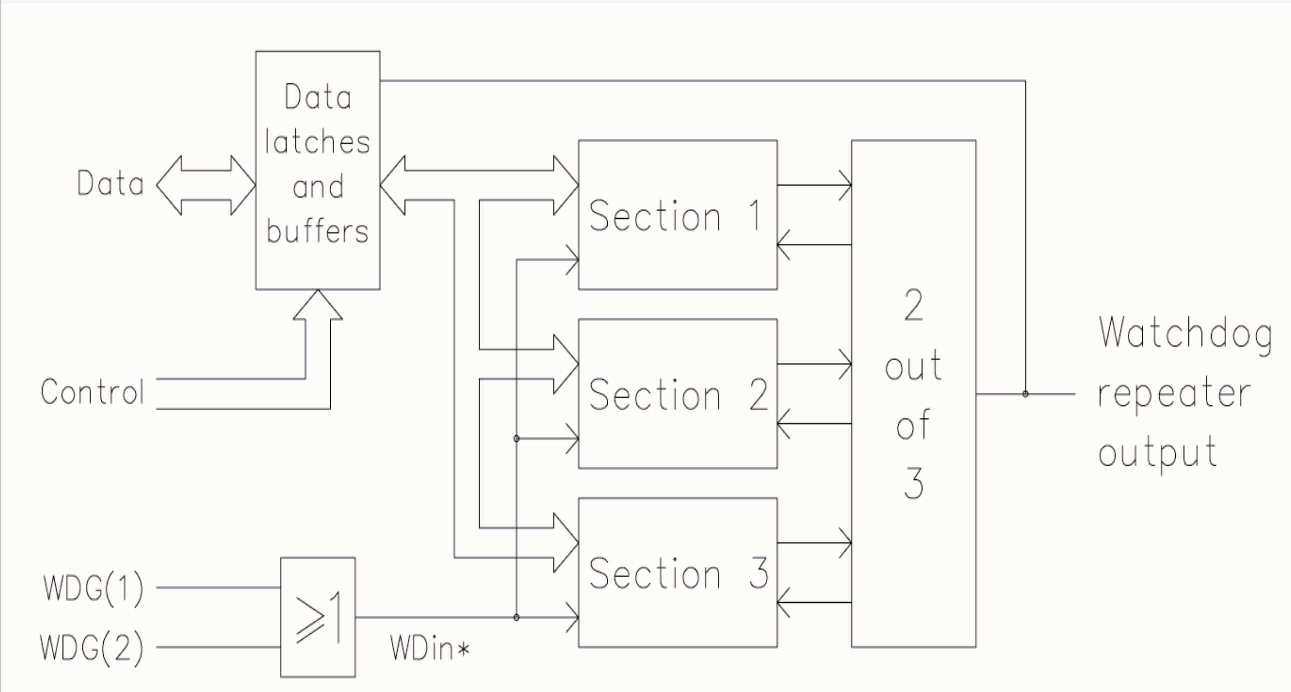
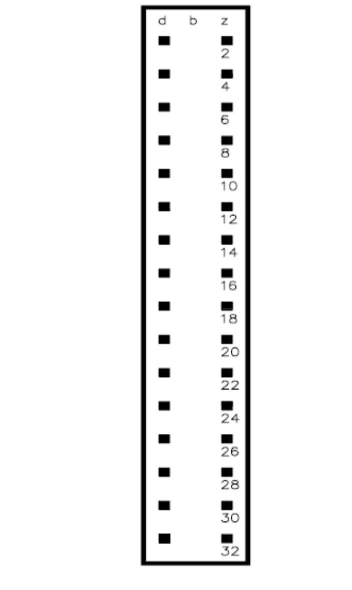


Figure 13-7: Block Diagram of 10302/1/1 WDR

13.2.1.2 Pin Allocation

The back view and pin allocation of the 10302/1/1 rack connector are as follows:



d2	WDG1 (5 Vdc)	z2	GND 5 Vdc
d4	WDG2 (5 Vdc)	z4	Supply 5 Vdc
d6		z6	
d8	GND 5 Vdc	z8	GND 5 Vdc
d10	WDR OUT	z10	WDR OUT
d12	GND 5 Vdc	z12	GND 5 Vdc
d14		z14	
d16		z16	
d18		z18	
d20		z20	
d22		z22	
d24	Link	z24	Link
d26		z26	
d28		z28	
d30	Supply 24 Vdc	z30	
d32	Supply 0 Vdc	z32	

Figure 13-8: Pin Allocation of the 10310/1/1 module connector

13.2.1.3 Technical Data

The 10302/1/1 module has the following specifications:

General	Type Number:	10302/1/1
	Approvals:	CE, TUV, UL
	Software Versions:	All
	Space Requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc 35 mA (without WDROUT output current)
		24 Vdc 25 mA
	WDG1 + WDG2 input current:	0.1 mA
WDR OUT	Max. output current:	900 mA
Key Coding	(See 'Key coding' data sheet)	
	Module code:	
	• Holes	A27
	• Pin	C11, C23, C27
	Rack code:	
	• Blind Spots	C3, C19, C31
	• Large pins	A27

13.2.2 10302/2/1

13.2.2.1 Description

The watchdog repeater 10302/2/1 is a module that monitors the 5 Vdc and 24 Vdc power supplies. The watchdog output of the watchdog repeater is connected to the watchdog input of those output modules whose power supply (5 Vdc and/or 24 Vdc) is monitored.

A watchdog repeater is required in the following cases:

- In multiple-PSU (10300/1/1) configurations, for each subsequent 24 Vdc to 5 Vdc power supply unit, e.g. PSU 2, 3, 4.
- If the 24 Vdc is supplied via an M24-20 HE or M24-12 HE power supply.
- If the 24 Vdc is supplied via an (external) power supply which can provide supply voltages that exceed 31.0 Vdc. (The maximum output voltage of the 24 Vdc supply must be less than 37 Vdc under any single or double fault condition of the 24 Vdc power supply unit.)
- If the required watchdog current exceeds 900 mA.
- In configurations that combine redundant and non-redundant I/O, in order to create the watchdog output for the output modules of the non-redundant I/O part.
- In configurations with redundant Central Parts and non-redundant I/O with safety related output modules.

The watchdog repeater requires a horizontal bus connection. This means that space must be reserved in the I/O racks. The WDR module can be placed in positions 1, 2, and 11 through 18 only. Jumpers at the back of the I/O back plane need to be modified as well, see the I/O back plane datasheets (i.e. 10314/1/1 and 10315/1/1) for more information.

A watchdog repeater shall always be placed in the same I/O section (redundant I/O vs. single I/O) as the output modules that are monitored by that watchdog repeater. This means that watchdog repeaters that monitor redundant I/O modules, may not be installed in single I/O racks.

If an I/O section is installed in multiple cabinets, the watchdog repeater module(s), shall be installed in the first cabinet where the I/O section in installed.

The watchdog repeater may be exchanged with the power supply switched on, but the Central Part will shut down, or both Central Parts may shut down if used in a configuration with redundant Central Parts and non-redundant I/O and the WDR is set as safety related.

The watchdog repeater is fitted with a male connector according to DIN 41612, type F, with the 'd', 'b' and 'z' rows used.

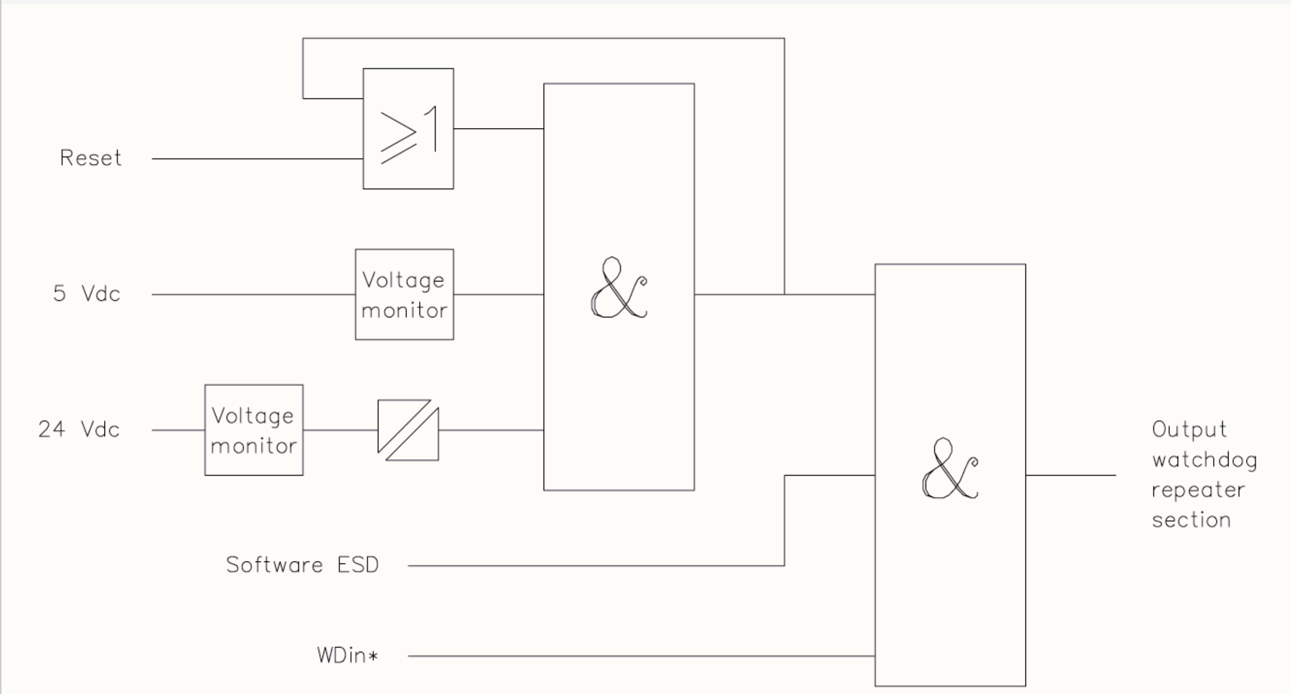


Figure 13-9: Logic Diagram of 10302/2/1 WDR

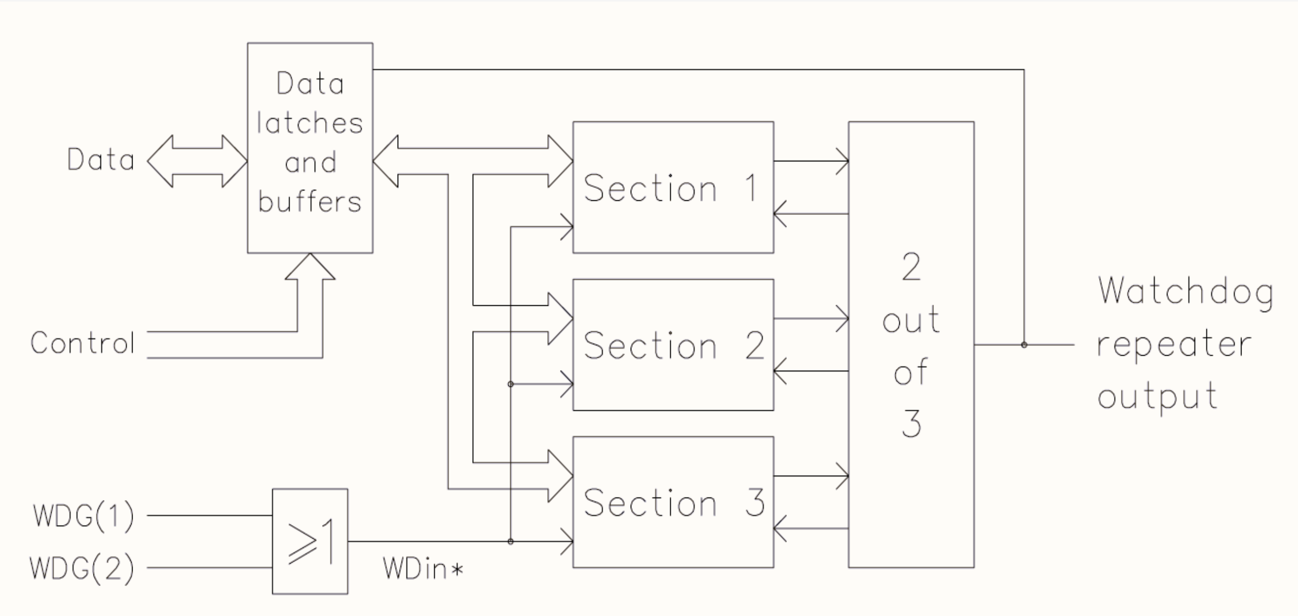
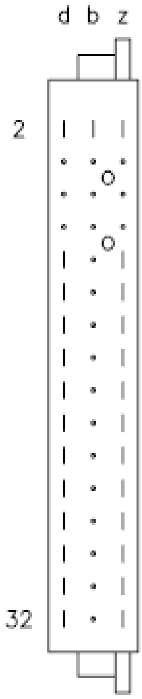


Figure 13-10: Logic Diagram of 10302/2/1 WDR

13.2.2.2 Pin Allocation

The back view and pin allocation of the 10302/2/1 module connector are as follows:



d2		b2	GND 5 Vdc	z2	Supply 5 Vdc
d4	–			z4	–
d6	–			z6	–
d8	–			z8	–
d10	(GND 5 Vdc)			z10	(GND 5 Vdc)
d12	WDG1 IN			z12	WDG2 IN
d14	GND 5 Vdc			z14	(GND 5 Vdc)
d16	WDR OUT			z16	(GND 5 Vdc)
d18	(GND 5 Vdc)			z18	(GND 5 Vdc)
d20				z20	
d22				z22	
d24				z24	
d26				z26	
d28				z28	
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 24 Vdc			z32	Supply 24 Vdc

Figure 13-11: Pin Allocation of the 10310/2/1 module connector

13.2.2.3 Technical Data

The 10302/2/1 module has the following specifications:

General	Type Number:	10302/2/1 12600
	Approvals:	CE, TUV, UL
	Software Versions:	≥ 3.00
	Space Requirements:	TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	Vdc 35 mA (without WDROUT output current)
		24 Vdc 25 mA
	WDG1 + WDG2 input current:	0.1 mA
WDR OUT	Max. output current:	900 mA
Key Coding	(See 'Key coding' data sheet)	
	Module code:	
	• Holes	A5, A9
	Rack code:	
	• Large pins	A5, A9

13.3 10310/3/1

13.3.1 Earth Leakage Detector (ELD)

The 10310/3/1 module is an Earth Leakage Detector (ELD) for 24 V DC systems. It has a manually operated self-test feature and an earth connection monitor (switch 2 in TEST position).

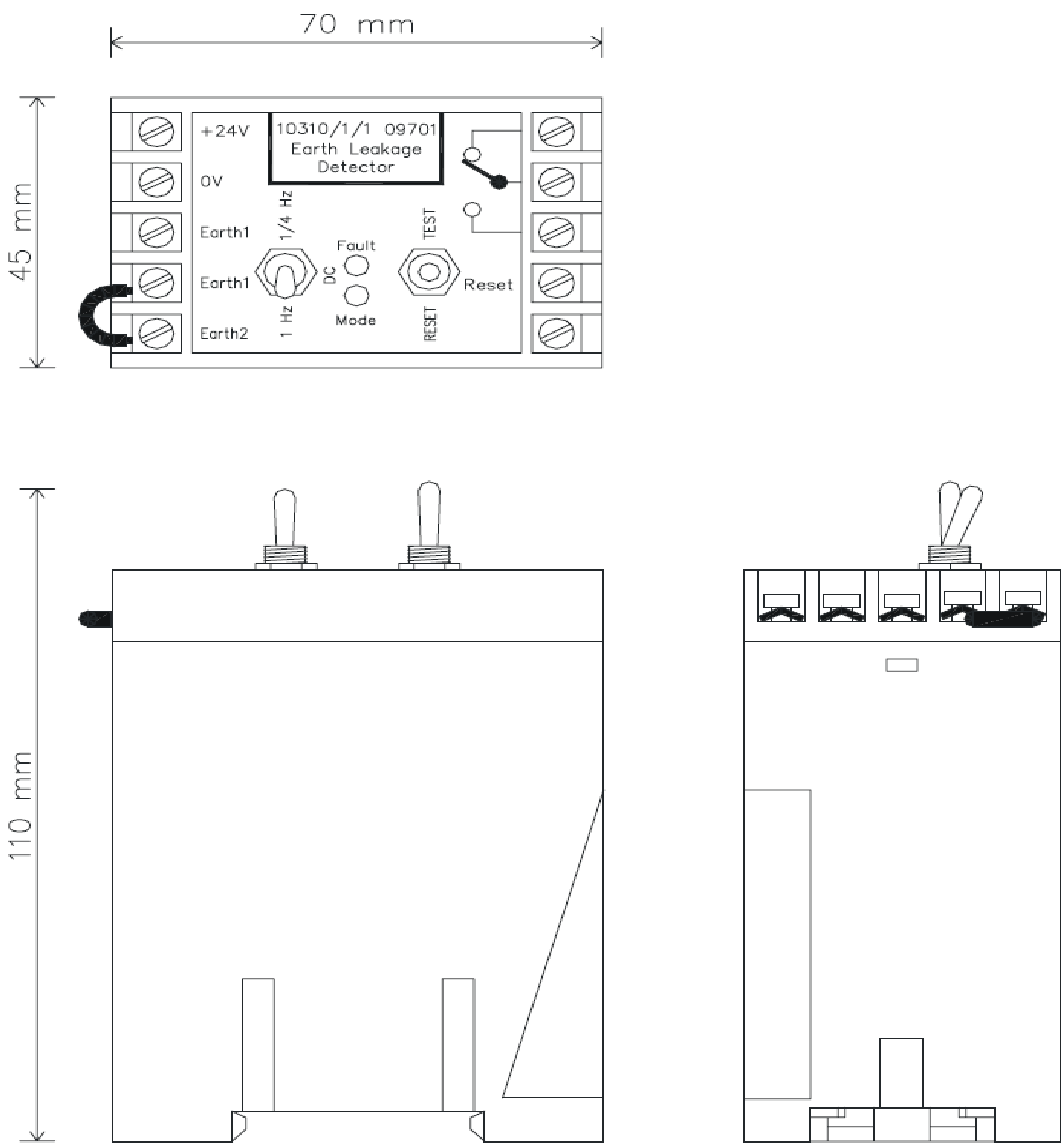


Figure 13-12: ELD module

The ELD module connects earth level with -12 V DC (referenced to the 0 V connection of the 24 V DC supply).

This connection is either:

- Continuous (switch 1 in DC position)
- Interrupting at 1 Hz (switch 1 in 1 Hz position)
- Interrupting at 0.25 Hz (switch 1 in 1/4 Hz position)

With switch 1 in the 1 Hz or 1/4 Hz position, the green “MODE” LED on the module front flashes at the selected connection frequency.

The ELD is normally used with switch 1 in the DC position.

The 1 Hz position should only be used to accommodate solenoids or relays that could stay energized by the negative earth voltage.

The 1/4 Hz position can be used for locating earth faults. To locate earth faults, you need to use a current clamp (such as the DCM300E digital clamp from AVO International).

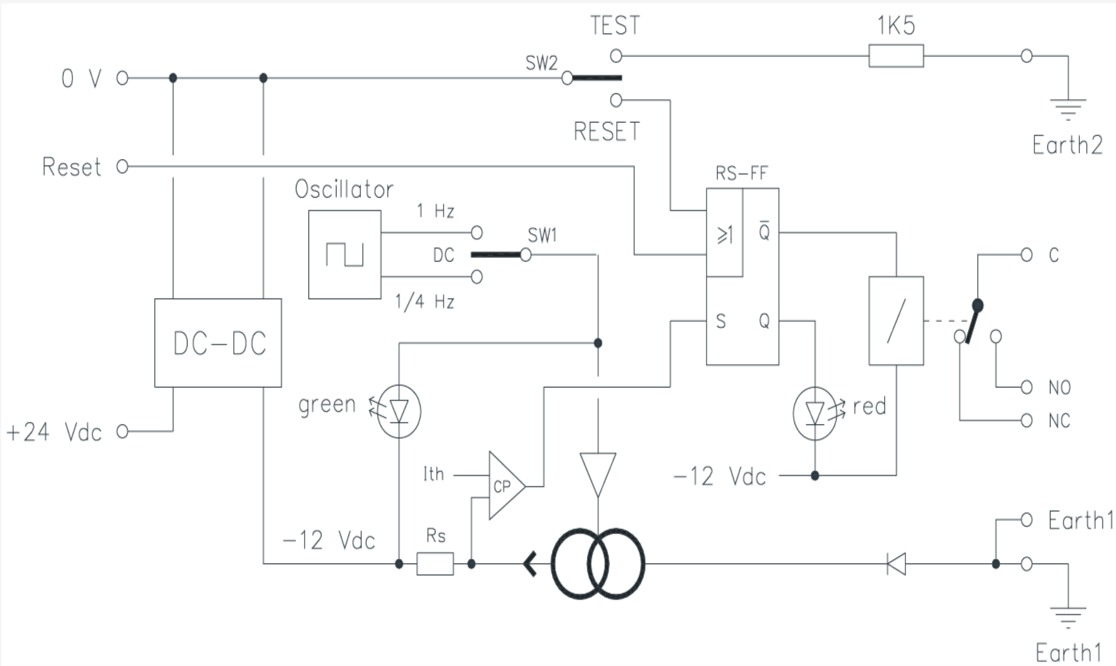


Figure 13-13: Block diagram of 10310/3/1 ELD

An earth fault sets the flip-flop (FF), and de-energizes the relay (see the above figure). The flip-flop remains set until a reset is given.

A reset can be given in two ways:

- Manually (by setting switch 2 to RESET position)
- By a high level occurring at the reset input

The ELD module can be tested by connecting a 1.5 kΩ resistor between 0 V and earth. This should set the flip-flop. A 1.5 kΩ resistor in the ELD with its own connection to earth (on the Earth2 pin) allows testing of the ELD and the earth connection (switch 2 in TEST position). A disconnected Earth1-to-Earth2 link will block the flip-flop set action (because no earth current is flowing).

By placing a link between Earth 1 and Earth 2, only one earth wire is required. However, a fault in this wire will not be detected during test (see Figure 2).

13.3.2 Earth fault for digital inputs

In order to enable detection of an earth fault to an input wire with an open field contact (SDI-1624), you need to ensure the BSDI-16UNI converter module is used. For details, refer to the corresponding data sheet (see section BSDI-16UNI).

13.3.3 Connection examples

The figures below show two connection examples of the 10310/3/1 ELD module. Figure 1 shows the preferred wiring because the Earth1 wire is included in the self-test (when switch SW2 is in the TEST position).

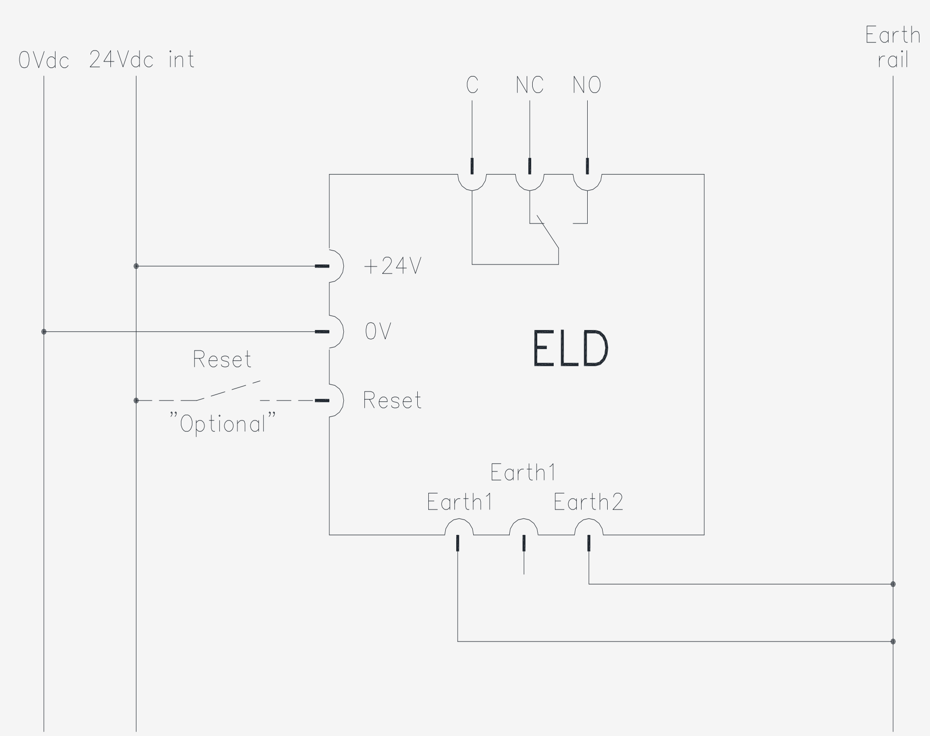


Figure 13-14: 24 V DC earth fault monitor wiring

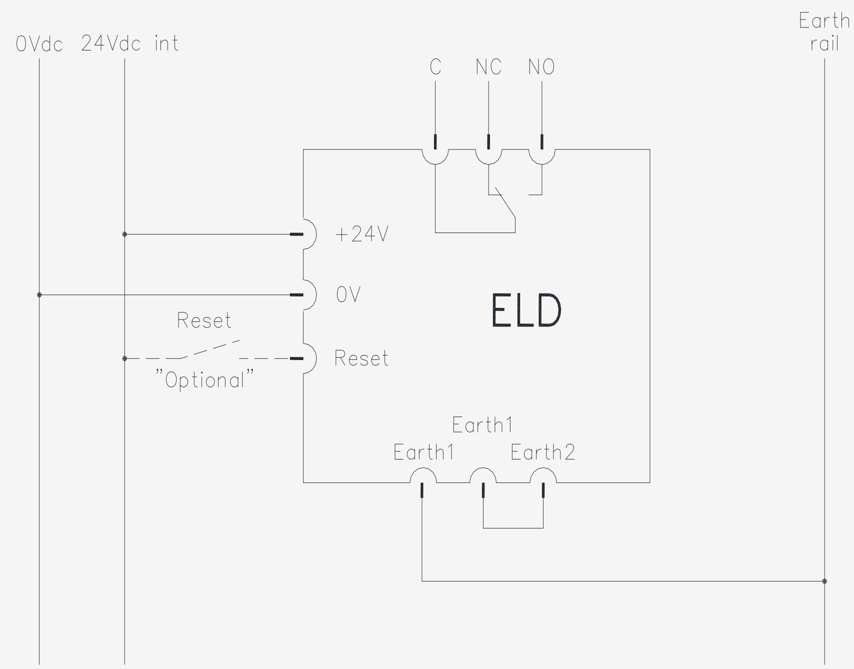


Figure 13-15: ELD with single earth wire

13.3.4 Technical data

The 10310/3/1 module has the following specifications:

General	Type number:	10310/3/1
	Operating temperature:	-5°C-+50°C (23°F-+122°F)
	Storage temperature:	-25°C-+80°C
		(-13°F-+176°F)
	Approvals:	CE, TUV, UL, CSA, FM
		pending
Power	Supply voltage:	24 V DC
	Supply current:	max. 45 mA
	Reset input voltage:	18 - 70 V DC
	Reset input current:	1.1 mA at 24 V DC
Earth	Earth voltage:	-12 V DC (no earth fault)
		-30 - +70 V DC (earth fault)
	Earth fault threshold:	5.5 mA (± 1 mA)
	Max. earth current:	25 - 32 mA
	Tightening torque of earth connections:	1 Nm (0.74 ft.-lb.)
Physical	Dimensions (L × W × H):	70 × 45 × 110 mm
		2.76 × 1.77 × 4.33 in
	DIN EN rails:	TS35 × 7.5
	Used rail length:	max. 46 mm (1.81 in)

Output contact	Max. output voltage:	36 V DC / 30 V AC
	Max. output current:	2 A
	Isolation	1500 V DC / 1000 V AC
	Initial contact resistance:	30 mW
	Expected life:	
	electrical	100,000 switch operations
	mechanical	200,000,000 switch operations

13.4 10313/1/1

13.4.1 5 V DC and watchdog distribution module

The 10313/1/1 module is used for the distribution of 5 V DC and watchdog (WD) signals in the FSC system.

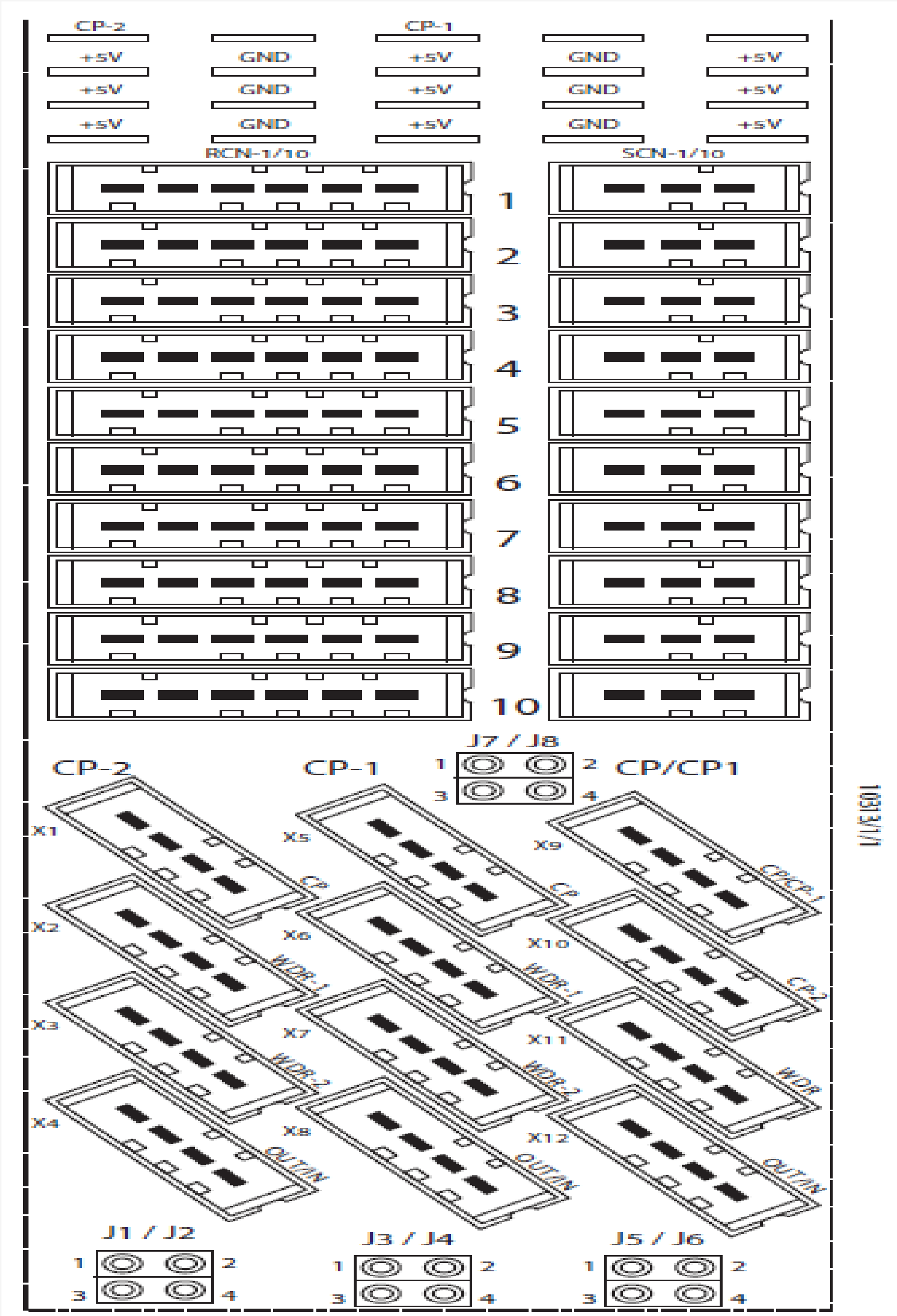


Figure 13-16: Top View

The module has a universal snap-in facility for standard DIN EN rails.

13.4.2 Connections

The connection diagram of the 10313/1/1 module is as follows:

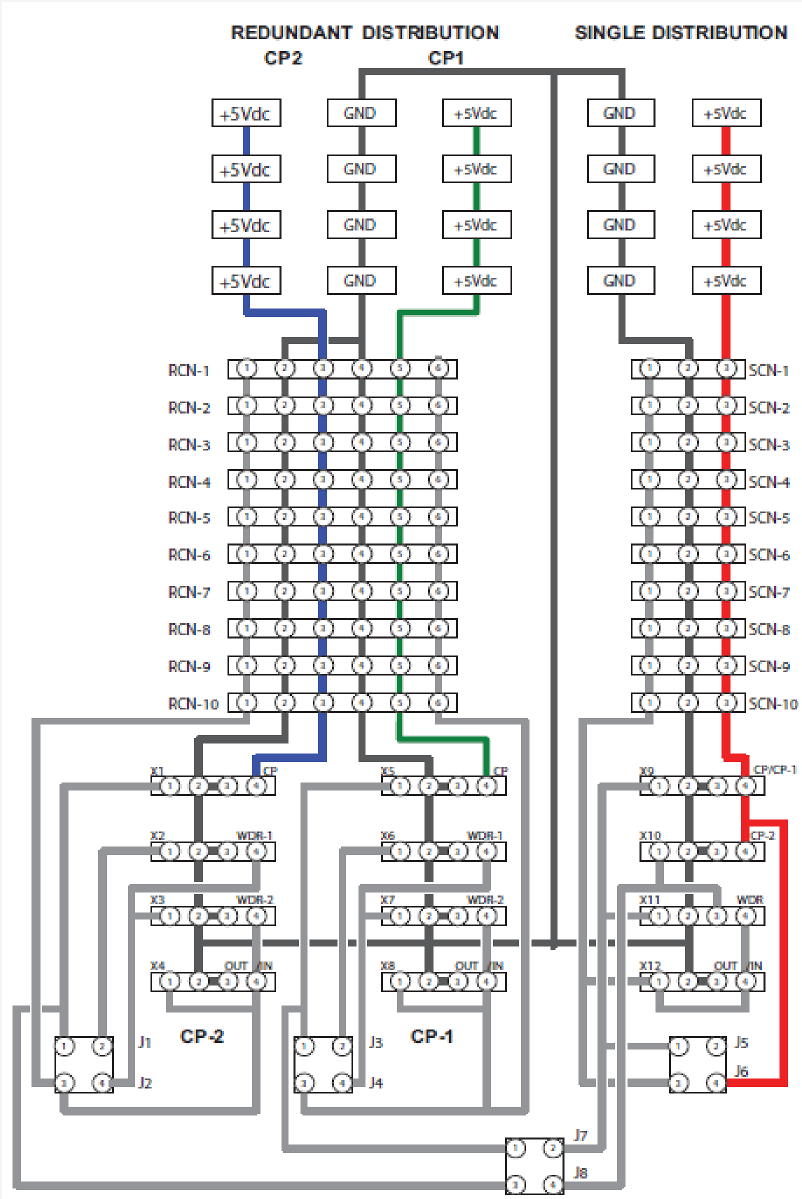


Figure 13-17: Connection diagram

The 10313/1/1 module has the following connection facilities:

- Ten connectors (RCN-1 to RCN-10) for connecting redundant I/O backplanes (10315/1/1),
- Ten connectors (SCN-1 to SCN-10) for connecting non-redundant I/O backplanes (10314/1/1),
- 'FSC101 or FSC102' fastons for the incoming 5 V DC power (for non-redundant I/O backplanes),
- 'FSC101R CP-1' and 'FSC101R CP-2' fastons for the incoming 5 V DC power (for redundant I/O backplanes),
- Connectors for directly connecting the watchdog repeaters (WDRs),
- Connectors for directly connecting the 10005/O/2 WD horizontal buses, and
- Connectors for linking an additional 10313/1/1 module in a separate cabinet (next 'section').

13.4.3 Pin connections

13.4.3.1 RCN-x

The below figure shows the pin connections of the RCN-x connectors, which are used to connect redundant I/O backplanes.

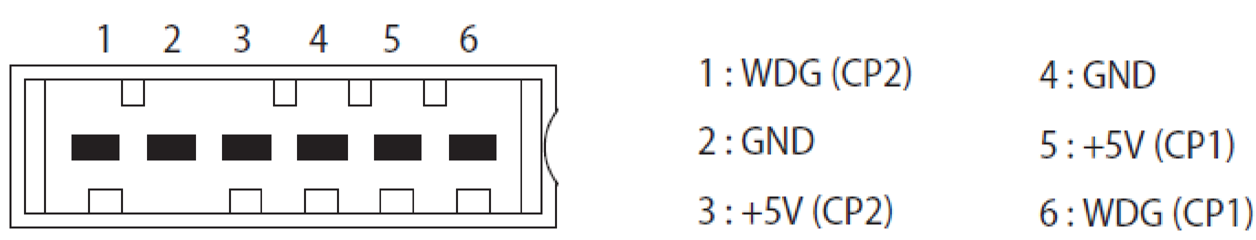


Figure 13-18: Pin connections of RCN-x

13.4.3.2 SCN-x

The below figure shows the pin connections of the SCN-x connectors, which are used to connect non-redundant I/O backplanes.

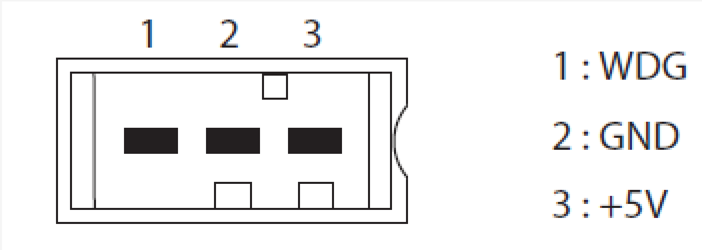


Figure 13-19: Pin connections of SCN-x

13.4.3.3 10005/O/2 WD horizontal bus

The below table shows the connectors that are used to connect 10005/O/2 WD horizontal bus, depending on the system configuration.

Table 1. Connectors used to connect 10005/O/2 WD horizontal bus

System Configuration		Connectors used on 10313/1/1 module
Central Part(s)	I/O	
Non-redundant	Non-redundant	'CP/CP-1' connector (X9)
Redundant	Non-redundant	'CP/CP-1' and 'CP-2' connectors (X9 and X10)
Redundant	Redundant	'CP' connectors of CP-1 and CP-2 (X1 and X5)
Redundant	Redundant & Non-redundant	'CP' connectors of CP-1 and CP-2 (X1 and X5)

The below figure shows the pin connections of these connectors.

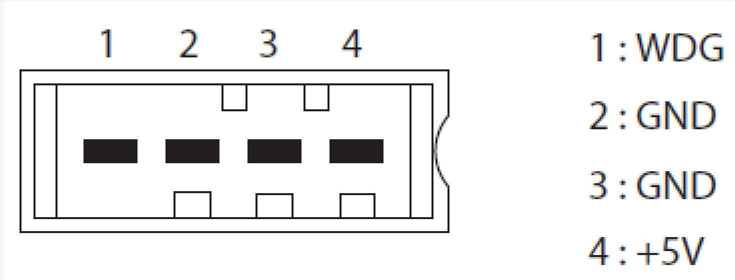


Figure 13-20: Pin connections of 'CP' and 'CP/CP-1' connector

13.4.3.4 Watchdog repeaters

The below table shows the connectors that are used to connect watchdog repeaters, depending on the system configuration.

Table 2. Connectors used to connect watchdog repeaters

System Configuration		Connectors used on 10313/1/1 module
I/O	Watchdog	
Redundant	1st watchdog repeater	'WDR-1' connectors (X2 and X6)
	2nd watchdog repeater	'WDR-2' connectors (X3 and X7)
Non-redundant	one watchdog repeater	'WDR' connector (X11)

The below figure shows the pin connections of these connectors.

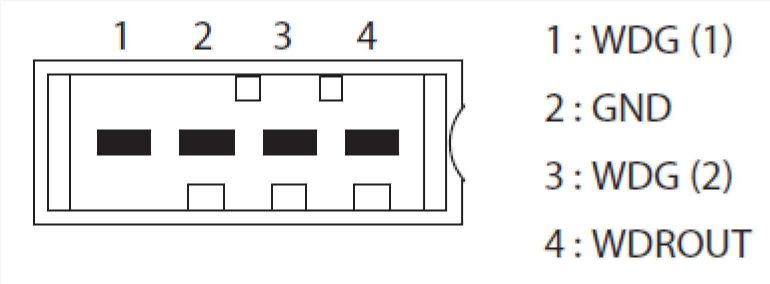


Figure 13-21: Pin connections of 'WDR', 'WDR-1' and 'WDR-2' connectors

13.4.3.5 Additional 10313/1/1 modules

The 'OUT/IN' connectors (X4, X8 and X12) are used to link an additional 10313/1/1 module in a separate cabinet (next 'section').

The below figure shows the pin connections of these connectors.

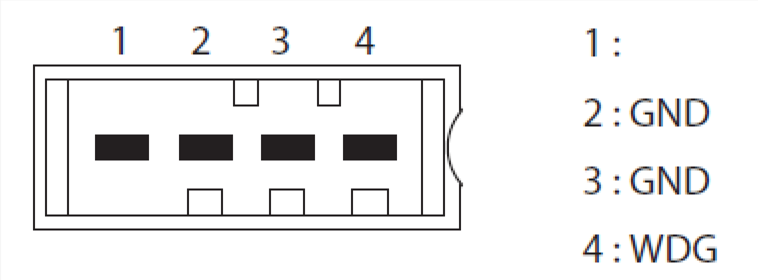


Figure 13-22: Pin connections of 'OUT/IN' connectors

13.4.3.6 Connectors used for various configurations

The below table provides an overview of the connectors that may be used for the various FSC configurations:

Table 3. Use of connectors on 10313/1/1 module

System Configuration		Connectors used on 10313/1/1 module		
Central Part(s)	I/O	‘RCN’	‘SCN’	‘X’
Non-redundant	Non-redundant	-	10-Jan	X9, X11, X12
Redundant	Non-redundant	-	10-Jan	X9-X12
Redundant	Redundant	10-Jan	-	X1-X8
Redundant	Redundant & Non-redundant	10-Jan	10-Jan	X1-X8, X12

13.4.4 Application

The below figure shows an example of how to use the 10313/1/1 module for the 5 V DC and watchdog distribution by using the system power interconnection cables:

- WD-01 cable, which connects the 10313/1/1 module to the non-redundant backplane 10314/1/1.
- WD-02 cable, which connects the 10313/1/1 module to the redundant backplane 10315/1/1.
- WDG-C cable, which connects the 10313/1/1 module to the 10005/O/2 watchdog horizontal bus.
- WD-WD cable, which connects the 10313/1/1 module to the 10313/1/1 module in the next section.
- WDR cable, which connects the 10313/1/1 module to the watchdog repeater 10302/2/1.

The concept diagram below shows the connections of a redundant configuration.

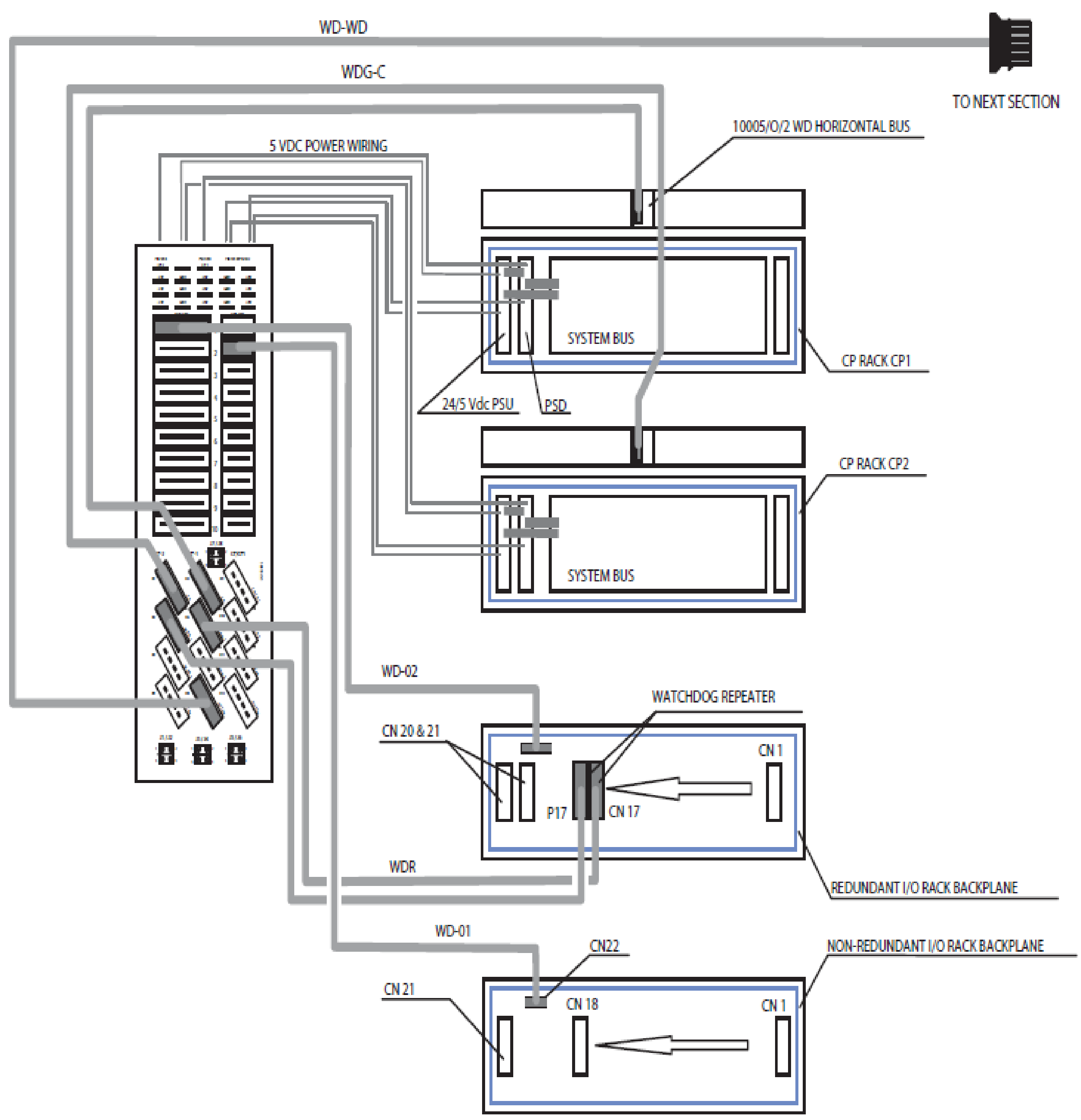


Figure 13-23: Concept diagram of 5 V DC & watchdog distribution

13.4.5 Distribution examples

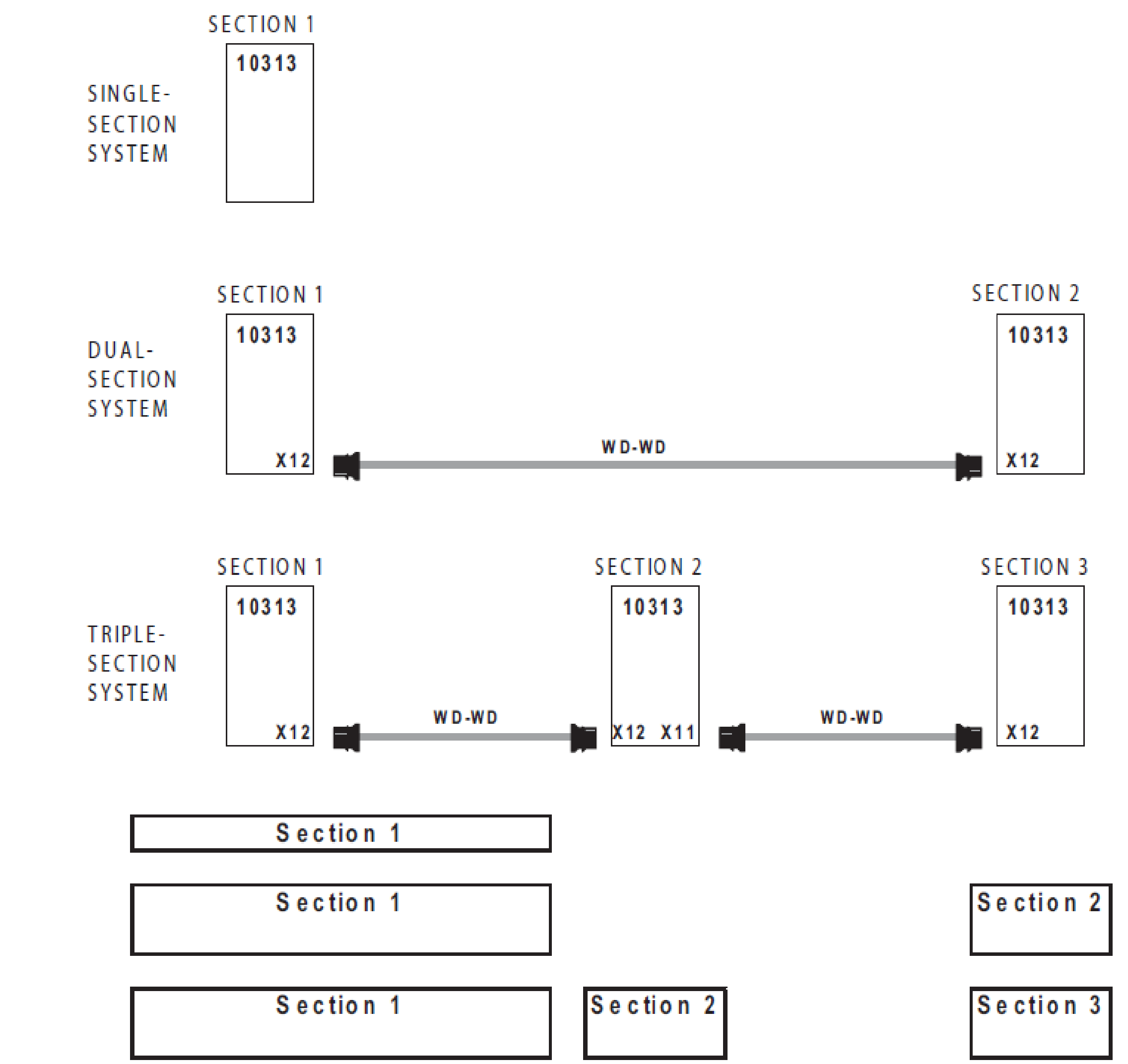
The following pages contain a number of distribution examples for the various FSC configurations. Each example has been subdivided into configurations that consist of one, two or three cabinets ('sections'). Each of the examples assumes that the Central Part racks are located in section 1.

Examples of the following configurations are given:

- Non-redundant Central Part and non-redundant I/O,
- Redundant Central Parts and non-redundant I/O,
- Redundant Central Parts and redundant I/O,
- Redundant Central Parts and redundant/non-redundant I/O,
- Redundant Central Parts, with redundant I/O in section 1 and non-redundant I/O in sections 2/3, and
- Redundant Central Parts, with redundant I/O in sections 1/2 and non-redundant I/O in section 3.

13.4.5.1 Example 1

Non-redundant Central Part and non-redundant I/O The Central Part racks are located in section 1. Depending on the number of watchdog repeaters (WDRs) and the number of sections per FSC system, the following jumper settings must be made:



Jumper:	1x WDR	No WDR	with only +5V	No WDR	No WDR
J1/J2	notplaced	notplaced	notplaced	notplaced	notplaced
J3/J4	notplaced	notplaced	notplaced	notplaced	notplaced
J5/J6	notplaced	1-3	3-4	1-3	notplaced
J7/J8	notplaced	notplaced	notplaced	notplaced	notplaced

Figure 13-24: Distribution example

13.4.5.2 Function of jumper settings:

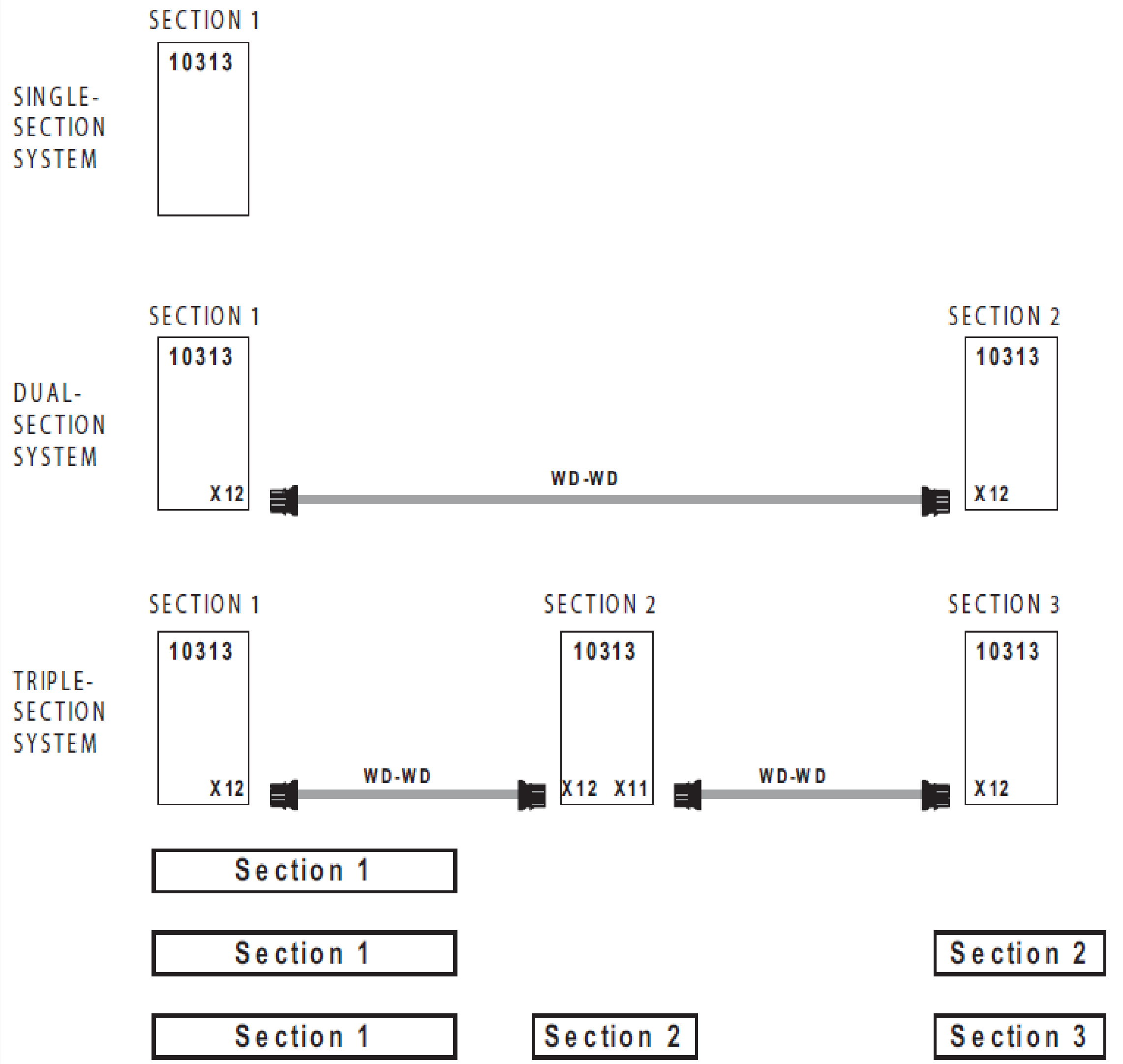
J5/J6 in section 1, setting 1-3: to connect the WDG line to the I/O racks via the SCN connectors.

J5/J6 in section 1, setting 3-4: to connect the 5 V DC to the WDG lines of the I/O racks via the SCN connectors.

J5/J6 in section 2, setting 1-3: to link the WDG line to section 3.

13.4.5.3 Example 2

Redundant Central Parts and non-redundant I/O The Central Part racks are located in section 1. Depending on the number of watchdog repeaters (WDRs) and the number of sections per FSC system, the following jumper settings must be made:



Jumper:	1x WDR	No WDR	No WDR	No WDR
J1/J2	not placed	not placed	not placed	not placed
J3/J4	not placed	not placed	not placed	not placed
J5/J6	not placed	3-4	1-3	not placed
J7/J8	not placed	not placed	not placed	not placed

Figure 13-25: Distribution example

13.4.5.4 Function of jumper settings:

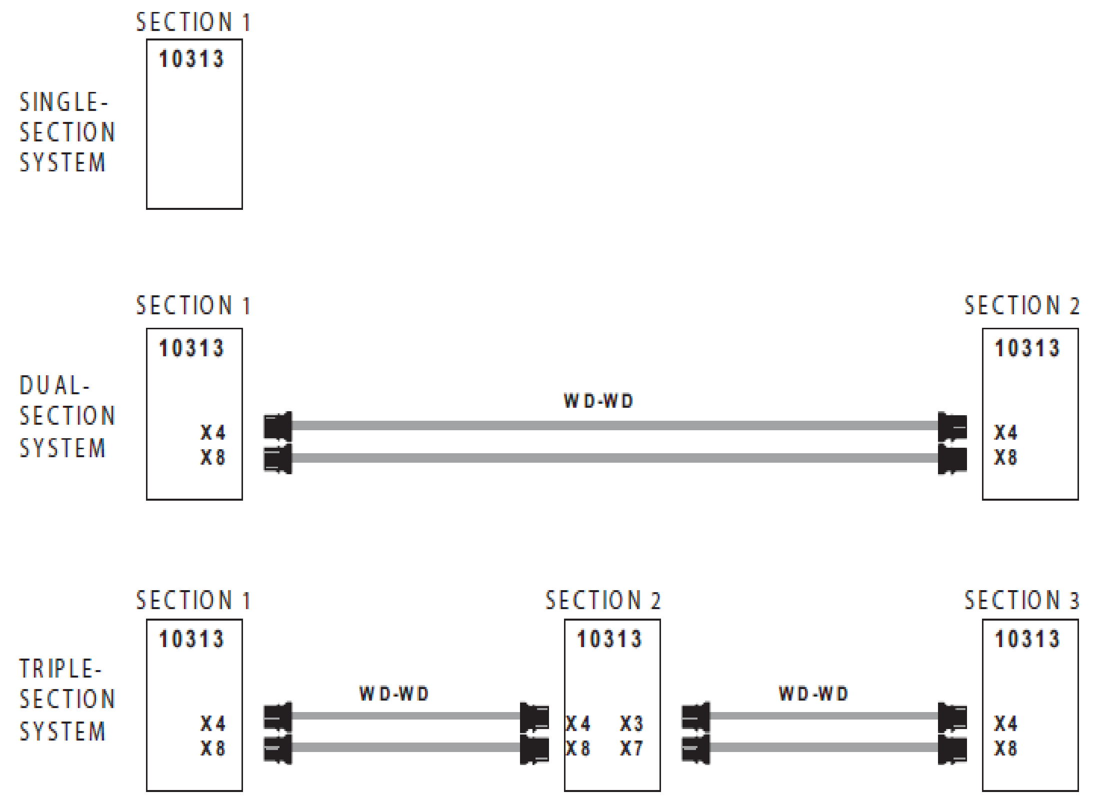
J5/J6 in section 1, setting 3-4: to connect the 5 V DC to the WDG lines of the I/O racks via the SCN connectors.

J5/J6 in section 2, setting 1-3: to link the WDG line to section 3.

10313/

13.4.5.5 Example 3

Redundant Central Parts and redundant I/O The Central Part racks are located in section 1. Depending on the number of watchdog repeaters (WDRs) and the number of sections per FSC system, the following jumper settings must be made:



Section 1

Section 1 | Section 2

Section 1 | Section 2 | Section 3

Jumper	2x WDR	1x WDR	No WDR	No WDR	No WDR
J1/J2	1-2	1-2 3-4	1-3	3-4	not placed
J3/J4	1-2	1-2 3'-4	1-3	3-4	not placed
J5/J6	not placed	not placed	not placed	not placed	not placed
J7/J8	not placed	not placed	not placed	not placed	not placed

Note: 2 x WDR = 2 x redundant WDR pairs in the redundant I/O part.

Figure 13-26: Distribution example

13.4.5.6 Function of jumper settings:

J1/J2 and J3/J4 in section 1, setting 1-2: to connect the WDs from the central parts to the WDG inputs of the watchdog repeater module.

J1/J2 and J3/J4 in section 1, setting 3-4: to connect the WDG outputs of the watchdog repeater module (if only one watchdog repeater module is used) to the WDG lines of the I/O racks via the RCN connectors.

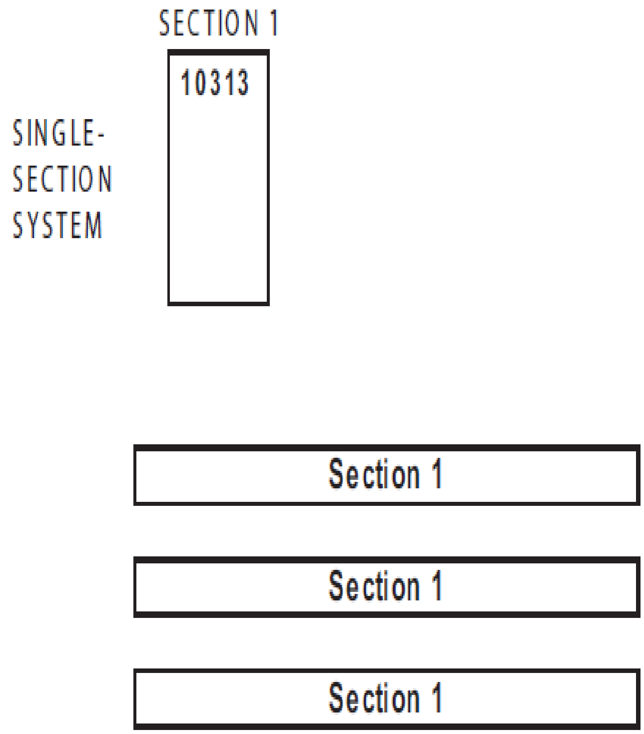
J1/J2 and J3/J4 in section 1, setting 1-3: to connect the WDG lines to the I/O racks via the RCN connectors.

J1/J2 and J3/J4 in section 2, setting 3-4: to link the WDG lines to section 3.

13.4.5.7 Example 4

Redundant Central Parts and hybrid I/O, with redundant/nonredundant I/O in one section.

Depending on the number of watchdog repeaters (WDRs) and the number of sections per FSC system, the following jumper settings must be made:



Jumper:	(2 + 1) x WDR	(1 + 1) x WDR	(0 + 1) x WDR	(0 + 0) x WDR
J1/J2	1-2	1-2 3-4	1-3	1-3
J3/J4	1-2	1-2 3-4	1-3	1-3
J5/J6	not placed	not placed	not placed	3-4
J7/J8	1-2 3-4	1-2 3-4	1-2 3-4	not placed

Note: (2 + 1) x WDR = 2 x redundant WDR pairs in the redundant I/O part and one WDR in non-redundant part.

Figure 13-27: Distribution example

13.4.5.8 Function of jumper settings:

J1/J2 and J3/J4, setting 1-2: to connect the WDs from the central parts to the WDG inputs of the watchdog repeater module.

J1/J2 and J3/J4, setting 3-4: to connect the WDG outputs of the watchdog repeater module (if only one watchdog repeater module is used) to the WDG lines of the I/O racks via the RCN connectors.

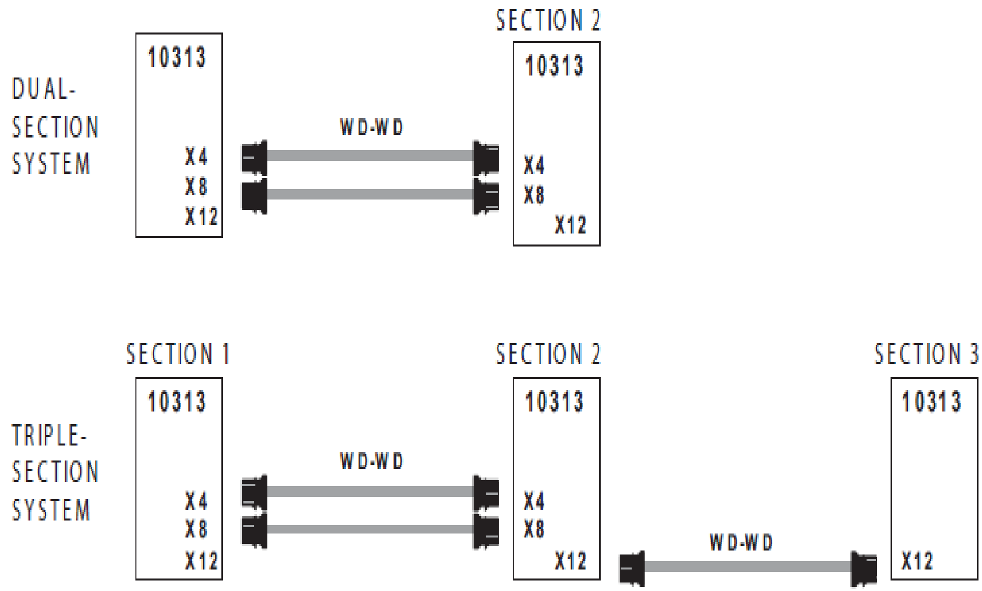
J1/J2 and J3/J4 setting 1-3: to connect the WDG lines to the I/O racks via the RCN connectors. J5/J6, setting 3-4: to link the WDG lines to the 5 V DC.

J7/J8, setting 1-2/3-4 To connect the WDs from the central parts to the WDG input of the watchdog repeater module in the non-redundant I/O part.

13.4.5.9 Example 5

Redundant Central Parts and hybrid I/O, with redundant I/O in section 1, redundant/non-redundant I/O in section 2, and non-redundant I/O in section 3.

The Central Part racks are located in section 1. Depending on the number of watchdog repeaters (WDRs) and the number of sections per FSC system, the following jumper settings must be made:



	Section 1			Section 2		
	Section 1			**Section 2**		**Section 3**
Jumper:	**(2 +0) x WDR**	**(1 + 0) x WDR**	**(0 + 0) x WDR**	**(0 + 1) x WDR**	**(0 + 0) x WDR**	**(0 + 0) x WDR**
J1/J2	1-2	1-2 3-4	1-3	1-3	not placed	not placed
J3/J4	1-2	1-2 3-4	1-3	1-3	not placed	not placed
J5/J6	not placed	not placed	not placed	not placed	3-4	not placed
J7/J8	not placed	not placed	not placed	1-2 3-4	not placed	not placed

Note: (2 + 0) x WDR = 2 redundant WDR pairs in redundant I/O part and no WDR in non-redundant part.

Figure 13-28: Distribution example

13.4.5.10 Function of jumper settings:

J1/J2 and J3/J4 in section 1, setting 1-2: to connect the WDs from the central parts to the WDG inputs of the watchdog repeater module.

J1/J2 and J3/J4 in section 1, setting 3-4: to connect the WDG outputs of the watchdog repeater module (if only one watchdog repeater module is used) to the WDG lines of the I/O racks via the RCN connectors.

J1/J2 and J3/J4 in section 1, setting 1-3: to connect the WDG lines to the I/O racks via the RCN connectors.

J1/J2 and J3/J4 in section 2, setting 1-3: to connect the WDs from the central parts to the WDG input of the watchdog repeater module in the non-redundant I/O part.

J5/J6 in section 2, setting 3-4: to connect the WDG line to the 5 V DC.

J7/J8 in section 2, setting 1-2/3-4: to connect the WDs from the central parts to the WDG input of the watchdog repeater module in the non-redundant I/O part.

13.4.5.11 Example 6

Redundant Central Parts and hybrid I/O, with redundant I/O in sections 1/2 and redundant/non-redundant I/O in section 3.

The Central Part racks are located in section 1. Depending on the number of watchdog repeaters (WDRs) and the number of sections per FSC system, the following jumper settings must be made:

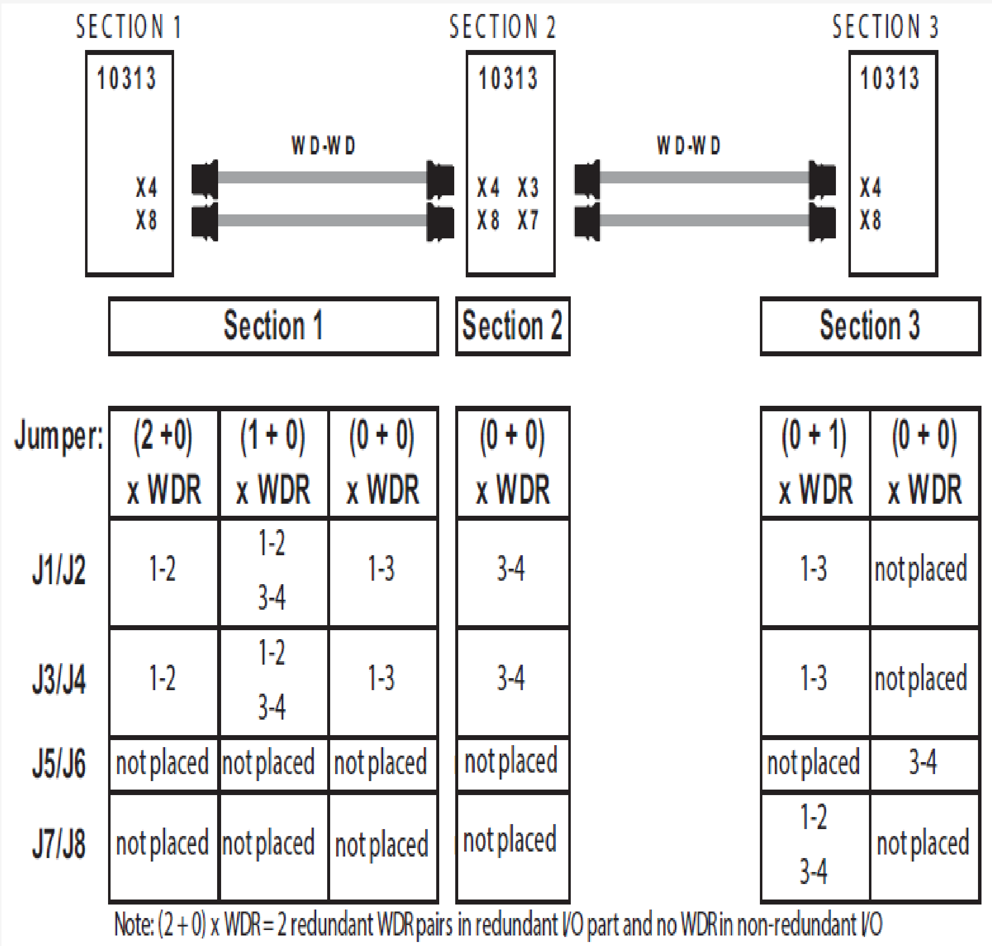


Figure 13-29: Distribution example

13.4.5.12 Function of jumper settings:

J1/J2 and J3/J4 in section 1, setting 1-2: to connect the WDs from the central parts to the WDG inputs of the watchdog repeater module.

J1/J2 and J3/J4 in section 1, setting 3-4: to connect the WDG outputs of the watchdog repeater module (if only one watchdog repeater module is used) to the WDG lines of the I/O racks via the RCN connectors.

J1/J2 and J3/J4 in section 1, setting 1-3: to connect the WDG lines to the I/O racks via the RCN connectors.

J1/J2 and J3/J4 in section 2, setting 3-4: to link WDG lines to section 3.

J1/J2 and J3/J4 in section 3, setting 1-3: to connect the WDs from the central parts to the WDG input of the watchdog repeater module in the non-redundant I/O part.

J5/J6 in section 3, setting 3-4: to connect the WDG line to the 5 V DC.

J7/J8 in section 3,setting 1-2/3-4: to connect the WDs from the central parts to the WDG input of the watchdog repeater module in the non-redundant I/O part.

13.4.6 Connectors

The connectors on the 10313/1/1 module are of make AMP.

The table below lists the items that should be used when handling the connectors:

Item	AMP description	AMP part no.
Receptacle housing:	3 POS. RECEPTACLE HOUSING	1-178288-3
	4 POS. RECEPTACLE HOUSING	1-178288-4
	6 POS. RECEPTACLE HOUSING	1-178288-6
Crimp pin type:	RECEPTACLE CONTACTS (on reel)	0-175195-2
	RECEPTACLE CONTACTS (loose pieces)	0-175217-2
Crimp tool for these pins:	HANDTOOL	0-914595-2
Extraction tool:	EXTRACTION TOOL	0-914677-1

13.4.7 Wire types

The following wire types can be used:

- 0.25 mm⊃ 2; (AWG 24), or
- 0.5 mm⊃ 2; (AWG 20)

13.4.8 Technical data

The 10313/1/1 module has the following specifications:

General	Type number:	10313/1/1 20701[1]
	Approvals:	CE, TÜV
		UL approval pending
Power	Current consumption:	none (included in I/O module data sheets)
	Max. current on faston pin:	4 A
	Max. current on I/O connector pin:	2 A
Physical	Dimensions:	240 x 87 x 60 mm (L x W x H)
		9.45 x 3.43 x 2.36 in (L x W x H)
	DIN EN rails:	TS32 / TS35 x 7.5
	Used rail length:	241 mm (9.49 in)

Note:

1. 10313/1/1 modules with suffix code 20700 have a different connector layout.

13.5 Earth Leakage Detector terminal (TELD)

The TELD-0001 is an Earth Fault Monitor in a terminal shaped housing. It is used to detect earth faults in all circuits and wiring that are galvanically connected in a power supply group. The TELD-0001 brings earth voltage to (approximately) +4Vdc as referenced to the 0Vdc of the monitored power supply group.

The (0-20mA) current that is drawn by the TELD-0001 gives the control system an indication of the type of earth fault present. While no earth fault is present, the TELD-0001 will draw approximately 10mA. An earth fault current flowing through the earth connection of the TELD-0001 will change that depending on its value and polarity.

The control system can switch-off the power to the TELD-0001. This will isolate the internal TELD-0001 circuit from its earth pin. That removes the earth fault current that ran at the point in the field where the earth fault is located.

The TELD-0001 needs to be connected with the RUSIO or RUSLS channel that is configured as the 'earth fault detection' channel.

The module has a universal snap-in provision for standard DIN EN rails.

The following figure shows the top and side view of the TELD-0001.

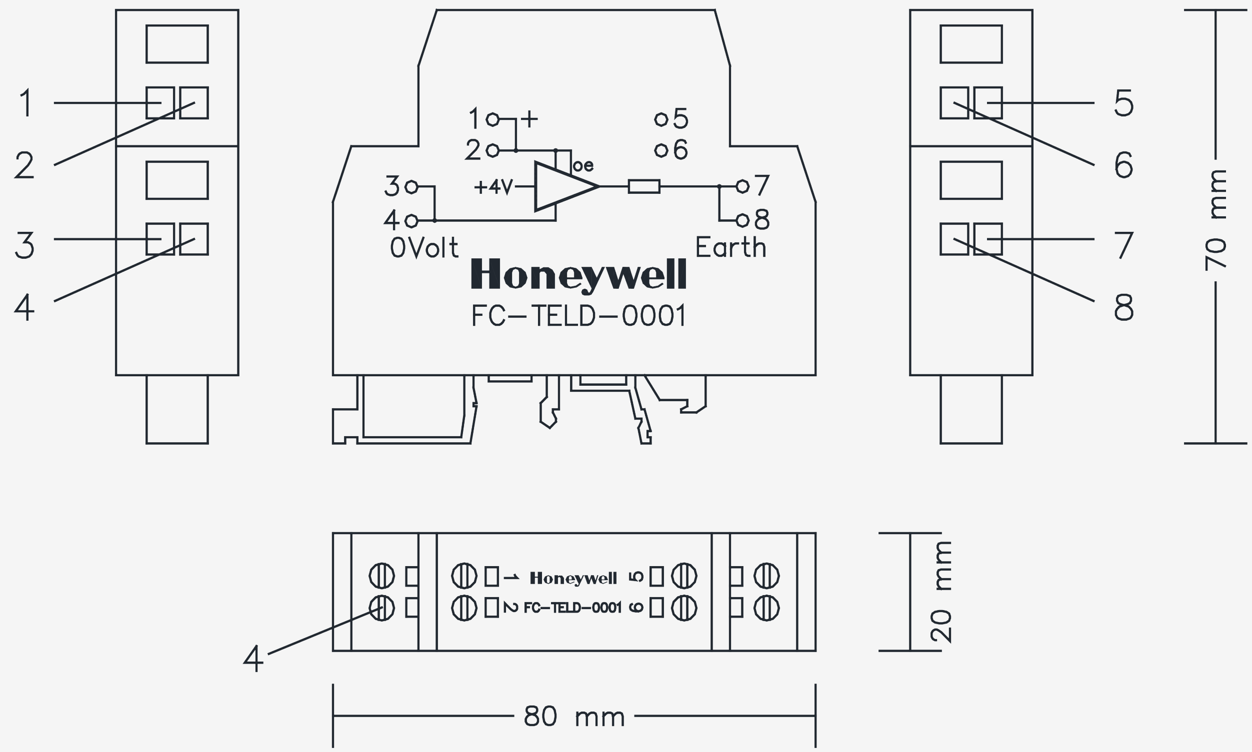


Figure 13-30: Top and side view of the TELD-0001

The following figure shows the block diagram of the TELD-0001.

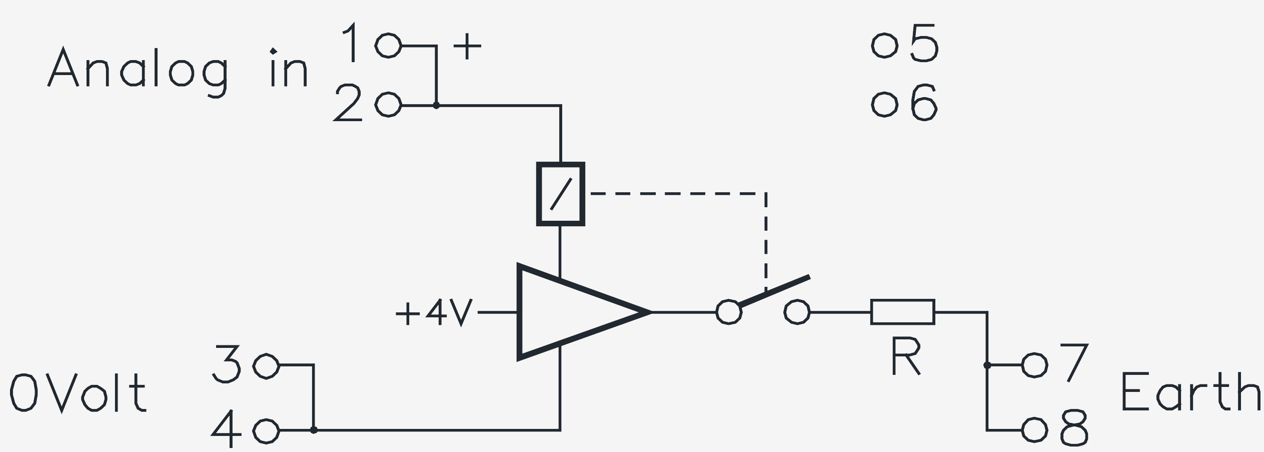


Figure 13-31: Block diagram of TELD-0001

Connections

The TELD-0001 connection details are as follows:

Connection	Pin	Function
A in+	1 + 2	Loop powered analog input signal (0-20mA)
0 Volt	3 + 4	0 V DC of supply
Earth	7 + 8	Earth connection

The following diagram shows the wiring diagram of the TELD-0001.

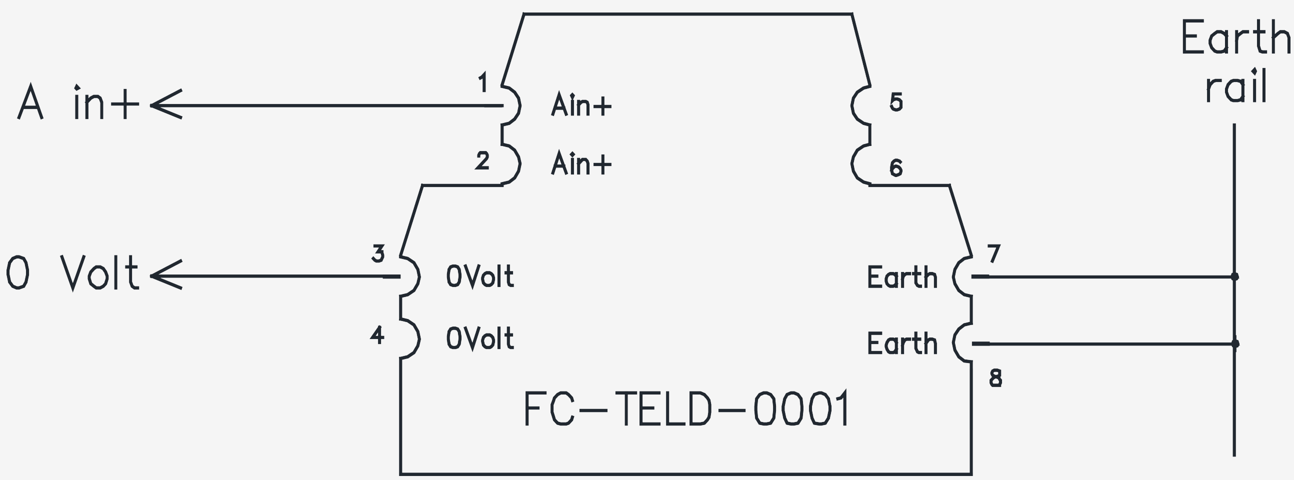


Figure 13-32: Wiring diagram of TELD-0001

Note:
The Earth Leak Detection (TELD) should be placed near the connected IOTA channel (Example: On a piece of DIN rail at the side). The TELD can be operated in an ambient air temperature range of -40°C to +75°C.

Connect the TELD earth wire and the instrument earth bar with a short wire. Route the earth wire two times through ferrite.

13.5.1 Technical data

The TELD-0001 module has the following specifications:

General	Type number:	FC-TELD-0001
	Temperature	-40°C to +75°C (-40°F to +167°F)
	Approvals	CE, TUV
Physical module dimensions		80 x 20 x 70 mm (L x W x H)
		3.15 x 0.79 x 2.76 in (L x W x H)
	DIN EN rails:	TS32 / TS35 x 7.5
	Used rail length	21 mm (0.82 in)
Analog	Input voltage:	24 VDC +30/-15% (with approximately 250 Ohm series impedance)
	Input current:	10 mA (no earth fault present) maximum 25 mA (to be limited by the power source)
Earth	Voltage	typically +4.1 VDC (with monitored 0 V as reference)
	Resistor (R)	approximately 2.8 kOhm (see "Block diagram of TELD-0001" on page 680)
	Earth fault detection threshold	approximately 0.6 mA (flowing into FC-TELD-0001) approximately 0.2 mA (coming from the FC-TELD-0001)
Termination screw terminals	wire size	0.2 mm^2 - 4 mm^2 (solid) 0.2 mm^2 - 2.5mm^2 (stranded)
	strip length	8 mm

CHAPTER 14

IO BUSSES

14 IO Busses

Item		See
General info about IO busses		General info about IO busses
Safety Manager		
IO-0001	IO Extender Module (Safety Manager)	IO-0001
TERM-0001 and TERM-0002	Bus terminator for non-redundant IO (TERM-0001) and redundant IO (TERM-0002)	TERM-0001 and TERM-0002
Safety Manager A.R.T.		
IO-0002	IO Extender Module (Safety Manager A.R.T.)	IO-0002
Safety Manager and Safety Manager A.R.T.		
IOBUS-CPIO	IO Bus from Controller chassis to IO chassis	IOBUS-CPIO
IOBUS-CPIOx	IO bus from Controller chassis to IO chassis	IOBUS-CPIOx
IOBUS-CPIOX	IO bus in extension cabinet	IOBUS-CPIOX
IOBUS-CPIOXx	IO bus in extension cabinet	IOBUS-CPIOXx
IOBUS-CPX-x	IO bus from controller cabinet to extension cabinet	IOBUS-CPX-x
IOBUS-CPX1x	IO bus from controller cabinet to extension cabinet	IOBUS-CPX-x

14.1 General info about IO busses

This sub-section contains these topics:

- General info about IO busses (Safety Manager)
- General info about IO busses (Safety Manager A.R.T.)

14.1.1 General info about IO busses (Safety Manager)

The IO busses in Safety Manager provide a parallel communication link between the Control Processors in the Controller chassis and the IO extender in the IO chassis.

Safety Manager has four (pairs of) IO busses. The below figure shows a detail of the Controller backplane with two of the four IO bus connector sets.

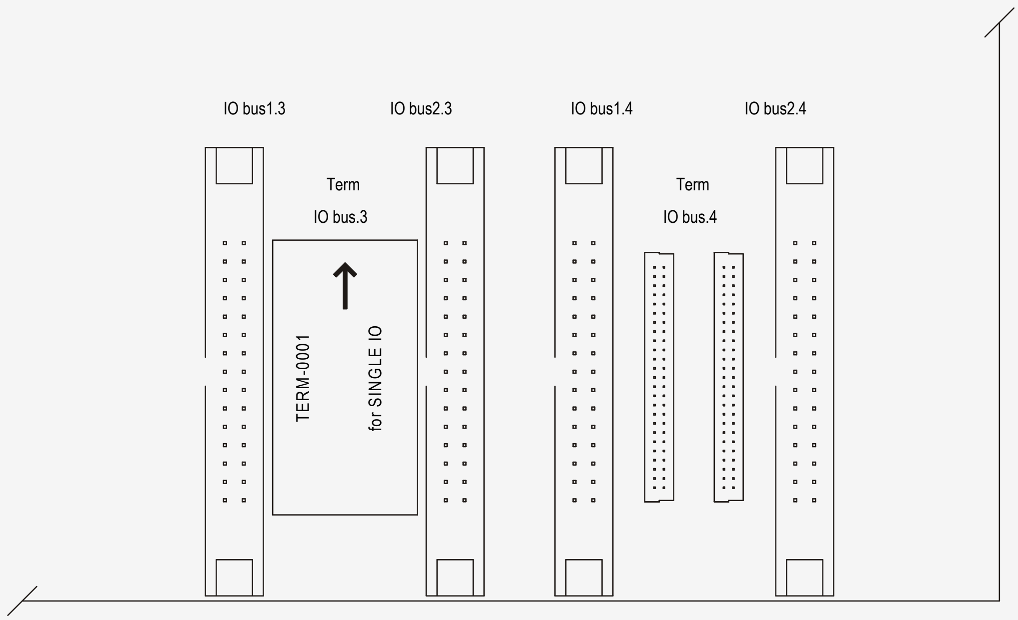


Figure 14-1: IO bus connectors detail of the CPB-0001

An IO bus connector set consists of two IO bus (flatcable) connectors (IO bus1.x and IO bus2.x) and two connectors for one IO bus terminator board (term IO bus.x).

IO bus.3 in the above figure has a terminator while IO bus.4 is unused.

Non-redundant IO requires one IO bus (controlled by Control Processor 1 and 2). Redundant IO requires a pair of IO busses (one controlled by Control Processor 1, the other by Control Processor 2).

A specific bus has to be used for non-redundant IO or redundant IO exclusively. Therefore, in Safety Manager with both redundant and non-redundant IO, at least three busses must be used: one pair that is connected to all IO chassis for redundant IO, and one bus that is connected to all IO chassis for non-redundant IO.

The below figure shows an example of the IO busses in a system with two cabinets:

- Chassis 1 to 5 of the controller cabinet are redundant and connected to IO bus 1.1 resp. IO bus 2.1 of CP1 resp. CP2.
- Chassis 1 to 7 of the extension cabinet are redundant and connected to IO bus 1.2 resp. IO bus 2.2 of CP1 resp. CP2.
- Chassis 6 to 8 of the controller cabinet are non-redundant and connected to IO bus x.3 of CP1 and CP2.

- Chassis 8 and 9 of the extension cabinet are non-redundant and connected to IO bus x.4 of CP1 and CP2.

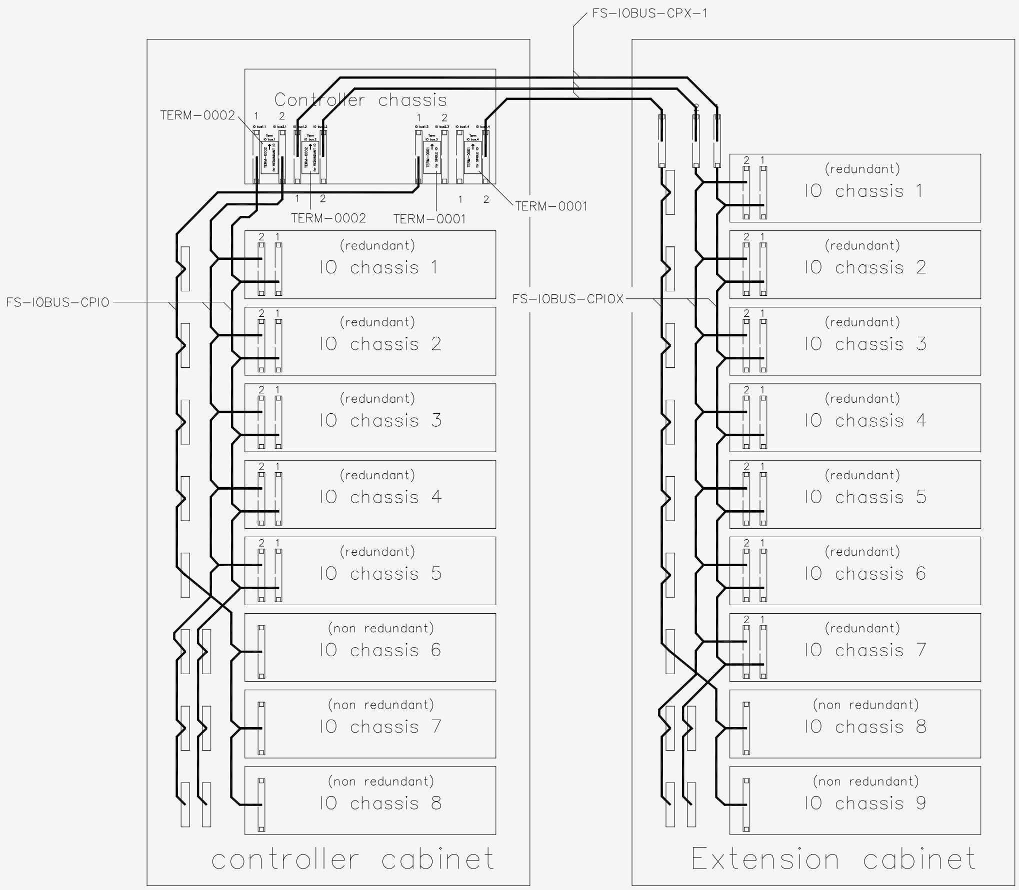


Figure 14-2: IO busses example for a two cabinet system

The connection cable between the Controller chassis and the IO chassis is the flatcable assembly IOBUS-CPIO (see section IOBUS-CPIO).

At the Controller chassis side, the IOBUS-CPIO cable is connected to the Controller backplane (see section Controller backplane CPB-0001), and IO bus terminators are placed on all IO busses that are in use.

Non-redundant IO chassis require one cable and a TERM-0001, and redundant IO chassis require two cables and a TERM-0002 (see TERM-0001 and TERM-0002).

At the IO chassis side, the IOBUS-CPIO cable is connected to the backplane of the IO chassis.

A non-redundant IO chassis has one IOBUS-CPIO cable connector marked “IO bus” (see Figure 1).

A redundant IO chassis has two IOBUS-CPIO cable connectors marked “IO bus1” and “IO bus2” (see Figure 1).

It is important to place the cables in the proper location: The cable on IO bus1.x of the Controller chassis must be placed on the IO bus1 connector of the IO chassis. The cable on IO bus2.x of the Controller chassis must be placed on the IO bus2 connector of the IO chassis.

14.1.2 General info about IO busses (Safety Manager A.R.T.)

The IO busses in Safety Manager A.R.T. provide a redundant set of parallel communication links between the Control Processors in the Controller chassis and the IO extenders in the IO chassis.

Safety Manager A.R.T. has two pair of IO busses. The below figure shows a detail of the A.R.T. Controller backplane with one pair of IO bus connectors.

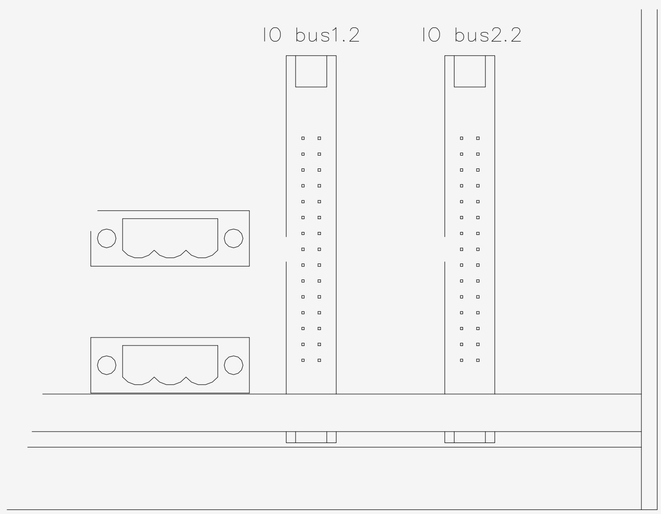


Figure 14-3: IO bus connectors detail of the CPB-0002

An IO bus set for IO chassis in the Controller cabinet consists of two flatcables type IOBUS-CPIO (see IOBUS-CPIO and).

An IO bus can control redundant or non-redundant IO chassis. The IO busses of a Safety Manager A.R.T. Controller chassis can only control Safety Manager A.R.T. IO chassis.

The below figure shows an example of a Controller cabinet with both redundant and non-redundant IO chassis.

- IO bus1.x on the CP backplane must be connected to IO bus1 on the IO backplane.
- IO bus2.x on the CP backplane must be connected to IO bus2 on the IO backplane.

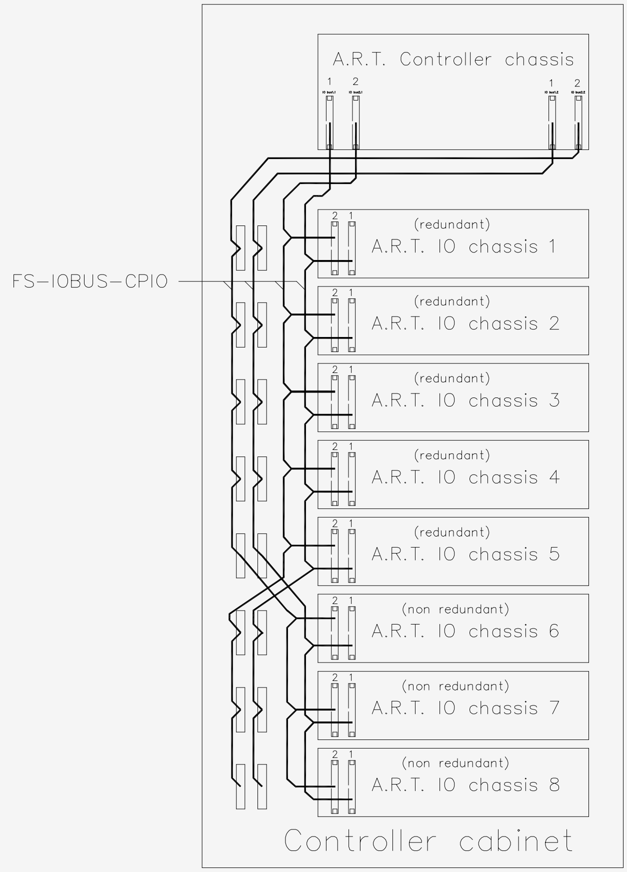


Figure 14-4: IO busses example for a IO chassis in the Controller cabinet

The below figure shows an example of a Controller cabinet with an extension cabinet.

The below table shows the possible configurations.

Table 1. Possible configurations of a Controller cabinet with an extension cabinet [1]

Type of cabinet	Possible configurations						
Controller	R and NR	R	NR	R	R	NR	NR
Extension	-	-	-	R	NR	R	NR

1. R = redundant IO chassis; NR = non-redundant IO chassis

An IO bus set for IO chassis in extension cabinets contains two pairs of flatcables:

- One pair of (round) flatcables type IOBUS-CPX-1,

  (see IOBUS-CPX-x)

- One pair of flatcables type IOBUS-CPIOX,

  (see IOBUS-CPIOX).

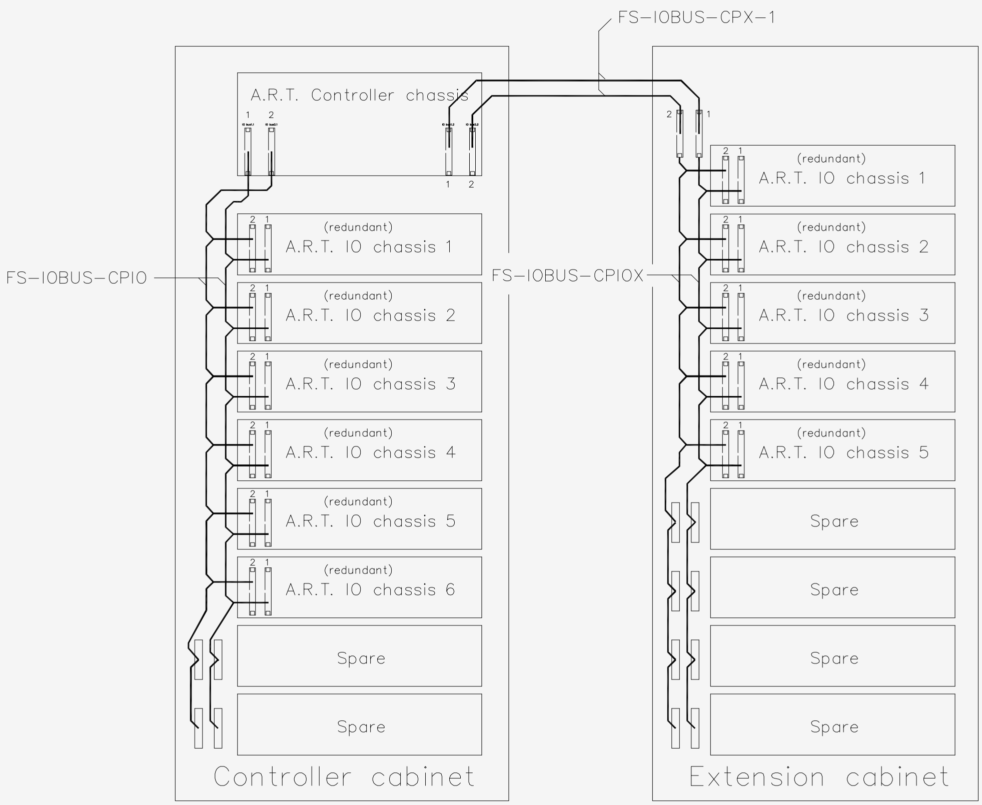


Figure 14-5: IO busses example for a IO chassis in the extension cabinet

14.2 IO-0001

14.2.1 IO Extender Module (Safety Manager)

The IO extender module is a basic module that is installed in the IO chassis.

The IO extender module transfers the communication of the Control Processor to the IO modules.

- Non-redundant IO chassis (IOCHAS-0001S) have one IO-0001 module, located in slot 21 (see Figure 1).
- Redundant IO chassis (IOCHAS-0001R) have two IO-0001 modules, located in slot 20 and 21 (see Figure 1).

Note:
The IO extender can be replaced when the power is switched on. However, in that case Safety Manager will shut down if the IO Extender is safety-related.

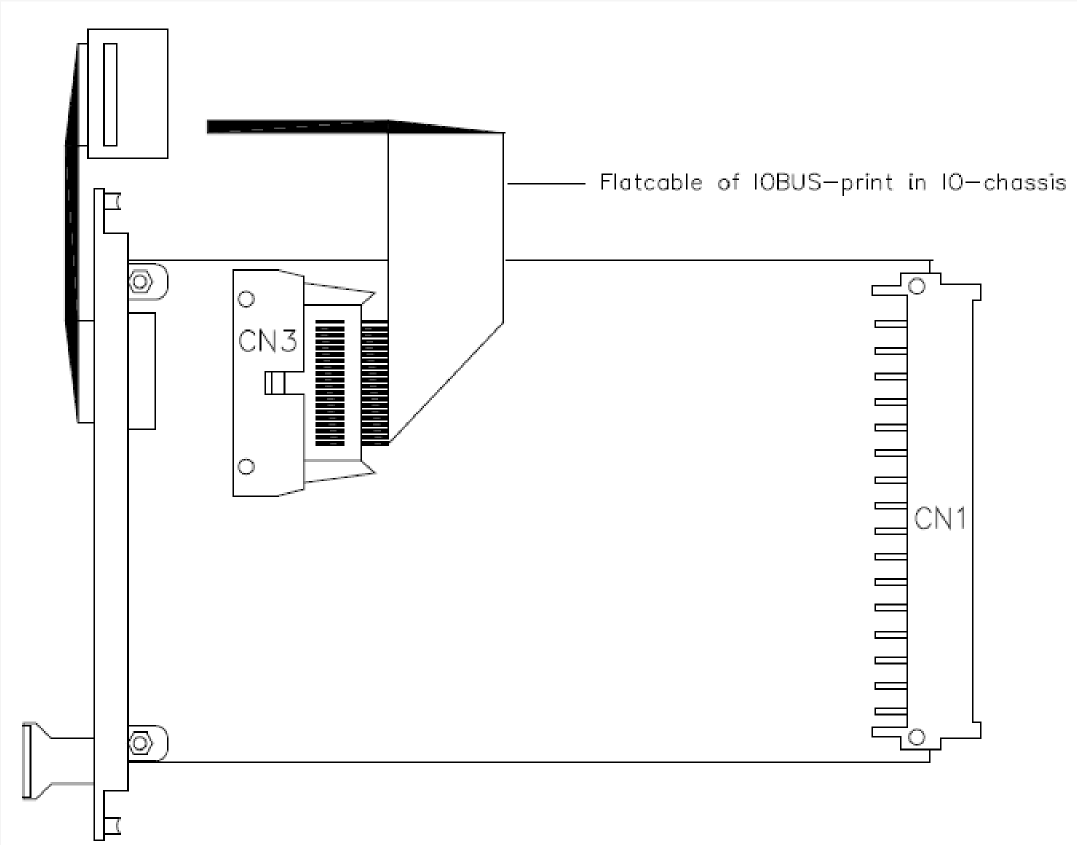


Figure 14-6: Side view of the IO-0001 module with a flatcable from a non-redundant IO chassis

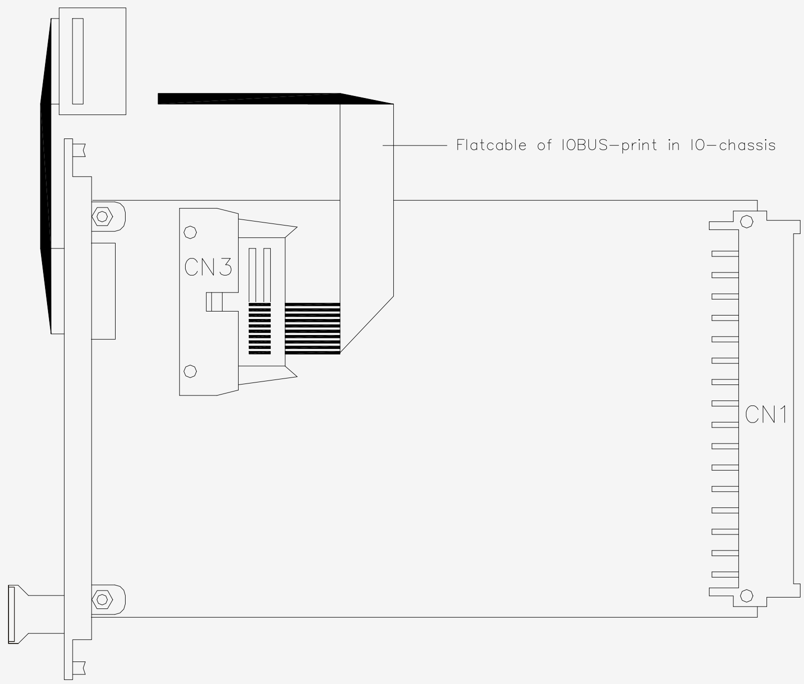


Figure 14-7: Side view of the IO-0001 module with a flatcable from a redundant IO chassis

The IO extender module communicates with the Control Processor via CN1 (see Figure 1).

The flatcable extending from the front of the IO extender module connects the IO extender module to the horizontal IO bus (see Figure 1 and Figure 1).

The flatcable assembly with the address selection lines of the IO modules is connected to the IO extender module on connector CN3 (see the figures above).

14.2.2 Pin allocation

The IO extender is fitted with a male chassis connector according to DIN 41612 type F, with the ‘d’, ‘b’ and ‘z’ rows used.

The below figure shows the back view of the IO-0001 chassis connector:

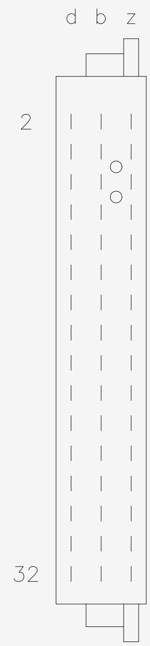


Figure 14-8: Back view of IO-0001 connector

14.2.3 Address settings

The chassis address of the IO extender is defined by means of jumpers (CA0, CA1, CA2, CA3) on the IO backplane (see the below figures).

The below table shows the jumper settings for the possible chassis addresses.

Table 1. Address setting for the IO-0001

Chassis address	Jumper setting[1]			
	CA3	CA2	CA1	CA0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	1	0	0	0
8	1	0	0	1
9	1	0	1	0

1. 0 and 1 positions are marked on the IO backplane

   0 = GND 5 V DC

   1 = supply 5 V DC

The below figure shows the jumper locations on the non-redundant IO-backplane (shows chassis address 1 selected).

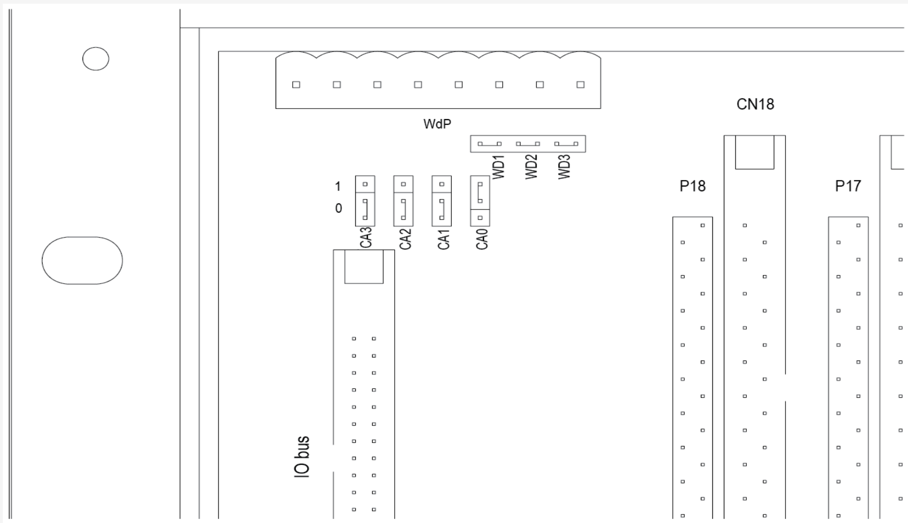


Figure 14-9: Jumpers on the CPB-0001S

The below figure shows the jumper locations on the redundant IO-backplane (shows chassis address 1 selected).

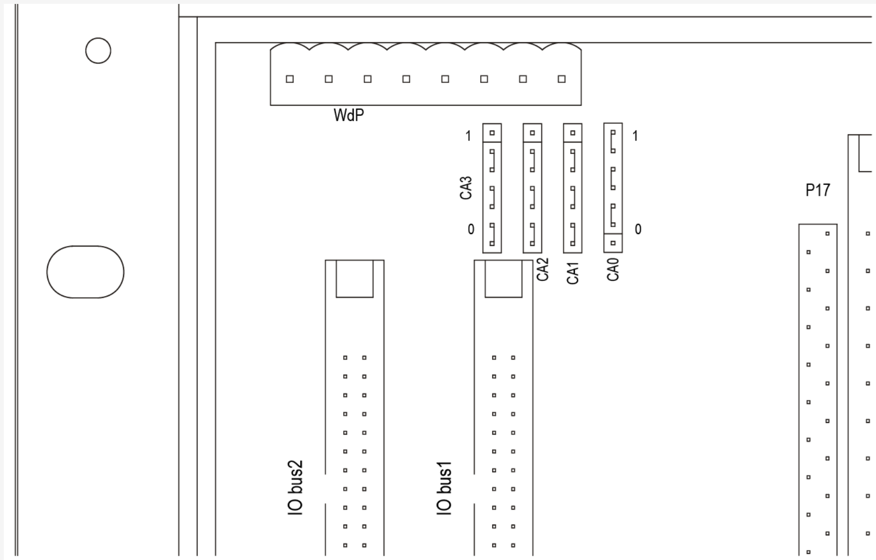


Figure 14-10: Jumpers on the CPB-0001R

14.2.4 Technical data

The IO-0001 module has the following specifications:

General	Type numbers:	FS-IO-0001
		FC-IO-0001
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 V DC, 35 mA
	Ripple content:	< 50 mV p-p
Key coding	(See section Key coding)	
	Module connector code:	
	• Holes	A5, A7
	Chassis connector code:	
	• Large pins	A5, A7

14.3 TERM-0001 and TERM-0002

14.3.1 Bus terminator for non-redundant IO (TERM-0001) and redundant IO (TERM-0002)

The TERM-0001 is a bus terminator for an IOBUS-CPIO / IOBUS-CPIOx flatcable to non-redundant IO. It has 27 termination resistors (1kΩ) and links the IO bus1.x with the IO bus2.x.

The TERM-0002 is a bus terminator for two IOBUS-CPIO / IOBUS-CPIOx flatcables to redundant IO. It has 54 termination resistors (1kΩ) and keeps the IO bus1.x and the IO bus2.x separated.

The TERM-000x terminates all used IO bus signals and is placed on connectors on the Controller backplane (CPB-0001). These connectors are labelled Term IO bus1, Term IO bus2, Term IO bus3 and Term IO bus4.

