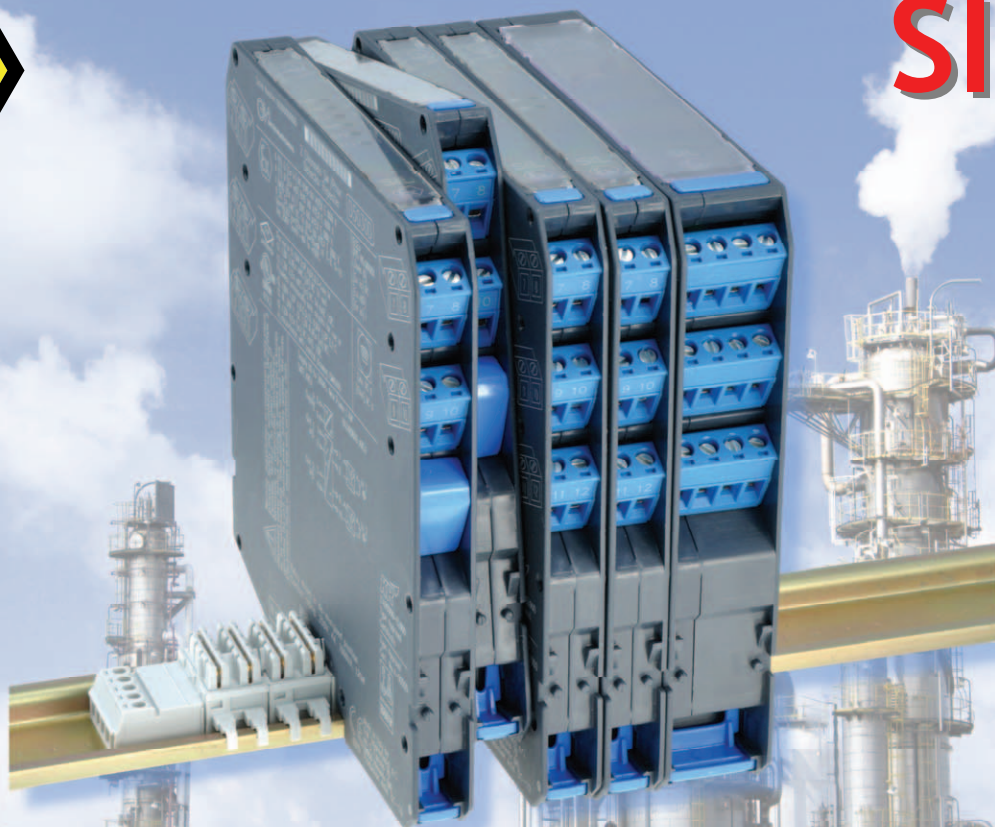




SIL 3



D5000 - D5200

INTRINSICALLY SAFE ISOLATORS AND SAFETY RELAYS

DIN-RAIL, POWER BUS, TERMINATION BOARD MOUNTING



D5000 SERIES

SIL 3 CERTIFIED

INTRINSICALLY SAFE ISOLATORS AND SAFETY RELAYS

D5000 Modules provide the most simple and cost effective means of implementing Intrinsic Safety for Hazardous Areas / Locations applications.

A complete line of Isolators and Safety Relays.

HIGH INTEGRITY

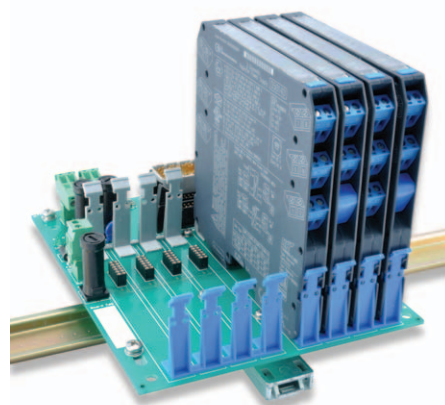
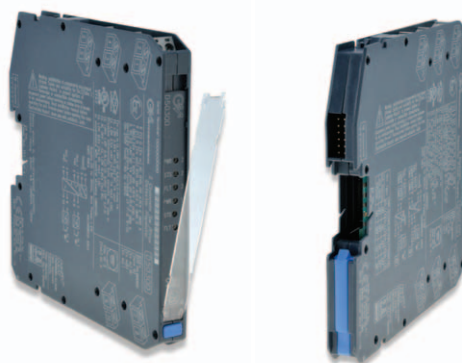
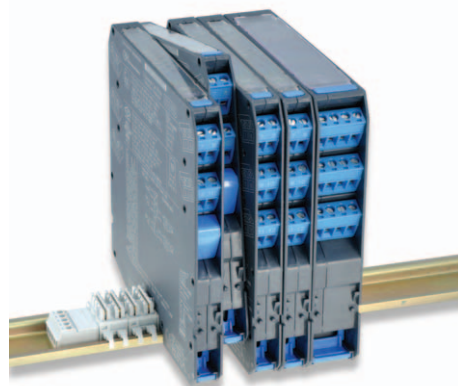
- ♦ SIL 3 according IEC 61508 - 61511
- ♦ Certified life duration: 20 years
- ♦ No electrolytic capacitors
- ♦ Three port galvanic isolation
- ♦ Safety Relay contacts rated for 4 A or 10 A

ENHANCED PACKING

- ♦ Space saving 12mm enclosure: 160 channels into just 1m DIN-Rail
- ♦ Reduced power consumption
- ♦ Power Bus and DIN-Rail mounting
- ♦ All modules can be mounted on DIN-Rail, Power Bus and Termination Boards.
- ♦ Detachable transparent front panel

ADVANCED FEATURES

- ♦ Short and open circuit detection reflected on PLC
- ♦ EMC compatibility for safety systems
- ♦ AI, AO, DI, DO, Temperature applications
- ♦ Signal converter, Encoders



D5000 SERIES

CHARACTERISTICS

Universal mounting enclosure

All D5000 Modules can be mounted on
DIN-Rail, Power Bus and Termination Boards.



