G.M. International S.r.l.

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Phone: +39 039 2325 038 • Fax: +39 039 2325 107
info@gminternationalsrl.com • www.gminternationalsrl.com

Worldwide Agents

ARGENTINA

Company: Dastec Srl
Address: Hippolita Yrigoyen 850,
Piso 3 of 335
City: C1086 Buenos Aires
Country: Argentina
Phone: +54 11 43 43 6200
Fax: +54 11 43 34 3120
Website: www.dastecsrl.com.ar

AUSTRALIA

Company: Transient Controls Australia
Address: PO Box 290,
City: Hillary's, Western Australia, 6923
Country: Australia
Phone: +61 8 9403 6077
Fax: +61 8 9403 6099
Website: www.transcon.com.au

AUSTRIA

Company: Vormayr Instruments & Components
Address: Ottensheimer Strasse, 43
City: 4040 Linz
Country: Austria
Phone: +43 707 101 6111
Fax: +43 707 101 6122
Website: www.vormayr-instruments.at

CANADA

Company: Vanko Analytics Limited
Address: 4340 - 97 Street
City: Edmonton T6E 5R9
Country: Alberta - Canada
Phone: +1 780 436 0281
Fax: +1 780 436 0283

Address: 2000 Pegasus Road NE
City: Calgary T2E 8K7
Country: Alberta - Canada
Phone: +1 780 436 0281
Fax: +1 780 436 0283

Address: 1275 West - 6th Avenue
City: Vancouver V6H 1A6
Country: British Columbia - Canada
Phone: +1 604 733 5222
Fax: +1 604 733 5233

Address: 204 - 468 Street, Anne's Road
City: Winnipeg R2M 3E1
Country: Manitoba - Canada
Phone: +1 204 694 9478
Fax: +1 204 694 5482
Website: www.vanko.net

FRANCE

Company: DIMELCO
Address: 120 rue du Fort, BP 78
City: 59175 Vendeville
Country France
Phone: +33 3 20 62 06 80
Fax: +33 3 20 96 95 62
Website: www.dimelco.com

GREECE

Company: Golden A/S
Address: #18122 - 7 Sarantaporou str.
City: 181122 Koridallos
Country: Greece
Phone: +30 210 496 5607
Fax: +30 210 495 9921
Website: www.gma.gr

HUNGARY

Company: PART-ner Hungary Kft
Address: Antalhegy u. 34
City: 2100 Godollo,
Country: Hungary
Phone: +36 28 415 105
Fax: +36 28 415 105
Website: www.part-ner.hu

IRELAND

Company: DWN Instrumentation Ltd.
Address: 7 Doughcloyne Court Industrial Estate
City: Wilto - Cork
Country: Ireland
Phone: +353 21 434 6953
Fax: +353 21 434 6954
Website: www.dwn.ie

KOREA

Company: Valcom Korea Co., Ltd.
Address: Deryung Techno-Town 8-1102
City: 481-11 Gasan-Dong, Gumchen-Gu, Seoul
Country: Korea
Phone: +82-2-2163-0344
Fax: +82-2-2163-0347
Website: www.valcom.co.kr

NEW ZEALAND

Company: Electrical Importing Co Ltd
Address: PO BOX 13-872
City 1006 Onehunga, Auckland
Country: New Zealand
Phone: +64 9 634 2978
Fax: +64 9 634 6819
Website: www.eicnz.com

NORWAY

Company: Tormatic AS
Address: Skreppestad Naeringspark
City: N-3261 Larvik
Country: Norway
Phone: +47 33 165 020
Fax: +47 33 165 045
Website: www.tormatic.no

POLAND

Company: TR Automatyka sp. z.o.o
Address: Lechicka 14
City: 02-156 Warszawa
Country: Poland
Phone: +48 22 886 10 16
Fax: +48 22 846 50 37
Website: www.trautomatyka.pl

PORTUGAL

Company: Falex Equipamentos e Servicos Lda
Address: Praceta Gil Vicente, 71/B - 3° DTO
City: 2765 484 Estoril
Country: Portugal
Phone: +351 214 460 290
Fax: +351 214 460 299
Website: www.falex.pt

RUSSIA

Company: **G.M. International Srl - Representative Office**
Address: 8 Serpukhovsky Val 8, office 10
City: 115191 Moscow
Country: Russia
Phone: +7 495 950 5779
Fax: +7 495 952 1006
Website: www.gminternational.ru

SPAIN

Company: Iberfluid Instruments SA
Address: Cardenal Reig, 12
City: 08028 Barcelona
Country: Headquarter - Spain
Phone: +34 93 333 36 00
Fax: +34 93 334 05 24

Address: Avda. Dr. Severo Ocha 38 - Nave 2-5
City: 28100 Alcobendas
Country: Centre - Spain
Phone: +34 91 634 35 95
Fax: +34 91 634 34 67

Address: San Prudencio, 28
City: 01005 Vittoria
Country: North - Spain
Phone: +34 945 14 43 94
Fax: +34 945 14 42 68
Website: www.iberfluid.com

SWEDEN

Company: Pulsteknik AB
Address: Alrunavagen, 16
City: 37239 Ronneby
Country: Sweden
Phone: +46 457 13475
Fax: +46 457 461275
Website: www.pulsteknik.se

THAILAND

Company: Phakarin Co. LTD
Address: 130/25 Moo 5
City: 21130 Banchang Rayong
Country: Thailand
Phone: +66 38 880 163
Fax: +66 38 603 636
Website:

THE NETHERLANDS

Company: Notra B.V.
Address: Losplaatsweg, 30
City: 2201 CV Noordwijk
Country: The Netherlands
Phone: +31 71 361 9207
Fax: +31 71 362 0192
Website: www.notra.nl

UNITED STATES OF AMERICA

Company: **G.M. International Safety Inc.**
Address: 9700 Rockside Road
City: Cleveland, OH 44125
Country: USA
Phone: +1 216 524 8400
Fax: +1 216 524 8401
Website: www.gmisafety.com

Company: Texas Technical Products Inc.
Address: 15535 W. Hardy Road, Suite 106
City: Houston, TX 77060
Country: USA
Phone: +1 832 327 1391
Fax: +1 832 327 1392
Website: www.texastechnicalproducts.com

Company: Exloc Instruments Inc
Address: 7089 Lineweaver Road, Bld. 180/a
City: Warrenton, VA 20187
Country: USA
Phone: +1 540 428 3088
Fax: +1 540 428 3028
Website: www.exloc.com

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History and Management

Glisente Landrini is the President and Commercial Director of G.M. International, a company founded in 1993.

Although the company activity dates over ten years, the core Management experience remarkably exceeds over 30 years of qualified activity in Intrinsic Safety and industrial electronics.

In 1970 Mr. Landrini founded Elcon Instruments, which has been acknowledged as an international leader in the design and manufacturing of Intrinsic Safety interface products and systems.

Mr. Landrini started his new business to provide qualified technical service and to support Intrinsically Safe instrumentation for plants in Oil & Gas, Petrolchemicals and Pharmaceutical Industry. G.M. International has supplied and serviced modern electronics I.S. instrumentation in various petrochemical plants in Europe, Russia, Middle and Far East and China.

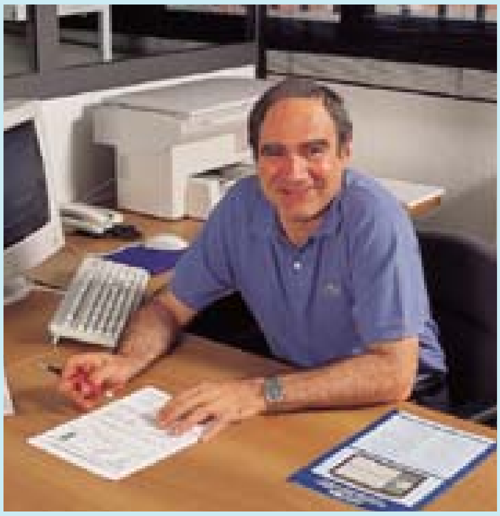
Glisente Landrini
is the President and Commercial Director of G.M. International

Sales and Administration Office.

Technical Management

Giorgio Novelli

is the Technical Director of G.M. International, he has over thirty years experience as R&D Manager for Leeds & Northrup and Elcon Instrument where he gained unique experience in the design of I.S. apparatus and interfaces.
Giorgio is working with us to insure the highest levels of skill and innovation are maintained.



Basilio Abbamonte

Basilio Abbamonte is the Quality Assurance Manager and ATEX expert within G.M. International. For over twenty-five years he has been Q. A. Manager and 50 % Partner of G. L. A., a well known electronic company in the industrial instrumentation field.
Basilio has carried out an impressive program to organize Q. A. procedures and strengthen the company's culture.
He has guided the Company in obtaining the ISO 9001: 2000 and ATEX qualifications.
His highly qualified knowledge in software design procedures has been very important to obtain SIL 2 and SIL 3 qualification for G. M. Interface Modules in accordance to IEC 61508 and IEC 61511 for Safety Related Systems.

Technical Management

Mauro Faltracco

Mauro Faltracco, despite his young age, is Engineering and Production Manager for G.M. International products. Mauro has proved to be active, capable and brilliant for both hardware and software for ATE design.

Information Technology and **Software**

Francesco Landrini

is G.M. International's Information Technology and Software Manager.
His knowledge of several programming languages together with his studies in telecommunications give great strength to G.M. International research and innovation.

Sales Management

Claudio Poncia

is G.M. International Sales Manager for Italy. Claudio has over twenty years sales experience in the process control field with numerous companies such as ABB Kent, MTL and Elcon Instruments. Mr. Poncia has experience in Intrinsically Safe applications in different fields. He has a very successful sales record and a highly-regarded industry reputation.
Mr. Poncia is devoted to his work and exemplifies a great sense of responsability.

Raffaele Radaelli

is G.M. International Product and Sales Manager for complex Ex Solutions which may include two or more protection methods like Ex-d, Ex-p, Ex-e, and Ex-i.
Raffaele has over 25 years of commercial and technical experience in Oil and Gas applications, working for R. Sthal, CEAG Cooper, Elcon Instruments and in plants worldwide.
He is very active, sound and quick in finding the required suitable solution.

Paolo Landrini

Is the Sales Export Manager.
For over 10 years he was responsible for sales Activities in U.S.A. and Canada of Elcon Inc. The American subsidiary of Elcon Instruments. He is presently engaged in the support of G.M. Representatives Reps in Europe, America and Far East.

Giorgio Landrini

is a Sales Product Specialist and Marketing Manager for the italian market. He has obtained B.P.A. degree at the University of Maryland and has travelled for sales in Russia, China and Far East, before joining G.M. During the last ten years he has gained a deep experience in selling Equipment, Systems, Engineering and a great know-how of commerce in the petrochemical field.

America Sales-Distribution **Office** and **Support**

Mauro Togneri

is the Consultant of G.M. International Safety Inc. He has over 30 years experience in Measurement & Automation companies.
Initially graduated as an Electrical Engineer, he has spent 14 years as VP at MTS a company serving the manufacturing and processing industries with sensors. 2 years as President t of Crisp Automation, a subsidiary of Square D Corporation; 2 years as President of Fife Corporation, a subsidiary of Rexnord; 13 years as President of Powell-Process System, Inc.
Mauro, on top of his corporate assignment, is also involved in the support of Marketing & Sales in the Huston TX area.

Joseph Zullo

is the Sales Manager for the North, Central, and South American markets for G.M. International Safety Inc. He served as an electro-mechanical engineer designing power transformers before starting in the field of Intrinsic Safety. Previously with Pepperl+Fuchs USA, Joe served as Product Manager of point to point products and Business Development Manager. He helped customers to understand and apply Intrinsic Safety for over 9 years. Joe earned his Bachelors of Science degree in Industrial Electronics from Kent State University in 1994.

Russia Sales **Office** and **Support**

Eugene Babikov

In 2004 G.M. International decided to open a representative office in Moscow to expand its presence on the Russian market.
Mr. Eugene Babikov has been appointed in charge of the Russian operations due to his deep experience working as a Business Development Manager for Elcon Instruments in this country.

Luciano Serrani

has been Sales Director with instrumentation companies like ABB-Taylor and Elcon Instruments for over 20 years and is now using his wide experience for the Russian and CIS market supporting the G.M. offices in Moscow from Italy. Luciano takes care also of sales in the eastern European countries.

Moscow office

Administration Management

Massimo Landrini

is the Financial Manager of G.M. International, his deep knowledge of accounting and business administration is successfully used to control cash flow and cost analysis.

Scilla De Gaetano

is the Accounting Director responsible for the accounting, balance sheet and tax return.

Office Management

Anna Redaelli

serves as the order processing and shipping agents coordination manager. She has recently joined G.M. to support export sales. She is taking part of the previous task of Isabella Casiraghi as office manager.

Production Management

Massimo Collesei

is the Production and Planning Manager for the complete line of instruments manufactured by G.M. International. He has built up his experience in small and large electronic production plants including CISCO and Pirelli. Massimo has a very positive approach to manage production workers, production programming and acquisition of electronic components.

Customer
Service

Gabriele Caglio

Quality in service is very important to achieve market penetration.
G.M. International considers service an integral part of Customer's requirements and satisfaction.

Product Quality

G.M. International products satisfy Customers expectation and meet the specifications of International standards.
Safety, performance, reliability and product documentation are the basic principles of product Quality.

Production line for DTM8000 Digital Temperature and Alarm Monitor.

SMD component mounting.

Product Test Validation.

PTH component mounting after SMD line.

Product Quality

G.M. International SMD products are manufactured internally in our production facilities.
This allows high quality management and handling of relatively small batches, resulting in better delivery times. Large quantity batches can also be handled up to 500 modules per day.

Laser engraving and automatic drilling for the isolator enclosures.

SMD production facilities.

Product

Quality

Production Testing using internally designed ATE facilities.

Cabinet Production and **Inspection**

Complete cabinet
ready to be shipped
to a plant in Mexico.

Cabinet Production and Inspection

Cabinet Production and Inspection

Complete cabinet ready to be shipped to a Plant in New Jersy.

Cabinet Production and Inspection

Cabinet Production and Inspection

Cabinet Production and Inspection

Mr. Joe Zullo is inspecting the cabinet before shipment to New Jersey.

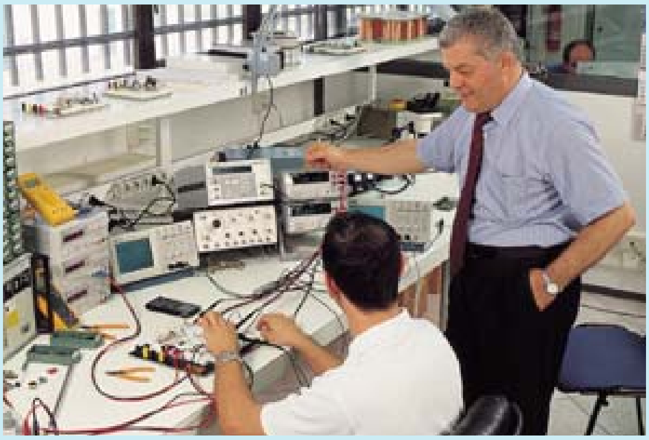
Quality Management Policy

The G.M. International mission is to increase its present position in the I.S. market with products and services that are suitable and appropriate for the Customer.

The G.M. International goal is to guarantee the highest stadards of Quality for the products and services offered.

The G.M. International Quality is synonymous with Customer satisfaction, all products must conform to specifications and be free from defects.

Quality Assurance System



The G.M. International Quality Assurance System is an organizational structure for implementing Quality management.

G.M. International is qualified according to:
ISO 9001: 2000.

ATEX, UL, C-UL, IEC EX, FM, FM-C, GOST for Products.

ATEX, UL, FM, IEC EX for Production Quality Assurance.

Service
Quality

Quality in Service is very important to achieve market penetration.
Therefore G.M. International considers service as an integral part of Customer's requirements.

Continuous
Improvement

G.M. International continuously insures that the performance of products, services, management and Quality System meets, or exceeds, Customer requirements.

G.M. International Management recognizes that human resources of the company play an important role in the achievement of its objectives.

Approvals

ATEX Company

Certificate No. DNV-2002-OSL-ATEX-0060Q.

- Production Quality Assurance Notification.

ATEX DMT

Certificate No. DMT 01 ATEX E 042 according II (1) G D [EEx ia] IIC/IIB/IIA and I M2 [EEx ia] I.

ATEX DNV

Certificate No. DNV-2004-OSL-ATEX-0066 according II 1 G D [EEx ia] IIC T6/T5 Tamb = -20 °C to +60 °C.

ATEX DNV

Certificate No. DNV-2004-OSL-ATEX-0199 according II 1 G D [EEx ia] IIC

I (M2) [EEx ia] I - Tamb = -20 °C to +60 °C.

EXIDA

Analysis for D1000 Series Modules according IEC 61508 - IEC 61511.

Gosgortehnadzor (Russia)

Permission No. PPC 04-11284, Valid until 25 February 2007.

Approvals

Gosnadzorohrantruda (Ukraine)

Permission No. 377.04.30-31.62.4, Valid until 27 February 2007.

Gosstandard (Russia)

Conformity Certificate No. POCC IT.ME92.B00289, Valid until 11 February 2007.

ISO9001:2000

Certificate No. CERT-10077-2002-AQ-MIL-SINCERT from D.N.V. Italia.

TCCExEE (Russia)

Approval No. 665 according standard GOST P51330.0-99, GOST P51330.10-99 [Exi] IIC X.

Valid until 15 February 2009.

TCCExEE (Ukraine)

Approval No. 665 according to GOST 12.2.007.0, GOST 22782.0, GOST 22782.5 [Exia] IIC X.

Valid until 25 February 2009.

UL & C-UL

Nr. QUZW, QUZW7, QVAJ, QVAJ7, File: E222308, according UL and CSA standards.

Approvals

Pattern Approval Certificate of Measuring Instruments

IT.C.34.001.A N° 20130.

FM & FM-C

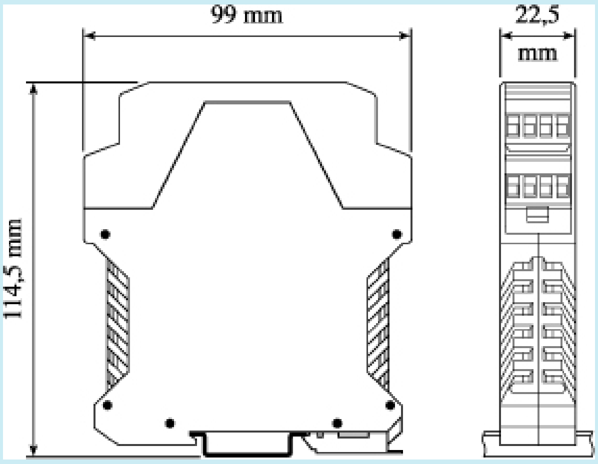
Certificates N°. 3024643, 3024643C, 3024644, 3024644C, for USA and Canada.

D1000 Series

Intrinsically Safe Isolators
Converters
Signal Conditioners
Trip Amplifiers
DIN Rail Mounting
Suitable for
SIL 2 and / or SIL 3 Applications

D1000 Series

G.M. International new DIN RAIL mounting Intrinsically Safe Galvanic Isolators.
The D Range provides the most simple and cost effective means of implementing Intrinsic Safety into your Hazardous Areas/Locations applications.



High Packing Density

- High channel density result from innovative circuit design using advanced surface mount components.
- Ultra slim 4 channels 22,5 mm wide DIN rail mounting modules.
- 6 mm per channel.
- 176 I/O channels per metre of DIN rail.
- Single, dual or quad channel models.

High Performance

- High signal transfer accuracy and repeatability.
- Advanced circuitry provides low heat dissipation, ensuring modules run cool despite their high functionality.
- Low power consumption.
- SMD manufacturing to maximise long, reliable life.

Wide Functionality

- Wide range of digital switch and analog I/O.
- Relay contacts rated for 2 amp. to directly switch 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 enclosure.

General Features

- Single channel versions available if required, to provide single loop integrity on Emergency Shut Down and Fire & Gas applications.
- Configuration using DIP switch for easy field set up.
- LED indication for power, signal status and line fault conditions.
- 35 mm (Top Hat) DIN Rail.
- Plug-in screw terminal blocks to secure termination up to 2,5 mm^2.
- Accept DC power supply over a wide (20-30 V) range.
- 20 modules are suitable for SIL 2 and / or SIL 3 applications according to IEC 61508, IEC 61511.
- 22 modules can be powered from 10 to 30 Vdc for 12 or 24 Vdc Applications.
- 2 modules (D1130 - D1180) can be powered from 85 to 264 Vac, 50-400 Hz, or from 100 to 350 Vdc.
- Wide operating temperature range. (-20 +60 °C).

D1000 Series
an **“Explosive”** Packing

D1000 Series
a Packing which Cares for Details

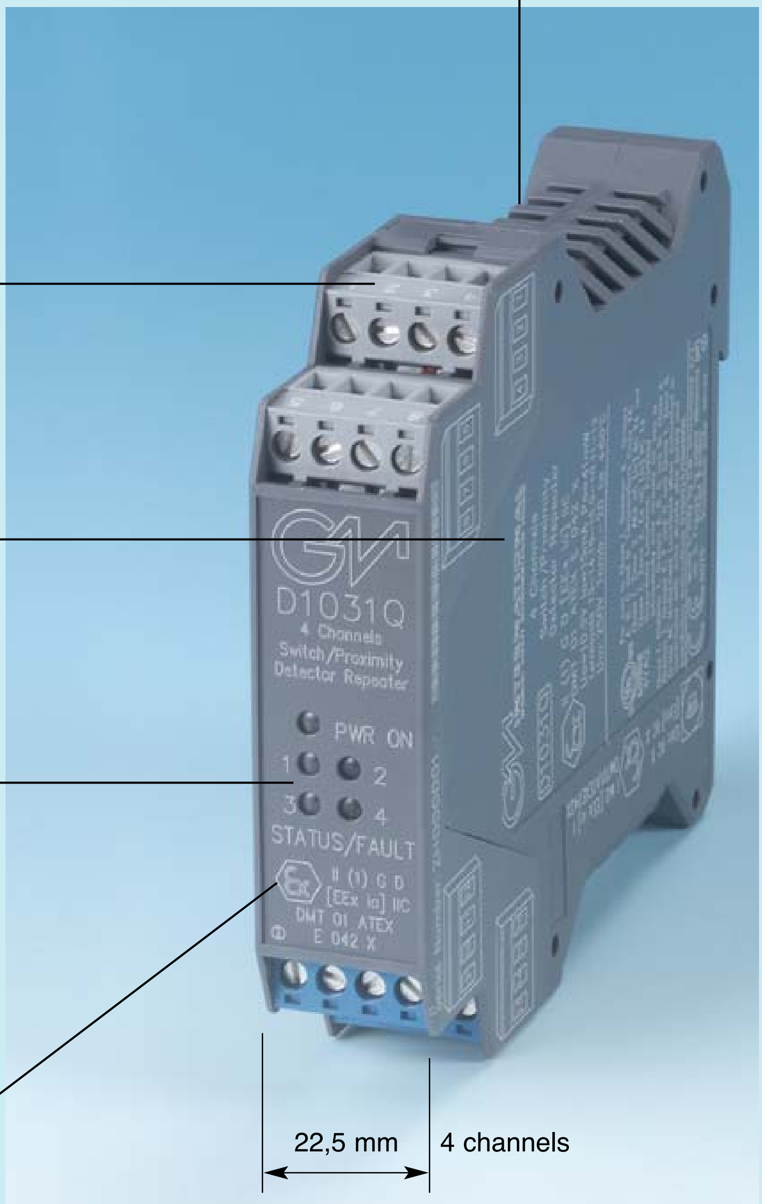
Aeration slots

Terminals Identification
Laser engraving

Laser engraving on two sides for schematic diagram, connections, tables and instructions

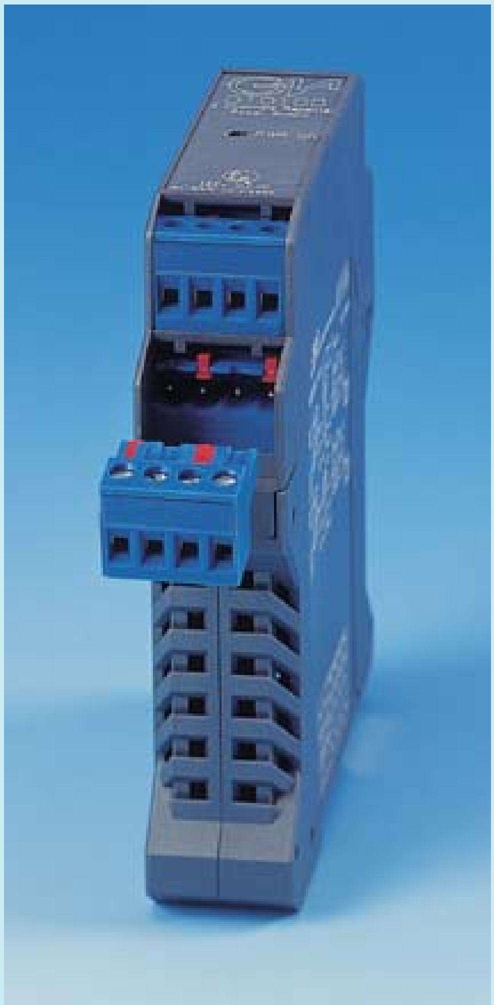
LED for status and fault indication

Laser engraving on front panel, accurate, safe and permanent



D1000 Series
a Packing which Cares for Details

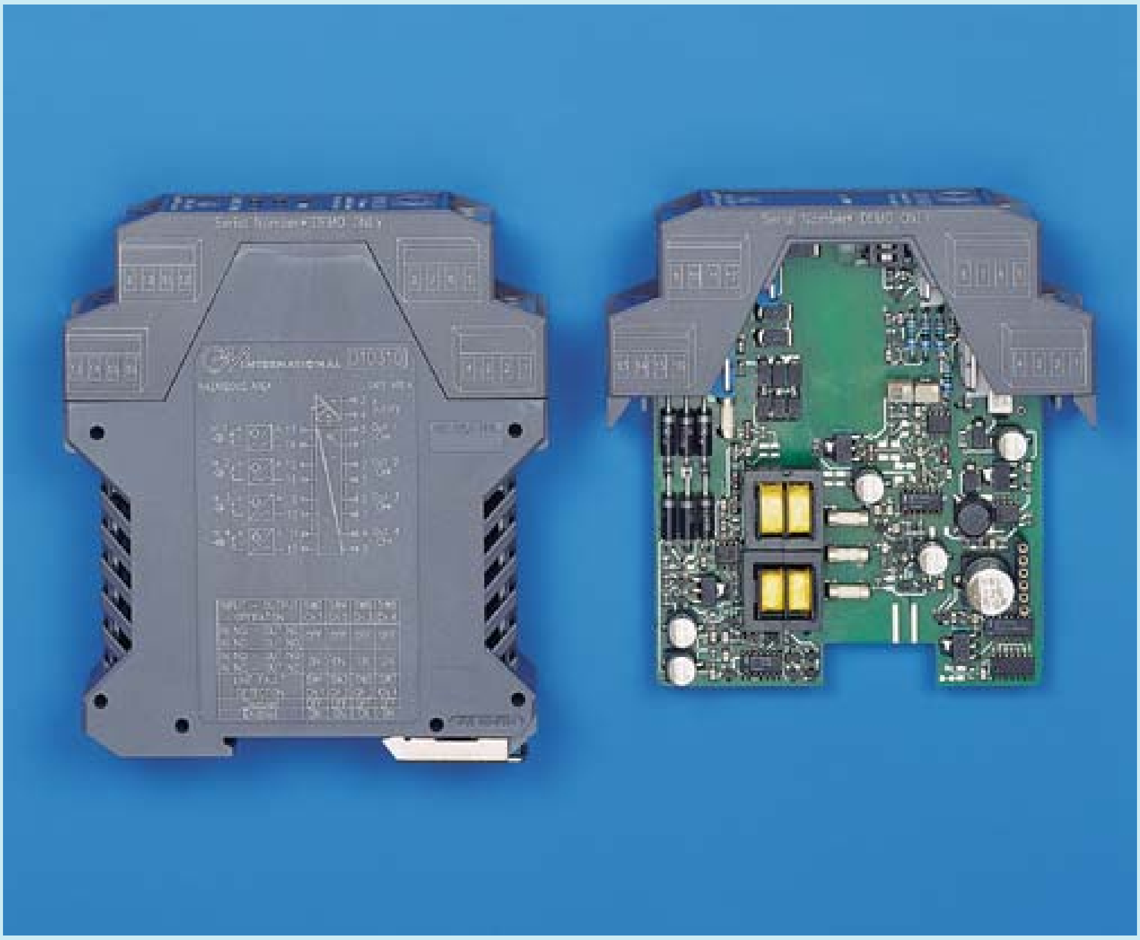
Plug-in Terminal Blocks



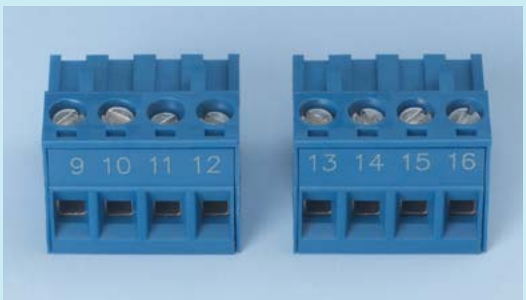
Blue Intrinsically
Safe Terminal Blocks
plug-in type.

D1000 Series
a Packing which Cares for Details

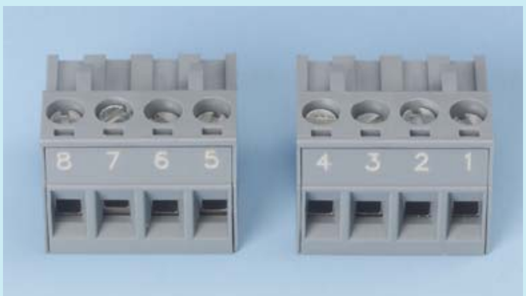
Terminal Blocks identification



Hazardous Area Terminal Block



Safe Area Terminal Block



D1000 Series
a Packing which Cares for Details

Front panel and P.C.B., removable with a tool slight pressure

D1000 Series
a Packing which Cares for Details

TAG Housing

The New TAG Housing, made of transparent LEXAN, can fit a paper strip label (preferably of 140 gr paper).

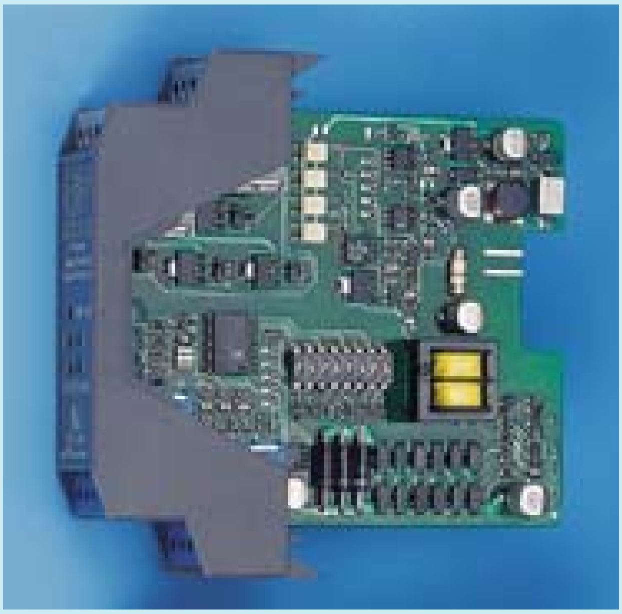
An electronic file (free of charge) is available to prepare up to 40 labels per one A4 sheet with a laser printer.

As alternative, an A4 sheet with 72 Mylar adhesive labels is available.

The electronic file to prepare these labels is available on our web site.

D1000 Series
a Packing which Cares for Details

Front panel integral with Printed Circuit Board plug-in type



D1000 Series
Pocket Portable Configurator

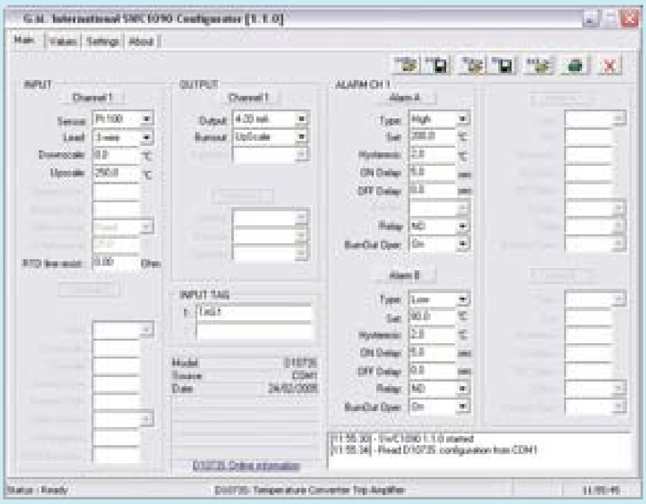
Model PPC 1090

A very small Pocket Portable Configurator suitable to program type of input Sensors, input and output Ranges, Burnout conditions, High/Low Alarm mode, Relay NE/ND, Alarm Trip Point, Deadband value and Alarm Delay.
For the Series 1000 units, DIN or Eurocard, which require access to the Configuration.
(powered by the unit in configuration).

D1000 Series

PC Adapter for Software Configuration

Model PPC 1092 adapter with CABF010 cable to interface PC for a complete configuration of Input and Output parameters



User friendly configuration with PC and PPC1092 adapter

D1000 Series
Power Bus Modules

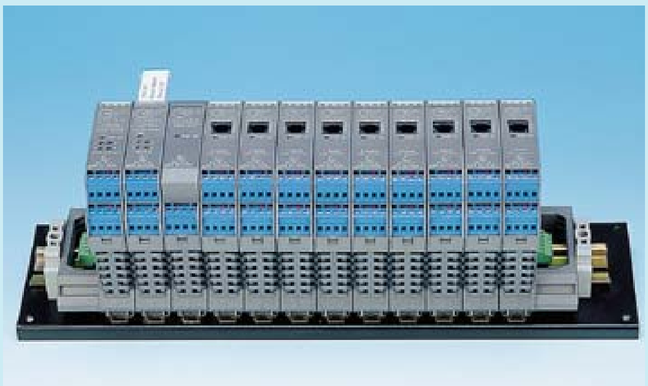
Power Supply Voltage 24 Vdc can be applied to the module, by connecting directly the voltage to the Plug-in Terminal Block (3+, 4-) of each module, or via the **Power Bus System.** The system consists of a standard Din Rail Bar and modules with Bus Connectors (Female on one side and Male on the opposite side) of 8 Amp. Capacity.
It is always possible to remove modules, without disconnecting the connectors, because modules are Plug- in types.
When the Power Bus is used, the Supply Contacts (3+, 4-) on the Terminal Block are omitted to avoid accidental short circuits on the Power Bus.

Module Enclosure with Power Bus Connector Female Side

Module with Power Bus Male Termination Block

Module Enclosure with Power bus Connector Male side

Set of Modules with Power Bus



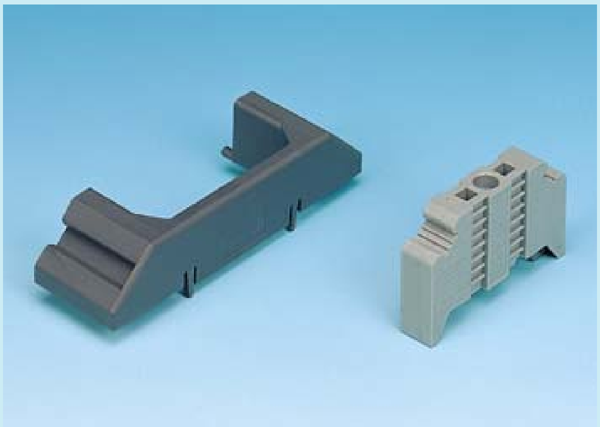
D1000 Series Connector Output Custom Panels for 8-16 Units (32-64 channels)

Custom Boards for ABB System Six DCS

Custom Boards for Invensys DCS

D1000 Series Accessories

Anchor (Mchp 065) and Stopper (Mor 016) for DIN-Rail



Code	Description
D1000 B	Housing with Power Bus
Mor 015	Terminal Block male, vertical out, for Power Bus
Mor 016	DIN-Rail Stopper
Mor 017	Terminal Block male, orizontal out, for Power Bus
Mor 022	Terminal Block female, orizontal out, for Power Bus
Mchp 065	DIN-Rail Anchor
Mchp 139	5 mm spacer for modules on custom boards
CABF 010	Sub-D 9 poles, female-female, Nul-Modem cable
Opz 91	Cold Junction Compensator to be used with THCs Inputs
PPC1090	Pocket Portable Configurator
PPC1092	PC Adapter, replace PPC1090 using PC for configuration
D1000R	19" Rack Unit, suitable for 16 modules

Mor 015 - Terminal Block male, vertical out, for Power Bus

Mchp 139 - 5 mm spacer for modules on custom boards, D1012Q and PSD1001C modules

Mor 017 - Terminal Block male, orizontal out, for Power Bus

Mor 022 - Terminal Block female, orizontal out, for Power Bus

D1000 Series
Accessories

19” Rack Unit Type D1000R for Rack Mounting of Series D1000 Isolators

PPC1090 - Pocket portable configurator with cable

CABF 010 - Sub-D 9 poles, female-female, Nul-Modem cable + PPC1092 - PC Adapter for configuration

D1000 B - Housing with Power Bus

Adapter for **Elcon Instruments** 1000 Series **Isolator Modules**

- ATEX, FM, FM-C Certification.
- Full interchangeability with Elcon 1000 Series modules.
- Possibility to replace Elcon modules without modifying any wiring or connections.
- Use of the same Elcon boards.
- Identification using the same Elcon part-number.

Elcon Intruments
1000 Series Adapters
Available Models

Model	Description	Ch.
	Analog Input, Power Supply Repeaters	
1020	(Tx or Current Source) Analogue Repeater and 1 Setpoint Trip Amplifier, Relay Output 2 x SPDT, Smart Tx Compatible	1
1021	Analog Input Repeater, Smart Tx Compatible, (non Honeywell Compatible)	1
1022	Analog Input Repeater, Smart Tx Compatible, (non Honeywell Compatible)	2
1023	Analog Input Repeater, Floating Output	1
1025	Analog Input Repeater, Smart Tx Compatible	1
1025G	Analog Input Repeater, Smart Tx Compatible, 3 Port Isolation, Isc=93mA for wider applications	1
1026	Analog Input Repeater, Smart Tx Compatible	2
1026G	Analog Input Repeater, Smart Tx Compatible, 3 Port Isolation, Isc=93mA for wider applications	2
1027	Analog Input (Tx or Current Source), Analogue Repeater and 2 Setpoint Trip Amplifier,	1
	Relay Output 1 x DPDT, Smart Tx Compatible	
1029	Analog Input Repeater, Smart Tx Compatible Sink/Source Output and Isc=93mA for wider applications	1
1030	Analog Input Repeater, Smart Tx Compatible Sink/Source Output and Isc=93mA for wider applications	2
	Analog Output, Powered Isolating Drivers for I/P	
1031	Analog Output Repeater, Bus Powered	1
1032	Analog Output Repeater, Bus Powered	2
1033	Analog Output Repeater, Bus Powered, (No Loop Powered)	1
1034	Analog Output Repeater, Bus Powered, (No Loop Powered)	2
1037	Analog Output Repeater, Bus Powered for Smart I/P and Positioner	1
1038	Analog Output Repeater, Bus Powered for Smart I/P and Positioner	2
	Anolog Signal and Temperature Converters Fully Programmable	
1061	TC or mV Input, (Linear 4-20 mA/1-5 V Output) including Compensator	1
1062	TC or mV Input, (Linear 4-20 mA/1-5 V Output) including Compensator	2
1065	TC or mV Input, (Linear mV Output) including Compensator	1
1066	TC or mV Input, (Linear mV Output) including Compensator	2
1071	RTD Input, Tx Pot (Linear 4-20 mA/1-5 V Output)	1
1072	RTD Input, Tx Pot (Linear 4-20 mA/1-5 V Output)	2
1073	RTD-Tx Pot Input, (Linear 4-20 mA/1-5 V Output) and 3 Port Isolation	1
1074	RTD-Tx Pot Input, (Linear 4-20 mA/1-5 V Output) and 3 Port Isolation	2
1090	Strain Gauge or Load Cell Input, 0-20/4-20 mA, 0-5/1-5/0-10 V Output	1

Model	Description	Ch.
	Digital Input Contact-Proximity Repeater	
1821	Namur Prox/Contact Input Repeater, Relay Output (1 x DPDT)	1
1822	Namur Prox/Contact Input Repeater, Relay Output (2 x SPDT)	2
1841	Namur Prox/Contact Input Repeater, Transistor Output	1
1842	Namur Prox/Contact Input Repeater, Transistor Output	2
	Digital Output Drivers for Solenoid Valves, LEDs, Horns	
1871	Digital Output Repeater for Solenoid Valves	1
1872	Digital Output Repeater for Solenoid Valves	2
1881	Digital Output Repeater for Solenoid Valves	1
1882	Digital Output Repeater for Solenoid Valves	2
	Frequency to Analog Converter + Pulse Repeater	
1891	Pulse Input, Prox or Mag Sensor, (4-20mA/1-5 V Out) and Pulse Repeater	1
1893	Pulse Input, Prox or Mag Sensor, (4-20mA/1-5 V Out) and Pulse Repeater	1
	Analog Signal and temperature Trip Amplifiers Fully Programmable	
1011	V - mA Input / V - mA output fullly programmable	1
1012	V - mA Input / V - mA output fullly programmable	2
1310	V/mA Input, 2 Setpoint, Relay Output, 2 x SPST	1
1311	V/mA Input, 2 Setpoint, Relay Output, 2 x SPST	1
1360	TC /mV Input, 2 Setpoint, Relay Output, 2 x SPST, including Compensator	1
1361	TC /mV Input, 2 Setpoint, Relay Output, 2 x SPST, including Compensator	1
1370	RTD/Pot Input, 2 Setpoint, Relay Output, 2 x SPST	1
1371	RTD/Pot Input, 2 Setpoint, Relay Output, 2 x SPST	1
PPC1090	Pocket Portable Configurator required for the programmable units	
PPC1092	PC Adapter required when a PC is used instead of PPC1090 to program units	

Elcon Intruments
1000 Series Adapters

ATEX, FM, FM-C Certified.

Fully interchangeable with all ELCON 1000 Series Modules.

Possibility to change ELCON Modules without changing wiring connection.

To be used with ELCON Boards.

Using the same ELCON P/N for order processing.

List of **D1000 models** Available and **Selection Tables**

	Field Device	Model	Hazardous Area	Safe Area	Nr. of Channels per unit	Supply	SIL according IEC 61508 and IEC 61511
ANALOG IN	SMART	D1010S D1010S-046	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two or three wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1	20-30 Vdc	SIL 2
ANALOG IN	SMART	D1010D D1010D-046			2	20-30 Vdc	SIL 2
ANALOG IN	HART	D1014S	4-20 mA (15 V) floating supply and signal to hart, or non hart, two wire Tx.	4-20 mA (1-5V) output signal totally isolated from Input and Supply.	1	10-30 Vdc	SIL 2
ANALOG IN	HART	D1014D			2	10-30 Vdc	SIL 2 - SIL 3
ANALOG IN		D1012Q	4-20 mA (15 V) floating supply and signal non hart, two wire Tx.	4-20 mA output signal.	4	20-30 Vdc	-
ANALOG OUT	SMART	D1020S	4-20 mA/0-20 mA and Smart Signal to I/P Converters, Electrovalve Actuators and Displays.	Bus powered 4-20 mA/ 0-20 mA Signal from DCS, PLC or other control devices. Smart compatible.	1	20-30 Vdc	SIL 2
ANALOG OUT	SMART	D1020D			2	20-30 Vdc	SIL 2
ANALOG OUT	SMART	D1021S		3 Alarms for Connections to I/P open or short circuit	1	20-30 Vdc	SIL 2
DIGITAL IN		D1030S	Dry Contact Proximity Switch.	1 SPDT (relay contact), 2 A/250 V, plus 1 SPDT (fault detection contact), 2 A/250 V for line fault detection and LED.	1 + 1	20-30 Vdc	
DIGITAL IN		D1030D	Dry Contact Proximity Switch.	2 SPDT (relay contact), 2 A/250 V, plus LED for line fault detection.	2	20-30 Vdc	
DIGITAL IN		D1130D	Dry Contact Proximity Switch.	2 SPDT (relay contact), 2 A/250 V, plus LED for line fault detection.	2	85 - 264 Vac 100-350 Vdc	
DIGITAL IN		D1031D	Dry Contact Proximity Switch.	4 Open collectors per 2 channel plus LED for line fault detection.	2	10-30 Vdc	
DIGITAL IN		D1031Q	Dry Contact Proximity Switch.	4 Open collectors per 4 channel plus LED for line fault detection.	4	10-30 Vdc	
DIGITAL IN		D1032D	Dry Contact Proximity Switch.	4 SPST (relay contact), 2 A / 250 V, plus LED for line fault detection.	2	20-30 Vdc	SIL 2
DIGITAL IN		D1032Q	Dry Contact Proximity Switch.	4 SPST (relay contact), 2 A / 250 V, plus LED for line fault detection.	4	20-30 Vdc	SIL 2
DIGITAL IN		D1033D	Dry Contact Proximity Switch.	1 Open collector per channel plus LED for line fault detection.	2	20-30 Vdc	SIL 2
DIGITAL IN		D1033Q	Dry Contact Proximity Switch.	1 Open collector per channel plus LED for line fault detection.	4	20-30 Vdc	SIL 2
DIGITAL IN		D1034S	Dry Contact Proximity Switch.	Dry Contact Proximity Switches.	1	10-30 Vdc	SIL 2
DIGITAL IN		D1034D			2	10-30 Vdc	SIL 2 - SIL 3

	Field Device	Model	Hazardous Area	Safe Area	Nr. of Channels per unit	Supply	SIL according IEC 61508 and IEC 61511
DIGITAL OUT		D1040Q	Electrovalve, Audible Alarm or other devices.	Dry Contact, Logic Level, Loop Powered 24 Vdc from DCS, PLC or other control devices.	4	20-30 Vdc or Loop Powered	SIL 2 when BUS Powered SIL 3 when Loop Powered
		D1041Q	LED		4	20-30 Vdc or Loop Powered	
		D1042Q	Electrovalve, Audible Alarm or other devices.		4	20-30 Vdc or Loop Powered	
		D1043Q			4	20-30 Vdc or Loop Powered	
SIGNAL CONVERTER TRIP AMPLIFIER		D1053S (*)	4-20 mA/0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments.	2 Independent set points 2 SPST Relay 2 A / 250 V. 4-20 mA / 0-20 mA (1-5 V / 0-5 V) output signal totally isoalted from Input and Supply.	1	20-30 Vdc	
		D1073S (*)	Input from TC with Automatic cold ref. junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.		1	20-30 Vdc	
	SMART	D1054S (*)	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two or three wire Tx.		1	20-30 Vdc	
SIGNAL CONVERTER		D1052S (*)	4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments.	4-20 mA / 0-20 mA (1-5 V / 0-5 V) output signal totally isoalted from Input and Supply.	1	10-30 Vdc	
		D1052D (*)		Two Independent 4-20 mA / 0-20 mA (1-5 V / 0-5 V) output signals totally isolated from Input and Supply.	2	10-30 Vdc	
		D1060S (*)	Frequency Signal 0-50 Khz	4-20 mA / 0-20 mA (1-5 V / 0-5 V) output signal totally isolated from Input and Supply. 2 Independent Alarm Pulse output scaled from 1 to 1000000.	1	10-30 Vdc	
SERIAL LINE CONV.	RS 485 RS 422 RS 232	D1061S	RS 485 - RS 422 up to 1,5 Mbit	RS 485 - RS 422 - RS 232.	1	20-30 Vdc	
LOAD CELLS ISOLATOR CONVERTER	up to 4	D1063S	Up to four 6 wire paralleled cells 350 Ω, 5 V, 80 mA total capacity.	mV corrisponding to Input Bridge. Accuracy, after system calibration, 0,003 %.	1	20-30 Vdc	
	up to 4	D1064S	Up to four 6 wire paralleled cells 350 Ω, 5 V, 80 mA total capacity.	4-20 mA MODBUS RTU	1	20-30 Vdc	
GAS & FIRE DETECTOR		D1022D	6 to 30 V 1 to 40 mA Loop Powered	1 to 40 mA Loop Powered	2	Loop Powered	SIL 3

Field Device	Model	Hazardous Area	Safe Area	Nr. of Channels per unit	Supply	SIL according IEC 61508 and IEC 61511
TEMPERATURE - TRASMITTING POT. CONVERTERS	**D1072 S (*)**	Input from TC with Automatic reference cold junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signals totally isolated from Input and Supply.	1	10-30 Vdc	SIL 2
	D1072 D (*)		Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signals totally isolated from Input and Supply. (A, B, A+B and A–B).	2	10-30 Vdc	
INFLAMMABLE LIQUID PRESENCE DETECTOR - INTERFACE	**D1080D**	3 wire electro-optic sensor	2 SPDT (relay contact), 2 A/250 V, plus LED	2	20-30 Vdc	
	D1081D	3 wire electro-optic sensor	1 Open collector per channel plus LED	2	15-30 Vdc	
	D1180D	3 wire electro-optic sensor	2 SPDT (relay contact), 2 A/250 V, plus LED	2	85 - 264 Vac / 100-350 Vdc	
POWER SUPPLY	**PSD1000**	Non I.S. input	24 Vdc, 600 mA	1	90-265 Vac	
	PSD1001	Intrinsically Safe Input	15 V, 20 mA for each channel	4	20-30 Vdc	SIL 2
	PSD1001C	Intrinsically Safe Input	10 V, 160 mA	1	20-30 Vdc	
	PSU1003 **for PCB Mounting**	Intrinsically Safe Input/Output	5 V, 160 mA	1	PSD1001C	
		Installation in Zone 0 - Div. 1 - IIB T4				
	PSD1004 **for DIN Rail Mounting**	Intrinsically Safe Input/Output	5 V, 160 mA	1	PSD1001C	
	PSD1206	For installation in Zone 2 - Div. 2 Category 3 IIC T4 24 V, 6 A, 150 W	Unit can be paralleled with load sharing	1	88-264 Vac	
	PSD1210	For installation in Zone 2 - Div. 2 Category 3 IIC T4 24 V, 10 A, 250 W	Unit can be paralleled with load sharing	1	88-264 Vac	
CONFIGURATOR	**PPC1090**	Pocket Portable Configurator suitable to program type of input Sensors, input and output Ranges, Burnout conditions, High/Low Alarm mode, Relay NE/ND, Alarm Trip Point, Deadband value and Alarm Delay. For the 1000 Series units, DIN or Eurocard, which require the Operator to access the Configuration. (powered by the unit in configuration).		1	Loop powered	

PC ADAPTER

PPC 1092 ADAPTER
and
CABF 010
Sub-D 9 poles,
female-female, Nul-Modem cable

(*) Microprocessor based units require configurator Mod. PPC-1090 or PPC 1092 with PC.

D1000 Series
Data Sheets with **Specifications** and Function Diagrams

INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1010

SIL 2 Repeater Power Supp Smart-Hart Compatible DIN Models D1010S, D1010D

Characteristics:

General Description:
The single and dual channel DIN Rail Repeater Power Supply, D1010S and D1010D, provides a fully floating dc supply for energizing conventional 2-wire 4-20 mA Transmitter, or separately powered 3, 4 wire 4-20, 0-20 mA Transmitter located in Hazardous Area, and repeats the current in floating circuit to drive a Safe Area load.
The circuit allows bi-directional communication signals, for Smart Transmitters.

Function:
1 or 2 channels I.S. analog input for 2 wire loop powered or separately powered Smart Transmitters, provides 3 port isolation (input/output/supply) and current (source or sink) or voltage output signal.

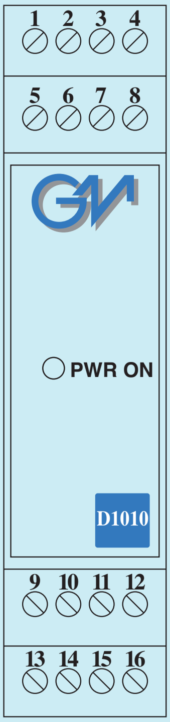
Signalling LED:
Power supply indication (green).

Field Configurability:
mA (source or sink) or V output signal.

Smart Communication Frequency Band:
0.5 to 40 KHz within 3 dB (Hart and higher frequency protocols).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 2 according to IEC 61508, IEC 61511.

4-20 or 0-20 mA Input, Output Signal.

Wide Band Smart Communication, Hart compatible.

Input and Output short circuit proof.

High Accuracy.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, UL & C-UL, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1010		
1 channel		S	
2 channels		D	
Power Bus enclosure			/B

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 115 mA for 2 channels D10
60 mA for 1 channel D1010S with 20 mA output typical.
Max. power consumption: 3.70 W for 2 channels, 2.00 W f
with 30 V supply voltage and short circuit condition.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 50
Out/Out 500 V; Out/Supply 500 V.

Input:
0/4 to 20 mA (separately powered input, voltage drop ≤ 1.0
4 to 20 mA (2 wire Tx current limited at ≈ 23 mA).

Transmitter line voltage:
≥ 15.0 V at 20 mA with max. 20 mVrms ripple
on 0.5 to 40 KHz frequency band.

Output:
0/4 to 20 mA, on max. 600 Ω load in source mode; V min.
load V max. 30 V in sink mode, current limited at ≈ 23 mA
0/1 to 5 V on internal 250 Ω shunt
(or 0/2 to 10 V on internal 500 Ω shunt on request).
Response time: 50 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load
on 0.5 to 40 KHz band.
Frequency response: 0.5 to 40 KHz bidirectional within 3
(Hart and higher frequency protocols).

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambier
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a mi
supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 t
load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a

Compatibility:
CE CE mark compliant, conforms to 94/9/EC Atex D
to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx n
associated electrical apparatus.
Uo/Voc = 27 V, Io/Isc = 93 mA, Po/Po = 625 mW at ter
14-15, 10-11.
c UL us Uo/Voc = 1.1 V, Io/Isc = 45 mA, Po/Po = 13 mW
15-16, 11-12 (non energy storing apparatus conne
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014
UL & C-UL E222308 conforms to UL913 (Div.1),
UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i
UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and
CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, A
CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1),
CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zon
TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-9
TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 2278
Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 according to
IEC 61511. Please refer to Functional Safety Manual for SIL

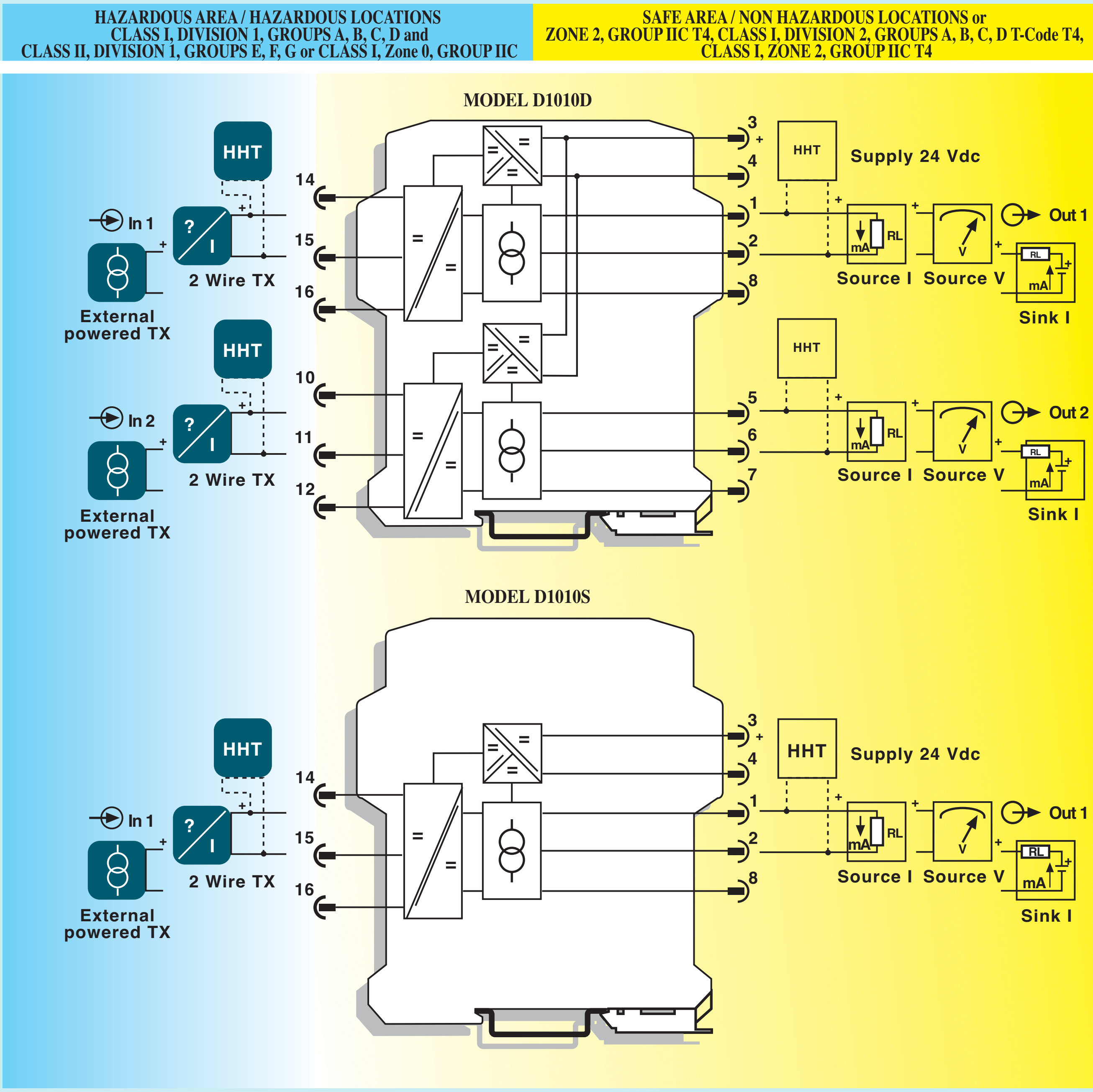
Mounting:
T35 DIN Rail according to EN50022.
Weight: about 175 g D1010D, 125 g D1010S.
Connection: By polarized plug-in disconnect screw termin
accomodate terminations up to 2.5 mm².
Location: Safe Area/Non Hazardous Locations or Zone 2, G
Class I, Division 2, Groups A, B, C, D Temperature Code T
Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 14-15, 10-11				
Uo/Voc = 27 V	II C	0.089	4.2	56.5
Io/Isc = 93 mA	II B	0.705	15.0	226.1
Po/Po = 625 mW	II A	2.320	33.0	452.3
Terminals 15-16, 11-12	Non energy storing apparatus connection			
Uo/Voc = 1.1 V	II C			
Io/Isc = 45 mA	II B			
Po/Po = 13 mW	II A			

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

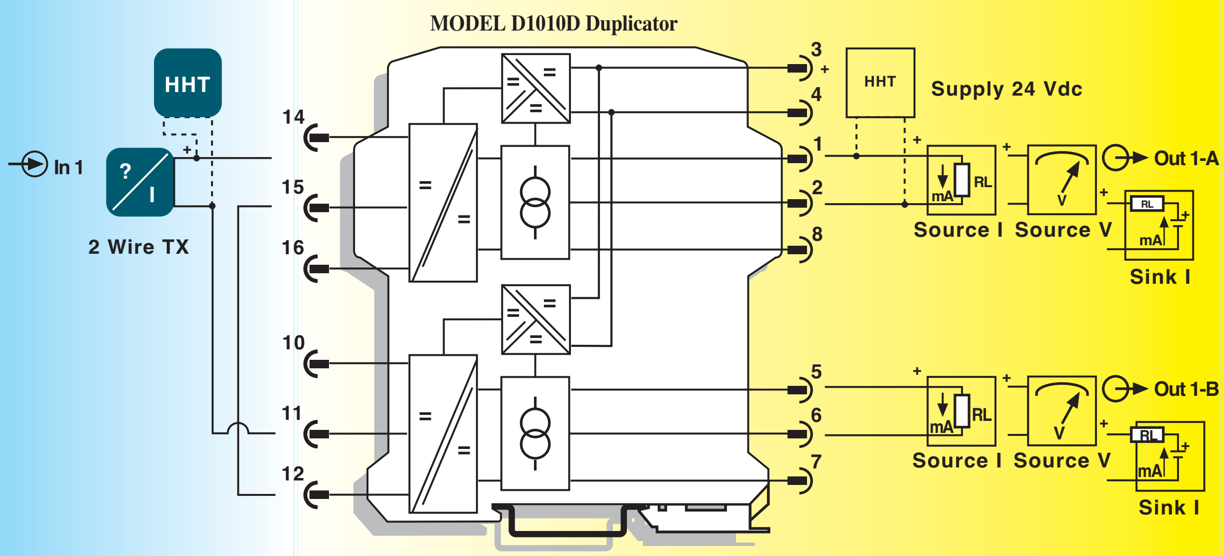
Safety Description

Terminals 14-15

Uo/Voc = 28.1 V

Io/Isc = 93 mA

Po/Po = 654 mW



Connections for Duplication of 2 wire Transmitter Input.

Restriction on Specifications for 2 wire Transmitter Input.

Bi-directional communication for Smart Transmitter is provided only output channel 1.

The minimum supply voltage available for transmitters (VTx) is 14.0 V at 20 mA input.

The allowable safety parameters must be changed in: Uo/Voc = 28.1 V.
Io/Isc = 93 mA.
Po/Po = 654 mW.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

Safety Description

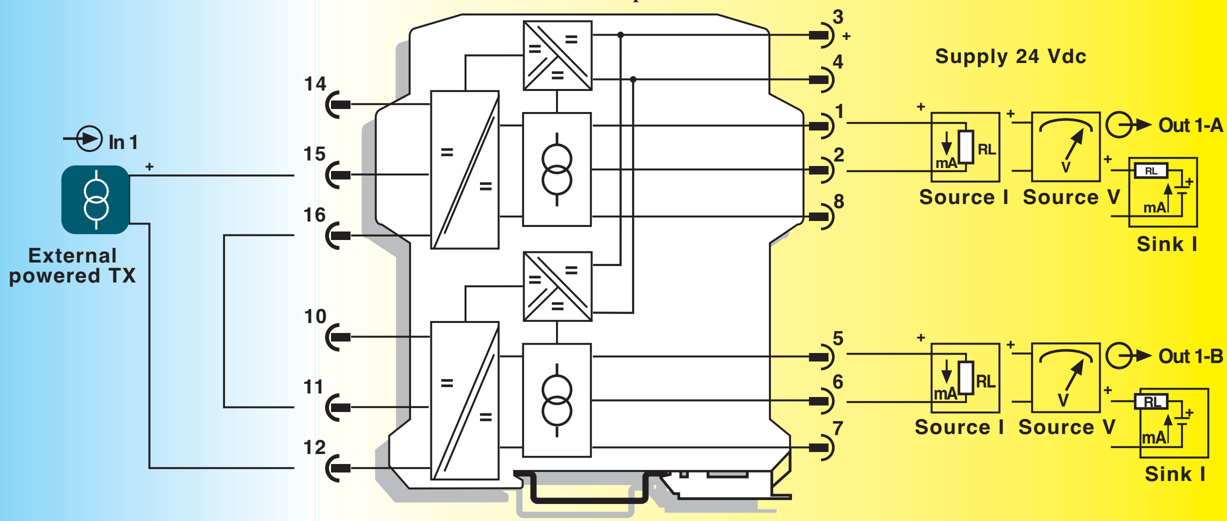
Terminals 15-16

Uo/Voc = 2.2 V

Io/Isc = 45 mA

Po/Po = 25 mW

MODEL D1010D Duplicator



Connections for Duplication of Active Input Signals.

Restriction on Specifications for external powered Transmitter.

The voltage drop must be changed in 2.0 V max.

The allowable safety parameters must be changed in: Uo/Voc = 2.2 V.
Io/Isc = 45 mA.
Po/Po = 25 mW.

INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1010
-046

SIL 2 Repeater Power Supply Smart-Hart Compatible DIN-Rail Models D1010S-046, D1010D-046

Characteristics:

General Description:
The single and dual channel DIN Rail Repeater Power Supply, D1010S-046 and D1010D-046, provides a fully floating dc supply for energizing conventional 2-wire 4-20 mA Transmitter, or separately powered 3, 4 wire 4-20, 0-20 mA Transmitter located in Hazardous Area, and repeats the current in floating circuit to drive a Safe Area load.
The circuit allows bi-directional communication signals, for Smart Transmitters.

Function:
1 or 2 channels I.S. analog input for 2 wire loop powered or separately powered Smart Transmitters, provides 3 port isolation (input/output/supply) and current (source or sink) or voltage output signal.

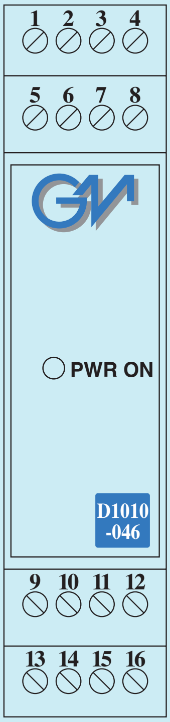
Signalling LED:
Power supply indication (green).

Field Configurability:
mA (source or sink) or V output signal.

Smart Communication Frequency Band:
0.5 to 40 KHz within 3 dB (Hart and higher frequency protocols).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 2 according to IEC 61508, IEC 61511.

4-20 or 0-20 mA Input, Output Signal.

Wide Band Smart Communication, Hart compatible.

Input and Output short circuit proof.

High Accuracy.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX Certification.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1010		
1 channel		S-046	
2 channels		D-046	
Power Bus enclosure			/B

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 115 mA for 2 channels D1010D-046, 60 mA for 1 channel D1010S-046 with 20 mA output typical.
Max. power consumption: 3.70 W for 2 channels, 2.00 W for 1 channel with 30 V supply voltage and short circuit condition.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V; Out/Out 500 V; Out/Supply 500 V.

Input:
0/4 to 20 mA (separately powered input, voltage drop ≤ 1.2 V) or
4 to 20 mA (2 wire Tx current limited at ≈ 23 mA).

Transmitter line voltage:
≥ 14.0 V at 20 mA with max. 20 mVrms ripple
on 0.5 to 40 KHz frequency band.

Output:
0/4 to 20 mA, on max. 600 Ω load in source mode; V min. 5 V at 0 Ω load V max. 30 V in sink mode, current limited at ≈ 23 mA or
0/1 to 5 V on internal 250 Ω shunt
(or 0/2 to 10 V on internal 500 Ω shunt on request).
Response time: 50 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load on 0.5 to 40 KHz band.
Frequency response: 0.5 to 40 KHz bidirectional within 3 dB (Hart and higher frequency protocols).

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 26.3 V, Io/Isc = 79 mA, Po/Po = 514 mW at terminals 14-15, 10-11.
Uo/Voc = 1.1 V, Io/Isc = 45 mA, Po/Po = 13 mW at terminals 15-16, 11-12 (non energy storing apparatus connection).
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020 EXIDA Report No. GM03/07-24 R001, SIL 2 according to IEC 61508, IEC 61511. Please refer to Functional Safety Manual for SIL applications.

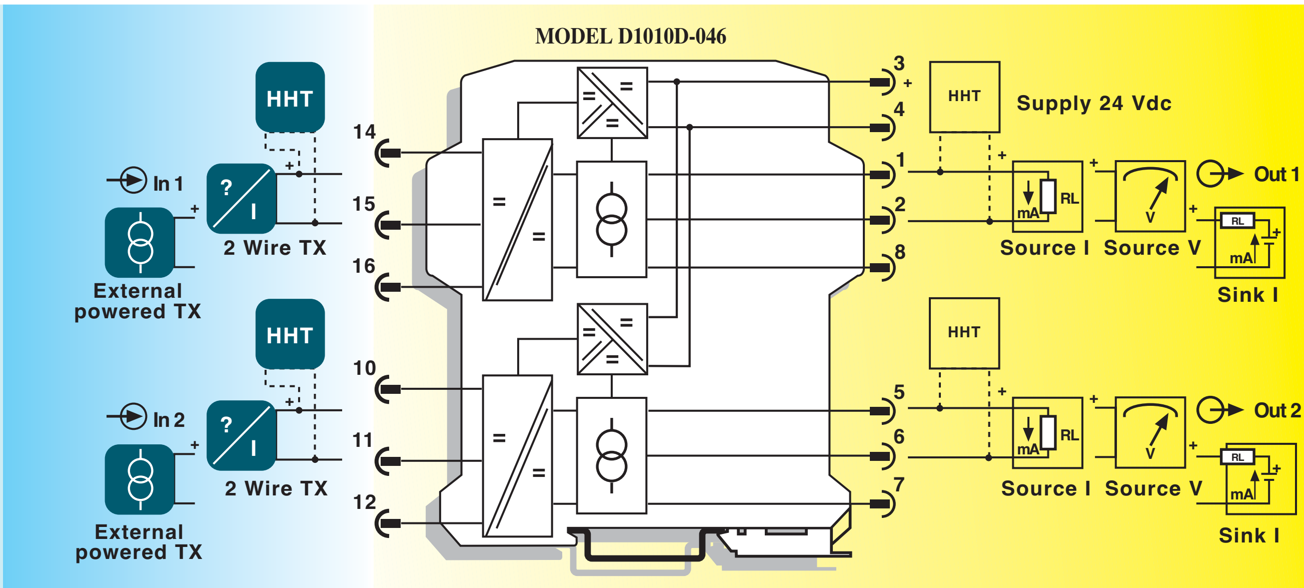
Mounting:
T35 DIN Rail according to EN50022.
Weight: about 175 g D1010D-046, 125 g D1010S-046.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

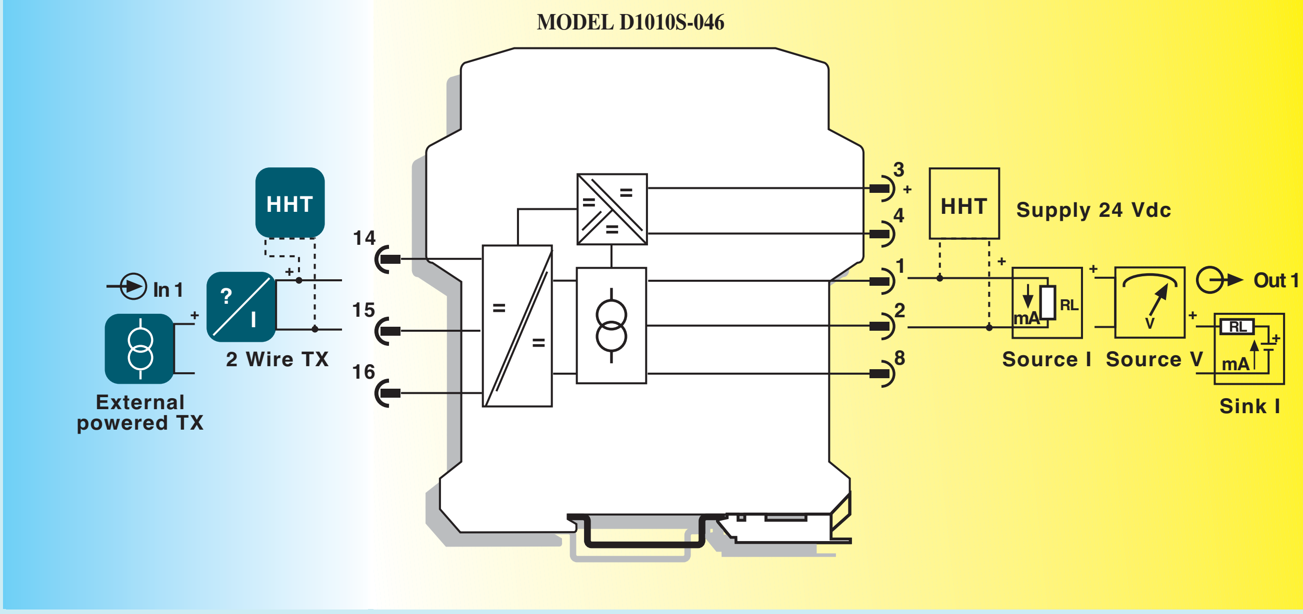
Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 14-15, 10-11				
Uo/Voc = 26.3 V	II C	0.089	5.8	69.2
Io/Isc = 79 mA	II B	0.705	23.2	276.8
Po/Po = 514 mW	II A	2.320	46.5	553.6
Terminals 15-16, 11-12	Non energy storing apparatus connection			
Uo/Voc = 1.1 V	II C			
Io/Isc = 45 mA	II B			
Po/Po = 13 mW	II A			

Function Diagram:

HAZARDOUS AREA	SAFE AREA





Function Diagram:

HAZARDOUS AREA	SAFE AREA

Safety Description

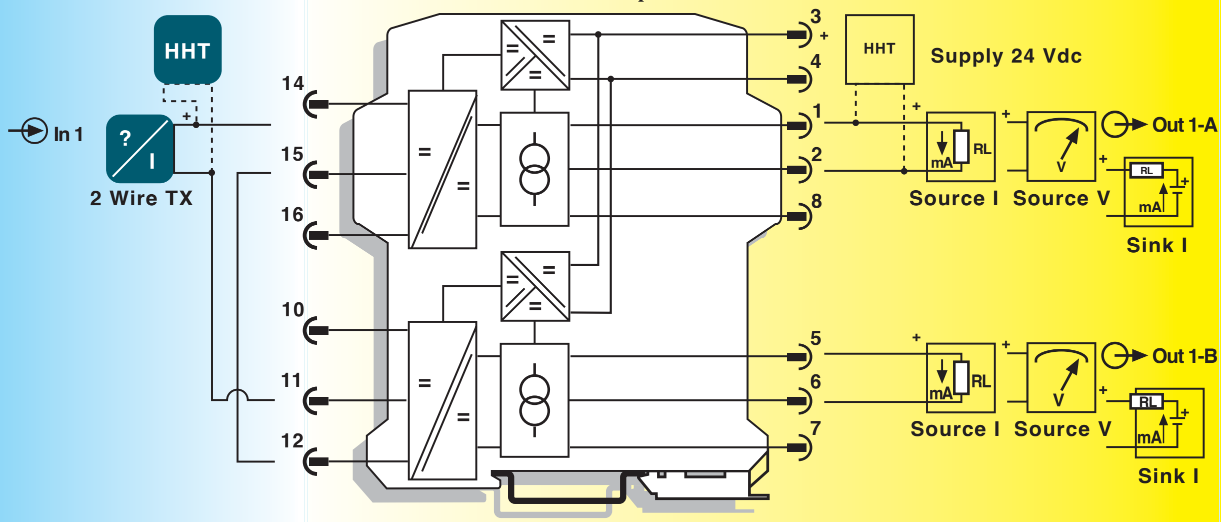
Terminals 14-15

Uo/Voc = 27.4 V

Io/Isc = 79 mA

Po/Po = 542 mW

MODEL D1010D-046 Duplicator



Connections for Duplication of 2 wire Transmitter Input.

Restriction on Specifications for 2 wire Transmitter Input.

Bi-directional communication for Smart Transmitter is provided only output channel 1.

The minimum supply voltage available for transmitters (VTx) is 12.8 V at 20 mA input.

The allowable safety parameters must be changed in: Uo/Voc = 27.4 V.
Io/Isc = 79 mA.
Po/Po = 542 mW.

Function Diagram:

HAZARDOUS AREA	SAFE AREA

Safety Description

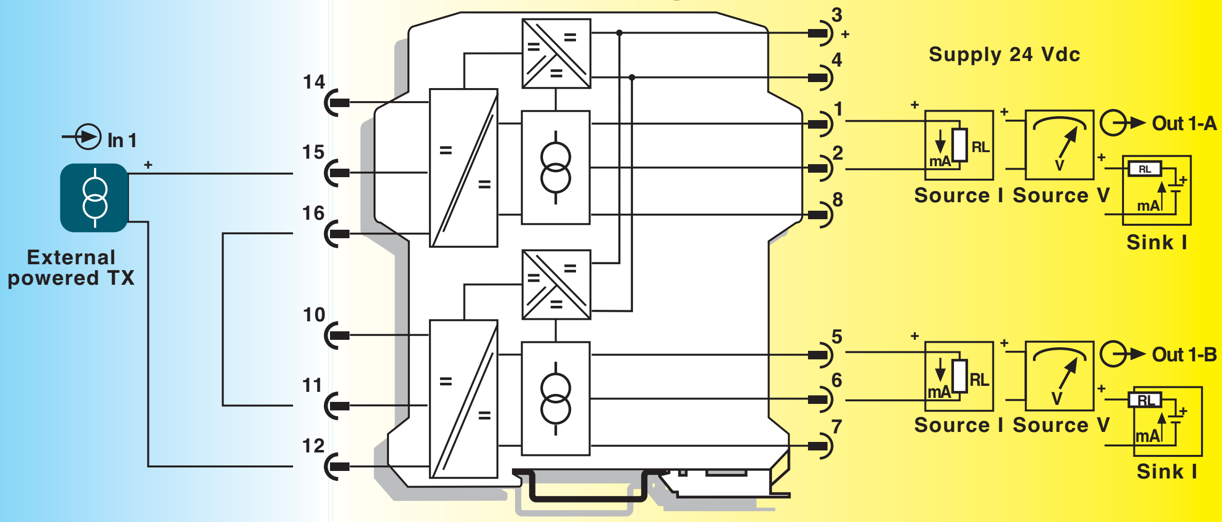
Terminals 15-16

Uo/Voc = 2.2 V

Io/Isc = 45 mA

Po/Po = 25 mW

MODEL D1010D-046 Duplicator



Connections for Duplication of Active Input Signals.

Restriction on Specifications for external powered Transmitter.

The voltage drop must be changed in 2.4 V max.

The allowable safety parameters must be changed in: Uo/Voc = 2.2 V.
Io/Isc = 45 mA.
Po/Po = 25 mW.

GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1012

Quadruple Repeater Power Supply DIN-Rail Model D1012Q

Characteristics:

General Description:
The quadruple channel DIN Rail Repeater Power Supply D1012Q provides a fully floating dc supply for energizing conventional 2-wire 4-20 mA Transmitter located in Hazardous Area, and repeats while isolating the current in Safe Area to drive a load.

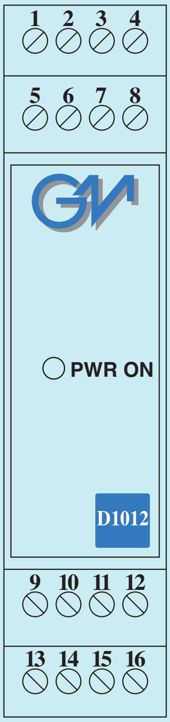
Function:
4 channels I.S. analog input for 2 wire loop powered Transmitters, provides isolation between input versus output and supply, and current (source mode) output signal.

On demand it is possible to supply the following combination of input / output:
2 independent input // 2+2 independent groups of output.
1 input // 4 outputs.

Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



Quadruple channels for 2 wire Transmitters.

4-20 mA Input, Output Signal.

Input and Output short circuit proof.

High Accuracy.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

ATEX Certification.

High Reliability, SMD components.

High Density, four channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 140 mA with 20 mA output typical.
Max. power consumption: 3.5 W for 4 channels with 30 V supply voltage.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV.

Input:
4 to 20 mA (2 wire Tx current limited at ≈ 22 mA).

Transmitter line voltage:
14.0 V typical at 20 mA with max. 30 mVrms ripple.

Output:
4 to 20 mA, on max. 300 Ω load source mode, current limited at 22 mA.
Response time: 500 ms (10 to 90 % step change).
Output ripple: ≤ 30 mVrms.

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits -40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 21.5 V, Io/Isc = 93 mA, Po/Po = 500 mW at terminals 13-14, 15-16, 9-10, 11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: ATEX, UL & C-UL, GOST applied for.
Conforms to the following standards: EN50014, EN50020, UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 140 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

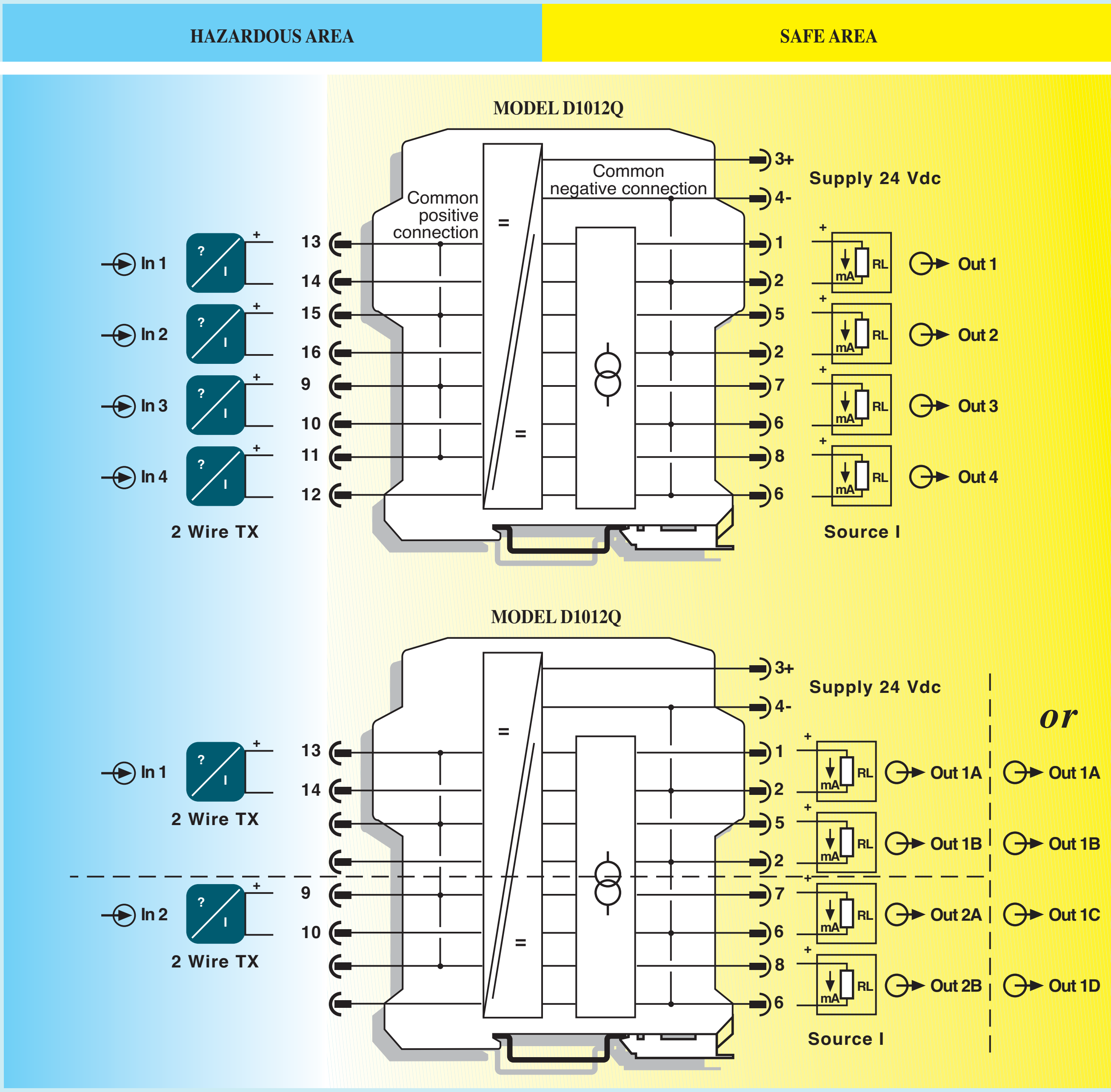
Ordering Information:

Model:	D1012Q

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-14, 15-16, 9-10, 11-12				
Uo/Voc = 21.5 V	II C	0.089	4.2	56.5
Io/Isc = 93 mA	II B	0.705	15.0	226.1
Po/Po = 500 mW	II A	2.320	33.0	452.3

Function Diagram:



GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1014

SIL 2 / SIL 3 Repeater Power Supply Hart Compatible DIN-Rail Models D1014S, D1014D

Characteristics:

General Description:
The single and dual single channel DIN Rail Repeater Power Supply, D1014S and D1014D is a high integrity analog input interface suitable for application requiring SIL 2 level (according to EN61508) in safety related system for high risk industries. Provides a fully floating dc supply for energizing conventional 2-wire 4-20 mA Transmitter located in Hazardous Area, and repeats the current in floating circuit to drive a Safe Area load.
The circuit allows bi-directional communication signals, for Hart Transmitters.

Function:
1 or 2 independent channels I.S. analog input for 2 wire loop powered Hart Transmitters, provides 3 port isolation (input/output/supply) and current (source or sink) or voltage output signal.

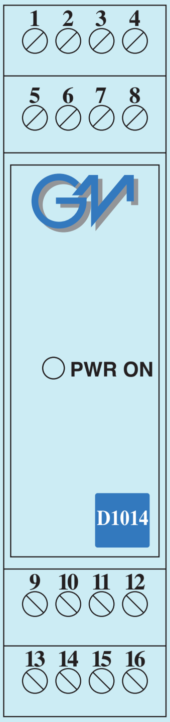
Signalling LED:
Power supply indication (green).

Field Configurability:
mA (source or sink) or V output signal.

Hart Communication Frequency Band:
0.5 to 2.5 KHz within 3 dB.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- 2 fully independent channels.
- SIL 2 / SIL 3 according to IEC 61508, IEC 61511.
- 4-20 mA Input, Output Signal.
- Hart compatible.
- Input and Output short circuit proof.
- High Accuracy.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Field programmability by DIP Switch.
- ATEX, UL & C-UL, FM & FM-C, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1014		
1 channel 2 channels		S D	
Power Bus enclosure			/B

Technical Data:

Supply: 12-24 Vdc nom (10 to 30 Vdc) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 110 mA for 2 channels D1014D, 55 mA for 1 channel D1014S with 20 mA output typical.
Current consumption @ 12 V: 240 mA for 2 channels D1014D, 120 mA for 1 channel D1014S with 20 mA output typical.
Max. power consumption: 3.30 W for 2 channels D1014D, 1.80 W for 1 channel D1014S with 30 V supply voltage and short circuit condition.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V; Out/Out 500 V; Out/Supply 500 V.

Input: 4 to 20 mA (2 wire Tx current limited at ≈ 25 mA).

Transmitter line voltage: ≥ 15.0 V at 20 mA with max. 20 mVrms ripple on 0.5 to 2.5 KHz frequency band.

Output: 4 to 20 mA, on max. 600 Ω load in source mode; V min. 5 V at 0 Ω load V max. 30 V in sink mode, current limited at ≈ 25 mA or 1 to 5 V on internal 250 Ω shunt (or 2 to 10 V on internal 500 Ω shunt on request).
Response time: 20 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load on 0.5 to 2.5 KHz band.
Frequency response: 0.5 to 2.5 KHz bidirectional within 3 dB (Hart protocol).

Performance: Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.1 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC, I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 25.2 V, Io/Isc = 93 mA, Po/Po = 585 mW at terminals 14-15, 10-11.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020. UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, FM & FM-C No. 3024643, 3024643C, conforms to Class 3600, 3610, 3611, 3810 and C22.2 No.142, C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 / SIL 3 according to IEC 61508, IEC 61511. Please refer to Functional Safety Manual for SIL applications.

Mounting: T35 DIN Rail according to EN50022.
Weight: about 160 g D1014D, 125 g D1014S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

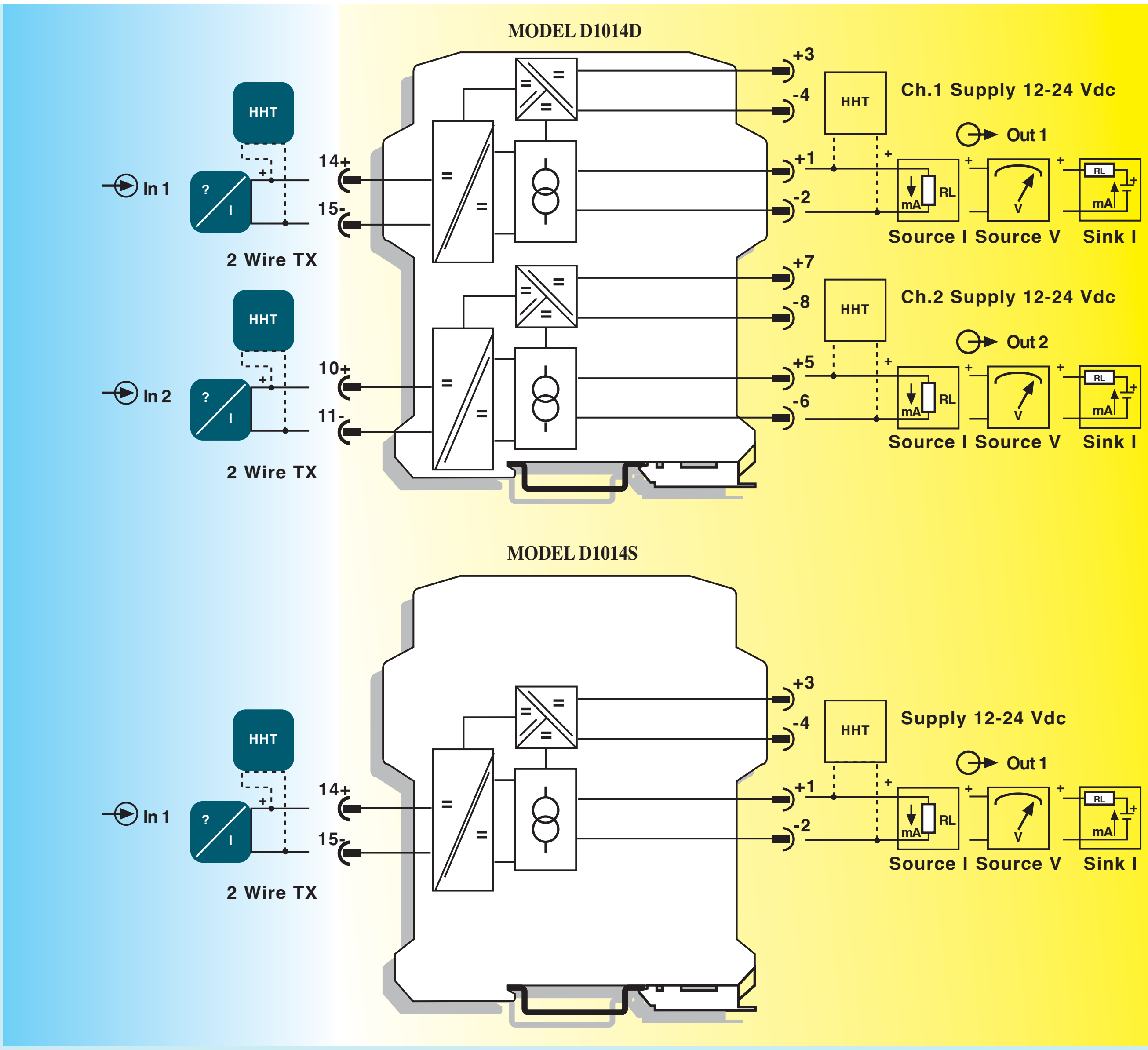
Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 14-15, 10-11				
Uo/Voc = 25.2 V	II C	0.102	4.2	60.7
Io/Isc = 93 mA	II B	0.820	15.0	242.9
Po/Po = 585 mW	II A	2.900	33.0	485.8

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



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TECHNOLOGY FOR SAFETY

D1014A

SIL 2 / SIL 3 Repeater Power Supply Hart Compatible DIN-Rail Models D1014AS, D1014AD

Characteristics:

General Description:
The single and dual single channel DIN Rail Repeater Power Supply, D1014AS and D1014AD is a high integrity analog input interface suitable for application requiring SIL 2 level (according to EN61508) in safety related system for high risk industries. Provides a fully floating dc supply for energizing conventional 2-wire 4-20 mA Transmitter, or separately powered 3,4 wire 4-20 mA transmitters, located in Hazardous Area, and repeats the current in floating circuit to drive a Safe Area load.
The circuit allows bi-directional communication signals, for Hart Transmitters.

Function:
1 or 2 independent channels I.S. analog input for 2 wire loop powered Hart Transmitters, or separately powered 3,4 wire 4-20 mA transmitters, provides 3 port isolation (input/output/supply) and current (source or sink) or voltage output signal.

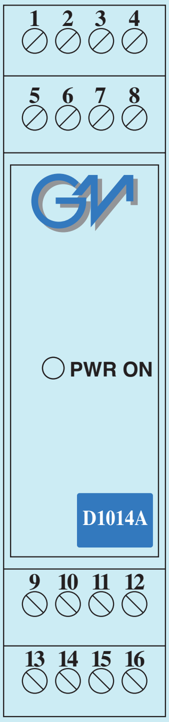
Signalling LED:
Power supply indication (green).

Field Configurability:
mA (source or sink) or V output signal.

Hart Communication Frequency Band:
0.5 to 2.5 KHz within 3 dB.

EMC: Fully compliant with CE marking applicable requirements.

Front Panel and Features:



2 fully independent channels.

SIL 2 / SIL 3 according to IEC 61508, IEC 61511.

4-20 mA Input, Output Signal.

Hart compatible.

Input and Output short circuit proof.

High Accuracy.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, UL & C-UL, FM & FM-C, Russia,Ukraine Certifications applied for.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1014A		
1 channel 2 channels		S D	
Power Bus enclosure			/B

Technical Data:

Supply: 12-24 Vdc nom (10 to 30 Vdc) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 110 mA for 2 channels D1014AD, 55 mA for 1 channel D1014AS with 20 mA output typical.
Current consumption @ 12 V: 240 mA for 2 channels D1014AD, 120 mA for 1 channel D1014AS with 20 mA output typical.
Max. power consumption: 3.30 W for 2 channels D1014AD, 1.80 W for 1 channel D1014AS with 30 V supply voltage and short circuit condition.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V; Out/Out 500 V; Out/Supply 500 V.

Input: 4 to 20 mA (2 wire Tx current limited at ≈ 25 mA) or 4-20 mA (separately powered input, voltage drop ≤ 1.2 V) .

Transmitter line voltage: ≥ 15.0 V at 20 mA with max. 20 mVrms ripple on 0.5 to 2.5 KHz frequency band.

Output: 4 to 20 mA, on max. 600 Ω load in source mode; V min. 5 V at 0 Ω load V max. 30 V in sink mode, current limited at ≈ 25 mA or 1 to 5 V on internal 250 Ω shunt (or 2 to 10 V on internal 500 Ω shunt on request).
Response time: 20 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load on 0.5 to 2.5 KHz band.
Frequency response: 0.5 to 2.5 KHz bidirectional within 3 dB (Hart protocol).

Performance: Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.1 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

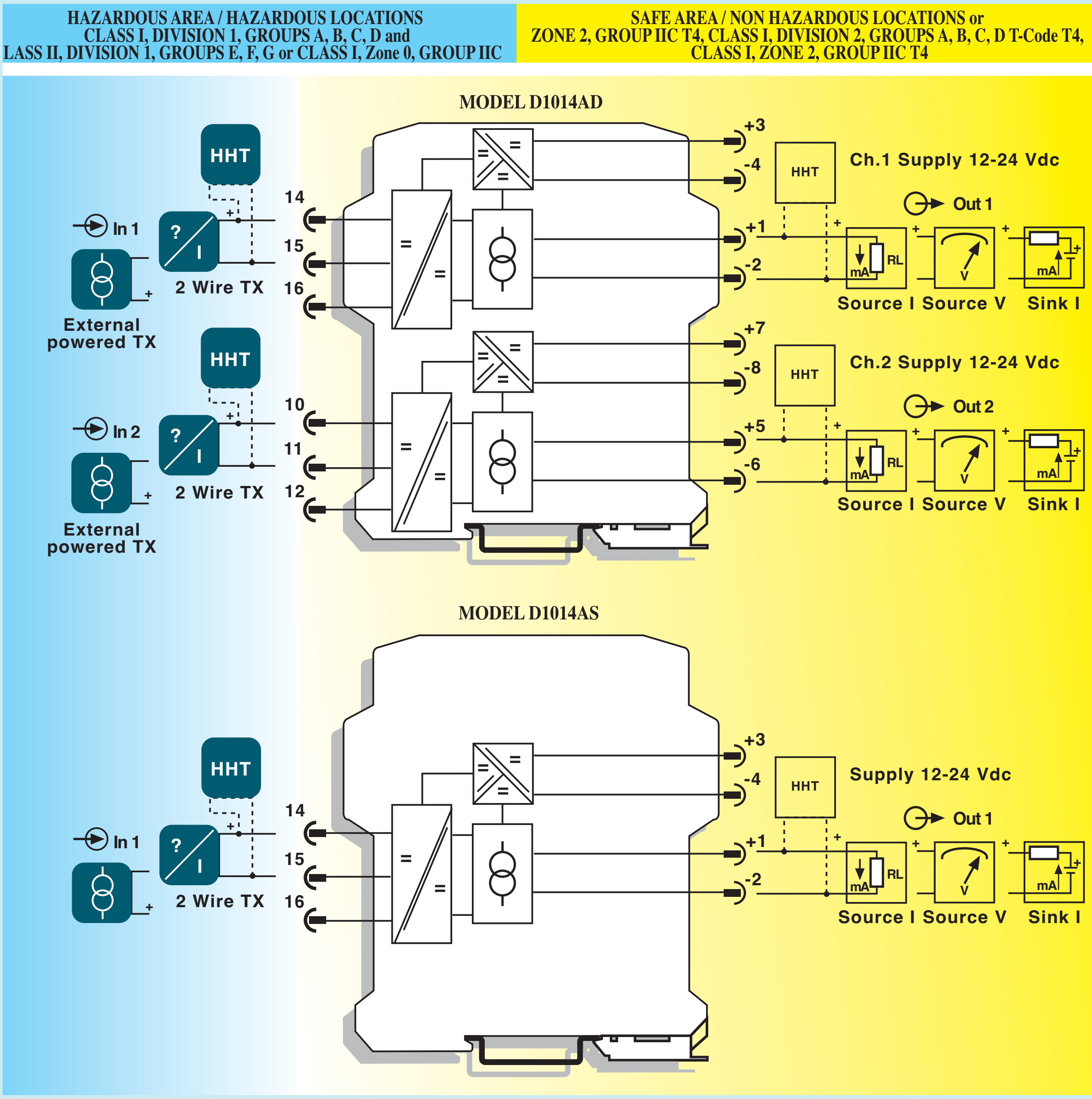
Safety Description:
II (1) G D [EEx ia] IIC, I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 25.2 V, Io/Isc = 93 mA, Po/Po = 585 mW at terminals 14-15, 10-11.
Uo/Voc = 1.2 V, Io/Isc = 100 mA, Po/Po = 25 mW at terminals 15-16, 11-12 (non energy storing apparatus connection).
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: ATEX applied for, conforms to EN50014, EN50020. UL & C-UL applied for, conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, FM & FM-C applied for, conforms to Class 3600, 3610, 3611, 3810 and C22.2 No.142, C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15, TCCExEE (Russia) applied for, according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X, TCCExEE (Ukraine) applied for, according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X.