The presence of a bus terminator on the CP backplane is checked by the software and required for all used IO busses.

Figure 1 shows the terminator.

Figure 2 shows a detail of the CP-backplane with an TERM-0002 placed.

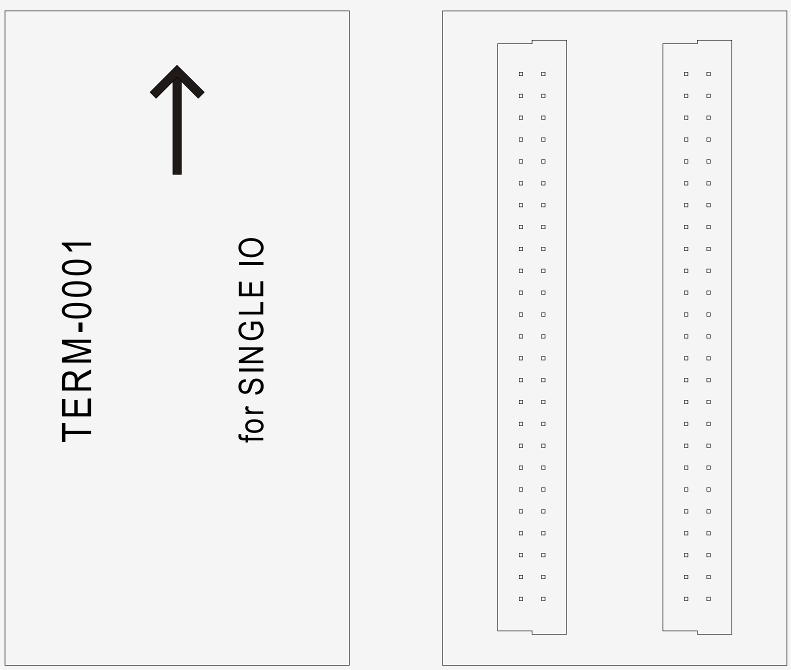


Figure 14-11: Front and back view of the TERM-0001

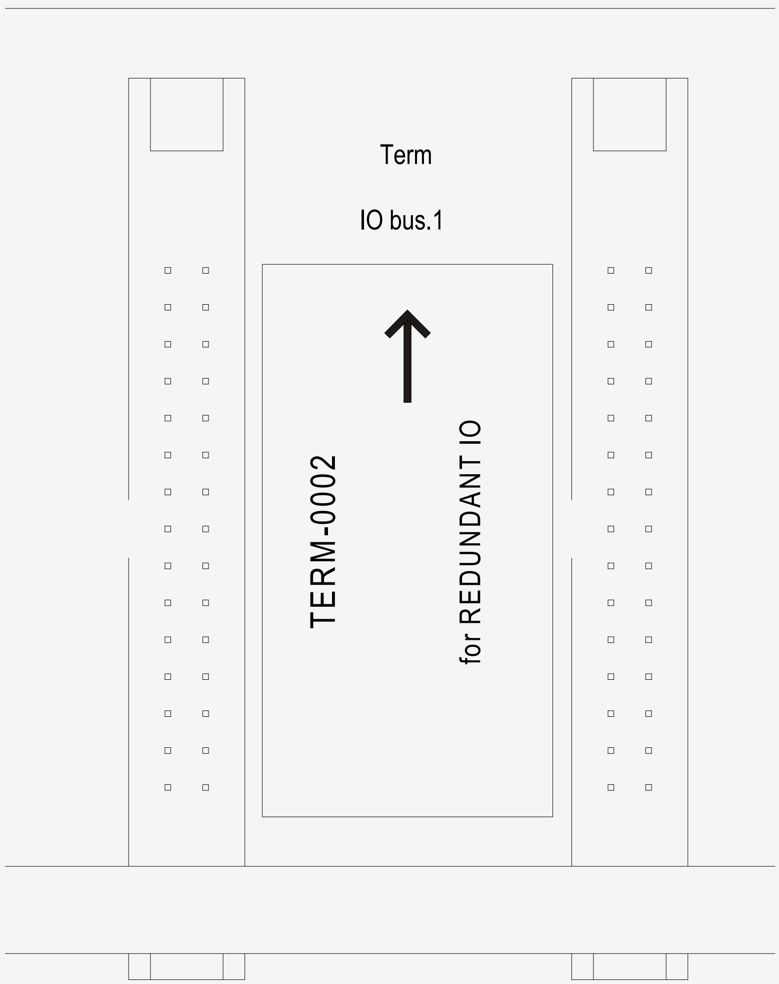


Figure 14-12: CP backplane detail with an TERM-0002 placed

14.3.2 Choosing the correct terminator

The below table describes which terminator to use for which configuration.

Table 1. Correct terminator placement for various configurations

Controller	IO	Terminator
Non-redundant	Non-redundant	TERM-0001
Redundant	Non-redundant	TERM-0001
Redundant	Redundant	TERM-0002

14.3.3 Technical data

General	Type numbers:	FS-TERM-0001 for non-redundant IO FS-TERM-0002 for redundant IO
		FC-TERM-0001 for non-redundant IO FC-TERM-0002 for redundant IO
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	50 mA (from 5 V DC of Control Processor)
Physical	Module dimensions:	19.7 × 38.1 × 7.8 mm
		(0.78 × 1.5 × 0.3 in)
	Weight:	Approximately 4.5 g (0.16 oz)
	Connectors:	2 × SMC female connector, 50-pins

14.4 IO-0002

14.4.1 IO Extender Module (Safety Manager A.R.T.)

The IO extender module is a basic module that is installed in the IO chassis at positions 20 and 21.

The IO extender module transfers the communication of the Control Processor to the IO modules.

The IO extender module transfers:

- the WatchDog signals of the Control Processors to each IO module position in the IO-chassis.

  This makes it possible to isolate each individual output module in case of an error on that output module (the Watchdog signal of that IO-module is switched off).

- the 5V of the Control Processor chassis to the IO-modules in the IO chassis. This is done in two groups.

  In case of a short (or an overload) in a group, the 5V to that group is switched off while the rest of the system continues to control the process.

In redundant IO chassis:

- 5V group 1 supplies the IO chassis positions 1, 3, 5, 7, 9, 11, 13, 15 and 17
- 5V group 2 supplies the IO chassis positions 2, 4, 6, 8, 10, 12, 14, 16 and 18.

In non-redundant IO chassis:

- 5V group 1 supplies the IO chassis positions 1 thru 9
- 5V group 2 supplies the IO chassis positions 10 thru 18.

The IO extender has a status LED (OFF, GREEN or RED) that indicates the module status.

Each Safety Manager A.R.T. IO chassis has two IO extender modules:

- The IO extender at position 20 is connected to IO bus 1 and IO bus 2.
- The IO extender at position 21 is connected to IO bus 1 and IO bus 2.

In a fault free system, module at position 20 controls the IO bus 1. If the module at position 20 is faulty, the module at position 21 takes over the control of IO bus 1, and will then be controlling IO bus 1 and IO bus 2.

Note:

An IO extender module can be replaced when the power is switched on and the system is controlling the process, provided the other IO extender module in the IO chassis is running without fault.

14.4.2 Address settings

The chassis address of the IO extender is defined by means of jumpers (CA0, CA1, CA2, CA3) on the IO backplane.

The below table shows the jumper settings for the possible chassis addresses. The below figure shows the jumper locations on the IO-backplane (with chassis address 1 selected).

Table 1. Address settings for the IO-0002

Chassis address	Jumper setting[1]			
	CA3	CA2	CA1	CA0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	1	0	0	0
8	1	0	0	1
9	1	0	1	0

1. 0 and 1 positions are marked on the IO backplane

   0 = GND 5 V DC

   1 = not connected

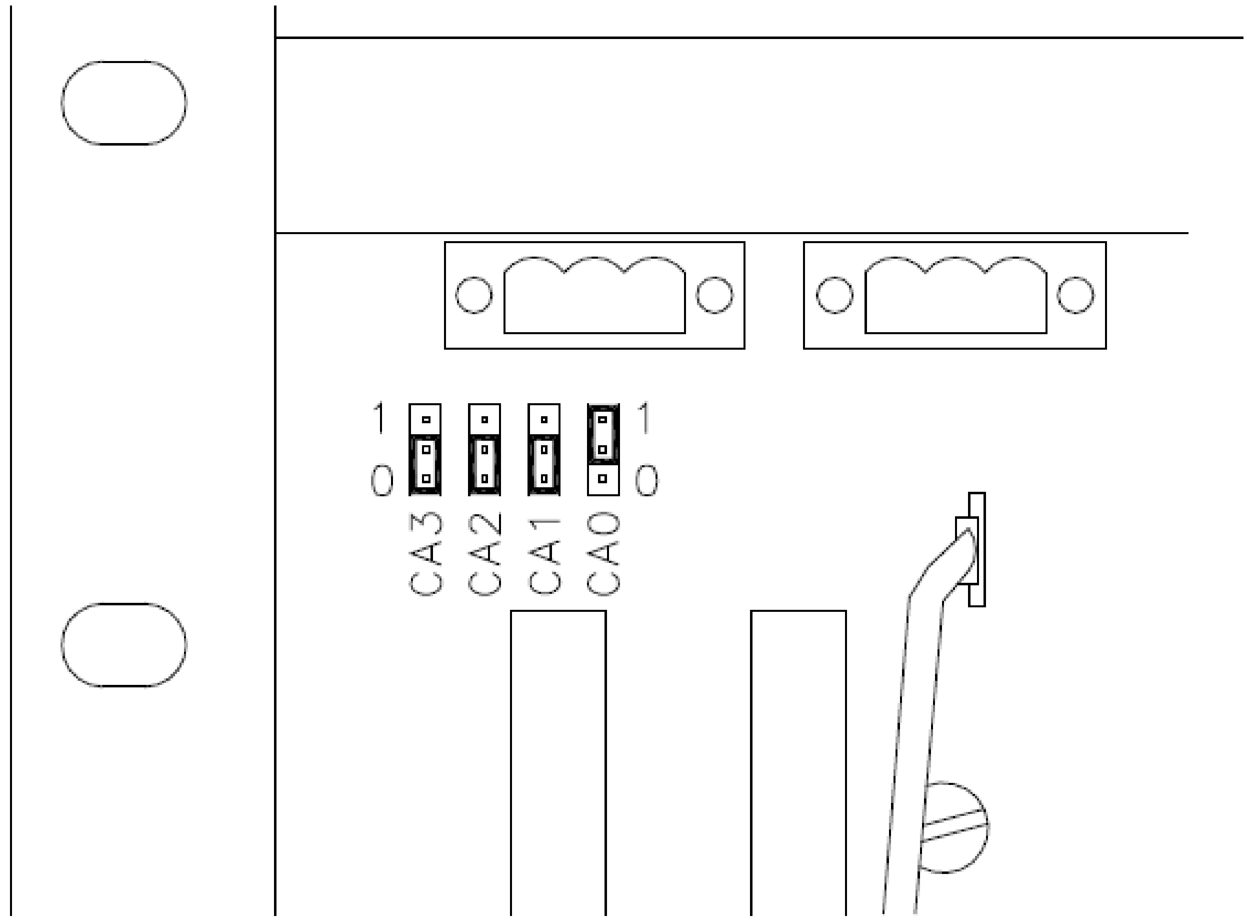


Figure 14-13: Address jumpers on the IO backplane

14.4.3 Technical data

The IO-0002 module has the following specifications:

General	Type number:	FC-IO-0002
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Watchdog	Number of inputs: • current:	2 max. 10 mA (WD1in + WD2in)
	Number of outputs: • current:	18 max. 25 mA
Power	Number of inputs: • power requirements: • current:	2 (diode OR-ed) 5Vdc 100 mA + 5V_load of all (18) IO boards + WD_load of all (18) IO boards
	Number of outputs: • voltage drop: • current:	2 groups 0.2V < V < 0.8V (versus highest Vin) > 1.25 A (per group)

14.5 IOBUS-CPIO

14.5.1 IO bus from Controller chassis to IO chassis

The IOBUS-CPIO is a vertical IO bus (34-wire flatcable) from the Controller chassis (CPCHAS-0001 or CPCHAS-0002 or CPCHAS-0003) to one or more IO chassis (IOCHAS-0001S or IOCHAS-0001R or IOCHAS-0002S or IOCHAS-0002R or IOCHAS-0003S or IOCHAS-0003R), as shown in the below figure. All scan, test and update actions between the QPP module and IO modules are routed via these IO busses.

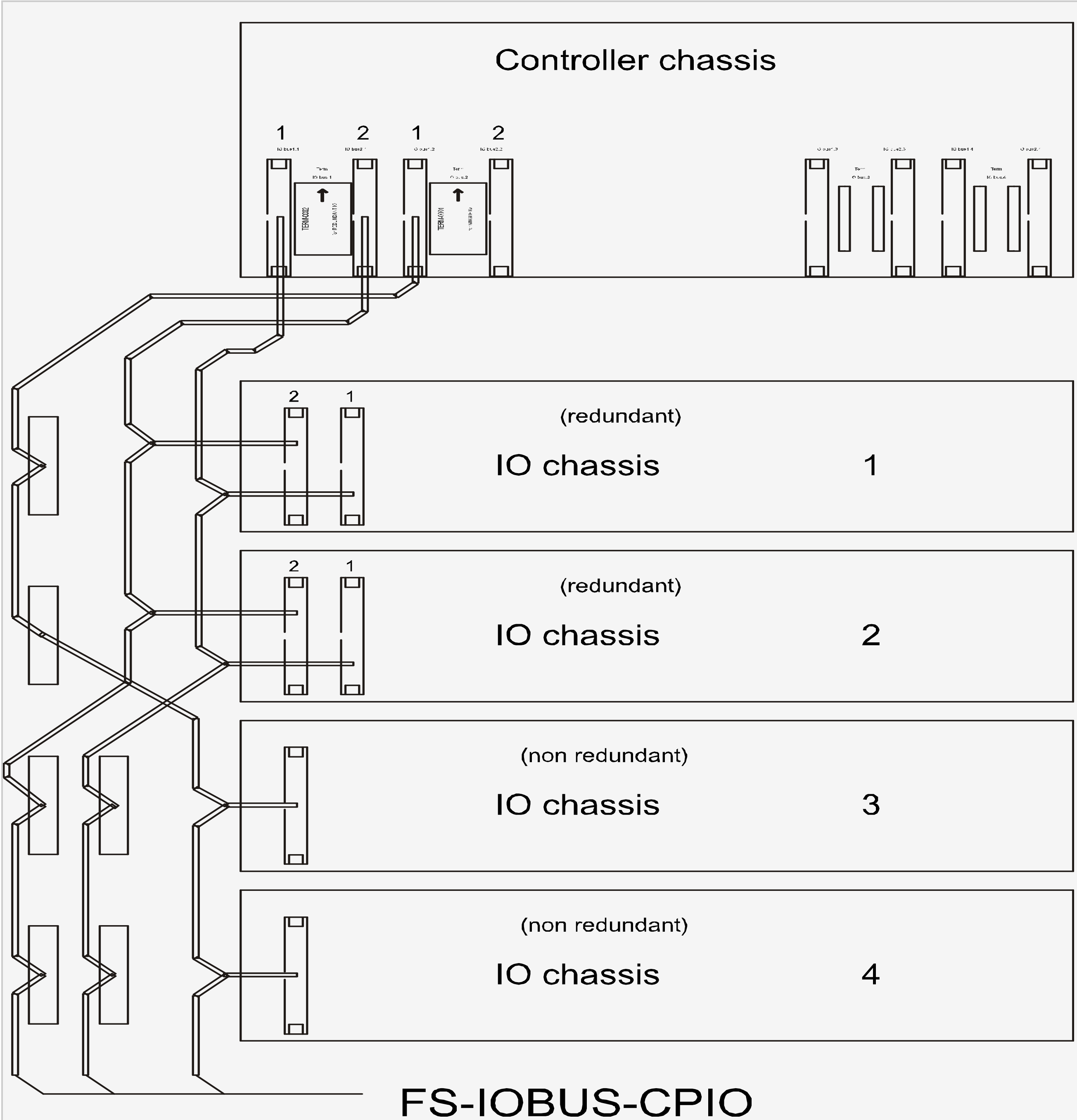


Figure 14-14: IOBUS-CPIO busses in a controller cabinet

At the side of the Controller chassis, the IOBUS-CPIO is connected to the Controller backplane, to the connector marked IO busx.x (see Table 1 and Figure 3).

At the side of the IO chassis, the IOBUS-CPIO is connected to the IO backplane IOB-0001S/R, to the connector marked IO busx (see Figure 1 and Table 1 or Figure 1 and Table 1).

The IOBUS-CPIO is used for redundant as well as non-redundant (Controller and/or IO) configurations.

The below figure shows a side view of the IO bus.

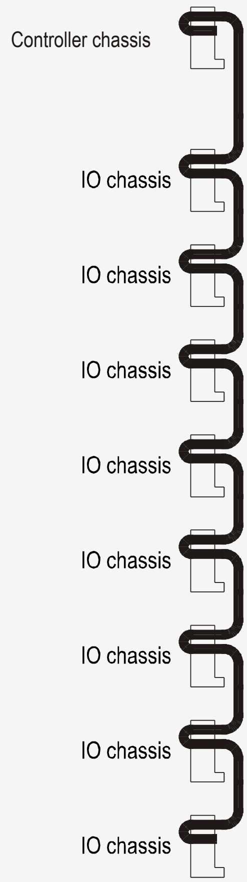


Figure 14-15: IOBUS-CPIO side view

14.5.2 Technical data

General	Type number:	FS-IOBUS-CPIO
	Approvals:	UL, CSA
Physical	Connectors:	34 pole latch (female)
	Weight:	0,31 kg

14.6 IOBUS-CPIOx

14.6.1 IO bus from Controller chassis to IO chassis

The IOBUS-CPIOx (where x = 1...8) is a vertical IO bus (34-wire flat cable) from the Controller chassis (CPCHAS-0001 or CPCHAS-0002) to one or a maximum of 8 IO chassis (IOCHAS-0001S or IOCHAS-0001R or IOCHAS-0002S or IOCHAS-0002R) within a Safety Manager cabinet.

All scan, test and update actions between the QPP module and IO modules are routed via these IO assemblies. The IOBUS-CPIOx is used for redundant as well as non-redundant (Controller and/or IO) configurations.

The IOBUS-CPIOx cable assembly is divided into 8 separate assemblies. Each assembly has its own part number and an own number of connections between Controller chassis and I/O chassis. The connector that is the closest to the ferrite is connected to the controller chassis. Depending on the number of the IO racks and the position of the IO racks, you must select the appropriate cable. If less than 8 IO chassis are used, the left over I/O connectors of the cable assembly will not be used.

The following figure shows the 8 separate cable assemblies.

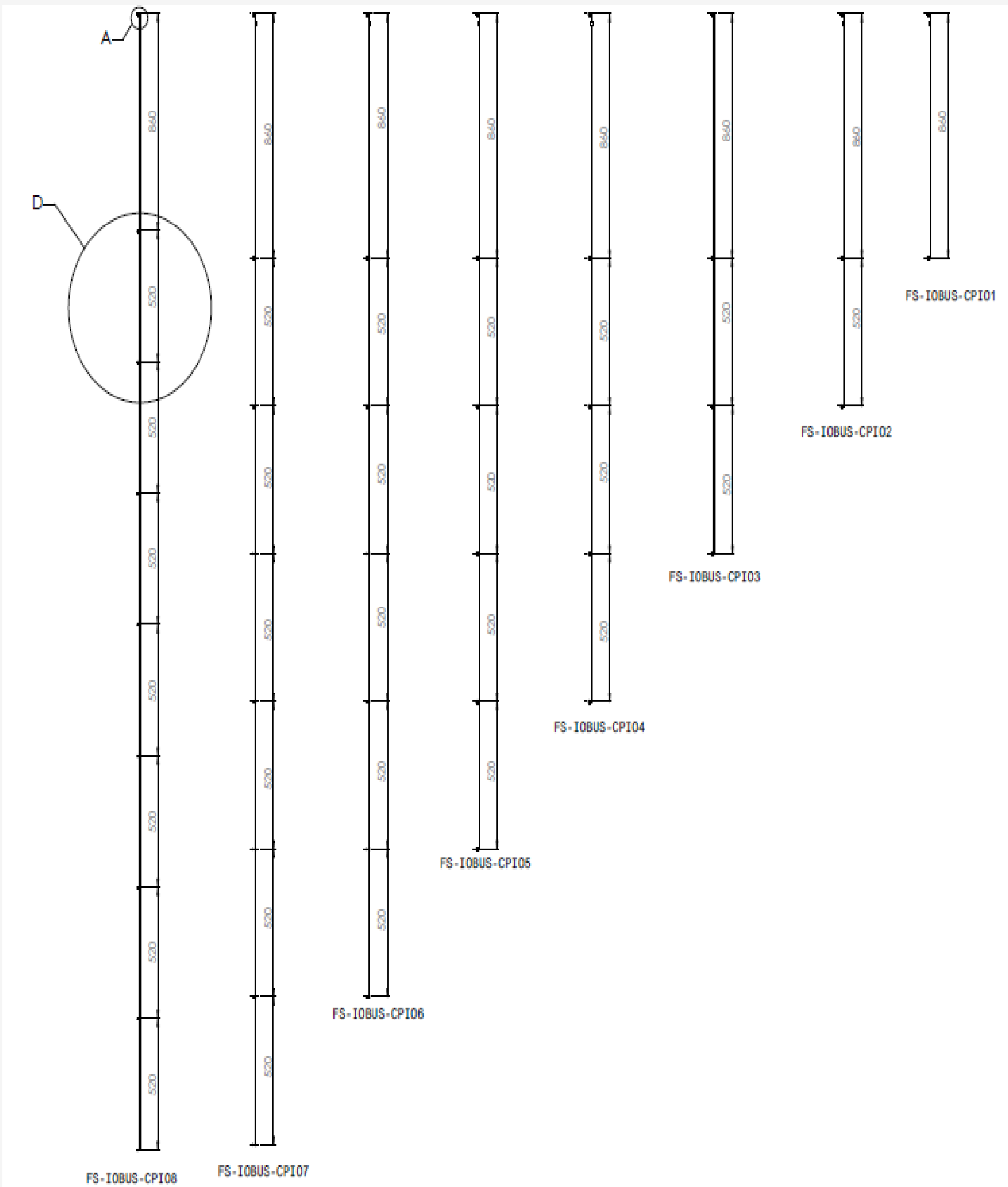


Figure 14-16: Separate cable assemblies

- The IOBUS-CPIO1 is used for connection between controller chassis and I/O chassis in position 1.
- The IOBUS-CPIO2 is used for connection between controller chassis and I/O chassis in position 1 and 2.

- The IOBUS-CPIO3 is used for connection between controller chassis and I/O chassis in position 1, 2, and 3.
- The IOBUS-CPIO4 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, and 4.
- The IOBUS-CPIO5 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4 and 5.
- The IOBUS-CPIO6 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, and 6.
- The IOBUS-CPIO7 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, 6, and 7.
- The IOBUS-CPIO8 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, 6, 7 and 8.

14.6.2 Technical data

General	Type numbers:	FS-IOBUS-CPIO1 FS-IOBUS-CPIO2 FS-IOBUS-CPIO3 FS-IOBUS-CPIO4 FS-IOBUS-CPIO5 FS-IOBUS-CPIO6 FS-IOBUS-CPIO7 FS-IOBUS-CPIO8
	Approvals:	UL, CSA, VDE

14.7 IOBUS-CPIOX

14.7.1 IO bus in extension cabinet

The IOBUS-CPIOX is a vertical IO bus (34-wire flatcable) from the top of an extension cabinet to one or more IO chassis (IOCHAS-0001S or IOCHAS-0001R IOCHAS-0002S or IOCHAS-0002R) in the extension cabinet (see the below figure). All scan, test and update actions between the QPP module and IO modules are routed via these IO busses.

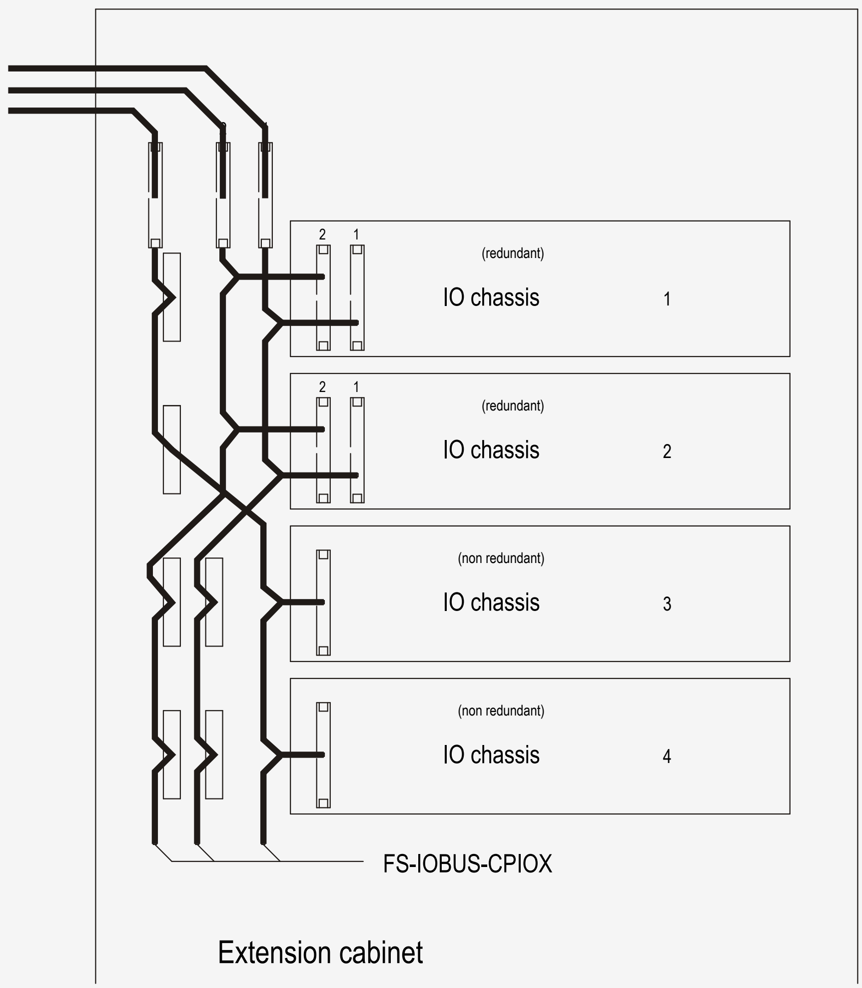


Figure 14-17: IOBUS-CPIOX busses in an extension cabinet

In the top of the extension cabinet, the IOBUS_CPIOX (male connector) is connected with an IOBUS-CPX-x cable (see IOBUS-CPX-x).

The other connectors (female) go to connectors on IO backplanes IOB-0001R marked IO busx (in redundant IO chassis) or on IO backplanes IOB-0001S marked IO bus (in non-redundant IO chassis).

The IOBUS-CPIOX is used for redundant as well as non-redundant configurations.

The below figure shows a side view of the IOBUS-CPIOX.

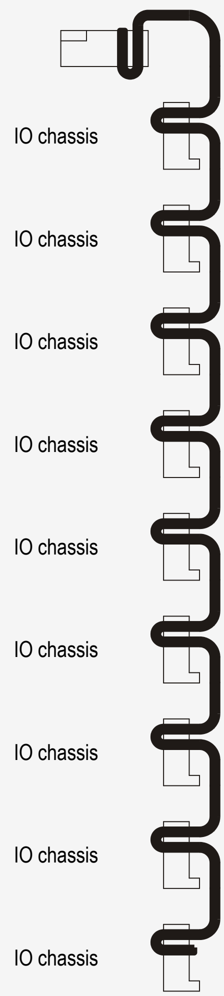


Figure 14-18: Side view of the IOBUS-CPIOX

14.7.2 Technical data

General	Type number:	FS-IOBUS-CPIOX
	Approvals:	UL, CSA
Physical	Connector (top):	34 pole latch (male)
	Connectors (other):	34 pole latch (female)

14.8 IOBUS-CPIOXx

14.8.1 IO bus in extension cabinet

The IOBUS-CPIOXx (where x = 1...9) is a vertical IO bus (34-wire flat cable) from the Controller chassis (CPCHAS-0001 or CPCHAS-0002) to one or a maximum of 9 I/O chassis (IOCHAS-0001S or IOCHAS-0001R or IOCHAS-0002S or IOCHAS-0002R) within a Safety Manager extension cabinet.

All scan, test and update actions between the QPP module and IO modules are routed via these IO assemblies. The IOBUS-CPIOXx is used for redundant as well as non-redundant (Controller and/or IO) configurations.

The IOBUS-CPIOXx cable assembly is divided into 9 separate assemblies. Each assembly has its own part number and an own number of connections between Controller chassis and I/O chassis. Depending on the number of the IO racks and the position of the IO racks, you must select the appropriate cable. If less than 9 IO chassis are used, the left over I/O connectors of the cable assembly will not be used. The following figure shows the 9 separate cable assemblies.

The following figure shows the 9 separate cable assemblies.

14.8 IOBUS-CPIOXx

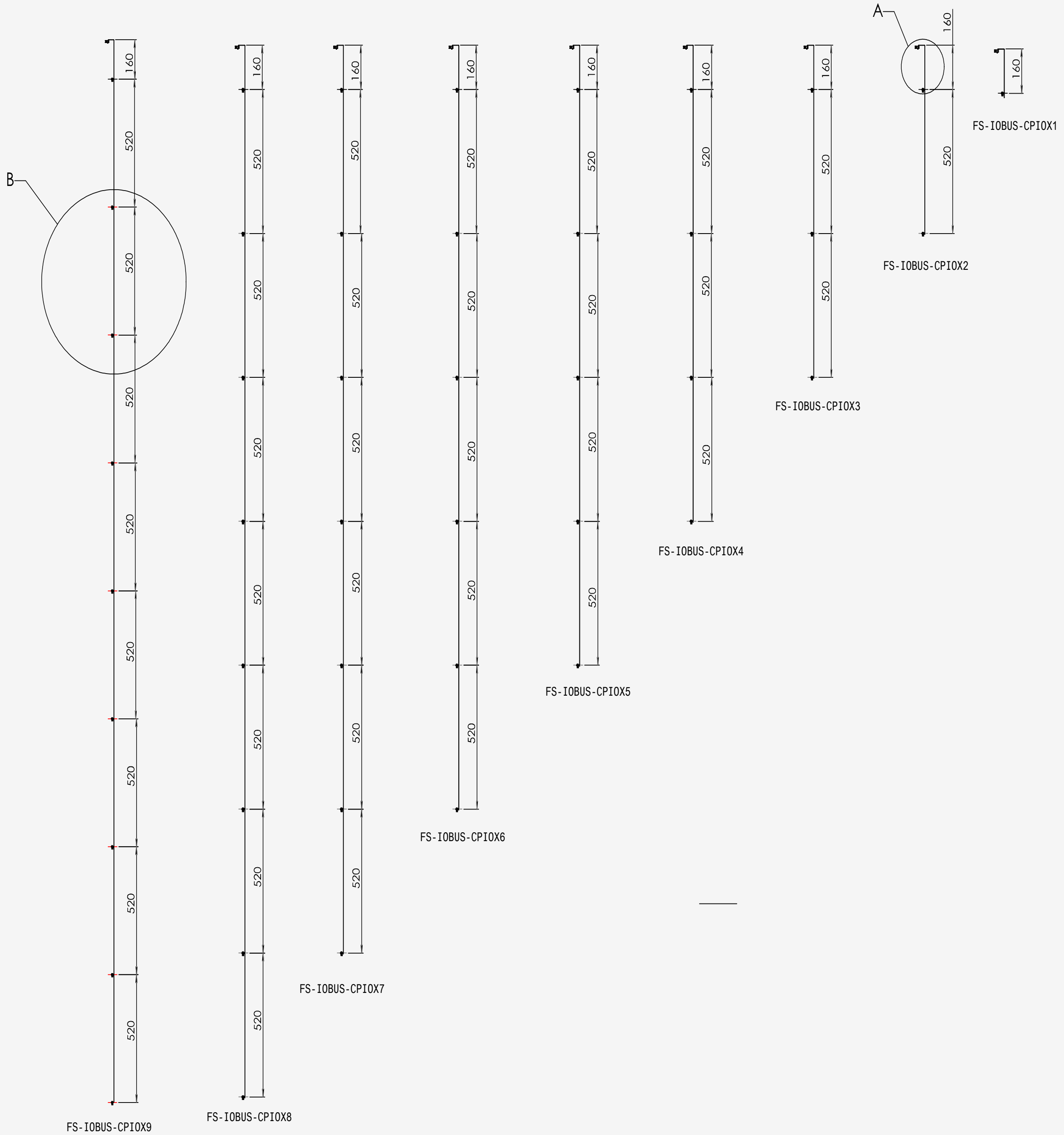


Figure 14-19: Separate cable assemblies

- The IOBUS-CPIOX1 is used for connection between controller chassis and I/O chassis in position 1.
- The IOBUS-CPIOX2 is used for connection between controller chassis and I/O chassis in position 1 and 2.
- The IOBUS-CPIOX3 is used for connection between controller chassis and I/O chassis in position 1, 2, and 3.
- The IOBUS-CPIOX4 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, and 4.•
- The IOBUS-CPIOX5 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4 and 5.
- The IOBUS-CPIOX6 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, and 6.
- The IOBUS-CPIOX7 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, 6, and 7.
- The IOBUS-CPIOX8 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, 6, 7 and 8.
- The IOBUS-CPIOX9 is used for connection between controller chassis and I/O chassis in position 1, 2, 3, 4, 5, 6, 7, 8, and 9.

14.8.2 Technical data

General	Type numbers:	FS-IOBUS-CPIOX1 FS-IOBUS-CPIOX2 FS-IOBUS-CPIOX3 FS-IOBUS-CPIOX4 FS-IOBUS-CPIOX5 FS-IOBUS-CPIOX6 FS-IOBUS-CPIOX7 FS-IOBUS-CPIOX8 FS-IOBUS-CPIOX9
	Approvals:	UL, CSA, VDE

14.9 IOBUS-CPX-x

14.9.1 IO bus from controller cabinet to extension cabinet

The IOBUS-CPX1x (where x = 1 or 2) is an IO bus (34-wire flat cable) from the Controller backplane (CPB-0001, CPB-0002 or CPB-0003) to an IOBUS-CPIOX in the top of an extension cabinet.

All scan, test and update actions between the QPP module and IO modules are routed via these IO busses.

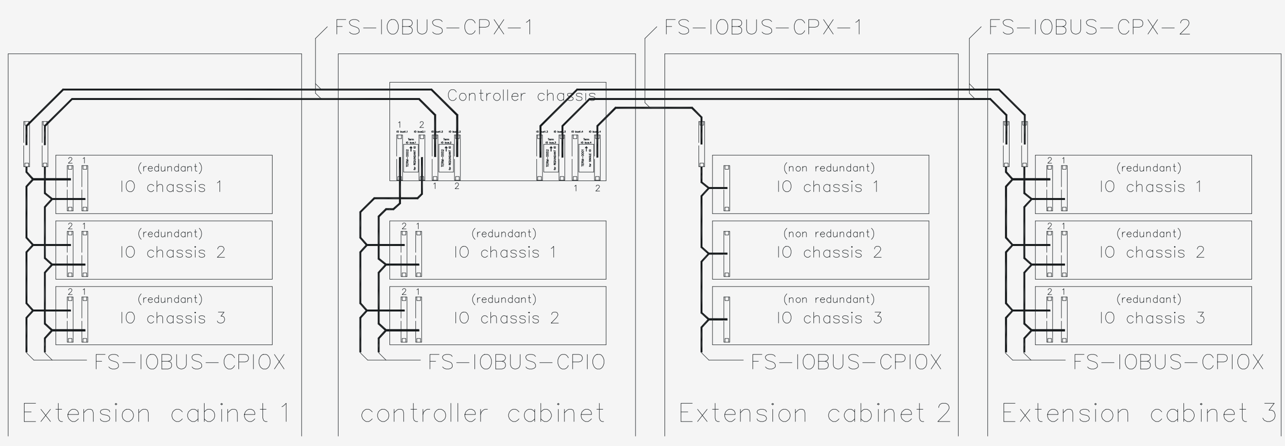


Figure 14-20: IO busses example with four cabinets

The IOBUS-CPX-x is used for redundant as well as non-redundant configurations.

- The IOBUS-CPX-1 is used between a controller cabinet and an extension cabinet next to the controller cabinet.
- The IOBUS-CPX-2 is used between a controller cabinet and an extension cabinet next to another extension cabinet.

The below figure shows a side view of the IOBUS-CPX-x.

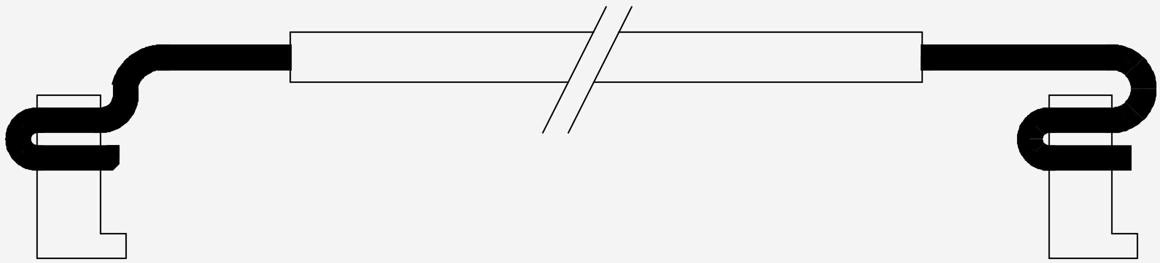


Figure 14-21: IOBUS-CPX-x side view

14.9.2 Technical data

General	Type numbers:	FS-IOBUS-CPX-1 (length 3.4 m) FS-IOBUS-CPX-2 (length 4.2 m)
	Approvals:	UL, CSA
Physical	Length:	3.4 resp. 4.2 m
	Connectors:	34 pole latch (female)

14.10 IOBUS-CPX1x

14.10.1 IO bus from Controller cabinet to extension cabinet

The IOBUS-CPX1x (where x = 1 or 2) is an IO bus (34-wire flat cable) from the Controller backplane (CPB-0001, CPB-0002 or CPB-0003) to an IOBUS-CPIOX in the top of an extension cabinet. The connector that is the closest to the ferrite is connected to the controller chassis.

All scan, test and update actions between the QPP module and IO modules are routed via these IO busses. The IOBUS-CPX1x is used for redundant as well as non-redundant (Controller and/or IO) configurations.

- The IOBUS-CPX11 is used between an IO bus with ferrite from CP chassis to first extension cabinet.
- The IOBUS-CPX12 is used between an IO bus with ferrite from CP chassis to second extension cabinet.

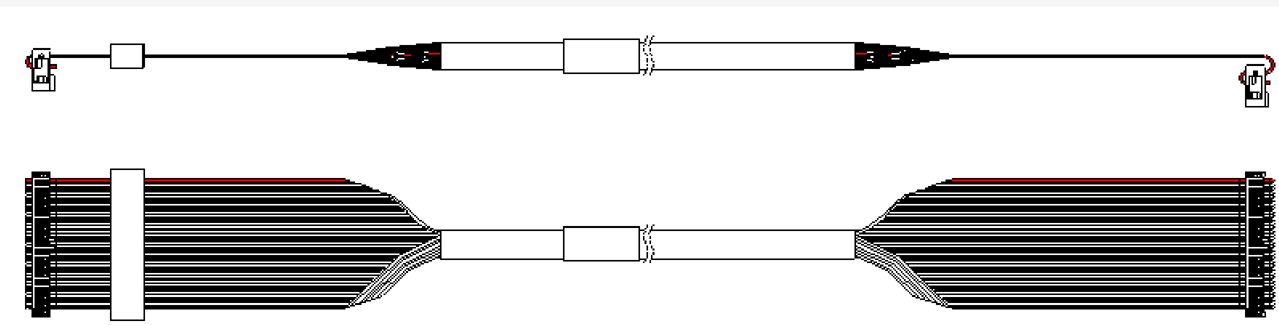


Figure 14-22: Example of an IO bus plus ferrite

14.10.2 Technical data

General	Type numbers:	FS-IOBUS-CPX11 FS-IOBUS-CPX12
	Approvals:	UL, CSA, VDE
Physical	Length:	3.4 resp. 4.2 m
	Connectors:	34 pole latch (female)

15 Field Termination Assembly Module

This chapter describes the field termination assembly modules that are available for Safety Manager.

The following Field Termination Assembly (FTA) modules are described:

FTA	
Input FTAs	
TIDI-1624	Non-safe Isolated passive digital input FTA (16 channels)
TSAI-0410	Safe analog input FTA (4 channels)
TSAI-1620m	Safe 0-20 mA and 4-20 mA analog input FTA (16 channels)
TSDI-16UNI	Safe digital input FTA (24/48 V DC, NAMUR, 16 channels)
TSDI-16115	Safe active/passive digital input FTA (115 V AC/dc, 16 channels)
TSDI-1624	Safe digital input FTA (24 V DC, 16 channels)
TSDI-1624C	Safe current-limited digital input FTA (24 V DC, 16 channels)
TSDI-1648	Safe digital input FTA (48 V DC, 16 channels)
TSFIRE-1624	Safe fire detector input FTA with line monitoring (24 V DC, 16 channels)
TSGAS-1624	Safe gas / flame detector input FTA (0-20 mA, 16 channels)
TSGASH-1624P	Safe gas/flame detector input FTA with HART interface (0-20 mA, 16 channels)
TSHART-1620m	Safe 0-20 mA and 4-20 mA analog input FTA with HART interface (16 channels)

FTA	
Output FTAs	
TDO-1624	Non-safe digital output FTA (24 V DC, 16 channels)
TDOL-07120	Line-monitored relay contact digital output (7 channels, 120Vac/120Vdc)
TDOL-0724P	Line-monitored relay contact digital output (7 channels, 24Vdc)
TDOL-0724U	Line-monitored relay contact digital output (7 channels, 24Vdc, RUSIO)
TRO-0824	Non-safe dry digital output FTA (8 channels, NO/NC)
TRO-1024	Non-safe dry digital output (relay contact) FTA (10 channels)
TSAO-0220m	Safe analog output FTA (0(4)-20 mA, 2 channels)
TSAOH-0220m	Safe analog output FTA with HART interface (0-20mA, 2 channels)
TSDO-04UNI	Safe digital output FTA (24/48/110 V DC, 4 channels)
TSDO-0424	Safe digital output FTA (24 V DC, 4 channels)
TSDO-0824	Safe digital output FTA (24 V DC, 8 channels)
TSDO-0824C	Conformal coated safe digital output FTA, current limited (24 V DC, 8 channels)
TSDOL-0424C	Conformal-coated safe digital output FTA, current limited, loop monitored (24 V DC, 4 channels)
TSRO-0824	Safe dry digital output FTA for SIL3 applications (8 channels)
Special FTAs	
DCOM-232/485	RS232/485 communication FTA
DCOM-485	RS422/485 communication FTA
MTL 24571	Single channel ethernet surge protector
SDW-550EC	5 port HSE communication FTA or "switch"
TPSU-2430	24 V DC to 30 V DC / 1 A converter
TSKUNI-1624	Sub-D to Knife terminals FTA (Universal,16ch)
TSPKUNI-1624	Sub-D to Powered Knife terminals FTA (Universal,16ch)
Remote IO termination assemblies	
IOTA-NR24	Non-redundant IO Termination Assembly
IOTA-R24	Redundant IO Termination Assembly

15.1 General info about Termination Assembly modules

Termination assembly modules are divided in two main groups:

- Field Termination Assembly (FTA) modules that are used in combination with Safety Manager chassis IO modules.

  See FTA modules in chapter Safety Manager Glossary.

- Termination Assembly modules that are used in combination Universal Safety IO modules.

  See Termination Assembly modules for Universal Safety IO modules in chapter General info about Termination Assembly modules.

15.1.1 FTA modules for Safety Manager chassis IO modules

This type of Field Termination Assembly (FTA) module is the interface between field components (e.g. sensors and valves) and chassis IO modules in Safety Manager.

FTA modules are connected to an IO module via a system interconnection cable (e.g. SICC-0001/Lx), which is plugged into the SIC connector on the FTA module.

The below tables show the possible connections of field signals to IO modules.

Table 1. possible connections of input field signals to input modules

<table>
<tr><th colspan="5">Input signals</th></tr>
<tr><td colspan="2">Field signal</td><td colspan="2">SICP cable</td><td>Input module</td></tr>
<tr><td colspan="2">Field signal</td><td>SICP cable</td><td>Input converter module</td><td>Input module</td></tr>
<tr><td>Field signal</td><td>FTA</td><td colspan="2">SICC cable</td><td>Input module</td></tr>
<tr><td>Field signal</td><td>FTA</td><td>SICC cable</td><td>Input converter module</td><td>Input module</td></tr>
</table>

Table 2. possible connections of output field signals to output modules

Output signals				
Output module		SICP cable		Field signal
Output module	Output converter module	SICP cable		Field signal
Output module		SICC cable	FTA	Field signal
Output module	Output converter module	SICC cable	FTA	Field signal

Specific FTAs can only be used with particular IO or IO converter modules. Table 3 shows possible FTA - IO module combinations and Table 4 shows possible FTA-CP module combinations.

Table 3. possible FTA-IO module combinations

FTA module	Input module	Output module	Remarks
TDO-1624		DO-1624	
		DO-1224	
TDOL-07120	SDI-1624	SDO-0824	both modules are required
TDOL-0724P	SDI-1624	SDO-0824	both modules are required
TIDI-1624	SDI-1624		
TPSU-2430			30 Vdc supply for other FTAs
TRO-0824		SDO-0824	
TRO-1024		RO-1024	
TSAI-0410	SAI-0410		
TSAI-1620m	SAI-1620m		
TSAO-0220m		SAO-0220m	
TSAOH-0220m		SAO-0220m	with HART connection
TSDI-16115	SDI-1624		
TSDI-1624	SDI-1624		
TSDI-1624C	SDI-1624		
TSDI-1648	SDI-1648		
TSDI-16UNI	SDIL-1608		
	SDI-1624		
	SDI-1648		
TSDO-04UNI		SDO-0448	
		SDO-04110	
		SDOL-0424	
		SDOL-0448	
TSDO-0424		SDO-0424	
TSDO-0824		SDO-0824	

FTA module	Input module	Output module	Remarks
TSDO-0824C		SDO-0824	
TSDOL-0424C		SDOL-0424	
TSFIRE-1624	SAI-1620m		
TSGAS-1624	SAI-1620m		
TSGASH-1624P	SAI-1620m		with HART connection
TSHART-1620m	SAI-1620m		with HART connection
TSRO-0824		SDO-0824	floating, non commoned, output contacts
TSRO-08UNI		SDO-0824	1 common for output contacts

Table 4. possible FTA-CP module combinations

FTA module	CP module	Remarks
DCOM-232/485	USI-0002	5 port HSE communication FTA or "switch"

15.1.2 Termination Assembly modules for Universal Safety IO modules

This type of Termination Assembly (TA) module is the interface between field components (e.g. sensors and valves) and Universal Safety IO modules of Safety Manager.

In all cases an IO Termination Assembly (IOTA) module is required. The purpose of an IOTA module is that of a facilitator. An IOTA module provides connections for power supply and communication for either redundant or non-redundant Universal Safety IO modules.

For certain purposes additional TA modules may be required or benificial.

The below table shows the possible combinations of TA modules and Universal Safety IO modules.

Table 1. possible combinations of TA, IOTA and Universal Safety IO modules

Field signal	TA module	Cable	IOTA module[1]	Universal Safety IO
Mixed			IOTA	RUSIO-3224 or RUSLS-3224
Mixed	TSPKUNI-1624	Yes	IOTA	RUSIO-3224 or RUSLS-3224
Output	TDOL-0724U	Yes	IOTA	RUSIO-3224 or RUSLS-3224

1. In this table ‘IOTA’ applies to both non-redundant and redundant applications.

15.2 DCOM-232/485

15.2.1 RS232/485 communication FTA

The communication FTA DCOM-232/485 is the combined RS232/485 communication interface of Safety Manager. It is used to provide Safety Manager with a RS485/422 or a RS232 connection.

The communication FTA may be driven by one (or a pair of redundant) Control Processor(s). The communication FTA does not require separate supply wiring. It is supplied by the connected Control Processor(s). The communication FTA must be connected with earth (use the supplied terminal). This will connect the shield of the internal cable(s) and the housing of the field connector(s) with (cabinet-) earth. For information on required communication cables, see section Communication cables.

The module has a universal snap-in provision for standard DIN EN rails.

Usage of DCOM-232/485

- It can be used for RS-232 and RS-485 communication with SM-SM SafeNet and 3rd party equipment.
- It cannot be used for RS-485 FSC-SM SafeNet communication for 1M or 2M baudrate.
- It is a preferred FTA for RS-232 communication.

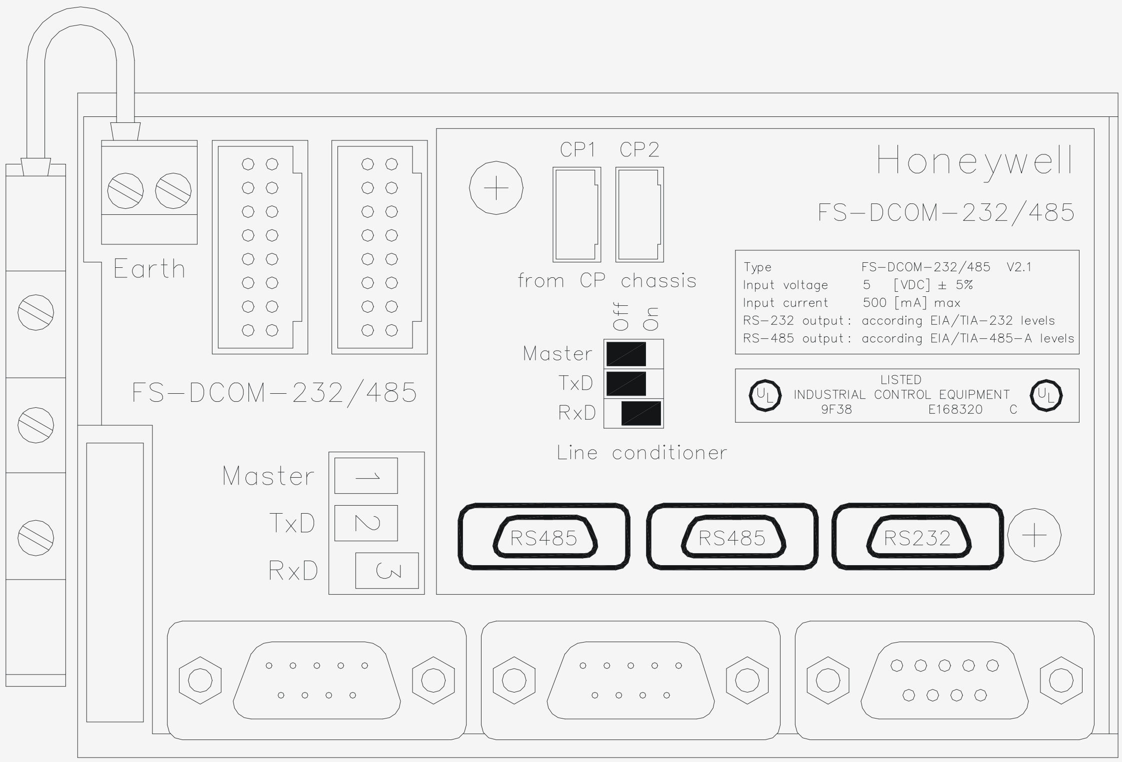


Figure 15-1: Top view of the DCOM-232/485 communication FTA

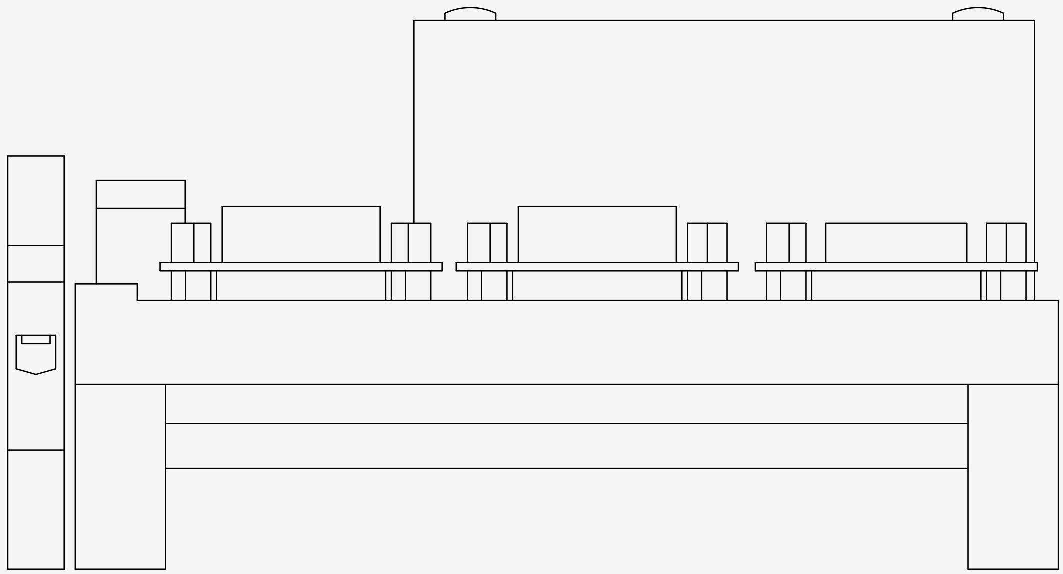


Figure 15-2: Front view of the DCOM-232/485 communication FTA

15.2.2 Connectors

The below table describes the connectors present on the DCOM-232/485.

Table 1. Connections for the DCOM-232/485

Connector	Quantity	Description	Use with cable
2-pin earth connector	1	FTA connection to cabinet earth (see Figure 1).	-
2-pin earth terminal		1 FTA connection to cabinet earth	Supplied
9pole sub-D male	2	Used for RS422 or RS485 communication. The two connectors are identical: if only one is used, then the other needs an end of line terminator.	CCE-485-01/Lx CCE-485-02/Lx EOL-485-01
9pole sub-D female	1	Used for RS232 communication.	CCE-232-01/Lx CCE-232-02/Lx
16-pins male	2	Communication and supply connection to the Control Processor (s).	CCI-UNI-02 CCI-UNI-04

15.2.3 Pin allocation

The below figure shows the pin allocation of the RS232 and RS485 connectors on the DCOM-232/485 communication FTA.

- The RS485/422 connectors are male type connectors.
- The RS232 connector is a female type connector.
- The pin assignment for the RS485/422 connectors depends on the position of the “Master” switch (dip switch 1).

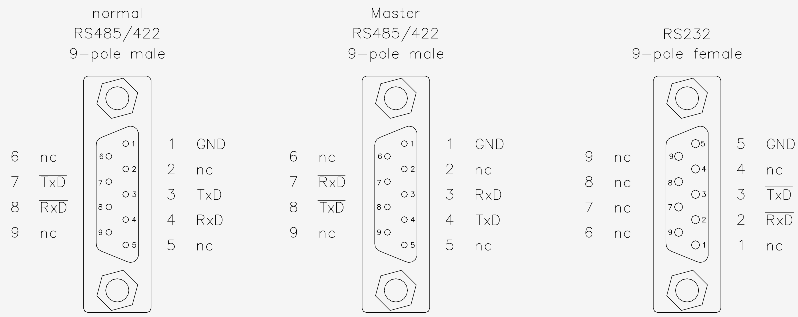


Figure 15-3: Pin allocation of the connectors on the DCOM-232/485[1]

Note:

1. Figure 1 shows the physical location of these connectors.

15.2.4 Dip switches

The DCOM-232/485 contains three color-coded dip switches for configuration of the external RS485/422 communication lines.

15.2.4.1 Line conditioner

A line conditioner consists of a pull-up and a pull-down resistor of 680 Ω each.

Line conditioners are connected to the RxD lines if switch 2 and/or 3 are ON. With these resistors connected, the receivers will get less noise during the periods in which no transmitter is active on the line.

15.2.5 DIP switch settings

The below figure and table show the possible settings when configuring the DCOM-232/485.

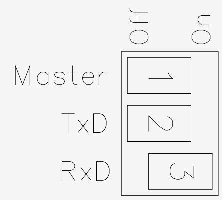


Figure 15-4: Detail of the DCOM-232/485 dip switches

- Dip switch 1 (Master) selects the RS485/422 pin configuration.
  - The *Off* position is “normal”.
  - The *On* position changes the pin allocation of the RS485/422 connectors from “normal” to “master”.

This switch makes it possible to use one-on-one cables only (see e.g. CCE-485-01/Lx). In case of a communication-master re configuration, no new cabling is required (provided only one-on-one cables are used).

- Dip switch 2 (TxD) is the line conditioner for the transmitter lines (on pins 3 and 7).
- Dip switch 3 (RxD) is the line conditioner for the receiver lines (on pins 4 and 8).

Usage of DCOM 232/485

- It can be used for RS-232 and RS-485 communication with SM-SM SafeNet and 3rd party equipment.
- It cannot be used for RS-485 FSC-SM SafeNet communication for 1M or 2M baudrate.
- It is a preferred FTA for RS-232 communication.

Table 1. dip switch settings for the DCOM-232/485[1]

DCOM-232/485 Configuration	Dip switch 1	Dip switch 2	Dip switch 3
RS422 Point-to-point	On/Off[2]	On	On
RS485 Slave	Off	Off	Off
RS485 Master	On	On	On
RS485 Master half duplex	On	On	Off
RS232 Point-to-point	Off	Off	On

1. *On* and *Off* positions are marked on the actual module (see Figure 1).
2. When using standard one-on-one cables (e.g. cable CCE-485-01/Lx), dip switch 1 of the DCOM-232/485 on one side must be On and dip switch 1 of the other DCOM-232/485 must be *Off*.

   When using a cross-cable, dip switch 1 of both DCOM-232/485s must be *Off*.

Note:
For proper RS232 operation, it is important that dip switch 3 is *On*!

15.2.6 Cable lengths

The maximum (total) cable length for RS232, RS422 and RS485 communication depends on the baud rate and the communication method (full-duplex or half-duplex).

The below table gives the maximum cable length provided a proper cable type is used.

Table 1. Maximum cable length versus baud rate

communication method	baud rate	maximum cable length
RS232 full-duplex	≤ 100 kBd	10 m
RS422 full-duplex RS485 full-duplex	≤ 100 kBd	1.2 km
	≤ 125 kBd	1 km
	≤ 1 MBd	120 m
	≤ 2 MBd	60 m
RS485 half-duplex	≤ 100 kBd	600 m
	≤ 125 kBd	500 m
	≤ 1 MBd	60 m
	≤ 2 MBd	30 m

15.2.7 Fan in/fan out

- RS232 connections are point to point only
- RS422 connections are point to point only
- RS485 full duplex connections allow maximum 32 connected devices
- RS485 half duplex connections allow maximum 16 connected devices

15.2.8 Technical data

General	Type numbers:	FS-DCOM-232/485
		FC-DCOM-232/485
	Approvals:	CE, TUV, UL, FM
Physical	Module dimensions:	110 × 70 × 61 mm (L × W × H) 4.33 × 2.76 × 2.40 in (L × W × H)
	Terminal dimensions:	6 × 57 × 47 mm (L × W × H) 0.24 × 2.24 × 1.85 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	117 mm (4.6 in)
Power	Input voltage:	5 V DC ±5%
	Input current:	Max 500 mA, supplied by the Control Processor(s)
Output	RS232 output:	According EIA/TIA-232 levels
	RS232 baudrate:	0-250 kBaud
	RS485/422 output:	According EIA/TIA-485-A levels
	RS485/422 baudrate:	0-2 MBaud (transparent, FM0, FM1 or Manchester coded)

15.3 DCOM-485

15.3.1 RS422/485 communication FTA

The communication FTA DCOM-485 is the RS422/485 communication interface of Safety Manager. It is used to provide Safety Manager with a RS422/485 connection facilities including Manchester, FM0 or FM1 modulation/demodulation at 1Mb and 2Mb.

The communication FTA may be driven by one (or a pair of redundant) Universal Communication Units (USI) in a Safety Manager Controller processor cabinet. The communication FTA does not require separate supply wiring. It is supplied by the connected Control Processor backplane. The communication FTA must be connected with earth (use the supplied earth terminal). This will connect the shield of the internal cable (s) and the housing of the field connector(s) with (cabinet-) earth. For information on required communication cables, see section Communication cables.

Use end of line terminators (EOL-485-01) on both ends of the communication link. They can be placed on the free (9 pole D) connectors.

The module has a universal snap-in provision for standard DIN EN rails.

Usage of DCOM-485

- It can be used for all RS-485 communication.
- It is a preferred FTA for RS-485 communication as it has no limitations.

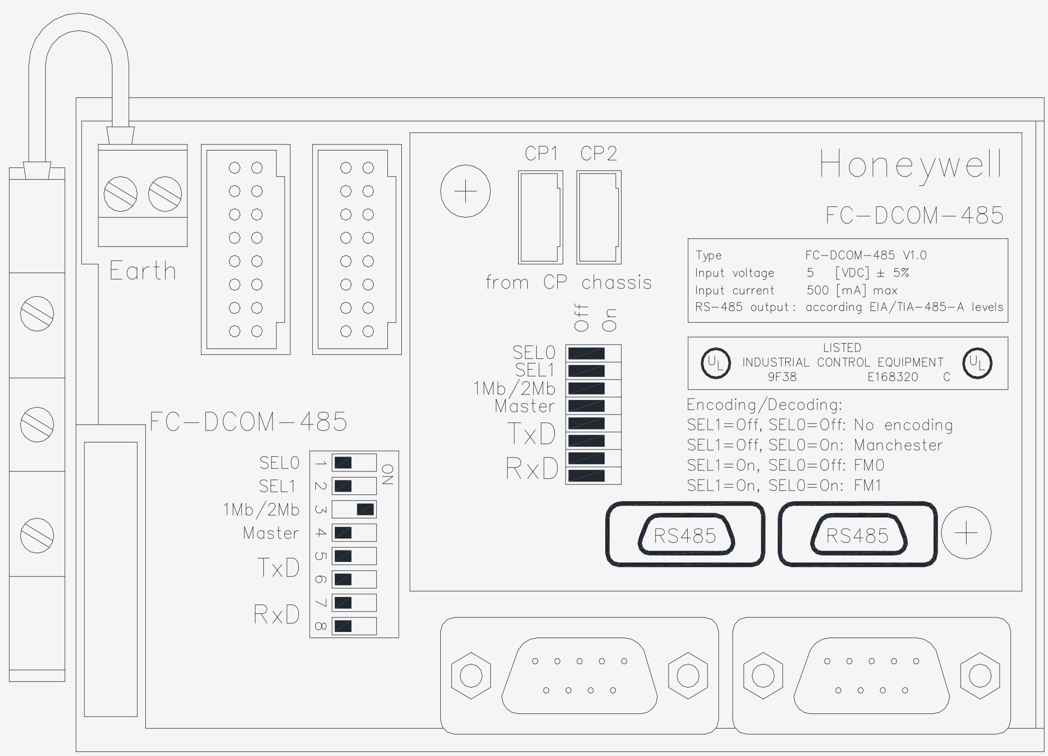


Figure 15-5: Top view of the DCOM-485 communication FTA

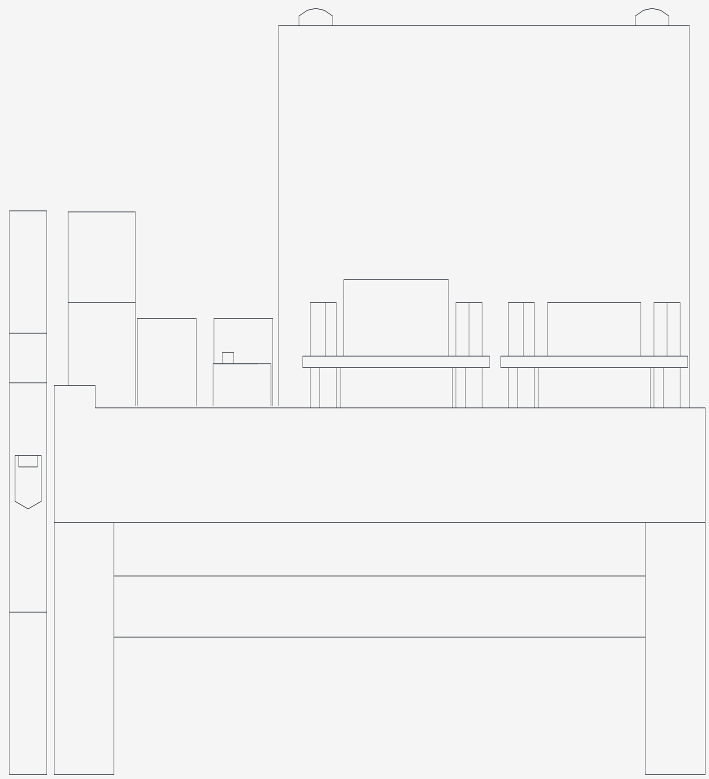


Figure 15-6: Side view of the DCOM-485 communication FTA

15.3.2 Connectors

The below table describes the connectors for the DCOM-485.

Table 1. connections for the DCOM-485

Connector	Quantity	Description	Use with cable
2-pin earth connector	1	FTA connection to cabinet earth (see Figure 1).	-
2-pin earth terminal		1 FTA connection to cabinet earth	Supplied
9pole sub-D male	2	Used for RS485 communication. The two connectors are identical: if only one is used, then the other needs an end of line terminator.	CCE-485-01/Lx CCE-485-02/Lx EOL-485-01
16-pins male	2	Communication and supply connection to the Control Processor(s).	CCI-UNI-02 CCI-UNI-04

15.3.3 Pin allocation

The below figure shows the pin allocation of the RS422 and RS485 connectors on the DCOM-485 communication FTA.

In RS422 connections, switch 4 of one DCOM-485 should be ON and the other should be OFF, or use a cross cable and put both switches in the same position.

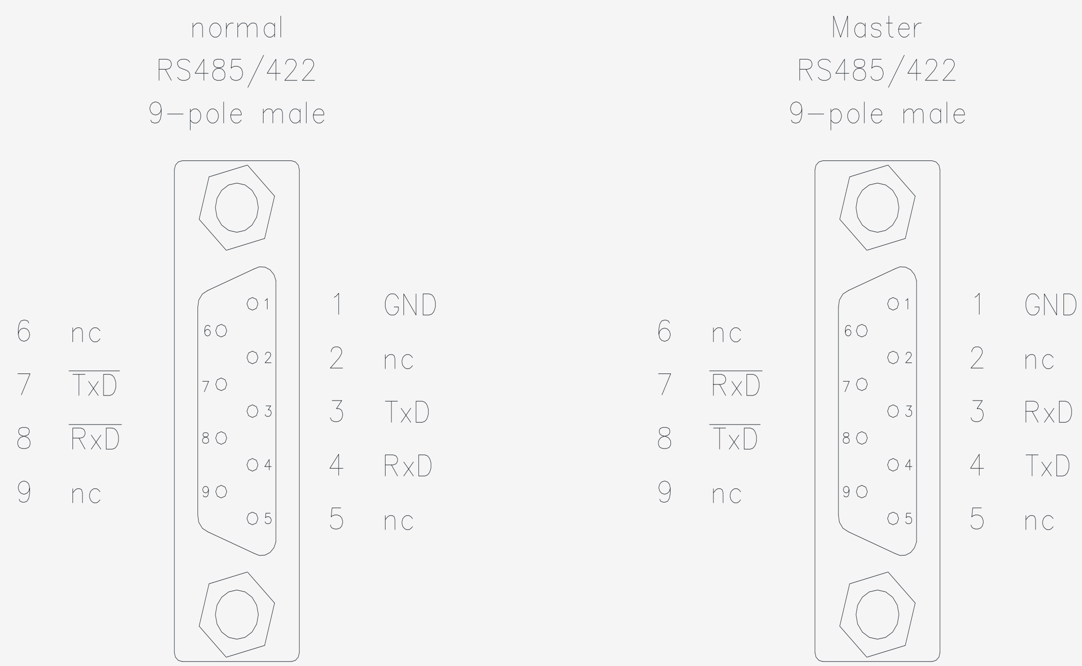


Figure 15-7: Pin allocation of the connectors on the DCOM-485

15.3.4 Dip switches

The DCOM-485 has 8 dip switches for selection of the modulation/demodulation method, the baud rate, and the configuration of the communication lines.

15.3.4.1 Modulation/demodulation selection

Switch 1 and 2 select the modulation/demodulation method.

- Switch 1 OFF + switch 2 OFF: Baudrates other than 1Mb or 2Mb
- Switch 1 OFF + switch 2 OFF: No modulation/demodulation
- Switch 1 ON + switch 2 OFF: Manchester

- Switch 1 OFF + switch 2 ON: FM0
- Switch 1 ON + switch 2 ON: FM1

15.3.4.2 Modulation/demodulation baud rate selection

Switch 3 selects the modulation/demodulation baud rate.

- Switch 3 OFF: 1Mbaud modulation/demodulation
- Switch 3 ON: All other baud rates.

15.3.4.3 Master/Slave selection

Switch 4 selects the Master or Slave.

This switch enables the use of one single cable type for all connections (Master/Slave and Slave/Slave). The required transmit-wires/receive-wires cross is 'done' by means of switch 4 on the Master.

- Switch 4 OFF: Normal / Slave
- Switch 4 ON: Master

Other selections may apply if (old) cables are used that have the master/slave cross in their connections.

15.3.4.4 Line conditioner

A line conditioner consists of a pull-up and a pull-down resistor of 680 Ω each.

Line conditioners are connected to:

- Switch 5: pull-down on pin 7
- Switch 6: pull-up on pin 3
- Switch 7: pull-down on pin 8
- Switch 8: pull-up on pin 4

Only the line conditioners of the Master are closed (ON); the line conditioners on all slaves stay open (OFF).

In half duplex mode (2 wire) only, switch 5 and 6 of the master are closed (ON); switch 7 and 8 stay open (OFF).

Usage of DCOM-485

- It can be used for ALL RS-485 communication.
- It is a preferred FTA for RS-485 communication as it has no limitations.

15.3.5 Cable lengths

The maximum (total) cable length for RS422 and RS485 communication depends on the baud rate and the communication method (full-duplex or half-duplex).

The below table gives the maximum cable length provided a proper cable type is used.

Table 1. Maximum cable length versus baud rate

communication method	baud rate	maximum cable length
RS422 full-duplex RS485 full-duplex	≤ 100 kBd	1.2 km
	≤ 125 kBd	1 km
	≤ 1 MBd	120 m
	≤ 2 MBd	60 m
RS485 half-duplex	≤ 100 kBd	600 m
	≤ 125 kBd	500 m
	≤ 1 MBd	60 m
	≤ 2 MBd	30 m

15.3.6 Fan-in / fan-out

- RS422 connections are point to point only
- RS485 full duplex connections allow for maximum 32 connected devices
- RS485 half duplex connections allow for maximum 16 connected devices

15.3.7 Technical data

General	Type number:	FC-DCOM-485
	Approvals:	CE, TUV, UL pending
Physical	Module dimensions:	110 x 70 x 61 mm (L x W x H) 4.33 x 2.76 x 2.40 in (L x W x H)
	Earth Terminal dimensions:	6 x 57 x 47 mm (L x W x H) 0.24 x 2.24 x 1.85 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	117 mm (4.6 in)
Power	Input voltage:	5 V DC ±5%
	Input current:	Max 500 mA, supplied by the Control Processor(s)
Output	RS485/422 output:	According EIA/TIA-485-A levels
	RS485/422 baud rate:	0—2 MBaud (transparent, Manchester, FM0, FM1)

15.4 IOTA-NR24

15.4.1 Non-redundant IO Termination Assembly

The IOTA-NR24 assembly enables the use of one RUSIO-3224 or RUSLS-3224 module. For physical and schematic representations of the IOTA-NR24 see Figure 1 and Figure 2.

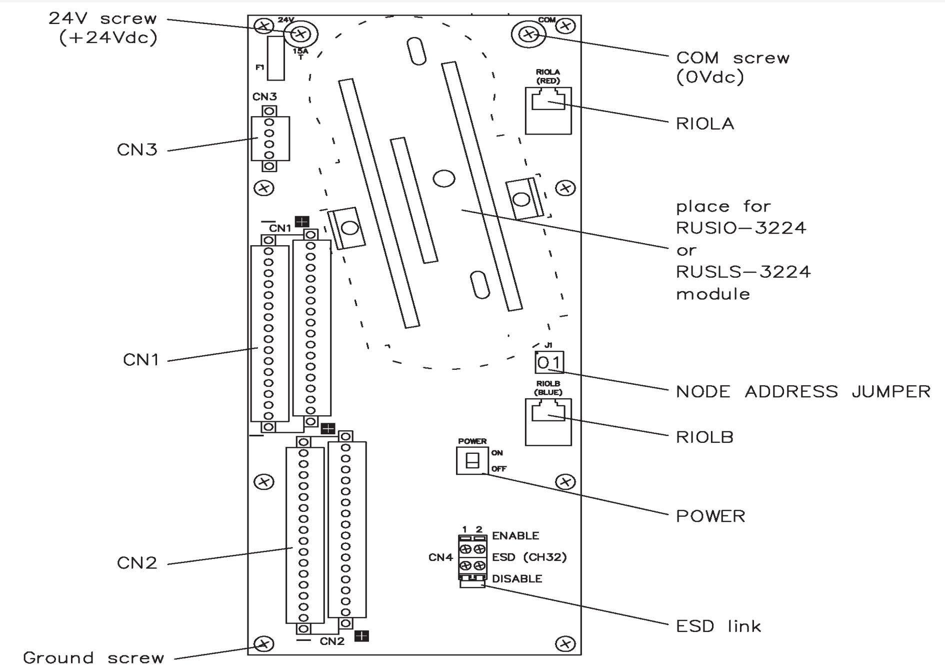


Figure 15-8: Mechanical layout

The IOTA-NR24 can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

The IOTA-NR24 provides for:

- connectors for one RUSIO-3224 or RUSLS-3224 module
- 32 (universal) IO channel connections (CN1 and CN2)
- 4 (identical) V+ connections (CN3), for active AI devices
- Two RJ45 connectors for 100MB Ethernet communication (RIOLA and RIOLB)
- 24V power connection (24V screw and COM screw to the carrier power rails)

The RUSIO-3224 or RUSLS-3224 module is placed on the indicated position of the IOTA-NR24. See Figure 1 for details.

The IOTA-NR24 module has a switch:

- Use POWER to switch the Module on and off

The node number of the IOTA-NR24 is set by placing the proper node addres jumper on the IOTA-NR24 assembly.

The Emergency ShutDown (ESD) function can be enabled or disabled with the ESD (CH32) link.

The IO field signals are connected on CN1 and CN2; see Figure 1. The minus-row of CN1 and CN2 (left side) are all connected with 0V. The plus-row of CN1 and CN2 (right side) are the 'real' channels. Any type of IO field signal has only to be connected to the two connections of the applicable universal channel.

CN3 is used to connect active AI devices.

The IOTA-NR24 module has two connectors to link the RUSIO-3224 or RUSLS-3224 module with the Safety Manager Controller:

- The RIOLA connector is used for link ‘A’
- The RIOLB connector is used for link ‘B’

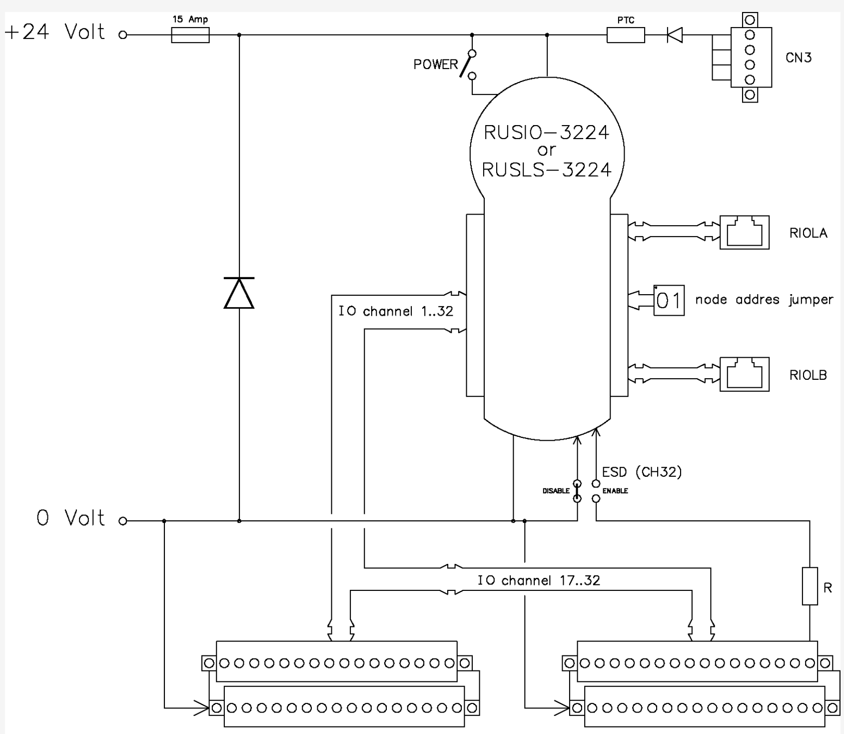


Figure 15-9: Block diagram

15.4.2 Mounting

The IOTA-NR24 is mounted on a (metal) carrier (18 inch or 36 inch long). For details see:

- MCAR-01
- MCAR-01

The carrier provides the ground rail and the (+24V and 0V) power rails.

15.4.3 Connections

15.4.3.1 Channel 1 thru 16 on CN1

IO-channel 1 thru 16 are terminated on CN1.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

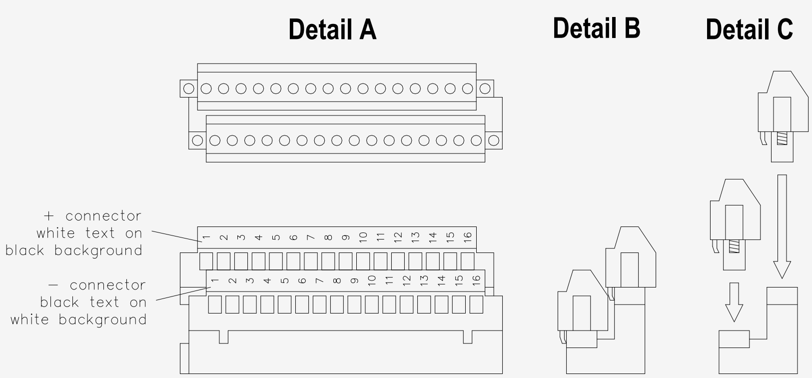


Figure 15-10: Channel 1 thru 16 on CN1

15.4.3.2 Channel 17 thru 32 on CN2

IO-channel 17 thru 32 are terminated on CN2.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

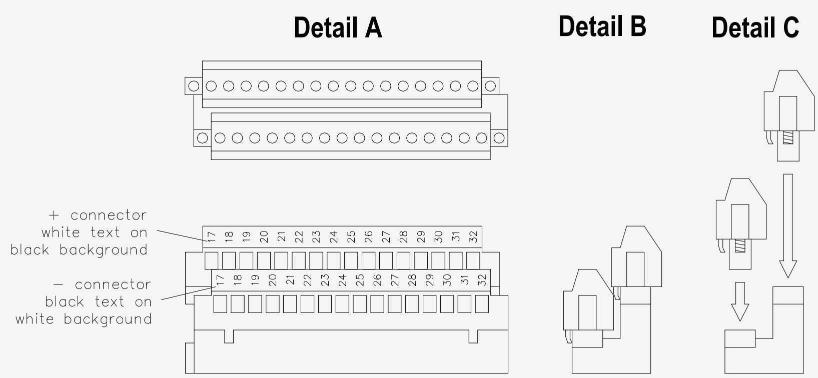


Figure 15-11: Channel 17 thru 32 on CN2

15.4.3.3 V+ connections on CN3

CN3 has four (uni-directional) V+ connections for field signals that require a passive analog input. For details about this type of channel configuration see RUSIO-3224 or RUSLS-3224.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connector placed.

Detail C shows the second side-view with the field-connector removed.

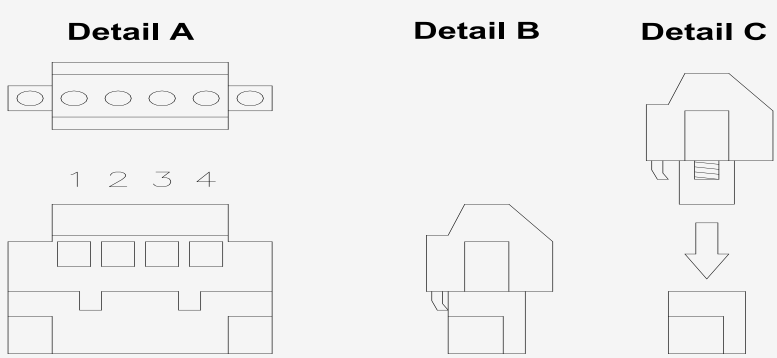


Figure 15-12: V+ connections on CN3

15.4.3.4 Ethernet connectors

The ethernet connectors (RIOLA and RIOLB) are shielded RJ-45 connectors.

The pin assignment of the RJ-45 connectors is shown below.

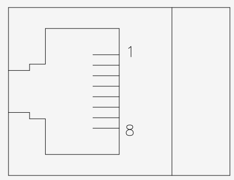


Figure 15-13: Ethernet Connectors

Contact	Signal	Direction	Description
1	TD+	Out	Transmitted data
2	TD-	Out	Transmitted data
3	RD+	In	Received data
4	-		
5	-		
6	RD-	In	Received data
7	-		
8	-		
Case	Shield		HF-connection to earth

15.4.3.5 ESD enable / disable link

The ESD function (on channel 32) can be enabled (or disabled) with a link on the IOTA.

In case the link is placed in the drawn position (See the below figure), channel 32 can be used as universal channel (analog or digital; input or output).

In case the link is in the ENABLE position, channel 32 must be used as ESD input.

A (normally closed) ESD switch (with 1 kOhm series resistor) must be connected between CH32+ and CH32- of the IOTA.

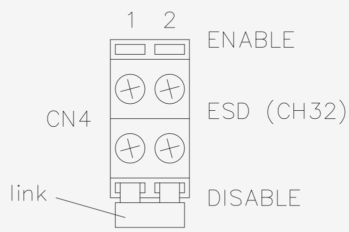


Figure 15-14: ESD (CH32) link

15.4.4 Node address jumpers

The node address jumper is used to give the processors in the RUSIO-3224 or RUSLS-3224 module(s) the node address of the IOTA.

The jumper is a 10.2 x 10.2 x 6.1 mm (0.4 x 0.4 x 0.24 in) gray plastic jumper set; it has a (two digit) number that is clearly visible.

For an example of a node address jumper see the below figure.

The jumpers are available in kits of ten numbers:

- 51153818-201 is a kit with the numbers 01 thru 10.
- 51153818-202 is a kit with the numbers 11 thru 20.
- 51153818-203 is a kit with the numbers 21 thru 30.
- 51153818-204 is a kit with the numbers 31 thru 40.

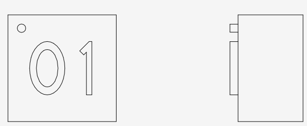


Figure 15-15: Node address jumper - front and side view

15.4.5 RUSIO-3224/RUSLS-3224 connections

The IOTA-NR24 assembly supports all IO types that can be configured in the RUSIO-3224 or RUSLS-3224 module.

The supported IO types are:

- Line monitored digital input
- Non line monitored digital input
- Line monitored ESD input (on Channel 32)
- Analog input 0-20mA or 4-20mA
- Digital output (0.5 A), with or without configurable line monitoring
- Multiple digital output (1 A or 2 A), with or without line monitoring
- Analog output 0-20mA or 4-20mA

Further details on the connection and specifications of these IO types is described elsewhere. See RUSIO-3224 or RUSLS-3224.

The below figure shows the IO connection diagram of the IOTA-R24 .

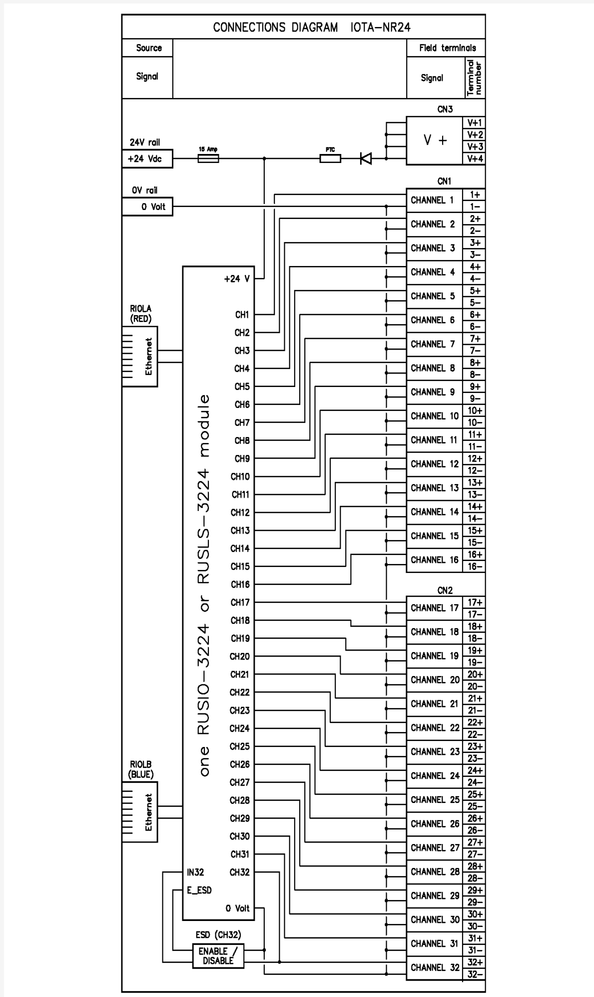


Figure 15-16: Connection diagram

15.4.6 Technical data

The IOTA-NR24 assembly has the following specifications:

General	Type number:	FC-IOTA-NR24
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE, UL, TUV
Power	Supply voltage:	24 V DC -15%..+30%
	Supply load:	max. 10 A
	Reverse polarity protection:	parallel diode (blows the fuse)
	V+ pins:	
	• Max. current:	1 A (total of four CN3 pins)
	• Max. voltage drop:	<1.5V (at 0.7A)
	• Max. reverse voltage:	36V
Fuse	Fuse rating:	15 A
	Fuse dimensions:	Blade 5x19 mm
	Voltage rating AC:	-
	Voltage rating DC:	32 V
	Manufacturer:	Littelfuse
	Manufacturer PN:	0287015.PXS

Connections	24V supply:	2 x M4 (to power rail of the carrier)
	Ground:	8 x M3.5 (to metal of the carrier)
	Ethernet:	RJ-45
	IO (CN1 and CN2):	Weidmuller: BLZ 5.08/16/90F SN SW
	V+ (CN3):	Weidmuller: BLZ 5.08/4/90F SN SW
	Screw terminals (CN1,CN2,CN3):	
	• Max. wire size:	0.50 .. 2.50 mm^2
	• Strip length:	7 mm
	• Tightening torque	0.5 Nm (0.37 ft-lb)
Physical Data	Dimensions (H x W x D):	64 x 120.7 x 293.4 mm 2.52 x 4.75 x 11.55 in
	Weight:	0.46 kg 1.01 lbs

15.5 IOTA-R24

15.5.1 Redundant IO Termination Assembly

The IOTA-R24 assembly enables the use of a redundant set of RUSIO-3224 or RUSLS-3224 modules. For physical and schematic representations of the IOTA-R24 see Figure 1 and Figure 2.

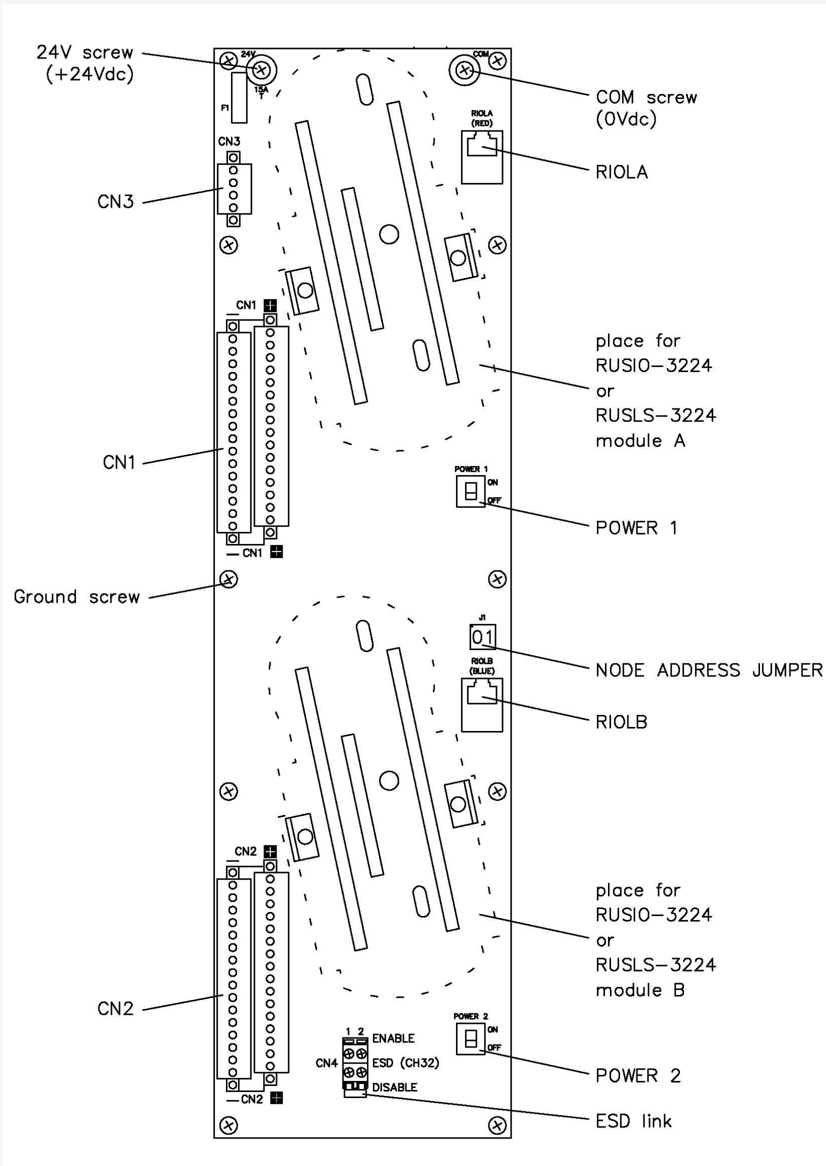


Figure 15-17: Mechanical layout

The IOTA-R24 can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

The IOTA-R24 provides for:

- Connectors for two (redundant) RUSIO-3224 or RUSLS-3224 modules
- 32 (universal) IO channel connections (CN1 and CN2)
- 4 (identical) V+ connections (CN3), for active AI devices
- Two RJ45 connectors for 100MB Ethernet communication (RIOLA and RIOLB)
- 24V power connection (24V screw and COM screw to the carrier power rails)

The RUSIO-3224 or RUSLS-3224 modules are placed on the indicated positions of the IOTA-R24. See for Figure 1 details.

The RUSIO-3224 or RUSLS-3224 module in the top position is addressed as module 'A', the bottom one as module 'B'.

The IOTA-R24 module has two switches:

- Use POWER 1 to switch Module 'A' on and off
- Use POWER 2 to switch Module 'B' on and off

The node number of the IOTA-R24 is set by placing the proper node addres jumper on the IOTA-R24 assembly.

The Emergency ShutDown (ESD) function can be enabled or disabled with the ESD (CH32) link.

The IO field signals are connected on CN1 and CN2; see Figure 1. The minus-row of CN1 and CN2 (left side) are all connected with 0V. The plus-row of CN1 and CN2 (right side) are the 'real' channels. Any type of IO field signal has only to be connected to the two connections of the applicable universal channel.

CN3 is used to connect active AI devices.

The IOTA-R24 module has two connectors to link the RUSIO-3224 or RUSLS-3224 modules with the Safety Manager Controller:

- The RIOLA connector is used for module ‘A’
- The RIOLB connector is used for module ‘B’

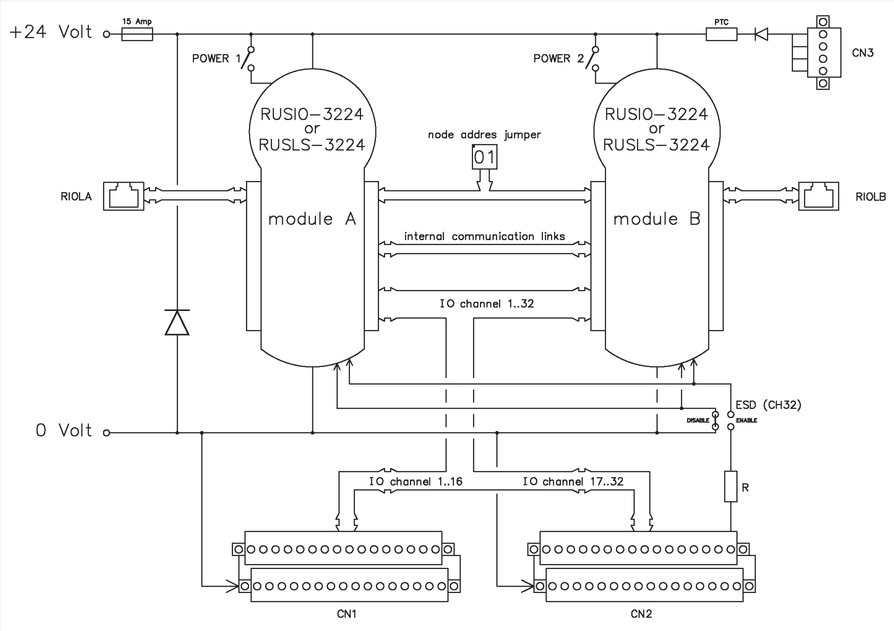


Figure 15-18: Block diagram

15.5.2 Mounting

The IOTA-R24 is mounted on a (metal) carrier (18 inch or 36 inch long). For details see:

- MCAR-01
- MCAR-02

The carrier provides the ground rail and the (+24V and 0V) power rails.

15.5.3 Connections

15.5.3.1 Channel 1 thru 16 on CN1

IO-channel 1 thru 16 are terminated on CN1.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

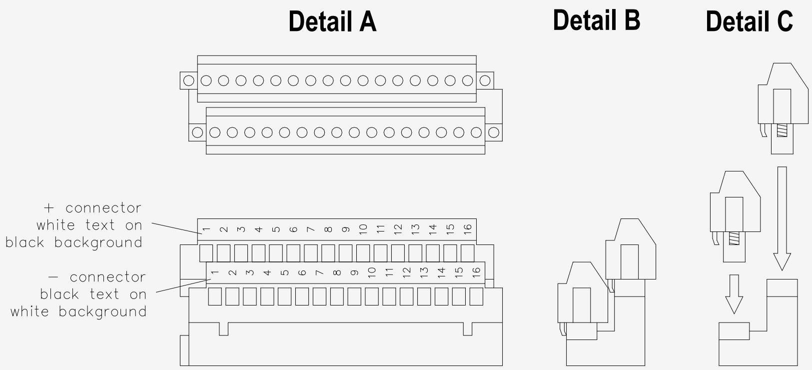


Figure 15-19: Channel 1 thru 16 on CN1

15.5.3.2 Channel 17 thru 32 on CN2

IO-channel 17 thru 32 are terminated on CN2.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

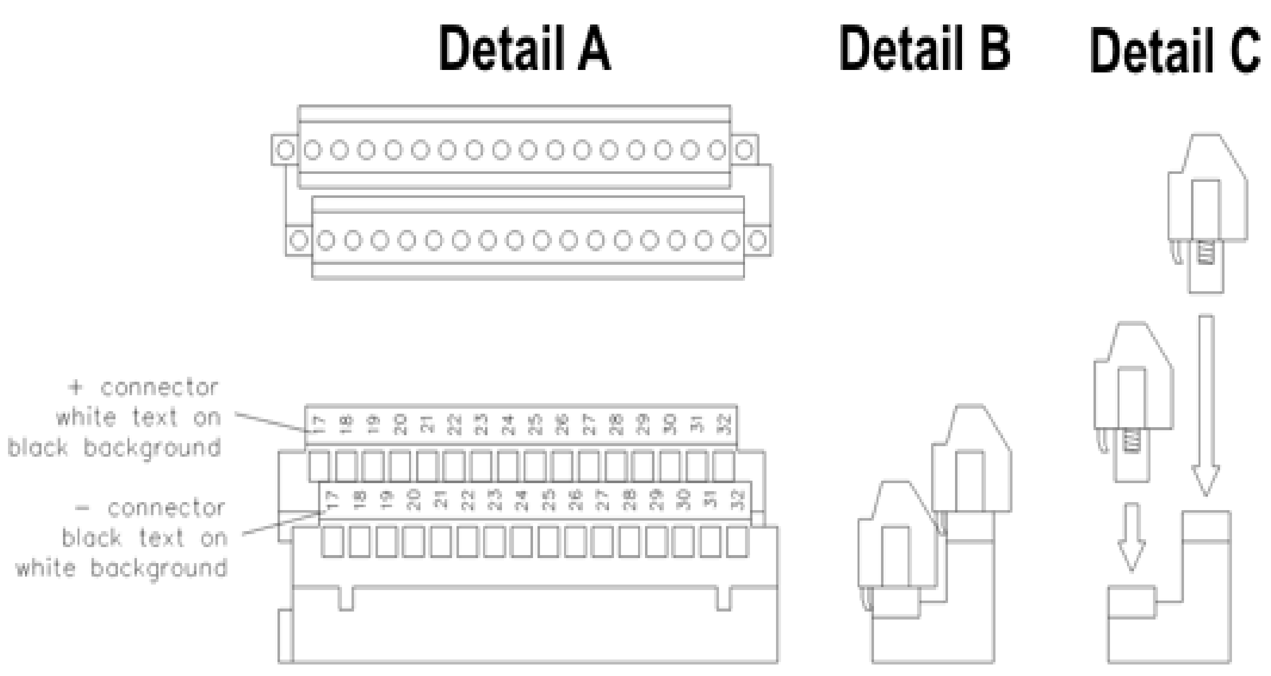


Figure 15-20: Channel 17 thru 32 on CN2

15.5.3.3 V+ connections on CN3

CN3 has four (uni-directional) V+ connections for field signals that require a passive analog input. For details about this type of channel configuration see RUSIO-3224 or RUSLS-3224.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connector placed.

Detail C shows the second side-view with the field-connector removed.

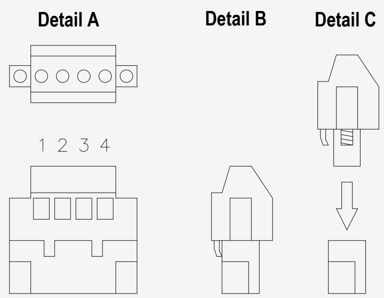


Figure 15-21: V+ connections on CN3

15.5.3.4 Ethernet connectors

The ethernet connectors (RIOLA and RIOLB) are shielded RJ-45 connectors.

The pin assignment of the RJ-45 connectors is shown below.

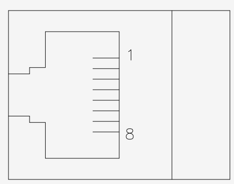


Figure 15-22: Ethernet Connectors

Contact	Signal	Direction	Description
1	TD+	Out	Transmitted data
2	TD-	Out	Transmitted data
3	RD+	In	Received data
4	-		
5	-		
6	RD-	In	Received data
7	-		
8	-		
Case	Shield		HF-connection to earth

15.5.3.5 ESD enable / disable link

The ESD function (on channel 32) can be enabled (or disabled) with a link on the IOTA.

In case the link is placed in the drawn position (See the below figure), channel 32 can be used as universal channel (analog or digital; input or output).

In case the link is in the ENABLE position, channel 32 must be used as ESD input.

A (normally closed) ESD switch (with 1 kOhm series resistor) must be connected between CH32+ and CH32- of the IOTA.

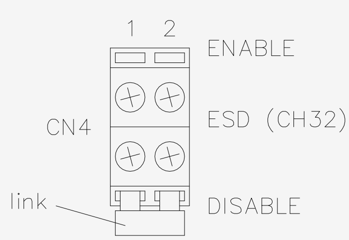


Figure 15-23: ESD (CH32) link

15.5.4 Node address jumpers

The node address jumper is used to give the processors in the RUSIO-3224 or RUSLS-3224 module(s) the node address of the IOTA.

The jumper is a 10.2 x 10.2 x 6.1 mm (0.4 x 0.4 x 0.24 in) gray plastic jumper set; it has a (two digit) number that is clearly visible.

For an example of a node address jumper see the below figure.

The jumpers are available in kits of ten numbers:

- 51153818-201 is a kit with the numbers 01 thru 10.
- 51153818-202 is a kit with the numbers 11 thru 20.
- 51153818-203 is a kit with the numbers 21 thru 30.
- 51153818-204 is a kit with the numbers 31 thru 40.

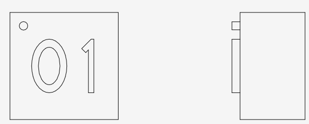


Figure 15-24: Node address jumper - front and side view

15.5.5 RUSIO-3224/RUSLS-3224 connections

The IOTA-R24 assembly supports all IO types that can be configured in the RUSIO-3224 or RUSLS-3224 module.

The supported IO types are:

- Line monitored digital input
- Non line monitored digital input
- Line monitored ESD input (on Channel 32)
- Analog input 0-20mA or 4-20mA
- Digital output (0.5 A), with or without configurable line monitoring

- Multiple digital output (1 A or 2 A), with or without line monitoring
- Analog output 0-20mA or 4-20mA

Further details on the connection and specifications of these IO types is described elsewhere. See RUSIO-3224 or RUSLS-3224.

The below figure shows the IO connection diagram of the IOTA-R24 .

The two RUSIO-3224 or RUSLS-3224 modules are connected in parallel. Each one is capable of controlling the IO.

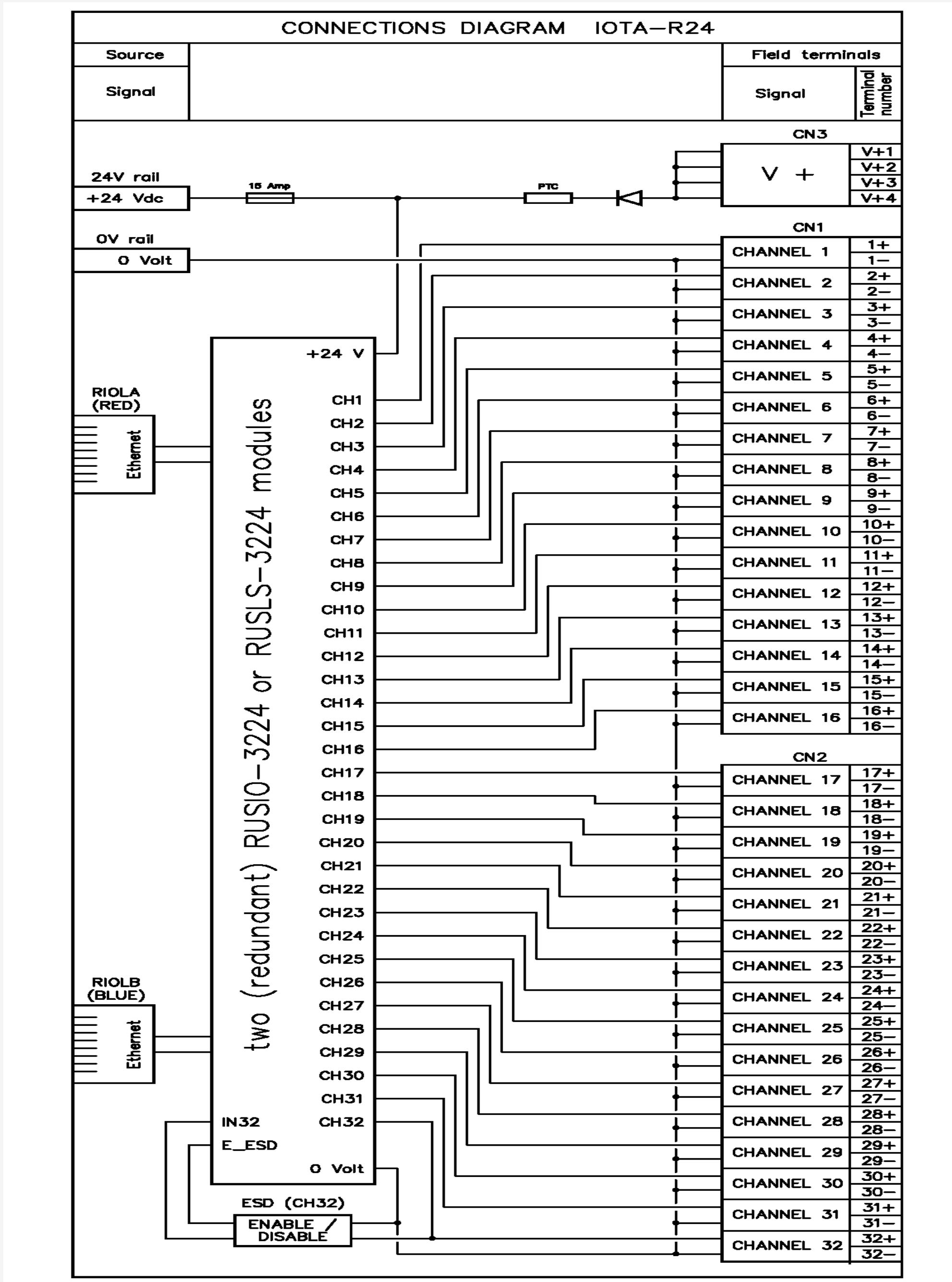


Figure 15-25: Connection diagram

15.5.6 Technical data

The IOTA-R24 assembly has the following specifications:

General	Type number:	FC-IOTA-R24
	Operating temperature:	-40 .. +70°C (-40 .. +158°F)
	Storage temperature:	-40 .. +85°C (-40 .. +185°F)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE, UL, TUV
Power	Supply voltage:	24 V DC -15%..+30%
	Supply load:	max. 10 A
	Reverse polarity protection:	parallel diode (blows the fuse)
	V+ pins:	
	• Max. current:	1 A (total of four CN3 pins)
	• Max. voltage drop:	<1.5V (at 0.7A)
	• Max. reverse voltage:	36V
Fuse	Fuse rating:	15 A
	Fuse dimensions:	Blade 5x19 mm
	Voltage rating AC:	-
	Voltage rating DC:	32 V
	Manufacturer:	Littelfuse
	Manufacturer PN:	0287015.PXS

Connections	24V supply:	2 x M4 (to power rail of the carrier)
	Ground:	10 x M3.5 (to metal of the carrier)
	Ethernet:	RJ-45
	IO (CN1 and CN2):	Weidmuller: BLZ 5.08/16/90F SN SW
	V+ (CN3):	Weidmuller: BLZ 5.08/4/90F SN SW
	Screw terminals (CN1,CN2,CN3):	
	• Max. wire size:	0.50 .. 2.50 mm^2
	• Strip length:	7 mm
	• Tightening torque	0.5 Nm (0.37 ft-lb)
Physical Data	Dimensions (H x W x D):	64 x 120.7 x 443.2 mm 2.52 x 4.75 x 17.45 in
	Weight:	0.57 kg 1.26 lbs

15.6 LT-5K15K

Line termination assembly LT-5K/15K

The LT-5K15K line termination assembly is placed near the field-contact of a line monitored digital input.

The following figure shows the mechanical layout of LT-5K15K.

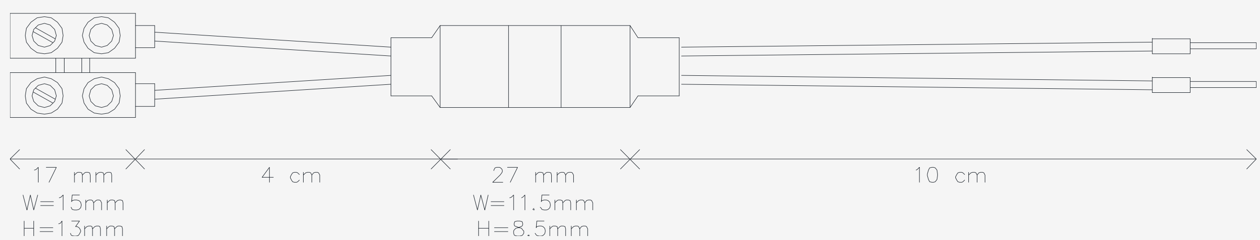


Figure 15-26: Mechanical layout of LT-5K15K

The LT-5K15K provides the resistors required to enable line-monitoring on a digital input. The resistors create a 5kOhm load when the field-contact is closed and a 15kOhm load when the field-contact is open. The field wires need to be connected to the 2-way terminal block. The two free wires need to be connected to the field-contact (or switch).

The following figure shows the schematic diagram of a line monitored digital input channel with an LT-5K15K.