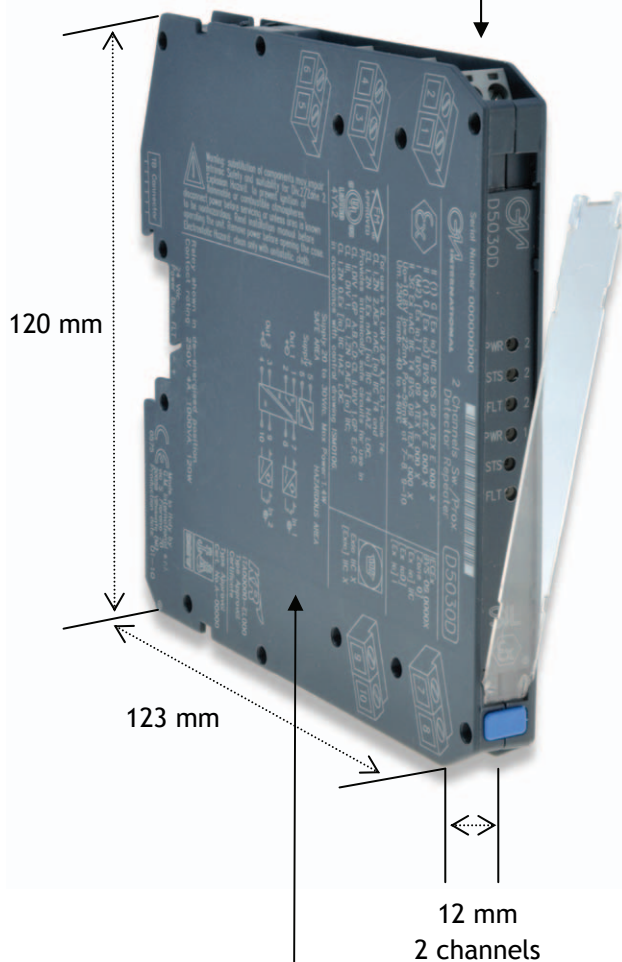
Termination Board connector

Power Bus connector

DIN-Rail lock

Guides for Termination
 board mounting

Safe Area Terminal blocks
 with engraved identification



Lexan detachable front cover

LEDs for power, status and fault indication
 are visible through the transparent cover

Modules are SIL 3 certified

Hazardous Area Terminal Blocks indicator

Laser engraving on entire enclosure and terminal blocks
 to provide accurate, safe and permanent marking of
 Intrinsic Safety parameters, schematic diagrams,
 connections and instructions.

D5000

D5000 - D5200 SERIES

HIGH INTEGRITY

INTRINSICALLY SAFE ISOLATORS & SAFETY RELAYS

High performance

- ◆ High signal transfer accuracy and repeatability.
- ◆ Advanced circuitry provides very low heat dissipation, ensuring modules run cool despite their high density and functionality.
- ◆ SMD manufacturing to maximize long, reliable life.
- ◆ Complete absence of electrolytic capacitors ensures minimum 20 years lifetime.

Wide functionality

- ◆ Wide range of digital and analog I/O.
- ◆ SIL 3 Safety Relay contacts rated for 4 A or 10 A for direct switching of high loads.
- ◆ Three port galvanic isolation to eliminate noise, ground loop problems and to provide Intrinsic Safety without a high integrity safety earth connection.
- ◆ Line fault alarm detects open or short circuit of field cables.
- ◆ Optional power bus DIN-Rail connector.
- ◆ Standard Termination Board, custom connectors for integration into customized Boards.
- ◆ EMC Compatibility to EN61000-6-2, EN61000-6-4, EN61326-1, EN61326-3-1 for safety system.

Save up to 50% space

General features

- ◆ More than 25 modules suitable for SIL 3 applications according to IEC 61508, IEC 61511.
- ◆ Independent power supply circuit for each channel.
- ◆ Double units are equivalent to two single units because of the absence of common circuitry.
- ◆ Single channel versions available if required, to provide single loop integrity on Emergency Shut Down and Fire & Gas applications.
- ◆ Configuration components are easily accessed by removing cover.
- ◆ DIP switch configurability for easy field setup.
- ◆ LED indication for power, signal status and line fault conditions.
- ◆ Modules accept DC power supply over a wide range for 24 Vdc (20-30 Vdc) applications.
- ◆ Wide operating temp. range: -40 to +60/+70 °C.
- ◆ Installation in Zone 2 / Division 2.
- ◆ Certified for Offshore and Marine applications.

High packing density

- ◆ 35 mm (Top Hat) DIN-Rail.
- ◆ Ultra slim 2 channels 12 mm wide DIN-Rail and Termination Board mounting modules.
- ◆ Power and fault on bus connectors.
- ◆ 6 mm per channel means 50% space reduction



6 mm per channel + Ultra-low power consumption



Up to 160 I/O channels per 1m of DIN-Rail as shown in the configuration above.

APPROVALS AND CERTIFICATIONS

D5000 SERIES APPLIED FOR

Intrinsically Safe products



G.M. International

has obtained IS certificates from the most credited
Notified bodies in the world for its D1000 Series.
D5000 and D5200 Series will be applied for certification in 2010.



SIL Certifications according IEC 61508 and IEC 61511



G.M. International

offers a wide range of products that have been proved to comply
with the most severe quality and safety requirements.
IEC 61508 and IEC 61511 standards represent a milestone in the progress
of industry in the achievement of supreme levels of safety through
the entire instrumented system lifecycle.