Mounting: T35 DIN Rail according to EN50022.
Weight: about 160 g D1014AD, 125 g D1014AS.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

fety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
rminals -15, 10-11				
ı/Voc = 25.2 V	II C	0.102	4.2	60.7
Isc = 93 mA	II B	0.820	15.33	242.9
/Po = 585 mW	II A	2.900	33.0	485.8
rminals -16, 11-12	**Non energy storing apparatus connection**			
ı/Voc = 1.2 V	II C			
Isc = 100 mA	II B			
/Po = 25 mW	II A			

)TE for USA and Canada:
C equal to Gas Groups A, B, C, D, E, F and G.
B equal to Gas Groups C, D, E, F and G.
A equal to Gas Groups D, E, F and G.

ınction Diagram:



Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

Safety Description

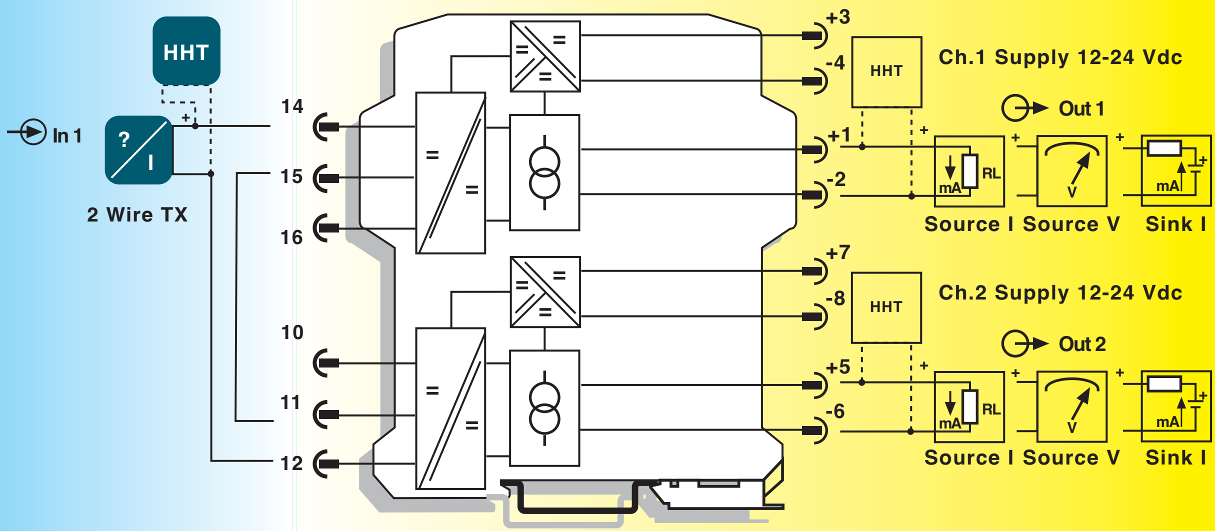
Terminals 14-15

Uo/Voc = 26.4 V

Io/Isc = 93 mA

Po/Po = 614 mW

MODEL D1014AD Duplicator



Connections for Duplication of 2 wire Transmitter Input.

Restriction on Specifications for 2 wire Transmitter Input.

Bi-directional communication for Smart Transmitter is provided only output channel 1.

The minimum supply voltage available for transmitters (VTx) is 14.0 V at 20 mA input.

The allowable safety parameters must be changed in: Uo/Voc = 26.4 V.
Io/Isc = 93 mA.
Po/Po = 614 mW.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

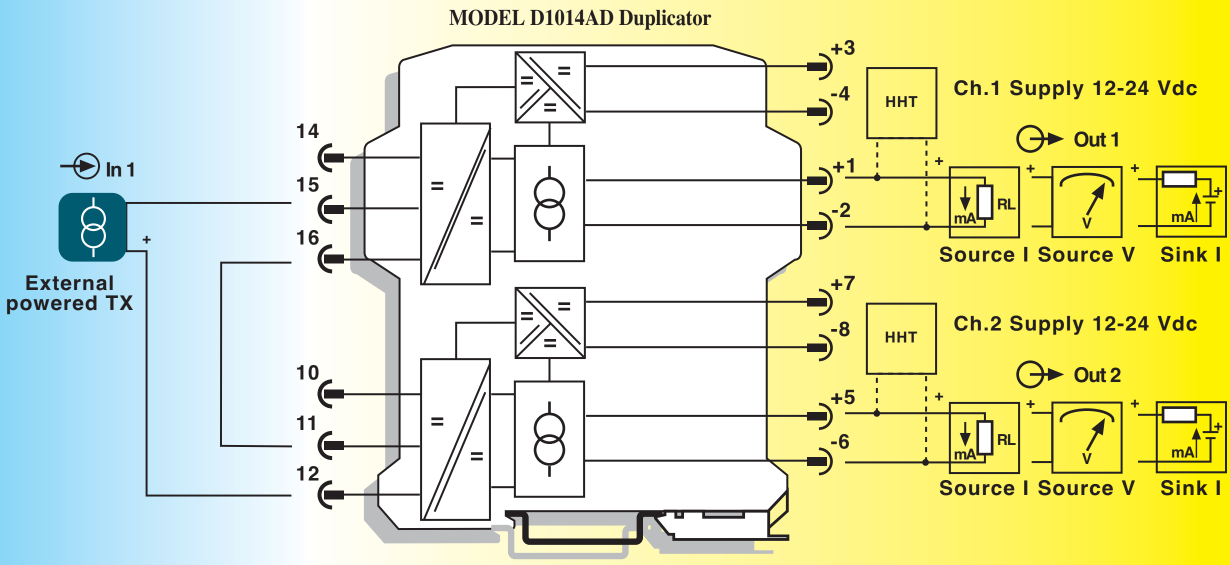
Safety Description

Terminals 15-16

Uo/Voc = 2.4 V

Io/Isc = 100 mA

Po/Po = 60 mW



Connections for Duplication of Active Input Signals.

Restriction on Specifications for external powered Transmitter.

The voltage drop must be changed in 2.0 V max.

The allowable safety parameters must be changed in: Uo/Voc = 2.4 V.
Io/Isc = 100 mA.
Po/Po = 60 mW.

INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1020

SIL 2 Powered Isolating Driver Smart-Hart Compatible DIN-Rail Models D1020S, D1020D

Characteristics:

General Description:
The single and dual Isolating Driver, D1020S and D1020D, isolates and transfers a 4-20, 0-20 mA signal from a Controller located in Safe Area to a load of up to 750 Ohm in Hazardous Area.
It has a high output capacity of 15 V at 20 mA combined with a low (2.0 V) drop across its input terminals. The circuit allows bi-directional communication signals, for Smart I/P.
In the 4-20 mA input range, a field open circuit reflects a high impedance to the control device output circuit.

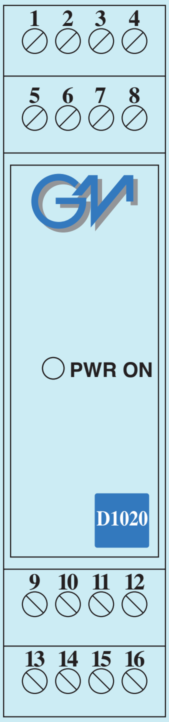
Function:
1 or 2 channels I.S. mA analog output for 2 wire I/P Smart converters or valve positioners, provides 3 port isolation (input/output/supply).

Signalling LED:
Power supply indication (green).

Smart Communication Frequency Band:
0.5 to 40 KHz within 3 dB (Hart and higher frequency protocols).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- SIL 2 according to IEC 61508, IEC 61511.
- 4-20 or 0-20 mA Input, Output Signal.
- Wide Band Smart Communication, Hart compatible.
- Field open circuit detection.
- High Accuracy.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1020		
1 channel 2 channels		S D	
Power Bus enclosure			/B

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 85 mA for 2 channels D1020D, 45 mA for 1 channel D1020S with 20 mA output typical.
Max. power consumption: 2.70 W for 2 channels, 1.50 W for 1 channel with 30 V supply voltage and overload condition.

Isolation (Test Voltage):
I.S. Out/In 1.5 KV; I.S. Out/Supply 1.5 KV; I.S. Out/I.S. Out 500 V; In/In 500 V; In/Supply 500 V.

Input:
0/4 to 20 mA with ≤ 2.0 V voltage drop, reverse polarity protected.

Output:
0/4 to 20 mA, on max. 750 Ω load, current limited at ≈ 23 mA.
Response time: 50 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load on 0.5 to 40 KHz band.
Frequency response: 0.5 to 40 KHz bidirectional within 3 dB (Hart and higher frequency protocols).

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 25.9 V, Io/Isc = 90 mA, Po/Po = 576 mW at terminals 14-15, 10-11.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 according to IEC 61508, IEC 61511. Please refer to Functional Safety Manual for SIL applications.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 175 g D1020D, 120 g D1020S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	L/R / La/Ra (µH/Ω)
Terminals 14-15, 10-11				
Uo/Voc = 25.9 V	II C	0.099	4.4	61.7
Io/Isc = 90 mA	II B	0.769	17.8	246.9
Po/Po = 576 mW	II A	2.630	35.7	493.8

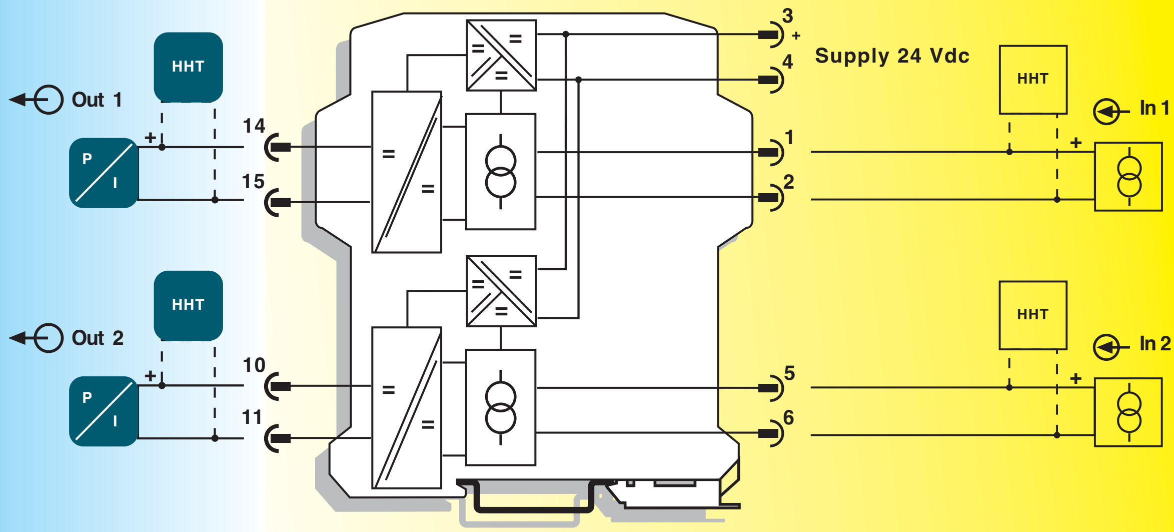
NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:

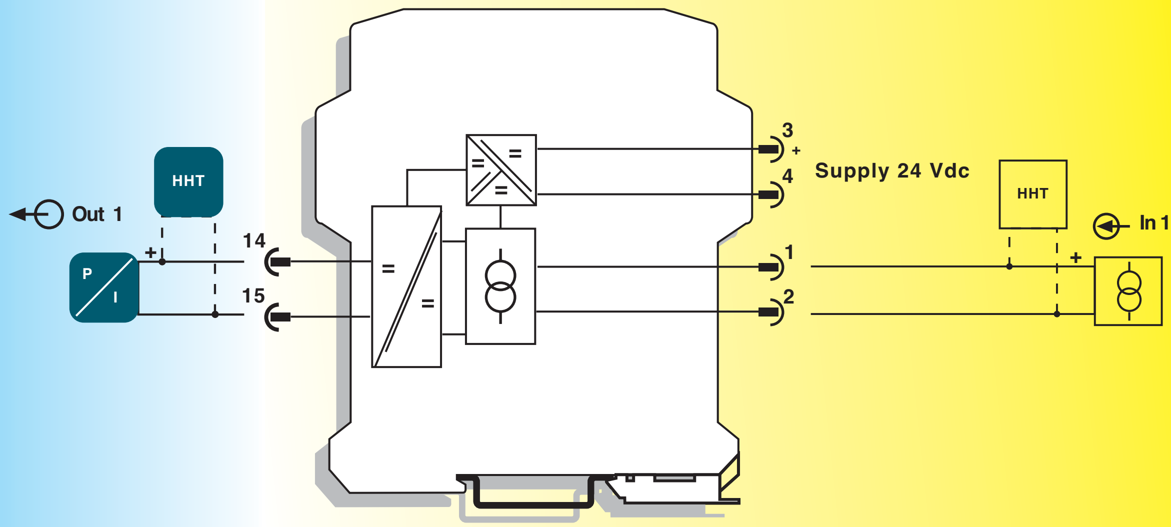
HAZARDOUS AREA / HAZARDOUS LOCATIONS
CLASS I, DIVISION 1, GROUPS A, B, C, D and
CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC

SAFE AREA / NON HAZARDOUS LOCATIONS or
ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4,
CLASS I, ZONE 2, GROUP IIC T4

MODEL D1020D



MODEL D1020S



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D1021

SIL 2 Powered Isolating Driver Fault detection Smart-Hart Compatible DIN-Rail Model D1021S

Characteristics:

General Description:
The single Isolating Driver D1021S isolates and transfers a 4-20 mA signal from a Controller located in Safe Area to a load of up to 750 Ohm in Hazardous Area.
It has a high output capacity of 15 V at 20 mA combined with a low (2.0 V) drop across its input terminals. The circuit allows bi-directional communication signals, for Smart I/P.
In the 4-20 mA input range, a field open/short circuit (load or wire fault) reflects a high impedance (>50 KΩ) to the control device output circuit and actuates (de-energizes) the fault indication relay/transistor.
An output underrange or overrange (< 1 mA or > 25 mA) also de-energizes the fault indication relay/transistor.

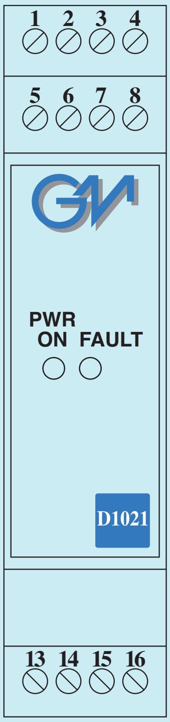
Function:
1 channel I.S. mA analog output for 2 wire I/P Smart converters or valve positioners, provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), fault condition (red).

Smart Communication Frequency Band:
0.5 to 40 KHz within 3 dB (Hart and higher frequency protocols).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- SIL 2 according to IEC 61508, IEC 61511.
- 4-20 mA Input, Output Signal.
- Wide Band Smart Communication, Hart compatible.
- Field fault circuit detection with signalling.
- Control Input fault detection with signalling.
- High Accuracy.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, FM & FM-C, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1021S	
Power Bus enclosure		/B

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 75 mA at 20 mA output typical.
Max. power consumption: 2.30 W with 30 V supply voltage and overload condition.

Isolation (Test Voltage):
I.S. Out/In 1.5 KV; I.S. Out/Supply 1.5 KV; I.S. Out/Fault Out 1.5 KV; In/Supply 500 V, In/Fault Out 1500 V, Supply/Fault Out 1500 V, Fault Out (relay)/Fault Out (transistor) 1500 V.

Input:
4 to 20 mA with ≤ 2.0 V voltage drop, reverse polarity protected.

Output:
4 to 20 mA, on max.750 Ω load, current limited at ≈ 24 mA .
Response time: 50 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load on 0.5 to 40 KHz band.
Frequency response: 0.5 to 40 KHz bidirectional within 3 dB (Hart and higher frequency protocols).

Fault detection:
Input Under/Overrange: Input current <1 mA or > 25 mA (± 0.5 mA).
Short Output detection: load resistance configurable from 0 Ω (short fault disabled) to 200 Ω, default setting 50 Ω.
Open Output detection: load resistance > 50 KΩ.
Fault signalling: Voltage free NE SPST optocoupled open-collector transistor and voltage free NE SPST relay contact (each output de-energized in fault condition).
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 1 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.
Relay Contact rating: 2 A 250 V 100 VA or 2 A 250 V 80 W (resistive load).
Response time: from 20 to 500 ms typical.

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.

Calibration accuracy:	≤ ± 0.1 % of full scale.
Linearity error:	≤ ± 0.1 % of full scale.
Supply voltage influence:	≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence:	≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence:	≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 25.9 V, Io/Isc = 90 mA, Po/Po = 576 mW at terminals 14-15.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020.
FM APPROVED
FM & FM-C No. 3024643, 3024643C, conforms to Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11,
TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X,
TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X,
Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 according to IEC 61508, IEC 61511.
Please refer to Functional Safety Manual for SIL applications.

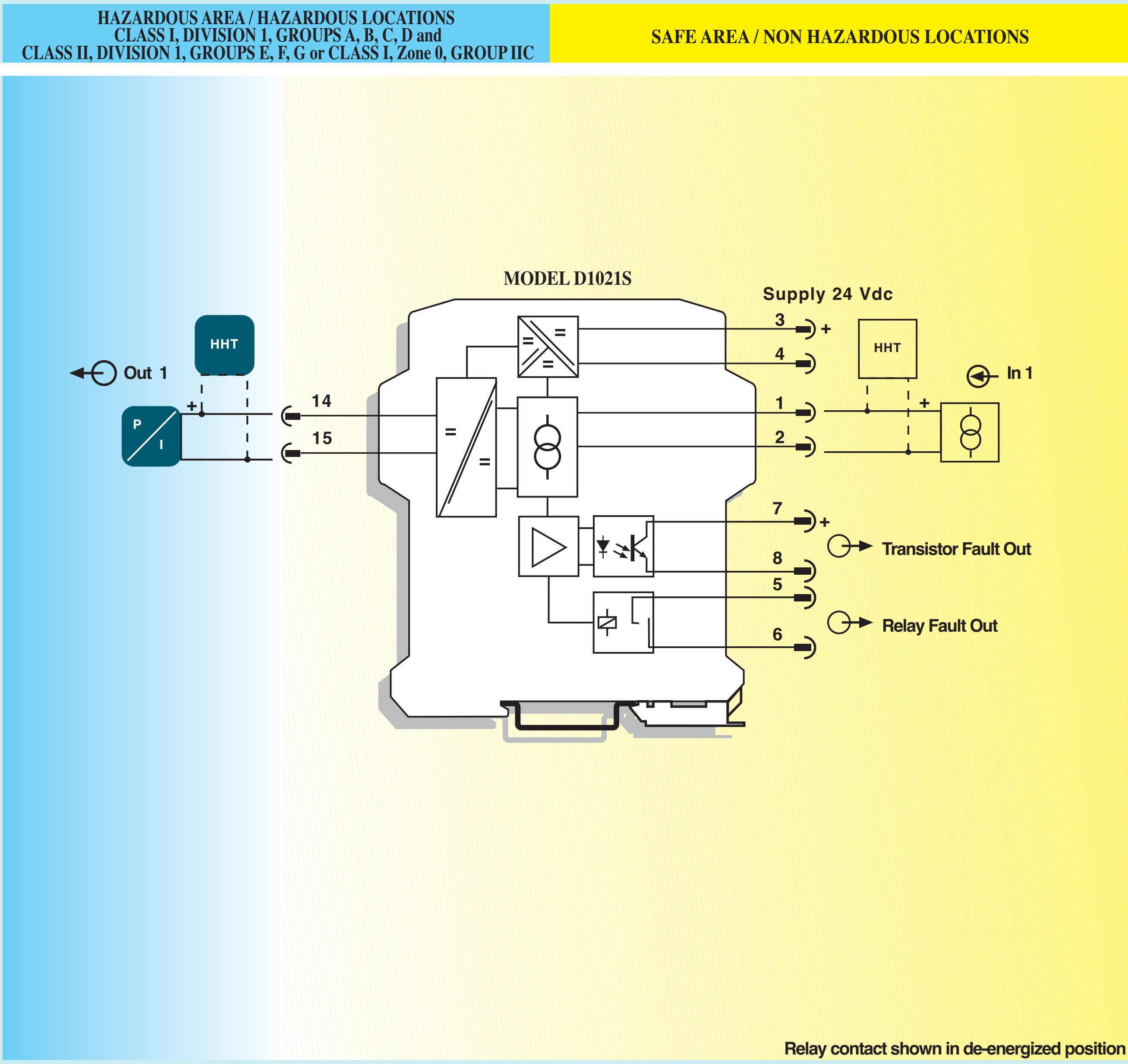
Mounting:
T35 DIN Rail according to EN50022.
Weight: about 130 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 14-15				
Uo/Voc = 25.9 V	II C	0.099	4.4	61.7
Io/Isc = 90 mA	II B	0.769	17.8	246.9
Po/Po = 576 mW	II A	2.630	35.7	493.8

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1022

SIL 3 Loop Powered Fire/Smoke Detector Interface DIN/Rail Models D1022S, D1022D

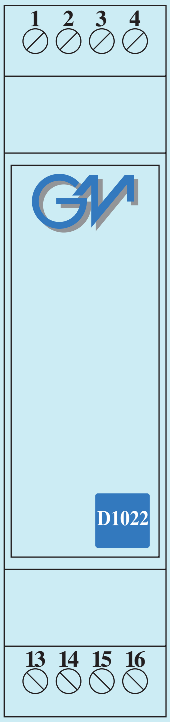
Characteristics:

General Description:
The D1022S or D1022D is a loop-powered single or dual channel isolated interface to be used with fire and smoke detectors located in hazardous areas, or with similar switched resistor systems requiring a wide output current range (from 1 to 40 mA) to operate properly.
The triggering of a detector causes a corresponding change in the safe area circuit.
The unit has reverse input polarity protection.
This unit can also be used to drive an I/P located in hazardous areas but with reduced accuracy (<1%).

Function:
1-2 channels (D1022S-D1022D) I.S. mA analog output for fire-smoke detectors providing input-output isolation.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 3 according to IEC 61508, IEC 615011.

Wide operating current range from 1 to 40 mA.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

ATEX, Russian and Ukraine Certifications.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
No supply voltage required because loop-powered.
Power dissipation: < 0.7 W per channel at 40 mA, 24 V.

Isolation (Test Voltage):
I.S. Out / In:1.5 KV; I.S. Out / I.S. Out: 500 V; In / In: 500 V.

Output Signal to Hazardous Areas:
Output: 1 to 40 mA.
Output characteristic (typical):
Vout = (Vin - 1.5) - (0.4 x Iout) for 6 V < Vin < 24 V.
Vout = (24 - 1.5) - (0.4 x Iout) for 24 V < Vin < 30 V.
4-20 mA output (on a max. load of 700 Ω): Accuracy ≤ 1%.

Input Signal to Safe Areas:
Operating voltage range: 6 to 30 V (loop powered).
Input current: 1 to 40 mA (loop powered).
Voltage drop-out: 9.5 V at 20 mA and with 500 Ω; 4 V at 4 mA.
Open circuit consumption: < 0.4 mA at 24 V.

Performance:
Reference Ambient Temperature Conditions: 23 ± 1 °C.
Current transfer error: 400 uA.
6 V < Vin < 24 V ; 1 mA < Iout < 40 mA.
Response time: 50 ms (10 to 90% step change).
Temperature influence: ≤ ± 0.01% for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits - 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 25.2 V, Io/Isc = 93 mA, Po/Po = 585 mW at terminals 13-14, 15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: ATEX, GOST applied for.
Conforms to the following standards: EN50014, EN50020, TCCExEE (Russia) to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 175 g D1022D, 120 g D1022S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

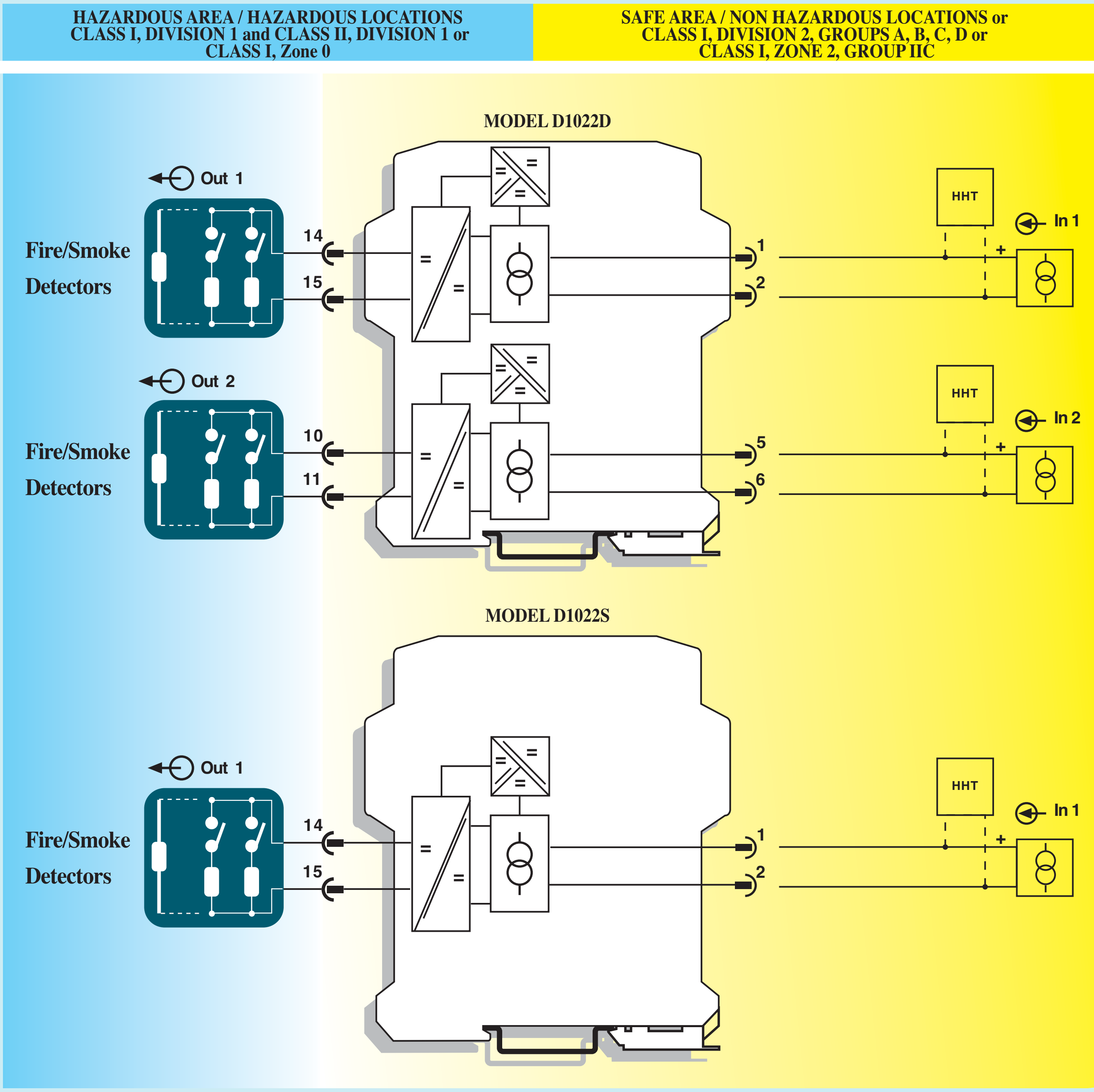
Model:	D1022		
1 channel		S	
2 channels		D	
Power Bus enclosure			/B

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	L/R / La/Ra (µH/Ω)
Terminals 14-15, 10-11				
Uo/Voc = 25.2 V	II C	-	-	-
Io/Isc = 93 mA	II B	-	-	-
Po/Po = 585 mW	II A	-	-	-

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



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GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1030

Switch/Proximity Detector Repeater Relay Output, DIN-Rail Models D1030S, D1030D

Characteristics:

General Description:
The Switch/Proximity Detector Repeater type D1030 is a DIN Rail unit with one or two independent channels.
The unit can be configured for contact or proximity detector, NO or NC and for NE or ND SPDT relay output contact.
Each channel enables a Safe Area load to be controlled by a switch, or a proximity detector, located in Hazardous Area.
D1030D dual channel type has two independent input channels and actuates the corresponding output relay.Two actuation modes can be independently DIP switch configured on each input channel: NO In/NE relay or NO In/ND relay. Contact or proximity sensor and its connection line short or open circuit fault detection is also DIP switch configurable: fault detection can be enabled (in case of fault it de-energizes the corresponding output relay and turns the fault LED on) or disabled (in case of fault the corresponding output relay repeats the input line open or closed status as configured).
D1030S single channel type has one input channel and two output relays; the unit has two DIP switch configurable operating modes:
Mode A) Input channel actuates in parallel the two output relays (DPDT contact).
Relay actuation mode can be independently configured for each output in two modes: NO In/NE relay or NO In/ND relay.
Mode B) Input channel actuates output relay (A) configurable in two modes as in mode A above. Output relay B operates as a fault output (in case of input fault, relay B actuates and the fault LED turns on while relay A repeats the input line as configured). Actuation can be DIP switch configured in two modes: No input fault/Energized relay (it de-energizes in case of fault) or No input fault/De-energized relay (it energizes in case of fault).

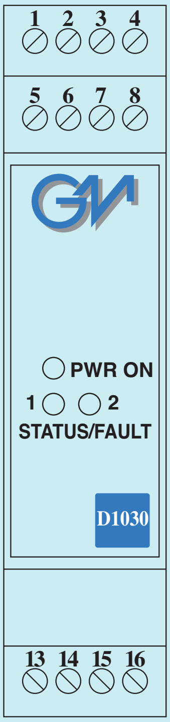
Function:
1 or 2 channels I.S. switch repeater for contact or EN60947-5-6 Proximity
Provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Output status (yellow), Line fault (red).

Field Configurability:
NO/NC input for Contact/Proximitor, NE/ND relay operation and Fault detection enable/disable.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



NO/NC Contact/Proximity Detector Input.

Two SPDT Relay Output Signals.

SPDT Relay Output for fault detection on 1 channel version.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, UL & C-UL, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 85 mA for 2 channels D1030D, 65 mA for 1 channel D1030S with relays energized.
Max. power consumption: 2.60 W for 2 channels, 2.20 W for 1 channel with 30 V supply voltage, short circuit input and relays energized.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV;
Out/Supply 1500 V, Out/Out 1500 V.

Input switching current levels:
ON ≥ 2.1 mA, OFF ≤ 1.2 mA,
Switch current ≈ 1.65 mA ± 0.2 mA hysteresis.
Fault current levels: Open fault ≤ 0.2 mA, Short fault ≥ 6.8 mA (when enabled both faults de-energize channel relay with dual channel unit D1030D or actuate fault relay with single channel unit D1030S).
Input equivalent source: 8 V 1 KΩ typical (8 V no load 8 mA short circuit).

Output:
Voltage free SPDT relay contact.
Contact rating: 2 A 250 V 100 VA or 2 A 250 V 80 W (resistive load).
Response time: 20 ms.
Frequency response: 10 Hz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 10.9 V, Io/Isc = 15 mA, Po/Po = 40 mW at terminals 13-14, 15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020,UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 140 g D1030D, 130 g D1030S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area / Non Hazardous Locations installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

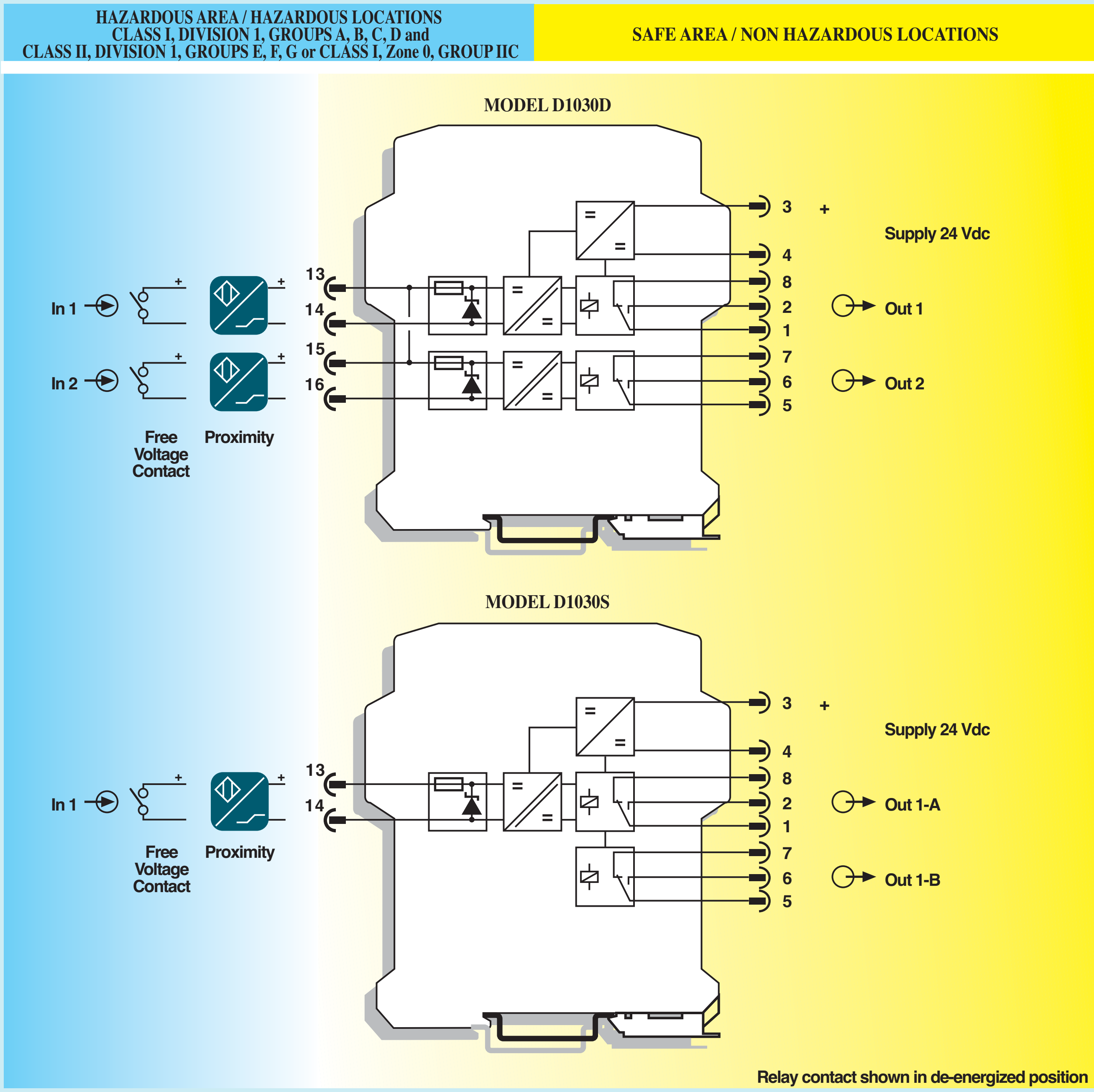
Model:	**D1030**		
1 channel 2 channels		S D	
Power Bus enclosure			/B

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-14, 15-16				
Uo/Voc = 10.9 V	II C	2.05	165	890
Io/Isc = 15 mA	II B	14.40	661	3580
Po/Po = 40 mW	II A	63.00	1320	7160

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1130

Switch/Proximity Detector Repeater Relay Output DIN-Rail Models D1130S, D1130D

Characteristics:

General Description:
The Switch/Proximity Detector Repeater type D1130 is a DIN Rail unit with one or two independent channels.
The unit can be configured for contact or proximity detector, NO or NC and for NE or ND SPDT relay output contact.
Each channel enables a Safe Area load to be controlled by a switch, or a proximity detector, located in Hazardous Area.
D1130D dual channel type has two independent input channels and actuates the corresponding output relay. Two actuation modes can be independently DIP switch configured on each input channel: NO In/NE relay or NO In/ND relay. Contact or proximity sensor and its connection line short or open circuit fault detection is also DIP switch configurable: fault detection can be enabled (in case of fault it de-energizes the corresponding output relay and turns the fault LED on) or disabled (in case of fault the corresponding output relay repeats the input line open or closed status as configured).
D1130S single channel type has one input channel and two output relays; the unit has two DIP switch configurable operating modes: Mode A) Input channel actuates in parallel the two output relays (DPDT contact). Relay actuation mode can be independently configured for each output in two modes: NO In/NE relay or NO In/ND relay. Mode B) Input channel actuates output relay (A) configurable in two modes as in mode A above. Output relay B operates as a fault output (in case of input fault, relay B actuates and the fault LED turns on while relay A repeats the input line as configured). Actuation can be DIP switch configured in two modes: No input fault/Energized relay (it de-energizes in case of fault) or No input fault/De-energized relay (it energizes in case of fault).

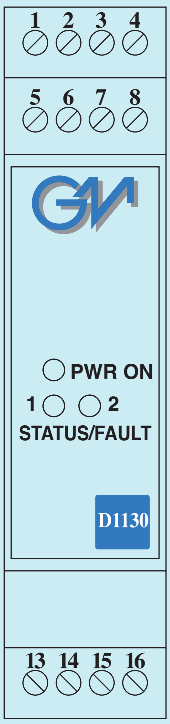
Function:
1 or 2 channels I.S. switch repeater for contact or EN60947-5-6 NAMUR Prox. Provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Output status (yellow), Line fault (red).

Field Configurability:
NO/NC input for Contact/Proximitor, NE/ND relay operation and Fault detection enable/disable.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



NO/NC Contact/Proximity Detector Input.

Two SPDT Relay Output Signals.

SPDT Relay Output for fault detection on 1 channel version.

Universal AC Supply Voltage (85 to 264 Vac or 100 to 350 Vdc).

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, UL & C-UL, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
115-230 Vac (85 to 264 Vac), 50 to 400 Hz or 110 Vdc (100 to 350 Vdc).
Limit supply voltage to 250 Vrms for Instrinsic Safety applications.
Current consumption: 25 mA @ 115 Vac, 17 mA @ 230 Vac with relays energized.
Max. power consumption: 2.00 W for 2 channels, 1.90 W for 1 channel at 264 Vac supply voltage, short circuit input and relays energized.

Isolation (Test Voltage):
I.S. In/Out 2.5 KV; I.S. In/Supply 2.5 KV;
Out/Supply 2500 V, Out/Out 2500 V.

Input switching current levels:
ON ≥ 2.1 mA, OFF ≤ 1.2 mA,
Switch current ≈ 1.65 mA ± 0.2 mA hysteresis.
Fault current levels: Open fault ≤ 0.2 mA, Short fault ≥ 6.8 mA (when enabled both faults de-energize channel relay with dual channel unit D1130D or actuate fault relay with single channel unit D1130S).
Input equivalent source: 8 V 1 KΩ typical (8 V no load 8 mA short circuit).

Output:
Voltage free SPDT relay contact.
Contact rating: 2 A 250 V 100 VA or 2 A 250 V 80 W (resistive load).
Response time: 20 ms.
Frequency response: 10 Hz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 10.9 V, Io/Isc = 15 mA, Po/Po = 40 mW at terminals 13-14, 15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60 °C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 150 g D1130D, 145 g D1130S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

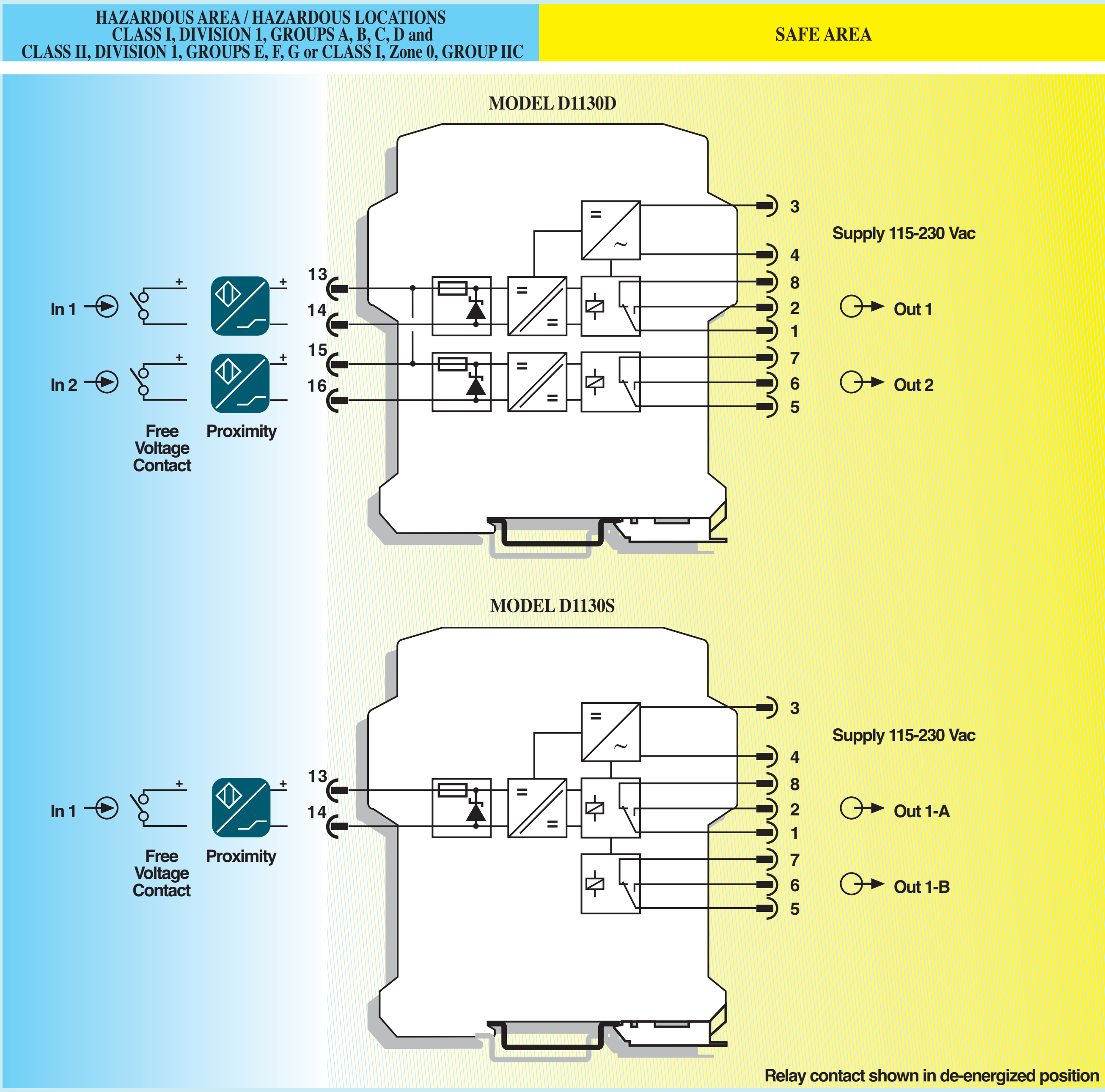
Model:	D1130	
1 channel		S
2 channels		D

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-14, 15-16				
Uo/Voc = 10.9 V	II C	2.05	165	890
Io/Isc = 15 mA	II B	14.40	661	3580
Po/Po = 40 mW	II A	63.00	1320	7160

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



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GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1031

Switch/Proximity Detector Repeater Transistor Output DIN-Rail Models D1031D, D1031Q

Characteristics:

General Description:
The Switch/Proximity Detector Repeater type D1031 is a DIN Rail unit configurable with two or four independent channels.
The unit can be configured for contact or proximity detector, NO or NC and for NO or NC optocoupled open collector transistor output.
Each channel enables a Safe Area load to be controlled by a switch, or a proximity detector, located in Hazardous Area.
D1031Q quad channel type has four independent input channels and actuates the corresponding output transistor.Two actuation modes can be independently DIP switch configured on each input channel: NO In/NC transistor or NO In/NO transistor. Contact or proximity sensor and its connection line short or open circuit fault detection is also DIP switch configurable: fault detection can be enabled (in case of fault it de-energizes the corresponding output transistor and turns the fault LED on) or disabled (in case of fault the corresponding output transistor repeats the input line open or closed status as configured).
D1031D dual channel type has two input channels and four output transistors; the unit has two DIP switch configurable operating modes:
Mode A) Input channel actuates in parallel the two output transistors. Transistor actuation mode can be independently configured for each output in two modes: NO In/NC transitor or NO In/NO transistor.
Mode B) Input channel actuates output transistor (A) configurable in two modes as in mode A above. Output transistor B operates as a fault output (in case of input fault, transistor B actuates and the fault LED turns on while transistor A repeats the input line as configured). Actuation can be DIP switch configured in two modes: No input fault/Energized transistor (it de-energizes in case of fault) or No input fault/De-energized transistor (it energizes in case of fault).

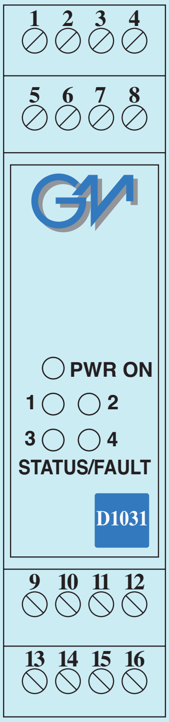
Function:
2 or 4 channels I.S. switch repeater for contact or EN60947-5-6 Proximity
Provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Output status (yellow), Line fault (red).

Field Configurability:
NO/NC input for Contact/Proximitor, NO/NC Transistor operation and Fault detection enable/disable.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- NO/NC Contact/Proximity Detector Input.
- Four Opto Isolated Voltage free Transistor Output Signals.
- Transistor Output for fault detection on 2 channels version.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Field programmability by DIP Switch.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, four channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
12-24 V nom (10 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 65 mA for 4 channels D1031Q, 60 mA for 2 channels D1031D with transistor energized.
Current consumption @ 12 V: 120 mA for 4 channels D1031Q, 110 mA for 2 channels D1031D with transistor energized.
Max. power consumption: 1.80 W for 4 channels, 1.60 W for 2 channels with 30 V supply voltage, short circuit input and transistor energized.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV;
Out/Supply 500 V, Out 1-3/Out 2-4 500 V.

Input switching current levels:
ON ≥ 2.1 mA, OFF ≤ 1.2 mA,
Switch current ≈ 1.65 mA ± 0.2 mA hysteresis.
Fault current levels: Open fault ≤ 0.2 mA, Short fault ≥ 6.8 mA (when enabled both faults de-energize channel transistor with quad channel unit D1031Q or actuate fault transistor with dual channel unit D1031D).
Input equivalent source: 8 V 1 KΩ typical (8 V no load 8 mA short circuit).

Output:
Voltage free SPST optocoupled open-collector transistor.
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 2.0 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.
Response time: 500 µs.
Frequency response: 1 KHz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 10.9 V, Io/Isc = 15 mA, Po/Po = 40 mW at terminals 13-14, 15-16, 9-10, 11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 130 g D1031Q, 120 g D1031D.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

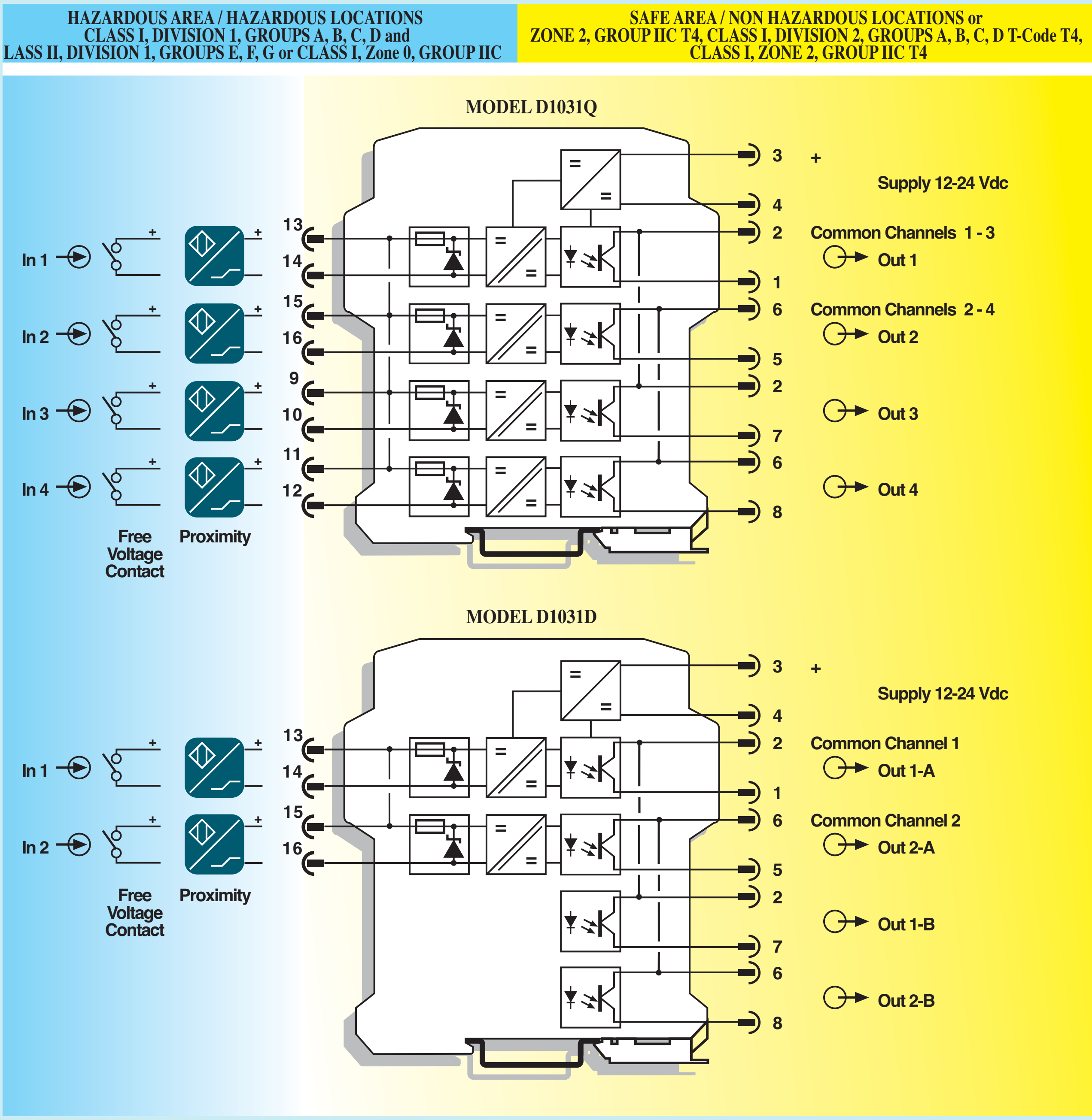
Ordering Information:

Model:	D1031		
2 channels 4 channels		D Q	
Power Bus enclosure			/B

fety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
ninals -14, 15-16, l0, 11-12				
ı/Voc = 10.9 V	II C	2.05	165	890
Isc = 15 mA	II B	14.40	661	3580
/Po = 40 mW	II A	63.00	1320	7160

)TE for USA and Canada:
C equal to Gas Groups A, B, C, D, E, F and G.
B equal to Gas Groups C, D, E, F and G.
A equal to Gas Groups D, E, F and G.

unction Diagram:



GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1032

SIL 2 Switch/Proximity Detector Repeater Relay Output DIN-Rail Models D1032D, D1032Q

Characteristics:

General Description:
The Switch/Proximity Detector Repeater type D1032 is a DIN Rail unit configurable with two or four independent channels.
The unit can be configured for contact or proximity detector, NO or NC and for NE or ND relay output.
Each channel enables a Safe Area load to be controlled by a switch, or a proximity detector, located in Hazardous Area.
D1032Q quad channel type has four, independent and isolated, input channels and actuates the corresponding output relay.Two actuation modes can be independently DIP switch configured on each input channel:
NO In/NE relay or NO In/ND relay. Contact or proximity sensor and its connection line short or open circuit fault detection is also DIP switch configurable: fault detection can be enabled (in case of fault it de-energizes the corresponding output relay and turns the fault LED on) or disabled (in case of fault the corresponding output relay repeats the input line open or closed status as configured).
D1032D dual channel type has two, independent and isolated, input channels and four output relays; the unit has two DIP switch configurable operating modes:
Mode A) Input channel actuates in parallel the two output relays.
Relay actuation mode can be independently configured for each output in two modes: NO In/NE relay or NO In/ND relay.
Mode B) Input channel actuates output relay (A) configurable in two modes as in mode A above. Output relay B operates as a fault output (in case of input fault, relay B actuates and the fault LED turns on while relay A repeats the input line as configured). Actuation can be DIP switch configured in two modes: No input fault/Energized relay (it de-energizes in case of fault) or No input fault/De-energized relay (it energizes in case of fault).

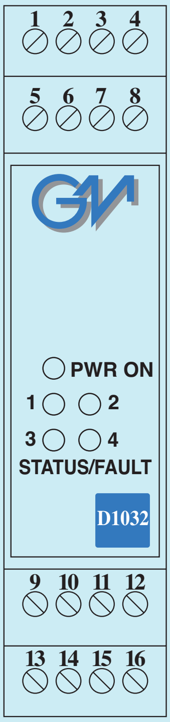
Function:
2 or 4 channels I.S. switch repeater for contact or EN60947-5-6 Proximity
Provides 3 port isolation (input/output/supply). Line-fault detection, common to all input signals, available when using enclosures with Power bus.

Signalling LEDs:
Power supply indication (green), Output status (yellow), Line fault (red).

Field Configurability:
NO/NC input for Contact/Proximitor, NE/ND relay operation and Fault detection enable/disable.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 2 according to IEC 61508, IEC 61511.

NO/NC Contact/Proximity Detector Input.

Four Voltage free SPST Relay Contact Output Signals.

Relay Output for fault detection on 2 channels version.

Common fault-line detection available when using Power bus enclosure.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, UL & C-UL, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, four channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 75 mA for 4 channels D1032Q, 60 mA for 2 channels D1032D with relays energized.
Max. power consumption: 2.60 W for 4 channels, 2.20 W for 2 channels with 30 V supply voltage, short circuit input and relays energized.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V
Out/Supply 1500 V, Out 1-3/Out 2-4 1500 V.

Input switching current levels:
ON ≥ 2.1 mA, OFF ≤ 1.2 mA,
Switch current ≈ 1.65 mA ± 0.2 mA hysteresis.
Fault current levels: Open fault ≤ 0.2 mA, Short fault ≥ 6.8 mA (when enabled both faults de-energize channel relay with quad channel unit D1032Q or actuate fault relay with dual channel unit D1032D).
Input equivalent source: 8 V 1 KΩ typical
(8 V no load 8 mA short circuit).

Output:
Voltage free SPST relay contact.
Contact rating: 2 A 250 V 100 VA or 2 A 250 V 80 W (resistive load).
Response time: 20 ms.
Frequency response: 10 Hz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 9.6 V, Io/Isc = 10 mA, Po/Po = 24 mW at terminals 13-14, 15-16, 9-10, 11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020,UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 according to IEC 61508, IEC 61511. Please refer to Functional Safety Manual for SIL applications..

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 190 g D1032Q, 160 g D1032D.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

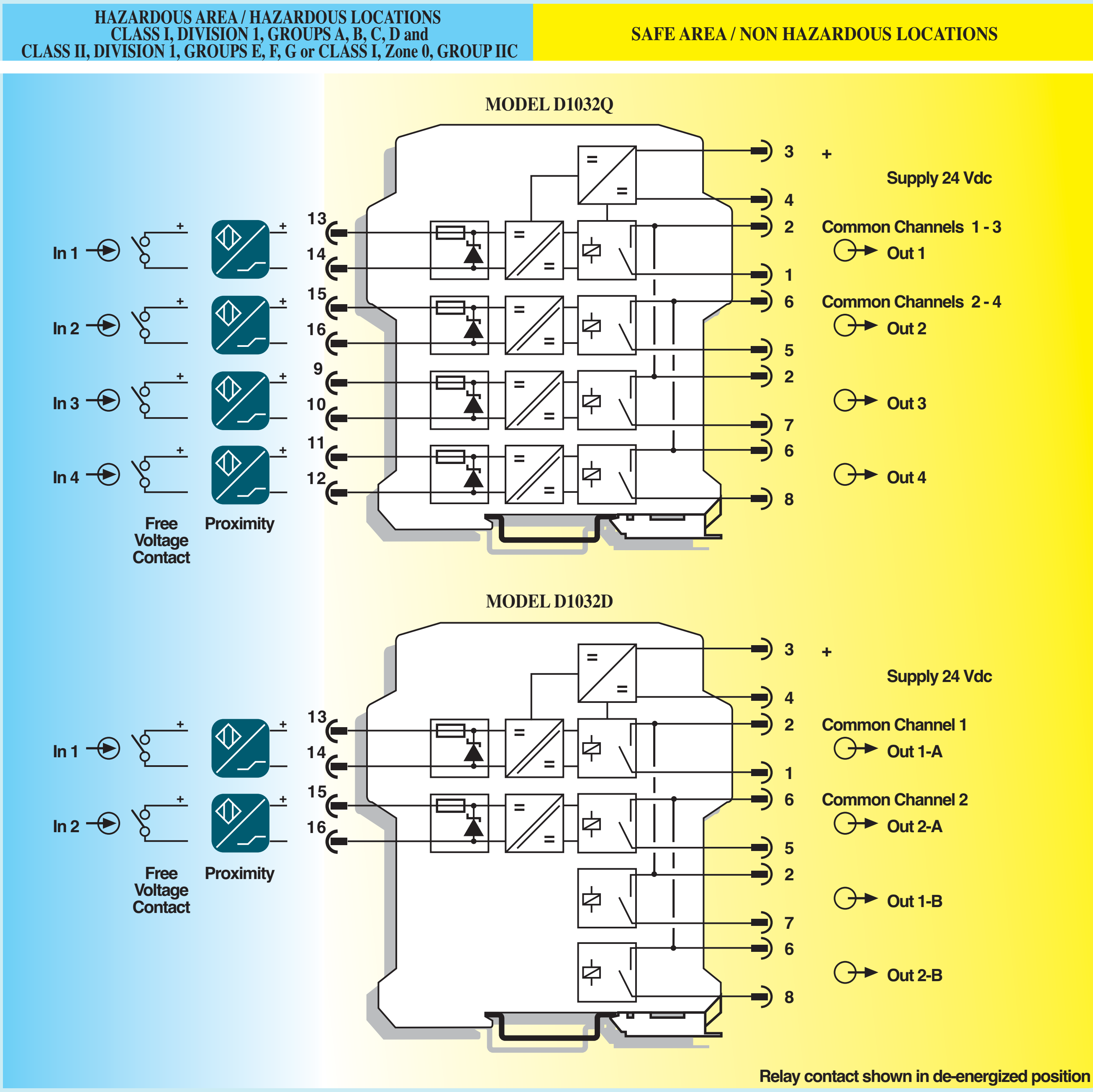
Model:	D1032		
2 channels		D	
4 channels		Q	
Power Bus enclosure			/B

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-14, 15-16, 9-10, 11-12				
Uo/Voc = 9.6 V	II C	3.60	330	1530
Io/Isc = 10 mA	II B	26.00	1420	6120
Po/Po = 24 mW	II A	210.00	2840	12240

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1033

SIL 2 Switch/Proximity Detector Repeater Transistor Output DIN-Rail Models D1033D, D1033Q

Characteristics:

General Description:

The Switch/Proximity Detector Repeater type D1033 is a DIN Rail unit configurable with two or four independent channels.
The unit can be configured for contact or proximity detector, NO or NC and for NO or NC optocoupled open collector transistor output.
Each channel enables a Safe Area load to be controlled by a switch, or a proximity detector, located in Hazardous Area.
D1033Q quad channel type has four, independent and isolated, input channels and actuates the corresponding output transistor.Two actuation modes can be independently DIP switch configured on each input channel:
NO In/NC transistor or NO In/NO transistor. Contact or proximity sensor and its connection line short or open circuit fault detection is also DIP switch configurable: fault detection can be enabled (in case of fault it de-energizes the corresponding output transistor and turns the fault LED on) or disabled (in case of fault the corresponding output transistor repeats the input line open or closed status as configured).
D1033D dual channel type has two, independent and isolated, input channels and four output transistors; the unit has two DIP switch configurable operating modes:
Mode A) Input channel actuates in parallel the two output transistors. Transistor actuation mode can be independently configured for each output in two modes: NO In/NC transitor or NO In/NO transistor.
Mode B) Input channel actuates output transistor (A) configurable in two modes as in mode A above. Output transistor B operates as a fault output (in case of input fault, transistor B actuates and the fault LED turns on while transistor A repeats the input line as configured). Actuation can be DIP switch configured in two modes: No input fault/Energized transistor (it de-energizes in case of fault) or No input fault/De-energized transistor (it energizes in case of fault).

Function:

2 or 4 channels I.S. switch repeater for contact or EN60947-5-6 Proximity Provides 3 port isolation (input/output/supply). Line-fault detection, common to all input signals, available when using enclosures with Power bus.

Signalling LEDs:

Power supply indication (green), Output status (yellow), Line fault (red).

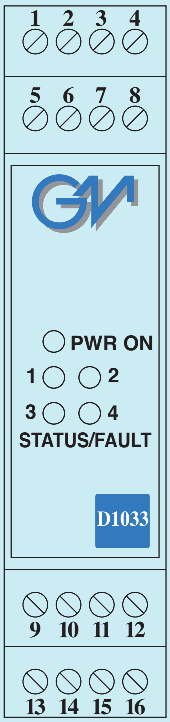
Field Configurability:

NO/NC input for Contact/Proximitor, NO/NC Transistor operation and Fault detection enable/disable.

EMC:

Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 2 according to IEC 61508, IEC 61511.

NO/NC Contact/Proximity Detector Input.

Four Opto Isolated Voltage free Transistor Output Signals.

Transistor Output for fault detection on 2 channels version.

Common fault-line detection available when using Power bus enclosure.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, UL & C-UL, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, four channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:

24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 60 mA for 4 channels D1033Q, 45 mA for 2 channels D1033D with transistor energized.
Max. power consumption: 1.60 W for 4 channels, 1.30 W for 2 channels with 30 V supply voltage, short circuit input and transistor energized.

Isolation (Test Voltage):

I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V
Out/Supply 500 V, Out 1-3/Out 2-4 500 V.

Input switching current levels:

ON ≥ 2.1 mA, OFF ≤ 1.2 mA,
Switch current ≈ 1.65 mA ± 0.2 mA hysteresis.
Fault current levels: Open fault ≤ 0.2 mA, Short fault ≥ 6.8 mA (when enabled both faults de-energize channel transistor with quad channel unit D1033Q or actuate fault transistor with dual channel unit D1033D).
Input equivalent source: 8 V 1 KΩ typical (8 V no load 8 mA short circuit).

Output:

Voltage free SPST optocoupled open-collector transistor.
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 2.0 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.
Response time: 500 µs.
Frequency response: 2 KHz maximum.

Compatibility:

CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:

Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:

II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 9.6 V, Io/Isc = 10 mA, Po/Po = 24 mW at terminals 13-14, 15-16, 9-10, 11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 according to IEC 61508, IEC 61511. Please refer to Functional Safety Manual for SIL applications..

Mounting:

T35 DIN Rail according to EN50022.
Weight: about 170 g D1033Q, 140 g D1033D.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

Model:	D1033		
2 channels		D	
4 channels		Q	
Power Bus enclosure			/B

Parameters Table:

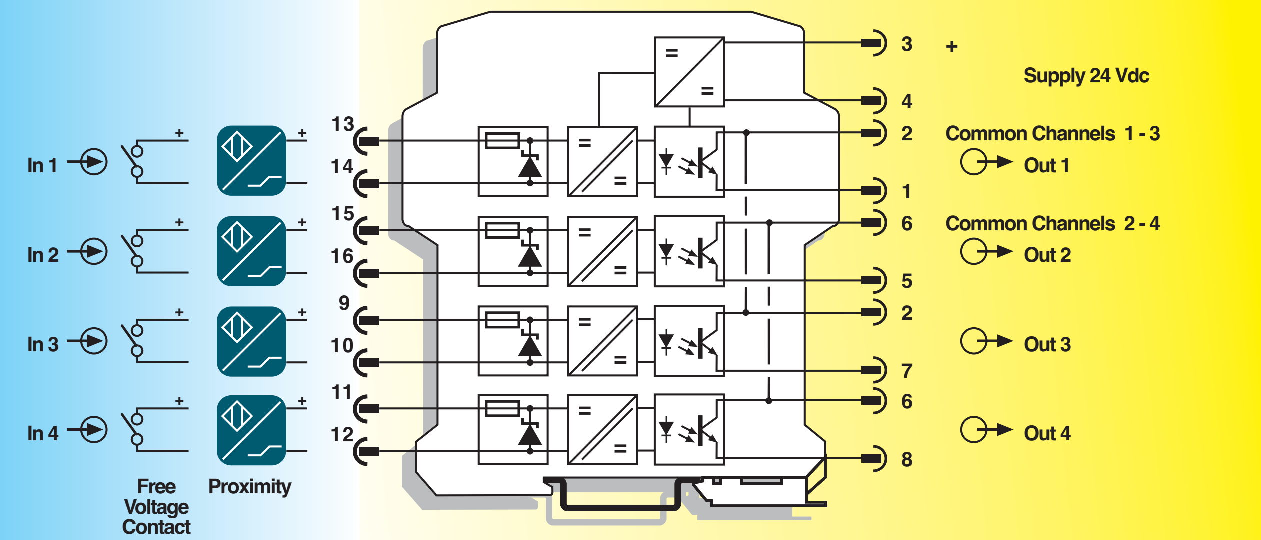
Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-14, 15-16, 9-10, 11-12				
Uo/Voc = 9.6 V	II C	3.60	330	1530
Io/Isc = 10 mA	II B	26.00	1420	6120
Po/Po = 24 mW	II A	210.00	2840	12240

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

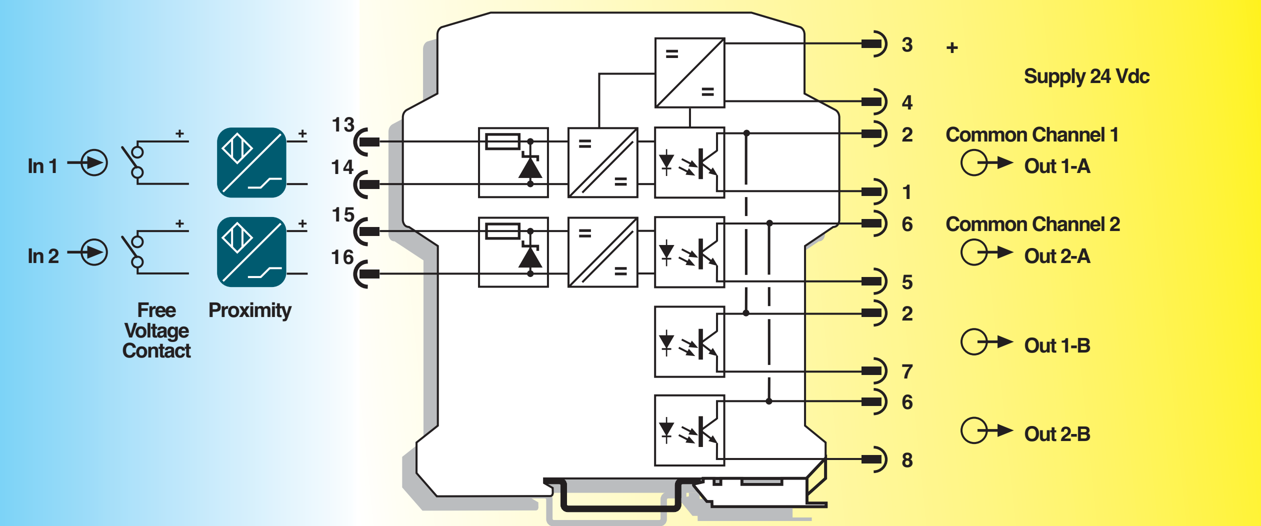
Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1033Q



MODEL D1033D



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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1034

SIL 2 / SIL 3 Contact/Proximity Detector Interface DIN-Rail Models D1034S, D1034D

Characteristics:

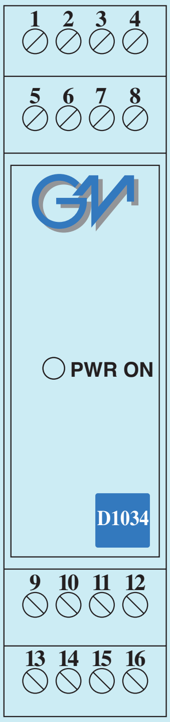
General Description:
D1034 is a single (D1034S) or double (D1034D) channel Intrinsically Safe interface with galvanic isolation, designed to interface contacts or proximity detectors maintaining a high level of loop integrity (safety integrity level SIL 2 according to EN61508). Field loop integrity and status (line plus contact or proximitor) are continuously and directly monitored, in transparent mode, into the PLC, ESD, DCS using their existing input line, without requiring an additional channel for failure detection. This solution results in 100% input channel saving with evident space cost and failure risk benefits.

Function:
1 or 2 totally independent and isolated channels I.S. for contact or EN60947-5-6 Proximity switches. Provides 3 port isolation (input/output/supply).

Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- SIL 2 / SIL 3 according to IEC 61508, IEC 61511.
- Contact/Proximity Detector Input.
- Two independent Output Signals.
- Short and open circuit fault detection.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, FM & FM-C, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
12-24 V nom (10 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 60 mA for 2 channels D1034D, 35 mA for 1 channel D1034S.
Current consumption @ 12 V: 130 mA for 2 channels D1034D, 80 mA for 1 channel D1034S.
Max. power consumption: 1.90 W for 2 channels, 1.20 W for 1 channel with 30 V supply voltage and short circuit input.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; Out/Supply 500 V, Out/Out 500 V.

Input:
Current levels: ≥ 0.1 mA, ≤ 7.0 mA
Input equivalent source: 8 V 1 KΩ typical (8 V no load 8 mA short circuit).

Output:
Repeats input current level.
Response time: 5 ms (10 to 90 % step change).

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC, I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 9.6 V, Io/Isc = 11 mA, Po/Po = 25 mW at terminals 14-15, 10-11.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020. UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, FM & FM-C No. 3024643, 3024643C, conforms to Class 3600, 3610, 3611, 3810 and C22.2 No.142, C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM03/07-24 R001, SIL 2 / SIL 3 according to IEC 61508, IEC 61511. Please refer to Functional Safety Manual for SIL applications.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 140 g D1034D, 130 g D1034S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

Model:	D1034	
1 channel	S	
2 channels	D	
Power Bus enclosure		/B

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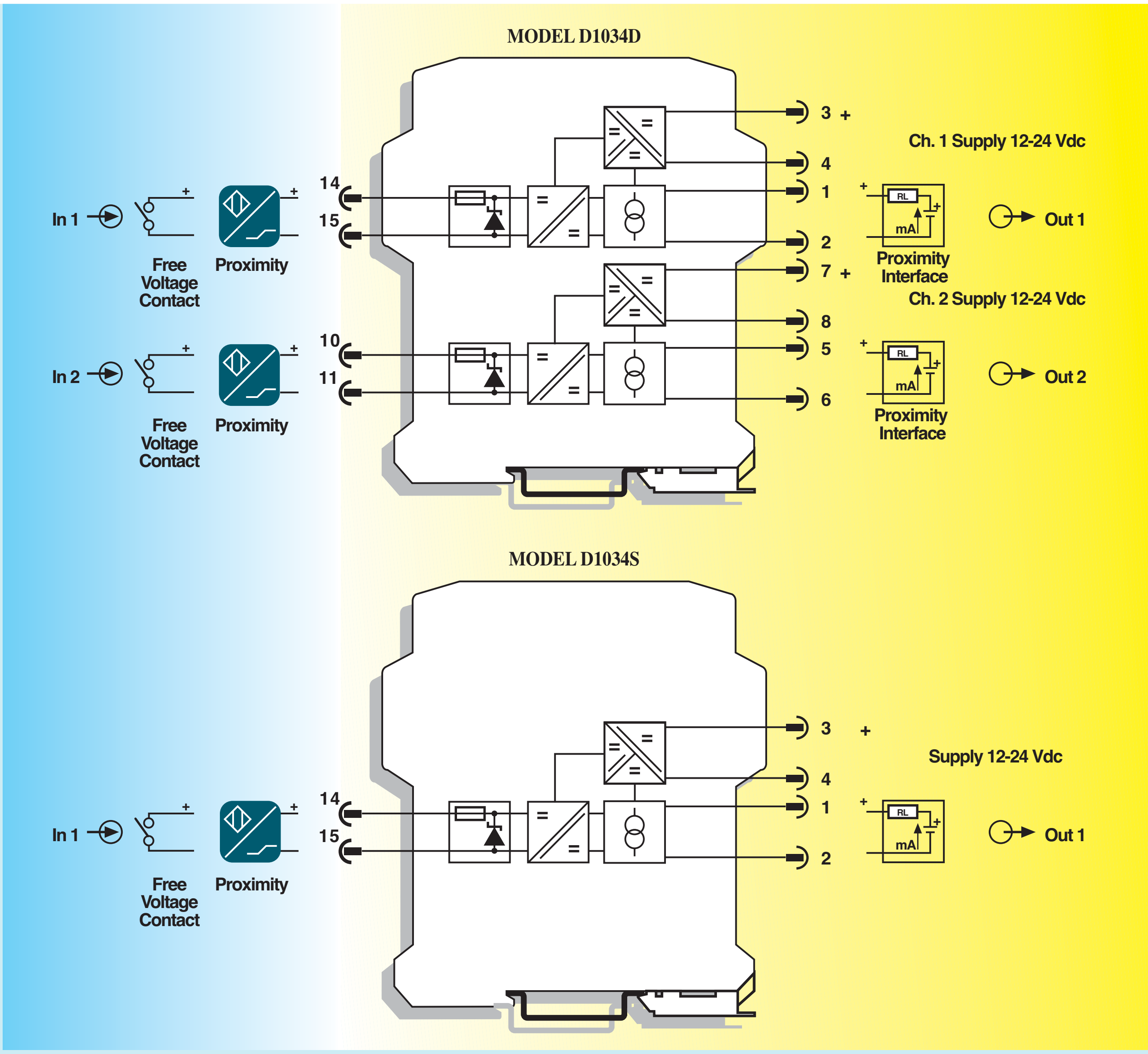
Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 14-15, 10-11				
Uo/Voc = 9.6 V	II C	3.60	263	1448
Io/Isc = 11 mA	II B	26.00	1345	5790
Po/Po = 25 mW	II A	210.00	2690	11580

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



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GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1035

Frequency-Pulse Isolating Repeater DIN-Rail Model D1035S

Characteristics:

General Description:
The single channel DIN-Rail Frequency-Pulse repeater D1035S repeats a low level frequency signal from magnetic pick-up or proximity, located in Hazardous Area, into pulse signal to drive a Safe Area load.

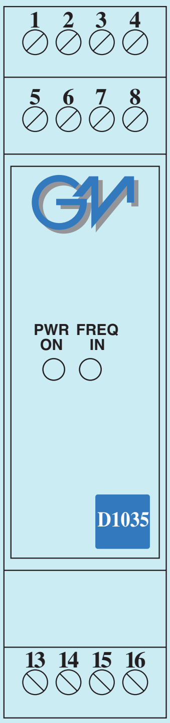
Function:
1 channel I.S. input from frequency-pulse signals, provides 3 port isolation (input/output/supply). Repeats the frequency input and provides one SPST transistor.

Signalling LEDs:
Power supply indication (green), Frequency input (yellow).

Configurability:
DIP-Switch configurable for hardware setting of input sensor.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- Magnetic Pick-up or proximity input sensor.
- Frequency range DC to 50 KHz input.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX Certifications.
- High Reliability, SMD components.
- High Density.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 12-24 V nom (10 to 30 V) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 45 mA transistors output energized.
Current consumption @ 12 V: 80 mA transistors output energized.
Max. power consumption: 1.6 W with 30 V supply voltage, overload condition, transistors energized.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; Digital Out/Supply 500 V.

Input: magnetic pick-up or proximity to EN60947-5-6, for frequency signal up to 50 KHz.
Input range: 0 to 50 KHz maximum.

Repeater Output: Voltage free SPST optocoupled open-collector transistor.
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 1.5 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.
Frequency response: 50 KHz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35°C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 10.6 V, Io/Isc = 1.1 mA,
Po/Po = 3 mW at term. 13-16.
Uo/Voc = 11.6 V, Io/Isc = 12 mA,
Po/Po = 34 mW at 14-15.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: ATEX applied for, conforms to EN50014, EN50020.

Mounting: T35 DIN Rail according to EN50022.
Weight: about 120 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

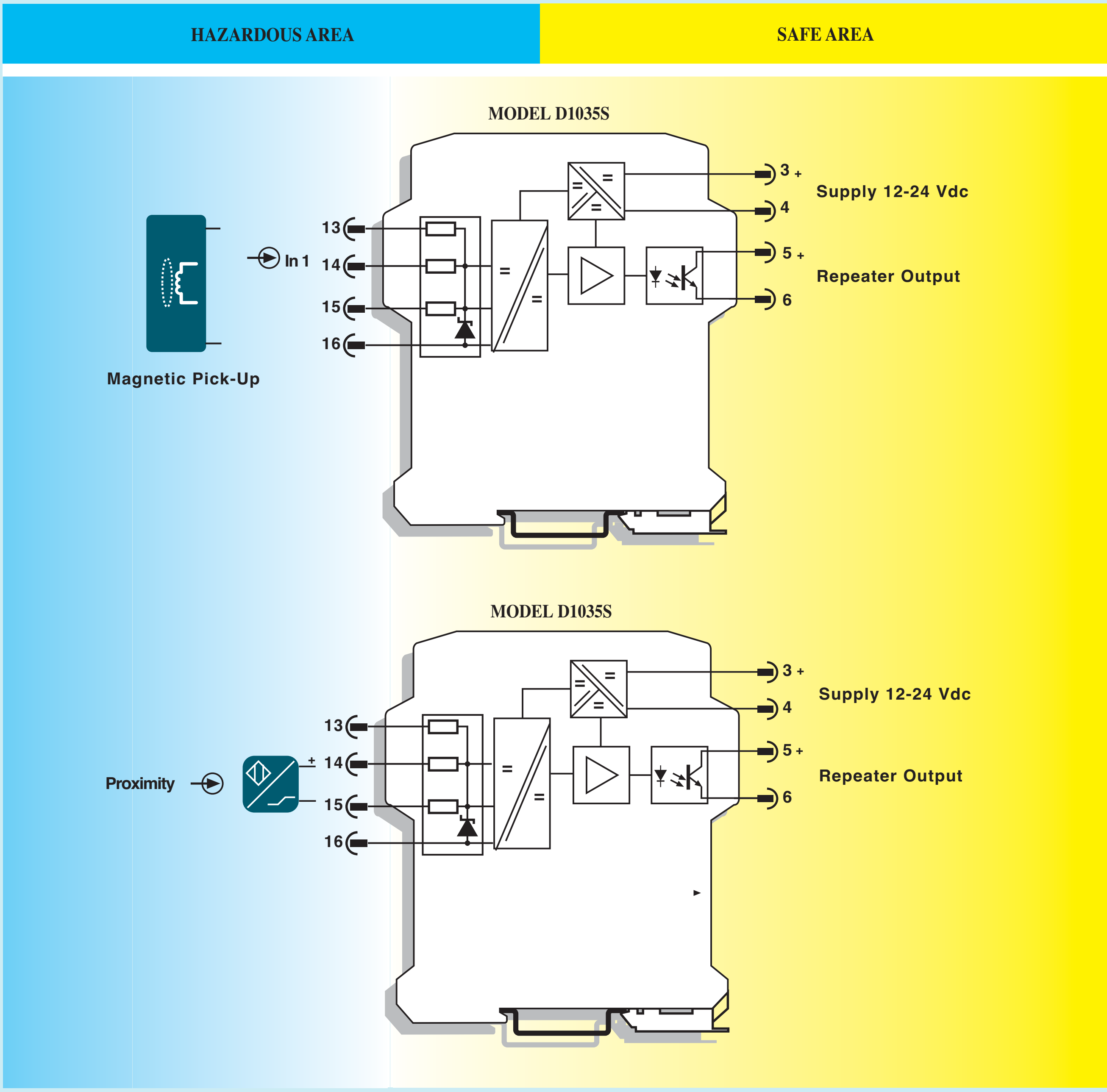
Ordering Information:

Model:	**D1035S**	
Power Bus enclosure		/B

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	L/R / La/Ra (μH/Ω)
Terminals 13-16				
Uo/Voc = 10.6 V	II C	2.32	31000	12600
Io/Isc = 1.1 mA	II B	16.20	124000	50400
Po/Po = 3 mW	II A	72.00	248000	100800
Terminals 14-15				
Uo/Voc = 11.6 V	II C	1.59	255	512
Io/Isc = 12 mA	II B	10.80	1023	2040
Po/Po = 34 mW	II A	43.00	2046	4090

Function Diagram:



G.M. International DTS0194-0 Page 2/2 PRELIMINARY INFORMATION

GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D104*

SIL2/SIL3 Digital Out Loop/Bus Powered to drive Solenoid/LED/Horn DIN-Rail Models D1040Q, D1041Q, D1042Q, D1043Q

Characteristics:

General Description:
The D104* series are quad channel Din Rail Digital Output Modules enabling a Safe Area contact, logic level or drive signal, to control a device in Hazardous Area, providing 3 port isolation (input/output/supply).
Typical application includes driving signalling LED s, Visual or Audible Alarms to alert a plant operator or driving a Solenoid Valve or other process control devices. It can also be used as a controllable supply to power measuring or process control equipments in Hazardous Area.
Output channels can be paralleled if more power is required. 2 channels in parallel are still suitable for Gas Group II C. Four basic models meet a large number of applications: it is possible to obtain 16 different combinations of Safety Parameters and Driving Currents.

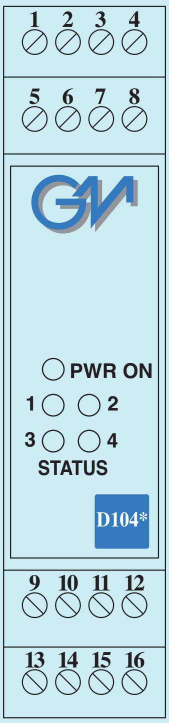
Function:
4 channels, actuated independently or in parallel to operate Hazardous Area Loads from contacts or logic levels or drive logics in Safe Area providing 3 port isolation (input/output/supply), Loop or Bus power.

Signalling LEDs:
Power supply indication (green), Output status (yellow).

Field Configurability:
Contact / logic levels inputs, Loop power operating mode, configurable by external wiring.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 2 according to IEC 61508, IEC 61511 when used in bus powered mode.

SIL 3 according to IEC 61508, IEC 61511 when used in loop powered mode.

Voltage input, common positive, common negative contacts, logic levels, loop powered or bus powered.

Flexible modular multi output capability.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Output short circuit proof and current limited.

ATEX, UL & C-UL, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, four channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (21.5 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 130 mA four channels energized with nominal load, 150 mA with short circuit output (90 mA type D1041Q).
Max. power consumption: 4.30 W (2.6 W type D1041Q) with 30 V supply voltage and short circuit output.

Isolation (Test Voltage):
I.S. Out/In 1.5 KV; I.S. Out/Supply 1.5 KV; In/Supply 500 V.

Input:
Voltage free, or common positive, or common negative contact, logic level, loop powered.
Trip voltage levels: OFF status ≤ 1.0 V, ON status ≥ 6.0 V.