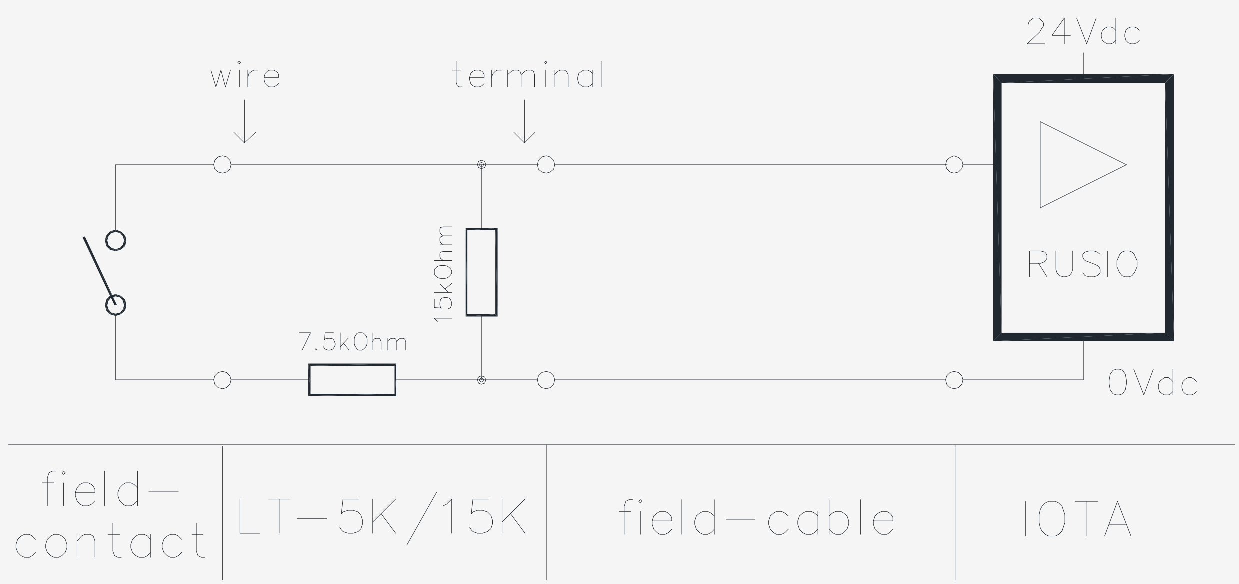


Figure 15-27: Schematic diagram of a line monitored digital input channel with an LT-5K15K

15.6.1 Technical data

The LT–5K15K module has the following specifications:

General	Type number:	FC-LT-5K15K
	Approvals:	CE
	Input resistance:	15 kOhm +/- 2% (open) 5 kOhm +/- 2% (closed)
	Input voltage:	max. 40V
	Ambient temperature:	-40 to 85°C
Wires:	Contact wires	10 cm; yellow; 2 mm ferrule
	Wires to terminal	4 cm; yellow
Screw terminals:	Wire diameter:	1 to 4 mm
	Stripped length:	5 mm

15.6.2 LT-5K15KD

Line termination assembly LT-5K/15KD

The LT-5K15KD line termination assembly is placed near the input connections of a line monitored digital input. It is used when it is not possible to place a line termination assembly near the field-contact.

The following figure shows the mechanical layout of LT-5K15KD.

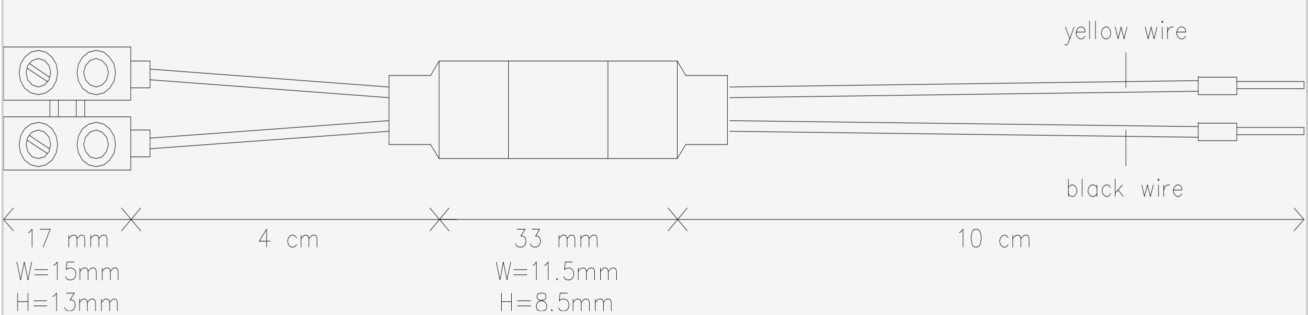


Figure 15-28: Mechanical layout of LT-5K15KD

The LT-5K15KD provides the resistors required to line-monitor a digital input.

Short-circuit or lead-breakage in the field-cable is NOT detected, as this requires placement of a line termination assembly near the field-contact. The LT-5K15KD also contains a diode to enable earth-fault detection and localization on the field-cable and/or field-contact. The resistors create a 5kOhm load when the field-contact is closed and a 15kOhm load when the field-contact is open.

Connect the wires as follows:

- The black wire to the IN- terminal (0Vdc).
- The yellow wire to the IN+ terminal (input).
- The field wires to the 2-way terminal block.

The following figure shows the schematic diagram of a line monitored digital input channel with an LT-5K15KD.

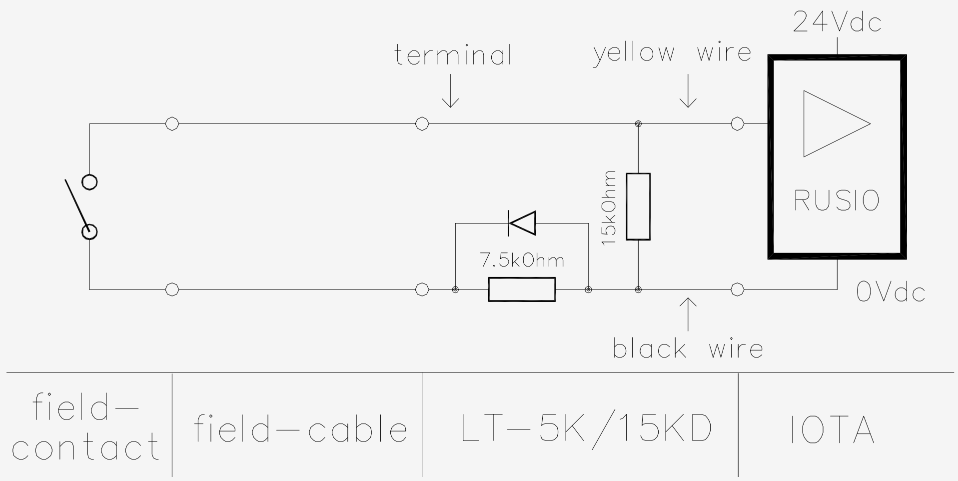


Figure 15-29: Schematic diagram of a line monitored digital input channel with an LT-5K15KD

15.6.2.1 Technical data

The LT–5K15KD module has the following specifications:

General	Type number:	FC-LT-5K15KD
	Approvals:	CE
	Input resistance:	15 kOhm +/- 2% (open) 5 kOhm +/- 2% (closed)
	Input voltage:	max. 35V
	Ambient temperature:	-40 to 85°C
Wires:	IN- wire	10 cm; black; 2 mm ferrule
	IN+ wire	10 cm; yellow; 2 mm ferrule
	Wires to terminal	4 cm; yellow
Screw terminals:	Wire diameter:	1 to 4 mm
	Stripped length:	5 mm

15.7 MTL 24571

15.7.1 Single channel ethernet surge protector

Note:
This data sheet contains an extract of a customized ZoneBarrier product issued by MTL Surge Technologies. For more information see the documentation provided by MTL Surge Technologies.

The MTL 24571 (made by MTL Surge Technologies) is a single channel Ethernet surge protector (100BaseT and 10BaseT).

When wired between an USI-0002 communication module and the field, it gives the USI-0002 and the Control Processor a IEC 61010 compliant protection against harmful voltages on the Ethernet lines.

The MTL 24571 can be used for shielded twisted pair (STP) cables and in IEEE 802.3af compliant networks which apply 48V power on pins 1, 2, 3 and 6.

The MTL24571 has universal snap-in provisions for standard DIN EN rails.

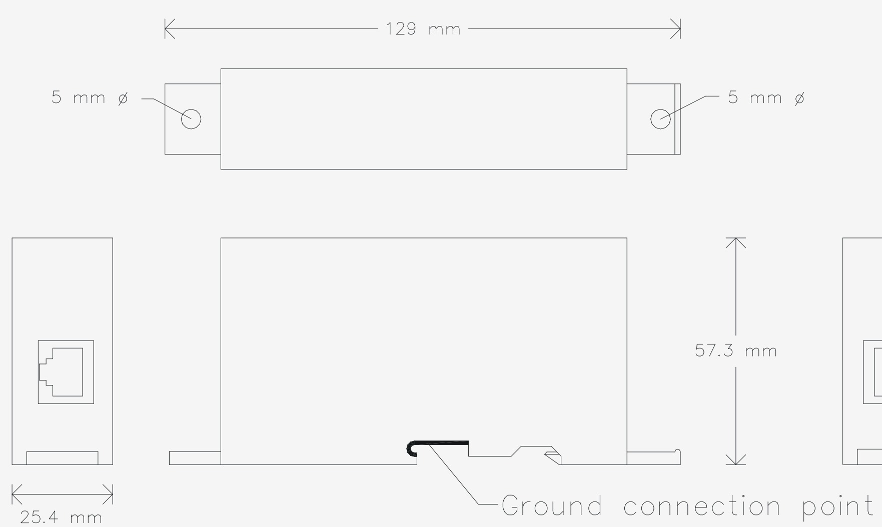


Figure 15-30: Top-view and side-view of an MTL 24571

The below figure provides a block diagram which shows the protected pins and that the shields of the RJ45 connectors are bonded to the protector ground.

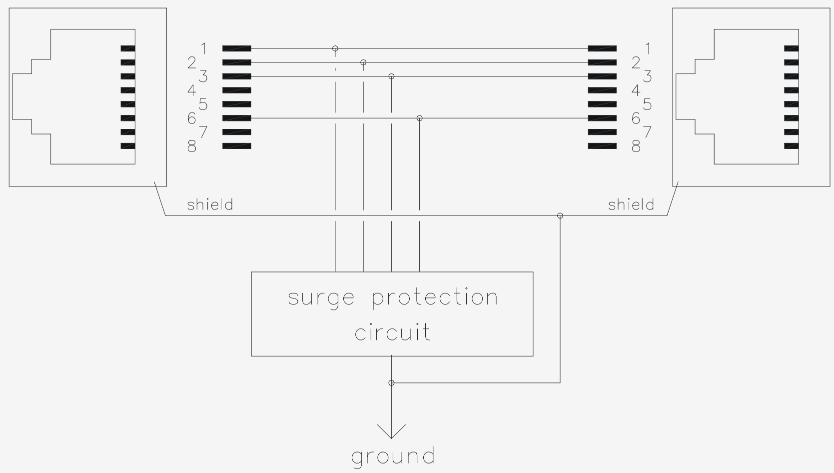


Figure 15-31: Block diagram of the MTL 24571

15.7.2 Grounding

The MTL 24571 needs a proper connection to ground.

This can be achieved by grounding the DIN EN rail it is mounted on.

The MTL 24571 can also be mounted as a stand alone unit on a flat surface, (using the two 5 mm holes). In that case grounding must be done with a wire of (minimum) AWG 10 to the metal plate on the bottom of the MTL 24571 (using the self tapping screw provided).

15.7.3 Technical data

The MTL 24571 has the following specifications:

General	Type number:	MTL 24571
	Manufacturer:	MTL Surge Technologies
Approvals		CE, UL
Power		none
Signals	Ethernet:	max. 155 MHz
	Attenuation:	max. -0.3 dB at 100 MHz
	PoE:	nominal 48 V DC
	common mode:	230 V AC
Termination	RJ45:	shielded 4 wire (pins 1, 2, 3 and 6)
	Grounding:	DIN EN rail or minimum AWG 10
Protection	Surge Capacity:	1 kA per wire
	Residual Voltage:	75 V @ 0.5 kA, 8/20 µs
	Clamp voltage:	62 V DC
Physical	Dimensions:	129 x 25.4 x 57.3 mm (D x W x H) 5.08 x 1.0 x 2.26 in (D x W x H)
	Weight:	0.09 kg
	Used rail length:	26 mm (1.02 in)

15.8 SDW-550 EC

15.8.1 5 port HSE communication FTA or "switch"

Note:
This data sheet contains an extract of the SDW-550 EC manufacturer specifications. For further information see the SDW-500 product documentation issued by Westermo.

The SDW-550 EC, make Westermo, is a five port 10/100Base Ethernet switch used as interface between USI-0002 communication modules in the Control Processor and the field.

The below figure shows that the SDW-550 EC has one (24Vdc) power connector and five isolated RJ-45 TX port connectors, divided into two sections.

The raised isolation level between the two port sections makes the SDW-550-EC compliant to the IEC 61010.

For IEC 61010 compliance use one section (e.g. ports 1, 2 and 3) must be connected to the field while the other section (ports 4 and 5) must connect to the CP backplane, thus optimizing power surge protection from the field.

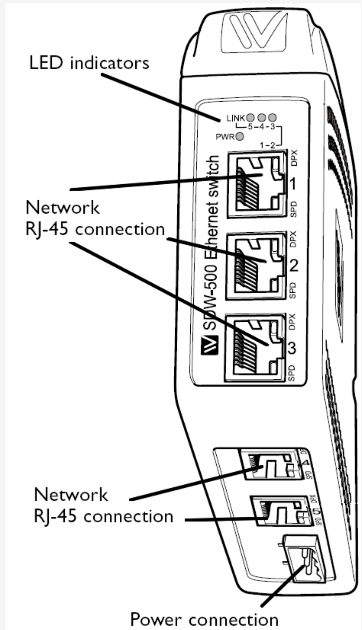


Figure 15-32: SDW-550 EC connections

It is recommended to keep port 1 available for a (portable) Safety Station. (See Figure 1 for details.)

15.8.2 Mounting

The SDW550 EC is to be mounted on a horizontally placed TS-35 rail.

Attention:
Westermo SDW-500 series modules have to be clamped on a horizontally mounted TS-35 rail, with free airflow around the module:

- At least 25mm (1.0 inch) above and below the module and
- At least 10mm (0.4 inch) left and right of the module.

The below figure shows the mounting instructions of the SDW 500 series switches.

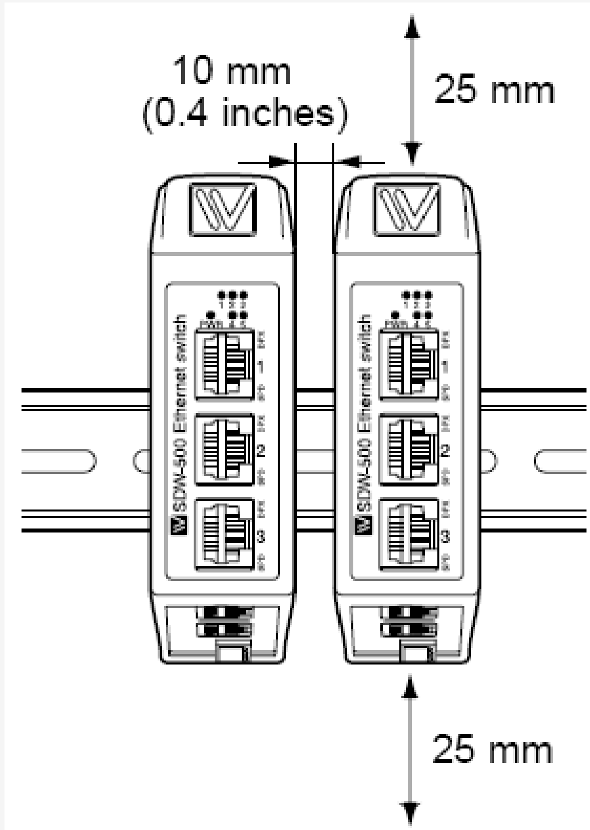


Figure 15-33: Mounting instructions SDW-500 series switches

15.8.3 DIP switch settings

Attention:

1. Do not open connected equipment.
2. Prevent damage to internal electronics by first discharging your body to ground (e.g. use an ESD wrist strap) before removing the lid on top of the unit.
3. Prevent access to hazardous voltage by disconnecting the unit from 24V supply and removing at least the RJ45 field connections (port 1 thru 3).

The DIP switches of the SDW-550 EC are located under the lid on top of the unit. The below figure shows how to access the DIP switches.

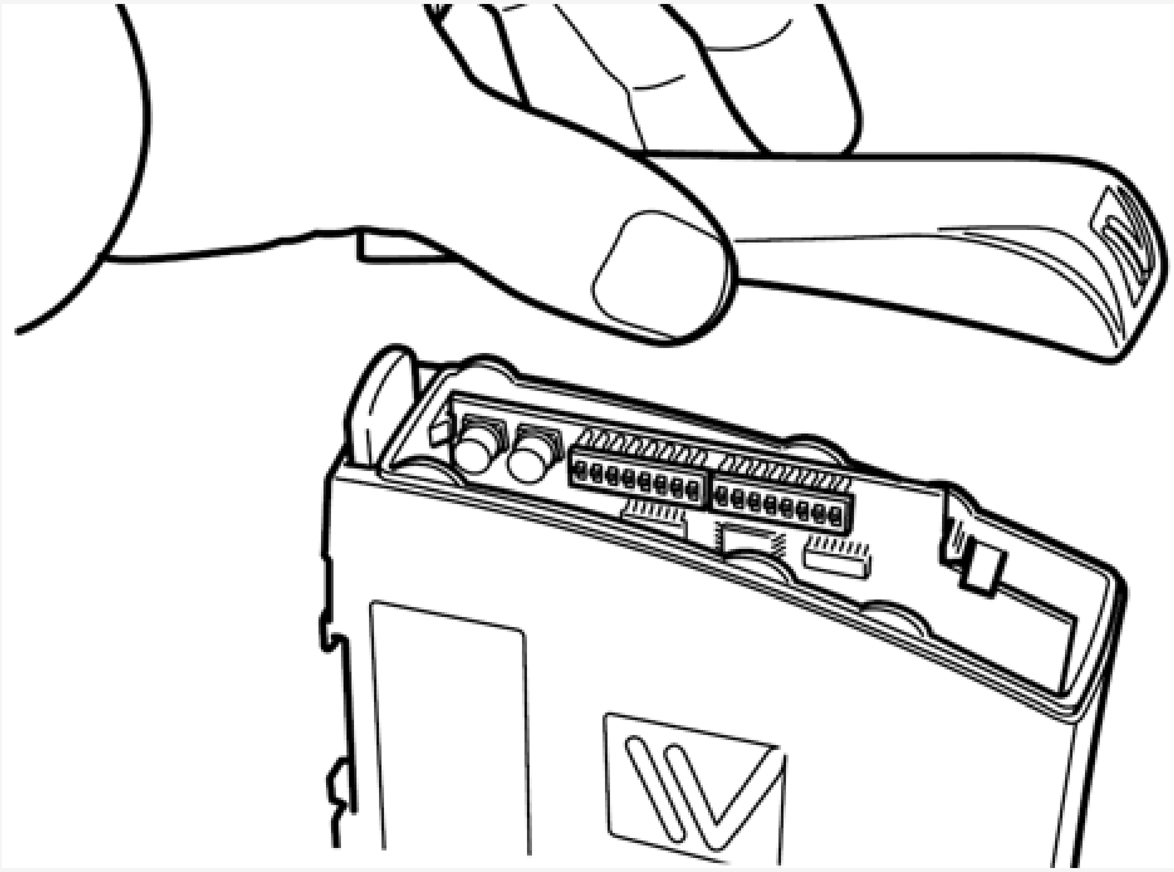


Figure 15-34: Lid removal to access DIP switches

The below figure shows the advised switch settings:

- The top half of the figure shows the normal settings for operation with Safety Manager.
- The bottom half of the figure shows the switch settings when port 1 is to be configured as monitor. When configured as monitor all packets throught the switch are mirrored to port 1 (e.g. to connect a Safety Station).

Note:

1. Neither setting in the below figure is the factory default setting!
2. The DIP switch configuration settings are only read during power-up.

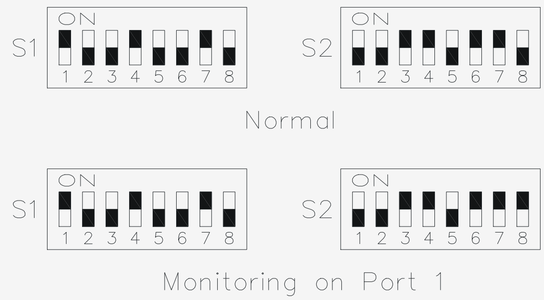
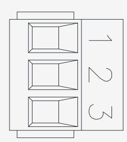


Figure 15-35: Advised DIP switch settings

15.8.4 Power

Each SDW-550 EC needs 24 V DC power and an Earth connection.

The Earth connection wire must be 1 mm2 (AWG 17) copper or more. The power wires must be 0.5mm2 (AWG 20) copper or more.

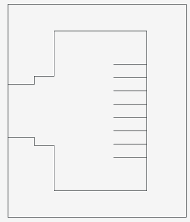


Pin	Description
1	0 Volt
2	24Volt
3	Earth

15.8.5 RJ 45 TX port connector

The RJ-45 TX port connectors of the SDW-550 EC module are shielded and equipped with status LEDs. For LED details see Status LEDs.

Below table shows the pin assignment of the RJ-45 TX connectors.



Contact	Signal	Direction	Description
1	TD+	Out/In	Transmitted/Received data
2	TD-	Out/In	Transmitted/Received data
3	RD+	In/Out	Received/Transmitted data
4	-		
5	-		
6	RD-	In/Out	Received/Transmitted data
7	-		
8	-		
Case	Shield		HF-connection to earth

15.8.6 Status LEDs

The SDW-550 EC has the following LEDs on the module front:

- a PWR (power) LED
- five LINK LEDs

The SDW-550 EC has the following LEDs on each RJ-45 TX port connector:

- a SPD (speed) LED
- a DPX (duplex) LED

The below table describes the indications of the status LEDs.

Table 1. Status LEDS of the SDW-550 EC rail mounted switch

Module front status LEDs		
LED	status	description
PWR	ON Slow flashing Fast flashing	Internal power, initialization OK Initialization progressing Initialization error
LINK	OFF ON Flashing	No ethernet link Good ethernet link Ethernet traffic indication
Port connector status LEDs		
LED	status	description
SPD	OFF ON	10 Mbit/s (TX only) 100 Mbit/s (TX only)
DPX	OFF ON	Half duplex (TX only) Full duplex (TX only)

15.8.7 Applications

Ethernet switches are used in combination with the USI-0001 or USI-0002 communication modules to:

- provide galvanic isolation between Safety Manager and the network
- connect to other segments of the network.

Safety Manager with a redundant Controller contains up to four USI-0001 or USI-0002 communication modules, so up to eight ethernet channels may be present on the RJ-45 connectors of the Controller backplane (each USI-0001 orUSI-0002 uses channel A and B for Ethernet communication).

The below figure shows the basic configurations for connecting Ethernet switches to these channels.

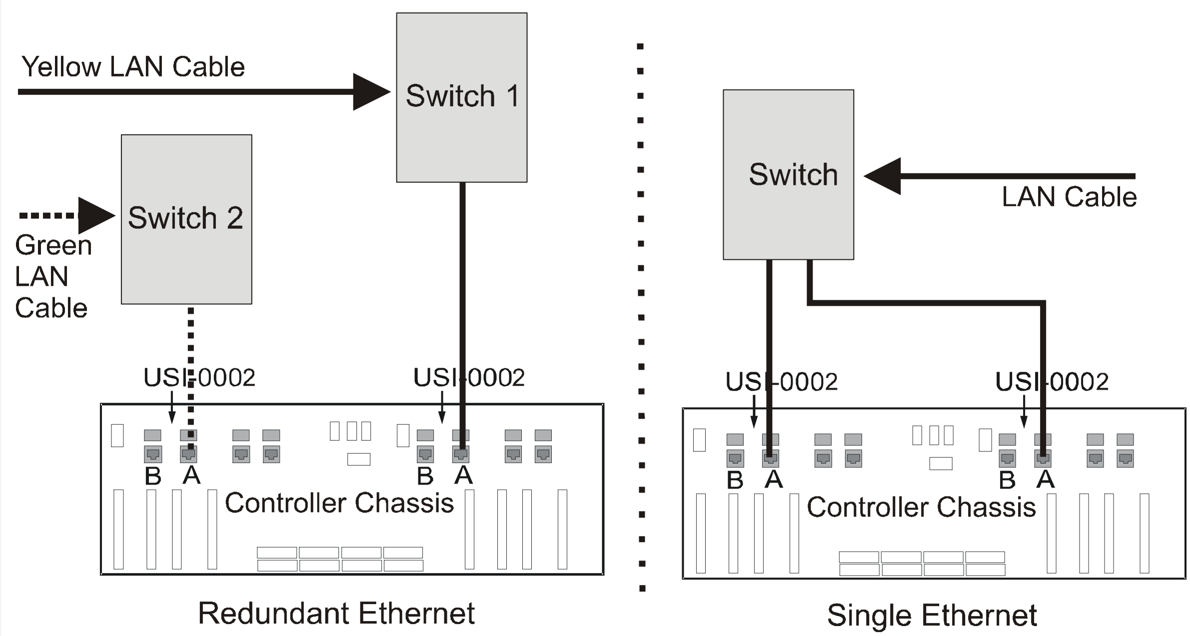


Figure 15-36: Connecting the Ethernet switch to the USI communication modules and the LAN

15.8.8 Technical data

The SDW-550 EC has the following specifications:

General	Type number:	SDW-550 EC
	Manufacturer	Westermo
	Number of channels:	5
	Operating temperature:	-25°C - +70°C (-13°F - +158°F)
	Storage temperature:	-25°C - +70°C (-13°F - +158°F)
	Relative humidity:	5% to 95% (non-condensing)
	Approval:	CE, TUV, UL, FM
Power	Operating voltage:	DC 12 V-48V
	Rated current:	max. 320mA
	Power connector fuse:	Internal
Physical	Dimensions:	121 x 35 x 119 mm (D × W × H) 4.76 × 1.38 × 4.69 in (D × W × H)
	Weight:	0.2 kg
	Used rail length:	55 mm (35 + 2 x 10 free space) 2.18 in (1.38 + 2 x 0.4 free space)

15.9 TDOL-07120

15.9.1 Line-monitored relay contact digital output (7 channels, 120Vac/120Vdc)

The field termination assembly module TDOL-07120 is an interface to field loads that require 120Vac or 120Vdc line-monitored digital outputs.

The TDOL-07120 has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads up to 240VA or 150Watt.

Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either energized or de-energized.

For these line-monitoring diagnostics the TDOL-07120 operates in combination with standard DI and DO modules of Safety Manager (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-07120 has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and (a pair of) screw terminals for the common supply connection.

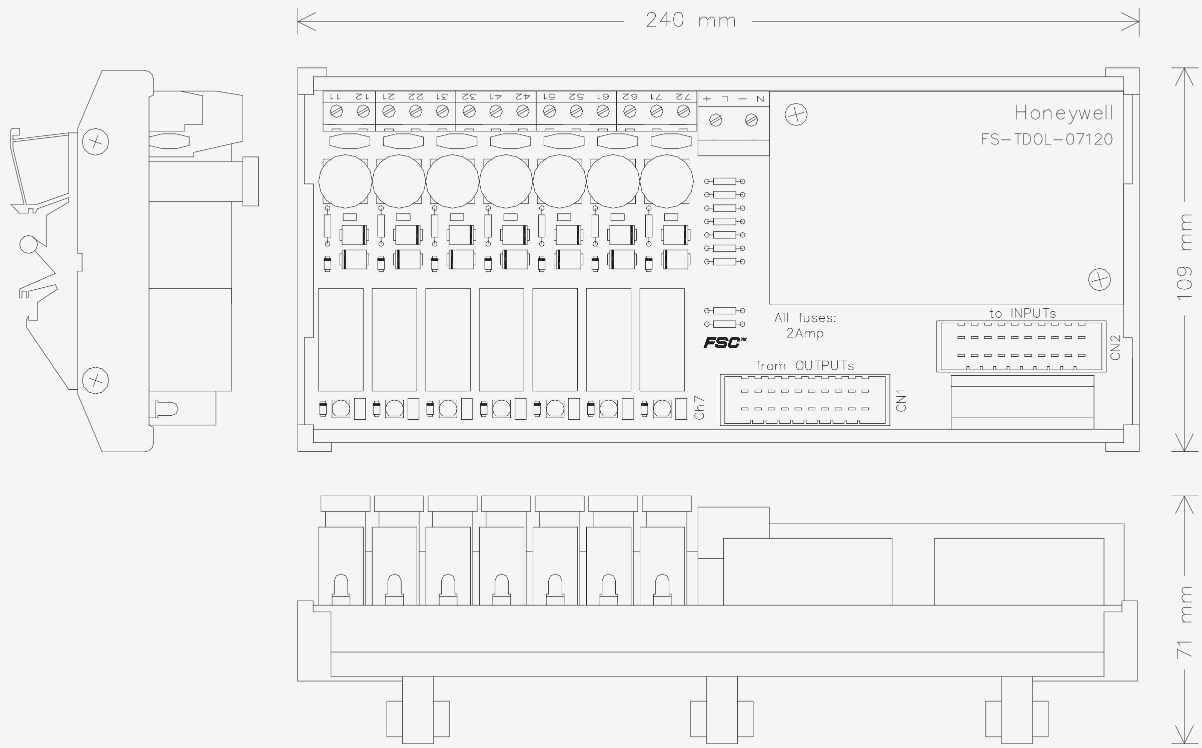


Figure 15-37: Mechanical layout

15.9.2 Main functions and usage

The TDOL-07120 is connected to a (non-redundant or redundant) SDO-0824 output module and a (non-redundant or redundant) SDI-1624 input module via system interconnection cables (SICs).

- A fused relay contact connects the common supply voltage (120Vac or 120Vdc) with a field terminal. The 7 output relays are controlled by channel 1 to 7 of the SDO-0824. A LED indicates the state of its output relay.
- Each output channel has line-monitoring circuits. The line-monitoring circuits are controlled by channel 8 of the SDO-0824 and are wired to channel 1 to 15 of the SDI-1624.
- Special application logic drives the outputs and processes the line monitoring results.

15.9.2.1 Schematic diagram of a channel

The below figure shows a schematic diagram of a channel. Each channel consists of:

- One relay with indicator LED
- A fused (2 AT) contact output
- A current injection resistor (120kΩ)
- A voltage readback circuit (with two ranges)
- A current sense connection and a current readback circuit

The common part of the module (see Figure 1) consists of:

- A DC/DC converter to supply the voltage- and current- readback circuits.
- A supply voltage monitor (generating the *RB_PWR* signal)
- An opto-coupler to transfer the range switch command from the 24V side to the 120V side.

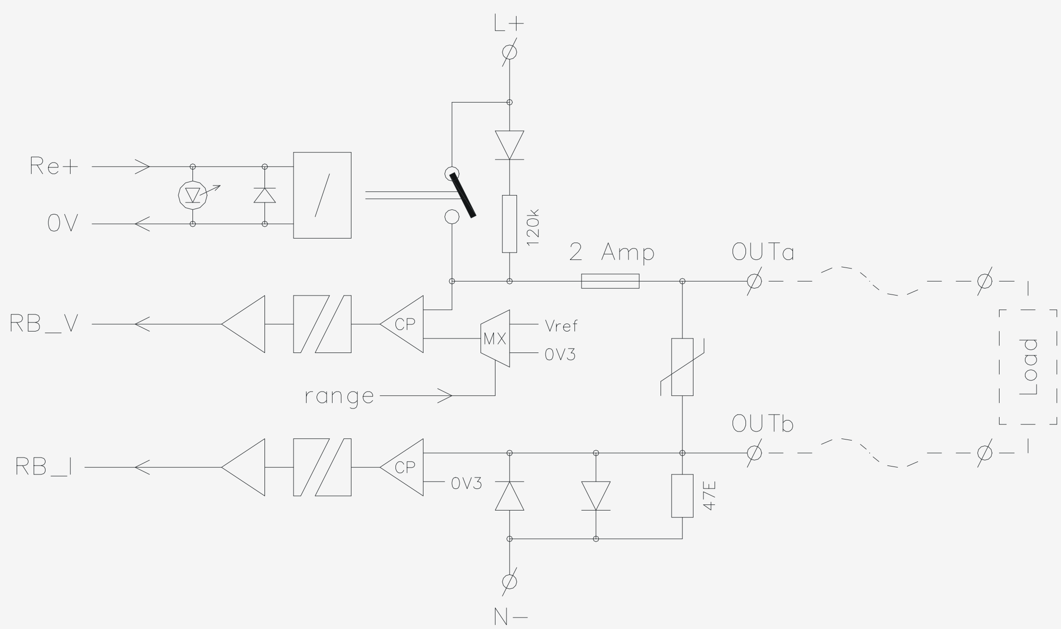


Figure 15-38: Schematic diagram of a channel

15.9.2.2 Lead breakage detection

Lead breakage in a channel is detected if:

- The channel is *off* and the 120kΩ channel resistor (see the above figure) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is *on* and the current readback (RB_I) threshold (approx. *0.3V*) is *not* met.

> **Note:**
> A blown channel fuse will be indicated as lead breakage of that channel.

To prevent lead breakage indication on a spare channel, the *USED* input of that channel (an input of the channel application function block) must be *low*. For details see Special application logic.

15.9.2.3 Short circuit detection

Short circuit in a channel is detected if:

- The channel is off and the 120kΩ channel resistor (see the above figure) is not able to create a field voltage drop higher than the *low* threshold value (approx. *0.3V*).
- The channel is *on*. This will blow the channel fuse and will be indicated as lead breakage.

15.9.2.4 Field loads with a (DC-)resistance below 400Ω

Field loads with a (DC-)resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional (pair of) diode(s) can be wired in series with the load as shown in the below figure. As these diodes prevent loads <400Ω to activate the short circuit detection they should be placed as close as possible to the load.

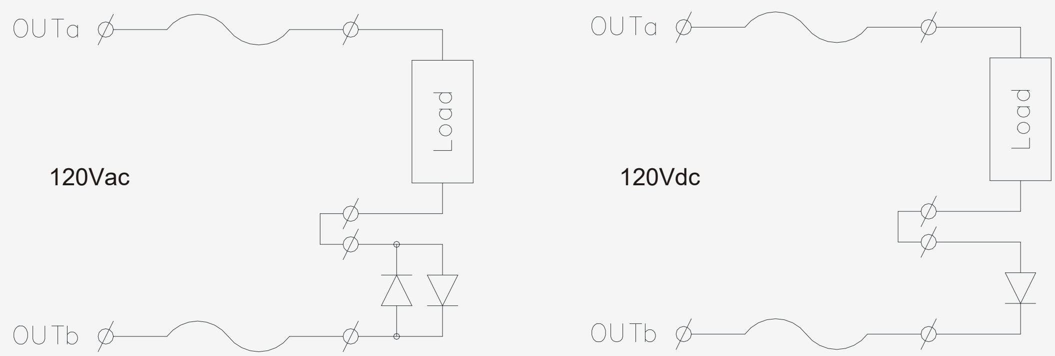


Figure 15-39: Additional diodes for loads < 400Ω

Note:
The additional diode(s) for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7A, or of type 1N5404 (or equivalent) for loads up to 2 A.

15.9.2.5 Inductive loads on 120Vdc

Inductive loads on 120Vdc require a spark suppression diode of type 1N4004 (or equivalent) as shown in the figure.

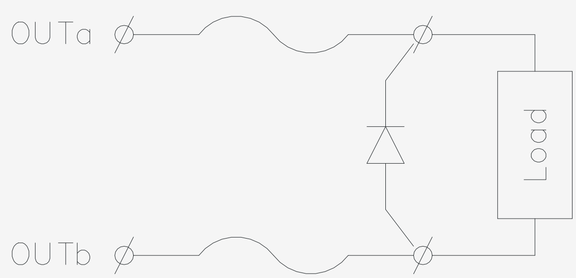


Figure 15-40: Spark suppression diode for inductive loads on 120Vdc

15.9.3 Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

Common function blocks and Channel function blocks explain the function of this special application logic.

Note:
Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

15.9.3.1 Common function blocks

The below figures show the schematics of the common function blocks required for the TDOL-07120.

15.9.3.2 Oscillator function block

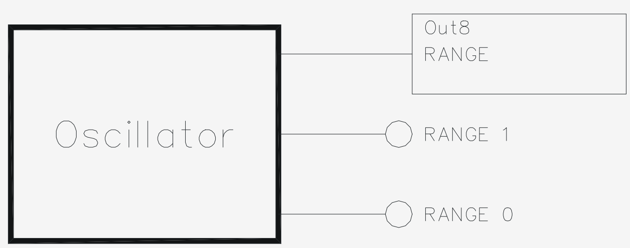


Figure 15-41: Example of the oscillator function block

The oscillator function block may be global (one per series of TDOL-07120 FTAs in a Safety Manager).

The oscillator toggles the RANGE input of the voltage readback circuits on each TDOL-07120 and controls the latches in each channel function block.

This allows each channel function block to monitor the line for both energized and de-energized channels.

15.9.3.3 Delay and OK function block

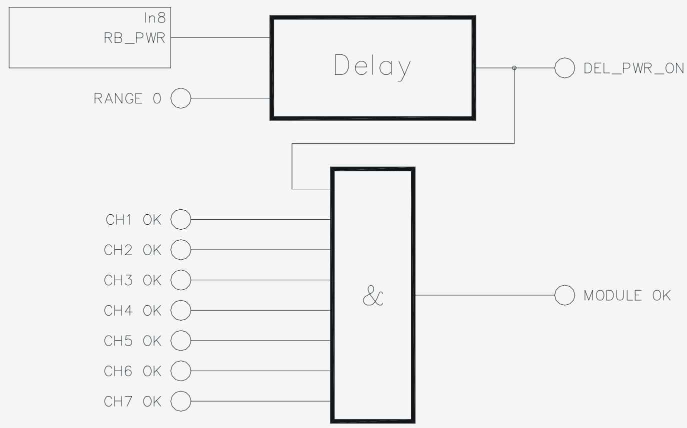


Figure 15-42: Example of the delay and OK function block

The delay and OK function block is common per TDOL-07120.

- The Delay logic monitors the presence of 120V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.
- The AND-gate collects the *CHx OK* signals of the seven channels function blocks of the TDOL-07120, as indicated in the above figure.

  If all channels are OK, the *MODULEOK* output is *high*.

15.9.3.4 Channel function blocks

The below figure shows the schematics of the channel function blocks.

One channel function block is needed per channel of the TDOL-07120 FTA.

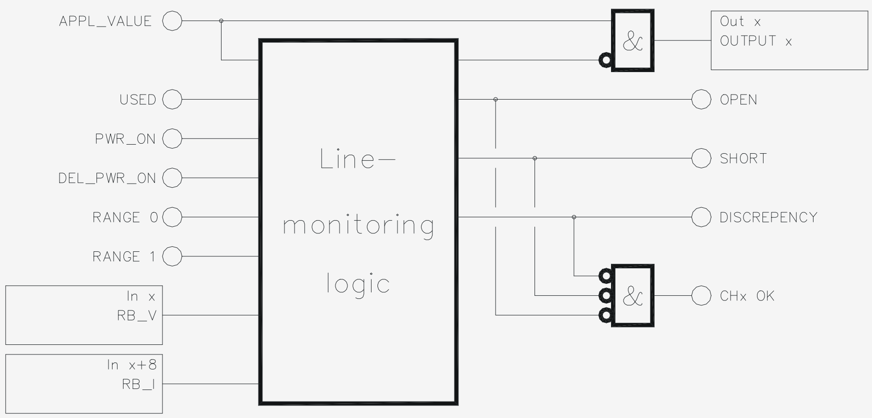


Figure 15-43: Example of a channel function block

A standard channel function block as shown in the above figure has:

- An application value input APPL_VALUE
- A USED input to prevent lead breakage (OPEN) indications on unused channels.
- Four inputs that must be linked to the common function blocks (for details see Common function blocks)
- One input for the voltage readback result RB_V of each channel (IN *1* thru *7*)
- One input for the current readback result RB_I of each channel (IN *9* thru *15*)
- One output for the output relay OUT of each channel (DO channel 1 thru 7)
- A *SHORT* output that indicates a short-circuit on the field wires (a SHORT detection also blocks the energization of the output relay)
- An *OPEN* output that indicated lead-breakage on the field wires (or output fuse blown)
- A *DISCREPENCY* output that indicates:
  - Field output is *on* while relay not energized or
  - Field output is *low*, while relay energized.
- A *CHx OK* output if no (line monitoring) errors are detected

15.9.3.5 Channel assignment:

When connected to the TDOL-07120 the IO channels of the SDO-0824 and the SDI-1624 are assigned as follows:

Field channel TDOL-07120	Controlling outputs SDO-0824 [1]	line monitoring inputs SDI-1624 [2]	
		RB_V	RB_I
Channel 1	Output 1	Input 1	Input 9
Channel 2	Output 2	Input 2	Input 10
Channel 3	Output 3	Input 3	Input 11
Channel 4	Output 4	Input 4	Input 12
Channel 5	Output 5	Input 5	Input 13
Channel 6	Output 6	Input 6	Input 14
Channel 7	Output 7	Input 7	Input 15

1. Channel 8 is assigned to the voltage range switcher (*RANGE*) in the common function block
2. Channel 8 is assigned to the 120V power monitor (*RB_PWR*) Channel 16 is unused.

15.9.4 Applications

For correct operation the TDOL-07120 must be combined with:

- A (redundant pair of) SDO-0824 module(s),
- A (redundant pair of) SDI-1624 module(s) and
- Dedicated function blocks in the application.

For details on applications and connection options for the TDOL-07120 module, see section SICC 0001/Lx.

15.9.5 Connections

The connections diagram of the TDOL-07120 module is as follows:

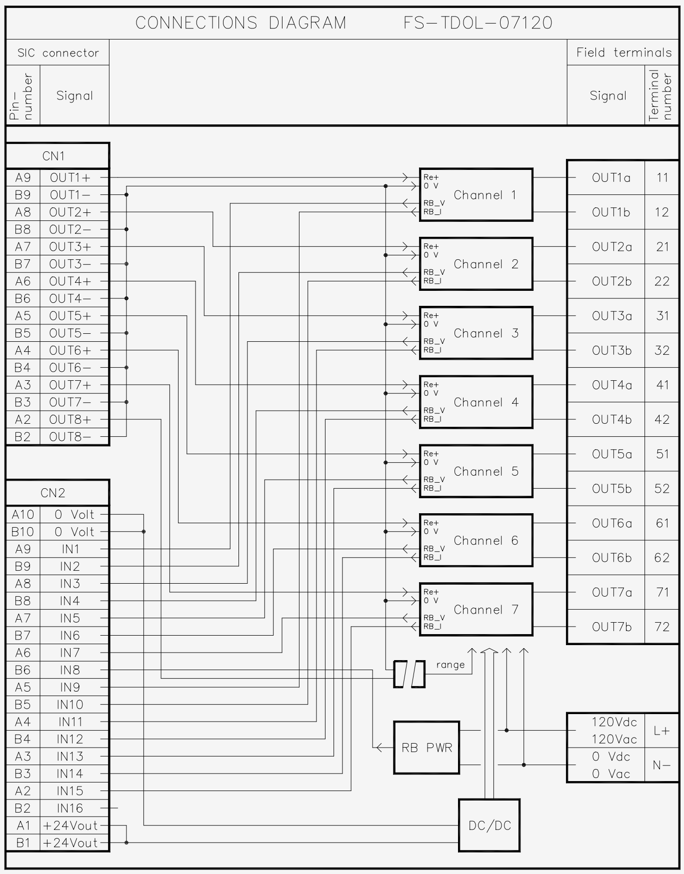


Figure 15-44: Connections diagram

SIC-connector CN1 (see Figure 1 and Figure 1) must be connected with the (redundant pair of) SDO-0824 module(s).

SIC-connector CN2 (see Figure 1 and Figure 1) must be connected with the (redundant) SDI-1624.

The TDOL-7120 has 7 pairs of terminals to connect the load.

External power must be connected to the TDOL-07120 via the power screw terminal pair marked L+ and N-.

- 120Vac(line) or +120Vdc must be connected with L+.
- 0Vac (neutral) or 0Vdc (-) must be connected with N-.

15.9.6 Maximum AC output load

The below figure shows the maximum AC channel load vs. the ambient temperature.

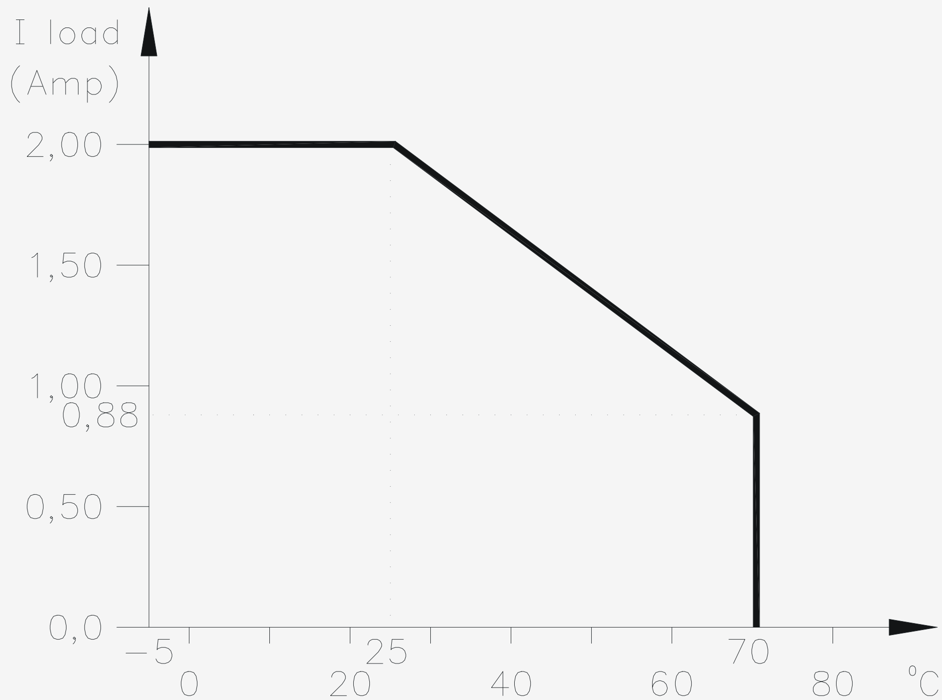


Figure 15-45: Derating curve (AC channel load vs. ambient temperature) for the TDOL-07120

15.9.7 Technical data

The TDOL-07120 module has the following specifications:

General	Type numbers:	FS-TDOL-07120
		FC-TDOL-07120
	Approvals:	CE, UL, CSA; TUV
Outputs	Number of channels:	7
	Max. output current:	2 A (at 120 V AC) 0.28 A at 120 V DC (UL limit) 0.5 A at 120 V DC (relay limit)
	Output load 120Vdc:	resistive or inductive with spark suppression diode
	Output supply voltage:	120 V AC or 120 V DC +/- 20%
	Minimum required field load:	1 Watt
	Leakage current to load:	max. 1 mA at 120 V
	No load output voltage:	
	• Output OFF • Output ON	35..130 V DC with AC output supply or 90% of DC output supply voltage 100% of output supply voltage (AC or DC)
	Short-circuit detection load threshold:	200Ω < R_{Th} < 400Ω
	Max. load capacitance:	1uF

Fuse	Fuse rating:	2 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2507
	Derating curve:	Linear from 2 A at 25 dC to 1.4 A at 70 dC
Relay contact	Max switched power:	1250 VA / 60 Watts
	Expected life:	
	• Electrical • Mechanical	100,000 switch operations 30,000,000 switch operations
Power consumption	Field power	
	120 V AC/V DC:	< 8 mA (all channels off)
	24 V DC (consumed via SDO-0824 and SDI-1624 IO)	
	Relays + channel 8:	approx. 200 mA (out of TSDO-0824) max. 250 mA at V_{max}
	Read back circuit:	< 110 mA (single SDI-1624 SDI-1624) or < 210 mA (redundant SDI-1624 SDI-1624) max. 275 mA at V_{max}
Physical	Module dimensions:	240 x 109 x 71 mm (L x W x H) 9.45 x 4.29 x 2.80 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241 mm (9.49 inch)

Termination	Channel screw terminals:	
	• Max wire size • Strip length • Tightening torque	2.5 mm^2 (AWG 14) 7 mm (0.28 in) 0.5 Nm (0.37 ft-lb)
	Power screw terminals:	
	• Max wire size • Strip length • Tightening torque	16 mm^2 (AWG 8) 7 mm (0.28 in) 1.2 Nm (0.88 ft-lb)

15.10 TDOL-0724P

15.10.1 Line-monitored relay contact digital output (7 channels, 24Vdc)

The field termination assembly module TDOL-0724P is an interface to field loads that require 24Vdc line-monitored digital outputs.

The TDOL-0724P has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads upto 50Watt.

Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either energized or de-energized.

For these line-monitoring diagnostics the TDOL-0724P operates in combination with standard DI and DO modules of Safety Manager (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-0724P has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and a (2-pole) power connector for the common supply connection.

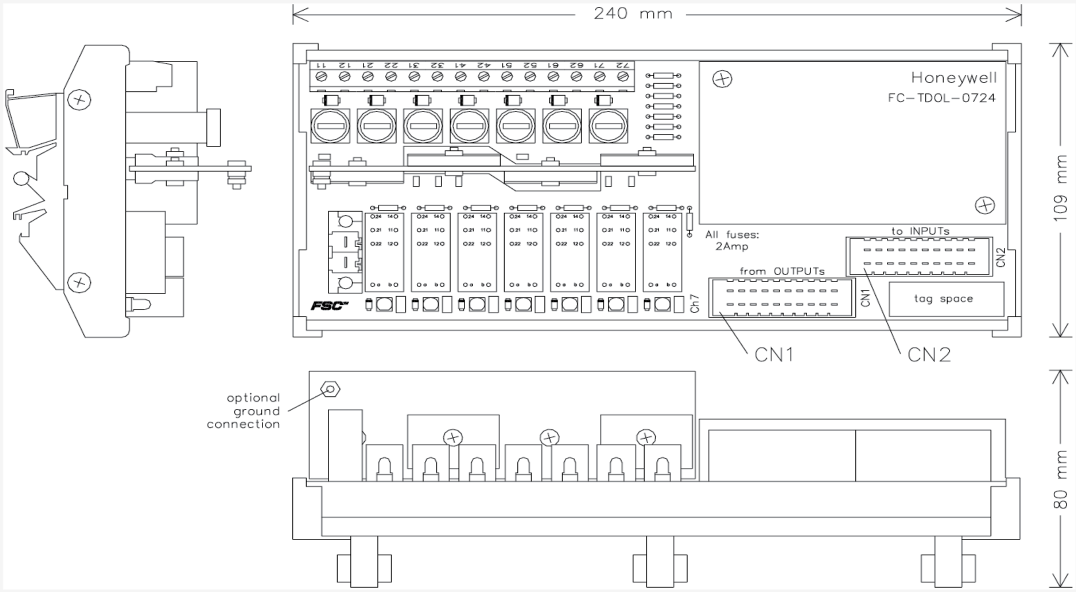


Figure 15-46: Mechanical layout

15.10.2 Main functions and usage

The TDOL-0724P is connected to a (non-redundant or redundant) SDO-0824 output module and a (non-redundant or redundant) SDI-1624 input module via system interconnection cables (SICs).

- A fused relay contact connects the common supply voltage (24Vdc) with a field terminal. The 7 output relays are controlled by channel 1 to 7 of the SDO-0824. A LED indicates the state of its output relay.
- Each output channel has line-monitoring circuits. The line-monitoring circuits are controlled by channel 8 of the SDO-0824 and are wired to channel 1 to 15 of the SDI-1624.
- Special application logic drives the outputs and processes the line monitoring results.

15.10.2.1 Schematic diagram of a channel

The below figure shows a schematic diagram of a channel. Each channel consists of:

- One relay with indicator LED
- A fused (2 AT) contact output
- A current injection resistor (22kΩ)
- A voltage readback circuit (with two ranges)
- A current sense connection and a current readback circuit

The common part of the module (see Figure 1) consists of:

- A DC/DC converter to supply the voltage- and current- readback circuits.
- A supply voltage monitor (generating the *RB_PWR* signal)
- An opto-coupler to transfer the range switch command from the Controller 24Vdc side to the field 24Vdc side.

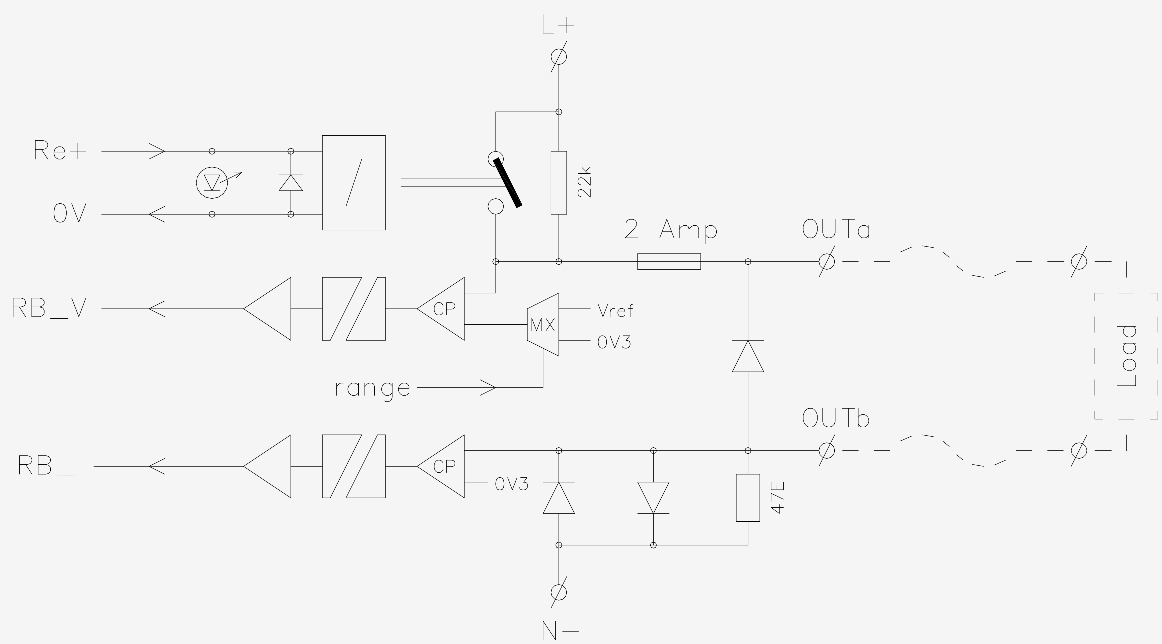


Figure 15-47: Schematic diagram of a channel

15.10.2.2 Lead breakage detection.

Lead breakage in a channel is detected if:

- The channel is *off* and the 22kΩ channel resistor (see the above figure) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is *on* and the current readback (RB_I) threshold (approx. *0.3V*) is *not* met.

> **Note:**
> A blown channel fuse will be indicated as lead breakage of that channel.

To prevent lead breakage indication on a spare channel, the *USED* input of that channel (an input of the channel application function block) must be *low*. For details see Special application logic.

15.10.2.3 Short circuit detection

Short circuit in a channel is detected if:

- The channel is *off* and the 22kΩ channel resistor (see the above figure) is not able to create a field voltage drop higher than the *low* threshold value (approx. *0.3V*).
- The channel is *on*. This will blow the channel fuse and will be indicated as lead breakage.

15.10.2.4 Field loads with a resistance below 400Ω

Field loads with a resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional diode can be wired in series with the load as shown in the below figure. Behind this diode the short circuit detection is “blind”, so this diode should be placed as close to the load as possible.

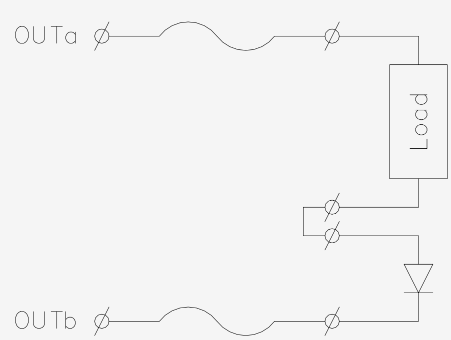


Figure 15-48: Additional diode for loads < 400Ω

Note:
The additional diode for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7A, or of type 1N5404 (or equivalent) for loads up to 2 A.

15.10.3 Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

Common function blocks and Channel function blocks explain the function of this special application logic.

Note:
Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

15.10.3.1 Common function blocks

Figure 1 and Figure 2 show the schematics of the common function blocks required for the TDOL-0724P.

15.10.3.2 Oscillator function block

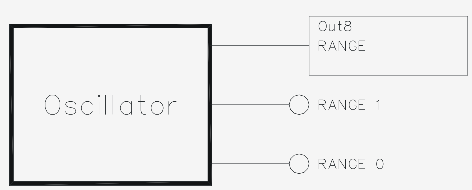


Figure 15-49: Example of the oscillator function block

The oscillator function block may be global (one per series of TDOL-0724P FTAs in a Safety Manager).

The oscillator toggles the *RANGE* input of the voltage readback circuits on each TDOL-0724P and controls the latches in each channel function block.

This allows each channel function block to monitor the line for both energized *and* de-energized channels.

15.10.3.3 Delay and OK function block

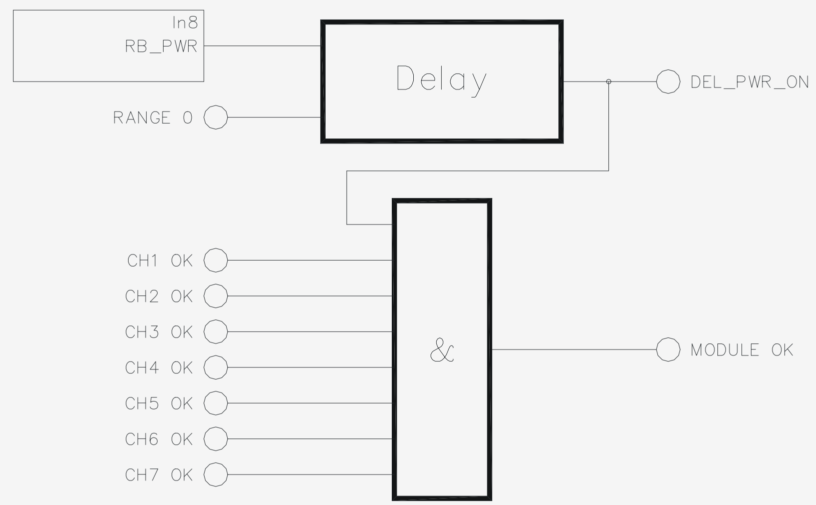


Figure 15-50: Example of the delay and OK function block

The delay and OK function block is common per TDOL-0724P.

- The Delay logic monitors the presence of 24V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.
- The AND-gate collects the *CHx OK* signals of the seven channels function blocks of the TDOL-0724P, as indicated in the below figure. If all channels are OK, the *MODULE OK* output is *high*.

15.10.3.4 Channel function blocks

The below figure shows the schematics of the channel function blocks.

One channel function block is needed per channel of the TDOL-0724P FTA.

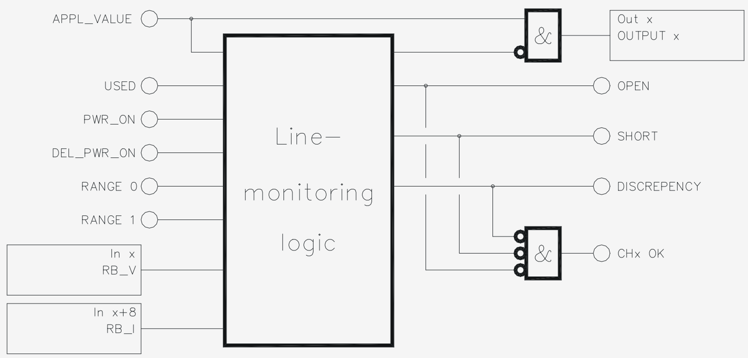


Figure 15-51: Example of a channel function block

A standard channel function block as shown in the figure has:

- An application value input *APPL_VALUE*
- A *USED* input to prevent lead breakage (*OPEN*) indications on unused channels.
- Four inputs that must be linked to the common function blocks (for details see Common function blocks)
- One input for the voltage readback result *RB_V* of each channel (IN *1* thru *7*)
- One input for the current readback result *RB_I* of each channel (IN *9* thru *15*)
- One output for the output relay OUT of each channel (DO channel 1 thru 7)
- A *SHORT* output that indicates a short-circuit on the field wires (a *SHORT* detection also blocks the energization of the output relay)
- An *OPEN* output that indicated lead-breakage on the field wires (or output fuse blown)
- A *DISCREPENCY* output that indicates:
  - Field output is *on* while relay not energized or
  - Field output is *low*, while relay energized.
- A *CHx OK* output if no (line monitoring) errors are detected

15.10.3.5 Channel assignment:

When connected to the TDOL-0724P the IO channels of the SDO-0824 and the SDI-1624 are assigned as follows:

Field channel TDOL-0724P	Controlling outputs	line monitoring inputs SDI-1624 [2]	
	SDO-0824 [1]	RB_V	RB_I
Channel 1	Output 1	Input 1	Input 9
Channel 2	Output 2	Input 2	Input 10
Channel 3	Output 3	Input 3	Input 11
Channel 4	Output 4	Input 4	Input 12
Channel 5	Output 5	Input 5	Input 13
Channel 6	Output 6	Input 6	Input 14
Channel 7	Output 7	Input 7	Input 15

1. Channel 8 is assigned to the voltage range switcher (*RANGE*) in the common function block
2. Channel 8 is assigned to the 24V power monitor (*RB_PWR*) Channel 16 is unused.

15.10.4 Applications

For correct operation the TDOL-0724P must be combined with:

- a (redundant pair of) SDO-0824 module(s),
- a (redundant pair of) SDI-1624 module(s) and
- dedicated function blocks in the application.

For details on applications and connection options for the TDOL-0724P module, see section SICC 0001/Lx.

15.10.5 Connections

The connections diagram of the TDOL-0724P module is as follows:

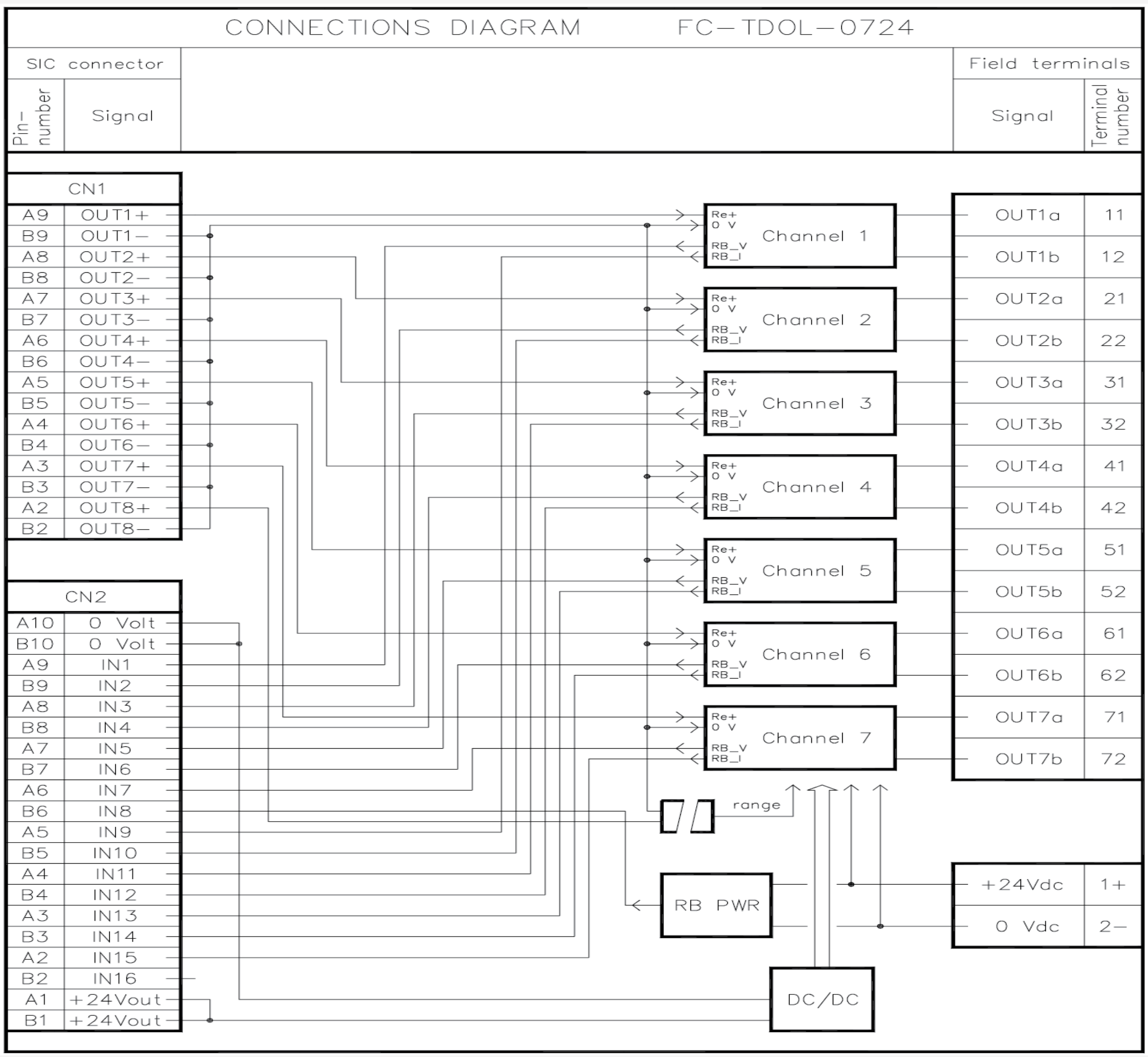


Figure 15-52: Connections diagram

SIC-connector CN1 (see Figure 1 and Figure 1) must be connected with the (redundant pair of) SDO-0824 module(s).

SIC-connector CN2 (see Figure 1 and Figure 1) must be connected with the (redundant) SDI-1624.

The TDOL-0724P has 7 pairs of terminals to connect the load.

15.10.6 External power

A 24 V DC power distribution cable (see datasheet PDC-MB24-y for details) can be used to connect the main busbar with the power connector on the TDOL-0724P module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

> **Note:**
> The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

The below figure shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked + is pin 1: connected to +24Vdc busbar.
- The pin marked - is pin 2: connected to the 0Vdc busbar.

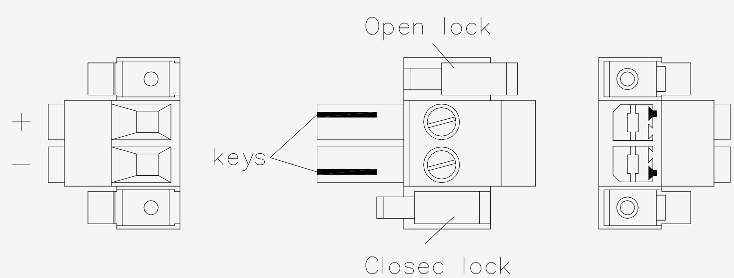


Figure 15-53: Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view

The two (red) locking slides of the cable-connector in the below figure keep the cable-connector locked when inserted into the power connector.

15.10.6.1 Grounding

Connect a ground wire to the (free) screw on the top left-side of the heatsink (see Figure 1 for location) if grounding of metal parts is required.

15.10.7 Maximum output load

The below figure shows the maximum channel load vs the ambient temperature.

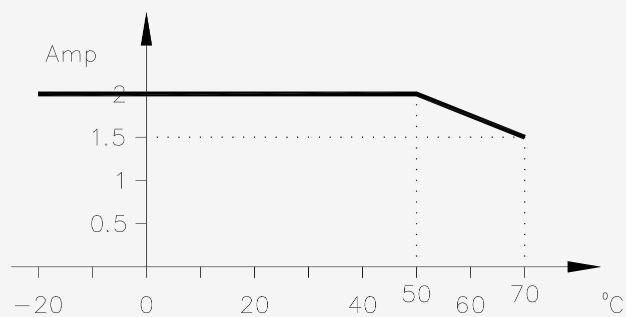


Figure 15-54: Derating curve (channel load vs ambient temperature) for the TDOL-0724P

15.10.8 Technical data

The TDOL-0724P module has the following specifications:

General	Type number:	FC-TDOL-0724P
	Approvals:	CE, TUV, UL, CSA pending
Outputs	Number of channels:	7
	Max. output current:	2 A
	Output load 24Vdc:	resistive or inductive with spark suppression diode
	Output supply voltage:	24 V DC +/- 20%
	Maximum load resistance:	2200Ω
	Leakage current to load:	approx. 1.1 mA at 24 V
	No load output voltage:	
	• output OFF	90% of output supply voltage
	• output ON	100% of output supply voltage
	Short-circuit detection load threshold:	200Ω < R_{Th} < 400Ω
Fuse	Fuse rating:	2 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Littelfuse
	Manufacturer PN:	0213002
	Derating curve:	Linear from 2A at 25dC to 1.9A at 70dC.

Relay contact	Max switched power:	150 Watts
	Expected life:	
	• electrical	100,000 switch operations
	• mechanical	30,000,000 switch operations
Power consumption	Field power	
	24Vdc:	< 9 mA (all channels off)
	24 V DC (consumed via SDO-0824 and SDI-1624) IO)	
	Relais + channel 8:	approx. 200 mA (out of TSDO-0824) max. 250 mA at V_{max}
	Read back circuit:	< 110 mA (single SDI-1624) or < 210 mA (redundant SDI-1624) max. 275 mA at V_{max}
Physical	Module dimensions:	240 x 109 x 80 mm (L x W x H) 9.45 x 4.29 x 3.15 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241 mm (9.49 inch)

Termination	Channel screw terminals:	
	• max wire diameter	2.5 mm (AWG 14)
	• strip length	7 mm (0.28 in)
	• tightening torque	0.5 Nm (0.37 ft-lb)
	Power connector	2 pole header with keying
	• make and type:	Weidmuller: BVZ 7.62HP/02/180F SN (conn.)
	• strip length:	Weidmuller: BV/SV7.62HP KO (keys) 8 mm (0.28 in)
	• Connectable conductors:	0.5-6mm (AWG 20-AWG 10)

15.11 TDOL-0724U

15.11.1 Line-monitored relay contact digital output (7 channels, 24Vdc, RUSIO)

The field termination assembly module TDOL-0724U is an interface to field loads that require 24Vdc line-monitored digital outputs.

The TDOL-0724U has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads upto 50Watt.

Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either energized or de-energized.

For these line-monitoring diagnostics the TDOL-0724U operates in combination with 16 RUSIO channels (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-0724U has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and a (2-pole) power connector (PWR) for the common supply connection.

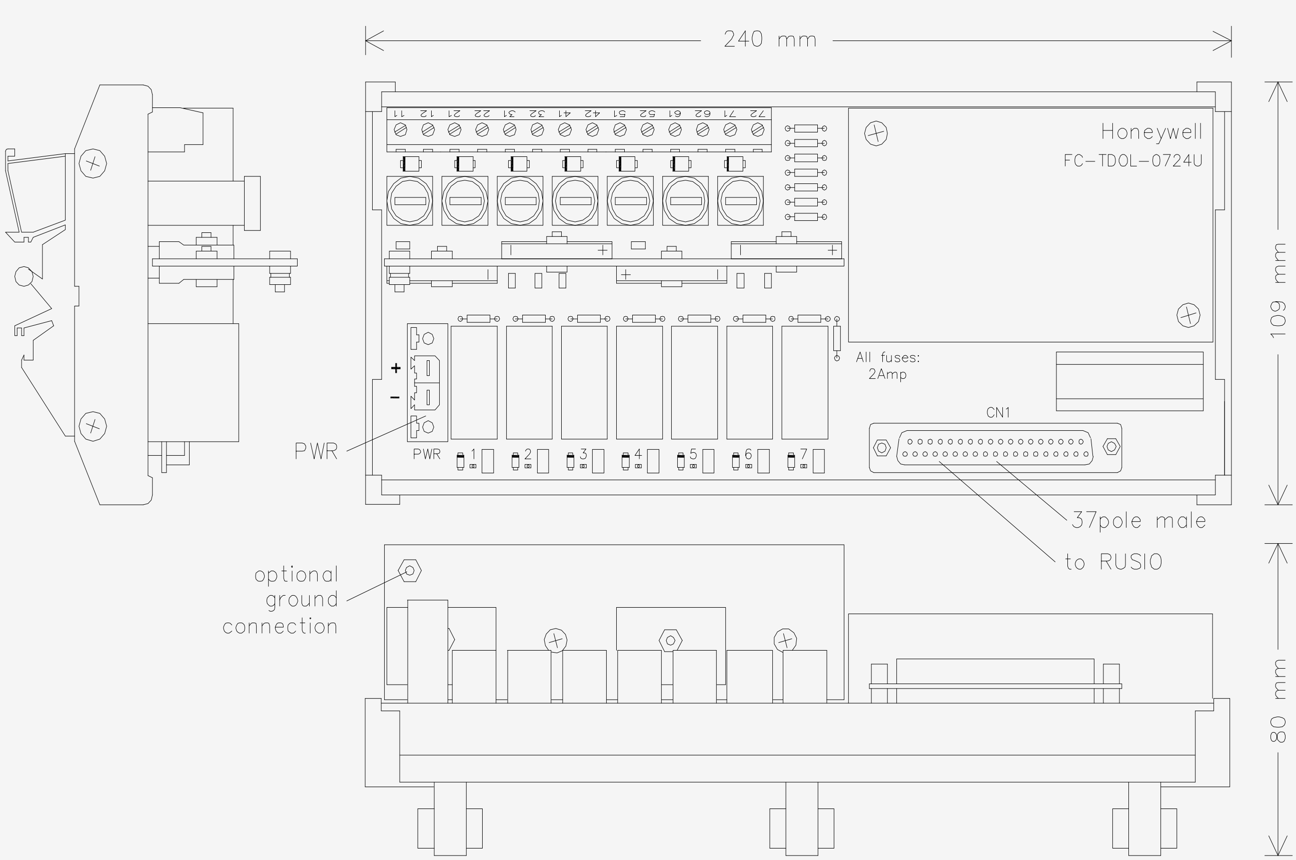


Figure 15-55: Mechanical layout

15.11.2 Main functions and usage

The TDOL-0724U is connected to a (non-redundant or redundant) IOTA via a CA-HWC300-AIO-DIO-xxM cable.

- A fused relay contact connects the common field supply voltage (24Vdc) with the field terminals. The 7 output relays are controlled by DO1-7 or DO17-23 of the RUSIO-3224. A led indicates the state of its output relay.
- Each output channel has a line-monitoring circuit. The line-monitoring circuit is powered by RUSIO channel 8 or 24. The (4-20mA) line-monitoring outputs are connected with analog inputs AI9-15 or AI25-31 of the RUSIO-3224.

- Presence of a proper common field supply voltage is monitored by a PWR_ON monitor that is connected with Line-Monitored Digital Input 16 or 32 of the RUSIO-3224.
- Special application logic drives the outputs and processes the line monitoring result.

15.11.2.1 Line-monitoring circuit output

The line-monitoring output has 5 states:

- 5 mA indicating a lead-breakage in the field wires
- 7 mA indicating an open contact output situation on the field wires
- 9 mA indicating a closed contact output situation on the field wires
- 11 mA indicating a short-circuit situation on the field wires
- Other; indicating an error (e.g. loss of power)

15.11.2.2 Schematic diagram of a channel

The below figure shows a schematic diagram of a channel. Each channel consists of:

- One relay with indicator LED
- A fused (2 AT) contact output
- A current injection resistor (22kΩ)
- A voltage readback circuit
- A current sense connection and a current readback circuit

The common part of the module (see Figure 1) consists of:

- A DC/DC converter to supply the voltage- and current- readback circuits
- A supply voltage monitor (generating the *RB_PWR* signal)

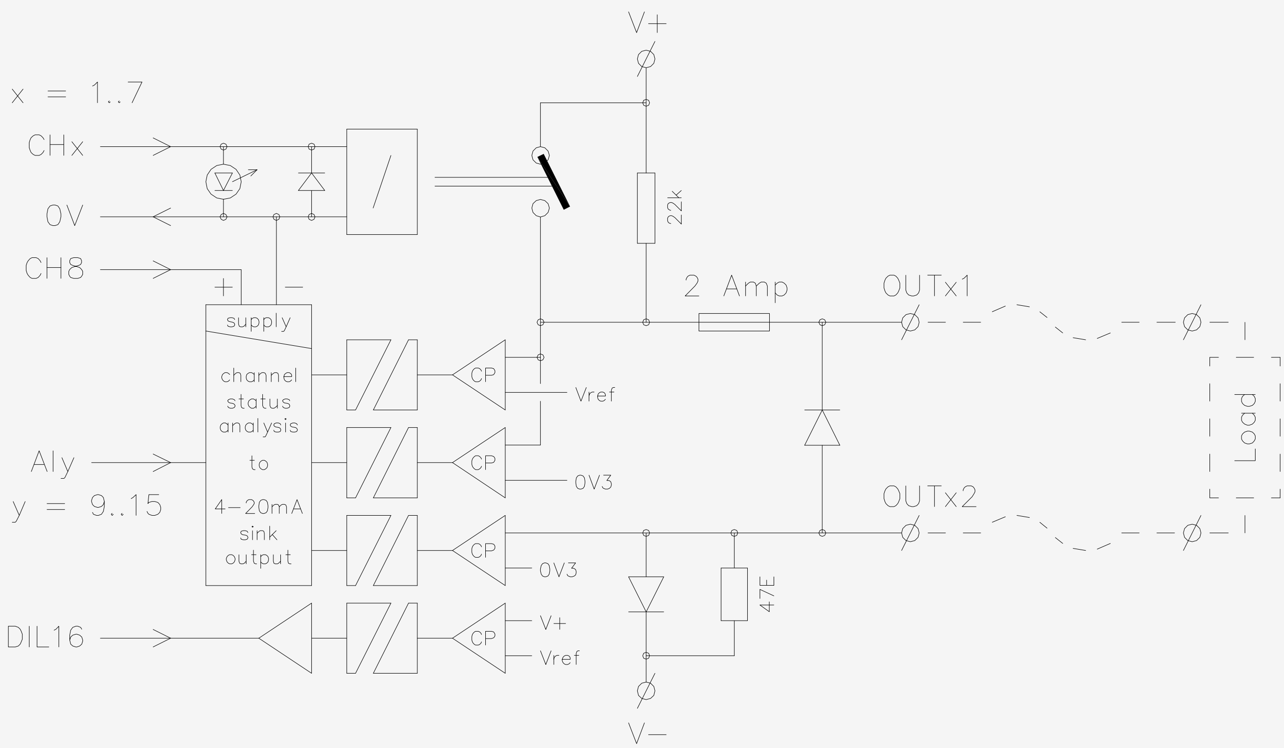


Figure 15-56: Schematic diagram of a channel

15.11.2.3 Lead breakage detection

Lead breakage in a channel is detected if:

- The channel is *off* and the 22kΩ channel resistor (see the above figure) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is *on* and the current readback (RB_I) threshold (approx. *0.3V*) is not met.

Note:
A blown channel fuse will be indicated as lead breakage of that channel.

15.11.2.4 Short circuit detection

Short circuit in a channel is detected if:

- The channel is *off* and the 22kΩ channel resistor (see the above figure) is not able to create a field voltage drop higher than the low threshold value (approx. *0.3*V).
- The channel is *on*. This will blow the channel fuse and will be indicated as lead breakage.

15.11.2.5 Field loads with a resistance below 400Ω

Field loads with a resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional diode can be wired in series with the load as shown in the below figure. Behind this diode the short circuit detection is “blind”, so this diode should be placed as close to the load as possible.

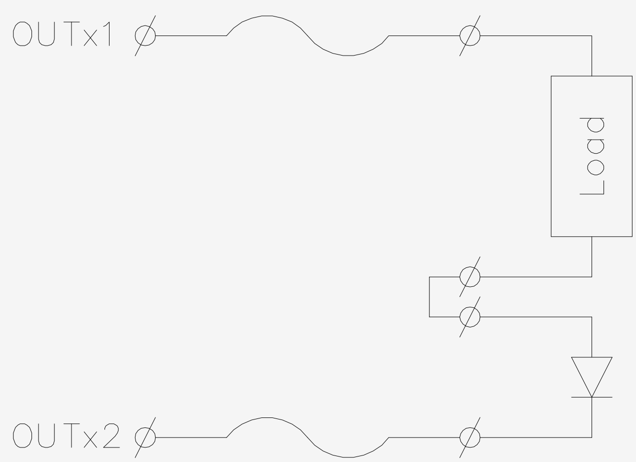


Figure 15-57: Additional diode for loads < 400Ω

Note:
The additional diode for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7A, or of type 1N5404 (or equivalent) for loads up to 2 A.

15.11.3 Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

Common function blocksand Channel function blocks explain the function of this special application logic.

> **Note:**
> Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

15.11.3.1 Common function blocks

The below figure shows the schematic of the common function block required for the TDOL-0724U.

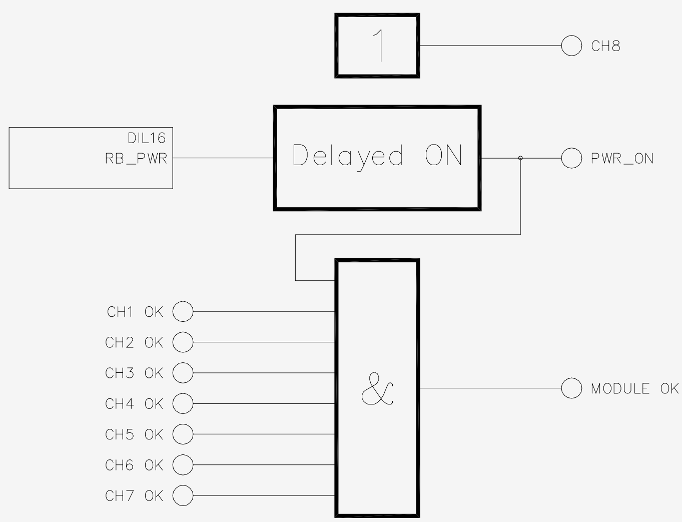


Figure 15-58: Example of the delay and OK function block

The delay and OK function block is common per TDOL-0724U.

- The Delay logic monitors the presence of 24V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.

- The AND-gate collects the *CHx OK* signals of the seven channels function blocks of the TDOL-0724U, as indicated in Figure 2 If all channels are OK, the *MODULE OK* output is *high*.
- Connect a “1” with SPARE or unused channels of the AND-gate.

15.11.3.2 Channel function blocks

The below figure shows the schematics of the channel function blocks.

One channel function block is needed per channel of the TDOL-0724U FTA.

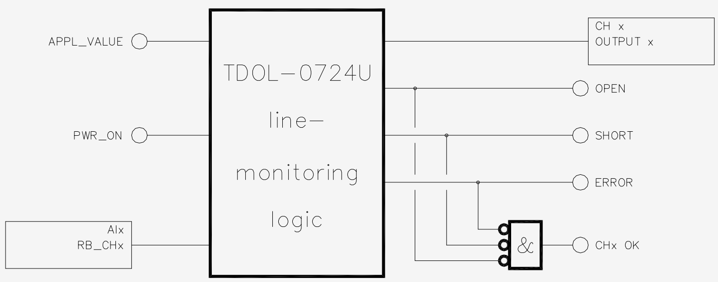


Figure 15-59: Example of a channel function block

A standard channel function block as shown in the above figure has:

- An application value input *APPL_VALUE*
- A PWR_ON input that must be linked to the common function block (for details see Common function blocks)
- One input for the voltage readback result *RB_CHx* of each channel (AI 9 thru 15)
- One output for the output relay OUT of each channel (DO 1 thru 7)
- A *SHORT* output that indicates a short-circuit on the field wires (a *SHORT* detection also blocks the energization of the output relay)
- An *OPEN* output that indicated lead-breakage on the field wires (or output fuse blown)
- an *ERROR* output that indicates:
  - Field output is *on* while relay not energized or
  - Field output is *low*, while relay energized.
- A *CHx OK* output if no (line monitoring) errors are detected

15.11.3.3 Channel assignment:

When connected to the TDOL-0724U the IO channels of the RUSIO-3224 are assigned as follows:

Field channel TDOL-0724U	RUSIO-3224	
	channel	type
CH 1	DO1 or DO17	DO
CH 2	DO2 or DO18	DO
CH 3	DO3 or DO19	DO
CH 4	DO4 or DO20	DO
CH 5	DO5 or DO21	DO
CH 6	DO6 or DO22	DO
CH 7	DO7 or DO23	DO
CH 8	DO8 or DO24	DO
RB_CH 1	AI9 or AI25	4-20mA
RB_CH 2	AI10 or AI26	4-20mA
RB_CH 3	AI11 or AI27	4-20mA
RB_CH 4	AI12 or AI28	4-20mA
RB_CH 5	AI13 or AI29	4-20mA
RB_CH 6	AI14 or AI30	4-20mA
RB_CH 7	AI15 or AI31	4-20mA
RB_PWR	DIL16 or DIL32	DIL

15.11.4 Applications

For correct operation, the TDOL-0724U must be combined with 16 channels of a (redundant set of) Safety Manager universal IO module(s).

A cable[1] of suitable lenght is used to connect the TDOL-0724U with an (redundant or non-redundant) IOTA.

1. Honeywell type numbers that are available: 4213509 up to and including 4212516.

   These type numbers correspond with part number CA-HWC300-AIO-DIO-xxM (Pepperl & Fuchs), where ‘xx’ stands for the length in meters.

   For details see the manufacturer’s data sheet (Pepperl & Fuchs).

15.11.5 Connections

The connections diagram of the TDOL-0724U module is as follows:

15.11 TDOL-0724U

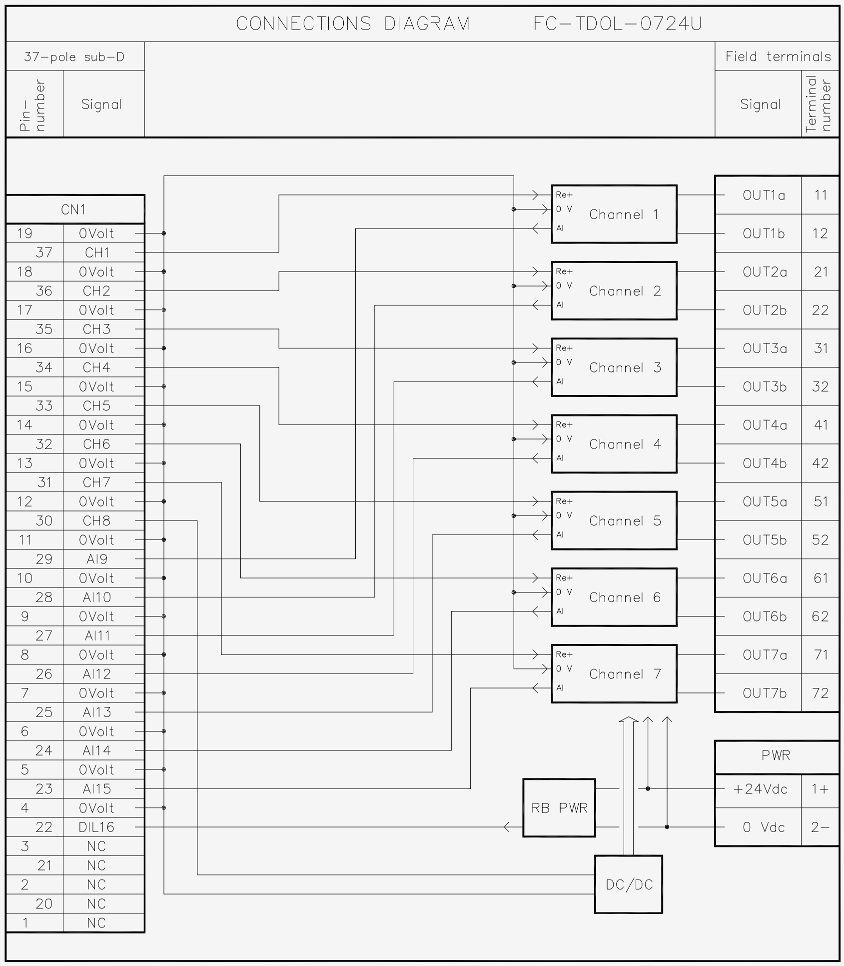


Figure 15-60: Connections diagram

The following connections apply:

- connector CN1 (37 pole Dsub male) must be connected with the IOTA
- 24Vdc (field-)power must be connected on connector PWR

The TDOL-0724U has 7 pairs of terminals to connect the load.

15.11.6 External power

A 24 V DC power distribution cable (see datasheet PDC-MB24-y for details) can be used to connect the main busbar with the power connector on the TDOL-0724U module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

> **Note:**
> The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

The below figure shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked + is pin 1: connected to +24Vdc busbar.
- The pin marked - is pin 2: connected to the 0Vdc busbar.

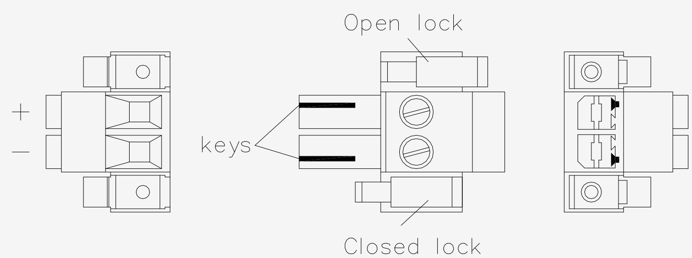


Figure 15-61: Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view

The two (red) locking slides of the cable-connector in the above figure keep the cable-connector locked when inserted into the power connector.

15.11.6.1 Grounding

Connect a ground wire to the (free) screw on the top left-side of the heatsink (see Figure 1 for location) if grounding of metal parts is required.

15.11.7 Maximum output load

The below figure shows the maximum channel load vs the ambient temperature.

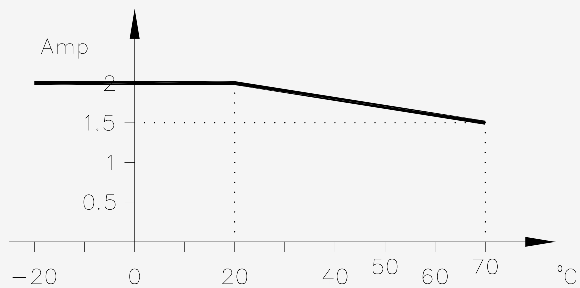


Figure 15-62: Derating curve (channel load vs ambient temperature) for the TDOL-0724U

15.11.8 Technical data

The TDOL-0724U module has the following specifications:

15.11 TDOL-0724U

General	Type number:	FC-TDOL-0724U
	Approvals:	CE, TUV, UL, CSA
Outputs	Number of channels:	7
	Max. output current:	2 A
	Output load 24Vdc:	resistive or inductive with spark suppression diode
	Output supply voltage:	24 V DC +/- 20%
	Module voltage drop:	max. 1 Volt (at 2 A)
	Minimum required load:	2200 W
	Leakage current to load:	max. 1.1 mA at 24 V
	No load output voltage:	
	• output OFF	95% of output supply voltage
	• output ON	100% of output supply voltage
	Short-circuit detection threshold on field wires:	200Ω < R_{Th} < 400Ω
Fuse	Fuse rating:	2 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2507
	Derating curve:	Linear from 2 A at 25 dC to 1.4 A at 70 dC module ambient

Return signals	4-20mA channels:	
	• lead breakage	5 mA +/- 1 mA
	• open contact	7 mA +/- 1 mA
	• closed contact	9 mA +/- 1 mA
	• short circuit	11 mA +/- 1 mA
	DIL channel:	
	• Field voltage low	15 kΩ +/- 2%
	• Field voltage OK	5 kΩ +/- 2%
Relay contact	Max switched power:	150 Watts
	Expected life:	
	• electrical	100,000 switch operations
	• mechanical	30,000,000 switch operations
Power consumption	PWR connector:	<10 mA (internal) + Field load
	CN1 connector:	max. 350 mA at 24 V DC
Physical	Module dimensions:	240 x 109 x 80 mm (L x W x H) 9.45 x 4.29 x 3.15 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241 mm (9.49 inch)

Termination	Screw terminals:	
	• max wire diameter	2.5 mm (AWG 14)
	• strip length	7 mm (0.28 in)
	• tightening torque	0.5 Nm (0.37 ft-lb)
	Power connector:	2 pole header with keying
	• make and type:	Weidmuller: BVZ 7.62HP/02/180F SN BK (conn.) Weidmuller: BV/SV7.62HP KO (keys)
	• strip length:	8 mm (0.28 in)
	• Connectable conductors:	0.5-6mm (AWG 20-AWG 10)
	CN1 connector:	37 pole Dsub female (cable side)

15.12 TIDI-1624

15.12.1 Non-safe isolated 24 V DC input channels

Field termination assembly module TIDI-1624 is the interface between the system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It has sixteen non-safe isolated 24 V DC input channels.

Sixteen channels can be connected to the TIDI-1624 module via the system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module and connects to a (redundant pair of) SDI-1624 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

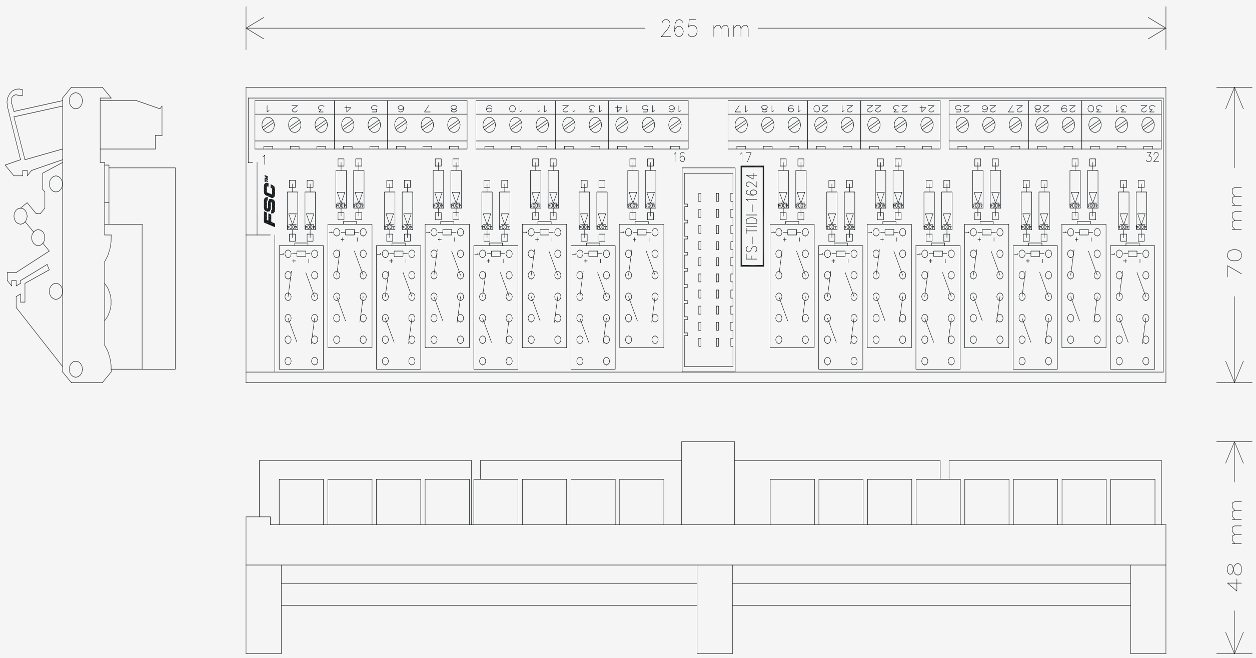


Figure 15-63: Mechanical layout

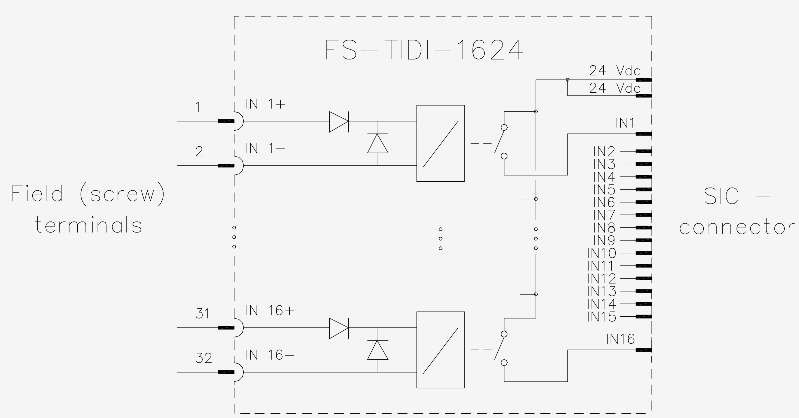


Figure 15-64: Schematic diagram

15.12.2 Applications

For details on applications and connection options for the TIDI-1624 module, see section SICC 0001/Lx.

15.12.3 Connections

The connections diagram of the TIDI-1624:

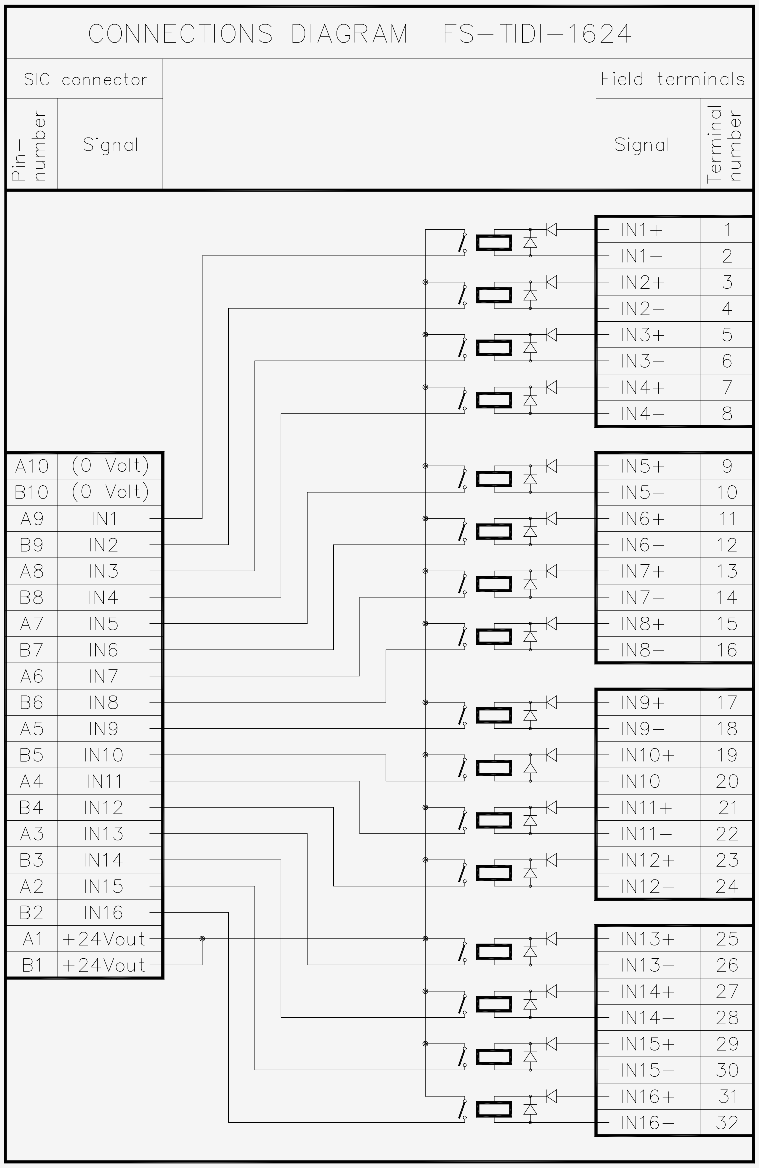


Figure 15-65: Connections diagram

15.12.4 Technical data

The TIDI-1624 module has the following specifications:

General	Type numbers:	FS-TIDI-1624
		FC-TIDI-1624
	Approvals:	CE, TUV, UL, CSA
Input	Number of input channels:	16
	Nominal input voltage:	24 V DC
	Drop-out voltage:	2.8 V DC
	Pick-up voltage:	17.5 V DC
	Max. input voltage:	47.5 V DC
	Reverse polarity protection:	Series diode
	Max. reverse voltage:	300 V
	Input current:	Typically 9 mA at 24 V DC
	Max. switching frequency:	20 Hz
Physical	Module dimensions:	265 × 70 × 48 mm (L × W × H)
		10.43 × 2.76 × 1.89 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	266 mm (10.47 in)
Relay contact	Expected life:	
	• electrical	1,000,000 switch operations
	• mechanical	10,000,000 switch operations

Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Isolation	Galvanic isolation:	
	• Input to output	1000 V AC
	• Input to input	1000 V AC

15.13 TPSU-2430

15.13.1 24 V DC to 30 V DC / 1 A converter

The TPSU-2430 module is a DC/DC converter, which provides an isolated 30 V DC / 1 A to other field termination assemblies (FTAs), such as the analog input FTA modules TSAI-1620m and TSHART-1620m. It has voltage monitoring capabilities with local LED indication and also provides alarm functions (read back relay contact). If the local DC/DC output voltage is OK, the LED is on and the read back relay contact is closed.

The FTA module has a universal snap-in provision for standard DIN-EN rails.

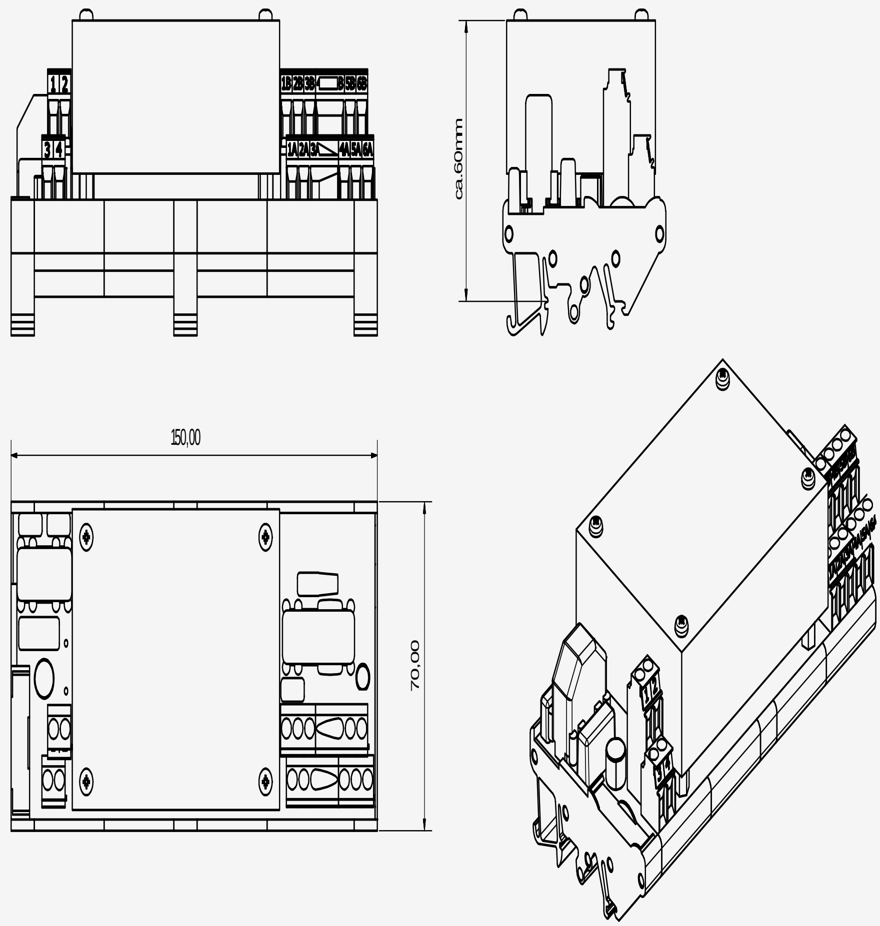


Figure 15-66: Mechanical layout

TPSU-2430 module is part of the Safety Manager system and is placed in the same enclosure as that of the Safety Manager.

15.13.2 Connections

The TPSU-2430 module has four screw terminals for connecting incoming power wires and the read back wiring. The screw terminals are numbered 1 to 4. The function of each terminal is listed below:

Screw terminal	Function
1	Read back contact
2	Read back contact
3	24 V DC IN +
4	24 V DC IN –

Caution:
Removal or connection of the 24 V DC IN+ and/or 24 V DC IN– wire(s) is only allowed when the 24 V DC power supply to the TPSU-2430 module has been switched off.

The TPSU-2430 module has twelve screw terminals for connection of outgoing power wires. The screw terminals are numbered ‘1A’, ‘1B’, ‘2A’, and so on, up to ‘6B’. The function of each terminal is listed below:

Screw terminal	Function
1A	30 V DC OUT
1B	0 V DC OUT
2A	30 V DC OUT
2B	0 V DC OUT
3A	30 V DC OUT
3B	0 V DC OUT
4A	30 V DC OUT
4B	0 V DC OUT
5A	30 V DC OUT
5B	0 V DC OUT
6A	30 V DC OUT
6B	0 V DC OUT or ground [1]

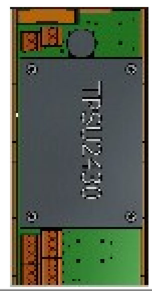
1. To provide a predictable system response in case of a short to earth in the field the ‘0V dc OUT’ must be connected to ground OR a dedicated ELD must be connected for this TPSU-2430 on the 30V side.

15.13.3 Technical data

The TPSU-2430 module has the following specifications:

General	Type numbers:	FS-TPSU-2430
		FC-TPSU-2430
	Approvals:	CE, TUV, UL, CSA, FM
	Safety class:	up to and including SIL3
	MTBF:	approx. 400,000 hours
Input	Nominal input voltage:	24 V DC
	Input voltage range:	18–36 V DC
	Inrush current:	≤ 4 A (see note below)
Output	Output voltage:	30 V DC, ± 0.25 V
	Output current:	1 A (short-circuit proof)
	Short-circuit current:	< 3.3 A
	Ripple (0—30 MHz):	< 0.1 Vrms
	Regulation:	< 1% (load + line)
	Transient response:	class C according to NFC42801C
	Power-on overshoot:	output < 33 V
	Overvoltage protection:	33 V
	Long-term stability (after 30 min. operation):	< 0.3%
	Efficiency:	> 75%
	Switching frequency:	> 25 kHz
Physical	Module dimensions:	150 × 70 × 62.3 mm (L × W × H) 5.91 × 2.76 × 2.45 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5

	Used rail length:	151 mm (5.94 in)
Fuse	Fuse rating:	3.15 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2509
Termination	Screw terminals:	
	• Max. wire size	2.5 mm^2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
	Wiring classification	80°C min.
Supply	Supply must be SELV compliant Supply must be over-voltage class II up to 300 V AC input	
Isolation	Isolation voltage:	
	• Input to output	2000 V AC (1 min.)
	• Input to relay contact	2000 V AC (1 min.)
	• Output to relay contact	2000 V AC (1 min.)
Environment	Operating temperature:	-5°C –+70°C (23°F –158°F)
	Storage temperature:	-40°C –+85°C (–40°F –+185°F)
	Cooling:	natural convection
	Altitude:	≤2000m

Alarm functions	Overvoltage protection:	dual, two-fault-tolerant
	Restart overvoltage protection:	only after removal of 24 V DC power
	Undervoltage detector:	LED on if voltage OK, read-back relay contact closed if voltage OK
	Undervoltage level:	typically 27.5 V DC
Mounting	The TPSU-2430 is DIN rail mounted. The TPSU-2430 unit can be mounted in horizontal or vertical position.	
		
Readback	Relay contact rating:	36 V DC / 40 mA, 30 V AC / 40 mA

Caution:
The inrush current limiter is only active at power-on.

To regain the inrush current limiting function, the TPSU-2430 module must be switched off for at least 30 seconds. Switching on the module within 30 seconds may blow a fuse or activate a circuit breaker.

15.14 TRO-0824

15.14.1 Non-safe dry digital output FTA (8 channels, NO/NC)

Field termination assembly module TRO-0824 is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). It has eight non-safe potential-free relay changeover contacts (NO/NC). The energized relay state is indicated by a LED on the module. You can connect up to eight channels to TRO-0824 via the system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDO-0824 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

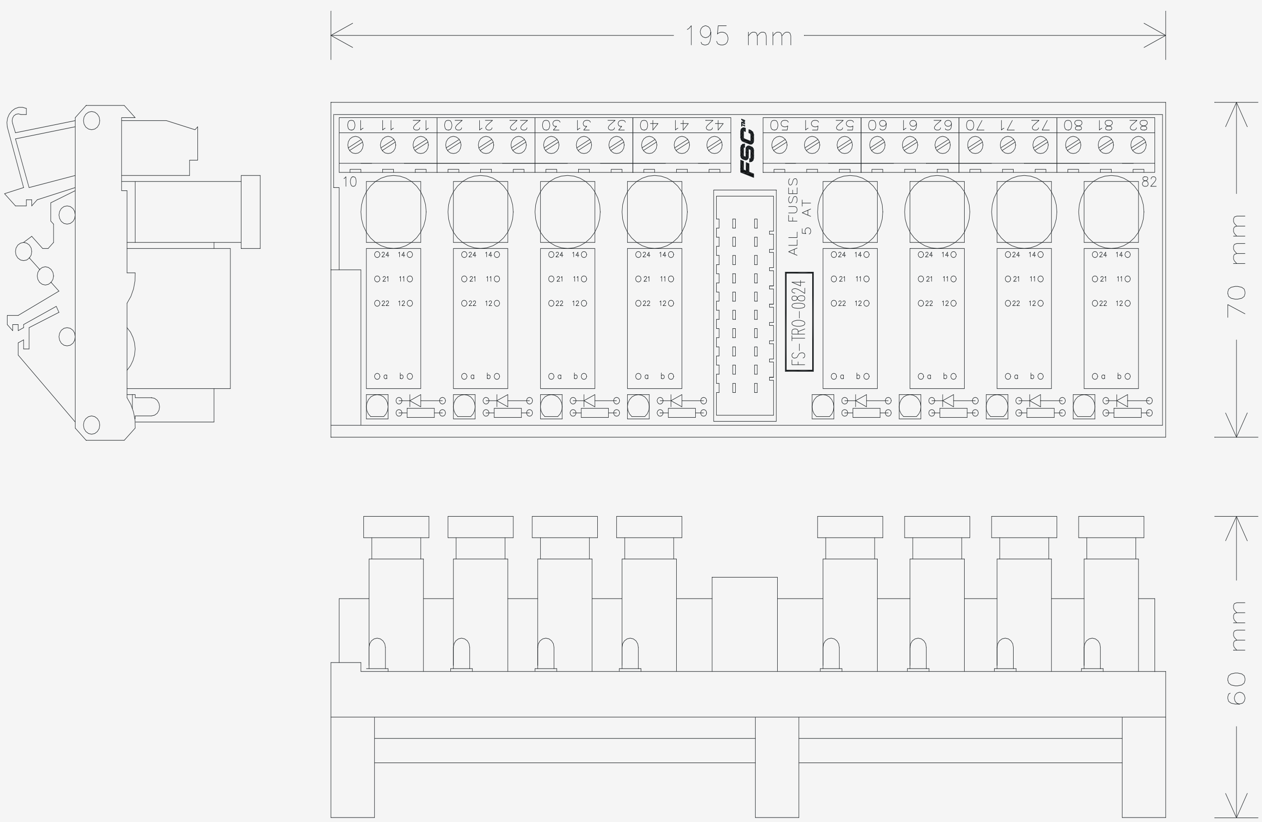


Figure 15-67: Mechanical layout

Each channel consists of:

- One relay
- A changeover contact with a fused (5 AT) common
- A status indicator LED

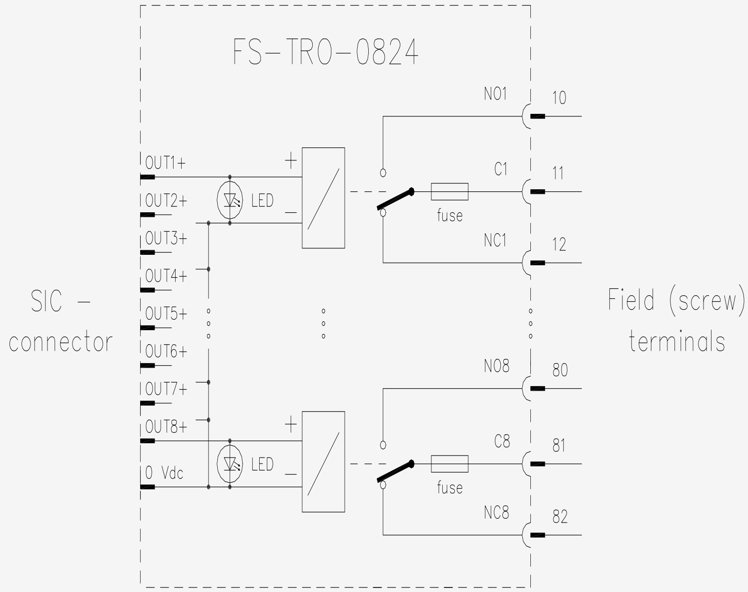


Figure 15-68: Schematic diagram

15.14.2 Relay life

The electrical life of the relays heavily depends on the contact rating the relay is exposed to. the below figure shows the expected relay life versus contact current.