Marine Type Approval



G.M. International

offers Type Approval Certificates for its line of Intrinsically Safe Isolators D1000 Series and
Power Supplies for use in Marine and Offshore applications.
Certificates have been released both by Korean Register of Shipping and Det Norske Veritas.
The D5000 and D5200 Series will be applied for soon.

Company Quality System



G.M. International's

Production Quality System is certified by Det Norske Veritas (Norway)
to be compliant with ATEX 94/9/EC Directive and ISO 9001/2008.
This means our production facilities are periodically re-assessed throughout the whole
manufacturing process, to ensure that the highest quality standards are met.

D5000 SERIES

FEATURES

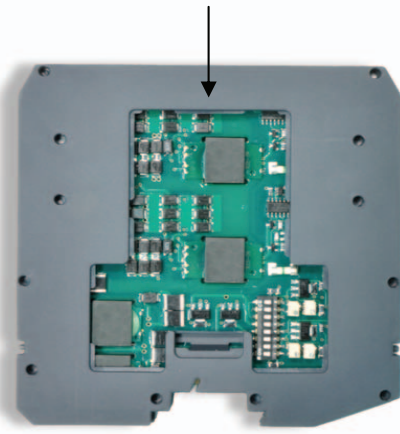
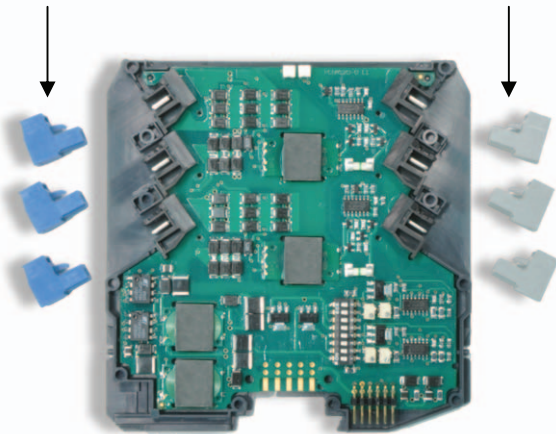
Enclosure Characteristics

- ◆ High channel density result from innovative circuit design using advanced surface mount components.
- ◆ Plug-in screw terminal blocks to secure termination up to 2.5 mm².
- ◆ Configuration components are easily accessed by removing side cover.

Blue terminal blocks for
Hazardous Area connections

Grey terminal blocks
for Safe Area connections

Detachable cover for access to
configuration component



Enhanced Power Bus mounting

Power Supply Voltage 24 Vdc can be applied to the module, by connecting directly the voltage to the plug-in Terminal Block of each module, or via the Power Bus System.

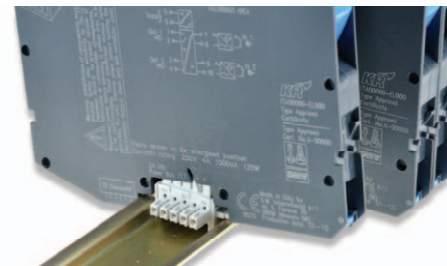
The system consists of standard DIN-Rail modules mounted on standard DIN-Rail Bus connectors. The maximum allowed powering capacity is 8 A.

It is always possible to remove modules, without disconnecting the bus connector which remains attached to the DIN-Rail.

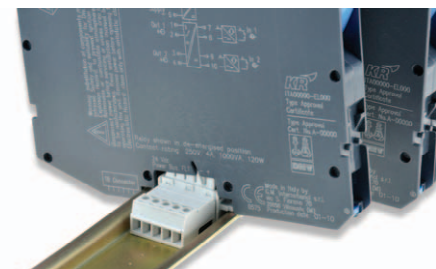
Cumulative Fault Alarm indication is provided on the Bus connection.

This signal is fed to a common unit (D5001S) which provides: 1 SPST Relay contact for common faults and 1 SPST Relay contact for power good (supply within operating range).

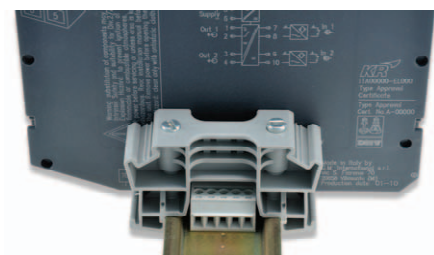
The D5002S is capable of operating also as redundant 4 A supply module for the system.