Output:
D1040Q: 22 mA per channel at 13.2 V.
D1041Q: 10 mA per channel for LED driving.
D1042Q: 22 mA per channel at 14.5 V.
D1043Q: 22 mA per channel at 10.6 V.
Short circuit current: ≥ 24 mA per channel (26 mA typical)
≤ 15 mA for D1041Q (13 mA typical).
Response time: 20 ms.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 24.2 V, Io/Isc, Po/Po see safety parameters table for different models and connections.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM04/10-26 R001, SIL 2 - SIL 3 according to IEC 61508, IEC 61511. Please refer to functional safety manual for SIL applications.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 130 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

Model: D104*Q		
22 mA at 13.2 V (per channel)	0	
10 mA for LED driving (per channel)	1	
22 mA at 14.5 V (per channel)	2	
22 mA at 10.6 V (per channel)	3	
Power Bus enclosure		/B




D1040Q, D1041Q Parameters Table Single-Dual Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9-10, 11-12 13-14, 15-16	**(Quad channel: 1 + 1 + 1 + 1)**			
Uo/Voc = 24.2 V	II C	0.122	6.40	79.3
Io/Isc = 74.1 mA	II B	0.910	25.90	318.0
Po/Po = 448 mW	II A	3.270	51.80	634.7
Terminals 9/11-10/12 13/15-14/16	**(Dual channel: 2 parallel + 2 parallel)**			
Uo/Voc = 24.2 V	II C	0.122	1.61	39.6
Io/Isc = 148.2 mA	II B	0.910	6.40	158.6
Po/Po = 897 mW	II A	3.270	12.90	317.3

D1040Q, D1041Q Parameters Table Triple-Quad Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9/11/13-10/12/14	**(Dual channel: 3 parallel + 1)**			
Uo/Voc = 24.2 V				
Io/Isc = 222.3 mA	II B	0.910	2.80	105.8
Po/Po = 1346 mW	II A	3.270	5.70	211.5
Terminals 9/11/13/15-10/12/14/16	**(Single channel: 4 parallel)**			
Uo/Voc = 24.2 V				
Io/Isc = 296.4 mA	II B	0.910	1.61	79.3
Po/Po = 1793 mW	II A	3.270	3.20	158.6

D1042Q Parameters Table Single-Dual Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9-10, 11-12 13-14, 15-16	**(Quad channel: 1 + 1 + 1 + 1)**			
Uo/Voc = 24.2 V	II C	0.122	4.30	64.7
Io/Isc = 90.7 mA	II B	0.910	17.20	259.0
Po/Po = 549 mW	II A	3.270	34.50	518.0
Terminals 9/11-10/12 13/15-14/16	**(Dual channel: 2 parallel + 2 parallel)**			
Uo/Voc = 24.2 V				
Io/Isc = 181.4 mA	II B	0.910	4.32	129.5
Po/Po = 1098 mW	II A	3.270	8.64	259.0

D1042Q Parameters Table Triple-Quad Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9/11/13-10/12/14	**(Dual channel: 3 parallel + 1)**			
Uo/Voc = 24.2 V				
Io/Isc = 272.1 mA	II B	0.910	1.92	86.4
Po/Po = 1647 mW	II A	3.270	3.84	172.7
Terminals 9/11/13/15-10/12/14/16	**(Single channel: 4 parallel)**			
Uo/Voc = 24.2 V				
Io/Isc = 362.8 mA	II B	0.910	1.08	64.7
Po/Po = 2195 mW	II A	3.270	2.16	129.4

D1043Q Parameters Table Single-Dual Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9-10, 11-12 13-14, 15-16	**(Quad channel: 1 + 1 + 1 + 1)**			
Uo/Voc = 24.2 V	II C	0.122	12.00	108.0
Io/Isc = 54.4 mA	II B	0.910	48.00	432.0
Po/Po = 329 mW	II A	3.270	96.10	864.0
Terminals 9/11-10/12 13/15-14/16	**(Dual channel: 2 parallel + 2 parallel)**			
Uo/Voc = 24.2 V	II C	0.122	3.00	54.0
Io/Isc = 108.8 mA	II B	0.910	12.00	216.0
Po/Po = 659 mW	II A	3.270	24.00	432.1

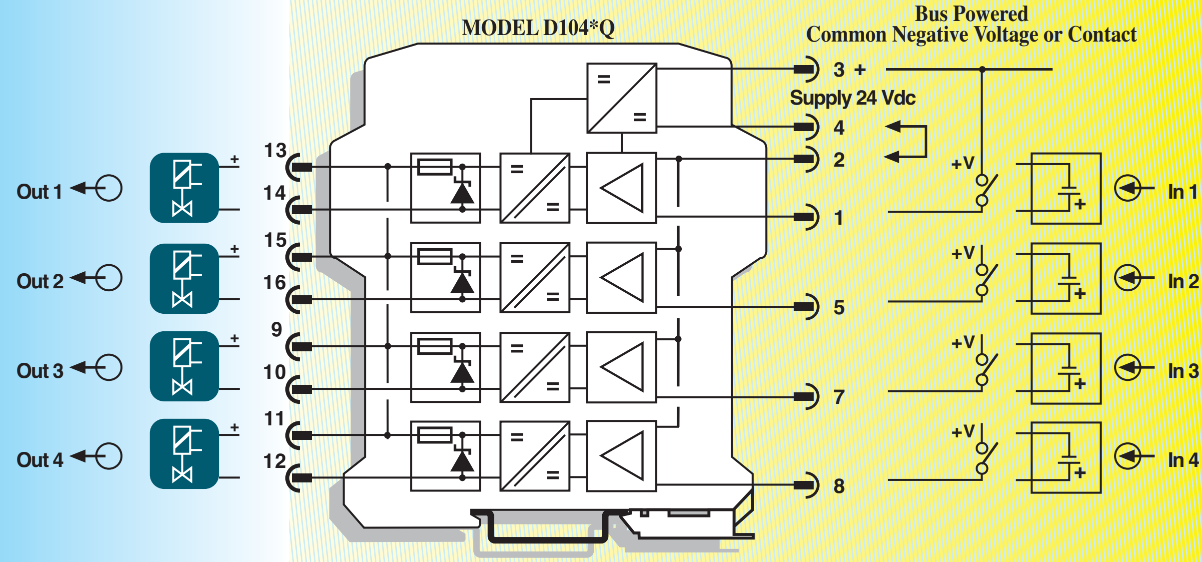
D1043Q Parameters Table Triple-Quad Output:

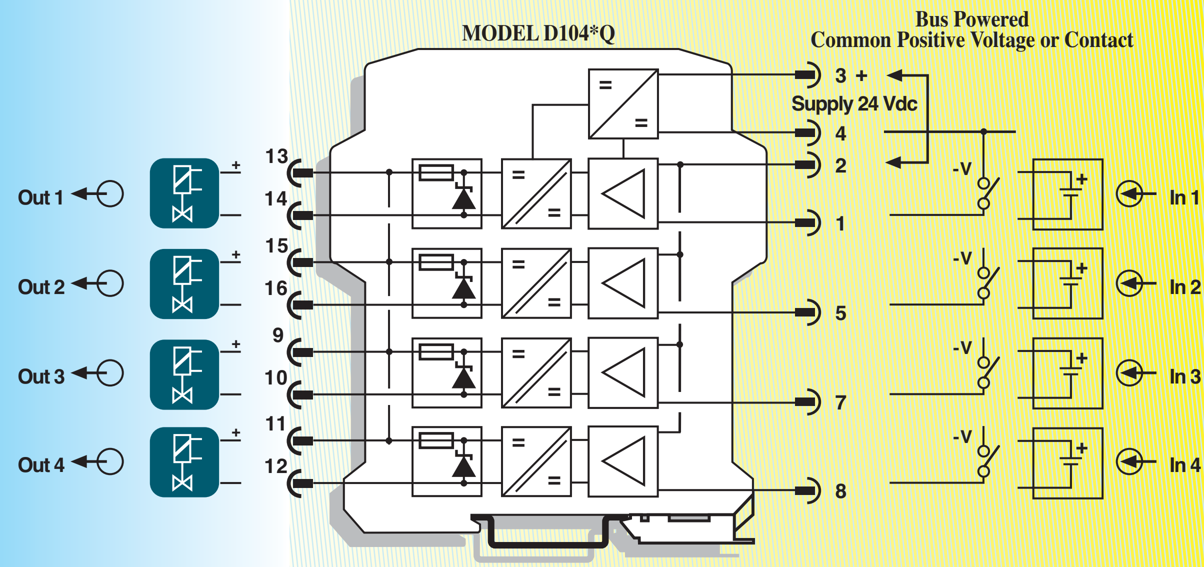
Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9/11/13-10/12/14	**(Dual channel: 3 parallel + 1)**			
Uo/Voc = 24.2 V	II C	0.122	1.33	36.0
Io/Isc = 163.2 mA	II B	0.910	5.33	144.0
Po/Po = 988 mW	II A	3.270	10.60	288.0
Terminals 9/11/13/15-10/12/14/16	**(Single channel: 4 parallel)**			
Uo/Voc = 24.2 V				
Io/Isc = 217.6 mA	II B	0.910	3.00	108.0
Po/Po = 1317 mW	II A	3.270	6.00	216.0

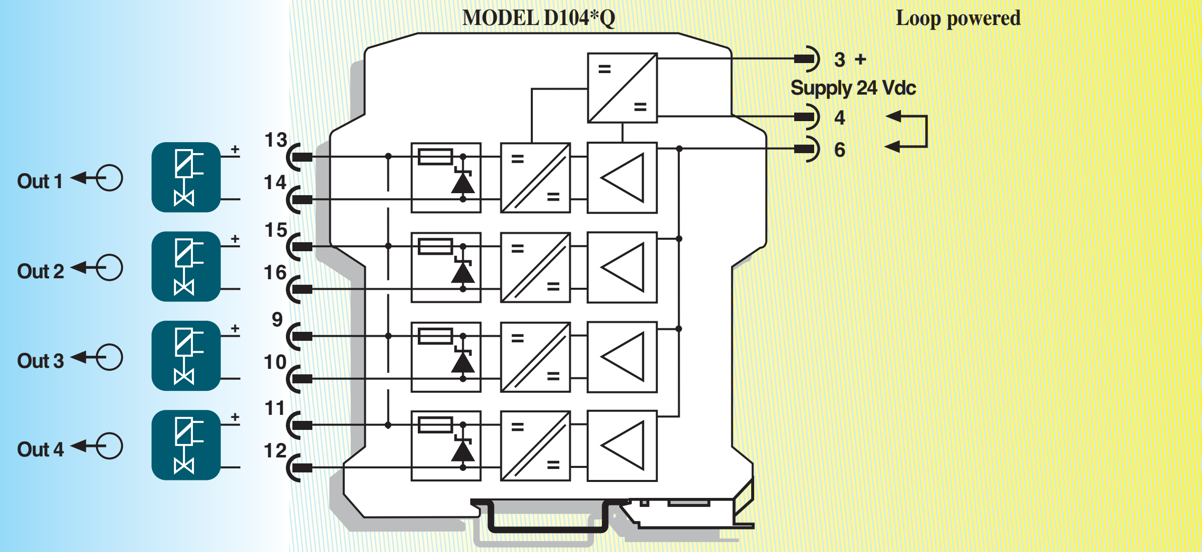
NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G. - II B equal to Gas Groups C, D, E, F and G. - II A equal to Gas Groups D, E, F and G.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

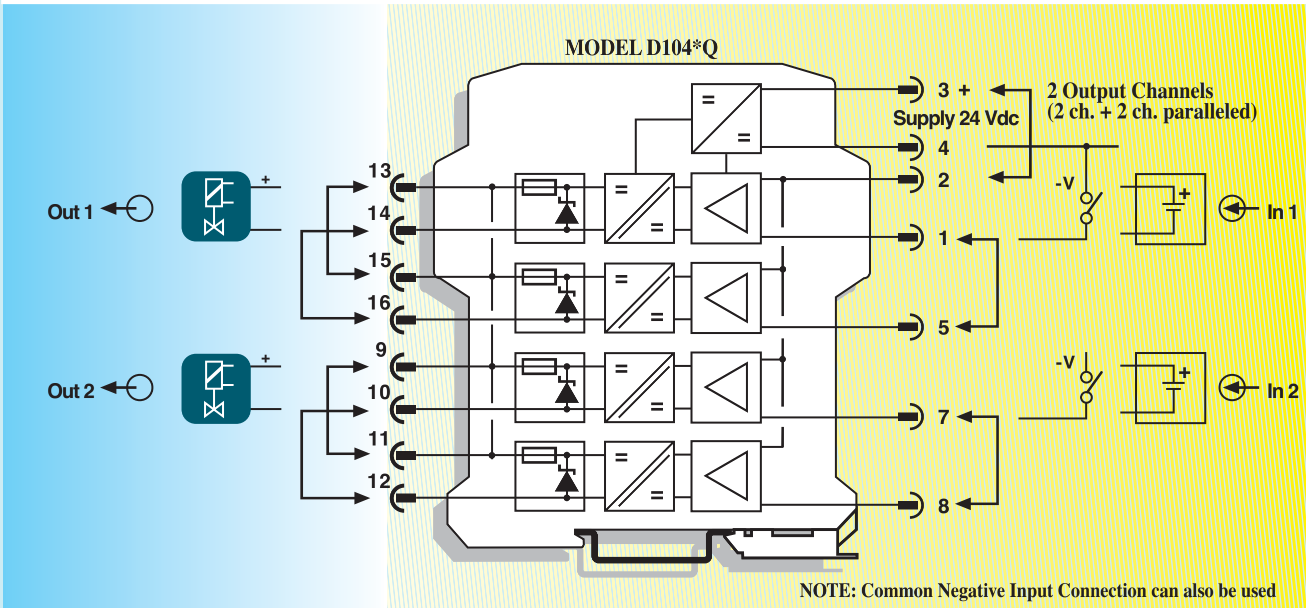


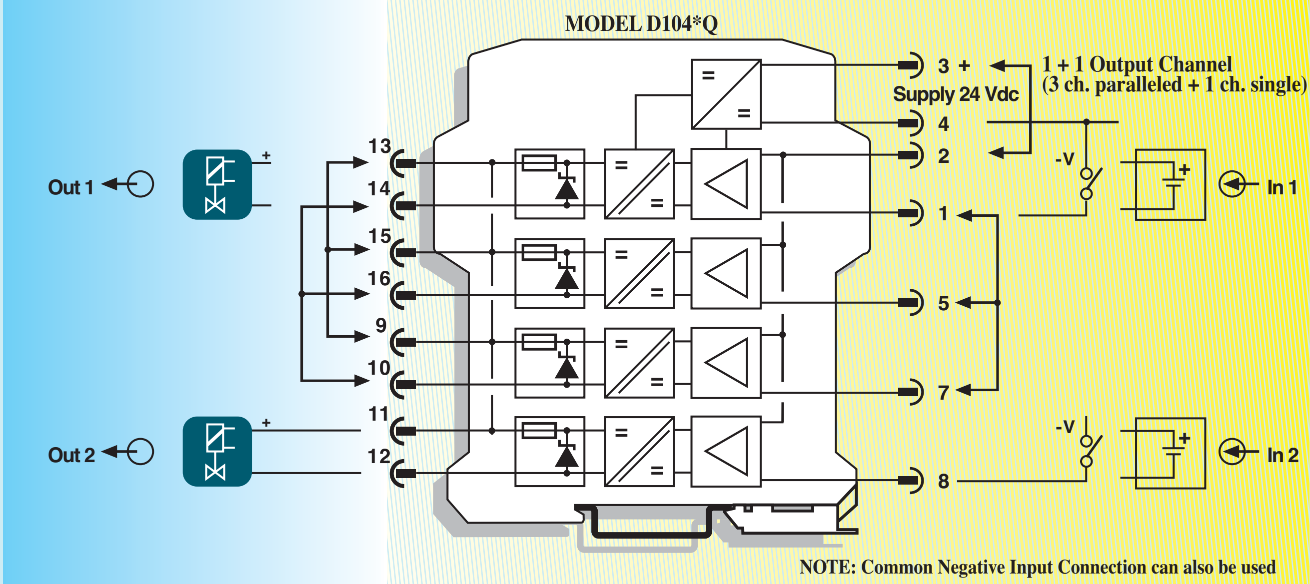


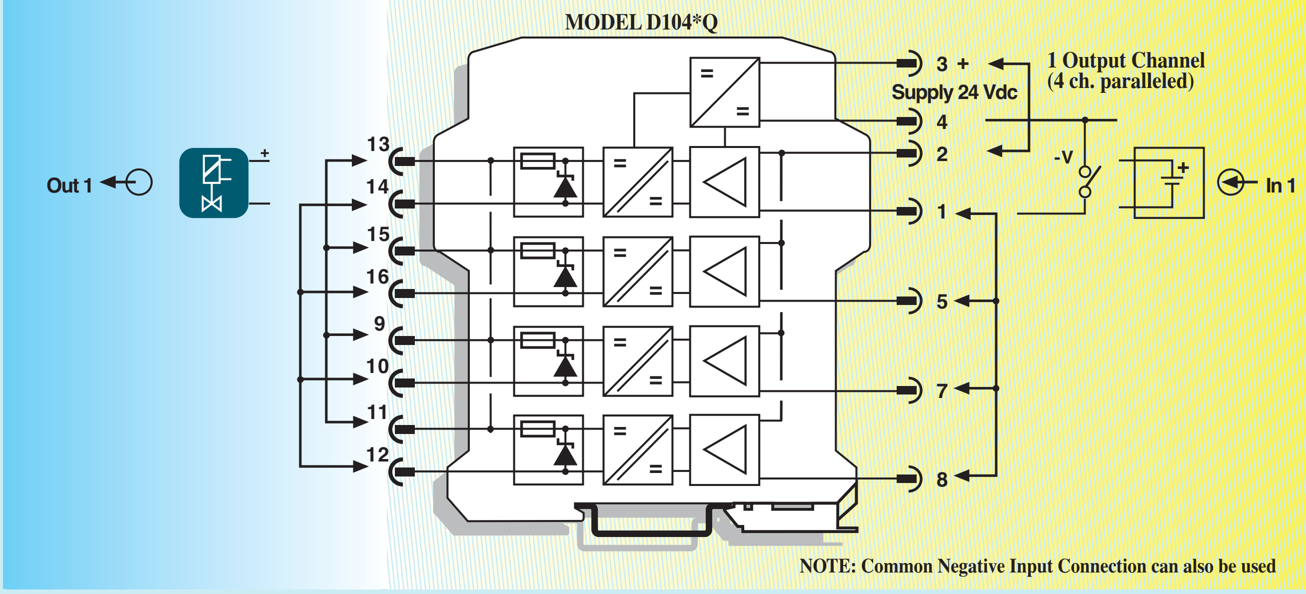


Function Diagram:

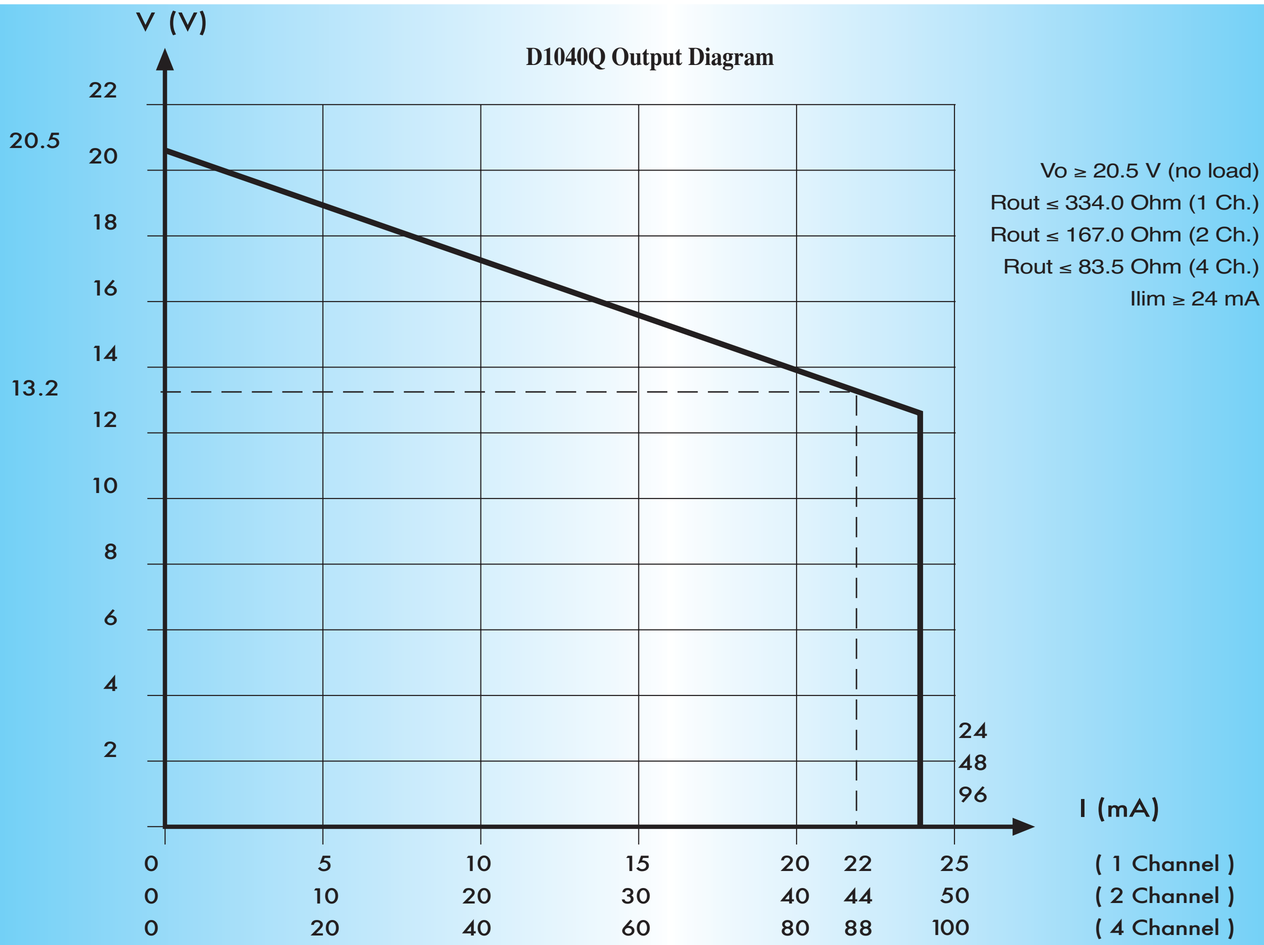
HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

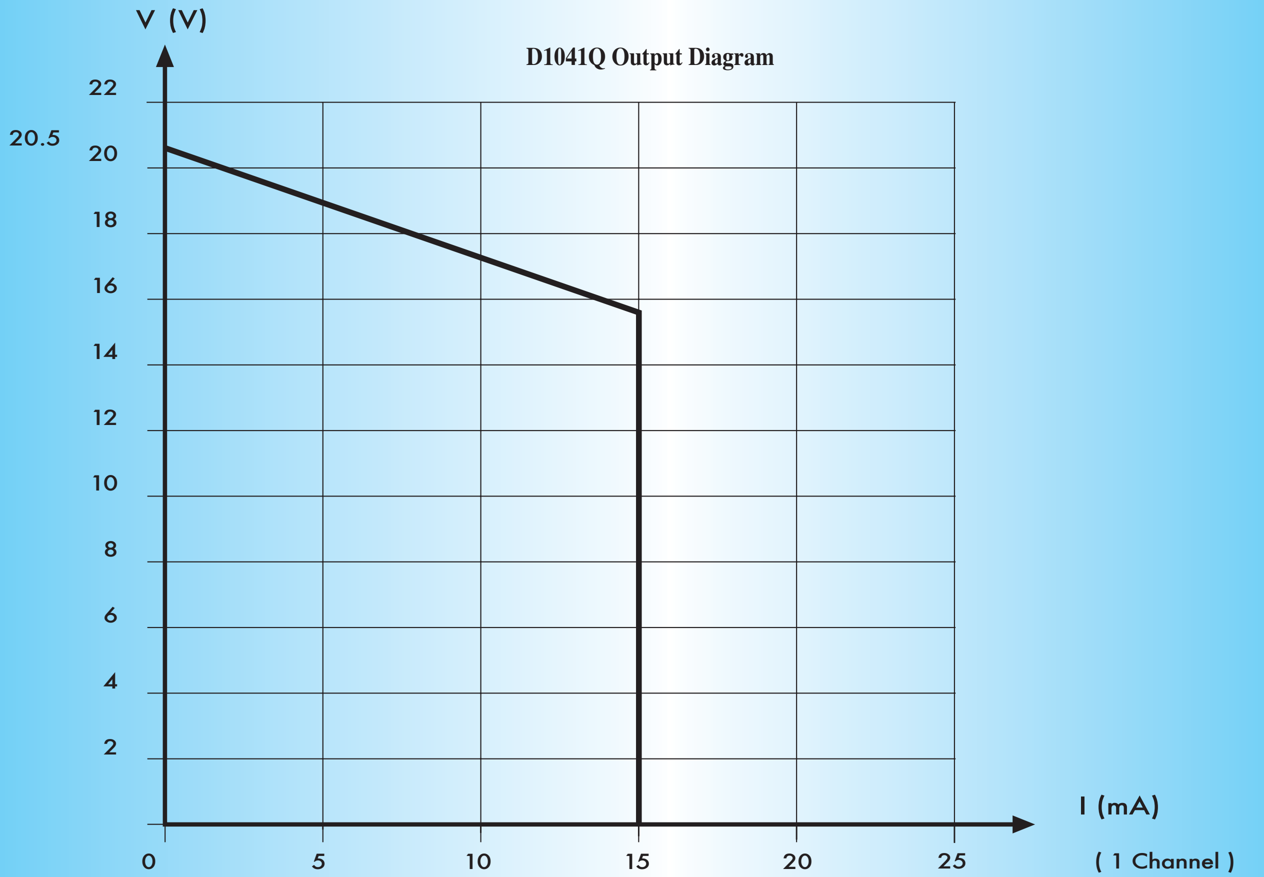






D1040Q - D1041Q OUTPUT DIAGRAM





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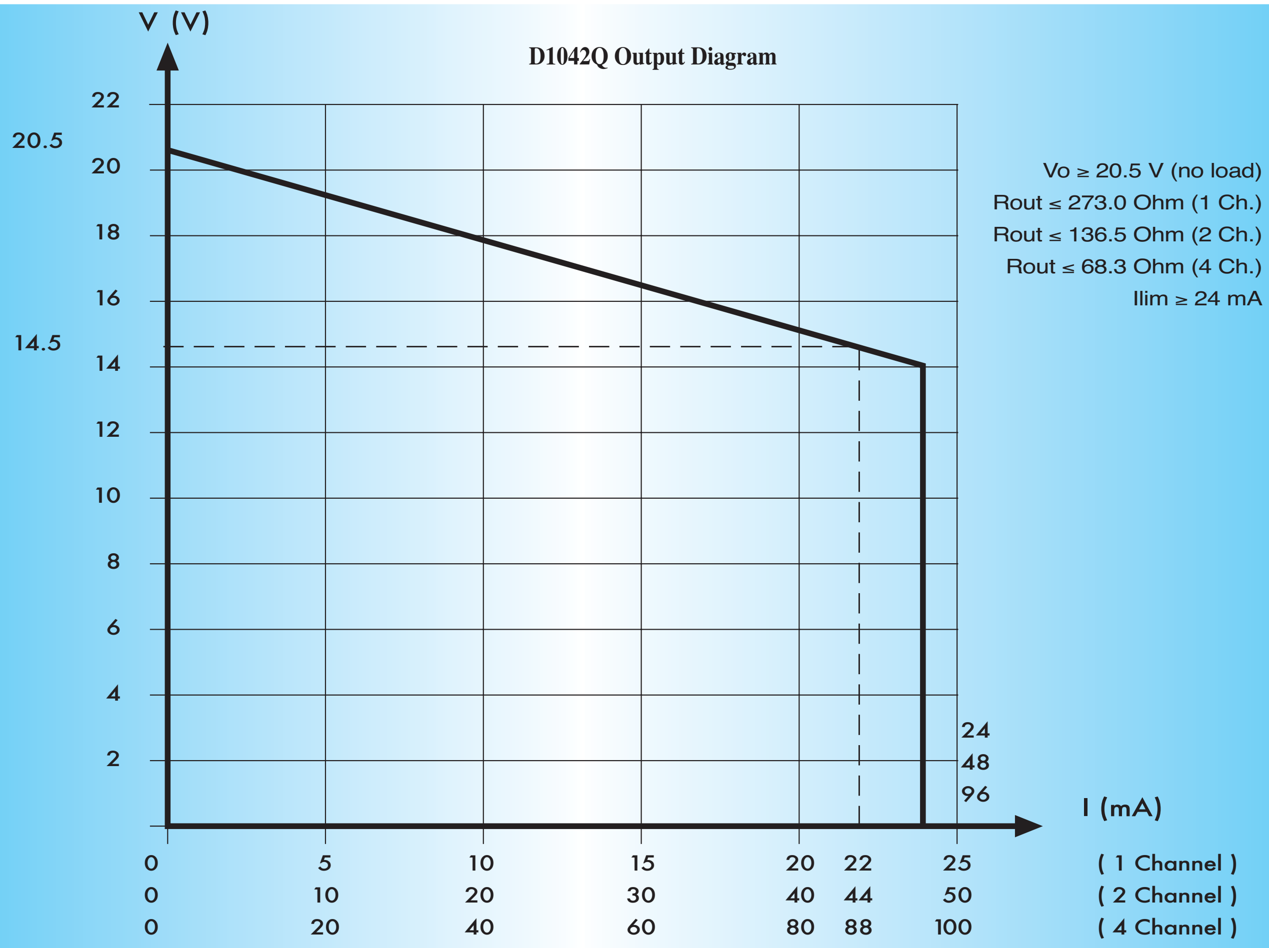
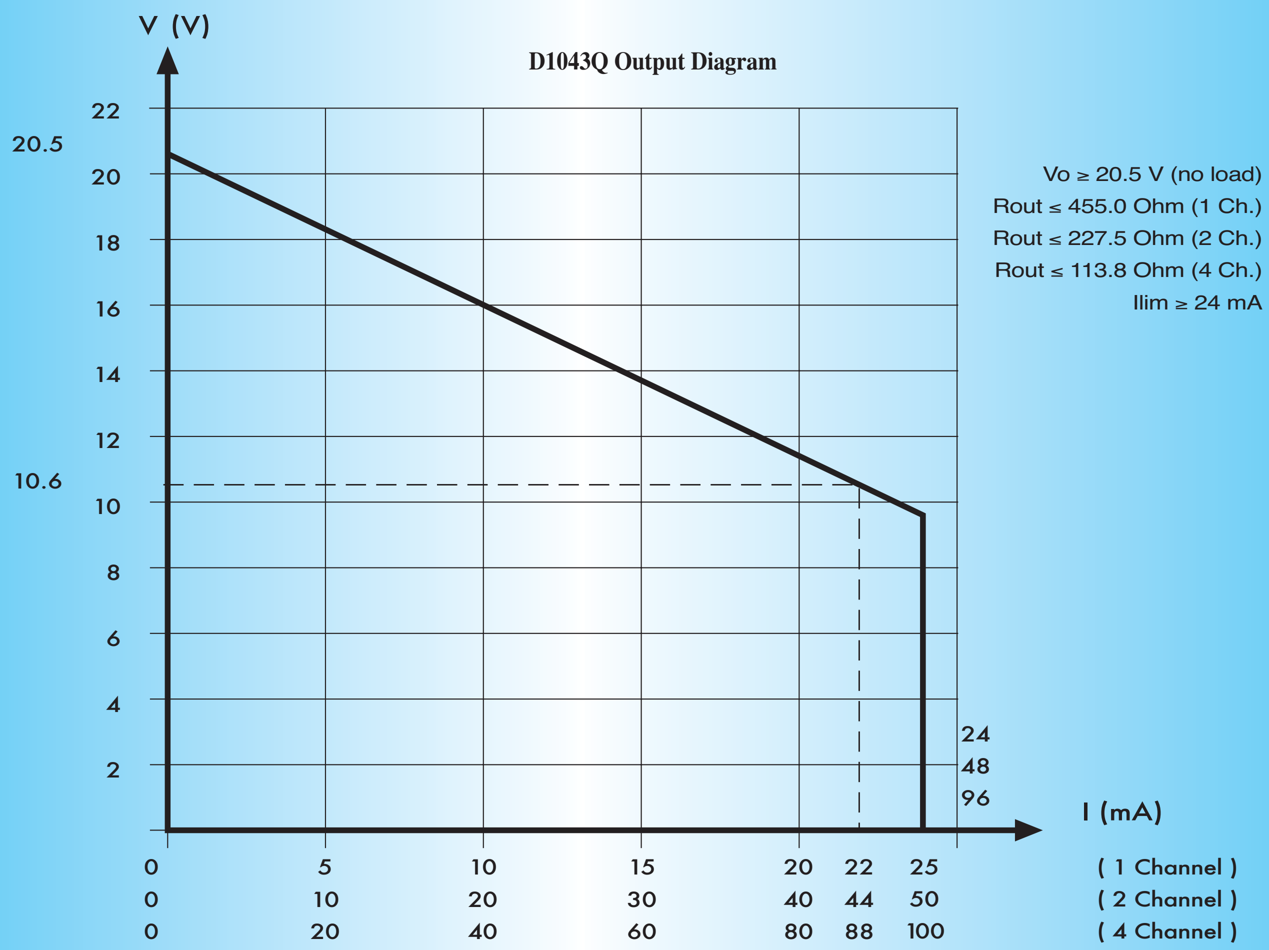
D1042Q - D1043Q OUTPUT DIAGRAM





GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D104*

Models Selection Using the PC Software Available on Web Site

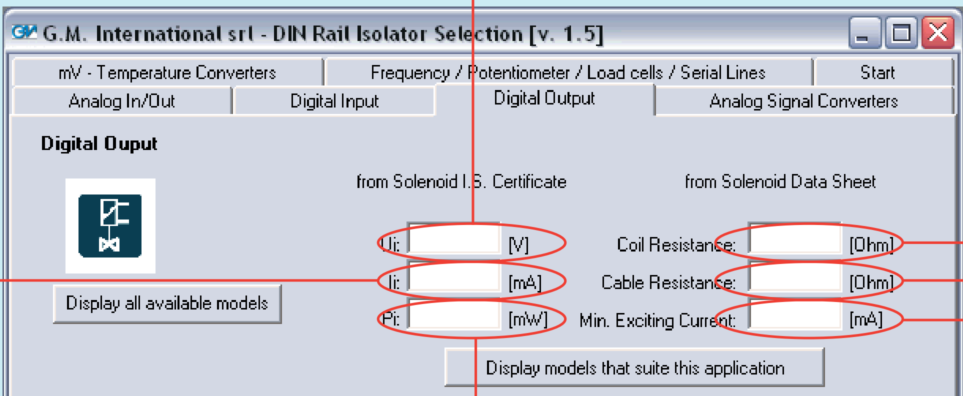
G.M. International presents a software for quick DIN Rail Isolator Selection of all D1000 Series available Models. The software is downloadable at www.gminternationalsrl.com

Specifically for Digital Output: inserting the solenoid I.S. parameters, available from the certificate, and the coil parameters available from the Data Sheet of the Unit, the software automatically selects the right Isolator Model. It is also possible to display all the available models.

Coil **Max. Open Voltage** V (Ui) from the I.S. Certificate.

Coil Resistance at ambient Temperature Ω.

Coil **Max. Short Circuit Current** mA (Ii) from the I.S. Certificate.



Model	Gas Group	Description	Max Power	Max Current	Resistance
D1040Q	IIC IIB IIA	4 separate channels	499 mW	74,1 mA	334 Ohm
D1040Q	IIC IIB IIC	2 + 2 channels in parallel	898 mW	148,2 mA	167 Ohm
D1040Q	IIB IIA	3 channels in parallel	1347 mW	222,3 mA	111 Ohm
D1040Q	IIB IIA	4 channels in parallel	1796 mW	296,4 mA	84 Ohm
D1040Q	IIB IIA	5 channels in parallel (2 units)	2242 mW	370,5 mA	67 Ohm
D1040Q	IIA	7 channels in parallel (2 units)	3139 mW	518,7 mA	48 Ohm
D1042Q	IIC IIB IIA	4 separate channels	563 mW	93 mA	273 Ohm
D1042Q	IIB IIA	2 + 2 channels in parallel	1126 mW	186 mA	137 Ohm
D1042Q	IIB IIA	3 channels in parallel	1689 mW	279 mA	91 Ohm
D1042Q	IIB IIA	4 channels in parallel	2252 mW	372 mA	68 Ohm
D1042Q	IIB IIA	6 channels in parallel (2 units)	3376 mW	558 mA	46 Ohm
D1043Q	IIC IIB IIA	4 separate channels	333 mW	55 mA	455 Ohm
D1043Q	IIC IIB IIA	2 + 2 channels in parallel	666 mW	110 mA	227 Ohm
D1043Q	IIC IIB IIA	3 channels in parallel	999 mW	165 mA	152 Ohm
D1043Q	IIB IIA	4 channels in parallel	1332 mW	220 mA	114 Ohm
D1043Q	IIB IIA	7 channels in parallel (2 units)	2330 mW	385 mA	65 Ohm
D1043Q	IIA	10 channels in parallel (3 units)	3328 mW	550 mA	46 Ohm

Cable Resistance Ω.

Coil **Max. Power** mW (Po) allowed by the I.S. Certificate.

Coil **Minimum Exciting Current** mA.

GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D104*

List of Available Models

	Model	Gas Group	Description	Max Power mW (Po)	Max Current mA (Io)	Barrier Resistance Ω	Supply	SIL Level
Solenoid Driver	D1040Q	IIC IIB IIA	4 separate channels	448 mW	74.1 mA	334 Ω	Bus 20-30 V	2
	D1040Q	IIC IIB IIA	2 + 2 channels in parallel	897 mW	148.2 mA	167 Ω	Bus 20-30 V	2
	D1040Q	IIB IIA	3 channels in parallel	1346 mW	222.3 mA	111 Ω	Bus 20-30 V	2
	D1040Q	IIB IIA	4 channels in parallel	1793 mW	296.4 mA	84 Ω	Bus 20-30 V	2
	D1040Q	IIB IIA	5 channels in parallel (2 units)	2240 mW	370.5 mA	67 Ω	Bus 20-30 V	2
	D1040Q	IIA	7 channels in parallel (2 units)	3136 mW	518.7 mA	48 Ω	Bus 20-30 V	2
	D1040Q	IIC IIB IIA	1 channel	448 mW	74.1 mA	334 Ω	Loop Powered	3
	D1040Q	IIC IIB IIA	2 channels in parallel	897 mW	148.2 mA	167 Ω	Loop Powered	3
	D1040Q	IIB IIA	3 channels in parallel	1346 mW	222.3 mA	111 Ω	Loop Powered	3
	D1040Q	IIB IIA	4 channels in parallel	1793 mW	296.4 mA	84 Ω	Loop Powered	3
	D1040Q	IIB IIA	5 channels in parallel (2 units)	2240 mW	370.5 mA	67 Ω	Loop Powered	3
	D1040Q	IIA	7 channels in parallel (2 units)	3136 mW	518.7 mA	48 Ω	Loop Powered	3
LED Driver	D1041Q	IIC IIB IIA	4 separate channels	448 mW	74.1 mA	334 Ω	Bus 20-30 V	2
	D1041Q	IIC IIB IIA	1 channel	448 mW	74.1 mA	334 Ω	Loop Powered	3
Solenoid Driver	D1042Q	IIC IIB IIA	4 separate channels	549 mW	90.7 mA	273 Ω	Bus 20-30 V	2
	D1042Q	IIB IIA	2 + 2 channels in parallel	1098 mW	181.4 mA	137 Ω	Bus 20-30 V	2
	D1042Q	IIB IIA	3 channels in parallel	1647 mW	272.1 mA	91 Ω	Bus 20-30 V	2
	D1042Q	IIB IIA	4 channels in parallel	2195 mW	362.8 mA	68 Ω	Bus 20-30 V	2
	D1042Q	IIB IIA	6 channels in parallel (2 units)	3294 mW	544.2 mA	46 Ω	Bus 20-30 V	2
	D1042Q	IIC IIB IIA	1 channel	549 mW	90.7 mA	273 Ω	Loop Powered	3
	D1042Q	IIB IIA	2 channels in parallel	1098 mW	181.4 mA	137 Ω	Loop Powered	3
	D1042Q	IIB IIA	3 channels in parallel	1647 mW	272.1 mA	91 Ω	Loop Powered	3
	D1042Q	IIB IIA	4 channels in parallel	2195 mW	362.8 mA	68 Ω	Loop Powered	3
	D1042Q	IIB IIA	6 channels in parallel (2 units)	3294 mW	544.2 mA	46 Ω	Loop Powered	3
Solenoid Driver	D1043Q	IIC IIB IIA	4 separate channels	329 mW	54.4 mA	455 Ω	Bus 20-30 V	2
	D1043Q	IIC IIB IIA	2 + 2 channels in parallel	659 mW	108.8 mA	227 Ω	Bus 20-30 V	2
	D1043Q	IIC IIB IIA	3 channels in parallel	988 mW	163.2 mA	152 Ω	Bus 20-30 V	2
	D1043Q	IIB IIA	4 channels in parallel	1317 mW	217.6 mA	114 Ω	Bus 20-30 V	2
	D1043Q	IIB IIA	7 channels in parallel (2 units)	2303 mW	380.8 mA	65 Ω	Bus 20-30 V	2
	D1043Q	IIA	10 channels in parallel (3 units)	3290 mW	544.0 mA	46 Ω	Bus 20-30 V	2
	D1043Q	IIC IIB IIA	1 channel	329 mW	54.4 mA	455 Ω	Loop Powered	3
	D1043Q	IIC IIB IIA	2 channels in parallel	659 mW	108.8 mA	227 Ω	Loop Powered	3
	D1043Q	IIC IIB IIA	3 channels in parallel	988 mW	163.2 mA	152 Ω	Loop Powered	3
	D1043Q	IIB IIA	4 channels in parallel	1317 mW	217.6 mA	114 Ω	Loop Powered	3
	D1043Q	IIB IIA	7 channels in parallel (2 units)	2303 mW	380.8 mA	65 Ω	Loop Powered	3
	D1043Q	IIA	10 channels in parallel (3 units)	3290 mW	544.0 mA	46 Ω	Loop Powered	3

NOTE: if two units are used on the same solenoid, the application is suitable only for Zone 1.

GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1052

Analog Signal Converter DIN-Rail Duplicator, Adder and Subtractor Models D1052S, D1052D, D1052X, D1052Y

Characteristics:

General Description:
The single and dual channel DIN-Rail Analog Signal Converter D1052S and D1052D converts a voltage or current input from externally powered transmitters, located in Hazardous Area, and repeats, with isolation, the signal to drive a Safe Area load. Output signal can be direct or reverse .
Duplicator type D1052X provides two independent outputs for the single input.
Adder and Subtractor type D1052Y provides two independent outputs representing Input A, Input B, Input A plus Input B, Input A minus Input B, low/high selector.

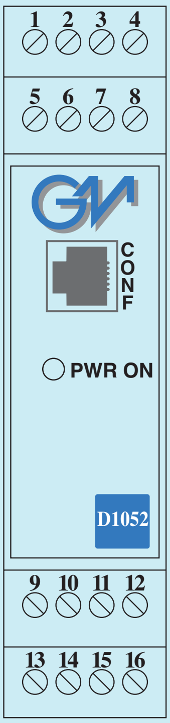
Function:
1 or 2 channels I.S. input from separately powered transmitters, provides 3 port isolation (input/output/supply) and current or voltage output signal. Duplicator type D1052X and adder, subtractor, low/high selector type D1052Y.

Signalling LED:
Power supply indication (green).

Configurability:
Totally Software configurable, no jumpers or switches, mA or V input/output signal, linear or reverse by a GM Pocket Portable Configurator PPC1090, powered by the unit or via RS-232 Serial line with PPC1092 Adapter and SWC1090 Configurator.
To operate PPC1090 refer to instruction manual.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- Duplicated output for single channel input (D1052X).
- Adder, Subtractor, low/high Selector (D1052Y).
- 0/4-20 mA, 0/1-5 V, 0/2-10 V Input-Output Signal Linear or Reverse.
- Software programmability.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 12-24 V nom (10 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 75 mA for 2 channels D1052D, 50 mA for 1 channel D1052S with 20 mA output typical.
Current consumption @ 12 V: 130 mA for 2 channels D1052D, 85 mA for 1 channel D1052S with 20 mA output typical.
Max. power consumption: 2.30 W for 2 channels, 1.50 W for 1 channel with 30 V supply voltage, overload condition and PPC1090 connected.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V; Out/Out 500 V; Out/Supply 500 V.

Input: 0/4 to 20 mA (-4 to +24 mA reading) separately powered input, voltage drop ≤ 0.5 V or 0/1 to 5 V or 0/2 to 10 V (-2 to +12 V reading).
Integration Time: 100 ms.
Resolution: 1 µA on current input, 1 µV on voltage input.
Visualization: 1 µA on current input, 1 µV on voltage input.
Input range: -4 to +24 mA on current input, -2 to +12 V on voltage input.

Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or highscale forcing.
Burnout range: low and high separated trip point value programmable between -5 to +25 mA on current input and -3 to +13 V on voltage input.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.
Resolution: 2 µA current output or 1 mV voltage output.
Transfer characteristic: linear or reverse.
Response time: 100 ms (10 to 90 % step change).
Output ripple: ≤ 20 mV rms on 250 Ω load.

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Input:
Calibration and linearity accuracy: ≤ ± 20 µA on current input or ≤ ± 10 mV on voltage input.
Temperature influence: ≤ ± 2 µA, 1 mV of input for a 1 °C change.
Analog Output:
Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 10.8 V, Io/Isc = 9 mA, Po/Po = 24 mW at terminals 14-15-16 and 10-11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

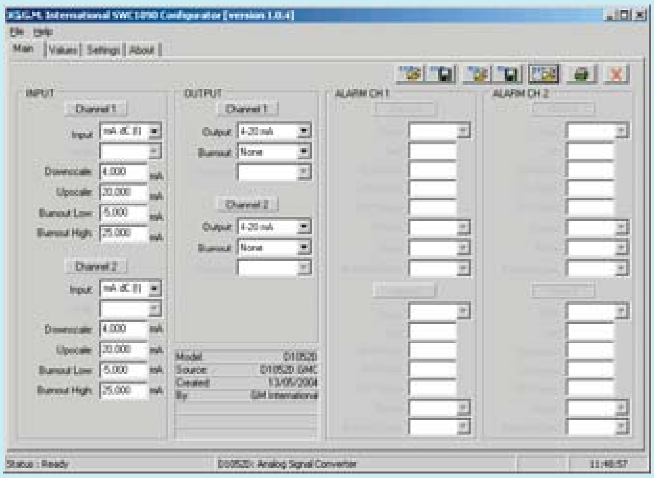
Mounting: T35 DIN Rail according to EN50022.
Weight: about 170 g D1052D, 140 g D1052S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 14-15-16, 10-11-12				
Uo/Voc = 10.8 V	II C	2.14	477	1530
Io/Isc = 9 mA	II B	15.00	1909	6130
Po/Po = 24 mW	II A	66.00	3819	12260

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Friendly Configuration with PC and PPC1092 Adapter



SWC1090 Software Configurator is downloadable for free on our web site www.gminternationalsrl.com.

Ordering Information:

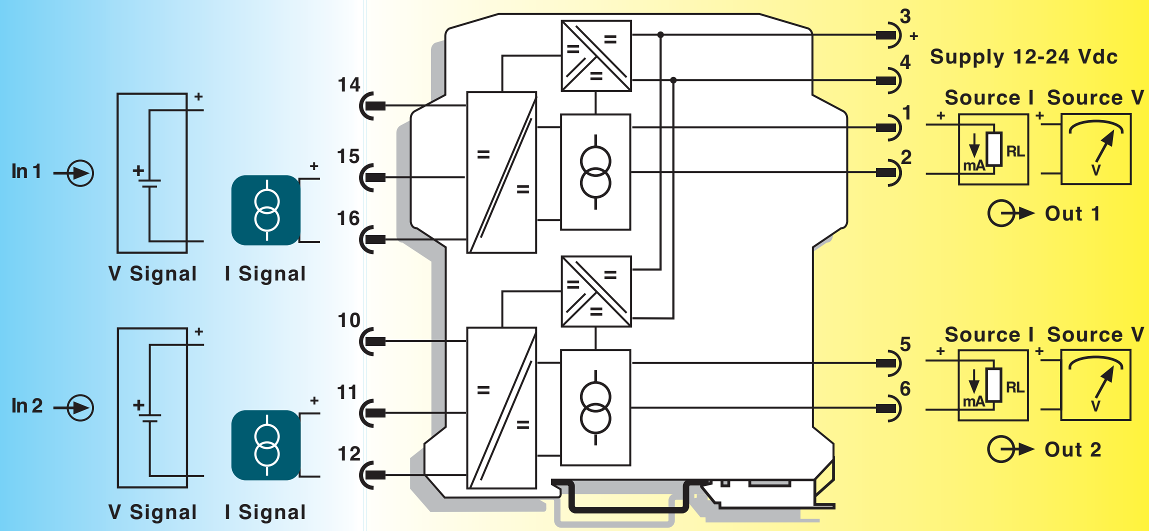
Model:	D1052		
1 channel	S		
2 channels	D		
1 input - 2 outputs (duplicator)	X		
2 inputs - 2 outputs (A, B, A+B, A-B)	Y		
Power Bus enclosure		/B	

Input types, output types, output range are programmable by the GM Pocket Portable Configurator type PPC1090 or via RS-232 Serial line with PPC1092 and SWC1090 Configurator. If the above information are provided with the Purchasing Order, the unit will be configured accordingly, otherwise the unit will be supplied by default, with the following parameters:
Input Type: 4-20 mA - Output Type: 4-20 mA.
The plate will record the unit type, serial number, function diagram and terminal block layout for connections.

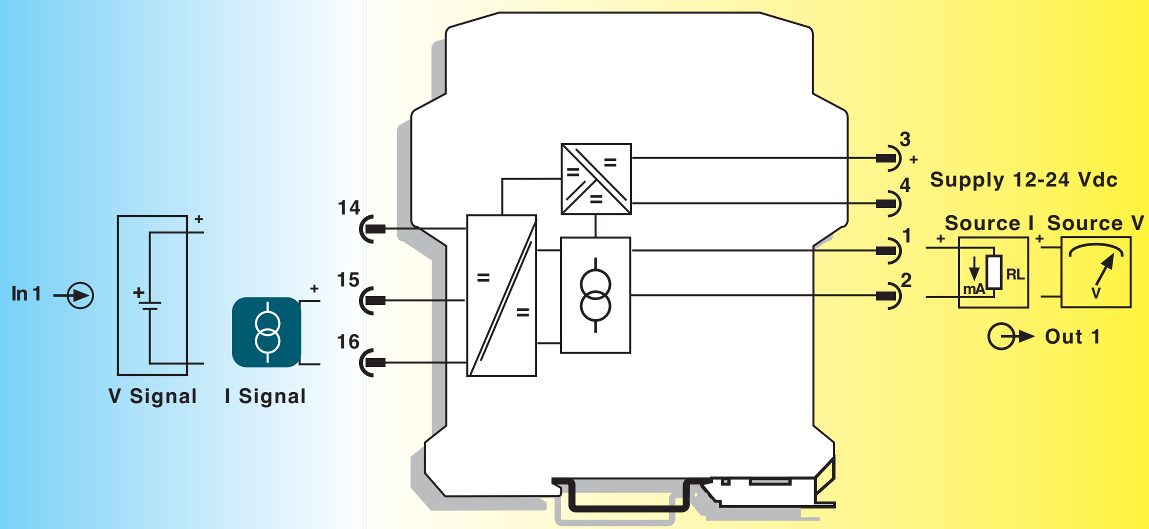
Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1052D

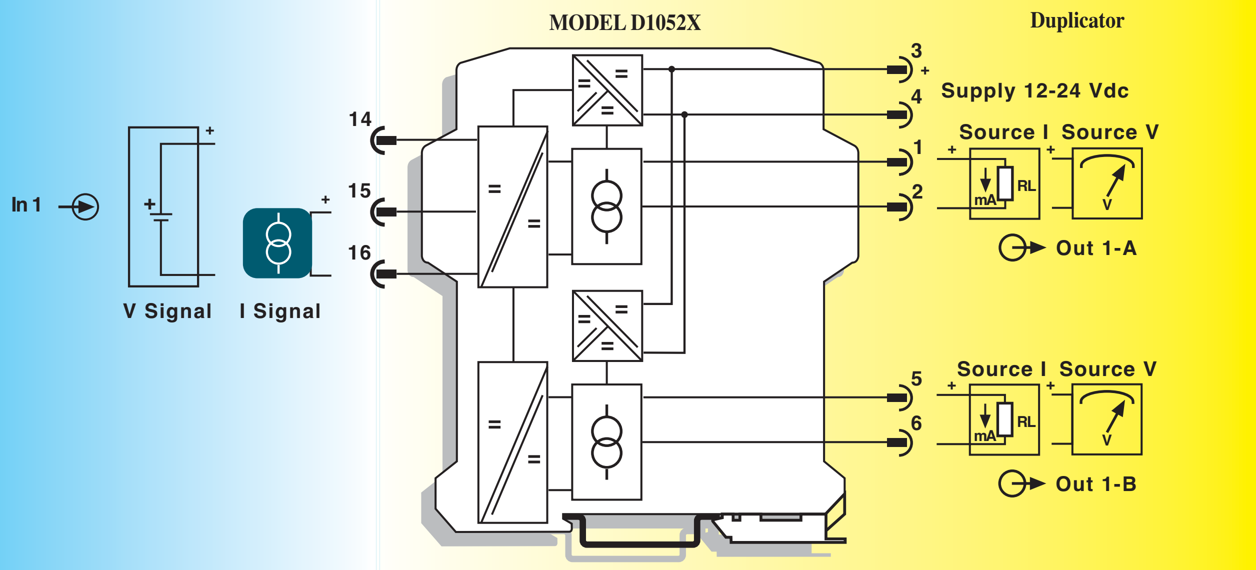


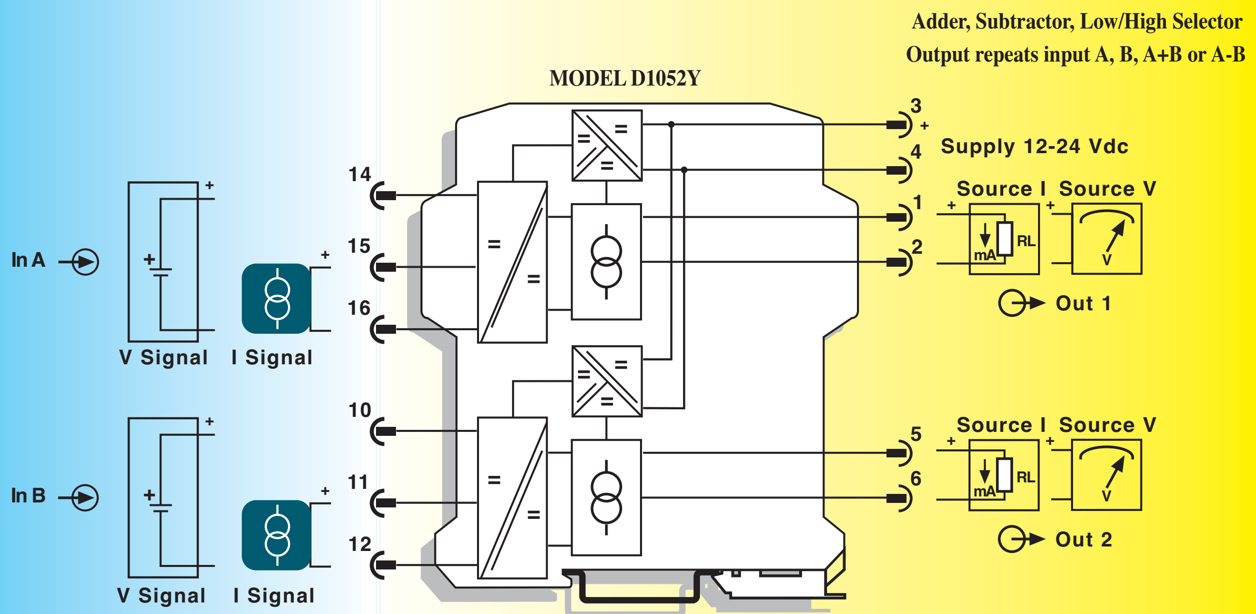
MODEL D1052S



Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4





GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1053

Analog Signal Converter and Trip Amplifiers DIN-Rail Model D1053S

Characteristics:

General Description:
The single channel DIN-Rail Converter and Trip Amplifier D1053S accepts a voltage or current input from externally powered transmitters, located in Hazardous Area, and repeats, with isolation, the signal to drive a Safe Area load. Output signal can be direct or reverse.
Two independent Alarm Trip Amplifiers are also provided. Each Alarm energizes, or de-energizes, an SPST Relay for High, Low, Low-startup or burnout Alarm functions. The two Alarm Relays Trip points are settable over the entire input signal range.

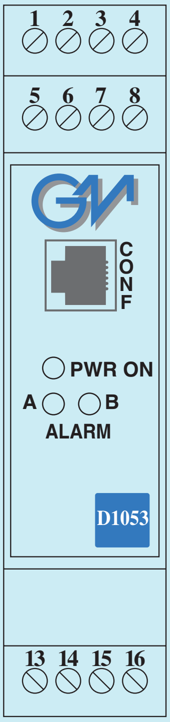
Function:
1 channel I.S. input from separately powered transmitters, provides 3 port isolation (input/output/supply) and current or voltage output signal. In addition it provides two SPST Relay Alarm contacts with adjustable Alarm Trip Point.

Signalling LEDs:
Power supply indication (green), Alarm A, Alarm B (red).

Configurability:
Totally Software configurable, no jumpers or switches, mA or V input/output signal, linear or reverse, Alarm Trip Point, High, Low, Low-startup or burnout Alarm mode, NE/ND relay operation, Hysteresis, Delay time, by a GM Pocket Portable Configurator PPC1090, powered by the unit or via RS-232 Serial line with PPC1092 Adapter and SWC1090 Configurator. To operate PPC1090 refer to instruction manual.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- 0/4-20 mA, 0/1-5 V, 0/2-10 V Input-Output Signal Linear or Reverse.
- Output for burnout detection.
- Software programmability.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, 1 channel 2 Trips per unit.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 65 mA with 20 mA output and relays energized.
Max. power consumption: 2.20 W with 30 V supply voltage, overload condition, relays energized and PPC1090 connected.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV;
Analog Out/Alarm Out 1500 V; Analog Out/Supply 500 V.
Alarm Out/Alarm Out 1500 V; Alarm Out/Supply 1500 V.

Input: 0/4 to 20 mA (-4 to +24 mA reading) separately powered input, voltage drop ≤ 0.5 V or 0/1 to 5 V or 0/2 to 10 V (-2 to +12 V reading).
Integration Time: 100 ms.
Resolution: 1 µA on current input, 1 µV on voltage input.
Visualization: 1 µA on current input, 1 µV on voltage input.
Input range: -4 to +24 mA on current input, -2 to +12 V on voltage input.

Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or highscale forcing.
Alarm can be programmed to detect burnout condition.
Burnout range: low and high separated trip point value programmable between -5 to +25 mA on current input and -3 to +13 V on voltage input.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.
Resolution: 2 µA current output or 1 mV voltage output.
Transfer characteristic: linear or reverse.
Response time: 100 ms (10 to 90 % step change).
Output ripple: ≤ 20 mV rms on 250 Ω load.

Alarm: *Trip Point range:* within rated limits of sensor (see input visualization parameters for step resolution).
Delay time: 0 to 1000 s, 100 ms step.
Hysteresis: 0 to 5 mA or 0 to 5 V. (see input visualization parameters for step resolution).
Output: Voltage free 1 + 1 SPST relay contact.
Contact rating: 2 A, 250 V, 100 VA or 2 A, 250 V, 80 W (resistive load).

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Input: Calibration and linearity accuracy: ≤ ± 20 µA on current input or ≤ ± 10 mV on voltage input.
Temperature influence: ≤ ± 2 µA, 1 mV of input for a 1 °C change.
Analog Output: Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: *Operating:* Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 10.8 V, Io/Isc = 9 mA, Po/Po = 24 mW at terminals 14-15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
c UL us ***Approvals:*** DMT 01 ATEX E 042 X conforms to EN50014, EN50020,UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1) for C-UL, TCCExEE (Russia) Nr. 665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr. 665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

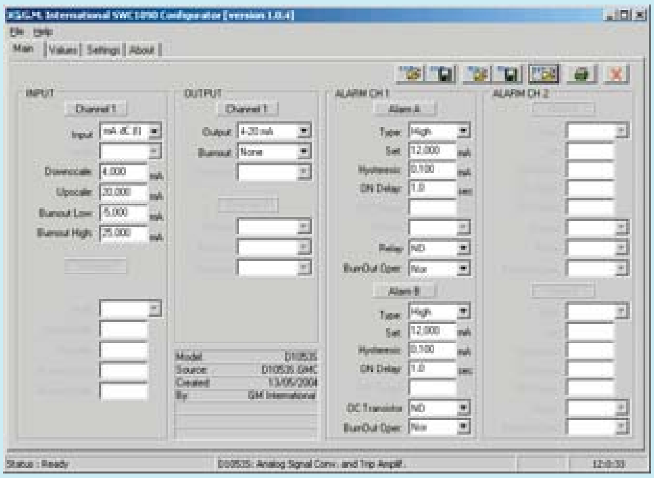
Mounting: T35 DIN Rail according to EN50022.
Weight: about 160 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 14-15-16				
Uo/Voc = 10.8 V	II C	2.14	477	1530
Io/Isc = 9 mA	II B	15.00	1909	6130
Po/Po = 24 mW	II A	66.00	3819	12260

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Friendly Configuration with PC and PPC1092 Adapter



SWC1090 Software Configurator is downloadable for free on our web site www.gminternationalsrl.com.

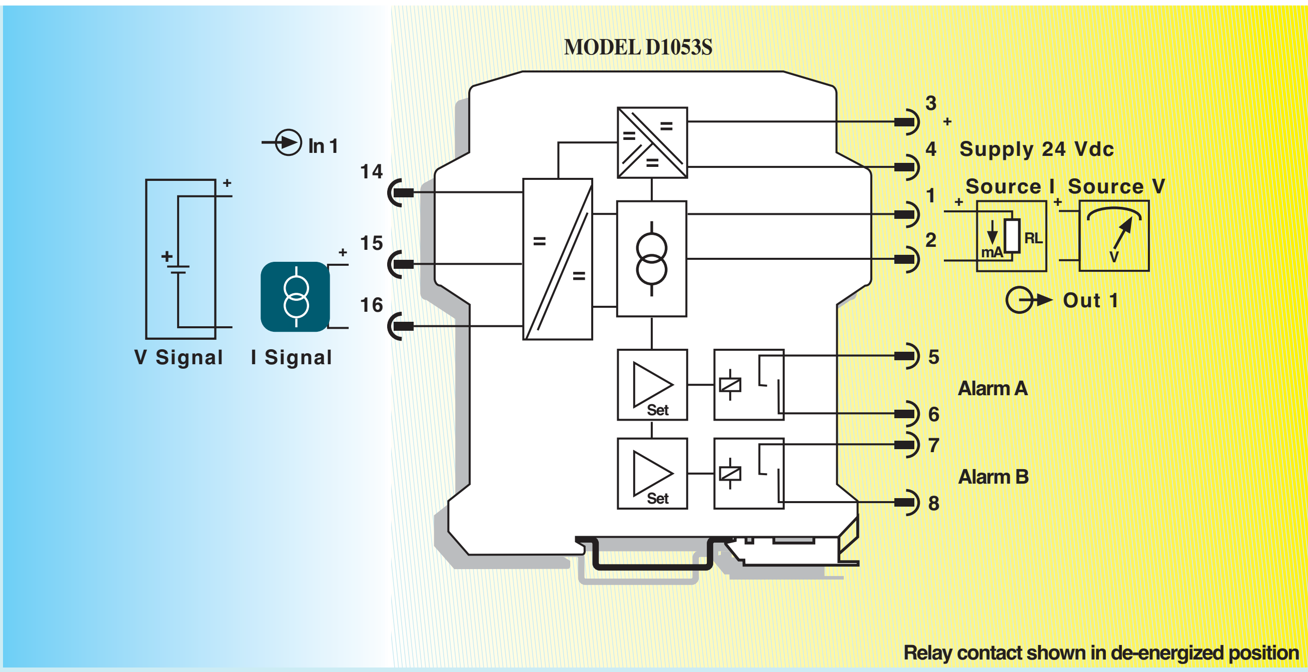
Ordering Information:

Model:	**D1053S**	
Power Bus enclosure		/B

Input types, output types, output range, alarm set point, conditions High, Low, Low-startup, burnout, hysteresis, delay, relay NE/ND are programmable by the GM Pocket Portable Configurator type PPC1090 or via RS-232 Serial line with PPC1092 adapter. If the above information are provided with the Purchasing Order, the unit will be configured accordingly, otherwise the unit will be supplied, by default, with the following parameters: Input Type: 4-20 mA - Output Type: 4-20 mA - Set: 50% - Alarm mode: High - Relay: ND Hysteresis: 0.1 mA - Alarm Delay: 0 s. The plate will record the unit type, serial number, function diagram and terminal block layout for connections.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS



GM INTERNATIONAL
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D1054

Repeater Power Supply and Trip Amplifiers DIN-Rail Model D1054S

Characteristics:

General Description:
The single channel DIN-Rail Repeater Power Supply and Trip Amplifier D1054S, provides a fully floating dc supply for energizing conventional 2-wire 4-20 mA Transmitter, or separately powered 3, 4 wire 4-20, 0-20 mA Transmitter located in Hazardous Area, and repeats the current in floating circuit to drive a Safe Area load.Output signal can be direct or reverse.
The circuit allows bi-directional communication signals, for Smart Transmitters.
Two independent Alarm Trip Amplifiers are also provided. Each Alarm energizes, or de-energizes, an SPST Relay for High, Low, Low-startup or burnout Alarm functions. The two Alarm Relays Trip points are settable over the entire input signal range.

Function:
1 channel I.S. analog input for 2 wire loop powered or separately powered Smart Transmitters, provides 3 port isolation (input/output/supply) and current (source mode) or voltage output signal. In addition it provides two SPST Relay Alarm contacts with adjustable Alarm Trip Point.

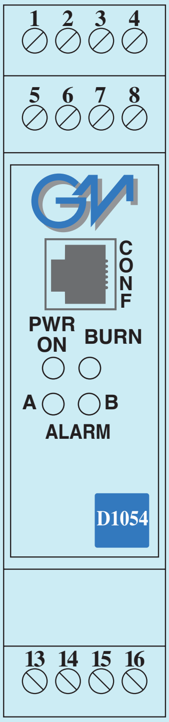
Signalling LEDs:
Power supply indication (green), Alarm A / B (red), burnout condition (red).

Field Configurability:
Totally Software configurable, no jumpers or switches, mA or V output signal, linear or reverse, Alarm Trip Point, High, Low, Low-startup or burnout Alarm mode, NE/ND relay operation, Hysteresis, Delay time, by a GM Pocket Portable Configurator PPC1090, powered by the unit or via RS-232 Serial line with PPC1092 Adapter and SWC1090 Configurator. To operate PPC1090 refer to instruction manual.

Smart Communication Frequency Band:
0.5 to 40 KHz within 3 dB (Hart and higher frequency protocols), only with mA direct current output.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- 4-20 or 0-20 mA loop or externaly powered Input Signal.
- 0/4-20 mA, 0/1-5 V, 0/2-10 V Output Signal Linear or Reverse.
- Wide Band Smart Communication, Hart compatible.
- Input and Output short circuit proof.
- Output for burnout detection.
- Field software programmability.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, FM & FM-C, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, 1 channel 2 Trips per unit.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 12-24 V nom (10 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 100 mA with 20 mA input/output and relays energized.
Current consumption @ 12 V: 220 mA with 20 mA input/output and relays energized.
Max. power consumption: 3.40 W with 30 V supply voltage, short circuit overload condition, relays energized and PPC1090 connected.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV;
Analog Out/Alarm Out 1500 V; Analog Out/Supply 500 V.
Alarm Out/Alarm Out 1500 V; Alarm Out/Supply 1500 V.

Input: 0/4 to 20 mA separately powered input (voltage drop ≤ 1 V) or 4 to 20 mA (2 wire Tx current limited at ≈ 23 mA).
Integration Time: 100 ms.
Resolution/Visualization: 1 µA on current input.
Input range: 0 to +22 mA on current input reading.

Transmitter line voltage: ≥ 15.0 V at 20 mA with max. 20 mVrms ripple on 0.5 to 40 KHz frequency band.

Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or highscale forcing.
Alarm can be programmed to detect burnout condition.
Burnout range: low and high separated trip point value programmable between -5 to +25 mA on current input.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.
Resolution: 1 µA current output or 1 mV voltage output.
Transfer characteristic: linear or reverse.
Response time: 100 ms (10 to 90 % step change).
Output ripple: ≤ 20 mVrms on 250 Ω communication load on 0.5 to 40 KHz band.
Frequency response: 0.5 to 40 KHz bidirectional within 3 dB (Hart and higher frequency protocols) only with mA direct current output.

Alarm: ***Trip Point range:*** within rated limits of sensor (see input visualization parameters for step resolution).
ON-OFF Delay time: 0 to 1000 s, 100 ms step, separate setting.
Hysteresis: 0 to 5 mA (see input visualization parameters for step resolution).
Output: Voltage free 1 + 1 SPST relay contact.
Contact rating: 2 A, 250 V, 100 VA or 2 A, 250 V, 80 W (resistive load).

Performance:
Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Input: Calibration and linearity accuracy: ≤ ± 20 µA on current input.
Temperature influence: ≤ ± 1 µA of input for a 1 °C change.
Analog Output: Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 26.7 V, Io/Isc = 91 mA, Po/Po = 611 mW at terminals 14-15.
Uo/Voc = 1.1 V, Io/Isc = 56 mA, Po/Po = 16 mW at terminals 15-16 (non energy storing apparatus connection).
Ui/Vmax = 30 V, Ii/Imax = 128 mA, Ci = 0 nF, Li = 0 µH at terminals 15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60 °C.
Approvals: DNV-2004-OSL-ATEX-0199 conf. to EN50014, EN50020.
UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1) for C-UL,
FM & FM-C No. 3024643, 3024643C, conforms to Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11,
TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X,
TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X,
Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

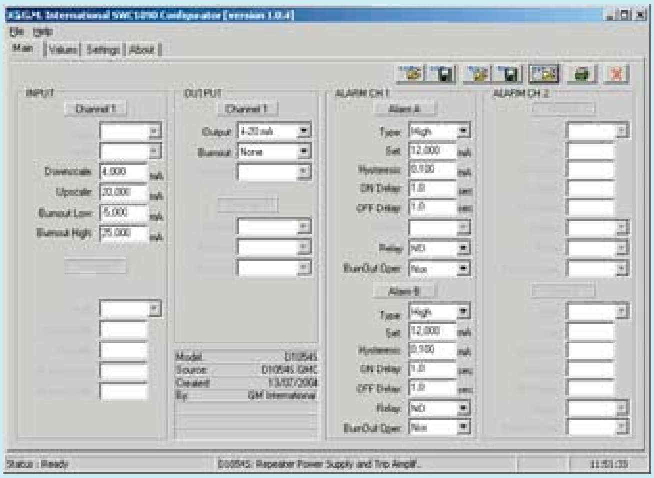
Mounting: T35 DIN Rail according to EN50022.
Weight: about 180 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 14-15				
Uo/Voc = 26.7 V	II C	0.091	4.3	57.8
Io/Isc = 91 mA	II B	0.720	17.2	231.2
Po/Po = 611 mW	II A	2.390	34.5	462.4
Terminals 15-16	Non energy storing apparatus connection			
Uo/Voc = 1.1 V	II C	100	11.3	2327
Io/Isc = 56 mA	II B	1000	45.3	9309
Po/Po = 16 mW	II A	1000	90.7	18618

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Friendly Configuration with PC and PPC1092 Adapter



SWC1090 Software Configurator is downloadable for free on our web site www.gminternationalsrl.com.

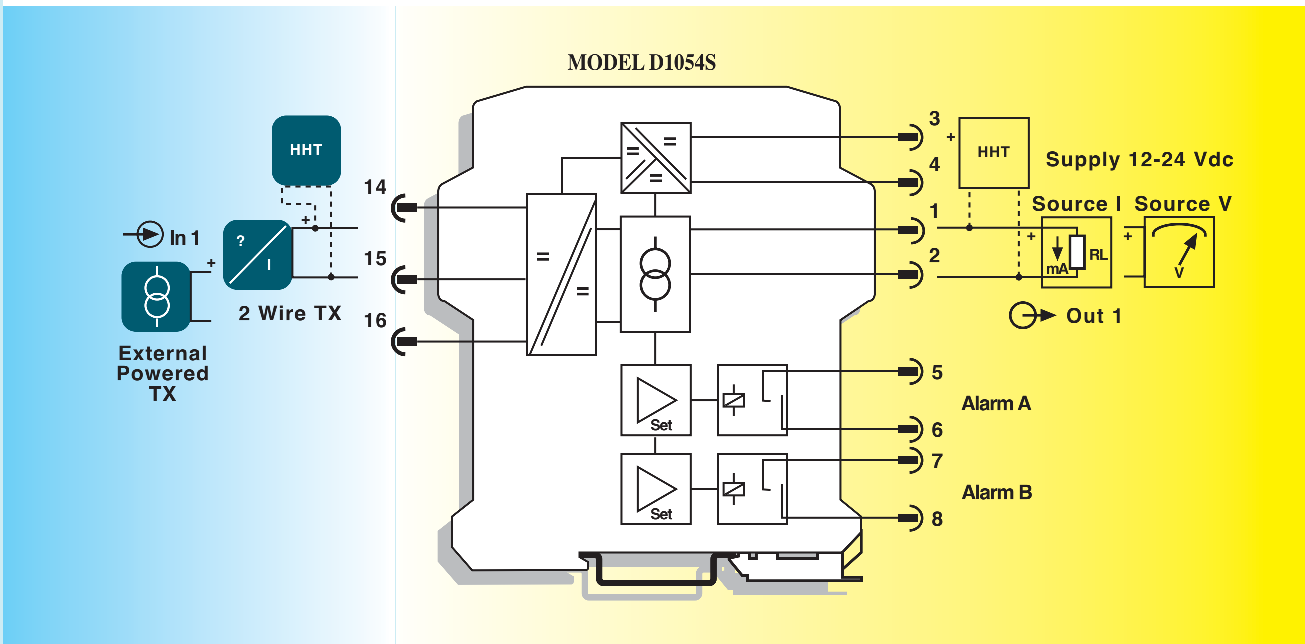
Ordering Information:

Model:	D1054S
Power Bus enclosure	/B

Input ranges, output types, output range, alarm set point, conditions High/Low/Low-startup, burnout, hysteresis, delay, relay NE/ND are programmable by the GM Pocket Portable Configurator type PPC1090 or via RS-232 Serial line with PPC1092 adapter. If the above information are provided with the Purchasing Order, the unit will be configured accordingly, otherwise the unit will be supplied, by default, with the following parameters: Input Type: 4-20 mA - Output Type: 4-20 mA - Set: 50% - Alarm mode: High - Relay: ND Hysteresis: 0.1 mA - Alarm Delay: 1 s. The plate will record the unit type, serial number, function diagram and terminal block layout for connections.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS



Relay contact shown in de-energized position

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D1060

Frequency-Pulse Converter, Repeater, Trip Amplifiers DIN-Rail Model D1060S

Characteristics:

General Description:
The single channel DIN-Rail Frequency-Pulse Converter, Repeater and Trip Amplifiers D1060S converts and repeats a low level frequency signal from magnetic pick-up, contact, proximity, open-collector transistor or logic level sensor, located in Hazardous Area, into 4-20, 0-20 mA current or voltage output signal to drive a Safe Area load. Repeater output can be direct, divided by 10, 100, 1000, 10000, 100000, 1000000 or programmed with alarm function. One independent Alarm Trip Amplifier is also provided. Alarm energizes, or de-energizes, an SPST optocoupled open-collector transistor for High, Low or Low-startup Alarm functions. The Alarm Trip point is settable over the entire input signal range. When repeater output is used as alarm output the unit provides two independent alarms.

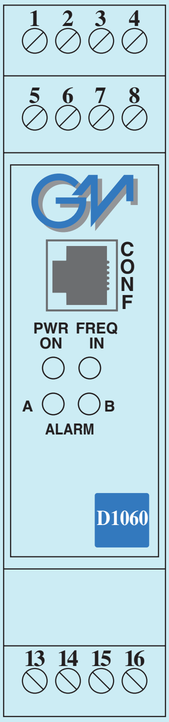
Function:
1 channel I.S. input from frequency-pulse signals, provides 3 port isolation (input/output/supply) and current or voltage output signal. In addition it repeats the frequency input and provides one SPST transistor with adjustable Alarm Trip Point.

Signalling LEDs:
Power supply indication (green), Frequency input (yellow), Alarms (red).

Configurability:
Software configurable for Frequency range, mA or V output signal, Alarm Trip Point, High/Low/Low-startup Alarm mode, NC/NO transistor operation, Hysteresis, Delay time, by a GM Pocket Portable Configurator PPC 1090, powered by the unit or via RS-232 Serial line with PPC1092 Adapter and SWC1090 Configurator. DIP-Switch configurable for hardware setting of input sensor. To operate PPC1090 refer to instruction manual.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- Magnetic Pick-up, contact, proximity or logic level input sensor.
- Frequency range DC to 50 KHz input.
- Repeater output direct or divided by 10, 100, 1000, 10000, 10000 or 1000000.
- 0/4-20 mA, 0/1-5 V, 0/2-10 V Output Signal Linear or Reverse.
- Software programmability.
- High Accuracy, µP controlled converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, 1 channel Converter, Repeater and Trip Amplifier per unit.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 12-24 V nom (10 to 30 V) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 65 mA with 20 mA output and transistors output energized.
Current consumption @ 12 V: 120 mA with 20 mA output and transistors output energized.
Max. power consumption: 2.10 W with 30 V supply voltage, overload condition, transistors energized and PPC1090 connected.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; Analog Out/Digital Outs 500 V; Analog Out/Supply 500 V. Digital Out/Digital Out 500 V; Digital Outs/Supply 500 V.

Input: magnetic pick-up, contact, proximity to EN60947-5-6, logic level signal, open-collector transistor for frequency signal up to 50 KHz.
Integration Time: 100 ms.
Resolution: 1 mHz for 50 Hz range, 10 mHz for 500 Hz range, 100 mHz for 5 KHz range, 1 Hz for 50 KHz range.
Visualization: 1 mHz for 50 Hz range, 10 mHz for 500 Hz range, 100 mHz for 5 KHz range, 1 Hz for 50 KHz range.
Input range: 0 to 50 KHz maximum.

Burnout: zero analog output signal for loss of input signal.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.
Resolution: 2 µA current output or 1 mV voltage output.
Transfer characteristic: linear direct or reverse.
Response time: 100 ms (10 to 90 % step change).
Output ripple: ≤ 20 mV rms on 250 Ω load.

Repeater Output: Voltage free SPST optocoupled open-collector transistor.
Output Factor: direct 1:1 or divided by 10, 100, 1000, 10000, 100000 or 1000000.
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 1.5 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.
Frequency response: 50 KHz maximum.

Alarm: ***Trip Point range:*** within rated limits of input range (see input visualization parameters for step resolution).
Delay time: 0 to 1000 s, 100 ms step.
Hysteresis: 0 to 5 Hz for 50 Hz range. 0 to 50 Hz for 500 Hz range. 0 to 500 Hz for 5 KHz range. 0 to 5 KHz for 50 KHz range. (see input visualization parameters for step resolution).
Output: Voltage free SPST optocoupled open-collector transistor.
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 1.5 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.

Performance: Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temperature.
Input: Calibration and linearity accuracy: ≤ ± 0.05 % of full scale of input range selected.
Temperature influence: ≤ ± 0.005 % of full scale of input range selected for a 1 °C change.
Analog Output: Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:

II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 10.6 V, Io/Isc = 1.1 mA, Po/Po = 3 mW at terminal 13-16.
Uo/Voc = 10.6 V, Io/Isc = 22 mA, Po/Po = 58 mW at 14-15-16.
Uo/Voc = 11.6 V, Io/Isc = 12 mA, Po/Po = 34 mW at 14-15.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.

Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting: T35 DIN Rail according to EN50022.
Weight: about 160 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

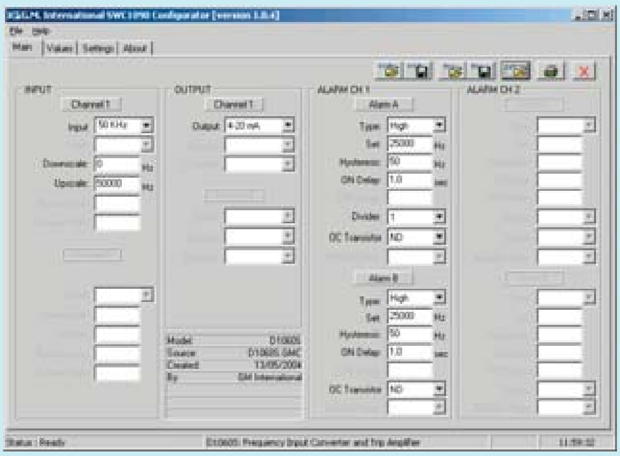
Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-16				
Uo/Voc = 10.6 V	II C	2.32	31000	12600
Io/Isc = 1.1 mA	II B	16.20	124000	50400
Po/Po = 3 mW	II A	72.00	248000	100800
Terminals 14-15-16				
Uo/Voc = 10.6 V	II C	2.32	75	622
Io/Isc = 22 mA	II B	16.20	303	2480
Po/Po = 58 mW	II A	72.00	607	4970
Terminals 14-15				
Uo/Voc = 11.6 V	II C	1.59	255	512
Io/Isc = 12 mA	II B	10.80	1023	2040
Po/Po = 34 mW	II A	43.00	2046	4090

Ordering Information:

Model:	**D1060S**	
Power Bus enclosure		/B

Input ranges, output types, output range, alarm set point, alarm conditi High/Low/Low-startup, hysteresis, delay, NC/NO transistor are programmab the GM Pocket Portable Configurator type PPC1090 or via RS-232 Serial with PPC1092 Configurator. If the above information are provided wit Purchasing Order, the unit will be configured accordingly, otherwise the unit be supplied, by default, with the following parameters:
Input Type: Proximity.
Range: 0 to 50 KHz.
Output Type: 4-20 mA.
Repeater: 1:1.
Set: 50%.
Alarm mode: High.
Relay: ND.
Hysteresis: 1 %.
Alarm Delay: 0 s.

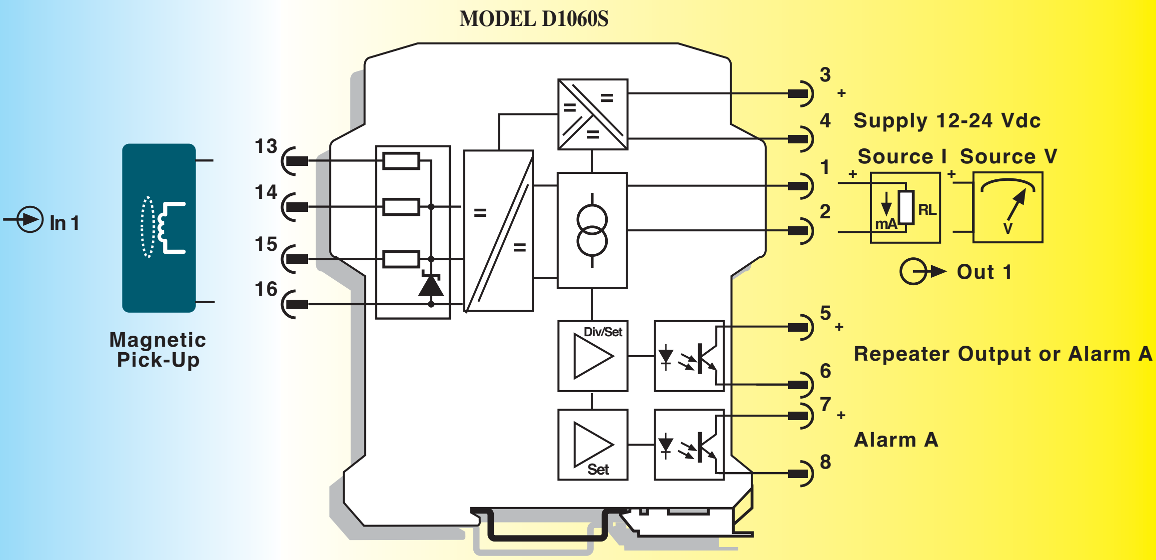
Friendly Configuration with PC and PPC1092 Adapter



SWC1090 Software Configurator is downloadable for free on our web site www.gminternationalsrl.com.

Function Diagram:

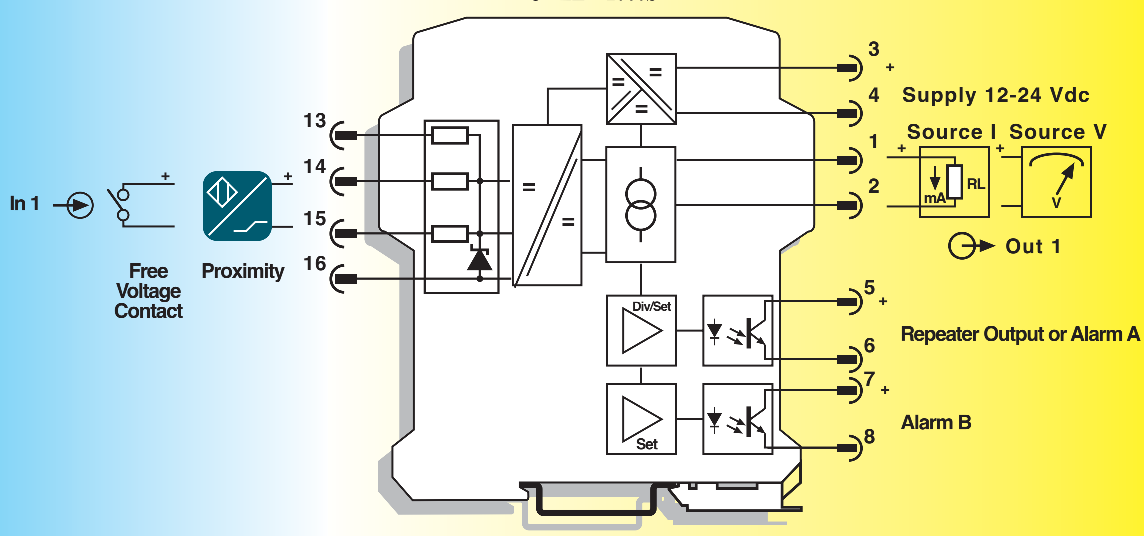
HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1060S



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TECHNOLOGY FOR SAFETY

D1061

RS 422 / RS 485 Fieldbus Isolating Repeater DIN-Rail Model D1061S

Characteristics:

General Description:
The single channel DIN-Rail RS 422 / RS 485 Fieldbus Isolating Repeater D1061S is used to separate Intrinsically Safe RS 422 / RS 485 equipment located in Hazardous Area from a RS 232 / RS 422 / RS 485 controller located in Safe Area.
Transmission speed is dip-switch adjustable from 1.2 Kbit/s up to 1.5 Mbit/s.
Terminating impedance is dip-switch selectable inside the unit (250 Ω value) for both sides of communication lines (Hazardous Area and Safe Area side).
RS422 / RS 485 connection in Safe Area is provided both on terminal block and DB9 female connector on the unit.
RS232 connection is provided on DB9 female connector.
The module also provides a shield terminal block for connecting cable on Hazardous Area side.

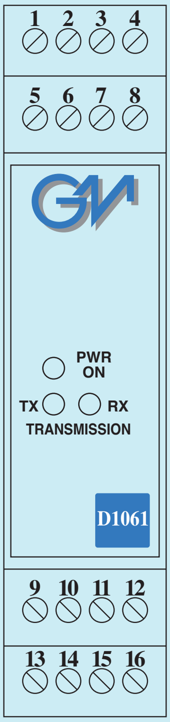
Function:
1 channel I.S. RS 422 / RS 485 isolating repeater, provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Rx-Tx transmission (yellow).

Field Configurability:
Hardware is totally configurable via dip-switches; parameters are:
Transmission speed adjustable from 1.2 Kbit/s up to 1.5 Mbit/s.
Terminating impedance enabled or disabled in both communication lines.
RS422 / RS 485 connection selection from Terminal Block or DB9 female connector.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- RS 422 / RS 485 Hazardous Area I.S. Signal.
- RS 232 / RS 422 / RS 485 Safe Area Signal.
- Transmission speed up to 1.5 Mbit/s.
- DIP-Switch Field programmability.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, FM & FM-C, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1061S	
Power Bus enclosure		/B

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 100 mA.
Max. power consumption: 2.80 W with 30 V supply voltage.

Isolation (Test Voltage):
I.S. RS422-RS485 / RS232-RS422-RS485 1.5 KV;
I.S. RS422-RS485 / Supply 1.5 KV;
RS232-RS422-RS485 / Supply 500 V.

Input/Output I.S. Hazardous Area:
RS 422 / RS 485 Intrinsically Safe connection
(EIA RS-422-A and EIA RS-485 applicable standard).
Terminating impedance: 250 Ω dip-switch selectable.
Transmission speed: 1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 38.4, 57.6, 93.75, 115.2, 187.5, 375, 500, 750 Kbit/s or 1.0, 1.5 Mbit/s dip-switch configurable.
Transmission cable length: ≤ 1200 m up to 93.75 Kbit/s, ≤ 1000 m up to 187.5 Kbit/s, ≤ 400 m up to 500 Kbit/s, ≤ 200 m up to 1.5 Mbit/s.
Connection: terminal block up to 2.5 mm^2, shield terminal block provided for cable connection.

Output/Input Safe Area:
RS232 / RS 422 / RS 485 connection
(EIA RS-232-C, EIA RS-422-A and EIA RS-485 applicable standard).
RS 422 / RS 485 Terminating impedance: 250 Ω dip-switch selectable.
RS 422 / RS 485 Transmission speed: see above.
RS 422 / RS 485 Transmission cable length: see above.
RS 422 / RS 485 Connection: terminal block up to 2.5 mm^2 or DB9 female connector (requires DB9 male mating connector), dip switch configurable.
RS 232 Transmission speed: 1.2, 2.4, 4.8, 9.6, 14.4, 19.2, 38.4, 57.6, 93.75, 115.2 Kbit/s dip-switch configurable.
RS 232 Transmission cable length: ≤ 15 m up to 115.2 Kbit/s.
RS 232 Connection: DB9 female connector (requires DB9 male mating connector).

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC, I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 3.7 V, Io/Isc = 225 mA, Po/Po = 206 mW at terminals 13-14 and 15-16.
FM APPROVED
Ui/Vmax = 30 V, Ii/Imax = 282 mA, Ci = 0 nF, Li = 0 µH at terminals 13-14-15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DNV-2004-OSL-ATEX-0199 conforms to EN50014, EN50020.
FM & FM-C conforms to Class 3600, 3610, 3611, 3810 and C22.2 No.142, C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15,
TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X,
TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X,
Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 160 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2 and SUB D 9 poles (DB9) DIN 41652 female connector (only for RS 232, RS 422, RS 485 Safe Area connection).
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

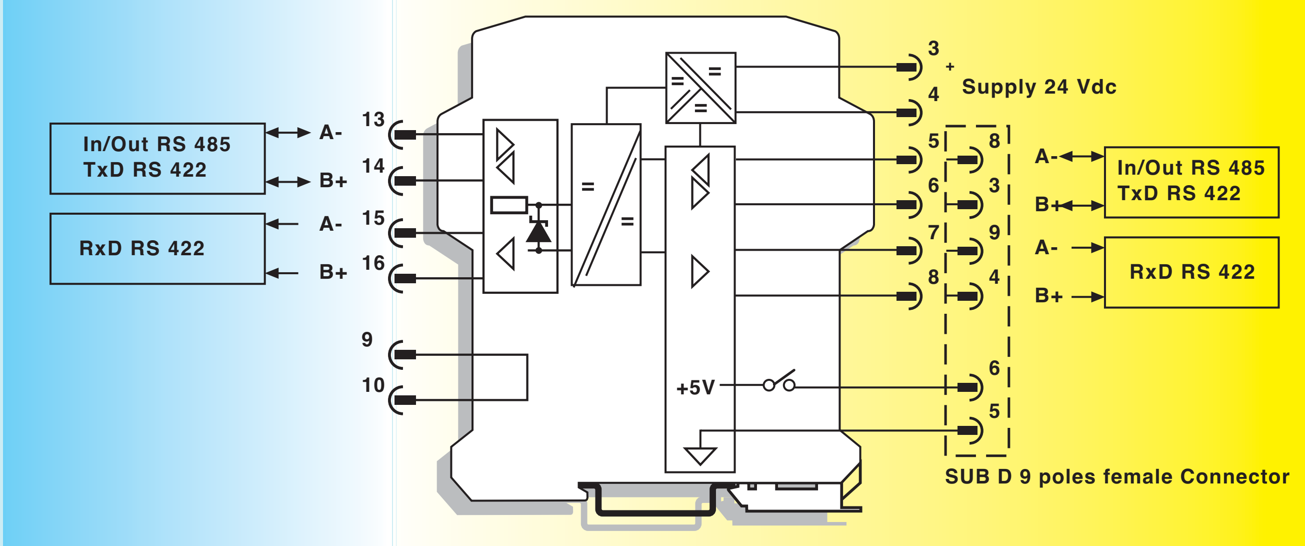
Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 13-14 and 15-16 Uo/Voc = 3.7 V Io/Isc = 225 mA Po/Po = 206 mW	II C II B II A	100 1000 1000	0.7 2.8 5.6	173 693 1386
Terminals 13-14-15-16 Ui/Vmax = 30 V Ii/Imax = 282 mA Ci = 0 nF; Li = 0 µH				

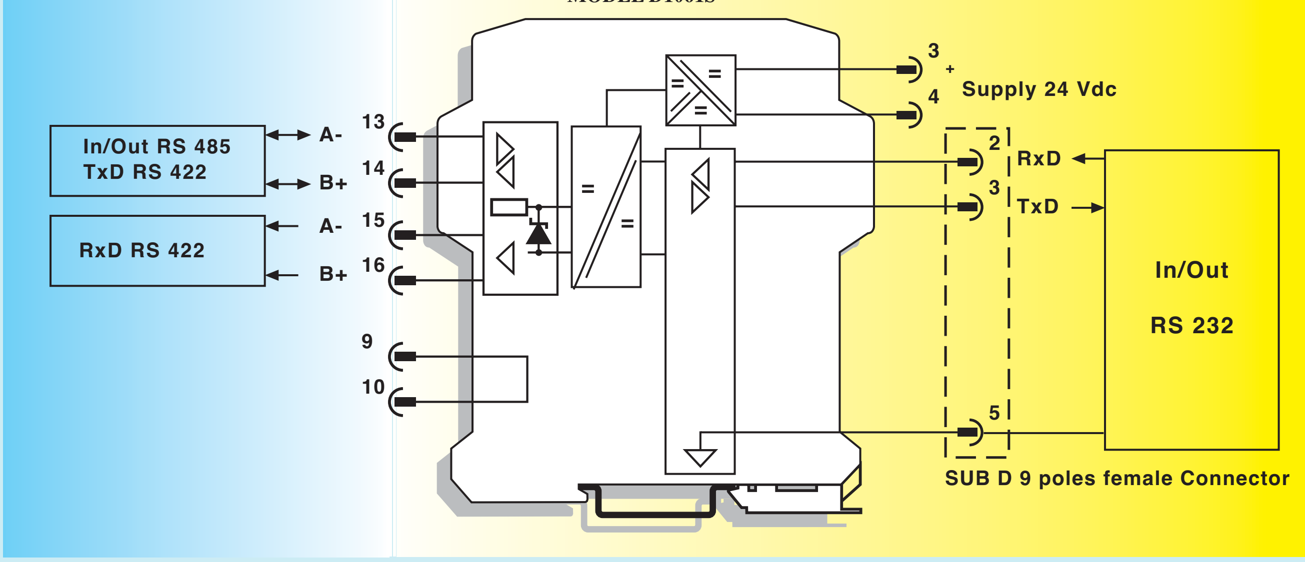
Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

MODEL D1061S

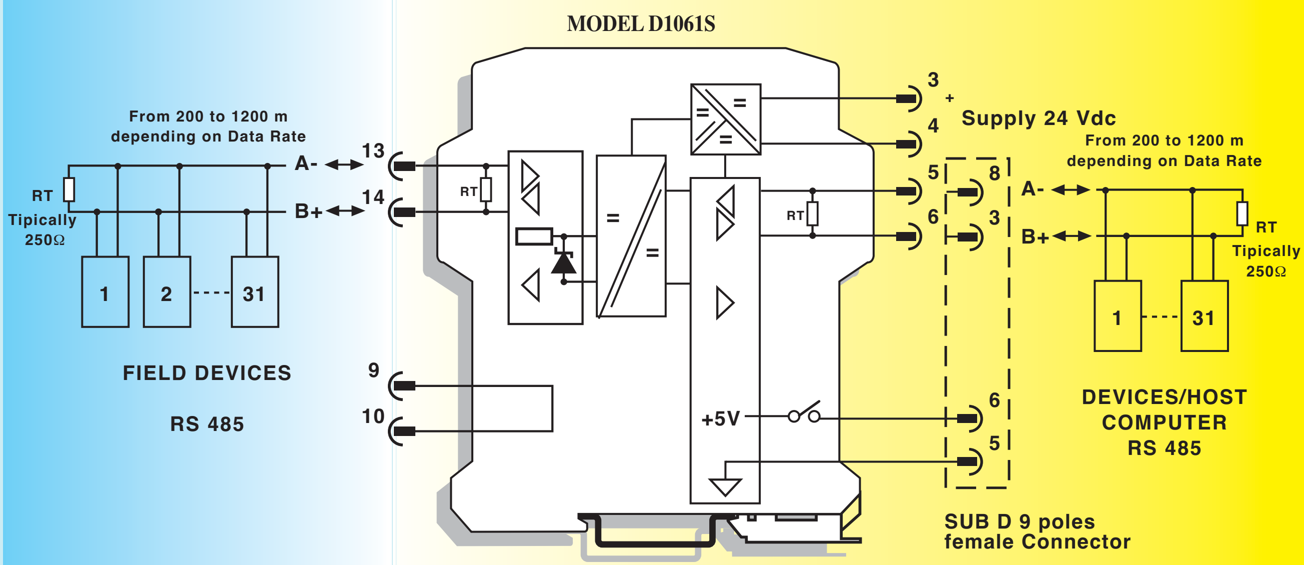


MODEL D1061S

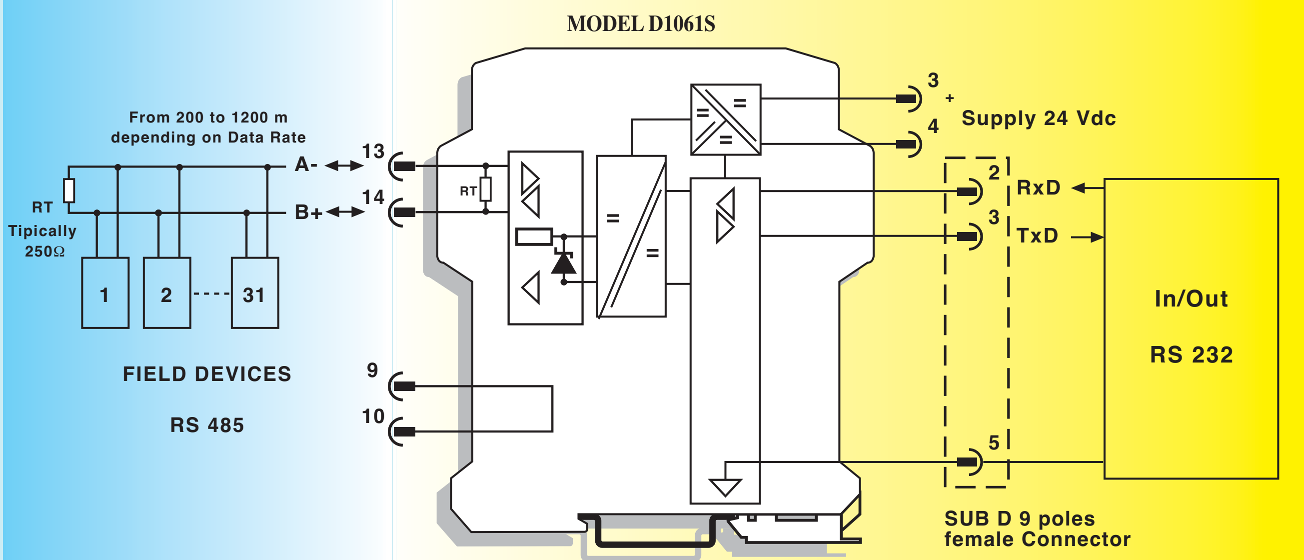


Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



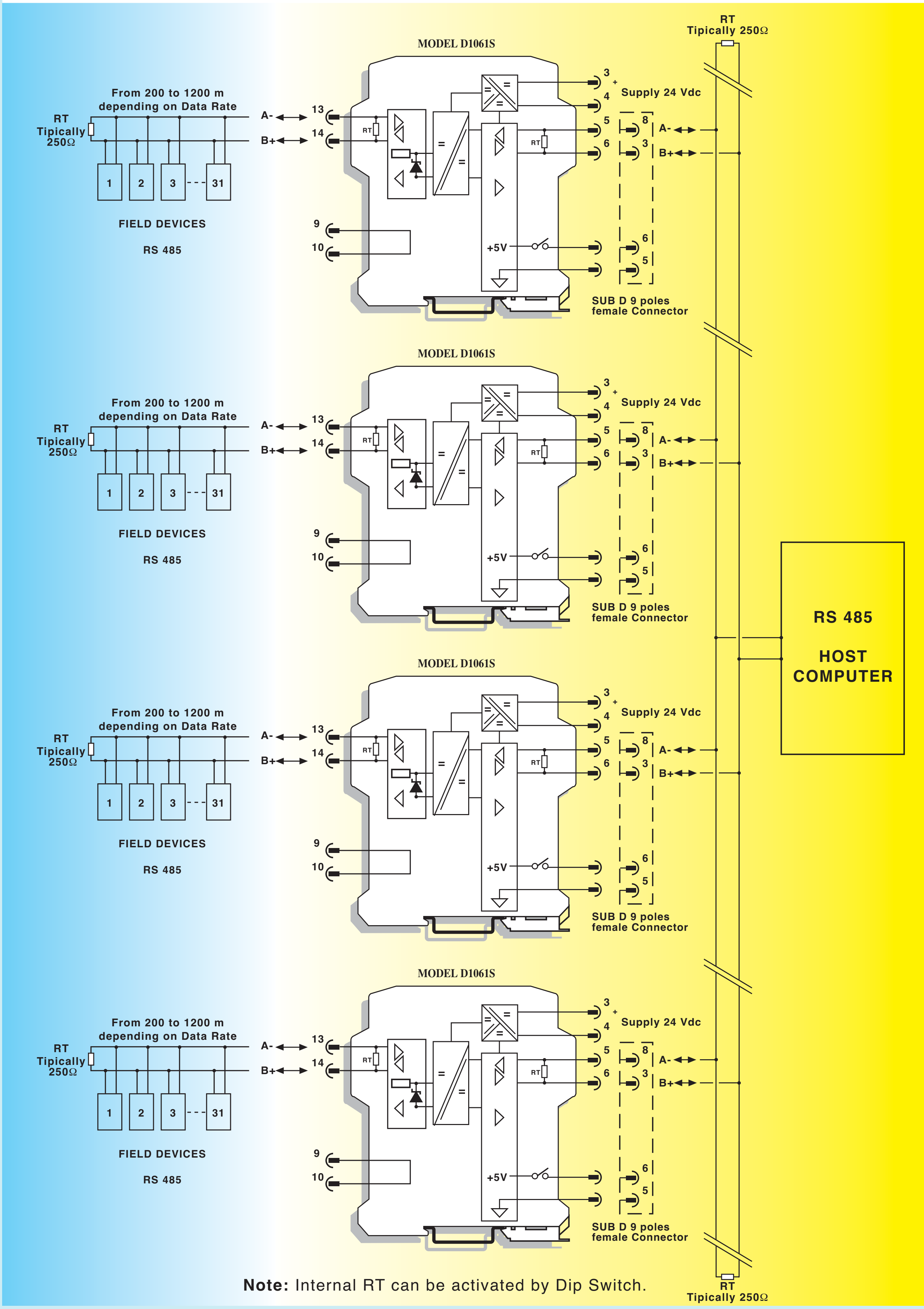
Note: Internal RT can be activated by Dip Switch.



Note: Internal RT can be activated by Dip Switch.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



Note: Internal RT can be activated by Dip Switch.

GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1063

Strain Gauge Bridge Isolating Repeater DIN-Rail Model D1063S

Characteristics:

General Description:

The single channel DIN-Rail Strain Gauge Bridge Isolating Repeater D1063S acts as a transparent galvanic isolated interface installed between a weighing indicator in Safe Area and a load cell (or group of n load cells) in Hazardous Area; it appears at the terminals of the indicator as a single load cell equivalent to the one in field. Provides a fully floating power supply voltage with remote sensing capability to strain gauge bridge located in Hazardous Area and repeats, while isolating, the mV signal output to drive a load in Safe Area depending on the host system reference voltage.

Up to four 350 Ω load cells, or six 450 Ω load cells, or twelve 1000 Ω load cells can be connected in parallel.

Voltage reference (Safe Area side) is dip switch configurable to select internal or external (host system) supply.

In addition a field wiring fault red LED indicates any wire break in the Hazardous Area side.

Function:

1 channel I.S. input from strain gauge signals, provides 3 port isolation (input/output/supply) and repeats, as a transparent unit, bridge signal output.

Signalling LEDs:

Power supply indication (green), Field wiring fault (red).

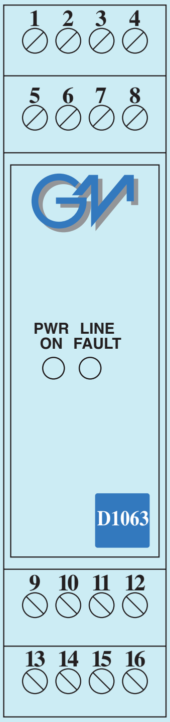
Field Configurability:

Voltage reference internal or external via dip switch.

EMC:

Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- Strain Gauge Bridge Transparent Repeater.
- Up to four 350 Ω load cells parallel connection.
- Up to six 450 Ω load cells parallel connection.
- Up to twelve 1000 Ω load cells parallel connection.
- Field wire break fault detection.
- DIP Switch programmability for voltage reference (internal or host system).
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, FM & FM-C, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Ordering Information:

Model:	D1063S	
Power Bus enclosure		/B

Technical Data:

Supply: 24 V nom (20 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 100 mA with four 350 Ω load cells connected.
Max. power consumption: 3.30 W with 30 V supply voltage, four 350 Ω load cells connected and overload condition.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; Out/Supply 500 V.

Input:
up to four 350 Ω load cells (parallel connected).
up to six 450 Ω load cells (parallel connected).
up to twelve 1000 Ω load cells (parallel connected).
Bridge supply voltage: 4.5 V nominal.
Bridge output signal: ≤ 2 mV/V.
Input range: ± 9 mV nominal span, ± 11 mV overrange.
Line resistance compensation: ≤ 10 Ω.

Burnout: LED indication for field wire break.

Output: ± 20 mV nominal span, ± 24 mV overrange
Output impedance: 350 Ω typical.
Host reference voltage: ≤ 10 V typical, ≤ 11 V maximum.
Internal reference voltage: 10 V typical, dip-switch settable.
Internal impedance: 350 Ω typical, dip-switch settable.
Transfer characteristic: linear based on mV input.
Response time: 100 ms (10 to 90 % step change).