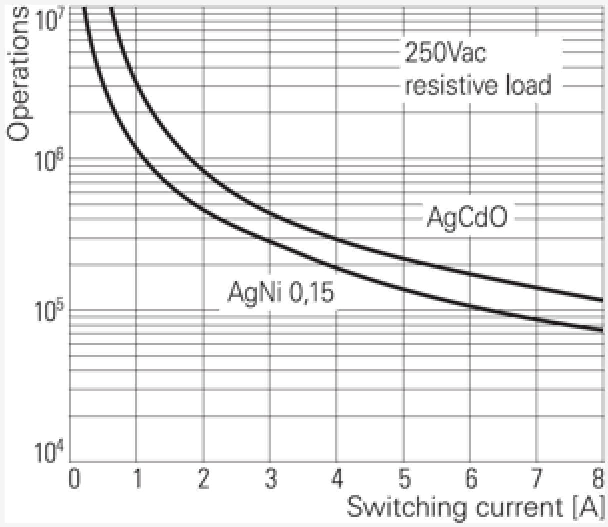


Figure 15-69: Life curve of the applied relays

15.14.3 Applications

For details on applications and connection options for TRO-0824, see section SICC 0001/Lx.

15.14.4 Connections

The connections diagram of the TRO-0824 module:

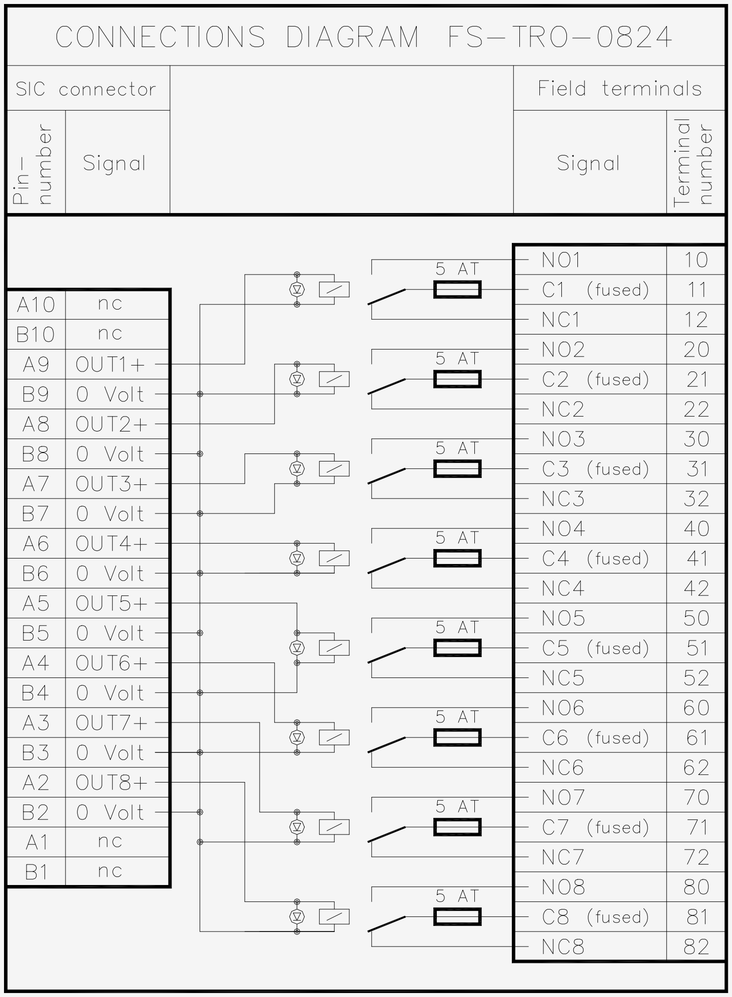


Figure 15-70: Connections diagram

15.14.5 Technical data

The TRO-0824 module has the following specifications:

General	Type numbers:	FS-TRO-0824
		FC-TRO-0824
	Approvals:	CE, UL, TUV, CSA
Input	Nominal input voltage:	24 V DC
	Max. input voltage:	31 V DC
	Relay cut-in voltage:	19 V DC
	Input current:	typically 27 mA at 24 V DC
Output	Number of output channels:	8
	Max. output current:	5 A
	Max. output voltage:	250 V AC / 300 V DC
	Max. switched load:	1250 VA / 150 W at 30 V DC (see Figure 1)
Fuse	Fuse rating:	5 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	150 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2511
	Derating curve:	Linear from 5 A at 25 dC to 3.5 A at 70 dC module ambient
Physical	Module dimensions:	195 × 70 × 60 mm (L × W × H) 7.68 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5

	Used rail length:	196 mm (7.72 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Relay contacts	Max. current:	8 A
	Max. switched voltage:	250 V AC / 300 V DC
	Max. switched load:	2000 VA / 192 W at 24 V DC (see Figure 1)
	Max. switching frequency:	20 Hz
	Expected life:	See Figure 1
	Isolation:	
	• Coil to contact	4000 V AC
	• Contact to contact	1000 V AC
	Ambient temperature:	-40°C-+70°C (-40°F-+158°F)
	Contact material:	Silver-cadmium oxide (AgCdO)

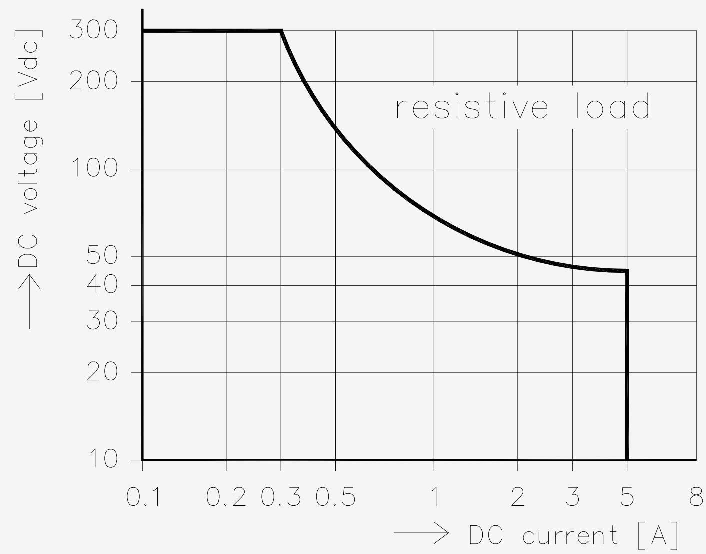


Figure 15-71: Maximum DC switched power curve for TRO-0824 module

15.15 TSAI-0410

15.15.1 Safe analog input FTA (4 channels)

Field termination assembly module TSAI-0410 is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals).

The four channels of a (redundant pair of) SAI-0410 module(s) can be connected to the TSAI-0410 module via system interconnection cable SICC-0001/Lx. Range selection (active, passive, volts/current) is set per module (4 channels) using an BSAI-04x or BSDIL-0426 board.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

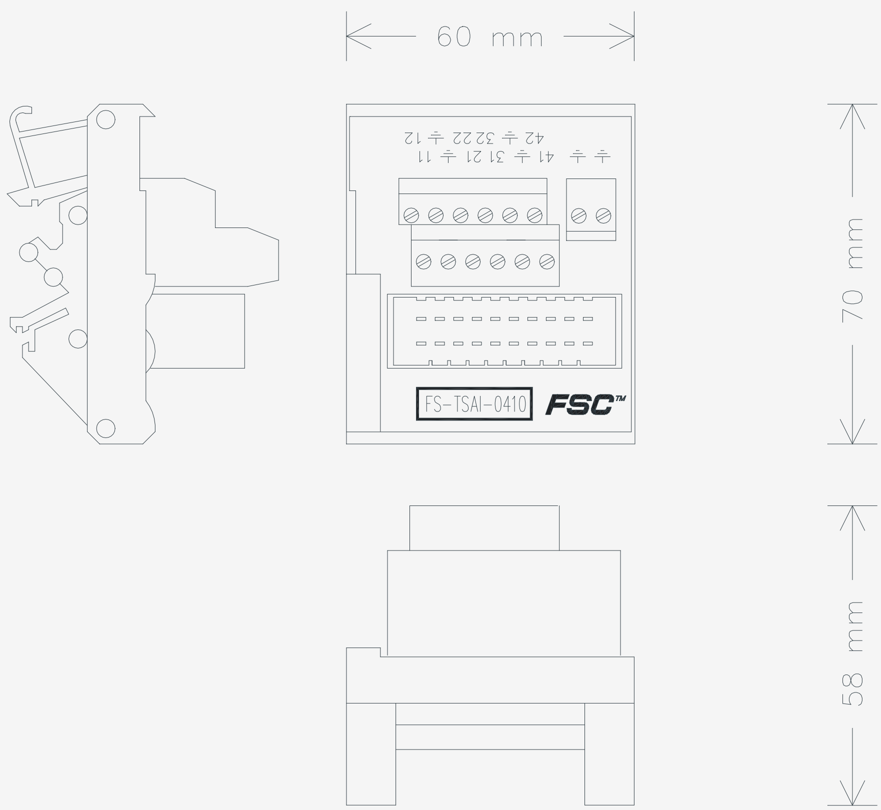


Figure 15-72: Mechanical layout

15.15.2 Applications

For details on applications and connection options for the TSAI-0410 module, see section SICC 0001/Lx.

15.15.3 Connections

The connections diagram of the TSAI-0410 module is as follows:

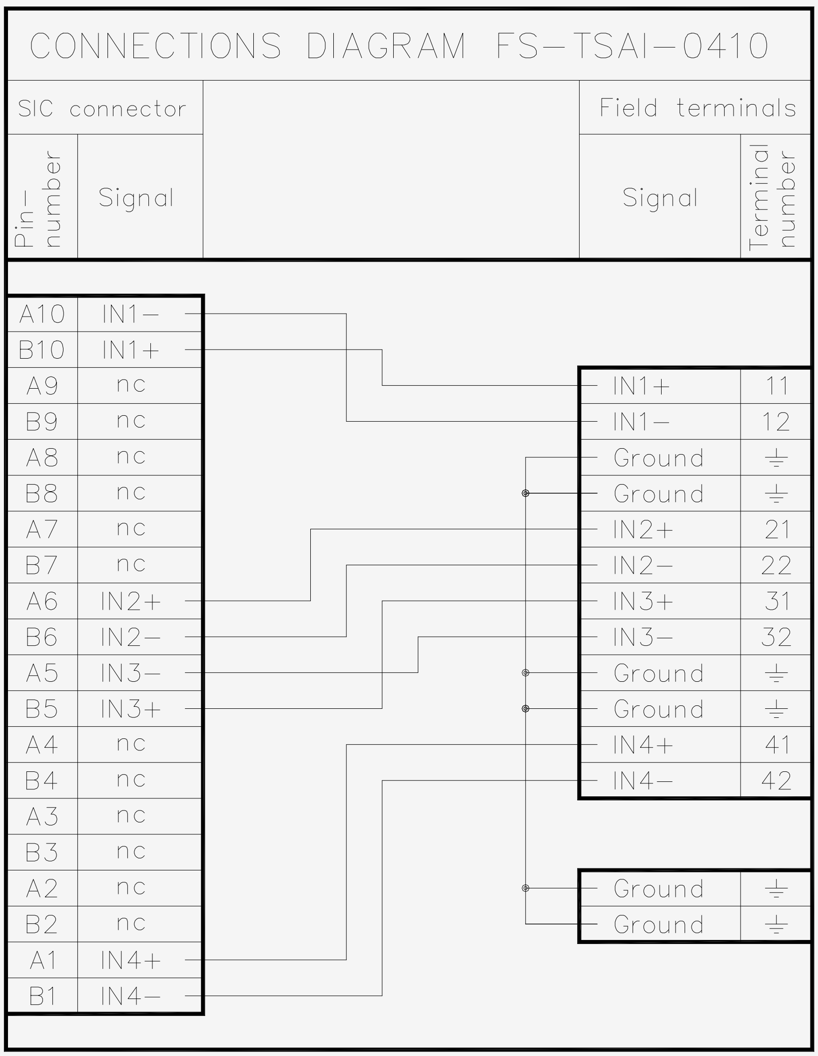


Figure 15-73: Connections diagram

15.15.4 Technical data

The TSAI-0410 module has the following specifications:

General	Type numbers:	FS-TSAI-0410
		FC-TSAI-0410
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	4
	Maximum voltage:	50 V DC – IEC 1010 (1990),
		overvoltage category 3 (Table D.12)
	Maximum continuous current/voltage per channel:	50 mA (for 0(4)-20 mA setting) 10 V (for 0 (2)-10V setting)
Physical	Module dimensions:	60 × 70 × 58 mm (L × W × H)
		2.36 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

15.16 TSAI-1620m

15.16.1 Safe 0-20 mA and 4-20 mA analog input FTA (16 channels)

Field termination assembly module TSAI-1620m is the interface between field components (such as sensors) and the safe high-density analog input module SAI-1620m in Safety Manager. It can be used for interfacing signals from Class I, Division 2 Hazardous Locations.

The TSAI-1620m module has sixteen analog input channels, which may be used for both safety-related and non-safety-related applications. These sixteen channels (separated into two groups of eight channels with common 0 V) are connected via a system interconnection cable (SICC-0001/Lx), which is plugged into the SIC connector on the FTA module.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply, ground and field wiring.

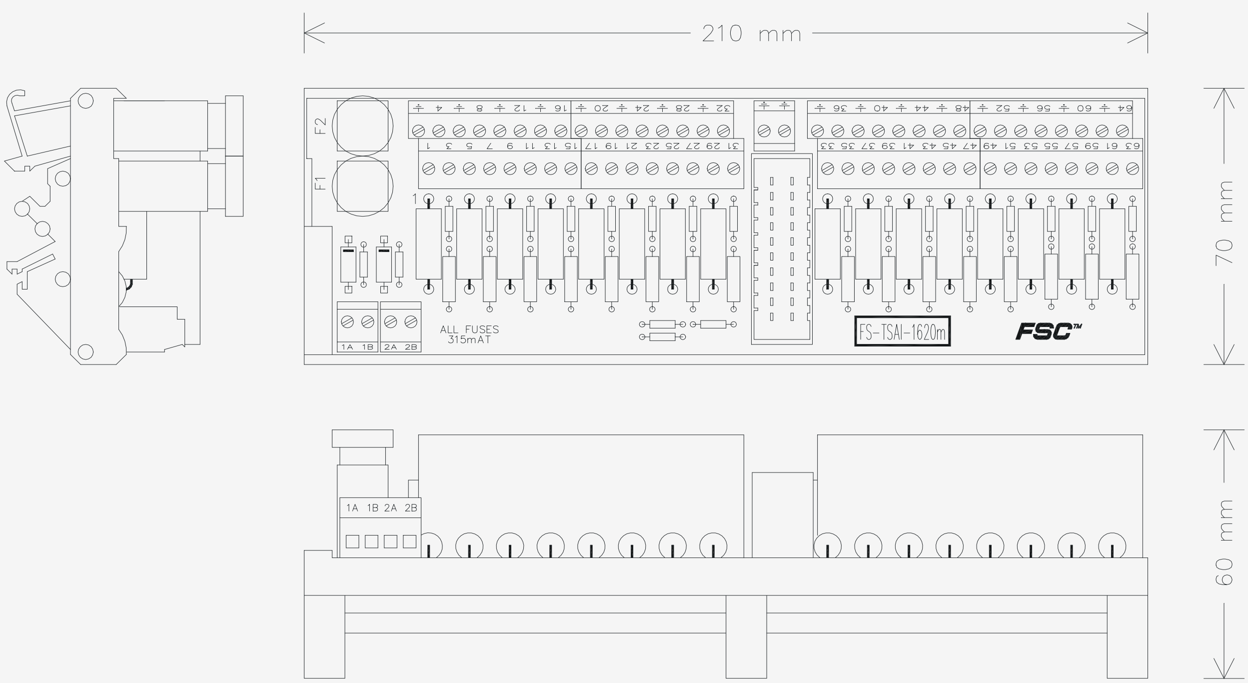


Figure 15-74: Mechanical layout

15.16.2 Main functions

TSAI-1620m module has three main functions:

- Linear direct conversion of 0(4)-20 mA DC field signals to the signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter with voltage-current limitation in compliance with Hazardous Area Class I Division 2
- Enabling monitoring of the external power connected to the FTA module

15.16.2.1 Linear direct conversion

The input circuit of each channel consists of a high-precision resistor, which converts the input current (0-20 mA) to the input voltage for the high-density analog input module SAI-1620m. Power is supplied to the analog transmitter via a series resistor. Each analog signal has its own terminal for the field cable shield. The below figure shows the schematic diagram for connecting a transmitter (active and passive).

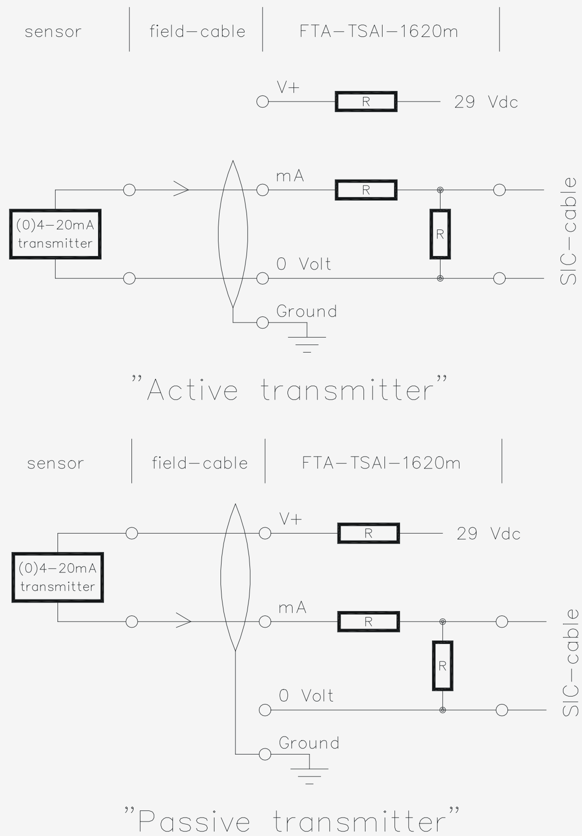


Figure 15-75: Schematic diagram for connecting a transmitter

15.16.2.2 Class I division 2

The TSAI-1620m module may be used for non-incendiary field circuits for Class I, Division 2 applications. The external output voltage (V+) is current-limited by means of a series resistor.

15.16.2.3 Transmitter voltage

The below figure shows the available transmitter voltage for passive transmitters.

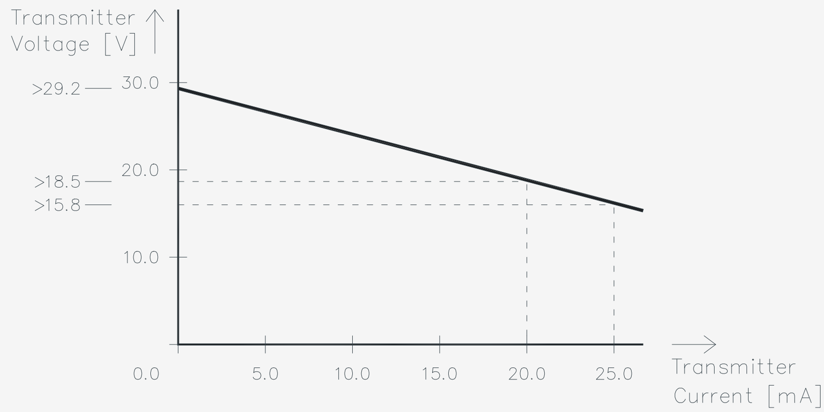


Figure 15-76: Transmitter voltage for passive transmitters

15.16.2.4 External power

If all inputs are active, no external power is required.

For loops, which contain passive transmitters, analog process data is only available if the supply voltage to the electronics is guaranteed. The high-density analog input concept (using TSAI-1620m / TPSU-2430 modules) offers full monitoring of power that is provided externally. If DC/DC converter modules TPSU-2430 are used, even redundant power supplies are covered.

Redundant external power can be connected to the TSAI-1620m module via two screw terminal pairs marked ‘1A’, ‘1B’, ‘2A’ and ‘2B’. The external power supplies are de-coupled via diodes (see the below figure). The sixteen channels on the FTA module are divided into two groups of eight channels, with each group being protected by a 315 mA fuse. Single-channel errors (shorts from V+ to 0 V) cannot blow the group fuse.

> **Note:**
> The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager application software must monitor the external power voltage via the safe high-density analog input module SAI-1620m when safety-related analog input signals are connected to the TSAI-1620m.

The below figure shows the schematic diagram for power distribution with monitoring.

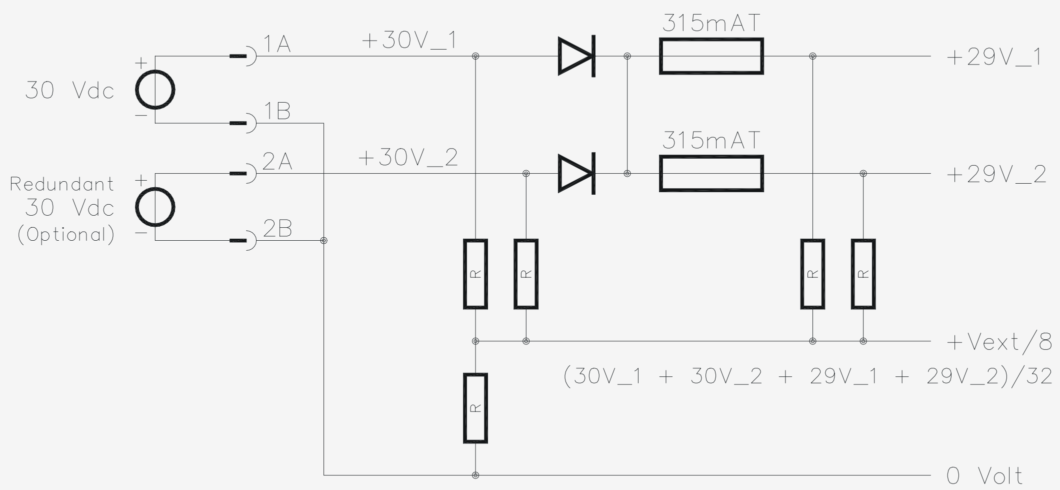


Figure 15-77: Schematic diagram for power distribution with monitoring

15.16.3 Applications

For details on applications and connection options for the TSAI-1620m module, see section SICC 0001/Lx.

15.16.4 Connections

15.16.4.1 External power and ground

The redundant external supply voltage (Vext) and ground are connected to the following screw terminals (marked '1A', '1B', '2A', '2B' and '⏚' on the FTA):

Screw terminal	Function
1A	30 V DC Vext feeder 1
1B	0 V DC Vext feeder 1
2A	30 V DC Vext feeder 2
2B	0 V DC Vext feeder 2
⏚	Ground connection
⏚	Ground connection (1 ground wire is enough)

15.16.4.2 Connections diagram

TSAI-1620m has 16 groups (= 16 channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

The connections diagram of the TSAI-1620m module:

15.16 TSAI-1620m

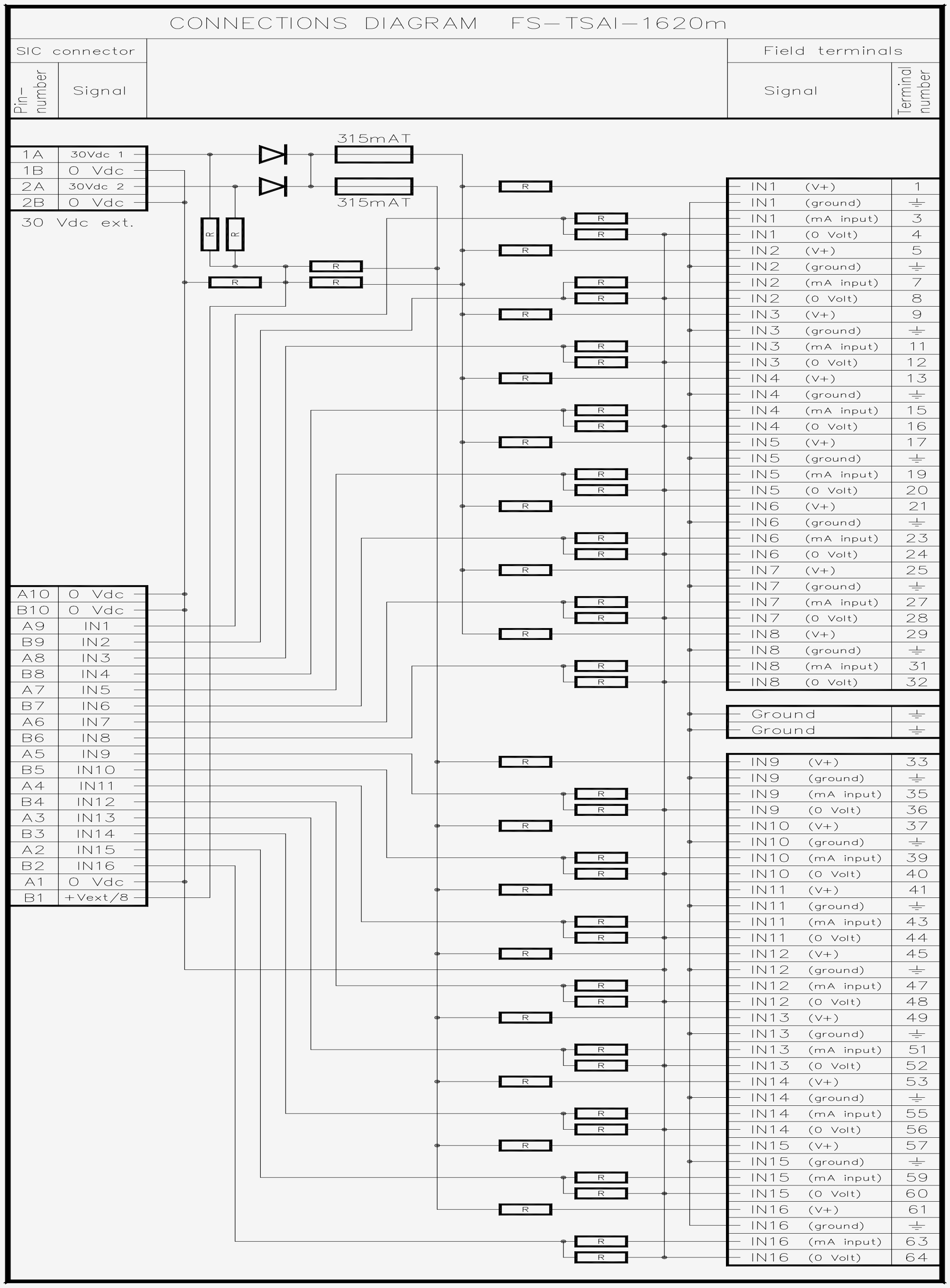


Figure 15-78: Connections diagram

15.16.5 Technical data

The TSAI-1620m module has the following specifications:

General	Type numbers:	FS-TSAI-1620m
		FC-TSAI-1620m
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (2 groups of 8 with common 0 V)
	Power requirements:	30 V DC external, 3 mA (without input loop loads)
	Input current:	0-25 mA
	Input resistance:	250 Ω (± 1%)
Output	To passive transmitters (Vext):	
	• Output resistance:	270 Ω (± 5%)
	• Igniting current per channel:	< 120 mA at 30 V DC
	To SAI-1620m module:	
	• Output voltage	0-4 V DC
	• Accuracy	0.10%
Fuse	Fuse rating:	315 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	125 V
	Voltage rating DC:	-
	Manufacturer:	SOC
	Manufacturer PN:	MQ2 315 mA
	Maximum output current per fuse:	220 mA

Physical	Module dimensions:	210 × 70 × 60 mm (L × W × H)
		8.26 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	211 mm (8.30 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

The TSAI-1620m module has the following for non-incendive field circuits, Class1 Division 2 specifications:

Field signal specifications for non-incendive field circuits, Class1 Division 2	HYDROGEN (Group A & B):	
	• Max. loop inductance	6 mH
	• Max. loop capacitance	0.25 µF
	NON-HYDROGEN (Group C & D):	
	• Max. loop inductance	20 mH
	• Max. loop capacitance	5 µF

15.17 TSAO-0220m

15.17.1 Safe analog output FTA (0(4)-20 mA, 2 channels)

Field termination assembly module TSAO-0220m is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). The two channels of an TSAO-0220m module can be connected to a (redundant pair of) SAO-0220m module(s) with the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

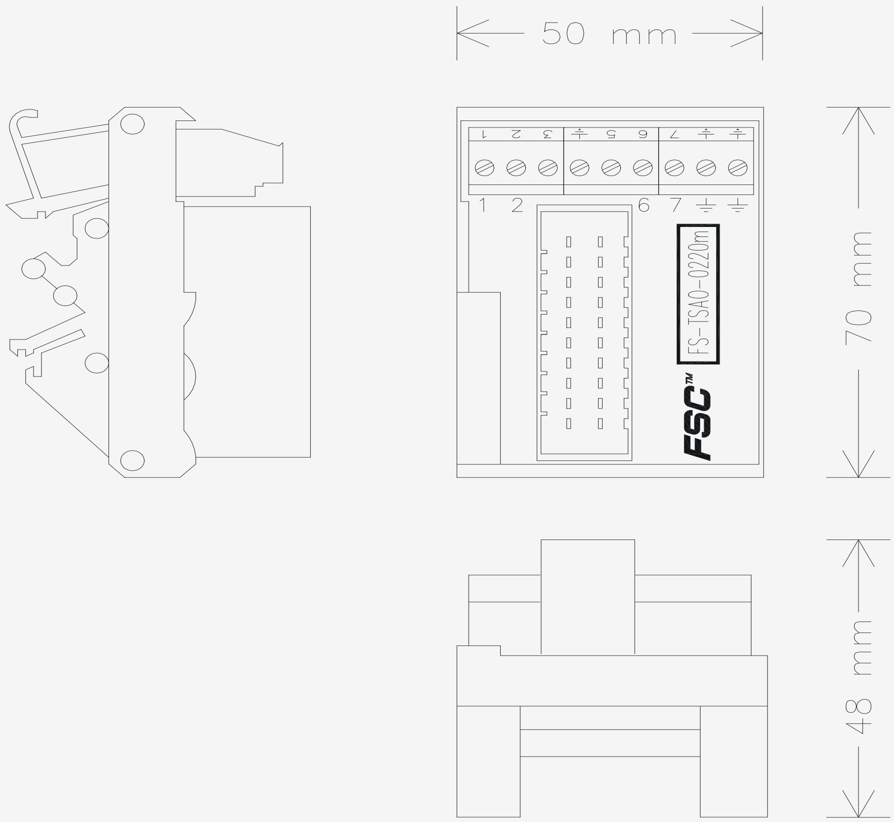


Figure 15-79: Mechanical layout

15.17.2 Applications

For details on applications and connection options for TSAO-0220m, see section SICC 0001/Lx.

15.17.3 Connections

The connections diagram of the TSAO-0220m module is as follows:

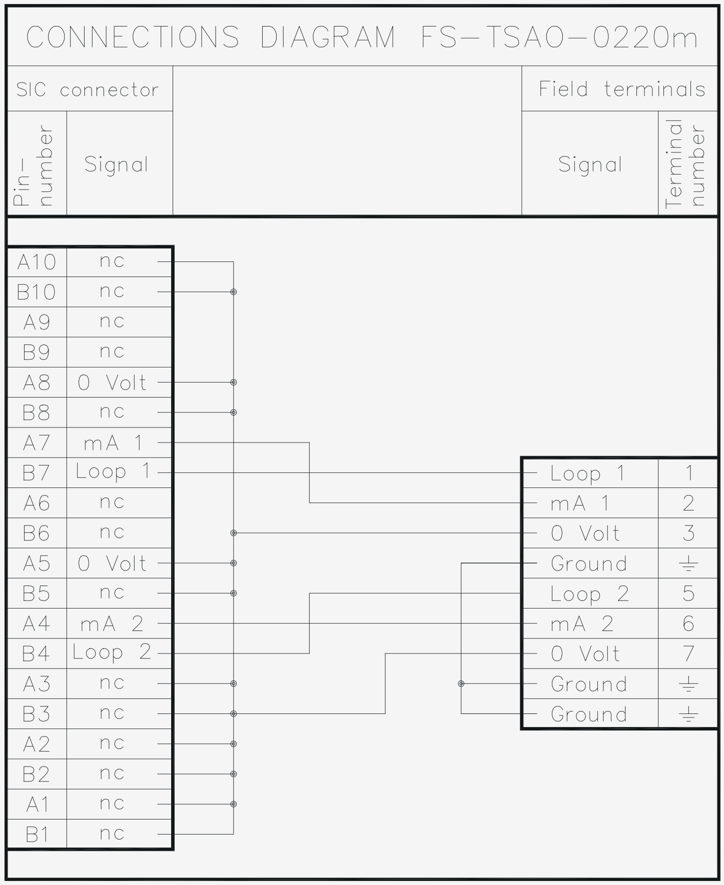


Figure 15-80: Connections diagram

15.17.4 Technical data

The TSAO-0220m module has the following specifications:

General	Type numbers:	FS-TSAO-0220m
		FC-TSAO-0220m
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	2
	Maximum voltage:	40 V DC – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	25 mA
Physical	Module dimensions:	50 × 70 × 48 mm (LxWxH) 1.97 × 2.76 × 1.89 in (LxWxH)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	51 mm (2.01 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

15.18 TSAOH-0220m

15.18.1 Safe analog output FTA with HART interface (0-20mA, 2 channels)

The field termination assembly module TSAOH-0220m is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). The two analog output channels of a (redundant pair of) SAO-0220m module(s) can be connected to the TSAOH-0220m with the system interconnection cable SICC-0001/Lx.

The TSAOH-0220m module provides a HART interface on each channel and enables connection of -up to eight- TSAOH-0220m modules in series, enabling the use of all 16 HART channels of the HART-multiplexer.

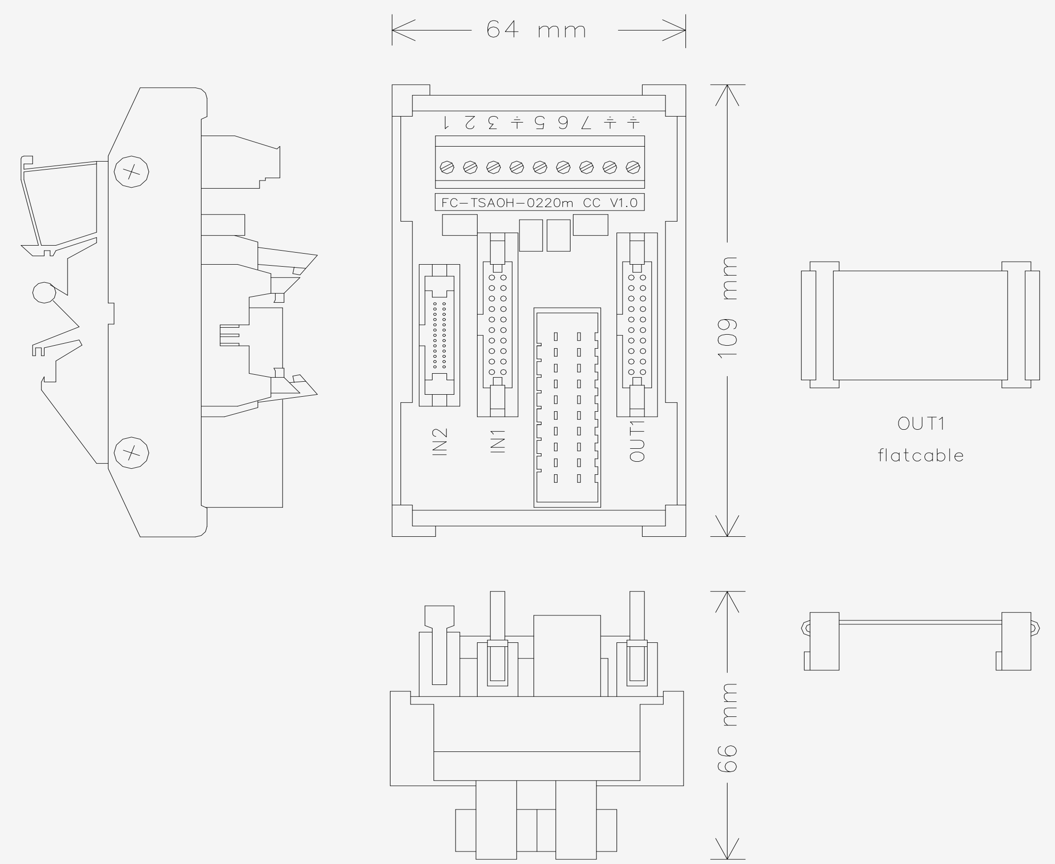


Figure 15-81: Mechanical layout

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for the connection of field wiring.

15.18.2 HART interface

Attention:

Suggested HART multiplexers have no galvanic isolation between (24 V DC) supply and the HART signals (common 0 V DC).

The TSAOH-0220m module provides an interface to HART multiplexer units from MTL and Pepperl+Fuchs (P+F). Dedicated connectors are installed on the FTA to enable the use of the standard cables from these suppliers.

The following equipment can be connected:

	MTL Solution	P+F solution
Multiplexer unit	MTL4850	KFD0-HMS-16 or KFD2-HMM-16
Cable	MTL FLAT20-2.2	K-MH26
Connector on FTA[1]	IN1	IN2

1. Figure 1

15.18.3 HART flatcable linking

The flatcable connector OUT1 in the above figure allows linking of up to eight TSAOH-0220m modules in series.

The below figure shows how the flatcable, supplied with each TSAOH-0220m, can be used to link OUT1 with IN1 of the next module:

This way the outputs of the first TSAOH-0220m module will be connected to channel 1 and 2 of the HART-multiplexer on connector IN1 or IN2, the second module to channel 3 and 4, the third module to channel 5 and 6, and so on.

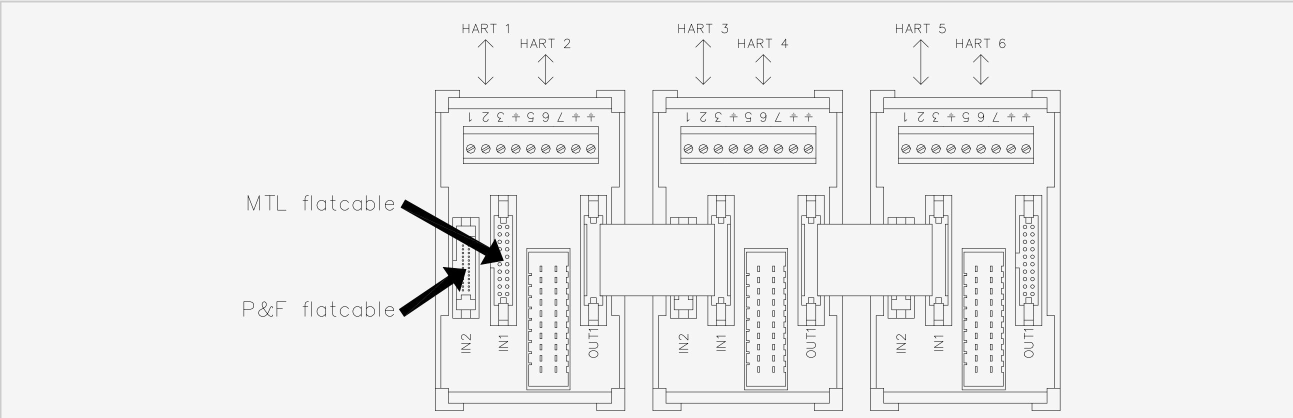


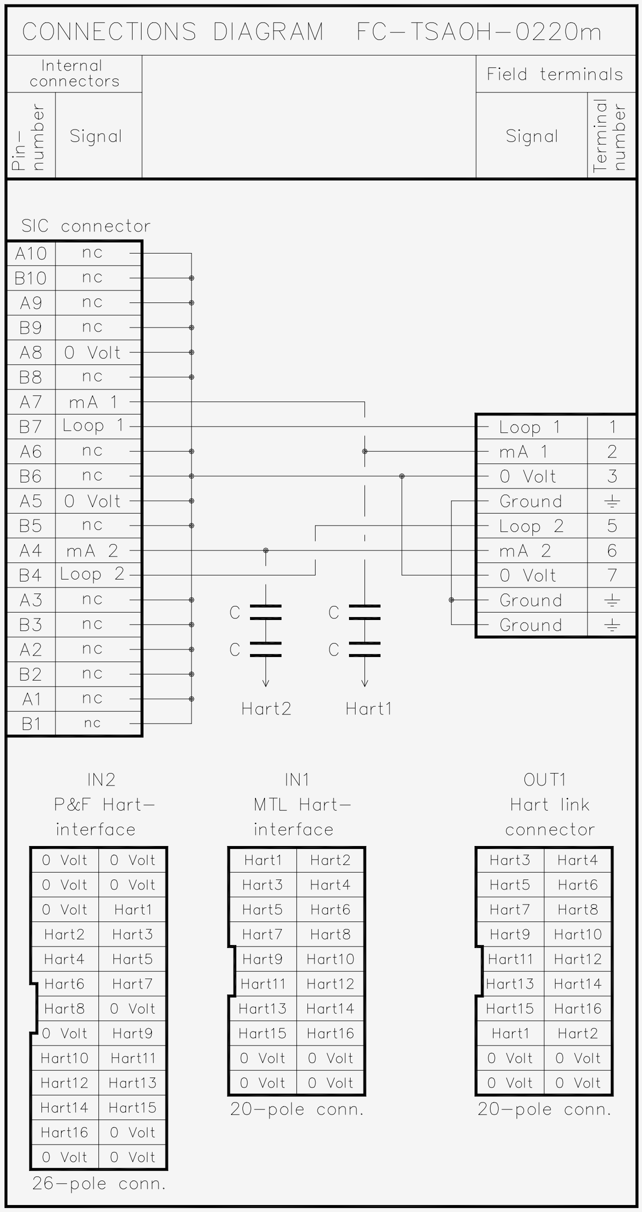
Figure 15-82: Linking up to 16 HART channels to one multiplexer unit

15.18.4 Applications

For details on applications and connection options for the TSAOH-0220m, see section SICC 0001/Lx.

15.18.5 Connections

The below figure shows the connections diagram of the TSAOH-0220m.



0 Volt	0 Volt
0 Volt	0 Volt
0 Volt	Hart1
Hart2	Hart3
Hart4	Hart5
Hart6	Hart7
Hart8	0 Volt
0 Volt	Hart9
Hart10	Hart11
Hart12	Hart13
Hart14	Hart15
Hart16	0 Volt
0 Volt	0 Volt

Hart1	Hart2
Hart3	Hart4
Hart5	Hart6
Hart7	Hart8
Hart9	Hart10
Hart11	Hart12
Hart13	Hart14
Hart15	Hart16
0 Volt	0 Volt
0 Volt	0 Volt

Hart3	Hart4
Hart5	Hart6
Hart7	Hart8
Hart9	Hart10
Hart11	Hart12
Hart13	Hart14
Hart15	Hart16
Hart1	Hart2
0 Volt	0 Volt
0 Volt	0 Volt

Figure 15-83: Connections diagram

15.18.6 Technical data

The TSAOH-0220m module has the following specifications:

General	Type number:	FC-TSAOH-0220m
	Approvals:	CE, TUV, UL, CSA
Power	Number of channels:	2 (with common 0V)
	Maximum voltage:	40 V DC – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	25 mA
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Physical	Module dimensions:	64 × 109× 66 mm (LxWxH) 2.52 x 4.29 x 2.60 in (LxWxH)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	65 mm (2.56 in)

15.19 TSDI-16115

15.19.1 Safe active/passive digital input FTA (115 V AC/DC, 16 channels)

Field termination assembly module TSDI-16115 is a 16-channel safe input converter module, universal for both 115 V AC and/or 115 V DC. All inputs are galvanically isolated.

Each channel converts an externally supplied 115 V input signal into a 24 V DC input signal which can be connected to the 24 V DC safe input module SDI-1624, thus creating a safe 115 V input for Safety Manager.

Sixteen channels can be connected to the TSDI-16115 module via the system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDI-1624 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

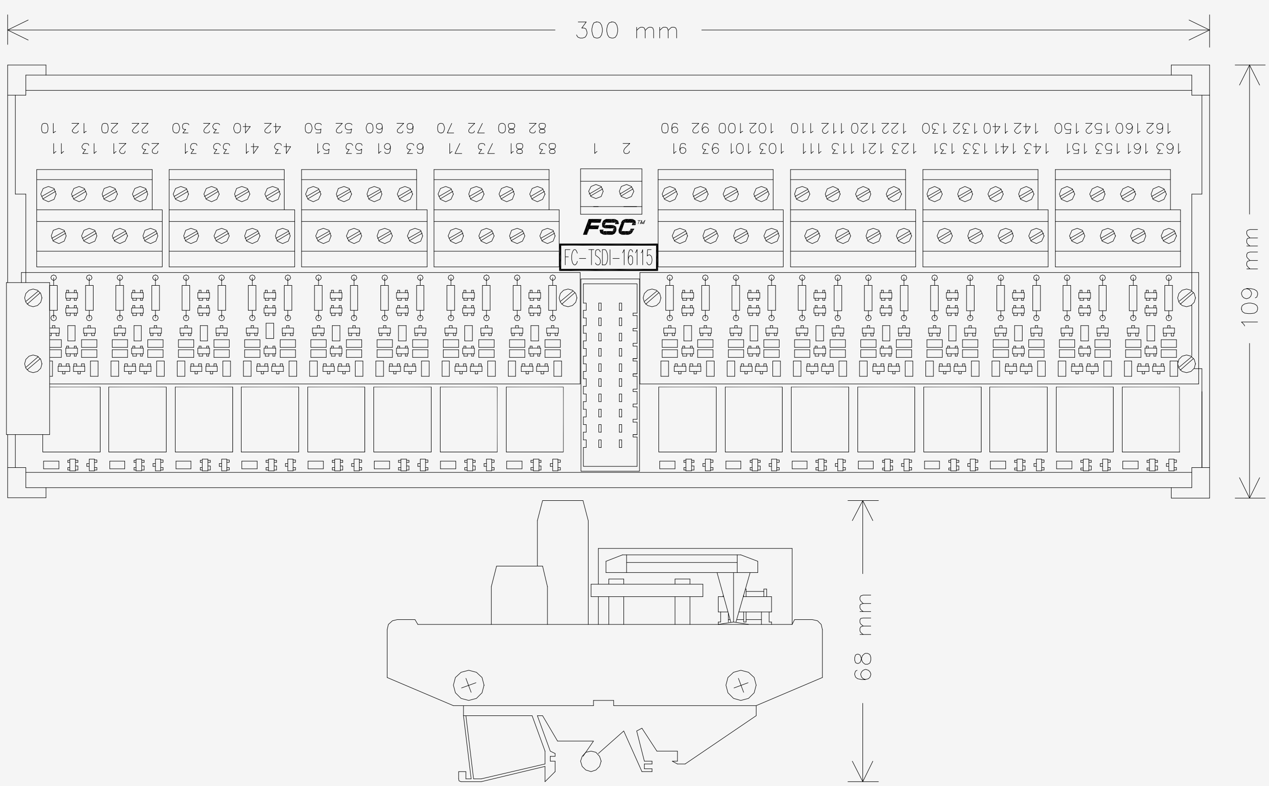


Figure 15-84: Mechanical layout

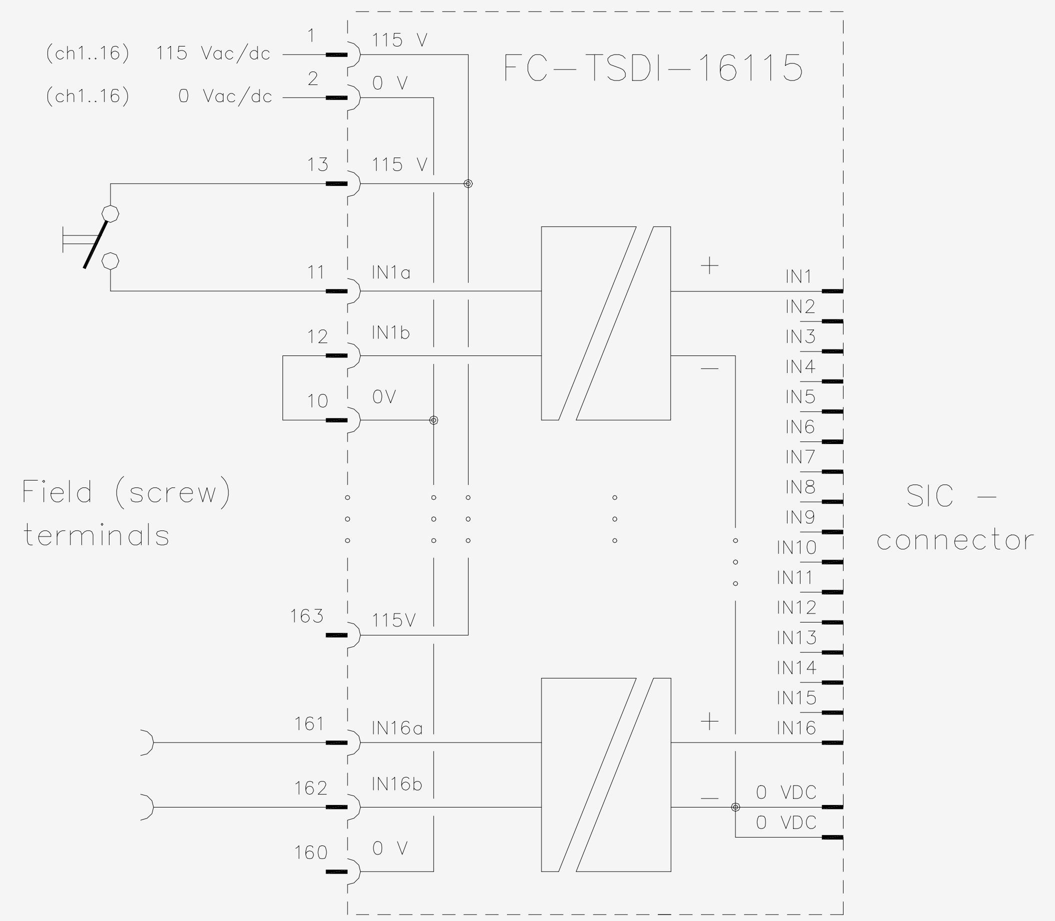


Figure 15-85: Schematic diagram

15.19.2 Applications

For details on applications and connection options for the TSDI-16115 module see section SICC 0001/Lx.

15.19.3 Field cable lengths

High-impedance AC inputs (like the inputs on this FTA) have a limited capability of handling the wire capacitance of standard multi-core field cables. The wire capacitance of the field cable acts as a shunt impedance over the field contact (see the below figure).

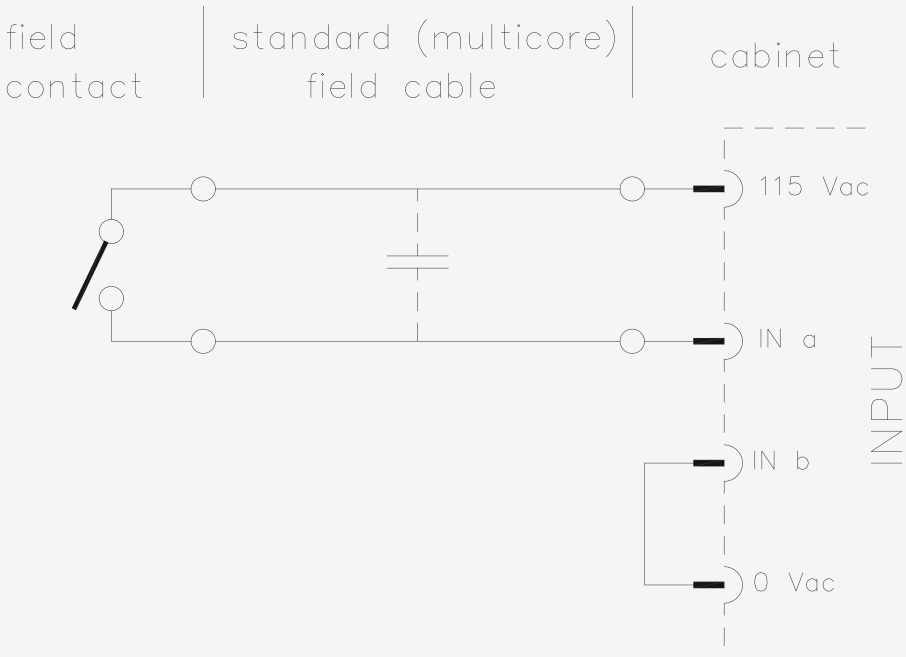


Figure 15-86: Standard (multi-core) field cable

When the current through this shunt impedance exceeds the maximum ‘LOW’ current, the input may be activated by this shunt impedance, thus disabling the input function (by keeping the input activated continuously, i.e. ON). Every AC input will have a maximum ‘LOW’ current that it can handle.

The maximum allowable cable length depends on the maximum ‘LOW’ current (for example 1.2 mA), the typical cable capacitance (for example 120 pF/m), the maximum supply voltage (for example 130 V AC) and the supply frequency (for example 60 Hz).

The maximum length (in meters) can be calculated using the following formula:

$$L_{max} = \frac{I_{low}}{V_{max} \cdot 2 \cdot \pi \cdot f \cdot C_{typ}}$$

where:

L_{max} = maximum allowable cable length

I_{low} = maximum 'LOW' current

V_{max} = maximum supply voltage

f = supply frequency

C_{typ} = typical cable capacitance

As an example, we will calculate the maximum field cable length (in meters) using the values mentioned above:

$$L_{max} = \frac{1.2 \cdot 10^{-3}}{130 \cdot 2 \cdot \pi \cdot 60 \cdot (120 \cdot 10^{-12})} = 204 \text{ m}$$

In this example, the maximum allowable field cable length is 204 meters (223 yards).

15.19.3.1 Solutions for long cables

The field cable length limit can be eliminated by using field cables with wires that are shielded separately (see Figure 2). The only (relevant) capacitance of the input wire is to the shield (0 V AC or earth) and this will not activate a 'LOW' input. However, this type of cable is rather unusual.

Field cables with shielded wire pairs are more commonly used (see Figure 3). This allows for two connections methods:

1. Use the method of Figure 2 and leave the second wire of each pair unconnected, or 2.
2. Connect the second wire of each pair to 0 V AC (as shown in Figure 3). The 115 V AC / 0 V AC supply pair can be used for more than one input.

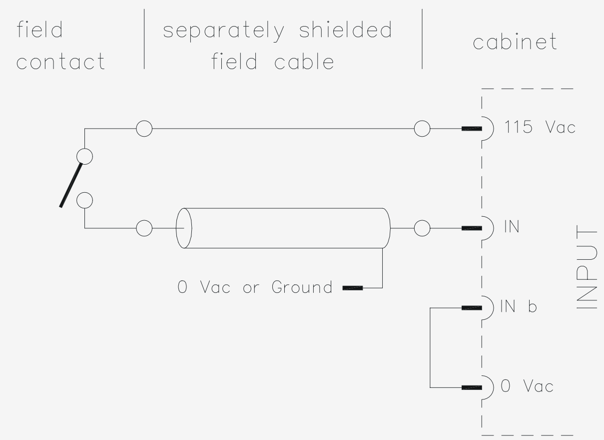


Figure 15-87: Field cable with separately shielded wires

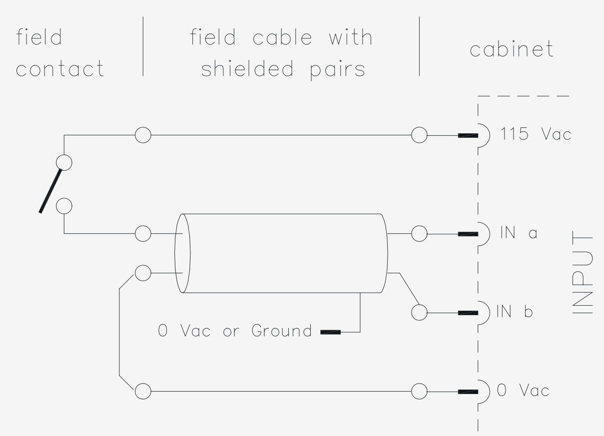


Figure 15-88: Field cable with shielded pairs

In practice, a mix of wiring methods may be used. For example, use a cable with shielded pairs between the control cabinet and a distribution box close to the process. This cable may be long, for example 3 km (1.8 mi). Then use a standard (multi-core) cable for the connection between the distribution box and the field contact. This cable length is limited to the value calculated using the formula mentioned above.

15.19.4 Connecting active/passive inputs

The TSDI-16115 module supports inputs for both active and passive signals. Figure 1 shows the schematic diagram for connecting active inputs. Figure 2 shows the diagram for connecting passive inputs.

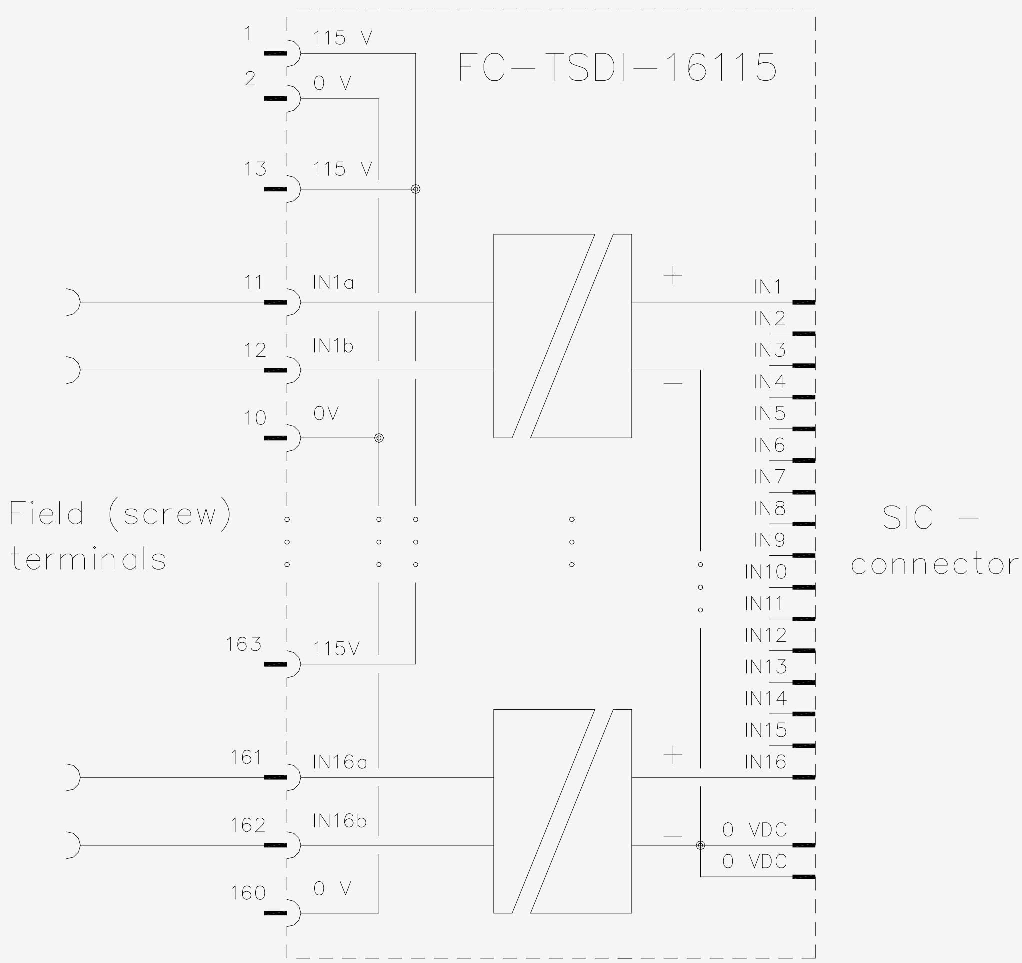


Figure 15-89: Schematic diagram for connecting active inputs

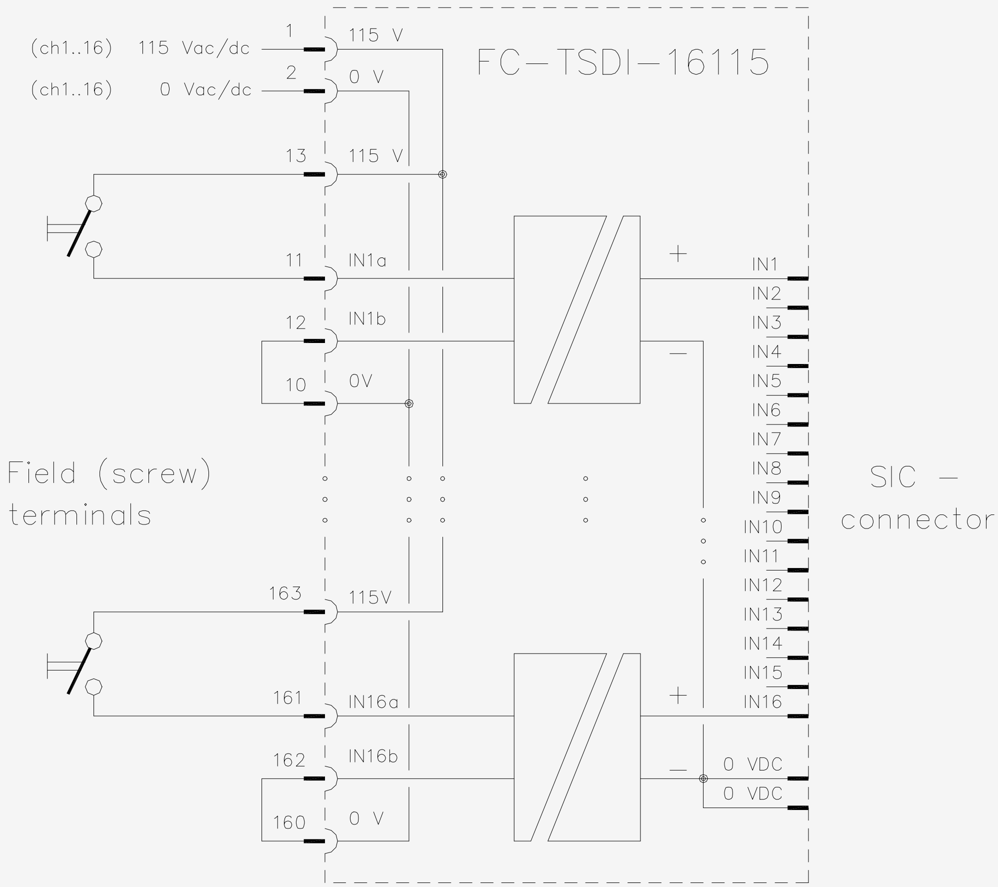


Figure 15-90: Schematic diagram for connecting passive inputs

Caution:

Dips and/or short interruptions of the 115V signal can cause an 'input low' detection by the Safety Manager Controller.

15.19.5 Connections

The connections diagram of the TSDI-16115 module is as follows:

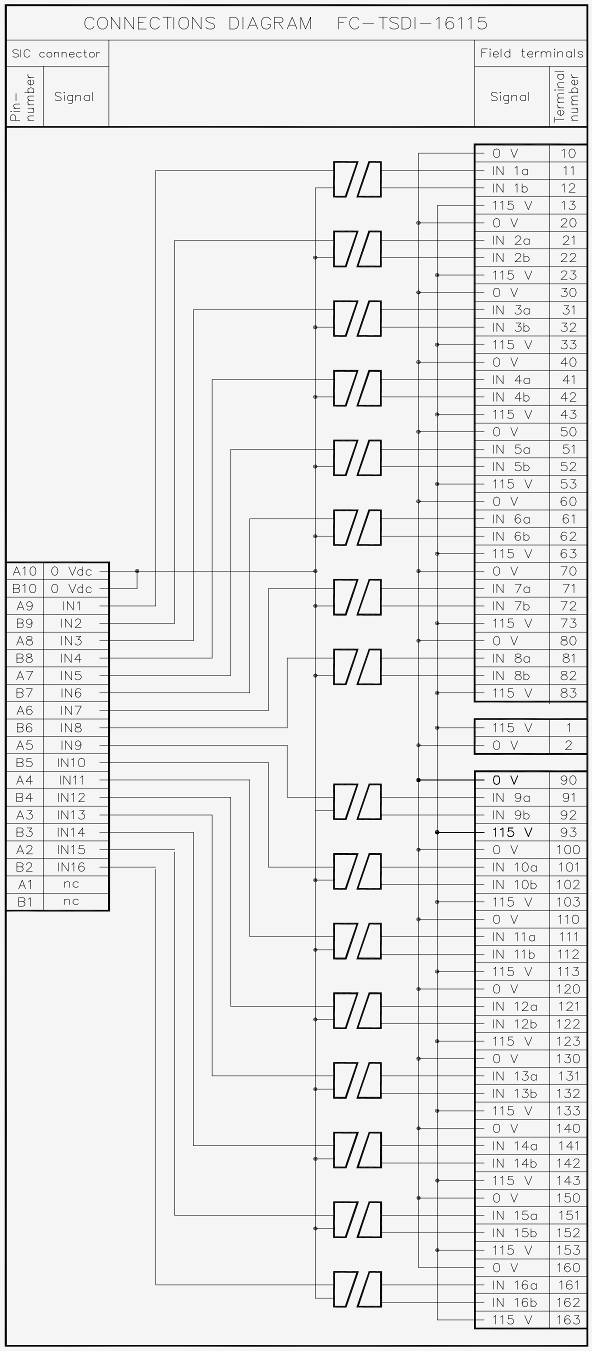


Figure 15-91: Connections diagram

15.19.6 Technical data

The TSDI-16115 module has the following specifications:

General	Type numbers:	FS-TSDI-16115
		FC-TSDI-16115
	Approvals:	UL, CE, TUV, CSA
Input	Number of input channels:	16
	Input voltage:	115 V, –15%-+30%
	Input frequency:	DC or 40-300 Hz
	Input current:	7.5 mA (± 1 mA) at 115 V
	Input impedance:	non-inductive, > 9 kW
	Input LOW:	U ≤ 15 V or
		I ≤ 1.2 mA (see Field cable lengths in this data sheet)
Physical	Module dimensions:	300 × 109 × 68 mm (L × W × H)
		11.81 × 4.29 × 2.68 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	301 mm (11.85 in)
Environment	Max. ambient temperature:	50°C (122°F) at 115 V, -15% - +30%
		60°C (140°F) at 115 V, -15% - +10%
		70°C (158°F) at 115 V, -15% - +0%
Isolation	Isolation input to output:	2 kV
Termination	Screw terminals:	
	• Max. wire size	2.5 mm^2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

15.20 TSDI-1624

15.20.1 Safe digital input FTA (24 V DC, 16 channels)

Field termination assembly module TSDI-1624 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The SICC cable interconnects the SIC connector on the FTA module and a (redundant pair of) SDI-1624 modules.

The TSDI-1624 module can interface with digital input signals from ‘Class I, Division 2 Hazardous Locations’.

The TSDI-1624 module can handle short circuits to 0 Volt of (INx+ or INx) field wires because the PTC (Positive Temperature Coefficient) resistor between the +24Vout of the SDI-1624 modules and the ‘+24Vout’ connection (INx+) of each input channel limits the current. This prevents the loss of all 16 channels (+24Vout fails) in the case of a single short circuit to 0 Volt of a connected field wire.

The FTA module has a universal snap-in provision for standard DIN EN rails and screw terminals for connecting field wiring.

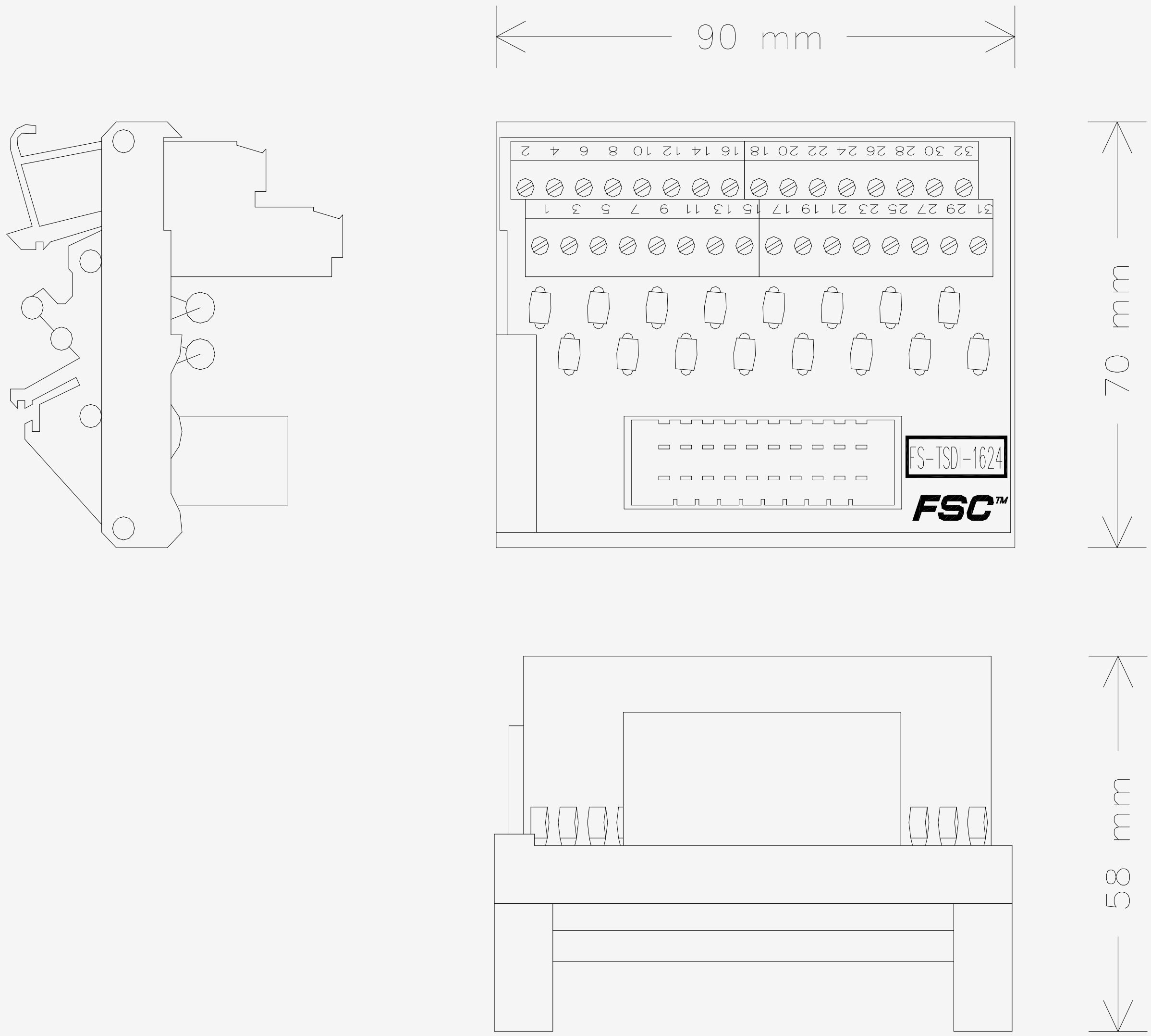


Figure 15-92: Mechanical layout

15.20.2 Applications

For details on applications and connection options for the TSDI-1624 module, see section SICC 0001/Lx.

15.20.3 Connections

The connection diagram of the TSDI-1624 module:

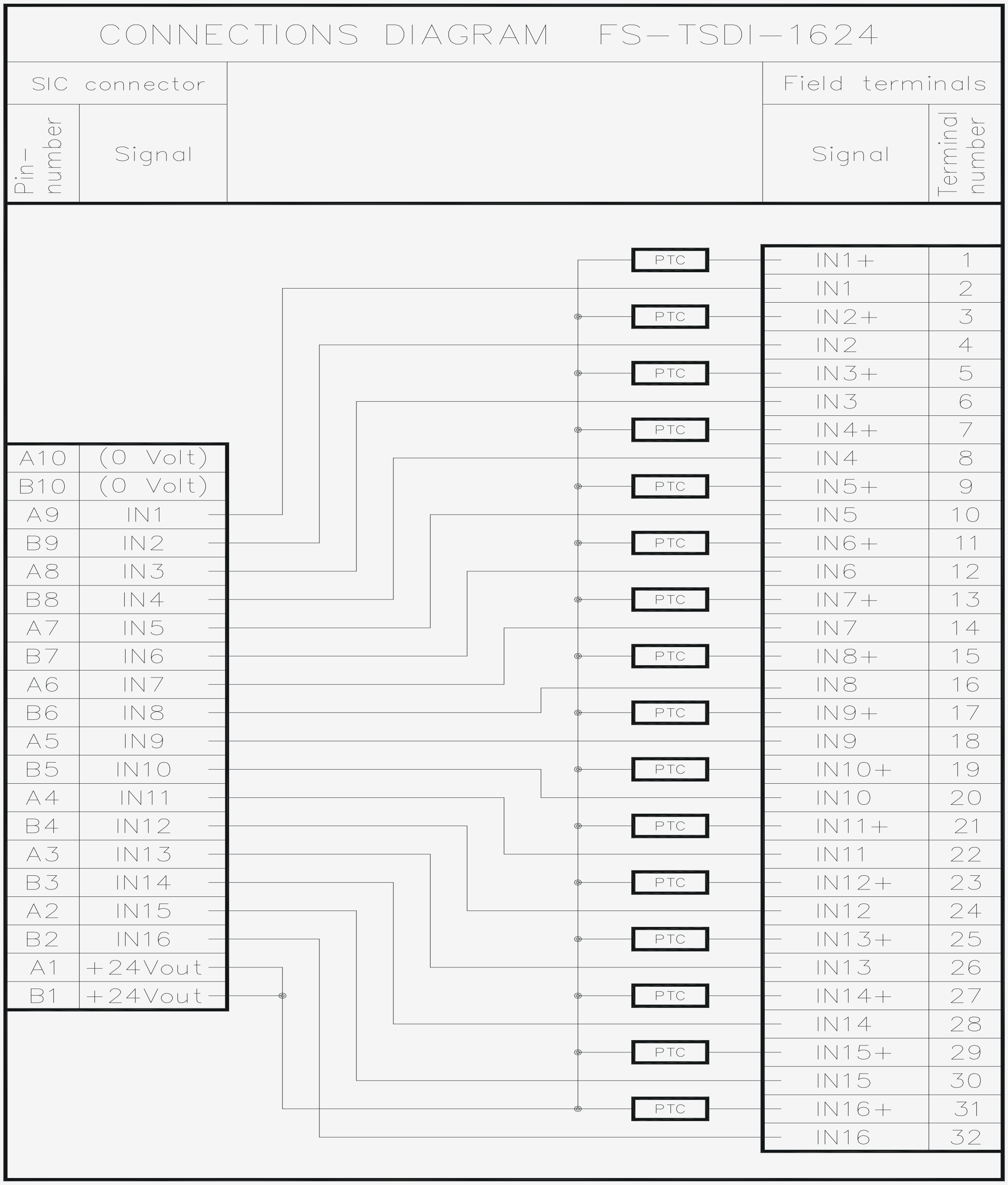


Figure 15-93: Connection diagram

15.20.4 Technical data

The TSDI-1624 module has the following specifications:

General	Type numbers:	FS-TSDI-1624
		FC-TSDI-1624
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16
	Input voltage:	24 V DC, -15%-+30%
	Input current:	≤ 15mA at 24 V DC (with a redundant pair of SDI-1624 modules as load)
	PTC resistance:	260Ω ±25% at 25°C
	PTC (steady) current:	typ. 45 mA ±35% at 24 V DC
Physical	Module dimensions:	90 × 70 × 58 mm (L × W × H)
		3.54 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb)

15.21 TSDI-1624C

15.21.1 Safe current-limited digital input FTA (24 V DC, 16 channels)

Field termination assembly module TSDI-1624C is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It can be used for interfacing digital input signals from Class I, Division 2 Hazardous Locations.

Sixteen channels (separated into two groups of eight channels with a 250 mA fuse in the common +) can be connected to the TSDI-1624C module via a system interconnection cable (SICC-0001/Lx). This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDI-1624 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

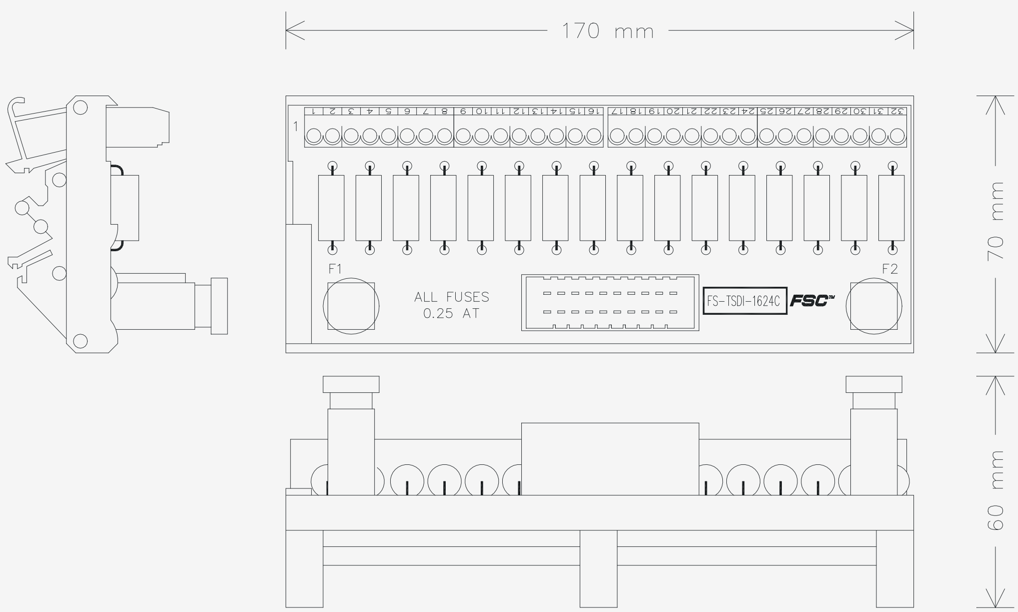


Figure 15-94: Mechanical layout

15.21.2 Applications

For details on applications and connection options for the TSDI-1624C module, see section SICC 0001/Lx.

15.21.3 Connections

The connections diagram of the TSDI-1624C module:

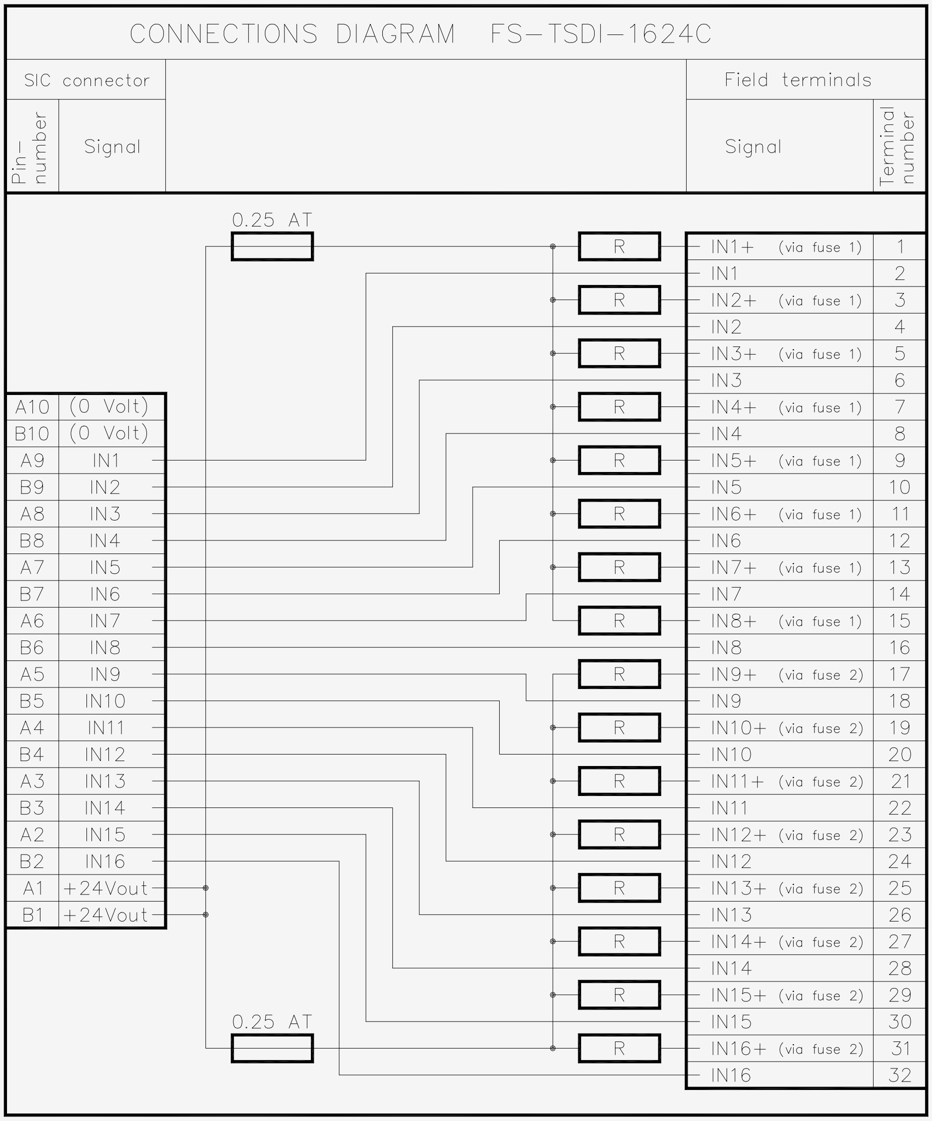


Figure 15-95: Connections diagram

15.21.4 RUSPSU-S

15.21.4.1 Non-redundant Power Supply assembly 24 V DC, 12 A

The RUSPSU-S is a power supply assembly providing a 25Vdc, 12 A supply voltage (out of a 120Vac or 230Vac line power).

The RUSPSU-S consists of:

- one PSUTA-0001 (see PSUTA-0001) with a PSU-blind coverplate
- one PSU-UNI2412 power supply units (see PSUTA-0001)

The RUSPSU-S is usable in SIL 3 applications.

The below figure shows the physical appearance of the RUSPSU-S.

Attention:
The switch must be in ⏻ stand-by position prior to insertion or removal of the power supply.

15.21.5 Technical data

The TSDI-1624C module has the following specifications:

General	Type numbers:	FS-TSDI-1624C
		FC-TSDI-1624C
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (2 groups of 8)
	Input voltage:	24 V DC, -15%-+30%
	Input current:	≤ 15 mA at 24 V DC (with a redundant pair of safe digital input modules SDI-1624 as load)
	Igniting current per channel:	< 100 mA at 24 V DC +30%
Physical	Module dimensions:	170 × 70 × 60 mm (L × W × H)
		6.69 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	171 mm
Fuse	Fuse rating:	250 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	400 V
	Voltage rating DC:	400 V
	Manufacturer:	SOC
	Manufacturer PN:	SHV12 250 mA
	Maximum output current per fuse:	175 mA

Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Field signal specifications for non-incendiary field circuits to Class 1 Division 2	Max. closed loop resistance:	250 Ω
	Min. open loop resistance:	15 kΩ
	HYDROGEN (Group A & B):	
	• Max. loop inductance	8 mH
	• Max. loop capacitance	0.3 μF
	NON-HYDROGEN (Group C & D):	
	• Max. loop inductance	22 mH
	• Max. loop capacitance	7 μF

15.22 TSDI-1648

15.22.1 Safe digital input FTA (48 V DC, 16 channels)

Field termination assembly module TSDI-1648 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The SICC cable interconnects the SIC connector on the FTA module and a (redundant pair of) SDI-1648 modules.

The TSDI-1648 module can interface with digital input signals from 'Class I, Division 2 Hazardous Locations'.

The TSDI-1648 module can handle short circuits to 0 Volt of (INx+ or INx) field wires because the PTC (Positive Temperature Coefficient) resistor between the +48Vout of the SDI-1648 modules and the '+48Vout' connection (INx+) of each input channel limits the current. This prevents the loss of all 16 channels (+48Vout fails) in the case of a single short circuit to 0 Volt of a connected field wire.

The FTA module has a universal snap-in provision for standard DIN EN rails and screw terminals for connecting field wiring.

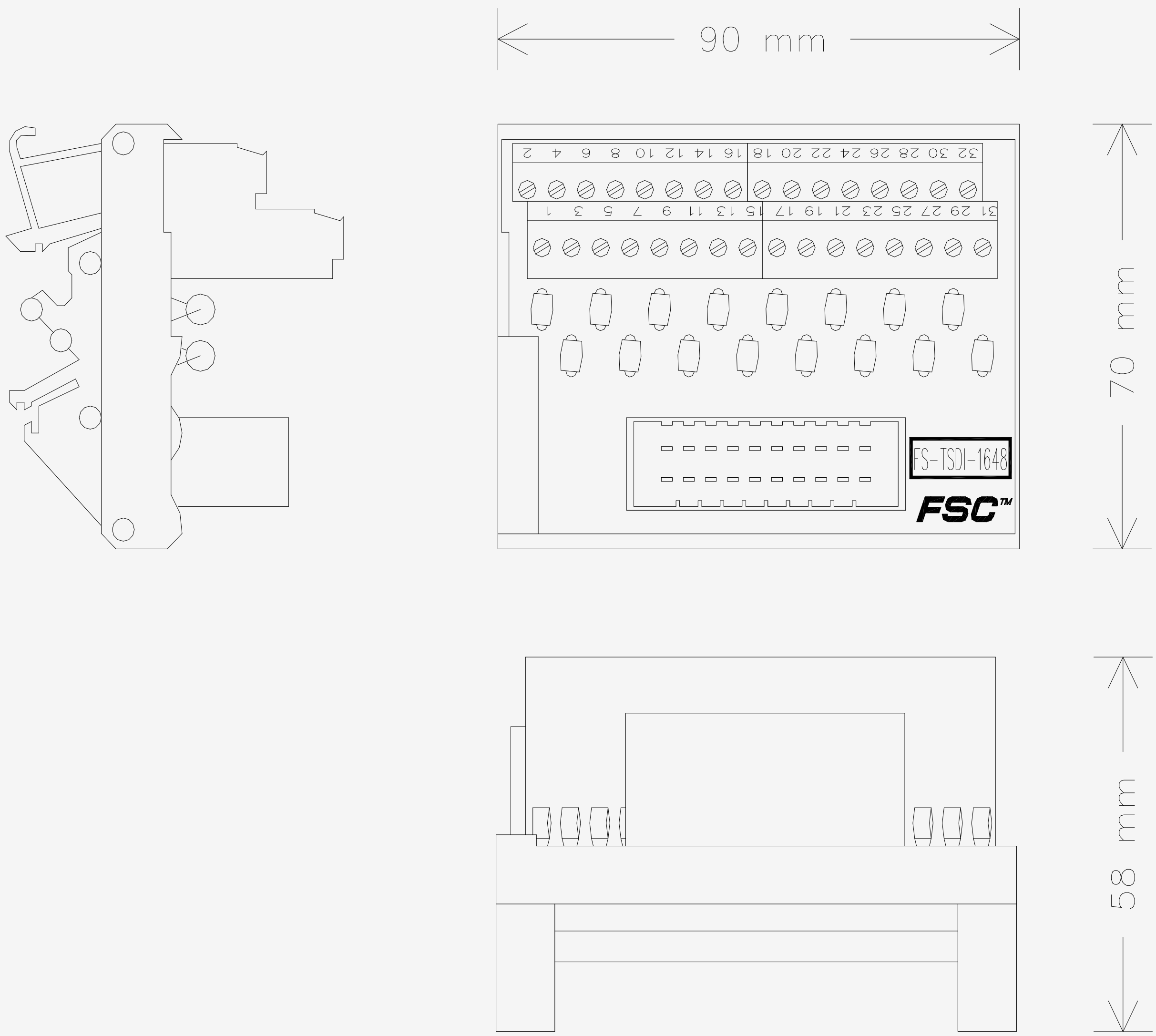


Figure 15-96: Mechanical layout

15.22.2 Applications

For details on applications and connection options for the TSDI-1648 module, see section SICC 0001/Lx.

15.22.3 Connections

The connection diagram of the TSDI-1648 module:

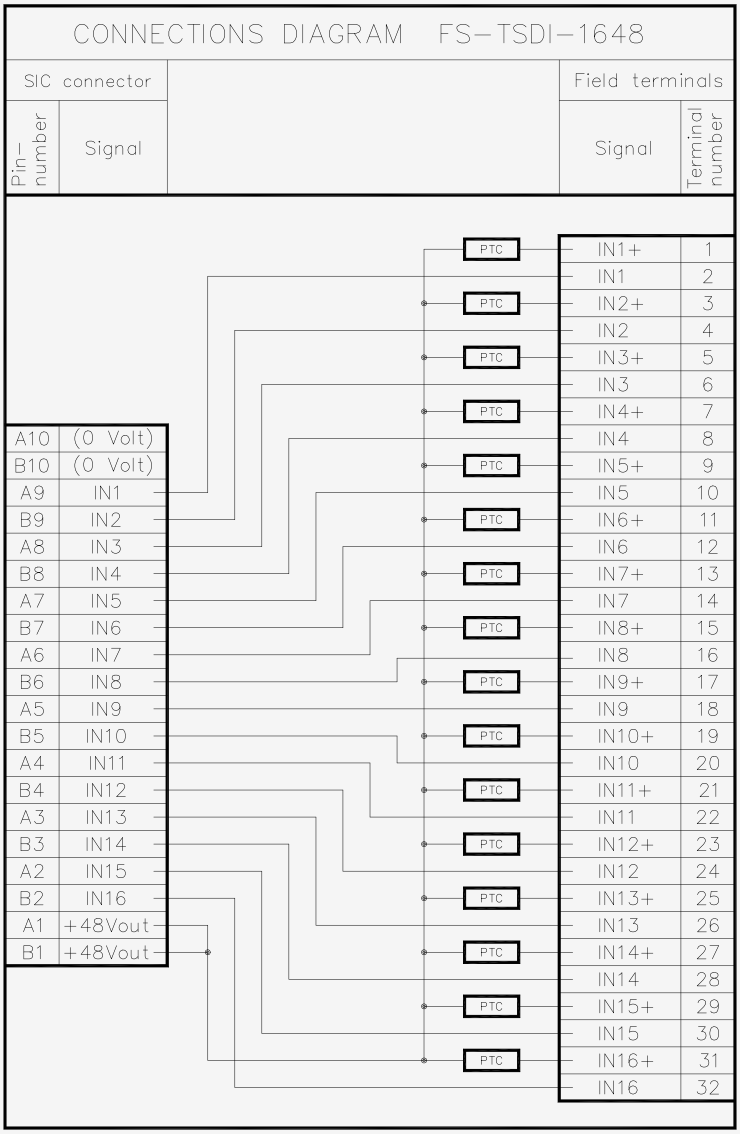


Figure 15-97: Connection diagram

15.22.4 Technical data

The TSDI-1648 module has the following specifications:

General	Type numbers:	FS-TSDI-1648
		FC-TSDI-1648
	Approvals:	CE, TUV, UL, CSA
Input	Number of input channels:	16
	Input voltage:	48 V DC, -15%-+15%
	Input current:	≤ 8mA at 48 V DC (with a redundant pair of SDI-1648 modules as load)
	PTC resistance:	1900 Ω ±25% at 25°C
	PTC (steady) current:	typ. 17 mA ±35% at 48 V DC
Physical	Module dimensions:	90 × 70 × 58 mm (L × W × H)
		3.54 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb)

15.23 TSDI-16UNI

15.23.1 Safe digital input FTA (24/48 V DC, NAMUR, 16 channels)

Field termination assembly module TSDI-16UNI is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals).

Sixteen channels (separated into two groups of eight channels with a 250 mA fuse in the common +) can be connected to the TSDI-16UNI module via a system interconnection cable (SICC-0001/Lx). This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDIL-1608 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

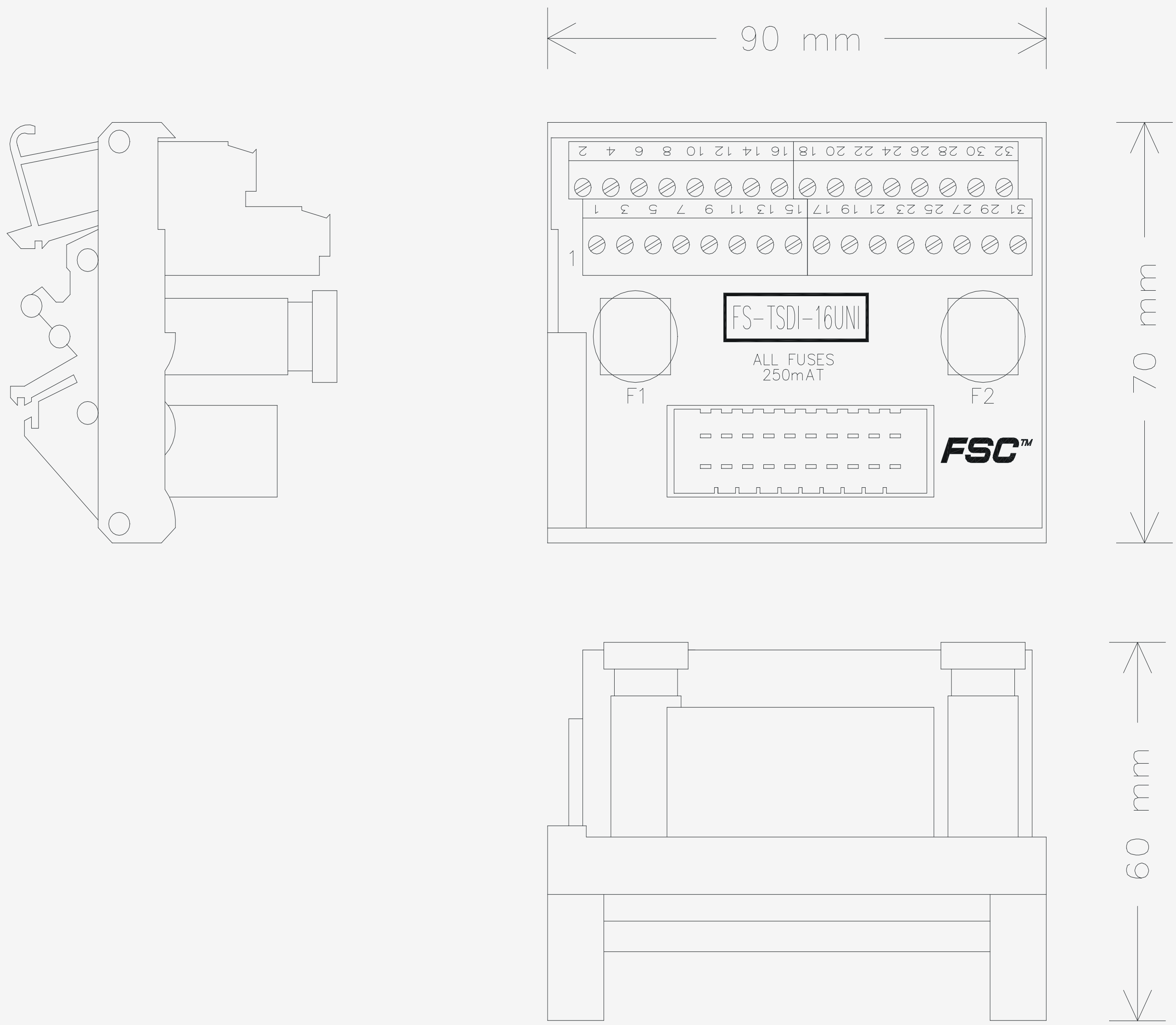


Figure 15-98: Mechanical layout

15.23.2 Applications

For details on applications and connection options for the TSDI-16UNI module see section SICC 0001/Lx.

15.23.3 Connections

The connections diagram of the TSDI-16UNI module is as follows:

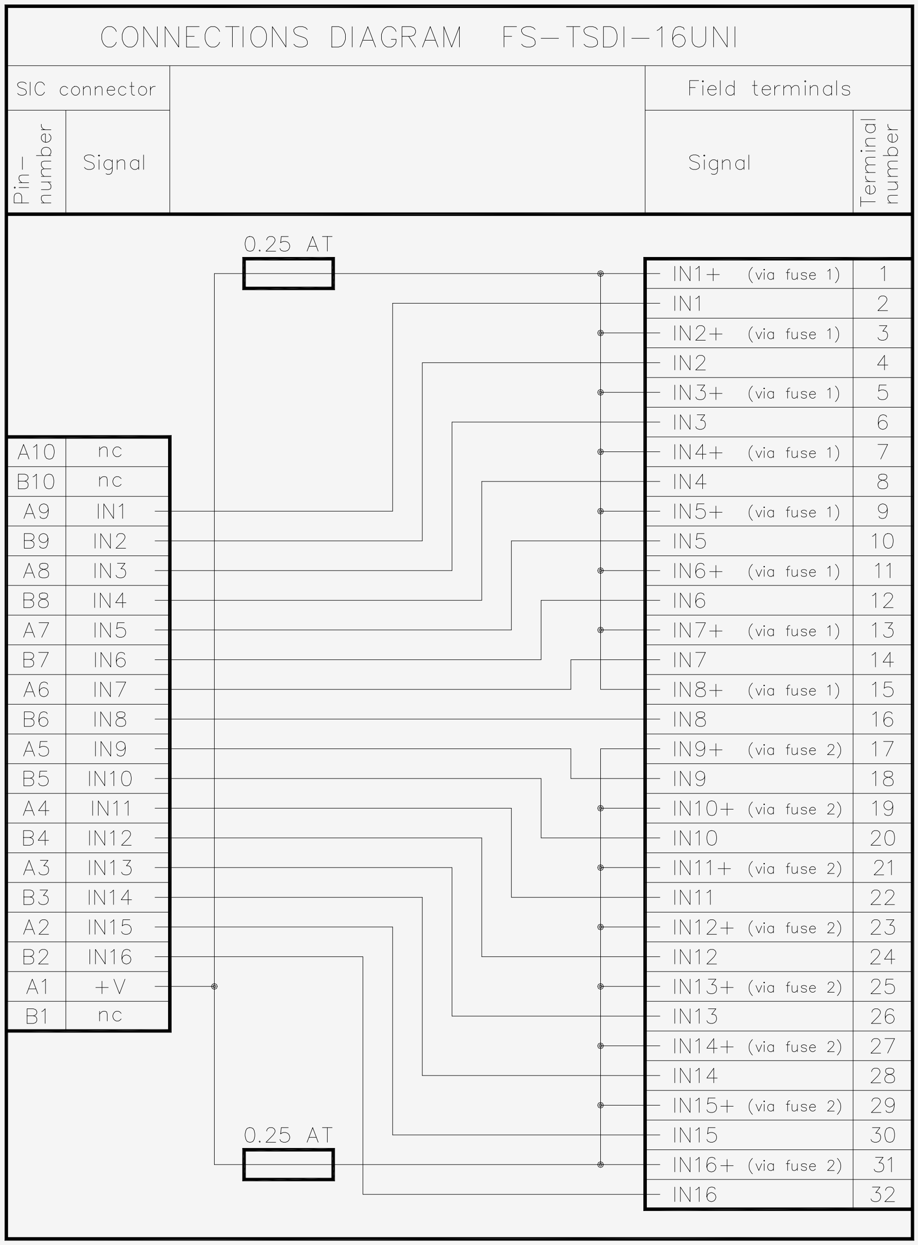


Figure 15-99: Connections diagram

15.23.4 Technical data

The TSDI-16UNI module has the following specifications:

General	Type numbers:	FS-TSDI-16UNI
		FC-TSDI-16UNI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	16 (2 groups of 8)
	Maximum voltage:	50 V DC - IEC 61010-1 (1990), over voltage category 3 (Table D.12)
		150 V DC - IEC 61010-1 (1990), over voltage category 2 (Table D.10)
	Actual maximum voltage defined by the connected input module	
Physical	Module dimensions:	90 × 70 × 60 mm (L × W × H)
		3.54 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Fuse	Fuse rating:	250 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	400 V
	Voltage rating DC:	400 V
	Manufacturer:	SOC
	Manufacturer PN:	SHV12 250 mA
	Maximum output current per fuse:	175 mA

Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

15.24 TSDO-0424

15.24.1 Safe digital output FTA (24 V DC, 4 channels)

The field termination assembly module TSDO-0424 is the interface between the system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The four channels of a (redundant pair of) SDO-0424 module(s) can be connected to the TSDO-0424 module via the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

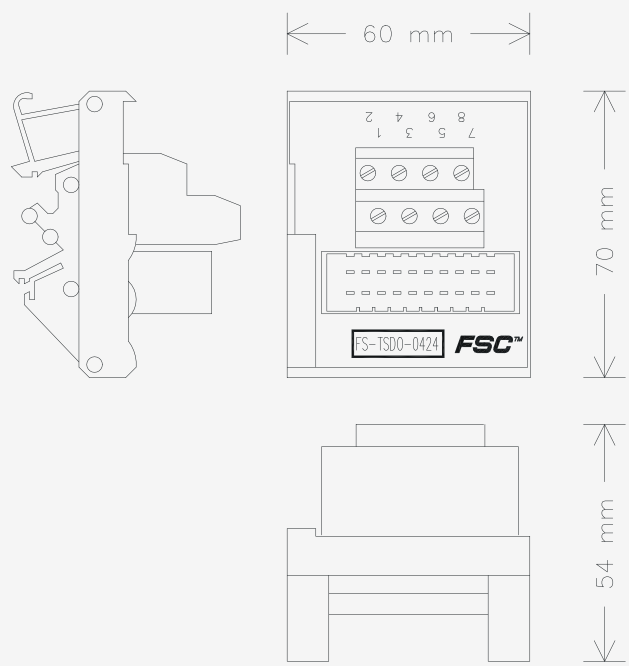


Figure 15-100: Mechanical layout

15.24.2 Applications

For details on applications and connection options for the TSDO-0424 module, see section SICC 0001/Lx.

15.24.3 Connections

The connections diagram of the TSDO-0424 module:

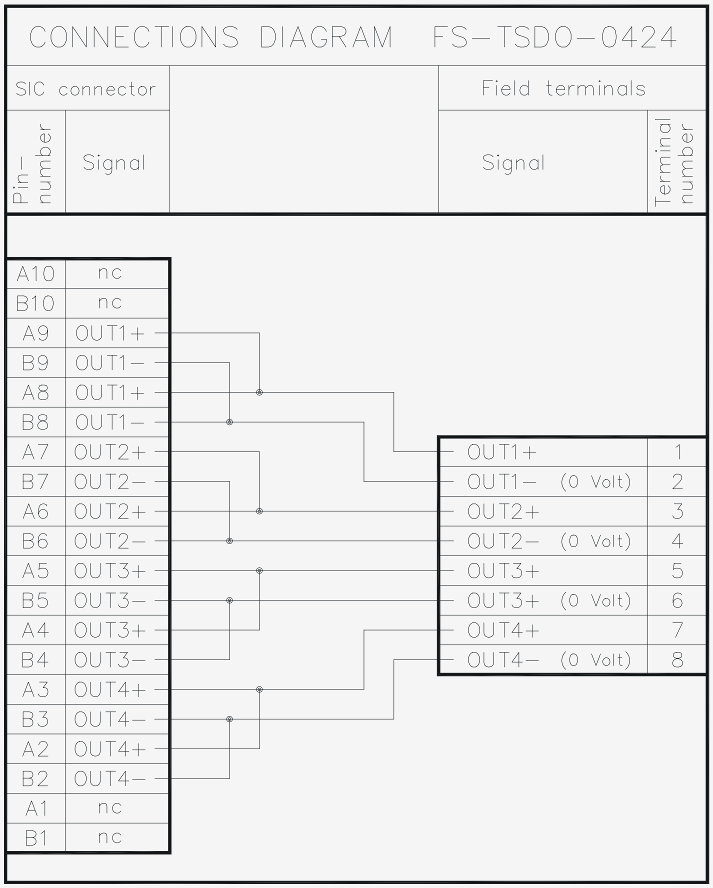


Figure 15-101: Connections diagram

15.24.4 Technical data

The TSDO-0424 module has the following specifications:

General	Type numbers:	FS-TSDO-0424
		FC-TSDO-0424
	Approvals:	CE, UL, TUV, CSA
Power	Number of channels:	4
	Maximum voltage:	36 V DC – IEC 1010 (1990),
		overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	4 A
	Actual maximum current defined by connected output module	
Physical	Module dimensions:	60 × 70 × 54 mm (L × W × H) 2.36 × 2.76 × 2.13 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

15.25 TSDO-0824

15.25.1 Safe digital output FTA (24 V DC, 8 channels)

Field termination assembly module TSDO-0824 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The eight channels of a (redundant pair of) SDO-0824 module(s) can be connected to the TSDO-0824 module via the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

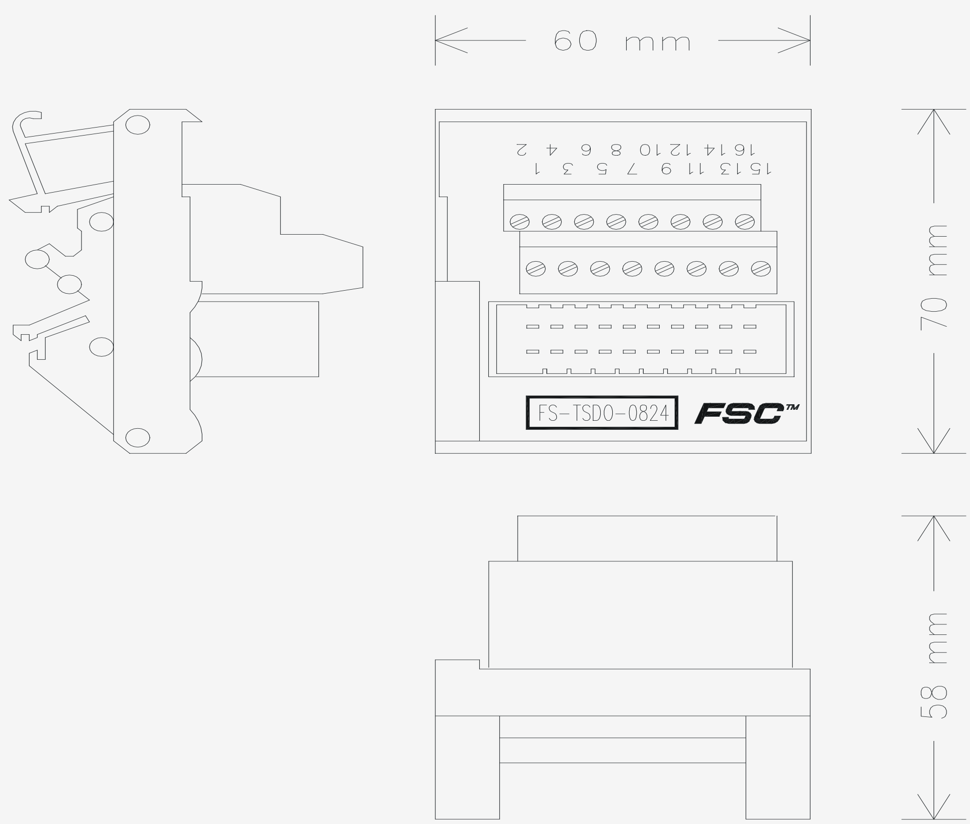


Figure 15-102: Mechanical layout

15.25.2 Applications

For details on applications and connection options for the TSDO-0824 module, see section SICC 0001/Lx.