Bus plug-in connector



Bus connector terminal



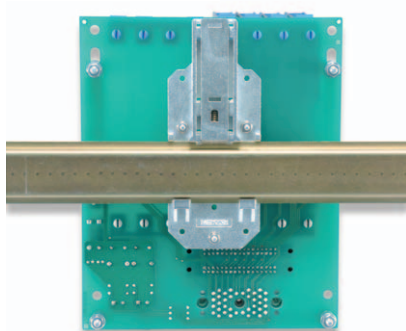
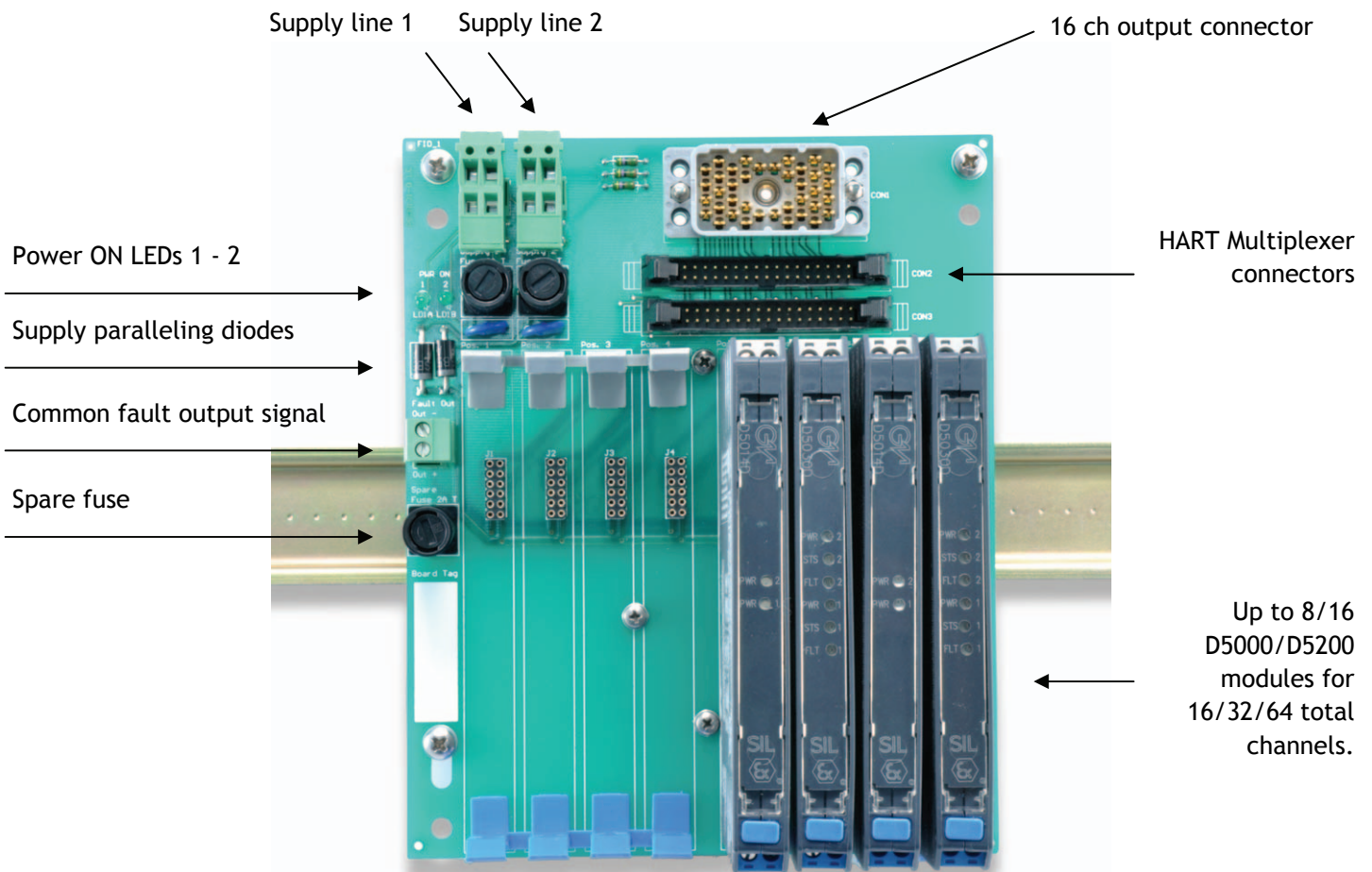
DIN-Rail stopper

D5000 SERIES

TERMINATION BOARDS

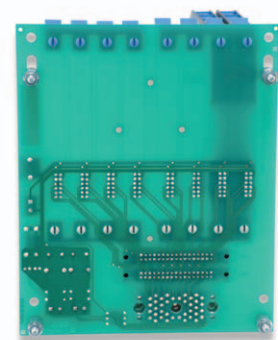
Characteristics


















- ◆ Suitable to accept up to 8/16 D5000 or D5200 SIL 3 modules 12mm/22mm wide, which can be single or double channel.
- ◆ AI - AO - DI - Temperature: double channels.
- ◆ DO - Signal converter, Encoders, Safety Relay: single channel.
- ◆ 24 Vdc Power supply terminal blocks can be disconnected from the board without disconnecting the power to other boards connected in series.
- ◆ Boards are available with custom connectors for any system / PLC / DCS.
- ◆ Boards are available also for 8/16+2 modules:
 the extra 2 modules (D5001S) provide separated fault signal relay contacts for power supply fault and input/output lines open and short circuit detection.
 Two D5001S modules can be paralleled for 1oo2 redundancy, to increase availability on fault detection.



DIN-Rail mounting






Wall mounting










	Field device	Model	Hazardous Area	Safe Area	Ch. per unit	Supply	SIL level
ANALOG IN		D5011S	4-20 mA		1	20-30 Vdc	SIL 3
		D5011D	2-Wires Tx only Smart compatible	4-20 mA (source only)	2		SIL 3
		D5014S	4-20 mA		1	20-30 Vdc	SIL 3
		D5014D	2-Wires Active or Passive Tx	4-20 mA (source or sink)	2		SIL 3
		D5014D	Smart compatible	Two duplicated outputs	1		SIL 3
		D5212Q 		4-20 mA	4	20-30 Vdc	SIL 3
		D5212Q 	4-20 mA	Two duplicated outputs	2		SIL 3
		D5212Q 	2-Wires Passive Tx	One Triplicated + One single outputs	2		SIL 3
		D5212Q 		One Quaduplicated output	1		SIL 3
		D5254S 	4-20 mA 2-Wires Tx Active or Passive Smart compatible	4-20 mA 2 Trip Amplifiers each with 1 SPST (relay contact)	1	20-30 Vdc	SIL 2
ANALOG OUT		D5020S	4-20 mA	4-20 mA	1	20-30 Vdc	SIL 3
		D5020D	Analog Signal to I/P Converters, Electrovalves, Actuators and Displays Smart compatible	Bus powered signal from DCS, PLC or other control devices. Two duplicated outputs.	2		SIL 3