Performance: Ref. Conditions 24 V supply, 23 ± 1 °C ambient temp.
Calibration accuracy after system calibration: ≤ ± 0.003 % of full scale of input range.
Linearity accuracy: ≤ ± 0.002 % of full scale of input range.
Temperature influence: ≤ ± 0.002 % of full scale of input range for a 1 °C change.
Supply voltage influence: ≤ ± 0.002 % of full scale of input range for a min to max supply voltage change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC, I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 17.3 V, Io/Isc = 199.6 mA, Po/Po = 864 mW at terminals 9-10-11-12-13-14.
FM APPROVED
Uo/Voc = 17.3 V, Io/Isc = 8 mA, Po/Po = 35 mW at terminals 13-14.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DNV-2004-OSL-ATEX-0199 conforms to EN50014, EN50020. FM & FM-C conforms to Class 3600, 3610, 3611, 3810 and C22.2 No.142, C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 Exia IIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

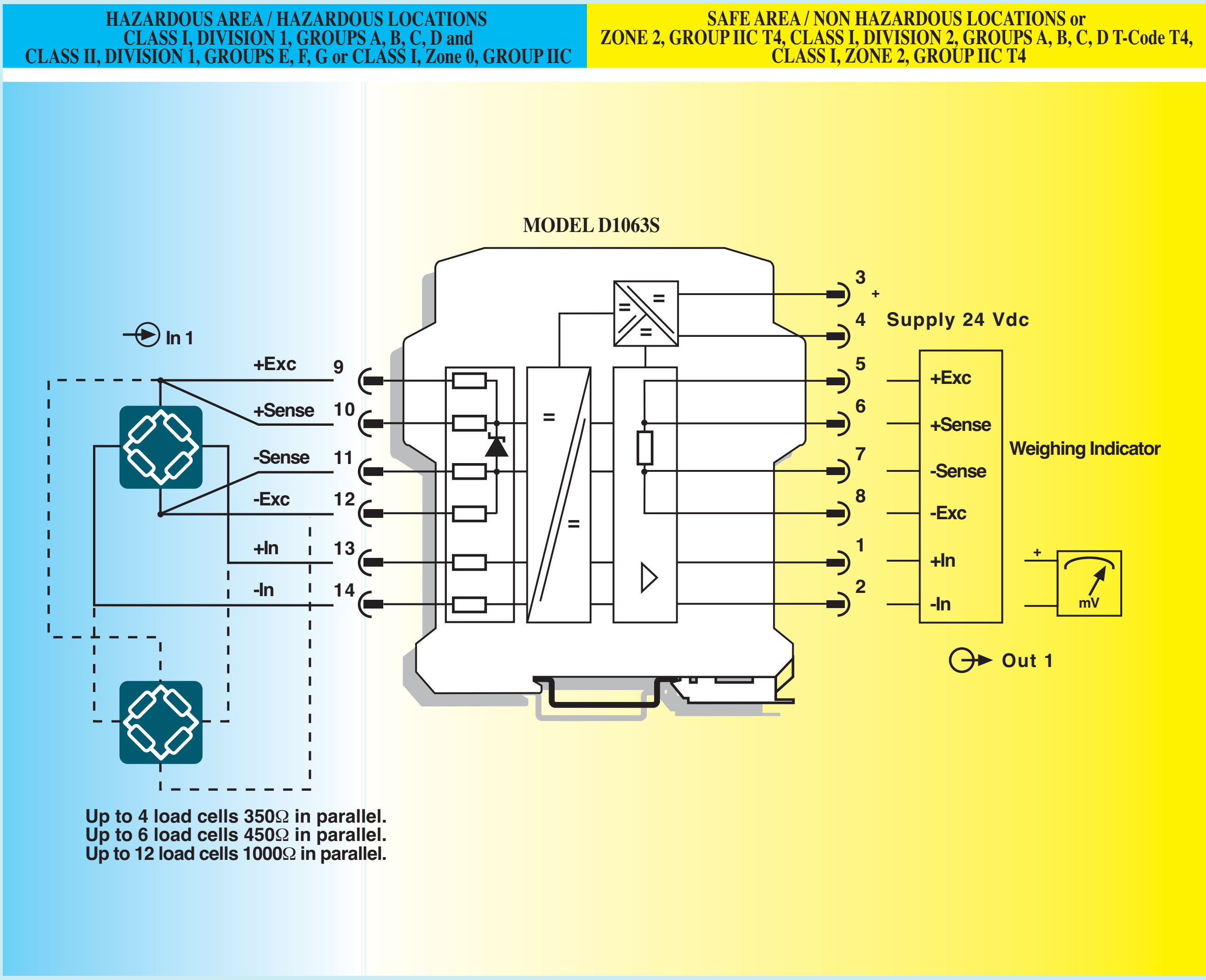
Mounting: T35 DIN Rail according to EN50022.
Weight: about 170 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 9-10-11-12-13-14				
Uo/Voc = 17.3 V	II C	0.351	0.85	41.2
Io/Isc = 199.6 mA	II B	2.060	3.40	164.8
Po/Po = 864 mW	II A	8.500	6.80	329.6
Terminals 13-14				
Uo/Voc = 17.3 V	II C	0.351	300	1020
Io/Isc = 8 mA	II B	2.060	1200	4110
Po/Po = 35 mW	II A	8.500	2400	8220

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



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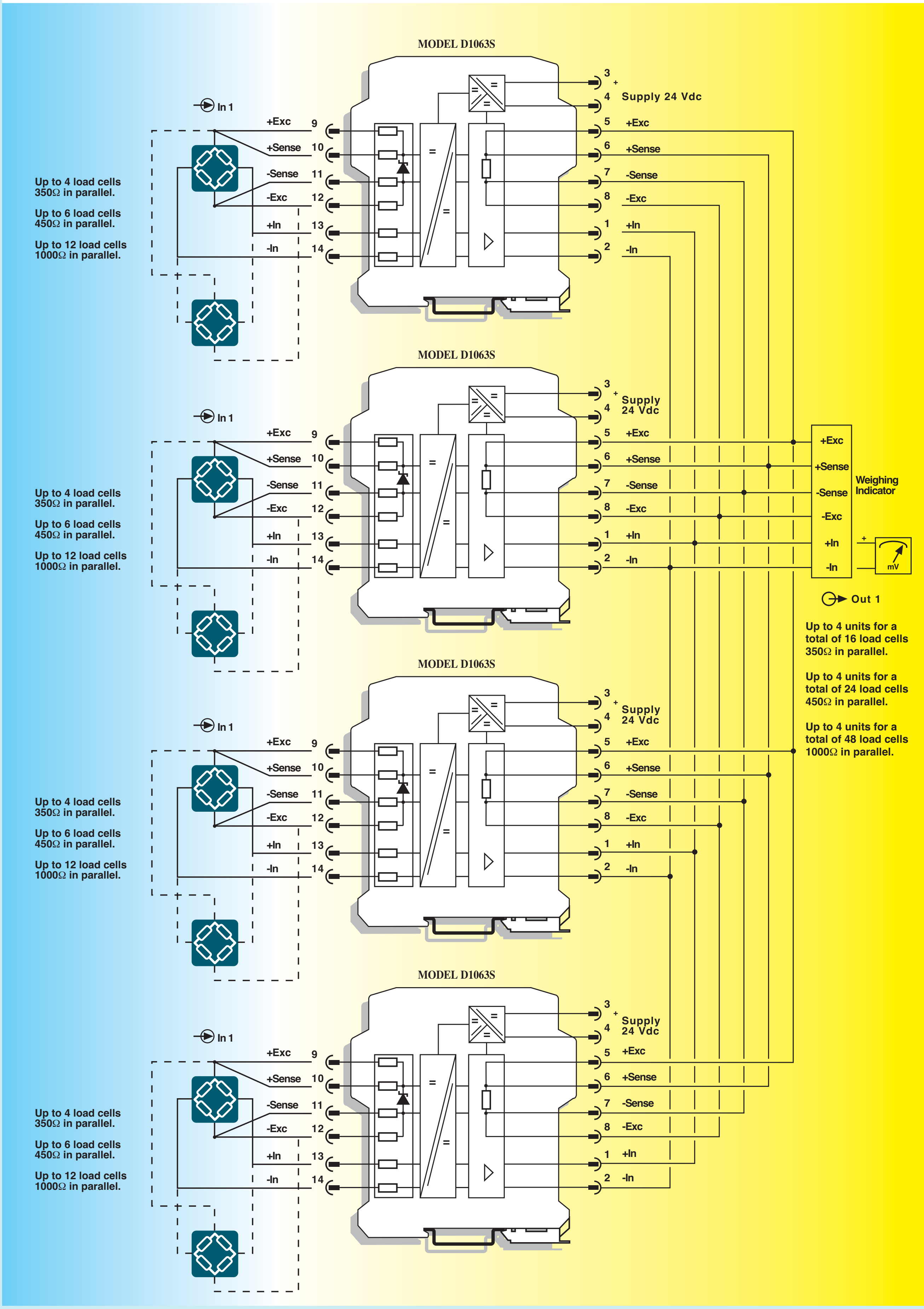
Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



Typical Wiring Diagram for Four Load Cells 350 Ω Using Standard G.M. International Cables Type: CABF012

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIV. 2, GROUPS A,B,C,D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

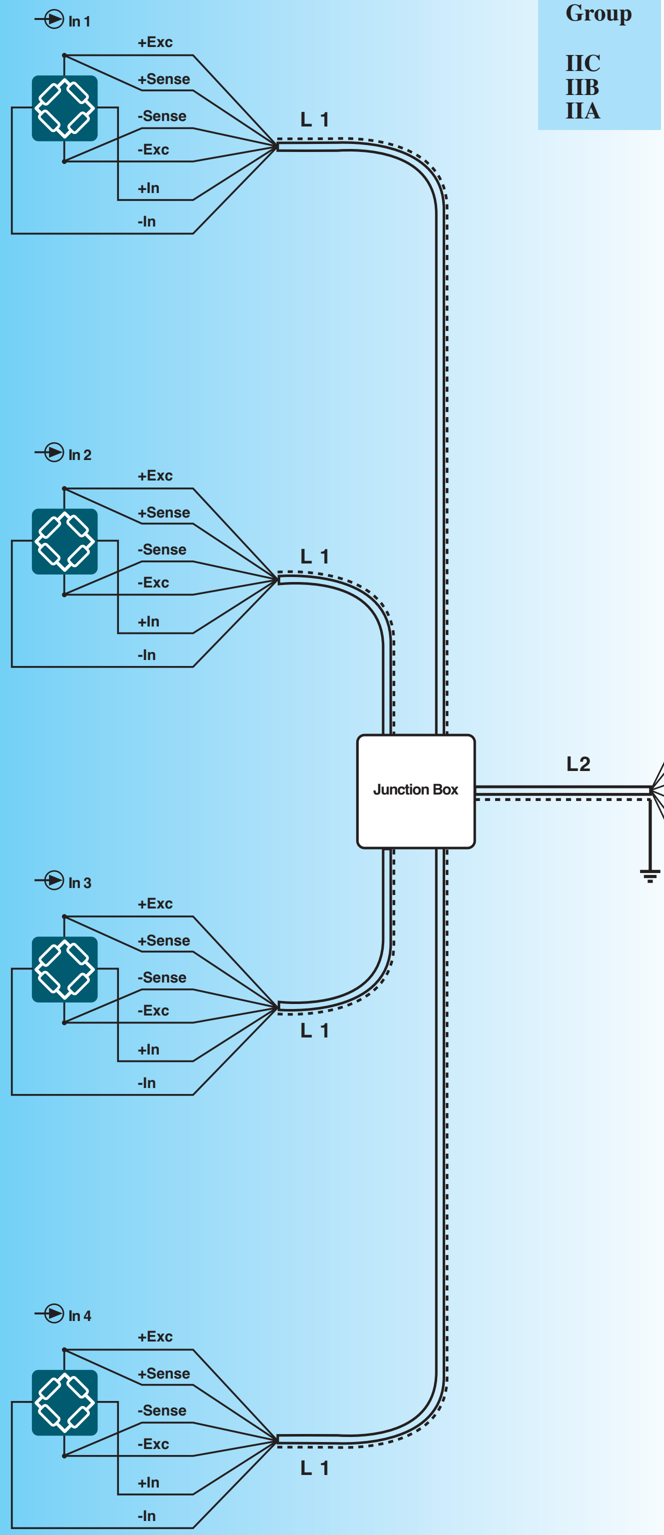
Gas Group	1 single Load Cell		3 paralleled Load Cells		4 paralleled Load Cells	
	L1 (m)	L2 (m)	L1 (m)	L2 (m)	L1 (m)	L2 (m)
IIC IIB IIA	100	1.000	70	700	50	500

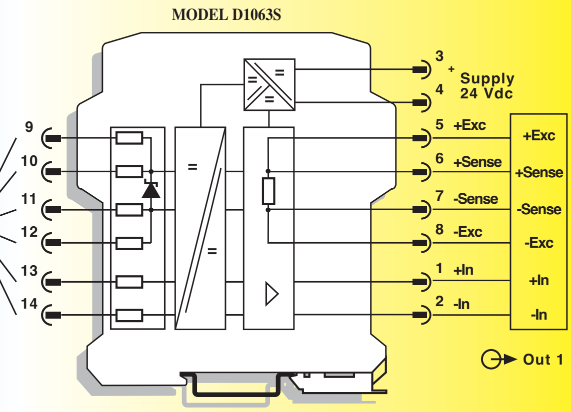
L1 = distance between Load Cell and Junction Box.

L2 = distance between Junction Box and D1063S Isolator.

Note: with these distances the values for max. capacitance and inductance remain within the specified parameters, for all Gas Groups, of the D1063S.

Cable shields must be grounded in Safe Area only.





Cable Specifications:

Size: 3 x 2 x 1 mm^2.

Screen: 3 pairs with overall screen.

Voltage Test: 1.500V r.m.s. per 1min (core/core).
1.500 V r.m.s. per 1min (core/screen).

Insulation resistance: ≥ 5.000 MΩ/Km. (at 20 °C).

Outer diameter: 11 mm.

Flame retardant: according to IEC 60332-1.

Outer sheath: PVC flame retardant Blue colour.

GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1072

SIL 2 Temperature Converter DIN-Rail Duplicator, Adder and Subtractor Models D1072S, D1072D

Characteristics:

General Description:
The single and dual channel DIN-Rail Temperature Converter D1072S and D1072D converts a low level dc signal from millivolt, thermocouple or RTD Temperature sensor, located in Hazardous Area, into 4-20, 0-20 mA current or voltage output signal to drive a Safe Area load.
Duplicator function (before provided by D1072X) provides two independent outputs for the single sensor input.
Adder, subtractor, low/high selector functions (before provided by D1072Y) provide two independent outputs representing Input A, Input B, Input A plus Input B, Input A minus Input B, low/high selector.

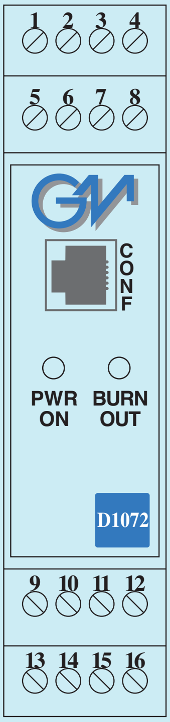
Function:
1 or 2 channels I.S. input from millivolt, thermocouples or 3, 4 wire resistance thermometers or transmitting potentiometers, provides 3 port isolation (input/output/supply) and current or voltage output signal.
Duplicator, adder, subtractor, low/high selector.
The programmable RTD line resistance compensation allows use of 2 wire RTDs or error compensation for 3-4 wire RTDs.
Cold Junction compensation can be automatic, with option 91, or fixed by software setting.

Signalling LED:
Power supply indication (green), Burnout condition (red).

Configurability:
Totally Software configurable, no jumpers or switches, Input sensor, Connection mode, Burnout operation, mA or V output signal, by a GM Pocket Portable Configurator PPC1090, powered by the unit or via RS-232 Serial line with PPC1092 Adapter and SWC1090 Software Configurator. To operate PPC1090 refer to instruction manual. A 16 characters Tag can be inserted using software configuration.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- SIL 2 according IEC 61508, IEC 61511.
- Duplicated output for single channel input.
- Adder, Subtractor, low/high Selector.
- mV, Thermocouples, RTD or Transmitting Potentiometers Input Signal.
- RTD line resistance compensation programmable.
- Cold Junction automatic or fixed.
- 0/4-20 mA, 0/1-5 V, 0/2-10 V Output Signal Temperature Linear or Reverse.
- Software programmability.
- 16 characters Tag for each channel.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 12-24 V nom (10 to 30 V) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 75 mA for 2 channels D1072D, 50 mA for 1 channel D1072S with 20 mA output typical.
Current consumption @ 12 V: 130 mA for 2 channels D1072D, 85 mA for 1 channel D1072S with 20 mA output typical.
Max. power consumption: 2.20 W for 2 channels, 1.50 W for 1 channel with 30 V supply voltage, overload condition and PPC1090 connected.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V; Out/Out 500 V; Out/Supply 500 V.

Input: millivolt or thermocouple type A1, A2, A3, B, E, J, K, L, N, R, S, T, U, Lr or 3, 4 wire RTD Pt 100, Pt 200, Pt 300 to DIN43760, Pt100 (0.3916), Ni 100 or Pt100, Pt50, Cu100, Cu53, Cu50 (russian standard) or 3 wire transmitting potentiometer (50 Ω to 20 KΩ).

Resolution: 5 µV on mV or thermocouple, 1 µV thermocouple type B, R or S, 20 mΩ on RTD, 0.05 % on Potentiometer.
Visualization: 0.1°C on temperature, 10 µV on mV, 0.1 % on Potentiometer
Input range: within rated limits of sensor (-10 to + 80 mV).
Measuring current: ≤ 0.5 mA.
Line resistance compensation: ≤ 10 Ω.
RTD line resistance compensation programmable: - 5 to + 20 Ω.
Thermocouple Reference junction compensation: automatic, by externally connected sensor (option 91 separately ordered), or fixed programmable from - 60 to + 100 °C.

Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or highscale forcing. Burnout condition signalled by red front panel LED.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.
Resolution: 2 µA current output or 1 mV voltage output.
Transfer characteristic: linear or reverse on mV or transmitting potentiometer, temperature linear or reverse on temperature sensors.
Response time: <= 50 ms (10 to 90 % step change).
Output ripple: ≤ 20 mV rms on 250 Ω load.

Performance: Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Input: Calibration and linearity accuracy: ≤ ± 40 µV on mV or thermocouple, 200 mΩ on RTD, 0.2 % on Potentiometer or ± 0.05% of input value, whichever is greater.
Temperature influence: ≤ ± 2 µV, 20 mΩ, 0.02 % or ± 0.01 % of input value for a 1 °C change.
Ref. junction compensation influence: ≤ ± 1 °C (thermocouple sensor).
Analog Output: Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I, II 3 G EEx nA IIC T4 associated electrical apparatus.
Uo/Voc = 10.8 V, Io/Isc = 9 mA, Po/Po = 24 mW at terminals 13-14-15-16 and 9-10-11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60 °C.

Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL,
TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM04/10-27 R001, SIL 2 - SIL 3 according to IEC 61508, IEC 61511. Please refer to functional safety manual for SIL applications.

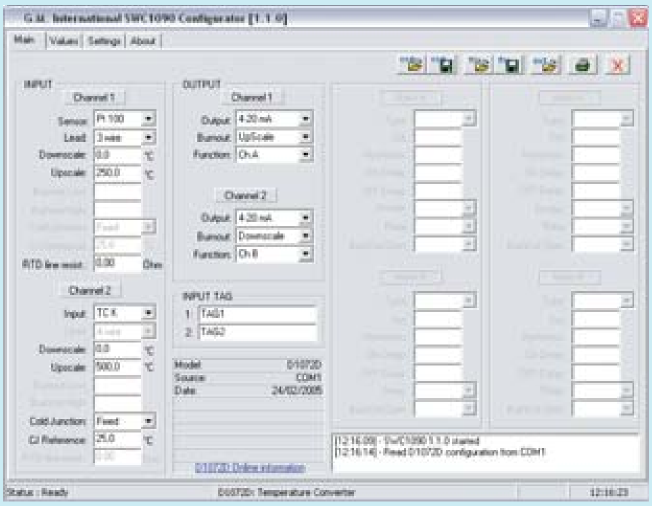
Mounting: T35 DIN Rail according to EN50022.
Weight: about 170 g D1072D, 140 g D1072S.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Terminals 13-14-15-16, 9-10-11-12				
Uo/Voc = 10.8 V	II C	2.14	477	1530
Io/Isc = 9 mA	II B	15.00	1909	6130
Po/Po = 24 mW	II A	66.00	3819	12260

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Friendly Configuration with PC and PPC1092 Adapter



SWC1090 Software Configurator is downloadable for free on our web site www.gminternationalsrl.com.

Ordering Information:

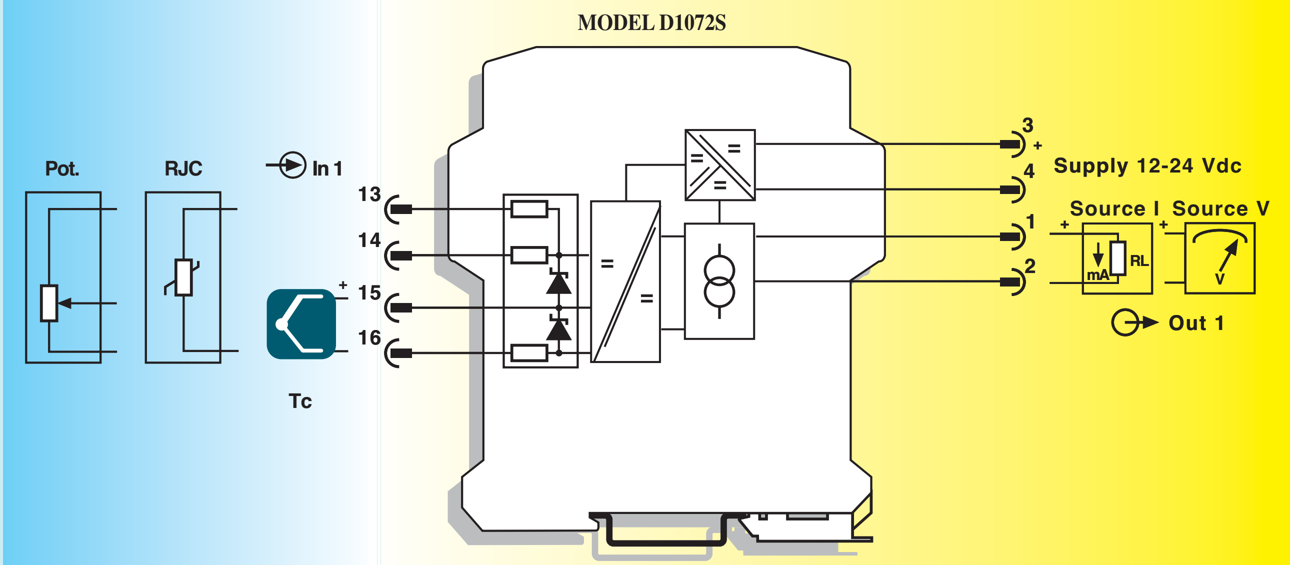
Model: **D1072**		
1 channel	S	
2 channels	D	
Power Bus enclosure		/B

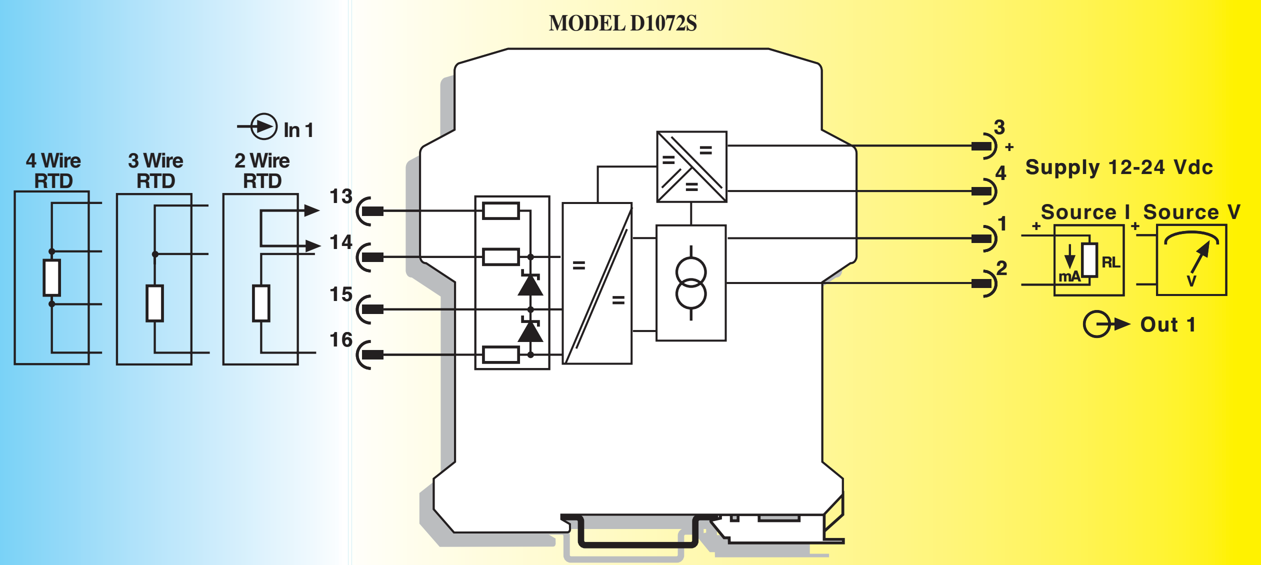
Input types, burnout conditions, output types, output range are programmable by the GM Pocket Portable Configurator type PPC1090 or via RS-232 Serial line with PPC1092 Adapter and SWC1090 software Configurator.
If the above information are provided with the Purchasing Order, the unit will be configured accordingly, otherwise the unit will be supplied, by default, with the following parameters:
Input Type: -10 to +80 mV
Output Type: 4-20 mA.
Burnout: highscale. The plate will record the unit type, serial number, function diagram and terminal block layout for connections.

Note: for thermocouple sensor input, the Reference Junction Compensator is required for automatic ambient temperature compensation. It has to be ordered as Option 91 .
It will be supplied separately and it has to be connected to the input Terminal Blocks as indicated in the function diagram.

Function Diagram:

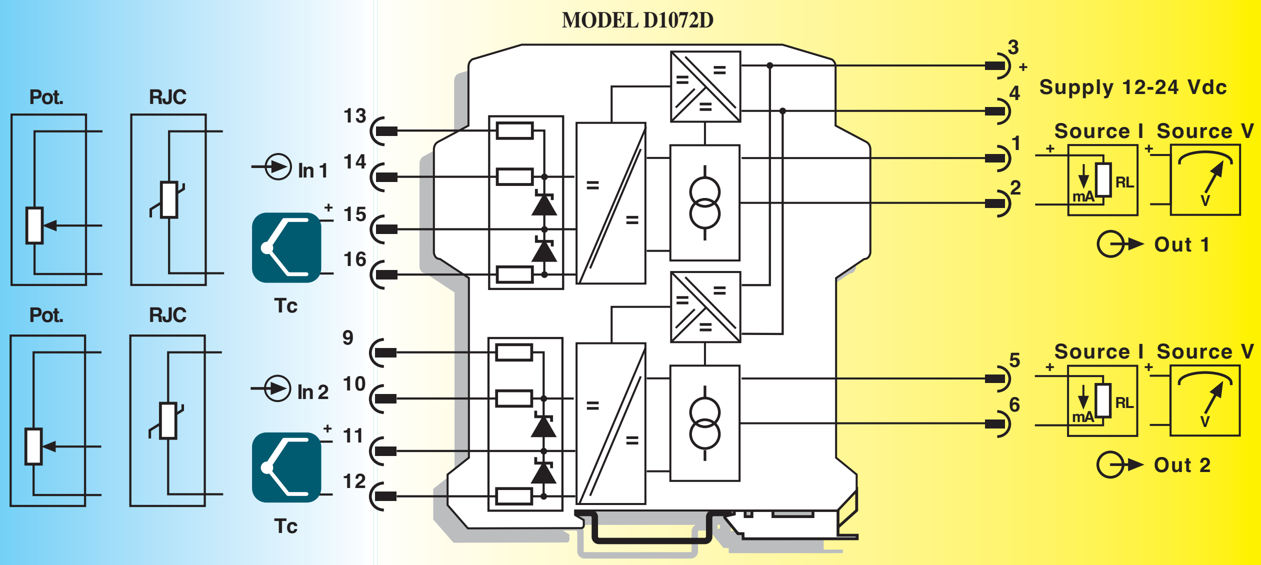
HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

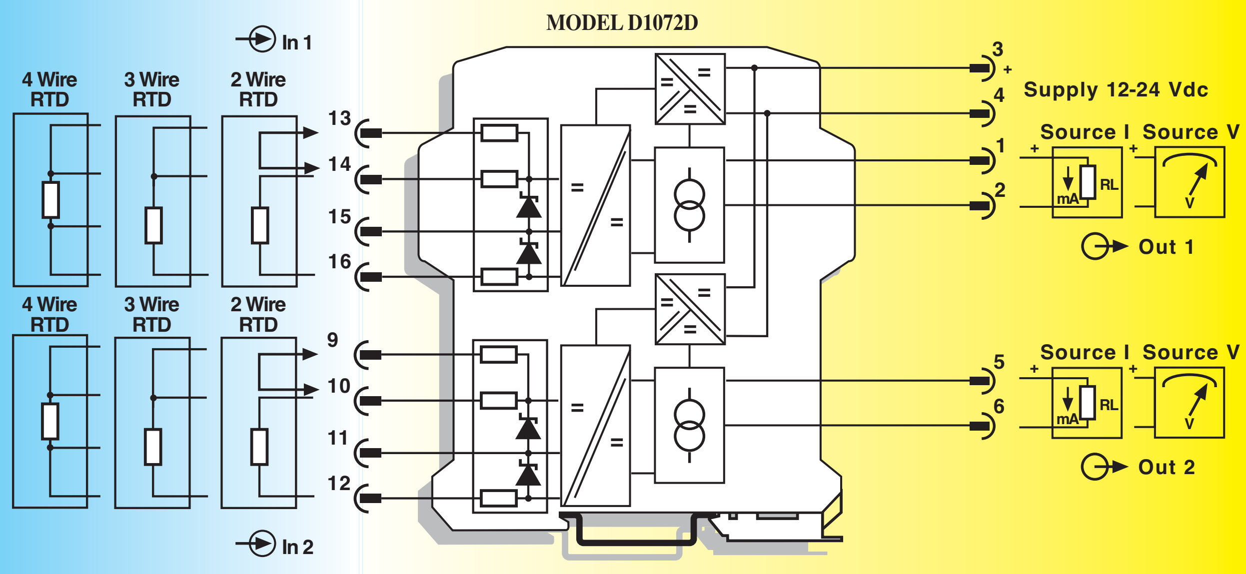




Function Diagram:

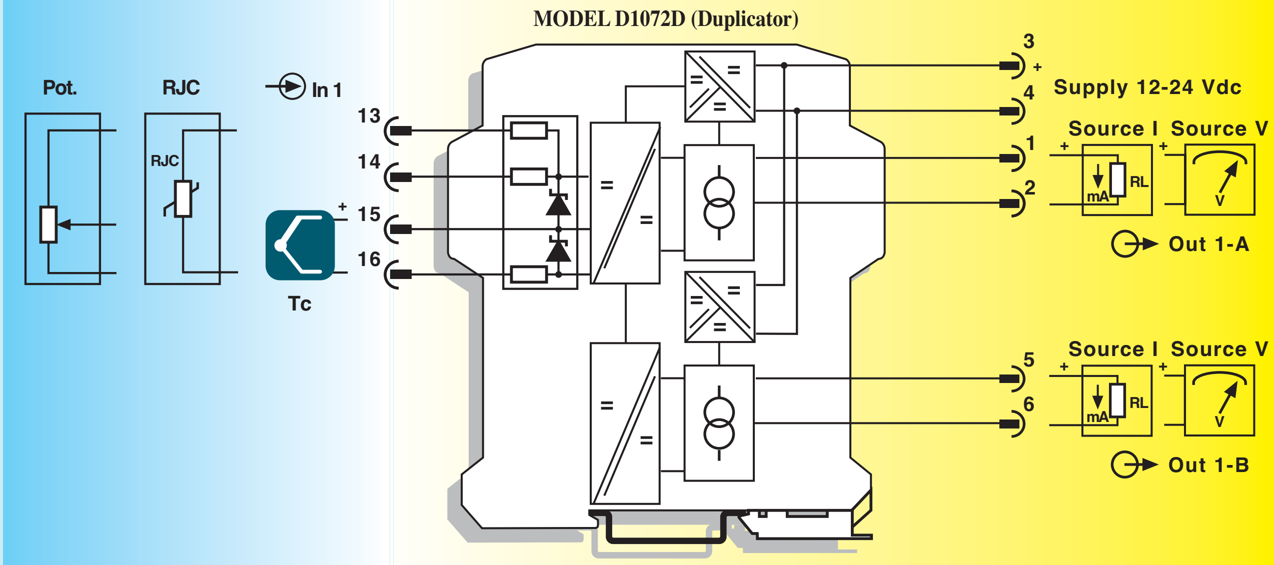
HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

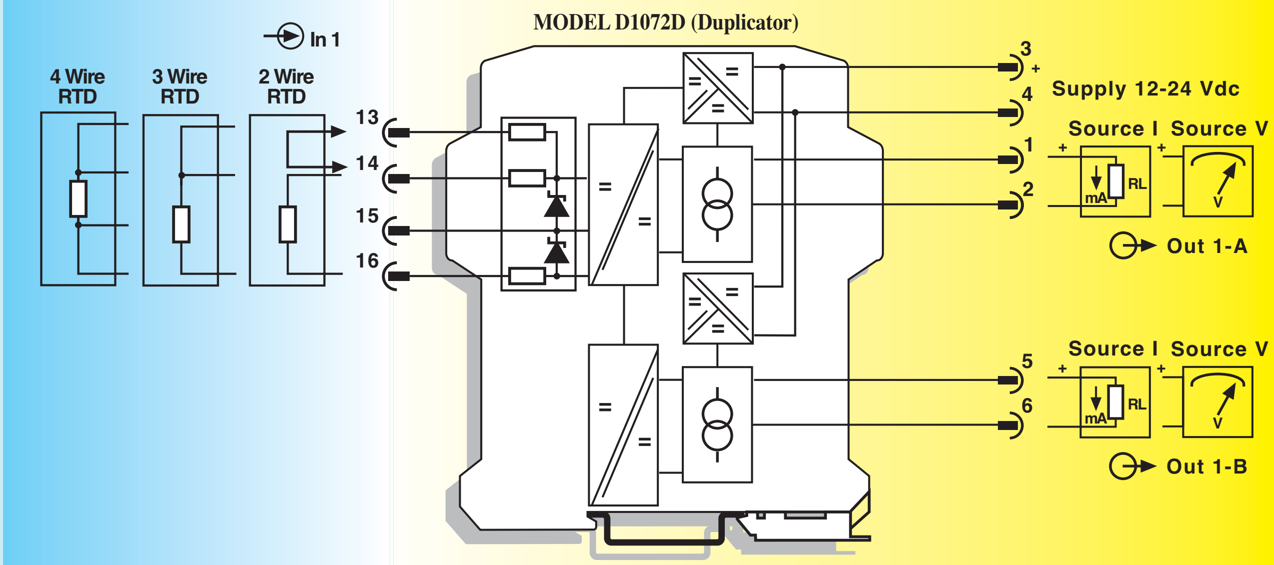




Function Diagram:

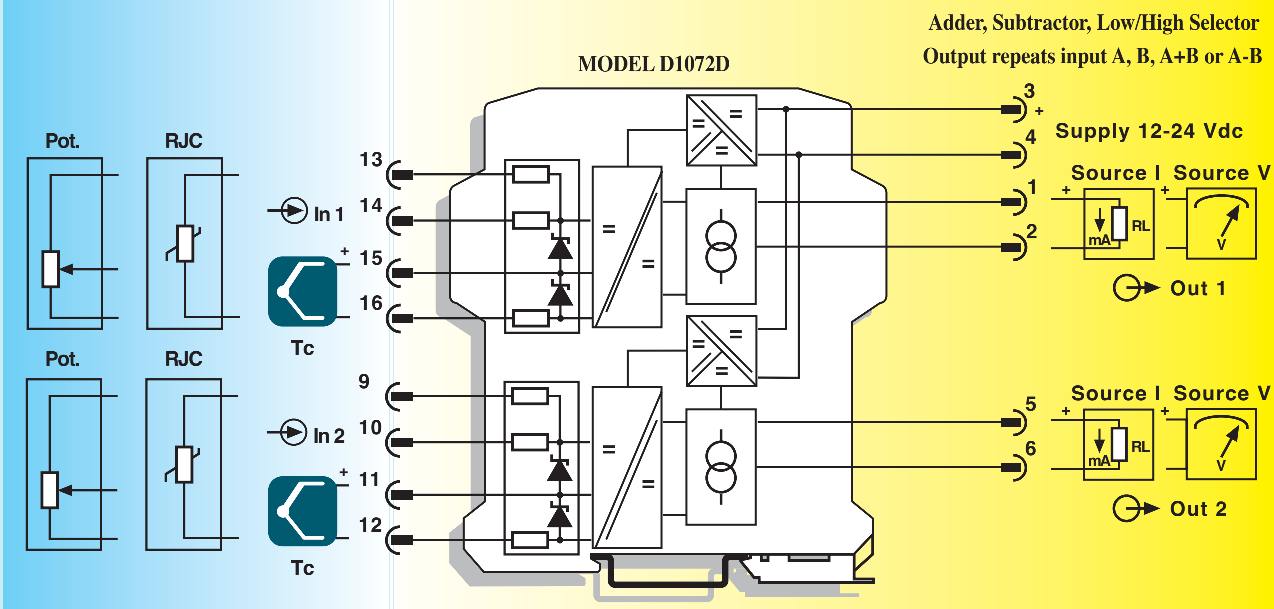
HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4

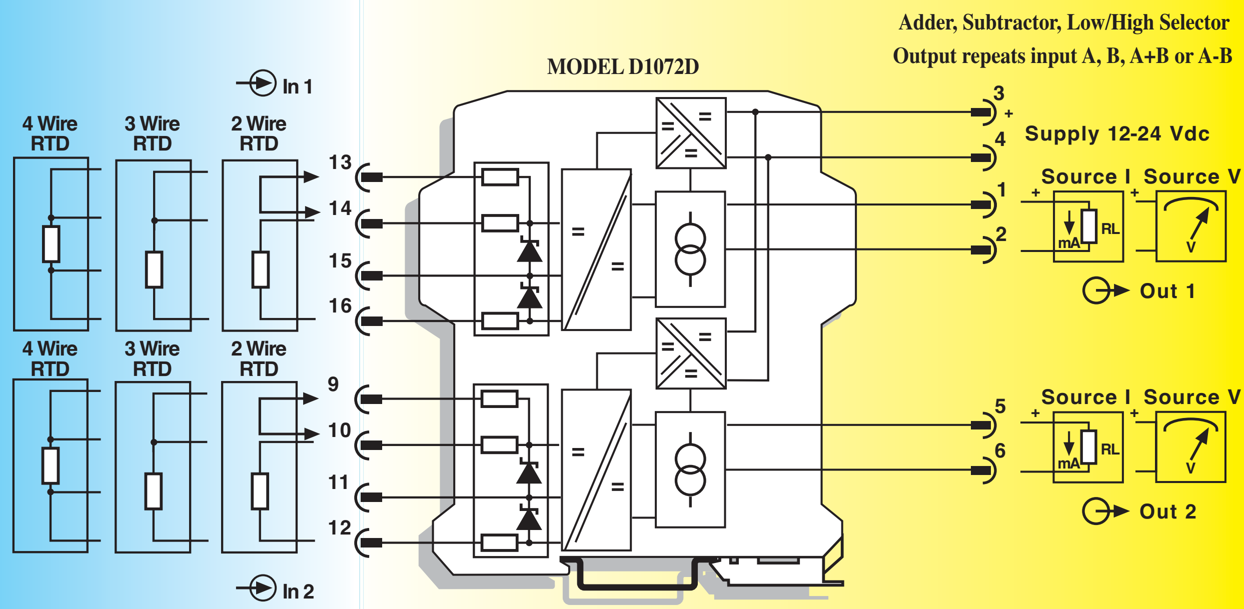




Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS or ZONE 2, GROUP IIC T4, CLASS I, DIVISION 2, GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4





GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1073

Temperature Converter and Trip Amplifiers DIN-Rail Model D1073S

Characteristics:

General Description:
The single channel DIN-Rail Temperature Converter and Trip Amplifiers D1073S converts a low level dc signal from millivolt, thermocouple or RTD Temperature sensor, located in Hazardous Area, into 4-20, 0-20 mA current or voltage output signal to drive a Safe Area load.
Two independent Alarm Trip Amplifiers are also provided. Each Alarm energizes, or de-energizes, an SPST Relay for High, Low, Low-startup or Burnout Alarm functions. The two Alarm Relays Trip points are settable over the entire input signal range.

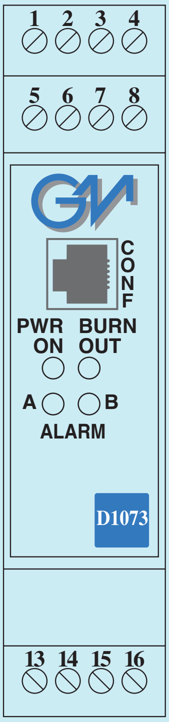
Function:
1 channel I.S. input for thermocouples or 3, 4 wire resistance thermometers or transmitting potentiometers, provides 3 port isolation (input/output/supply) and current or voltage output signal. In addition it provides two SPST Relay Alarm contacts with adjustable Alarm Trip Point.
The programmable RTD line resistance compensation allows the use of 2 wire RTDs or error compensation for 3-4 wire RTDs.
Cold Junction compensation can be automatic, with option 91, or fixed by software setting.

Signalling LEDs:
Power supply indication (green), Alarm A, Alarm B (red), Burnout (red).

Configurability:
Totally Software configurable, no jumpers or switches, Input sensor, Connection mode, Burnout operation, mA or V output signal, Alarm Trip Point, High/Low/Low-startup, Burnout Alarm mode, NE/ND relay operation, Hysteresis, Delay time, by a GM Pocket Portable Configurator PPC1090, powered by the unit or via RS-232 Serial line with PPC1092 Adapter and SWC1090 Software Configurator.
To operate PPC1090 refer to instruction manual.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- mV, Thermocouples, RTD or Transmitting Potentiometers Input Signal.
- 0/4-20 mA, 0/1-5 V, 0/2-10 V Output Signal Temperature Linear or Reverse.
- Output for burnout detection.
- Software programmability.
- RTD line resistance compensation programmable.
- Cold Junction automatic or fixed.
- 16 characters Tag for each channel programmable.
- High Accuracy, µP controlled A/D converter.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, 1 channel 2 Trips per unit.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply: 24 V nom (20 to 30 V) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 65 mA with 20 mA output and relays energized.
Max. power consumption: 2.20 W with 30 V supply voltage, overload condition, relays energized and PPC1090 connected.

Isolation (Test Voltage): I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; Analog Out/Alarm Out 1500 V; Analog Out/Supply 500 V. Alarm Out/Alarm Out 1500 V; Alarm Out/Supply 1500 V.

Input: millivolt or thermocouple type A1, A2, A3, B, E, J, K, L, N, R, S, T, U, Lr or 3, 4 wire RTD Pt 100, Pt 200, Pt 300 to DIN43760, Pt100 (0.3916), Ni 100 or Pt100, Pt50, Cu100, Cu53, Cu50 (russian standard) or 3 wire transmitting potentiometer (50 Ω to 20 KΩ).
Integration Time: 500 ms.
Resolution: 5 µV on mV or thermocouple, 1 µV thermocouple type B, R or S, 20 mΩ on RTD, 0.05 % on Potentiometer.
Visualization: 0.1 °C on temperature, 10 µV on mV, 0.1 % on Potentiometer
Input range: within rated limits of sensor (-10 to + 80 mV).
Measuring current: ≤ 0.5 mA.
Line resistance compensation: ≤ 10 Ω.
RTD line resistance compensation programmable: - 5 to + 20 Ω.
Thermocouple Reference junction compensation: automatic, by externally connected sensor (option 91 separately ordered), or fixed programmable from - 60 to + 100 °C.

Burnout: enabled or disabled. Analog output can be programmed to detect burnout condition with downscale or highscale forcing. Alarm can be programmed to detect burnout condition. Burnout condition signalled by red front panel LED.

Output: 0/4 to 20 mA, on max. 600 Ω load source mode, current limited at 22 mA or 0/1 to 5 V or 0/2 to 10 V signal, limited at 11 V.
Resolution: 2 µA current output or 1 mV voltage output.
Transfer characteristic: linear or reverse on mV or transmitting potentiometer, temperature linear or reverse on temperature sensors.
Response time: 100 ms (10 to 90 % step change).
Output ripple: ≤ 20 mV rms on 250 Ω load.

Alarm: ***Trip Point range:*** within rated limits of sensor (see input visualization parameters for step resolution).
ON-OFF delay time: 0 to 1000 s, 100 ms step programmable.
Hysteresis: 0 to 5 °C for temperature sensor input. 0 to 50 mV for mV input, 0 to 50% for potentiometer input. (see input visualization parameters for step resolution).
Output: Voltage free 1 + 1 SPST relay contact.
Contact rating: 2 A, 250 V, 100 VA or 2 A, 250 V, 80 W (resistive load).

Performance: Ref. Conditions 24 V supply, 250 Ω load, 23 ± 1 °C ambient temp.
Input: Calibration and linearity accuracy: ≤ ± 40 µV on mV or thermocouple, 200 mΩ on RTD, 0.2 % on Potentiometer or ± 0.05% of input value.
Temperature influence: ≤ ± 2 µV, 20 mΩ, 0.02 % or ± 0.01 % of input value for a 1 °C change.
Ref. junction compensation influence: ≤ ± 1 °C (thermocouple sensor).
Analog Output: Calibration accuracy: ≤ ± 0.1 % of full scale.
Linearity error: ≤ ± 0.05 % of full scale.
Supply voltage influence: ≤ ± 0.05 % of full scale for a min to max supply voltage change.
Load influence: ≤ ± 0.05 % of full scale for a 0 to 100 % load resistance change.
Temperature influence: ≤ ± 0.01 % on zero and span for a 1 °C change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions: ***Operating:*** Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:

II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 10.8 V, Io/Isc = 9 mA, Po/Po = 24 mW at terminals 13-14-15-16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.

Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting: T35 DIN Rail according to EN50022.

Weight: about 160 g.

Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.

Location: Safe Area / Non Hazardous Locations installation.

Protection class: IP 20.

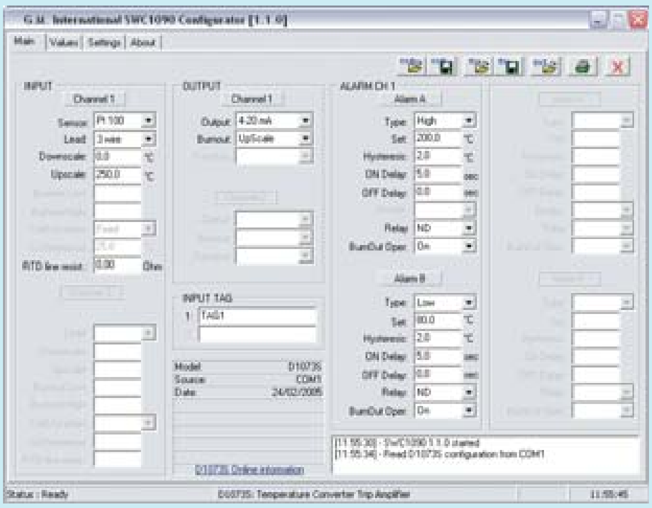
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 13-14-15-16				
Uo/Voc = 10.8 V	II C	2.14	477	1530
Io/Isc = 9 mA	II B	15.00	1909	6130
Po/Po = 24 mW	II A	66.00	3819	12260

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Friendly Configuration with PC and PPC1092 Adapter



SWC1090 Software Configurator is downloadable for free on our web site www.gminternationalsrl.com.

Ordering Information:

Model:	**D1073S**	
Power Bus enclosure		/B

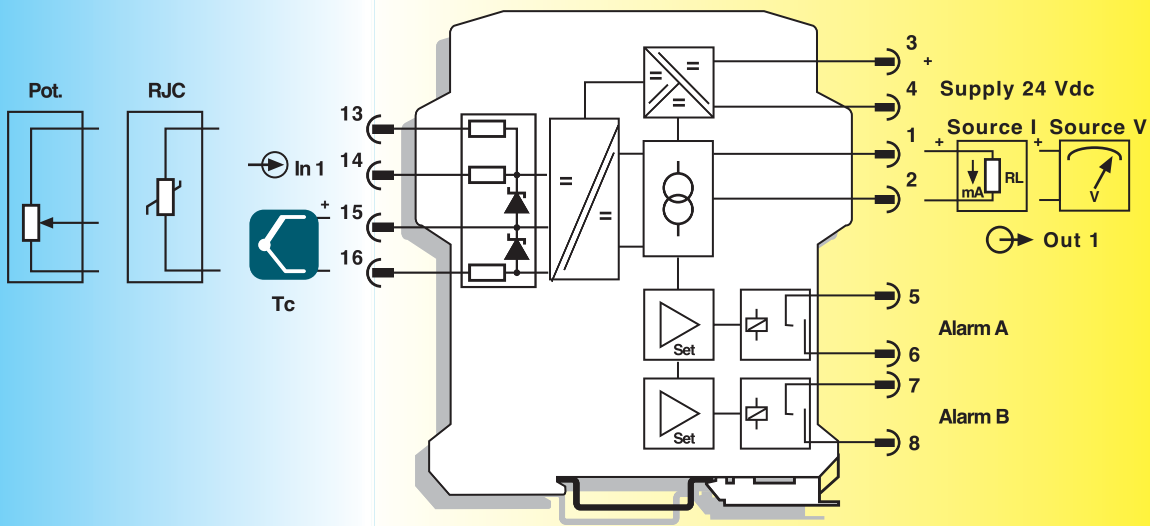
Input types, burnout conditions, output types, output range, alarm set point, conditions High/Low/Low-startup, Burnout, hysteresis, delay, relay NE/ND are programmable by the GM Pocket Portable Configurator type PPC 1090 or via RS-232 Serial line with PPC1092 Configurator. If the above information are provided with the Purchasing Order, the unit will be configured accordingly, otherwise the unit will be supplied, by default, with the following parameters:
Input Type: -10 to +80 mV.
Output Type: 4-20 mA.
Burnout: highscale.
Set: 50%.
Alarm mode: High.
Relay: ND.
Hysteresis: 4 mV.
Alarm Delay: 1 sec.
The plate will record the unit type, serial number, function diagram and terminal block layout for connections.

Note: for thermocouple sensor input, the Reference Junction Compensator is required for automatic ambient temperature compensation. It has to be ordered as Option 91 .
It will be supplied separately and it has to be connected to the input Terminal Blocks as indicated in the function diagram.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS

MODEL D1073S

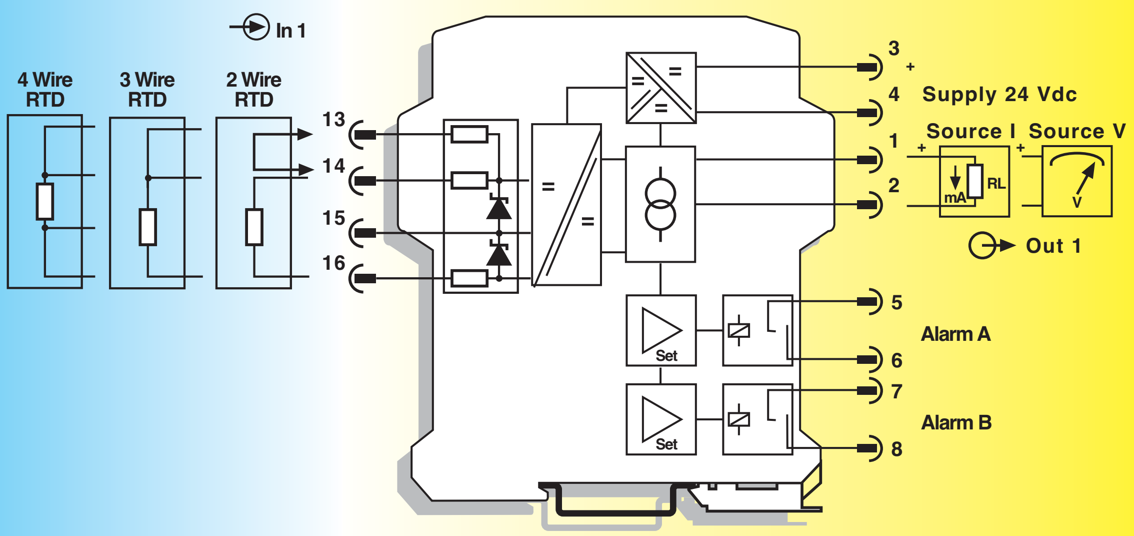


Relay contact shown in de-energized position

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D and CLASS II, DIVISION 1, GROUPS E, F, G or CLASS I, Zone 0, GROUP IIC	SAFE AREA / NON HAZARDOUS LOCATIONS

MODEL D1073S



Relay contact shown in de-energized position

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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1080

Flammable Liquid Presence Detector Interface Relay Output DIN-Rail Model D1080D

Characteristics:

General Description:
The Flammable Liquid Presence Detector Interface type D1080D is a DIN Rail unit configurable with two isolated independent channels.
The unit can be configured for NPN or PNP transistor type input, NO or NC and for NE or ND relay output.
Each channel enables a Safe Area load to be controlled by 3 wire opto-electronic sensor located in Hazardous Area.

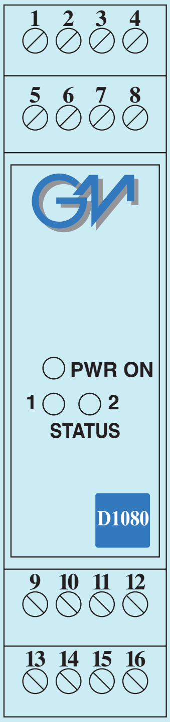
Function:
2 channels I.S. flammable liquid presence detector interface. Provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Output status (yellow).

Field Configurability:
NO/NC input for sensor transistor input, NE/ND relay operation, switching current levels.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



Dual Channel Flammable Liquid Presence Detector Interface Input.

Two Voltage free SPDT Relay Contact Output Signals.

Three port isolation, Input/Output/Supply.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Field programmability by DIP Switch.

ATEX, Russia and Ukraine Certifications.

High Reliability, SMD components.

High Density, two channels per unit.

Simplified installation using standard DIN Rail plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (20 to 30 V) reverse polarity protected ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 65 mA for 2 channels with relays energized.
Max. power consumption: 2.20 W for 2 channels at 30 V supply voltage with relays energized and short circuit input.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V Out/Supply 1500 V, Out/Out 1500 V.

Input switching current levels:
Dip switch settable at ≈ 8.0, 11.0, 14.0, 17.0 mA trip point.
Sensor supply current range is 0 to 5, 3 to 8, 6 to 11, 9 to 14 mA, switching current ≈ 8.0 mA ± 0.5 mA hysteresis.
Input equivalent source: 13.0 V 150 Ω typical (13 V no load, 25 mA short circuit limited current).

Output:
Voltage free SPDT relay contact.
Contact rating: 2 A 250 V 100 VA or 2 A 250 V 80 W (resistive load).
Response time: 20 ms.
Frequency response: 10 Hz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 15.8 V, Io/Isc = 109 mA, Po/Po = 428 mW at terminals 13-16, 9-12.
Uo/Voc = 15.8 V, Io/Isc = 13 mA, Po/Po = 51 mW at terminals 14-16, 13-15, 10-12, 9-11.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 150 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

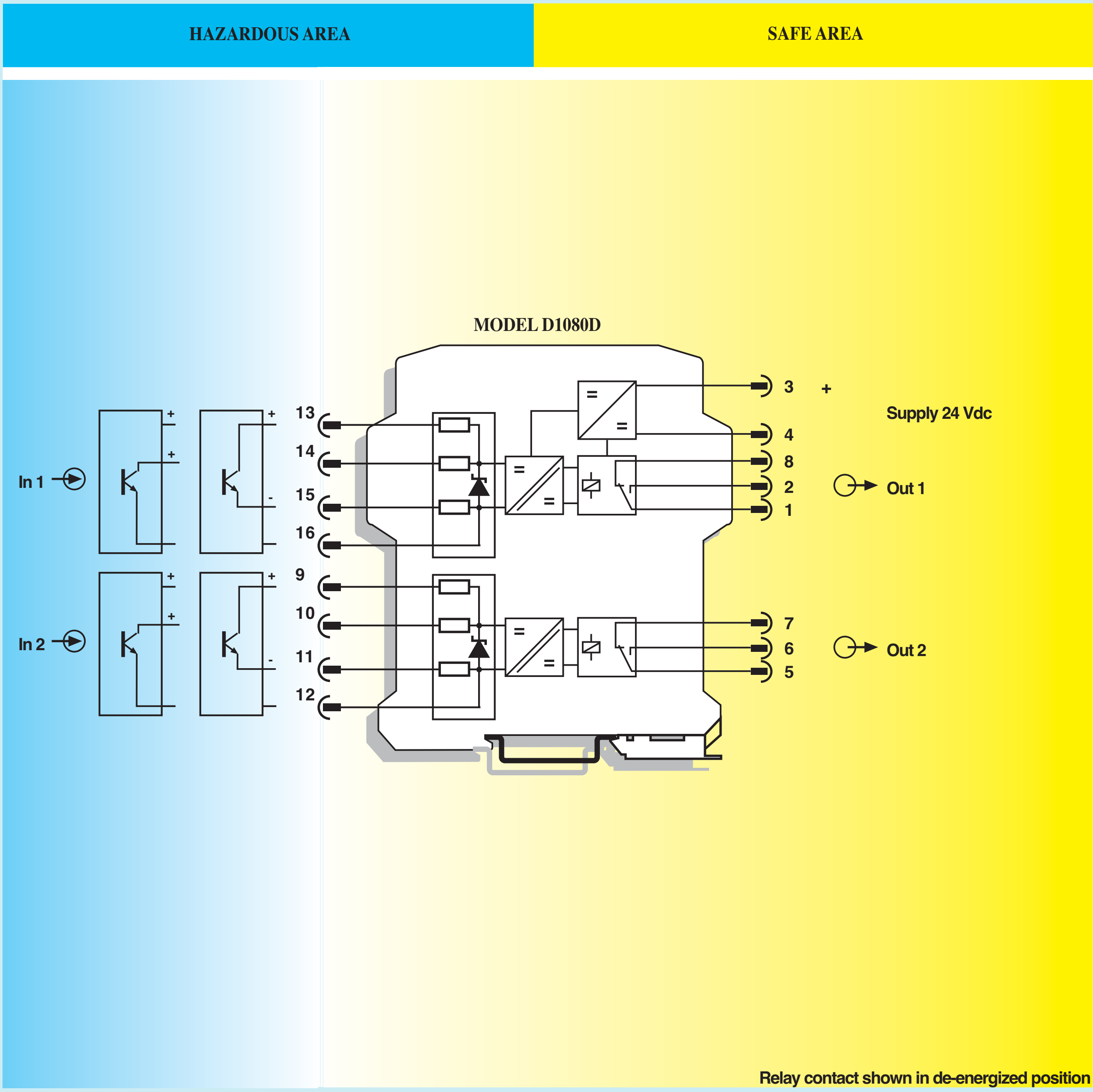
Ordering Information:

Model:	**D1080D**	
Power Bus enclosure		/B

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 13-16, 9-12				
Uo/Voc = 15.8 V	II C	0.478	3.0	83
Io/Isc = 109 mA	II B	2.880	12.0	337
Po/Po = 428 mW	II A	11.600	24.0	664
Terminals 14-16, 13-15, 10-12, 9-11				
Uo/Voc = 15.8 V	II C	0.478	217.6	706
Io/Isc = 13 mA	II B	2.880	870.7	2920
Po/Po = 51 mW	II A	11.600	1741.0	5650

Function Diagram:



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GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D1180

Flammable Liquid Presence Detector Interface Relay Output DIN-Rail Model D1180D

Characteristics:

General Description:
The Flammable Liquid Presence Detector Interface type D1180D is a DIN Rail unit configurable with two isolated independent channels.
The unit can be configured for NPN or PNP transistor type input, NO or NC and for NE or ND relay output.
Each channel enables a Safe Area load to be controlled by 3 wire opto-electronic sensor located in Hazardous Area.

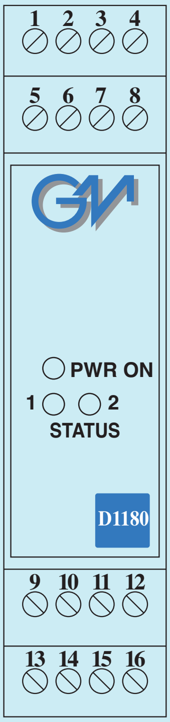
Function:
2 channels I.S. flammable liquid presence detector interface. Provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Output status (yellow).

Field Configurability:
NO/NC input for sensor transistor input, NE/ND relay operation, switching current levels.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- Dual Channel Flammable Liquid Presence Detector Interface Input.
- Two Voltage free SPDT Relay Contact Output Signals.
- Universal AC Supply Voltage (85 to 264 Vac or 100 to 350 Vdc).
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Field programmability by DIP Switch.
- ATEX, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
115-230 Vac (85 to 264 Vac), 50 to 400 Hz or 110 Vdc (100 to 350 Vdc).
Limit supply voltage to 250 Vrms for Instrinsic Safety applications.
Current consumption: 30 mA @ 115 Vac, 22 mA @ 230 Vac with relays energized.
Max. power consumption: 2.90 W for 2 channels at 264 Vac supply voltage, relays energized and short circuit input.

Isolation (Test Voltage):
I.S. In/Out 2.5 KV; I.S. In/Supply 2.5 KV; I.S. In/I.S. In 500 V
Out/Supply 2500 V, Out/Out 2500 V.

Input switching current levels:
Dip switch settable at ≈ 8.0, 11.0, 14.0, 17.0 mA trip point.
Sensor supply current range is 0 to 5, 3 to 8, 6 to 11, 9 to 14 mA, switching current ≈ 8.0 mA ± 0.5 mA hysteresis.
Input equivalent source: 13.0 V 150 Ω typical
(13 V no load, 25 mA short circuit limited current).

Output:
Voltage free SPDT relay contact.
Contact rating: 2 A 250 V 100 VA or 2 A 250 V 80 W (resistive load).
Response time: 20 ms.
Frequency response: 10 Hz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 15.8 V, Io/Isc = 109 mA, Po/Po = 428 mW at terminals 13-16, 9-12.
Uo/Voc = 15.8 V, Io/Isc = 13 mA, Po/Po = 51 mW at terminals 14-16, 13-15, 10-12, 9-11.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60 °C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 160 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

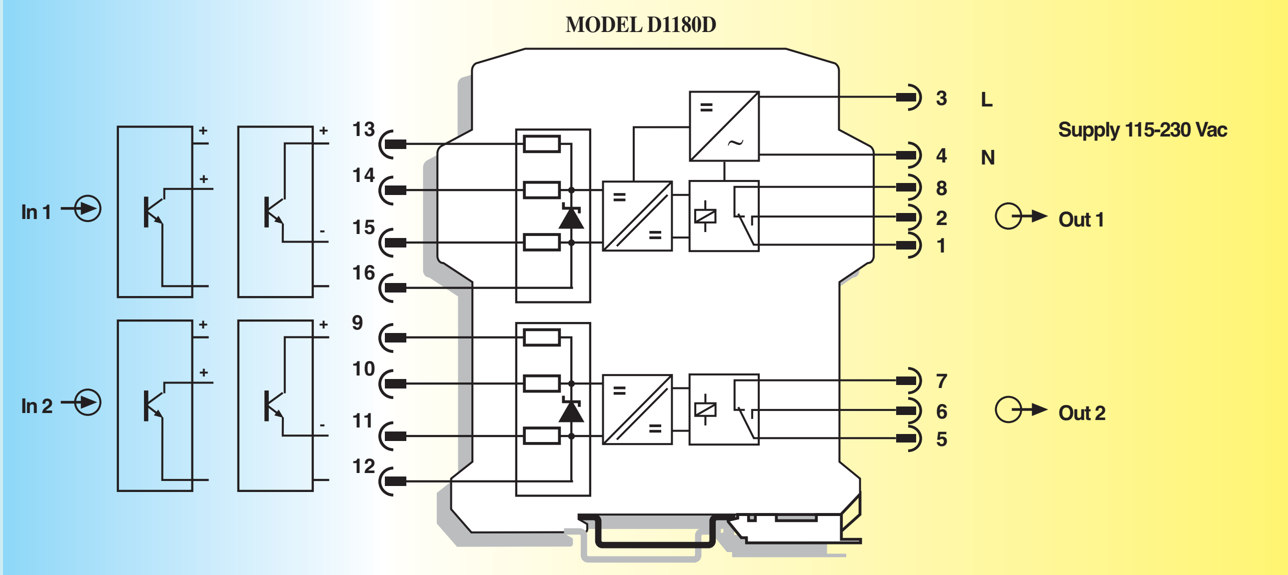
Model:	**D1180D**

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 13-16, 9-12				
Uo/Voc = 15.8 V	II C	0.478	3.0	83
Io/Isc = 109 mA	II B	2.880	12.0	337
Po/Po = 428 mW	II A	11.600	24.0	664
Terminals 14-16, 13-15, 10-12, 9-11				
Uo/Voc = 15.8 V	II C	0.478	217.6	706
Io/Isc = 13 mA	II B	2.880	870.7	2920
Po/Po = 51 mW	II A	11.600	1741.0	5650

Function Diagram:

HAZARDOUS AREA | SAFE AREA



Relay contact shown in de-energized position

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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D1081

Flammable Liquid Presence Detector Interface Transistor Output DIN-Rail Model D1081D

Characteristics:

General Description:
The Flammable Liquid Presence Detector Interface type D1081D is a DIN Rail unit configurable with two isolated independent channels.
The unit can be configured for NPN or PNP transistor type input, NO or NC and for NC or NO optocoupled open-collector transistor output.
Each channel enables a Safe Area load to be controlled by 3 wire opto-electronic sensor located in Hazardous Area.

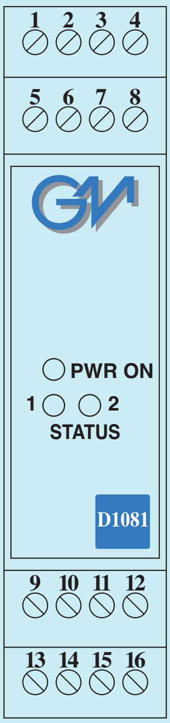
Function:
2 channels I.S. flammable liquid presence detector interface. Provides 3 port isolation (input/output/supply).

Signalling LEDs:
Power supply indication (green), Output status (yellow).

Field Configurability:
NO/NC input for sensor transistor input, NO/NC transistor operation, switching current levels.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- Dual Channel Flammable Liquid Presence Detector Interface Input.
- Two Voltage free optocoupled open-collector transistor Output Signals.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Field programmability by DIP Switch.
- ATEX, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, two channels per unit.
- Simplified installation using standard DIN Rail plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
15-24 V nom (14 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 55 mA for 2 channels with transistor energized.
Current consumption @ 15 V: 80 mA for 2 channels with transistor energized.
Max. power consumption: 2.00 W for 2 channels at 30 V supply voltage with transistor energized and short circuit input.

Isolation (Test Voltage):
I.S. In/Out 1.5 KV; I.S. In/Supply 1.5 KV; I.S. In/I.S. In 500 V
Out/Supply 500 V, Out/Out 500 V.

Input switching current levels:
Dip switch settable at ≈ 8.0, 11.0, 14.0, 17.0 mA trip point.
Sensor supply current range is 0 to 5, 3 to 8, 6 to 11, 9 to 14 mA,
switching current ≈ 8.0 mA ± 0.5 mA hysteresis.
Input equivalent source: 13.0 V 150 Ω typical
(13 V no load, 25 mA short circuit limited current).

Output:
Voltage free SPST optocoupled open-collector transistor.
Open-collector rating: 50 mA at 35 V or 100 mA at 12 V (≤ 1.5 V voltage drop).
Leakage current: ≤ 50 µA at 35 V.
Response time: 500 µs.
Frequency response: 2 KHz maximum.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 15.8 V, Io/Isc = 109 mA, Po/Po = 428 mW at terminals 13-16, 9-12.
Uo/Voc = 15.8 V, Io/Isc = 13 mA, Po/Po = 51 mW at terminals 14-16, 13-15, 10-12, 9-11.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60 °C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 130 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

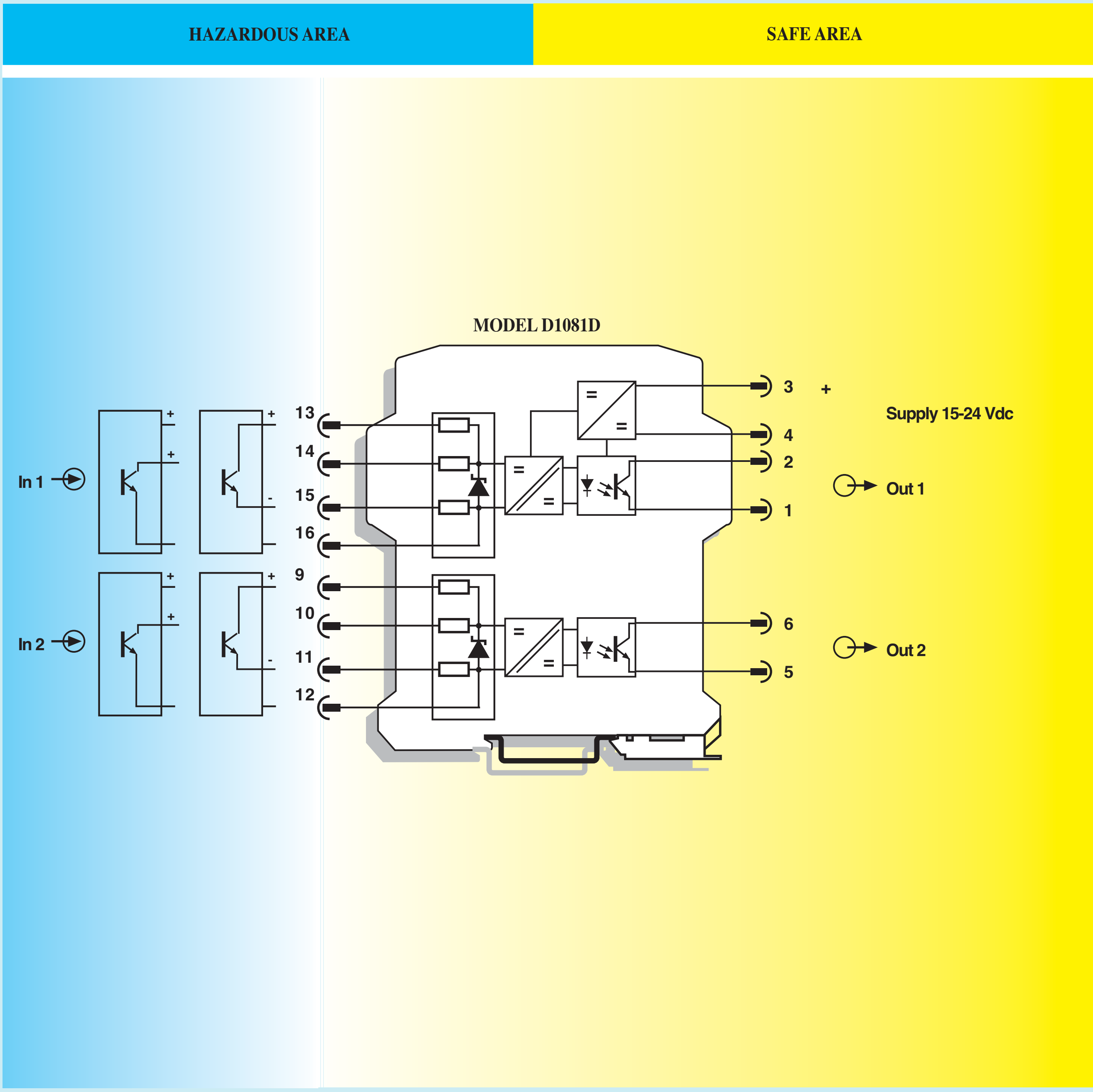
Ordering Information:

Model:	**D1081D**	
Power Bus enclosure		/B

Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Terminals 13-16, 9-12				
Uo/Voc = 15.8 V	II C	0.478	3.0	83
Io/Isc = 109 mA	II B	2.880	12.0	337
Po/Po = 428 mW	II A	11.600	24.0	664
Terminals 14-16, 13-15, 10-12, 9-11				
Uo/Voc = 15.8 V	II C	0.478	217.6	706
Io/Isc = 13 mA	II B	2.880	870.7	2920
Po/Po = 51 mW	II A	11.600	1741.0	5650

Function Diagram:



Power Supplies
PSD1000-1200 Series

Data Sheets with **Specifications** and Function Diagrams

GM INTERNATIONAL TECHNOLOGY FOR SAFETY

PS D1000

Universal AC Input Switching Power Supply 24 Vdc Output Model PSD1000

Characteristics:

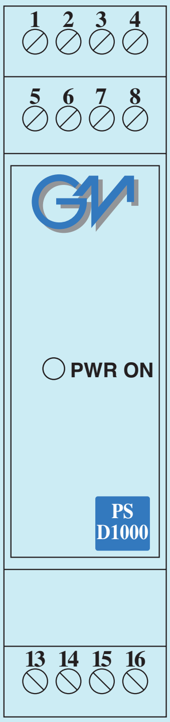
General Description:
The PSD1000 is a DIN Rail mounting universal AC input switching power supply with 24 Vdc 500 mA current output capability, to supply D1000 Series units or other 24 Vdc devices; it provides isolation between input and output and a relay for detection of supply fault (input line, output overload or thermal overload). The output is protected from overload (current or thermal) and short circuit (the unit switches the output off for a second and then tries to re-activate it until the fault condition is removed). The output is diode protected to connect multiple power supply (redundant output) or to increase the output power.

Function:
Universal Input Power Supply to drive D1000 Series units or other field equipment.

Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



Units can be mounted close to the I.S. modules (no 50 mm distance) because V ac input and Vdc output are on the same side (safe) of the unit.

Universal AC Input Power Supply.

Stabilized 24 Vdc 500 mA output capability.

Redundant outputs connection.

Isolation Input/Output.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Output short circuit proof and current limited.

Simplified installation using standard DIN Rail with plug-in disconnect terminal blocks.

Technical Data:

Supply:
115-230 Vac input, 50-60 Hz typical connection (90 to 264 Vac, 48 to 400 Hz), or 130 to 370 Vdc, ripple within voltage limits ≤ 10 Vpp.
Current consumption: 220 mA at 115 Vac, 150 mA at 230 Vac with 500 mA output current.
Inrush Current: 10 A with < 10 ms duration.
Max. power consumption: 15 W with full output, 1W with no load, max. internal power dissipation 3 W.

Isolation:
AC Input/DC Output 2.5 KV, Fault Output/AC Input 2.5 KV
Fault Output/DC Output 500 V.

Output:
24 Vdc (22.8 to 25.2 V) with 500 mA current capability, parallel connection possible for redundant output.
Current output: 400 mA with 90 Vac input, 60 °C ambient temperature 700 mA with 230 Vac input and 40 °C ambient temperture.
Short circuit current: 750 mA.
Ripple content: < 400 mVrms.
Efficiency: 80% at 115 Vac input, 82% at 230 Vac input.

Fault Output:
Voltage free SPDT relay contact, normally energized. De-energize in fault conditions (output overload or input line fault).
Contact rating: 1 A 50 V (resistive load).
Response time: 20 ms.

Compatibility:
CE mark compliant, conforms to EN61000-6-2, EN61000-6-4 and EN60950 for electrical safety.

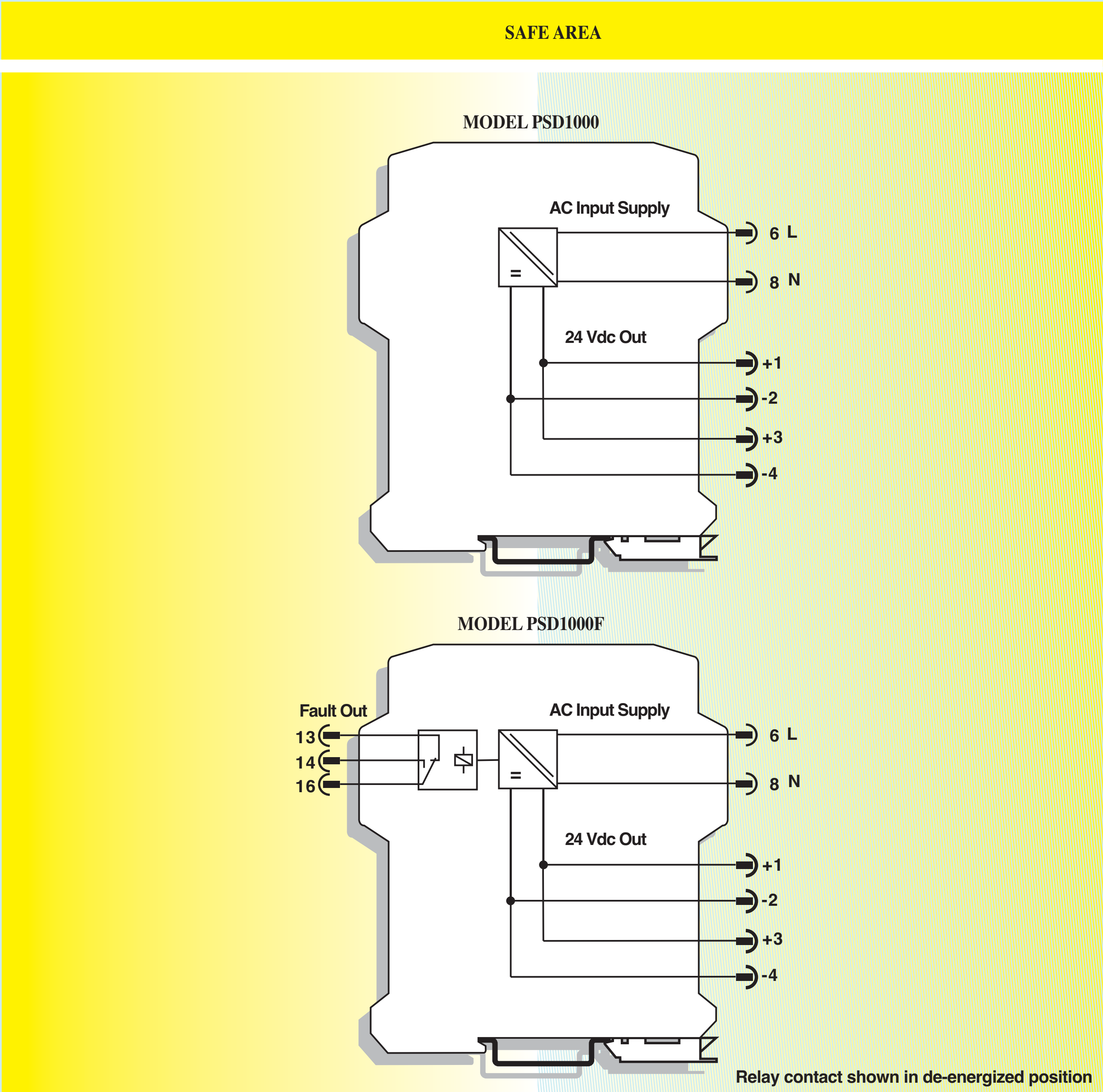
Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 150 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2,5 mm^2.
Location: Safe Area installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

Model: PSD1000		
Without Fault Relay Output Terminal	Blank	
With Fault Relay Output Terminal	F	
Power Bus enclosure output option		/B

Function Diagram:



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GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

PS D1001

4 Channels Power Supply for Hazardous Area Equipment Model PSD1001

Characteristics:

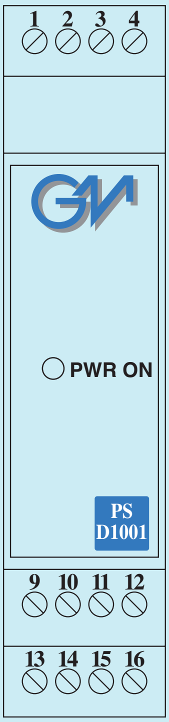
General Description:
The PSD1001 is a quad channel Din Rail Power Supply to drive measuring, process control equipments in Hazardous Area; it provides isolation between input and output (1.5 KV).
Typical application is to drive 4-20 mA 2 wire transmitter with local indication (no repetition of current in Safe Area).
Output channels can be paralleled if more power is required.

Function:
4 channels power supply indipendently or in parallel to operate Hazardous Area Loads providing isolation (input/output).

Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- SIL 2 - SIL 3 according IEC 61508, IEC 61511.
- 4 Channels Power Supply for Hazardous Area equipment.
- Flexible modular multi output capability.
- Isolation Input/Output.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Output short circuit proof and current limited.
- ATEX, UL & C-UL, Russia and Ukraine Certifications.
- High Reliability, SMD components.
- High Density, four channels per unit.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.
- 250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (21.5 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 110 mA four channels at 20 mA nominal load, 140 mA with short circuit output.
Max. power consumption: 3.80 W at 30 V supply voltage with short circuit output.

Isolation (Test Voltage):
I.S. Out/Supply 1.5 KV;

Output:
20 mA per channel at 15 V (20.5 V no load, 273 Ω series resistance).
Short circuit current: ≥ 24 mA per channel (26 mA typical).

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIC or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 24.2 V, Io/Isc = 90.7 mA, Po/Po = 549 mW
at terminals 13-14, 15-16, 9-10, 11-12.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL, TCCExEE (Russia) Nr.665 according to GOST R 51330.0-99, 51330.10-99 [Exia]IIC X, TCCExEE (Ukraine) Nr.665 according to GOST 12.2.007.0, 22782.0, 22782.5 ExiaIIC X, Gosgortekhnadzor of Russia Permit Nr. PPC 04-11284.
EXIDA Report No. GM04/10-26 R001, SIL 2 - SIL 3 according to IEC 61508, IEC 61511. Please refer to functional safety manual for SIL applications.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 120 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations or Class I, Division 2, Groups A, B, C, D and Class I, Zone 2, Group IIC installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

Model:	**PSD1001**	
Power Bus enclosure		/B

PSD1001 Parameters Table Single-Dual Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	L/R / La/Ra (μH/Ω)
Terminals 9-10, 11-12 13-14, 15-16	**(Quad channel: 1 + 1 + 1 + 1)**			
Uo/Voc = 24.2 V	II C	0.122	4.30	64.7
Io/Isc = 90.7 mA	II B	0.910	17.20	259.0
Po/Po = 549 mW	II A	3.270	34.50	518.0
Terminals 9/11-10/12 13/15-14/16	**(Dual channel: 2 parallel + 2 parallel)**			
Uo/Voc = 24.2 V				
Io/Isc = 181.4 mA	II B	0.910	4.32	129.5
Po/Po = 1098 mW	II A	3.270	8.64	259.0

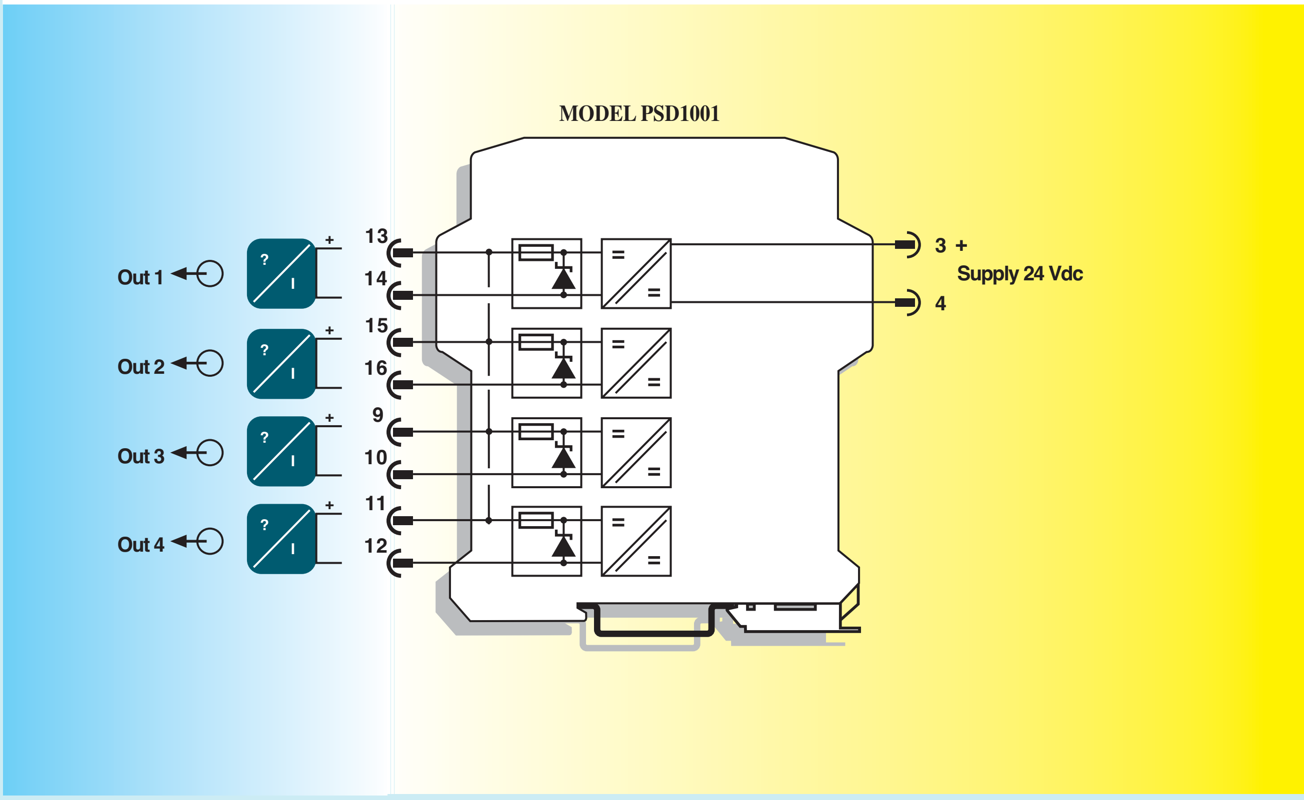
PSD1001 Parameters Table Triple-Quad Output:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	L/R / La/Ra (μH/Ω)
Terminals 9/11/13-10/12/14	**(Dual channel: 3 parallel + 1)**			
Uo/Voc = 24.2 V				
Io/Isc = 272.1 mA	II B	0.910	1.92	86.4
Po/Po = 1647 mW	II A	3.270	3.84	172.7
Terminals 9/11/13/15-10/12/14/16	**(Single channel: 4 parallel)**			
Uo/Voc = 24.2 V				
Io/Isc = 362.8 mA	II B	0.910	1.08	64.7
Po/Po = 2195 mW	II A	3.270	2.16	129.4

NOTE for USA and Canada:
II C equal to Gas Groups A, B, C, D, E, F and G.
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1 and CLASS II, DIVISION 1 or CLASS I, Zone 0	SAFE AREA / NON HAZARDOUS LOCATIONS or CLASS I, DIVISION 2, GROUPS A, B, C, D or CLASS I, ZONE 2, GROUP IIC



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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

PSD 1001C

IIB Group Power Supply for Hazardous Area Equipment Model PSD1001C

Characteristics:

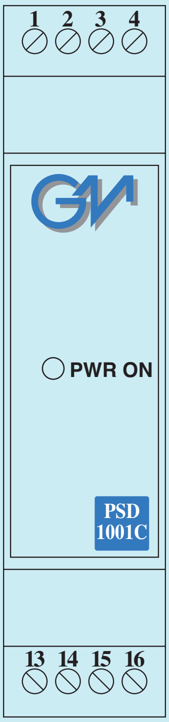
General Description:
The PSD1001C is a single channel Din Rail Power Supply to drive measuring, process control equipments in IIB Group Hazardous Area; it provides isolation between input and output (1.5 KV).
Typical application is to drive high power devices, transmitter or other equipment with 13 V, 100 mA supply capability.

Function:
1 channel IIB Group power supply to operate Hazardous Area Loads providing isolation (input/output).

Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



SIL 2 - SIL 3 according IEC 61508, IEC 61511.

High Output Capability Power Supply for Hazardous Area equipment.

Isolation Input/Output.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Output short circuit proof and current limited.

ATEX, UL & C-UL Certifications.

High Reliability, SMD components.

Simplified installation using standard DIN Rail with plug-in terminal blocks.

250 Vrms (Um) max. voltage applied to the instruments associated with barrier.

Technical Data:

Supply:
24 V nom (21.5 to 30 V) reverse polarity protected
ripple within voltage limits ≤ 5 Vpp.
Current consumption @ 24 V: 110 mA with 80 mA nominal load, 130 mA with 100 mA load and 150 mA with short circuit output.
Max. power consumption: 3.80 W at 30 V supply voltage with short circuit output.

Isolation (Test Voltage):
I.S. Out/Supply 1.5 KV;

Output:
100 mA at 13.5 V, 150 mA at 10 V (20.5 V no load, 68 Ω series resistance).
Short circuit current: ≥ 160 mA.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C,
relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II (1) G D [EEx ia] IIB or I M2 [EEx ia] I associated electrical apparatus.
Uo/Voc = 24.2 V, Io/Isc = 362.8 mA, Po/Po = 1724 mW
at terminals 13/15-14/16.
Um = 250 Vrms, -20 °C ≤ Ta ≤ 60°C.
Approvals: DMT 01 ATEX E 042 X conforms to EN50014, EN50020, UL & C-UL E222308 conforms to UL913 (Div.1), UL 60079-0 (General, All Zones), UL60079-11 (Intrinsic Safety i Zones 0 & 1), UL60079-15 (n Zone 2), UL 1604 (Div.2) for UL and CSA-C22.2 No.157-92 (Div.1), CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 213-M1987 (Div. 2) and CSA-E60079-15 (n Zone 2) for C-UL. EXIDA Report No. GM04/10-26 R001, SIL 2 - SIL 3 according to IEC 61508, IEC 61511. Please refer to functional safety manual for SIL applications.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 120 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Safe Area / Non Hazardous Locations or Class I, Division 2, Groups A, B, C, D and Class I, Zone 2, Group IIC installation.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

Model:	**PSD1001C**	
Power Bus enclosure		/B

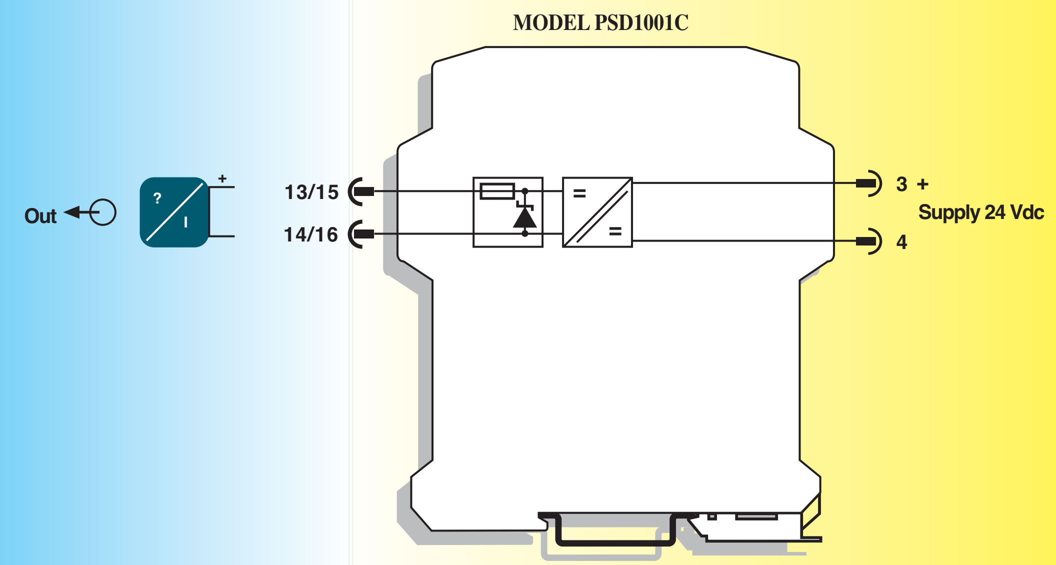
Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	L/R / La/Ra (μH/Ω)
Terminals 13/15-14/16				
Uo/Voc = 24.2 V Io/Isc = 362.8 mA Po/Po = 1724 mW	II B II A	0.910 3.270	1.08 2.16	64.7 129.4

NOTE for USA and Canada:
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:

HAZARDOUS AREA / HAZARDOUS LOCATIONS CLASS I, DIVISION 1 and CLASS II, DIVISION 1 or CLASS I, Zone 0	SAFE AREA / NON HAZARDOUS LOCATIONS or CLASS I, DIVISION 2, GROUPS A, B, C, D or CLASS I, ZONE 2, GROUP IIC



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GM INTERNATIONAL TECHNOLOGY FOR SAFETY

PSU 1003

Intrinsically Safe 5 V Supply Module Model PSU1003

Characteristics:

General Description:
PSU1003 power supply is an intrinsically safe module potted as a sealed component in a 55 x 30 x 15 mm plastic enclosure with soldering pins for PCB mounting, the module can be installed in Hazardous Areas Zone 0 (20), Zone 1 (21), Zone 2 (22), Gas Group IIB or IIA temperature classification T4. Powered at about 12 V from the intrinsically safe PSD1001C supply module, it provides a stabilized 5 V, 160 mA supply with 500 V input/output isolation, short circuit and reverse input polarity protection, remote sensing and regulation.

Function:
Typical application is to power at 5 V, 160 mA intrinsically safe circuits implementing digital logic blocks, microcontroller operated peripherals like keyboards, encoders, logic solvers, LCD display units and transmitters.

EMC:
Fully compliant with CE marking applicable requirements.

Features:

High Output Capability for Powering Hazardous Areas Circuits.

500 V Input/Output Isolation.

EMC Compatibility to EN61000-6-2, EN61000-6-4.

Short circuit proof highly stabilized output with remote sensing voltage regulation.

Input reverse polarity protected.

ATEX, UL & C-UL Certifications.

High Reliability, SMD components.

Rugged sealed construction suitable for installation in harsh environments.

Technical Data:

Supply:
From PSD1001C supply module (nominal 19 V with 68 Ω series resistance).

Isolation (Test Voltage):
500 V Input/Output.

Output:
Voltage: 5 V ± 3%.
Current: 0 to 160 mA.
Voltage regulation: ≤ 0.2% for a 0 to 160 mA load change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

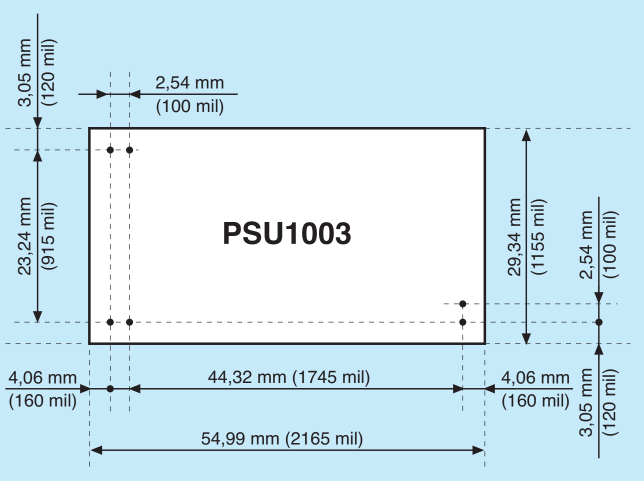
Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits 40 to + 80 °C.

Safety Description:
II 1 G EEx ia IIB T4-U.
Uo/Voc = 6.51 V, Po/Po = 1760 mW, Co/Ca = 270 µF, at output pins O+ and O-, S+ and S-.
Ui/Vmax = 24.2 V, Ii/Imax = 373 mA, Pi/Pi = 1760 mW, Ci/Ci = 0.36 µF, Li/Li = 0 µH at input pins I+ and I-.

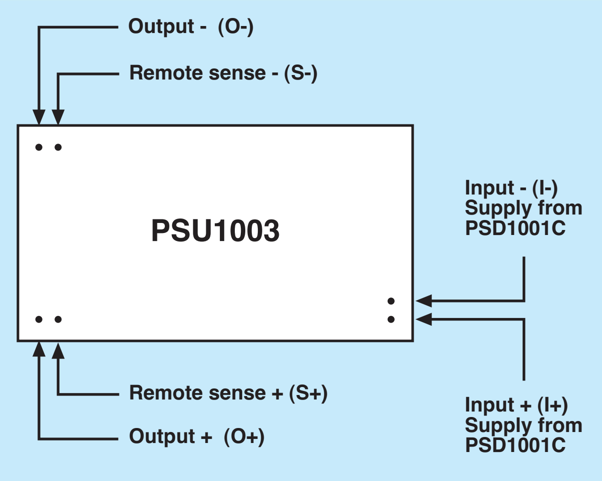
Approvals: applied for conforms to EN50014, EN50020.

Mounting:
Soldered on printed circuit board by connection pins.
Weight: about 30 g.
Connection: By PCB soldering square pins 0.6 mm, lenght 7 mm (1 mm PCB drilling).
Location: Hazardous Areas Zone 0 (20), Zone 1 (21), Zone 2 (22). Gas group IIB or IIA, Temperature class T4.
Dimensions: Width 55 mm, Depth 30 mm, Height 15 mm.