15.25.3 Connections

The connections diagram of the TSDO-0824 module:

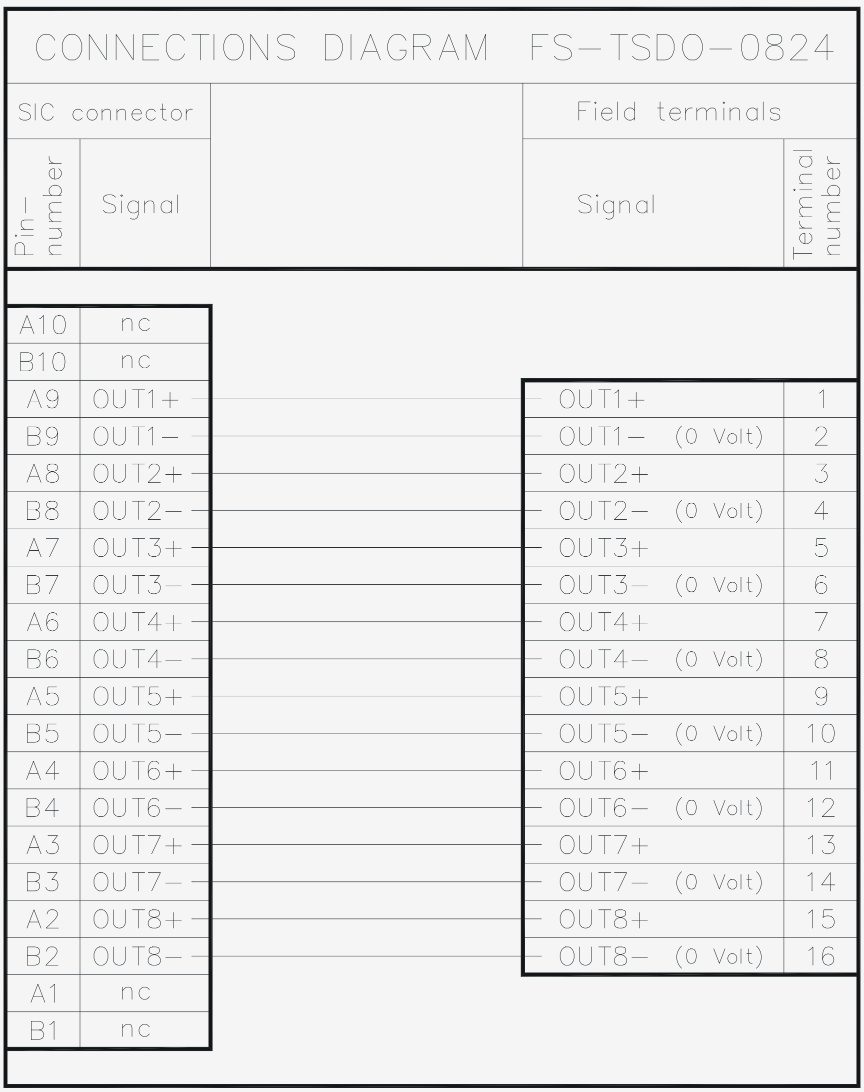


Figure 15-103: Connections diagram

15.25.4 Technical data

The TSDO-0824 module has the following specifications:

General	Type numbers:	FS-TSDO-0824
		FC-TSDO-0824
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	8
	Maximum voltage:	36 V DC - IEC 1010 (1990),
		Overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	1.5 A
	Actual maximum current defined by connected output module	
Physical	Module dimensions:	60 × 70 × 58 mm (L × W × H)
		2.36 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

15.26 TSDO-0824C

15.26.1 Conformal coated safe digital output FTA, current limited (24 V DC, 8 channels)

Field termination assembly module TSDO-0824C is the interface between safe digital output module SDO-0824 with a system interconnection cable (SICC-0001/Lx) and the external field wiring (screw terminals). It can be used for interfacing to Class I, Division 2 Hazardous locations.

The TSDO-0824C provides eight current limited safe digital outputs to the field. Each output is capable of supplying 110 mA (= 2.5 Watt at 24 V DC).

The FTA module is coated conform the requirements for type A coatings given in IEC 60664-3 (the values for POLLUTION DEGREE 1 apply), has a universal snap-in provision for standard DIN EN rails, and screw terminals for the field wiring.

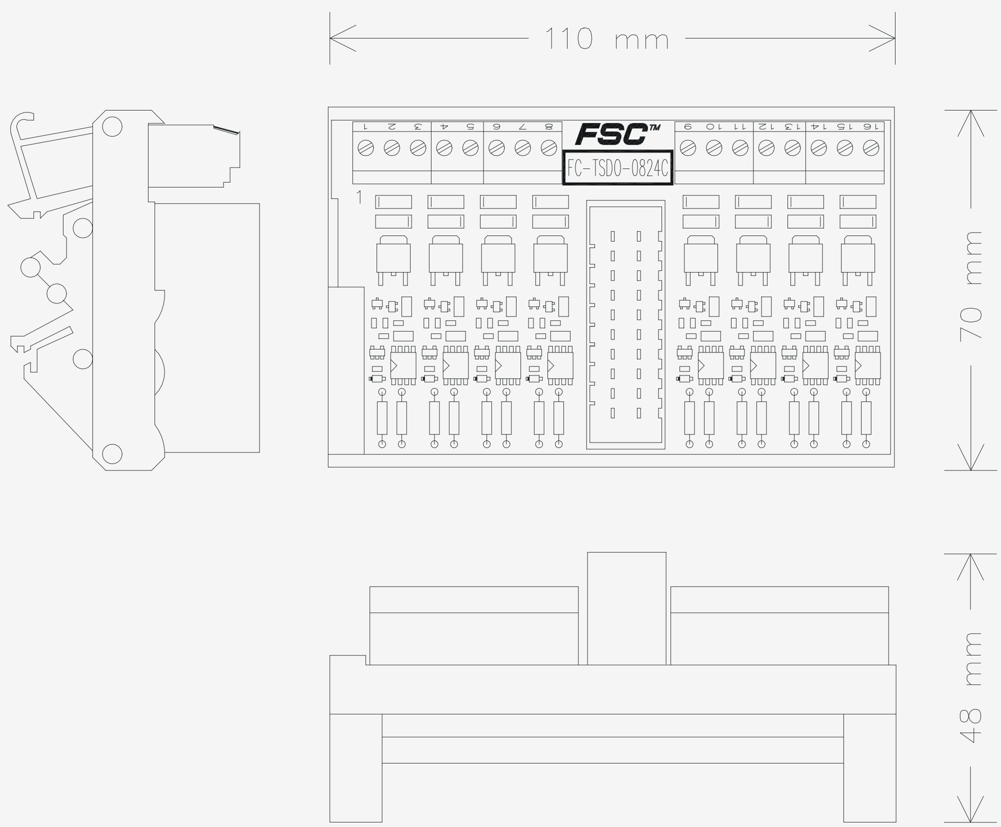


Figure 15-104: Mechanical layout

15.26.2 Applications

For details on applications and connection options for the TSDO-0824C module, see section SICC 0001/Lx.

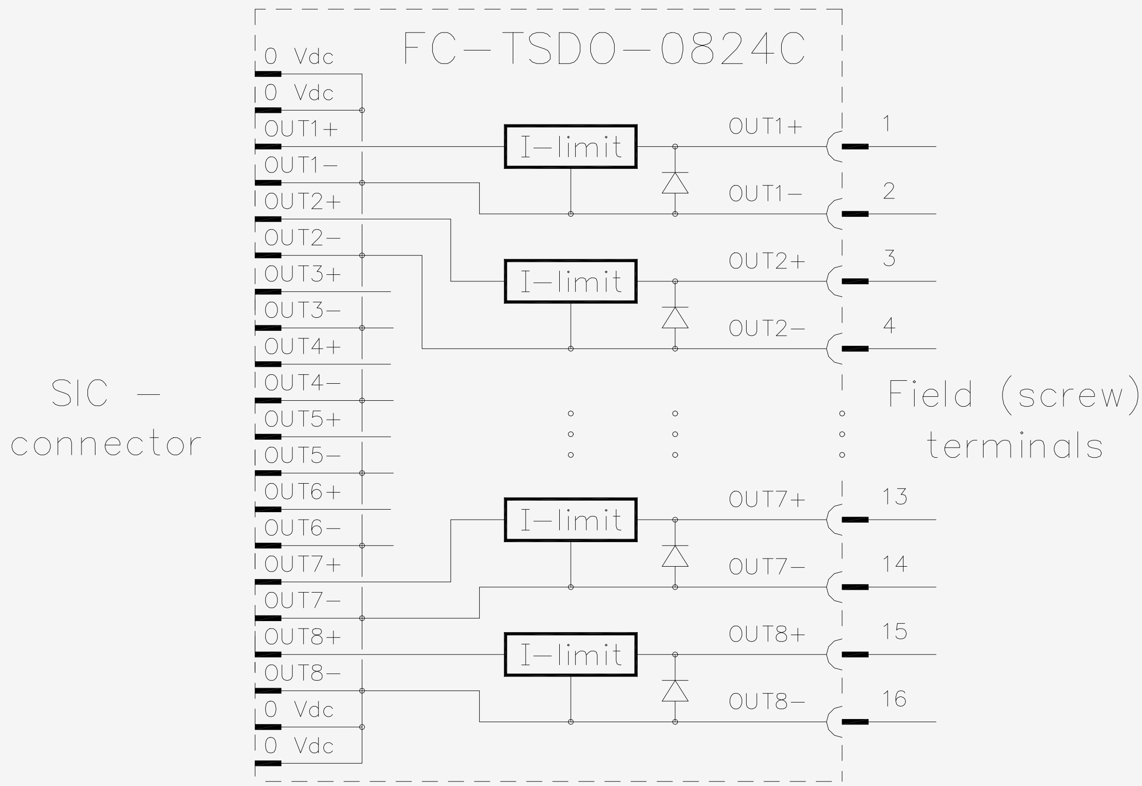


Figure 15-105: Schematic diagram

15.26.3 Main functions

The TSDO-0824C can energize loads (for example solenoids or LEDs) with voltage-current limitation in compliance with Hazardous Class I, Division 2. The external output-signal (OUT+) is electronically current-limited.

15.26.4 Connections

The connections diagram of the TSDO-0824C:

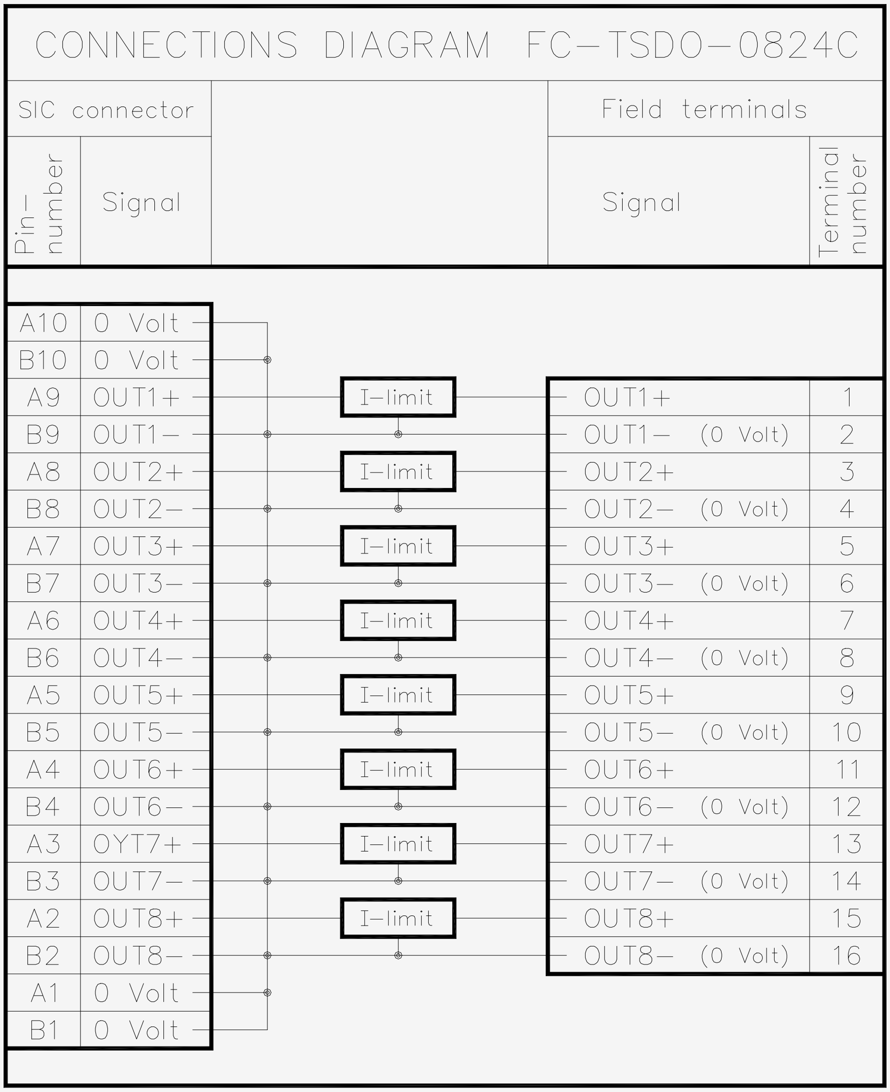


Figure 15-106: Connections diagram

15.26.5 Technical data

The TSDO-0824C has the following specifications:

General	Type number:	FC-TSDO-0824C
	Approvals	CE, TUV, UL, CSA, FM
Power	Number of channels:	8
	Maximum voltage:	36 V DC - IEC 1010 (1990),
		overvoltage category 3 (Table D.12)
	Power requirements:	5 mA per channel (plus output load)
Output	Output current limit:	> 110 mA
	Max. output load:	2.5 Watt (at 24 V DC)
	Voltage drop:	< 1.5 V DC at 110 mA
	Off current:	< 0.1 mA
Physical	Module dimensions:	110 × 70 × 48 mm (L × W × H)
		4.32 × 2.76 × 1.89 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	111 mm (4.36 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

Field signal specifications	HYDROGEN (Group A & B)	
	• Max. loop inductance	3.0 mH
	• Max. loop capacitance	0.2 µF
	NON-HYDROGEN (Group C & D)	
	• Max. loop inductance	12 mH
	• Max. loop capacitance	5 µF

15.27 TSFIRE-1624

15.27.1 Safe fire detector input FTA with line monitoring (24 V DC, 16 channels)

Field termination assembly module TSFIRE-1624 is the interface between (digital) fire detectors and the safe high-density analog input module SAI-1620m in Safety Manager. It may be used for installations in, and interfacing signals to Class I, Division 2 Hazardous Locations.

The TSFIRE-1624 module has sixteen digital detector input channels which may be used for both safety-related and non-safety-related applications. The TSFIRE-1624 module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply and field wiring.

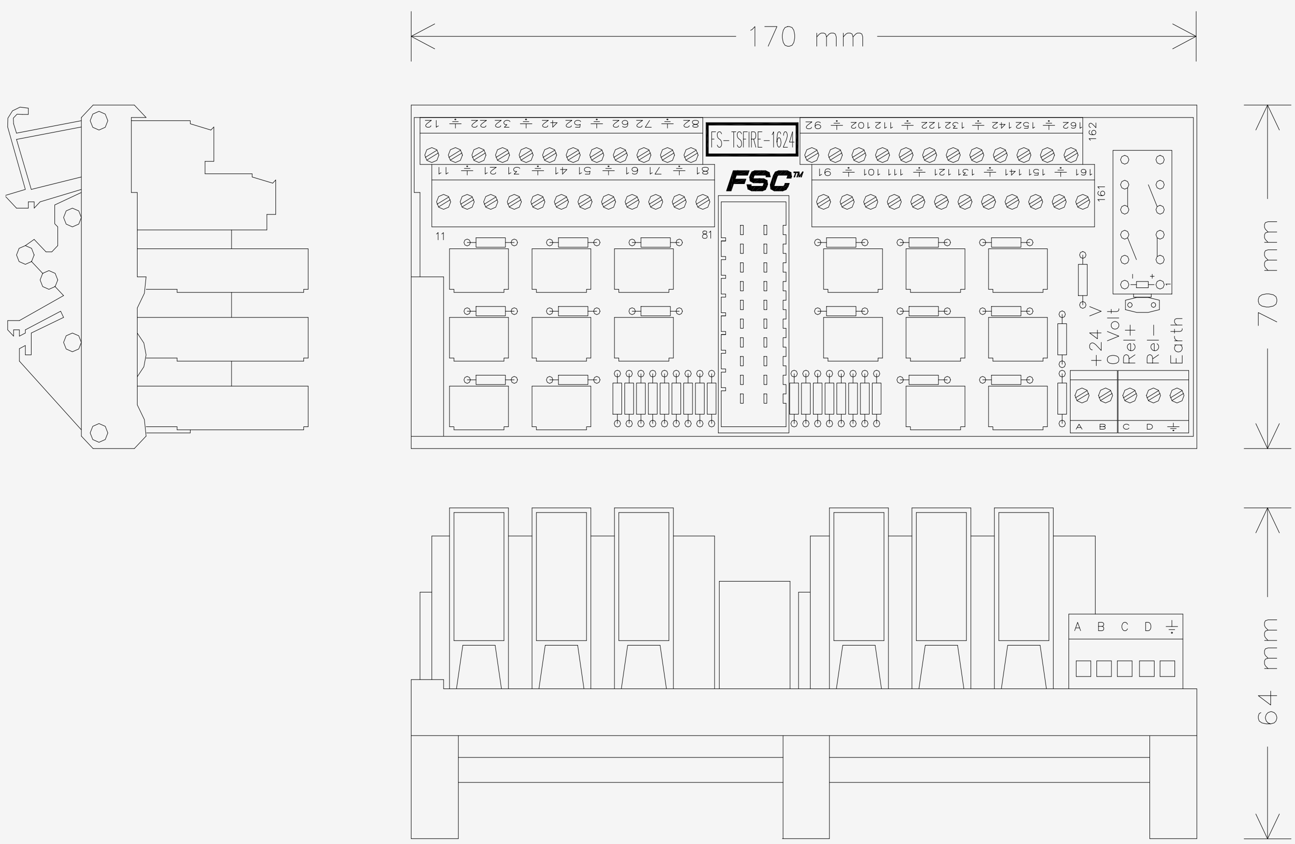


Figure 15-107: Mechanical layout

15.27.2 Main functions

The TSFIRE-1624 module has three main functions:

- Power supply to each detector with voltage-current limitation in compliance with Hazardous Area Class I Division 2
- Fire detection input function
- Global reset of the connected sensors

15.27.2.1 Power supply detector

The TSFIRE-1624 module requires an external 24 V DC power supply. This provides a field signal with open voltage of approximately 24 V DC and a short-circuit current of approximately 35 mA. Normal operating voltage (with a 4.7 kΩ EOL resistor) is approximately 20.5 Volts.

15.27.2.2 Fire detector input

The TSFIRE-1624 module converts an input for 24 V fire detectors to levels suitable for the SAI-1620m module.

The below figure shows the schematic diagram for the connection of fire detectors or manual call points.

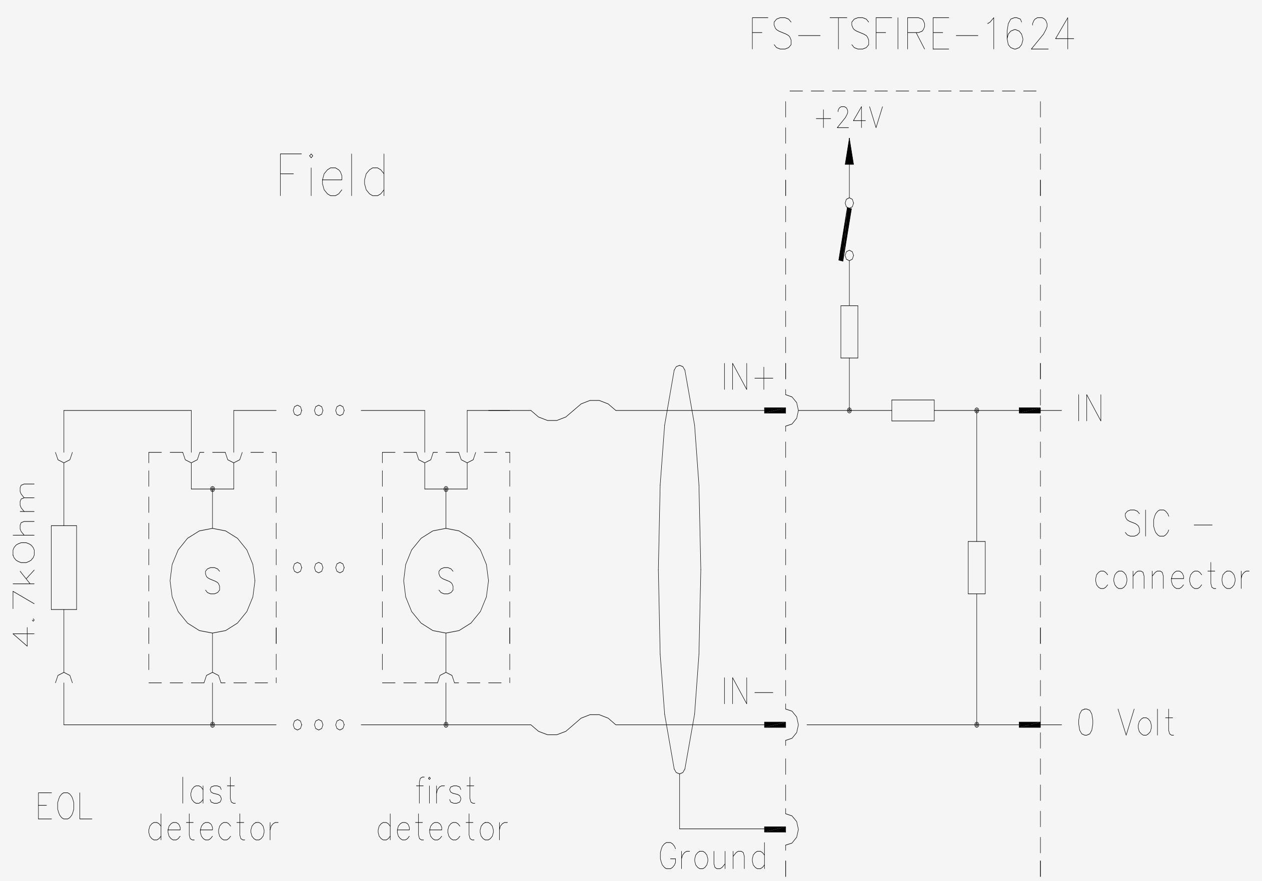


Figure 15-108: Typical schematic diagram for TSFIRE-1624 input

15.27.2.3 Global reset

The relay on the TSFIRE-1624 module enables a reset of all connected detectors by removing the supply voltage to the field. The relay is normally de-energized (energized = reset detectors). The Global Reset function is non-safety related.

15.27.3 Applications

For details on applications and connection options for the TSFIRE-1624 module, see section [SICC 0001/Lx](#).

15.27.4 Connections

15.27.4.1 Common signals

The connections for common signals are as follows:

Screw terminal	Function
A	+24 V DC Vext
B	0 V DC Vext
C	Rel+
D	Rel–
E	Ground

15.27.4.2 Connections diagram

The TSFIRE-1624 module has 48 screw terminals for connection of field wiring. The connections diagram of the TSFIRE-1624 module is as follows:

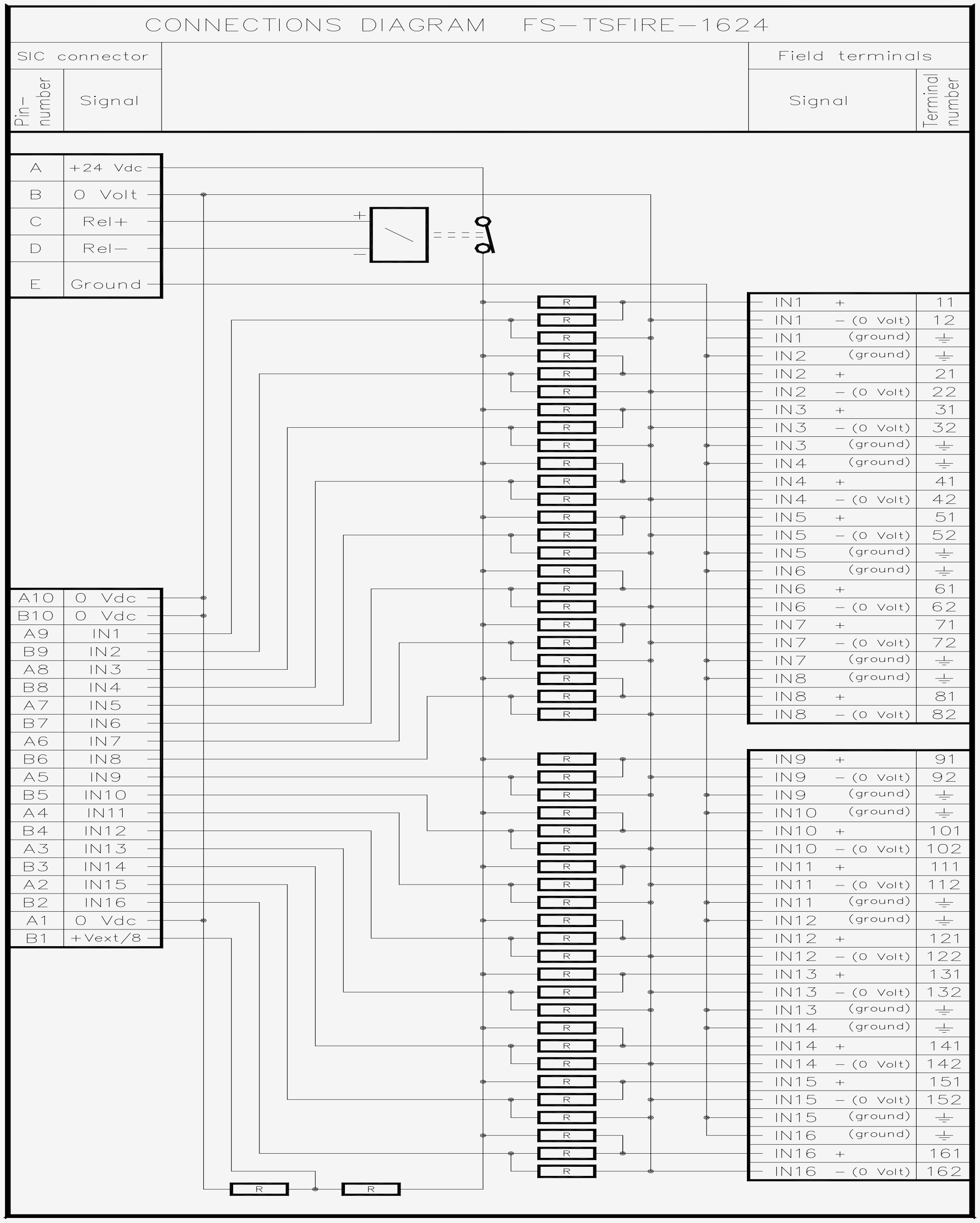


Figure 15-109: Connections diagram

15.27.5 Technical data

The TSFIRE-1624 module has the following specifications:

General	Type numbers:	FS-TSFIRE-1624
		FC-TSFIRE-1624
	Approvals	CE, TUV, UL, CSA, FM
Pwr requirements 24 V DC ext.	Voltage	24 V DC +25% / –15%
	Current	Max. 570 mA (at 24 V DC ext.)
	• With EOL resistors	• Typ. 70mA (at 24 V DC ext.)
	• No load	• Typ. 11mA (at 24 V DC ext.)
Input	Number of channels	16
	Input Voltage • With EOL resistor (4k7) • No load	• Typ. 20.5 V DC (at 24 V DC ext.) • Typ. 23.5 V DC (at 24 V DC ext.)
	Channel resistance	680 Ω +/–5%
	Shorted current	35 mA (at 24 V DC ext.)
Relay	Relay voltage	17 – 39 V DC
	Current	Typ. 8.5 mA at 24 V DC
Termination	Screw terminals	
	• Max. wire diameter	2.5 mm⊃ 2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

Field signal specifications	Field wire resistance	< 100 Ω
	End-of-line (EOL) resistor	For example 4k7, ± 5% (0.25 W) (see F&G Application Manual, PM.MAN.8163)
	HYDROGEN (Group A & B)	
	• Max. loop inductance	60 mH
	• Max. loop capacitance	0.3 μF
	NON-HYDROGEN (Group C & D)	
	• Max. loop inductance	230 mH
	• Max. loop capacitance	7 μF
Physical	Module dimensions	170 × 70 × 64 mm (L × W × H) 6.72 × 2.76 × 2.52 in (L × W × H)
	DIN EN rails	TS32 / TS35 × 7.5
	Used rail length	171 mm (6.73 in)

15.28 TSGAS-1624

15.28.1 Safe gas / flame detector input FTA (0-20 mA, 16 channels)

The field termination assembly module TSGAS-1624 is the interface between gas/flame detectors in the field and the safe high-density analog input module SAI-1620m in Safety Manager. The TSGAS-1624 module has sixteen analog input channels which may be used for both safety-related and non-safety-related applications. The TSGAS-1624 module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply, ground and field wiring.

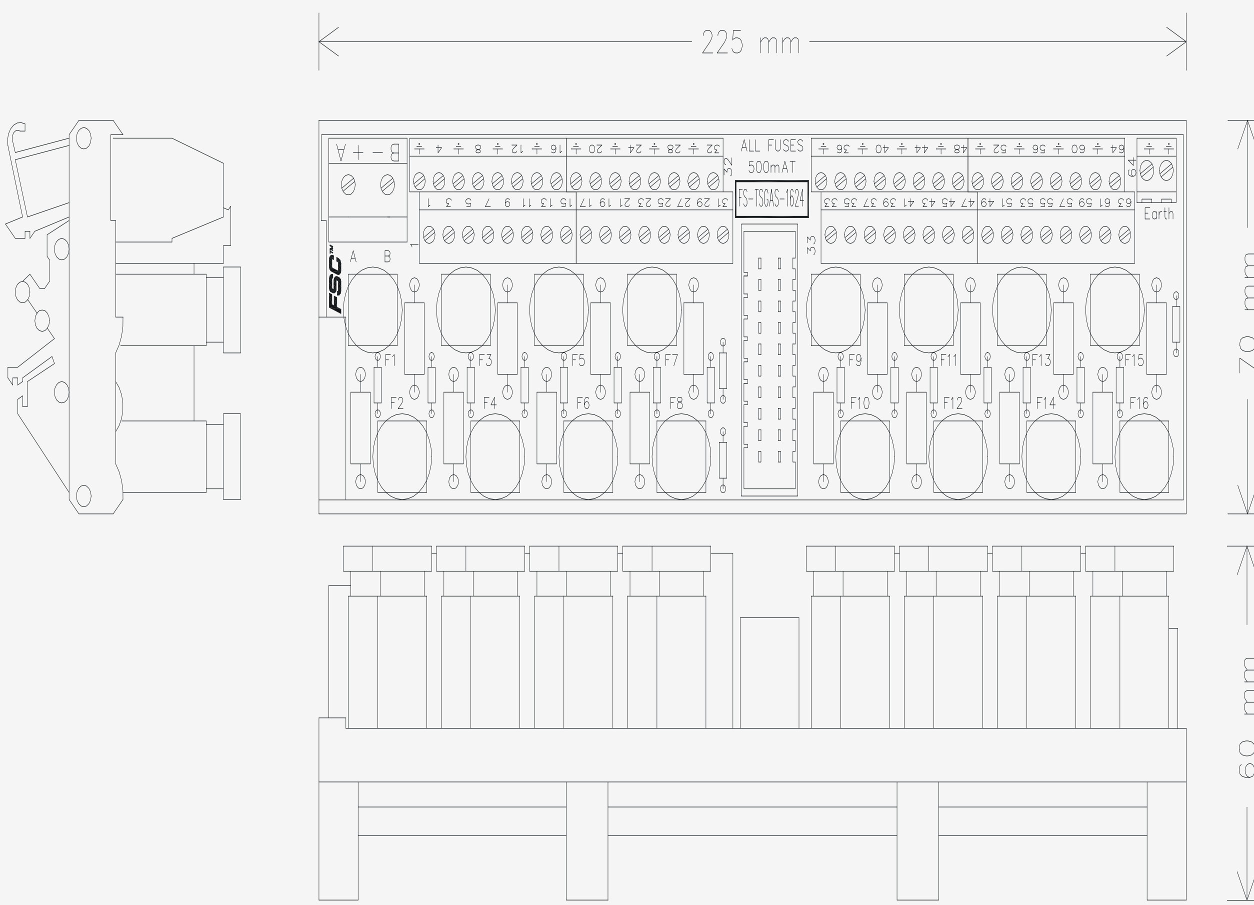


Figure 15-110: Mechanical layout

15.28.2 Main functions

The TSGAS-1624 module has three main functions:

- Linear direct conversion of 0(4)-20 mA DC field signals to the signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter (500 mAT fused)
- Enable monitoring of the external power connected to the TSGAS-1624 module

15.28.2.1 Linear direct conversion

The input circuit of each channel consists of a high-precision resistor which converts the input current (0-20 mA) to the input voltage for the high-density analog input module SAI-1620m . The power to the analog transmitter is fused (500 mAT) per channel. Each analog input has its own terminal for the field cable shield.

The below figure shows the schematic diagram for connecting a transmitter (active and passive).

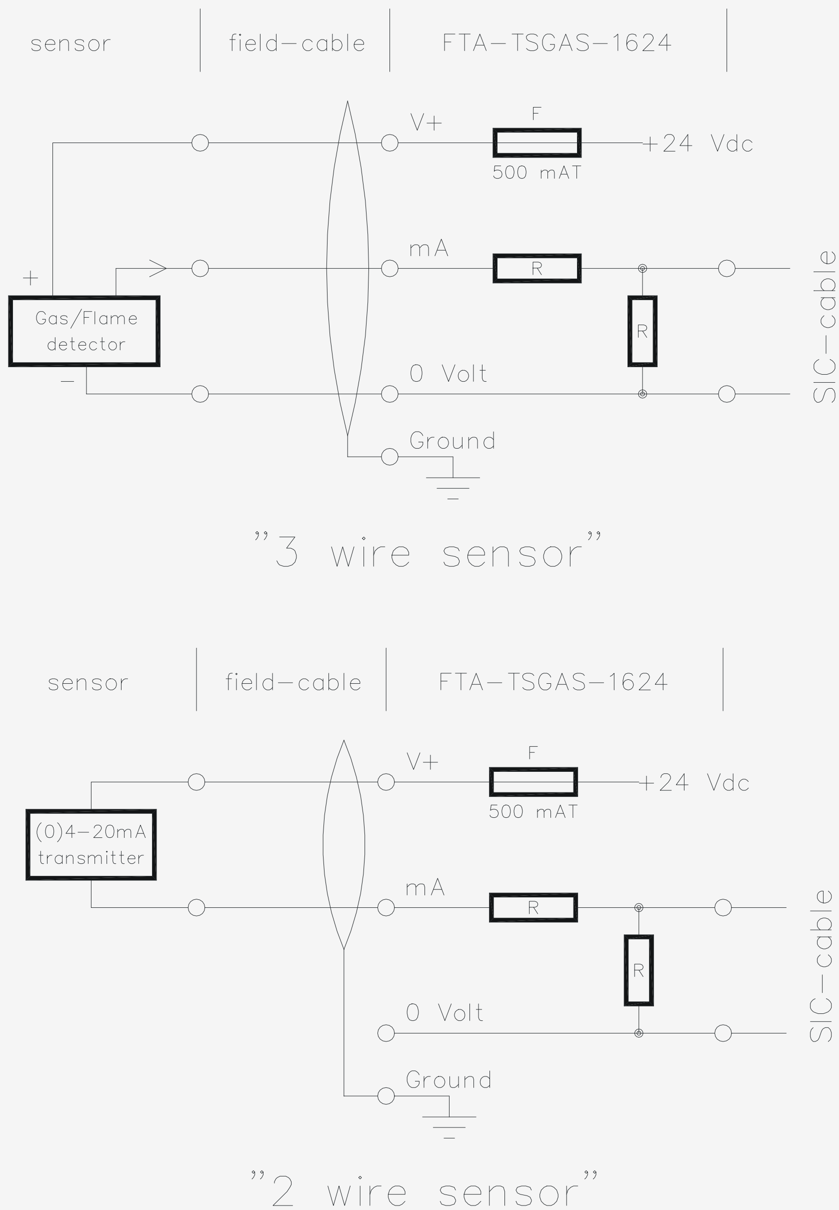


Figure 15-111: Schematic diagram for connecting a transmitter

15.28.2.2 External power

External power can be connected to the TSGAS-1624 module via the power screw terminal pair marked ‘A’ and ‘B’.

> **Note:**
> The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager software can monitor the external power voltage via the safe high-density analog input module SAI-1620m.

15.28.3 Applications

For details on applications and connection options for the TSGAS-1624 module, see section SICC 0001/Lx.

15.28.4 Connections

15.28.4.1 External power and ground

The external supply voltage (Vext) and ground are connected to the following screw terminals (marked ‘A’ and ‘B’ and ‘⏚’ on the FTA):

Screw terminal	Function
A	24 V DC Vext
B	0 V DC Vext
⏚	Ground connection
⏚	Ground connection (1 ground wire is enough)

15.28.4.2 Connections diagram

The TSGAS-1624 module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64. The connections diagram of the TSGAS-1624 module is as follows:

15.28 TSGAS-1624

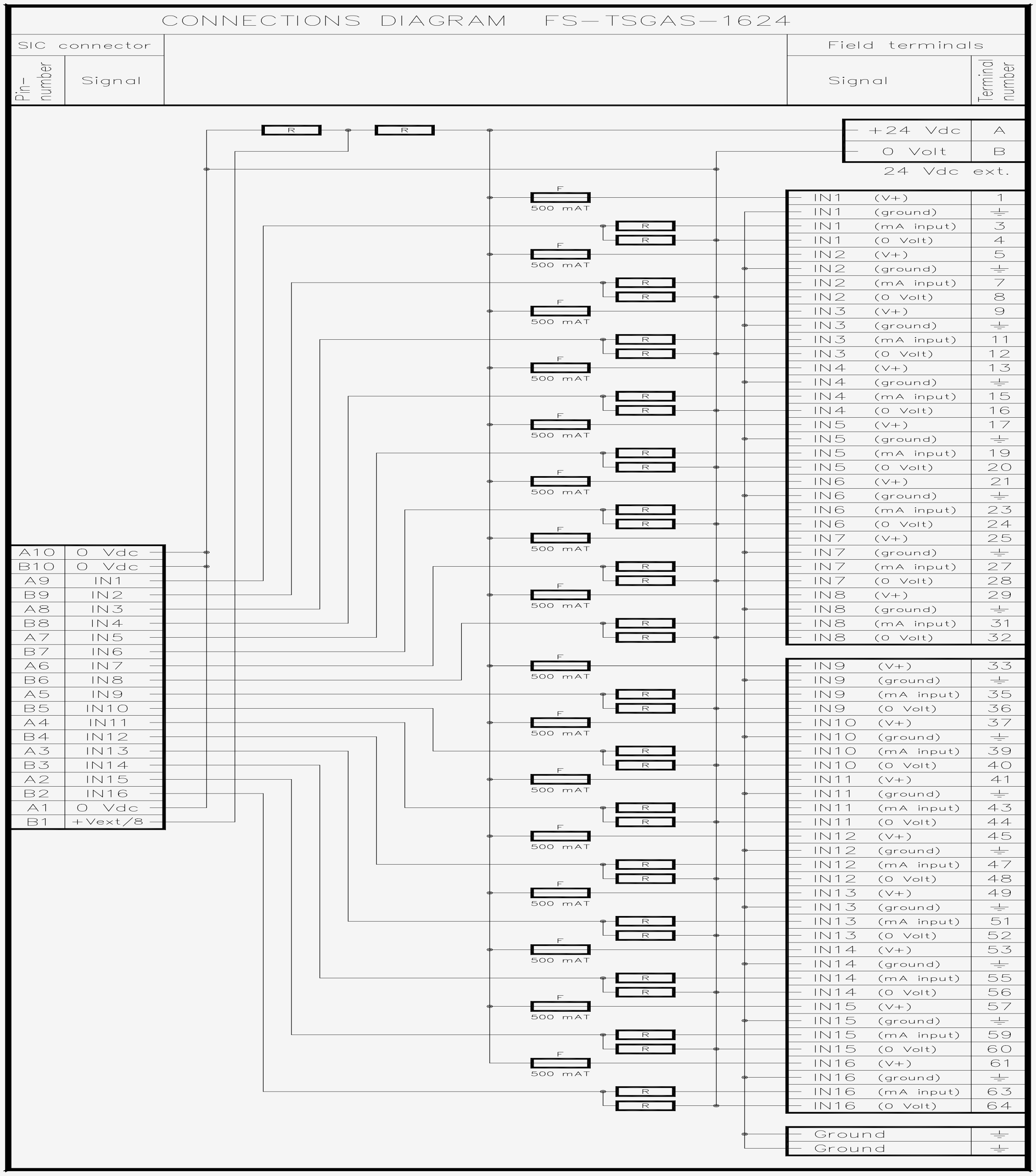


Figure 15-112: Connections diagram

15.28.5 Technical data

The TSGAS-1624 module has the following specifications:

General	Type numbers:	FS-TSGAS-1624
		FC-TSGAS-1624
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (with common 0 V)
	Power requirements:	24 V DC external, 3 mA (without field loads)
	Input current:	0-25 mA
	Input resistance:	500 Ω (± 5%)
Output	To SAI-1620m module:	
	• Output voltage	0-4 V DC
	• Accuracy	0.1%
Fuse	Fuse rating:	500 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2501
	Derating curve:	Linear from 0.5 A at 25 dC to 0.35 A at 70 dC module ambient
Physical	Module dimensions:	225 × 70 × 60 mm (L × W × H)
		8.86 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	226 mm (8.90 in)

Termination	Screw terminals:	
	• Max. wire size	2.5 mm^2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
	Power screw terminals (A, B):	
	• Max. wire size	16 mm^2; (AWG 8)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	1.2 Nm (0.88 ft-lb)

15.29 TSGASH-1624P

15.29.1 Safe gas/flame detector input FTA with HART interface (0-20 mA, 16 channels)

The field termination assembly module TSGASH-1624P is the interface between gas/flame detectors with HART interface in the field and the safe high-density analog input module SAI-1620m in Safety Manager.

The TSGASH-1624P module has sixteen analog input channels which may be used for both safety-related and non-safety-related applications.

The TSGASH-1624P module provides HART interface on all 16 channels. The module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of ground and field wiring.

The FTA module has a 2-pole power connector to connect the module with a 24Vdc power source.

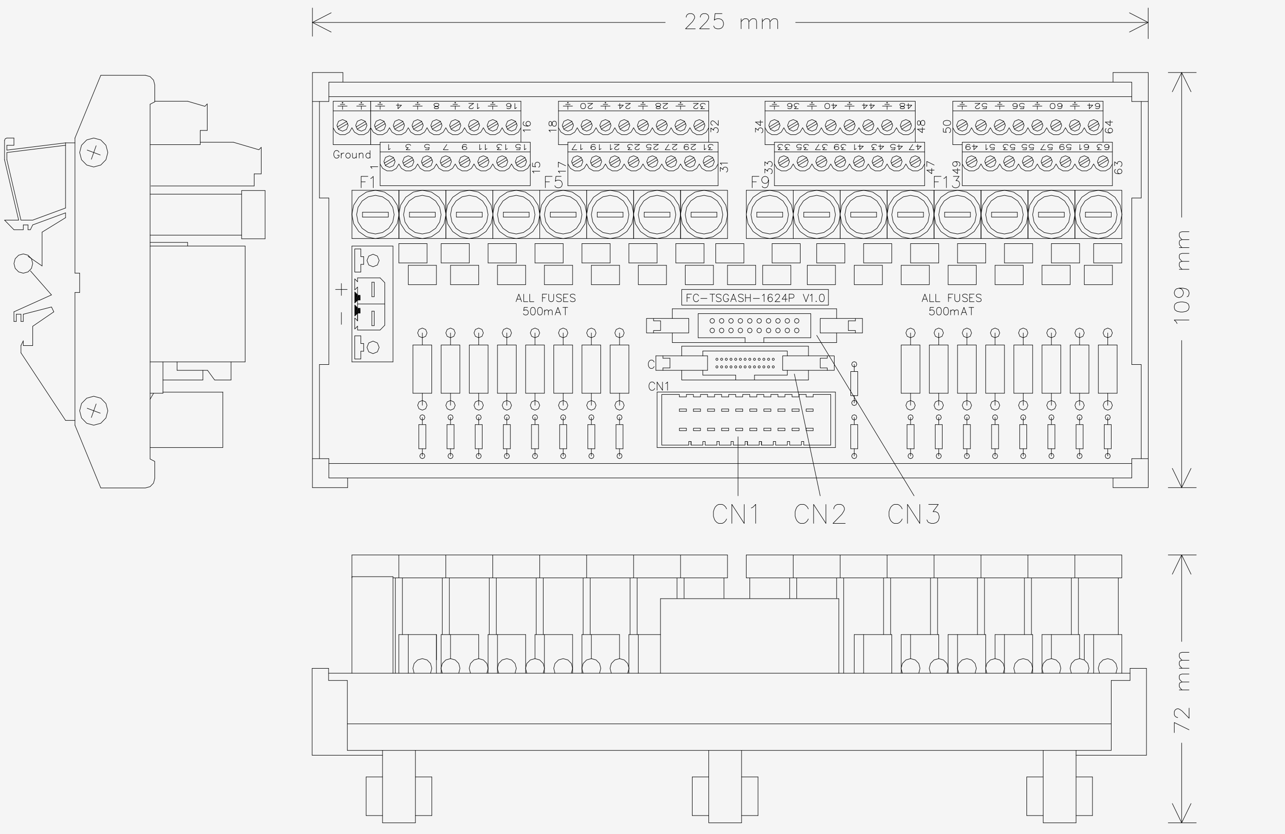


Figure 15-113: Mechanical layout

15.29.2 Main functions

The TSGASH-1624P module has the following functions:

- Linear direct conversion of 0(4)-20mA DC field signals to signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter (500mAT fused)
- Enable connection to HART multiplex units of MTL or Pepperl+Fuchs (P+F)
- Enable monitoring of the external power connected to the TSGASH-1624P module.

15.29.2.1 Linear direct conversion

The input circuit of each channel consists of a high-precision resistor which converts the input current (0-20mA) to the input voltage for the high-density analog input module SAI-1620m. The power to the analog transmitter is fused (500mAT) per channel.

Each analog input has its own terminal for the field cable shield.

The below figure shows the schematic diagram for connecting a transmitter (active or passive).

15.29.2.2 HART interface

The TSGASH-1624P module provides interfaces to HART multiplex units from MTL and Pepperl+Fuchs (P+F). Dedicated connectors are installed on the FTA to enable the use of the standard cables from these suppliers.

The following equipment can be connected:

	MTL Solution	P+F solution
Multiplexer unit	MTL4850	KFD0-HMS-16 or KFD2-HMM-16
Cable	MTL FLAT20-2.2	K-MH26
Connector on FTA[1]	CN3	CN2

1. See Figure 1

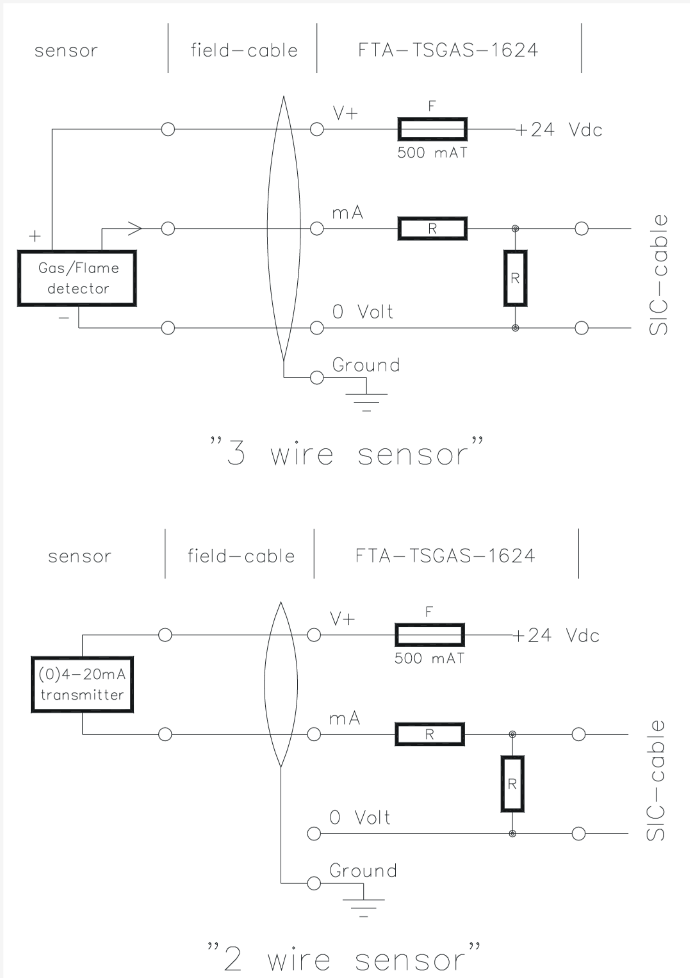


Figure 15-114: Schematic diagram for connecting a transmitter

15.29.2.3 External power

A 24 V DC power distribution cable (see data sheet PDC-MB24-y for details) can be used to connect the main bus bar with the power connector on the TSGASH-1624P module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

> **Note:**
> The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager software can monitor the external power voltage via the safe high-density analog input module SAI-1620m.

15.29.3 Applications

For applications and connection options for the TSGASH-1624P module, see section SICC 0001/Lx.

15.29.4 Connections

15.29.4.1 External power and ground

The below figure shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked '+' is pin 1: connected to +24Vdc bus bar.
- The pin marked '-' is pin 2: connected to the 0Vdc bus bar.

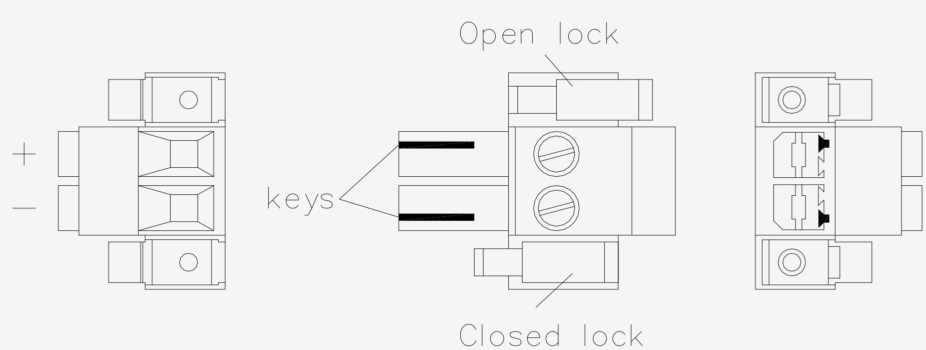


Figure 15-115: Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view

The two (red) locking slides of the cable-connector in the above figure keep the cable-connector locked when inserted into the power connector.

The (two) Ground screw connections on the top left side in Figure 1 are used to connect Ground with the "ground" pins of the channels. One ground wire is enough.

15.29.4.2 Connections diagram

The TSGASH-1624P module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

The connections diagram of the TSGASH-1624P module is as follows:

15.29 TSGASH-1624P

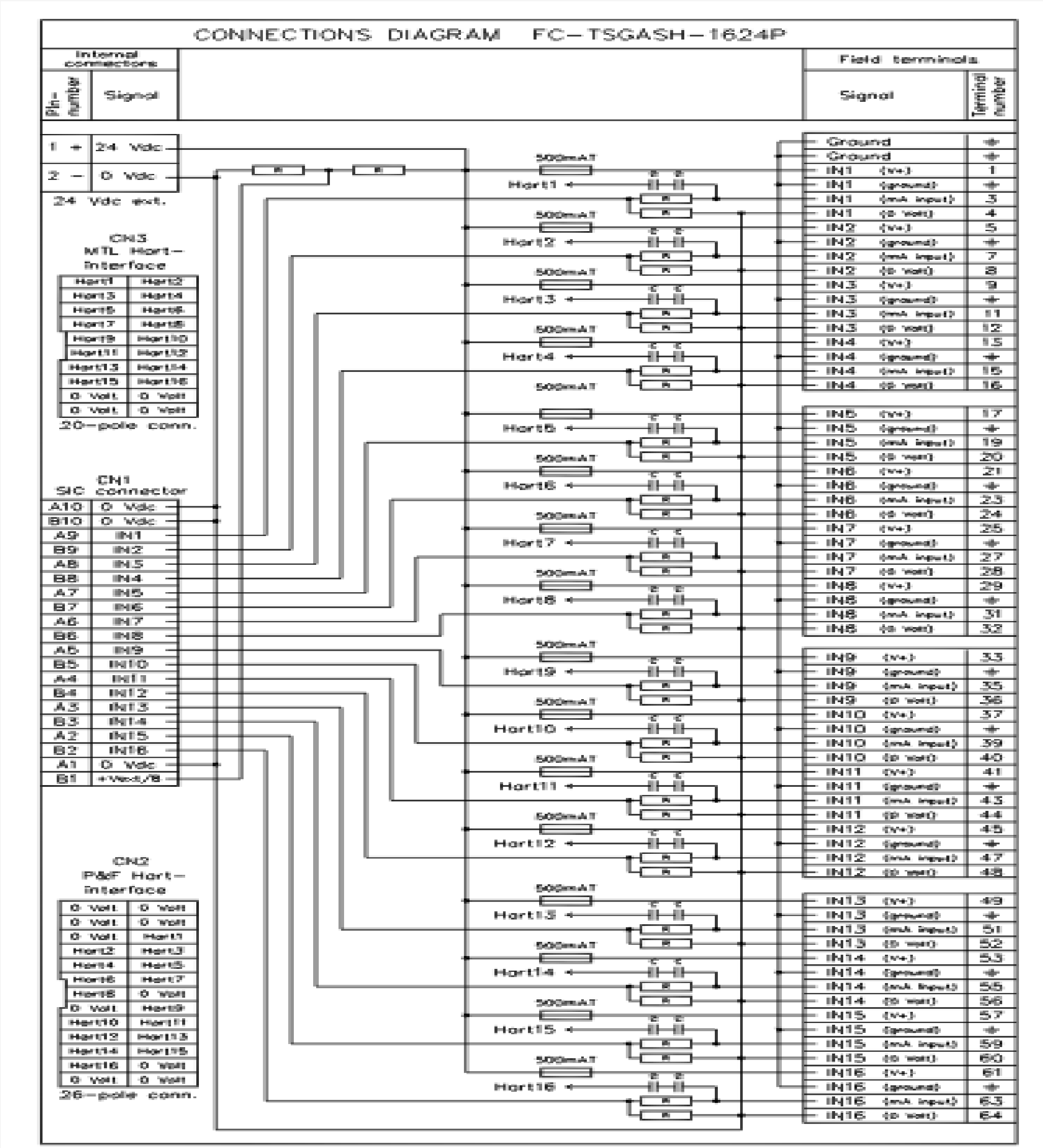


Figure 15-116: Connections diagram

15.29.5 Technical data

The TSGASH-1624P module has the following specifications:

General	Type numbers:	FC-TSGASH-1624P
	Approvals:	CE, TUV, UL, CSA
Input	Number of input channels:	16 (with common 0 V)
	Power requirements:	24 V DC external, 2.5mA (without field loads)
	Input current:	0-25 mA
	Input resistance:	500 Ω (± 5%)
Output	To SAI-1620m module:	
	• Output voltage	0-4 V DC
	• Accuracy	0.1%
	To HART multiplexer unit:	
	• Output voltage	Max. 11 V peak-peak
	• Series impedance	> 2µF
Fuse	Fuse rating:	500 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2501
	Derating curve:	Linear from 0.5 A at 25 dC to 0.35 A at 70 dC module ambient

<table>
<tr><td rowspan="4">Physical</td><td rowspan="2">Module dimensions:</td><td>225 × 109× 60 mm (L × W × H)</td></tr>
<tr><td>8.86 × 4.29 × 2.36 in (L × W × H)</td></tr>
<tr><td>DIN EN rails:</td><td>TS32 / TS35 × 7.5</td></tr>
<tr><td>Used rail length:</td><td>226 mm (8.90 in)</td></tr>
<tr><td rowspan="11">Termination</td><td>Screw terminals:</td><td></td></tr>
<tr><td>• Max. wire diameter</td><td>2.5 mm⊃ 2; (AWG 14)</td></tr>
<tr><td>• Strip length</td><td>7 mm (0.28 in)</td></tr>
<tr><td>• Tightening torque</td><td>0.5 Nm (0.37 ft-lb)</td></tr>
<tr><td colspan="2">Power connector:</td></tr>
<tr><td>• model</td><td>2 pole header with keying</td></tr>
<tr><td rowspan="2">• Make and type</td><td>Weidmuller:
BVZ 7.62HP/02/180F SN (con.)</td></tr>
<tr><td>Weidmuller:
BV/SV7.62HP KO (keys)</td></tr>
<tr><td>• Strip length</td><td>8 mm (0.28 in)</td></tr>
<tr><td>• connectable conductors</td><td>0.5-6 mm (AWG20-AWG10)</td></tr>
</table>

15.30 TSHART-1620m

15.30.1 Safe 0-20 mA and 4-20 mA analog input FTA with HART interface (16 channels)

Field termination assembly module TSHART-1620m is the interface between field components (sensors, etc.) and the safe high-density analog input module SAI-1620m in Safety Manager. The FTA provides HART interface. It can be used for interfacing signals from Class I, division 2 Hazardous Locations.

The TSHART-1620m module has sixteen analog input channels, which may be used for both safety-related and non-safety-related applications. These sixteen channels (separated into two groups of eight channels with common 0 V) are connected via a system interconnection cable (SICC-0001/Lx), which is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply, ground and field wiring.

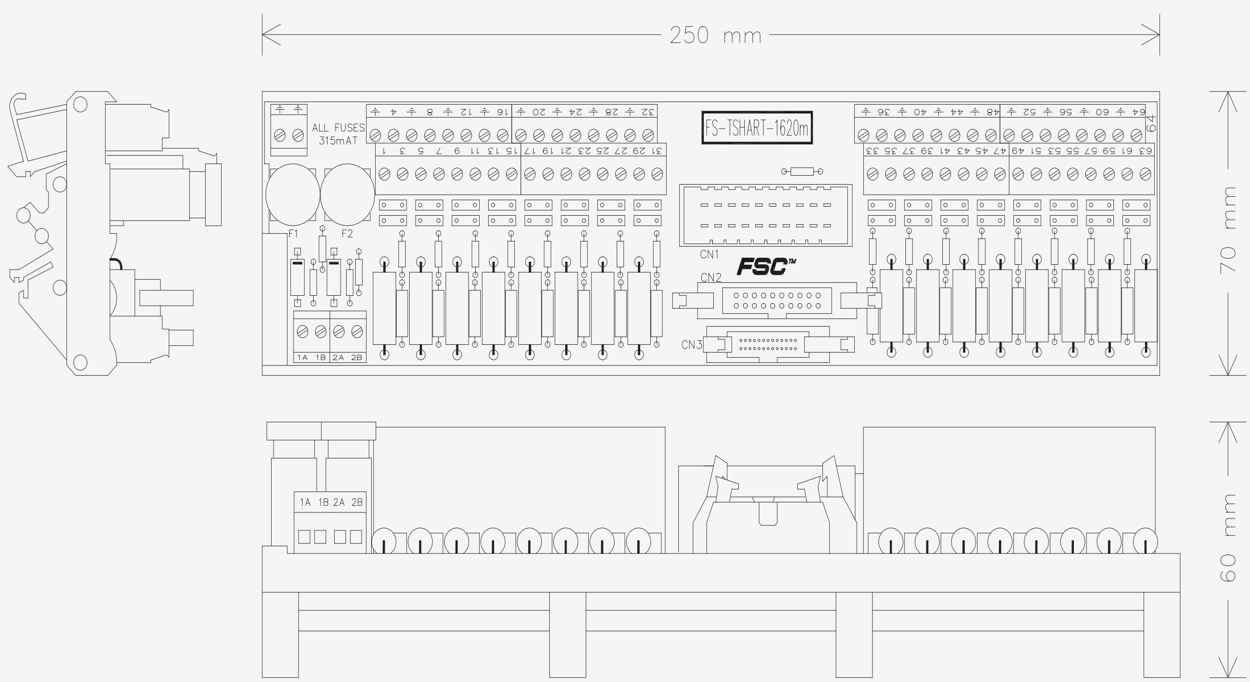


Figure 15-117: Mechanical layout

15.30.2 Main functions

The TSHART-1620m module has four main functions:

- Linear direct conversion of 0(4)-20 mA DC field signals to the signal levels of the safe high-density analog input module SAI-1620m
- Enable connection to HART multiplex units of MTL or Pepperl+Fuchs (P+F)
- Power supply distribution to each transmitter with voltage-current limitation in compliance with Hazardous Area Class I Division 2
- Enable monitoring of the external power connected to the FTA module

15.30.2.1 Linear direct conversion

The input circuit of each channel consists of a high-precision resistor, which converts the input current (0-20 mA) to the input voltage for the high-density analog input module SAI-1620m. The power to the analog transmitter is supplied via a series resistor. Each analog signal has its own terminal for the field cable shield. The below figure shows the schematic diagram for connecting a transmitter (active and passive).

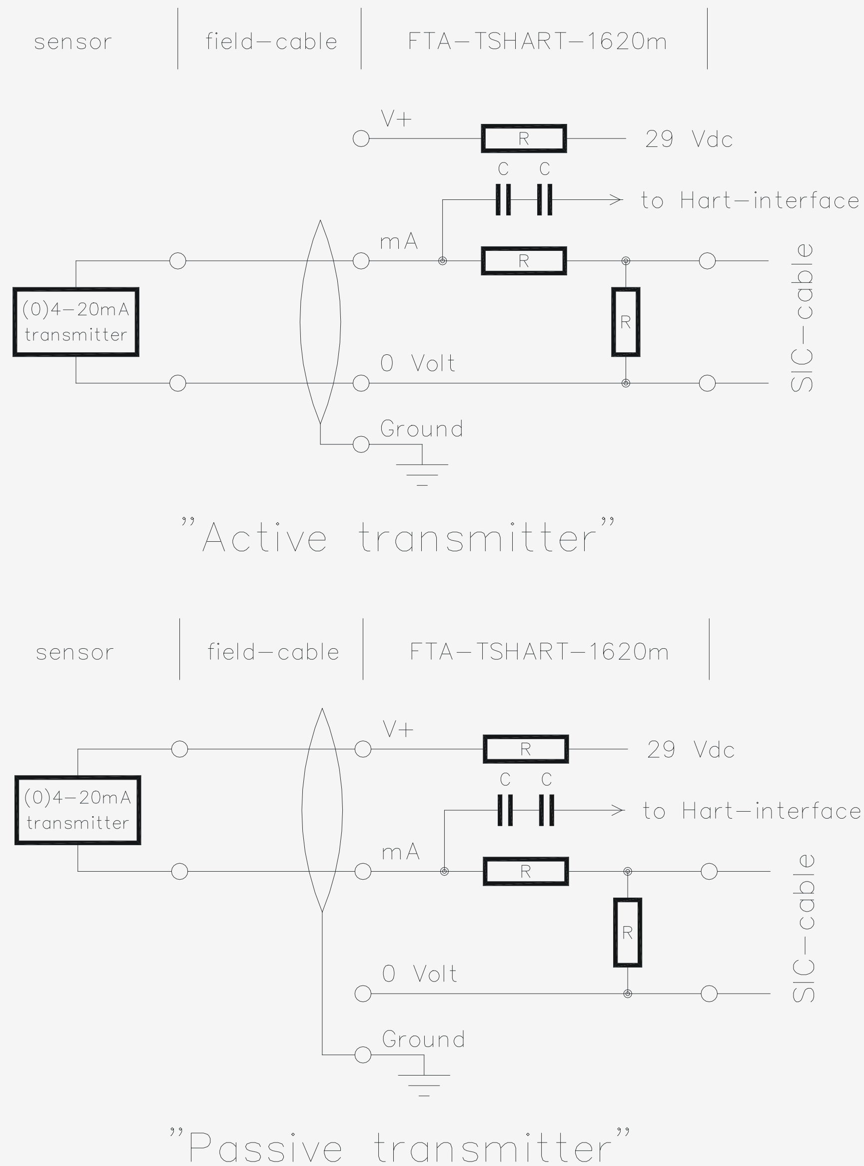


Figure 15-118: Schematic diagram for connecting a transmitter

15.30.2.2 HART interface

Attention:
Suggested HART multiplexers have *no* galvanic isolation between (24 V DC) supply and the HART signals (common 0 V DC).

The TSHART-1620m module provides an interface to HART multiplex units from MTL and P+F. Special connectors are installed on the FTA for connection of the standard cables from these suppliers.

The following connections and equipment can be used:

MTL solution:

- Multiplex unit MTL4850
- Cable: MTL FLAT20-2.2
- Connector on FTA: CN2 (see "Figure 1")

P+F solution:

- Multiplex unit KFD0-HMS-16 or KFD2-HMM-16
- Cable: K-HM26
- Connector on FTA: CN3 (see Figure 1)

15.30.2.3 Class I division 2

The TSHART-1620m module may be used for non-incendiary field circuits to Class I, division 2 applications. The external output voltage (V+) is current-limited by means of a series resistor.

15.30.2.4 Transmitter voltage

The below figure shows the available transmitter voltage for passive transmitters.

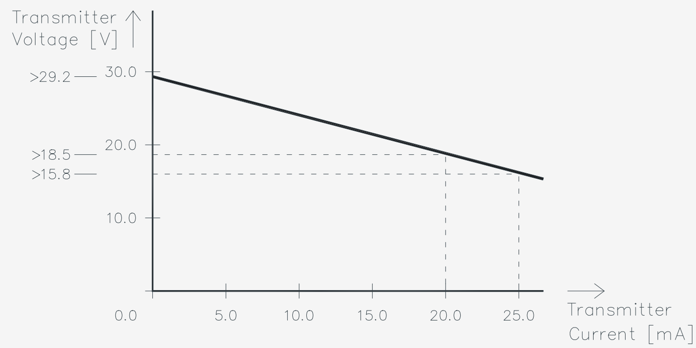


Figure 15-119: Transmitter voltage for passive transmitters

15.30.2.5 External power

If all inputs are active, no external power is required.

For loops, which contain passive transmitters, analog process data is only available if the supply voltage to the electronics is guaranteed. The high-density analog input concept (using TSHART-1620m / TPSU-2430 modules) offers full monitoring of power that is provided externally. If DC/DC converter modules TPSU-2430 are used, even redundant power supplies are covered.

Redundant external power can be connected to the TSHART-1620m module via two screw terminal pairs marked ‘1A’, ‘1B’, ‘2A’ and ‘2B’. The screw terminal pairs are interconnected on the FTA module but de-coupled via diodes. The sixteen channels on the FTA module are divided into two groups of eight channels, with each group being protected by a 315 mA fuse. Single-channel errors (shorts from V+ to 0 V) cannot blow the group fuse.

Note:
The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager application software must monitor the external power voltage via the safe high-density analog input module SAI-1620m when safety-related analog input signals are connected to the TSHART-1620m.

The below figure shows the schematic diagram for power distribution with monitoring.

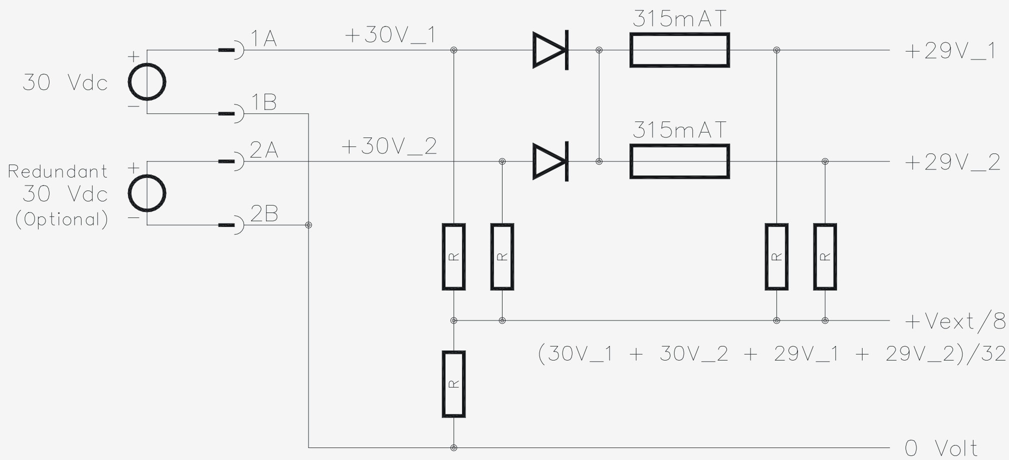


Figure 15-120: Schematic diagram for power distribution with monitoring

15.30.3 Applications

For details on applications and connection options for the TSHART-1620m module see section SICC 0001/Lx.

15.30.4 Connections

15.30.4.1 External power and ground

The redundant external supply voltage (Vext) and ground are connected to the following screw terminals (marked ‘1A’, ‘1B’, ‘2A’, ‘2B’ and ‘$\perp$’ on the FTA):

Screw terminal	Function
1A	30 V DC Vext feeder 1
1B	0 V DC Vext feeder 1
2A	30 V DC Vext feeder 2
2B	0 V DC Vext feeder 2
$\perp$	Ground connection
$\perp$	Ground connection (1 ground wire is enough)

15.30.4.2 Connections diagram

The below figure shows the connections diagram of the TSHART-1620m module.

The TSHART-1620m module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

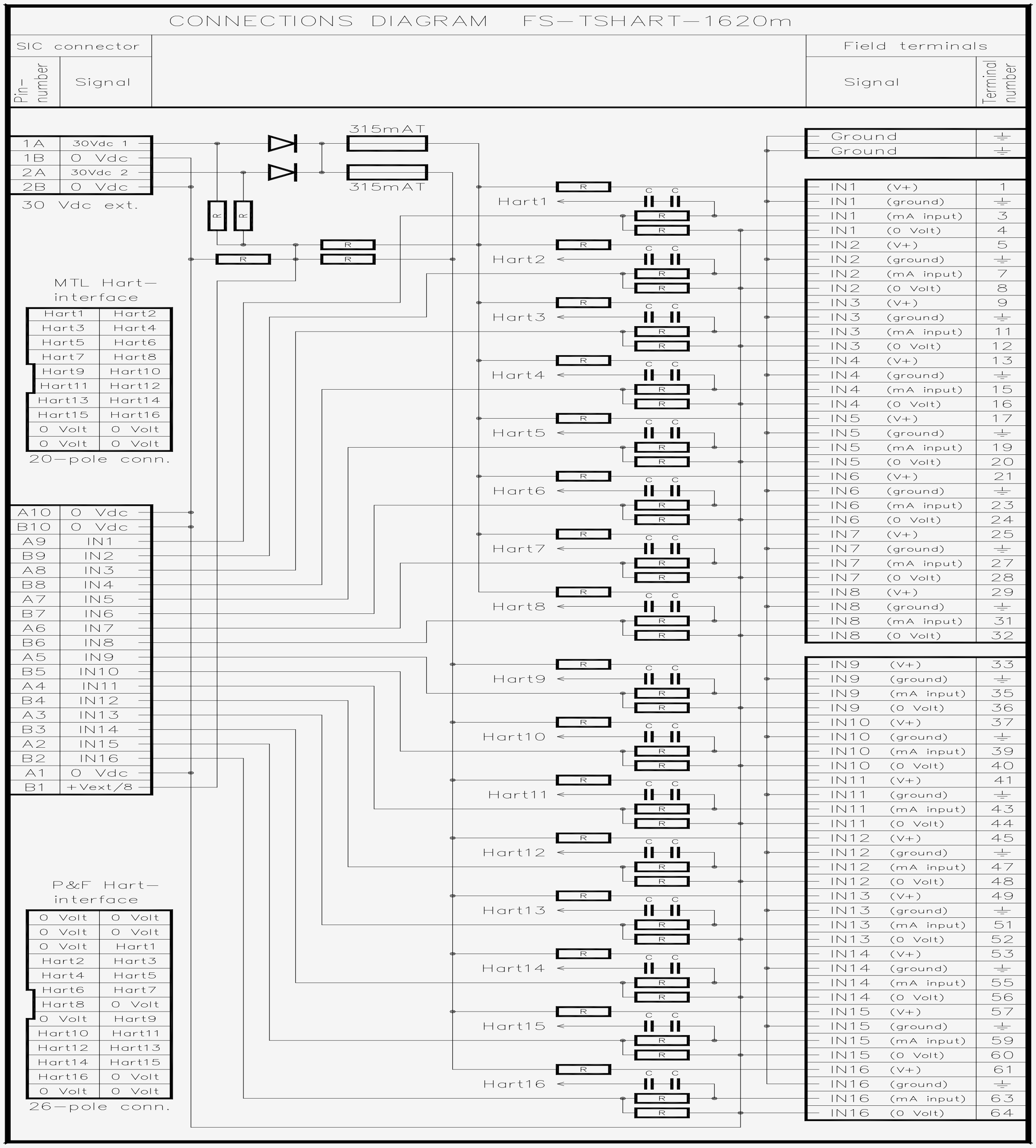


Figure 15-121: Connections diagram

15.30.5 Technical data

The TSHART-1620m module has the following general specifications:

General	Type numbers:	FS-TSHART-1620m
		FC-TSHART-1620m
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (2 groups of 8 with common 0 V)
	Power requirements:	30 V DC external, 3 mA (without input loop loads)
	Input current:	0-25 mA
	Input resistance:	250 Ω (± 1%)
Output	To passive transmitters (Vext):	
	• Output resistance:	270 Ω (± 5%)
	• Igniting current per channel:	< 120 mA at 30 V DC
	To SAI-1620m module:	
	• Output voltage	0-4 V DC
	• Accuracy	0.10%
	To HART multiplex unit:	
	• Output voltage	Max. 5 V peak-peak
	• Series impedance	> 100 nF

Fuse	Fuse rating:	315 mA
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	125 V
	Voltage rating DC:	-
	Manufacturer:	SOC
	Manufacturer PN:	MQ2 315 mA
	Maximum output current per fuse:	220 mA
Physical	Module dimensions:	250 × 70 × 60 mm (L × W × H)
		9.84 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	251 mm (9.87 in)
Termination	Screw terminals:	
	• Max. wire size	2.5 mm^2; (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

The TSHART-1620m module has the following specifications for non-incendive field circuits, Class1 Division 2:

Field signal specifications for non-incendive field circuits, Class1 Division 2	HYDROGEN (Group A & B):	
	• Max. loop inductance	6 mH
	• Max. loop capacitance	0.25 μF
	NON-HYDROGEN (Group C & D):	
	• Max. loop inductance	20 mH
	• Max. loop capacitance	5 μF

15.31 TSKUNI-1624

15.31.1 Sub-D to Knife terminals FTA (Universal,16ch)

The field termination assembly module TSKUNI-1624 provides sixteen sets of two knife terminals for RUSIO signals.

The TSKUNI-1624 has:

- 37-pole sub-D male connector (CN1) that must be connected with (16) RUSIO channels
- 16 sets of two knife terminals for the sixteen channels

Each channel has a the following knife terminal connections:

- A+ terminal that is the (RUSIO) signal connection.
- A- terminal that is the common 0 Volt connection.

The TSKUNI-1624 has universal snap-in provisions for standard DIN EN rails.

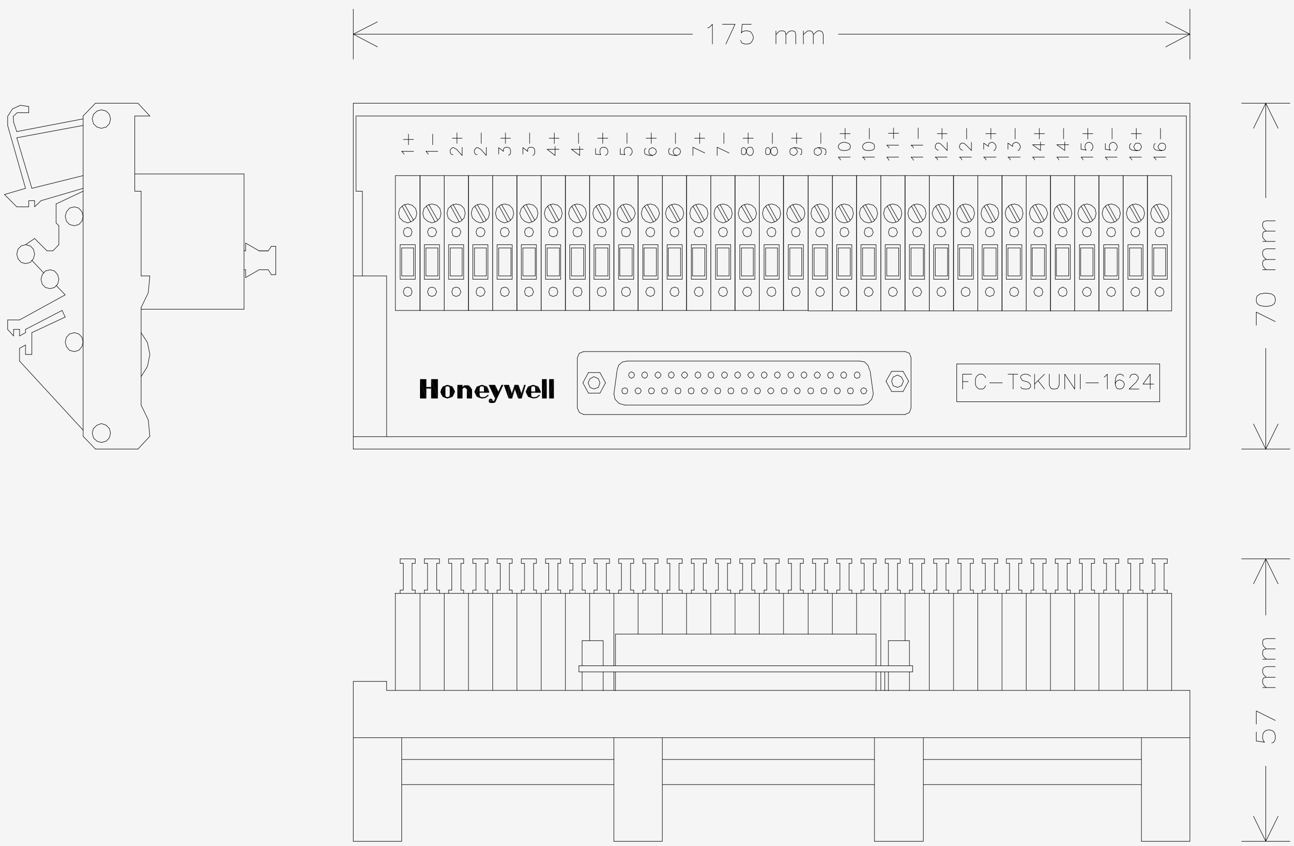


Figure 15-122: Mechanical layout

15.31.2 Connections

The connection diagram of the TSKUNI-1624 module is as follows:

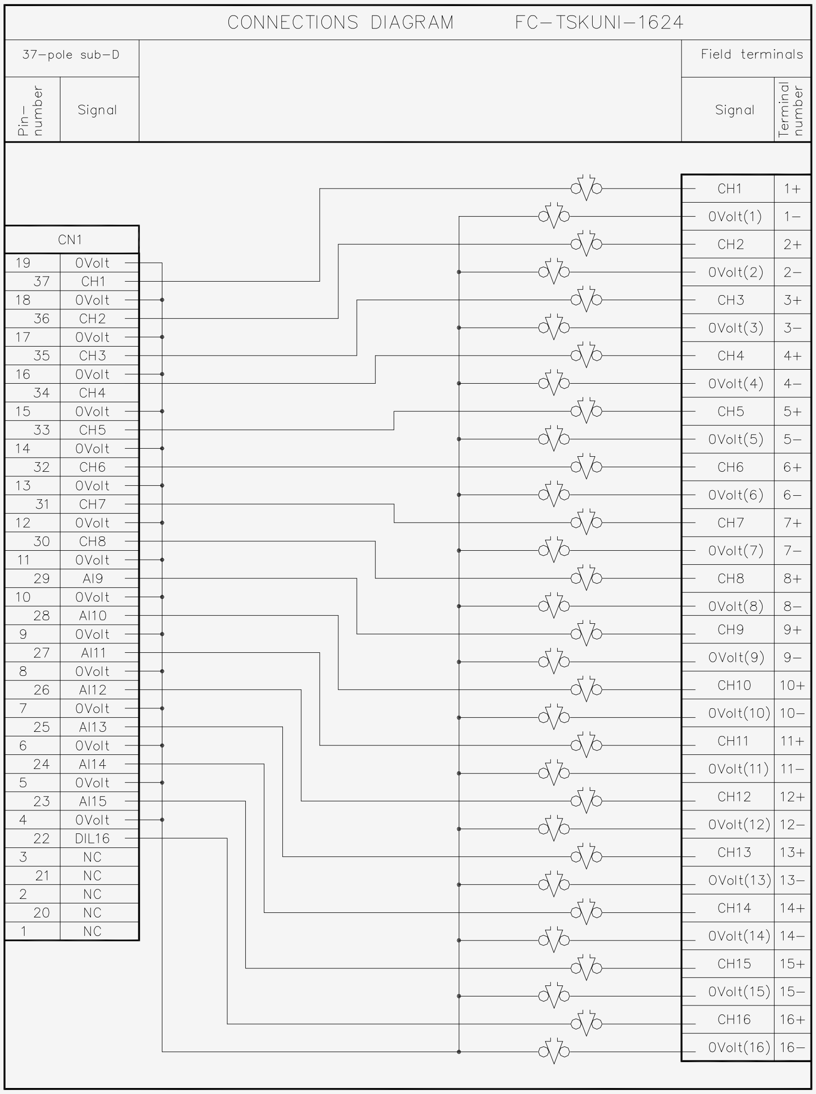


Figure 15-123: Connection diagram

The TSKUNI-1624 must be combined with 16 channels of a (redundant set of) universal IO module(s). A cable of suitable length is used to connect the TSKUNI-1624 with an (redundant or non-redundant) IOTA.

15.31.3 Technical data

The TSKUNI-1624 module has the following specifications:

General	Type number:	FC-TSKUNI-1624
	Approvals:	CE, UL, CSA; TUV pending
Physical	Module dimensions:	175 x 70 x 57 mm (L x W x H) 6.89 x 2.76 x 2.24 in (L x W x H)
	DIN EN rails:	TS32 / TS35 x 7.5
	Used rail length:	176 mm (6.93 in)
Termination	Channel screw terminals:	
	wire size	0.2 - 4 mm^2 (AWG 28 - AWG 12)
	strip length	8 mm (0.31 in)
	tightening torque	max. 0.6 Nm (0.44 ft-lb)

15.32 TSLT-5K15KD

Line termination terminal TSLT-5K15KD

The TSLT-5K15KD line termination terminal is placed near the input connections of a line monitored digital input. The TSLT-5K15KD is used when it is not possible to place a line terminator near the field-contact. However, it is allowed to place the TSLT-5K15KD near the field-contact.

The following figure shows the mechanical layout of TSLT-5K15KD.

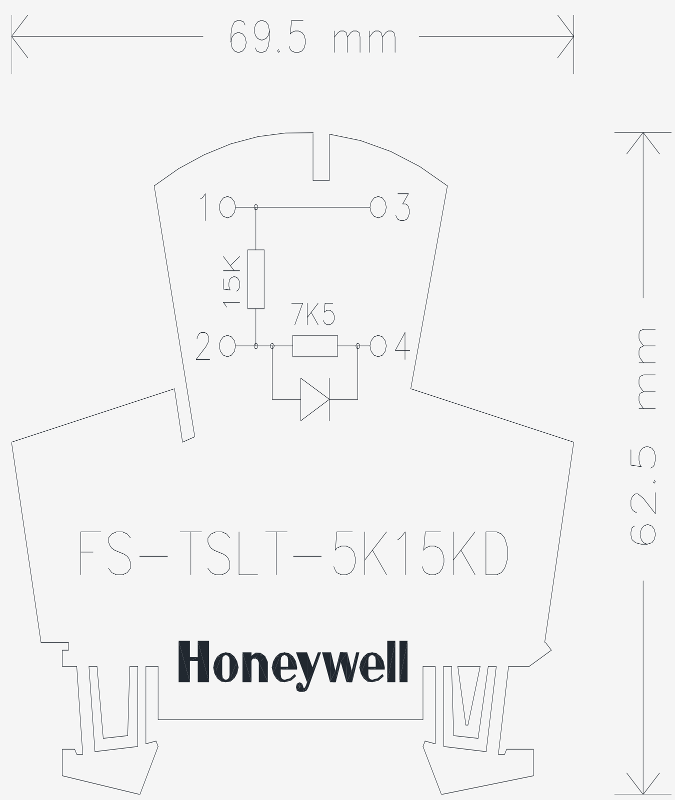


Figure 15-124: Mechanical layout of TSLT-5K15KD

The TSLT-5K15KD provides the resistors required to line-monitor a digital input. Short-circuit or lead-breakage in the field-cable is NOT detected, as this requires placement of the line terminator near the field-contact. The TSLT-5K15KD also contains a diode to enable earth-fault detection and localization on the field-cable and/or field-contact. The resistors create a 5kOhm load when the field-contact is closed and a 15kOhm load when the field-contact is open.

Connect the wires as follows:

- Screw terminal 1 to the IN+ terminal (input).
- Screw terminal 2 to the IN- terminal (0Vdc).
- The field wires to screw terminal 3(+) and 4(-).

The TSLT-5K15KD has a snap-on provision for a TS35 (mounting) rail.

The following figure shows the schematic diagram of a line monitored digital input channel with a TSLT-5K15KD.

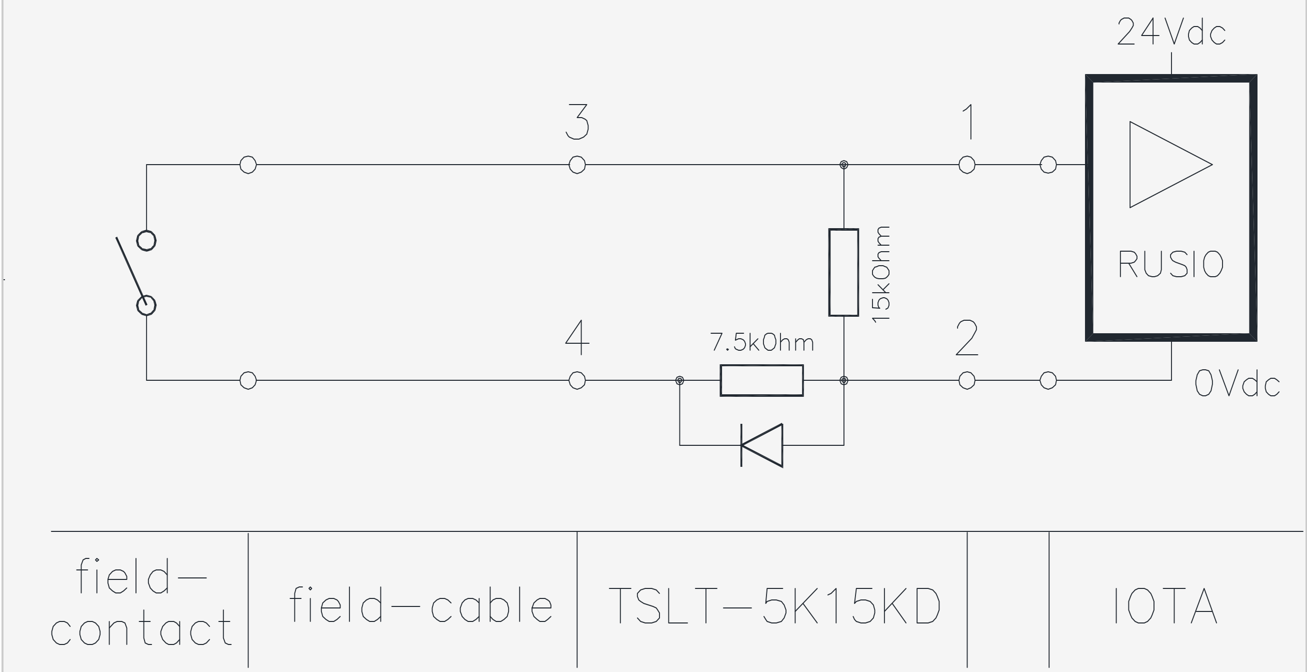


Figure 15-125: Schematic diagram of a line monitored digital input channel with a TSLT-5K15KD

15.32.1 Technical data

The TSLT–5K15KD module has the following specifications:

General	Type number:	FS-TSLT-5K15KD
	Approvals:	CE
	Input resistance:	15 kOhm +/- 2% (open) 5 kOhm +/- 2% (closed)
	Input voltage:	max. 35V
	Ambient temperature:	-40 to 85°C
Physical Terminal dimensions:	—	69.5 x 62.5 x 6.6 mm (L x H x T) 2.74 x 2.46 x 0.26 in (L x H x T)
	DIN EN rail:	TS35
	Used rail length:	6.7 mm (0.264 in)
Screw terminals:	Wire diameter:	0.5 to 4 mm
	stripped length:	10 mm
	Tightening torque:	max. 0.6 Nm

15.33 TSPKUNI-1624L AND TSPKUNI-1624R

15.33.1 Sub-D to Powered Knife terminals FTA (Universal,16ch)

The field termination assembly module TSPKUNI-1624L and TSPKUNI-1624R provides sixteen sets of three knife terminals for RUSIO signals.

The TSPKUNI-1624L and TSPKUNI-1624R has :

- A Power input connector (PWR) that supplies the (+24 V DC) field power
- 37-pole sub-D male connector (CN1) that must be connected with (16) RUSIO channels
- 16 sets of three knife terminals for the sixteen channels

Each channel has a the following knife terminal connections:

- A P terminal that has a (2 A) fused +24 V DC connection.
- A + terminal that is the (RUSIO) signal connection.
- A - terminal that is the common 0 Volt connection.

The TSPKUNI-1624L and TSPKUNI-1624R has universal snap-in provisions for standard DIN EN rails.

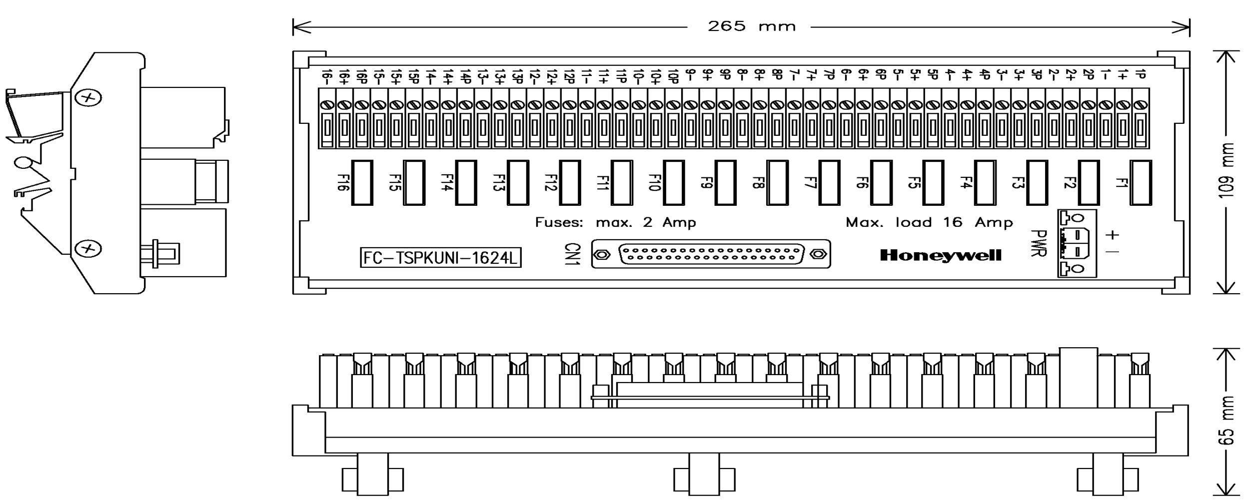


Figure 15-126: Mechanical layout (TSPKUNI-1624L)

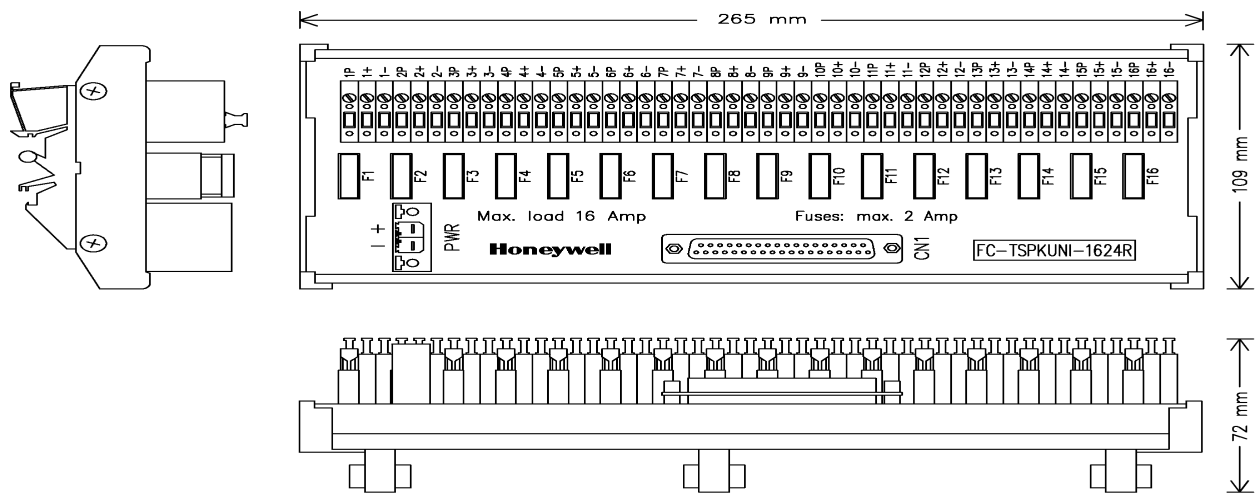


Figure 15-127: Mechanical layout (TSPKUNI-1624R)

15.33.2 Connections

The connection diagram of the TSPKUNI-1624L and TSPKUNI-1624R module is as follows:

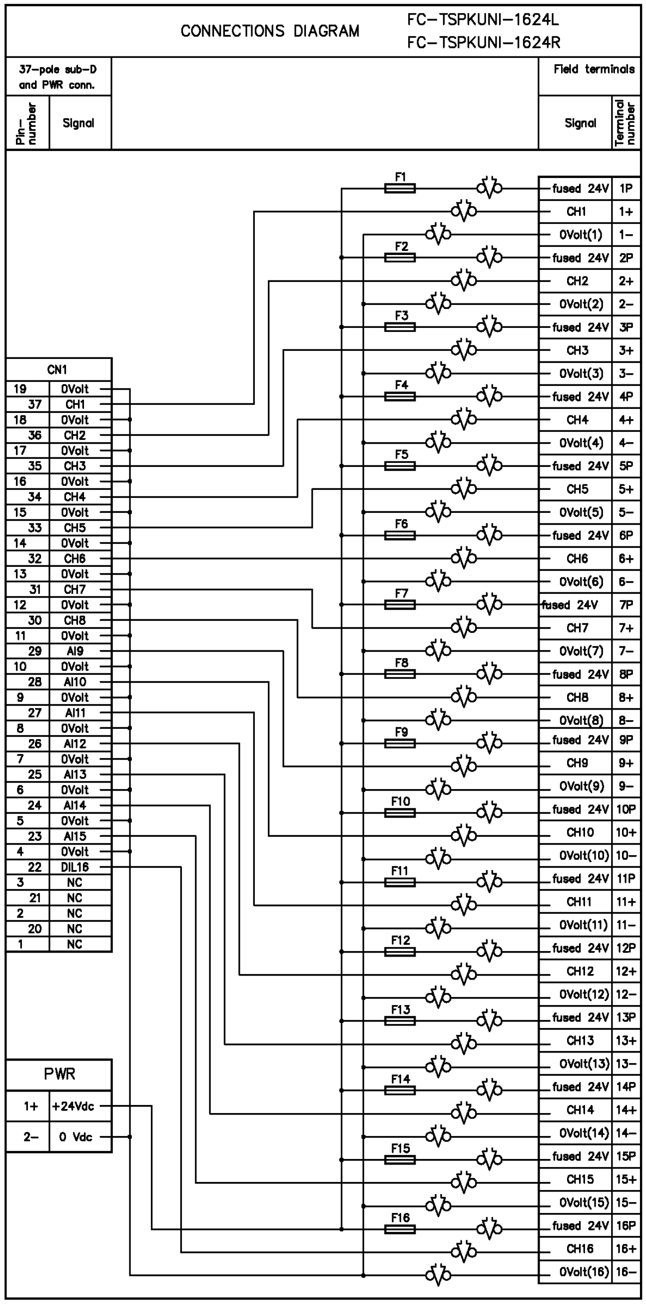


Figure 15-128: Connections diagram

The TSPKUNI-1624L and TSPKUNI-1624R must be combined with 16 channels of a (redundant set of) Safety Manager universal IO module(s).

A cable[1] of suitable length is used to connect the TSPKUNI-1624L and TSPKUNI-1624R with an (redundant or non-redundant) IOTA.

1. Honeywell type numbers that are available: 4213509 up to and including 4212516. These type numbers correspond with part number CA-HWC300-AIO-DIO-xxM (Pepperl & Fuchs), where 'xx' stands for the length in meters.

   For details see the manufacturer's data sheet (Pepperl & Fuchs).

15.33.3 External power

A 24 V DC power distribution cable (see datasheet PDC-MB24-y for details) can be used to connect the main busbar with the power connector (PWR).

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

Note:
The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

The below figure shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked + is pin 1: connected to +24 V DC busbar.
- The pin marked - is pin 2: connected to the 0 V DC busbar.

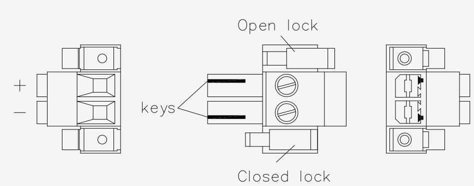


Figure 15-129: Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view

The two (red) locking slides of the cable-connector in the above figure keep the cable-connector locked when inserted into the power connector (PWR).

15.33.4 Technical data

The TSPKUNI-1624L and TSPKUNI-1624R module has the following specifications:

General	Type numbers:	TSPKUNI-1624L and TSPKUNI-1624R
	Approvals:	CE, TUV, UL, CSA
Power	Field power:	24 V DC
	Total field load:	max 16 A
Fuse	Fuse rating:	2 A
	Fuse dimensions:	Blade 5x19 mm
	Voltage rating AC:	-
	Voltage rating DC:	32 V
	Manufacturer:	Littelfuse
	Manufacturer PN:	0287002.PXS
	Maximum output current per fuse:	1.4 A
Physical	Module dimensions:	265 x 109 x 72 mm (L x W x H) 10.44 x 4.29 x 2.84 in (L x W x H)
	DIN EN rails:	TS32 / TS35 x 7.5
	Used rail length:	266 mm (10.47 in)

Termination	Channel screw terminals:	
	• Wire diameter	0.2 - 4 mm (AWG 28 - AWG 12)
	• Strip length	8 mm (0.31 in)
	• Tightening torque	max. 0.6 Nm (0.44 ft-lb)
	Power connector:	
	• Make and type:	Weidmuller: BVZ 7.62HP/02/180F SN (conn.) Weidmuller: BV/SV7.62HP KO (keys)
	• Strip length:	8 mm (0.28 in)
	• Connectable conductors:	0.5-6 mm (AWG 20-AWG 10)

15.34 TSRO-0824

15.34.1 Safe dry digital output FTA for SIL3 applications (8 channels)

Field termination assembly module TSRO-0824 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It has eight relay-based potential-free safe output channels suitable for applications up to and including SIL3 without the use of fault exclusions. TSRO-0824 complies with safety requirements for general use in safety requirement classes SIL3 as defined in IEC 61508.

The TSRO-0824 has floating, non commoned, output contacts that can be wired independently. Each output channel consists of:

- Three relays
- A fused NO field contact (5 AT, slow-acting)
- A status indication LED

The relays are capable of driving a wide variety of loads, including 115/230 V AC, which gives Safety Manager a 115/230 V AC output capability for SIL3 applications. The energized relay state is indicated by a LED on the module.

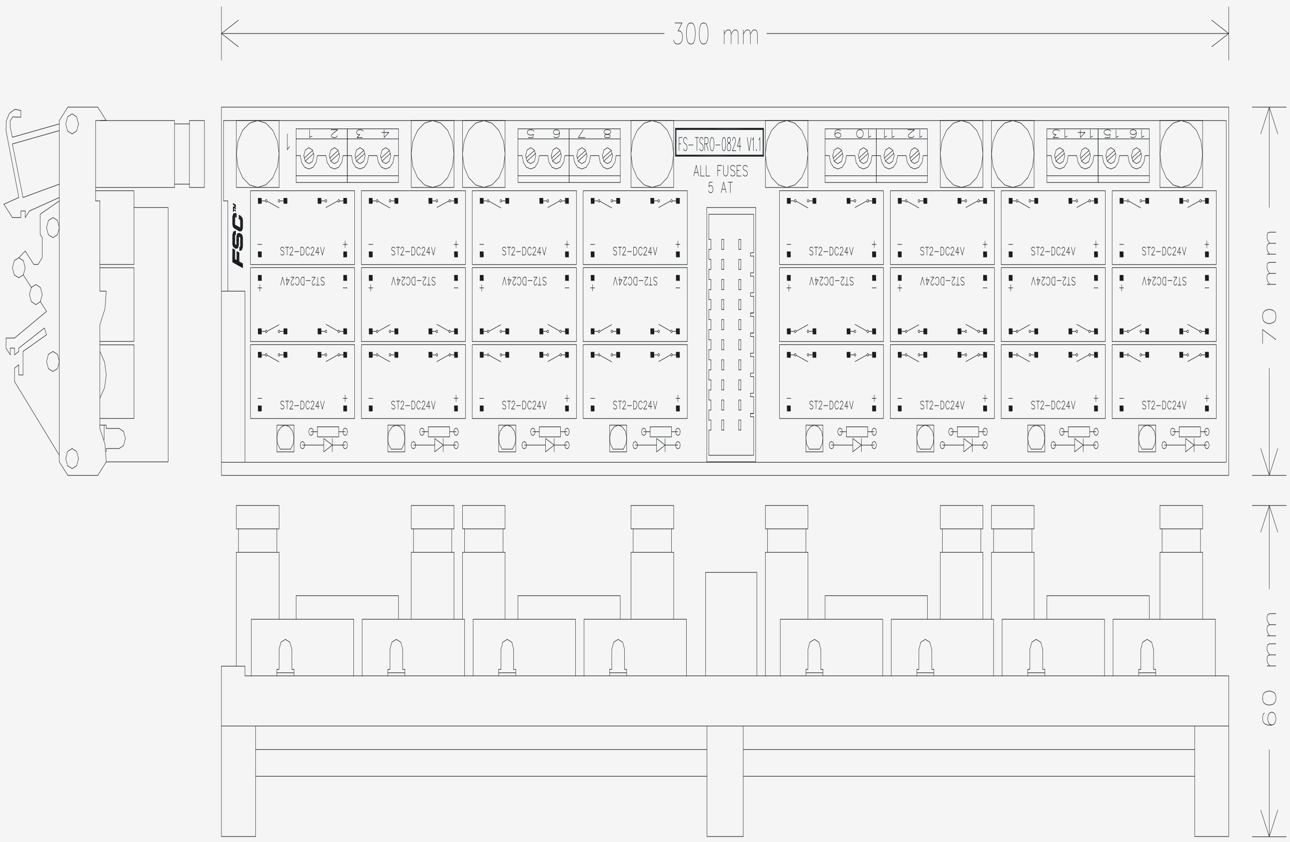


Figure 15-130: Mechanical layout

Eight channels can be connected to the TSRO-0824 module via system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDO-0824 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

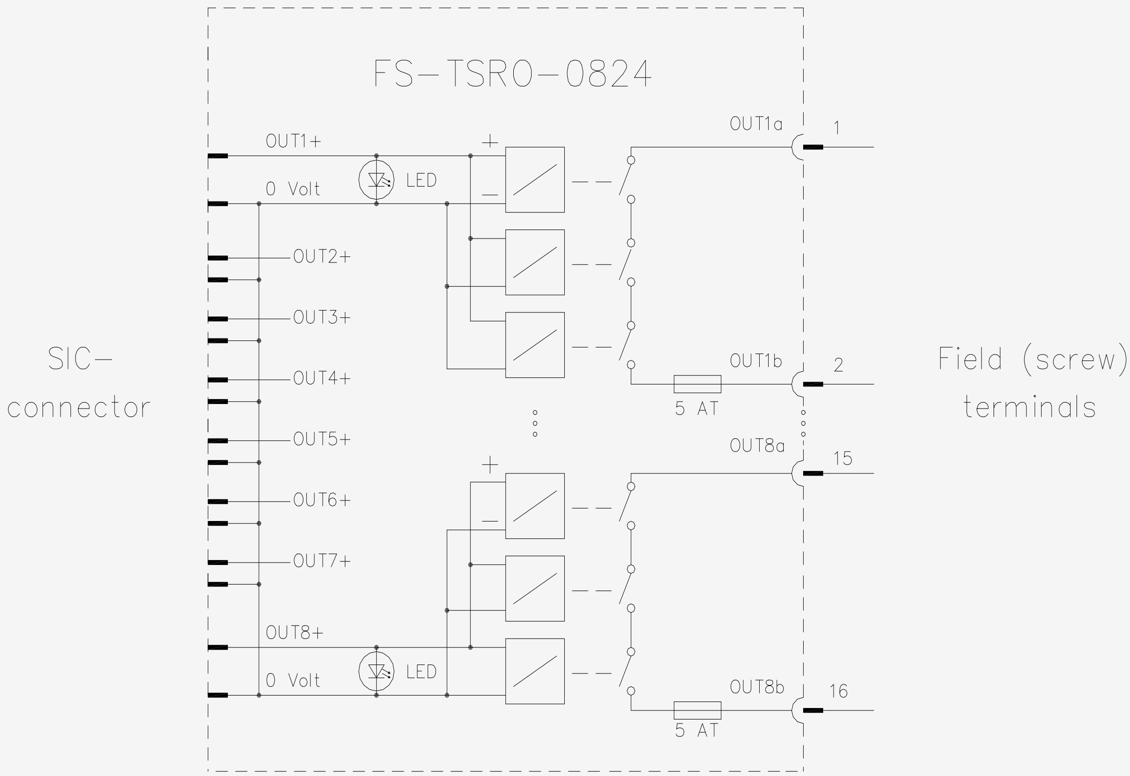


Figure 15-131: Schematic diagram

15.34.2 Relay life

The electrical life of the relays heavily depends on the contact rating the relay is exposed to. the below figure shows the expected relay life versus contact current.

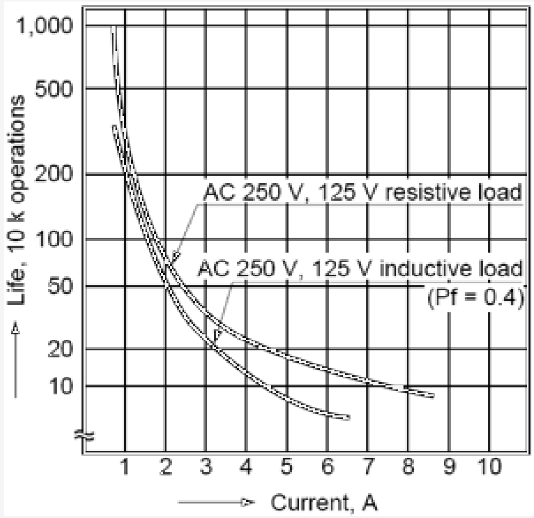


Figure 15-132: Life curve of the applied relays

15.34.3 Applications

For details on applications and connection options for TSRO-0824, see section SICC 0001/Lx.