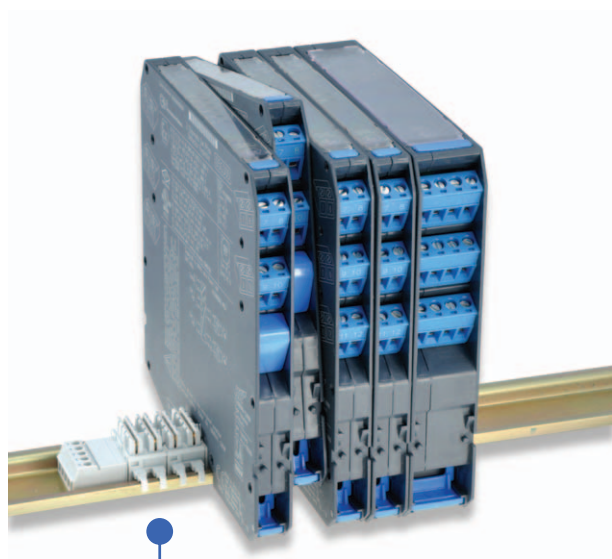
Configurable via PPC5092 with Software SWC5090

Field device	Model	Hazardous Area	Safe Area	Ch. per unit	Supply	SIL level
DIGITAL IN	 D5030S	Voltage free Contact, Proximity Switch Line fault detection Isolated inputs	1 SPDT (relay contact) + LED (fault status)	1	20-30 Vdc	SIL 3
	 D5030D		1 SPST (relay contact) + 1 SPST (alarm or duplicator) + LED (fault status)	1		SIL 3
	 D5030D		2 SPST (relay contact) + LED (fault status)	2		SIL 3
	 D5031S	Voltage free Contact, Proximity Switch Line fault detection Isolated inputs	1 Open Collector + LED (fault status)	1	20-30 Vdc	SIL 3
	 D5031D		2 Open Collectors + LED (fault status)	2		SIL 3
	 D5231Q		4 Open Collectors + LED (fault status)	4		SIL 2
	 D5231E	Voltage free Contact, Proximity Switch Line fault detection Isolated inputs	8 Open Collectors + LED (fault status)	8	20-30 Vdc	SIL 2
	 D5032S		1 SPDT (relay contact) + LED (fault status)	1		SIL 3
	 D5032D		1 SPST (relay contact) + 1 SPST (alarm or duplicator) + LED (fault status)	1		SIL 3
	 D5032D	Voltage free Contact, Proximity Switch Line fault detection Isolated inputs	2 SPST (relay contact) + LED (fault status)	2	20-30 Vdc	SIL 3
	 D5034S		Transparent repeater of input status	1		SIL 3
	 D5034D		0 to 8 mA range	2		SIL 3

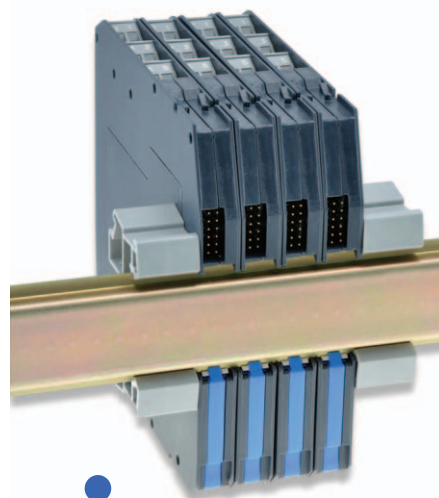
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	Field device	Model	Hazardous Area	Safe Area	Ch. per unit	Supply	SIL level
DIGITAL OUTPUT DRIVER		D5048S	NE solenoid valve, other control devices. Line open/short fault detection reflected on PLC.	Loop Powered control signal from safety PLC, DCS	1	Loop + 20-30 Vdc	SIL 3
		D5049S	F&G solenoid valve, other control devices. Line open/short fault detection. High Availability (1oo2)	Bus Powered control signal from safety PLC, DCS	1	20-30 Vdc	SIL 3
		D5247S	NE 12W 'Ex d' solenoid valve, other control devices. Line open/short fault detection.	Loop Powered control signal from safety PLC, DCS	1	Loop + 20-30 Vdc	SIL 3
		D5280S	F&G 12W 'Ex d' solenoid valve, other control devices. Line open/short fault detection. High Availability (1oo2)	Loop Powered control signal from safety PLC, DCS	1	Loop + 20-30 Vdc	SIL 3
		D5281S	0-50 KHz Magnetic Pickup or Proximity Switch	mA (source) or V Out, Pulse repeater Output	1	20-30 Vdc	SIL 2
SIGNAL CONV.		D5060S	Intrinsically Safe Encoder	Transparent repeater	1	20-30 Vdc	
ENCODER		D5265S					