PCB Drilling Dimensions



Pin Assignement Top View:



Ordering Information:

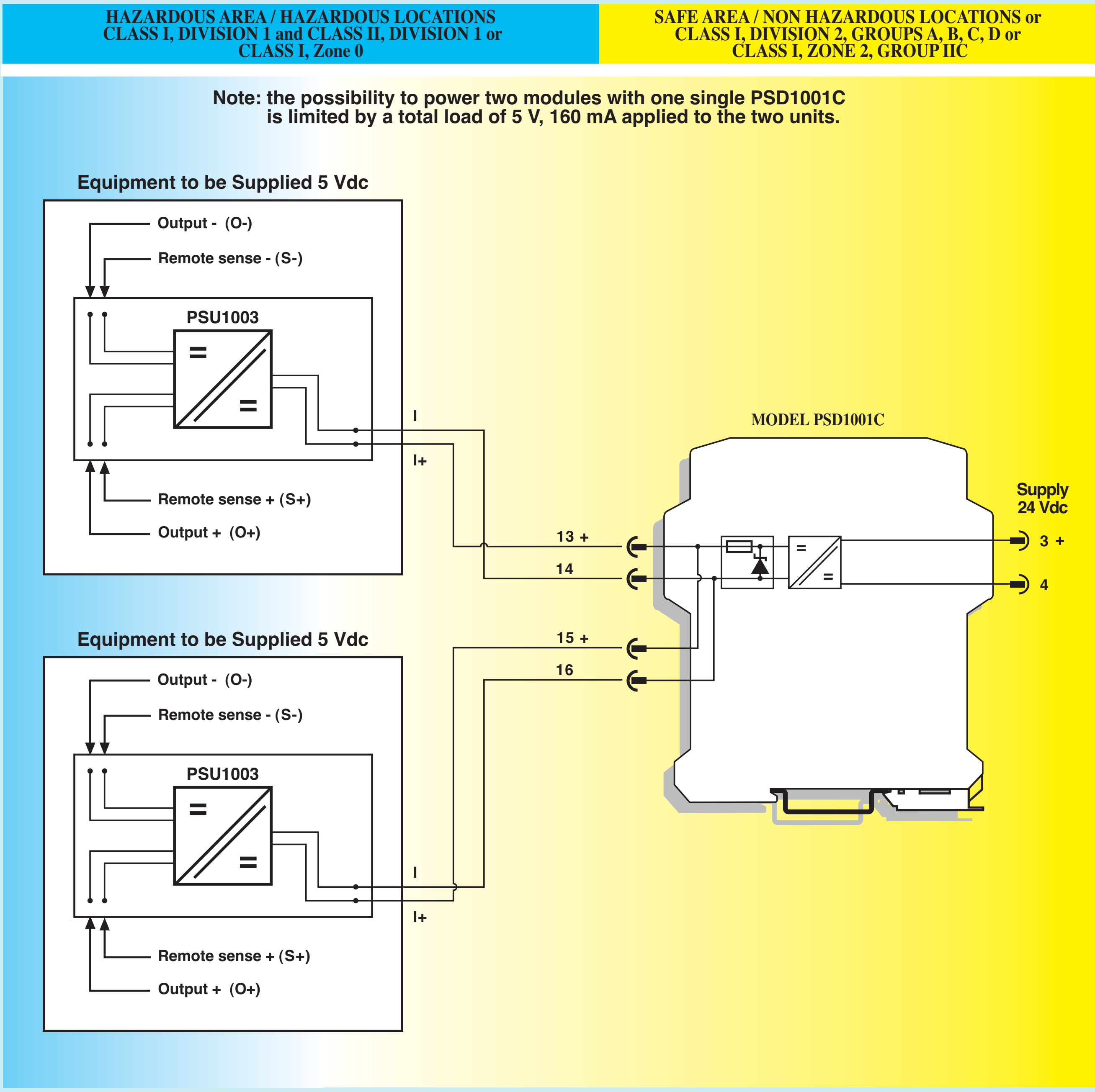
Model:	PSU1003

Parameters Table:

Safety Description	Maximum External Parameters	
	Group Cenelec	Co/Ca (µF)
Pins O+, O-, S+, S-		
Uo/Voc = 6.51 V	IIB	270
Po/Po = 1760 mW	II A	700
Pins I+ and I-		
Ui/Vmax = 24.2 V	IIB	
Ii/Imax = 373 mA	II A	
Pi/Pi = 1760 mW		
Ci/Ci = 0.36 µF		
Li/Li = 0 µH		

NOTE for USA and Canada:
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



GM INTERNATIONAL TECHNOLOGY FOR SAFETY

PSD 1004

Intrinsically Safe 5 V Supply Module DIN Rail Model PSD1004

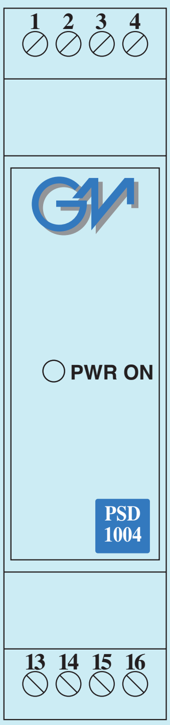
Characteristics:

General Description:
PSD1004 power supply is an intrinsically safe module that can be installed in Hazardous Areas Zone 0 (20), Zone 1 (21), Zone 2 (22), Gas Group IIB or IIA temperature classification T4.
Powered at about 12 V from the intrinsically safe PSD1001C supply module, it provides a stabilized 5 V, 160 mA supply with 500 V input/output isolation, short circuit and reverse input polarity protection, remote sensing and regulation.

Function:
Typical application is to power at 5 V, 160 mA intrinsically safe circuits implementing digital logic blocks, microcontroller operated peripherals like keyboards, encoders, logic solvers, LCD display units and transmitters.

EMC:
Fully compliant with CE marking applicable requirements.

Front Panel and Features:



- High Output Capability for Powering Hazardous Areas Circuits.
- 500 V Input/Output Isolation.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Short circuit proof highly stabilized output with remote sensing voltage regulation.
- Input reverse polarity protected.
- Power ON indication.
- ATEX, UL & C-UL Certifications.
- High Reliability, SMD components.
- Rugged sealed construction suitable for installation in harsh environments.
- Simplified installation using standard DIN Rail with plug-in terminal blocks.

Technical Data:

Supply:
From PSD1001C supply module (nominal 19 V with 68 Ω series resistance).

Isolation (Test Voltage):
500 V Input/Output.

Output:
Voltage: 5 V ± 3%.
Current: 0 to 160 mA.
Voltage regulation: ≤ 0.2% for a 0 to 160 mA load change.

Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:
Operating: Temperature limits -20 to + 60 °C, relative humidity max 90 % non condensing, up to 35 °C.
Storage: Temperature limits -40 to + 80 °C.

Safety Description:
II 1 G EEx ia IIB T4.
Uo/Voc = 6.51 V, Po/Po = 1760 mW, Co/Ca = 270 µF, at terminals 13-14-15-16.
Ui/Vmax = 24.2 V, Ii/Imax = 373 mA, Pi/Pi = 1760 mW, Ci/Ci = 0.36 µF, Li/Li = 0 µH at terminals 1-2/3-4.

Approvals: applied for conformity to EN50014, EN50020.

Mounting:
T35 DIN Rail according to EN50022.
Weight: about 80 g.
Connection: By polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Hazardous Areas Zone 0 (20), Zone 1 (21), Zone 2 (22). Gas group IIB or IIA, Temperature class T4.
Protection class: IP 20.
Dimensions: Width 22.5 mm, Depth 99 mm, Height 114.5 mm.

Ordering Information:

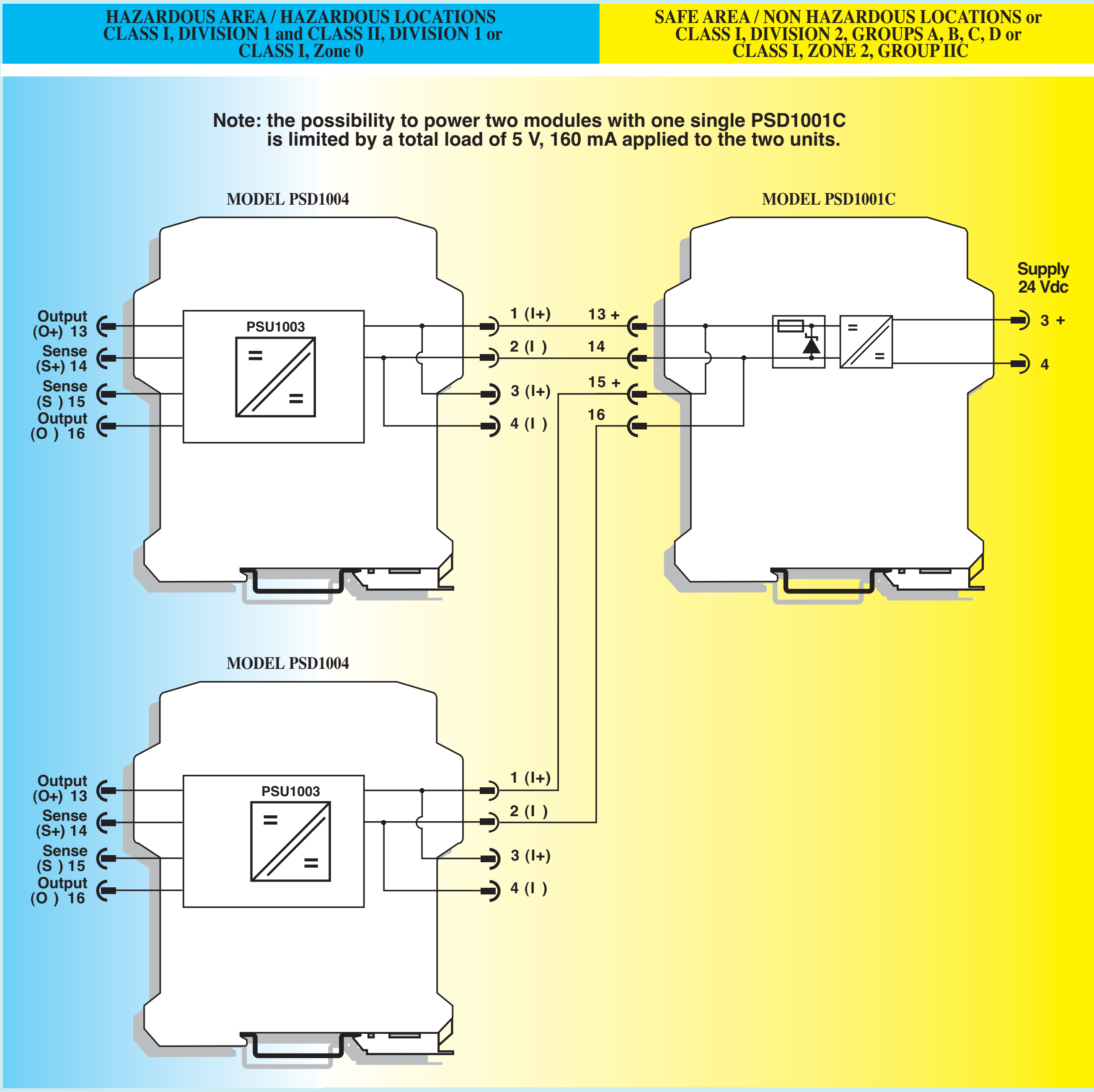
Model:	**PSD1004**

Parameters Table:

Safety Description	Maximum External Parameters	
	Group Cenelec	Co/Ca (µF)
Terminals 13-14-15-16		
Uo/Voc = 6.51 V	IIB	270
Po/Po = 1760 mW	II A	700
Terminals 1-2/3-4		
Ui/Vmax = 24.2 V	IIB	
Ii/Imax = 373 mA	II A	
Pi/Pi = 1760 mW		
Ci/Ci = 0.36 µF		
Li/Li = 0 µH		

NOTE for USA and Canada:
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Function Diagram:



GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

PS D1206

Switching Power Supply Type PSD1206 24 Vdc, 6 A, 150 W for Installation in Zone 2 / Div. 2, DIN-Rail Mounting

Characteristics:

General Description:
The PSD1206 is a DIN-Rail Power Supply to supply process control in Zone 2/Division 2 Hazardous Area equipments; it provides isolation between input - output - ground (2000 V). This supply module can be paralleled for redundancy.

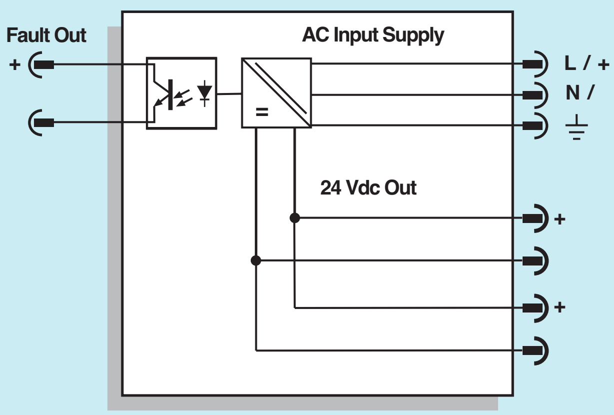
Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Features:

Universal AC / DC Input: 88 to 264 Vac (48 to 62 Hz) or 115 to 350 Vdc.
Power Factor correction (0.95) eliminates power-line harmonics loading.
Highly regulated (0.2 %), trimmable output of 24 Vdc up to 6 A.
Over-voltage protection prevents risks to the connected load.
Supports redundant parallel connection with load sharing.
Under-Over voltage alarm monitoring with signalling output.
100 ms Hold-up time at full load, mitigates power-line glitches.
Durable metal enclosure, improves shielding and heat sinking.
High (better than 80 %) efficiency.
Simplified installation using standard DIN-Rail with plug-in input and output terminal blocks.

MODEL PSD1206



Technical Data:

Supply:
Input Voltage: 88 to 264 Vac (48 to 62 Hz) or 115 to 350 Vdc.
Power Factor Correction (AC input): 0.95.
Efficiency: higher than 80 %.
Max. internal Power Dissipation at 6 A: 30 W.
AC Input Current (sinusoidal at full load):
Protection: 6.5 A fuse.
Connection: plug-in terminal block for 4 mm² wire.

Isolation:
Input to Output Isolation: 2000 Vrms (routine test).
Input to Ground Isolation: 2000 Vrms (routine test).

Output:
Output Voltage: 24 Vdc (adjustable from 21.6 to 26.4 Vdc).
Regulation: 0.2 % for a 100 % load change.
Stability: 0.1 % for a 20 % line voltage change.
Ripple: less than 50 mVpp.
Output Current: 6 A nominal. Parallel connection for redundancy with load sharing.
Connection: plug-in terminal block for 4 mm² wire.
Hold-up Time at full load: 100 ms (AC input).
Over-Voltage Protection: output limited to 27 Vdc.

Power-good Signalling:
Output good: 0.95 < Vout < 1.05 nominal value.
Indication: power good green LED.
Signalling: voltage free SPST optocoupled open-collector transistor.
Open-collector Rating: 100 mA at 35 V (≤ 2.0 V voltage drop)
Leakage Current: ≤ 50 μA at 35 V.
Connection: plug-in terminal Block for 2.5 mm² wire.

Compatibility:
CE mark compliant, conforms to EN61000-6-2, EN61000-6-4 and EN60950 for electrical safety.

Environmental conditions:
Operating Temperature Limits: -20 to + 60 °C.
Relative Humidity Limits (up to 40 °C): 10 to 90 %.
Transport/Storage Temperature Limits: -40 to + 80 °C.

Safety Description:
ATEX Category 3 for Zone 2.
II 3G EEx nA IIC T4.
FM/FM-C Class 1, Division 2, Groups A, B, C, D.

Mechanical:
Dimensions: width 200 mm, height 95 mm, depth 110 mm.
Weight: about 1.8 Kg.
Location: Hazardous Area installation, Zone 2, Division 2.
Protection class: IP 20.

Ordering Information:

Model:	**PSD1206**

INTERNATIONAL
TECHNOLOGY FOR SAFETY

PS
D1210

Switching Power Supply Type PSD1210 24 Vdc, 10 A, 250 W for Installation in Zone 2 / Div. 2, DIN-Rail Mounting

Characteristics:

General Description:
The PSD1210 is a DIN-Rail Power Supply to supply process control in Zone 2/Division 2 Hazardous Area equipments;
it provides isolation between input - output - ground (2000 V).
This supply module can be paralleled for redundancy.

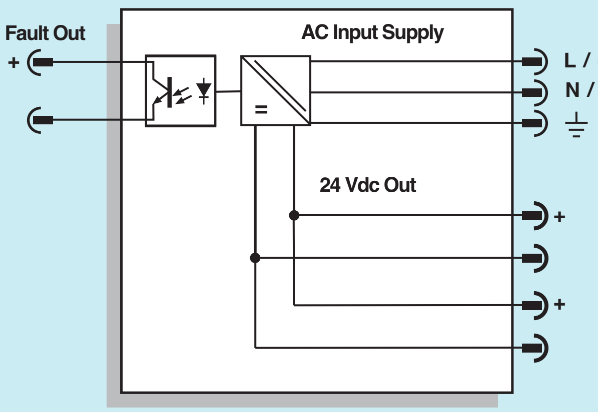
Signalling LED:
Power supply indication (green).

EMC:
Fully compliant with CE marking applicable requirements.

Features:

- Universal AC / DC Input: 88 to 264 Vac (48 to 62 Hz) or 115 to 350 Vdc.
- Power Factor correction (0.95) eliminates power-line harmonics loading.
- Highly regulated (0.2 %), trimmable output of 24 Vdc up to 10 A.
- Over-voltage protection prevents risks to the connected load.
- Supports redundant parallel connection with load sharing.
- Under-Over voltage alarm monitoring with signalling output.
- 100 ms Hold-up time at full load, mitigates power-line glitches.
- Durable metal enclosure, improves shielding and heat sinking.
- High (better than 80 %) efficiency.
- Simplified installation using standard DIN-Rail with plug-in input and output terminal blocks.

MODEL PSD1210



Technical Data:

Supply:
Input Voltage: 88 to 264 Vac (48 to 62 Hz) or 115 to 350 Vdc.
Power Factor Correction (AC input): 0.95.
Efficiency: higher than 80 %.
Max. internal Power Dissipation at 10 A: 50 W.
AC Input Current (sinusoidal at full load):
Protection: 6.5 A fuse.
Connection: plug-in terminal block for 4 mm² wire.

Isolation:
Input to Output Isolation: 2000 Vrms (routine test).
Input to Ground Isolation: 2000 Vrms (routine test).

Output:
Output Voltage: 24 Vdc (adjustable from 21.6 to 26.4 Vdc).
Regulation: 0.2 % for a 100 % load change.
Stability: 0.1 % for a 20 % line voltage change.
Ripple: less than 50 mVpp.
Output Current: 10 A nominal. Parallel connection for redundancy with load sharing.
Connection: plug-in terminal block for 4 mm² wire.
Hold-up Time at full load: 100 ms (AC input).
Over-Voltage Protection: output limited to 27 Vdc.

Power-good Signalling:
Output good: 0.95 < Vout < 1.05 nominal value.
Indication: power good green LED.
Signalling: voltage free SPST optocoupled open-collector transistor.
Open-collector Rating: 100 mA at 35 V (≤ 2.0 V voltage drop)
Leakage Current: ≤ 50 µA at 35 V.
Connection: plug-in terminal Block for 2.5 mm² wire.

Compatibility:
CE mark compliant, conforms to EN61000-6-2, EN61000-6-4 and EN60950 for electrical safety.

Environmental conditions:
Operating Temperature Limits: -20 to + 60 °C.
Relative Humidity Limits (up to 40 °C): 10 to 90 %.
Transport/Storage Temperature Limits: -40 to + 80 °C.

Safety Description:
ATEX Category 3 for Zone 2.
II 3G EEx nA IIC T4.
FM/FM-C Class 1, Division 2, Groups A, B, C, D.

Mechanical:
Dimensions: width 200 mm, height 110 mm, depth 110 mm.
Weight: about 2.5 Kg.
Location: Hazardous Area installation, Zone 2, Division 2.
Protection class: IP 20.

Ordering Information:

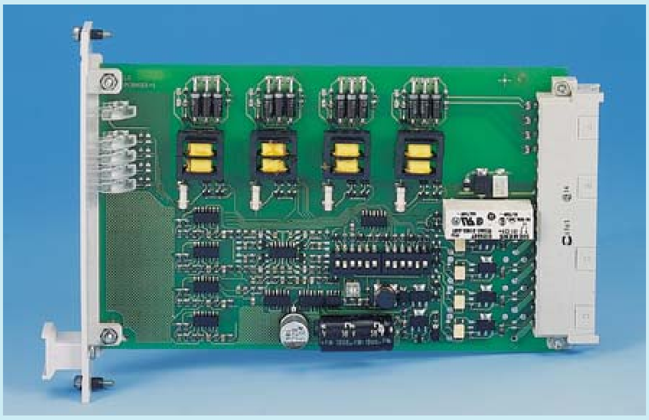
Model:	**PSD1210**

E1000 Series

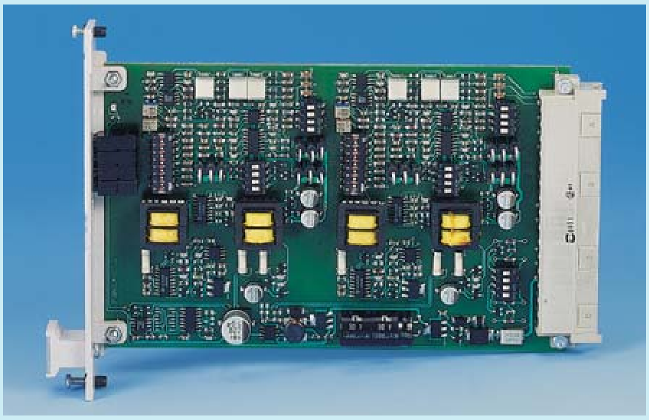
Intrinsically Safe Isolators Signal and Temperature Converters with Trip Amplifiers

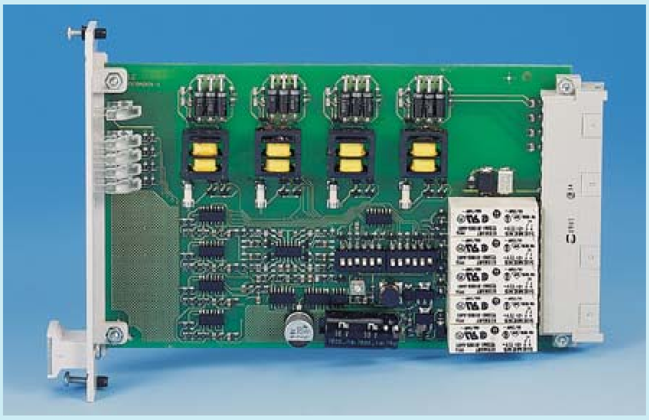
19" Rack Mounting

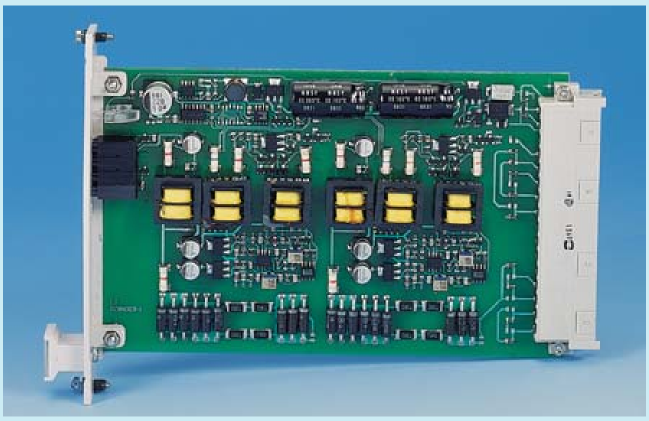
Large Choice of Models



Over **50** Different Types Available







E1000 SERIES
EUROCARD Features

G.M. International Eurocard mounting Intrinsic Safety Galvanic Isolators.
The Eurocard provides the most simple and cost effective means of implementing Intrinsic Safety into your Hazardous Area applications.

High Packing Density

- High channel density result from innovative circuit design using advanced surface mount components.
- Ultra slim 4 channels 20 mm wide Eurocard mounting modules.
- 5 mm per channel.
- 80 I/O channels per 19" Rack.
- Single, dual or quad channels cards.

High Performance

- High signal transfer accuracy and repeatability.
- Advanced circuitry provides low heat dissipation, ensuring modules run cool despite their high functionality.
- Low power consumption.
- SMD manufacturing to maximise long, reliable life.

Wide Functionality

- Wide range of digital switch and analog I/O.
- Relay contacts rated for 2 amp. to directly switch high loads.
- Over 40 different models available up to 4 channels per cards or two inputs with 4 Trip Amplifiers
- 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.

General Features

- Single loop versions available (AI+AO) if required, to provide single loop integrity on Emergency Shut Down and Fire & Gas applications.
- Configured using DIP switch for easy field setup of AI, AO, DI, DO types.
- Total Programmability, with a Pocket Portable Configurator (mod PPC 1090 + PPC 1092) for Analog/Temperature inputs with or without Trip Amplifiers.
- LED indication for power, signal status and line fault conditions.
- Eurocard plug-in 20 cards per 19" Rack, 3 unit high.
- Accept DC power supply over a wide (20-30 V) range.
- Wide operating temperature range.

Approvals

- ATEX.
- GOST.
- GOSGORTEKNADSOR.
- ISO 9001:2000.
- CE-EMC.
- Barrier circuits have patent held or applied for.

	Field Device	Model	Hazardous Area	Safe Area	Nr. of Channel per unit	Supply	Pin compatible with
ANALOG IN	SMART	E1010 S E1010 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	TURCK Model MC 33-22 Ex 0i
	SMART	E1011 S E1011 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	CEAG Model CS 3/420 CS 3/520 CS 4/520
	SMART	E1012 S E1012 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	HUNSBACH Model 77261
	SMART	E1013 S E1013 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	SIEMENS 7NG Series
	SMART	E1014 S E1014 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	ECKARDT Model MUS 80
	SMART	E1015 S E1015 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	STAHL 9601/25-22-11
	SMART	E1019 S E1019 D	4-20 mA/0-20 mA (15 V) floating supply and signal to Smart, or non Smart, two wire Tx.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1 - 2	24 Vdc	GM Standard Bus
ANALOG OUT	SMART	E1020 S E1020 D	4-20 mA/0-20 mA and Smart Signal to I/P Converters, Electrovalve Actuators and Displays.	Bus powered 4-20mA/0-20mA Signal from DCS, PLC or other control devices. Smart compatible.	1 - 2	24 Vdc	CEAG Model MC 2/304
	SMART	E1021 S E1021 D	4-20 mA/0-20 mA and Smart Signal to I/P Converters, Electrovalve Actuators and Displays.	Bus powered 4-20mA/0-20mA Signal from DCS, PLC or other control devices. Smart compatible.	1 - 2	24 Vdc	HUNSBACH Model 77239
	SMART	E1029 S E1029 D	4-20 mA/0-20 mA and Smart Signal to I/P Converters, Electrovalve Actuators and Displays.	Bus powered 4-20mA/0-20mA Signal from DCS, PLC or other control devices. Smart compatible.	1 - 2	24 Vdc	GM Standard Bus

	Field Device	Model	Hazardous Area	Safe Area	Nr. of Channel per unit	Supply	Pin compatible with
ANALOG IN	SMART	**E1022 S** **E1022 D**	4-20 mA/0-20 mA and Smart Signal to I/P Converters, Electrovalve Actuators and Displays.	Bus powered 4-20mA/0-20mA Signal from DCS, PLC or other control devices. Smart compatible.	1 - 2	24 Vdc	STAHL 9618/24-11-11
DIGITAL IN		**E1030 D** **E1030 Q**	Dry contact Proximity Switch	4 SPDT (relay contact) 2A/40V plus 1 SPDT (fault detection contact) 2A/40V for common line fault detection and LED.	2 - 4	24 Vdc	P+F Model ED 2 - SR - Ex 2 ED 2 - SR - Ex 4
DIGITAL IN		**E1031 D** **E1031 Q**	Dry contact Proximity Switch	1 Open collector per channel plus line fault detection relay 2A/40V for common line fault detection and LED.	2 - 4	24 Vdc	P+F Model ED 2 - ST - Ex 2 ED 2 - ST - Ex 4 ED 2 - SOT - Ex 4
DIGITAL IN		**E1032 D** **E1032 Q**	Dry contact Proximity Switch	1 Open collector per channel plus line fault detection relay 2A/40V for common line fault detection and LED.	2 - 4	24 Vdc	P+F Model EG 4 - T
DIGITAL IN		**E1033 D** **E1033 Q**	Dry contact Proximity Switch	1 Open collector per channel plus line fault detection.	2 - 4	24 Vdc	STAHL 9650/40-14-10
DIGITAL IN		**E1038 D** **E1038 Q**	Dry contact Proximity Switch	4 SPDT Relay Conctact 2 A / 40 V Line fault detection and LED.	2 - 4	24 Vdc	GM Standard Bus
DIGITAL IN		**E1039 D** **E1039 Q**	Dry contact Proximity Switch	1 Open collector per channel plus line fault detection.	2 - 4	24 Vdc	GM Standard Bus
DIGITAL OUT		**E1040 Q**	Electrovalve, LED, Audible Alarm or other devices.	Dry Contact, Logic Level, Loop Powered 24 Vdc from DCS, PLC or other control devices.	4	24 Vdc	GM Standard Bus
CONFIGURATOR		**PPC 1090**	Pocket Portable Configurator suitable to programm type of input Sensors, input and output Ranges, Burnout conditions, High/Low Alarm mode, Relay NE/ND, Alarm Trip Point, Deadband value and Alarm Delay, in the units Series 1000, DIN or Eurocard, which require the Operator to access the Configuration. (powered by the unit in configuration).				

PC ADAPTER

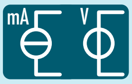
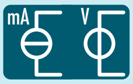
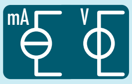
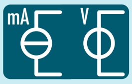
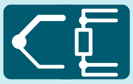
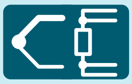
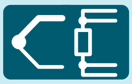
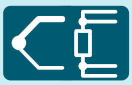
PPC 1092 ADAPTER
and
CABF 010
Sub-D 9 poles,
female-female, Nul-Modem cable

(*) Microprocessor based units require configurator Mod. PPC-1090 or PPC 1092 with PC.

SIGNAL AND TEMPERATURE CONVERTERS

Field Device	Model	Hazardous Area	Safe Area	Nr. of Channel per unit	Supply	Pin compatible with
	E1059 S (*)	4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1	24 Vdc	GM Standard Bus
	E1059 D (*)			2	24 Vdc	GM Standard Bus
	E1059 X (*)	One Input 4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply.	1	24 Vdc	GM Standard Bus
	E1059 Y (*)	Two Input 4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply. (A, B, A+B and A–B)	2	24 Vdc	GM Standard Bus
	E1079 S (*)	Input from TC with Automatic ref. cold junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply.	1	24 Vdc	GM Standard Bus
	E1079 D (*)			2	24 Vdc	
	E1079 X (*)	One Input from TC with Automatic ref. cold junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply.	1	24 Vdc	GM Standard Bus
	E1079 Y (*)	Two Input from TC with Automatic ref. cold junction compensation, burnout indication or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply. (A, B, A+B and A–B)	2	24 Vdc	GM Standard Bus
	E1070 S E1070 D	2, 3, 4 wire RTD Pt 100 Ω DIN 43760 or ANSI	4-20mA/0-20mA (1-5 / 0-5 V) output signal totally isolated from input and supply.	1 - 2	24 Vdc	ECKARDT Model TSY 175
	E1071 S (*)	Input from TC with Automatic reference cold junction compensation, or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	4-20 mA / 0-20 mA (1-5 / 0-5 V) output signal totally isolated from input and supply, 2 Independent set point, 2 SPST relay, 2 A / 40 V	1	24 Vdc	ECKARDT Model TSY 175 TSV 175

SIGNAL - TEMPERATURE CONVERTERS AND TRIP AMPLIFIERS

Field Device	Model	Hazardous Area	Safe Area	Nr. of Channel per unit	Supply	Pin compatible with
	E1058 S (*)	4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply. 2 Independent set points, 2 SPST Relay 2 A / 40 V for each output.	1	24 Vdc	GM Standard Bus
	E1058 D (*)			2	24 Vdc	GM Standard Bus
	E1058 X (*)	One Input 4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply. 2 Independent set points, 2 SPST Relay 2 A / 40 V for each output.	1	24 Vdc	GM Standard Bus
	E1058 Y (*)	Two Input 4-20 mA / 0-20 mA or 1-5 V / 0-5 V / 0-10 V from 3 wire powered Tx or other instruments	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply. (A, B, A+B and A–B) 2 Independent set points, 2 SPST Relay 2 A / 40 V for each output.	2	24 Vdc	GM Standard Bus
	E1078 S (*)	Input from TC with Automatic ref. cold junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	4-20 mA/0-20 mA (1-5V/0-5V) output signal totally isolated from Input and Supply. 2 Independent set points, 2 SPST Relay 2 A / 40 V for each output.	1	24 Vdc	GM Standard Bus
	E1078 D (*)			2	24 Vdc	
	E1078 X (*)	One Input from TC with Automatic ref. cold junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply. 2 Independent set points, 2 SPST Relay 2 A / 40 V for each output.	1	24 Vdc	GM Standard Bus
	E1078 Y (*)	Two Input from TC with Automatic ref. cold junction compensation or 2, 3, 4 wire RTD, Pt 100 Ω DIN 43760 or ANSI, burnout indication, Transmitter Pot, 100 Ω min., 10 KΩ max.	Two Independent 4-20 mA/0-20 mA (1-5V/ 0-5V) output signal totally isolated from Input and Supply. (A, B, A+B and A–B) 2 Independent set points, 2 SPST Relay 2 A / 40 V for each output.	2	24 Vdc	GM Standard Bus

D2000M SERIES
Intrinsically Safe Modular
Multiplexer System
for Installation in Hazardous
Areas Zone 0, 1, 2
Gas Group IIC, IIB, IIA T4
Class I, II, III, Div. 1, Groups A, B, C, Indoor and Outdoor Hazardous Locations

Transmit up to 7936 Analog, or 3968 Digital, Signals from TC, RTD, mV, 4-20 mA, or contact, Proximity sensors, at distances up to 5 Kilometers.

D2000M Series Intrinsically Safe Modular Multiplexer System

System Features

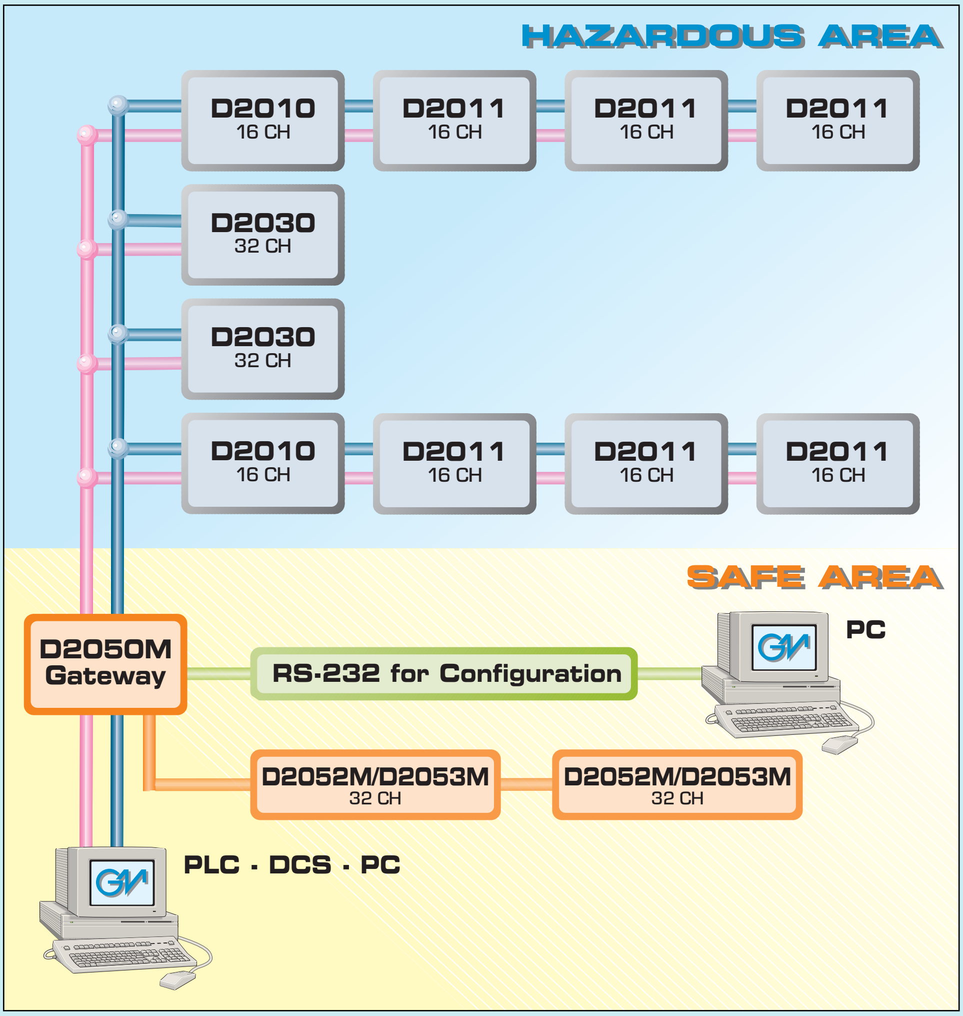
- High Density, up to 256 Analog Inputs (TC, RTD, mV, mA, Ohm) and up to 128 Digital inputs (Contacts, Proximity sensors) on the same system.

  Expandable up to 7936 Analog and 3968 Digital.

- Robust Galvanic Isolation (± 200 V channel to channel) provides high immunity against interferences and ground loops.
- Intrinsically Safe for installation in Zone 0, 1, 2, 20, 21, 22, Gas Group IIC T4 or Class I, II and III, Division 1 and Class I, Zone 0 & 1 Hazardous Location.
- Send data as far as 5 Km distance at high speed 38400 baud.
- High Accuracy 18 bits D/D converter.
- Direct connection of sensors to input plug-in type Terminal Blocks. No auxiliary Terminal Blocks required.
- Communication line, used also as Supply line, can be redundant.
- IEC Ex, ATEX, FM, FM-C, GOST Certifications.
- System configuration software performed

  (SW free of charge).

- Interfaces with PLC/DCS via redundant Modbus RTU protocol.
- Connects directly to PC RS 232 port for system configuration and diagnostic.



- Repeats input contact via Relays or O.C. Transistor Outputs.
- Lower Cables and installation costs.
- Lower PLC-DCS I/O card costs.
- Lower wiring costs, 1 terminal Block per input connection, no auxiliary T.B. needed.
- Simplified Installation.

Brief Information about Multiplexing Tecnique

Signal Data Acquisition

In industrial process is a common need to acquire a relevant number of temperatures, pressures, flows, levels and other process variables as well as the status of switches or proximitors and collect all these data in a single remote collection area (i.e. in a control room) where a PLC (Programmable Logic Controller) or a Process Computer collect all data and use them for monitoring purposes or make them available to the operators.
SCADA (Signal Conditioning And Data Acquisition) equipment are particularly suited for this purpose.
Modern micro electronics permits fast, accurate and stable Analog to Digital converters, high speed computing , sophisticated intelligence and powerful measuring capabilities.
All this performance can be packed into compact reliable units that can operate in harsh environments.
Multiplexers are a typical SCADA multi channel equipment that can be located in the field close to the process area where the input channels can be connected with short lines. All input channel signals are converted in a numeric form and transmitted to a remote location via a single communication line.

How a Multiplexer works

The multiplexer cyclically scans each input channel for a few milliseconds (connects with electrical or semiconductor switches each input signal, one at a time, to the internal circuits) and converts with an A/D (Analog to Digital) converter each process signal into a digital value.
This digital value is computed by a microprocessor and transformed into a numerical data expressed in terms of engineering units corresponding to the effective process variable of the channel (°C, PSI or ATE , liters/sec etc).
After completion of the scanning and conversion cycle of one channel the multiplexer connects the next channel in a sequential fashion so that in a few milliseconds all input channel signals are converted into their corresponding numerical data, expressed in engineering units and stored on a buffer memory.
Multiplexers also perform the tagging of each variable for channel identification and diagnostic functions to detect failures, out of range values, errors in the data etc.; all data are transmitted under command in a numerical form as a sequence of strings via a single serial communication interface and connection line up to the data collection area (i.e. in a control room).
Communication line can also serve as supply line eliminating the need of an extra power line. Additionally, the supply/communication line can be dual redundant to eliminate the effects of failures in one of the lines.

When multiplexing is the only viable solution

In the case of revamping or add-on of new parts in the plant, the space for adding cables may be limited or the few existing spare cables are the only ones that can be used.
Radio Frequency links, beside cost and licensing problems, present severe data security and reliability limitations that make, most of the times, this technique impractical. Multiplexer becomes the only practical solution.

The advantages of multiplexing

When a consistent quantity of variables must be made available to a far location, instead of wiring each process variable signal with long individual connection lines up to the control room, it is advantageous to connect all input signals to a conveniently field located Multiplexer with short local connections lines to the sensors and to send all data through a single communication line to the remote data collection area. Even when space for cable is available the saving just in cable cost alone justifies, most of the times, the multiplexer solution, in addition a tidy simple connection is obtained avoiding cluttering of wires in the control room area.

Multiplexing in Hazardous area

For applications in classified hazardous areas each signal must be protected from the risk of causing an ignition of flammable mixtures, this requires a safety barrier for each input channel and a protection for the multiplexer itself and its communication line substantially increasing the complexity and cost of such a solution.

The advantages of using an Intrinsically Safe Multiplexer

The use of an intrinsically safe multiplexer allows equipment installation in hazardous area and connection of all its inputs directly to the process variable signals without the requirement of any further protection; retaining the simplicity and cost effectiveness of a multiplexing solution.

In addition to the cable cost and simplicity of installation discussed above, the elimination of safety barriers drastically simplifies and reduces the cost of this solution compared to other options.

D2000M Series General Description

D2000M Series Intrinsically Safe Multiplexing System consists of one to four Analog-Temperature Multiplexer Units model D2010M, up to twelve Expander Units model D2011M, or up to four D2030M Digital Multiplexer Units, mounted in Zone 0, 1, 2 Hazardous Area, Gas Group IIC T4, connected via a single / redundant 2 wire data communication / Supply line to a Modbus Gateway Unit model D2050M, mounted in Safe Area and connected to a PLC, DCS or PC.

The Multiplexer Units D2010M, and the Expander Units D2011M can be installed in the field, close to input sensors, for data acquisition from Hazardous Areas and connected to a Safe Area PLC/DCS or other devices, via 2 wire communication link and the Gateway Unit D2050M, saving wiring, cables and costs.

The Units are primarily intended for Hazardous Areas acquisition of low level signal from Thermocouples, RTDs, mV or mA sources.

The Expander Units D2011M are controlled by D2010M Units. D2010M scans all enabled channels using state

D2050M Gateway Unit.

of the art solid state isolated relays, and stores all data in a memory buffer, where they can be rapidly accessed by the Modbus Gateway Unit D2050M.

Each Mux Unit accepts directly up to 16 input channels and, by adding from one to three Expander Units D2011M, is expandable to 64 channels in blocks of 16

D2010M Multiplexer Unit.

each. Four D2010M Units, connected to twelve D2011M Expanders reach 256 inputs with a single Modbus Gateway Unit D2050M. Redundant communication is obtained by in built dual data/supply interface line.
Safety Parameters maintain capability with Gas Group II C (A, B) even in redundant mode.
An Integrating type, High Rejection, High Accuracy (18 bits) A/D Converter, automatically calibrates Zero and Span providing accurate and stable measurements.
All parameters are software configurable by serial commands via the D2050M Unit.
The Multiplexer Units D2030M, can be installed in the field close to input sensors, for data acquisition from Hazardous Areas and connected to a Safe Area PLC/DCS or other devices, via 2 wire communication link and Gateway Unit D2050M, saving wiring, cables and costs.
These Units are primarily intended for Hazardous Area acquisition from contacts or proximity detectors.
D2030M scans all enabled channels and stores all data in a memory buffer, where they can be rapidly accessed by the Modbus Gateway Unit D2050M.
Each Mux Units D2030M accepts directly up to 32 inputs channels and from one to four Units canbe used in a System.
Four D2030M Units reach 128 inputs with a single Modbus Gateway Unit D2050M.
Redundant communication is obtained by in built dual data/supply interface line.
Safety Parameters maintain compatibility with Gas Group II C (A, B) even in redundant mode.

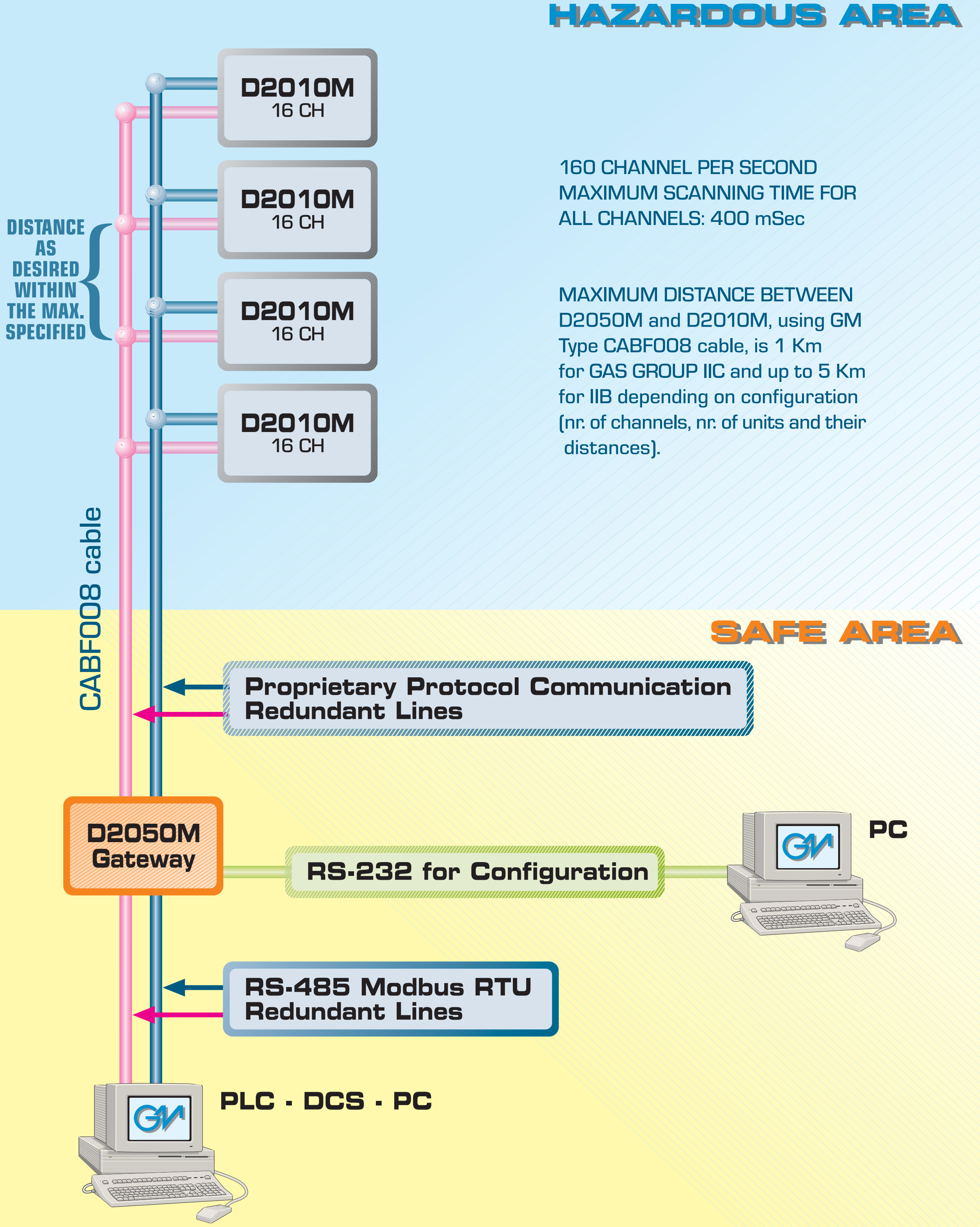
The D2052M Unit is equipped with 32 relay output SPDT contacts. Connected to D2050M Unit it repeats the status of each D2030M digital input Multiplexer Unit.

The D2053M Unit is equipped with 32 Open Collector Transistor Outputs. Connected to D2050M Unit it repeats the status of each D2030M digital input Multiplexer Unit.

Distance between Gateway Unit D2050M and the field Units D2010M, D2011M, D2030M can be up to 1000 mt. for gas group IIC (A, B) and up to 5000 mt. for group IIB, II A (C, D, E, F, G).
GM CABF008 is an available cable for communication lines between the D2050M Gateway and field Units.

NOTE: This cable is included in the system certification and it may be substituted only by cables with same specifications, in order for the certification to maintain its validity.

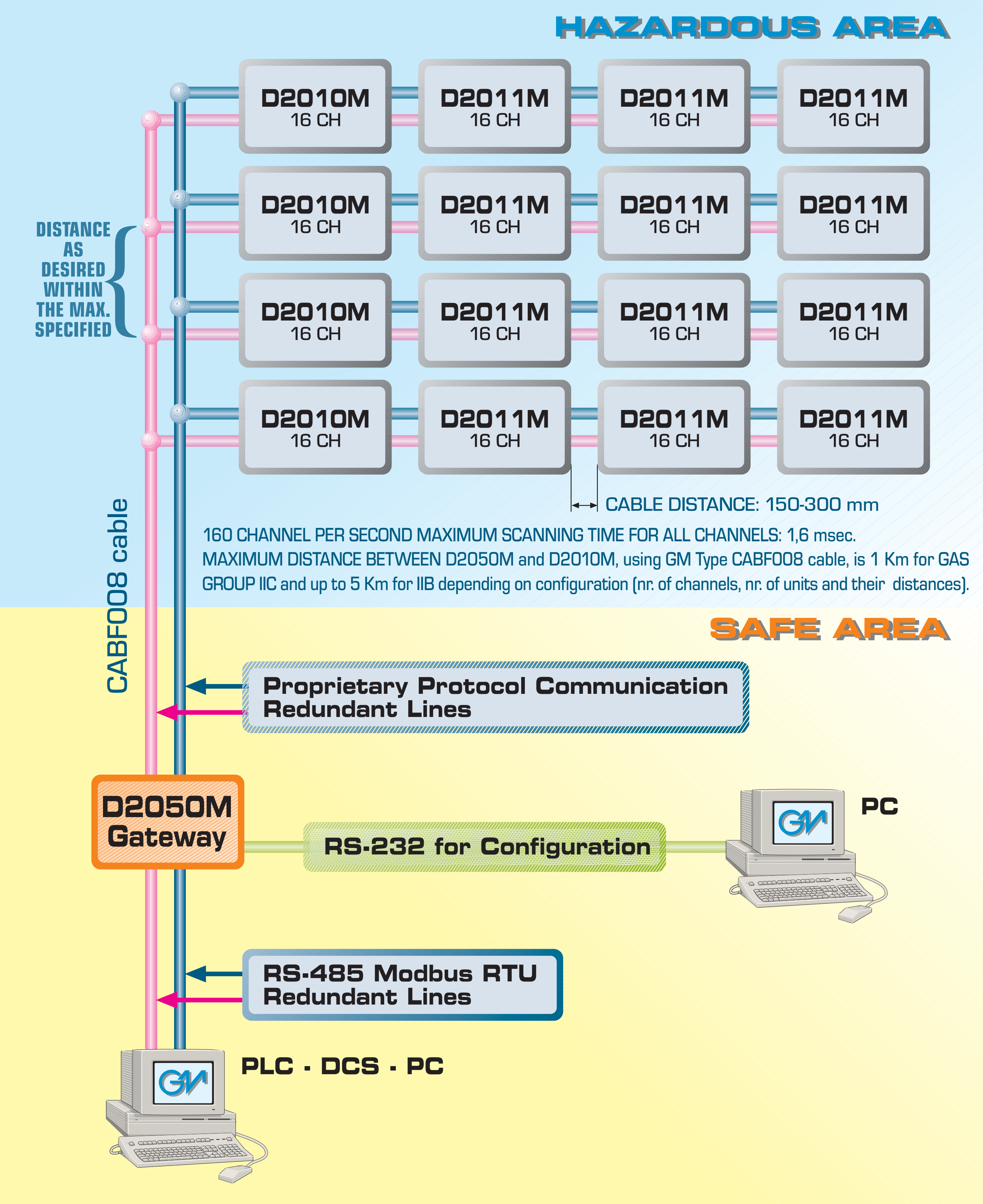
ANALOG - TEMPERATURE MULTIPLEXER D2000M SERIES SYSTEM SUITABLE for INSTALLATION in ZONE 0, 1, 2 CONFIGURATION for 64 TEMPERATURE INPUTS



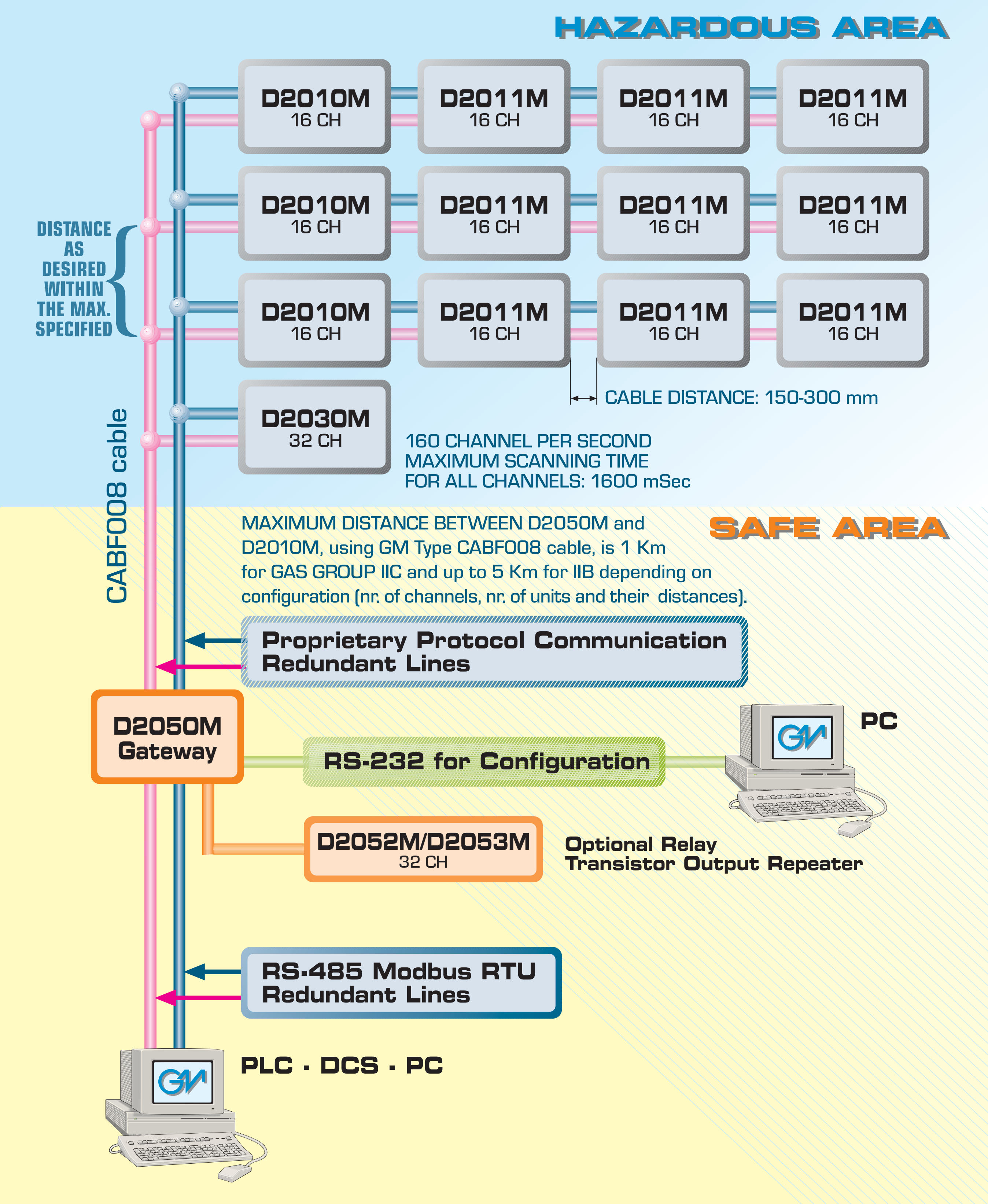
160 CHANNEL PER SECOND
MAXIMUM SCANNING TIME FOR ALL CHANNELS: 400 mSec

MAXIMUM DISTANCE BETWEEN D2050M and D2010M, using GM Type CABF008 cable, is 1 Km for GAS GROUP IIC and up to 5 Km for IIB depending on configuration (nr. of channels, nr. of units and their distances).

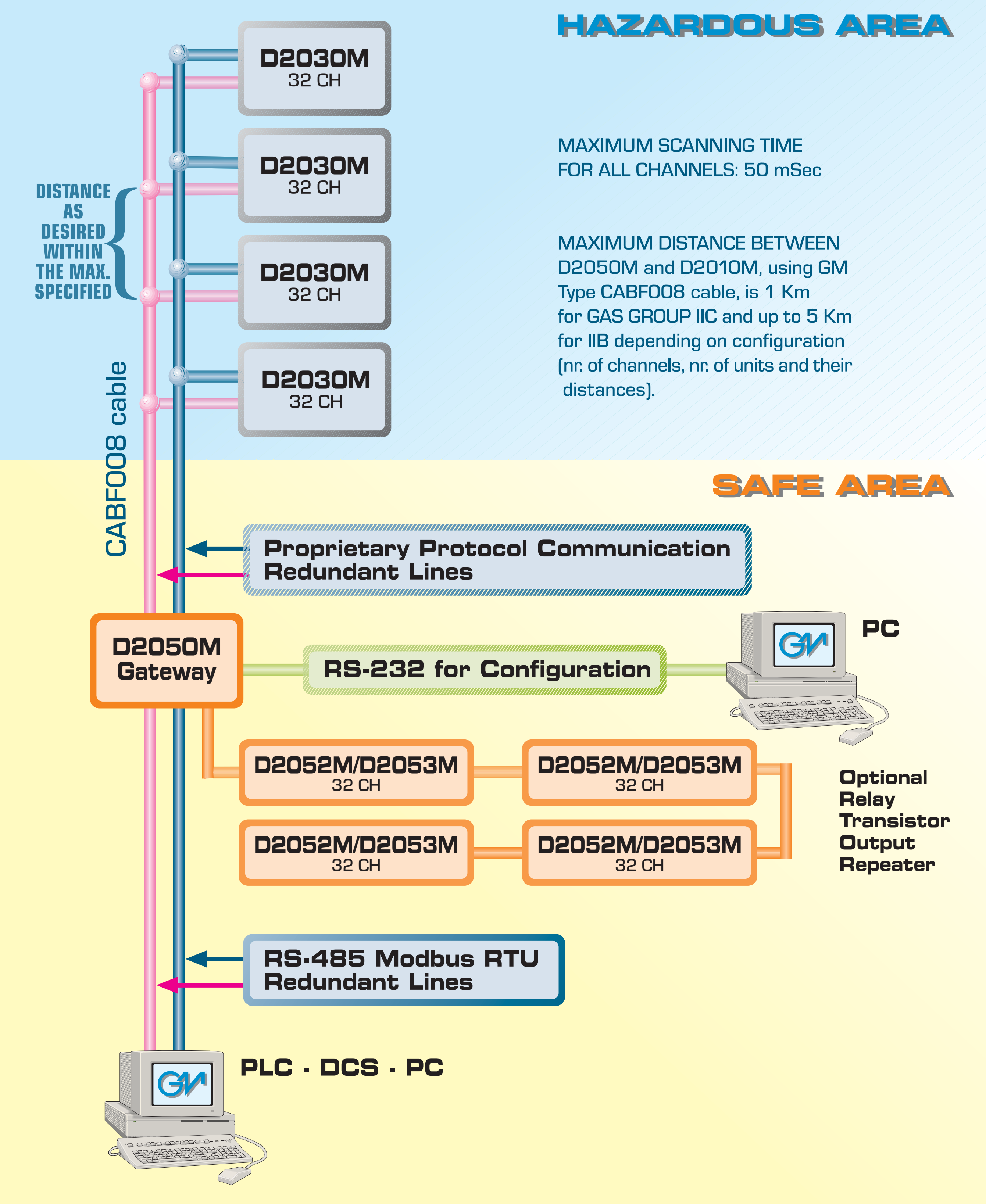
ANALOG - TEMPERATURE MULTIPLEXER D2000M SERIES SYSTEM SUITABLE for INSTALLATION in ZONE 0, 1, 2 CONFIGURATION for 256 TEMPERATURE INPUTS



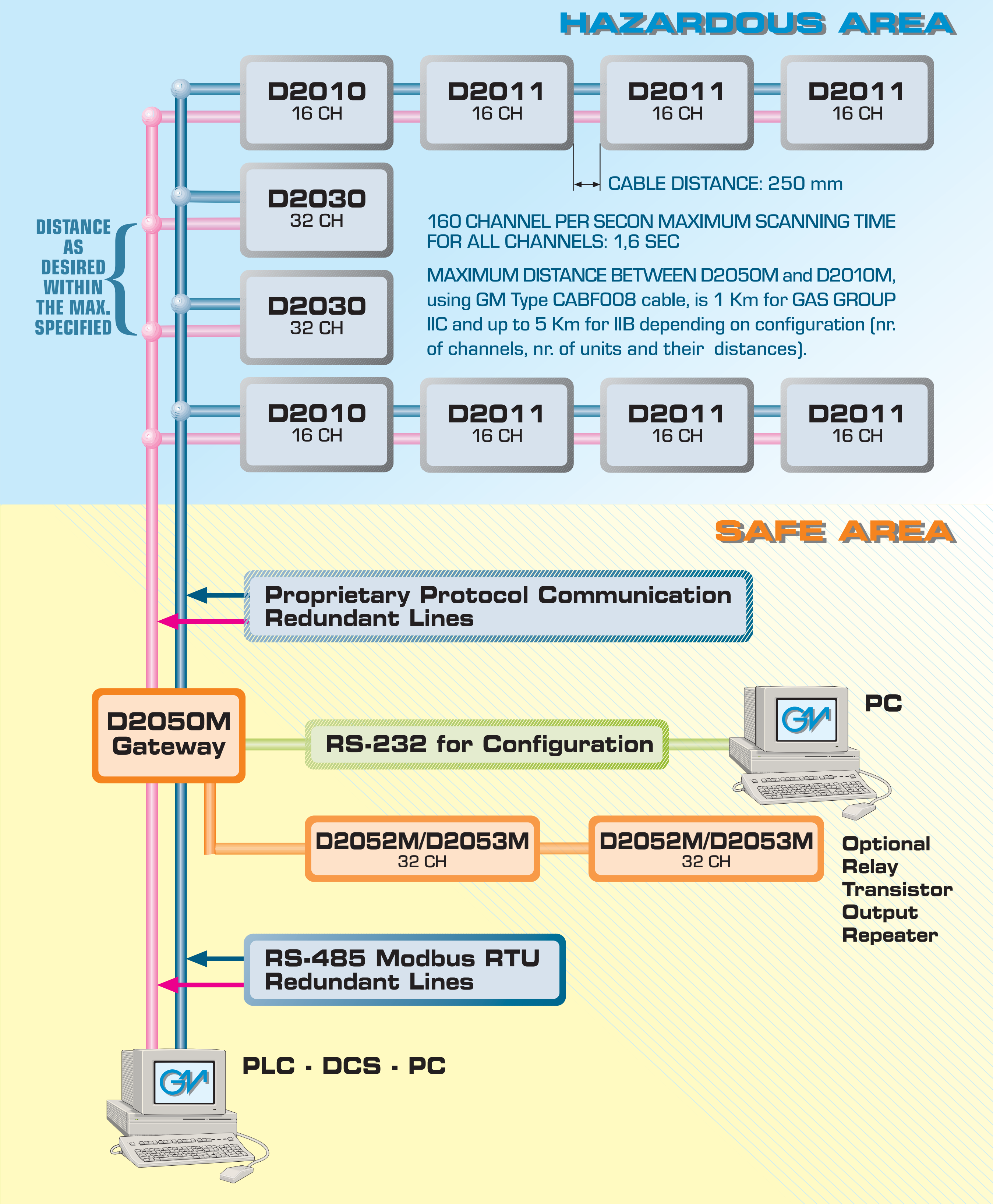
ANALOG - TEMPERATURE - DIGITAL MULTIPLEXER D2000M SERIES SYSTEM SUITABLE for INSTALLATION in ZONE 0, 1, 2 CONFIGURATION for 192 TEMPERATURE and 32 DIGITAL INPUTS



MULTIPLEXER D2000M SERIES SYSTEM SUITABLE for INSTALLATION in ZONE 0, 1, 2 MAX. CONFIGURATION for 128 DIGITAL INPUTS and 128 REPEATER OUTPUTS



ANALOG - TEMPERATURE - DIGITAL MULTIPLEXER D2000 SERIES SYSTEM SUITABLE for INSTALLATION in ZONE 0, 1, 2 CONFIGURATION for 128 TEMPERATURE INPUTS and 64 DIGITAL INPUTS

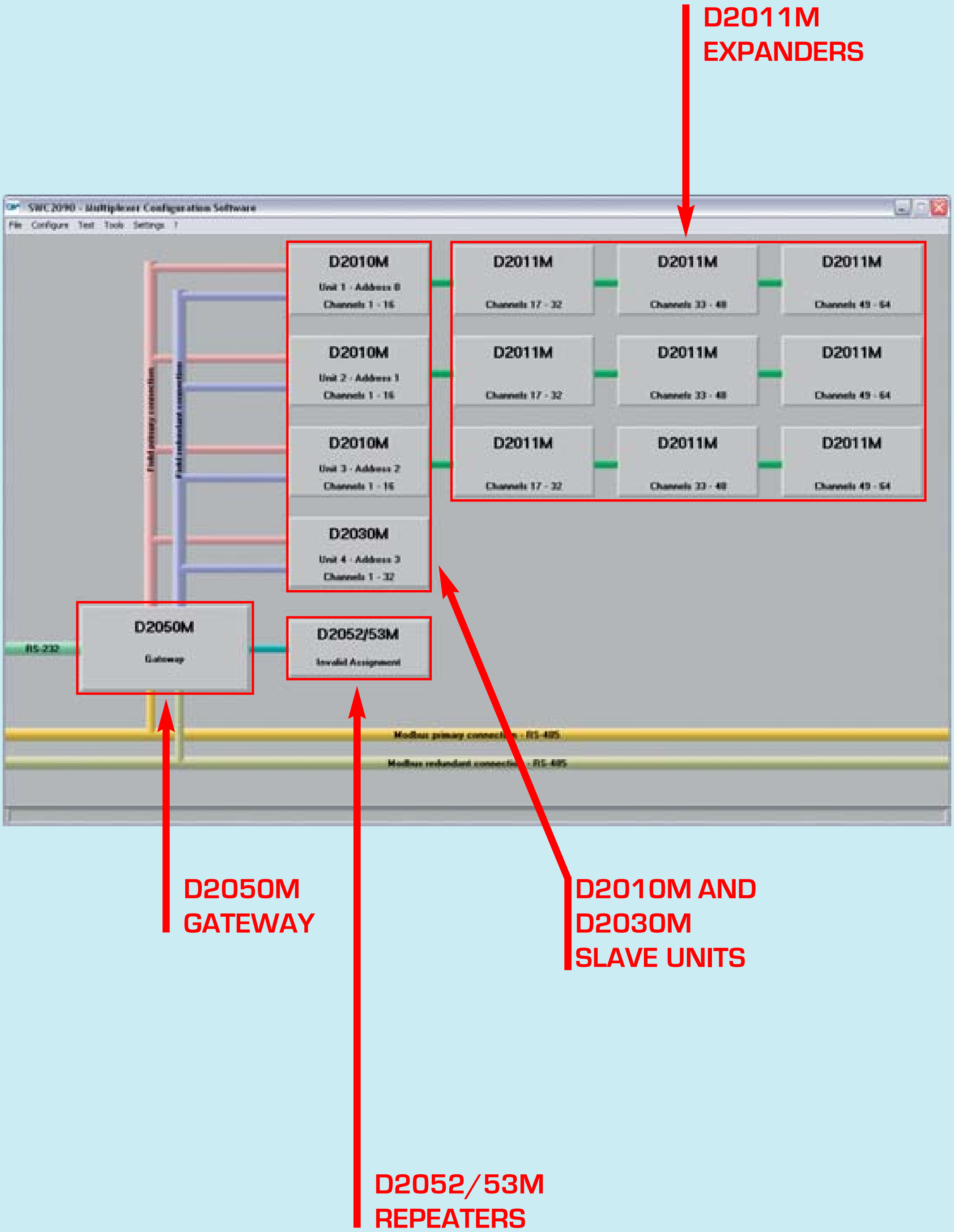


Configuring **D2010M, D2011M, D2030M** Field Units Using a PC Serial Line via the **Gateway D2050M.** Configuration Software Available, free of charge, from G.M. web site.

SWC2090 GRAPHICAL LAYOUT

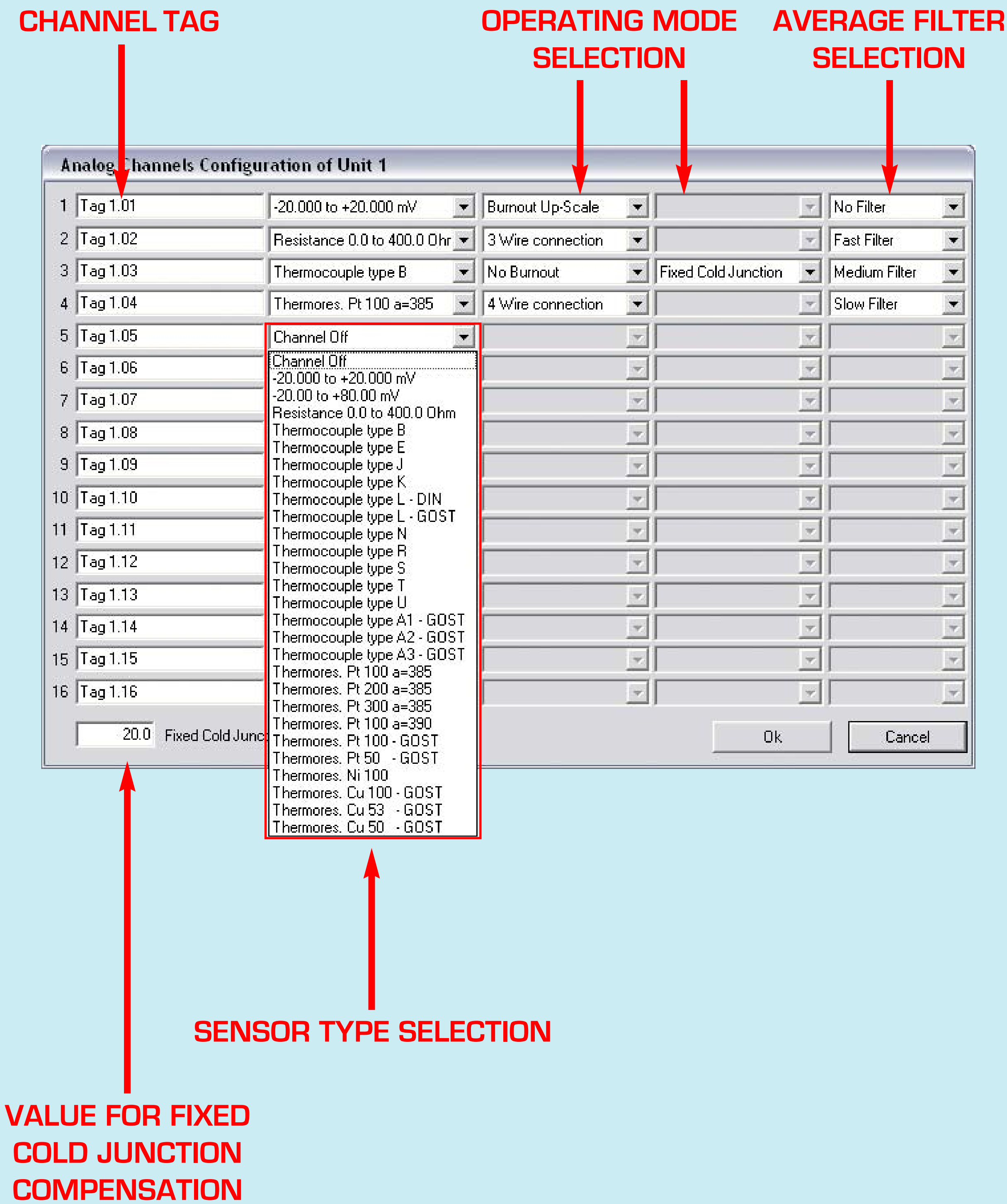
The SWC 2090 is the software to configure the D2000M Series Multiplexer System.

It is available from our website free of charge together with a "Quick start guide".

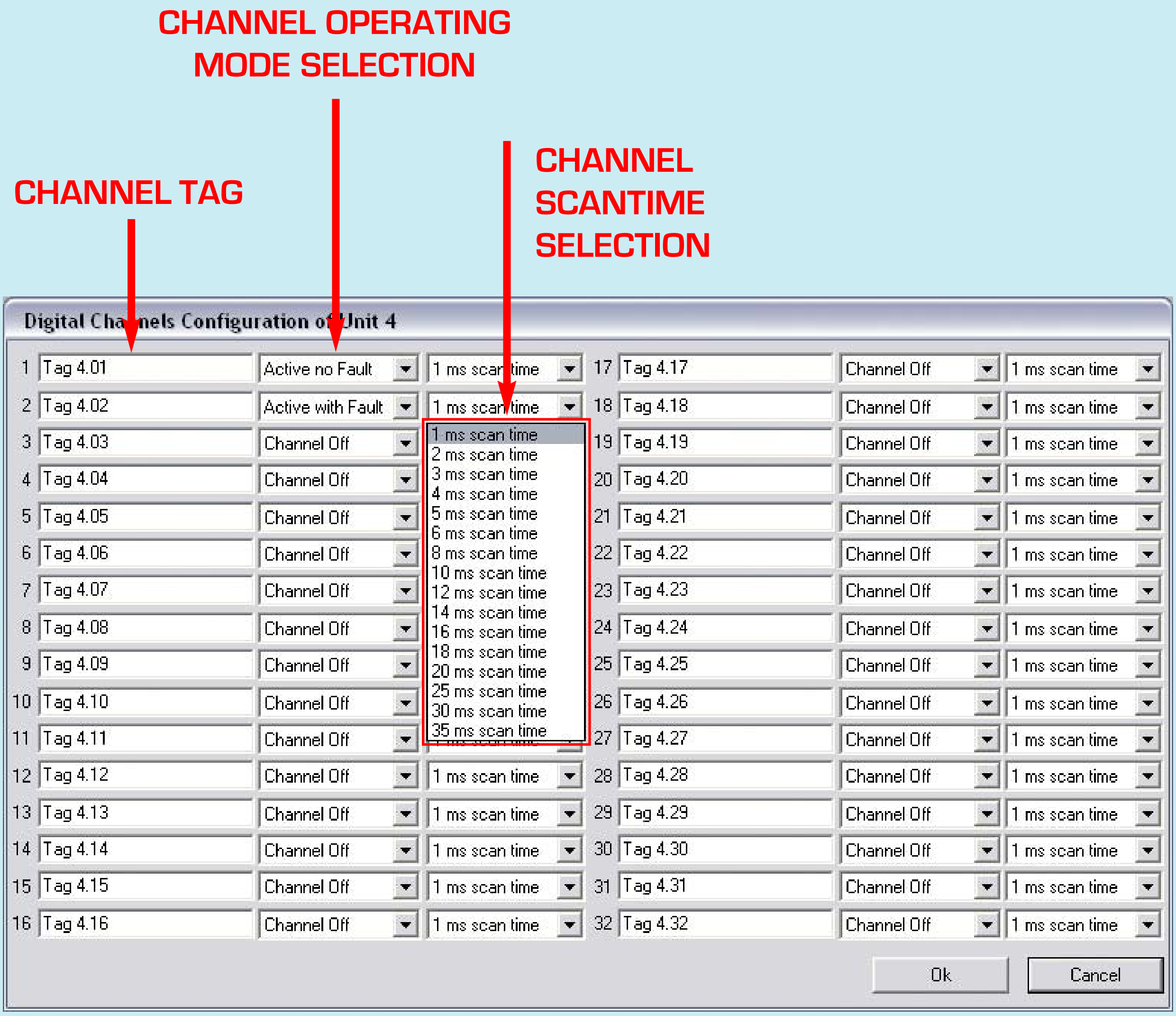


Unit configuration is accessed by double-clicking the corresponding icon in the layout.

PROGRAMMING 16 CHANNELS D2010M AND D2011M ANALOG-TEMPERATURE UNITS



PROGRAMMING 32 CHANNELS D2030M DIGITAL INPUT UNIT



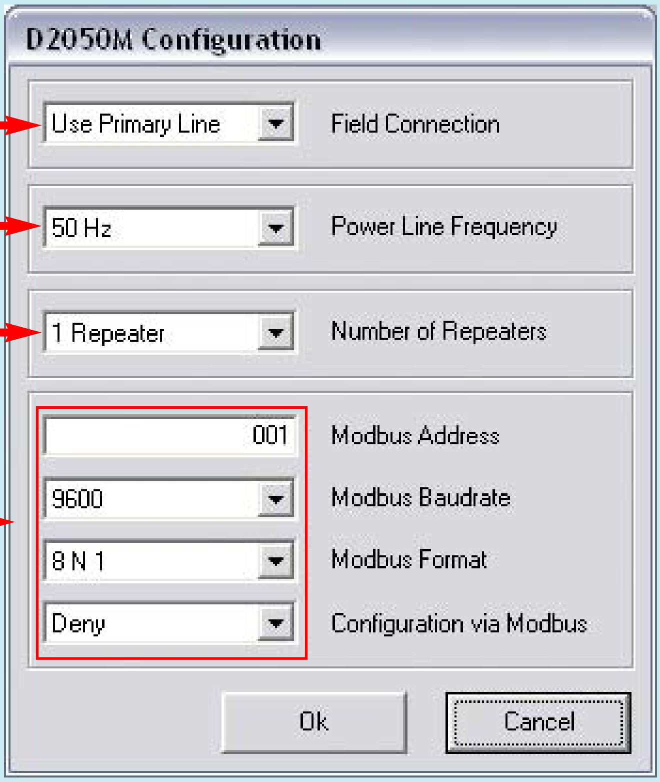
PROGRAMMING D2050M MULTIPLEXER GATEWAY

FIELD CONNECTION

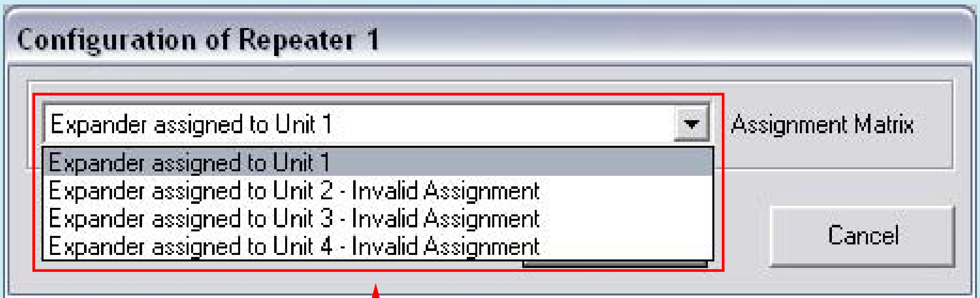
POWER LINE FREQUENCY

NUMBER OF REPEATERS

MODBUS LINE PARAMETERS



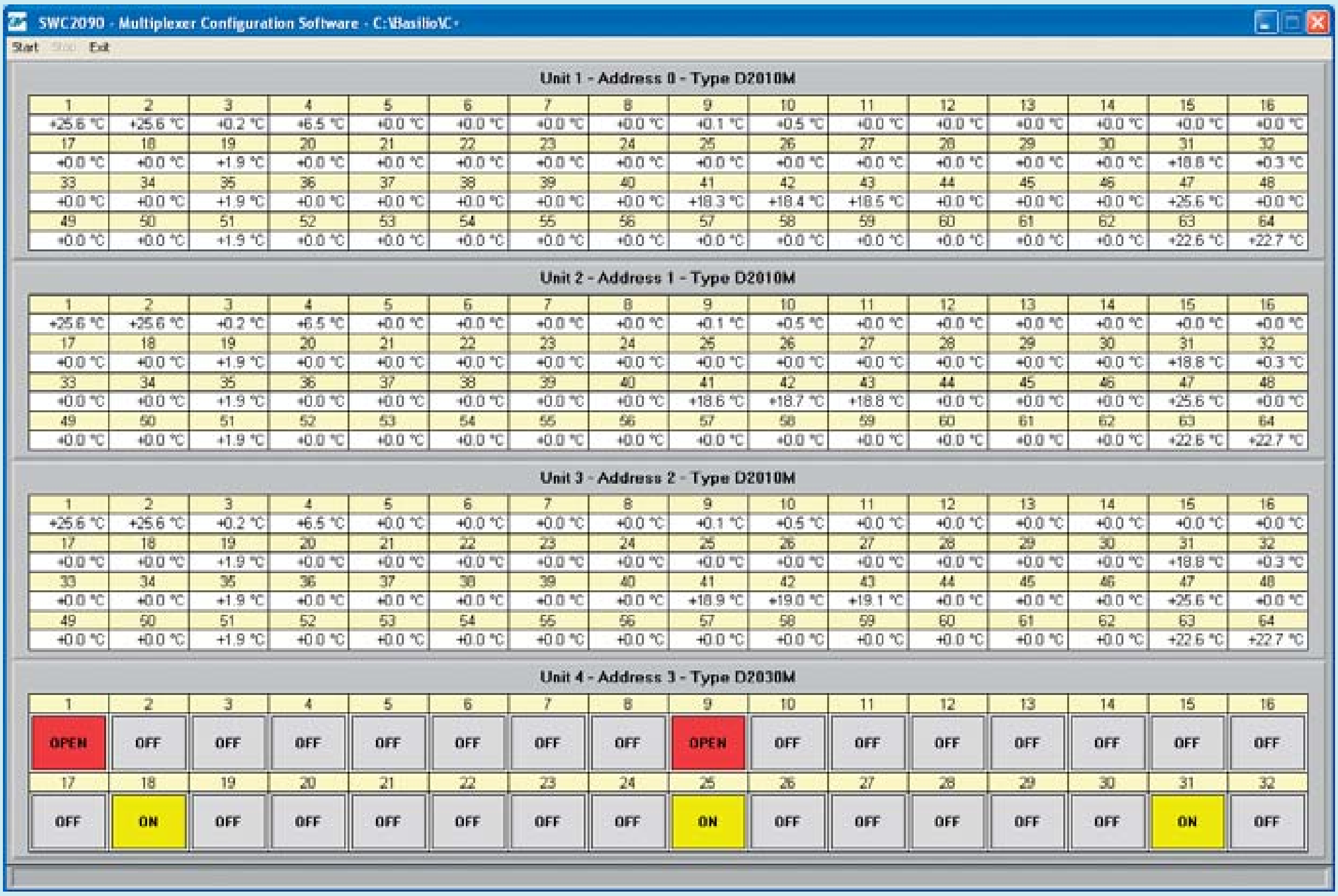
PROGRAMMING D2052/53M CONTACT-PROXIMITY OUTPUT REPEATERS



SELECTION OF D2030M SLAVE TO BE REPEATED

GLOBAL MONITORING OF THE MULTIPLEXER SYSTEM

The entire D2000M Multiplexer System can be monitored "live", either via serial or Modbus port. All units and their corresponding channel values are displayed in one screen, for an easy global view of the Multiplexer System.



SWC2090 - Multiplexer Configuration Software - C:\Basilio\C -

Start Stop Exit

Unit 1 - Address 0 - Type D2010M

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
+25.6 °C	+25.6 °C	+0.2 °C	+6.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.1 °C	+0.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+18.8 °C	+0.3 °C
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+18.3 °C	+18.4 °C	+18.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+25.6 °C	+0.0 °C
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+22.6 °C	+22.7 °C

Unit 2 - Address 1 - Type D2010M

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
+25.6 °C	+25.6 °C	+0.2 °C	+6.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.1 °C	+0.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+18.8 °C	+0.3 °C
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+18.6 °C	+18.7 °C	+18.8 °C	+0.0 °C	+0.0 °C	+0.0 °C	+25.6 °C	+0.0 °C
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+22.6 °C	+22.7 °C

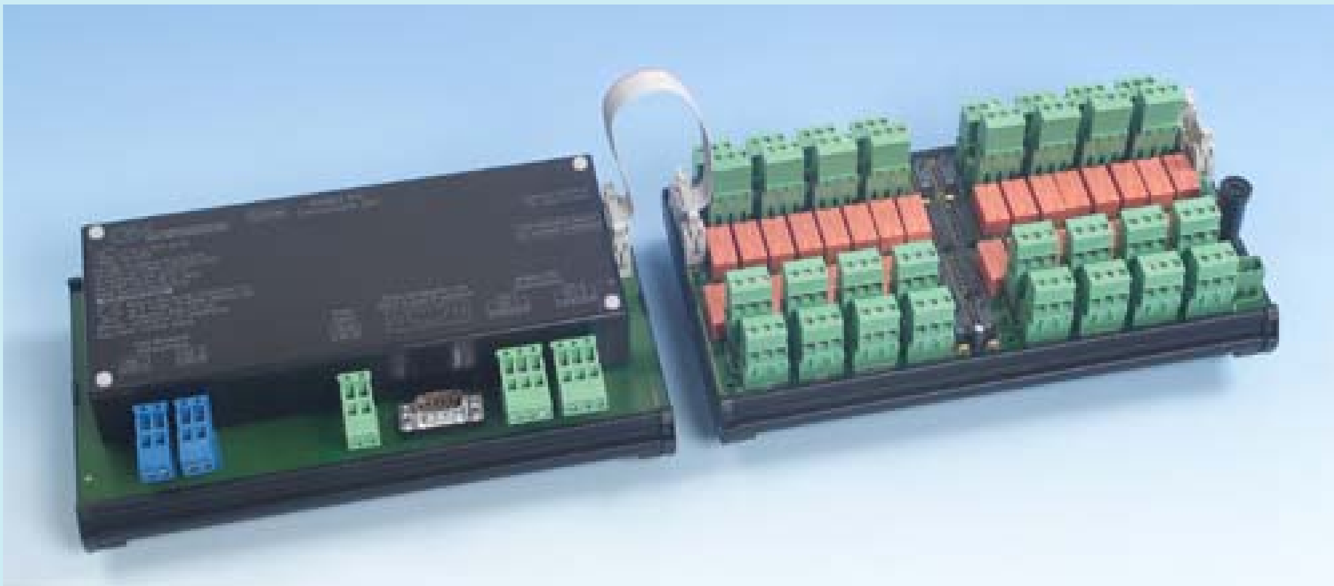
Unit 3 - Address 2 - Type D2010M

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
+25.6 °C	+25.6 °C	+0.2 °C	+6.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.1 °C	+0.5 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+18.8 °C	+0.3 °C
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+18.9 °C	+19.0 °C	+19.1 °C	+0.0 °C	+0.0 °C	+0.0 °C	+25.6 °C	+0.0 °C
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
+0.0 °C	+0.0 °C	+1.9 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+0.0 °C	+22.6 °C	+22.7 °C

Unit 4 - Address 3 - Type D2030M

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OPEN	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	OFF
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF

D2000M SERIES
Multiplexer UNITS
SPECIFICATIONS.



GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D2010
D2011

Intrinsically Safe Analog - Temperature Multiplexer Units - Model D2010M-D2011M for DIN rail Mounting in Zone 0, 1, 2

Characteristics:

General description:

D2000M Series Intrinsically Safe Multiplexing System consists of one to four Analog-Temperature Multiplexer Units model D2010M, up to twelve Expander Units model D2011M, or up to four D2030M Digital Multiplexer Units, mounted in Zone 0, 1, 2 Hazardous Area, Gas Group IIC T4, connected via a single / redundant 2 wire data communication / Supply line to a Modbus Gateway Unit model D2050M, mounted in Safe Area and connected to a PLC, DCS or PC.

Multiplexer D2010M Units, and Expander D2011M Units can be installed in the field, close to input sensors, for data acquisition from Hazardous Area and connected to a Safe Area PLC/DCS or other devices, via 2 wire communication link and Gateway D2050M Unit, saving wiring, cables and costs. The Units are primarily intended for Hazardous Area acquisition of low level signal from Thermocouples, RTDs, mV or mA sources.

Expander D2011M Units are controlled by D2010M Units.

D2010M scans all channels using state of the art solid state isolated relays, and stores all data in a memory buffer, where they can be rapidly accessed by the Modbus Gateway D2050M Unit. Each Mux Unit accepts directly up to 16 input channels and, by adding from one to three D2011M Units, is expandable to 64 channels in blocks of 16 each.

Four D2010M Units, connected to twelve D2011M Expander Units achieve 256 inputs with a single Modbus Gateway D2050M Unit.

Redundant communication is obtained by dual data/supply interface line. Safety Parameters mantain compatibility with Gas Group II C even in redundant mode.

An Integrating type, High Rejection, High Accuracy (18 bits) A/D Converter, provides accurate and stable measurements. All parameters are software configurable by serial commands via D2050M Gateway Unit.

Feature:

Intrinsically Safe for installation in Zone 0, 1, 2, 20, 21, 22, Gas Group IIC T4 or Class I, II and III, Division 1 and Class I, Zone 0 & 1 Hazardous Location.

Universal Inputs (mV, TC, RTD, V and mA).

200 V input-to-input, and 500 V input-to-ground, isolation accepts multiple grounded sensors.

High Accuracy A/D Converter, 18 bits.

16 input channels.

Expandability up to 256 channels per System and 31 Systems on a single serial link for up to 7936 Channels.

Redundant field communication.

EMC according to EN50081-2, EN50082-2.

ATEX, IECEx, FM & FM-C, GOST applied for.

High Reliability, SMD components.

High Density, 16 channels per unit, 256 channels per System.

Configurable via D2050M Gateway using SWC2090 Software (free of charge).

Lower PLC/DCS I/O card s cost.

Lower Cables and installation costs.

1 Terminal Block per input connection, no external Terminal Block required.

Simplified installation using standard DIN Rail mounting Units.

Technical Data:

Supply:
Via D2050M Gateway Unit.

Max. Power Consumption: D2010M: 200 mW; D2011M: 10 mW.

Isolation:
I.S. In/Out, Communication line, 0,5 KV; I.S. In/ I.S. In 200 V for mV/TC, 60 V for RTD; I.S. In/Ground 500 V; Communication line/Ground 500V; I.S. In/I.S. In between Units 500 V.

Inputs:
mV or Thermocouple type A1, A2, A3, B, E, J, K, L, N, R, S, T, U, Lr or 3, 4 wire RTD Pt 100, Pt 200, Pt 300 to DIN43760, Pt100 (0.3916), Ni 100 or Pt100, Pt50, Cu100, Cu53, Cu50 (Gost standard), mA signals with external shunt or V signals with external divider.
Input Channels: 16 on D2010M and 16 on D2011M.
Resolution: 2 µV on mV or thermocoupler, 10 mΩ on RTD.
Input Ranges: within sensor s rated limits.
mV range from -20.00 to + 80.00 mV or -20.000 to + 20.000 mV.
RTD Measuring Current: ≤ 0,2 mA.
RTD Line Resistance Compensation: ≤ 10 Ω.
TC Ref. Junction Compensation: Automatic with external Sensor on channel nr. 16 (OPT 2091 separately ordered or user selectable RTD) or fixed programmable from -60 to + 100 °C.
Burnout: up, down or none.

Scan cycle Time:
1600 ms for a system with four D2010M and twelve D2011M (256 ch.).

Performance:
Field Units powered by D2050M Gateway at 23 ± 1 °C ambient temperature.

Calibration and Linearity Accuracy: ≤ ± 20 µV on mV or Thermocouple, 200 mΩ on RTD, ± 0,05 % of input value, whichever is greater.

TC Ref. Junction Comp. influence: ≤ ± 2 µV, 10 mΩ, 0,02 % or ± 0,01 % of input value for a 1 °C change.

Ref. Junction Compensation Influence:
≤ ± 1 °C (thermocouple sensors only).

Compatibility:

CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN60010-1.

Environmental Condition:
Operating: - 20 to + 60 °C, Relative Humidity max 90 % non condensing, up to 35 °C.

Storage: 40 to + 80 °C.

Safety description of measuring inputs:

Uo/Voc = 12 V, Io/Isc = 12 mA, Po/Po = 36 mW, at terminals 1-2-3-4.
II 1 G D EEx ia IIC T4 or I M2 EEx ia IS Apparatus.

Approvals:

ATEX, IECEx, FM & FM-C, GOST applied for.
Conforms to EN 60079-0, EN 60079-11, EN 60079-25, IEC 60079-27, EN 50281-1-1, EN 50284, FM 3600, FM 3610, FM 3810, CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 142 and CSA-C22.2 No. 157, ANSI/NEMA 250, ANSI/IEC 60529,
TCCExEE (Russia) to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X,
TCCExEE (Ukraine) to GOST 12.2.007.0, 22782.0, 22782.5 [Exia] IIC X.

Mounting: DIN Rail T35 according EN50022.
Weight: About 300 g.
Connections: By screw terminals for up to 2,5 mm^2.
Installation Area: Zone 0, 1, 2, 20, 21, 22, Gas Group IIC T4 or Class I, II and III, Division 1 and Class I, Zone 0 & 1 Hazardous Location.
Protection Class: IP 20.
Dimensions: 127W x 220L x 78D mm.
Note: for field mounting and dust, see GM 2300 Series enclosures.

Parameters Table:

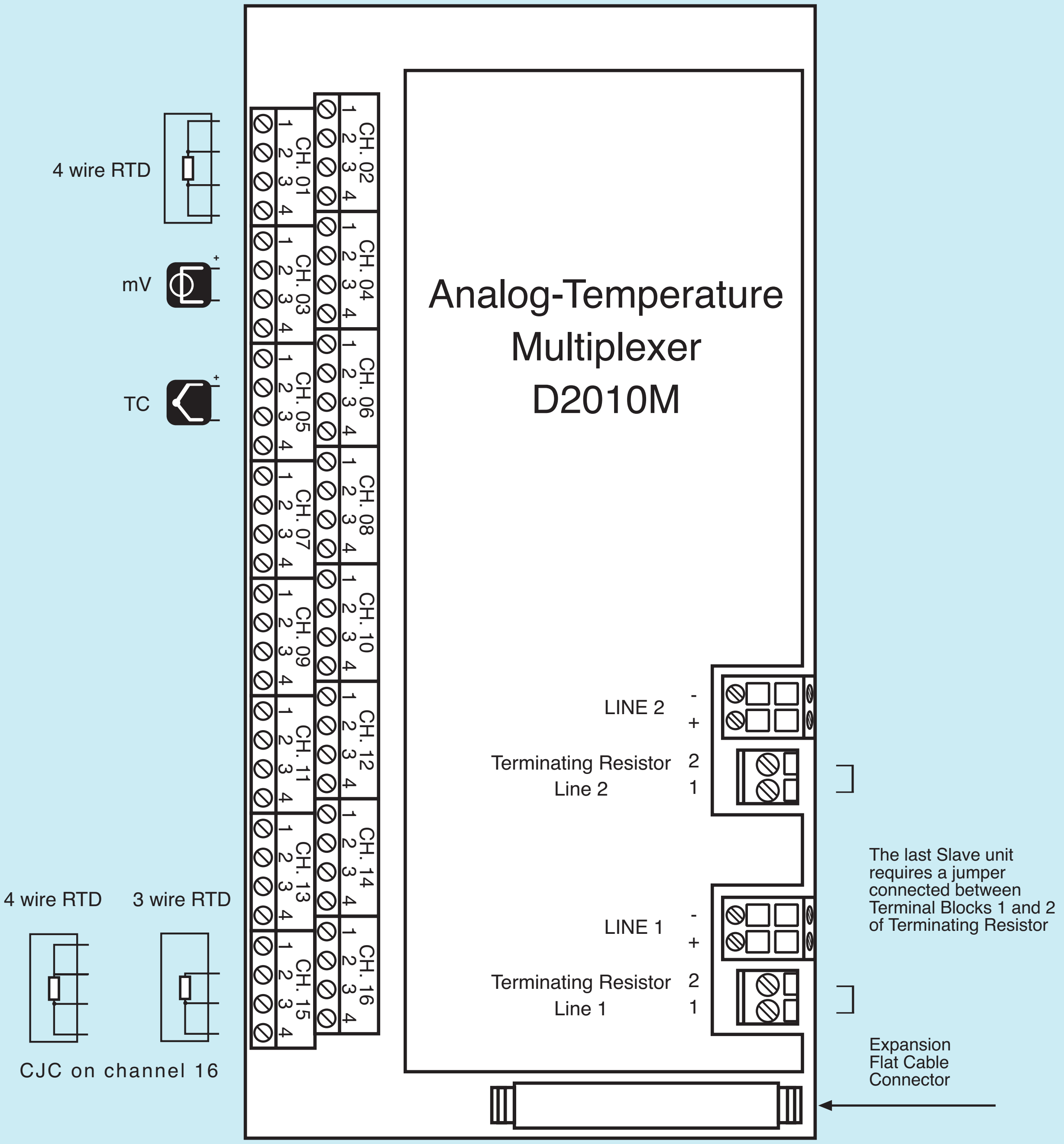
Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (μF)	Lo/La (mH)	Lo/Ro (μH/Ω)
Uo/Voc = 12 V Io/Isc = 12 mA Po/Po = 36 mW	IIC II B II A			

NOTE for USA and Canada:

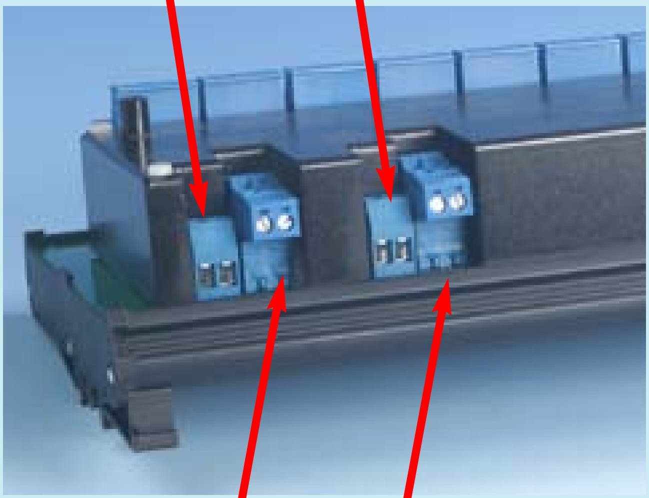
II C equal to Gas Groups A and B
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Ordering Information:

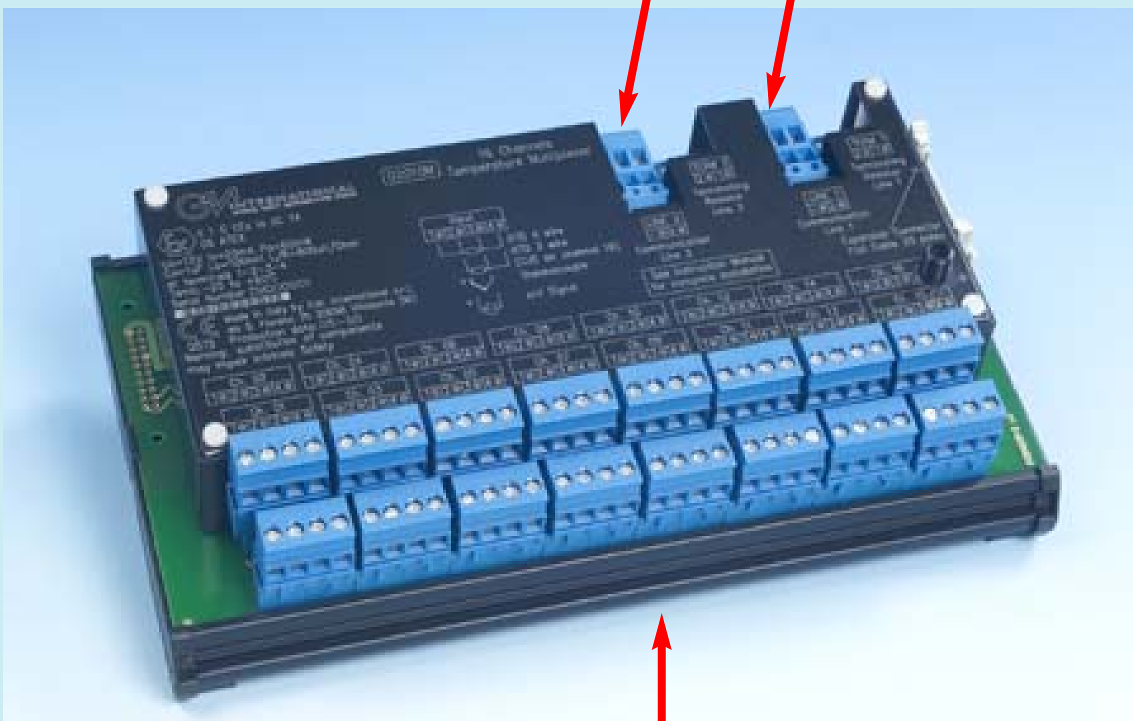
Model:	**D2010M**
16 channels	



Terminating Resistor Lines 1 and 2.