15.34.4 Connections

The connections diagram of the TSRO-0824 module:

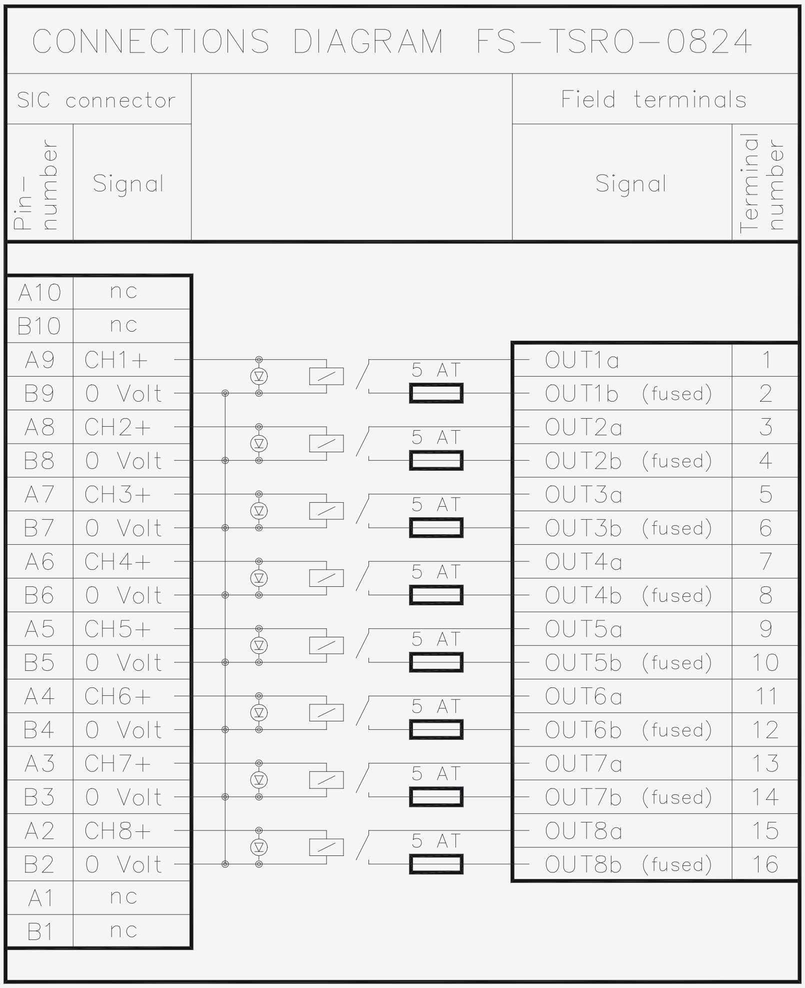


Figure 15-133: Connections diagram

15.34.5 Technical data

The TSRO-0824 module has the following specifications:

General	Type numbers:	FS-TSRO-0824
		FC-TSRO-0824
	Approvals:	CE, UL, TUV, CSA
	Safety class:	up to and including SIL3
Input	Nominal input voltage:	24 V DC
	Max. input voltage:	36 V DC
	Relay pick-up voltage:	19.2 V DC
	Input current:	Typically 40 mA at 24 V DC
Output	Number of output channels:	8
	Max. output current:	5 A (fused)
	Min. output current:	1 mA at 5 V
	Max. output voltage:	250 V AC / 250 V DC
	Max. switched load:	1250 VA / 150 W (see Figure 1)
Fuse	Fuse rating:	5 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	150 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2511
	Derating curve:	Linear from 5 A at 25 dC to 3.5 A at 70 dC module ambient
Physical	Module dimensions:	300 × 70 × 60 mm (L × W × H)

		11.81 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	301 mm (11.85 in)
Termination	Screw terminals:	
	• Max. wire diameter:	2.5 mm⊃ 2; (AWG 14)
	• Strip length:	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Environment	Ambient temperature:	-5°C-+60°C (23°F-140°F)
Isolation	Isolation:	
	• Coil to contact	4000 V AC
	• Contact to contact	1200 V AC
Relay contact	Max. switching load:	250 V AC, 5 A 24 V DC, 5 A 48 V DC, 1 A 110 V DC, 500 mA
	Max. switching frequency:	20 Hz
	Expected life:	See Figure 1
	Contact material:	gold flash over silver alloy

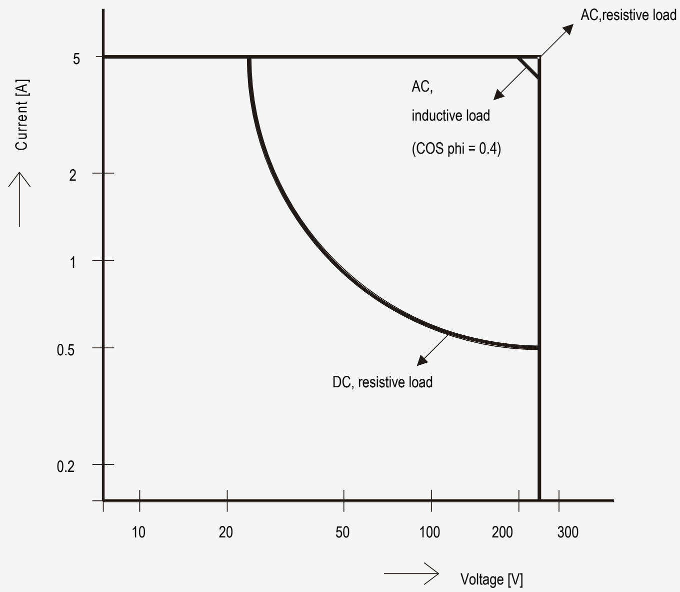


Figure 15-134: Maximum switched power

15.35 TSRO-08UNI

15.35.1 Safe common external power relay output FTA for SIL3 applications (8 channels)

Field termination assembly module TSRO-08UNI is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It has eight relay-based safe output channels suitable for applications up to SIL3 without the use of fault exclusions. TSRO-08UNI complies with safety requirements for general use in safety requirement classes SIL3 as defined in IEC 61508.

The TSRO-08UNI has one (common) external power connection (screw terminals).

Each channel consists of:

- Three relays
- A fused NO field contact (2 AT, slow-acting)
- A status indication LED

The relays are capable of switching a wide variety of loads, including 115/230 V AC, which gives Safety Manager a 115/230 V AC output for SIL3 applications. The energized relay state is indicated by a LED on the module.

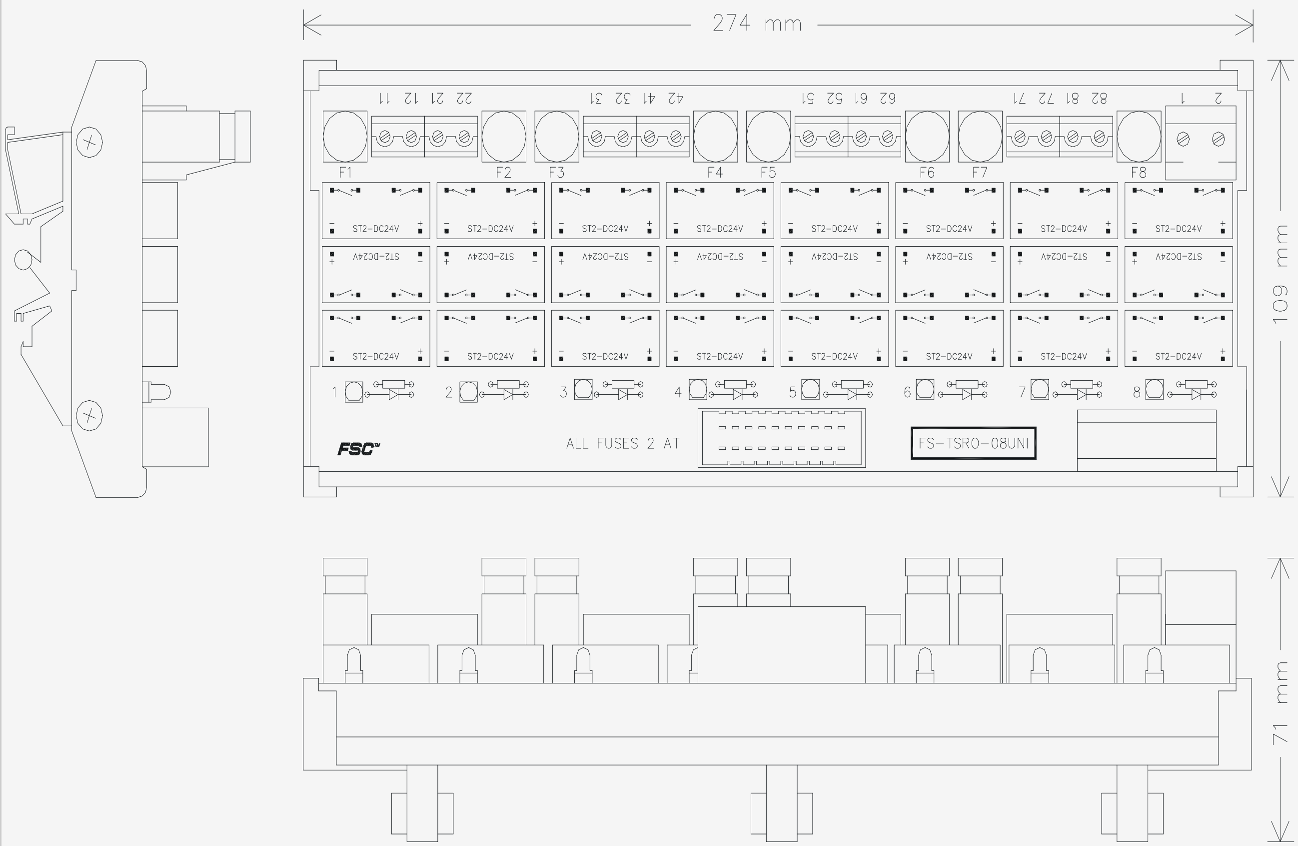


Figure 15-135: Mechanical layout

Eight channels can be connected to the TSRO-08UNI module via system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDO-0824 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

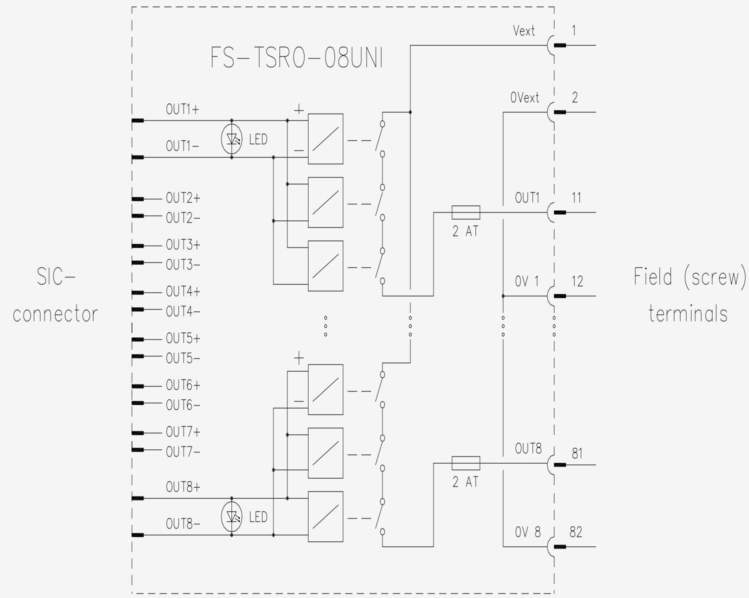


Figure 15-136: Schematic diagram

15.35.2 Relay life

The electrical life of the relays heavily depends on the contact rating the relay is exposed to. the below figure shows the expected relay life versus contact current.

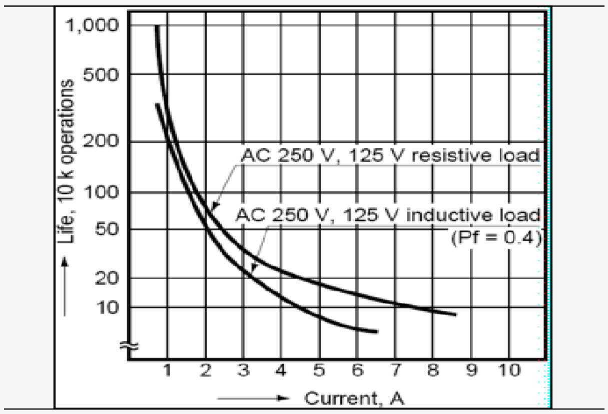


Figure 15-137: Life curve of the applied relays

15.35.3 Applications

For details on applications and connection options for TSRO-08UNI, see section SICC 0001/Lx.

15.35.4 Connections

The connections diagram of the TSRO-08UNI module:

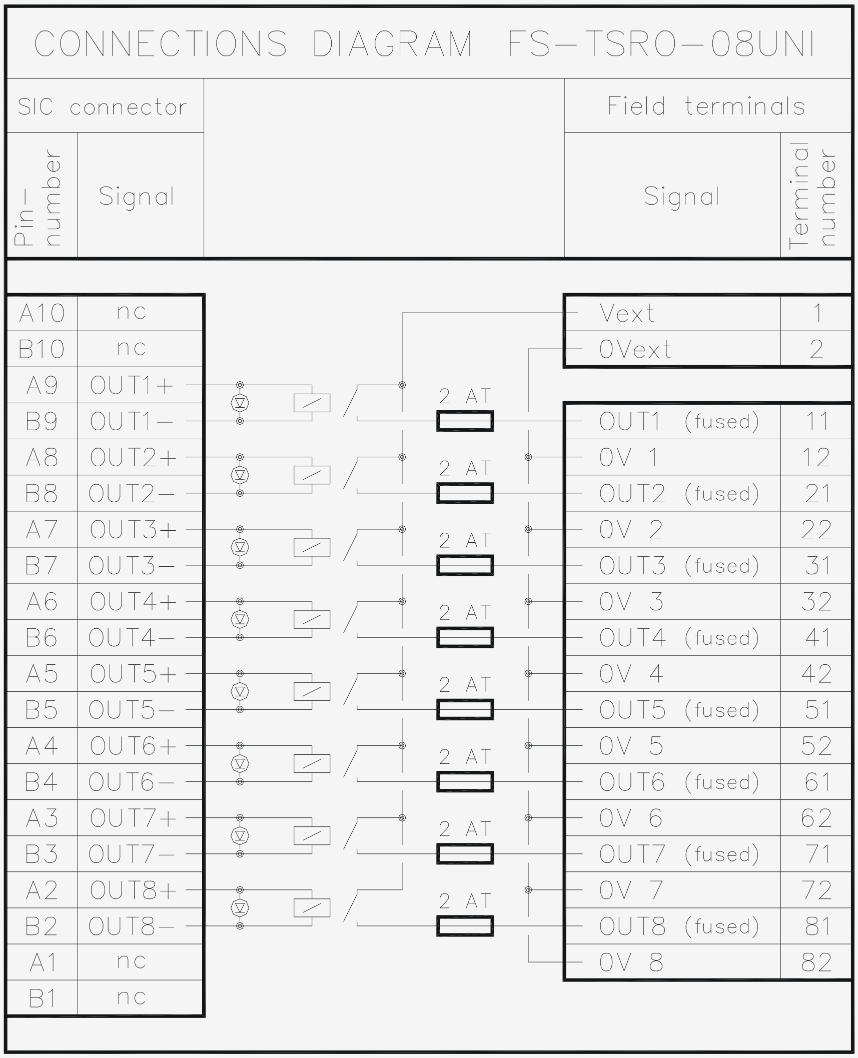


Figure 15-138: Connections diagram

15.35.5 Technical data

The TSRO-08UNI module has the following specifications:

General	Type numbers:	FS-TSRO-08UNI
		FC-TSRO-08UNI
	Approvals:	CE, UL, CSA; TUV
	Safety class:	up to SIL3
Input	Nominal input voltage:	24 V DC
	Max. input voltage:	36 V DC
	Relay pick-up voltage:	19.2 V DC
	Input current:	Typically 40 mA at 24 V DC
Output	Number of output channels:	8
	Max. output current:	2 A (fused)
	Min. output current:	1 mA at 5 V
	Max. output voltage:	250 V AC / 250 V DC
	Max. switched load:	500 VA / 150 W (see the above Figure)
Fuse	Fuse rating:	2 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Littelfuse
	Manufacturer PN:	0213002
	Derating curve:	Linear from 2 A at 25 dC to 1.9 A at 70 dC module ambient
Physical	Module dimensions:	274 × 109 × 71 mm (L × W × H)

		10.8 × 4.3 × 2.8 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	275 mm (10.8 in)
Termination	Channel screw terminals:	
	• Max. wire diameter:	2.5 mm⊃ 2; (AWG 14)
	• Strip length:	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
	External power screw terminals:	
	• Max. wire diameter:	16 mm⊃ 2; (AWG 8)
	• Strip length:	7 mm (0.28 in)
	• Tightening torque	1.2 Nm (0.88 ft.-lb.)
Environment	Ambient temperature:	–5°C—+60°C (23°F—140°F)
Isolation	Isolation:	
	• Coil to contact	3750 V AC
	• Contact to contact	1200 V AC
Relay contact	Max. switching load:	250 V AC, 2A 24 V DC, 2A 48 V DC, 1A 110 V DC, 500 mA
	Max. switching frequency:	20 Hz
	Expected life:	See the above figure.
	Contact material:	gold flash over silver alloy

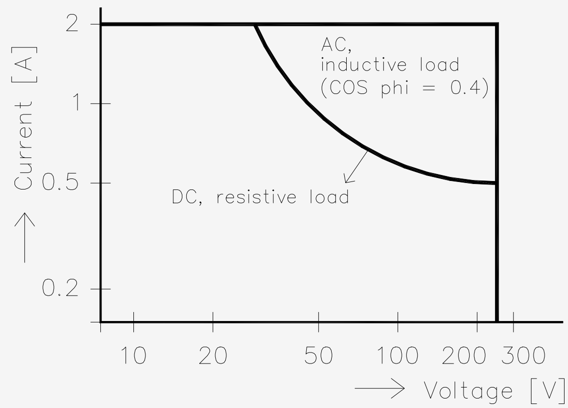


Figure 15-139: Maximum switched power

CHAPTER 16

SYSTEM INTERCONNECTION CABLES

16 System interconnection cables

This chapter describes the following items:

Item		See
General info about System Interconnection Cables (SIC)		General info about System Interconnection Cables (SIC)
SM chassis IO to FTA		
SICC-0001/Lx	System Interconnection Cable for chassis IO terminating on FTAs (SICC)	SICC 0001/Lx
SICP-0001/Lx	System Interconnection Cable for chassis IO terminating on crimp pins (SICP)	SICP-0001/Lx
CP backplane to external sources		
SICP-0002/L3	Digital input cable for Control Processor backplane	SICP-0002/L3
SM universal IO		
SICC-1002/Lx	System Interconnection Cable for universal IO terminating on FTAs (SICC)	SICC-1002/Lx
SICC-2001/Lx	System Interconnection Cable for universal IO terminating on FTAs (SICC)	SICC-2001/Lx
CA-HWC300-AIO-DIO-xM	System Interconnection Cable for universal IO terminating on IOTAs (SICC)	CA-HWC300-AIO-DIO-xM

16.1 General info about System Interconnection Cables (SIC)

System Interconnection Cables (SIC) are divided in these main groups:

- SIC to connect Safety Manager chassis IO to FTAs.

  See SIC for Safety Manager chassis IO.

- SIC to connect CP backplane to external contact.

  See SIC for CP backplane.

- SIC to connect Safety Manager universal IO to FTAs.

  See SIC for Safety Manager universal IO.

16.1.1 SIC for Safety Manager chassis IO

This type of System Interconnection Cable (SIC) transports field signals to Safety Manager chassis IO modules. Depending on whether or not an FTA is used in the configuration, you either use a SICC cable, or a SICP cable. Refer to Table 1 for input signals and Table 2 for output signals.

Table 1. possible ways to connect input field signals to input modules (read table from left to right to see possible interface/wiring options)

Input Signals				
Field signal		SICP cable		Input module
Field signal		SICP cable	Input converter module	Input module
Field signal	FTA	SICP cable		Input module
Field signal	FTA	SICP cable	Input converter module	Input module

Table 2. possible ways to connect output field signals to output modules (read table from left to right to see possible interface/wiring options)

Output Signals				
Output module		SICP cable		Field signal
Output module	Output converter module	SICP cable		Field signal
Output module		SICP cable	FTA	Field signal
Output module	Output converter module	SICP cable	FTA	Field signal

At the back plane side each of the above mentioned connection methods uses an IO-connector.

At the field signal side:

- SICC cables connect to an FTA with a special (20-pins) FTA-connector; the connection principle for this method is shown in Figure 1,

- SICP cables connect directly to field signals with 20 wires (crimp pins); the connection principle for this method is shown in Figure 2.

16.1.1.1 Connection principles

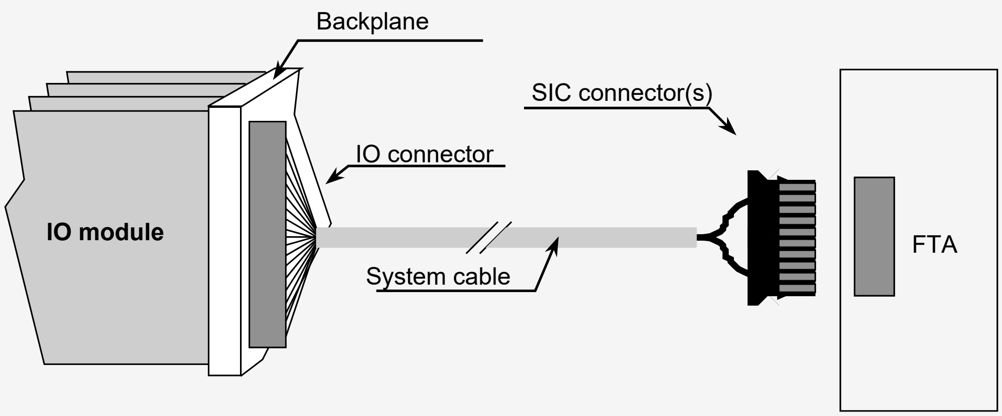


Figure 16-1: Principle of SICC connection method

The wiring method that uses SIC cables terminating on crimp pins (SICP) is shown in the below figure.

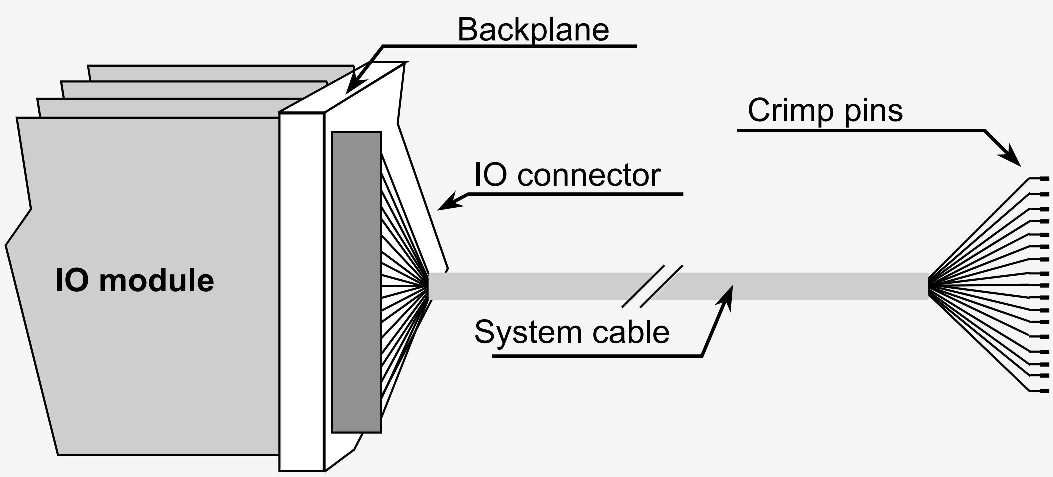


Figure 16-2: Principle of SICP connection method

Related topic(s):

SICC 0001/Lx

SICP-0001/Lx

16.1.2 SIC for CP backplane

This type of System Interconnection Cable (SIC) is used to connect one or more inputs on the CP backplane with external (potential free) contacts.

SICP-0002/L3

16.1.3 SIC for Safety Manager universal IO

This type of System Interconnection Cable (SIC) transports field signals to Safety Manager universersal IO modules.

Related topic(s):

SICC-1002/Lx

SICC-2001/Lx

CA-HWC300-AIO-DIO-xM

16.2 SICC-0001/Lx

16.2.1 System Interconnection Cable for chassis IO terminating on FTAs (SICC)

System interconnection cables - for Safety Manager chassis IO - with termination to Field Termination Assemblies (FTA) can connect Safety Manager IO modules to FTAs (via an IO backplane). Figure 1 illustrates this process. These cables are called SICC cables and have one IO connector on one end and one 20-pin FTA connector on the other end.

16.2.2 Connection principles

The wiring method for SIC cables terminating on FTAs (SICC) is shown in the below figure.

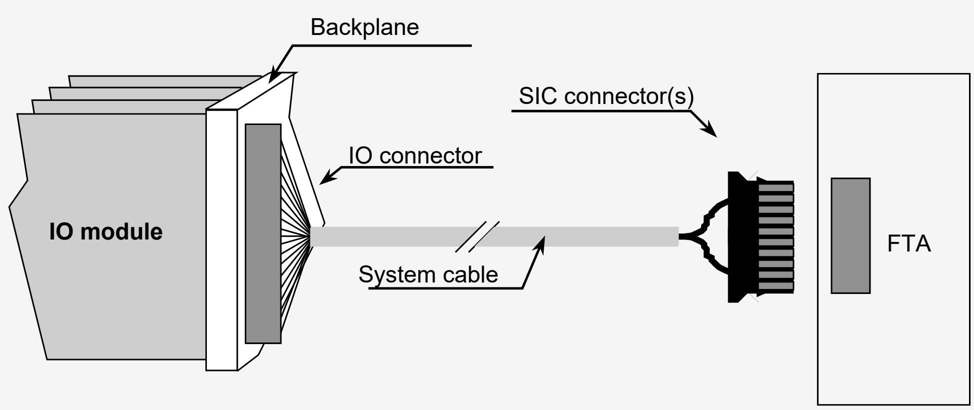


Figure 16-3: Principle of SICC connection method

16.2.3 Technical data

The SICC cable has the following specifications:

General	Type number:	FS-SICC-0001/Lx (where x = length)
	Cable type:	20 × AWG 22 (= 0.34 mm⊃ 2;) double shielded
	Outer diameter (nominal):	9.93 mm / 0.39 in
	Available lengths:	x = 3.25 m, 5 m, 6 m, 8 m, 10 m, 15 m, 20 m, 25 m and 30 m.

16.2.4 SICC Cable connections

The tables below describe possible connections of SIC cables to input and output modules.

Table 1. Connections for standard SICC-0001/Lx cable to input modules

Signal				Connector pin	
SDI-1624 SDI-1648	SAI-0410	SAI-1620m	SDIL-1608	IO module	FTA
		Shield		41	–
0 V DC	IN1-	0 Volt	0 Volt	40	A10
0 V DC	IN1+	0 Volt	0 Volt	37	B10
IN1		IN1	IN1	36	A9
IN2		IN2	IN2	33	B9
IN3		IN3	IN3	32	A8
IN4		IN4	IN4	29	B8
IN5		IN5	IN5	28	A7
IN6		IN6	IN6	25	B7
IN7	IN2+	IN7	IN7	24	A6
IN8	IN2-	IN8	IN8	21	B6
IN9	IN3-	IN9	IN9	20	A5
IN10	IN3+	IN10	IN10	17	B5
IN11		IN11	IN11	16	A4
IN12		IN12	IN12	13	B4
IN13		IN13	IN13	12	A3
IN14		IN14	IN14	9	B3
IN15		IN15	IN15	8	A2

Signal				Connector pin	
SDI-1624 SDI-1648	SAI-0410	SAI-1620m	SDIL-1608	IO module	FTA
IN16		IN16	IN16	5	B2
+ Vext	IN4+	0 Volt	+ Vext (8 V DC)	4	A1
+ Vext	IN4-	+ Vext/8	Earth	1	B1

Table 2. Connections for standard SICC-0001/Lx cable to output modules

Signal									Connector pin	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110 SDO-0448	SDO-0424	SDOL-0424	SDOL-0448	IO module	FTA
–	Shield	–	–	–	–	–	–	–	41	–
(0 V DC)	–	–	CH1	c	–	–	–	–	40	A10
(0 V DC)	–	–	CH1	no	–	–	–	–	37	B10
OUT1+	–	OUT1	CH2	c	OUT1	(0 V DC)	OUT1+	(0 V DC)	36	A9
OUT1–	–	OUT2	CH2	no	OUT2	(0 V DC)	Out1–	(0 V DC)	33	B9
OUT2+	0V (1)	OUT3	CH3	c	OUT3	OUT1+	OUT1+	OUT1-	32	A8
OUT 2–	–	OUT4	CH3	no	OUT4	OUT1–	OUT1–	OUT1-	29	B8
OUT3+	mA1	OUT5	CH4	c	OUT5	(0 V DC)	OUT2+	(0 V DC)	28	A7
OUT3–	Loop1	OUT6	CH4	no	OUT6	(0 V DC)	OUT2–	(0 V DC)	25	B7
OUT4+	–	OUT7	CH5	c	OUT7	OUT2+	OUT2+	OUT2+	24	A6
OUT4–	–	OUT8	CH5	no	OUT8	OUT2–	OUT2–	OUT2-	2 1	B6
OUT5+	0V (2)	OUT9	CH6	c	OUT9	(0 V DC)	OUT3+	(0 V DC)	20	A5
OUT5–	–	OUT10	CH6	no	OUT10	(0 V	OUT3–	(0 V	17	B5

Signal									Connector pin	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110 SDO-0448	SDO-0424	SDOL-0424	SDOL-0448	IO module	FTA
						DC)		DC)		
OUT6+	mA2	OUT11	CH7	no	OUT11	OUT3+	OUT3+	OUT3+	16	A4
OUT6–	Loop2	OUT12	CH7	no	OUT12	OUT3–	OUT3–	OUT3-	13	B4
OUT7+	–	(0 V DC)	CH8	c	OUT13	(0 V DC)	OUT4+	(0 V DC)	12	A3
OUT7–	–	(0 V DC)	CH8	no	OUT14	(0 V DC)	OUT4–	(0 V DC)	9	B3
OUT8+	–	(0 V DC)	CH9	c	OUT15	OUT4+	OUT4+	OUT4+	8	A2
OUT8–	–	(0 V DC)	CH9	no	OUT16	OUT4–	OUT4–	OUT4-	5	B2
(0 V DC)	–	(0 V DC)	CH10	c	(0 V DC)	(0 V DC)	(0 V DC)	(0 V DC)	4	A1
(0 V DC)	–	(0 V DC)	CH10	no	(0 V DC)	(0 V DC)	(0 V DC)	(0 V DC)	1	B1

16.3 SICP-0001/Lx

16.3.1 System Interconnection Cable for chassis IO terminating on crimp pins (SICP)

System interconnection cables - for Safety Manager chassis IO - terminating on crimp pins are suitable for the connection to screw terminals (see Figure 1). These cables are called SICP cables and are fitted with one IO connector on one end and crimp pins on the other.

16.3.2 Connection principles

The wiring method that uses SIC cables terminating on crimp pins (SICP) is shown in the below figure.

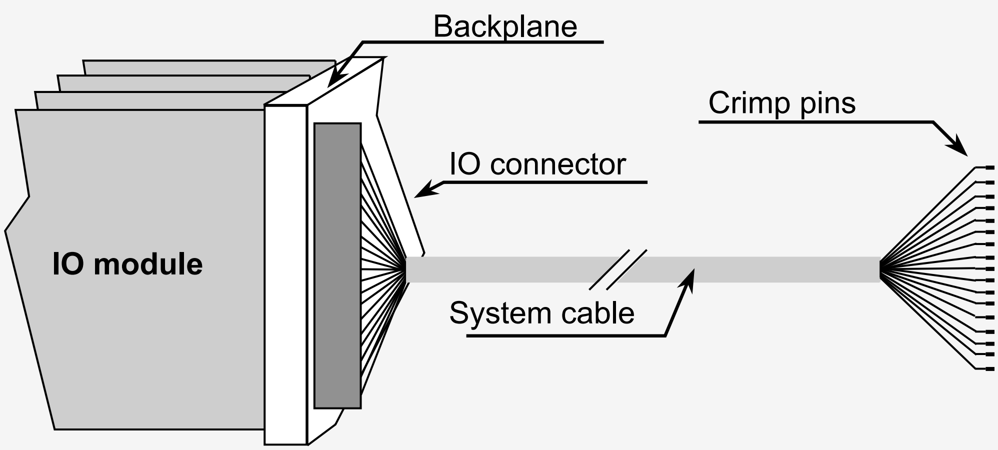


Figure 16-4: Principle of SICP connection method

16.3.3 Technical data

The SICP cable has the following specifications:

General	Type number:	FS-SICP-0001/Lx (where x = length)
	Cable type:	20 × AWG 22 (= 0.34 mm⊃ 2;) double shielded
	Outer diameter (nominal):	9.93 mm / 0.39 in
	Available lengths:	x = 3.25 m, 5 m, 6 m, 8 m, 10 m, 15 m, 20 m, 25 m and 30 m.

16.3.4 SICP Cable connections

The tables below describe possible connections of SIC cables to input and output modules.

Table 1. connections for standard SICP-0001/Lx cable to input modules

Signal				Pins	
SDI-1624	SAI-0410	SAI-1620m	SDIL-1608	IO module	Color code
SDI-1648				connector pin	crimp pin
		Shield		41	Yellow / Green
0 V DC	IN1–	0 Volt	0 Volt	40	White
0 V DC	IN1+	0 Volt	0 Volt	37	Brown
IN1		IN1	IN1	36	Green
IN2		IN2	IN2	33	Yellow
IN3		IN3	IN3	32	Gray
IN4		IN4	IN4	29	Pink
IN5		IN5	IN5	28	Blue
IN6		IN6	IN6	25	Red
IN7	IN2+	IN7	IN7	24	Black
IN8	IN2–	IN8	IN8	21	Violet
IN9	IN3–	IN9	IN9	20	Gray / Pink
IN10	IN3+	IN10	IN10	17	Red / Blue
IN11		IN11	IN11	16	White / Green
IN12		IN12	IN12	13	Brown / Green
IN13		IN13	IN13	12	White / Yellow
IN14		IN14	IN14	9	Yellow / Brown
IN15		IN15	IN15	8	White / Gray

Signal				Pins	
SDI-1624	SAI-0410	SAI-1620m	SDIL-1608	IO module	Color code
SDI-1648				connector pin	crimp pin
IN16		IN16	IN16	5	Gray / Brown
+ Vext	IN4+	0 Volt	+Vext (8 V DC)	4	White / Pink
+ Vext	IN4–	+ Vext/8	Earth	1	Pink / Brown

Table 2. connections for standard SICP-0001/Lx cable to output modules

Signal								Pins	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110 SDO-0448	SDO-0424	SDOL-0424 SDOL-0448	IO module connector pin	Color code crimp pin
					Shield		Shield	41	Yellow / Green
			OUT1 c					40	White
			OUT1 no					37	Brown
OUT1+		OUT1	OUT2 c	OUT1		OUT1+		36	Green
OUT1-		OUT2	OUT2 no	OUT2		OUT1-		33	Yellow
OUT2+	0V (1)	OUT3	OUT3 c	OUT3	OUT1+	OUT1+	OUT1+	32	Gray
OUT2–		OUT4	OUT3 no	OUT4	OUT1–	OUT1–	OUT1–	29	Pink
OUT3+	mA1	OUT5	OUT4 c	OUT5		OUT2+		28	Blue
OUT3-	Loop 1	OUT6	OUT4 no	OUT6		OUT2-		25	Red
OUT4+		OUT7	OUT5 c	OUT7	OUT2+	OUT2+	OUT2+	24	Black
OUT4–		OUT8	OUT5 no	OUT8	OUT2–	OUT2-	OUT2–	21	Violet
OUT5+	0V (2)	OUT9	OUT6 c	OUT9		OUT3+		20	Gray /

Signal								Pins	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110 SDO-0448	SDO-0424	SDOL-0424 SDOL-0448	IO module connector pin	Color code crimp pin
									Pink
OUT5-		OUT10	OUT6 no	OUT10		OUT3–		17	Red / Blue
OUT6+	mA2	OUT11	OUT7 c	OUT11	OUT3+	OUT3+	OUT3+	16	White / Green
OUT6–	Loop 2	OUT12	OUT7 no	OUT12	OUT3–	OUT3–	OUT3–	13	Brown / Green
OUT7+		0 V DC	OUT8 c	OUT13		OUT4+		12	White / Yellow
OUT7-		0 V DC	OUT8 no	OUT14		OUT4–		9	Yellow / Brown
OUT8+		0 V DC	OUT9 c	OUT15	OUT4+	OUT4+	OUT4+	8	White / Gray
OUT8–		0 V DC	OUT9 no	OUT16	OUT4–	OUT4–	OUT4–	5	Gray / Brown
		0 V DC	OUT10 c	0 V DC				4	White / Pink
		0 V DC	OUT10 no	0 V DC				1	Pink / Brown

1. c = common

16.3 SICP-0001/Lx

Signal								Pins	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110 SDO-0448	SDO-0424	SDOL-0424 SDOL-0448	IO module connector pin	Color code crimp pin
2. no = normally open									

16.4 SICP-0002/L3

16.4.1 Digital input cable for Control Processor backplane

The SICP-0002/L3 digital input cable for the Control Processor backplane is used to connect the SD and INx input(s) on the CP backplane with external (potential free) contacts.

Safety Manager

The cables can be placed on the connectors SD, IN1, IN2 resp. IN3, as indicated in the below table.

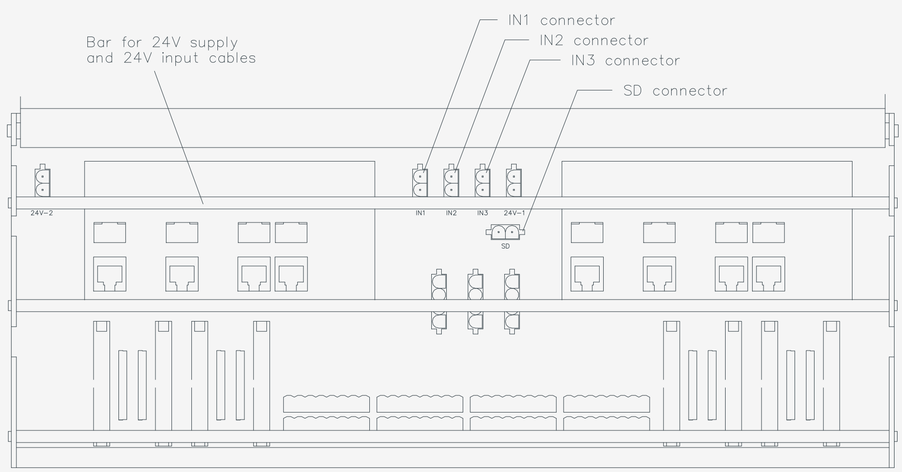


Figure 16-5: Safety Manager - Position of the SD, IN1, IN2 and IN3 connectors on the CP-back-plane.

Safety Manager A.R.T.

The cables can be placed on the connectors SD and IN1 as indicated in the below figure.

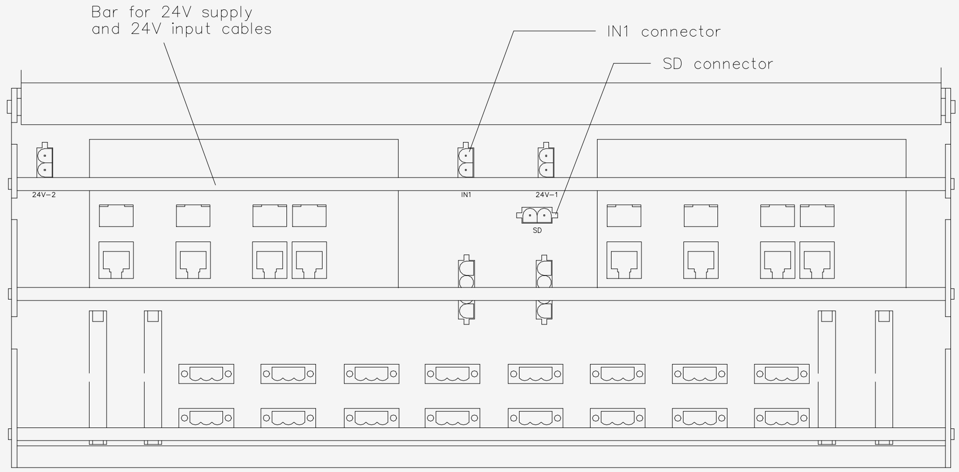
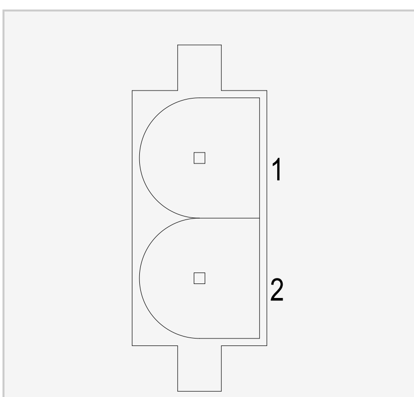


Figure 16-6: Safety Manager A.R.T. - Position of the SD and IN1 connectors on the CP-backplane.

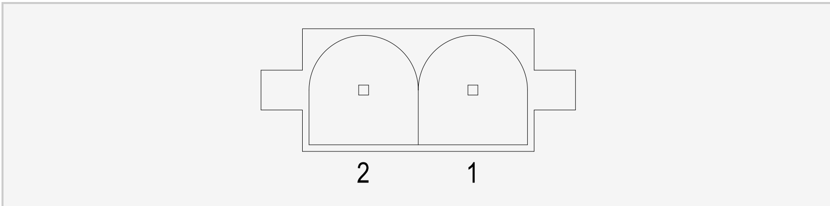
16.4.2 Pin allocation

The back view and pin allocation of the IN1, IN2 and IN3 connectors are:



	IN1	IN2	IN3
1	+24V_red	+24V_red	+24V_red
2	input1	input2	input3

The back view and pin allocation of the SD connector is:



	SD
1	+24V_sd
2	input

16.4.3 Layout

The below figure shows the layout of the SICP-0002/L3 input cable.

The red wire connects to +24V. The black wire connects to the input.

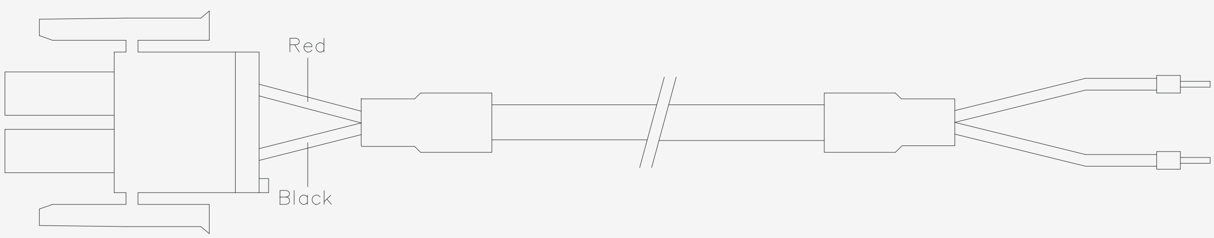


Figure 16-7: Layout of the SICP-0002/L3 input cable

16.4.4 Technical data

General	Type number:	FS-SICP-0002/L3
	Approvals:	CE, UL, CSA, FM
Cable	Type:	Alphawire 1899AWG/2C (2 × 1.3 mm^2)
	Length:	3 m
Connectors	CP side:	2 pole mate-n-lock
	Field side:	(crimp-on) pin

16.5 SICC-1002/Lx

16.5.1 System Interconnection Cable for universal IO terminating on FTAs (SICC)

System interconnection cables - for Universal Safety IO - with termination to Field Termination Assemblies (FTA) connect Universal Safety IO modules to FTAs (via an IOTA).

The below figure shows the SICC-1002/Lx[1].

1. The ‘x’ in the model number represents the cable lenght in meters.

The 16-pole grommet connects to channel 1 thru 16 (high row of CN1 position) or channel 17 thru 32 (high row of CN2 position) of the IOTA.

The two COMMON wires are connected to:

- CN3 of the IOTA (pins 1 and 2 for channel 1 thru 16 or pins 3 and 4 for channel 17 thru 32), if the field devices supply the channel energy,
- two pins of the low row connector of CN1 for channel 1 thru 16 or to the low-row of connector 2 for channel 17 thru 32, if the IOTA needs to supply the channel energy.

The 20-pole connector is placed on the FTA.

The grommet has a (8 inch long) wire to ground the cable shield.

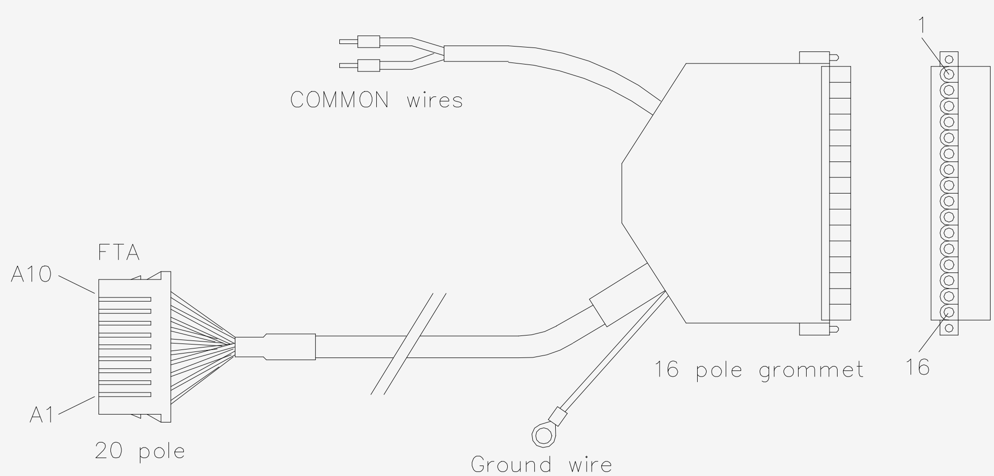


Figure 16-8: SICC-1002/Lx - Mechanical layout

16.5.2 Connections

The below figure shows the connection diagram of the SICC-1002/Lx.

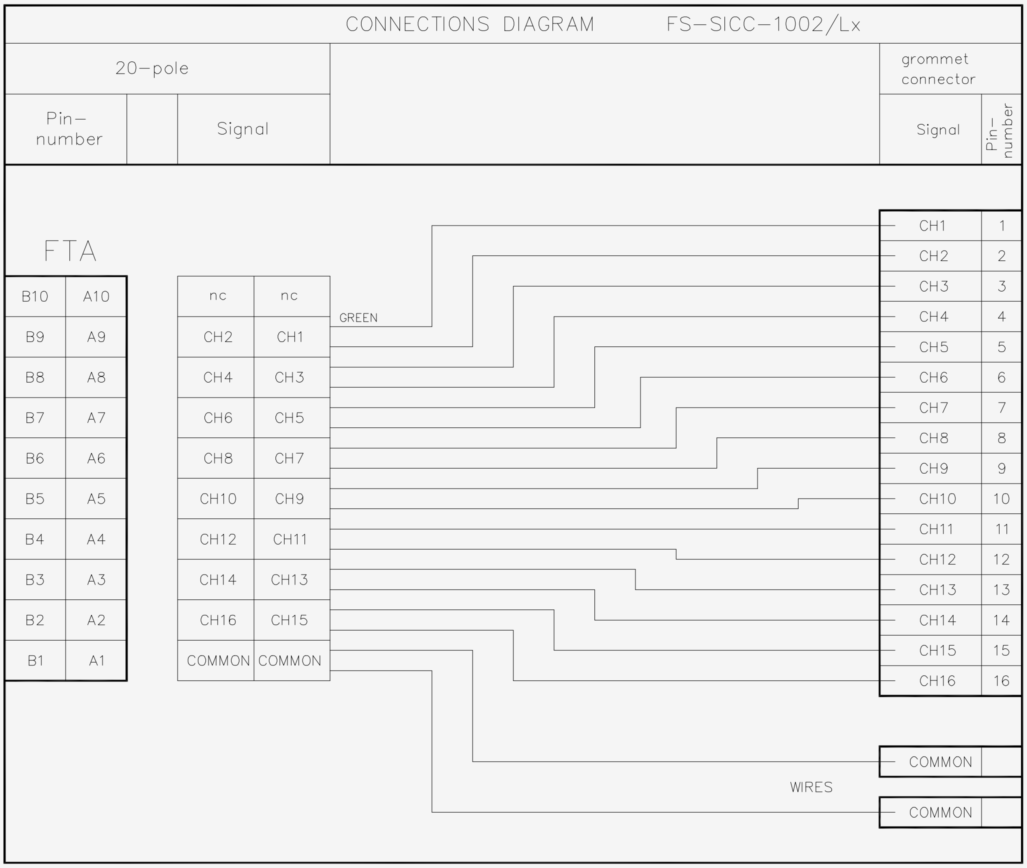


Figure 16-9: Connection diagram

16.5.3 Technical data

General	Type number: • available length (m):	FS-SICC-1002/Lx[1] 3, 5, 6 and 10
	Approvals:	UL; CSA pending
Cable	Type:	20 x AWG22 shielded cable AWG style 2464
	COMMON wires:	AWG20
Connectors	20-pole:	2x10 pins Dynamic Housing no. 178289-8
	• make:	TYCO
	Grommet:	SP-BLZ5.08 16P CLAMSHELL
	• make:	Weidmuller
	COMMON wires:	crimp-on cable tube
	Ground wire	Ring terminal (5 mm hole)

Note:
1. Where ‘x’ = length.

16.6 SICC-2001/Lx

16.6.1 System Interconnection Cable for universal IO terminating on IOTAs (SICC)

System interconnection cables - for Universal Safety IO - with termination to Field Termination Assemblies (FTA) connect Universal Safety IO modules to FTAs (via an IOTA).

The below figure shows the SICC-2001/Lx[1].

The 32-pole grommet connects to channel 1 thru 16 (CN1 position) or channel 17 thru 32 (CN2 position) of the IOTA. The 20-pole connectors are placed on the FTAs. The grommet has a (8 inch long) wire to ground the cable shields.

1. The ‘x’ in the model number represents the cable lenght in meters.

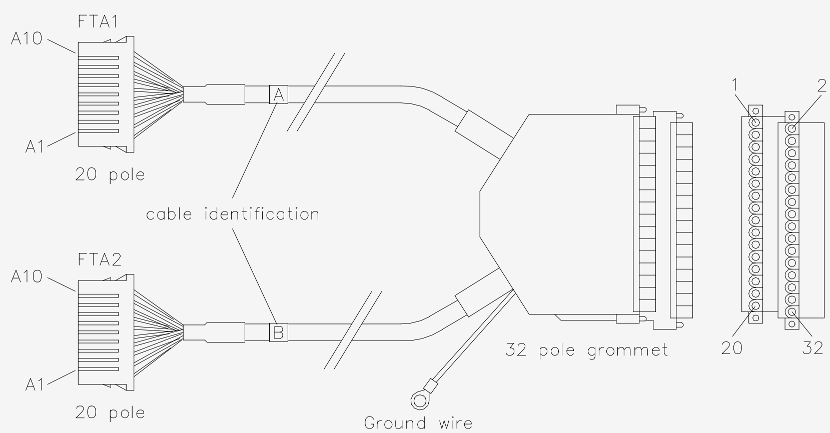


Figure 16-10: SICC-2001/Lx - Mechanical layout

16.6.2 Connections

The below figure shows the connection diagram of the SICC-2001/Lx.

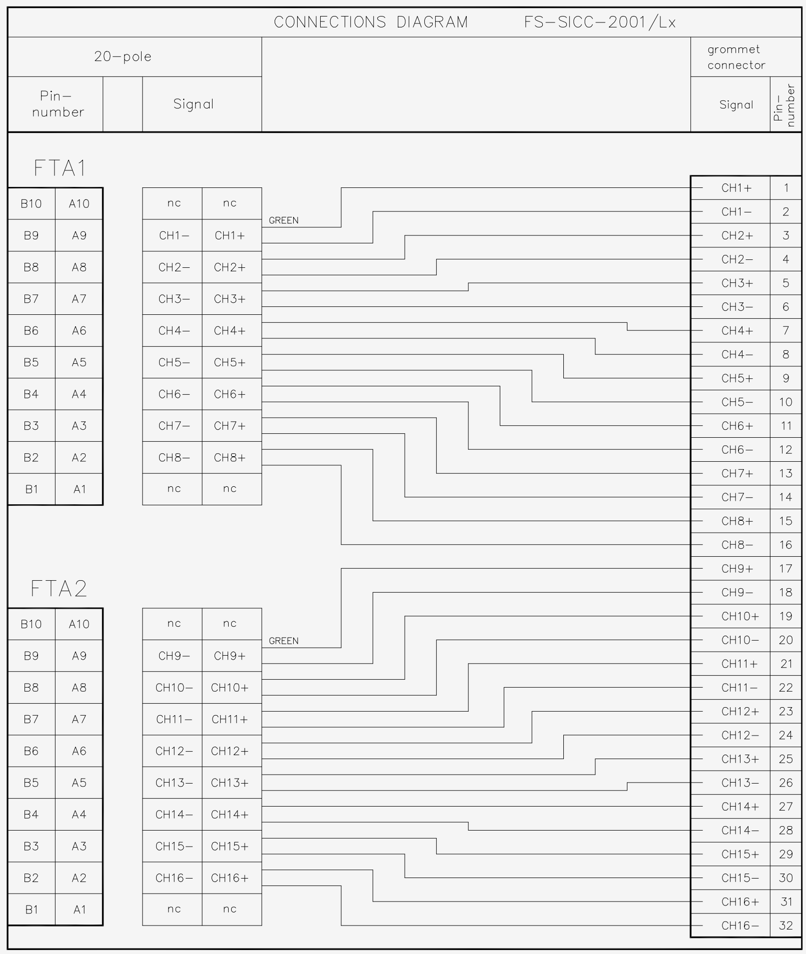


Figure 16-11: Connection diagram

16.6.3 Technical data

General	Type number:	FS-SICC-2001/Lx [1]
	• available length (m):	3, 5, 6 and 10
	Approvals:	UL; CSA pending
Cable	Type:	20 x AWG22 shielded cable AWG style 2464
Connectors	20-pole:	2x10 pins Dynamic Housing no. 178289-8
	• make:	TYCO
	Grommet:	SP-BLZ5.08 32P CLAMSHELL
	• make:	Weidmuller
	Ground wire	Ring terminal (5 mm hole)

Note:

1. Where ‘x’ = length.

16.7 SICC-1011Lx

16.7.1 System Interconnection Cable for universal IO terminating on IOTAs (SICC)

System interconnection cables - for Safety Manager Universal Safety IO - with termination to Field Termination Assemblies (FTA) connect Safety Manager Universal Safety IO modules to FTAs (via an IOTA).

The below figure shows the SICC-1011. The 32-pole grommet connects to channel 1 thru 16 (CN1 position) or channel 17 thru 32 (CN2 position) of the IOTA.

The 37-pin female Sub-D connector is placed on the field termination board. The grommet has a (8 inch long) wire to ground the cable shield.

1. The 'x' in the model number represents the cable length in meters.

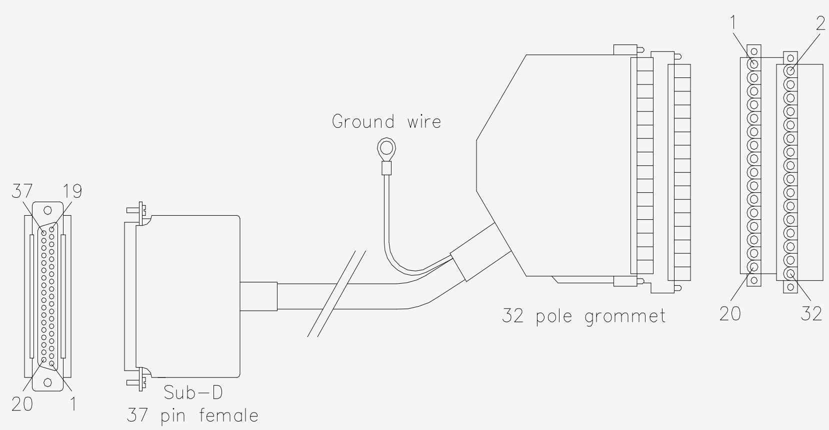


Figure 16-12: SICC-1011/Lx - Mechanical layout

16.7.2 Connections

The below figure shows the connection diagram of the SICC-1011.

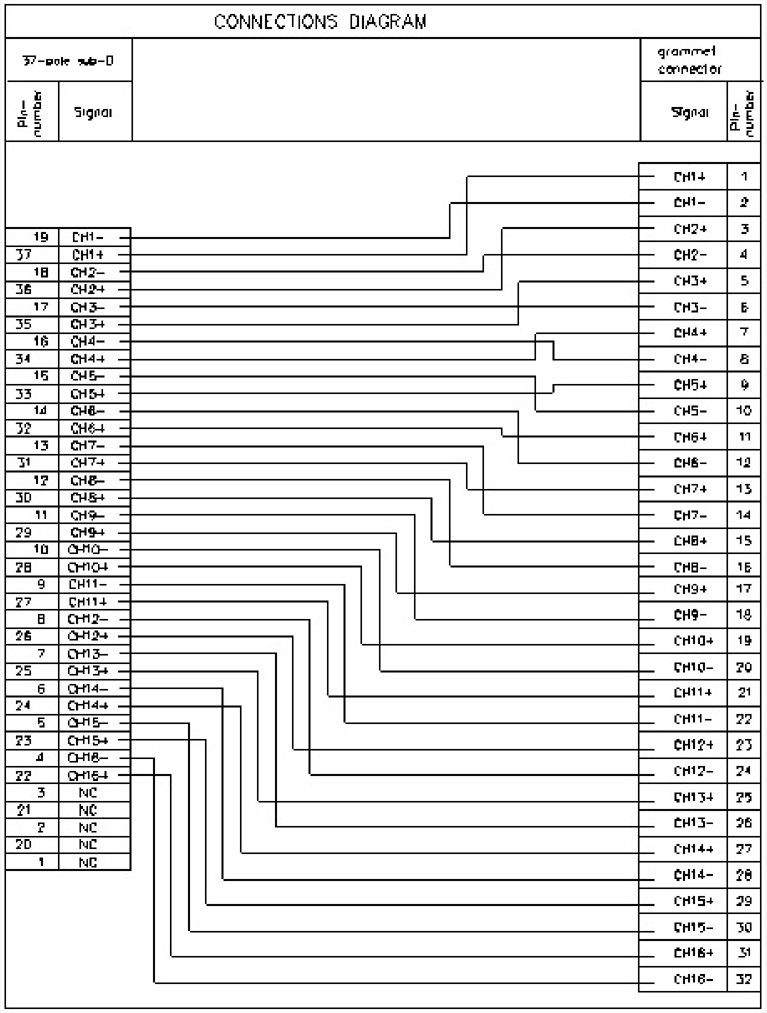


Figure 16-13: Connections diagram

16.7.3 Technical Data

System interconnection cables terminating on IOTAs have the following specifications:

General	Type numbers: • Available lengths (m)	FS-SICC-1011/Lx (where × = length) 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, and 30
	Approvals:	UL, CSA pending
Cable	Construction type:	22 AWG 7/0096 tinned copper 18 individually twisted pairs overall foil
	Shielding:	aluminum foil 100% coverage 24 AWG 7/32 T.C.DW.
Connectors	Sub-D:	37-pin Sub-D socket female
	Grommet • Make	SP-BLZ5.08 32P CLAMSHELL Weidmuller
	Ground wire:	Ring terminal (5 mm hole)

16.8 CA-HWC300-AIO-DIO-xM

16.8.1 System Interconnection Cable for universal IO terminating on IOTAs (SICC)

System interconnection cables - for Universal Safety IO - with termination to Field Termination Assemblies (FTA) connect Universal Safety IO modules to FTAs (via an IOTA).

The below figure shows the CA-HWC300-AIO-DIO-xM[1]. The 32-pole grommet connects to channel 1 thru 16 (CN1 position) or channel 17 thru 32 (CN2 position) of the IOTA.

The 37-pin female Sub-D connector is placed on the field termination board. The grommet has a (8 inch long) wire to ground the cable shield.

1. The ‘x’ in the model number represents the cable lenght in meters.

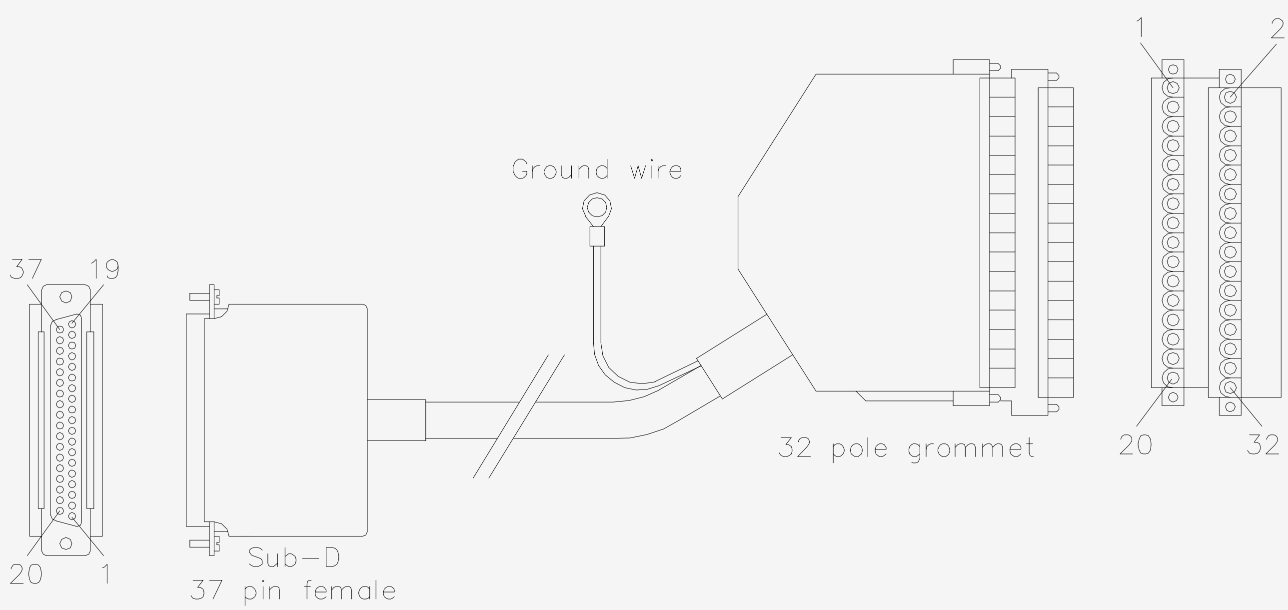


Figure 16-14: CA-HWC300-AIO-DIO-xM - Mechanical layout

16.8.2 Connections

The below figure shows the connection diagram of the CA-HWC300-AIO-DIO-xM.

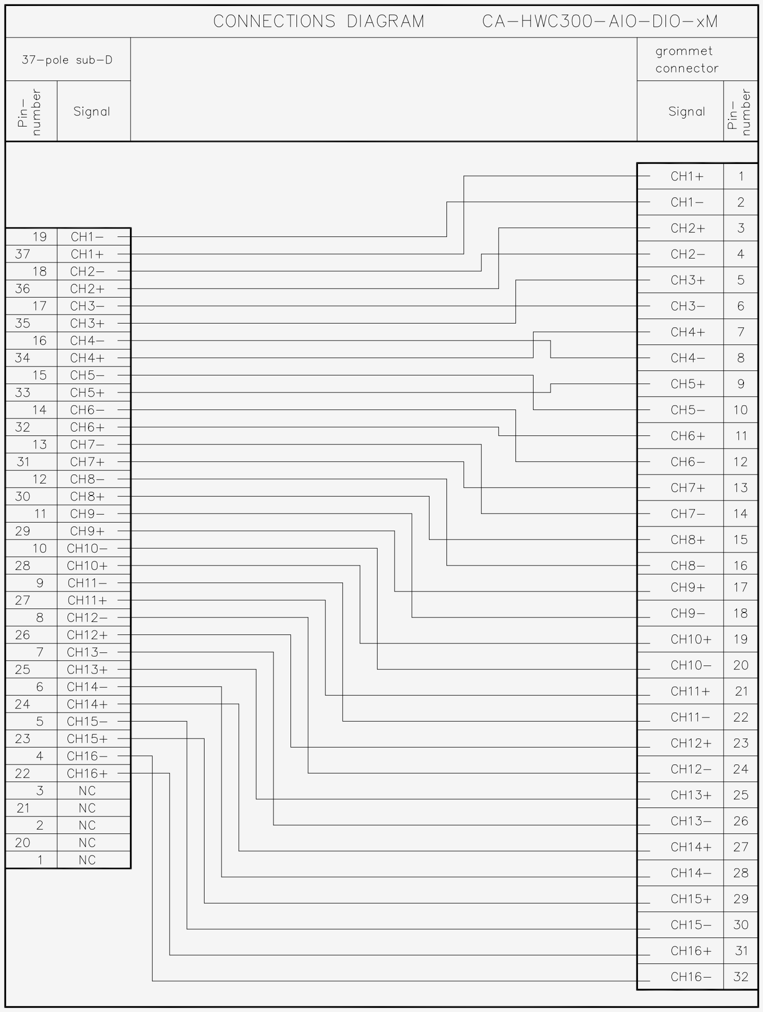


Figure 16-15: Connections diagram

16.8.3 Technical data

System interconnection cables terminating on IOTAs have the following specifications:

General	Type numbers: • available lenghts (m)	CA-HWC300-AIO-DIO-xM (where × = length) 1, 2, 3, 4, 5, 7.5, 10, 12.5, 15, 20, 25, 30
	Approvals:	UL, CSA pending
Cable	Construction type:	22 AWG 7/0096 tinned copper 18 individually twisted pairs overall foil
	Shielding:	aluminium/poly foil 100% coverage 24 AWG 7/32 T.C.DW.
Connectors	Sub-D:	37-pin Sub-D socket female
	Grommet • make	SP-BLZ5.08 32P CLAMSHELL Weidmuller
	Ground wire:	Ring terminal (5 mm hole)

CHAPTER 17

COMMUNICATION CABLES

17 Communication cables

This chapter describes the following communication-related items:

Item	See
Internal communication cables	
CCI-UNI-0x	CCI-UNI-0x
CCI-HSE-0x	CCI-HSE-0x
External communication cables	
CCE-232-01/L10	CCE-232- 01/L10
CCE-232-02/L10	CCE-232-02/L10
CCE-485-01/Lx	CCE-485-01/Lx
CCE-485-02/Lx	CCE-485-02/Lx
CCE-485-04/Lx	CCE-485-04/Lx
CCE-485-05/Lx	CCE-485-05/Lx
CCE-485-FO-01/Lx	CCE-485-FO-01/Lx
CCE-485-FO-02/Lx	CCE-485-FO-02/Lx
CCE-485-FO-04/Lx	CCE-485-FO-04/Lx
TAPS / switches / terminators	
EOL-485-01	EOL-485-01

17.1 General info on communication cables

17.1.1 Safety Manager communication

A Safety Manager communication architecture is created with a specific set of assembly guidelines and materials.

The options are:

- High-speed ethernet (10/100 Mbaud, twisted pair, full duplex) using STP-wiring and RJ45 connectors to an ethernet switch (UCOM-HSE) and offering four RJ45 connector positions as field connection.
- RS485/422 communication (full duplex or half duplex) using a SIC-cable to the FTA (DCOM 232/485 or DCOM 485) and offering two 9-pole male connectors as field connections.
- RS232 communication (full duplex, no handshake) using a SIC-cable to the FTA (DCOM-232/485) and offering a 9-pole female connector as field connection.

17.1.2 Internal and external cabling

Internal cables connect the Control Processor(s) to the high-speed Ethernet FTA (“UCOM-HSE”) or to the communication FTA (DCOM-232/485) or to the communication FTA (DCOM-485).

External cables connect external devices such as stations, other Safety Managers, network servers, other control systems, and so on to communication FTAs (DCOM 232/485 or DCOM 485).

The below table shows all available cables, the items they connect and the type of connection they are used for.

Table 1. Internal and external communication cables

Cable	Connects		Connection type
Internal			
CCI-UNI-02 CCI-UNI-04	USI-0002	to DCOM 232/485 or DCOM 485	Point-to-point duplex or (RS485) full-duplex
CCI-HSE-01 and CCI-HSE-02	USI-0002	to SDW-550 EC MTL 24571	High Speed Ethernet
External			
CCE-232-01/Lx	DCOM-232/485	to DCOM-232/485	Point-to-point
CCE-232-02/Lx	Development system	to DCOM-232/485	Point-to-point
CCE-485-01/Lx	DCOM-232/485	to DCOM 232/485 or DCOM 485	Between slaves
CCE-485-02/Lx	PC RS485 BB113	to DCOM 232/485 or DCOM 485	Point-to-point duplex or master-slave duplex
CCE-485-04/Lx	PC RS485 BB114	to DCOM 232/485 or DCOM 485	Point-to-point duplex or master-slave duplex
CCE-485-05/Lx	PC RS485 QT	to DCOM 232/485 or DCOM 485	Point-to-point duplex or master-slave duplex

17.1.3 Internal communication wiring examples

The DCOM-232/485 module (see DCOM-232/485) is connected to the Safety Manager Controller chassis.

The below figure shows the non-redundant connection to either Control Processor 1 or Control Processor 2.

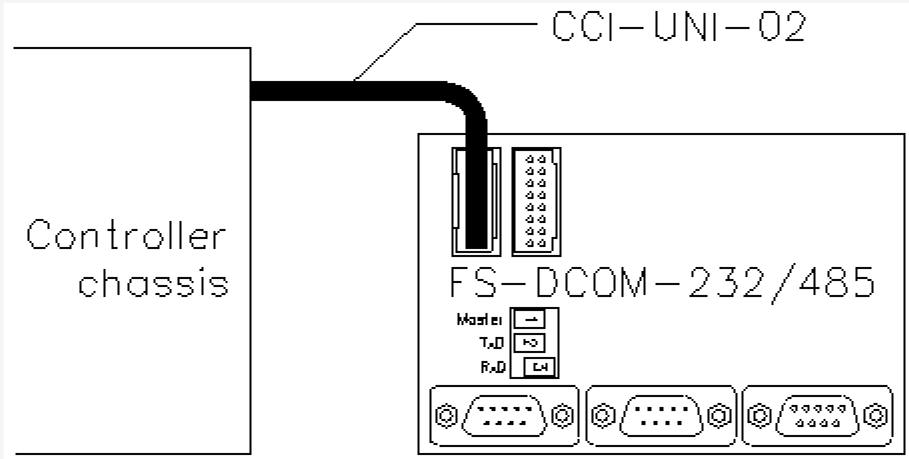


Figure 17-1: Non-redundant internal communication wiring to a DCOM-232/485 module

The below figure shows the redundant connection to Control Processor 1 and Control Processor 2.

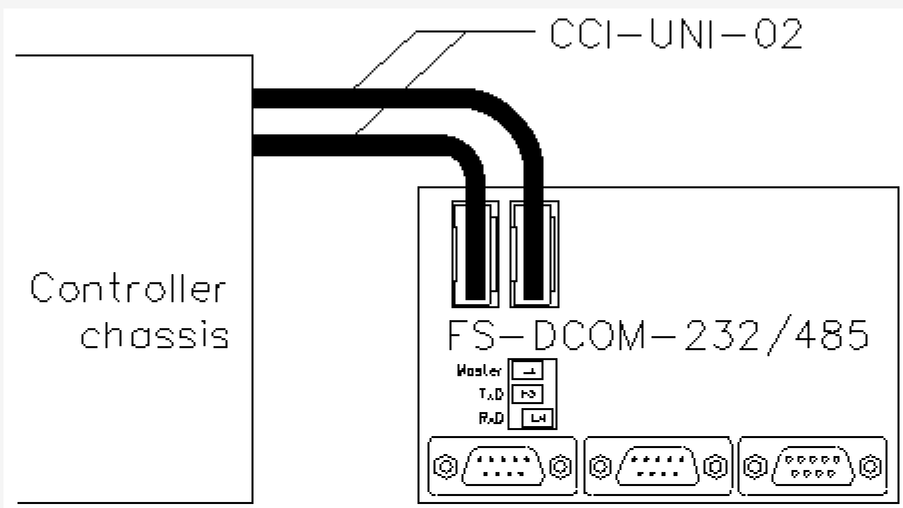


Figure 17-2: Redundant internal communication wiring to a DCOM-232/485 module

A connection is made by connecting one or two CCI-UNI-02 cables (see CCI-UNI-0x). The other ends are connected to 10-pin male connectors on the Safety Manager Controller backplane (see Table 1).

- The RS232 or RS485 connections of a non-redundant Control Processor require one internal cable (see Figure 1).

- The RS232 connections of a redundant Control Processor require redundant internal cabling (see Figure 2).
- The RS485 connections of a redundant Control Processor can consist of redundant internal cabling (which only requires one DCOM 232/485 or DCOM 485module) or redundant external cabling (which requires two DCOM 232/485 or DCOM 485 modules).

17.1.4 Full duplex RS485 wiring examples

17.1.4.1 RS485 connection between Safety Station and Safety Manager(s)

The below figure shows a wiring example for a full duplex RS485 link between a Safety Station (PC) and one or more (DCOM-232/485 modules of) Safety Manager(s).

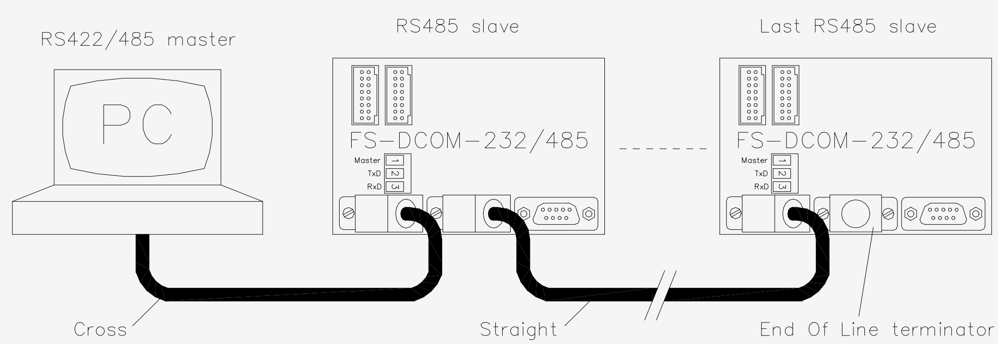


Figure 17-3: RS485 link between a PC master and multiple Safety Manager slaves

In the above figure:

- The used cable marked 'cross' is the CCE-485-02/Lx (see CCE-485-02/Lx).
- All other cables (between slaves) are the CCE-485-01/Lx (see CCE-485-01/Lx).
- The end of line terminator on the last DCOM-232/485 is the EOL-485-01 (see EOL-485-01).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cables or EOL) may be interchanged.
- All three dip switches on all DCOM-232/485 modules must be *Off*.

17.1.4.2 RS485 connection between master and slave Safety Managers

The below figure shows a wiring example for a full duplex RS485 link between (the DCOM-232/485 modules of) an Safety Manager master and one or more (DCOM-232/485 modules of) slave Safety

Manager(s).

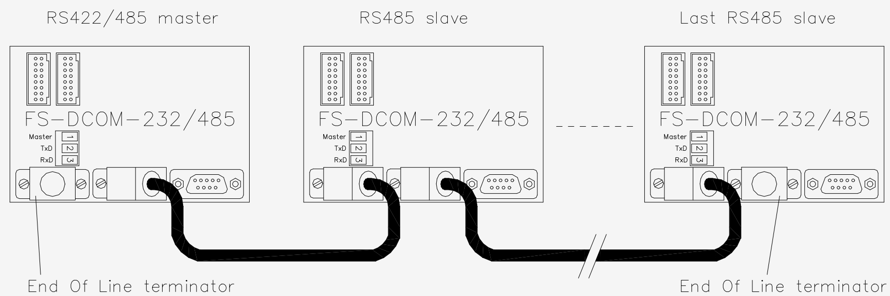


Figure 17-4: RS485 link between a master Safety Manager and multiple Safety Manager slaves

In the above figure:

- The used cables are the CCE-485-01/Lx (see CCE-485-01/Lx).
- The end of line terminators on the DCOM-232/485 modules of the master and the last slave are the EOL-485-01 (see EOL-485-01).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cables or EOL) may be interchanged.
- All dip switches on the master DCOM-232/485 must be *On*.
- All dip switches on the slave DCOM-232/485 module(s) must be *Off*.

17.1.5 RS422 wiring examples

17.1.5.1 RS422 connection between Safety Station and Safety Manager

The below figure shows a wiring example for an RS422 link between a Safety Station (PC) and the DCOM-232/485 module of Safety Manager.

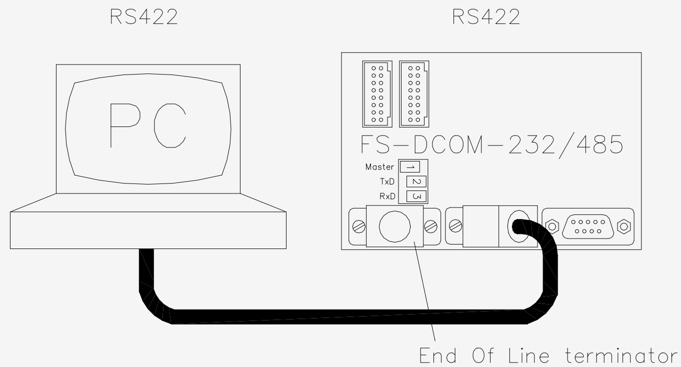


Figure 17-5: RS422 link from PC to Safety Manager

In the above figure:

- The used cable is the CCE-485-02/Lx (see CCE-485-02/Lx).
- The end of line terminator on the DCOM-232/485 is the EOL-485-01 (see EOL-485-01).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cable and EOL) may be interchanged.
- Dip switch 1 (Master) on the DCOM-232/485 must be Off.
- The dip switches 2 (TxD) and 3 (RxD) on the DCOM-232/485 must be On.

17.1.5.2 RS422 connection between master and slave Safety Manager

The below figure shows a wiring example for an RS422 link between (the two DCOM-232/485 modules of) two Safety Managers.

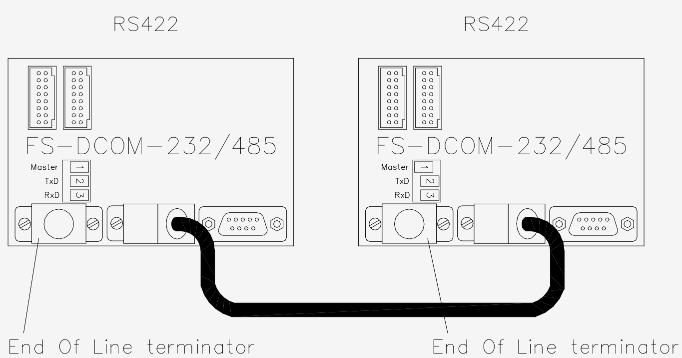


Figure 17-6: RS422 link between two Safety Manager systems

In the above figure:

- The used cable is the CCE-485-01/Lx (see CCE-485-01/Lx).
- The end of line terminators are EOL-485-01 (see EOL-485-01).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cable and EOL) may be interchanged.
- Dip switch 1 (Master) must be:
  - *On* on the first DCOM-232/485
  - *Off* on the second DCOM-232/485.
- The dip switches 2 (TxD) and 3 (RxD) on the DCOM-232/485 must be *On*.

17.1.6 RS232 wiring examples

The below figure shows a wiring example for an RS232 link between a development station (PC) and the DCOM-232/485 module of Safety Manager.

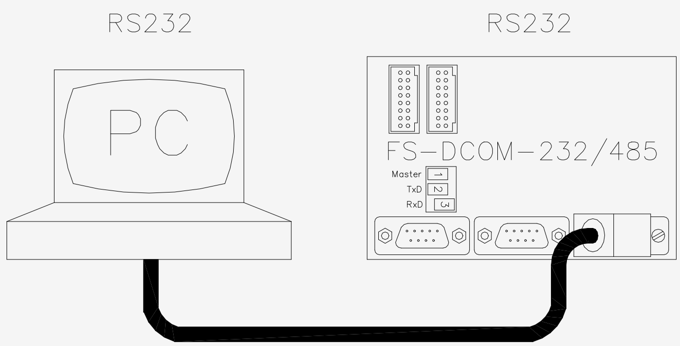


Figure 17-7: RS232 link from PC to Safety Manager

In the above figure:

- The used cable is the CCE-232-02/Lx (see CCE-232-02/L10).
- Dip switches 1 (Master) and 2 (TxD) on the DCOM-232/485 must be *Off*.
- Dip switch 3 (RxD) must be *On*.

17.2 CCI-UNI-0x

The CCI-UNI-02 and CCI-UNI-04 are internal communication cables that connect a general purpose channel of the Safety Manager Universal Safety Interface (USI-0002) to the communication FTA (DCOM-232/485).

- For more information on the Universal Safety Interface, see section FX-USI-0002
- For more information on the Communication FTA, see section DCOM-232/485.

The below figure shows the connectors of a CCI-UNI-02 or CCI-UNI-04 cable.

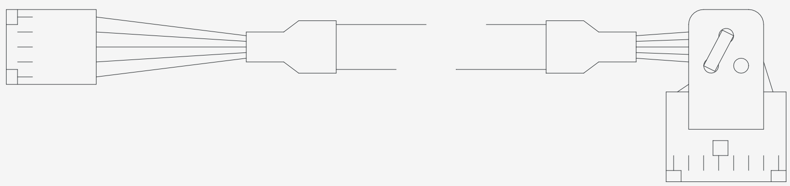


Figure 17-8: connectors of a CCI-UNI-0x cable

17.2.1 Technical data CCI-UNI-02

General	Type number:	FS-CCI-UNI-02
	Approval:	UL, CSA, FM
Cable	Type:	BELDEN 8105 5x2 CORE SHIELD
	Length:	2 m
Connectors	Control Processor side: (USI-0002)	10-pins
	DCOM-232/485 side:	16-pins

17.2.2 Technical data CCI-UNI-04

General	Type number:	FS-CCI-UNI-04
	Approval:	UL, CSA, FM
Cable	Type:	BELDEN 8105 5x2 CORE SHIELD
	Length:	4 m
Connectors	Control Processor side: (USI-0002)	10-pins
	DCOM-232/485 side:	16-pins

17.3 CCI-HSE-0x

The CCI-HSE-01 and CCI-HSE-02 are cable sets, each consisting of a pair of shielded internal communication cables, used for High Speed Ethernet (HSE) connections. Each pair consists of a yellow and a green color coded STP cable.

Each pair is connects the high-speed ethernet channels of the Universal Safety Interface (USI-0002) to a galvanically isolated Ethernet interface (an approved switch or alike).

- For more information on the Universal Safety Interface, see section FX-USI-0002
- For more information on approved galvanically isolated HSE interfaces see Table 4.

The CCI-HSE-01 and CCI-HSE-02 STP cable sets are Experion™ FTE compatible.

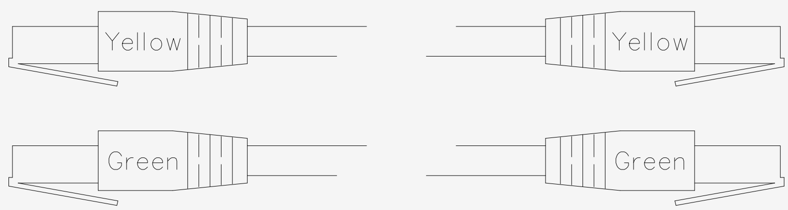


Figure 17-9: The CCI-HSE-0x shielded cable set

17.3.1 Technical data CCI-HSE-01

General	Type number:	FS-CCI-HSE-01
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	3 m
	Cable set:	1x cable connector Green 1x cable connector Yellow
Connectors	Both sides:	RJ45

17.3.2 Technical data CCI-HSE-02

General	Type number:	FS-CCI-HSE-02
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	2m25
	Cable set:	1x cable connector Green 1x cable connector Yellow
Connectors	Both sides:	RJ45

17.3.3 Technical data CCI-HSE-08

General	Type number:	FS-CCI-HSE-08
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	0.8 m
	Cable set:	1x cable connector Red 1x cable connector Blue
Connectors	Both sides:	RJ45

17.3.4 Technical data CCI-HSE-20

General	Type number:	FS-CCI-HSE-20
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	2 m
	Cable set:	1x cable connector Red 1x cable connector Blue
Connectors	Both sides:	RJ45

17.3.5 Technical data CCI-HSE-30

General	Type number:	FS-CCI-HSE-30
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	3 m
	Cable set:	1x cable connector Red 1x cable connector Blue
Connectors	Both sides:	RJ45

17.3.6 Technical data CCI-HSE-60

General	Type number:	FS-CCI-HSE-60
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	6 m
	Cable set:	1x cable connector Red 1x cable connector Blue
Connectors	Both sides:	RJ45

17.3.7 Technical data CCI-HSE-90

General	Type number:	FS-CCI-HSE-90
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	9 m
	Cable set:	1x cable connector Red 1x cable connector Blue
Connectors	Both sides:	RJ45

17.4 CCE-232-01/L10

The CCE-232-01/L10 external communication cable is used for a full-duplex RS232 (no handshake) ‘point-to-point’ connection from a communication FTA (DCOM-232/485) to another communication FTA.

For more information on the Communication FTA, see section DCOM-232/485.

17.4.1 Signals

Signal	9-p male (master)	9-p male (slave)	Color code
DCD/CTS	1, 8	7	white / blue stripe
RTS	6, 7	8	white / green stripe
–RxD	2	3	green / white stripe
–TxD	3, 9	2	blue / white stripe
GND	5	5	orange / white stripe

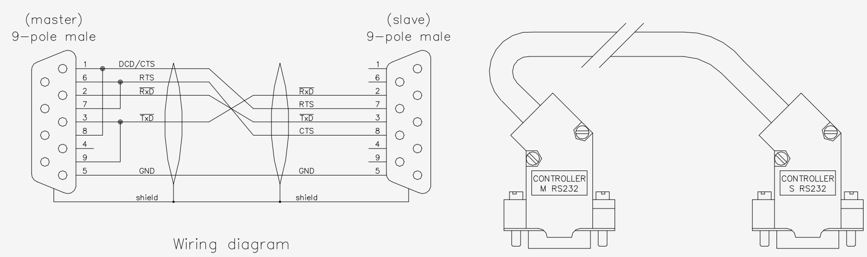


Figure 17-10: Pin assignment and layout of the CCE-232-01/L10 communication cable

The Safety Manager communication FTA (DCOM-232/485) only uses pins 2, 3 and 5. This means that the ‘master’ connector as well as the ‘slave’ connector of the CCE-232-01/L10 may be placed on the Safety Manager communication FTA.

The handshake lines (and the master links to pins 6 and 9) are included to keep the cable compatible with the FSC-system RS232 cable.

17.4.2 Technical data

General	Type number:	FS-CCE-232-01/L10
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 CORE SHIELD
	Length:	10 meter
Connectors	Both sides:	9 Pole sub-D male Metal housing: 45 deg.

17.5 CCE-232-02/L10

The CCE-232-02/L10 external communication cable is used for a full-duplex RS232 (no handshake) “point-to-point” connection between a “slave” Safety Manager communication FTA (DCOM-232/485) and the “master” Development System (DS) running on a PC.

For more information on the Communication FTA, see section DCOM-232/485.

17.5.1 Signals

Table 1. Pin assignment and layout of the CCE-232-02/L10 communication cable

Signal	9-p female (PC)	9-p male (slave)	Color code
DCD/CTS	1, 8	6, 7	white / green stripe
–RxD	2	3, 9	blue / white stripe
–TxD	3	2	green / white stripe
DTR	4	1, 8	white / blue stripe
GND	5	5	orange / white stripe

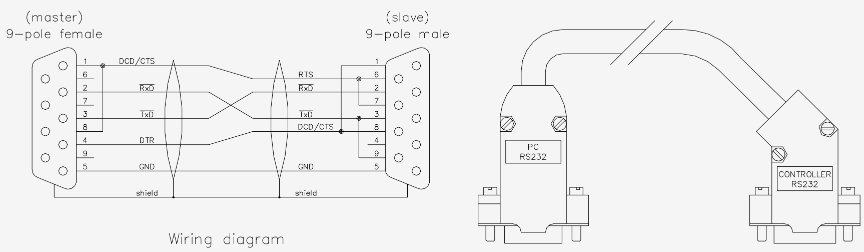


Figure 17-11: Pin assignment and layout of the CCE-232-02/L10 communication cable

The Safety Manager communication FTA (DCOM-232/485) only uses pins 2, 3 and 5.

The handshake lines (and the slave links to pins 6 and 9) are included to keep the cable compatible with the FSC-system RS232 cable.

17.5.2 Technical data

General	Type number:	FS-CCE-232-02/L10
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 CORE SHIELD
	Length:	10 meter
Connectors	Master side:	9 Pole sub-D female Metal housing: straight
	Slave side:	9 Pole sub-D male Metal housing: 45 deg.

17.6 CCE-485-01/Lx

The CCE-485-01/Lx external communication cable is used for

- Full-duplex (RS485) connection between Safety Manager communication FTAs (DCOM-232/485) from "master" to "slave" or between slaves.
- RS422 "point-to-point" connection between two communication FTAs (DCOM-232/485).

17.6.1 Signals

Signal	9-p Female	9-p Female	Color code
GND	1	1	orange / white stripe
+TxD	3	3	white / blue stripe
+RxD	4	4	white / green stripe
–TxD	7	7	blue / white stripe
–RxD	8	8	green / white stripe

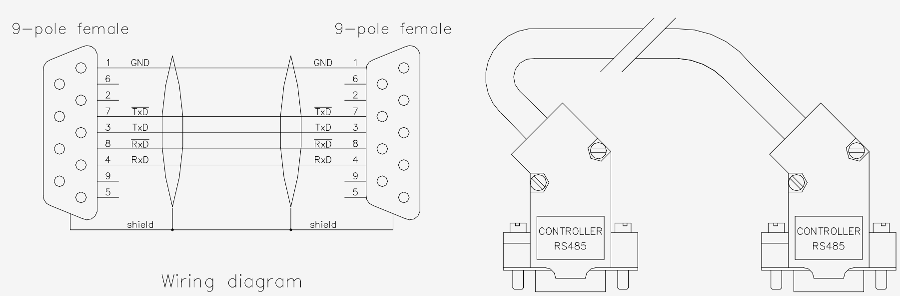


Figure 17-12: Pin assignment and layout of the CCE-485-01/Lx communication cable

17.6.2 Technical data

General	Type numbers:	FS-CCE-485-01/L10 (10 meter) FS-CCE-485-01/L25 (25 meter) FS-CCE-485-01/L50 (50 meter) FS-CCE-485-01/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 CORE SHIELD
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	Both sides:	9 Pole sub-D female Metal housing: 45 deg.

17.7 CCE-485-02/Lx

The CCE-485-02/Lx external communication cable is used for:

- Full-duplex connection between a PC (Blackbox IC113C/133C)(RS485/422 'master') and the first Safety Manager communication FTA (DCOM-232/485)(RS485 'slave').
- RS422 'point to point' connection between a PC (Blackbox IC113C/133C) and a Safety Manager communication FTA (DCOM-232/485).

If only one Safety Manager is used, then this connection is a 'point-to-point' connection. If multiple Safety Managers are used, then the PC takes the role of master and the communication FTA the role of slave (this communication FTA is then connected to the other communication FTAs in a "in-between-slaves" connection using a CCE-485-01/Lx cable).

For more information on the Communication FTA, see sectionDCOM-232/485

17.7.1 Signals

Signal	9-p Female (PC)	9-p Female (slave)	Color code
+RxD	1	3	white / blue stripe
–RxD	2	7	blue / white stripe
–TxD	3	8	green / white stripe
+TxD	4	4	white / green stripe
GND	5	5	orange / white stripe

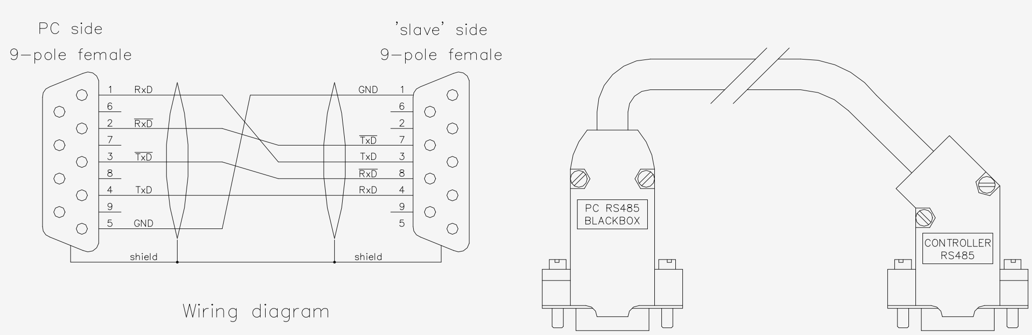


Figure 17-13: Pin assignment and layout of the CCE-485-02/Lx communication cable

17.7.2 Technical data

General:	Type numbers:	FS-CCE-485-02/L10 (10 meter) FS-CCE-485-02/L25 (25 meter) FS-CCE-485-02/L50 (50 meter) FS-CCE-485-02/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	Master side:	9 Pole sub-D female Metal housing: straight
	Slave side:	9 Pole sub-D female Metal housing: 45 deg.

17.8 CCE-485-04/Lx

The CCE-485-04/Lx external communication cable is used for:

- Full-duplex connection between a PC (Blackbox IC114A) (RS485/422 ‘master’) and the first Safety Manager communication FTA (DCOM-232/485) (RS485 ‘slave’).
- RS422 ‘point-to-point’ connection between a PC (Blackbox IC114A) and a Safety Manager communication FTA (DCOM-232/485).

For more information on the Communication FTA, see DCOM-232/485.

17.8.1 Signals

Signal	25-p Female (master)	9-p Female (slave)	Color code
+TxD	14	4	white / green stripe
–TxD	2	8	green / white stripe
–RxD	3	7	blue / white stripe
+RxD	16	3	white / blue stripe
GND	7	1	orange / white stripe

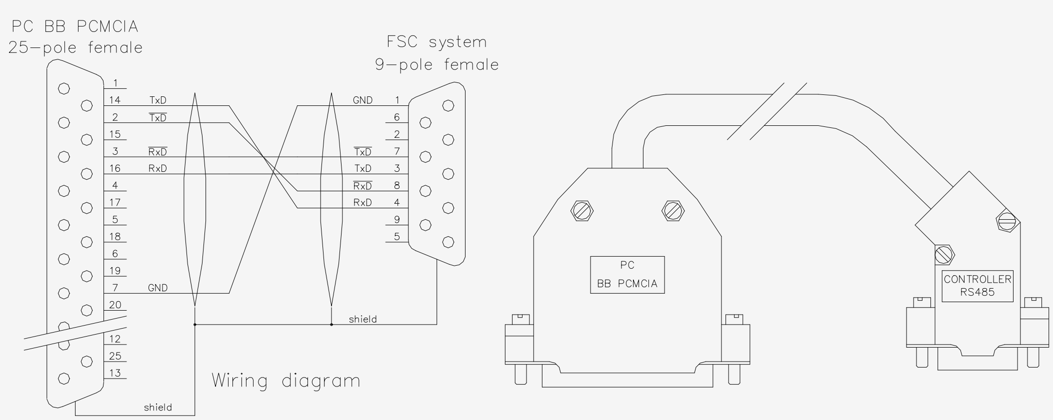


Figure 17-14: Pin assignment and layout of the CCE-485-04/Lx communication cable

17.8.2 Technical data

General	Type numbers:	FS-CCE-485-04/L10 (10 meter) FS-CCE-485-04/L25 (25 meter) FS-CCE-485-04/L50 (50 meter) FS-CCE-485-04/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	PC side:	25 Pole sub-D female Metal housing: straight
	Slave side:	9 Pole sub-D female Metal housing: 45 deg.

17.9 CCE-485-05/Lx

The CCE-485-05/Lx external communication cable is used for:

- Full-duplex connection between a PC (Quatech SSP/200/300) (RS485/422 ‘master’) and the first Safety Manager communication FTA (DCOM-232/485) (RS485 ‘slave’).
- RS422 ‘point-to-point’ connection between a PC (Quatech SSP/200/300) and a Safety Manager communication FTA (DCOM-232/485).

For more information on the Communication FTA, see DCOM-232/485.

17.9.1 Signals

Signal	9-p Male (master)	9-p Female (slave)	Color code
+TxD	2	4	white / green stripe
–TxD	7	8	green / white stripe
GND	3	1	orange / white stripe
–RxD	8	7	blue / white stripe
+RxD	4	3	white / blue stripe

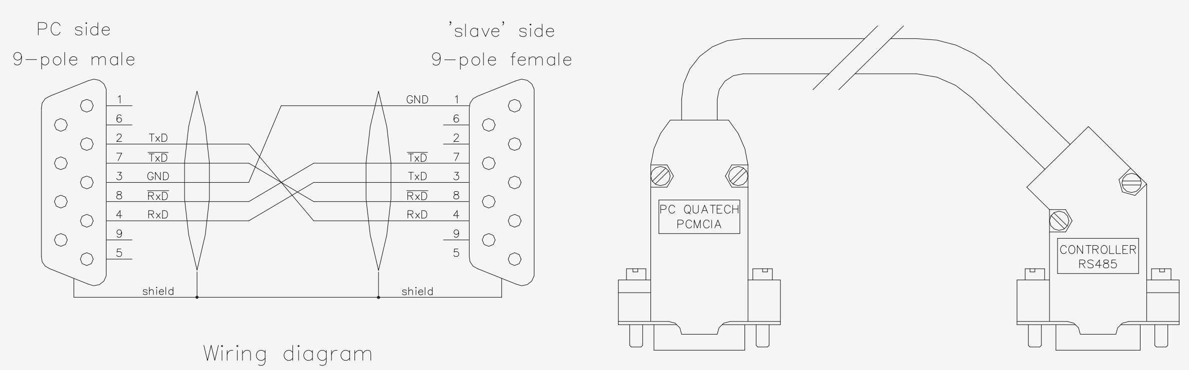


Figure 17-15: Pin assignment and layout of the CCE-485-05/Lx communication cable

17.9.2 Technical data

General	Type numbers:	FS-CCE-485-05/L10 (10 meter) FS-CCE-485-05/L25 (25 meter) FS-CCE-485-05/L50 (50 meter) FS-CCE-485-05/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	PC side:	9 Pole sub-D male Metal housing: straight
	Slave side:	9 Pole sub-D female Metal housing: 45 deg.

17.10 CCE-485-FO-01/Lx

The CCE-485-FO-01/Lx external communication cable is used for:

- Full-duplex RS485/422 connection of a PC (Blackbox IC113C/133C) with a field-cable.
- RS422 ‘point-to-point’ connection between a PC (Blackbox IC113C/133C) with a field-cable.

17.10.1 Signals

Signal	9-p Female (PC)	Sleeve text	Color code
+RxD	1	4 (T–)	white / blue stripe
–RxD	2	3 (T+)	blue / white stripe
–TxD	3	1 (R+)	green / white stripe
+TxD	4	2 (R–)	white / green stripe
GND	5	5 (GND)	orange / white stripe
shield	housing	shield	-

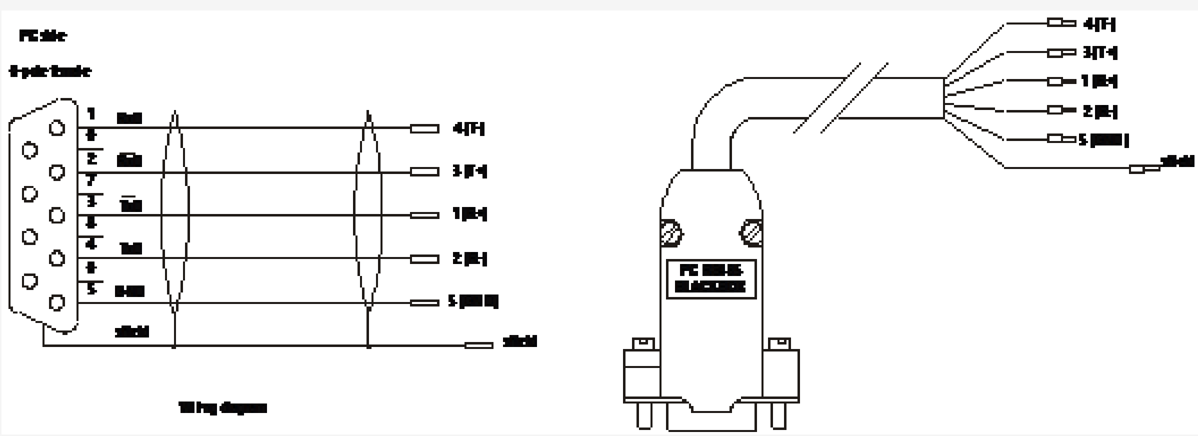


Figure 17-16: Pin assignment and layout of the CCE-485-FO-01/Lx communication cable

17.10.2 Technical data

General	Type number:	FS-CCE-485-FO-01/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: straight
Wire ends	Pins:	8 mm < 1 mm^2
	Strip length:	approx. 24 cm (shield) approx. 9 cm (others)

17.11 CCE-485-FO-02/Lx

The CCE-485-FO-02/Lx external communication cable is used for:

- Full-duplex RS485/422 connection of a Safety Manager communication FTA (DCOM-232/485) with a field-cable.
- RS422 ‘point-to-point’ connection of a Safety Manager communication FTA (DCOM-232/485) with a field-cable.

For more information on the Communication FTA, see DCOM-232/485.

17.11.1 Signals

Signal	9-p Female	Sleeve text	Color code
GND	1	5 (GND)	orange / white stripe
–TxD	7	1 (R+)	blue / white stripe
+TxD	3	2 (R–)	white / blue stripe
–RxD	8	3 (T+)	green / white stripe
+RxD	4	4 (T–)	white / green stripe
shield	housing	shield	-

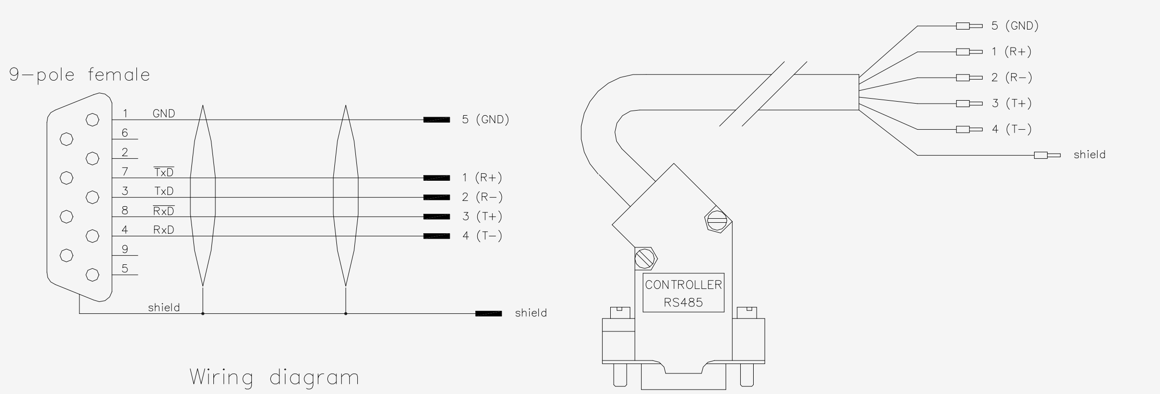


Figure 17-17: Pin assignment and layout of the CCE-485-FO-02/Lx communication cable

17.11.2 Technical data

General	Type number:	FS-CCE-485-FO-02/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: 45 deg.
Wire ends	Pins:	8 mm < 1 mm^2
	Strip length:	approx. 24 cm (shield) approx. 9 cm (others)

17.12 CCE-485-FO-03/Lx

The CCE-485-FO-03/Lx external communication cable is used for:

- Full-duplex RS485/422 connection of a PC (Westermo MD63).
- RS422 ‘point-to-point’ connection of a PC (Westermo MD63).

17.12.1 Signals

Signal	9-p Female	Color code
GND	1	orange / white stripe
–TxD	7	blue / white stripe
+TxD	3	white / blue stripe
–RxD	8	green / white stripe
+RxD	4	white / green stripe
shield	housing	-

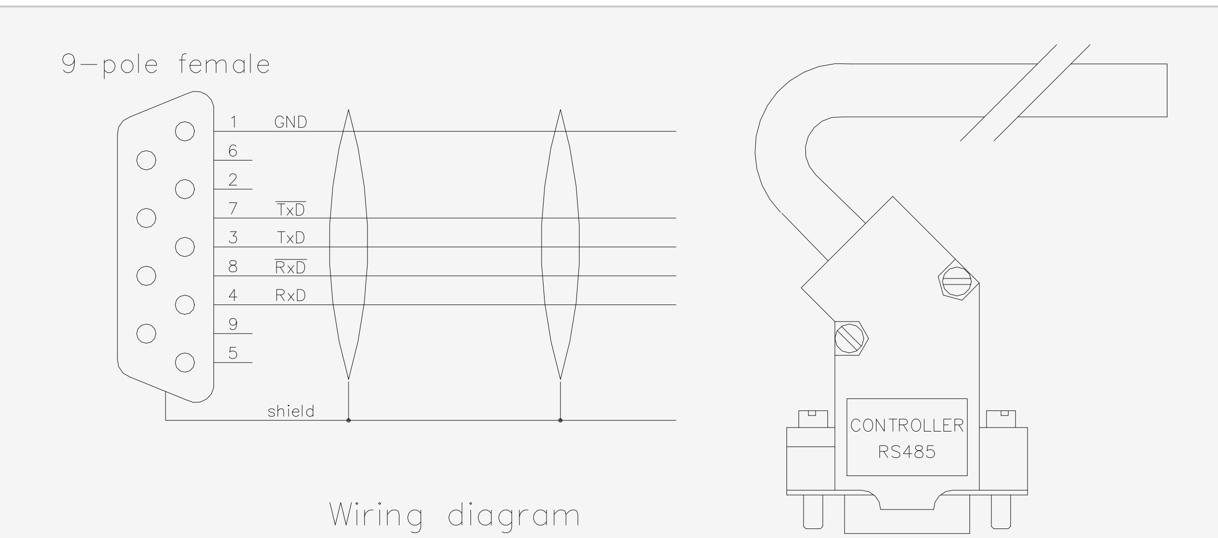


Figure 17-18: Pin assignment and layout of the CCE-485-FO-03/Lx communication cable

17.12.2 Technical data

General	Type number:	FS-CCE-485-FO-03/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: 45 deg.

17.13 CCE-485-FO-04/Lx

The CCE-485-FO-04/Lx external communication cable is used for:

- Full-duplex RS485/422 connection of a Safety Manager communication FTA (DCOM-232/485).
- RS422 'point-to-point' connection of a Safety Manager communication FTA (DCOM-232/485).

For more information on the Communication FTA, see DCOM-232/485.

17.13.1 Signals

Signal	9-p Female	Color code
GND	1	orange / white stripe
–TxD	7	blue / white stripe
+TxD	3	white / blue stripe
–RxD	8	green / white stripe
+RxD	4	white / green stripe
shield	housing	-

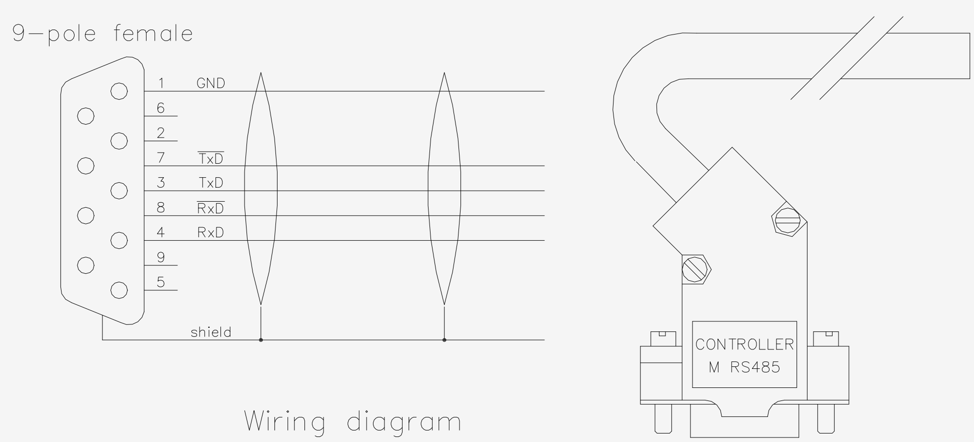


Figure 17-19: Pin assignment and layout of the CCE-485-FO-04/Lx communication cable

17.13.2 Technical data

General	Type number:	FS-CCE-485-FO-04/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: 45 deg.

17.14 EOL-485-01

17.14.1 Dual 120 Ω end of line terminator

The dual 120 Ω End Of Line terminator (EOL-485-01) is used as line terminator for RS422 or RS485 connections that end on the Safety Manager communication FTA (DCOM-232/485).

They are placed on the vacant RS485 connector position of a communication FTA (see section DCOM-232/485).

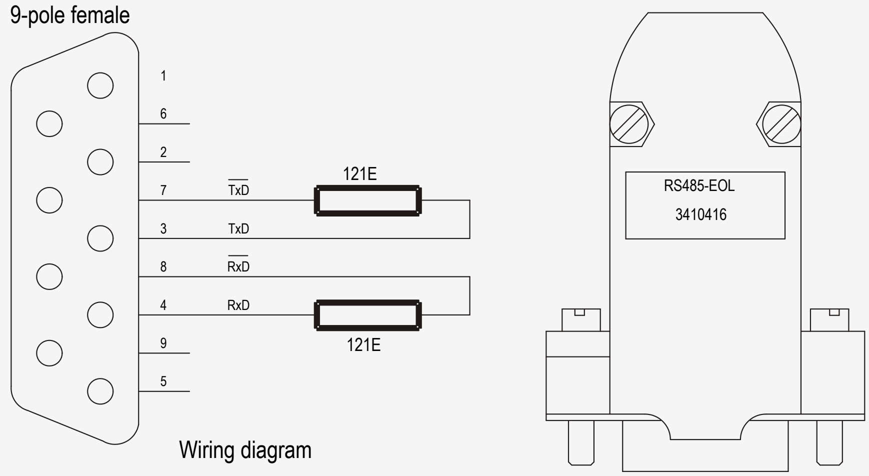


Figure 17-20: Side view of the EOL-485-01

17.14.2 Technical data

General	Type number:	FS-EOL-485-01
	Approvals:	n/a
Physical	Module dimensions:	31 × 16.5 × 46.5 mm (L × W × H) 1.22 × 0.65 × 1.83 in (L × W × H)
Electrical	Resistors:	121 Ω, 1%, 0.5 W
	Connector:	9-pole sub-D female

17.15 AutroSafe Cable Specifications

The following figure depicts the AutroSafe FNG connection to a Safety Manager, a complete solution for fire and gas detection.