 Configurable via PPC5092 with Software SWC5090




Side view

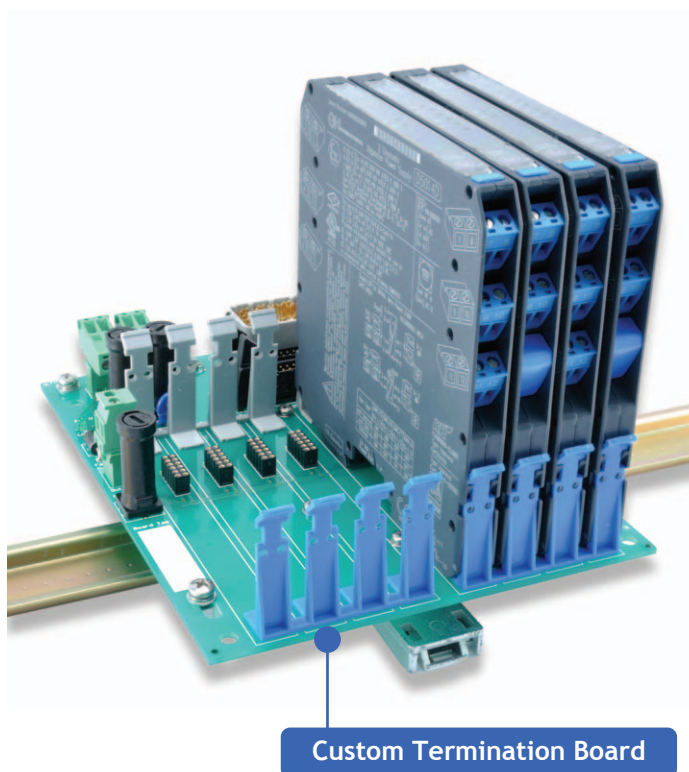


Rear view


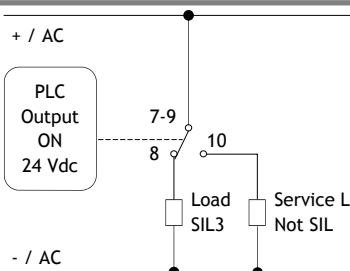

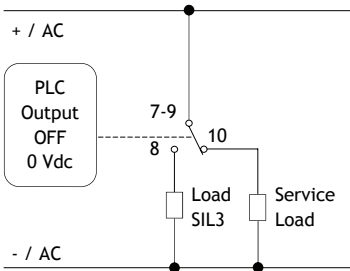

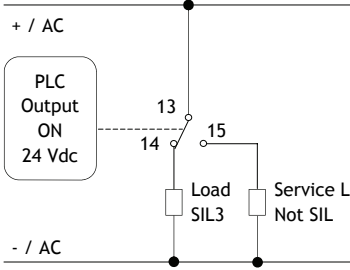

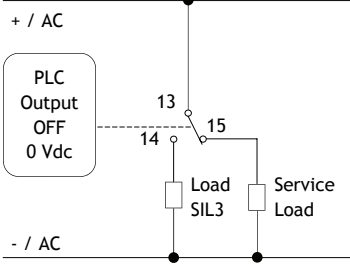
Field device	Model	Hazardous Area	Safe Area	Ch. per unit	Supply	SIL level
	 D5072S	Universal TC, 3/4-Wires RTD, Potentiometer, mV	4-20 mA (source) 1 Independent set point via 1 Solid State Relay	1	20-30 Vdc	SIL 2
	 D5072D	Universal TC, 3-Wires RTD, Potentiometer, mV	4-20 mA (source)	2	20-30 Vdc	SIL 2
	 D5072D		4-20 mA (source) Duplicator	2		SIL 2
		2 inputs in 1oo2 Universal TC, 3-Wires RTD, Pot, mV	4-20 mA (source)	1	20-30 Vdc	SIL 3

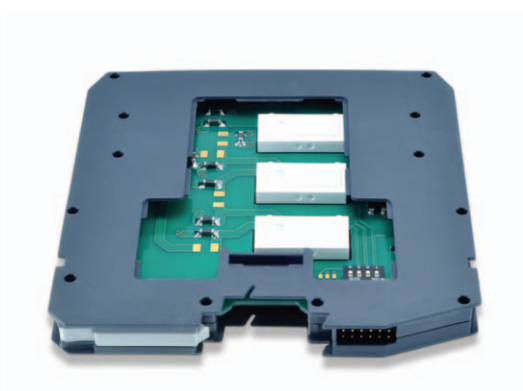
 Configurable via PPC5092 with Software SWC5090

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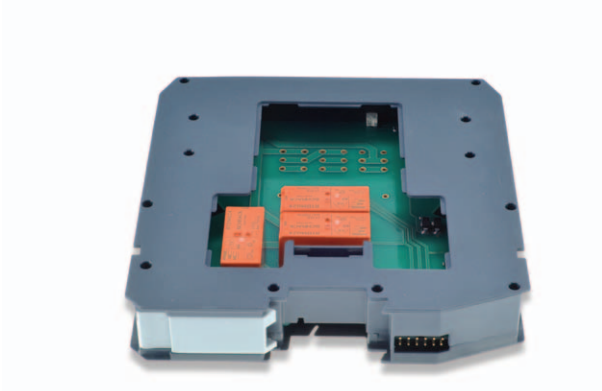


Custom Termination Board


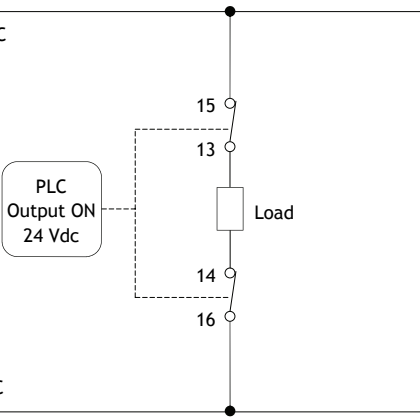

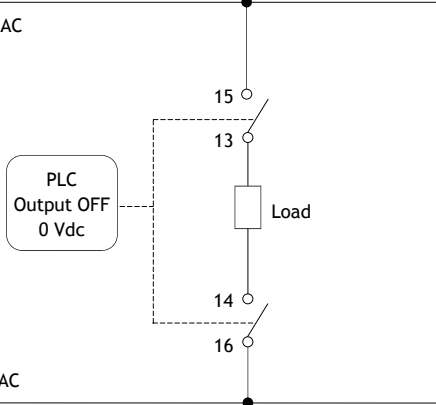
Field device	Model	Load Contacts	Connections	Rating	SIL level
	D5090S	4 A NE Load		250 Vdc 250 Vac	SIL 3
	D5091S	4 A ND Load		250 Vdc 250 Vac	SIL 3
	D5290S	10 A NE Load		250 Vdc 250 Vac	SIL 3
	D5291S	10 A ND Load		250 Vdc 250 Vac	SIL 3