Communication Lines are connected to a double insertion Terminal Block, Plug-in type, to avoid disconnection of downstream Multiplexer units.



16 channels Input Terminal Blocks plug-in type

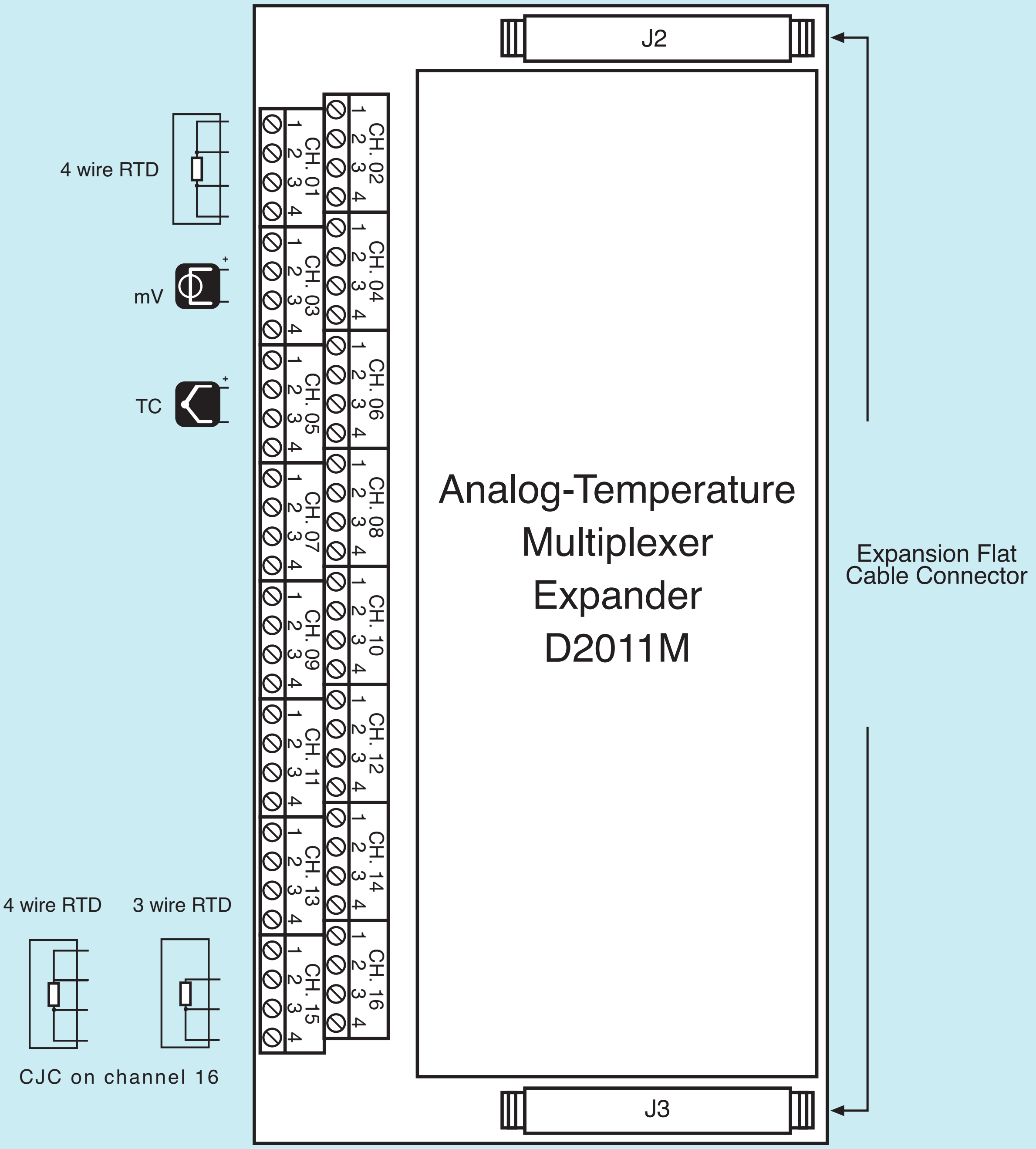
Parameters Table:

Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Uo/Voc = 12 V Io/Isc = 12 mA Po/Po = 36 mW	IIC II B II A			

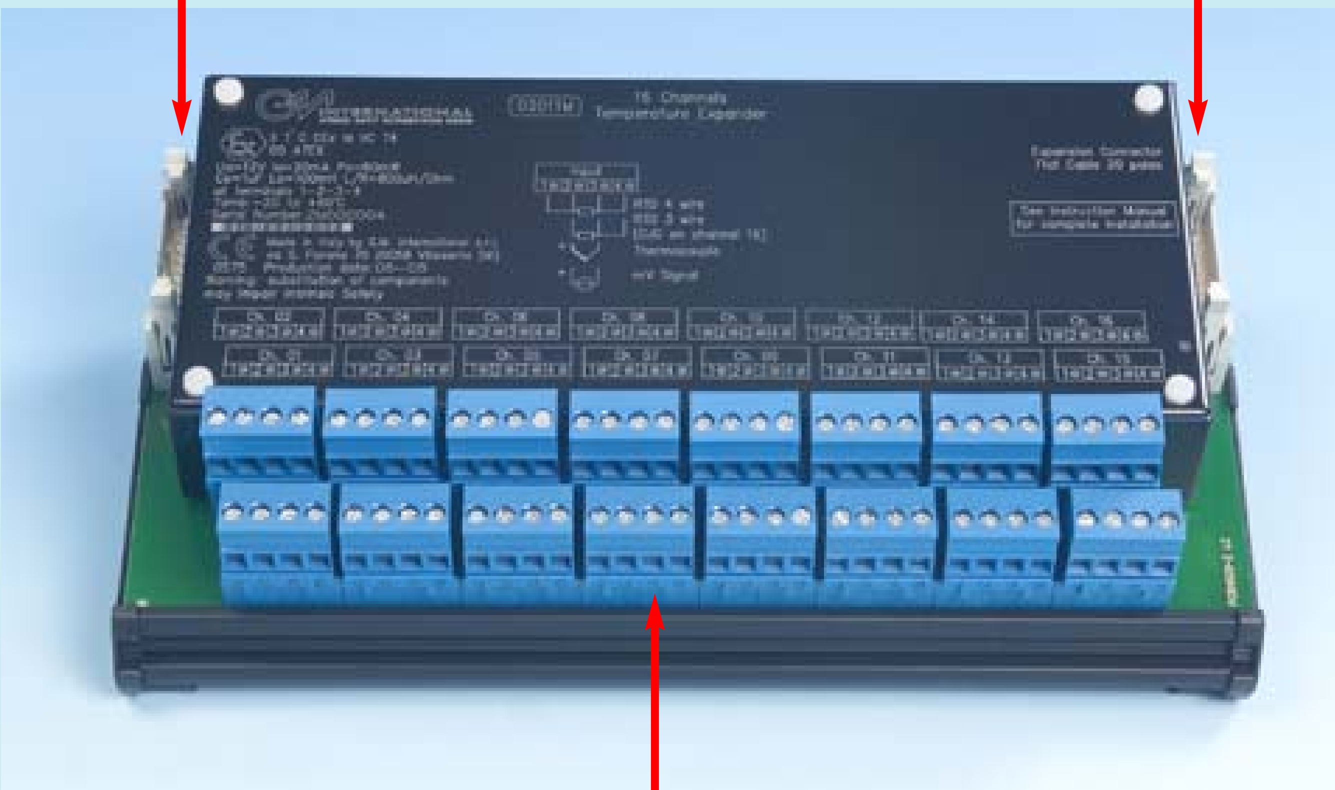
NOTE for USA and Canada:
II C equal to Gas Groups A and B
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

Ordering Information:

Model:	D2011M
16 channels	

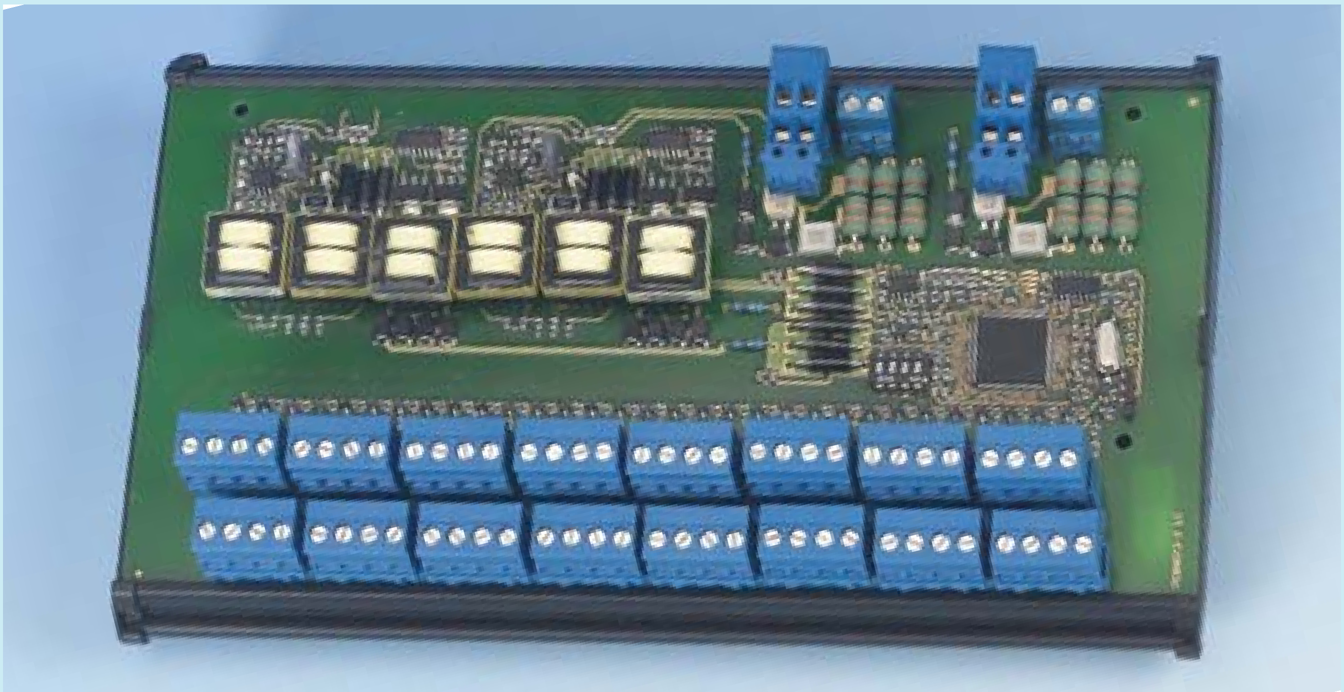


Flat Cable Connectors for Expansion



16 channels Input Terminal Blocks plug-in type

D2030M Unit without cover



GM INTERNATIONAL TECHNOLOGY FOR SAFETY

D2030

Intrinsically Safe Digital Multiplexer Model D2030M for DIN-Rail Mounting in Zone 0, 1, 2

Characteristics:

General description:

D2000M Series Intrinsically Safe Multiplexing System consists of one to four Analog-Temperature Multiplexer Units model D2010M, up to twelve Expander Units model D2011M, or up to four D2030M Digital Multiplexer Units, mounted in Zone 0, 1, 2 Hazardous Area, Gas Group IIC T4, connected via a single / redundant 2 wire data communication / Supply line to a Modbus Gateway Unit model D2050M, mounted in Safe Area and connected to a PLC, DCS or PC.

Multiplexer D2030M Units, can be installed in the field, close to input sensors, for data acquisition from Hazardous Area and connected to a Safe Area PLC/DCS or other devices, via 2 wire communication link and Gateway D2050M Unit, saving wiring, cables and costs. The Units are primarily intended for Hazardous Area acquisition from contacts or proximity detectors.

D2030M scans all channels and stores all data in a memory buffer, where they can be rapidly accessed by the Modbus Gateway D2050M Unit. Each Mux D2030M Unit accepts directly up to 32 input channels and is expandable to 128 channels.

Four D2030M Units reach 128 inputs with a single Modbus Gateway D2050M Unit

Redundant communication is obtained by dual data/supply interface line. Safety Parameters maintain compatibility with Gas Group II C even in redundant mode.

Features:

Intrinsically Safe for installation in Zone 0, 1, 2, 20, 21, 22, Gas Group IIC T4 or Class I, II and III, Division 1 and Class I, Zone 0 & 1 Hazardous Location.

Inputs from contats or NAMUR Proximity Sensors.

32 input channels.

Expandability up to 128 channels per System and 31 Systems on a single serial link for up to 3968 Channels.

Field Redundant communication.

EMC according to EN50081-2, EN50082-2.

ATEX, IECEx, FM & FM-C, GOST applied for.

High Reliability, SMD components.

High Density, 32 channels per unit, 128 channels per System.

Configurable via D2050M Gateway using SWC2090 Software (free of charge).

Lower PLC/DCS I/O card s cost.

Lower Cables and installation costs.

1 Terminal Block per input connection, no external Terminal Block required.

Simplified installation using standard DIN Rail mounting Units.

Technical Data:

Supply:

Via D2050M Gateway Unit.

Max. Power Consumption: 200 mW.

Isolation:

I.S. In/Out, Communication line, 0,5 KV;
I.S. In/Ground 500 V;
Communication line/Ground 500 V;
I.S. In/I.S. In between Units 500 V.

Input switching current levels:

ON ≥ 2.1 mA, OFF ≤ 1.2 mA,
Switch current ≈ 1.6 mA ± 0.2 mA hysteresis.

Fault current levels: Open fault ≤ 0.2 mA, Short fault ≥ 6 mA.

Input equivalent source: 7,5 V 1 KΩ typical

Scan cycle Time: 50 ms for four D2030M units (128 channels).

Compatibility:

CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN60010-1.

Environmental Condition:

Operating: - 20 to + 60 °C, Relative Humidity max 90 % non condensing, up to 35 °C.

Storage: 40 to + 80 °C.

Safety description of measuring inputs:

Uo/Voc = 9,6 V, Io/Isc = 14 mA, Po/Po = 29 mW, at terminals 1-2, 3-4.
II 1 G D EEx ia IIC T4 or I M2 EEx ia IS Apparatus.

Approvals:

ATEX, IECEx, FM & FM-C, GOST applied for.
Conforms to EN 60079-0, EN 60079-11, EN 60079-25, IEC 60079-27, EN 50281-1-1, EN 50284, FM 3600, FM 3610, FM 3810, CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 142 and CSA-C22.2 No. 157, ANSI/NEMA 250, ANSI/IEC 60529,
TCCExEE (Russia) to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X,
TCCExEE (Ukraine) to GOST 12.2.007.0, 22782.0, 22782.5 [Exia] IIC X.

Mounting:

DIN Rail T35 according EN50022.

Weight: About 300 g.

Connections: By screw terminals for up to 2,5 mm^2.

Installation Area: Zone 0, 1, 2, 20, 21, 22, Gas Group IIC T4 or Class I, II and III, Division 1 and Class I, Zone 0 & 1 Hazardous Location..

Protection Class: IP 20.

Dimensions: 127W x 220L x 78D mm.

Note: for field mounting see GM 2300 Series enclosures.

Parameters Table:

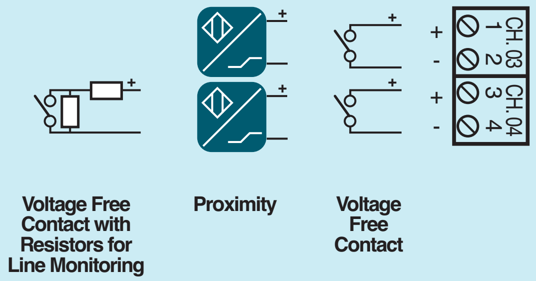
Safety Description	Maximum External Parameters			
	Group Cenelec	Co/Ca (µF)	Lo/La (mH)	Lo/Ro (µH/Ω)
Uo/Voc = 9,6 V Io/Isc = 14 mA Po/Po = 29 mW	IIC II B II A			

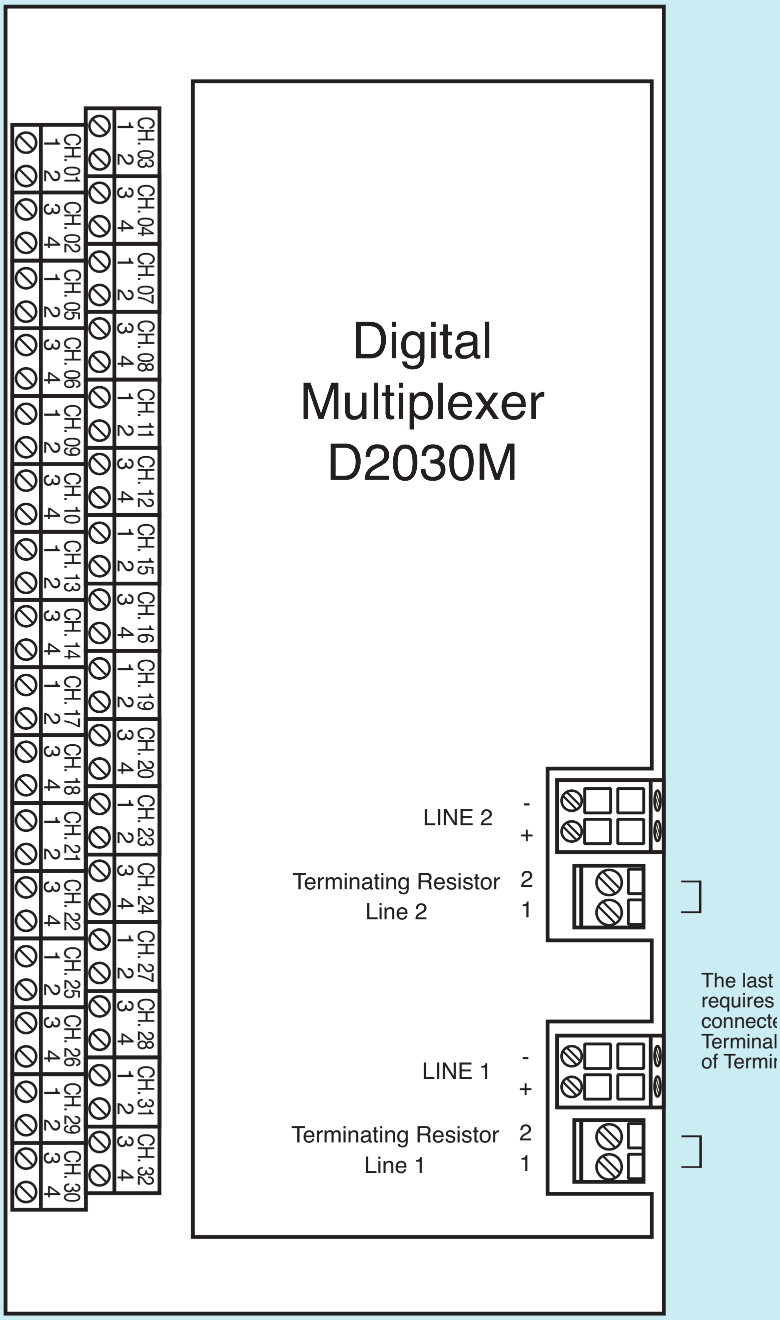
NOTE for USA and Canada:

II C equal to Gas Groups A and B
II B equal to Gas Groups C, D, E, F and G.
II A equal to Gas Groups D, E, F and G.

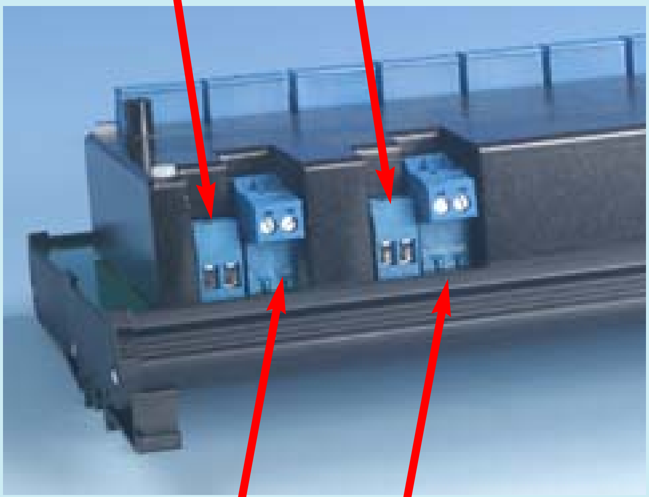
Ordering Information:

Model:	**D2030M**
32 channels	

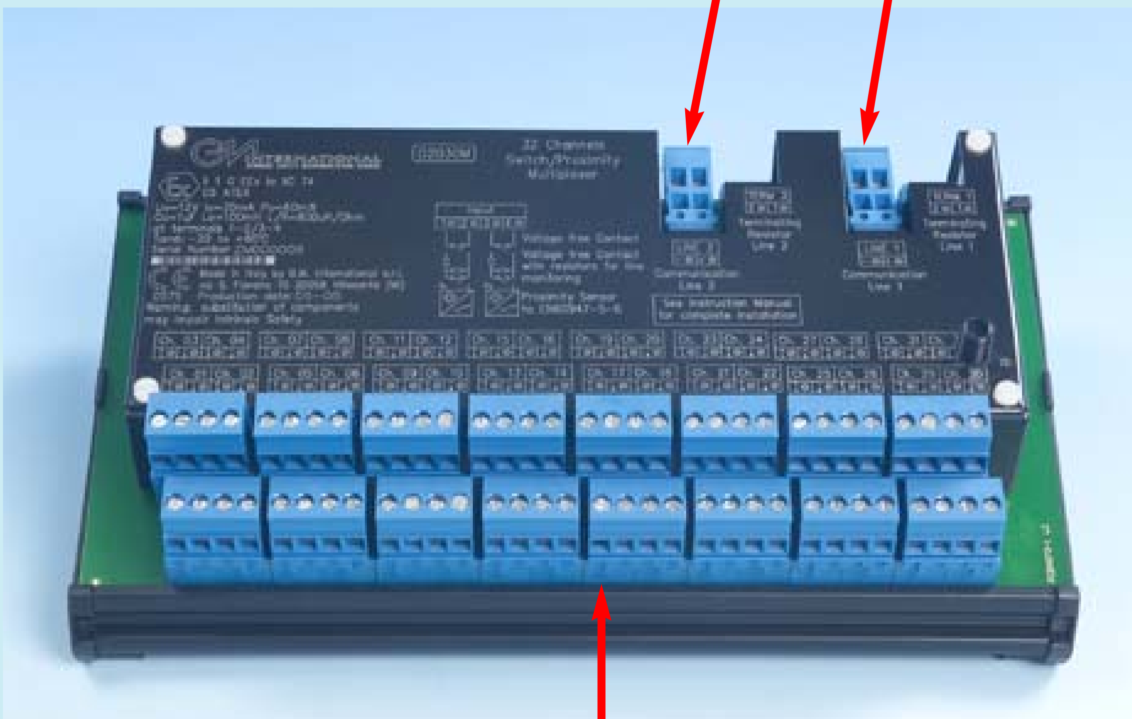




Lines Termination Resistor Terminal Blocks



Communication Lines double Terminal Block
Plug-in type



32 channels Input Terminal Blocks plug-in type

INTERNATIONAL
TECHNOLOGY FOR SAFETY

D2050

Gateway - Power Supply Unit for Multiplexer D2000M Series - Model D2050M for DIN-Rail Mounting

Characteristics:

General description:

D2000M Series Intrinsically Safe Multiplexing System consists of one to four Analog-Temperature Multiplexer Units model D2010M, up to twelve Expander Units model D2011M, or up to four D2030M Digital Multiplexer Units, mounted in Zone 0, 1, 2 Hazardous Area, Gas Group IIC T4, connected via a single / redundant 2 wire data communication / Supply line to a Modbus Gateway Unit model D2050M, mounted in Safe Area and connected to a PLC, DCS or PC.

The Power Supply Gateway D2050M Unit, mounted in Safe Area, provides Intrinsically Safe protection to the 2 wire communication link, and supplies power to D2010M, Expander D2011M, and Digital Multiplexer D2030M Units, installed in Hazardous Area, close to input sensors, for data acquisition and connects the field Multiplexers to a Safe Area PLC/DCS or other devices saving wiring cables and costs. The Unit is primarily intended to interface field Mux with the PLC/DCS systems via Modbus serial lines with redundant communication.

Units D2010M, D2011M and D2030M scan all channels, using state of the art solid state isolated relays, and store all data in a memory buffer, where they can be rapidly accessed by the Modbus Gateway Unit D2050M. Each Mux Unit D2010M accepts directly up to 16 input channels and, by adding from one to three D2011M, is expandable to 64 channels. Four D2010M units, connected to twelve D2011M Expanders achieve 256 inputs via one Modbus Gateway D2050M. D2030M Unit accepts up to 32 Digital Input channels and four D2030M Units (128 channels) can be connected to the D2050M Gateway. One D2050M Unit can support up to 256 analog input channels from D2010M-D2011M or 128 digital channels from D2030M Unit.

Redundant communication is obtained by dual data/supply interface line. Safety Parameters mantain compatibility with Gas Group II C even in redundant mode.

Features:

Intrinsically Safe, as Associated Apparatus in Safe Area, to supply Multiplexers D2010M - D2011M - D2030M installed in Zone 0, 1, 2, 20, 21, 22 Gas Group IIC T4.

Supplies up to 256 input channels from D2010M - D2011M - D2030M Field Units.

Expandability up to 31 Systems on a single serial link for up to 7936 Temperature Channels, or 3968 Digital Channels.

Field Redundant communication.

Modbus interface RTU protocol on redundant RS-485.

RS-232 port for system configuration.

EMC according to EN50081-2, EN50082-2.

ATEX certification.

High Reliability, SMD components.

Configurable by SWC2090 Software (free of charge).

Lower PLC/DCS I/O cards cost (just 1 serial port per 256 inputs).

Simplified installation using standard DIN Rail mounting Units.

Repeat Input Contacts - Proximity Detector in Safe Area via D2052M with relay Outputs.

Repeat Input Contacts - Proximity Detector in Safe Area via D2053M with O.C. Transistor Outputs.

Technical Data:

Supply:

24 V nom. (24 ± 10%) reverse polarity protected, ripple within voltage limits ≤ 5 Vpp.

Max. Power Consumption: 7 W.

Isolation:

I.S. Out/Serial line - Supply 1,5 KV; Serial line/Ground 500 V.

Inputs:

Modbus RTU protocol up to 38.400 baud with redundant connection.

Outputs: Dual Serial Communication proprietary protocol line and RS232 Supply.

Scan cycle Time:

50 ms: for four D2030M Units (64 digital channels).

1600 ms: for four D2010M Unit and twelve D2011M (256 analog channels).

Compatibility:

CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN60010-1.

Environmental Condition:

Operating: - 20 to + 60 °C, Relative Humidity max 90 % non condensing, up to 35 °C.

Storage: 40 to + 80 °C.

Safety description of measuring inputs:

II (1) GD [EEx ia] II C associated electrical apparatus.

Approvals:

ATEX, IECEx, FM & FM-C, GOST applied for.
Conforms to EN 60079-0, EN 60079-11, EN 60079-25, IEC 60079-27, EN 50281-1-1, EN 50284, FM 3600, FM 3610, FM 3810, CSA-E60079-0 (General, All Zones), CSA-E60079-11 (Intrinsic Safety i Zones 0 & 1), CSA-C22.2 No. 142 and CSA-C22.2 No. 157, ANSI/NEMA 250, ANSI/IEC 60529,
TCCExEE (Russia) to GOST R 51330.0-99, 51330.10-99 [Exia] IIC X,
TCCExEE (Ukraine) to GOST 12.2.007.0, 22782.0, 22782.5 [Exia] IIC X.

Mounting:

DIN Rail T35 according EN50022.

Weight: About 300 g.

Connections: By screw terminals for up to 2,5 mm^2.

Installation: Safe Area.

Protection Class: IP 20.

Dimensions: 45 W x 220 L x 99 D mm.

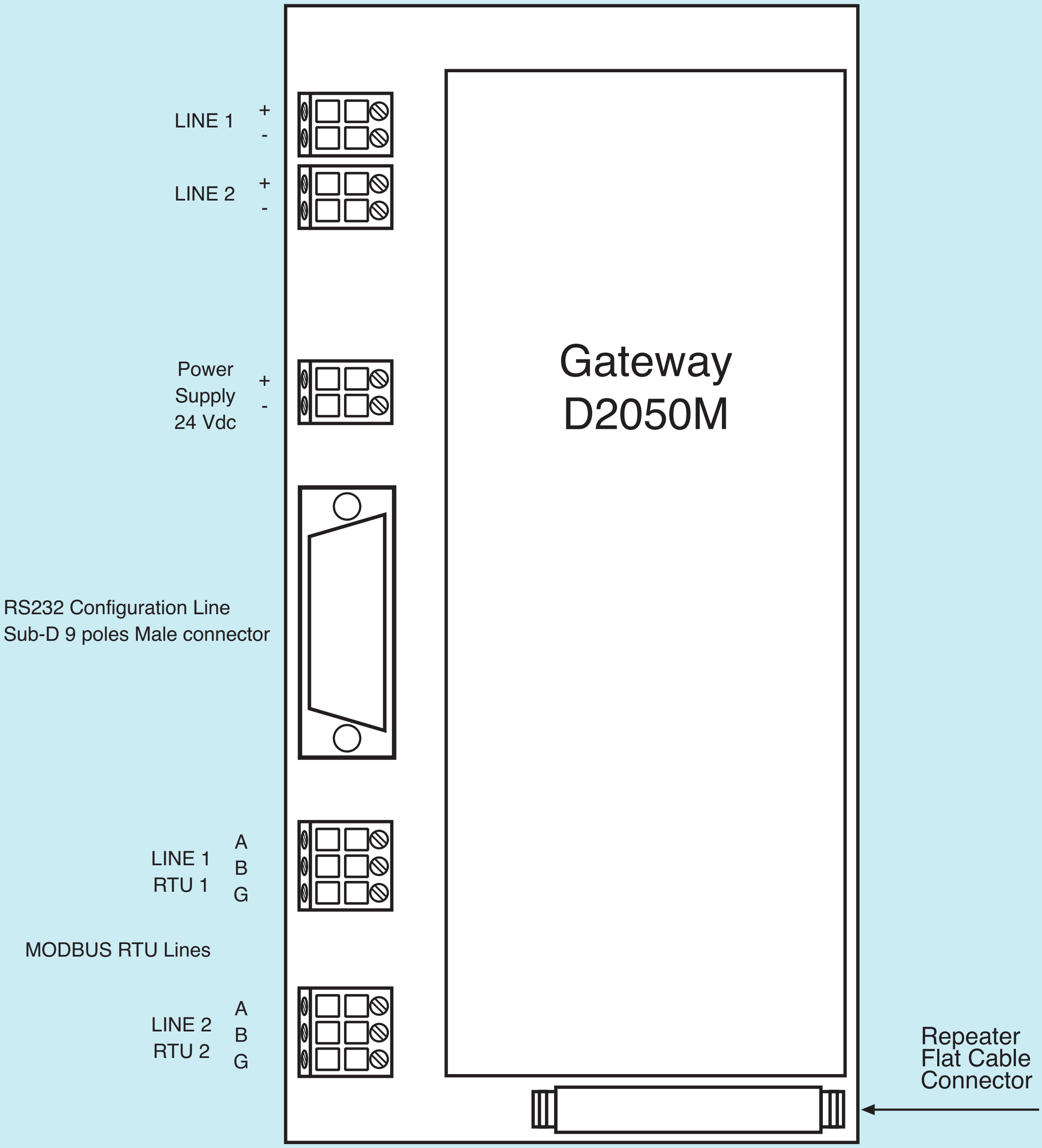
Safety Specifications:

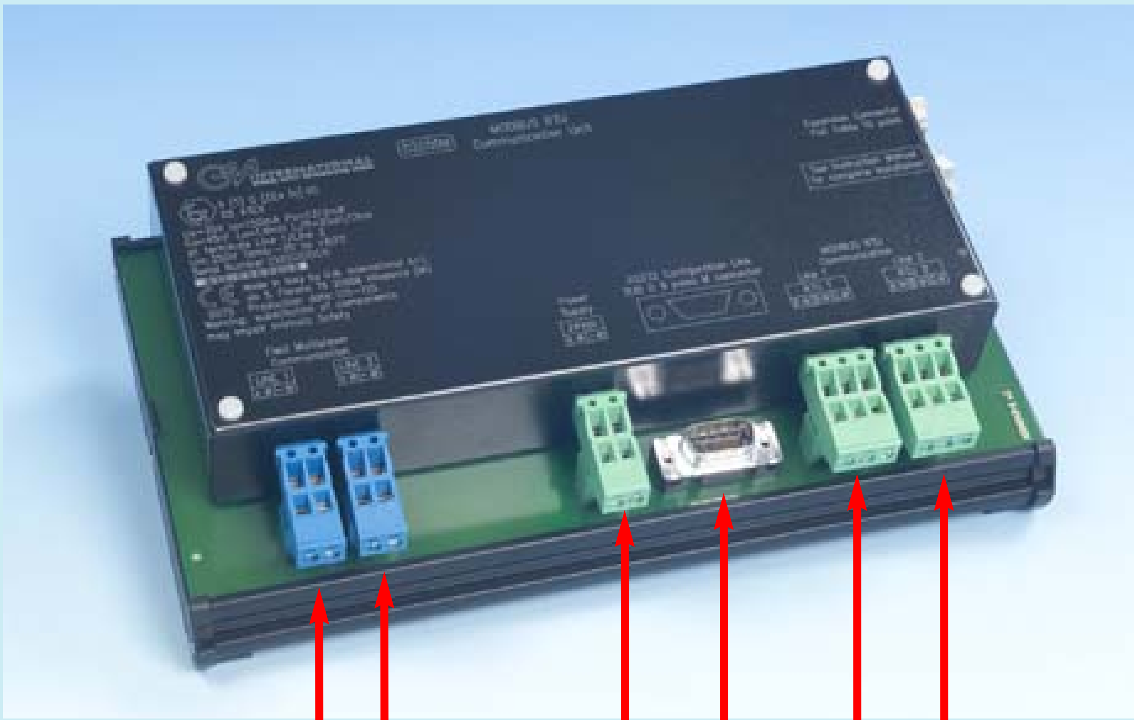
The intrinsically safe ia system consisting of a D2050M, connected to field units D2010M or D2030M with a cable conforming to IEC 60079-27 (FISCO), is suitable for installation in Zone 0, 1, 2, 20, 21, 22, Gas Group IIC T4 or Class I, II and III, Division 1 and Class I, Zone 0 & 1 Hazardous Location.

GM cable CABF008, for connections not exceeding 1 Km in Gas Group II C (Class I A,B), or 5 Km for Gas Group II B (Class I C), is a compliant cable for this application.

Ordering Information:

Model:	**D2050M**
Gateway	





Redundant Communication Lines double Terminal Block Plug-in type

24 V dc Supply Line double Terminal Block Plug-in type

RS232 Serial Line Connector for Configuration

Redundant Modbus RTU Lines double Terminal Block Plug-in type

GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

D2052
D2053

Contact-Proximity Output Repeaters Model D2052M-D2053M for DIN-Rail Mounting in Safe Areas

Characteristics:

General description:

D2000M Series Intrinsically Safe Multiplexing System consists of one to four Analog-Temperature Multiplexer Units model D2010M, up to twelve Expander Units model D2011M, or up to four D2030M Digital Multiplexer Units, mounted in Zone 0, 1, 2 Hazardous Area, Gas Group IIC T4, connected via a single / redundant 2 wire data communication / Supply line to a Modbus Gateway Unit model D2050M, mounted in Safe Area and connected to a PLC, DCS or PC.

The D2052M Unit is equipped with 32 relay output SPDT contacts. When connected to D2050M Unit, it repeats the status of each D2030M digital input Multiplexer Unit.

The D2053M Unit is equipped with 32 Open Collector Transistor Outputs. When connected to D2050M Unit, it repeats the status of each D2030M digital input Multiplexer Unit.

Features:

32 Fully Isolated Channels.

EMC according to EN50081-2, EN50082-2.

High Reliability, SMD components.

High Density, 32 channels per unit, 128 channels per System.

Simplified installation using standard DIN Rail mounting Units.

Technical Data:

Supply:

24 V nominal (24 ± 10%). Reverse polarity protected.

Max. Power Consumption: D2052M: 5 W. D2053M: 1,8 W.

Isolation:

500 V.

Relay Output:

SPDT Contacts 2 A, 60 V.

Open Collector Output:

50 mA at 35 V or 100 mA at 12 V (≥1 V drop).

Compatibility:

CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN60010-1.

Environmental Condition:

Operating: - 20 to + 60 °C, Relative Humidity max 90 % non condensing, up to 35 °C.

Storage: 40 to + 80 °C.

Mounting:

DIN Rail T35 according EN50022.

Weight: About 300 g.

Connections: By screw terminals for up to 2,5 mm^2.

Installation Area: Safe Area.

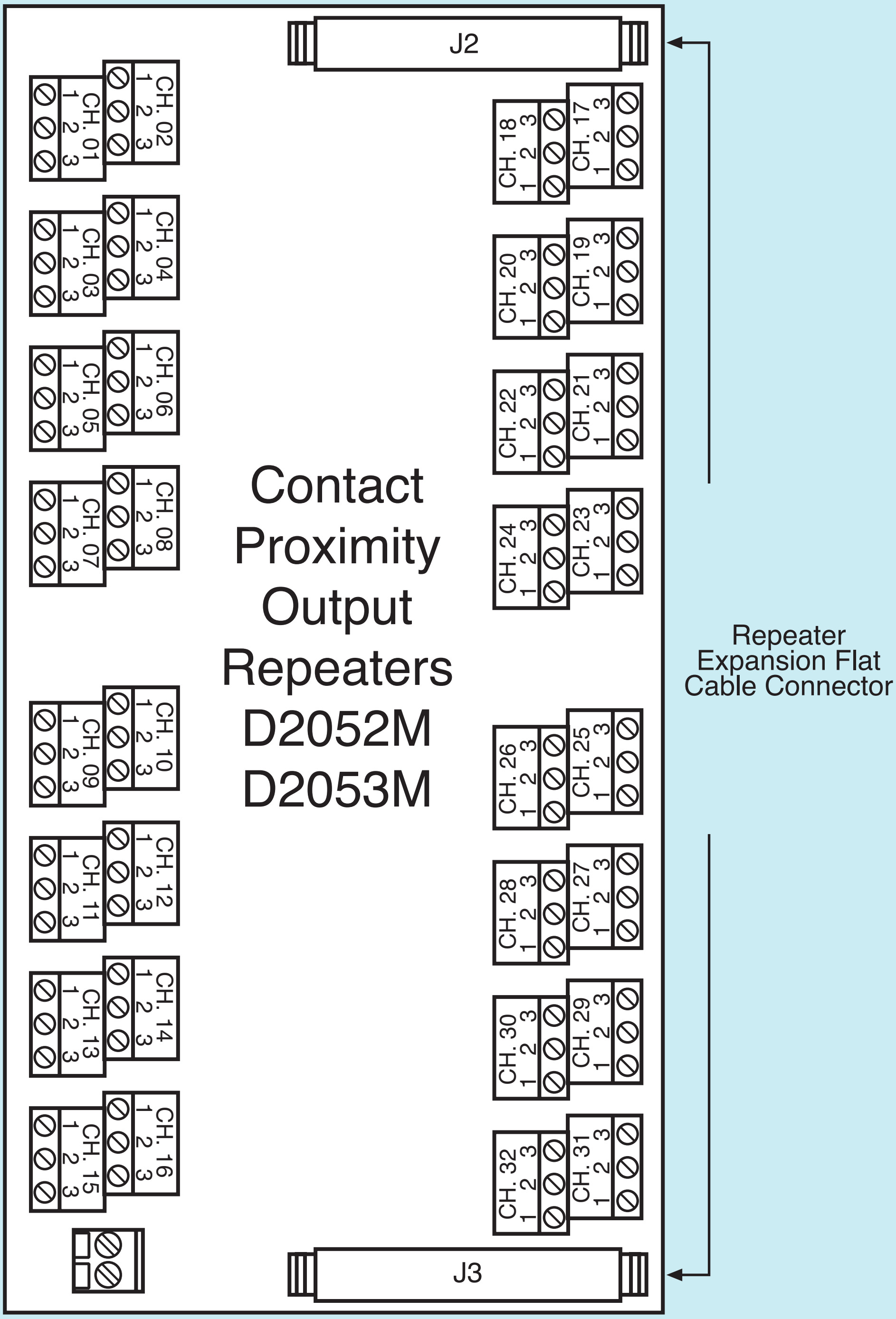
Protection Class: IP 20.

Dimentions: 127 W x 220 L x 78 D mm.

Ordering Information:

Model:	**D2052M**
32 Relay Outputs	

Model:	**D2053M**
32 Open Collector Outputs	



J2
J3
Contact
Proximity
Output
Repeaters
D2052M
D2053M
Repeater
Expansion Flat
Cable Connector
CH. 01
CH. 02
CH. 03
CH. 04
CH. 05
CH. 06
CH. 07
CH. 08
CH. 09
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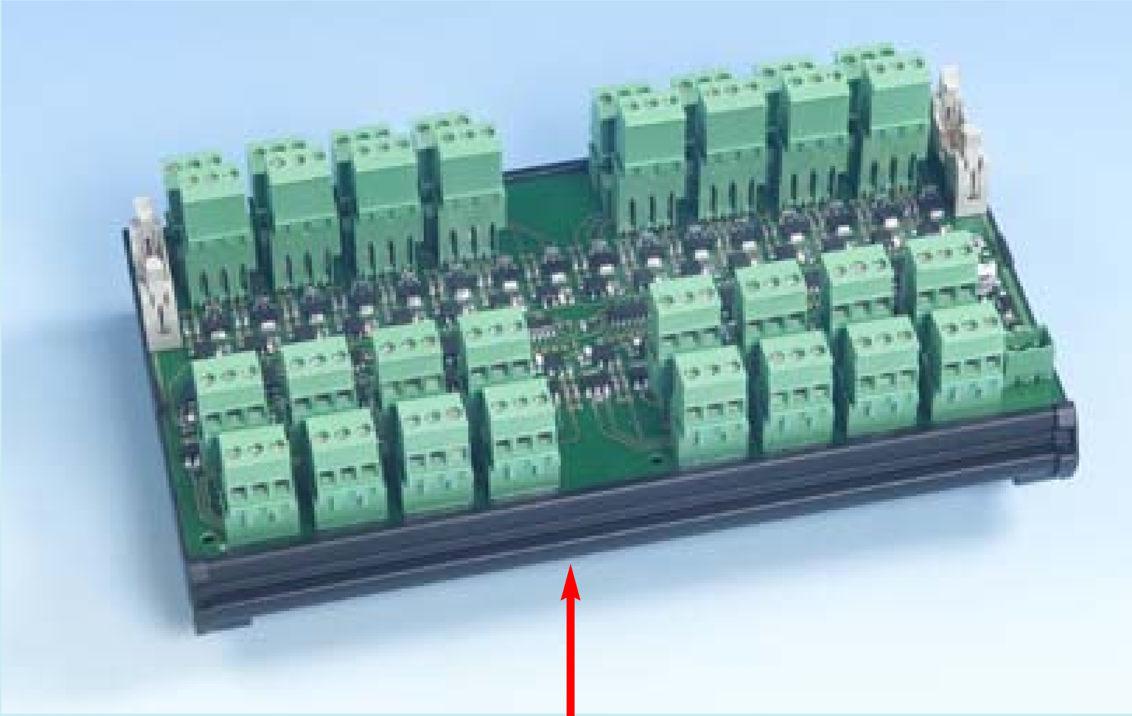
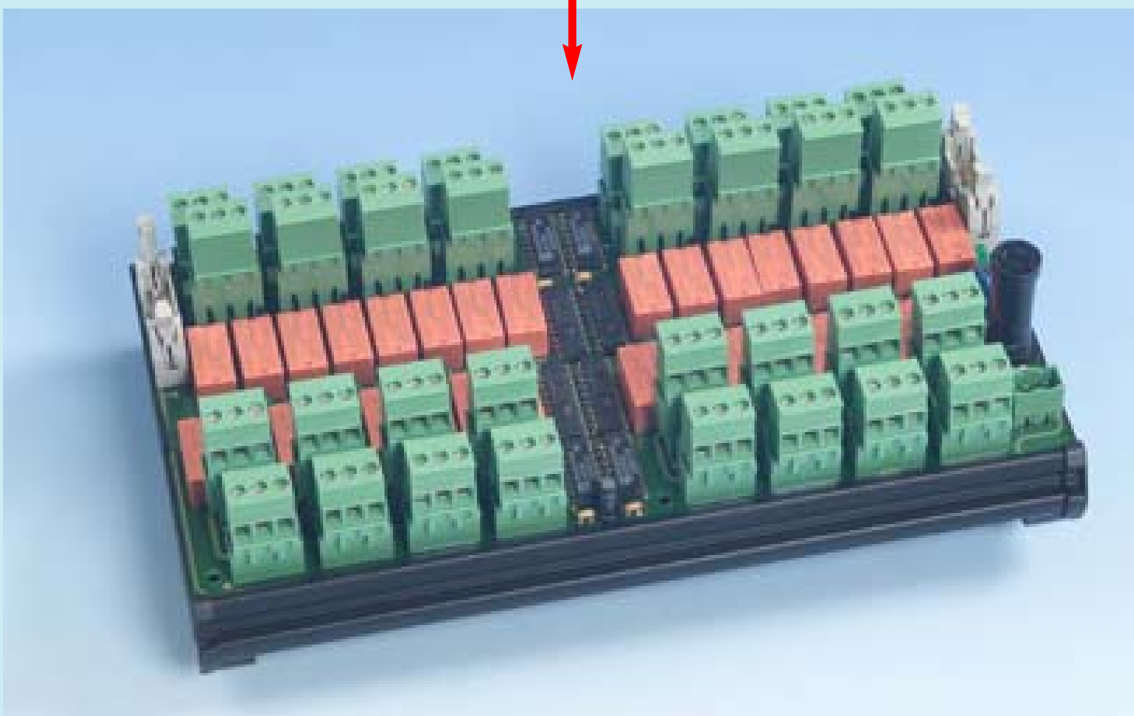
CH. 32



D2053M Unit Transistor Output with 32 Plug-in Terminals Blocks

D2052M Unit Relay Output with 32 Plug-in Terminals Blocks



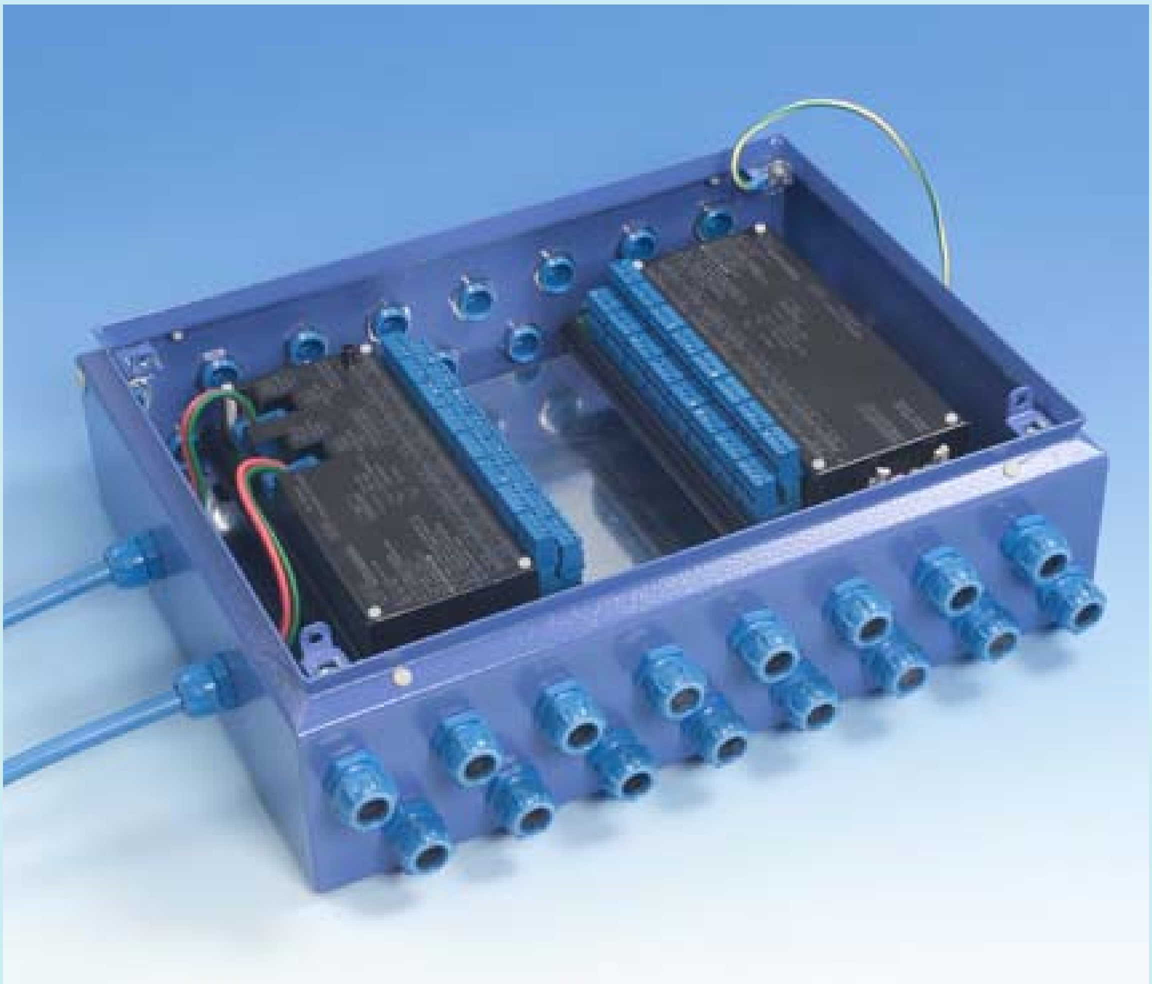
GM2300 SERIES
Enclosures
for Multiplexer
UNITS D2000M Series

FIELD MOUNTING ENCLOSURES
GM2300 SERIES
FOR D2000M SERIES
MULTIPLEXER SYSTEM
MODELS TABLE
AND
CHARACTERISTICS

The GM2300 series field mounting enclosures are manufactured from carbon steel or stainless steel 316 sheet to provide high levels of corrosion resistance to process environments. The GM2300 series are suitable for Zones 0, 1, 2 and 20, 21, 22 application, equipped with suitable cable glands to accommodate wiring and one, two or four D2000 Series Multiplexer units D2010, D2011 and D2030. Models GM2322 and GM2329 are provided each with four flanges to let the customer accommodate the cable gland.
All other models are supplied with appropriate cable gland as indicated in the table. All cable glands are size PG16 and codes PGM is for plastic blue colour; BRA is for brass armoured cable: BRNA is for brass non armoured cable; SSA is for Stainless steel armoured cable; SSNA is for stainless steel non armoured cable.
The carbon steel models are painted in blue colour.
All models are equipped with internal steel plate and T35 DIN Rail, according to EN 50022, for D2000M series system units mounting and wiring.
Models with the code final letter “H” are equipped with heating cable and an EEx d thermostat.
These boxes require an EEx e junction box for the 220 Vac supply of the heating cable. Applications are for low ambient temperature of -40 °C.

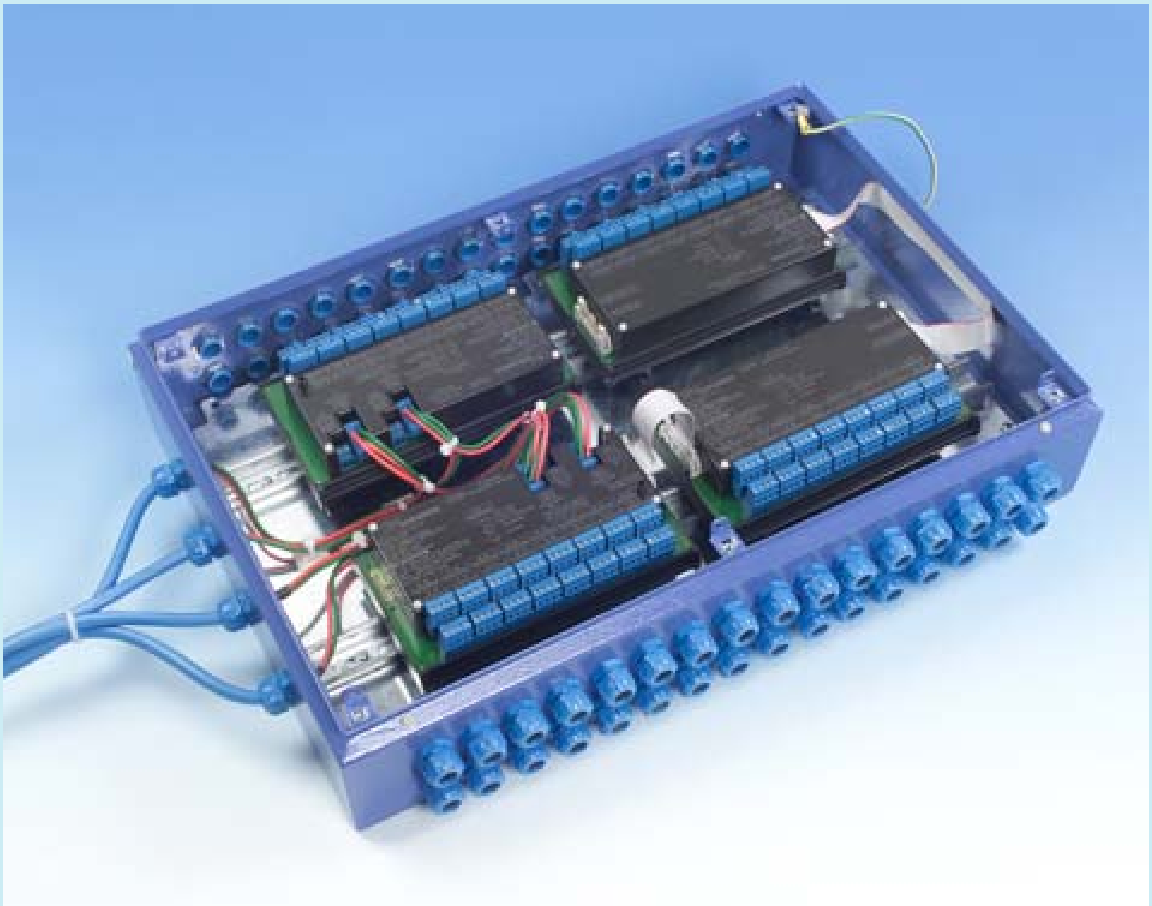
Model	Material	Prot.	N. of Cable Gland	Color	Overall Dimension in mm.	Weight Kg	Suitable for mounting
GM2310	Carbon steel	IP65	18 PMG	Blue	300 x 200 x 120	4	One D2010M
GM2311	Stainless steel 316	IP65	18 PMG	St. St.	300 x 200 x 150	7	One D2010M
GM2312	Stainless steel 316	IP65	18 BRA	St. St.	300 x 200 x 150	7	One D2010M
GM2313	Stainless steel 316	IP65	18 BRNA	St. St.	300 x 200 x 150	7	One D2010M
GM2314	Stainless steel 316	IP65	18 SSA	St. St.	300 x 200 x 150	7	One D2010M
GM2315	Stainless steel 316	IP65	18 SSNA	St. St.	300 x 200 x 150	7	One D2010M
GM2316	Carbon steel	IP65	34 PMG	Blue	400 x 300 x 120	7	Two D2010/11M or one D2030M
GM2317	Stainless steel 316	IP65	34 PMG	St. St.	400 x 300 x 200	11	Two D2010/11M or one D2030M
GM2318	Stainless steel 316	IP65	34 BRA	St. St.	400 x 300 x 200	11	Two D2010/11M or one D2030M
GM2319	Stainless steel 316	IP65	34 BRNA	St. St.	400 x 300 x 200	11	Two D2010/11M or one D2030M
GM2320	Stainless steel 316	IP65	34 SSA	St. St.	400 x 300 x 200	11	Two D2010/11M or one D2030M
GM2321	Stainless steel 316	IP65	34 SSNA	St. St.	400 x 300 x 200	11	Two D2010/11M or one D2030M
GM2322	Carbon steel	IP55	Flanged	Blue	400 x 300 x 120	8	Two D2010/11M or one D2030M
GM2323H	Stainless steel 316	IP65	34 BRA	St. St.	400 x 300 x 200	12	One D2010/11M or D2030
GM2324H	Stainless steel 316	IP65	34 BRNA	St. St.	400 x 300 x 200	12	One D2010/11M or D2030M
GM2325H	Stainless steel 316	IP65	34 SSA	St. St.	400 x 300 x 200	12	One D2010/11M or D2030M
GM2326H	Stainless steel 316	IP65	34 SSNA	St. St.	400 x 300 x 200	12	One D2010/11M or D2030M
GM2327	Carbon steel	IP65	68 PMG	Blue	600 x 400 x 120	13	Four D2010/11M or two D2030M
GM2328	Stainless steel 316	IP65	68 PMG	SS	600 x 400 x 200	20	Four D2010/11M or two D2030M
GM2329	Stainless steel 316	IP65	68 BRA	SS	600 x 400 x 200	20	Four D2010/11M or two D2030M
GM2330	Stainless steel 316	IP65	68 BRNA	SS	600 x 400 x 200	20	Four D2010/11M or two D2030M
GM2331	Stainless steel 316	IP65	68 SSA	SS	600 x 400 x 200	20	Four D2010/11M or two D2030M
GM2332	Stainless steel 316	IP65	68 SSNA	SS	600 x 400 x 200	20	Four D2010/11 or two D2030
GM2333	Carbon steel	IP55	Flanged	Blue	600 x 400 x 120	15	Four D2010/11M or two D2030M
GM2334H	Stainless steel 316	IP65	68 BRA	SS	600 x 400 x 200	22	Two D2010/11M or D2030M
GM2335H	Stainless steel 316	IP65	68 BRNA	SS	600 x 400 x 200	22	Two D2010/11M or D2030M
GM2336H	Stainless steel 316	IP65	68 SSA	SS	600 x 400 x 200	22	Two D2010/11M or D2030M
GM2337H	Stainless steel 316	IP65	68 SSNA	SS	600 x 400 x 200	22	Two D2010/11M or D2030M

GM2321 Stainless Steel 400x300x200 mm



GM2316 Carbon Steel 400x300x120 mm

GM2322 Carbon Steel - Flanged - 400x300x120 mm

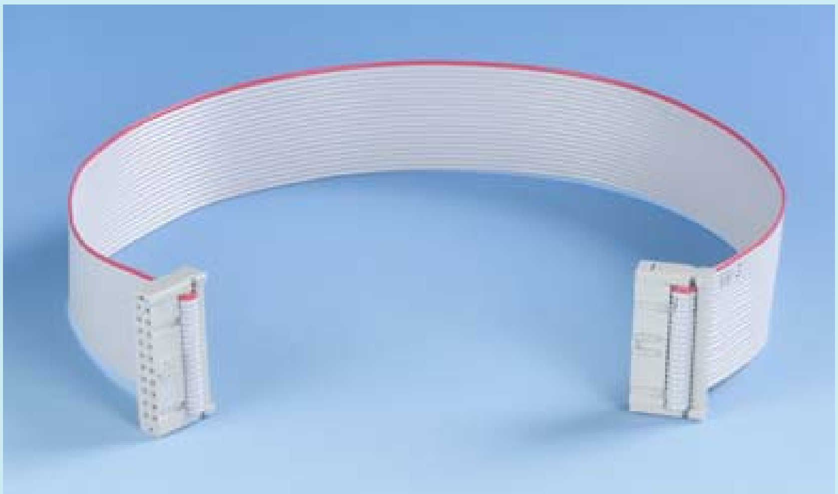


GM2327 Carbon Steel 600x400x120 mm

GM2310 Carbon Steel 300x200x120 mm

OPT 94: accessories kit for wall mounting

OPT 95: hinge accessories kit for front door



Flat Cable accessories

PPC 2094: optional kit for System Configuration

OPT 2091: optional Terminal Block to be used on channel 16 for Cold Junction Compensation on Thermocouples Input (Units D2010M and D2011M)

Technical Specifications for Cable PN: CABF008

Description: Cable to interconnect D2050 to D2010/D2030 IIC max 1Km or IIB max 5Km

Conductors	stranded plain annealed copper wires to IEC60228 class 2, stranding 7/0.53 mm
Core Identification	Green and Red
Overall Screen	aluminium/polyester tape with metallic surface outside in contact with a tinned copper wire braid
Outer Sheath	PVC flame retardant type, UV and oil resistant, colour blue (I.S.)
Cable Marking	G.M. International ITALY – P.N. CABF008 – 2x1.5 mm² – Intrinsically Safe FIELDBUS to IEC61158-2 – 31.25 Kbit/s
Outer Diameter	9.8 mm
Net Weight	120 Kg/Km
Voltage Test	1000 Vrms per 1 min. core/core and core/screen
Conductor Resistance	≤ 24.2 Ω/Km at 20 °C in dc
Overall Screen Resistance	≤ 15.0 Ω / Km at 20 °C in dc
Insulation Resistance	≥ 5000 MΩ/Km at 20 °C
Nominal Capacitance	65 nF/Km core/core, 115 nF/Km core/screen
Capacitance Unbalanced to Earth≤	≤ 2000 pF/Km
Inductance	≤ 0.90 mH/Km
Characteristic Impedance	100 ± 20 Ω at 3 to 20 MHz
Nominal Impedance	100 Ω Ω
Bending Radius	≥ 95 mm repeating bending, ≥ 50 mm single bending
Maximum Tensile Strength	150 N
UV-Resistant	to UL1581 section 1200
Oil Resistance	to ICEA S 61-402
Flame Retardant	to IEC60332-1
Fire Retardant	to IEC60332-3 outer sheath

Note:

The D200M Series multiplexer units need, for safe operation, a cable, between the field units and the gateway, according to the requirements of the standard IEC 60079-27 (FISCO).
Our cable CABF008 fully complies with FISCO specifications.

However G.M. International can evaluate the applicability of cables already in place, if the following information is provided:

- Cable length.
- Core to core capacitance per Km.
- Core to screen capacitance per Km.
- Inductance per Km.
- Loop resistance per Km.
- Nominal Impedance, in the frequency range of 10 to 40 KHz.
- Nominal Attenuation dB/Km, in the frequency range of 10 to 40 KHz.
- Capacitance Unbalanced to Earth in pF/Km.
- Isolation between core/core and core/screen in Vrms.

T 3010S
4 1/2 digit
Intrinsically Safe
4-20 mA
Loop Indicator

GM INTERNATIONAL TECHNOLOGY FOR SAFETY

T3010

4 1/2 digit Intrinsically Safe 4-20 mA Loop Indicator Model T3010S

Characteristics:

General Description:

The single channel 4 1/2 digit Intrinsically Safe 4-20 mA Loop Indicator type T3010S provides process variable reading in Hazardous Area field.
It is a loop powered 4-20 mA unit with less than 1 V voltage drop.
It monitors 4-20 mA current, 0-100% percentage or process variable between -19999 to +19999 range with a 20 mm height 7-digit LCD display.
Blinking display indicates over range or under range condition.
An internal protected slot-in label is provided, after the last digit, to allow the unit measurement indication. Also loop tag indication can be provided.
The indicator is housed in a moulded reinforced polyammide 66/polycarbonate IP 66 case to allow installation in field area. It can be mounted on flat surface, front panel or 2 pipe or post. The housing is divided in two parts, one for cable connection and the other for indicator parameters setting.
The certification as non energy storing simple apparatus permits the use into any IS loop without need of further certification.

Field Configurability:

4 push button provided, protected with a cover, allows the configuration of the indicator parameters: decimal point position, low scale indication and high scale indication.

EMC:

Fully compliant with CE marking applicable requirements.

Features:

- 4 1/2 digit 20 mm height LCD display.
- -19999 to +19999 visualization range.
- 4-20 mA Loop Powered.
- Voltage drop < 1 V.
- Non energy storing apparatus.
- Hazardous Area Zone 0, IIC T5/T6 installation.
- IP 66 Enclosure for field mounting.
- High Accuracy.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- Field programmability by Push-button.
- ATEX Certification.
- High Reliability, SMD components.

Technical Data:

Input Range:

4-20 mA nominal (3 to 22 mA reading).
Voltage drop: ≤ 1.0 V, loop powered.
Over range protection: ≤ 200 mA without damage.

Visualization:

4 1/2 digit, 20 mm height, 7 segment LCD display.
Range indication: -19999 to +19999.
Decimal point: any position or disabled.
Setting: any value within range, direct or reverse indication.
Out of range indication: ≤ 3.5 mA or ≥ 20.5 mA blinking display.
Engineering value: internal slot-in label.
Reading rate: 2 measures per second.

Performance:

Ref. Conditions 4-20 mA range, 23 ± 1 °C ambient temperature.
Calibration accuracy: ± 5 digit.
Linearity error: ± 3 digit.
Series mode rejection: ± 1 digit for 1 mA peak-peak 50 Hz signal.
Temperature influence: ≤ ± 0.2 digit for a 1 °C change.

Compatibility:

CE mark compliant, conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive.

Environmental conditions:

Operating: Temperature limits -20 to + 60 °C, relative humidity max 95 % non condensing, up to 35 °C.
Storage: Temperature limits - 40 to + 80 °C.

Safety Description:

II 1 G D EEx ia IIC T5/T6 non energy storing simple apparatus.
Uo/Voc ≤ 1.2 V, Io/Isc ≤ 100 mA, Po/Po ≤ 25 mW, Ceq=0, Leq=0,
Ui ≤ 30 V, Ii ≤ 200/100 mA, Pi ≤ 0.85 W at input terminals +1, -2.
Can be connected into any IS loop without further certification.
-20 °C ≤ Ta ≤ 60°C.
Approvals: DNV-2004-OSL-ATEX-0066 conforms to EN50014, EN50020.

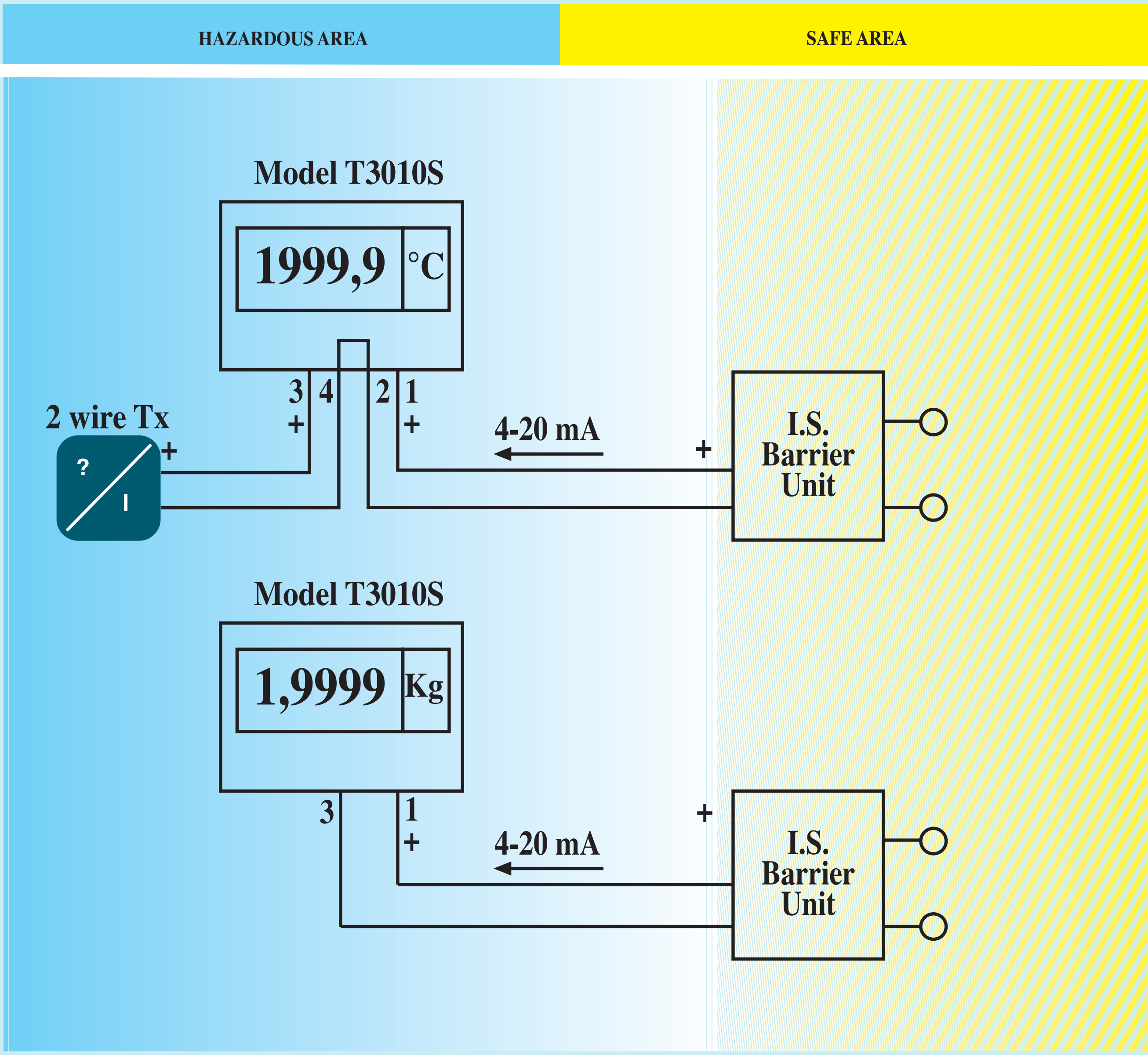
Mounting:

Flat surface, Front panel or 2 pipe/post using appropriate accessories.
Weight: about 650 g.
Connection: By disconnection of clamp terminal blocks to accomodate terminations up to 2.5 mm^2.
Location: Hazardous Area Zone 0 IIC T5/T6 installation.
Protection class: IP 66, panel mounting IP40 standard or IP65 with gasket provided in monting kit OPT93.
Dimensions: Width 144 mm, Depth 61 mm, Height 144 mm.
Cut-out for panel mounting: 139 x 139 mm.

Ordering Information:

Model: T3010S	
Suitable for flat surface mounting	Blank
2 Pipe/Front Panel Mounting Kit	/OPT93

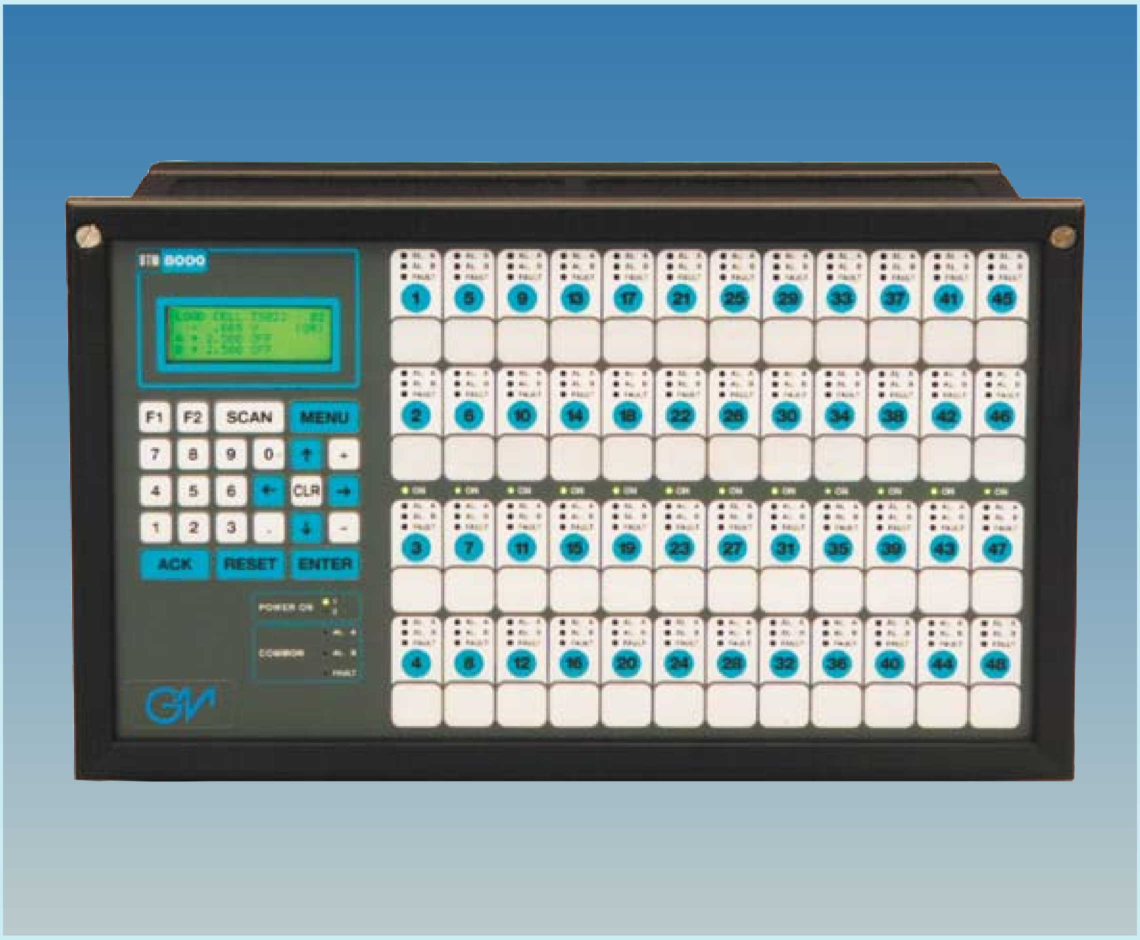
Function Diagram:



Vertical/Horizontal
2" Pipe/Post Mounting

Front Panel **Mounting**

DTM 8000
Continuous
Digital Alarm-Monitor System
for
Turbines-Compressors and Motors



DTM 8000
Digital Alarm-Monitor
Features

- **Up to 48 independent channels with parallel reading per unit,**
  in step of 4, to suit different applications (16-24-32-40-48 channels).
- **Suitable for Turbines and Compressors,**
  Temperature Alarm-Monitoring.
- **Independent and simultaneous monitoring**
  on all micro-processors controlled channel for maximum integrity and fault tolerance (each channel has its own micro-processor).
- **Automatic self checking**
  for reliable fault detecting operation.
- **Redundant Supply**
  with fault detection for high integrity operation (optional).
- **Two independent Alarm Levels**
  and one isolated Analog Output per channel operated directly by the channel processor to enhance channel integrity and fault tolerance.
- **IP 40 rated front panel standard**
  (IP 54 optional).
- **Total software configuration**
  of Input / Output features provides maximum flexibility and ease of use. No switches or jumpers required.
- **One standard channel card**
  (non dedicated) can be used for any type of input (TC, RTD, mA, Volt) minimizing number of cards to stock and easing future expansion.
- **Cold junction compensation.**
  local or remote.
- **One shot accurate and complete channel data readout**
  with a single alphanumeric presentation of: TAG (16 Char), VAR. VALUE (5 digit), ENG. UNIT, ALARM SET A and B, and STATUS.
- **Low power**
  circuit has low heat dissipated for reliable operation at high temperatures.
- **Reliable**
  low consumption, fault tolerant architecture, system integrity and self check.
- **Low maintenance cost**
  all vital parts are plug-in modules, including power supply, that can be inserted or extracted without disconnecting power to the unit.

DTM 8000 Digital Alarm-Monitor Specifications

General Description

The DTM 8000 is a Continuous Smart Digital Alarm Monitor System used for the reliable and effective monitoring of up to 48 channels of process variables.

The system is not a multiplexing type machine,

but a continuous one, which means there is no delay in monitoring the variables, because each input signal is continuously monitored in a parallel operating mode.

For this unique feature the unit is suitable to monitor critical rotating machines like Turbines and Compressors, (for instance: Bearing Temperature) where a few millisecond delay in alarming and shutting down could result in a disaster for the entire machine and plant operation.

Modular

All vital parts of the Monitor, like Power Supply Units, Channel Cards, Channel Alarm and Analog Output Cards, Central Coordinator Cards, etc., are hot swappable interchangeable plug-in modules to facilitate product expansion and service.

Flexibility

Each channel can be configured by software commands for all different types of input, practically encountered in industrial applications.

Each input circuit can be configured for:

Thermocouples: Type J, K, T, N, R, S with automatic Cold Junction Compensation, linearisation, burnout.

RTD: Pt 100 Ω DIN 43760.

Transmitter Potentiometer: 100 Ω min., 10 KΩ max.

mV: 0 to ± 100 mV (Input imped. > 10 MΩ).

Volt: 0-1 or 0-5 or 1-5 V (Input impedance > 50 KΩ).

mA: 0-20 or 4-20 mA (Input impedance 20 Ω).

Analog Ouptput can be configured for:

0-20 or 4-20 mA.

Alarms can be configured as:

High, Low or **Disabled**, operating mode **NE** or **ND** relay, direct/delayed actuation and adjustable dead band.

Configuration

Quick system setup by an easy to use configuration menu. The display presents options in a simple user friendly form.

Configuration data can be entered directly by the front panel keyboard.
Configuration menu is easily accessed via protection password, to safeguard against unauthorized entry.

Data Presentation

For each channel the display presents, on a high definition back lit 4 line by 20 column alphanumeric display:

TAG (16 alphanumeric characters) Channel Number

Variable value (5 digit)	Engineering Unit
Alarm SET A value	Alarm A Status
Alarm SET B value	Alarm B Status

The display is also used in the setup phase to present, in a simple user friendly form, configuration menus and channel or monitor operating parameters.

Alarm or abnormal monitor or channel status is also highlighted on the front panel by flashing Leds corresponding to the relevant channel or monitor section.

Cumulative Alarm Acknowledge/Reset

Three cumulative alarm SPDT relay contacts (cumulative Alarm A, cumulative Alarm B, cumulative Fault) are provided.

Any channel in alarm or abnormal status and any Monitor malfunctions will de-energize the corresponding cumulative relay and lit the corresponding cumulative alarm Led on the front panel. Cumulative relay can be used for remote alarm signaling purposes.

The acknowledge key will re-energize the relay returning the system to its normal status.
Remote operation of acknowledge and reset are provided in addition to front panel key.

Channel Alarm And Trip Function

Each channel has two alarm relays (Alarm A and Alarm B) with SPDT contact and flashing Alarm Led on the front panel corresponding channel.

The aknowledge key, in addition to reset the cumulative alarm relay, will change the Alarm Led from flashing to steady.

Applications

Typical Application is Temperature Alarm-Monitoring of Gas Turbines and Compressors.

Large quantities of Temperature Monitor Systems have been supplied world-wide, in the past, for Gas Pumping Stations and Chemical Plants, by manufactures like Fisher Rosemount (Series 4002) or Elcon Instruments (DTM-4000).

These manufactures have discontined production of these types of instruments.

G.M. International DTM-8000 can easily be used as a replacement, with improved performances, without need of major modifications.

Input Circuit (All Types)

Four input channels per card totally independent and isolated from each other, from ground, supply and output circuits.

Each channel is operated by an individual microprocessor and isolated from the field circuit.

Input Protection (All types)

All inputs are protected against over voltage up to 30 V.

Analog to Digital Converter

18 Bit bipolar input - integration type (100 ms conversion time)

NMRR 80 dB at 50-60 Hz.

CMRR 120 dB at 50-60 Hz.

RTD Input

Pt 100 Ω 2, 3, 4 - wire connection with automatic line resistance compensation and sensor / line fault detection (4 wire connection have no line fault detection) linear with temperature over max sensor range, according to DIN 43760 standard.

Range: - 200 to + 850 °C.

Accuracy: ± 0,5°C.

Resolution: 0.1 °C.

Stability: 0.05 °C/°C.

Transmitting Potentiometer input

Resistance range (end to end) 100 Ohm up to 10 KΩ (no burn-out detection)

Accuracy: ± 0,2%.

Resolution: 0,1%.

Thermocouple / mV input

Type K, J, T, R, S, N with fixed or automatic Reference Junction Compensation, (local or remote) and sensor/line burn-out detection, linear with temperature over the entire sensor range.

Type	Range	Resolution	Accuracy
TC K	-200 to +1300 °C	0.1 °C	± 0.5 °C
TC J	-200 to +750 °C	0.1 °C	± 0.5 °C
TC T	-200 to +400 °C	0.1 °C	± 0.5 °C
TC N	-200 to +1300 °C	0.1 °C	± 0.5 °C
TC R	0 to +1750 °C	0.1 °C	± 2 °C
TC S	0 to +1750 °C	0.1 °C	± 2 °C
mVolt	0 to ±100 mVolt	10 μVolt	± 20 μVolt

Input impedance: > 10 MΩ.

Stability: 0.5 μVolt / °C.

Analog Input

Current: -20 to +20 mA

(standard 4-20 / 0-20 mA) from externally powered signal sources or loop powered circuits.

Input impedance: 20 Ω.

Accuracy: ± 20 μA.

Resolution: 1 μA.

Stability: 1 μA / °C.

Voltage: -5 to +5 V (standard 0-1, 0-5, 1-5 V).

Input Impedance: > 50 KΩ.

Accuracy: ± 2 mV.

Resolution: 1 mV.

Stability: 0.5 mV / °C.

Cables Termination

Cables can be easily terminated on compression type 2,5 mm² (12 AWG) terminal blocks.

Supply

Power consumption for typical configuration

		16 ch.	32 ch.	48 channel
24 Vdc	(21 min to 30V max)	30 W	53 W	77 W worst case
115 Vac	(100 min to 130V max 50/60 Hz)	35 VA	58 VA	82 VA worst case
230 Vac	(200 min to 260V max 50/60 Hz)	35 VA	58 VA	82 VA worst case

Fuse 3,2 A type 6x32.

Power Supply Interruption Tolerance

Can withstand 20 ms power loss at nominal supply voltage without causing spurious alarm, fault or loss of control.

Overvoltage Transient Protection

Protected against overvoltage surges (4 J) and filtered to reduce interferences.

Redundant Supply (Optional)

Redundant Supply unit can be used as Backup Supply. Automatic transfer from Main Supply to Backup Supply will occur when one of the two Units fails, in this case an automatic supply fault detection and alarm signalling is generated.

Isolation

Power Supply	versus Input	1500 Vrms.
Power Supply	versus Output	1500 Vrms.
Input	versus Output	1500 Vrms.
Input	versus Input	500 Vrms.
Output	versus Output	500 Vrms.

Relay Output Cards (Optional)

Each card has 8 SPDT relay contacts (2 per input channel).

Rating AC: 250V, 3A, 500 VA.

Rating DC: 125V, 2A, 50VA.

Relay Action Delay Time (software programmable): min. 100 ms; max 25 s.

Analog Output Cards (Optional)

Each card has four fully isolated Analog Output Signals:

0-20 / 4-20 mA; 0-5/1-5 V with 250 Ω internal shunt.

Accuracy: ± 0.2% of full scale.

Max. Load: 500 Ω.

Ripple: 50 mVpp.

Environmental Conditions

Temperature: Operating -10 °C to +60 °C.

Storage -30 °C to +70 °C.

Relative Humidity:

0 to 90 % (non condensing, up to 35 °C).

Electro Magnetic Compatibility:

Compliance with EN50081-2 and EN50082-2 on request.

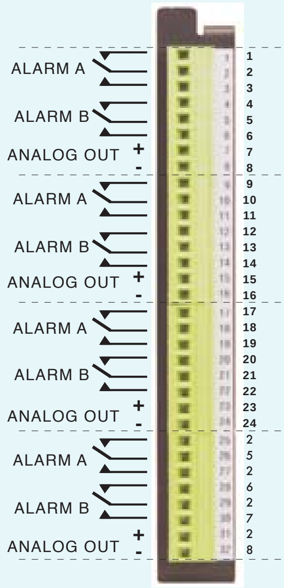
Weight:

19 Kg. (48 channels max extension).

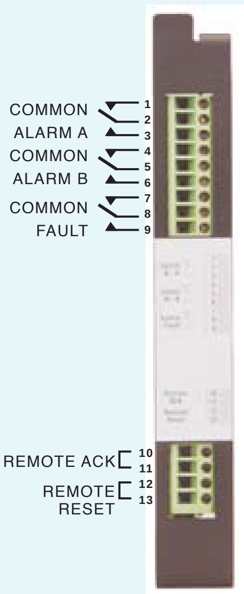
Input/Output Connections

RELAY AND ANALOG OUTPUT CONNECTIONS

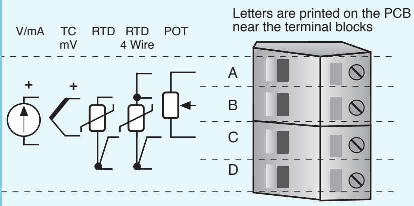
(relay contacts shown in deenergized condition)



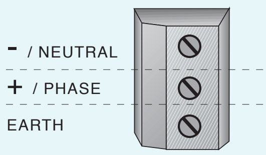
CUMULATIVE ALARM CONNECTIONS DETAILS



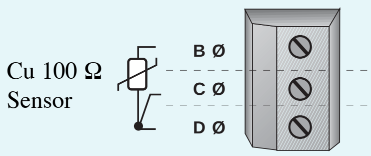
TYPICAL INPUT CONNECTIONS



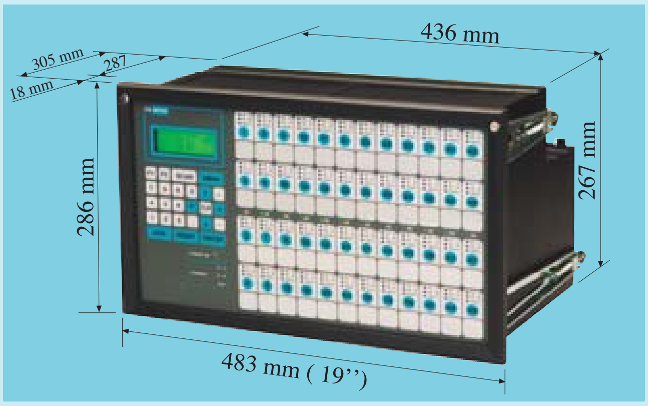
SUPPLY CONNECTIONS



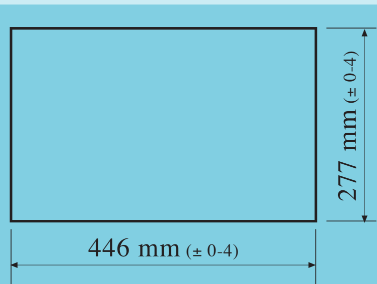
REMOTE CJC CONNECTIONS



External Dimensions

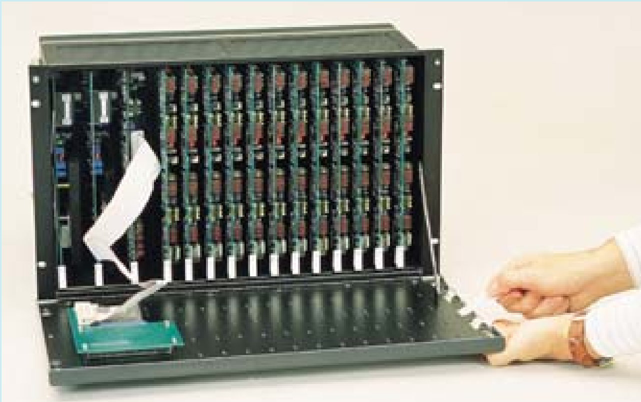


Cut Out

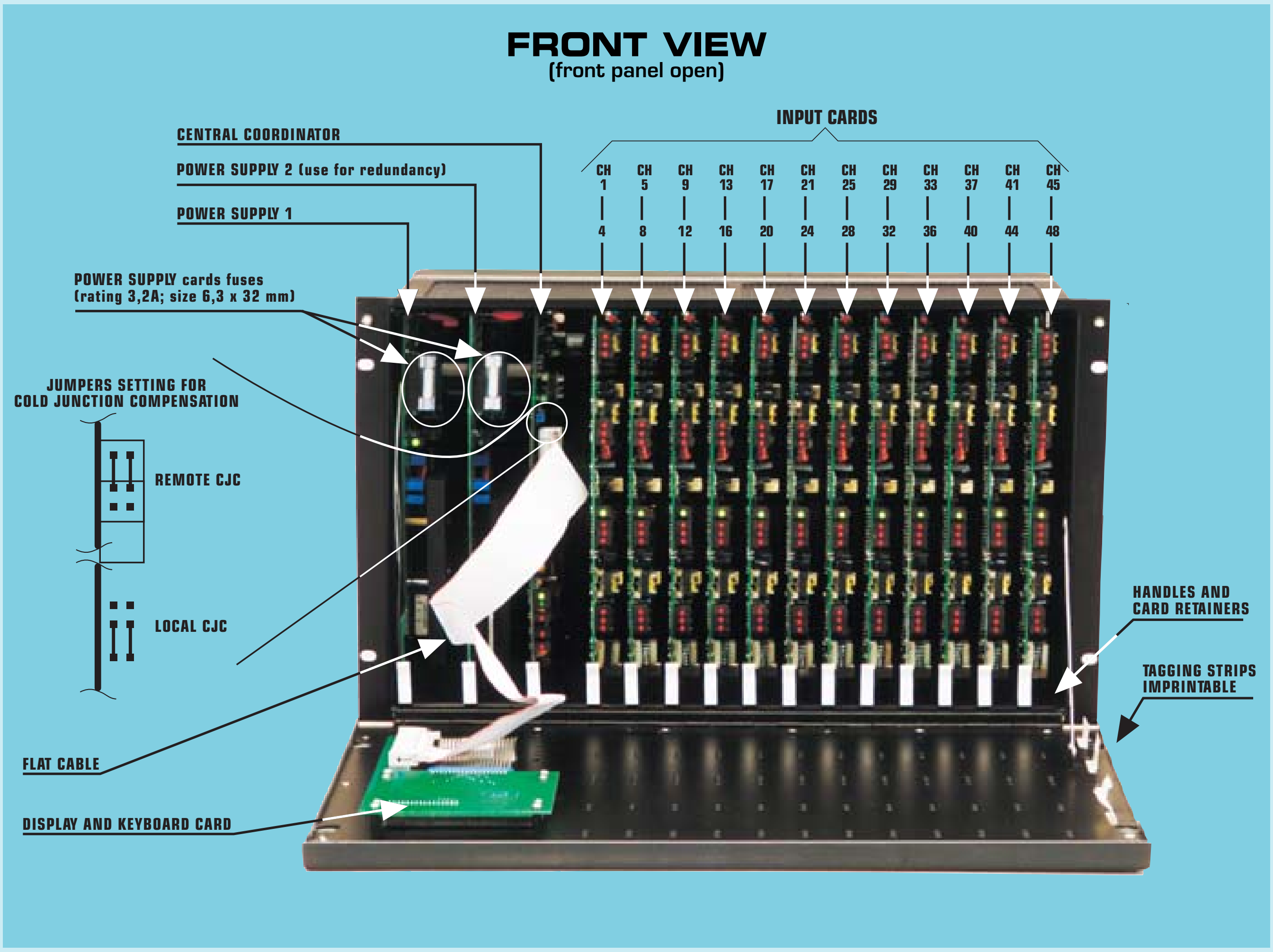


Cut-Out for panel mounting
(use the removable optional mounting clamps)

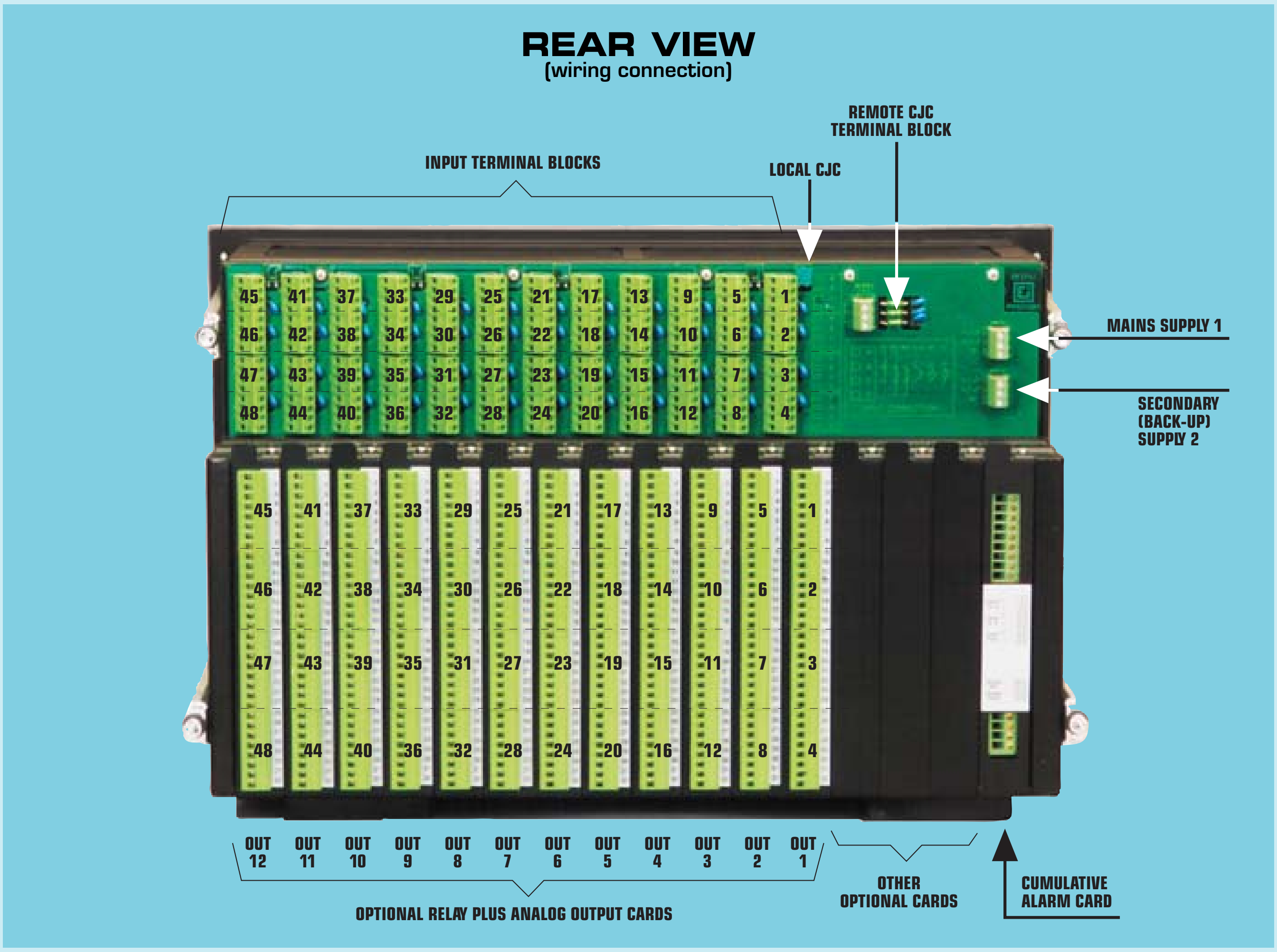
Tagging Strips Insertion



DTM 8000
Digital
Alarm-Monitor
Layout



DTM 8000
Digital Alarm-Monitor
Layout



DTM 8000

Digital Alarm-Monitor

Ordering Information

Ordering Information:

DTM8000 *Code:* **DTM-**

Number of Input Channels

12
16
20
24
28
32
36
40
44
48

Main Supply	
24 Vdc	1
115 Vac	2
230 Vac	3
Backup Supply (optional)	
not present	0
24 Vdc	1
115 Vac	2
230Vac	3
Dual Output Relay Cards (optional) Note 1-2	
not present	0
present	1
Analog Output Cards (optional) Note 1-2	
not present	0
present 0-20 / 4-20 mA	1
present 0-5 /1-5 Vdc	2
Cumulative Alarm Card (optional)	
not present	0
present	1
Front Panel Degree of Protection	
IP - 40 (standard)	1
IP - 54 (optional)	2

Coding example: **DTM- 24 2 0 1 1 1 1**

24 Input channels, 115 Vac Supply, No back-up Supply,
24 Dual Output:Relays, 24 Analog Output (0-20 / 4-20 rnA),
Cumulative Alarm Relay, IP-40.