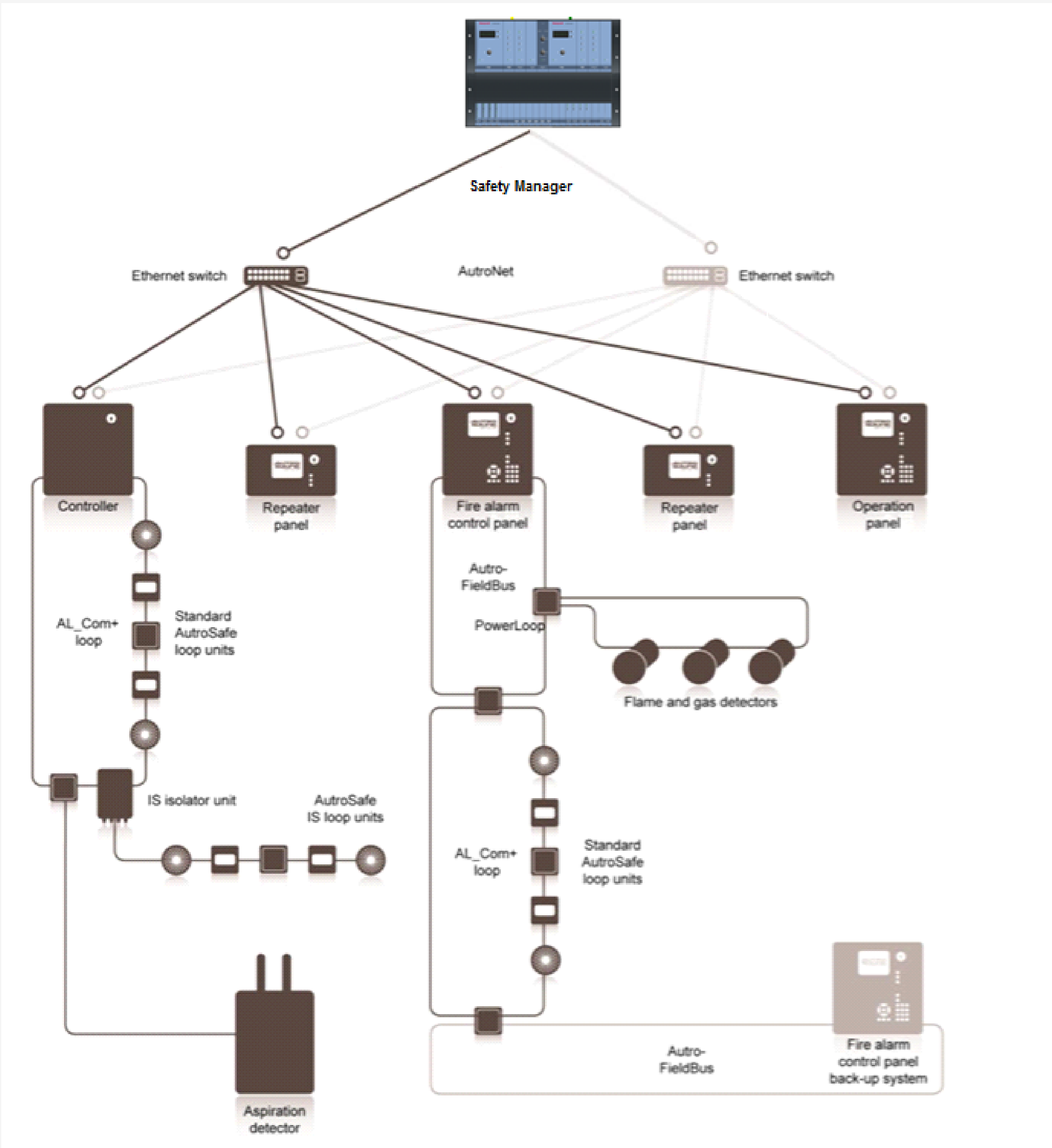


Figure 17-21: AutroSafe FNG

AutroSafe Cable Specifications

Cabling	Cable type / category	Maximum cable length (m)
Ethernet –TCP/IP (AutroNet)	CAT 5 or 6, shielded or unshielded.	Maximum 100 m
	Single-mode or multi-mode optic fibre	Maximum fibre length is determined by the transmission budget calculated from specifications of fiber cable, equipment, loss by fibre cable joints and connectors.
AutroCom Serial RS232	Multi-wired cable	Maximum 10 m
AutroCom Serial VDR, ESPA, Modbus RS422/RS485	CAT 4, 5 or 6.	Maximum cable length of 1000 m depending on the cable quality and baud rate. The transceiver is referenced to Earth in the AutroSafe panel. The transceiver at the other end shall be terminated and referenced to ensure low common mode voltage. For cable connections out of the AutroSafe installation cabinet or earth reference (or where common mode voltage noise is expected) a galvanic isolation shall be introduced in the communication path.

AutroSafe Wiring Details

The following tables give the communication details between the FNG system and the Serial interface (RS422 and RS232).

Table 1. Serial RS232 - DCOM settings[1]

Safety Manager		FNG	
Pin	**Type**	**Pin**	**Type**
2	Rx	12	Tx
3	Tx	14	Rx
5	GND	16	GND

Note:

1. "Rx" stands for Receive, "Tx" stands for Transmit, and "GND" stands for Ground.

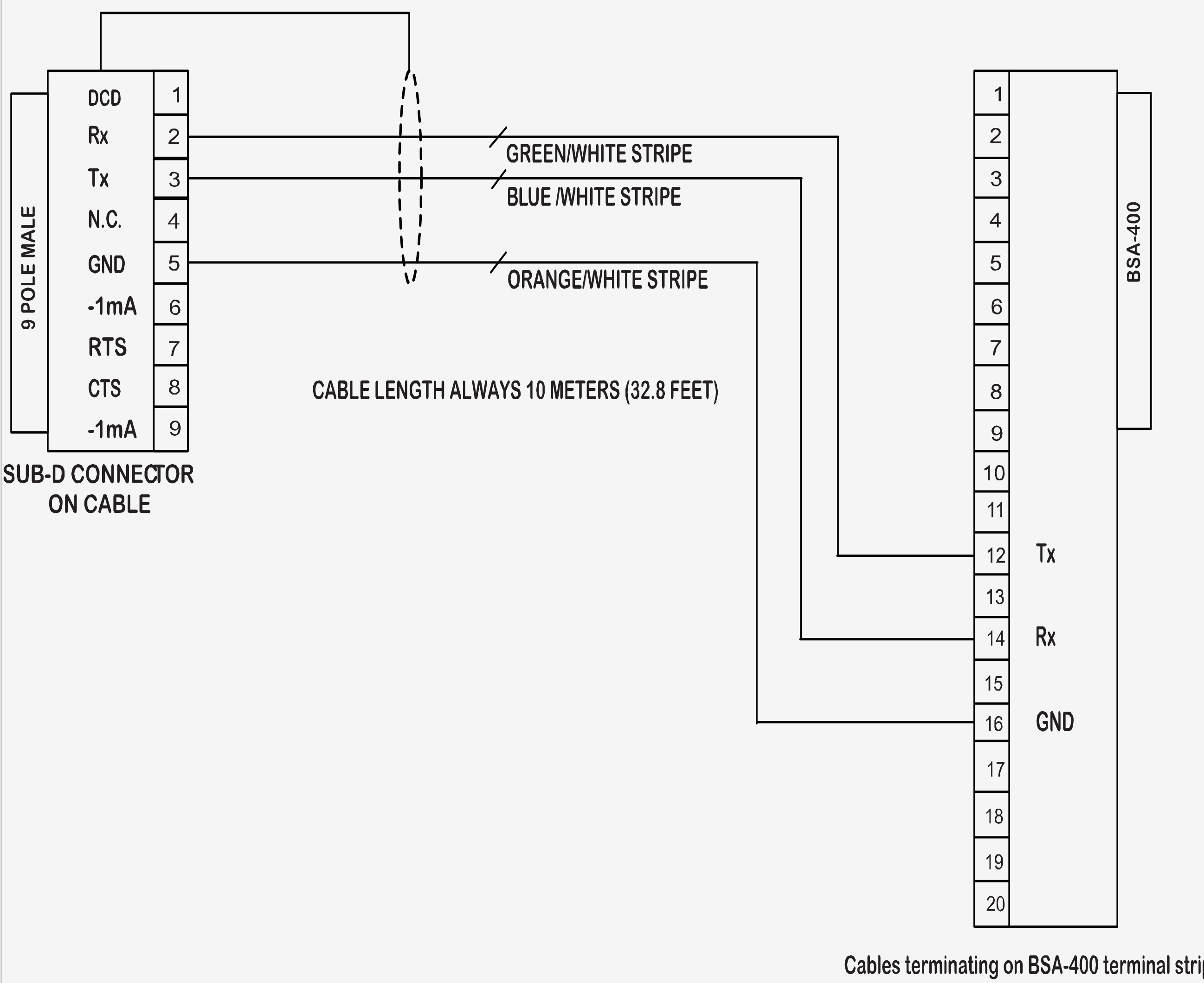


Figure 17-22: RS232 Connector

Table 2. Serial RS422 - DCOM settings[1]

Safety Manager		FNG	
Pin	**Type**	**Pin**	**Type**
1	GND	16	GND
3	Tx+	4	Rx+
4	Rx+	8	Tx+
7	Tx-	6	Rx-
8	Rx-	10	Tx-

Note:

1. "Rx" stands for Receive, "Tx" stands for Transmit, and "GND" stands for Ground.

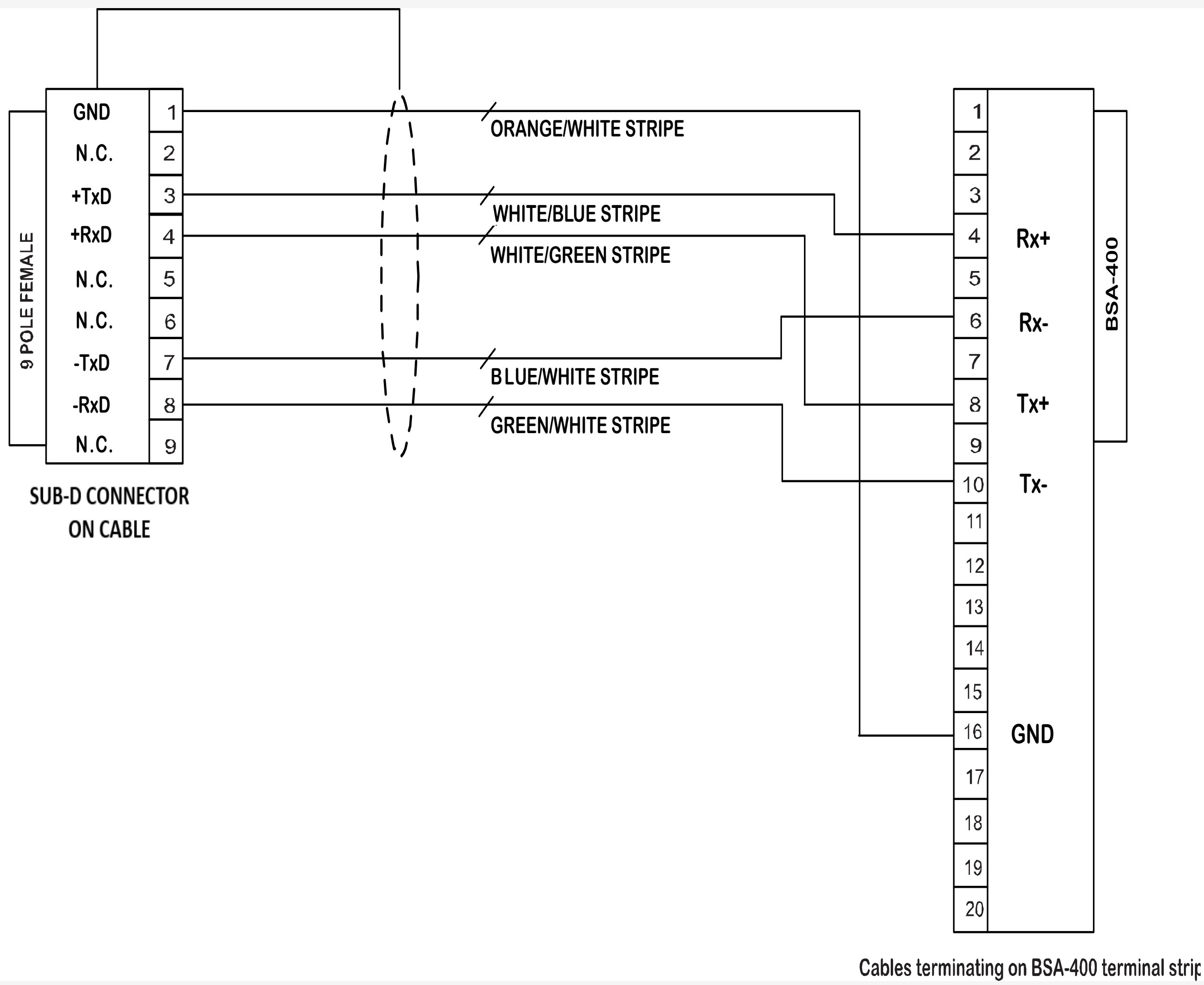


Figure 17-23: RS422 Connector

DCOM Jumper settings

The below figure and table show the possible settings when configuring the DCOM-232/422.

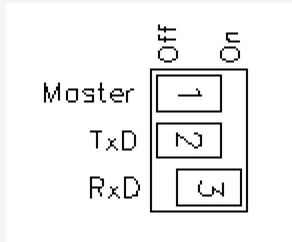


Figure 17-24: DCOM Jumper

Table 3. Dip switch settings for the DCOM-232/422[1]

DCOM-232/422 Configuration	Master	TxD	RxD
RS422 Point-to-point	Off	On	On
RS232 Point-to-point	Off	Off	On

Note:
1. *On* and *Off* positions are marked on the actual module (see DCOM_Jumper).

Note: For proper RS232 operation, it is important that dip switch 3 is *On*.

AutroSafe Jumper settings

Configure AutroSafe jumper settings for RS422 point-to-point as per AutroSafe specifications.

CHAPTER 18

POWER DISTRIBUTION

18 Power distribution

This chapter describes various types of power distribution modules and cables which can be used for the power distribution in Safety Manager.

The following power distribution modules are described:

Power distribution modules
SIF-X; Supply Input Filters (SIF)
MB-0001; Mains power rail (24Vdc—110Vdc) with 10 sections
PDB-0824P; Power Distribution Board (24Vdc, 2 A, 8 channel)
PSU-FLTR2450; Common mode filter for the PSU-UNI2450

Power distribution cables
PDC-MBMB-1; Mains power distribution cable (24Vdc, 48Vdc)
PDC-CPSET; Power distribution cable set Control Processor (24Vdc)
PDC-IOSET; Power distribution cable set IO chassis (24Vdc, 48Vdc or 110Vdc)
PDC-MB24-y; Power Distribution Cable (24Vdc), -1P, -2P and -3P cables
PDC-FTA24; Power Distribution Cable (24Vdc)

18.1 General info about the power distribution concept

Safety Manager main power wiring concepts are built around the MB-0001 mains power rail, power distribution cables (PDC cables) and power distribution boards (PDB boards).

- Mains power rails distribute the power from (multiple) redundant power supplies to the users.
- PDB power distribution boards enable easy distribution of 24Vdc from the mains power rail to individual devices inside the cabinet enclosure, such as fan units and FTAs.
- Standard PDC cables are used to connect the modules together.

18.1.1 Connecting power supplies to the mains power rail

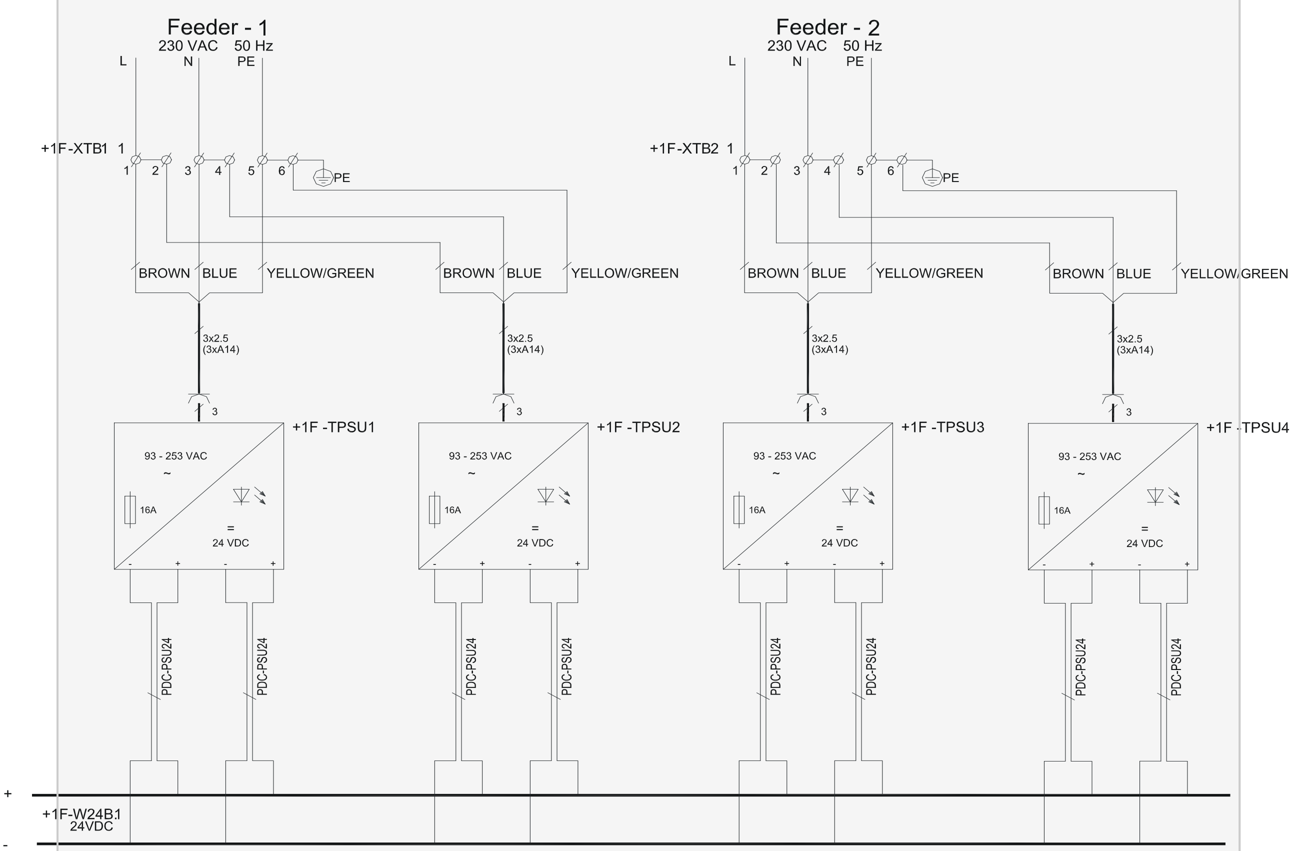


Figure 18-1: Redundant PSU concept on an MB-0001 mains power rail

The above figure shows an example of a redundant power supply concept feeding an MB-0001 mains power rail.

The concept is based on redundant feeders, PSU-UNI2450 PSU's, an MB-0001 mains power rail and PDC-MB24-x power distribution cables.

18.1.2 Connecting Controller and IO chassis to the mains power rail

The below figure shows how a Controller chassis and a IO chassis are powered by an MB-0001 mains power rail; via dedicated PDC cables.

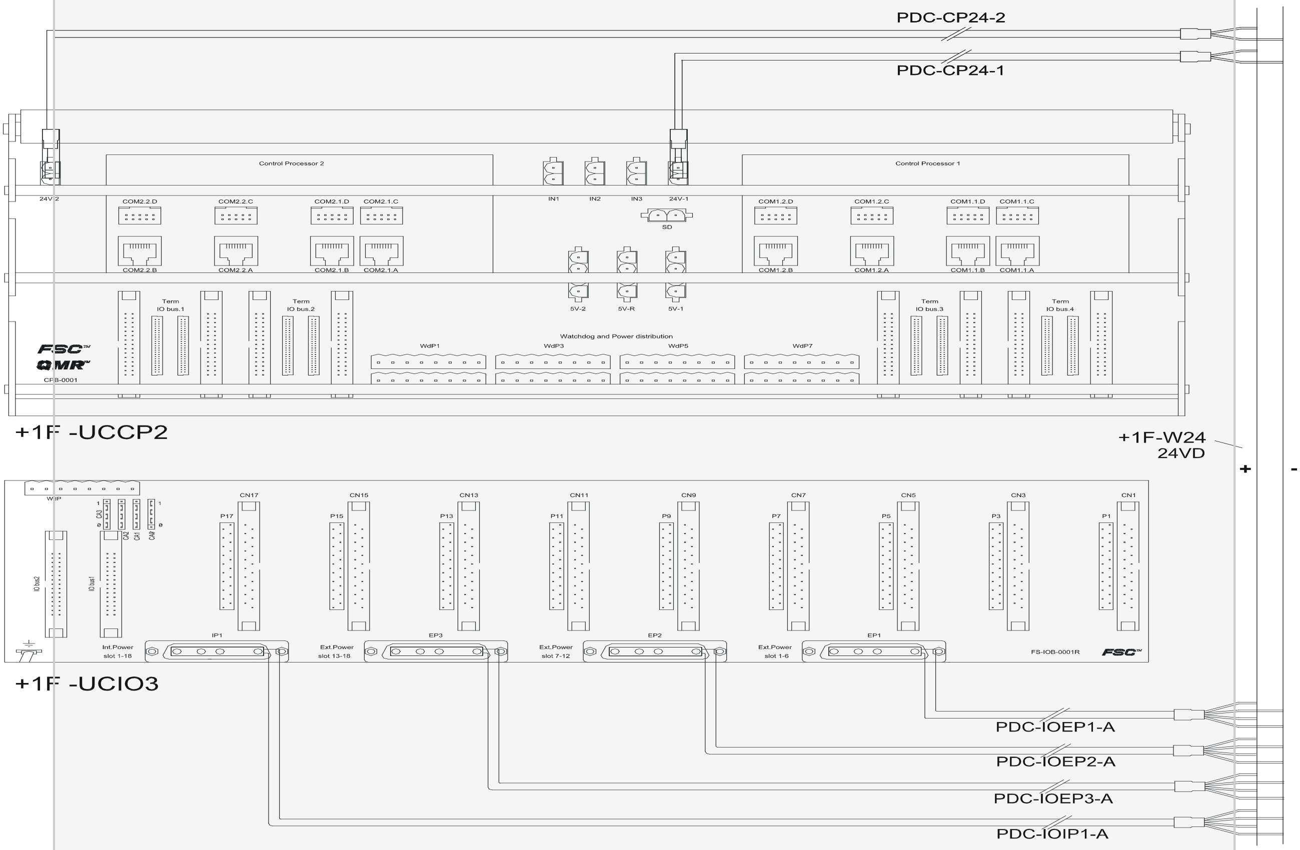


Figure 18-2: Controller chassis and IO chassis wired to an MB-0001 mains power rail

The Controller chassis receives its power via an PDC-CPSET power distribution cable-set (see PDC-CPSET). These cables connect the backplane of the chassis (connector 24V-1 supplies Control Processor 1 and connector 24V-2 supplies Control Processor 2) to the mains power rail.

The IO chassis receive their internal and external supply voltages (24 V DC, 48 V DC, or 110 V DC) from the mains power rail via a set of PDC-IOSET power distribution cables (see PDC-IOSETfor details).

IO module slots	Power supply voltage	Cable
1-6	External	PDC-IOEP1A
7-12	External	PDC-IOEP2A
13-18	External	PDC-IOEP3A
All	Internal	PDC-IOIP1A

The 5 V DC power distribution is not part of the main power distribution and is described in 5 Volt and watchdog distribution.

18.1.3 Connecting to the mains power rail via the power distribution board

The below figure shows an example of how 24 V DC devices, requiring less than 2A (fan units, ELD's, FTA's, etc.), are powered by the MB-0001 mains power rail; via a PDB-0824P power distribution board and dedicated PDC cables.

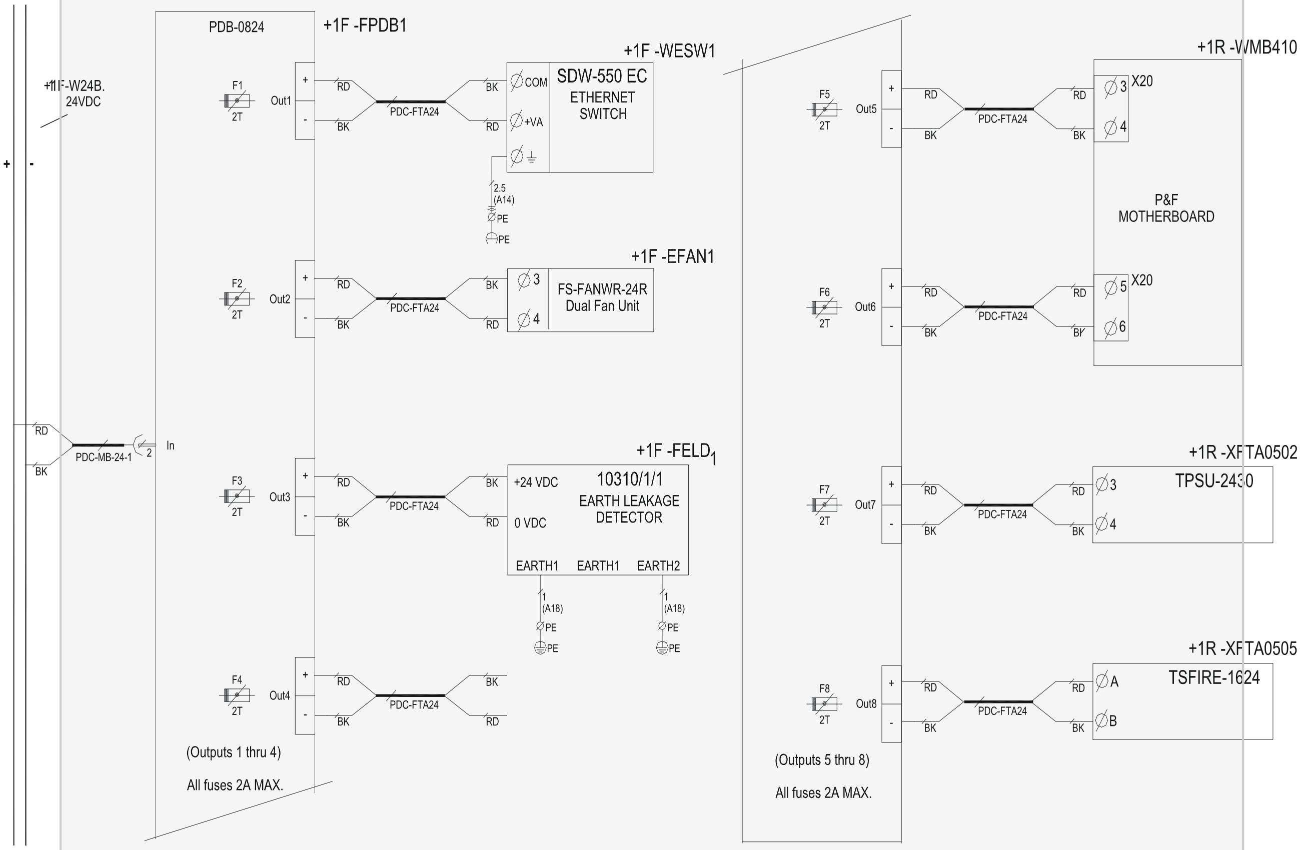


Figure 18-3: Low power consumers wired to an MB-0001 mains power rail

18.1.4 Connecting directly to the mains power rail

Note:
A dedicated mains power rail must be installed for each voltage used. For power options see MB-0001.

The below figure shows how the remaining devices (24 V DC devices requiring more than 2A or devices powered by voltages other than 24 V DC) are powered by the MB-0001 mains power rail.

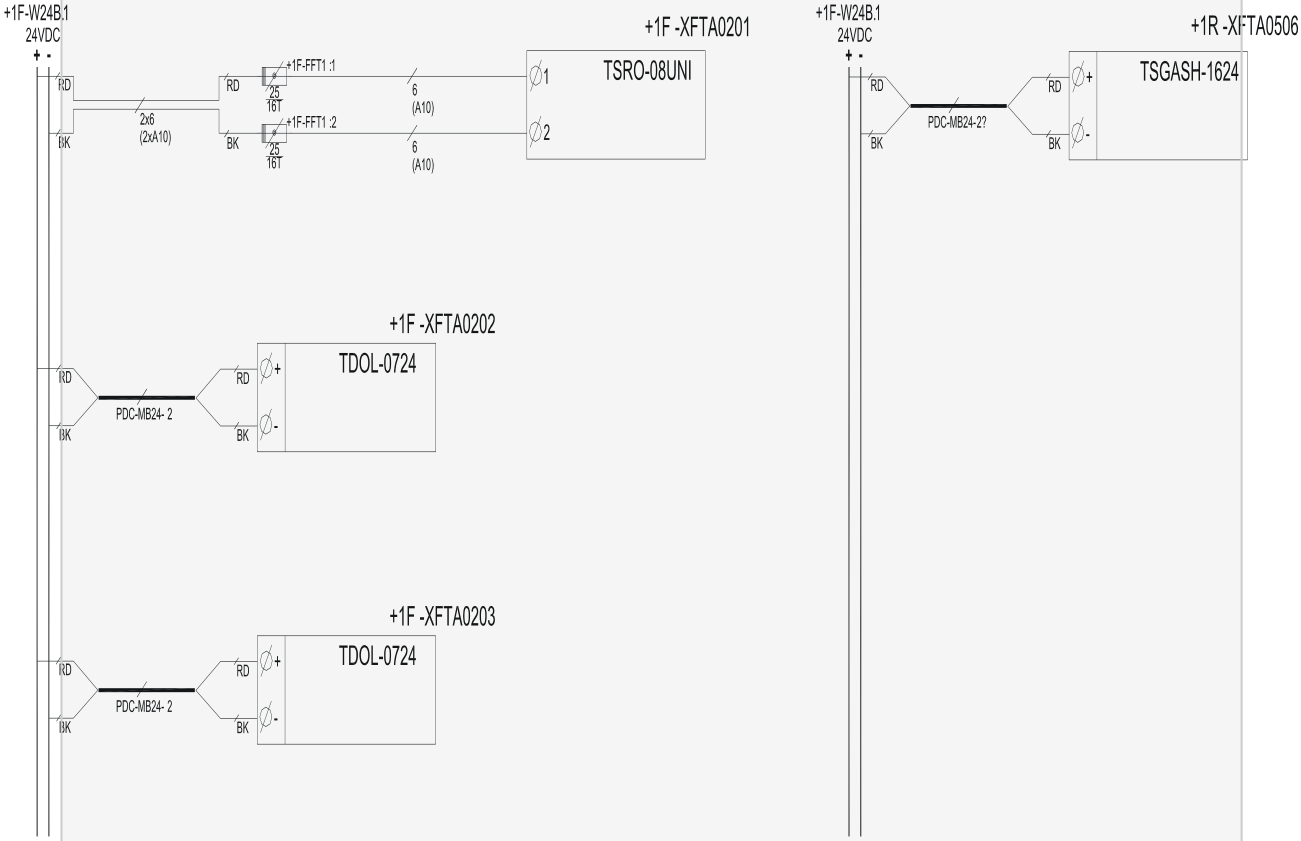


Figure 18-4: High power consumers wired to an MB-0001 mains power rail

18.2 SIF-X

18.2.1 Supply Input Filters (SIF)

The SIF-X modules are used as power supply input filters. The type of SIF-X module to be used depends on the voltage level:

- 24 V DC: SIF-24
- 48 V DC: SIF-48
- 60 V DC: SIF-60
- 110 V DC: SIF-110

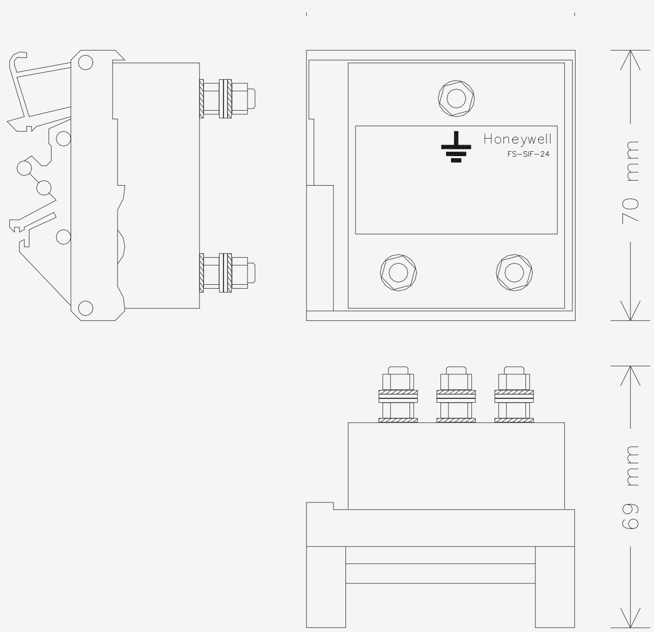


Figure 18-5: SIF-X mechanical layout

The SIF-X modules have a universal snap-in provision for standard DIN EN rails.

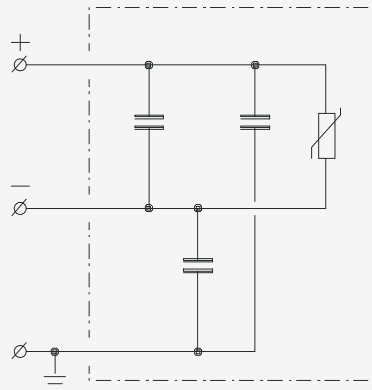


Figure 18-6: SIF-X circuit

If the DC power is supplied externally, the input filter must be placed close to the input terminals of the power supply. The plus (+) and minus (-) connections are arbitrary. The ground connection is indicated.

The supply wires must be routed via filter terminals, or they must be connected to the input filter using wires with a diameter of at least 6 mm⊃ 2; (AWG 10) and a maximum length of 10 cm (4 in).

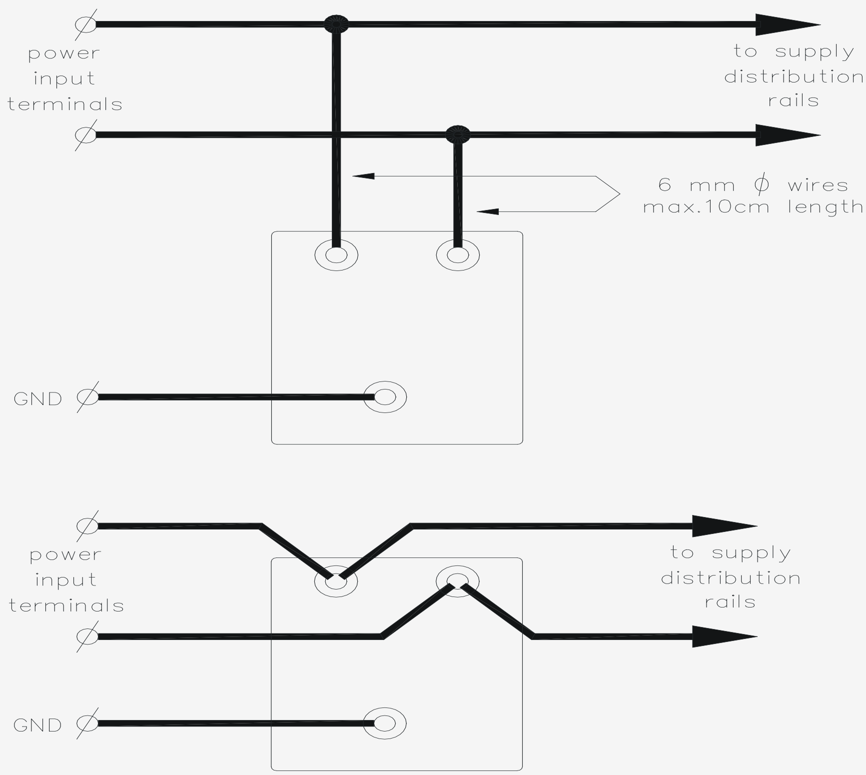


Figure 18-7: Wiring examples for SIF-X modules

18.2.2 Technical data

The SIF-X modules have the following specifications:

General	Type numbers[1]:	24 V DC: FS-SIF-24 48 V DC: FS-SIF-48 60 V DC: FS-SIF-60 110 V DC: FS-SIF-110
	Approvals:	CE, CSA, UL; TUV, FM[2] pending
Physical	Dimensions:	70 × 70× 69 mm (L × W × H) 2.76 × 2.76 × 2.72 in (L × W × H)
	DIN EN rails:	TS32 / TS35 x 7.5
	Used rail length:	71 mm (2.80 in)
	Weight:	Approximately 130 gr. (4.18 oz.)
Power	Power requirements:	None
	Maximum voltage:	FS-SIF-24: 31Vdc FS-SIF-48: 55Vdc FS-SIF-60: 65Vdc FS-SIF-110: 125 V DC
	Maximum voltage between any input and GND:	500 V AC or 700 V DC
Terminations	Connection type:	M5

Note:

1. The SIF-X input supply filter types replace the10306/1/x input supply filter types which only have an UL approval up to 40°C. There are no functional changes.
2. FM approval applies to the FS-SIF-24 module type only.

18.3 PSU-FLTR2450

18.3.1 Common mode filter for the PSU-UNI2450

The PSU-FLTR2450 module is a common mode filter that can be fitted on the PSU-UNI2450 V1.0 power supply, as described in “PSU-UNI2450”.

> **Note:**
> The PSU-FLTR2450 is mandatory for version 1.0 of the PSU-UNI2450.

The PSU-FLTR2450 has:

- two female connectors that slot in the 24V connectors of the PSU-UNI2450.
- two male connectors to connect the mains power rail via a dual cable set. (For more information see MB-0001.)
- a mounting bracket, to secure the filter on top of the mounting bracket located at the output side of the PSU-UNI2450.

The below figure shows the front view of the PSU-FLTR2450.

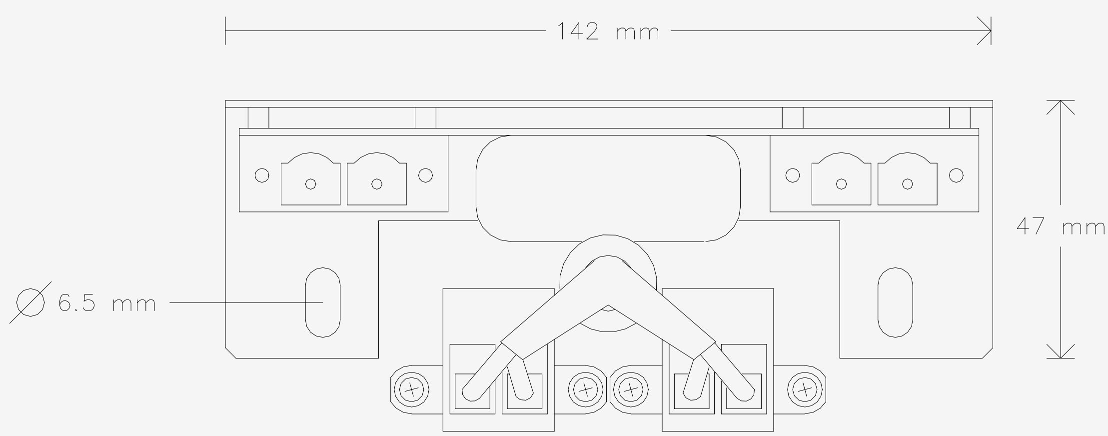


Figure 18-8: PSU-FLTR2450 front view

The below figure contains a schematic diagram of the PSU-FLTR2450 common mode filter.

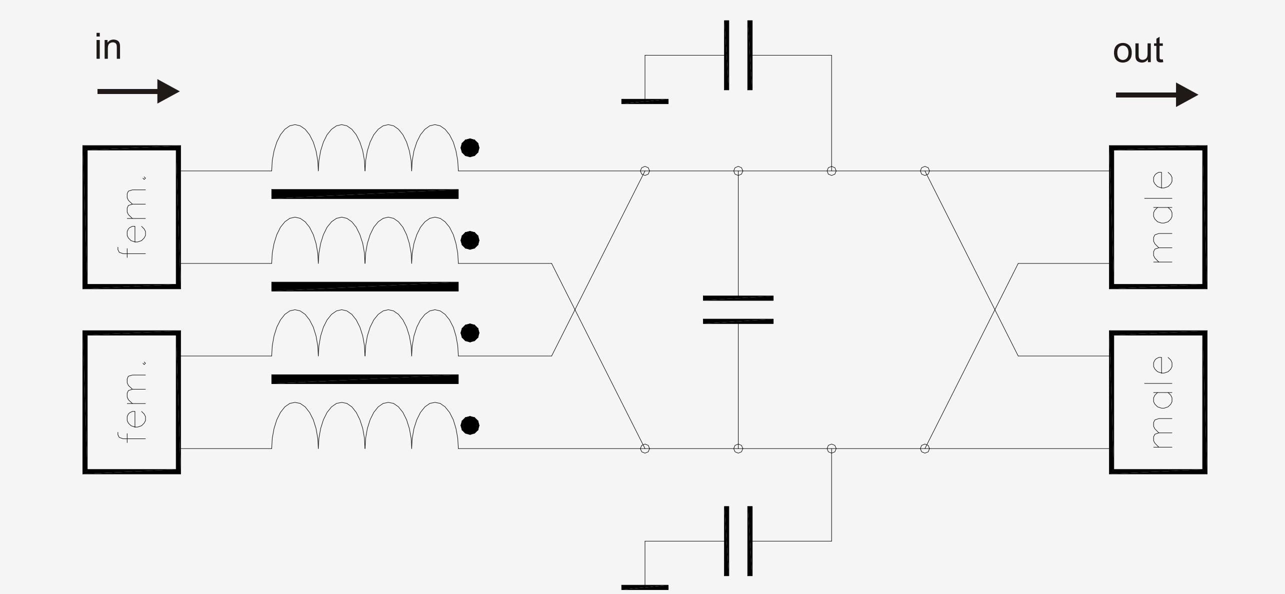


Figure 18-9: PSU-FLTR2450 schematic diagram

18.3.2 Connection and assembly instructions

The figure below shows how the PSU-FLTR2450 filter module is installed to the PSU-UNI2450 power supply unit:

- Disconnect the 24 V DC power cables and remove the two bolts securing the output side of the PSU-UNI2450 to the mounting plate.
- Slot the PSU-FLTR2450 in the 24V connectors of the PSU-UNI2450 and position the filter over the mounting brackets of the PSU-UNI2450.
- Secure the PSU-FLTR2450 to the PSU-UNI2450 and the mounting plate with the two bolts removed earlier, and reconnect the 24 V DC power cables.

18.3 PSU-FLTR2450

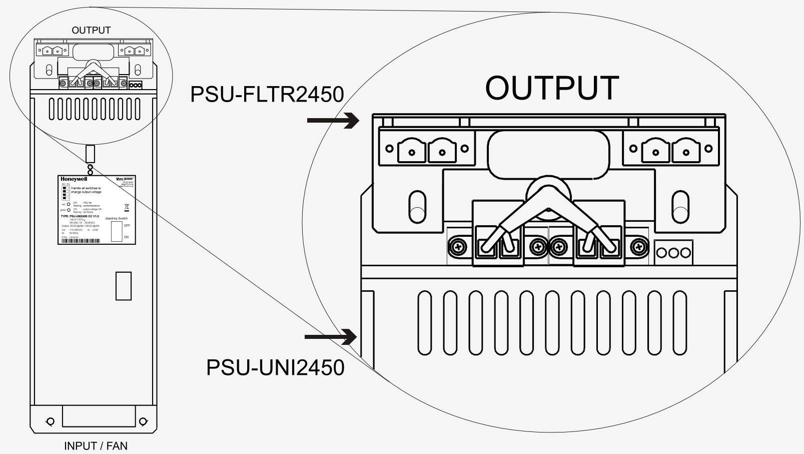


Figure 18-10: PSU-FLTR2450 connected to a PSU-UNI24520 V1.0

18.3.3 Technical data

The PSU-FLTR2450 module has the following specifications:

General	Type number:	FC-PSU-FLTR2450
	Approvals:	CE, TUV
Physical	Dimensions:	60 x 142 x 100 mm (L × W × H) 2.36 x 5.6 x 3.94 in (L × W × H)
	Mounting:	on PSU-UNI2450 mounting bracket with M6 bolts
	Weight:	Approximately 360 gr. (12.7oz.)
Power	Power requirements:	None
	Output power:	Complies with PSU-UNI-2450
	Maximum voltage between any input and GND:	500 V AC or 700 V DC
Terminations	Output connector type:	2 x Phoenix PCV6-16 2G1F-10,16 male with locking screws

18.4 PSU-FLTR-MARINE

The essence of PSU-FLTR-MARINE V2.0 is to comply with EMC Marine standards regarding EMC.

The following diagram is the block diagram of PSU-FLTR-MARINE :

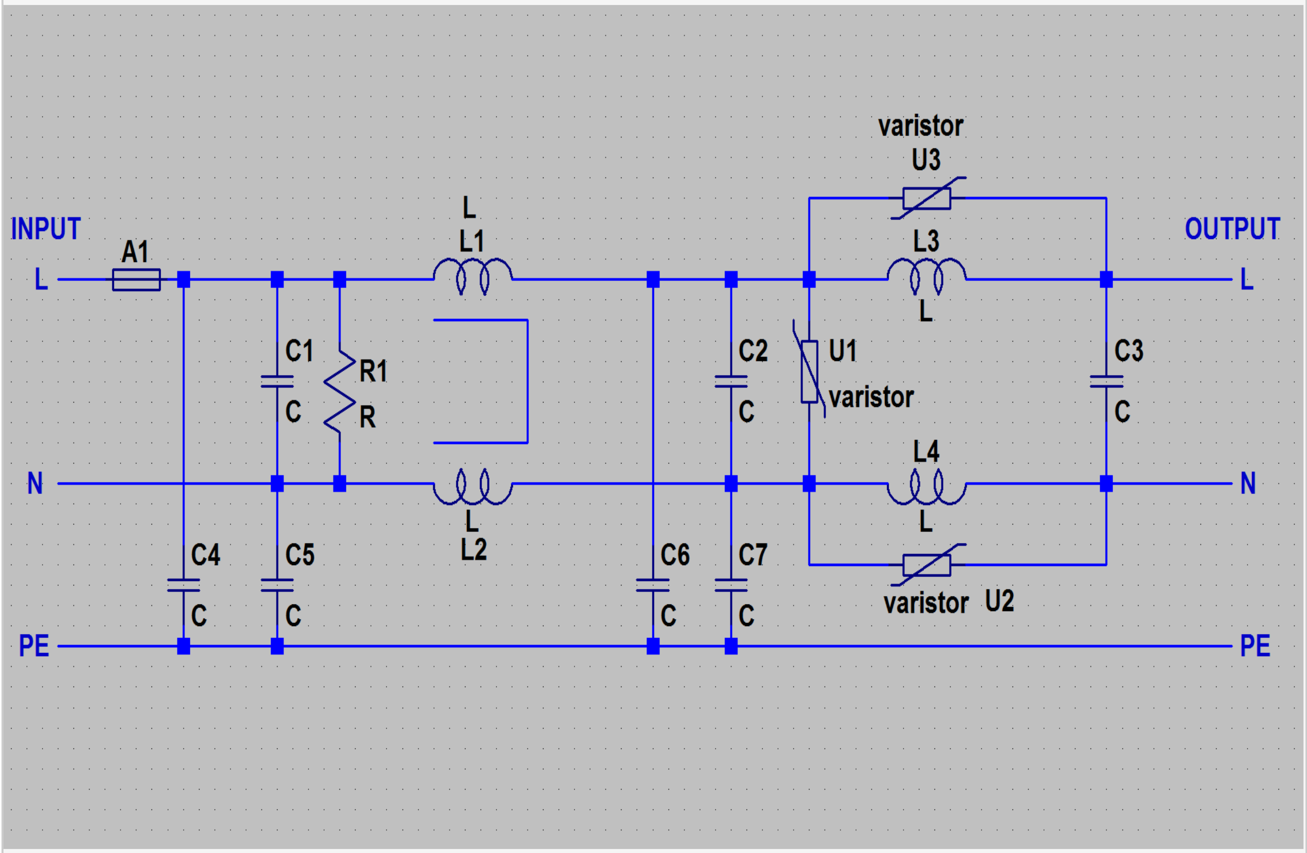


Figure 18-11: Block diagram of PSU-FLTR-MARINE

18.4.1 Installation and Electric Connection

The filter must be fixed on vertical mounting surfaces by 100mm wide DIN Rail (not part of the filter)

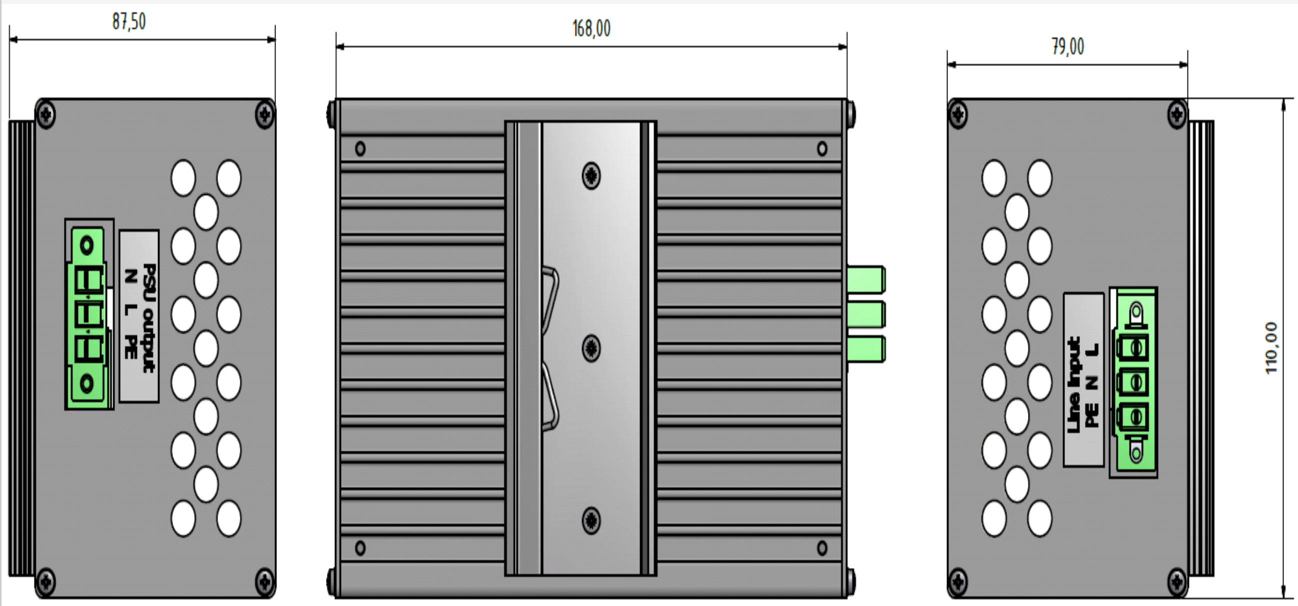


Figure 18-12: DIN Rail fixed on vertical mounting surfaces by 100mm wide

There is also an option that the DIN Rail holder could be replaced by an adapter plate as shown beneath. This plate is not part of the standard product packaging (this is just shown as an example)

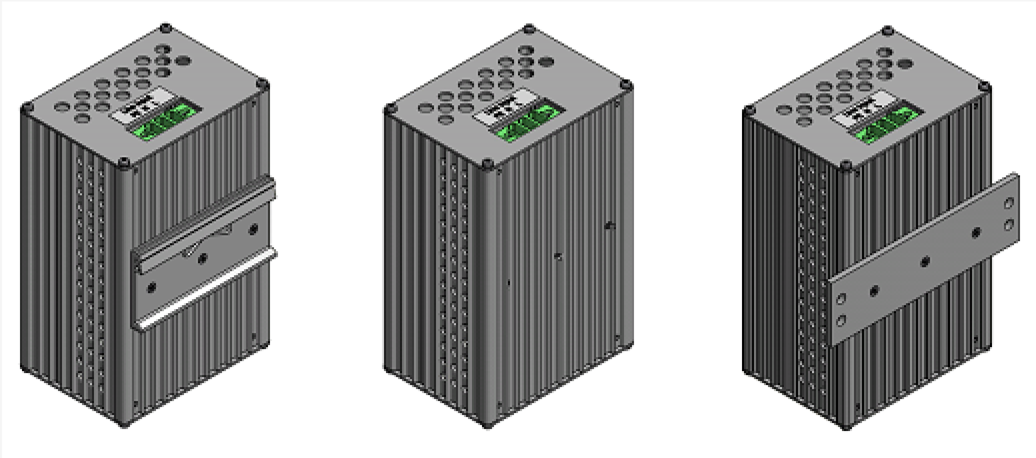


Figure 18-13: DIN Rail holder replaced by an adapter plate

The three figures shows the following steps :

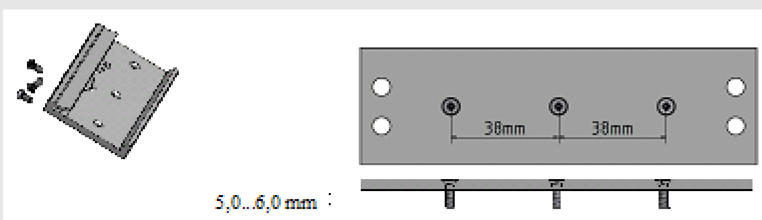
a) remove the 3 screws from DinRail holder

b) order fixing plate with 38mm

c) fix plate with 3 screws type M3 distance between the holes

Caution:

- Screws must be 5,0 to 6,0mm long.
- Pull screws with a torque of 0.5 Nm.



18.4.1.1 Mounting

a) Horizontal mounting

The figure shows the position of the PSU-FLTR-MARINE V2.0 when it is put horizontal.

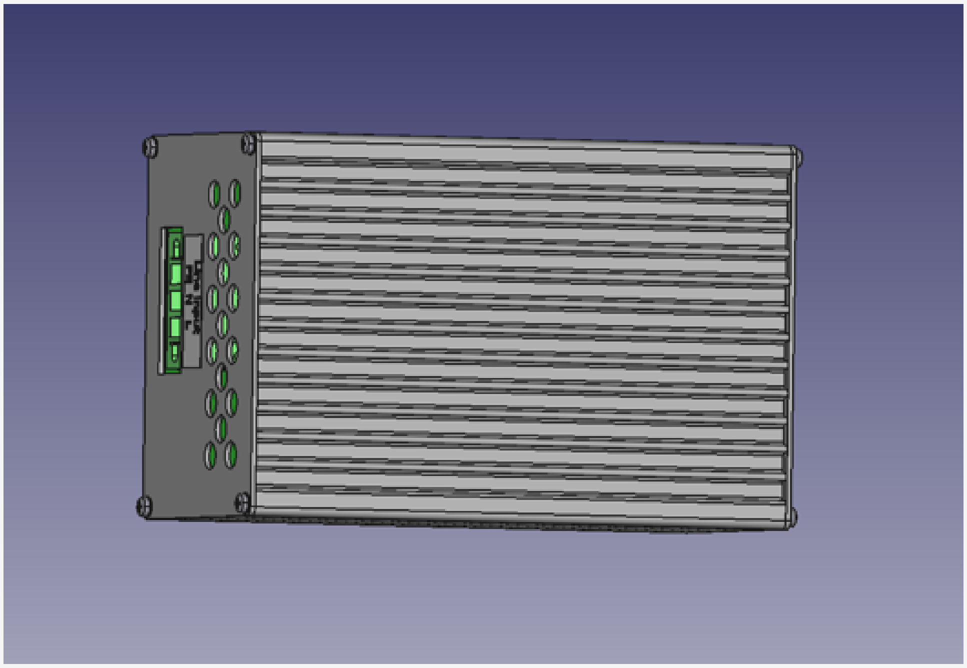


Figure 18-14: Horizontal mounting of PSU-FLTR-MARINE V2.0

Attention:
For sufficient cooling by natural convection ensure 5 cm clearance on sides and front and 10 cm on bottom and top.

b) Vertical Mounting

The figure shows the position of the PSU-FLTR-MARINE V2.0 when put vertical.

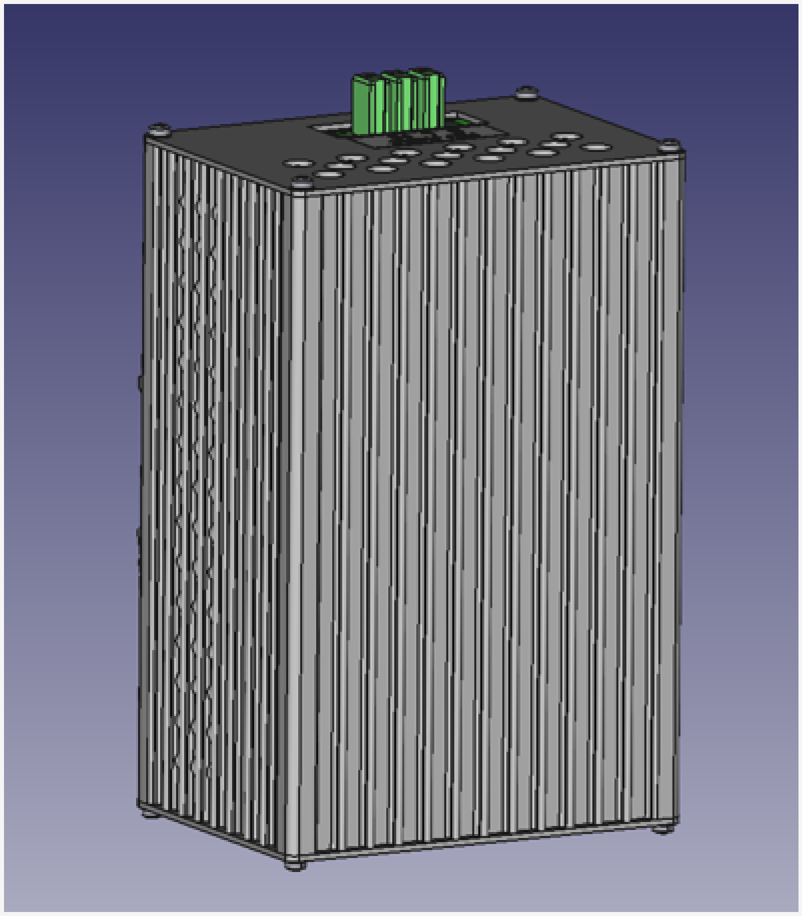


Figure 18-15: Vertical mounting of PSU-FLTR-MARINE V2.0

Attention:
For sufficient cooling by natural convection ensure 5 cm clearance on sides and front and 10 cm on bottom and top

18.5 MB-0001

18.5.1 Mains power rail (24Vdc—110Vdc) with 10 sections

The MB-0001 mains power rail distributes a DC voltage in the range of 24Vdc - 110Vdc from (multiple) redundant power supplies to its users.

The MB-0001 mains power rail has 120 connection points and can distribute up to 200 A. Connection to the rail requires special connectors.

They may be of type Jackscrew (JCK) or of type Squeeze-To-Release (STR), as shown in the below figure .

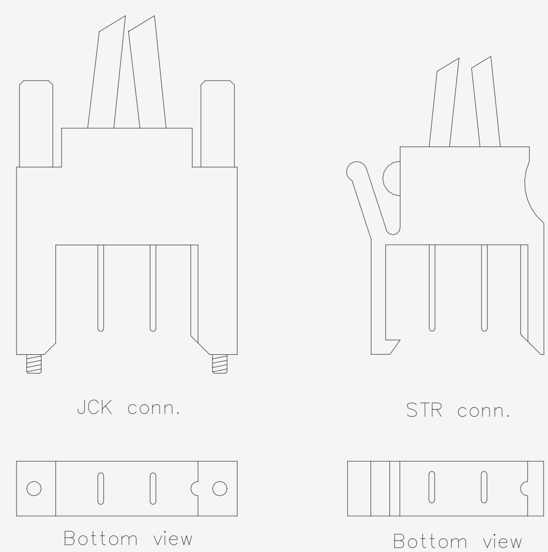


Figure 18-16: JCK and STR type connectors for the MB-0001

The below figure shows that the MB-0001 mains power rail consists of:

- Two copper rails,
- Two end caps and
- Ten 6 inch sections.

Each section has twelve connector positions.

- The second, fifth, eighth and the eleventh connector position of each section have nuts in the housing to accommodate for JCK connectors.
- All (twelve) positions (of each section) can be used for STR connectors.

18.5 MB-0001

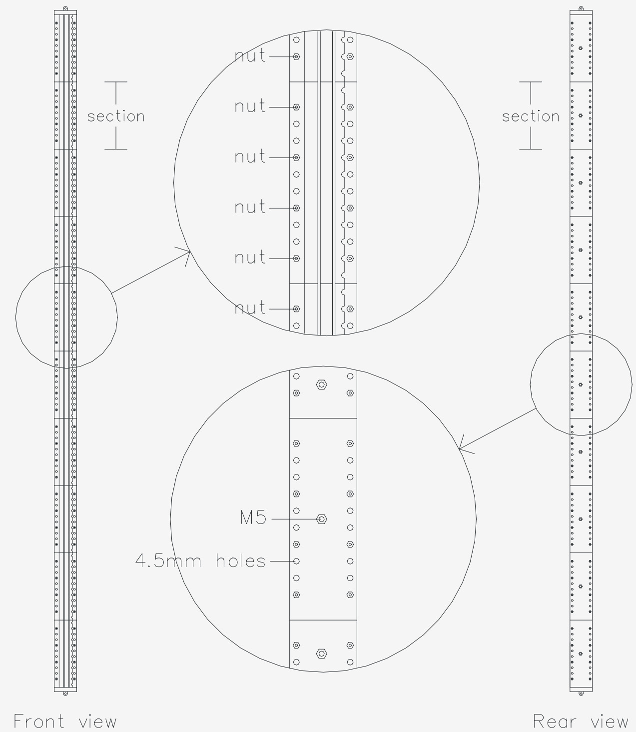


Figure 18-17: MB-0001 – 10 section power rail, front view and rear view

The rail can be mounted using the M5 thread hole on the rear centre of the rail, as shown in the above figure.

Mounting without rear access is possible using the 4.5mm diameter holes on both sides of the rail and on each end cap.

18.5.2 Technical data

General	Type number:	FS-MB-0001
	Approvals:	UL, CSA, FM pending
Load	Rail current:	max. 200 A
Connectors	D-TAB-200-JCK	max. 55 A (with AWG 8 wire)
	D-TAB-200-STR	max. 25 A (with AWG 12 wire)
	Temperature rail and JCK connector	max. 125°C (257°F)
	Temperature STR connector	max. 105°C (221°F)
Sections	quantity per rail	10
	JCK positions per section	max 4
	STR positions per section	max 12
	length per section	152.4 mm (6 inch)
Physical	Rail dimensions	1563 x 5.08 x 34.8 mm (L x W x H)
		61.52 x 2.0 x 1.37 in (L x W x H)
	Weight	3.7kg (8.16 lb)
	M5 mounting thread hole	6.5mm (0.256 inch) depth, 152.4mm (6 inch) mounting interval

18.6 MB-0002

18.6.1 Mains power rail (24Vdc—110Vdc) with 4 sections

The MB-0002 mains power rail distributes a DC voltage in the range of 24Vdc- 110Vdc from (multiple) redundant power supplies to its users.

The MB-0002 mains power rail has 48 connection points and can distribute up to 200 A. Connection to the rail requires special connectors.

They may be of type Jackscrew (JCK) or of type Squeeze-To-Release (STR), as shown in the below figure.

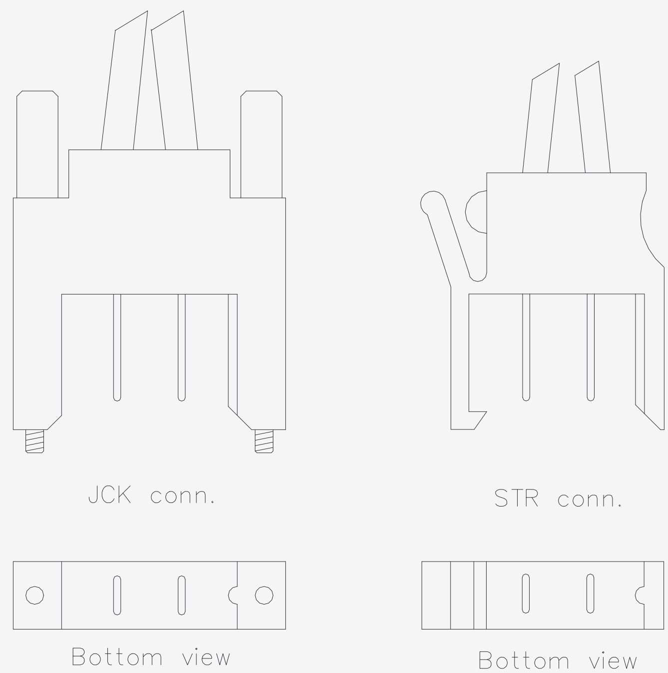


Figure 18-18: JCK and STR type connectors for the MB-0002

The below figure shows that the MB-0002 mains power rail consists of:

- Two copper rails,
- Two end caps and
- Four 6 inch sections.

Each section has twelve connector positions.

- The second, fifth, eighth and the eleventh connector position of each section have nuts in the housing to accommodate for JCK connectors.
- All (twelve) positions (of each section) can be used for STR connectors.

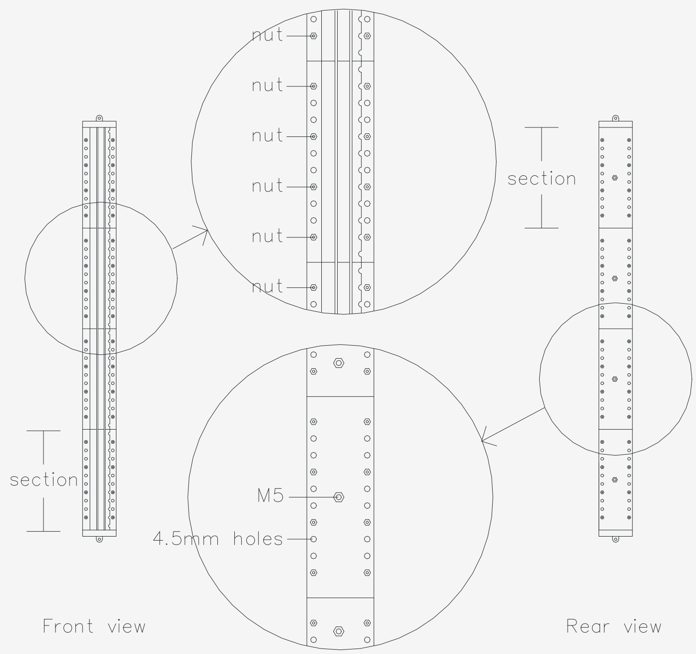


Figure 18-19: MB-0002 – 4 section power rail, front view and rear view

The rail can be mounted using the M5 thread hole on the rear centre of the rail, as shown in the above figure.

Mounting without rear access is possible using the 4.5mm diameter holes on both sides of the rail and on each end cap.

18.6.2 Technical data

General	Type number:	FS-MB-0002
	Approvals:	UL, CSA, FM pending
Load	Rail current:	max. 200 A
Connectors	D-TAB-200-JCK	max. 55 A (with AWG 8 wire)
	D-TAB-200-STR	max. 25 A (with AWG 12 wire)
	Temperature rail and JCK connector	max. 125°C (257°F)
	Temperature STR connector	max. 105°C (221°F)
Sections	quantity per rail	4
	JCK positions per section	max 4
	STR positions per section	max 12
	length per section	152.4 mm (6 inch)
Physical	Rail dimensions	649 x 5.08 x 34.8 mm (L x W x H)
		25.52 x 2.0 x 1.37 in (L x W x H)
	Weight	1.5kg (3.3 lb)
	M5 mounting thread hole	6.5mm (0.256 inch) depth, 152.4mm (6 inch) mounting interval

18.7 MB-0003

18.7.1 Mains power rail (24Vdc—110Vdc)) with 6 sections

The MB-0003 mains power rail distributes a DC voltage in the range of 24Vdc - 110Vdc from (multiple) redundant power supplies to its users.

The MB-0003 mains power rail has 72 connection points and can distribute up to 200 A. Connection to the rail requires special connectors.

They may be of type Jackscrew (JCK) or of type Squeeze-To-Release (STR), as shown in the below figure.

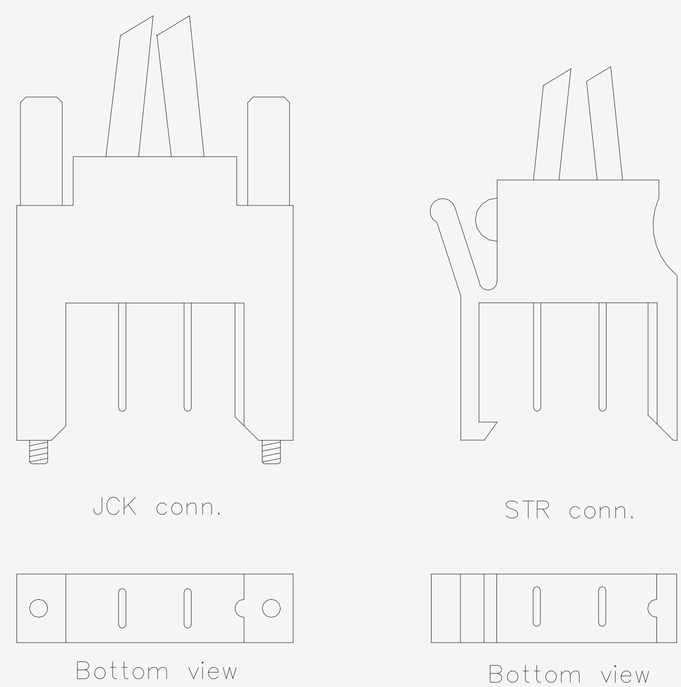


Figure 18-20: JCK and STR type connectors for the MB-0003

The below figure shows that the MB-0003 mains power rail consists of:

- Two copper rails,
- Two end caps and
- Ten 6 inch sections.

Each section has twelve connector positions.

- The second, fifth, eighth and the eleventh connector position of each section have nuts in the housing to accommodate for JCK connectors.
- All (twelve) positions (of each section) can be used for STR connectors.

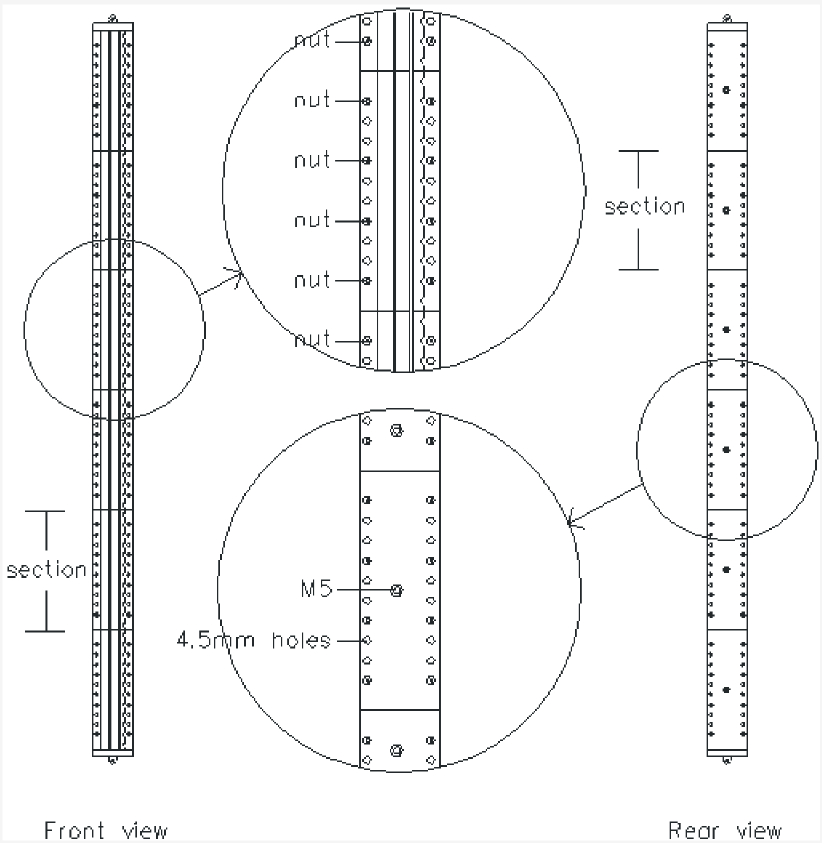


Figure 18-21: MB-0003 – 6 section power rail, front view and rear view

The rail can be mounted using the M5 thread hole on the rear centre of the rail, as shown in the below figure.

Mounting without rear access is possible using the 4.5mm diameter holes on both sides of the rail and on each end cap.

18.7.2 Technical data

General	Type number:	FS-MB-0003
	Approvals:	UL, CSA, FM pending
Load	Rail current:	max. 200 A
Connectors	D-TAB-200-JCK	max. 55 A (with AWG 8 wire)
	D-TAB-200-STR	max. 25 A (with AWG 12 wire)
	Temperature rail and JCK connector	max. 125°C (257°F)
	Temperature STR connector	max. 105°C (221°F)
Sections	quantity per rail	6
	JCK positions per section	max 4
	STR positions per section	max 12
	length per section	152.4 mm (6 inch)
Physical	Rail dimensions	954 x 5.08 x 34.8 mm (L x W x H)
		37.52 x 2.0 x 1.37 in (L x W x H)
	Weight	2.22 kg (4.9 lb)
	M5 mounting thread hole	6.5mm (0.256 inch) depth, 152.4mm (6 inch) mounting interval

18.8 PDB-0824P

18.8.1 Power Distribution Board (24Vdc, 2 A, 8 channel)

The PDB-0824P power distribution board enables easy distribution of 24Vdc from the main power rail to individual 24Vdc devices inside the cabinet enclosure, such as fan units and FTAs.

The below figure shows the PDB-0824P board with one 24Vdc entry connector (In) for connection to the main bus bar and eight (2 A fused) 24Vdc field connectors (Out1 thru Out8) for connection to eight 24Vdc devices.

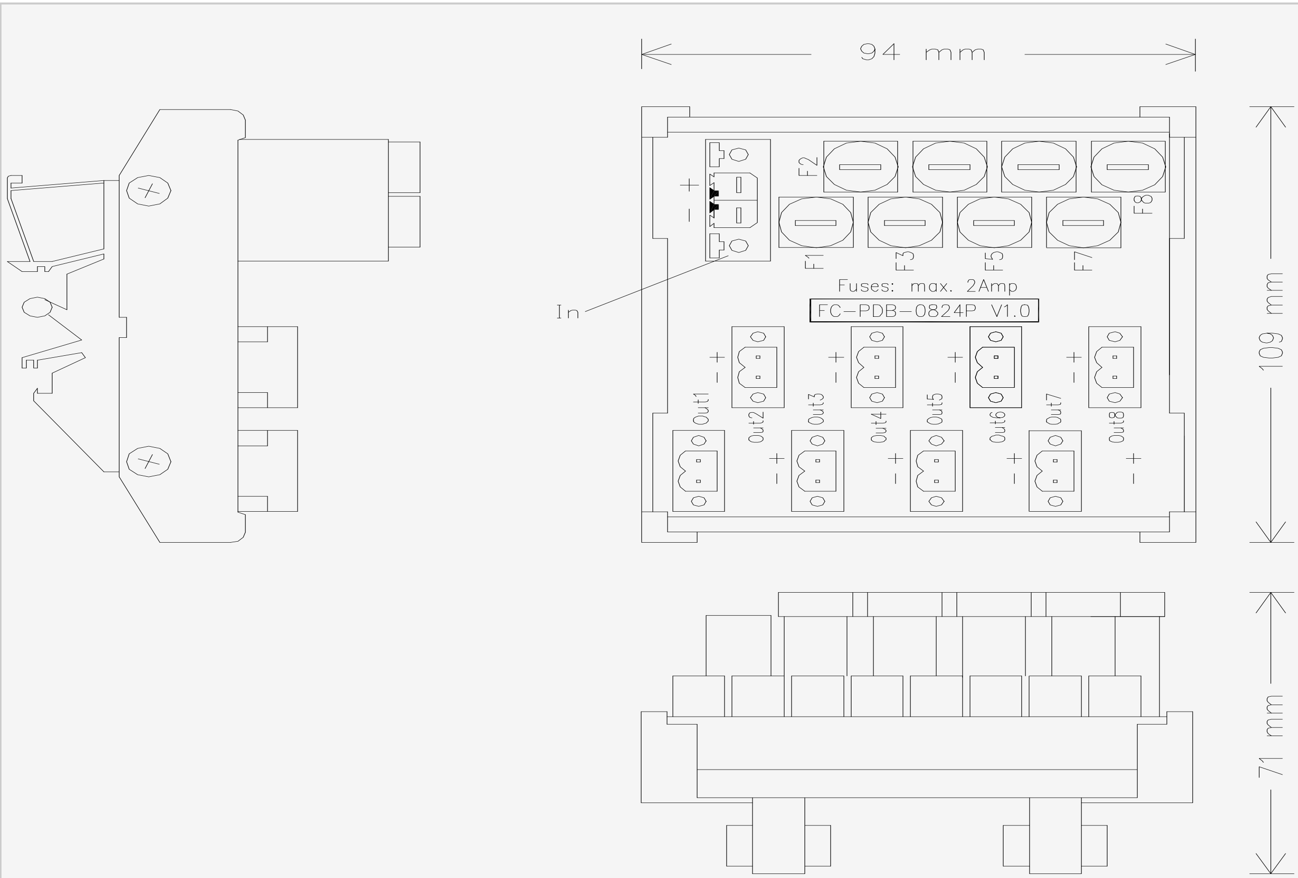


Figure 18-22: PDB-0824P board layout

A 24 V DC power distribution cable (see data sheet PDC-MB24-y for details) can be used to connect the main power bar to In.

- When using other connection cables make sure the wire size is adequate and a Weidmuller BVZ 7.62HP/02F SN connector with two keying pins is used to connect to In of the PDB-0824P (see Pin allocation).

24V distribution cables (see PDC-FTA24P) connect the PDB-0824P with up to eight 24Vdc devices.

- When using other connection cables make sure the wire size is adequate and a Weidmuller BLZ 5.08/2F SN SW or equivalent connector (e.g. BL 5.08/2 SN OR) is used to connect to one of the Outx connectors of the PDB-0824P (see Pin allocation).

18.8.2 Pin allocation

The below figure shows the top, side & bottom view and the pin assignment of the Weidmuller BVZ 7.62HP/02F SN cable-connector on In.

1. The pin marked "+" is pin 1; connect to +24Vdc wire to the main bus bar
2. The pin marked "-" is pin 2; connect to 0Vdc wire to the main bus bar

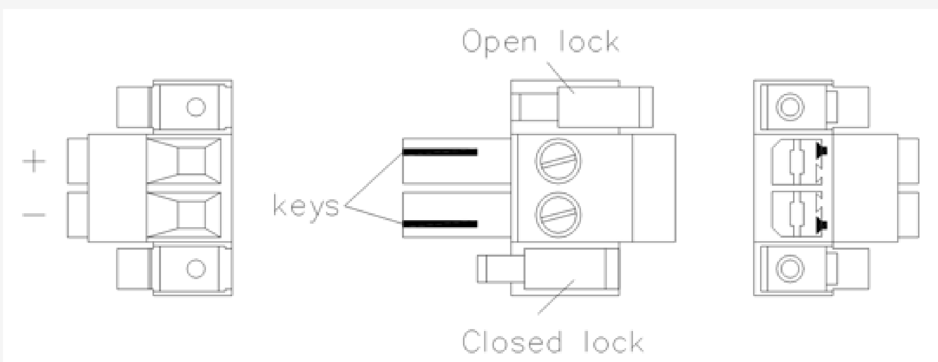


Figure 18-23: Power connector on In (Weidmuller BVZ 7.62HP/02F SN) top, side and bottom view

The two (red) locking slides of the cable-connector in Figure 528 on page 857 keep the cable-connector locked when inserted into In.

The below figure shows the top, side & bottom view and the pin assignment of the Weidmuller BLZ 5.08/2F SN SW.

1. The pin marked "+" is pin 1; connect to +24Vdc wire to the consumer
2. The pin marked "-" is pin 2; connect to 0Vdc wire to the consumer

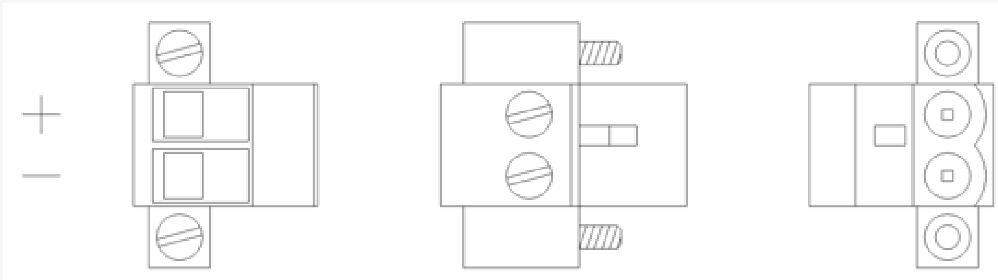


Figure 18-24: Power connector on Outx (Weidmuller BLZ 5.08/2F SN SW) top, side and bottom view

18.8.3 Connections

The connection diagram of the PDB-0824P module:

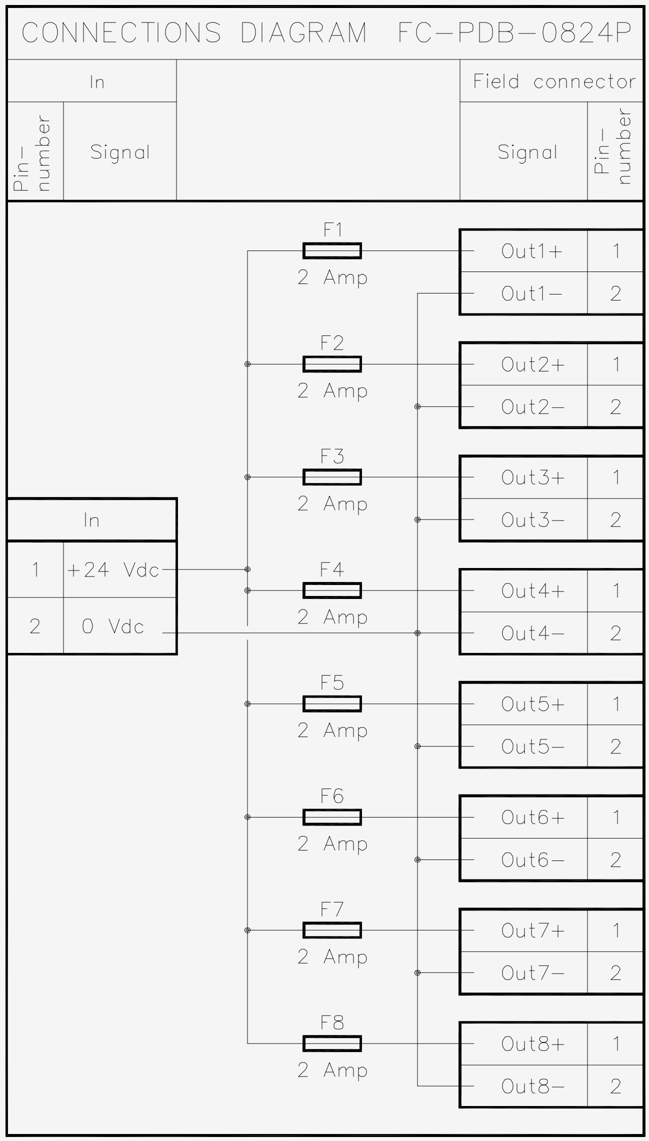


Figure 18-25: Connection diagram

18.8.4 Technical data

General	Type number:	FC-PDB-0824P
	Approvals:	CE; UL, TUV, CSA pending
Fuse	Fuse rating	2 A
	Fuse dimensions:	5x20 mm
	Voltage rating AC:	250 V
	Voltage rating DC:	300 V
	Manufacturer:	Schurter
	Manufacturer PN:	0001.2507
	Dearting curve:	Linear from 2 A at 25 dC to 1.4 A at 70 dC module ambient
Connectors	In	2 pole header with keying
	make and type:	• Weidmuller: BVZ 7.62HP/02F SN (conn.) • Weidmuller: BV/SV7.62HP KO (keys)
	Field connector make and type:	2 pole socket block Weidmuller: BLZ 5.08/2F SN SW
Physical	Module dimensions:	94 x 109 x 71 mm (L x W x H) 3.7 x 4.3 x 2.8 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	95 mm (3.74 in)

18.9 PDC-MBMB-1

18.9.1 Mains power distribution cable (24Vdc, 48Vdc)

The PDC-MBMB-1 power distribution cable transfers the 24Vdc or 48Vdc from one mains power rail of type MB-0001 to another mains power rail of that type.

The below figure shows the layout of the PDC-MBMB-1 power distribution cable.

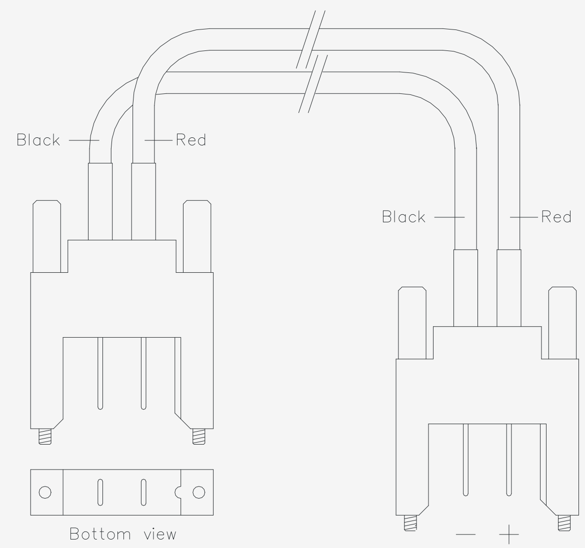


Figure 18-26: Layout of PDC-MBMB-1 power distribution cable

The cable plugs in the mains power rail with a polarized connector that must be locked on the rail using its two screws. To enable this, the plug must be placed on one of the rail positions that has nuts in the rail housing (see the below figure).

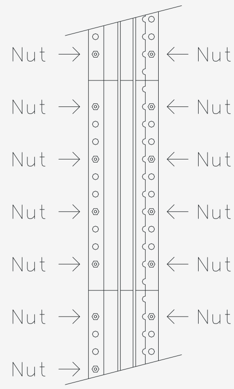


Figure 18-27: Section of the MB-0001 mains power rail

18.9.2 High loads

With second rail loads exceeding 30 A (up to 100 A) it is recommended to use two PDC-MBMB-1 cables to connect the two power rails.

- Connect the first cable close to the top of each power rail.
- Connect the second cable close to the bottom of each power rail.

18.9.3 Technical data

General	Type number:	FS-PDC-MBMB-1
	Approvals:	UL, CSA; FM pending
Cables	Type:	HV8-55-c (AWG 8)
	Length:	3 meter
Connectors	2-pole Jackscrew	
	Type connector:	D-TAB-200-JCK
	Type pin:	D-TAB-200-8-S
	Power rating:	55 A
	Temperature:	max. 125°C (257°F)

18.10 PDC-CPSET

18.10.1 Power distribution cable set Control Processor (24Vdc)

The PDC-CPSET power distribution cable-set transfers power from the 24 V DC mains bus bar type MB-0001 to the Controller chassis.

The set consists of 2 power cables, one for each Control Processor.

The cables are placed on the appropriate connectors on the backplane (24V-1 and 24V-2 see the below figure).

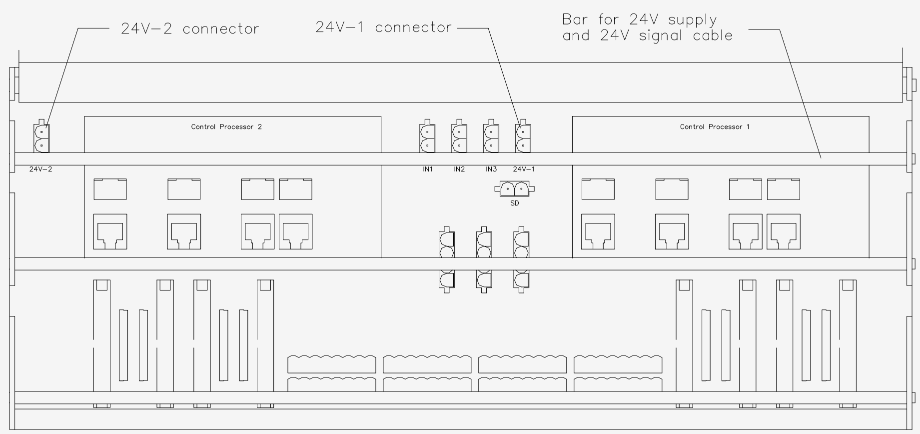
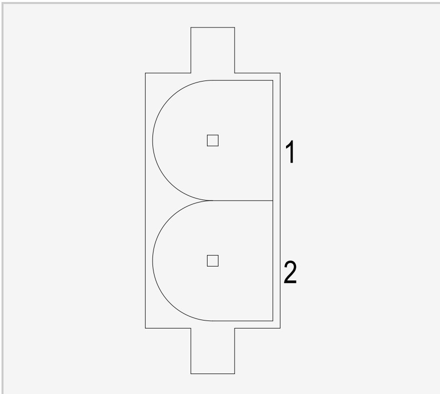


Figure 18-28: Position of 24 V connectors on the Safety Manager Controller backplane

18.10.2 Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:

		24V-1	24V-2
	1	+24V for CP1	+24V for CP2
	2	0V for CP1	0V for CP2

18.10.3 Layout

The below figure shows the layout of the PDC-CPSET power distribution cable set.

- The PDC-CP24-1 (the short cable in the below figure) connects CP1 with the 24V supply. This cable is placed between the 24V-1 connector on the Safety Manager Controller backplane and the 24 V DC mains bus bar, type MB-0001.
- The PDC-CP24-2 (the long cable in the below figure) connects CP2 with the 24V supply. This cable is placed between the 24V-2 connector on the Safety Manager Controller backplane and the 24 V DC mains bus bar, type MB-0001.

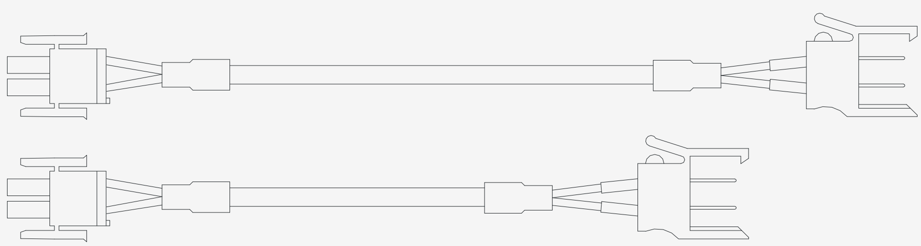


Figure 18-29: Layout of the PDC-CPSET power distribution cables

18.10.4 Technical data

General	Type number:	FS-PDC-CPSET
	Approvals:	UL, CSA; FM pending
Cable	Type:	CC600 2 x 2.5 mm^2
	Length FS-PDC-CP24-1:	54 cm (21.26 in)
	Length FS-PDC-CP24-2:	77 cm (30.31 in)
Connectors	Bus bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	SM Controller side:	2 pole mate-n-lock

18.11 PDC-IOSET

18.11.1 Power distribution cable set IO chassis (24Vdc, 48Vdc or 110Vdc)

The PDC-IOSET power distribution cables of the IO chassis transfer 24 V DC, 48 V DC or 110Vdc from mains power rails of type MB-0001 to the IO chassis. The below figure shows the position of the IP1, EP1, EP2, and EP3 connector on the back of an IO chassis.

Attention:
To avoid assembly mistakes the use of color coded labels and/or sleeves is recommended on both the cable sets and the connectors when applied for voltages other than 24Vdc.

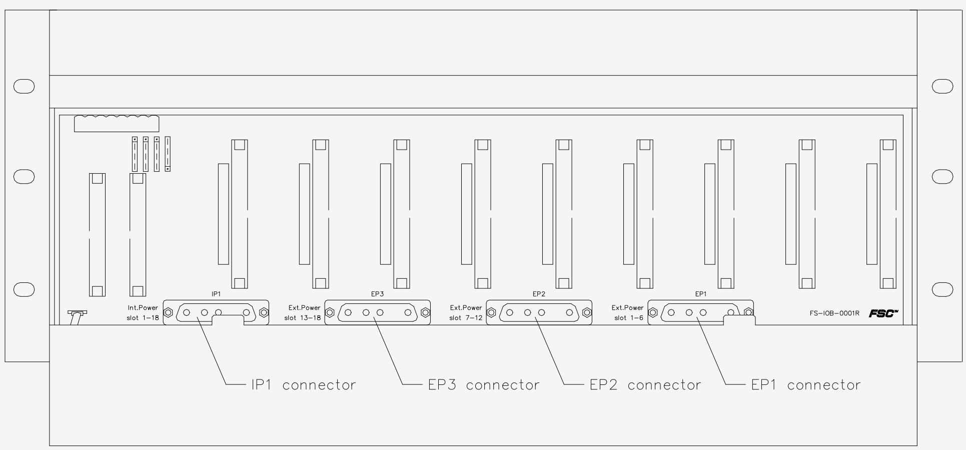


Figure 18-30: Position of the power connectors on an IO backplane

The following module slots are powered by the IO chassis power distribution cables:

IO module slots	Power supply voltage	Cable
1-6	External	PDC-IOEP1a
7-12	External	PDC-IOEP2a
13-18	External	PDC-IOEP3a
All	Internal	PDC-IOIP1a

18.11.2 Pin allocation

The pin allocation of the external power connectors EP1, EP2 and EP3 of a redundant IO chassis are:

Pin	Marking	EP3	EP2	EP1
1	Red (1)	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	Black (1)	0 Volt	0 Volt	0 Volt
4	Black (2)	0 Volt	0 Volt	0 Volt
5	Red (2)	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The pin allocation of the internal power connector IP1 of a redundant IO chassis is:

Pin	Marking	IP1	To slot
1	Red (1)	IP	1, 3, 5, 7, 9, 11, 13, 15 and 17
3	Black (1)	0 Volt	
4	Black (2)	0 Volt	
5	Red (2)	IP	2, 4, 6, 8, 10, 12, 14, 16 and 18

The pin allocation of the External Power connectors EP1, EP2 and EP3 of a non-redundant IO chassis are:

Pin	marking	EP3	EP2	EP1
1	Red (1)	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	Black (1)	0 Volt	0 Volt	0 Volt
4	Black (2)	0 Volt	0 Volt	0 Volt
5	Red (2)	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

The pin allocation of the Internal Power connector IP1 in a non-redundant IO chassis is:

Pin	Marking	IP1
1	Red (1)	IP slot 1-9
3	Black (1)	0 Volt
4	Black (2)	0 Volt
5	Red (2)	IP slot 10-18

18.11.3 Layout

The below figure shows the layout of the PDC-IOSET power distribution cables.

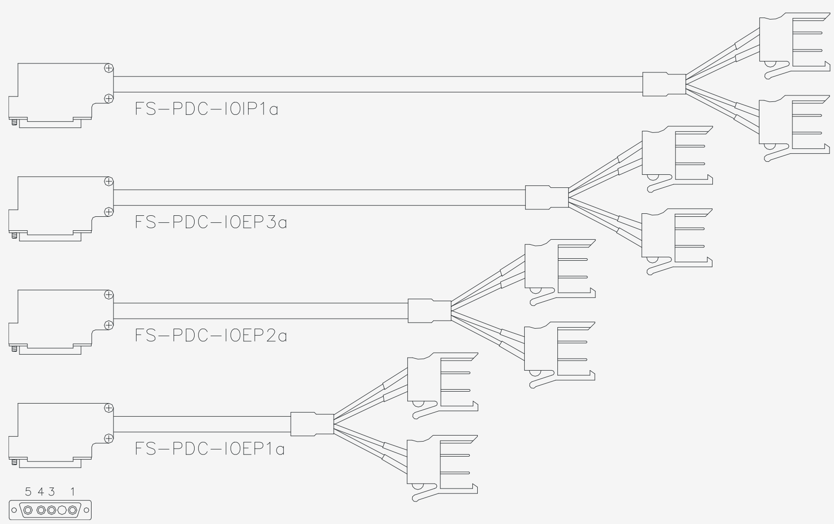


Figure 18-31: Layout of the PDC-IOSET power distribution cables

18.11.4 Technical data

General	Type number:	FS-PDC-IOSET
	Approvals:	UL, CSA; FM pending
Cable	Type:	CC 600 World 4 × 2.5 mm^2
	Length:	33 cm (FS-PDC-IOEP1a) 41 cm (FS-PDC-IOEP2a) 49 cm (FS-PDC-IOEP3a) 57 cm (FS-PDC-IOIP1a)
Connectors	Bus bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	IO chassis side:	FM5W5 S (female) housing: low profile, 90°

18.12 PDC-MB24-y

18.12.1 Power Distribution Cable (24Vdc)

The PDC-MB24-y (where “y” stands for 1P, 2P or 3P) power distribution cables transfer the 24Vdc from the main power rail of type MB-0001 to:

- power distribution boards like the PDB-0824P (for details see PDB-0824P),
- FTAs equipped with a Weidmuller SV 7.62HP/02/180F power connector, keyed for 24Vdc.

The below table provides a listing of available cable types and associated lengths.

Table 1. Type and length of PDC-MB24-y power distribution cables

Cable type	length
PDC-MB24-1P	145 cm (57.1 in)
PDC-MB24-2P	245 cm (96.5 in)
PDC-MB24-3P	325 cm (128.0 in)

18.12.2 Layout

The below figure shows the layout of the PDC-MB24-y power distribution cable.

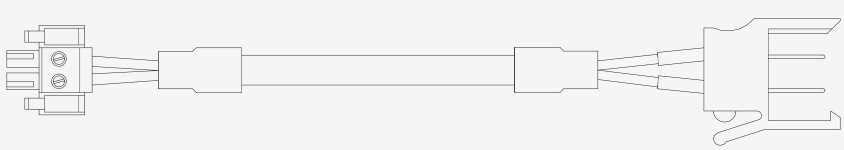


Figure 18-32: Layout of the PDC-MB24-y power distribution cable

18.12.3 FTA/board connector with 24 V DC keying

A Weidmuller BVZ 7.62HP/02F SN cable-connector with 24Vdc keying is used to connect the cable to an FTA or a 24Vdc power distribution board.

The below figure shows the views, keying and the pin assignment of the Weidmuller BVZ 7.62HP/02F SN cable-connector

1. The pin marked "+" is pin 1; connect to +24Vdc wire to the main bus bar
2. The pin marked "-" is pin 2; connect to 0Vdc wire to the main bus bar

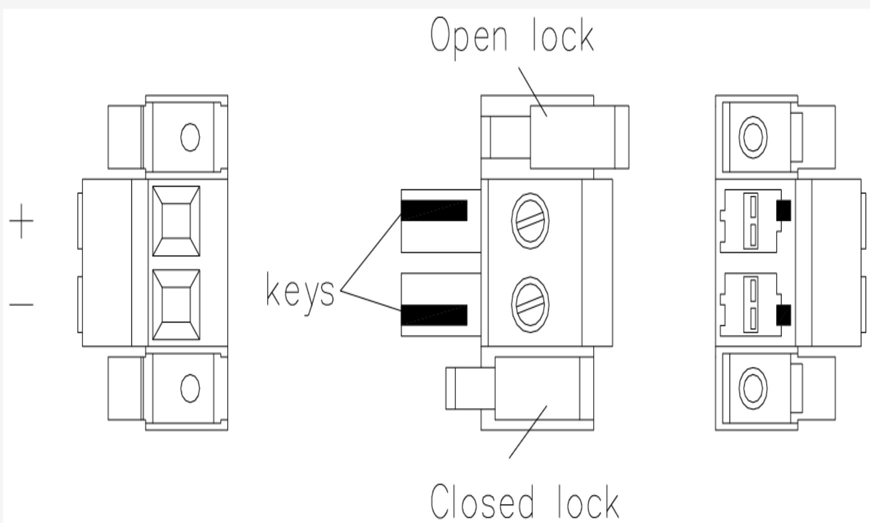


Figure 18-33: FTA/board side connector (Weidmuller BVZ 7.62HP/02F SN) views and 24 V DC keying

Two (red) locking slides of the cable-connector in the above figure keep the cable-connector locked when inserted into the FTA or the power distribution board.

18.12.4 Technical data

General	Type numbers:	FS-PDC-MB24-1P FS-PDC-MB24-2P FS-PDC-MB24-3P
	Approvals:	UL, CSA and FM pending
Cable	Type:	CC600 2 x 6mm^2
	Length FS-PDC-MB24-1P:	145 cm (57.1 in)
	Length FS-PDC-MB24-2P	245 cm (96.5 in)
	Length FS-PDC-MB24-3P:	325 cm (128.0 in)
Connectors	mains power bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	FTA / board side:	2 pole header with keying Weidmuller: BVZ 7.62HP/02F SN
	FTA / board keying	Weidmuller: BV/SV7.62HP KO

18.13 PDC-FTA24P

18.13.1 Power Distribution Cable (24Vdc)

The PDC- FTA24P power distribution cables transfer the 24Vdc from the PDB- 0824P power distribution board to individual 24Vdc devices inside the cabinet enclosure, such as fan units and FTAs.

(For details on the PDB-0824P power distribution board see “PDB-0824P”.)

Unlike the PDC-FTA24, the PDC-FTA24P includes screws for connection. Both can be used on the PDB-0824 as well the PDB- 0824P. They are fully interchangeable because PDC- FTA24 is obsolete.

The PDC-FTA24Pis equipped with a connector on the PDB-0824 side, and no connector on the device side.

The below figure shows the layout of the PDC-FTA24Ppower distribution cable.

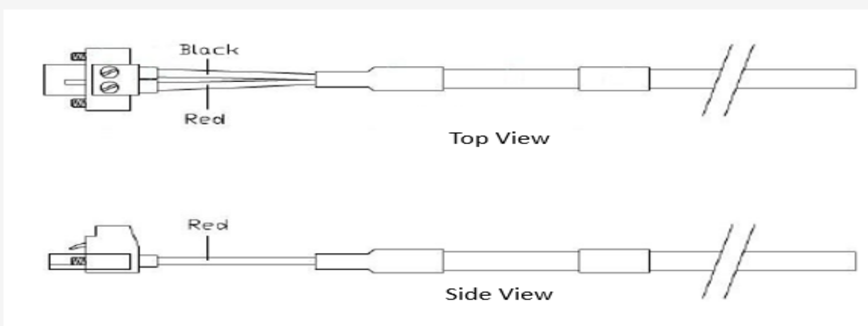


Figure 18-34: Layout of the PDC-FTA24P power distribution cable

Before connecting the PDC-FTA24P to the device, its wires must be cut to the required length and fitted with a suitable connector for the device. In the above figure:

- The red wire represents the +24Vdc.
- The black wire represents the 0Vdc.

18.13.2 Technical data

General	Type numbers:	FS-PDC-FTA24P
	Approvals:	UL, CSA; FM pending
Cable	Type:	2 x 1.31 mm2 (AWG 16) tri-rated
	Length:	2 m (78.74 in)
Connector	Housing type:	2 pole socket block Weidmuller BLZ 5.08/2F
	Crimp pin type:	Weidmuller DFFC 1.5-2.5 SN E

CHAPTER 19

5 VOLT AND WATCHDOG DISTRIBUTION

19 5 Volt and watchdog distribution

This chapter describes the 5 Volt and Watchdog distribution boards and cables.

Item		See
Volt and Watchdog distribution layout - general information		Volt and Watchdog distribution layout
modules - Safety Manager and Safety Manager A.R.T.		
PDB-IOX05	Power Distribution Board extension IO cabinet (5 V DC, Watchdog)	PDB-IOX05
PDB-IO05	Power Distribution Board extension IO cabinet (5 V DC, Watchdog)	PDB-IO05
PDB-CPX05	Power Distribution Board Controller cabinet (5 V DC, Watchdog)	PDB-CPX05
modules - Safety Manager A.R.T.		
PDB-ARTF05	Fused Power Distribution Board for IO cabinet - 5 V DC, Watchdog (Safety Manager A.R.T.)	PDB-ARTF05
cables - Safety Manager and Safety Manager A.R.T.		
PDC-IOX05-x	Power Distribution Cable for IO cabinets (5 V DC, Watchdog)	PDC-IOX05-x
PDC-CPX05	Power Distribution Cable for controller cabinets (5 V DC, Watchdog)	PDC-CPX05
cables - Safety Manager		
PDC-IOS05	Power Distribution Cable for a non-redundant IO chassis - 5 V DC, Watchdog (Safety Manager)	PDC-IOS05
PDC-IOR05	Power Distribution Cable for a redundant IO chassis - 5 V DC, Watchdog (Safety Manager)	PDC-IOR05
cables - Safety Manager A.R.T.		
PDC-ART05	Power Distribution Cable for an IO chassis - 5 V DC, Watchdog (Safety Manager A.R.T.)	PDC-ART05

19.1 5 Volt and Watchdog distribution layout

This sub-section contains these topics:

- 5 Volt and Watchdog distribution layout (Safety Manager); see Volt and Watchdog distribution layout (Safety Manager),
- 5 Volt and Watchdog distribution layout (Safety Manager A.R.T.); see Volt and Watchdog distribution layout (Safety Manager A.R.T.).

19.1.1 Volt and Watchdog distribution layout (Safety Manager)

The 5V supply voltages and watchdog signals of Safety Manager are generated in the Controller chassis (see CPCHAS-0001). These signals are available on the backplane of the Controller chassis.

The below figure shows a -simplified- view of the Controller backplane.

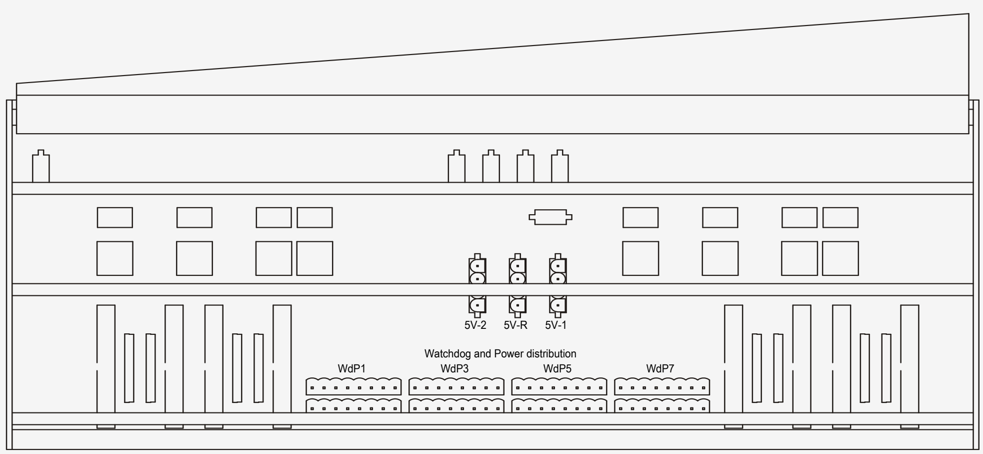


Figure 19-1: Position of the 5V and Wd connectors on a Controller backplane

Attention:
The connectors that are used on the cables for Watchdog and 5V distribution can be sensitive to mechanical tension. These cables are connected to WdP1 thru WdP8 on the CP backplane and WdP on IO backplanes. Make sure that the cables are appropriately secured to avoid inadvertant disconnection.

The eight WdPx connectors (two rows of four connectors) at the bottom middle of Figure 546 on page 881 are used to transfer watchdog and power (5V) to the IO-chassis in the controller cabinet.

19 5 Volt and watchdog distribution

19.1 5 Volt and Watchdog distribution layout

The three 5V-x connectors (5V-2, 5V-R and 5V-1) in the center of the above figure are used to transfer watchdog and 5V to the IO chassis in the extension cabinet(s).

The below figure shows the watchdog and power (5V) connector on a -simplified- non-redundant IO backplane IOCHAS-0001.

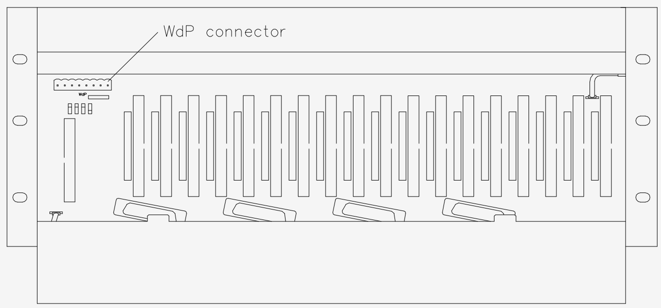


Figure 19-2: Position of the WdP connector on a non-redundant IO chassis

The below figure shows the watchdog and power (5V) connector on a -simplified- redundant IO backplane.

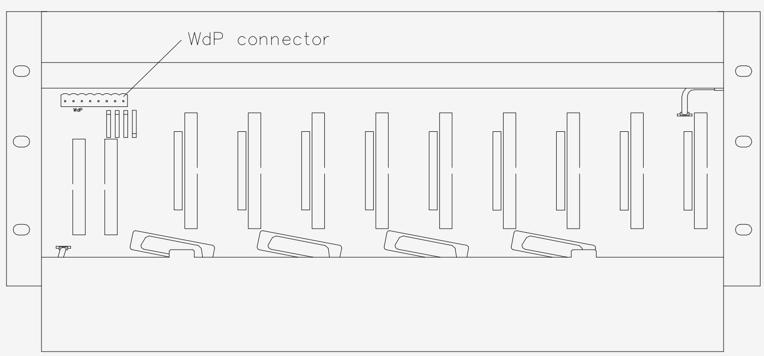


Figure 19-3: Position of the WdP connector on a redundant IO chassis

The below figure shows the watchdog and 5V distribution inside a controller cabinet (left) and inside an IO extension cabinet (right).

In a controller cabinet, all cables come from the CP chassis backplane. In an IO extension cabinet, all cables come from an PDB-IOX05 board (see PDB-IOX05).

The used cable depends on the IO chassis type that is connected:

- Non-redundant IO chassis require the PDC-IOS05 cable (see PDC-IOS05).

- Redundant IO chassis require the PDC-IOR05 cable (see PDC-IOR05).

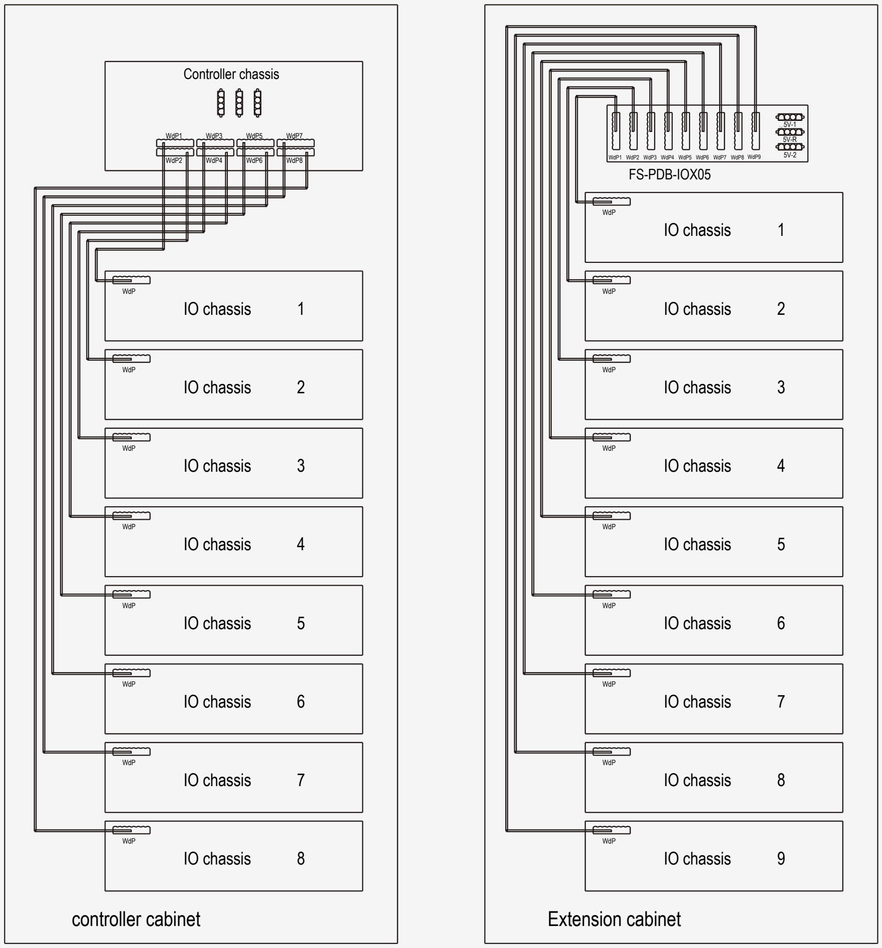


Figure 19-4: 5V and Wd distribution wiring in a controller cabinet resp. extension cabinet

The below figure shows the 5V and watchdog distribution between the controller cabinet and a single IO extension cabinet.