D5090S



D5290S

Field device	Model	Load Contacts	Connections	Rating	SIL level
	D5293S	10 A, NE Load + line and load diagnostic for open / short circuit programmable + earth leakage detection. 2 fault output contacts		250 Vdc 250 Vac	SIL 3
		<i>Contacts 13-15 / 14-16: SIL 3 Function is met when contacts are in open state.</i>			
	D5294S	10 A, F & G Load + line and load diagnostic for open /short circuit programmable + earth leakage detection. 2 fault output contacts		250 Vdc 250 Vac	SIL 3
		<i>Contacts 13-15 / 14-16: SIL 3 Function is met when contacts are in closed state.</i>			

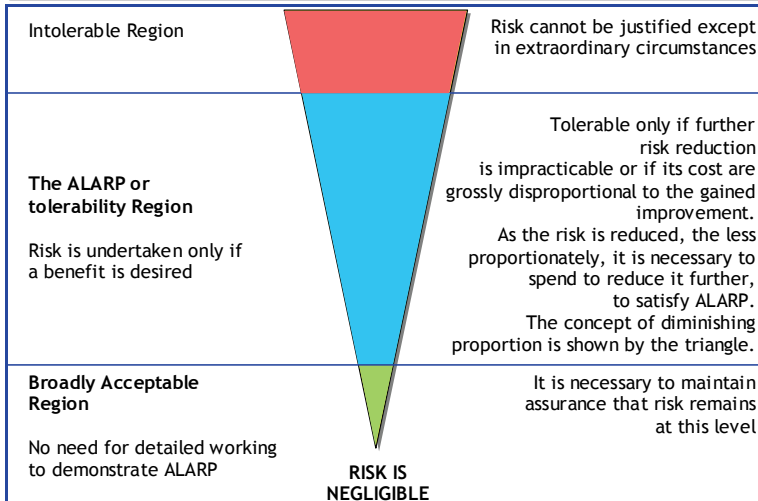


D5090S-5091S-5290S-5291S

SIL LEVELS ACCORDING IEC 61508 / IEC 61511

SIL Safety Integrity Level	PFDavg Average probability of failure on demand per year (low demand)	RRF Risk Reduction Factor	PFDavg Average probability of failure on demand per hour (high demand)
SIL 4	$\geq 10^{-5}$ and $< 10^{-4}$	100000 to 10000	$\geq 10^{-9}$ and $< 10^{-8}$
SIL 3	$\geq 10^{-4}$ and $< 10^{-3}$	10000 to 1000	$\geq 10^{-8}$ and $< 10^{-7}$
SIL 2	$\geq 10^{-3}$ and $< 10^{-2}$	1000 to 100	$\geq 10^{-7}$ and $< 10^{-6}$
SIL 1	$\geq 10^{-2}$ and $< 10^{-1}$	100 to 10	$\geq 10^{-6}$ and $< 10^{-5}$

TOLERABLE RISKS AND ALARP (ANNEX 'B')



IEC 61508-61511 FACTS AND FORMULAE

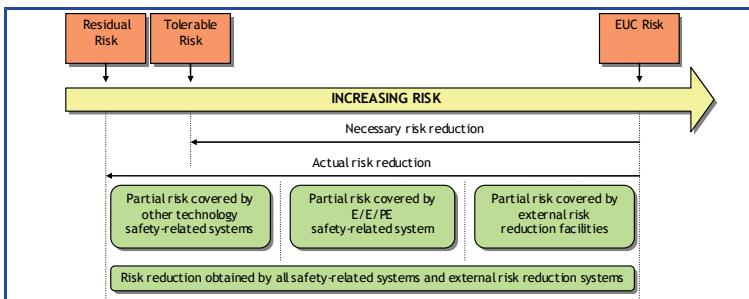
IEC 61508 and IEC 61511 standards represent a milestone in the progress of industry in the achievement of supreme levels of safety through the entire instrumented system lifecycle.

The benefits of these new standards include details and a greater effectiveness for what concerns:

- ♦ the definition of risk reduction and related requirements;
- ♦ system design and implementation;
- ♦ documentation management;
- ♦ safety assessment and validation;
- ♦ plant maintenance;
- ♦ cost management.

The majority of our products are SIL 3 or SIL 2 certified.

RISK REDUCTION



AVERAGE PROBABILITY OF FAILURE ON DEMAND (PFDavg)

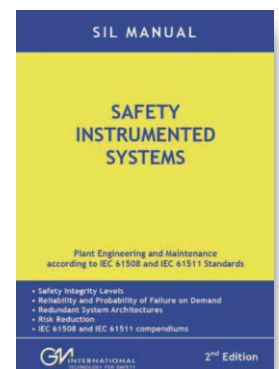
PFDavg	Tolerable accident frequency Frequency of accidents without protections = $\frac{1}{RRF}$	
	Simplified equations	
	Without common causes	With common causes (Beta factor)
1001	$\lambda_{DU} \times \frac{TI}{2}$	-
1002 1002D	$\lambda_{DU1} \times \lambda_{DU2} \times \frac{TI^2}{3}$	$\frac{[(1-B) \times (\lambda_{DU} \times TI)]^2}{3} + \frac{(B \times \lambda_{DU} \times TI)}{2}$
1003	$\lambda_{DU1} \times \lambda_{DU2} \times \lambda_{DU3} \times \frac{TI^3}{4}$	$\frac{[(1-B) \times (\lambda_{DU} \times TI)]^3}{4} + \frac{(B \times \lambda_{DU} \times TI)}{2}$
2002	$(\lambda_{DU1} + \lambda_{DU2}) \times \frac{TI}{2}$	$[(1-B) \times (\lambda_{DU} \times TI)] + \frac{(B \times \lambda_{DU} \times TI)}{2}$
2003	$\left[(\lambda_{DU1} \times \lambda_{DU2}) + (\lambda_{DU1} \times \lambda_{DU3}) + (\lambda_{DU2} \times \lambda_{DU3}) \right] \times \frac{TI^2}{3}$	$[(1-B) \times (\lambda_{DU} \times TI)]^2 + \frac{(B \times \lambda_{DU} \times TI)}{2}$
1001 ($E_t \neq 100\%$)	$\lambda_{DU} \left[\left(Et \times \frac{TI}{2} \right) + (1-Et) \frac{SL}{2} \right]$	TI: Proof Test time interval Et: Test Effectiveness λ_{DU} : dangerous undetected failures