Note 1: The number of Optional Relay Output and Analog Output channels, is the same of the Input Channels.

Note 2: Analog Output Option may only be ordered if Output Relay Cards are specified.

Note 3: All information to program the DTM 8000 are included in the Operating Instruction Manual.

For factory configuration, all parameters have to be specified with the order.

INTRINSIC SAFETY
BASIC PRINCIPLES

In many industrial processes, the presence of flammable materials (gases, vapours, liquids, dusts, fibres and flyings) requires the adoption of safety practices to protect both, plant and personnel, from the risk of fires and explosions.

An explosion or fire can occur when, in certain areas at certain times, an explosive or flammable mixture and a means of ignition, thermal or electrical, are present.
Flammable materials are grouped according to the ignition energy (Gas Groups) and classified for their minimum ignition temperature (Temperature Class), while Area classification ("Zone" in Europe, "Division" in the USA) takes into account the probability of the presence of an explosive mixture.

Electrical equipment, in Hazardous Areas ("Locations" in the USA), constitute potential sources of danger because they may generate arcs or sparks or hot surfaces which could ignite the explosive atmosphere.

Ignition Triangle

From a chemical point of view, oxidation, combustion and explosion are all exothermic reactions with different reaction speeds. For such reactions to take place, it is essential that the following three components be present simultaneously in due proportions:

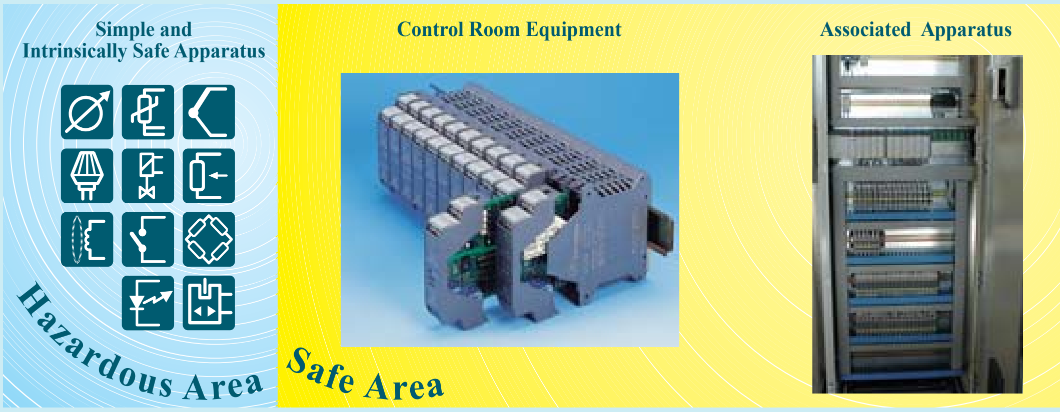
- **Fuel:** flammable vapors, liquids or gases, or combustible dusts or fibers;
- **Oxidizer:** generally, air or oxygen;
- **Ignition Energy:** electrical or thermal.

INTRINSIC SAFETY
BASIC PRINCIPLES

Protection methods

Basic safety concept is to avoid the simultaneous existence of a dangerous atmosphere and a source of ignition by:
Containing the explosion within a well-defined space where it will not cause any harm.

Physically segregating the sources of energy from the explosive mixtures.
Preventing the release of sufficient energy to ignite any explosive mixture.



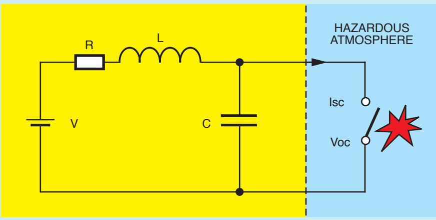
According to the safety concept and the way to apply it, there are different explosion protection methods suitable to enable electrical equipment to be used in Hazardous Area.

All these techniques are ruled by national and international standards, as well as codes of practice, that define how to design and install the equipment, while recognized authorities issue the conformity certificate of the apparatus or systems. Among the protection methods, the simplest and most effective, applied to electrical and electronic instrumentation, is Intrinsic Safety.

INTRINSIC SAFETY
BASIC PRINCIPLES

The basic principle of intrinsic safety is to limit, under normal and foreseeable fault conditions, the amount of electrical energy in Hazardous Area circuits such that any sparks or arcs or high surface temperatures will not ignite the explosive atmosphere.

Electrical equipment, in Hazardous Area, as well as the interconnected instrumentation in Safe Area, must be designed to reduce the open circuit voltage (Voc) and short circuit current (Isc) to values that cannot cause ignition by opening, closing or earthing the circuit or by heating of any parts belonging to the circuit.



Intrinsic Safety works on the principle of preventing the possibility of explosion by limiting the electrical energy and the surface temperature.

Resistive Circuits

A circuit is considered as resistive when the reactive part, inductance and capacitance, is zero or negligible (figure A)

The energy released by this type of circuit depends essentially on the power supply source V and the current limitation due to the presence of resistor R.

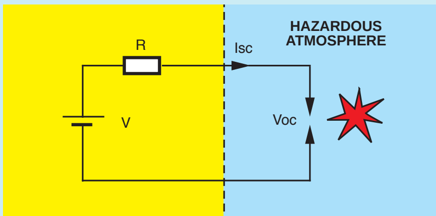


figure A

Schematic of a resistive circuit.

In this case, it is difficult to correlate the minimum ignition energy (MIE) with a circuital situation that generates the spark.

The experimental tests on this type of circuit have demonstrated that the capacity for igniting a dangerous mixture depends on the open- circuit voltage (Voc = V) and the short-circuit current (Isc = V/R).

INTRINSIC SAFETY
BASIC PRINCIPLES

The ignition curve for resistive circuits is shown in Figure B.

This graph shows the ignition curve relative to the group of gases that are considered by the standards.

The trend curve shows that the lower the open-circuit voltage, the greater the amount of power that can be used safely.

This characteristic allows process instrumentation that works with voltages on the order of 20-30 V to be used efficiently in intrinsic safety applications.

For a more detailed ignition curve, refer to Appendix 5.

The inherent low power involved, even in unfavourable circumstances, gives some advantages that can not be obtained with other techniques:

- Intrinsic safety is the only method accepted for the most Hazardous Areas (Zone 0; DIV. 1).
- Maintenance and calibration of field equipment can be carried out while the plant is in operation and the circuit “live”.
  Low voltages are also safe for personnel.
- No special mechanical protection of field wiring is required but ordinary instrument cabling is acceptable.

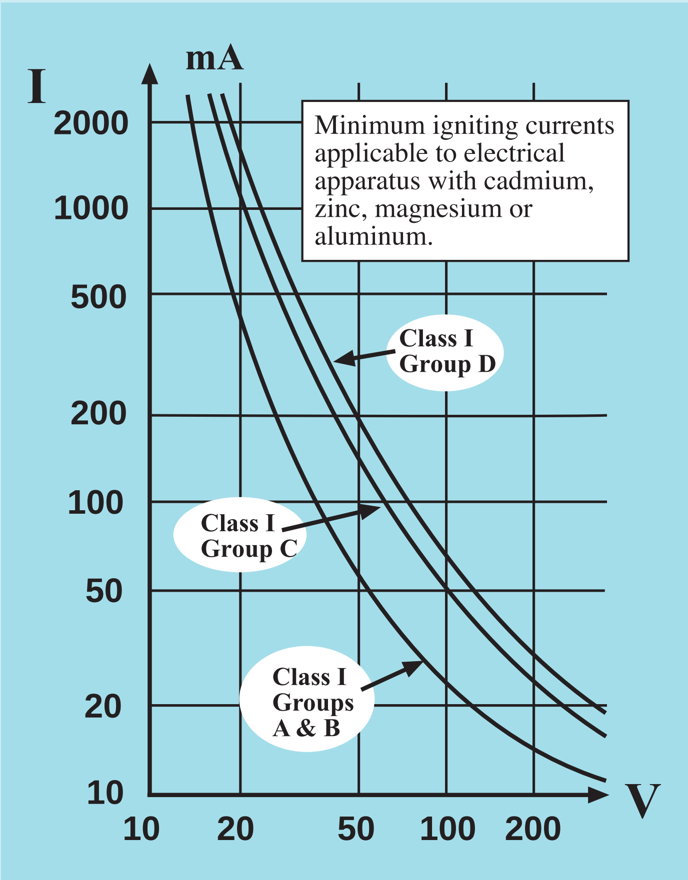


figure B

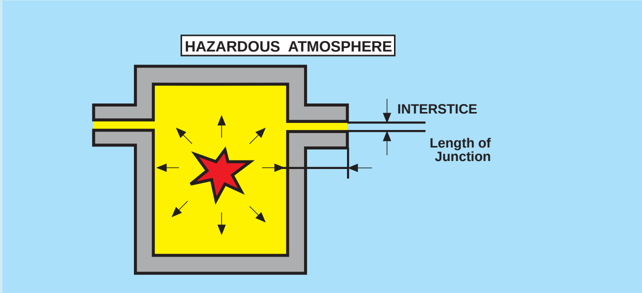
In Intrinsic Safety applications three basic parts have to be considered:

- Hazardous Area devices (Simple Apparatus), or equipment (Intrinsically Safe Apparatus).
- Safety interfaces (Associated Apparatus).
- Interconnecting cables.

INTRINSIC SAFETY
BASIC PRINCIPLES

Simple Apparatus

Passive components (switches, resistive sensors, potentiometers), simple semiconductor (LEDs, photo-transistors) and simple generating devices (thermocouples, photocells) are regarded as Simple Apparatus if they do not generate or store more than: 1.5 V, 100 mA, 25 mW (see IEC 60079-11 and EN 50020 standards).
Simple Apparatus can be used in Hazardous Area without certification; they have to be assessed for the temperature classification on the basis of the matched output power of the interface device.



Other techniques work on the principles of keeping the hazardous material away from the circuit, containment of the explosion, or preventing arcs, sparks or hot surfaces.

Intrinsically Safe Apparatus

Transmitters, I/P converters, solenoid valves and any other "energy-storing" device must be certified as Intrinsically Safe Apparatus suitable for use in Hazardous Area, according to the zone, or division, classification and gas characteristics (group and temperature class).
For more details refer to Appendix 6.

Associated Apparatus

Interfaces between field and control room equipment, usually called "Barriers or Isolators", protect the Hazardous Area circuits by limiting the voltage and current in normal and in fault conditions. Two types of intrinsically safe interfaces exist: "Zener Barriers" and "Galvanic Isolator Barriers"; they basically differ for the way the potentially dangerous energy, from control room equipment, is diverted to prevent it from passing through to the Hazardous Area circuits. Barriers must be designed and certified as Associated Apparatus suitable for connection to intrinsically safe or simple apparatus in Hazardous Area. Associated apparatus are the key to any intrinsically safe system because they define maximum allowable safety parameters of the circuits connected to the Hazardous Area terminals of the barriers.

Interconnecting Cables

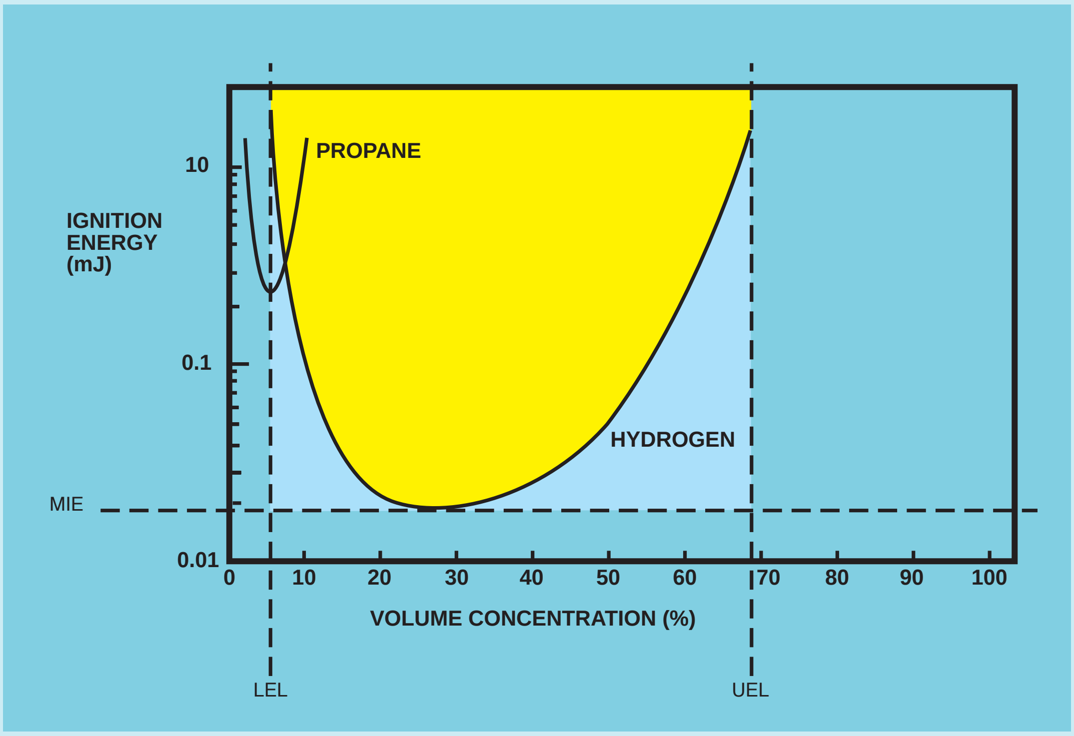
Low voltage and current, in intrinsically safe circuits, allow the use of ordinary instrumentation cables provided that capacitance and inductance are taken into account in assessing the safety of the system; cable parameters seldom are a problem and long distances can be easily achieved.

EXPLOSIVE MIXTURE CHARACTERISTICS

The risk of an ignition of an air/gas mixture depends on the probability of the simultaneous presence of the following two conditions:

- Formation of flammable or explosive vapors, liquids or gases, or combustible dusts or fibers with atmosphere or accumulation of explosive or flammable material;
- Presence of an energy source "electrical spark, arc or surface temperature" that is capable of igniting the dangerous mixture present.

It is possible to draw an ignition characteristic for each type of fuel. The characteristic curves of hydrogen and propane are illustrated in this page.



Ignition energy in relation to hydrogen and propane air/gas concentration

EXPLOSIVE MIXTURE CHARACTERISTICS

A minimum ignition energy (MIE) exists for every fuel that represents the ideal ratio of fuel to air. At this ratio, the mixture is most easily ignited. Below the MIE, ignition is impossible for any concentration.
For a concentration lower than the one corresponding to the MIE, the quantity of energy required to ignite the mixture increases until a concentration value is reached below which the mixture cannot be ignited due to the low quantity of fuel. This value is called the lower explosive limit (LEL).

In the same way, when increasing the concentration the energy requirement increases, and a concentration value is identified above which ignition cannot occur due to the low quantity of an oxidizer. This value is called the upper explosive limit (UEL).

THE CHOICE BETWEEN “ZENER BARRIERS” AND “GALVANICALLY ISOLATED BARRIERS”

Safety barriers are protection devices placed between, Hazardous and non Hazardous Area interconnected apparatus with the purpose of limiting the energy, in the Hazardous Area, to a level lower than the minimum required to ignite the explosive atmosphere.
The intrusion of excessive electrical energy into Hazardous Area circuits, due to fault conditions in the Safe Area, can be prevented by:

- diverting the fault energy to earth (“ground” in the USA).
- Or by blocking the fault energy with isolating elements.

During fault conditions, voltage and current levels, which can appear in Hazardous Area, are limited to safe values.

Zener barriers

Since their introduction, long ago, “Zener Barriers” have been widely used as safety interfaces to meet the majority of applications in Hazardous Areas.
Based on energy-diversion concept, this type of barrier is a very simple network of components arranged as shown in Figure 1.
In normal operating conditions, the barrier passes electrical signals, in both directions, without shunting them.
When a fault voltage (250 Vrms max.) appears at the non Safe Area terminals of the barrier, the resulting high current flows to ground through the fuse and zener diodes. The fuse is rated to blow very quickly in order to prevent the failure of zener diodes and to isolate, when blown, Hazardous from Safe Area circuits.
Standards require that the fuse must not be accessible for substitution to avoid errors that could impair safety; thus once the fuse is blown it is necessary to replace the whole barrier.

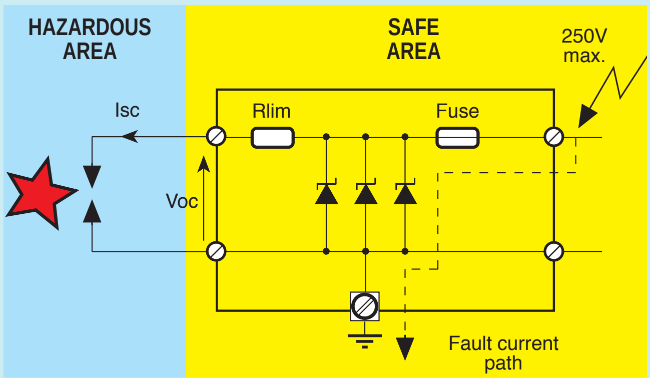


Fig. 1

During fault transient, the open circuit voltage (Voc) at the Hazardous Area terminals of the barrier is clamped to zener voltage, while the short circuit current (Isc), in Hazardous Area, is limited by the output resistor (Rlim).
These values, Voc and Isc, are relevant to assess maximum allowable capacitance and inductance, at the Hazardous Area terminals, for the gas groups that cannot be ignited by those values.

The efficiency of a barrier depends on a good ground connection which must provide a return path for the fault current, back to the Safe Area, preventing any substantial increase in the voltage and current at the Hazardous Area terminals.

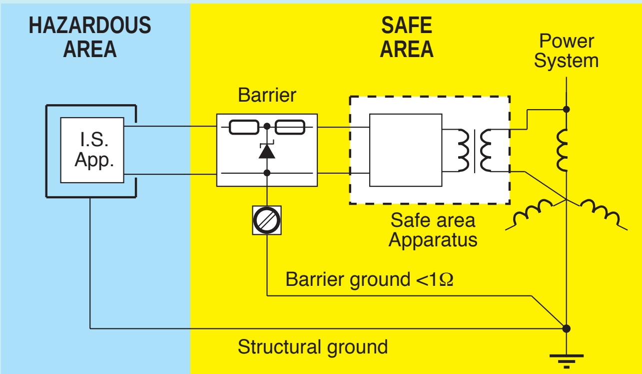


Fig. 2

This is accomplished by using a dedicated conductor which must be run, separately from any other structural ground, to the reference ground point (see Figure 2).

The resistance from the furthest barrier to the ground point must be maintained at less than 1Ω and standard requirements are for a minimum size of 4 mm^2 (12 AWG in the USA).

"Zener Barriers" are simple, reliable and low cost devices, however they present some drawbacks that must be considered when choosing them for intrinsic safety applications.

Main disadvantages are:

- A good ground connection must be provided and maintained.
- Field devices must be isolated from ground (and maintained as such).
- Voltage drop across the barriers can make some applications difficult.
- Improper connection or voltage surges could blow the fuse.
- Very poor common mode rejection (Common mode regection is the immunity of a device to interfering voltages applied at both input terminals with respect to ground).

Galvanically Isolated Barriers

Problems that arise with "Zener Barriers" can be overcome by using safety interfaces based on the concept of isolation rather than energy diversion.

The basic difference consists in providing isolation, between Hazardous and Safe Area circuits, by using components, such as transformers, relays, and optocouplers, that must comply with requirements of safety standards to guarantee safety (see Figure 3).

When properly designed, "Galvanic Isolator Barriers" do not permit the fault voltage (250 Vrms Max) to reach the energy limitation circuit that must be able to withstand only the maximum voltage at the secondary side.

Galvanic isolation allows the energy limitation circuit to be floating from ground; thus a ground connection, as well as a protective fuse, for this circuit are not needed.

Safety parameters, Voc and Isc, are determined in a similar way to that used for "Zener Barriers".

The main features of "Galvanic Isolator Barriers" are:

- A dedicated ground connection is not required and field devices can be connected to ground.
- Full voltage is available to field devices.
- Signal conditioning and circuit protection are combined in a single unit.
- Simple installation and commissioning with elimination of ground loops.
- High common mode voltage can be tolerated.

Intrinsic Safety Interfaces

All I.S. interfaces use zener diode techniques to limit the flow of power into the hazardous area.

In simple form, they can employ shunt diode circuits in which excess current is routed to ground through a direct earth connection.

These products are commonly known as Zener Barriers.

Alternatively, the instrument signal can be passed through transformers and associated modulation and demodulation circuits to simplify earth grounding and installation, by galvanically isolating the hazardous circuit from the safe area circuit and power source.

These products are commonly known as Galvanic Isolators.

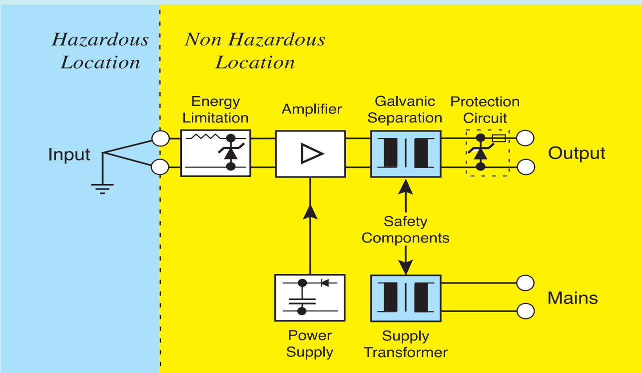


Fig. 3

INSTALLATION OF **INTRINSICALLY SAFE** AND ASSOCIATED APPARATUS

North American cable Installation

Electrical apparatus in hazardous (classified) locations may be installed using one of the following three basic installation systems:

- **Conduit Systems:** The electrical wiring is installed inside closed, threaded metal pipes (rigid steel or intermediate metal conduit) approved for the purpose.
  The pipes are screwed into entrances in the enclosures which contain electrical equipment. The entire conduit system is required to be explosion-proof and frequently requires a seal between the connected enclosure and the pipe.
  In Class I, Division 2 locations, the conduit system need to be explosion-proof only between any explosion-proof enclosure and the required sealing fittings. In Class I, Division 1 locations in Canada, one difference is that threaded steel intermediate conduit is not acceptable.

- **Cable Systems with Direct Entry:** In the U.S. the NEC will not allow cables (except for mineral-insulated (MI) cable and cables used in intrinsically safe systems) to be installed in Class I, Division 1 locations. In Class I, Division 2 locations certain cable constructions are allowed (refer to API RP14F).
  In Canada for Class I, Division 1 locations, armored and metal-sheathed cables with matching cable glands, tested to the requirements of CSA standard C22.2, No. 174, are permitted for direct entry to explosion-proof equipment.

- **Cable Systems with Indirect Entry:** Indirect entry cable systems offer a decided advantage in that it can be connected without opening the explosion-proof equipment. The connection is to terminals made in an "increased safety" terminal chamber.

European Practice EN50.039

Below are the European requirements for cable installation in intrinsically safe systems according to the EN 50.039 standard, Intrinsically Safe System "i."

1.0 Connecting

Conductors of an Intrincally Safe electrical system.

1.1 General

The electrical parameters and all characteristics of specific connecting conductors of an intrinsically safe electrical system must be specified in the system's descriptive document because **Intrinsic Safety** relies on them.

1.2 The multi-conductor

cables can contain one or more intrinsically safe circuits; however, they can not contain any non-intrinsically safe circuits, apart from particular applications as specified in the European standard EN 50.020.

2.0 Multi-Conductor

Cables Containing Different Intrinsically Safe Circuits.

2.1 Conductors

The radial thickness of the isolation material must be appropriate for the diameter of the conductor and the nature of the isolation material.

For the normally used isolation material, for example polyethylene, the minimum must be such to tolerate an applied test voltage with an alternate voltage with intrinsically safe circuit with a minimum of 500 V.

2.2 Conductor Shields

When conductor shields guarantee the individual protection of intrinsically safe circuits in a way that avoid the circuits to come in contact with each other, the rate of isolation of those shields must be at least equal to 60% in surface.

2.3 Cables

The multi-conductor cables must be able to tolerate an applied test voltage with an alternate voltage with an rms value equal to:

- 500 V applied between any shield and/or armor connected together and all of the conductors of the cables connected together.

- 1000 V, applied between a bundle of half the cable conductors connected together and a bundle including the other half of the cable conductors connected together.

2.4 Tests

All the tests required to prove the conformity with points 2.1, 2.2, and 2.3 must be performed by the cable manufacturer.

All the applied voltage tests must be performed conforming to a method specified in an appropriate cable standard.

If such a method does not exist, the tests must be performed as follows:

- The voltage must be alternate and with sinusoidal wave form, and a frequency within 48 and 62 Hz.
- A voltage must be obtained from a power transformer with an output at least equal to 500 VA.
- The voltage must be gradually increased up to the specified value in a time frame of at least 10 seconds and maintained at such value for at least 60 seconds.

3.0 Types of Multi-Conductor Cables

The different points to be considered for multi-conductor cables used in intrinsically safe electrical systems depend on the type of cable used.

3.1 Type A Cables

Cables conforming to the requirements per points 1.1, 1.2, 2.1, 2.2, and 2.3. Do not consider any fault between the circuits if each circuit has an individual conductive shield.

Note: For any shield connection, for example grounding, refer to the installation rules.

3.2 Type B Cables

Fixed cables efficiently protected against damages and conforming to the requirements per points 1.1, 1.2, and 2.3.
Do not consider any fault between the circuits if a peak voltage greater than 60 V is not present in any of the cable circuits.

3.3 Type C Cables

Cables conforming to the requirements per points 1.1, 1.2, 2.1, and 2.3.
It is necessary to consider up to two connections between conductors and simultaneously up to four interruptions of the conductors.

3.4 Type D Cables

Cables conforming to the requirements per points 1.1 and 1.2.
There is no limit to the number of connections between conductors and simultaneously the number of interruptions of the conductors that must be considered.

European Cable Installation

In Europe the installation, or laying, of the cable can be performed in the following ways:

- **Pipe laying:**
  The cable must be furnished with isolation of an anti-abrasive function, if the laying condition does not exclude damaging during insertion.

- **Direct-ground laying:**
  The cable must be specified for this particular type of installation.

- **Suspended pipe laying:**
  The cable must be incapable of propagating fire and must be protected against mechanical and chemical damage with continuous isolation, incorporated or external.

When installing, or laying, cable in specific environments, the cable must be suitable for that environment unless adequate protective measures, such as pipes, special installation methods, thermal isolation, etc, are used.
Intrinsically safe circuit conductors must not be contained in a tray or pipe that includes conductors of non intrinsically safe electrical circuits unless certain precautions are taken, such as the containment of the intrinsically safe conductor or the non intrinsically safe conductor within a grounded shield.
When designing and installing intrinsically safe systems, keep in mind that capacitance and inductance parameters of the connecting cables are important factors, even if they are not always determining factors.
The capacitance and inductance values of the cable (generally, given in pF/m and μH/m) should be easily available from the cable manufacturer.
However, if there are difficulties in obtaining this data, the following values can be hypothesized (but only in an extreme situation).

Capacitance: 200 pF/m

Inductance: I μH/m

As an alternative to the inductance, another characteristic of the cable, the inductance/resistance ratio (L/R), can be used and is normally given in μH/Ω.
This parameter permits more flexibility in the cable installation process.

ATEX DIRECTIVE 99/92/EC (ATEX 137) USE

The last few years have seen many changes to the regulations that apply to industry:

- **Directive 94/9/EC (ATEX 95): Products.**
- **Directive 98/24/EC: Chemical Agents.**
- **Directive 99/92/EC (ATEX 137): Use.**

Directive 99/92/EC requires employers to protect workers from the risk of explosive atmospheres.
An explosive atmosphere is defined as a mixture with air, under atmospheric conditions, of dangerous substances in the form of gases, vapour, mist or dust in which after ignition has occurred, combustion spreads to the entire unburned mixture.
With a clear focus on worker safety and employer responsibility, **ATEX 137** demands careful consideration.
Since 30 June 2003, all new and modified workplaces, where potentially atmospheres may occur, have had to comply with this Directive.
By June 2006 all such workplaces must comply.
The Directive provides workers with a minimum level of protection in hazardous areas throughout the member states.

ATEX 137 Directive is based on 3 straightforward principles:

- Where possible, to prevent the formation of explosive atmospheres.
- Where such atmospheres are unavoidable, to prevent ignition, and
- To ensure the health and safety of workers by mitigating the effects of any explosions that do occur.

There are a number of specific exclusions to **ATEX 137**.
These include areas for medical treatment.
The mineral extraction industry and transportation by land, sea or international waters.
The drilled oil and gas extraction industry is also outside the scope of **ATEX 137** as it is covered by the separate Directive 92/91/EC.
However, generally **ATEX 137** applies to all EU workplaces where explosive atmospheres could occur from small garages to large petrochemical plants.
This applies to millions of workplaces in the EU/EEA area.

Obligation of Employer under ATEX 137

General Obligations

The employer has a duty to ensure that where explosive atmospheres could occur, workers can carry out their work in safety. Appropriate supervision must be given to such workers and the use of appropriate safety equipment such as **ATEX 95** certified gas alarms should be used to help ensure safety.

Where workers from different organizations are present on one site, it is the employer who has responsibility for the workplace that must coordinate and implement the safety measures for all workers.

Assessment of Explosion Risk

There is a requirement for an overall assessment of the explosion risk to be carried out. The responsibility lies with the employer although outside specialists can obviously be used if required. There are a number of independent organizations that run training courses or who can be employed to carry out the audit and assessments.The assessment should include anticipating the likelihood and persistence of any explosive atmospheres; the likelihood of ignition sources being present (including electrostatic discharge); the installations, substances and processes used on site and any possible interaction; the scale of any anticipated effects. The assessment must be reviewed regularly and at any significant change to the workplace. The guidelines of IEC 61508, standard for Functional Safety of Electrical-Electronic-Programmable Electronic Safety-Related Systems, may help the assessment.

Zoning and Warning Signs

Places where explosive atmospheres can occur must be classified into zones by the employer.

These zones are the same as in use for the Directive 94/9/EC (ATEX 95).

At locations where explosive atmospheres may occur, the “Ex” warning sign must be displayed at the point of entry. These signs need to conform to the shape, colours and proportions laid down in the Directive and can display further information if required to clarify risks or actions to be taken.

Eplosion Protection Document

Classification criteria occurrence	Area classification for gas, vapour and mists	Area classification for dusts
Frequently likely or for long periods or continuously	Zone 0	Zone 20
Occasionally likely in normal operation	Zone 1	Zone 21
Unlikely in normal operation and only for short periods	Zone 2	Zone 22

Classification of hazardous places – Annex I of ATEX 137

An important and mandatory part of the process is the recording of the risk assessment.
An "Explosion Protection Document" must be created before work commences on a site and kept current.
The purpose of the document is to demonstrate that the risks have been determined and suitably assessed and that measures put in place meet the aims of the Directive.
It must detail,

- Places classified as zoned areas.
- Places where particular organizational measures or explosive protection measures apply.
- A demonstration that the workplace and equipment have been designed and operated with safety in mind.
- Arrangements for the safe use of work equipment.

Work Equipment and Protective System Requirements

All work equipment and protective systems need to be assessed.
Their design, constructions, installation and maintenance must minimise the explosion risk.
This includes ensuring they are suitable for the type of explosion hazard whether gas, vapour, mist or dust.
After 30 June 2003, equipment and systems must be approved to ATEX 95: Products.
These will be marked as detailed in the table presented at page 240 for the category 1, 2 or 3.

Workplace Requirements

All workplaces put into service or modified after 30 June 2003 must fully meet the requirements of **ATEX 137**.
Those in use before 30 June 2003 date have until June 2006 to show they fully comply.
It is worth noting that unlike the rule for products **(ATEX 95)**, all workplaces will need to comply, it is just a matter of by what date.
The workplace requirements are divided into organizational measures and explosion protection measures. These include but not necessarily limited to the following:

Organizational Measures

- Training of Workers: sufficient and appropriated training on explosion protection must be provided.
- Written Instructions: must be given for work in hazardous areas.
- Permit to Work: permit system must be used for carrying out hazardous work activities which could cause hazardous situations.

Explosion Protection Measures

- Assessment before use: before its first use, any areas containing potentially explosive atmospheres must be assessed and verified and any conditions required for ensuring safety identified and maintained.
  Such verification must be carried out by someone "competent in the field of explosion protection" through experience or professional training.
- Dealing with Releases: any potentially explosive release should be diverted to a safe place or rendered safe.

- Multiple Hazard: where several type of hazards exist (eg. different types of gas and dust), protection measures must be appropriate for the hazard that poses the greatest risk.

- Ignition Prevention: static discharge must be considered as a source of ignition. Workers must be provided with suitable work clothes that cannot create sufficient static to ignite.

- Adherence to Explosion Protection Document: plant, equipment, protecting system and any associated connecting devices can only be brought into service if the Explosion Protection Document indicates they can be safely used.

- Safety Warnings: where necessary workers must be given visual and acoustic warning and withdrawn before explosive conditions are reached.

- Worker Evacuation: emergency evacuation procedures and facilities must be in place to ensure endangered areas can be evacuated promptly and safely.

- Additional Risk: consideration must be given to any additional risks that may arise due to power failure.

- Manual Override: manual override must be possible on automatic protective systems and only to be used by workers competent to do so.

- Energy Dissipation: in the event of emergency shutdown, accumulated energy must be dissipated quickly and safely.

Useful Standards

EN 1127-1

Explosion Prevention and Protection Basic concepts and methodology. This is the main standard for "how to control ignition sources".

EN 50014-28 and EN 50039

for Electrical Equipment: (generic/construction).

EN 60079-10

Classification of Hazardous areas (Gas).

EN 50281-3

Classification of areas where combustible dust are or may be present.

EN50284-1

Special Requirements for construction, test and marking of electrical apparatus of equipments group II, category 1G.

EN 60079-14

Electrical Installation in Hazardous areas (other than mines).

EN 60079-17

Inspection and maintenance of electrical installations in hazardous areas (other than mines).

EN 60079-19

Repair and overhaul for apparatus used in explosive atmosphere (other than mines).

EN 13463, part 1 to part 8

for non Electrical Equipment. Typical non-Electrical Equipments are:

- Drilling Equipment (top drive, rough neck, draw work.
- Cranes.
- Mud handling Equipments.
- Gas turbines.
- Compressors, pumps, fans-skids, that shall be placed in Zone 1 or Zone 2 areas.
- Diesel engines for generators of pumps.
- Various not defined rotating machine, assembly line and also provisional equipment and containers.

EN 13980

for application of quality systems (production).

EN 12874

for flame arresters (protective systems).

EN 62013-1

for caplights for use in mines susceptible to firedamp.

EN 1755

for safety of industrial truck.

EN 1834

for series for reciprocating internal combustion engines.

EN 50303

Group I, category M1 equipment intended to remain functional in atmospheres endangered by firedump and / or coal dust.

Following standards are under work:

EN 14373

for explosion suppression systems.

EN 14460

for explosion resistant equipments.

EN 14797

for explosion venting devices.

EN 14491

for dust explosion venting systems.

EN 14994

for gas explosion venting protective systems.

EN 14986

for safety requirements for ignition protected fans.

ATEX DIRECTIVE 94/9/EC (ATEX 95) PRODUCTS AND OTHER HARMONIZED STANDARDS

Directive 94/9/EC (ATEX 95) Equipment and Protective Systems for use in potentially explosive atmospheres. Covers electrical and non electrical products intended for use in hazardouse areas (Gas, vapours or dust atmospheres).

The Directive 94/9/EC was first issued in 1996 and is a product directive. It gives the manufacturer requirements to fulfill regarding construction, certification, conformity, and QA requirements.

The Directive is mandatory 1/July/2003 for all countries within the EU/EEA area.

It includes electrical equipment, non-electrical equipment and protective systems.

The Directive applies for dust, gas and mines.

Potentially explosive atmospheres are classified with respect to the possibility of the presence of an explosive mixture due to:

dust in air

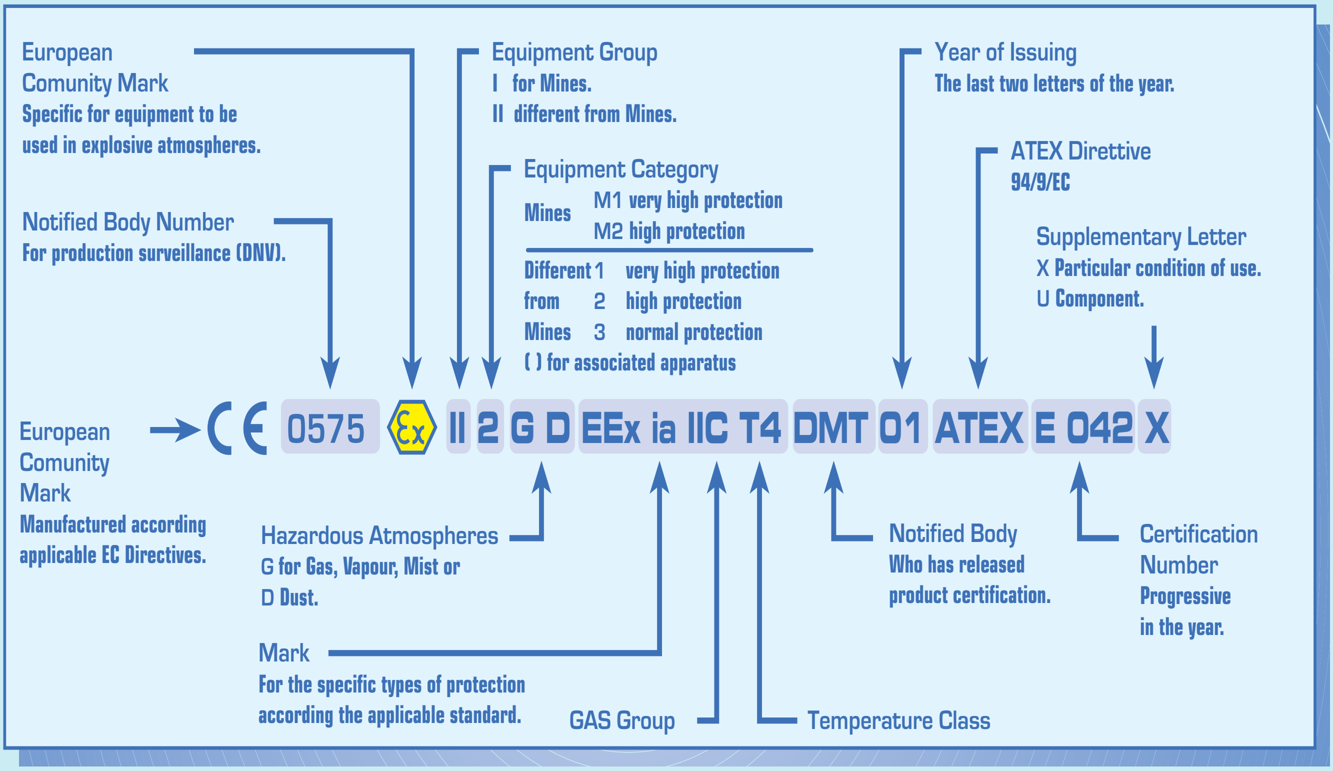
gas in air

vapours and **mists** in air

ATEX ZONES and CATEGORIES

		Level of Protection	Equipment Category Directive 94/9/EC	Area Classification Directive 1999/92/EC
GAS	Dust	Definitions	ATEX	Typical Zone Suitability
EN 60079-10 0	EN 50281-3 20	Very High: two independent means of protection or safe even when two faults occur independently of each other. Place in which an explosive atmosphere is frequently likely or for long periods or continuosly present	High probability of Explosive Atmosphere 1G / 1D / M1	Equipment for Zone 0 Equipment for Zone 20
1	21	High: suitable for normal operation and frequently occuring disturbances or equipment where faults are taken into account. A place in which an explosive atmosphere is occasionally likely to occur in normal operation	Possibility of Explosive Atmosphere 2G / 2D / M2	Equipment for Zone 1 Equipment for Zone 21
2	22	Normal: suitable for normal operation. A place in which an explosive atmosphere is unlikely to occur in normal operation, and only for short periods.	Low probability of Explosive Atmosphere 3G / 3D	Equipment for Zone 2 Equipment for Zone 22

MARKING ACCORDING ATEX DIRECTIVE 94/9/EC



DIRECTIVE 94/9/EC

Equipment and Protective Systems

Group	Substance	Potentially Explosive Atmosphere	Protection Level	Fault or Protection Mode	Category	Zone
I Mines and surface installation	Methane (Grisou) and coal dusts	Present	Very High	2 independent faults or 2 protection modes.	M1	
		Probably present	High	1 fault or 1 protection mode.	M2	
II Surface industries and other sites	Gas, Vapours, Fogs or Powder	Continuosly present, or for long periods.	Very High	2 independent faults or 2 protection modes.	1	Zone 0 (G) Zone 20 (D)
		Probably present during normal operation.	High	1 fault or 1 protection mode.	2	Zone 1 (G) Zone 21 (D)
		Occasionally present, for short periods only.	Normal	No fault during normal operation.	3	Zone 2 (G) Zone 22 (D)

Note: Group II (Category 1 and Category 2) electric, or internal combustion motor, certification mandatory (Notified Body).
(Category 2 non electric) manufacturer declaration and deposit of technical file to Notified Body.
(Category 3) manufacturer declaration.

Electrical apparatus for Potentially Explosive Atmospheres

CATEGORY 1 and 2 apparatus GAS

Type of protection	CENELEC Code	EN Standard	New Numbers IEC
General requirements		EN 50014	EN 60079-0
Intrisic Safety	EEx ia; ib	EN 50020	EN 60079-11
Increased Safety	EEx e	EN 50019	EN 60079-7
Flameproof	EEx d	EN 50018	EN 60079-1
Pressurization	EEx p	EN 50016	EN 60079-2
Powder Filling	EEx q	EN 50017	EN 60079-5
Encapsulation	EEx m	EN 50028	EN 60079-18
Oil Immersion	EEx o	EN 50015	EN 60079-6
Type n	EEx n	EN 50021	EN 60079-15
Intrinsically Safe Systems	EEx ia; ib	EN 50039	EN 60079-25
Special requirements for construction, test and marking of electrical apparatus of equipment group II, Category 1G			EN 50284-1

CATEGORY 3 GAS

Type n equipment containing:	Additional code letter
Enclosed break device	C
Non incendive component	C
Ermetically sealed device	C
Sealed device	C
Encapsulated device	C
Energy limited apparatus and circuits	L
Restricted breathing enclosure	R
Simplified pressurization	P
Non sparking	A

A: for non sparking apparatus.
C: for sparking apparatus in which the contacts are suitably protected.
R: for restricted breathing enclosures.
L: for energy limited apparatus.
Z: for enclosure with n-pressurization.

Electrical apparatus for use in the presence of combustible dust Category 1, 2 and 3 Dust

EN 50281-1-1	Electrical apparatus protected by enclosures - Construction and Testing.
EN 50281-1-2	Electrical apparatus protected by enclosures - Selection, installation and maintenance.
EN 50281-2-1	Test methods - Methods for determining the minimun ignition temperatures of dust.

Note: EN 50281-1-1 can be combined with other EN standards where appropriate.

Dust Explosions in General

A dust explosion occurs when fine particles suspended in the air ignite and burn rapidly, causing a violent increase in pressure. In order to cause an explosion, the combustible mixture of air and dust must be contained in some type of vessel. Grains and other agricultural products are a common fuel for dust explosions due to the nature of their handling and storage. Any time that grain is handled or moved, potentially explosive dust is generated.

Grain is usually stored in large upright silos. The grain is elevated to an entrance in the top of a silo and allowed to fall down and gradually fill the silo. As it falls, dust separates out and becomes suspended in the airspace of the silo, creating an explosion hazard.

Many factors have an effect on the violence of a dust explosion. First and most obvious is the dust material itself. Some materials that are not even considered combustible in bulk form, such as aluminum, are capable of high-pressure explosions when they are in dust form. Most grain dusts are combustible and can cause an explosion, but some types are much more dangerous than others, especially dust associated with corn or sugar.

The size of the dust particles also plays an important role in determining the severity of an explosion. A solid fuel only burns at its surface, where it is exposed to air. A cloud of very fine dust particles has a much greater surface area than a cloud of coarser particles. In addition, fine particles weigh less and tend to stay suspended in air longer. Generally speaking, particles smaller than 840 microns (0.033 inches) can be an explosion hazard.

Dust particles must reach some minimum concentration in the air before they can support combustion. This concentration varies with the material in question. In addition, dust that has settled on walls or surfaces may be stirred up by a primary explosion, possibly causing secondary explosions.

In a dust cloud containing 20 g (0.70 ounces) per cubic meter (35 cubic feet) of dust, a human being would not be able to see beyond about one meter (three feet). A concentration of 20 g (0.70 onces) per cubic meter (35 cubic feet) is below the minimum explosive limit for most grain dusts. Obviously, concentrations of dust above the minimum explosive limit usually do not occur in occupied areas. However, these concentrations frequently exist in bucket elevators, conveyor housings, bins, silos, and other such structures where grain is moved around. Different types of grain dust have different combustibility and explosive characteristics.

The United States Bureau of Mines has devised a scale to relate the explosion severity of one type of dust to another.

This is shown in the table above.

Dust Explosion Class	Kst (BAR • m/sec)	Type of Explosion
St 0	0	No Explosion
St 1	> 0 < 200	Weak
St 2	> 200 < 300	Strong
St 3	> 300	Very Strong

Note: Kst is the maximum rate of pressure rise, in bar • m/sec, and is used to measure the explosivity value of a combustible dust.

The Explosibility Index is included in the explosion hazard comparison of several agricultural dusts found in the table below.

This table lists several common agricultural product dusts and gives a comparison of the hazards associated with each one.

Do not be misled by the table above.

The maximum explosion pressure for any one of these grain dusts is rarely reached. In order for grain dust to reach its maximum possible pressure, two things must happen.

First, the dust must mix with air in much higher proportions than the minimum explosive limit.

For maximum explosive pressure there must be enough dust to consume all available oxygen without any leftover dust.

This proportion is around one ounce per cubic foot for most grains.

Second, the explosive mixture must be contained in a vessel strong enough to withstand the maximum pressure.

If the vessel breaks, all of the pressure is vented immediately and the maximum pressure is not achieved.

Perhaps the most damaging property of grain dust explosions is the cascade effect.

Grain dust that has settled on floors or walls can be thrown into the air by a dust explosion, thus providing fuel for secondary explosions.

Often, these secondary explosions cause more damage than the first.

In this way, a dust explosion can jump from room to room or from silo to silo.

This is a common phenomenon in grain dust explosions. For example, one of the most dangerous areas for grain dust explosions is in the

Explosive Properties of Agricultural Dusts

Type of Dust	MIT Minimum Ignition Temperature of Cloud		MIE Minimum Ignition Energy	LEL Explosivity Level		Maximum Explosion Pressure		Kst Maximum Rate of Pressure Rise		Relative Explosion Hazard Class.
	°F	°C	m Joul	Oz/Ft^3	g/m^3	psig	bar	psi/sec	bar•m/sec	
Alfalfa	860	460	320	0.1	100	66	4.55	1100	25	Weak
Cocoa	788	420	100	0.045	45	65	4.50	1200	28	Weak
Corn	752	400	40	0.045	45	95	6.55	6000	137	Weak
Corn Cob	752	400	40	0.030	30	110	7.6	5000	115	Weak
Cornstarch	716	380	20	0.040	40	115	7.9	9000	206	Strong
Cotton linters	968	520	192	0.500	500	48	3.3	150	3.5	Weak
Cottonseed	878	470	60	0.050	50	104	7.2	3000	69	Weak
Grain, mixed	806	430	30	0.055	55	115	7.9	5500	126	Weak
Rice	824	440	40	0.045	45	93	6.4	3600	82	Weak
Sugar	662	350	30	0.035	35	91	6.3	5000	115	Weak
Tobacco	788	420	-	-	-	7	0.5	200	4.5	Weak
Wheat	896	480	60	0.055	55	103	7.1	3600	82	Weak
Wheat flour	716	380	50	0.050	50	95	6.55	3700	85	Weak

bucket elevator area of a silo. The grain is always in motion, so dust is constantly generated. In addition, possible sources of ignition such as static discharge and friction heated bearings are always present. Frequently, a primary explosion in this area cascades into the silo itself, causing a much larger and more damaging secondary explosion.

The importance of good housekeeping in preventing cascade explosions cannot be overemphasized. It is necessary to remove dust buildup on interior surfaces regularly.

Often, the ignition source and location of the primary explosion are unknown.

This is due in part to the fact that not all of these explosions are investigated.

Grain dust is nine times as explosive as coal dust and pound for pound it is more explosive than TNT.

REFERENCE STANDARDS

IEC Hazardous Locations Certification Documents

IEC 60079-0	Electrical apparatus for explosive gas atmospheres - Part 0: General requirements.
IEC 60079-1	Electrical apparatus for explosive gas atmospheres - Part 1: Construction and verification test of flameproof enclosures of electrical apparatus.
IEC 60079-1-1	Electrical apparatus for explosive gas atmospheres - Part 1.1: Flameproof enclosures "d" - Method of test for ascertainment of maximum experimental safe gap.
IEC 60079-2	Electrical apparatus for explosive gas atmospheres - Part 2: Electrical apparatus - type of protection "p".
IEC 60079-3	Electrical apparatus for explosive gas atmospheres - Part 3: Spark-test apparatus for intrinsically-safe circuits.
IEC 60079-4	Electrical apparatus for explosive gas atmospheres - Part 4: Method of test for ignition temperature.
IEC 60079-5	Electrical apparatus for explosive gas atmospheres - Part 5: Powder filling "q".
IEC 60079-6	Electrical apparatus for explosive gas atmospheres - Part 6: Oil immersion "o".
IEC 60079-7	Electrical apparatus for explosive gas atmospheres - Part 7: Increased safety "e".
IEC 60079-10	Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas.
IEC 60079-11	Electrical apparatus for explosive gas atmospheres - Part 11: Intrinsic safety "I".
IEC 60079-14	Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines).
IEC 60079-15	Electrical apparatus for explosive gas atmospheres - Part 15: Electrical apparatus with type "n".
IEC 60079-17	Electrical apparatus for explosive gas atmospheres - Part 17: Inspection and Maintenance of electrical installations in hazardous areas (other than mines).
IEC 60079-18	Electrical apparatus for explosive gas atmospheres - Part 18: Encapsulation "m".
IEC 60079-19	Electrical apparatus for explosive gas atmospheres - Part 19: Repair and overhault for apparatus used in explosive atmospheres (other than mines or explosive).
IEC 60079-25	Intrinsically Safe Systems.
IEC 60079-26	Electrical apparatus for explosive gas atmospheres - Part 20: Test and Marking of Group II, Zone 0, Electrical Apparatus.
IEC 60529	Degree of protection provided by enclosures (IP code).
IEC 61241-0	Electrical apparatus for use in the presence of combustible dust - Part 0: General requirements.

IEC 61241-1	Electrical apparatus for use in the presence of combustible dust - Part 1-1: Electrical apparatus protected by enclosures and surface temperature limitation - Specification for apparatus.
IEC 61241-2-1	Electrical apparatus for use in the presence of combustible dust - Part 2: Test methods - Section 1: Method for determining the minimum ignition temperature of dust.
IEC 61241-2-2	Electrical apparatus for use in the presence of combustible dust - Part 2: Test methods - Section 2: Method for determining the electrical resistivity of dust in layers.
IEC 61241-2-3	Electrical apparatus for use in the presence of combustible dust - Part 2: Test methods - Section 3: Method for determining minimum ignition energy of dust/air mixtures.
IEC 61779-1	Electrical apparatus for the detection and measurement of flammable gases - Part 1: General requirements and test methods.
IEC 61779-2	Electrical apparatus for the detection and measurement of flammable gases - Part 2: Performance requirements for group I apparatus indicating a volume fraction up to 5% methane in air.
IEC 61779-3	Electrical apparatus for the detection and measurement of flammable gases - Part 3: Performance requirements for group I apparatus indicating a volume fraction up to 100% methane in air.
IEC 61779-4	Electrical apparatus for the detection and measurement of flammable gases - Part 4: Performance requirements for group II apparatus indicating a volume fraction up to 100% lower explosive limit.
IEC 61779-5	Electrical apparatus for the detection and measurement of flammable gases - Part 5: Performance requirements for group II apparatus indicating a volume fraction up to 100% gas.
IEC 61779-6	Electrical apparatus for the detection and measurement of flammable gases - Part 6: Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases.

IEC Standards Available From:
American National Standards Institute
1430 Broadway
New York, New York 10018.
or www.IEC.ch

Europe

		New number
CENELEC EN50014	General Requirements.	EN60079-0
CENELEC EN50015	Oil Immersion “o”.	EN60079-6
CENELEC EN50016	Pressurized Apparatus “p”.	EN60079-2
CENELEC EN50017	Powder Filling “q”.	EN60079-5
CENELEC EN50018	Flameproof Enclosure “d”.	EN60079-1
CENELEC EN50019	Increased Safety Protection Method “e”.	EN60079-7
CENELEC EN50020	Intrinsic Safety Protection Method “i”.	EN60079-11
CENELEC EN50028	Encapsulation “m”.	EN60079-18
CENELEC EN50039	Intrinsically Safe Systems “i”.	EN60079-25
CENELEC EN50284-1	Special Requirements for construction, test and marking of electrical apparatus of equipments group II, category 1G.	

Canada

C22.1	Canadian Electrical Code, Part I.
C22.2-25	Enclosures for Use in Class II, Groups E, F, and G Hazardous Locations.
C22.2-30	Explosion-Proof Enclosures for Use in Class I Hazardous Locations.
C22.2-152	Combustible Gas Detection Equipment.
C22.2-157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Locations.
C22.2-213	Non Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations.

CSA Standards Available From:

Canadian Standards Association

178 Rexdale Boulevard

Rexdale (Toronto), Ontario, Canada M9W IR3

United States

NFPA 70	National Electrical Code, Article 500, Hazardous (Classified) Locations.
NFPA 70	National Electrical Code, Article 501, Class I Locations.
NFPA 70	National Electrical Code, Article 502, Class II Locations.
NFPA 70	National Electrical Code, Article 503, Class III Locations.
NFPA 70	National Electrical Code, Article 504, Intrinsically Safe Systems.
NFPA 70	National Electrical Code, Article 505, Class 1, Zone 0, 1 and 2 locations.
NFPA 493	Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1 Hazardous Locations.
NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (Classified) Locations.
NFPA 497	Classification of Class I Hazardous Locations for Electrical Equipment.
ISA-S12.1	Definitions and Information Pertaining to Electrical Instruments in Hazardous (Classified) Locations.
ISA-RP12.2	Intrinsically Safe and Non-Incendive Electrical Instruments.
ISA-S12.4	Instrument Purging for Reduction of Hazardous Area Classification.
ISA-RP12.6	Installation of Intrinsically Safe Instrument Systems for Hazardous (Classified) Locations.
ISA-S12.10	Area Classification in Hazardous (Classified) Dust Locations.
ISA-S12.11	Electrical Instruments in Hazardous Dust Locations.
ISA-S 12.12	Electrical Equipment for Use in Class 1, Division 2 Hazardous (Classified) Locations.

ISA Standards Available From:

Instrument Society of America
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, North Carolina 27709

ANSI C39.5	Safety Requirements for Electrical/Electronic Equipment Note: ISA standards are approved by ANSI and identified by the prefix ANSI/ISA.

ANSI Standards Available From:

American National Standards Institute
11 West 42nd Street
New York, New York 10036

NFPA 497M	Classification of Gases, Vapors and Dusts for Electrical Equipment in Hazardous (Classified) Locations.

NFPA Standards Available From:

National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269

FM 3610	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations.
FM 3615	Explosion-proof Electrical Equipment.
FM 3820	Electrical Utilization Equipment (General Purpose Requirements).

FM Standards Available From:

Factory Mutual Research Corporation
1151 Boston-Providence Turnpike
Norwood, Massachusetts 02062

UL 698	Standard for Industrial Control Equipment for Use in Hazardous Locations, Class I, Groups A, B, C and D and Class II, Groups E, F and G.
UL 913	Standard for Intrinsically Safe Electrical Circuits and Equipment for Use in Hazardous Locations.

UL Standards Available From:

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook Illinois 60062.

Code Development

- CMP-14 responsible for Division & Zone issues.
- Article 505 (on zones) in 1996 NEC provided an initial framework.
- Industry effort re-wrote Article 505 for 1999 NEC.
- Article 505 in 1999 NEC provides much more detail, but further clarification needed.
- CMP-14 WG further clarifying Article 505 for 2002 NEC.

Division-Based Zones

- Fall 1996: All UL Division standards revised.
- July 1997: NFPA 497 revised.
- July 1998: NFPA 496 revised.
- On-Going: Other NFPA Division documents are considering revisions.

IEC-Based Zones

- Based on IEC 60079 Zone series.
- October 1995: Adoption of IEC Zone requirements w/US deviations
- July 1996: UL 2279 published.
- June 1997: IEEE 515 published.
- June 1998: ISA SP12 series published

North American Armonization

- US/Canadian Bi-national effort
- CANENA Tri-national effort
- National harmonization efforts underway among US standards-writing bodies (i.e: IEEE, ISA, NFPA and UL)

IEC Armonization

• Part 0 (general):	Several pages of deviations.
• Part 1 (flameproof):	Several pages of deviations.
• Part 5 (powder filled):	Virtually no deviations.
• Part 6 (oil immersion):	Virtually no deviations.
• Part 7 (increased safety):	Many pages of deviations.
• Part 11 (intrinsic safety):	A few deviations.
• Part 15 (zone 2)	A few deviations.
• Part 18 (encapsulation):	Virtually no deviations.

Equipment Certifications

- Fall 1995: 1st US Division-based Zone Listings.
- To Date: US Division-based Zone Listing now exist in virtually all equipment categories.
- Dec. 1995: 1st US IEC-based Zone Listings.
- To Date: US IEC-based Zone Listings exist for:
  - Zone 0 gas monitoring & transducer.
  - Zone 1 motor controllers, t-blocks, auxiliary devices.
    Switches, panelboards, flashlights, fixtures, alarms,
    Boxses, gas monitors, hubs, & heat tracing.
  - Zone 2 auxiliary devices, motor controller, fixtures.

ENCLOSURE **PROTECTION** DEGREES

In 1976 IEC publication 529 combined the requirements of IEC 144 and 34-5.

The requirements set forth in IEC 529 are basically the same as in 144, except that the test probes are 50, 12, 2.5 and 1.0 mm (IEC 144 test probes are 52.5, 12.5, 2.5 and 1.0).

A protection degree is specified by a code, e.g., IP64, where the first numeral (6) defines the degree of protection against contact with live or moving parts and against ingress of solid foreign bodies.

The second numeral (4) defines the degree of protection against ingress of liquid.

The following tables are taken from the EN 60429 standard, Table E.1 defines the first numeral, and Table E.2 defines the second.

Enclosure Protection Degrees
(From EN 60429 Standard)

First Characteristic Number	**DEGREE OF PROTECTION MATERIAL**	
	Short Description	*Complete Description*
0	Non protected	No particular protection provided.
1	Protected against solid objects greater than 50 mm.	Protected against large human body parts, e.g., hand (but not protected against voluntary penetration), or solid objects with diameters greater than 50 mm.
2	Protected against solid objects greater than 12 mm.	Protected against penetration of fingers or objects of similar length not exceeding 80 mm., or solid objects with diameters greater than 12 mm.
3	Protected against solid objects greater than 2.5 mm.	Protected against penetration of tools, wires, etc., with diameters of thickness greater than 2.5 mm., or solid objects with diameters greater than 2.5 mm.
4	Protected against solid objects greater than 1 mm.	Protected against penetration of wires with a thickness greater than 1 mm., or solid objects with diameters greater than 1 mm.
5	Dust protected.	Penetration of dust is not totally excluded, but the quantity that can penetrate is not such as to interfere with the proper functioning of the equipment.
6	Dust tight.	No penetration of dust is allowed.

Degree of protection against contact with live or moving parts and against ingress of solid foreign bodies

Enclosure Protection Degrees
(From EN 60429 Standard)

Second Characteristic Number	DEGREE OF PROTECTION MATERIAL	
	Short Description	***Complete Description***
0	Non protected	No particular protection provided.
1	Protected against dripping water.	Vertically dripping water shall have no harmful effect.
2	Protected against dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted with a maximum angle of 15°, respective of its original position.
3	Protected against rain.	Water falling in the form of rain at an angle of up to 60° vertically shall have no harmful effect.
4	Protected against splashing water.	Water splashed against the enclosure from any direction shall have no harmful effect.
5	Protected against water jets.	Water projected by a nozzle against the enclosure from any direction shall have no harmful effect.
6	Protected against heavy seas.	Water from heavy seas or water projected in powerful jets shall not enter the enclosure in harmful quantities.
7	Protected against the effects of immersion.	Water must not penetrate the enclosure in harmful quantities when immersed in water with determined pressure and time conditions.
8	Protected against the effects of submersion.	The enclosure is suitable to be permanently submerged in water in the condition specified by the manufacturer. ***Note:*** This normally means that the enclosure is watertight, but for certain types of enclosures, this could mean that the water can penetrate only in certain points in a quantity such as not to cause damaging effects.

Degree of protection against ingress of liquid

MINIMUM **IGNITION** CURVES

The graphs on the following pages answer the question: What is a dangerous amount of electrical energy?

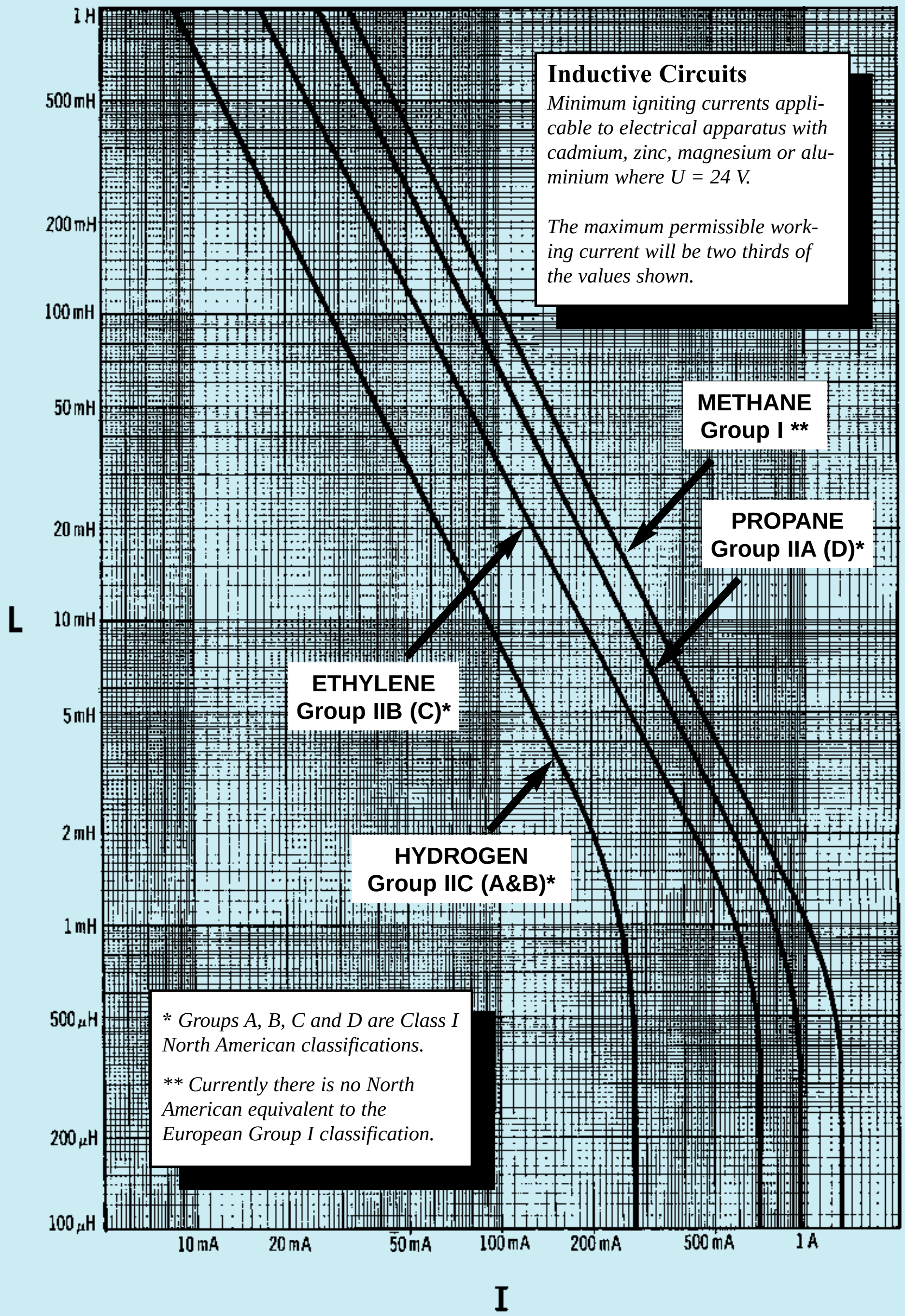
These graphs are for circuits containing aluminum, cadmium, magnesium or zinc–substances that produce a high temperature incendiary spark.

It is important to keep in mind that these curves reflect the worst case scenario.

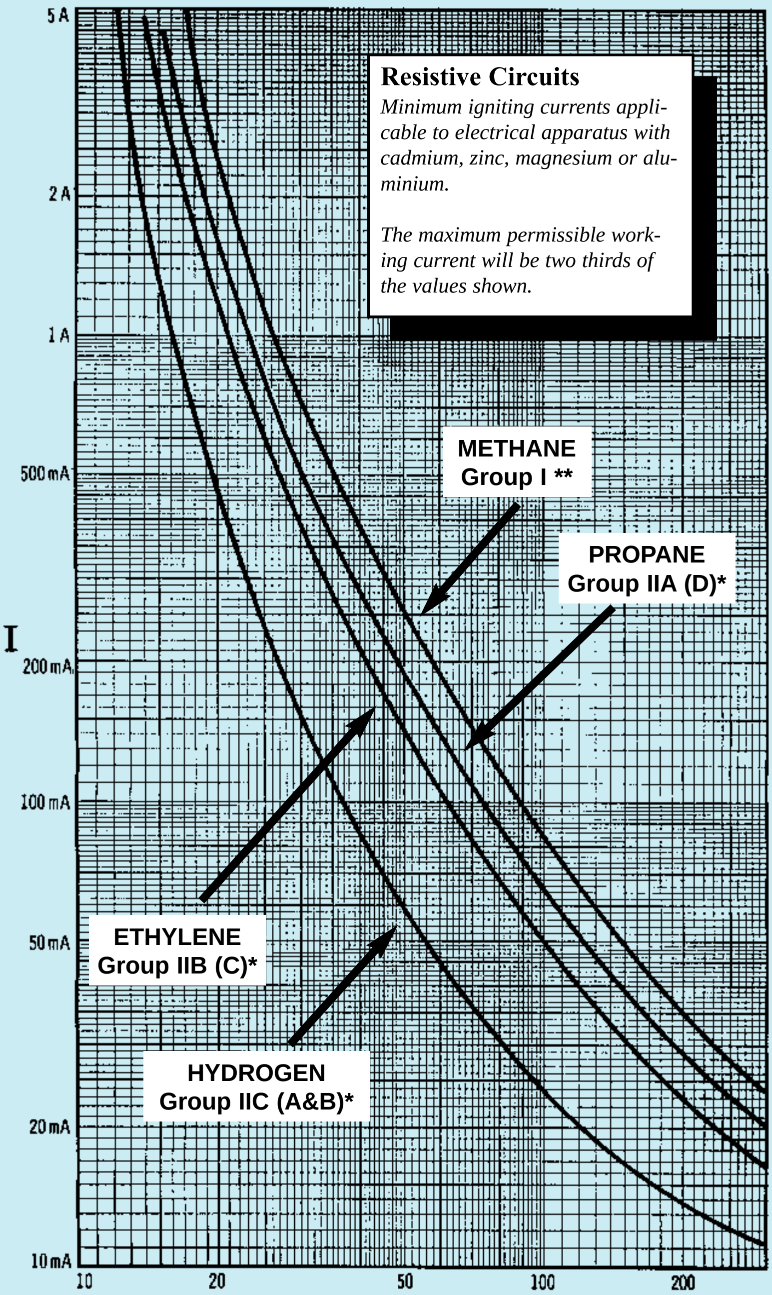
When designing intrinsically safe electronic equipment today, most manufacturers start by specifying the equipment for the worst possible case.

The graphs chosen are those that are used most often by designers and manufacturers of electrical apparatus.

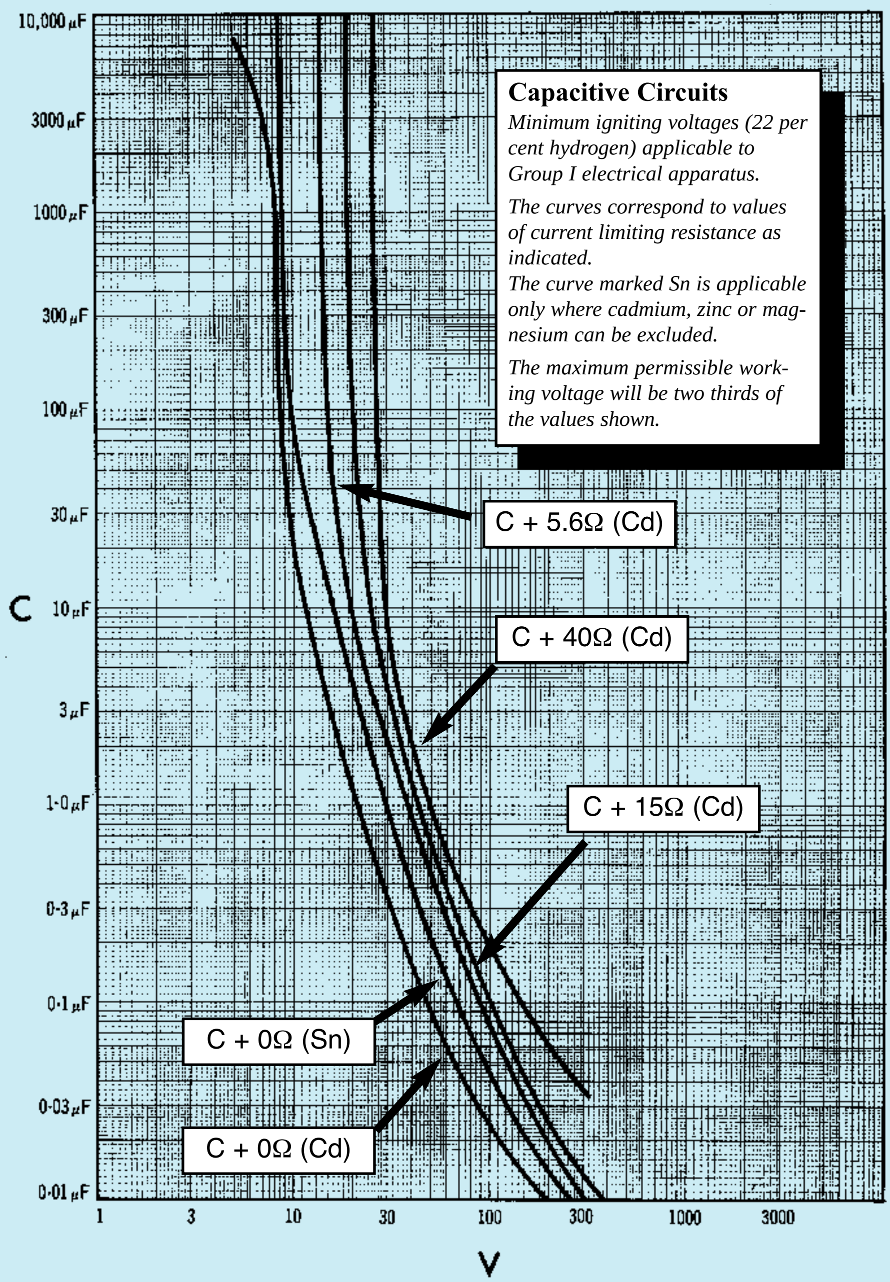
Minimum Ignition Curves for Inductive Circuits



Minimum Ignition Curves for Resistive Circuits



Minimum Ignition Curves for Capacitive Circuits Group I



Capacitive Circuits

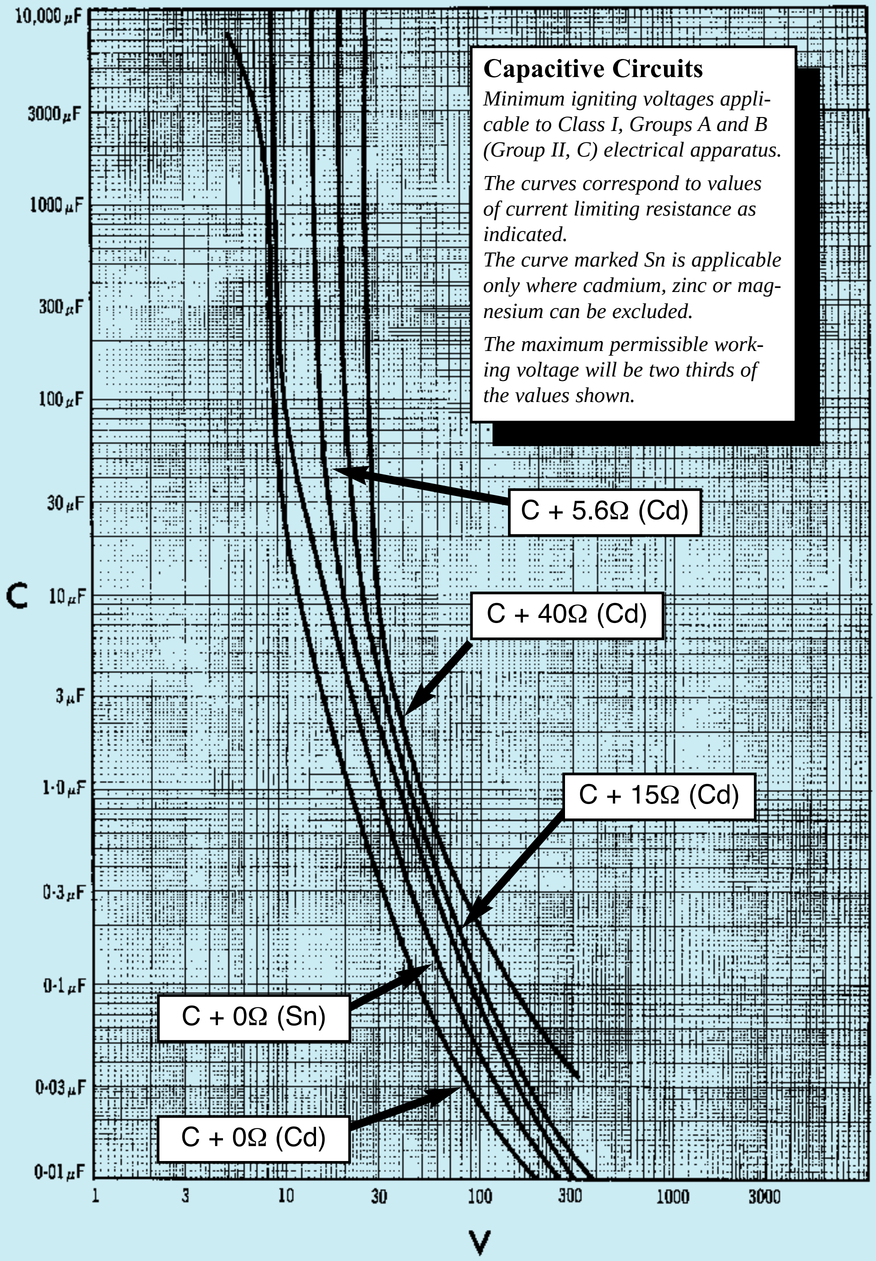
Minimum igniting voltages (22 per cent hydrogen) applicable to Group I electrical apparatus.

The curves correspond to values of current limiting resistance as indicated.

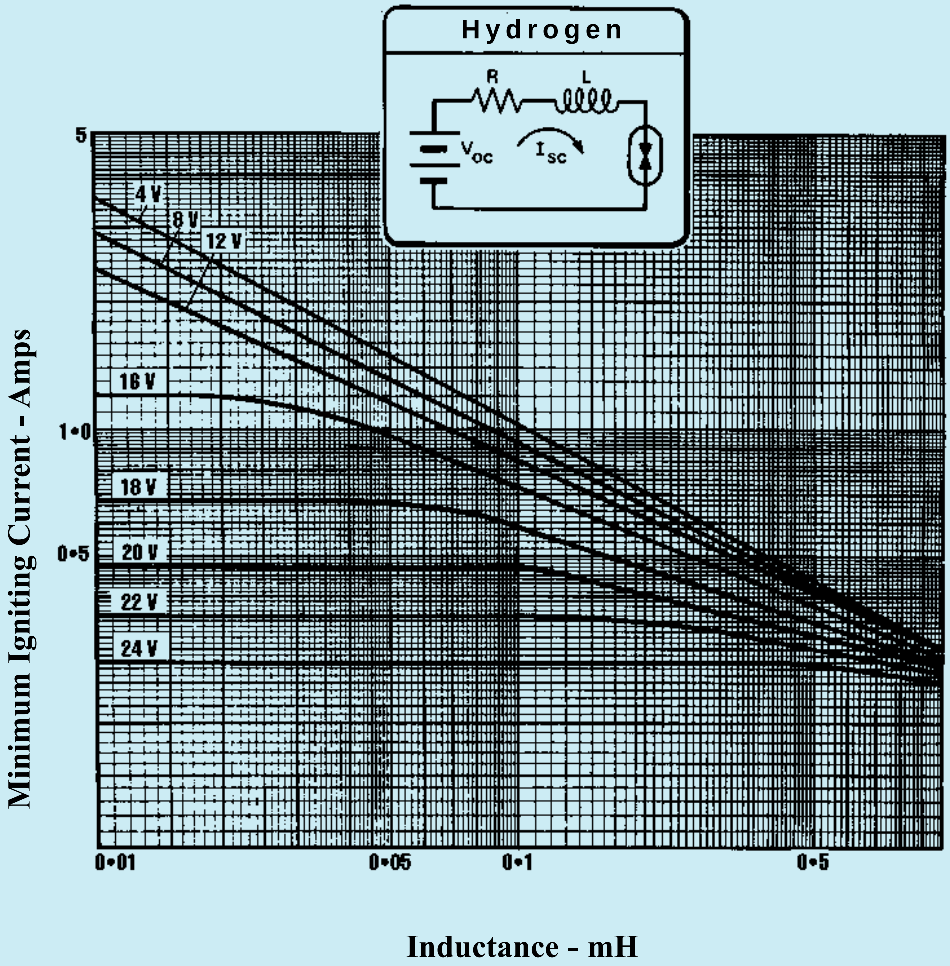
The curve marked Sn is applicable only where cadmium, zinc or magnesium can be excluded.

The maximum permissible working voltage will be two thirds of the values shown.

Minimum Ignition Curves for Capacitive Circuits
Class I, Groups A & B (Group II, C)



Certification Curves Showing Relationship Between Inductance and Minimum Igniting Current



SUBDIVISION OF **GASES** AND THEIR CLASSIFICATION RELATIVE TO **IGNITION TEMPERATURE**

Following tables list gases which are subdivided by hazardous area classification according to ignition temperature and temperature class.

The group classifications in parentheses are North American classifications.

Group I has no equivalent in North America.

Group I
METHANE (Mines)

Group II, A (Class I, Group D)
Representative Gas – PROPANE

HYDROCARBONS

Alkanes	*Ignition Temperature (°C)*	*Temperature Class*
Butane	365	T2
Cyclobutane	–	–
Cycloheptane	–	–
Cyclohexane	259	T3
Cyclopentane	380	T2
Decahydronaphthalene	250	T3
Decane	205	T3
Ethane	515	T1
Ethyl cyclobutane	210	T3
Ethyl cyclohexane	260	T3
Ethyl cyclopentane	260	T3
Heptane	215	T3
Hexane	233	T3
Methane	538	T1
Methyl cyclobutane	–	–
Methyl cyclohexane	265	T3
Methyl cyclopentane	–	–
Nonane	205	T3
Octane	210	T3
Pentane	285	T3
Propane	466	T1

Group II, A (Class I, Group D)
Representative Gas – PROPANE

HYDROCARBONS

Alkenes	*Ignition Temperature (°C)*	*Temperature Class*
Propylene	410	T2
Aromatic hydrocarbons		
Methyl styrene	–	–
Styrene	490	T1
Benzenoids		
Benzene	560	T1
Cumene	420	T2
Cymene	435	T2
Ethylbenzene	430	T2
Naphthalene	528	T1
Toluene	535	T1
Trimethylbenzene	470	T1
Xylene	465	T1
Hydrocarbon mixtures		
Benzene (motors)	–	–
Combustible oil	250	T3
Diesel oil	330	T2
Kerosene	210 - 350	T3 - T2
Methane (industrial)	–	T1
Naphtha (from carbon)	272	T3
Naphtha (from petrol.)	290	T3
Naphtha solvent	232	T3
Petroleum (including gasoline)	250	T3
Terabenzene	–	T3

Group II, A (Class I, Group D)
Representative Gas – PROPANE

OXYGEN COMPOSITIONS

Oxides (including esters)	*Ignition Temperature (°C)*	*Temperature Class*
Carbon monoxide	605	T1
Dipropylether	–	–
Alcohols & Phenols		
Butanol	340	T2
Cresol	555	T1
Cyclohexanol	300	T3
Diacetone alcohol	600	T1
Ethanol	423	T2
Heptanol	–	–
Hexanol	–	–
Mathanol	455	T1
Methyl cyclohexanol	295	T3
Nonanol	–	–
Octanol	–	–
Pentanol	300	T3
Phenol	606	T1
Propanol	371	T2
Aldehydes		
Acetaldehyde	143	T4
Methaldehyde	–	–
Acids		
Acetic acid	427	T2

Group II, A (Class I, Group D)
Representative Gas – PROPANE

OXYGEN COMPOSITIONS

Ketones	*Ignition Temperature (°C)*	*Temperature Class*
Acetalacetone	340	T2
Acetone	535	T1
Amyl methyl ketone	533	T1
Butyl methyl ketone	530	T1
Cyclohexanone	419	T2
Ethyl methyl ketone	505	T1
Propyl methyl ketone	505	T1

Esters		
Amyl acetate	380	T2
Butyl acetate	370	T2
Ethyl acetate	427	T2
Ethyl acetyl acetate	295	T3
Ethyl formate	440	T2
Ethyl methyl acrylate	–	–
Methyl acetate	475	T2
Methyl formate	449	T2
Methyl methyl acrylate	421	T2
Propyl acetate	430	T2
Vinyl acetate	385	T3

Group II, A (Class I, Group D)
Representative Gas – PROPANE

Halogen Compositions

With Oxygen	*Ignition Temperature (°C)*	*Temperature Class*
Acetychloride	390	T2
Chloroethanol	413	T2

Without Oxygen		
Allyl choride	392	T2
Benzotrifluoride	–	–
Benzyl chloride	585	T1
Bromobutane	265	T3
Bromoethane	511	T1
Chlorobenzene	637	T1
Chlorobutane	460	T1
Chloroethane	410	T2
Chloethylene (vinyl chloride)	472	T1
Chloromethane	625	T1
Chloropropane	520	T1
Dichlorobenzene	640	T1
Dichloroethane	413	T2
Dichloroethylene	460	T1
Dichloropropane	557	T1
Methylene chloride	458	T1

Group II, A (Class I, Group D)
Representative Gas – PROPANE

Sulphur Compositions

	Ignition Temperature (°C)	*Temperature Class*
Ethyl mercaptan	299	T3
Propyl mercaptan	–	–
Tetrahydrothiophene	–	–
Tiophene	–	–

Group II, A (Class I, Group D)
Representative Gas – PROPANE

Nitrogen Compositions

	Ignition Temperature (°C)	*Temperature Class*
Acetonitrile	–	–
Ammonia	630	T1
Ethylnitrile	–	–
Nitroethane	410	T2
Nitromethane	412	T2

Group II, A (Class I, Group D)
Representative Gas – PROPANE

Nitrogen Compositions

Amines	*Ignition Temperature (°C)*	**Temperature Class**
Amphetamine	-	-
Aniline	538	T1
Butylamine	312	T2
Cyclohexylamine	293	T3
Diaminoethane	385	T2
Diethylamine	312	T2
Diethylaminoethanol	-	-
Dimethylamine	400	T2
Dimethylaniline	371	T2
Methylamine	430	T2
Monoethylamine	-	-
Pyridine	482	T1
Propylamine	320	T2
Toluidine	482	T1
Triethylamine	-	-
Trimethylamine	190	T4

Group II, B (Class I, Group C)
Representative Gas – ETHYLENE

Hydrocarbons

	Ignition Temperature (°C)	*Temperature Class*
Allylene (propin)	–	–
Butadine	430	T2
Cyclopropane	498	T1
Ethylene	425	T2

Group II, B (Class I, Group C)
Representative Gas – ETHYLENE

Nitrogen Compositions

	Ignition Temperature (°C)	*Temperature Class*
Acrylonitrile	481	T1
Hydrocyanic acid	535	T1
Isopropylnitrate	175	T4

Group II, B (Class I, Group C)
Representative Gas – ETHYLENE

Oxygen Compositions

	Ignition Temperature (°C)	*Temperature Class*
Acrolein	278	T3
Butyl ester of acid	–	–
Butyl ether	185	T4
Crotonaldehyde	232	T3
Dioxane	379	T2
Dioxolane	–	–
Epoxypropane	430	T2
Ethyl acrylate	–	–
Ethyl ether	170	T4
Ethyl methyl ether	190	T4
Ethylene oxide	430	T2
Furan	–	–
Hydroacetic	–	–
Methyl acrylate	–	–
Methyl ether	190	T4
Tetrahydrofuran	224	T3
Tetrahydrofurfuryl alcohol	282	T3
Trioxane	414	T2

Group II, B (Class I, Group C)
Representative Gas – ETHYLENE

MIXTURES

	Ignition Temperature (°C)	*Temperature Class*
City gas	560	T1
Coke oven gas	–	–

Group II, B (Class I, Group C)
Representative Gas – ETHYLENE

HALOGEN COMPOSITIONS

	Ignition Temperature (°C)	*Temperature Class*
Epichlorodine (propane, 1 chloro, 2, 3 epoxy)	–	–
Tetrafluoroethylene	–	–

Group II, B (Class I, Group C)
Representative Gas – ETHYLENE

SULPHUR COMPOSITIONS

	Ignition Temperature (°C)	*Temperature Class*
Sulphurous hydrogen	260	T3

Group II, C (Class I, Group A or B)
Representative Gas – HYDROGEN

	Ignition Temperature (°C)	*Temperature Class*
Acetylene	300	T3
Carbon disulphide	102	T5
Ethyl nitrate	–	T6
Hydrogen	560	T1
Water gas	600	T1

IEC 61508
&
IEC 61511

COMPENDIUM

Brief recapitulation of
the salient Parts of
IEC 61508 Standard
for Functional Safety of
Electrical/Electronic/
Programmable Electronic
Safety-Related Systems
&
Safety Instrumented
Systems for
the Process Industry

INDEX of CONTENT

1.0 Presentation of IEC 61508 Parts and other Standards related to the same objectives.

IEC 61508 is an international standard for the "Functional Safety" of electrical, electronic, and programmable electronic equipments.
The total IEC 61508 is divided into seven parts.

Parts 1, 3, 4, and 5 were approved in 1998. Parts 2, 6 and 7 were approved in February 2000. The relationship between the technical requirements presented in parts 1, 2 and 3 and the supporting information in parts 4 through 7 is shown in Figure 1.

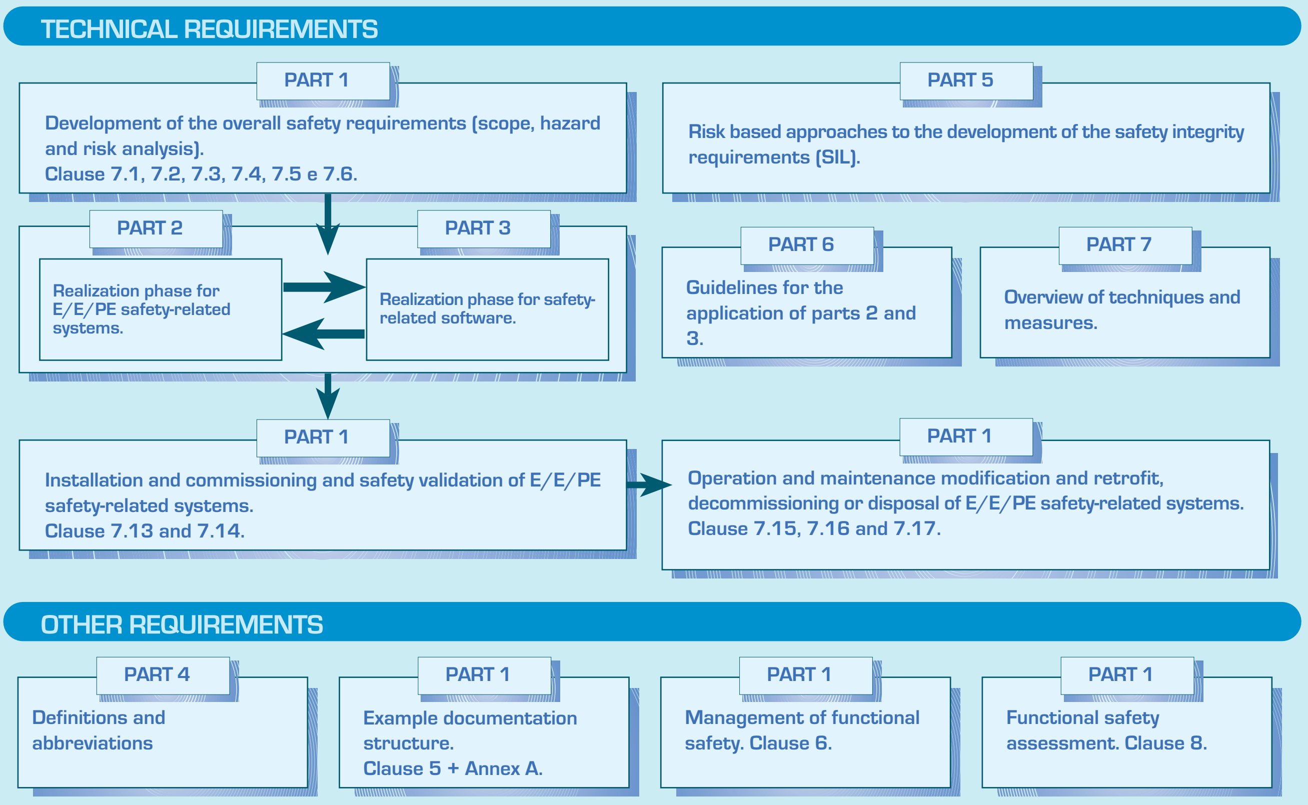


Figure 1: Technical requirements of IEC 61508.

Part 1: General Requirements (required for compliance), covers the basic requirements of the standard and provides a detailed presentation of the safety lifecycle. This section is considered to be the most important, as it provides overall requirements for documentation, compliance, management of functional safety, and functional safety assessment. Three annexes provide examples of documentation structure (Annex A), a personnel competency evaluation (Annex B), and a bibliography (Annex C).

Part 2: Requirements for electrical/electronic /programmable electronic safety-related systems (required for compliance), covers the hardware requirements for safety-related systems.
Many consider this part, along with part 3, to be the key area for those developing products for the safety market. Part 2 is written with respect to the entire system but many of the requirements are directly applicable to safety-related hardware product development. Part 2 covers a detailed safety lifecycle for hardware as well as specific aspects of assessing functional safety for the hardware.
Part 2 also has detailed requirements for techniques to deal with "control of failures during operation" in Annex A (required for compliance). This Annex covers hardware fault

tolerance, diagnostic capability requirements and limitations, and systematic safety integrity issues for hardware.
Annex B of Part 2 (required for compliance) contains listings of "techniques and measures" for "avoidance of systematic failures during different phases of the lifecycle".
This covers design, analysis, and review procedures required by the standard.
Annex C of Part 2 discusses the calculation of diagnostic coverage factor (what fraction of failures are identified by the hardware) and safe failure fraction (what fraction of failures lead to a safe rather than a hazardous state).

Part 3: Software requirements (required for compliance), covers the software requirements for IEC 61508. It applies to any software used in a safety-related system or software used to develop a safety-related system.
This software is specifically referred to as safety-related software. This part provides details of the software safety lifecycle, a process to be used when developing software. Annex A (required for compliance) provides a listing of "techniques and measures" used for software development where different techniques are chosen depending on SIL level of the software. Annex B (required for compliance) has nine detailed tables of design and coding standards and analysis and testing techniques that are to be used in the safety-related software development, depending on SIL level of the software and in some cases the choice of the development team.

Part 4: Definitions and abbreviations (supporting information), contains the definitions and abbreviations used throughout all parts of the standard. This section is extremely useful both to those new to the standard and to those already familiar with it as a reference to the precise meanings of terms in the standard.

Part 5: Examples of methods of the determination of safety integrity levels (supporting information), includes informative Annexes A through E which contains discussion and example methods for risk, safety integrity, qualitative methods.
The quantitative method in Annex C is based on calculating the frequency of the hazardous event from failure rate data or appropriate predictive methods combined with an assessment of the magnitude of the consequence compared to the level of risk that can be tolerated in a given situation.
The qualitative risk graph and severity matrix essentially address the same frequency and magnitude components, only with general categories rather than numbers before comparing the solution with the tolerable level.

Part 6: Guidelines on the application of parts 2 and 3 (supporting information), provides guidelines on the application of parts 2 and 3 via informative Annexes A through E. Annex A gives a brief overview of part 2 and 3 as well as example flowcharts of detailed procedures to help with implementation. Annex B provides example techniques for calculating probabilities of failure for the safety-related system with tables of calculation results. Equations that approximate various example architectures are presented, although reliability block diagrams are used and these can be confusing in multiple failure mode situations. Annex C shows detailed calculation of diagnostic coverage factor based on FMEDA techniques (Failure Modes Effects and Diagnostic Analysis). Annex D shows a method for estimating the effect of common cause modes of failure (beta factors) in a redundant hardware architecture. This method lists relevant parameters and provides a method of calculation. Annex E shows examples applying the software integrity level tables of part 3 for two different safety software cases.

Part 7: Overview of techniques and measures (supporting information), contains important information for those doing product development work on equipment to be certified per IEC 61508. Annex A addresses control of random hardware failures. It contains a reasonable level of detail on various methods and techniques useful for preventing or maintaining safety in the presence of component failure. Annex B covers the avoidance of systematic failures through the different phases of the safety lifecycle. Annex C provides a reasonably detailed overview of techniques for achieving high software safety integrity. Annex D covers a probabilities-based approach for SIL determination of already proven software. Although the standard has been criticized for its "extensive" documentation requirements and use of unproven "statistical" techniques, in many industries it represents a great step forward. The standard focuses attention on risk-based safety-related system design, which should result in far more cost-effective implementation. The standard also requires the attention to detail that is vital to any safe system design. Because of these features and the large degree of international acceptance for a single set of documents, many consider the standard to be major advance for the technical world.

1.1 HSE - PES

Programmable Electronic Systems In Safety Related Applications, Parts 1 and 2, U.K. Health & Safety Executive,1987. This documents was the first of the kind and was published by the HSE. Although it focused on software programmable systems, the concepts presented applied to other technologies as well. It covered qualitative and quantitative evaluation methods and many design checklists.

1.2 AIChE - CCPS

Guidelines for Sfe Automation of Chemical Processes, 1993.
The American Institute of Chemical Engineers formed the Center for Chemical Process Safety (CCPS) after the accident in Bhopal, Indeia. The CCPS has since released several dozen textbooks on various design and safety-related topics for the process industry. In particular text covers the design of Distributed Control Systems (DCS) and Safety Interlock Systems (SIS) and contains other very useful background information.