All (three) cables to the IO extension cabinet are of the type PDC-IOX05-1 (see PDC-IOX05-x).

The cable on connector '5V-1' carries 0V (ground), the watchdog of CP1 and the 5V of CP1.

The cable on connector '5V-2' carries 0V (ground), the watchdog of CP2 and the 5V of CP2.

19 5 Volt and watchdog distribution

19.1 5 Volt and Watchdog distribution layout

The cable on connector ‘5V-R’ carries 0V (ground), the ‘second’ watchdog output of CP1 and CP2 (for non-redundant IO see Figure 2) and the (redundant) 5V of CP1 and CP2 (see Figure 2).

IO extension cabinets containing only redundant IO use the signals on the ‘5V-1’ and ‘5V-2’ cables.

IO extension cabinets containing only non-redundant IO only use the signals on the ‘5V-R’ cable.

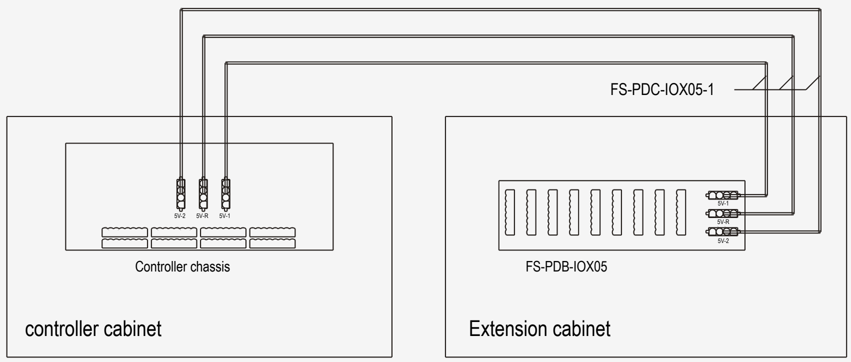


Figure 19-5: 5V and Wd distribution between the controller cabinet and a single IO extension cabinet

The below figure shows the 5V and watchdog distribution between the controller cabinet and more than one IO extension cabinet.

All cables to the IO extension cabinet are of type PDC-IOX05-1 (short) or type PDC-IOX05-2 (long) (see PDB-IOX05). These cables go to an PDB-CPX05 board (see PDB-CPX05) in the controller cabinet.

The PDB-CPX05 board itself is linked to the CP backplane using three PDC-CPX05 cables (see PDC-CPX05).

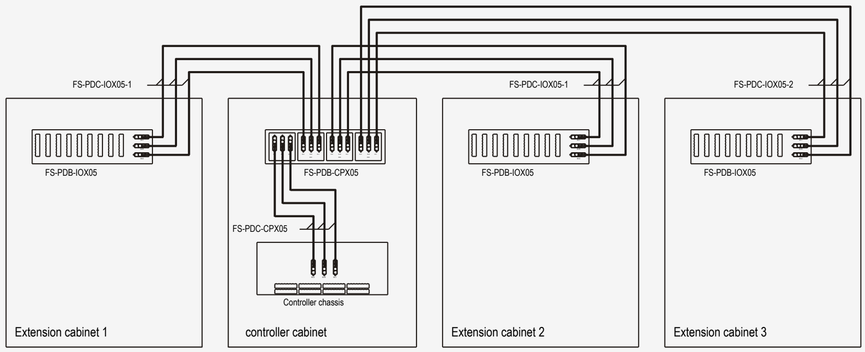


Figure 19-6: 5V and Wd distribution between the controller cabinet and three IO extension cabinets

19.1.2 5 Volt and Watchdog distribution layout (Safety Manager A.R.T.)

The 5V supply voltages and watchdog signals of Safety Manager are generated in the Control Processor chassis (see CPCHAS-0002). These signals are available on the rear side of the Control Processor chassis.

The below figure shows a -simplified- view of the rear side of the Controller chassis.

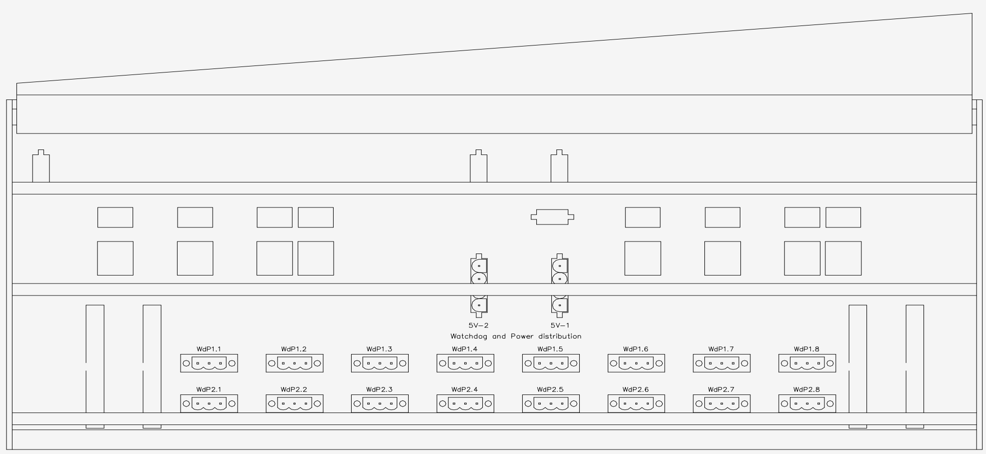


Figure 19-7: Position of the 5V and Wd connectors on the rear side of a Controller chassis

The sixteen WdPx.y connectors (two rows of eight) at the bottom middle of the above figure are used to transfer WatchDog and Power (5 Volt) to the IO-chassis in the controller cabinet of non-UL cabinets.

- The WdP1.y connectors carry the 5V and WD of CP1.
- The WdP2.y connectors carry the 5V and WD of CP2.

19 5 Volt and watchdog distribution

19.1 5 Volt and Watchdog distribution layout

The two 5V-x connectors (5V-2 and 5V-1) in the centre of the above figure are used to transfer WatchDog and 5 Volt to the IO-chassis in an extension cabinet and for all IO-chassis in UL cabinets.

The below figure shows the WatchDog and Power (5 Volt) connectors on the back of a -simplified- non-redundant IO chassis.

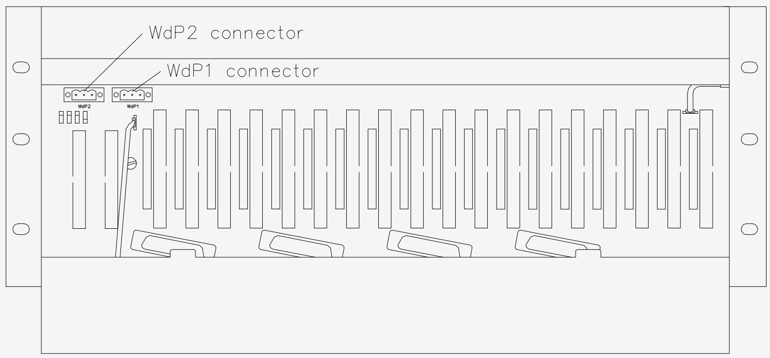


Figure 19-8: Position of the WdP connector on a non-redundant IO chassis

The below figure shows the WatchDog and Power (5 Volt) connectors on the back of a -simplified- redundant IO chassis.

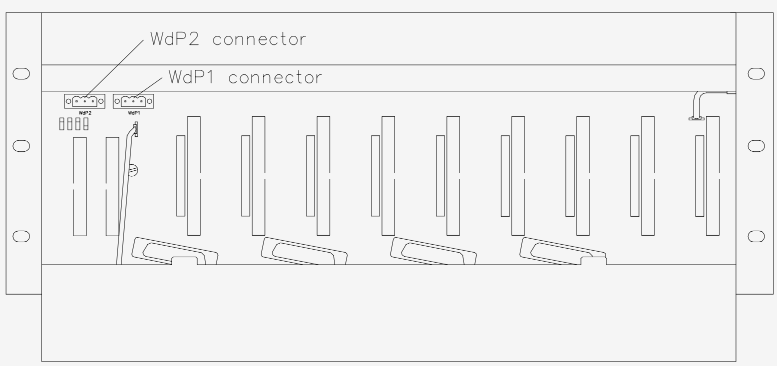


Figure 19-9: Position of the WdP connector on a redundant IO chassis

The below figure shows the WatchDog and 5 Volt distribution inside a controller cabinet (left) and inside an IO extension cabinet (right) for non-UL applications.

Each chassis requires one pair of cables type PDC-ART05 (see PDC-ART05). In the controller cabinet, all cables come from the CP chassis backplane.

In the IO extension cabinet, all cables come from an PDB-ARTF05 board (see “PDB-ARTF05).

The cables between the controller cabinet and the PDB-ART05 are a pair of PDC-IOX05-1 cables.

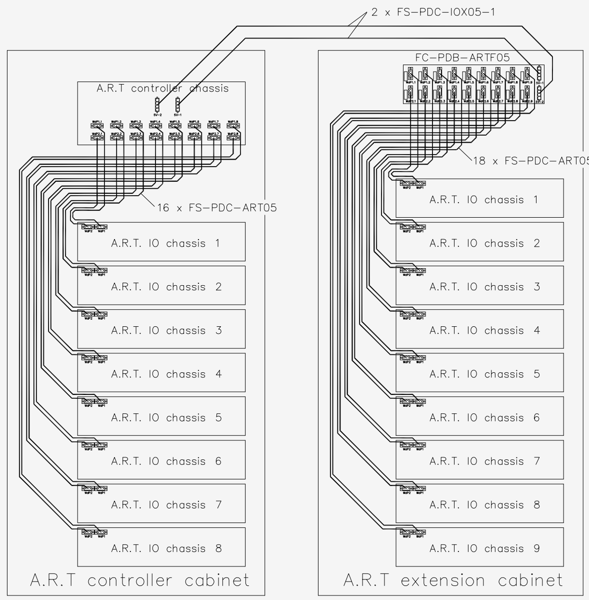


Figure 19-10: 5V and Wd distribution wiring in a controller cabinet and an extension cabinet - non-UL version

The below figure shows the 5 Volt and watchdog distribution in the controller cabinet for UL applications.

UL requires the use of fused 5 Volt distribution that is accomplished on the PDB-ARTF05 module.

The PDB-ARTF05 gets its power from the Controller chassis with a pair of PDC-CPX05 cables (see PDC-CPX05).

All IO chassis are connected with the PDB-ARTF05.

Each chassis requires one pair of cables type PDC-ART05 (see PDC-ART05).

19 5 Volt and watchdog distribution

19.1 5 Volt and Watchdog distribution layout

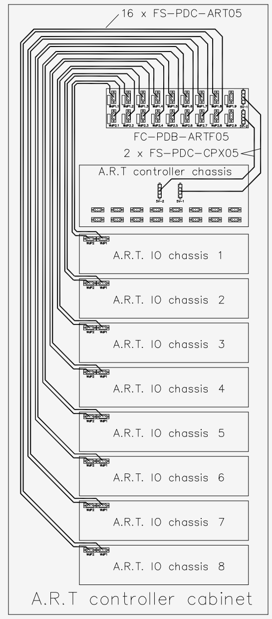


Figure 19-11: 5V and Wd distribution wiring in a controller cabinet - UL version

The below figure shows the 5 Volt and watchdog distribution in a Controller cabinet with Extension cabinet for UL applications.

UL requires the use of fused 5 Volt distribution that is accompleshed on the PDB-ARTF05 module.

The 5V and Watchdog signals of the controll chassis are multiplied on the PDB-CPX05 module (see PDB-CPX05).

The local PDB-ARTF05 gets its power from the PDB-CPX05 using a pair of PDC-CPX05 cables (see PDC-CPX05).

The PDB-ARTF05 in the extension cabinet gets its power from the PDB-CPX05 using a pair of PDC-IOX05-1 cables (see PDC-IOX05-x).

All A.R.T. IO chassis are connected with the PDB-ARTF05.

Each chassis requires one pair of cables type PDC-ART05 (see PDC-ART05).

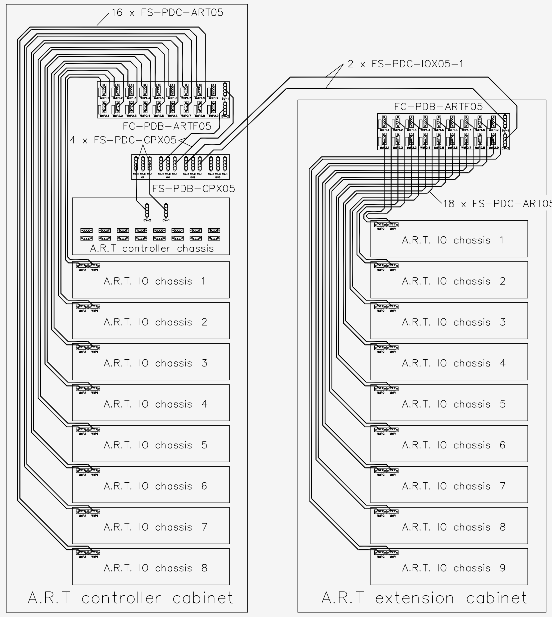


Figure 19-12: 5V and Wd distribution wiring in a controller cabinet and an extension cabinet - UL version

19.1.3 5 Volt and Watchdog distribution (Safety Manager)

The 5V supply voltages and watchdog signals of Safety Manager are generated in the Controller chassis (see CPCHAS-0003). These signals are available on the backplane of the Controller chassis.

The below figure shows a -simplified- view of the Controller backplane.

19 5 Volt and watchdog distribution

19.1 5 Volt and Watchdog distribution layout

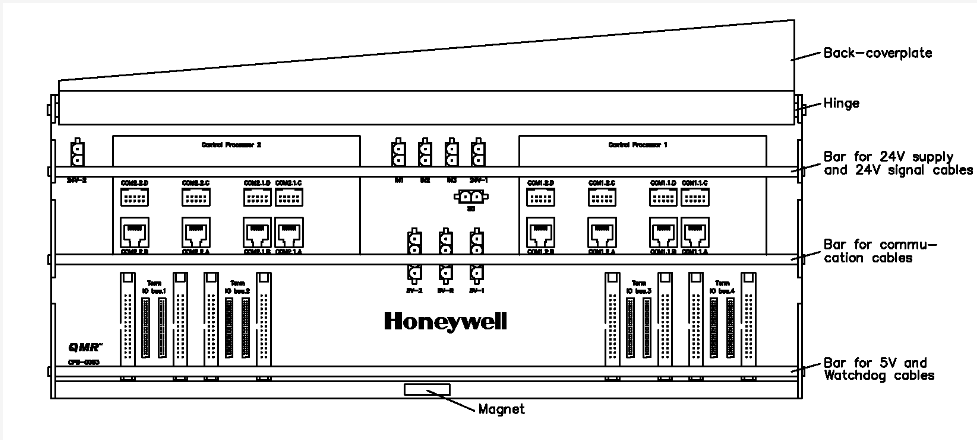


Figure 19-13: Position of the 5V and Wd connectors on a Controller backplane

The three 5V-x connectors (5V-2, 5V-R and 5V-1) in the center of the above figure are used to transfer watchdog and 5V to the IO chassis in the extension cabinet(s).

The below figure shows the watchdog and power (5V) connector on a -simplified- non-redundant IO backplane (IOCHAS-0003).

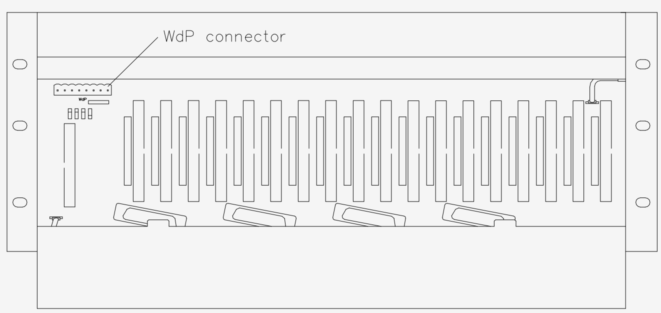


Figure 19-14: Position of the WdP connector on a non-redundant IO chassis

The below figure shows the watchdog and 5V distribution inside a controller cabinet (left) and inside an IO extension cabinet (right).

In a controller cabinet, all cables come from the CP chassis backplane. In an IO extension cabinet, all cables come from an PDB-IOX05 board (see PDB-IOX05).

The used cable depends on the IO chassis type that is connected:

- Non-redundant IO chassis require the PDC-IOS05 cable (see PDC-IOS05).

- Redundant IO chassis require the PDC-IOR05 cable (see PDC-IOR05).

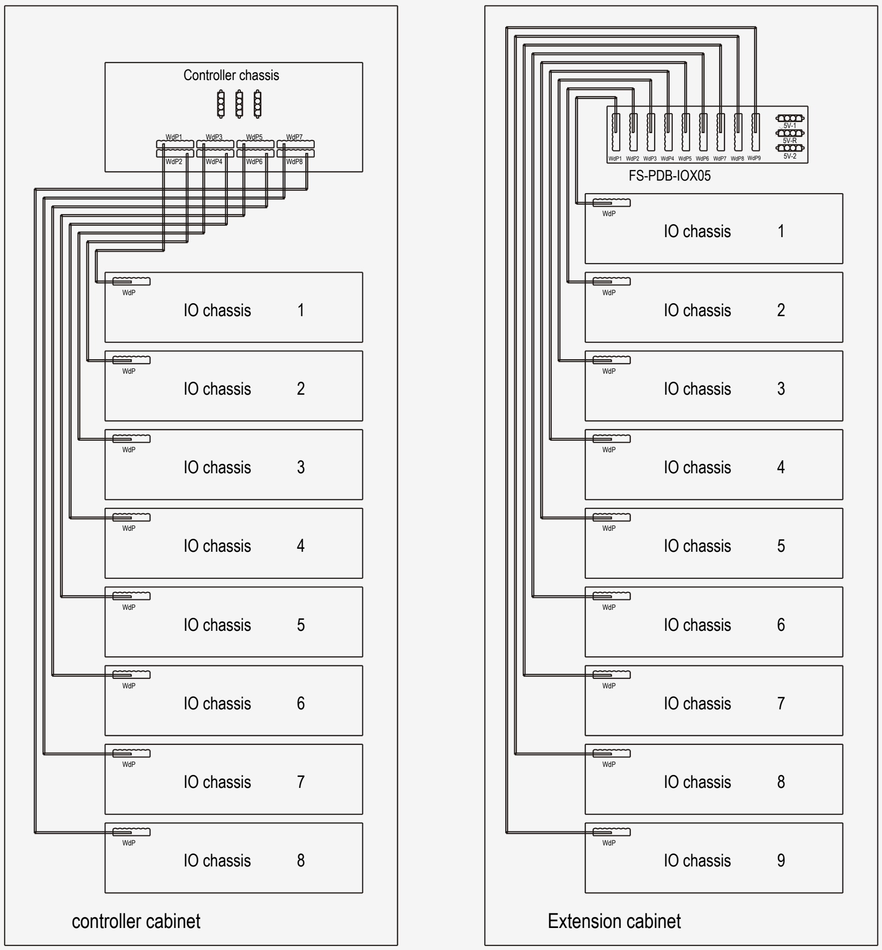


Figure 19-15: 5V and Wd distribution wiring in a controller cabinet resp. extension cabinet

The below figure shows the 5V and watchdog distribution between the controller cabinet and a single IO extension cabinet.

All (three) cables to the IO extension cabinet are of the type PDC-IOX05-1 (see PDC-IOX05-x).

The cable on connector ‘5V-1’ carries 0V (ground), the watchdog of CP1 and the 5V of CP1.

The cable on connector ‘5V-2’ carries 0V (ground), the watchdog of CP2 and the 5V of CP2.

19 5 Volt and watchdog distribution

19.1 5 Volt and Watchdog distribution layout

The cable on connector '5V-R' carries 0V (ground), the 'second' watchdog output of CP1 and CP2 (for non-redundant IO see Figure 8-6) and the (redundant) 5V of CP1 and CP2 (see Figure 6-5).

IO extension cabinets containing only redundant IO use the signals on the '5V-1' and '5V-2' cables.

IO extension cabinets containing only non-redundant IO only use the signals on the '5V-R' cable.

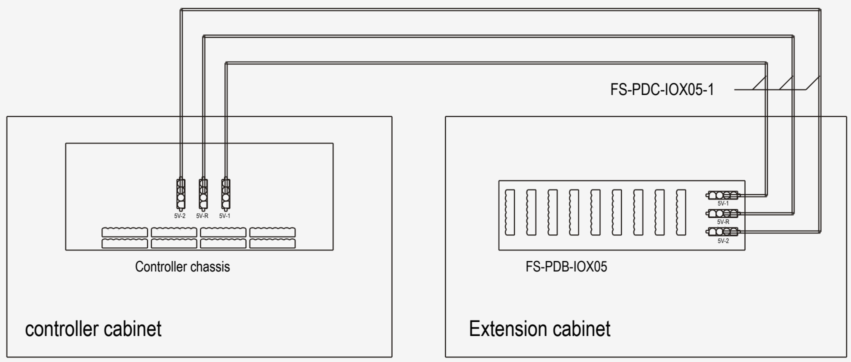


Figure 19-16: 5V and Wd distribution between the controller cabinet and a single IO extension cabinet

The below figure shows the 5V and watchdog distribution between the controller cabinet and more than one IO extension cabinet.

All cables to the IO extension cabinet are of type PDC-IOX05-1 (short) or type PDC-IOX05-2 (long) (see PDB-IOX05). These cables go to an PDB-CPX05 board (see PDB-CPX05) in the controller cabinet.

The PDB-CPX05 board itself is linked to the CP backplane using three PDC-CPX05 cables (see PDC-CPX05).

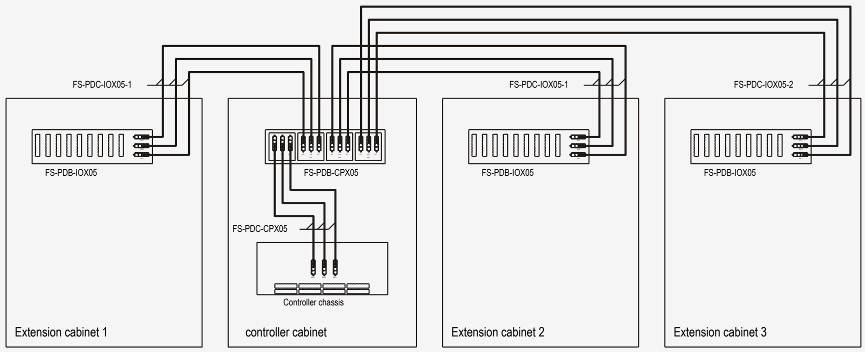


Figure 19-17: 5V and Wd distribution between the controller cabinet and three IO extension cabinets

19.2 PDB-IOX05

19.2.1 Power Distribution Board extension IO cabinet (5 V DC, Watchdog)

The PDB-IOX05 power distribution board for extension IO cabinets is a board that enables the distribution of the 5V and watchdog signals of the controller cabinet to the IO chassis in an IO extension cabinet.

The below figure shows the PDB-IOX05 with its 9+3 connectors.

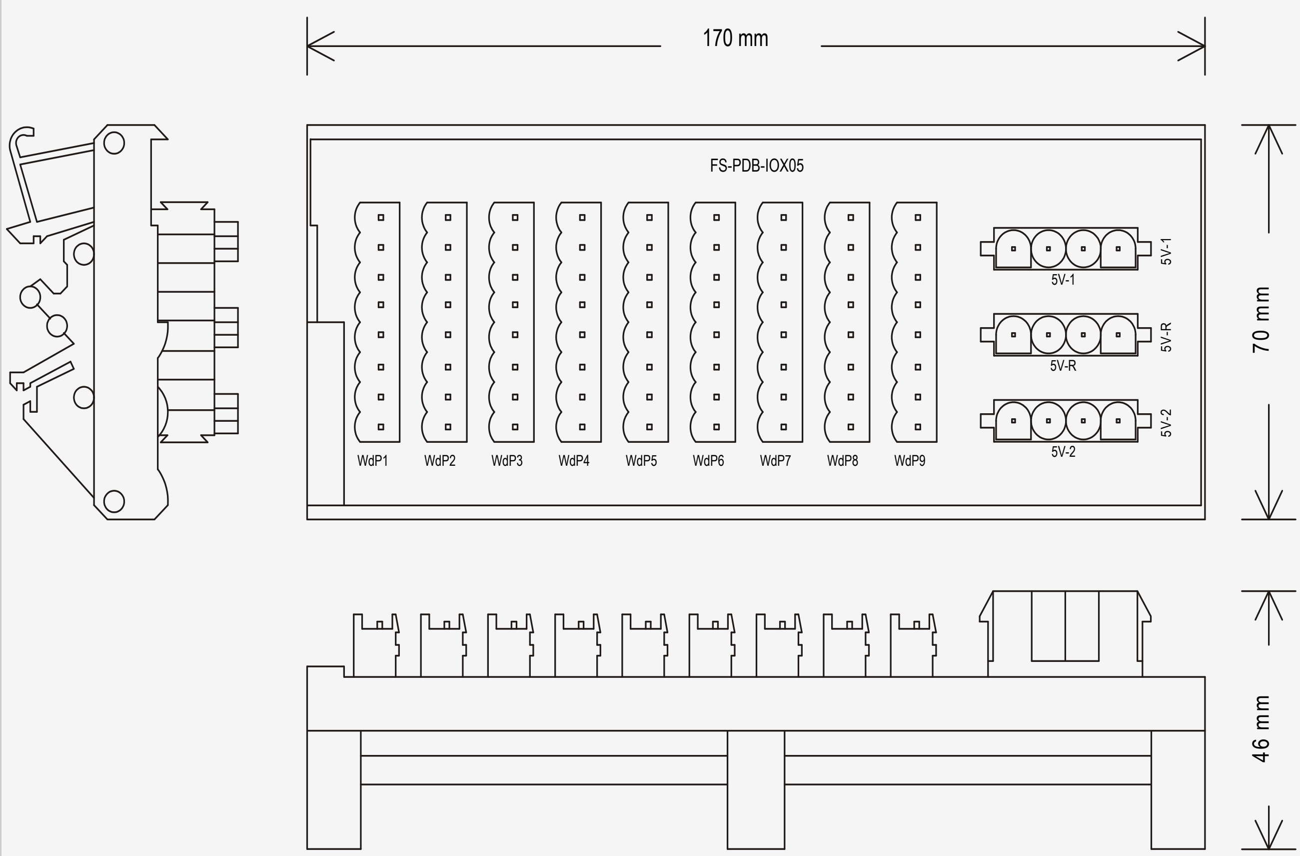


Figure 19-18: PDB-IOX05 board layout

Power distribution cables from the controller cabinet (PDC-IOX05-1 and PDC-IOX05-2, see PDC-IOX05-x) are placed on the three (4-pole) connectors.

The cable on connector ‘5V-1’ provides 0V (ground), the watchdog of CP1 and the 5V of CP1.

The cable on connector ‘5V-2’ provides 0V (ground), the watchdog of CP2 and the 5V of CP2.

The cable on connector ‘5V-R’ carries 0V (ground), the ‘second’ watchdog output of CP1 and CP2 (for non-redundant IO see Figure 5 on page 34) and the (redundant) 5V of CP1 and CP2 (see Figure 2).

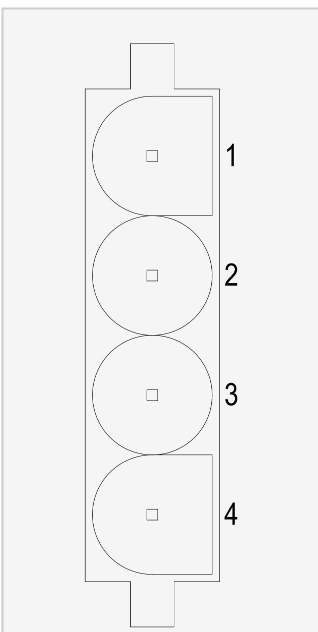
Power Distribution Cables (see PDC-IOS05 or PDC-IOR05) transfer the 5V and watchdog signal(s) to the IO chassis.

The cable on WdP1 should go to the first (highest) IO chassis.

Cables on WdP2 to WdP9 go to the next IO chassis (as far as these are available).

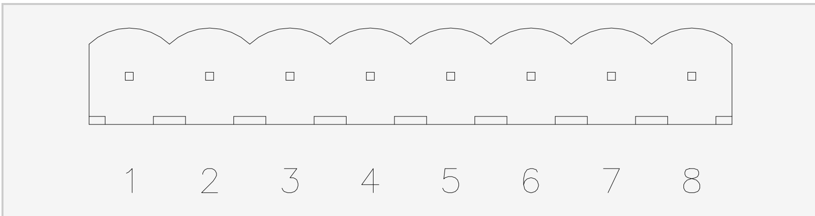
19.2.2 Pin allocation

The top view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	5V-R	5V-1
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

The top view and pin allocation of the nine WdPx connectors are:



	WdPx
1	5V of CP2
2	WD of CP2
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	5V of CP1
8	WD of CP1

19.2.3 Technical data

General	Type numbers:	FS-PDB-IOX05 FC-PDB-IOX05
	Approvals:	CE, UL, TUV, CSA
Connectors	5V-x:	4 pos, action pin, header
	WdPx:	8 pole, pin header
Physical	Module dimensions:	170 × 70 × 46 mm (L × W × H) 6.69 × 2.76 × 1.81 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	171 mm (6.73 in)

19.3 PDB-IO05

19.3.1 Power Distribution Board extension IO cabinet (5 V DC, Watchdog)

The PDB-IO05 power distribution board for extension IO cabinets is a board that enables the distribution of the 5V and watchdog signals of the controller cabinet to the IO chassis in an IO extension cabinet.

The below figure shows the PDB-IO05 with its 9+3 connectors.

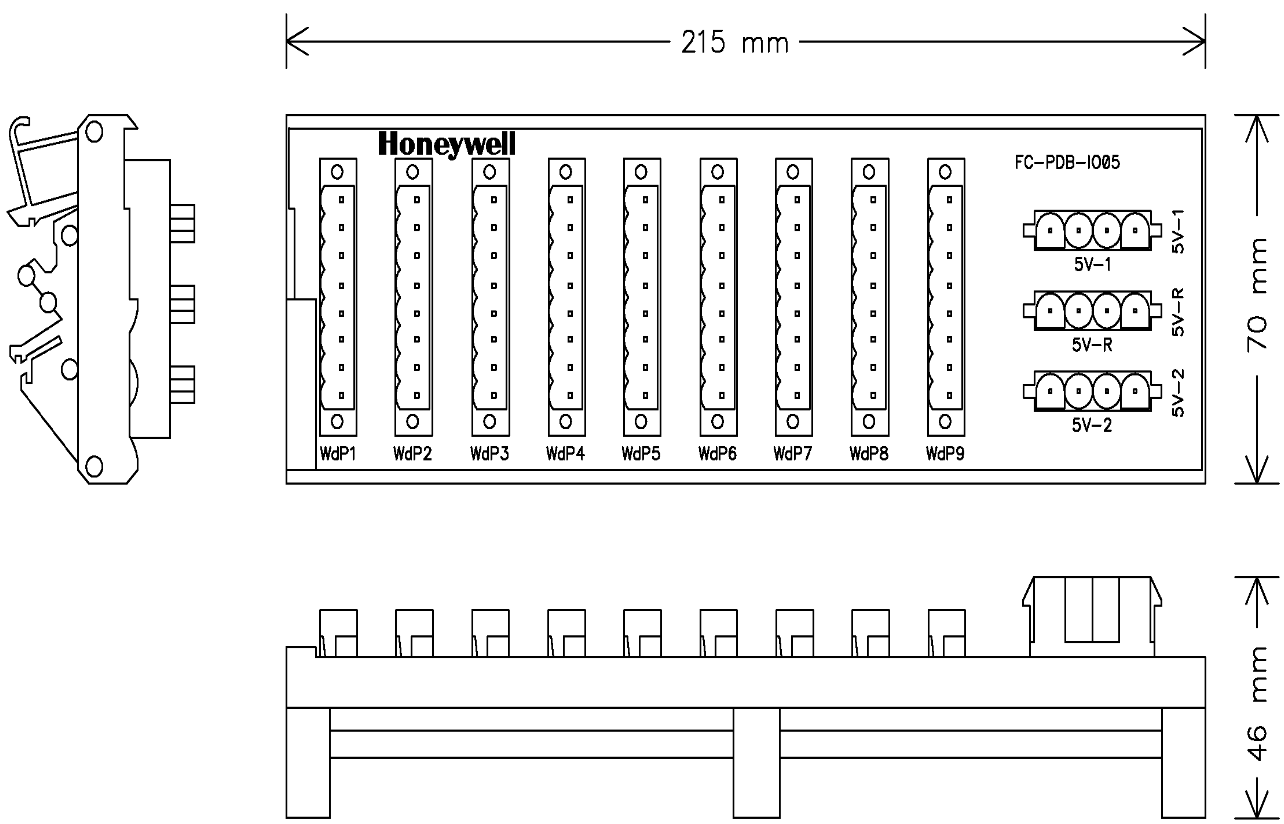


Figure 19-19: PDB-IO05 board layout

Power distribution cables from the controller cabinet (PDC-IO05-1 and PDC-IO05-2, see PDC-IO05-x) are placed on the three (4-pole) connectors.

The cable on connector ‘5V-1’ provides 0V (ground), the watchdog of CP1 and the 5V of CP1.

The cable on connector ‘5V-2’ provides 0V (ground), the watchdog of CP2 and the 5V of CP2.

The cable on connector ‘5V-R’ carries 0V (ground), the ‘second’ watchdog output of CP1 and CP2 (for non-redundant IO see Figure 8-6) and the (redundant) 5V of CP1 and CP2 (see Figure 6-5).

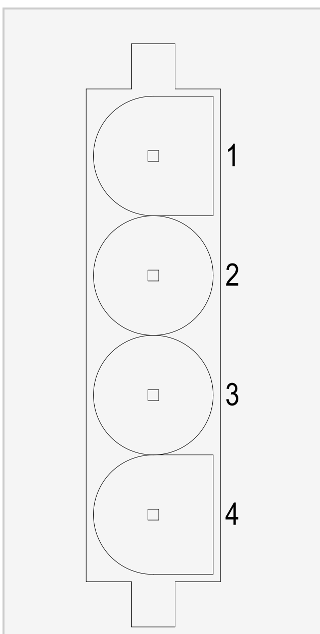
Power Distribution Cables (see PDC-IOS05 or PDC-IOR05) transfer the 5V and watchdog signal(s) to the IO chassis.

The cable on WdP1 should go to the first (highest) IO chassis.

Cables on WdP2 to WdP9 go to the next IO chassis (as far as these are available).

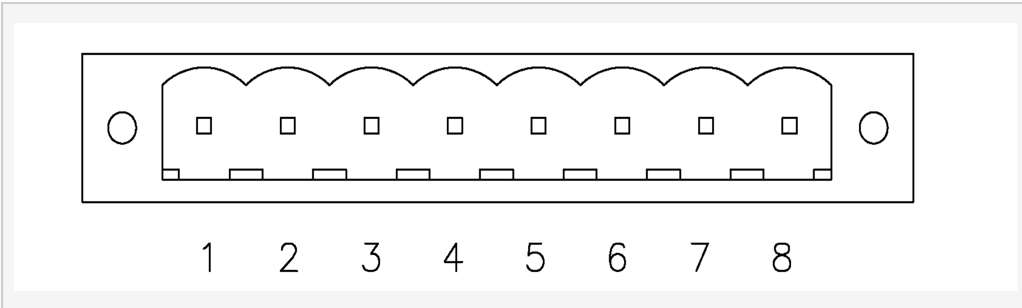
19.3.2 Pin allocation

The top view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	5V-R	5V-1
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

The top view and pin allocation of the nine WdPx connectors are:



	WdPx
1	5V of CP2
2	WD of CP2
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	5V of CP1
8	WD of CP1

19.3.3 Technical data

General	Type numbers:	FS-PDB-IO05 FC-PDB-IO05
	Approvals:	CE, UL, TUV, CSA
Connectors	5V-x:	4 pos, action pin, header
	WdPx:	8 pole, pin header
Physical	Module dimensions:	170 × 70 × 46 mm (L × W × H) 6.69 × 2.76 × 1.81 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	171 mm (6.73 in)

19.4 PDB-CPX05

19.4.1 Power Distribution Board Controller cabinet (5 V DC, Watchdog)

The PDB-CPX05 power distribution board for controller cabinets is a board that enables the distribution of the 5V and watchdog signals of the Controller chassis to more than one IO extension cabinet.

The below figure shows the PDB-CPX05 with its 4 × 3 connectors.

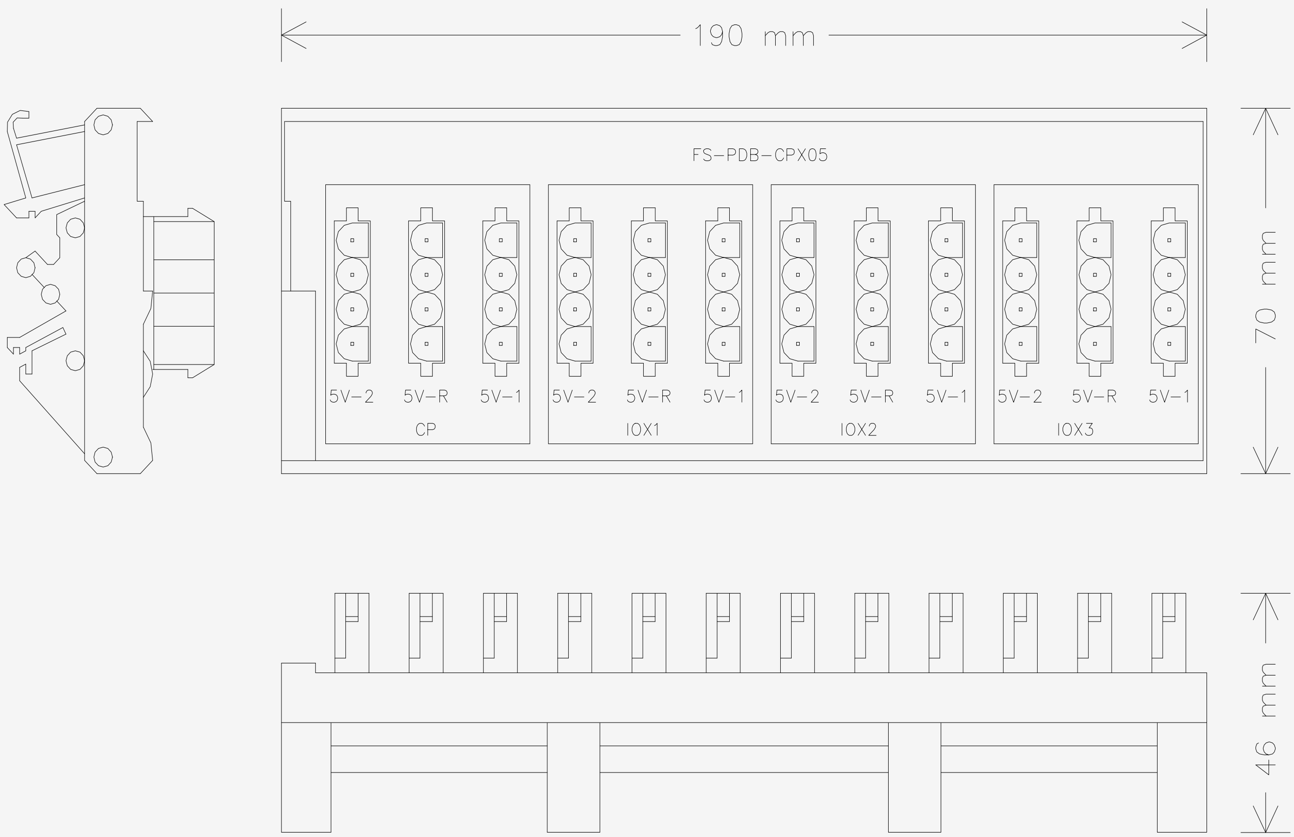


Figure 19-20: PDB-CPX05 board layout

Power Distribution Cables from the Controller chassis (see PDC-CPX05) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘CP’.

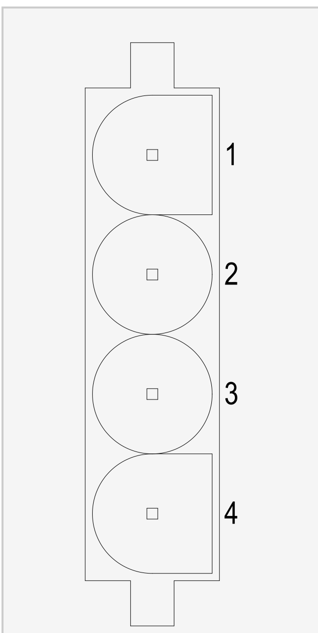
Power Distribution Cables to the first IO extension cabinet (see PDC-IOX05-x) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘IOX1’.

Power Distribution Cables to the second IO extension cabinet (see PDC-IOX05-x are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘IOX2’.

Power Distribution Cables to the third IO extension cabinet (see PDC-IOX05-x) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘IOX3’.

19.4.2 Pin allocation

The top view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	5V-R	5V-1
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

19.4.3 Technical data

General	Type numbers:	FS-PDB-CPX05 FC-PDB-CPX05
	Approvals:	CE, UL, TUV, CSA
Connectors	Type:	4 pos, action pin, header
Physical	Module dimensions:	190 × 70 × 46 mm (L × W × H) 7.48 × 2.76 × 1.81 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	191 mm (7.52 in)

19.5 PDB-ARTF05

19.5.1 Fused Power Distribution Board for IO cabinet - 5 V DC, Watchdog (Safety Manager A.R.T.)

The PDB-ARTF05 fused power distribution board for an IO cabinet is a board that enables the distribution of the watchdog signals and fused 5V of the controller cabinet to an IO cabinet.

Fuse Fx.y transfers the incoming 5V of CPx to connector WdPx.y (e.g. fuse F2.9 transfers the incoming 5V of CP2 to connector WdP2.9).

The below figure shows the PDB-ARTF05 with its 2 x 10 connectors and 2 x 9 fuses.

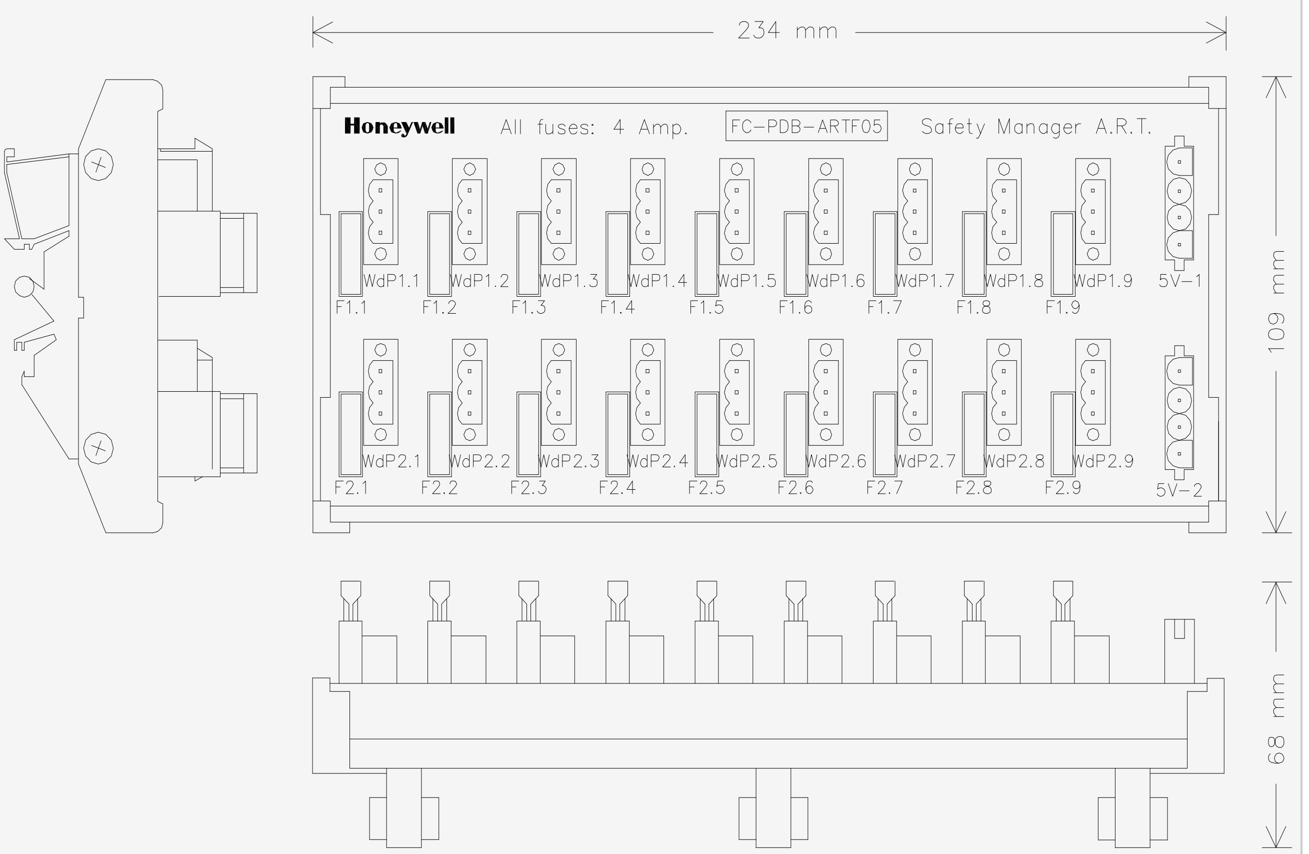


Figure 19-21: PDB-ARTF05 board layout

The PDB-ARTF05 for the Controller cabinet IO-racks is placed on top of the controller chassis.

The PDB-ARTF05 for IO-racks in the extension IO cabinet is placed in the extension IO cabinet.

Two Power Distribution Cables (type PDC-CPX05) are used to connect the Controller chassis with the PDB-ARTF05 in the controller cabinet.

Two Power Distribution Cables (type PDC-IOX05-1) are used to connect the Controller chassis with the PDB-ARTF05 in an extension IO-cabinet.

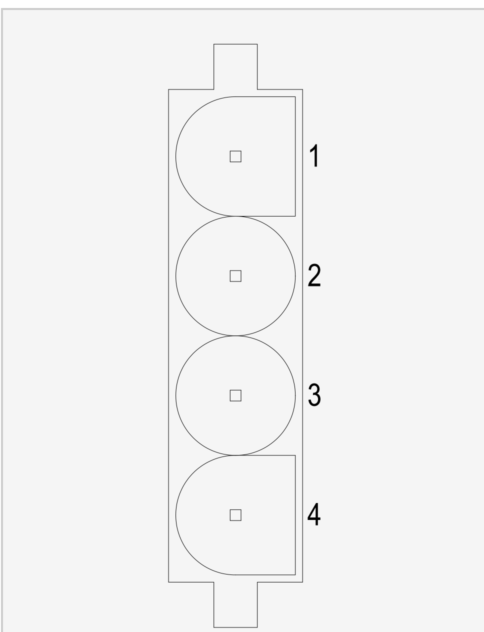
- Connect 5V-1 of the Controller chassis with 5V-1 of the PDB-ARTF05.
- Connect 5V-2 of the Controller chassis with 5V-2 of the PDB-ARTF05.

Each IO-rack uses a pair of PDC-ART05 cables to connect with the PDB-ARTF05:

- Connect WdP1.x of the PDB-ARTF05 with WdP1 of the IO-rack.
- Connect WdP2.x of the PDB-ARTF05 with WdP2 of the IO-rack.

19.5.2 Pin allocation

The top view and pin allocation of the 5V-1 and 5V-2 connectors are:



	5V-1	5V-2
1	ground	ground
2	WD of CP1	WD of CP2
3	ground	ground
4	5V of CP1	5V of CP2

The top view and pin allocation of the WdPx connectors are:

		WdP1.x	WdP2.x
	3	WD of CP1	WD of CP2
	2	ground	ground
	1	5V of CP1	5V of CP2

19.5.3 Technical data

General	Type number:	FC-PDB-ARTF05
	Approvals:	CE: UL,TUV,CSA
Power	• 5V-1 • 5V-2:	max. 16A max. 16A
Fuse	Fuse rating:	4 A
	Fuse dimensions:	Blade 5×19 mm
	Voltage rating AC:	-
	Voltage rating DC:	32 V
	Manufacturer:	Littelfuse
	Manufacturer PN:	0287004.PXS
	Maximum y output current per fuse:	2.8 A
Connectors	5V-x:	4 pos, action pin,header
	WdPx.y:	3 pole, pin header
Physical	Module dimensions:	234 x 109 x 68 mm (L × W × H) 9.21 x 4.29 x 2.68 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	235 mm (9.25 in)

19.6 PDC-IOS05

19.6.1 Power Distribution Cable for a non-redundant IO chassis - 5 V DC, Watchdog (Safety Manager)

The PDC-IOS05 power distribution cable for a non-redundant IO chassis is used to transfer the (redundant) 5V of CP1 and CP2 (see Figure 6-5) and the 'second' watchdog output of CP1 and CP2 (for non-redundant IO see Figure 8-6) to a non-redundant IO chassis.

Attention:
The connectors that are used on this cable can be sensitive to mechanical tension. Make sure that the cables are appropriately secured to avoid inadvertant disconnection.

19.6.2 Signals

Signal	Connector pin	Wire color
GND	3	green/yellow (sleeved)
5V-R	4	brown
WD-R	5	blue
GND	6	black

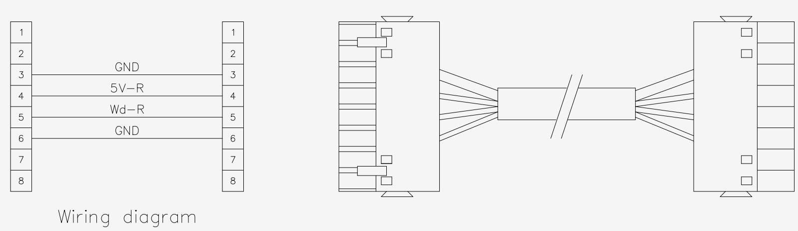


Figure 19-22: Pin assignment and layout of the PDC-IOS05 cable

19.6.3 Technical data

General	Type number:	FS-PDC-IOS05
	Approvals:	UL, CSA
Cable	Type:	SAB 2040415 CC600 4 × 1.5 mm^2
	Length:	2.45 m
Connectors	Type:	8 pole, pin header Weidmuller: BLC 5.08/8 BR
	Pins:	Weidmuller: DFFC 0.5 - 1.0 SN E

19.7 PDC-IOR05

19.7.1 Power Distribution Cable for a redundant IO chassis – 5 V DC, Watchdog (Safety Manager)

The PDC-IOR05 power distribution cable for a redundant IO chassis is used to transfer the 5V of CP1 and CP2 (see Figure 6-5) and the watchdog outputs of CP1 and CP2 to a redundant IO chassis.

Attention:
The connectors that are used on this cable can be sensitive to mechanical tension. Make sure that the cables are appropriately secured to avoid inadvertant disconnection

19.7.2 Signals

Signal	Connector pin	Wire indication
5V-2	1	'1' marking
WD-2	2	'2' marking
GND	3	'3' marking
GND	6	'4' marking
5V-1	7	'5' marking
WD-1	8	'6' marking

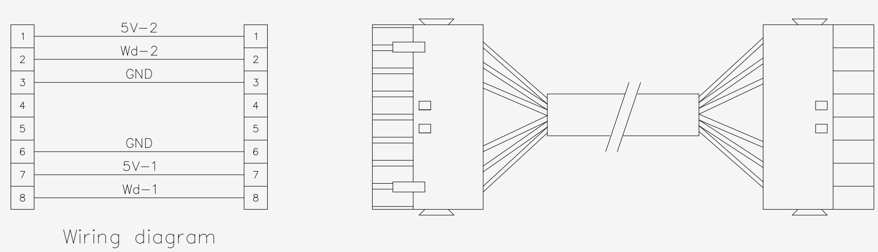


Figure 19-23: Pin assignment and layout of the PDC-IOR05 cable

19.7.3 Technical data

General	Type number:	FS-PDC-IOR05
	Approvals:	UL, CSA
Cable	Type:	SAB 2040707 CC600 7 × 0.75 mm^2
	Length:	2.45 m
Connectors	Type:	8 pole, pin header Weidmuller: BLC 5.08/8 BR
	Pins:	Weidmuller: DFFC 0.5 - 1.0 SN E

19.8 PDC-IOS05A

19.8.1 Power Distribution Cable for a non-redundant IO chassis - 5 V DC, Watchdog (Safety Manager)

The PDC-IOS05A power distribution cable for a non-redundant IO chassis (IOCHAS-0003S only) is used to transfer the (redundant) 5V of CP1 and CP2 (see Figure 6-5) and the 'second' watchdog output of CP1 and CP2 (for non-redundant IO see Figure 8-6) to a non-redundant IO chassis.

Attention:
The connectors that are used on this cable can be sensitive to mechanical tension. Make sure that the cables are appropriately secured to avoid inadvertant disconnection.

19.8.2 Signals

Signal	Connector pin	Wire color
GND	3	green/yellow (sleeved)
5V-R	4	brown
WD-R	5	blue
GND	6	black

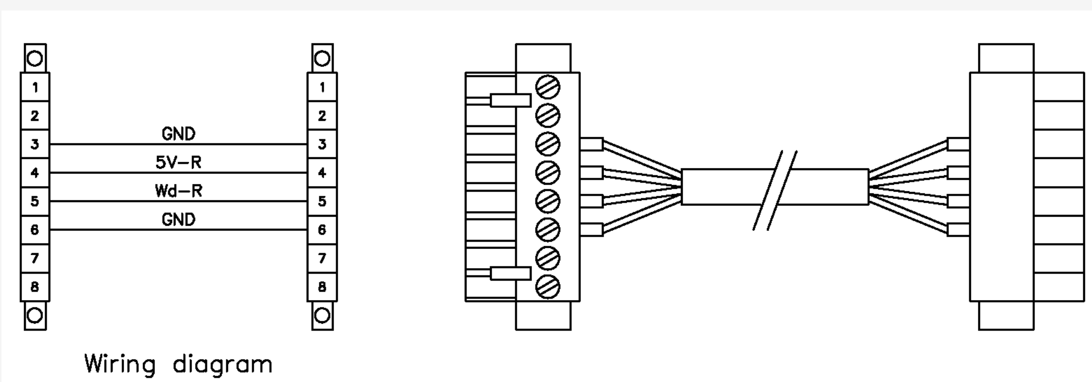


Figure 19-24: Pin assignment and layout of the PDC-IOS05A cable

19.8.3 Technical data

General	Type number:	FS-PDC-IOS05A
	Approvals:	UL, CSA
Cable	Type:	SAB 2040415 CC600 4 × 1.5 mm^2
	Length:	2.45 m
Connectors	Type:	8 pole, pin header Weidmuller: BLZP 5.08HC/08/180F SN BK

19.9 PDC-IOR05A

19.9.1 Power Distribution Cable for a redundant IO chassis - 5 V DC, Watchdog (Safety Manager)

The PDC-IOR05A power distribution cable for a redundant IO chassis (IOCHAS-0003R only) is used to transfer the 5V of CP1 and CP2 (see Figure 2) and the watchdog outputs of CP1 and CP2 to a redundant IO chassis.

Attention:
The connectors that are used on this cable can be sensitive to mechanical tension. Make sure that the cables are appropriately secured to avoid inadvertant disconnection

19.9.2 Signals

Signal	Connector pin	Wire indication
5V-2	1	‘1’ marking
WD-2	2	‘2’ marking
GND	3	‘3’ marking
GND	6	‘4’ marking
5V-1	7	‘5’ marking
WD-1	8	‘6’ marking

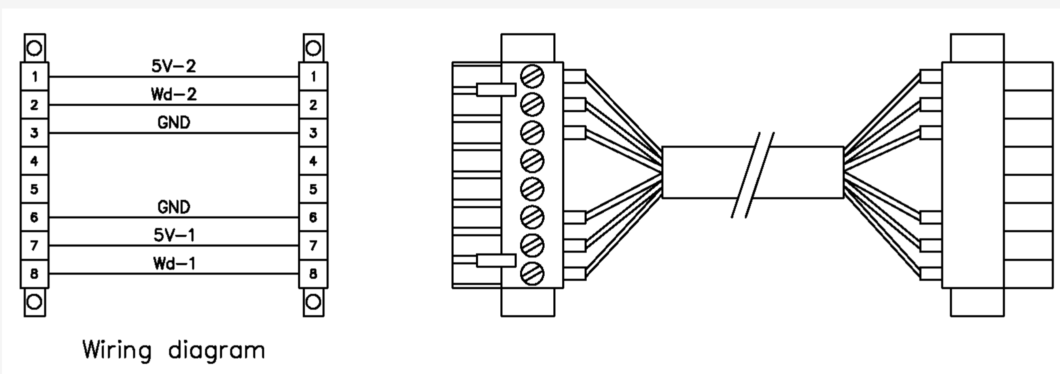


Figure 19-25: Pin assignment and layout of the PDC-IOR05A cable

19.9.3 Technical data

General	Type number:	FS-PDC-IOR05A
	Approvals:	UL, CSA
Cable	Type:	SAB 2040707 CC600 7 × 0.75 mm^2
	Length:	2.45 m
Connectors	Type:	8 pole, pin header Weidmuller: BLZP 5.08HC/08/180F SN BK

19.10 PDC-IOX05-x

19.10.1 Power Distribution Cable for IO cabinets (5 V DC, Watchdog)

The PDC-IOX05-x power distribution cable for IO cabinets is used to transfer the 5V of CP1, CP2 or the redundant 5V (see Figure 6-5) and the watchdog outputs of CP1, CP2 or the redundant watchdog (for non-redundant IO see Figure 8-6) to an IO cabinet.

The PDC-IOX05-x cables are generally used in a set of three, to transfer all 5V and watchdog signals to the IO cabinet.

The PDC-IOX05-x cables run from the controller cabinet to the PDB-IOX05 board in the IO cabinet (see Figure 20-16 and Figure 20-17)

19.10.2 Signals

Signal	Connector pin	Wire indication
5V	1	red ‘1+’ marking
GND	2	black ‘1-’ marking
Watchdog	3	red ‘2+’ marking
GND	4	black ‘2-’ marking

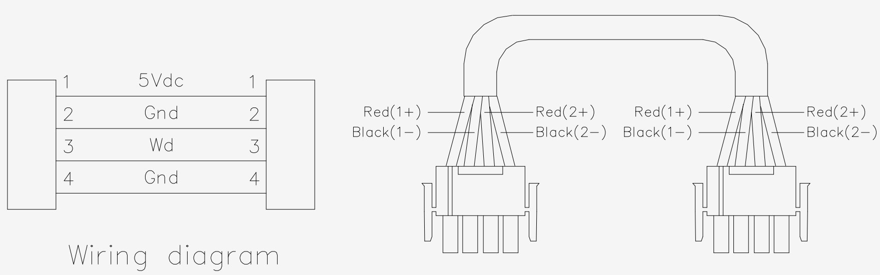


Figure 19-26: Pin assignment and layout of the PDC-IOX05-x cable

19.10.3 Technical data

General	Type numbers:	FS-PDC-IOX05-1 (3.1 meter) FS-PDC-IOX05-2 (3.9 meter)
	Approvals:	UL, CSA
Cable	Type:	Special CC 600 World 4 × 2.5 mm^2
	Length:	3.1 / 3.9 m
Connectors	Type:	4 pole, mate-n-lock Tyco: 350779-1
	Pins:	Mate-n-lock crimp-socket Tyco: 350550-1

19.11 PDC-CPX05

19.11.1 Power Distribution Cable for controller cabinets (5 V DC, Watchdog)

The PDC-CPX05 power distribution cables for controller cabinets are used to transfer the 5V of CP1, CP2 and the redundant 5V from the Controller chassis backplane to an PDB-CPX05 board.

The PDC-CPX05 cables are used in a set of three.

19.11.2 Signals

Signal	Connector pin	Wire indication
5V	1	red ‘1+’ marking
GND	2	black ‘1-’ marking
Watchdog	3	red ‘2+’ marking
GND	4	black ‘2-’ marking

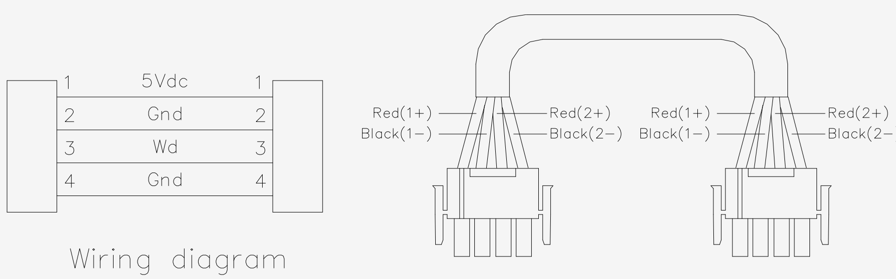


Figure 19-27: Pin assignment and layout of the PDC-CPX05 cable

19.11.3 Technical data

General	Type number:	FS-PDC-CPX05
	Approvals:	UL, CSA
Cable	Type:	Special CC 600 World $4 \times 2.5\ mm^2$
	Length:	0.8 m
Connectors	Type:	4 pole, mate-n-lock Tyco: 350779-1
	Pins:	Mate-n-lock crimp-socket Tyco: 350550-1

19.12 PDC-ART05

19.12.1 Power Distribution Cable for an IO chassis - 5 V DC, Watchdog (Safety Manager A.R.T.)

The PDC-ART05 power distribution cable for an IO chassis is used to transfer the 5V of CP1 or CP2 and the watchdog of CP1 or CP2 to the IO chassis (see 5 Volt and Watchdog distribution layout (Safety Manager A.R.T.)).

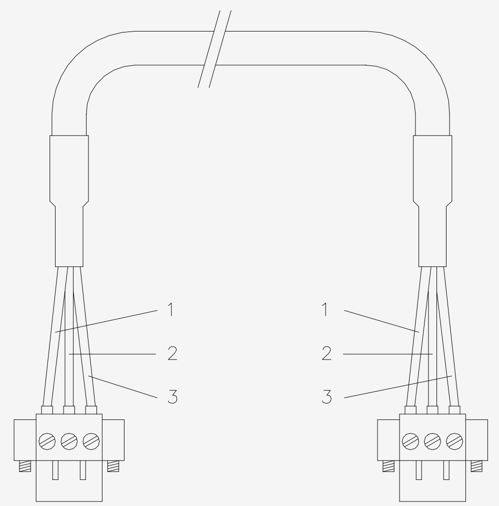


Figure 19-28: Wire assignment of the PDC-ART05 cable

19.12.2 Signals

The pin assignment of the PDC-ART05 connectors is:

		WdP1.x	WdP2.x
	1	5V of CP1	5V of CP2
	2	ground	ground
	3	WD of CP1	WD of CP2

19.12.3 Technical data

General	Type number:	FS-PDC-ART05
	Approvals:	UL, CSA pending
Cable	Type:	SAB 02040415
		CC600 4 × 1.5 mm^2
	Length:	2 m
Connectors	Type:	3 pole socket connector
	Make:	Weidmuller: BLZ 5.08/03/180F SN BK

Note:
If the cable is used as a replacement of FS-PDC-MB24-1, then replace the connector at the FTA side with the connector of the old cable.

CHAPTER 20

LIST OF ABBREVIATIONS

20 List of abbreviations

AI	Analog Input
AO	Analog Output
ASM	Abnormal Situation Management
ATEX	Explosive Atmosphere (in French: “ATmospheres EXplosibles”)
A.R.T.	Advanced Redundancy Technique
BKM	Battery and Key switch Module
BMS	Burner Management System
CDA	Common Data Access
CEE	Control Execution Environment
CP	Control Processor
DCF	Digital Coded Frequency
DCS	Distributed Control System
DI	Digital Input
DO	Digital Output
DTI	Diagnostic Test Interval
E/E/PES	Electrical/Electronic/Programmable Electronic System
ELD	Earth Leakage Detector
EMC	Electromagnetic Compatibility
ESD	• ElectroStatic Discharge • Emergency ShutDown system
EUC	Equipment Under Control
EUT	Equipment Under Test
F&G	Fire and Gas
FB	Function Block

FDM	Field Device Management
FGS	Fire and Gas System
FLD	Functional Logic Diagram
FSC	Fail Safe Communication
FTA	Field Termination Assembly
FTE	Fault Tolerant Ethernet
GPS	Global Positioning System
HIPS	High-Integrity Protection Systems
HMI	Human Machine Interface
HSE	High Speed Ethernet
HSMS	Honeywell Safety Management Systems
IO	Input/Output
IP	• Internet Protocol • Ingress Protection
IS	Intrinsically Safe
LAN	Local Area Network
LED	Light-Emitting Diode
MAC	Media Access Control
MAP	Manufacturing Automation Protocol
MOS	Maintenance Override Switch
MTBF	Mean Time Between Failure
MTTF	Mean Time To Failure
MTTR	Mean Time To Repair

NTP	Network Time Protocol
OLE	Object Linking and Embedding
OLM	On-line Modification
OPC	Open Platform Communications
OS	Operating System
P&ID	Piping and Instrumentation Diagram
PCDI	Peer Control Data Interface
PE	Protective Earth
PES	Programmable Electronic System
PFD	Probability of Failure on Demand
PKS	Process Knowledge System
PLC	Programmable Logic Controller
PST	Process Safety Time
PSU	Power Supply Unit
PTP	Precision Time Protocol
PUC	Process Under Control
PV	Process Value
QMR	Quadruple Modular Redundant
QPP	Quad Processor Pack
RFI	Radio Frequency Interference
RO	Relay Output (for descriptions use: potential free output contact)
SCADA	Supervisory Control And Data Acquisition
SCN	Software Change Notification (formerly addressed as Release Note)
SIC	System Interconnection Cable

SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
SMOD	Secondary Means Of De-energization
SOE	Sequence Of Events
SRS	Safety-Related System
SSC	Serial Communication Channel
STP	Shielded Twisted Pair
TELD	Earth Leakage Detector Terminal
USI	Universal Safety Interface
UTP	Unshielded Twisted Pair
UTC	Coordinated Universal Time (Universal Time Coordinated)
WAN	Wide Area Network

CHAPTER 21

SAFETY MANAGER GLOSSARY

21 Safety Manager Glossary

A

Alarm

An automatic signal that serves as a warning of an event or danger.

Application

The definition of the EUC-dependent function for Safety Manager.

Application Compiler

A tool of the Safety Builder used to create a controller file.

Application Editor

A tool of the Safety Builder used to create or edit functional logic diagrams.

Application value

The value of a process point as provided to, or calculated by, the application software.

Application version

A first or subsequent version of the application that is controlled in Safety Manager. An application version can have several states (see Application version state). An application version will be consolidated – or 'frozen' – when the application is loaded or published. The next change to the application will increment its version.

Application version state

A defined status of the application version. Safety Manager has a limited and controlled number of application version states to:

- enforce a useful sequence of activating program functions,
- enable control and/or comparison of application versions between connected components (i.e. Safety Builder, Safety Manager Controller, Experion).

Safety Manager uses these application version states:

State Meaning

Changed (Compile and Load Application needed)
: changes to the application were made that do require loading to Safety Manager Controller

Changed (Publish Application needed)
: changes to the application were made that do not require loading to Safety Manager Controller

Compiled
: the application was successfully compiled

Published (load needed)
: the application was compiled and subsequently published

Published (loaded)
: the application was either; published (without compiling) or, loaded into the Safety Manager Controller

Application Viewer

A tool of the Safety Builder used to view functional logic diagrams on-line.

ATEX Directive

A directive which describes equipment and protective systems intended for use in potentially explosive atmospheres.

Safety Manager ATEX modules can be used for connection to hazardous locations in compliance with EN 60079-15:2005 (zone 2, sub groups IIA, IIB and IIC).

Availability

- The ratio of system up time to total operating time.
- The ability of an item to perform its designated function when required for use.

B

Battery and Key switch Module (BKM)

A module in the Safety Manager Controller used to:

- Supply battery power to the system memory (RAM) and the real time clock of the Control Processor modules, in case of power outage.
- Enable or disable forces, by turning the Force key switch. When enabled, forcing of certain input and output signals is allowed. When disabled, all forces are removed.
- Provide a fault reset, by turning the Reset key switch. See Fault reset.

> **Attention:**
> Turning the Reset key switch during an On-Line Modification procedure may cause the Control Processors to swap status.

C

Communication module

See: Universal Safety Interface (USI)

Communication redundancy fail-over

The automated capability of a device to switch over to a redundant or dormant communication path upon the failure or abnormal termination of the active path.

Communication time-out

An error caused by an unacceptable large time interval during which there was no communication.

Control Processor (CP)

Core component of the Safety Manager Controller consisting of: Power Supply Unit (PSU), Quadruple Processor Pack (QPP) and 1 or 2 communication modules (USI).

Control Processor states

A Control Processor (CP) can have many states. For fault detection and reaction the following states are relevant.

> **Attention:**
> The states described below are presented on the display of the relevant QPP, while the key switch of that QPP is in the RUN position.

- Running (without faults); CP is fully functional and executes the application.
- Running with Flt (with faults); CP executes the application but the controller detected one or more faults (e.g. open loop or a hardware fault).
- Halt; CP does not execute the application.

The applicable CP state can be read from the User Interface Display located on each Control Processor and from the diagnostic screens available on Experion™ and Safety Stations.

Controller chassis

19” chassis to slot the BKM and Control Processor modules.

Controller configurations

Distinction is made between *Non redundant Controllers* and *Redundant Controllers*. A *Non redundant Controller* has one Control Processor (CP); the response of the CP is automatically the response of the controller. A *Redundant Controller* has two CPs; the response of one of the CPs does not necessarily affect the safety related functioning of the controller.

> **Note:**
> Safety Manager can have both non redundant controllers and redundant controllers.
>
> Safety Manager A.R.T. only has redundant controllers.

See also: Safety Manager and Safety Manager A.R.T.

Controller Management

A tool of the Safety Builder used to perform the following functions:

- Load controller.
- View system status.
- Retrieve controller and application files.

Coordinated Universal Time (UTC)

Also referred to as “Universal Time Coordinated” and “Zulu time”.

An atomic realization of Universal Time (UT) or Greenwich Mean Time (GMT), the astronomical basis for civil time. Time zones around the world are expressed as positive and negative offsets from UT. UTC differs by an integral number of seconds from atomic time and a fractional number of seconds from UT1.

Cycle time

The time period needed to execute the application software once.

D

Dangerous failure

Failure which has the potential to put the safety-related system in a hazardous or fail-to-function state.

> **Note:**
> Whether or not the potential is realized may depend on the channel architecture of the system; in systems with multiple channels to improve safety, a dangerous hardware failure is less likely to lead to the overall dangerous or fail-to-function state.

Deutsches Institut für Normung (DIN)

German Institute for Standards, which determines the standards for electrical and other equipment in Germany.

Diagnostic Test Interval (DTI)

The time period used by Safety Manager to cyclically locate and isolate safety related faults within on-line system components that could otherwise cause a hazardous situation.

With Safety Manager, the default DTI is set at 3 seconds. This setting needs to be verified for each process.

See also “Process safety time (PST)”.

Distributed Control System (DCS)

System designed to control industrial processes. A DCS receives the measured values of the process instrumentation, e.g. flow, pressure, temperature. It controls the process via analog control equipment such as control valves. In addition, a DCS may receive many digital signals for alarm and management purposes.

Dual Modular Redundant (DMR)

Safety configuration providing 1oo2 configuration. The DMR technology is used in the architecture of a non redundant QPP where on-board 1oo2D voting is based on dual-processor technology.

DMR is characterized by a high level of diagnostics and fault coverage.

E

Electrical/Electronic/Programmable Electronic (E/E/PE) device

A device based on electrical (E) and/or electronic (E) and/or programmable electronic (PE) technology.

> **Note:**
> This term is intended to cover any and all devices operating on electrical principles and would include:
>
> - electro-mechanical devices (“electrical”);
> - solid state non-programmable electronic devices (“electronic”);
> - electronic devices based on computer technology (“programmable electronic”).

Electrical/Electronic/Programmable Electronic system (E/E/PES)

A system based on one or more E/E/PE devices, connected to (and including) input devices (e.g. sensors) and/or output devices/final elements (e.g. actuators), for the purpose of control, protection or monitoring.

See also “Programmable electronic system (PES)”.

Extended Function Block

Element in a functional logic diagram (FLD) which performs a user defined logic function. Extended function blocks are designed to implement & re-use complex functions via a single (user defined) element.

Electromagnetic Compatibility (EMC)

The ability of a device, equipment or system to function satisfactory in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

ElectroStatic discharge (ESD)

The transfer of electrostatic charge between bodies of different electrostatic potential, which may cause damage to system components.

Emergency ShutDown (ESD)

Manual or automatic turning off or closing down of process equipment in case of anomalous conditions in order to prevent damage to the system or process.

EUC risk

Risk arising from the EUC or its interaction with the EUC control system.

See also “Equipment Under Control (EUC)”.

Equipment Under Control (EUC)

Equipment/machinery/apparatus/Plant used for manufacturing, process, transportation, medical or other activities for which designated safety-related systems could be used to:

- prevent hazardous events associated with the EUC from taking place; or,
- mitigate the effects of the hazardous events.

Error

Discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition.

Ethernet

A local area network specification developed by Xerox in 1976. The specification served as the basis for the IEEE 802.3 standard, which specifies the physical and lower software layers of the network. It uses CSMA/CD to handle simultaneous transmissions and is the most popular LAN Technology is use today.

See also: Local Area Network (LAN).

Event

- Occurrence of some programmed action within a process which can affect another process.
- Asynchronous occurrence that is detected by the control system, time and other information is recorded, e.g. process alarm.

Experion PKS

Honeywell Process Knowledge System™ for process, business and asset management.

Experion Station

Windows based station for viewing process schematics and interactions with the system. This station provides comprehensive alarm and event detection, management, reporting facilities, and history collection along with the capability of custom process graphics.

Event collection & management system

A device used to collect, log and manage sequence of events (SOE) data.

See also Safety Historian and Sequence Of Events (SOE).

External device

A generic term for a system the Safety Manager Controller is communicating with. This may be an Experion server, a Modbus device, a Safety Station or even another Safety Manager Controller. Also known as third party device.

External risk reduction measures

Physical measures taken externally to safety-related systems to reduce or mitigate the risks. Examples would include a drain system, fire wall, etc.

F

Fail-over

See “Communication redundancy fail-over”.

Failure

The termination of the ability of a functional unit to perform a required function.

Note:

- The definition in IEV 191-04-01 is the same, with additional notes.
- See figure in “Functional Safety” for the relationship between faults and failures, both in IEC 61508 and IEV 191.
- Performance of required functions necessarily excludes certain behavior, and some functions may be specified in terms of behavior to be avoided. The occurrence of such behavior is a failure.
- Failures are either random (in hardware) or systematic (in hardware or software).

Fault

Abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function.

Note:
IEV 191-05-01 defines “fault” as a state characterized by the inability to perform a required function, excluding the inability during preventative maintenance or other planned actions, or due to lack of external resources.

Fault reaction

The reaction to faults in the Controller, application and/or IO.

- The fault reaction towards Controller and/or application faults is fixed.
- The fault reaction to IO faults can be configured on a point or module level; it should be customized to the application for which Safety Manager is used.

See also “IO states”.

Fault reset

An action that clears the fault database and attempts a restart of tripped or halted components of the system.

Fault Tolerant Ethernet (FTE)

An Ethernet based control network of Experion PKS.

FC

Prefix used to identify conformal-coated module from non conformal coated modules. See also FS.

- FC-SDI-1624 is a safe digital input module with conformal coating
- FS-SDI-1624 is a safe digital input module without conformal coating

Field Termination Assembly (FTA)

Assembly to connect field wiring to the Safety Manager chassis IO modules.

Field value

The value of a process point as present at the interface of the system with the EUC.

Fieldbus

Wiring solution and communication protocol in which multiple sensors and actuators are connected to a DCS or SIS, using a single cable.

Fire and Gas system

Independent protective system which continuously monitors certain process points (e.g. combustible gas levels) and environmental points (e.g. heat, smoke, temperature and toxic gas levels). If any of these points exceed a predetermined level, the system will raise an alarm and take automatic action to close operating valves and damper doors, activate extinguishers, cut off electrical power and vent dangerous gases.

Force

A signal override of some sort that is applied on a system level.

A force applied to an input affects the input application state as it overrides the actual field value and diagnostic state of the forced input.

A force applied to an output affects the output field state as it overrides the application value or diagnostic value with the forced value.

Caution:
Forcing introduces a potentially dangerous situation as the corresponding point could go unnoticed to the unsafe state while the force is active.

FS

Prefix used to identify non conformal-coated module from conformal coated modules. See also FC.

- FS-SDI-1624 is a safe digital input module without conformal coating
- FC-SDI-1624 is a safe digital input module with conformal coating

Function block

Element in a functional logic diagram (FLD) which performs a user defined logic function. Function blocks are designed to implement & re-use complex functions via a single (user defined) element.

Functional Logic Diagram (FLD)

Diagrammatic representation of the application (conform the IEC 61131-3 standard) which is used to program Safety Manager. FLDs are directly translated into code that can be executed by Safety Manager, thus eliminating the need for manual programming. See also: Application Editor.

Functional safety

Part of the overall safety relating to the EUC and the EUC control system which depends on the correct functioning of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities.

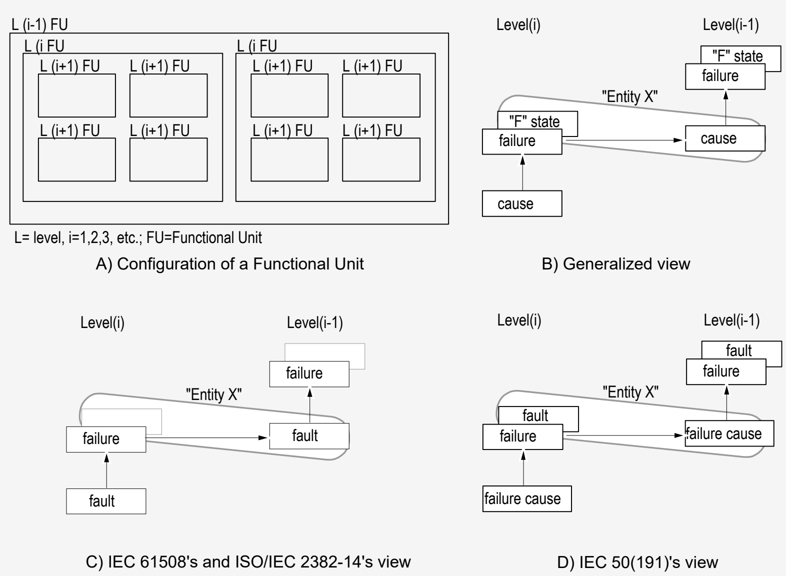


Figure 21-1: Failure model

Note:

- As shown in A), a functional unit can be viewed as a hierarchical composition of multiple levels, each of which can in turn be called a functional unit. In level (i), a “cause” may manifest itself as an error (a deviation from the correct value or state) within this level (i) functional unit, and, if not corrected or circumvented, may cause a failure of this functional unit, as a result of which it falls into an “F” state where it is no longer able to perform a required function (see B)). This “F” state of the level (i) functional unit may in turn manifest itself as an error in the level (i-1) functional unit and, if not corrected or circumvented, may cause a failure of this level (i-1) functional unit.
- In this cause and effect chain the same thing (“Entity X”) can be viewed as a state (“F” state) of the level (i) functional unit into which it has fallen as a result of its failure, and also as the cause of the level (i-1) functional unit. This “Entity X” combines the concept of “fault” in IEC 61508 and ISO/IEC 2382-14, which emphasizes its cause aspect as illustrated in C), and that of “fault” in IEC 50(191), which emphasizes its state aspect as illustrated in D). The “F” state is called fault in IEC 50(191), whereas it is not defined in IEC 61508 and ISO/IEC 2382-14.
- In some cases, a failure may be caused by an external event such as lightning or electrostatic noise, rather than by an internal fault. Likewise, a fault (in both vocabularies) may exist without a prior failure. An example of such a fault is a design fault.

Functional safety assessment

Investigation, based on evidence, to judge the functional safety achieved by one or more E/E/PE safety-related systems, other technology safety-related systems or external risk reduction facilities.

H

Hardware Configurator

A tool of the Safety Builder used to configure the hardware of Safety Manager.

Hardware safety integrity

Part of the safety integrity of the Safety Instrumented Systems (SIS) relating to random hardware failures in a dangerous mode of failure.

Note:

The term relates to failures in a dangerous mode. That is, those failures of a safety-related system that would impair its safety integrity. The two parameters that are relevant in this context are the overall dangerous failure rate and the probability of failure to operate on demand. The former reliability parameter is used when it is necessary to maintain continuous control in order to maintain safety, the latter reliability parameter is used in the context of safety-related protection systems.

Hazard

A physical situation with a potential for human injury.

> **Note:**
> The term includes danger to persons arising within a short time scale (e.g. fire and explosion) and also those that have a long-term effect on a persons health (e.g. release of a toxic substance).

High voltage

A voltage of 30VAC, 40VDC or above.

Human error

Mistake.

Human action or inaction that produces an unintended result.

I

IEC 61131-3

Part of the international standard IEC 61131, which provides a complete collection of standards on programmable controllers and their associated peripherals.

The IEC 61131-3 specifies the syntax and semantics of programming languages for programmable controllers as defined in part 1 of IEC 61131 (FLD symbols).

IEC 61508

International IEC standard on functional safety entitled “Functional safety: safety-related systems”, which sets out a generic approach for all electrically based systems that are used to perform safety functions. A major objective of this international standard is to facilitate the development of application sector standards.

Institute of Electrical and Electronic Engineers (IEEE)

An American professional organization of scientists and engineers whose purpose is the advancement of electrical engineering, electronics and allied branches of engineering and science. It also acts as a standardization body.

International Electrotechnical Commission (IEC)

An international standards development and certification group in the area of electronics and electrical engineering, including industrial process measurement, control and safety.

Interval time between faults

See Repair timer.

IO bus

A bus-structure within Safety Manager that interconnects the Control Processor with the IO.

IO bus driver

Part of the Quad Processor Pack that controls the IO bus.

IO chassis

19” chassis to slot the (redundant) IO extender(s) and Safety Manager chassis IO modules.

IO database

Database in which input, output and configuration data is stored.

IO extender

Module which controls the IO bus of the IO chassis. A maximum of ten IO extender modules can be connected to one IO bus.

IO module

An IO module is always chassis-mounted within a Safety Manager cabinet. This type of module handles input or output functions of Safety Manager. IO modules can be digital or analog.

IO states

From a system point of view, IO can have either the healthy state, the de-energized state or the fault reaction state.

- When healthy, the IO is active and has the application value applied.
- When de-energized, the IO is de-activated (as if no power was supplied).
- When the fault reaction state is applied, the IO responds according to a predefined fault condition (fault reaction).
- When forced, the force value is applied.

L

Local Area Network (LAN)

A general term to See also the network and its components that are local to a particular set of devices.

See also Wide area network (WAN).

M

Maintenance override

A function, which allows the user to apply an application value to an input independent of the input channel scan value.

Maintenance Override Switch (MOS)

Switch used to file a request for a maintenance override. Acknowledgement is decided by the application program. An acknowledged maintenance override allows maintenance to be performed on field sensors or field inputs without causing the safety system to shutdown the process.

Master-clock source

The source that is responsible for the time synchronization between a group of systems or within a network.

Mean Time Between Failure (MTBF)

- For a stated period in the life of a functional unit, the mean value of the length of time between consecutive failures under stated conditions.
- The expected or observed time between consecutive failures in a system or component.

MTBF is used for items which involve repair.

See also Mean Time To Repair (MTTR), Mean Time To Failure (MTTF).

Mean Time To Failure (MTTF)

The average time the system or component of the system works without failing.

MTTF is used for items with no repair.

See also Mean Time To Repair (MTTR), Mean Time Between Failure (MTBF).

Mean Time To Repair (MTTR)

The mean time to repair a safety-related system, or part thereof. This time is measured from the time the failure occurs to the time the repair is completed.

Media Access Control (MAC)

The lower sublayer of the data link layer (Layer 2) unique to each IEEE 802 local area network. MAC provides a mechanism by which users access (share) the network.

Modbus

A communications protocol, based on master/slave or Node ID/Peer ID architecture, originally designed by Modicon for use with PLC and SCADA systems. It has become a de facto standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices.

Mode of operation

Way in which a safety-related system is intended to be used, with respect to the frequency of demands made upon it in relation to the proof check frequency, which may be either:

- Low demand mode - where the frequency of demands for operation made on a safety-related system is not significantly greater than the proof check frequency; or
- High demand or continuous mode - where the frequency of demands for operation made on a safety-related system is significantly greater than the proof check frequency.

Note:
Typically for low demand mode, the frequency of demands on the safety-related system is the same order of magnitude as the proof test frequency (i.e. months to years where the proof test interval is a year). While typically for high demand or continuous mode, the frequency of demands on the safety-related system is hundreds of times the proof test frequency (i.e. minutes to hours where the proof test interval is a month).

Multidrop link

A multidrop link is a physical link that interconnects multiple systems. (see below figure)

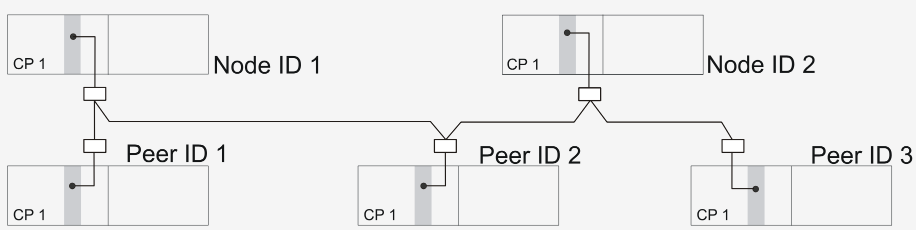


Figure 21-2: Example of a multidrop connection based on Ethernet

N

Namur

A 2-wire proximity switch operating at a working voltage of 8.2 V and an operating current of 8mA max (CENELEC Standard). Because of the small amount of energy needed to operate NAMUR sensors, they can be used in intrinsically safe applications.

Note:
Special switching amplifiers or dedicated input modules, like the SDIL-1608, are required to read the status of NAMUR proximity switches.

Network Configurator

A tool of the Safety Builder used to configure the communication architecture.

Network Time Protocol (NTP)

See “Time protocol”

Node

Hardware entity connected to a network.

Node ID

- A communication initiator on an Ethernet network. Counterpart of a Peer ID (See “Peer ID”).
- The address or ID number of a node. (See “Node”.)

O

Open Platform Communications (OPC)

Technology developed originally by Microsoft, now being standardized. Microsoft technology for application interoperability. Object Linking and Embedding (OLE) is a set of services that provides a powerful means to create documents consisting of multiple sources of information from different applications. Objects can be almost any type of information, including text, bitmap images, vector graphics, voice, or video clips.

Off-line

A system is said to be “off-line” when it is not in active control of equipment or a process.

A process or equipment is said to be “off-line” when it is in shut-down.

On-line

A system is said to be “on-line” when it is in active control of equipment or a process.

A process or equipment is said to be “on-line” when it is operating.

Operating temperature

The temperature a system and its modules are operating on.

For systems it represents the temperature within the cabinet. For modules in general it represents the temperature outside the module in its direct vicinity. For specific modules (i.e. QPP and universal modules) operating temperature is specified as ‘outside’ and ‘inside’ module temperature.

In Safety Manager cabinets temperature monitoring is done in the CP chassis within the QPP module. For remote IO locations (e.g. remote cabinets) temperature monitoring is done within the universal module(s).

Operational state

The values of an application point during normal process operation.

P

Peer Control Data Interface (PCDI)

A Honeywell licensed communication interface for non-safe peer-to-peer data communication between (Experion) Process controllers and Safety Manager Controllers.

Peer ID

A responder in Ethernet communication. Counterpart of a Node ID (See “Node ID”.)

Peer-to-peer

A logical connection between two points.

Plant

A component in Safety Builder which contains devices, controllers as well as physical and logical communication configurations used to interconnect these devices and controllers.

Point

A data structure in the IO database, usually containing information about a field entity. A point can contain one or more parameters. Safety Manager uses different point types to represent a range of different field values.

Point Configurator

A tool of the Safety Builder used to create and modify points of a Safety Manager Controller.

Point Viewer

A tool of the Safety Builder used to view points with dynamic update of states and values.

Power Supply Unit (PSU)

Separate module which supplies electrical power to the Safety Manager.

Precision Time Protocol (PTP)

See “Time protocol”

Probability of Failure on Demand (PFD)

A value that indicates the probability of a system failing to respond to a demand. PFD equals 1 minus Safety Availability. (ISA, S84.01, 1996)

Process safety time (PST)

The time a process can be left running uncontrolled without loosing the ability to regain control.

See also Diagnostic Test Interval (DTI).

Process states

A process can have many states. Related to fault detection and reaction in the safety loop of a process, the following process states are described:

- running without detected faults
- running with detected faults
- halted

Process value

An amount, expressed in engineering units, that represents the value of a process variable, e.g. a temperature, a pressure or a flow.

Programmable electronic system (PES)

System for control, protection or monitoring based on one or more programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices (See also Figure).

> **Note:**
> The structure of a PES is shown in Programmable electronic system (PES): structure and terminology A). Programmable electronic system (PES): structure and terminology B) illustrates the way in which a PES is represented in IEC 61508, with the programmable electronics shown as a unit distinct from sensors and actuators on the EUC and their interfaces, but the programmable electronics could exist at several places in the PES. Programmable electronic system (PES): structure and terminology C) illustrates a PES with two discrete units of programmable electronics. Programmable electronic system (PES): structure and terminology D) illustrates a PES with dual programmable electronics (i.e. two channel), but with a single sensor and a single actuator.

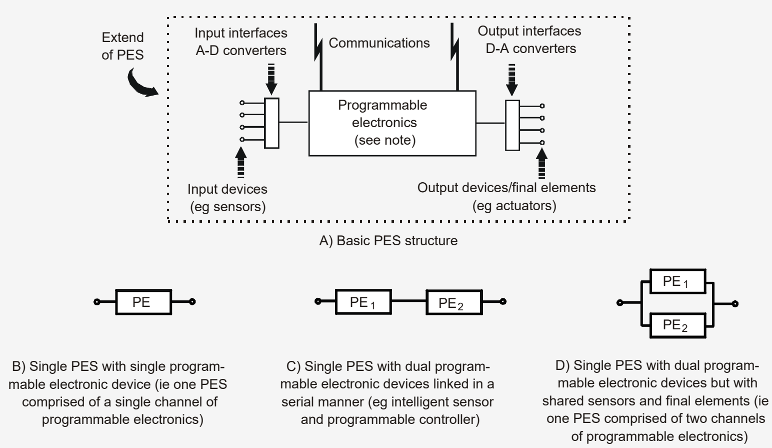


Figure 21-3: Programmable electronic system (PES): structure and terminology

Q

Quad Processor Pack (QPP)

The main processing module of the Safety Manager Controller.

Quadruple Modular Redundant (QMR)

Safety configuration providing a 2oo4D configuration. The QMR technology is used in the architecture of a redundant QPP where on-board 1oo2D voting (see Dual Modular Redundant (DMR)) is combined with 1oo2D voting between the two QPPs.

Voting takes place on two levels: First on a module level and secondly between the Control Processors.

QMR is characterized by a high level of diagnostics, fault coverage and fault tolerance.

R

Redundancy

- In an item, the existence of more than one means of performing a required function.
- Use of duplicate (or triple or quadruple) modules or devices to minimize the chance that a failure might disable an entire system.

Repair time

The time allowed to keep a Safety Instrumented System (SIS) running with a fault present that “may affect safety upon accumulation of multiple faults”. Repair time is introduced to extend the SIS up-time for a limited time frame, allowing system repair.

Repair timer

A configurable count-down timer triggered upon detection of a fault that minimizes the safety availability of the system.

The default repair window is 200 hours, which is more than sufficient if spare parts are available. The repair timer can be deactivated.

Each Control Processor has its own repair timer. Once running, a repair timer shows the remaining time to repair the fault that triggered the repair timer in the Control Processor (200 hours default). If the fault is not repaired within the repair time the Control Processor containing the fault halts.

A repair timer protects the system from certain fault accumulations that may affect the safety of Safety Manager. The timer only starts on detection of:

- faults on output modules with fault reaction set to Low
- faults detected with non-redundant IO bus extenders.

Reset

See also Fault reset.

Risk

Combination of the probability of occurrence of harm and the severity of that harm.

Router

A network device which forwards packets (messages or fragments of messages) between networks.

The forwarding decision is based on network layer information and routing tables, often constructed by routing protocols.

S

Safe

A design property of an item in which the specified failure mode is predominantly in a safe direction.

Safe failure

Failure which does not have the potential to put the safety-related system in a hazardous or fail-to-function state.

> **Note:**
> Whether or not the potential is realized may depend on the channel architecture of the system; in systems with multiple channels to improve safety, a safe hardware failure is less likely to result in an erroneous shutdown.

SafeNet

A SIL3 network protocol used by Safety Manager for i.e. safe data exchange between Safety Managers.

Safety

Freedom from unacceptable risk.

Safety Availability

The fraction of time (%) that a safety system is able to perform its designated safety service when the process is operating. See also Probability of Failure on Demand (PFD).

Safety Builder

- Station software used to configure, design, validate, log and monitor a Safety Manager project.
- Protocol used by Safety Manager to communicate with Safety Stations.

Safety Controller

Safety Controller refers to Safety Manager controller or Fail Safe Controller (FSC).

Safety Historian

Sequence of events collecting device. Windows-based software tool used to record, view and process sequence of events (SOE) data. SOE data is stored in a database for (re-)use at a later stage.

See also: Event collection & management system and Sequence Of Events (SOE).

Safety Instrumented Function (SIF)

A Safety Instrumented Function (SIF) is an isolated function, initially designed to protect “life and limb” against a specific hazard. A more popular term for SIF is safety loop. Each SIF operates on its own Safety Integrity Level.

See also: Safety instrumented System (SIS) and Safety integrity level (SIL).

Communication that is based on either an RS232, RS422 or RS485 link.

Safety instrumented System (SIS)

A Safety Instrumented System (SIS) is a system that executes one or more SIFs. The various SIFs inside a SIS may each require a different Safety Integrity Level.

Shutdown

A SIS should be able to support all SIFs, including the one with the highest SIL level.

See also: Safety Instrumented Function (SIF) and Safety integrity level (SIL).

Safety integrity

Probability of a safety-related system to satisfactorily perform the required safety functions under all stated conditions within a stated period of time.

Safety integrity level (SIL)

Discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest.

Note:

- The target failure measures for the safety integrity levels are specified in Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in low demand mode of operation and Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation.

Table 1. Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in low demand mode of operation

Safety integrity level	Low demand mode of operation (average probability of failure to perform its design function on demand)
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$
Note: See also notes below for details on interpreting this table.	

Table 2. Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation

Safety integrity level	High demand or continuous mode of operation (probability of a dangerous failure per hour)
4	$\geq 10^{-9}$ to $< 10^{-8}$
3	$\geq 10^{-8}$ to $< 10^{-7}$
2	$\geq 10^{-7}$ to $< 10^{-6}$
1	$\geq 10^{-6}$ to $< 10^{-5}$
Note: See also notes below for details on interpreting this table.	

Note:

1. The parameter in Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation, probability of a dangerous failure per hour, is sometimes referred to as the frequency of dangerous failures, or dangerous failure rate, in units of dangerous failures per hour.
2. This document sets a lower limit on the target failure measures, in a dangerous mode of failure, than can be claimed. These are specified as the lower limits for safety integrity level 4 (that is an average probability of failure of 10^{-5} to perform its design function on demand, or a probability of a dangerous failure of 10^{-9} per hour). It may be possible to achieve designs of safety-related

systems with lower values for the target failure measures for non-complex systems, but it is considered that the figures in the table represent the limit of what can be achieved for relatively complex systems (for example programmable electronic safety-related systems) at the present time.

3. The target failure measures that can be claimed when two or more E/E/PE safety-related systems are used may be better than those indicated in Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in low demand mode of operation and Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation providing that adequate levels of independence are achieved.

4. It is important to note that the failure measures for safety integrity levels 1, 2, 3 and 4 are target failure measures. It is accepted that only with respect to the hardware safety integrity will it be possible to quantify and apply reliability prediction techniques in assessing whether the target failure measures have been met. Qualitative techniques and judgements have to be made with respect to the precautions necessary to meet the target failure measures with respect to the systematic safety integrity.

5. The safety integrity requirements for each safety function shall be qualified to indicate whether each target safety integrity parameter is either:

   - the average probability of failure to perform its design function on demand (for a low demand mode of operation); or
   - the probability of a dangerous failure per hour (for a high demand or continuous mode of operation).

Safety life cycle

Necessary activities involved in the implementation of safety-related systems, occurring during a period of time that starts at the concept phase of a project and finishes when all of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities are no longer available for use.

Safety Manager

A safety solution to protect the integrity of a Process Under Control (PUC) and/or Equipment Under Control (EUC) in accordance with IEC 61508.

Assuming a full range configuration, Safety Manager includes the following components:

- Safety Manager Controller
- Safety Manager chassis IO

- Safety Manager universal IO
- Field interfaces (e.g. FTA’s, cabling)

Safety Station is used to control and configure Safety Manager, and to enable communication with other applications.

For details See also Overview Guide.

A process by which an operating Plant or system is brought to a non-operational state.

Safety Manager A.R.T.

Safety Manager with Advanced Redundancy Technique. Safety Manager A.R.T. uses specific hardware in a dedicated architecture and has extended availability compared to Safety Manager. Safety Manager A.R.T. has the capability to continue normal operation with a combination of a Control Processor fault and an IO fault.

Safety related

A flag to indicate that a signal is used for a safe function.

See also Safe and Safety-related system.

Safety-related system

Designated system that both:

- implements the required safety functions necessary to achieve or maintain a safe state for the EUC, and
- is intended to achieve, on its own or with other E/E/PE safety-related systems, other technology safety-related systems or external risk reduction facilities, the necessary safety integrity for the required safety functions

Note:

1. The term refers to those systems, designated as safety-related systems, that are intended to achieve, together with the external risk reduction facilities, the necessary risk reduction in order to meet the required tolerable risk.
2. The safety-related systems are designed to prevent the EUC from going into a dangerous state by taking appropriate action on receipt of commands. The failure of a safety-related system would be included in the events leading to the identified hazard or hazards. Although there may be other systems having safety functions, it is the safety-related systems that have been designated to achieve, in their own right, the required tolerable risk. Safety-related systems can broadly be divided into safety-related control systems and safety-related protection systems, and have two modes of operation.

3. Safety-related systems may be an integral part of the EUC control system or may interface with the EUC by sensors and/or actuators. That is, the required safety integrity level may be achieved by implementing the safety functions in the EUC control system (and possibly by additional separate and independent systems as well) or the safety functions may be implemented by separate and independent systems dedicated to safety.
4. A safety-related system may:
   - be designed to prevent the hazardous event (that is if the safety-related systems perform their safety functions then no hazard arises). The key factor here is the ensuring that the safety-related systems perform their functions with the degree of certainty required (for example, for the specified functions, that the average probability of failure should not be greater than 10^{-4} to perform its design function on demand).
   - be designed to mitigate the effects of the hazardous event, thereby reducing the risk by reducing the consequences. As for the first item in this list, the probability of failure on demand for the specified functions (or other appropriate statistical measure) should be met.
   - be designed to achieve a combination of both kinds of systems.
5. A person can be part of a safety-related system. For example, a person could receive information from a programmable electronic device and perform a safety task based on this information, or perform a safety task through a programmable electronic device.
6. The term includes all the hardware, software and supporting services (for example power supplies) necessary to carry out the specified safety function (sensors, other input devices, final elements (actuators) and other output devices are therefore included in the safety-related system).
7. A safety-related system may be based on a wide range of technologies including electrical, electronic, programmable electronic, hydraulic and pneumatic.

Safety Station

Station running Safety Builder to control and configure Safety Manager. Safety Station can also run one or more other applications to manage loggin and communication.

Examples are: Safety Historian, Trip & Bypass management, communication with plant control systems.

Second fault timer

See: Repair timer.

Secondary Means

A means designed to drive towards a safe state in case the primary means is unable or unreliable to do so.

An example of a secondary means is the watchdog: The watchdog is designed to drive the Control Processor and related outputs to a safe state if the Control Processor itself is unable or unreliable to do so.

Secondary Means Of De-energization (SMOD)

A SMOD is a Secondary Means designed to de-energize the output in case the primary means is unable or unreliable to do so.

The following figure shows an example of a SMOD protecting 4 output channels.

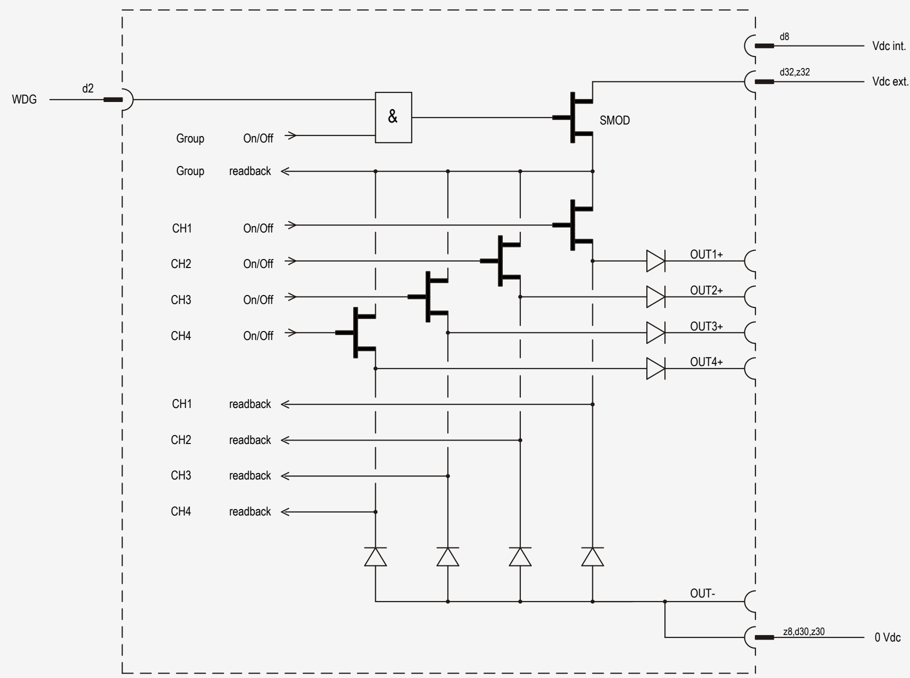


Figure 21-4: Schematic diagram of a SMOD with 4 channels

Sequence Of Events (SOE)

The function detecting the occurrence of events. See also: Safety Historian and Event collection and management system.

Serial communication

Communication that is based on either an RS232, RS422 or RS485 link.

Shutdown

A process by which an operating Plant or system is brought to a non-operational state.

SICC

IO signal wiring using system interconnection cables that hook up the FTA board to the IO.

SICPI

IO signal wiring using system interconnection cables that hook up the screw terminals to the IO.

The temperature the system can be stored at.

Single fault tolerant

Built-in ability of a system to correctly continue its assigned function in the presence of a single fault in the hardware or software.

Single fault tolerant for safety

Built-in ability of each Safety Manager configuration to continue to maintain safety in the presence of a single fault in the hardware or software.

A network device which forwards packets (messages or fragments of messages) by means of packet switching.

Safety Manager Controller

Assembly of Control Processor, Controller chassis and BKM. A Controller can be redundant or non redundant. A redundant Controller contains two Control Processors. A non redundant Controller contains one Control Processor. Note that IO is not included.

Safety Manager chassis IO

Safety Manager chassis IO stands for Safety Manager chassis based IO. This type of IO is always chassis-mounted within a Safety Manager cabinet. This type of IO is also called 'chassis IO'.

Safety Manager universal IO

Safety Manager universal IO stands for Safety Manager universal IO. This type of IO is IOTA-mounted in remote locations and/or within a Safety Manager cabinet.

Safety Manager RIO Link

A real-time communication IO-bus that uses a dedicated protocol for safe exchange of IO data between a Safety Manager Controller and one or more Safety Manager universal IO modules.

Safety Manager universal IO modules

Part of the safety integrity of safety-related systems relating to systematic failures in a dangerous mode of failure.

A Safety Manager universal IO modules is a Remote Universal Safe device. It has multiple channels that can be configured individually depending on system needs. A Safety Manager universal IO modules is placed on an IOTA.

Typical Safety Manager Universal IO modules are:

- RUSIO-3224
- RUSLS-3224

Storage temperature

The temperature the system can be stored at.

Switch

A network device which forwards packets (messages or fragments of messages) by means of packet switching.

The forwarding decision is based on the most expedient route (as determined by some routing algorithm). Not all packets travelling between the same two hosts, even those from a single message, will necessarily follow the same route.

System Interconnection Cable (SIC)

Cables to connect IO modules with FTAs or terminals.

Systematic safety integrity

Part of the safety integrity of safety-related systems relating to systematic failures in a dangerous mode of failure.

> **Note:**
> Systematic safety integrity cannot usually be quantified (as distinct from hardware safety integrity which usually can).

T

Third party device

See “External device”

Time protocol

A collective for Internet protocols to provide machine readable date and time:

- The Precision Time Protocol (PTP) is a protocol that allows precise synchronization of networks. It is used in SafeNet where it reaches clock synchronization accuracies of 10ms.
- The Network Time Protocol (NTP) is an older protocol for synchronizing the clocks of computer systems over internet/ethernet. Safety Manager supports NTP3 and NTP4, reaching clock synchronization accuracies of 100ms.

Timestamp

As a verb, the act of putting the current time together with an event. As a noun, the time value held with an event.

Trend

A display defined primarily for presentation of and navigation through historical information.

Trip

An action by which part of an operating Plant or system is brought to a non-operational state.

See also: Shutdown.

Triple Modular Redundant (TMR)

Safety technology which is based on comparison principles and which requires triplicated system components.

U

Universal Safety Interface (USI)

Communication module of the Safety Manager Controller.

V

Validation

Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification

Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled.

> **Note:**
> In the context of IEC 61508, verification means the process of demonstrating for each phase of the relevant safety lifecycle (overall, E/E/PES, software), by analysis and/or tests, that, for the specific inputs, the deliverables meet in all respects the objectives and requirements set for the specific phase.
>
> Examples of verification activities would include:
>
> 1. Reviews on deliverables (documents from all phases of the safety lifecycle) to ensure compliance with the objectives and requirements of the phase taking into account the specific inputs to that phase.
> 2. Design reviews.
> 3. Tests performed on the designed products to ensure that they perform according to their specifications.

4. Integration tests performed where different parts of a system are put together in a step-by-step manner and by the performance of environmental tests to ensure that all the parts work together in the specified manner.

Voting configuration

To prevent that a safety-related system remains passive or false signals occur in this system it is possible to use voting. With voting the safety-related system makes a decision based on signals. The usage of more than one signal enhances the safety and reliability of the system.

W

Watchdog

A combination of diagnostics and an output device (typically a switch) the aim of which is to monitor the correct operation of the programmable electronic (PE) devices and takes action upon detection of an incorrect operation.

Note:
The watchdog is used to de-energize a group of safety outputs when dangerous failures are detected in order to put the EUC into a safe state. The watchdog is used to increase the on-line diagnostic coverage of the logic system

Wide area network (WAN)

A general term to See also a piece of a network and its components that are used to inter-connect multiple LANs over a wide area.

CHAPTER 22

NOTICES

22 Notices

Notice

Honeywell trademarks

Other trademarks

22.1 Documentation feedback

If you have comments about Honeywell Safety Manager documentation; send your feedback to Honeywell Local Affiliate at:

- Send your feedback to Honeywell HPSCustomerSupport@Honeywell.com
- You can also write to;

  Safety Manager user documentation

  Honeywell Process Solutions, Safety Management Systems

  Burgemeester Burgerslaan 40

  5245 NH Rosmalen ('s-Hertogenbosch)

  The Netherlands

22.2 How to report a security vulnerability

For the purpose of submission, a security vulnerability is defined as a software defect or weakness that can be exploited to reduce the operational or security capabilities of the software.

Honeywell investigates all reports of security vulnerabilities affecting Honeywell products and services.

To report a potential security vulnerability against any Honeywell product, please follow the instructions at:

https://honeywell.com/pages/vulnerabilityreporting.aspx

Submit the requested information to Honeywell using one of the following methods:

- Send an email to security@honeywell.com.

  or

- Contact your local Honeywell Process Solutions Customer Contact Center (CCC) or Honeywell Technical Assistance Center (TAC) listed in the "Support and other contacts" section of this document.

22.3 Support

If you have any technical questions, please contact your local Honeywell office or the HPS Technical Support Center. Visit process.honeywell.com and select "Contact Us" for country-specific Customer Contact Numbers.

After you log on to process.honeywell.com you may also search in our "Knowledge Articles", "Technical Publications" or request help by selecting "Support Request".

22.4 Training classes

Honeywell holds technical training classes on Safety Manager. These classes are taught by experts in the field of process control systems. For more information about these classes, contact your Honeywell representative, or see Training Course-list.