Safety Instrumented Systems

The experience in safety and electronics acquired during the years has lead us to the writing of a comprehensive manual on IEC61508 and IEC 61511.

This effort has already proven to be a great benefit for engineers, maintenance personnel and whoever wishes to approach the concept of functional safety.

The manual is available on request in English, Spanish and Italian language.



SAFETY: FREEDOM FROM UNACCEPTABLE RISK



Boiling Liquid expanding Vapor Explosion (BLEVE)



Flash Fire



Jet Fire



Pool Fire



Fireball

AVAILABILITY AND RELIABILITY

Basic Concepts:

Failure Rate:

$$\lambda = \frac{\text{Failures per unit time}}{\text{Components exposed to functional failure}}$$

1 FIT = 1×10^{-9} Failures per hour

$$\text{MTBF} = \text{MTTF} + \text{MTTR} \quad \mu = \frac{1}{\text{MTTR}}$$

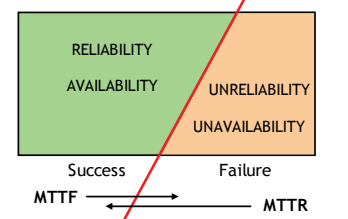
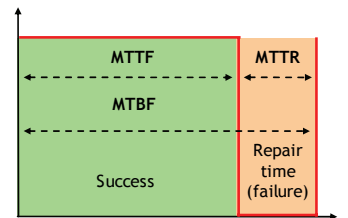
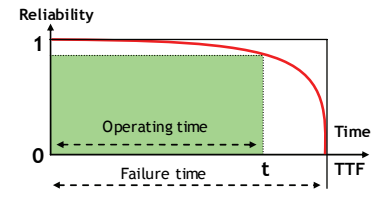
$$\text{MTTF} = \text{MTBF} - \text{MTTR} = \frac{1}{\lambda} \quad \lambda = \frac{1}{\text{MTTF}}$$

$$\begin{aligned} \text{Availability} &= \frac{\text{Operating Time}}{\text{Operating Time} + \text{Repair Time}} = \\ &= \frac{\text{MTTF}}{\text{MTTF} + \text{MTTR}} = \frac{\text{MTTF}}{\text{MTBF}} = \frac{\mu}{\mu + \lambda} = \\ &= \frac{\text{MTBM}}{\text{MTBM} + \text{MSD}} \end{aligned}$$

$$\text{Unavailability} = 1 - \text{Availability} = \frac{\lambda}{\mu}$$

Acronyms:

MTBF: Mean Time Between Failures
MTTF: Mean Time To Failure
MTTR: Mean Time To Repair
MTBM: Mean Time Between Maintenance
MSD: Expected Mean System Downtime
 λ : Failure rate
 μ : Repair rate



SAFE FAILURE FRACTION (SFF) AND SIL LEVELS

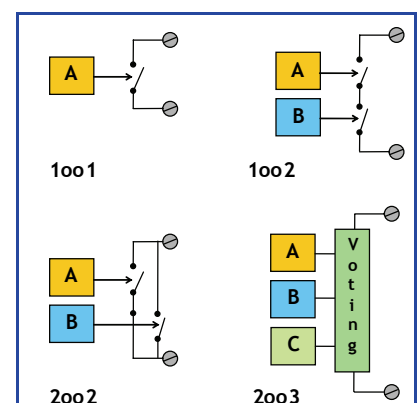
SFF	$\frac{\sum \lambda_{DD} + \sum \lambda_{SD} + \sum \lambda_{SU}}{\sum \lambda_{DD} + \sum \lambda_{DU} + \sum \lambda_{SD} + \sum \lambda_{SU}} = 1 - \frac{\sum \lambda_{DU}}{\sum \lambda_{TOT}}$		
	Hardware fault tolerance 0	Hardware fault tolerance 1	Hardware fault tolerance 2
TYPE A Components			
< 60%	SIL 1	SIL 2	SIL3
60% - < 90%	SIL 2	SIL 3	SIL 4
90% - < 99%	SIL 3	SIL 4	SIL 4
> 99%	SIL 3	SIL 4	SIL 4
TYPE B Components			
< 60%	Not allowed	SIL 1	SIL2
60% - < 90%	SIL 1	SIL 2	SIL 3
90% - < 99%	SIL 2	SIL 3	SIL 4
> 99%	SIL 3	SIL 4	SIL 4

Failure rates categories: λ_{DD} : dangerous detected; λ_{DU} : dangerous undetected
 λ_{SD} : safe detected; λ_{SU} : safe undetected

MEAN TIME TO FAILURE SPURIOUS

MTTFs	
1oo1	$\frac{1}{\lambda_s}$
1oo2	$\frac{1}{2\lambda_s}$
2oo2	$\frac{1}{2\lambda_s^2 \times \text{MTTR}}$
2oo3	$\frac{1}{6\lambda_s^2 \times \text{MTTR}}$

SYSTEM ARCHITECTURES





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Note: All specifications are subject to change or modification without prior notice. For latest documentation refer to www.gmintsrl.com