1.3 API RP 556

Recommended Practice for Instrumentation and Control Systems for Fired Heaters and Steam Generator, American Petroleum Institute, 1997.
This recommended practice has sections covering shutdown systems for fired heaters, steam generators, carbon monoxide or waste gas steam generator, gas turbine exhaust fired steam generators, and unfired waste heat steam generator. While intended for use in refineries, the document states that it is "applicable without change in chemical plants, gasoline plants, and similar installations".

1.4 DIN 19250

It is a German draft standard titled "Fundamental safety aspects to be considered for measurement and control equipment", last issued 1994. It has been influent in the preparation of Part 5 of IEC 61508 risk analysis examples. This standard was intended to provide guidance to standardization committees that wish to define rules for carrying out risk analysis. It describes a qualitative risk analysis process using the risk graph leading to the appropriate "class". (abbreviated to AK).

AK Risk classes are of the same nature as the safety integrity levels (SILs) of IEC 61508. Whereas IEC 61508 defines four safety integrity levels, DIN 19250 defines eight requirements classes and a correspondences between the two categorisation may be derived.

1.5 API RP 14C

Recommended Practice for Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms, American Petroleum Institute, 2001.

This prescriptive recommended practice is based on “proven practices” and covers the design, installation, and testing of surface safety systems on offshore production platforms. It is intended for design engineers and operating personnel.

1.6 ISA-SP84.01 - 1996

This American standard titled “Application of Safety Instruments Systems for the Process Industries” it is specific for the process industries and addresses the application of safety instrumented systems (SIS) and not equipment under control (EUC) as described in the IEC 61508. It defines the full life cycle assuming that the risk analysis and the determination of SILs, has already been carried out. Thus placing itself in the context of IEC 61508, and this is stated in the introduction. This standard does not cover the non-SIS and restricts itself to good practice in the provision of safety instrumentation systems, from specification to their decommissioning.

1.7 ANSI/ISA 84.00.01.2004

ANSI/ISA-84.01-96 stated it would be re-released in five-year intervals to account for new developments. Rather than rewrite the ISA-SP84's standards from scratch, the committee decided to adopt the IEC 61511 standard.

1.8 IEC 61511 - 2003

This standard titled “ Functional Safety: Safety Instrumented Systems for the Process Industry Sector”, has been developed as a Process Sector implementation of the IEC 61508.

The standard is primarily concerned with SIS for the process industry sector like sensors, logic solvers and final elements which are included as part of the safety instrumented system.

It also deals with the interface between the SIS and other safety systems in requiring that a process hazard and risk assessment be carried out. The standard consists of three parts:

Part 1: Framework, definitions, systems, hardware and software requirements.

Part 2: Guidelines in the application of IEC 61511-1.

Part 3: Example methods for determining safety integrity in the application of Hazard 6 Risk Analysis.

IEC 61511 follows the IEC 61508 overall safety lifecycle and uses the system of SILs described in the standard.

In short, it is a sector specific interpretation of the more generic IEC 61508 standard.

1.9 NFPA 85

Boiler and Combustion Systems Hazard Code, National Fire Protection Association,2004.

NFPA 85 is the most recognized standard worldwide for combustion systems safety. This is a very prescriptive standard with specific design requirements. The standard covers:

- Single Burner Boiler Operation.
- Multiple Burner Boilers.
- Pulverized Fuel Systems.
- Stoker Operation.
- Atmospheric Fluidizer-Bed Boiler Operation.
- Heat Recovery Steam Generator Systems.

The purpose of NFPA 85 is to provide safe operation and prevent uncontrolled fires, explosions and implosions.

Many countries and companies require compliance with NFPA 85 for burner management systems (BMS). The NFPA 85 does not address Safety Integrity Levels.

1.10 More to Learn

Safety Instrumented Systems (SIS) are designed to respond to the conditions of a plant, which may be hazardous in themselves, or if no action is taken could eventually give rise to a hazardous event.
They must generate the correct outputs to prevent, or mitigate, the hazardous event.
The proper design and operation of such systems are described in various standards, guidelines, recommended practices, and regulations. Setting specifications, electing technologies, levels of redundancy, safety integrity levels, test intervals, etc. is not always an easy, straightforward matter.
The various industry standards are written to assist those in the process industry tasked with proper selection, design, operation, and maintenance of systems.

2.0 GENERAL PRESENTATION OF THE IEC 61508 STANDARD

2.1 OBJECTIVES

IEC 61508 is a basic safety publication of the International Electrotechnical Commission (IEC). As such, it is an "umbrella" document covering multiple industries and applications.
A primary objective of the standard is to help individual industries develop supplemental standards, tailored specifically to those industries based on the original 61508 standard.
A secondary goal of the standard is to enable the development of E/E/PE safety-related systems where specific application sector standards do not already exist.

As of January 2001, work has already begun on two such industry specific standards:
IEC 61511 for the process industries and
IEC 62061 for machinery safety.
Both of these standards build directly on
IEC 61508 and reference it accordingly.

2.2 SCOPE

The 61508 standard covers safety-related systems when one or more of such systems incorporates electrical/electronic/programmable electronic devices.
These devices can include anything from electrical relays and switches through to Programmable Logic Controllers (PLCs) and all the way up to complicated computer-driven overall safety systems.
The standard specifically covers possible hazards created when failures of the safety functions performed by E/E/PE safety-related systems occur. The overall program to insure that the safety-related E/E/PE system brings about a safe state when called upon to do so is defined as "functional safety."
IEC 61508 does not cover safety issues like electric shock, hazardous falls, long-term exposure to a toxic substance, etc.; these issues are covered by other standards like ATEX. IEC 61508 also does not cover low safety E/E/PE systems where a single E/E/PE system is capable of providing the necessary risk reduction and the required safety integrity of the E/E/PE system is less than safety integrity level 1, i.e., the E/E/PE system is only reliable 90 percent of the time or less.
IEC 61508 is concerned with the E/E/PE safety-related systems whose failure could affect the safety of persons and/or the environment. However, it is recognized that the methods of IEC 61508 also may be applied to business loss and asset protection cases.

2.3 FUNDAMENTAL CONCEPTS

The standard is based on two fundamental concepts: the safety lifecycle and safety integrity levels (SIL). The safety lifecycle is defined as an engineering process that includes all of the steps necessary to achieve required functional safety. The safety lifecycle from IEC 61508 is shown in Figure 2. The basic philosophy behind the safety lifecycle is to develop and document a safety plan, execute that plan and document its execution (to show that the plan has been met), and continue to follow that safety plan through to decommissioning with further appropriate documentation throughout the life of the system. Changes along the way must similarly follow the pattern of planning, execution, validation, and documentation.

2.4 Safety Integrity Levels

Safety integrity levels (SILs) are order of magnitude levels of risk reduction. There are four SILs defined in IEC 61508. SIL1 has the lowest level of risk reduction. SIL 4 has the highest level of risk reduction. The SIL table for "demand mode" and "continuous mode" of operation is shown in Figure 3.

The mode differences (defined in Part 4 of the standard) are:

Low demand mode – where the frequency of demands for operation made on a safety-related system is no greater than one per year and no greater than twice the proof test frequency; High demand or continuous mode – where the frequency of demands for operation made on a safety-related system is greater than one per year or greater than twice the proof check frequency. Note that the proof test frequency refers to how often the safety system is completely tested and insured to be fully operational. While the continuous mode appears to be far more stringent than the demand mode, it should be remembered that the units for the continuous mode are per hour. The demand mode units assume a time interval of roughly one year per the definition.

Considering the fact that there are about 10,000 hours in a year (actual 8,760), the modes are approximately the same in terms of safety metrix. Basically speaking, functional safety is achieved by properly designing a Safety Instrumented System (SIS) to carry out a Safety Instrumented Function (SIF) at a reliability indicated by the Safety Integrity Level (SIL). The concepts of risk and safety integrity are further discussed in Part 5 of the standard.

2.5 COMPLIANCE

The IEC 61508 standard states: "To conform to this standard it shall be demonstrated that the requirements have been satisfied to the required criteria specified (for example safety integrity level) and therefore, for each clause or sub-clause, all the objectives have been met."

In practice, demonstration of compliance often involves listing all of the IEC 61508 requirements with an explanation of how each requirement has been met.

This applies to both products developed to meet IEC 61508 and specific application projects wishing to claim compliance.

Because IEC 61508 is technically only a standard and not a law, compliance is not always legally required. However, in many instances, compliance is identified as best practice and thus can be cited in liability cases. Also, many countries are incorporating IEC 61508 or large parts of the standard directly into their safety codes, so in those instances it will be indeed law.

Finally, many industry and government contracts for safety equipment, systems, and services specifically require compliance with IEC 61508.

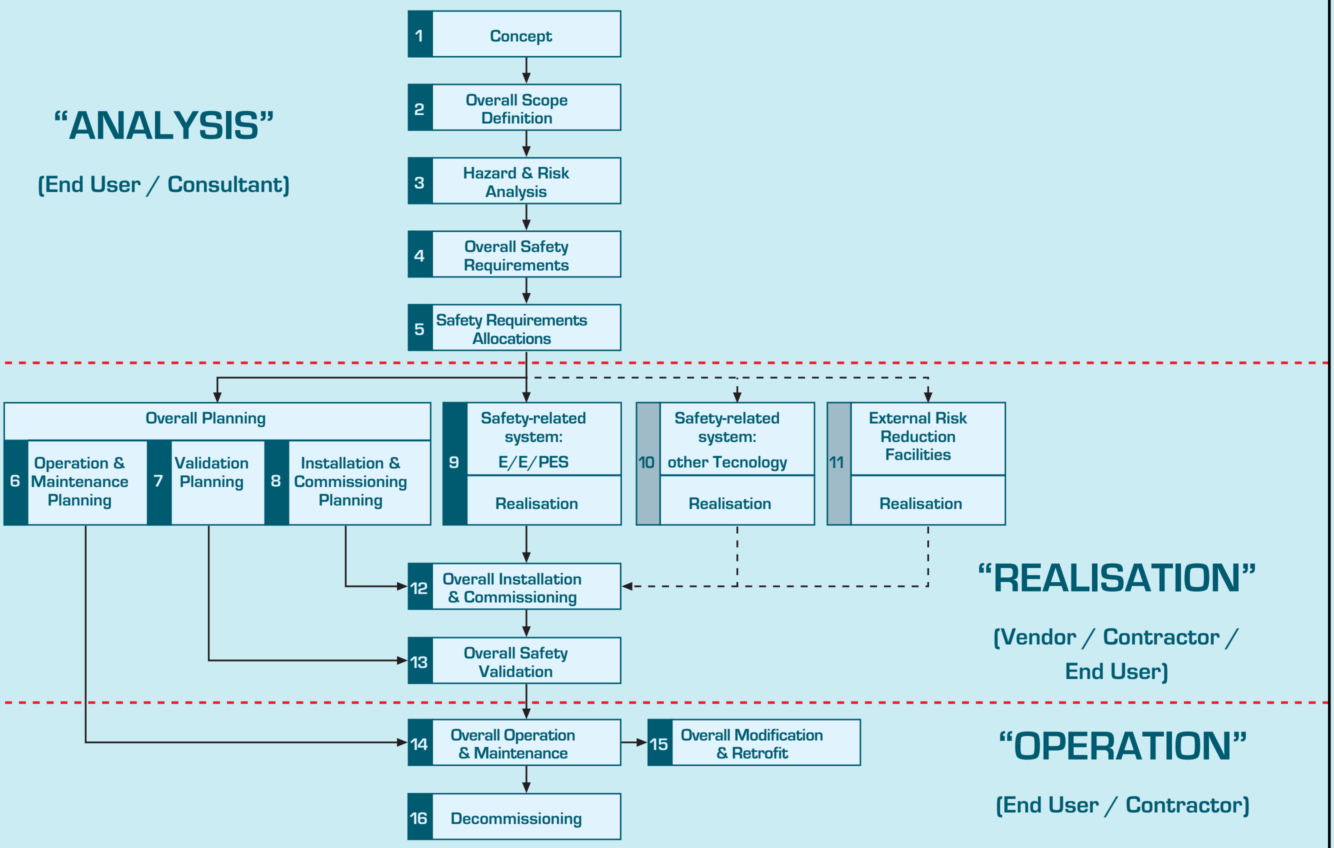


Figure 2: Safety lifecycle from IEC61508.

Safety Integrity Level (SIL)	Probability of failure on Demand per year (or low demand) (PFD)	Safety Availability (1 - PFD)	Risk Reduction Factor (RRF = 1/PFD)	Probability of Dangerous failure per hour (continuous mode or high demand) (PFD)
SIL 4	$>= 10^{-5}$ to $< 10^{-4}$	99,99 - 99,999%	from 100000 to 10000	$>= 10^{-9}$ to $< 10^{-8}$
SIL 3	$>= 10^{-4}$ to $< 10^{-3}$	99,9 - 99,99%	from 10000 to 1000	$>= 10^{-8}$ to $< 10^{-7}$
SIL 2	$>= 10^{-3}$ to $< 10^{-2}$	99 - 99,9%	from 1000 to 100	$>= 10^{-7}$ to $< 10^{-6}$
SIL 1	$>= 10^{-2}$ to $< 10^{-1}$	90 - 99%	from 100 to 10	$>= 10^{-6}$ to $< 10^{-5}$

Figure 3: SIL Table for Demand and Continuous mode of operation.

So although IEC 61508 originated as a standard, its wide acceptance has led to legally required compliance in nearly all relevant cases.

2.6 SAFETY LIFECYCLE IN THE IEC 61508 STANDARD

The safety lifecycle can be viewed as a logical "identify-assess-design-verify" closed loop (Figure 4). The intended result is the optimum design where the risk reduction provided by the safety-related system matches the risk reduction needed by the process.

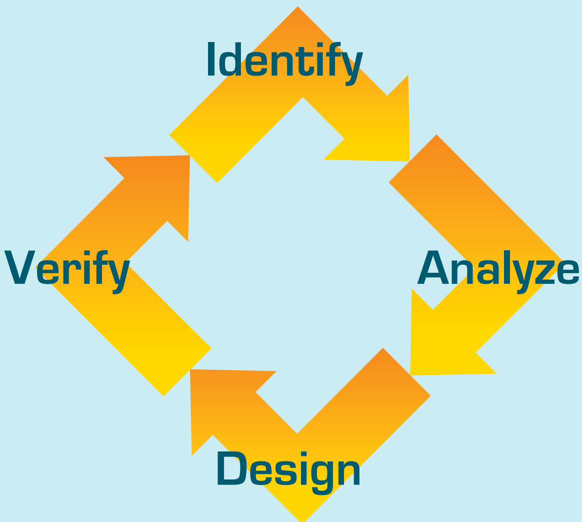


Figure 4: Closed loop view of the safety life cycle.

2.6.1 Findings of the HSE

The safety lifecycle concept came from studies done by the Health Safety Executive (HSE) in the United Kingdom. The HSE examined 34 accidents that were the direct result of control and safety system failures in a variety of different industries.

Their findings are summarized in Figure 5. The majority of accidents (44%) were due to incorrect and incomplete specifications. Specifications consists of both the functional specification (i.e., what the system should do) and the integrity specifications (i.e., how well it should do it). There are many examples of functional specifications errors. Kletz documented a case where a computer controlled controller an exothermic reactor.

When material was added to the reactor the flow of cooling water needed to increase. However, the system was also programmed so that for any fault in the plant - and many things were categorized as a fault - the output would freeze at their last known value.

Fate would have it that these two conflicting conditions happened at the same time. Material was added to the reactor and then the system detect a low gear box oil level. The flow of cooling water did not increase so the reactor overheated and discharged its contents. The system did exactly what it was programmed to do. These was not an hardware failure. Trevor Kletz said: "Accidents are not due to lack of knowledge, but failure to use the knowledge we already have".

The next largest portion of problems (20%) were due to change after commissioning. Operations and maintenance problems were found to be responsible for 15% of accidents. Therefore the 35% of accidents are responsibility of the end users. Design and implementation errors accounted for 15% of problems.

This is about the only error that are responsibility of the vendor or system integrator. There have been cases where specifications were correct, but system supplied did not meet at least one of the requirements and was not thoroughly tested in order to reveal that fault.

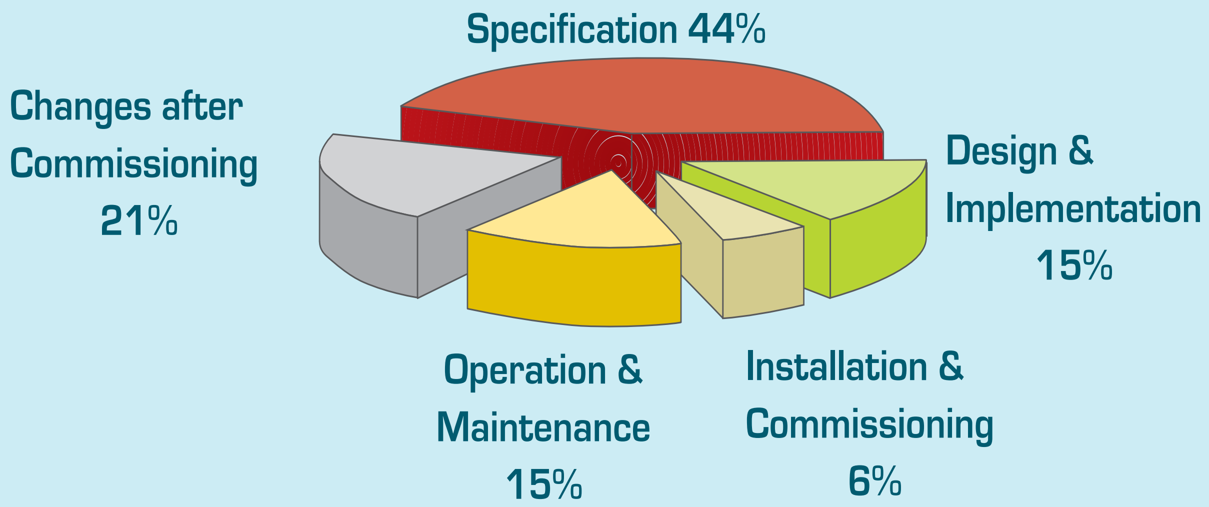


Figure 5: Results of system failure cause study: HSE "Out of Control."

The origin of safety lifecycle is shown in figure 6. The basic aspects of the safety life cycle (shown in Figure 2) were created to address all of the causes identified in the HSE study.

2.6.2 Safety Lifecycles

The first part of the safety life cycle, known as the analysis portion, covers:

- Concept and scope of the system or equipment under control (EUC);
- Hazard and Risk Analysis to identify both hazards and the events that can lead to them, including Preliminary Hazards and Operability (HAZOP) study, Layers of Protection Analysis (LOPA), Criticality Analysis;
- Creation of overall safety requirements and identification of specific safety functions to prevent the identified hazards;
- Safety requirements allocation, i.e., assigning the safety function to an E/E/PE safety-related system, an external risk reduction facility, or a safety-related system of different technology.

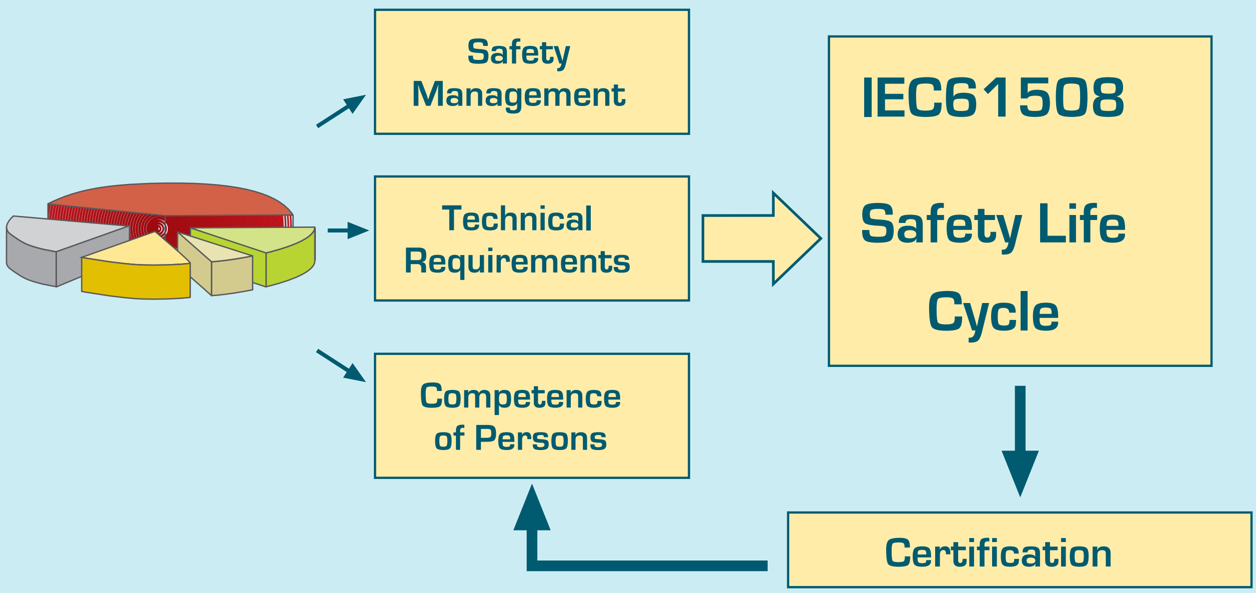


Figure 6: Origin of the safety life cycle.

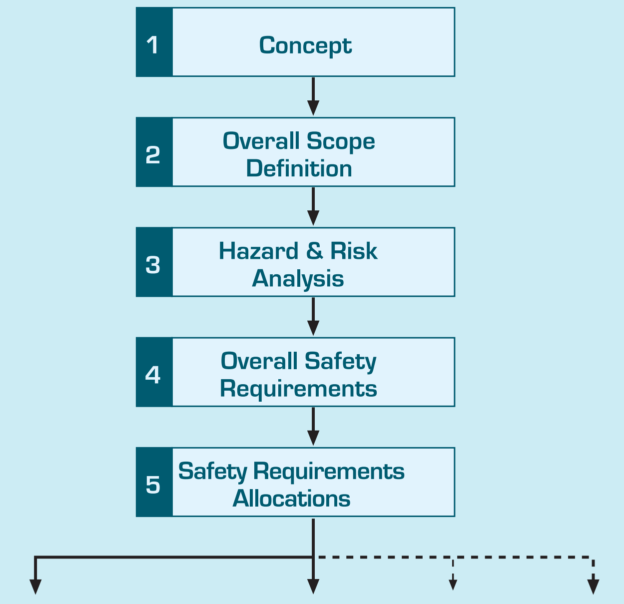


Figure 7: Analysis activities, first portion of the overall safety lifecycle.

This also includes assigning a safety integrity level (SIL) or risk reduction factor required for each safety function (SIF).

These first phases are shown in Figure 7. The safety life cycle continues with the realization activities as shown in Figure 8. The safety systems must be designed to meet the target safety integrity levels as defined in the risk analysis phase. This requires that a probabilistic calculation be done to verify that the design can meet the SIL (either in demand mode or continuous mode). The system must also meet detailed hardware and software implementation requirements given in Parts 2

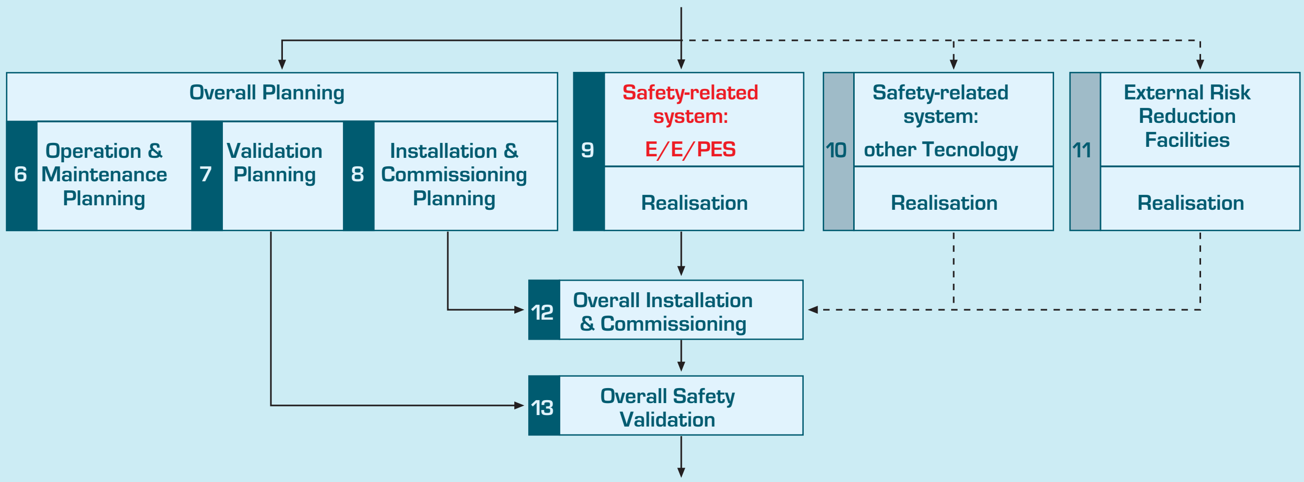


Figure 8: Realization activities in the overall safety lifecycle.

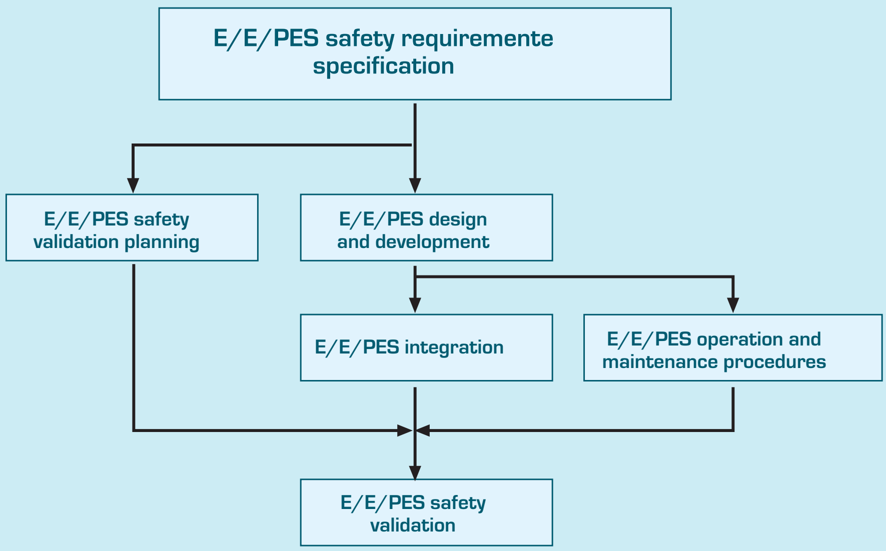


Figure 9: E/E/PES safety lifecycle (IEC 61508, Part 2).

and 3. One of the most significant is the "Safe Failure Fraction" (SFF) restriction.

2.6.3 Hazard & Risk Analysis

One of the goal of process plant design is to have a facility that is inherently safe. As Trevor Kletz said, " What you don't have, can't leak".

Hazard analysis consists of identifying the hazards and hazardous events.

There are numerous techniques that can be used (e.i. HAZOP, Fault Tree, Checklist, etc.). Risks assessment consists of a classification of risk of the hazardous events that have been identified in the hazard analysis. Risk is a function of the frequency, or probability, of an event, and the severity, or consequences, of the event. Risks may inpact personnel, production, capital equipment, the environment, company image, etc.

For all safety instrumented functions (SIF) the level of performance required needs to be determined. The standard refer to safety integrity level (SIL). These SIL levels are not directly a measure of process risk, but rather a measure of the safety instrumented system performance required in order to control the risk identified earlier to an acceptable level.

2.6.4 Operation & Maintenance Phases

There is a more detailed subsection of the overall lifecycle called the E/E/PE lifecycle, which details the activities in box 9 above.

This E/E/PE lifecycle is shown in Figure 9 (page 289) and 12 (page 297).

These activities are detailed in Part 2 of the IEC 61508 standard.

The final operation of the overall safety lifecycle are shown in Figure 10.

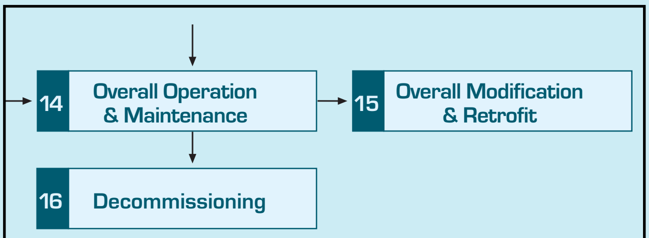


Figure 10: Operation and Maintenance phases of the overall safety lifecycle.

In summary, the safety lifecycle generally lays out the different activities required to achieve functional safety and compliance with the standard. It also should be noted that if all of the "shall be…" and "must…" conditions are met, other safety lifecycle variations also are fully compliant with the standard.

2.6.5 Process Control Vs. Safety control

The HSE study finally strongly recommend that the control and protection systems, provided for a process, must be separated.
Process control systems are active and dynamic, therefore most faults are inherently self-revealing.
Safety systems are passive or dormant, therefore many faults are not self-revealing. Safety systems require either manual testing or effective self-diagnostics, many general purpose control systems do not incorporate this very effectively.
Control systems are designed to allow relatively easy access so operators can make the frequent changes that are required. Safety systems, however, require strict security procedures and access control in order to prevent inadvertent changes.
The control system, or any changes made to it, must not prevent the safety system from functioning properly.
The design of safety systems requires following strict and conservative design requirements. Analysis, documentation, design, operation, maintenance, and management of change procedures all require extra effort for safety systems.
Implementing both control and safety in one system means that the extra effort must be applied to the entire control system.

2.6.6 Protection Layers

Accident rarely have a single cause.
Accidents are usually a combination of rare events that people initially assumed were independent and would not happen at the same time.
The Figure 10-1, the onion diagram, it shows how there are various safety layers, some of which are prevention layers, other which are mitigation layers.
Risk is a function of probability of an event and its severity. Multiple safety layers in any facility are designed to reduce one or the other. Prevention layers are implemented to reduce the probability of a hazardous event from ever acuring.
Mitigation layers are implemented to reduce the consequences once the event has already happened.
However, in reality, the layers are not solid but with holes like a Swiss cheese.
The holes are caused by flaws due to management, engineering, operations, maintenance and other errors.
Not only are there holes in each layer, the holes are constantly moving, growing, and shrinking, as well as appearing and disappearing. If the holes line up properly a failure can easily propagate through all of them.

2.6.6.1 Layer 1: Process Plant Design

The process plant must be designed with safety in mind. This is why HAZOP (HAZard and OPerability) and other safety reviews are performed. An inherently safer systems may have a higher initial cost, but they offer a lower cost of ownership over the life of any project.
Reducing hazards often results in simpler design, which may in itself reduce risk.

2.6.6.2 Layer 2: Process Control System

The process control system is the next layer of safety. It control the plant for optimum energy use, production quality, it attempts to keep variables like pressure, temperature, level, flow, etc. within safe bounds, therefore it can be considered a safety layer. However a control system

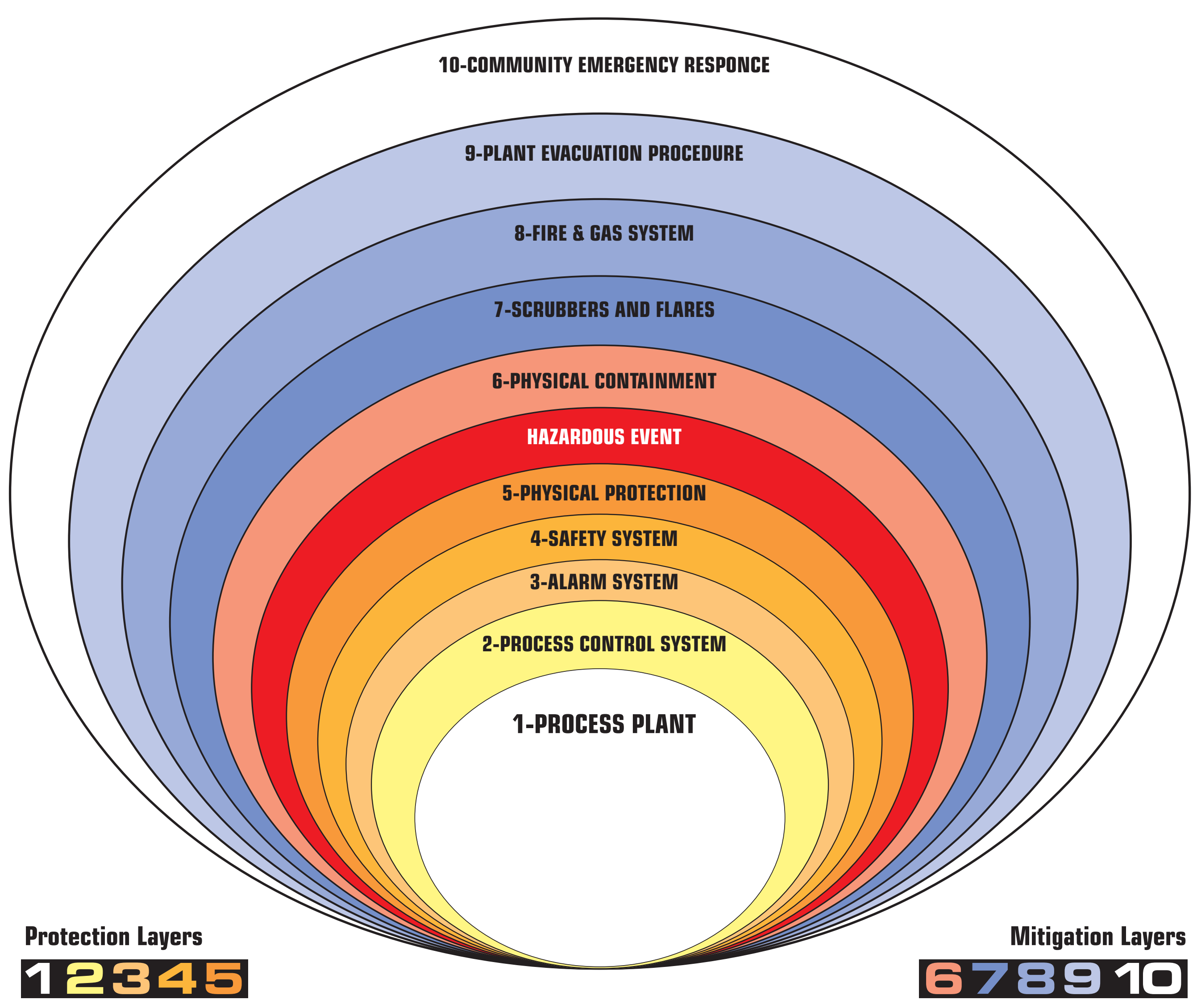


Figure 11: Protection Layers.

failure may also initiate a hazardous event, or an operator error.

Experience has shown that humans make poor monitors of automated systems. Lower alertness and vigilance can lead to a complacency on automated systems.

2.6.6.3 Layer 3: Alarm System

Alarm and monitor systems should:

1. Detect problems as soon as possible, at a level low enough to insure action can be taken before hazardous conditions are reached.
2. Be independent of the device they are monitoring (i.e., they should not fail if the system they are monitoring fails).
3. Add as little complexity as possible.
4. Be easy to maintain, check and calibrate.

Alarm and monitoring systems are considered to be the safety layer where people get actively involved. Operators are generally be required in plants because not everything can be automated. But human reliability can fail.

Accidents have occurred because:

1. Operators did not believe rare events were real or genuine.
2. Operators were overload with information, and fail to act.

When faced with life threatening situations, requiring decision within one minute, people tend to make the wrong decisions 99% of the time.

This was determined from actual studies. During emergencies, people are about the worst thing to rely on, no matter how well trained they may be.

2.6.6.3.1 Operating and Maintenance Procedures

Some might consider operating and maintenance procedures as protection layers. This is a rather controversial subject. Inspection to detect corrosion and degradation of a vessel, procedures limiting the operation of a unit to below its safety limits may help prevent accidents. However, all procedures will be violated at some point (intentionally or not).

With the push for cost and manpower reductions, procedure that are possible today may not feasible in the future.

If procedures are to be accounted for as a protection layer they need to be documented, people need to be trained to follow them, and their use must be audited.

2.6.6.4 Layer 4: Shutdown-Interlock-Instrumented System (Safety - Related Instrumented System - SIS)

If the control system and the operators fail to act, the automatic shutdown systems take action.

These systems are usually completely separate, with their own sensors, logic system and final elements.

These systems are designed to:

1. Permit a process to move forward in a safe manner when specified conditions allow, or
2. Automatically take a process to a safe state when specified conditions are violated, or
3. Take action to mitigate the consequences of an industrial hazard.

These systems require a higher degree of security to prevent inadvertent changes and tampering, as well as a greater diagnostics.

It is important to distinguish between SIF and SIS. A SIF refer to a single function like pressure shutdown, or low level shutdown.

A SIS refers to all the combined functions that make up the overall system.

2.6.6.5 Layer 5: Physical Protections

Relief valve and rupture discs are one means of physical protection to prevent an overpressure condition.

While this may serve to prevent a pressure vessel from exploding, venting material may result in a secondary hazardous event (i.e., release of a toxic material) or to an environmental violation.

In spite of all the Protection Layers we may have Uncontrolled Damaging Events.

Mitigation layers

Mitigation layers are implemented to reduce the consequences once the event has already happened. They may contain, disperse or neutralize the release.

2.6.6.6 Layer 6: Containment Systems (Physical Protections)

If an atmospheric storage tank were to burst, dikes could be used to contain the release. However, holding process fluids within dikes may results in a secondary hazards.

2.6.6.7 Layer 7: Scrubbers and Flares

Scrubbers are designed to neutralize a release. Flares are designed to burn off excess material. Note that Bhopal had both systems, yet both were not functioning during the maintenance phase the plant was at that time.

2.6.6.8 Layer 8: Fire an Gas System (F&G)

A F&G system is composed of sensors, logic solver, and final elements designed to detect combustible gas, toxic gas, or fire and to provide an alarm condition, to bring the process to a safe state, and take action to mitigate the consequences of the hazardous event.

Sensors may consist of heat, smoke, flame, and or g

as detectors, along with manual boxes.

Logic systems may consist of PLCs, DCS, safety PLCs or special purpose PLCs.

Final elements may consist of flashing/strobe lights, sirens, telephone notification system, exploding squibs, deluge systems, and or process shutdown.

Major difference between process shutdown system and F&G system is that shutdown systems are normally energized and de-energize on trip action.

The F&G systems are normally de-energized and energize to take action.

The reasons are quite simple.

The shutdown systems are designed to bring the plant to a safe state stopping production.

Nuisance trip (i.e. stopping production when nothing is actually wrong) is not catastrophic in terms of safety.

Spurious operation of a F&G system can result even in deaths (i.e., unannounced CO2 dump in a control room).

2.6.6.9 Layer 9: Plant Evacuation Procedure

In the event of catastrophic release, evacuation procedures are used to evacuate plant personnel from the area. If necessary using sirens and masks.

2.6.6.10 Layer 10: Community Emergency Response

These procedures must be carefully discussed with local authorities and let the community aware of the potential risk.

A siren was used at Bhopal to warm citizens nearby.

However, it had the unintended effect of attracting nearby residents rather than repelling them.

In general, the more safety layers, the better. Combining to much functionality in any one single layer may actually have the detrimental effect of degrading safety.

However, the best defense is to remove the hazard during the initial design phase.

2.7 FUNCTIONAL SAFETY ASSESSMENT

Part 1 of IEC 61508 describes the functional safety assessment activities required by the standard.

The objective of the assessment is to investigate and arrive at a conclusion regarding the level of safety achieved by the safety-related system. The process requires that one or more competent persons be appointed to carry out a functional safety assessment.

These individuals must be suitably independent of those responsible for the functional safety being assessed, depending on the SIL and consequences involved. These requirements are shown in Tables 1 and 2.

The functional safety assessment shall include all phases of the safety lifecycles.

The assessment must consider the lifecycle activities carried out and the outputs obtained.

The assessment may be done in parts after each activity or group of activities.

The main requirement is that the assessment be done before the safety-related system is needed to protect against a hazard.

Table 1

Assessement independence level as a function of consequence.

Minimum level of	Consequence			
Indepedence	A	B	C	D
Indepedence	HR	HR1	NR	NR
Indepedence department	-	HR2	HR1	NR
Indepedence organization	-	-	HR2	HR

Typical consequence could be:

Consequence A - minor injury (for example temporary loss of function);

Consequence B - serious permanent injury to one or more persons; death to one person;

Consequence C - death to several people;

Consequence D - very many people killed.

Abbreviations - HR = highly recommended. NR = not recommended.

Table 2

Assessment independence level for E/E/PE and software life cycle activities.

Minimum level of independence	Safety Integrity Level			
	1	2	3	4
Indepedence person	HR	HR1	NR	NR
Indepedence department	-	HR2	HR1	NR
Indepedence organization	-	-	HR2	HR

The functional safety assessment must consider:

1. All work done since the previous functional safety assessment;
2. The plans for implementing further functional safety assessments;
3. The recommendations of the previous assessments including a check to verify that the changes have been made.

The functional safety assessment activities shall be consistent and planned.

The plan must specify the personnel who will perform the assessment, their level of independence, and the competency required.

The assessment plan must also state the scope of the assessment, outputs of the assessment, any safety bodies involved, and the resources required.

At the conclusion of the functional safety assessment, recommendations shall indicate acceptance, qualified acceptance, or rejection.

2.8 SAMPLE OF DOCUMENTATION STRUCTURE

IEC 61508 does not specify a particular documentation structure. Users have flexibility in choosing their own documentation structure as long as it meets the criteria described in the standard. An example set of documents for a safety lifecycle project is shown in Table 3.

Personnel Competency (Annex B) IEC 61508 specifically states, “All persons involved in any overall, E/E/PES or software safety lifecycle activity, including management activities, should have the appropriate training, technical knowledge, experience and qualifications relevant to the specific duties they have to perform.”

It is suggested that a number of things be considered in the evaluation of personnel.

These are:

1. engineering knowledge in the application;
2. engineering knowledge appropriate to the technology;
3. safety engineering knowledge appropriate to the technology;
4. knowledge of the legal and safety regulatory framework;
5. the consequences of safety-related system failure;
6. the assigned safety integrity levels of safety functions in a project;
7. experience and its relevance to the job.
   The training, experience, and qualifications of all persons should be documented.

Table 3

Documentation Example.

Safety Lifecycle Phase	Information
Safety requirements	Safety Requirements Specification (safety functions and safety integrity);
E/E/PES validation	Validation Plan;
E/E/PES design and development	
E/E/PES architecture	Architecture Design Description (hardware and software);
Hardware architecture	Hardware Architecture Description;
Hardware module design	Detail Design Specification (s);
Components construction and/or procurement	Hardware modules; Report (hardware modules test);
Programmable electronic integration	Integration Report;
E/E/PES operation and maintenance procedures	Operation and Maintenance; Instruction;
E/E/PES safety validation E/E/PES modification	Validation Report; E/E/PES modification procedures; Modification Request; Modification Report; Modification Log;
Concerning all phases	Safety Plan; Verification Plan and Report; Functional Safety Assessment; Plan and Report;

2.9 HARDWARE REQUIREMENT IN THE IEC 61508 STANDARD

IEC 61508 Part 2 covers specific requirements for safety-related hardware.

As in other parts of the standard, a safety lifecycle is to be used as the basis of requirement compliance. (Figure 9 shows the general safety lifecycle model.)

The hardware safety life cycle is an expanded plan for Phase 9 of the overall safety lifecycle from Part 1 that is focused on the design of the control hardware for safety systems.

As for the overall safety lifecycle, there are requirements for a functional safety management plan and safety requirements specification including all verification and assessment activities.

One particular aspect of the hardware design and development requirements (Clause 7.4) is the limit on the safety integrity level achievable by any particular level of fault tolerant safety redundancy.

These are shown in Tables 4 and 5 (Page 297) for various fractions of failures leading to a safe state (SFF).

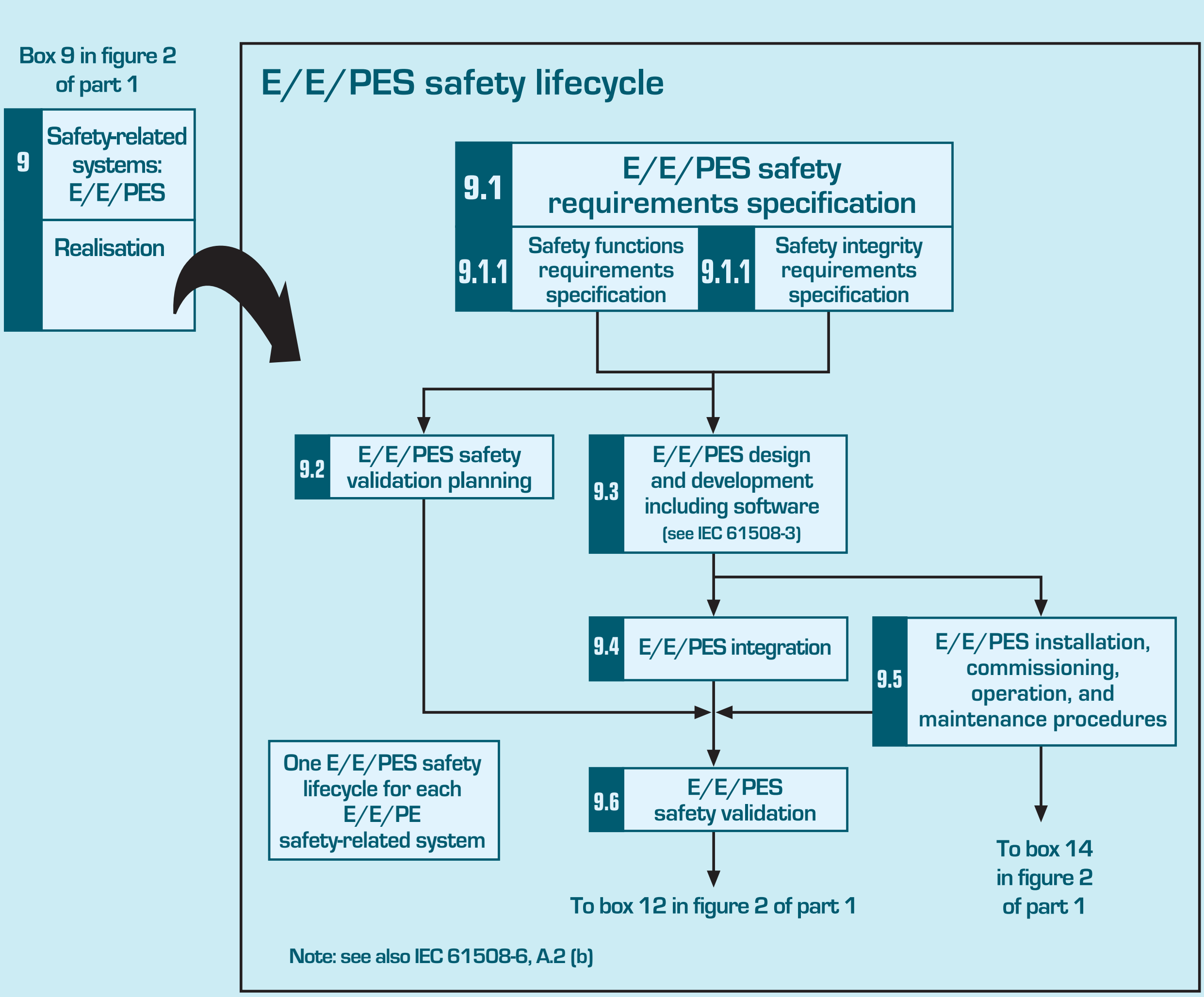


Figure 12 Hardware safety lifecycle.

Table 4

Type A Safe Failure Fraction chart.

Safe failure fraction	Hardware fault tolerant		
	0	1	2
< 60%	SIL1	SIL2	SIL3
60% - < 90%	SIL2	SIL3	SIL4
90% - <99%	SIL3	SIL4	SIL4
≥99%	SIL3	SIL4	SIL4

Note1: a hardware fault tolerance of N means that N+1 faults could cause a loss of the safety function.

Table 5

Type B Safe Failure Fraction chart.

Safe failure fraction	Hardware fault tolerant See Note1		
	0	1	2
< 60%	Not allowed	SIL1	SIL2
60% - < 90%	SIL1	SIL2	SIL3
90% - <99%	SIL2	SIL3	SIL4
≥99%	SIL3	SIL4	SIL4

Note1: a hardware fault tolerance of N means that N+1 faults could cause a loss of the safety function.

Type A components are described as simple devices with well-known failure modes and a solid history of operation.

Type B devices are complex components with potentially unknown failure modes, i.e., microprocessors, ASICs, etc.

Table 4 and 5 reprepsent limits on the use of single or even dual architectures in higher SIL levels. This is appropriate based on the level of uncertainty present in the failure data as well as in the SIL calculations themselves. (See Pages 318 - 320 - 321).

Note: the separate phase specifically devoted to integrating the software and the hardware before validating the safety of the combined system (as described in Clause 7.5). Operation and maintenance procedures and documentation are described in Clause 7, 6 while validation, modification, and verification phase details are provided in the remaining parts of Clause 7.

Control of Failures during Operation (Annex A).
This Annex limits claims that can be made for self diagnostic capabilities and also recommends methods of failure control. Numerous types of failures are addressed including random, systematic, environmental, and operational failures. It should be noted that following these methods does not guarantee that a given system will meet a specific SIL level.

Avoidance of Systematic Failures during Different Phases of the lifecycle (Annex B).
Here, numerous tables present recommended techniques for different lifecycle phases to achieve different SILs. Again, simply using these techniques does not guarantee a system will achieve a specific SIL level.

Diagnostic Coverage and Safe Failure Fraction (Annex C).
Here, a basic procedure is described for calculating the fraction of fail ures that can be self-diagnosed and the fraction that result in a safe stat. Before proceeding with the other Parts 3 of IEC 61508 it is recommended to briefly read the few basic metrics, and some simple consideration on the IEC 61508 application, presented at Chapter 9 (Page 313-328).

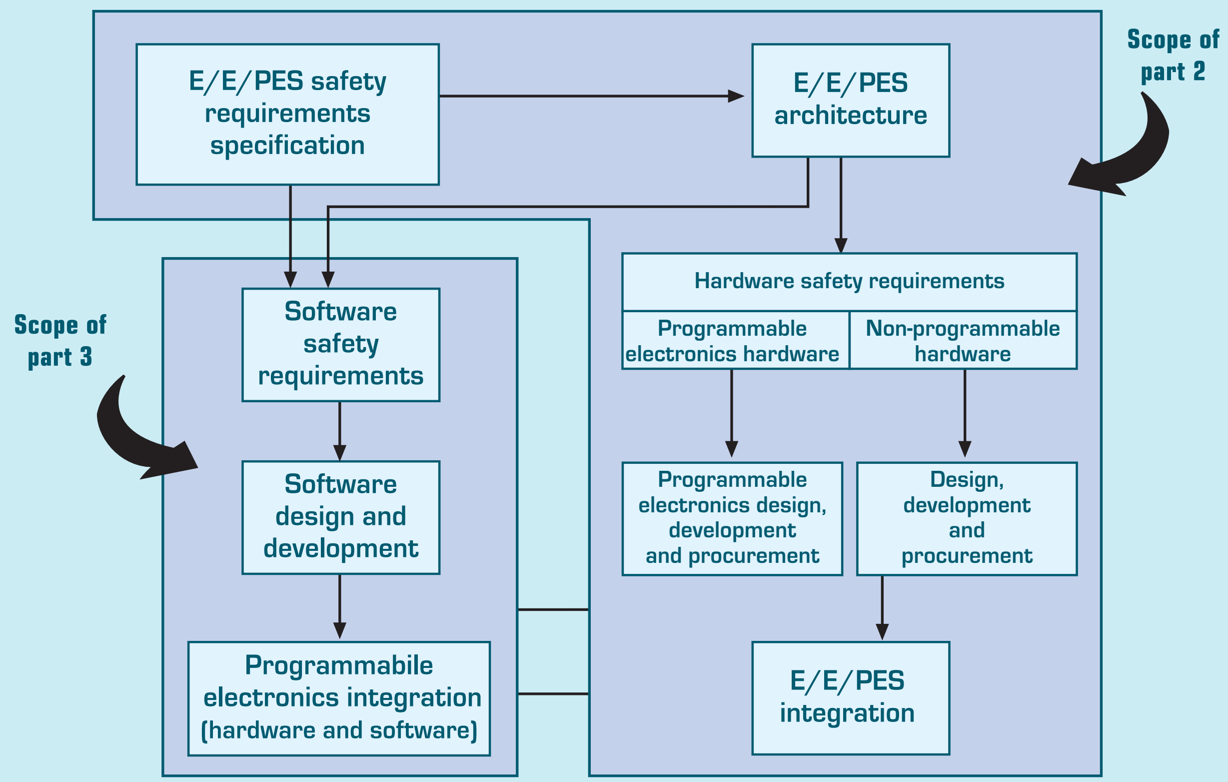


Figure 13 Software requirements.

3.0 PART 3 OF IEC 61508: SOFTWARE REQUIREMENTS

IEC 61508 Part 3 covers requirements for safety-related software.

As in other parts of the standard, a safety lifecycle is to be used as the basic of requirement compliance.

The software safety lifecycle is an expanded plan of phase 9 of the overall safety lifecycle from Part 1 and is closely linked with the hardware lifecycle.

As for the overall safety lifecycle, there are requirements for a functional safety management plan and safety requirements specifications, including all variation and assessment activities.

The functional safety here is addressed in the context of a software quality management system (QMS) in Clause 6.

A detailed functional safety plan is presented as part of this QMS, As in other parts of the standard, the same key features of change management, demonstration, and documentation are present.

3.1 SOFTWARE FUNCTIONAL SAFETY PLAN (Clause 6)

A software functional safety plan (either as a part of other documentation or as a separate document) shall define the strategy of the software procurement, development, integration, verification, validation, and modification as required for the SIL level of the safety-related system. The plan must specify a configuration management system, and this system must:

1. Manage software changes to ensure that the specified requirements for software safety are satisfied.
2. Guarantee that all necessary activities have been carried out to demonstrate that the required software safety integrity has been achieved.
3. Accurately maintain all documentation and source code including the safety analysis and requirements; software specification and design documents; software source code modules; test plan and results; commercial off the shelf (COTS) and pre-existing software components which are to be incorporated into the E/E/PE safety-related system; all tools and development environments which are used to create or test, or carry out any action, on the software of E/E/PE safety-related system.
4. Prevent unauthorized modifications.
5. Document modification/change requests.
6. Analyze the impact of a proposed modification.
7. Approve or reject the modification request.
8. Establish baseline software and document the (partial) integration testing that justifies the baseline.
9. Formally document the release of safety-related software.

Master copies of the software and all documentation should be maintained throughout the operational lifetime of the released software.

3.2 SOFTWARE SAFETY LIFECYCLE (Clause 7)

IEC 61508 has a considerable but appropriate number of requirements for safety critical software put forth in the details of the software safety life cycle framework.

The major phases of the software safety life cycle are shown in Figures 13-14.

Part 3 requires that a process (such as the safety life cycle) for the development of software shall be selected and specified during safety planning. Note that the exact process is not specified, it may be customized according to company preference. Appropriate quality and safety assurance procedures must be included. Each step of the software safety life cycle must

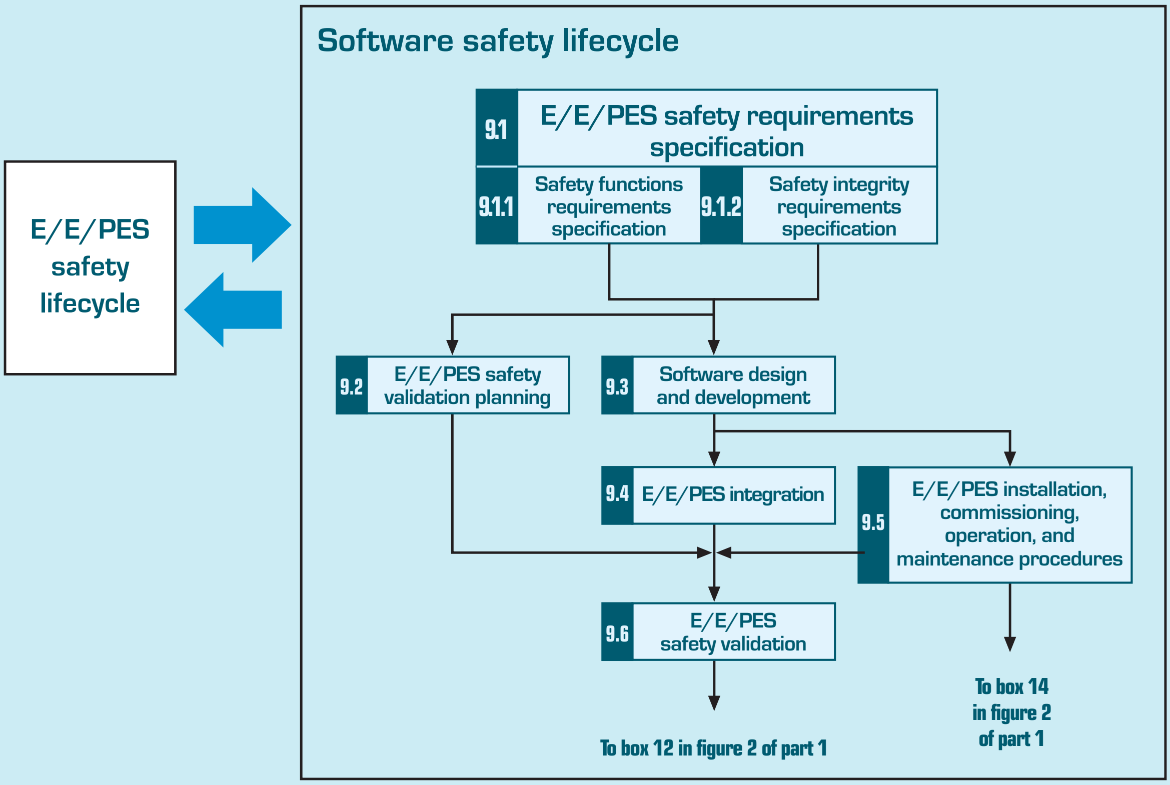


Figure 14 Software safety lifecycle.

be divided into elementary activities with the functions, inputs, and outputs specified for each phase. The standard has complete details of an example software safety life cycle.

During each step of process, appropriate "techniques and measures" must be used.

Part 3, Annexes A and B give recommendations from a list of software techniques. The standard says, "If at any stage of the software safety life cycle, a change is required pertaining to an earlier life cycle phase, then that earlier safety life cycle phase and the following phases shall be repeated".

3.3 SOFTWARE SAFETY REQUIREMENTS SPECIFICATION (Clause 7.2)

The functional safety requirements for software must be specified. This can be done in a separate document or as part of another document.

The specification of the requirements for software safety shall be derived from the specified safety requirements of the safety-related system and any requirements of safety planning. The requirements for software safety shall be sufficiently detailed to allow design and implementation and to allow a functional safety assessment.

The software developers should review the document to verify that it contains sufficient detail. It should be noted that this is often another iterative process.

The requirements must be clear, precise, verifiable, testable, maintainable, and feasible.

The requirements must also be appropriate for the safety integrity level and traceable back to the specification of the safety requirements of the safety-related system.

Terminology must be clear and understandable by those using the document.

All modes of operation for the safety-related system must be listed.

The requirements must detail any relevant constraints between the hardware and the software. Since the software is often called upon to perform much of the online diagnostics, the requirements must detail all software self-monitoring, any diagnostic tests performed on the hardware, periodic testing of critical functions, and means of online testing of safety functions.

If the software also performs non-safety functions, means to insure that the software safety is not compromised (non-interfering) must also be specified.

3.4 SOFTWARE SAFETY VALIDATION PLANNING (Clause 7.3)

A plan must be set up to demonstrate that the software satisfies the safety requirements set out in the specification.

A combination of analysis and testing techniques is allowed and the chosen techniques must be specified in the plan.

The plan must consider:

1. Required equipment.
2. When validation will be done.
3. Who will do the validation.
4. The modes of operation to be validated including start up, teach, automatic, manual, semi-automatic, steady state of operation, re-set, shut down, and maintenance.
5. Reasonably foreseeable abnormal conditions.
6. Identification of the safety-related software that needs to be validated.
7. Specific reference to the specified requirements for software safety.
8. Expected results and pass/fail criteria.

The plan must show how assessment will be done, who will review the plan, and the assessor's level of independence.

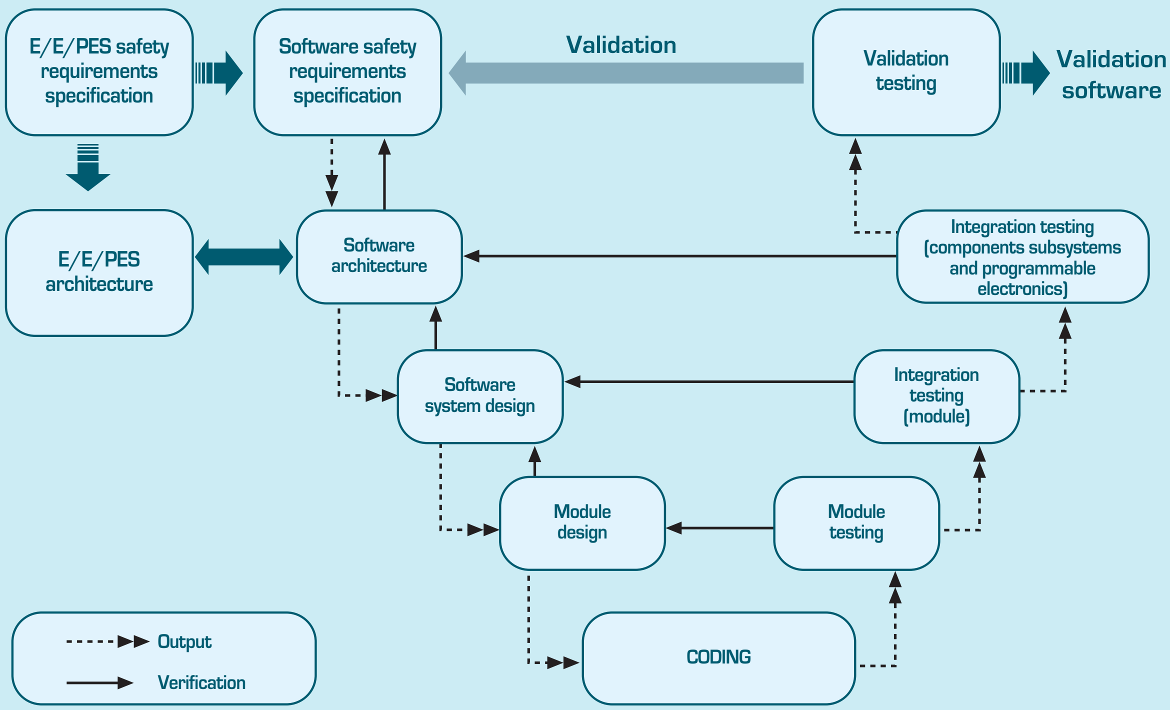


Figure 15 Software safety validation.

3.5 SOFTWARE DESIGN AND DEVELOPMENT (Clause 7.4)

Design methods shall be chosen that support abstraction, modularity, information hiding, and other good software engineering practices.

The design method shall allow clear and un ambiguous expression of functionality, data flow, sequencing, and time-dependent data, timing constraints, concurrency, data structures, design assumptions, and their dependencies.

During design, the overall complexity of the design, its testability, and the ability to make safe modifications shall be considered.

The entire design is considered safety-related even if non-safety functions are included unless sufficient independence between safety and non-safety can be demonstrated.

If different safety integrity levels are part of the design, the overall design is only valid for the least stringent SIL of the component parts.

The design must include software functions to execute proof tests and all online diagnostic tests as specified in the requirements.

Software diagnostics shall include monitoring of control flow and data flow.

The architectural design defines the major components and subsystems of the software.

The architectural design description must include:

1. Interconnections of these components.
2. The "techniques and measures" necessary during the software safety life cycle phases to satisfy requirements for software safety at the required safety integrity level including software design strategies for fault tolerance and/or fault avoidance (redundancy/diversity).
3. The software safety integrity level of the subsystem/component;
4. All software/hardware interactions and their significance;
5. The design features for maintaining the safety integrity of all data;
6. Software architecture integration tests to ensure that the software architecture satisfies the requirements for software.

It is assumed and permitted that iteration occurs between the design and the requirements phases. Any resulting changes in requirements must be documented and approved. Support tools and programming languages must meet the safety integrity needs of the software. A set of integrated tools, including languages, compilers, configuration management tools, and, when applicable, automatic testing tools, shall be selected for the required safety integrity level.

Detailed design and coding shall follow the software safety life cycle. Coding standards shall be employed and must specify good programming practice, prohibit unsafe language features, and specify procedures for source code documentation including:

1. Legal entity.
2. Description.
3. Inputs and outputs.
4. Configuration management history.

   The software code must be:

1. Readable, understandable, and testable.
2. Able to satisfy the specified requirements.
3. Reviewed.
4. Tested as specified during software design.

3.6 INTEGRATION AND TESTING (Clause 7.5)

Tests of the integration between the hardware and software are created during the design and development phases and specify the following:

1. Test cases and test data in manageable integration sets.
2. Test environment, tools, and configuration.
3. Test criteria;
4. Procedures for corrective action on failure of test. The integration testing results shall state each test and the pass/fail results.

3.7 SOFTWARE SAFETY VALIDATION (Clause 7.7)

Software validation is done as an overall check to insure that the software design meets the software safety requirements and must include the appropriate documentation.

The validation may be done as part of overall system validation or it may be done separately for the software.

Testing must be the primary method of validation with analysis used only to supplement.

All tools used in the validation must be calibrated and an approved quality system must be in place. If validation is done separately for the software, the validation must follow the software safety validation plan. For each safety function, the validation effort shall document:

1. A record of the validation activities.
2. The version of the software safety validation plan.
3. The safety function being validated with reference to planned test.
4. Test environment (tools and equipment).
5. The results of the validation activity with discrepancies, if any.

If discrepancies occur, a change request must be created and an analysis must be done to determine if the validation may continue.

3.8 OPERATION AND MODIFICATION (Clauses 7.6 and 7.8)

Software modification requires authorization under the procedures specified during safety planning and must insure that the required safety integrity level is maintained. This authorization must address:

1. The hazards that may be affected.
2. The proposed change.
3. The reasons for change.

   The modification process starts with an analysis on the impact of the proposed software.

Modification on functional safety. The analysis will determine how much of the safety life cycle must be repeated.

3.9 SOFTWARE VERIFICATION (Clause 7.9)

The software verification process tests and evaluates the results of the software safety life cycle phases to insure they are correct and consistent with the input information to those phases.

Verification of the steps used in the software safety life cycle must be performed according to the plan and must be done concurrently with design and development.

The verification plan must indicate the activities performed and the items to be verified (documents, reviews, etc.).

A verification report must include an explanation of all activities and results.

Verification must be performed on:

1. Software safety requirements.
2. Software architecture design.
3. Software system design.
4. Software module design.
5. Software source code.
6. Data.
7. Software module testing.
8. Software integration testing.
9. Hardware integration testing.
10. Software safety requirements testing (software validation).

3.10 SOFTWARE FUNCTIONAL SAFETY ASSESSMENT (Clause 9)

The software assessment process is similar to the other assessment processes in the standard.

Techniques and measures relevant to this assessment are listed in Annexes A and B as well as in Part 1 of the standard.

3.11 GUIDE TO THE SELECTION OF TECHNIQUES AND MEASURES (Annex A)

Annex A provides ten tables of different techniques relevant to the software safety requirements, software design and development, architecture design, support tools and programming languages, detailed design, software module testing, integration testing, safety validation, modification and functional safety assessment.

Different techniques are "recommended" or "highly recommended" as a function of safety integrity level required.

Some techniques are used alone or in combination with other techniques to show compliance with the standard.

3.12 DETAILED TABLES (Annex B)

Provides nine tables of detailed techniques for design and coding standards, dynamic analysis and testing, functional and black box testing, failure analysis, modelling, performance testing, semi-formal methods, static analysis, and modular approaches.

These tables are also referenced in the tables from Annex A.

4.0 PART 4 OF IEC 61508: ABBREVIATIONS AND DEFINITIONS

Part 4 of the standard contains the abbreviations and definitions used throughout the entire document.

Some selected key definitions are:

Diversity - different means of performing a required function equipment under control (EUC).

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.

Harm - physical injury or damage to the health of people either directly or indirectly as a result of damage to property or to the environment.

Hazard - potential source of harm.

Limited variability language - software programming language, either textual or graphical, for commercial and industrial programmable electronic controllers with a range of capabilities limited to their application.

Redundancy - means, in addition to the means which would be sufficient, for a functional unit to perform a required function or for data to represent information.

Risk - combination of the probability of occurrence of harm and the severity of that harm.

Safety - freedom from unacceptable risk.

Safety function - function to be implemented by an E/E/PE Safety-related system, other technology safety-related system, or external risk reduction facilities which is intended to achieve or maintain a safe state for the EUC, with respect to a specific hazardous event .

Safety integrity - probability of a safety-related system satisfactorily performing the required safety functions under all the 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.

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-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.

Systematic failure - failure related in a deterministic way to a certain cause, which can only be eliminated by a modification of the design or of the manufacturing process, operational procedures, documentation, or other relevant factors.

Tolerable risk - risk which is accepted in a given context based on the current values of society.

5.0 PART 5 OF THE IEC 61508: Examples of Methods for the Determination of Safety Integrity Levels (Informative)

Part 5 is primarily composed of Annexes A through E which describe key concepts as well as various methods of SIL selection and verification.

5.1 RISK AND SAFETY INTEGRITY – GENERAL CONCEPTS (Annex A)

This annex describes the required safety actions to bridge the gap between the current level of risk present in the system and the level that can be tolerated in the given situation.
This necessary risk reduction is noted to include contributions from E/E/PE safety-related systems, other safety-related systems, and external risk reduction methods.
Elements of safety integrity relating to both the hardware and the overall systematic safety integrity are sometimes difficult to assess.
This is part of the basis for SIL only referring to the order of magnitude of risk reduction for a safety-related system.

5.2 ALARP AND TOLERABLE RISK CONCEPTS (Annex B)

Annex B describes the concept of a finite level of tolerable risk based on the benefits derived from undertaking that risk in the context of the norms of society. It further describes the reduction of existing risk to a level "As Low As Reasonably Practicable" or ALARP.
This level again takes into account the benefits derived from the risk as well as the costs to reduce the risk even further.

ALARP ZONE OR TOLERABLE RISK
(As Low As Reasonably Practicable)

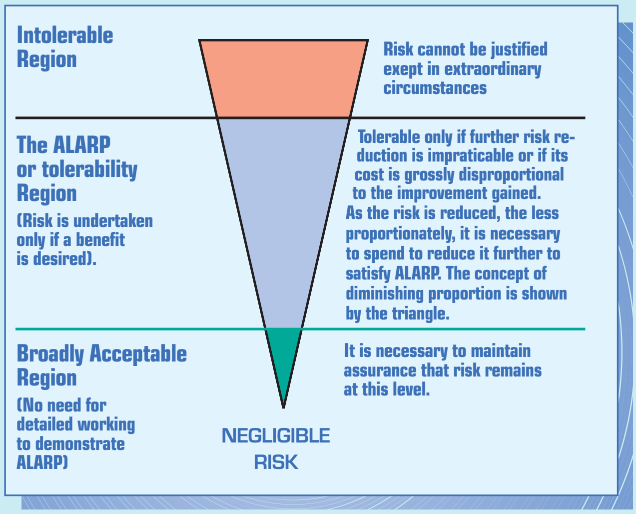


Figure 16 Alarp zone or tolerable risk.

Accidents are usually a combination of rare events that people initially assume were independent and would not happen at the same time.
One method of protection is to implement multiple, diverse safety layers.
This makes it harder for any one initiating event to propagate through all the layers culminating in a hazardous event.

Reducing risk with multiple protection layers

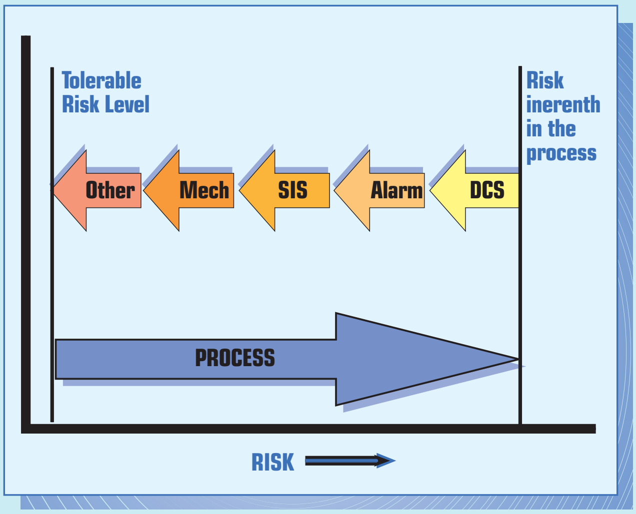


Figure 16 - 1
Reducing risk with multiple protection layers.

5.3 DETERMINATION OF SAFETY INTEGRITY LEVELS – A QUANTITATIVE METHOD (Annex C)

This quantitative method presented is based on calculating a frequency of a hazard and the magnitude of its consequences to determine the difference between the existing risk and the tolerable risk. First the frequency of the initiating event is determined based on either local operating experience, failure rate database references for similar equipment in similar environments, or detailed analytical estimation. Then the probabilities that the initiating event will actually lead to the hazard are determined and combined with the initiating event to determine a hazard frequency. In parallel, the consequence of the hazard is calculated. Finally, the frequency and consequence of the hazard are assessed relative to the tolerable risk and a SIL is selected to bridge any gap.

5.4 DETERMINATION OF SAFETY INTEGRITY LEVELS – A QUALITATIVE METHOD: RISK GRAPH (Annex D)

This method assigns a category to both the frequency and severity of a hazard to assess the risk relative to the tolerable level.
Some allowance is made for the likelihood that a given initiating event will not always lead to the potential hazard.

5.5 DETERMINATION OF SAFETY INTEGRITY LEVELS – A QUALITATIVE METHOD: HAZARDOUS EVENT SEVERITY MATRIX (Annex E)

This method is similar to the risk graph except that the form follows a matrix rather than a sequential graph.

6.0 PART 6 OF THE IEC 61508: Guidelines in the Application of Parts 2 and 3 (Informative)

Part 6 provides more detailed explanations and examples on how to comply with Parts 2 and 3 and also is made up almost entirely of Annexes.

6.1 APPLICATION OF PARTS 2 AND 3 (Annex A)

This annex shows flow charts of the expected implementation of both Part 2 (Hardware) and Part 3 (Software) and provides an overview of the requirements.

6.2 EXAMPLE TECHNIQUE FOR EVALUATING PROBABILITIES OF FAILURE (Annex B)

This annex provides an example of evaluating probabilities of failure with many tables showing results for particular architectures for selected values of diagnostic coverage and common cause beta factors (factors assessing the likelihood of a common cause failure).
The methods used for these calculations are approximation formulas based on reliability block diagrams. These methods consider the hardware train of field sensor, logic box, and final control element and address various architecture configurations.

6.3 CALCULATION OF DIAGNOSTIC COVERAGE: WORKED EXAMPLE (Annex C)

This annex covers the Failure Modes, Effects, and Diagnostics Analysis (FMEDA) technique for calculating diagnostic coverage factor.

6.4 A METHODOLOGY FOR QUANTIFYING THE EFFECT OF HARDWARE-RELATED COMMON CAUSE FAILURES IN MULTI-CHANNEL PROGRAMMABLE ELECTRONIC SYSTEMS (Annex D)

This annex explains the important phenomenon of common cause failures in redundant systems. A chart is provided along with a method of estimating the beta factor (factor assessing the likelihood of a common cause failure) to be used in subsequent calculations.

6.5 EXAMPLE APPLICATION OF SOFTWARE SAFETY INTEGRITY TABLES OF PART 3 (Annex E)

This annex provides an example of how to use the software safety integrity level tables of Part 3. Twenty tables are provided with detailed examples of a SIL2 ladder logic program with PLC hardware and a SIL3 full pre-coded complex plant system.

7.0 PART 7 OF THE IEC 61508: Overview of Techniques and Measures (Informative)

Part 7 provides descriptions and an explanation of the many engineering techniques presented earlier in the standard.

7.1 OVERVIEW OF TECHNIQUES AND MEASURES FOR E/E/PES: CONTROL OF RANDOM HARDWARE FAILURES (Annex A)

This annex addresses random hardware failures. It contains methods and techniques useful to prevent or maintain safety in the presence of component failures.
The explanations provided here support many of the recommended techniques listed in the hardware tables in Part 2.

7.2 OVERVIEW OF TECHNIQUES AND MEASURES FOR E/E/PES: AVOIDANCE OF SYSTEMATIC FAILURES (Annex B)

This annex covers the avoidance of systematic failures in both hardware and software systems and is referenced by Parts 2 and 3.
It is structured according to the safety lifecycle and addresses numerous points relevant to the key phases as noted in the annex.

7.3 OVERVIEW OF TECHNIQUES AND MEASURES FOR ACHIEVING SOFTWARE SAFETY INTEGRITY (Annex C)

This annex provides an overview of techniques for achieving high software safety integrity.
Many of these techniques fall into the detailed design phase of the lifecycle.
Architectural design issues are also addressed as well as development tools and programming languages.
The annex also addresses the verification, modification, and functional safety assessment phase of the lifecycle.

7.4 PROBABILISTIC APPROACH TO DETERMINING SOFTWARE SAFETY INTEGRITY FOR PRE-DEVELOPED SOFTWARE (Annex D)

The annex covers a probabilistic approach for SIL determination of proven software.
With many systems seeking to employ previously written software, this annex can be valuable.
It lists several tests to determine the integrity level of the software based on statistical analysis.

8.0 IEC 61511 SAFETY INSTRUMENTED SYSTEMS FOR PROCESS INDUSTRY

IEC 61511 has been developed as a Process Sector implementation of the IEC 61508.
Like IEC 61508 this standard has the two concepts, which are fundamental to its application: the safety lifecycle and the safety integrity level (SIL).
The safety lifecycle forms the central framework which links together most of the concepts in this international standard.
It is a good engineering procedure for safety instrumented systems (SIS) design.
In the safety lifecycle, process risks are evaluated and SIS performance requirements are established (availability and risk reduction).
Layers of protection are designed and analysed.
Finally, a SIS, if needed, is optimally designed to meet the particular process risk.
Safety integrity levels are order of magnitude levels of risk reduction.
There are four SIL's defined in the standard, just as in IEC 61508. SIL 1 has the lowest level of risk reduction.
SIL 4 has the highest level of risk reduction.
The standard suggests that applications which require the use of a single safety instrumented function of SIL 4 are rare in the process industry and that they shall be avoided where reasonably practicable.
The standard is primarily concerned with safety-instrumented systems for the process industry sector (sensors, logic solvers and final elements are included as part of the SIS).
It also deals with the interface between safety-instrumented systems and other safety systems in requiring that a process hazard and risk assessment be carried out.

8.1 PART 1 FRAMEWORK, DEFINITIONS, SYSTEMS, HARDWARE AND SOFTWARE REQUIREMENTS

Part 1 specifies requirements for system architecture and hardware configuration, application software, and system integration.
This includes sections on management of functional safety, safety lifecycle requirements, verification. Process hazard and risk analisis, and allocation of safety functions to protection layers.
These last two sections only contain general requirements and no detailed requirements.
Furthermore, there are sections on SIS safety requirements specification, and SIS design and engineering, and requirements for application software, including selection criteria for utility software.
This section contains a detailed safety lifecycle overview for application software.
Finally there are sections on factory acceptance testing, SIS installation and commissioning, SIS operation and maintenance, SIS decommissioning, and information requirements.
Part 1,2,3 and 4 of IEC 61508 have thus been combined into Part 1 of IEC 61511.
IEC 61511-1 have also sections on scope, references, abbreviations, and definitions (process sector specific), and conformance.
This relationship between IEC 61508 and 61511 is also defined in Part 1, as shown in figure 16. The key differences between IEC 61508 and IEC 61511 are discussed in Part 1, Annex A.

8.2 PART 2 GUIDELINES IN THE APPLICATION OF IEC 61511-1

Part 2 contains sections on scope, definitions and abbreviations (same apply as Part1), and six informative annexes. Part 2 generally contains information and guidelines on

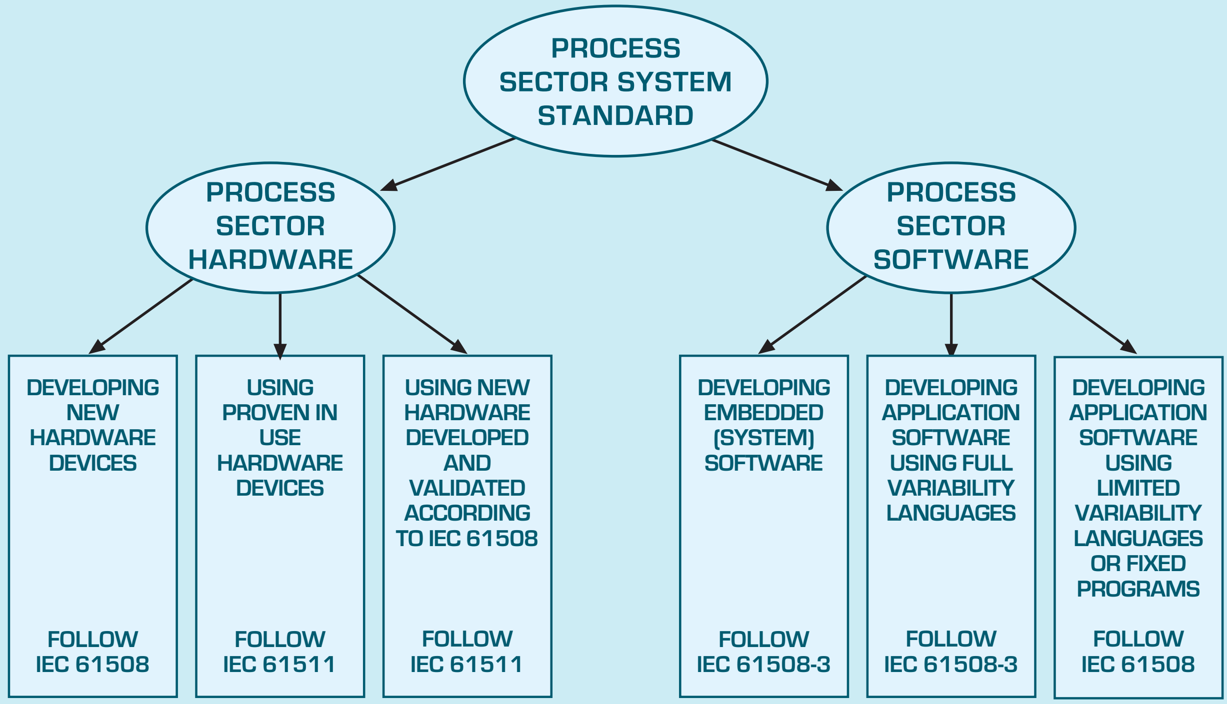


Figure 17 Process sector system standard.

IEC 61511, Part 1. Annex A gives a brief overview of the requirements of clause 5 (functional safety management), 6 (safety lifecycle requirements) and 7 (software requirements) of IEC 61511 Part 1 and sets out the functional steps in their application. In this way, this part of IEC 61511 corresponds to part 6 of IEC 61508.

Annex B refers to example techniques for calculating the probabilities of failure on demand,either from IEC 61508, Part 6 Annex B.

Annex C provides an example of the application of IEC 61511, Part 1 in a chemical company, i.e. a typical SIS architecture development.

Annex D provides three examples of the application of IEC 61511, Part1, related to various aspects of application programming. It gives information on attributes of a programming language for SIS, an example of the development of application code for a process sector programmable electronic SIS,

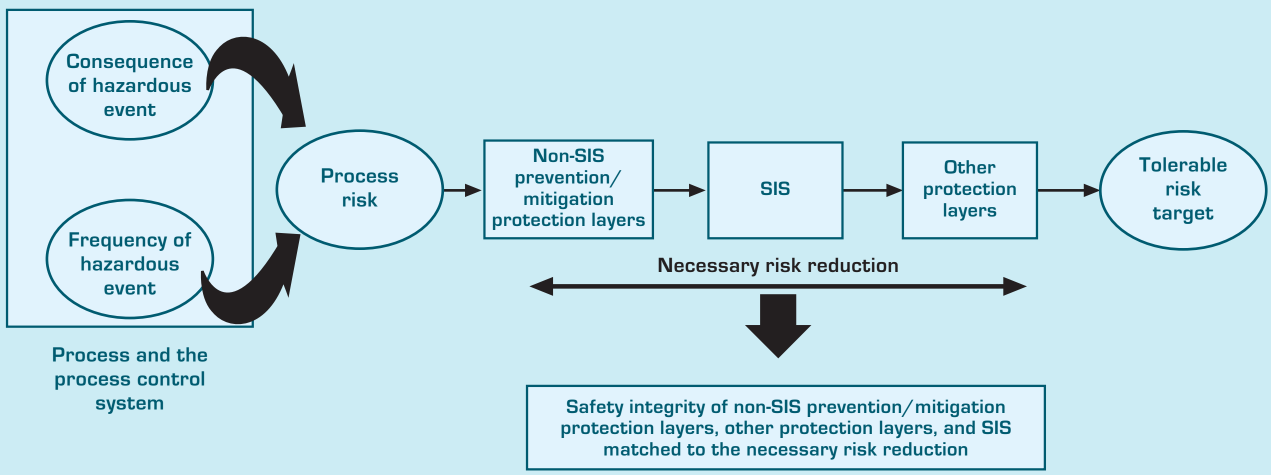


Figure 18 Guidelines in the application of hazard and risk analysis.

and an example that illustrates how a major SIS logic solver manufacturer/integrator develops safety application software for customers.
Annex E provides an example of a safety PLC manufacturer's approach in developing a programmable logic solver certified to IEC 61508 for the process sector.
Annex F contains an overview of relevant safety techniques and measures relevant to Part 1, 2 and 3 of this standard. Shortly stating, aim, description and references,of the specific technique. It only gives an overview of additional process sector references. For other techniques it refer to IEC 61508, Part 7.

8.3 PART 3 GUIDELINES IN THE APPLICATION OF HAZARD AND RISK ANALYSIS

This part of IEC 61511 contains guidelines in the area of selecting safety integrity level (SIL) in hazards and risk analysis, and in this way corresponds to Part 5 of IEC 61508.
The information is intended to provide a broad overview of the wide range of global methods used to do hazards and risk analyses.
It provides information on the underlying concepts of risk and the relationship of risk to safety integrity and number of methods that should enable the safety integrity levels for the Safety Instrumented Functions to be determined.
IEC 61511, Part 3 consists of a clause on the underlying concepts of risk and the relationship of the risk to safety integrity (general guidance), see figure 17.
Furthermore there are several informative annexes, of which Annex A covers the ALARP principle (As Low As Reasonably Practicable) and tolerable risk concepts.
Part 3, Annex B through F cover both quantitative and qualitative approaches to SIL selection.
These include a qualitative method (the Safety Matrix Method), a Calibrated risk graph (semi-qualitative), a risk graph (qualitative), and Layer Of Protection Analysis (LOPA semi-qualitative) are described. All methods have been simplified in order to illustrate the underlying principles.
The information provided is not of sufficient detail to implement any of these approaches.
Overall, IEC 61511 is considered a standard for users. Figure 17 shows that also it is expected that engineering companies and instrumentation users will find the most value from this document.

8.4 PROVEN-IN-USE ASSESSMENT

8.4.1 DEFINITION OF THE TERM PROVEN-IN-USE ACCORDING TO IEC 61508-7; B.5.4

Aim: To use field experience from different applications to prove that the safety-related system will work according to its specification.

Description: Use of components or sub-systems, which have been shown by experience to have no, or only unimportant, faults when used, essentially unchanged, over a sufficient period of time in numerous different application.

For proven by use to apply, the following requirements must have been fulfilled:

1. Unchanged specification.
2. 10 systems in different applications.
3. 100.000 operating hours and a test at least 1 year of service history.

The proof is given through documentation of a vendor and/or operating company.
This documentation must contain at least the:

1. Exact designation of the system and its component, including version control for hardware.
2. User and time of operation.
3. Operating hours.
4. Procedures for the selection of the systems and applications procedure to the proof.
5. Procedures for fault detection and fault registration as well as fault removal.

8.4.2 "Prior-use" requirements according to IEC 61511-1

According to IEC 61511-1 First Edition 2003-01 section 11.4.4 for all sub-systems (e.g. sensor, final elements and non-PE logic solver) except PE logic solvers the minimum fault tolerance specified in the table 6 of this standard may be reduced by one of the devices under consideration comply with all of the following:

1. The hardware of the device is selected on the basis of prior use (see 11.5.3).
2. The device allows adjustment of process-related parameters only, e.g., measuring range, upscale, or downscale failure direction, etc.
3. The adjustment of the process-related parameters of the device is protected, e.g., jumper, password.
4. The function has a SIL requirement less than 4.

Table 6 of IEC 61511-1 first Edition 2003-01 Minimum hardware fault tolerance of sensors and final elements and non-PE logic solvers.

Table 6 of IEC 61511-1 first Ed. 2003-01

	MHFT Minimum Hardware Fault Tolerance	MHFT Minimum Hardware Fault Tolerance
SIL	Does not Meet 11.4.4 requirements	Meets 11.4.4 requirements
1	0	0
2	1	0
3	2	1
4	Special requirements apply see IEC 61508	Special requirements apply see IEC 61508

This means that if the requirements of section 11.4.4 of IEC 61511-1 First Edition 2003-01 are fulfilled a hardware fault tolerance of 0 is sufficient for SIL 2 (sub-) systems with a SFF of 60% to < 90%.

8.5 REQUIRED INFORMATION FOR A PROVEN-IN-USE PROOF OF A SUB-SYSTEM

Following informationg are required for a proven-in-use proof of a sub-system.

1. Current version of Hardware and Software of the considered devices.
2. Number of sold devices with current version of the hardware and software.
3. Number of failures of the sold devices with current version of the hardware and software.
4. Indication of the operating hours (counted 6 months after the months the devices were sold) of the considered devices with current version of the hardware and software.
5. Indication of all currently available version of hardware and software on the market.
6. List of at least 10 different applications of the devices with current version of hardware and software.
7. Certification of the quality system.
8. Description (procedure) of how the field feed-back tracking is done.

9. Description (procedure) about the use version and configuration management system according the requirements of IEC 61508.
10. Description (procedure) about the modification process according the requirements of IEC 61508.
11. Description of the adjustment possibilities of process-related parameters of the considered devices and related protection mechanism.
12. Feature / configurations of the considered devices, which cannot be used (by the user) for safety applications.

13. Description why theses features / configurations do not interfere with the considered safety function (FMEDA).
14. Fault scenarios of the used sensor elements.

8.6 HOW TO DOCUMENT THE FUTURE SOFTWARE CHANGE IN A SUB-SYSTEM

For software modifications an impact analysis shall be carried out according IEC 61508. Type of interferences and tests to be considered are:

1. Input interference: will the input still be valid to the safety related module?
2. Temporal interference: does the change affect the routine in a way that could interfere with safety? (loops, recursion).
3. Data interference: can the change alter or corrupt safety critical data? (shared memory, pointers).
4. Code interference: can the change or corrupt executable code in memory?
5. Resource interference: can the change prevent or delay access to a required resource (memory, semaphore, etc.)?
6. Violation of Criticality assumptions: does the change affect the justification of independence used in the criticality analysis?
7. Tests shall be done in accordance with the SIL level requirements of IEC 61508-3 (Table A.5 requires for SIL 2).
8. Dynamic analysis and testing.
9. Functional and black box testing.
10. Boundary value analysis.
11. Equivalence classes and input partition testing.

9.0 PRESENTATION OF BASIC METRICS FOR EASIER UNDERSTANDING OF THE IEC 61508 STANDARD AND SAFETY MANUALS

9.1 SAFETY AND RISK

When considering an industrial process, it is recognized that there is an inherent risk of operation. Things do go wrong. Safety is defined in the standard as "freedom from unacceptable risk of harm". The IEC 61508 goes on to define the level of safety as "a level of how far safety is to be pursued in a given context, assessed by reference to an acceptable risk, based on current values of society". When evaluating safety, the frequency of an accident and the consequences (the costs) of an accident are both taken into consideration. Risk is defined as the probable rate of occurrence of a hazard causing harm and the degree of severity of the harm. Thus, risk evaluation includes a combination of frequency and cost. For example, if the consequences of an accident are estimated to be 10 million Euro and the frequency of the accident is estimated to be once per ten years (probability of an accident is 0,1 for a time interval of one year). Then the inherent risk is stated to be 1million Euro per year. Frequently it is judged that risk inherent in operating an industrial process is unacceptable high, corporate rules, government regulations, law, insurance company rules, or public opinion may require a lower level risk. This leads to the concept of "tolerable risk". When inherent risk, perceived or actual, is high than "tolerable risk", then risk reduction is required (see Figure 19).

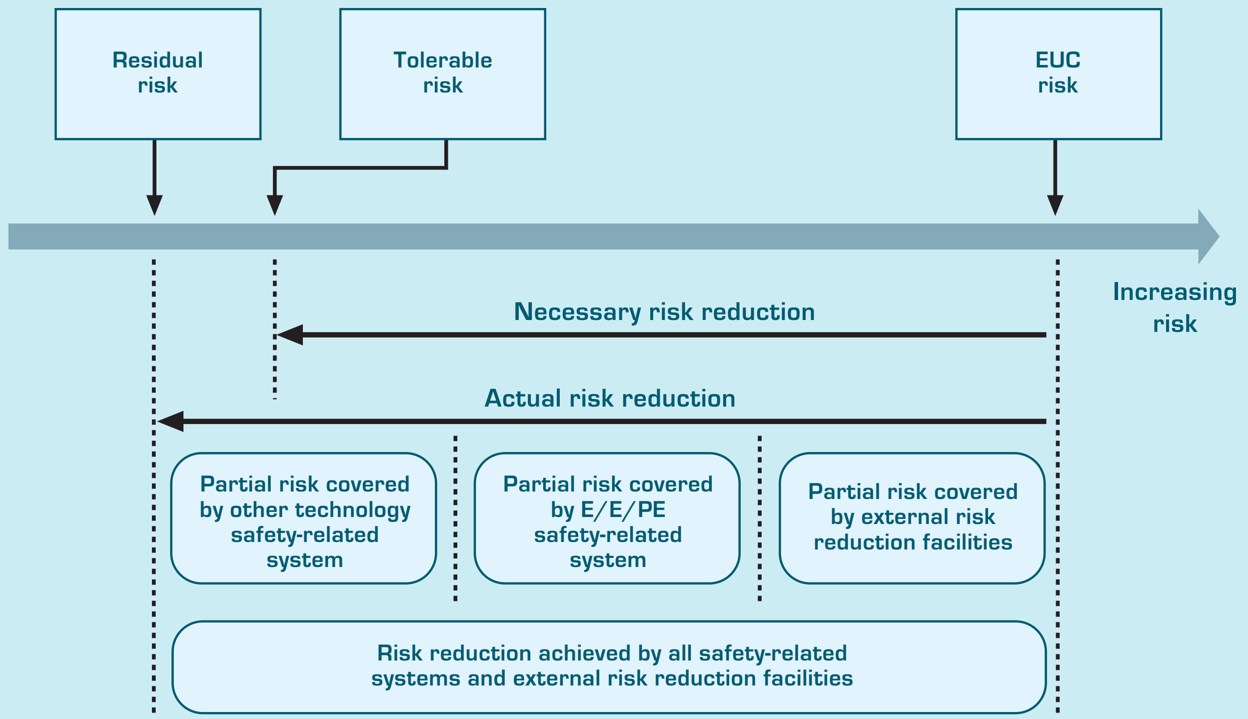


Figure 19 Risk reduction.

9.2 RISK REDUCTION FACTOR AND PROBABILITY OF FAILURE ON DEMAND

The risk reduction factor can be expressed as a number greater than one. For example, consider a risk estimate of 1 million Euro per year. If the responsible company decides that a risk no greater than 10.000 Euro per year is acceptable, then a risk reduction of 100 is

CORRELATION BETWEEN PROBABILITY OF FAILURE ON DEMAND AND RISK REDUCTION FACTOR

$$\text{PFD avg} = \frac{\text{Tolerable frequency of the accident}}{\text{Frequency of the accident with no protection}} = \frac{1}{\text{Risk Reduction Factor}}$$

$$\text{Risk Reduction Factor} = \frac{\text{Frequency of the accident with no protection}}{\text{Tolerable frequency of the accident}} = \frac{1}{\text{PFD avg}}$$

Figure 20

required in a safety protection device that reduces the frequency of an accident.

The standards use the term "Probability of Failure on Demand (PFD)".

This is the probability that a system designed to prevent an accident will fail to prevent the accident when needed.

9.3 SAFETY INSTRUMENTED SYSTEM (SIS)

For each potentially dangerous process situation a design is done to detect the situation and automatically take action to mitigate the danger.

Each design is called a Safety Instrumented Function (SIF). For each SIF the needed risk reduction factor is determined.

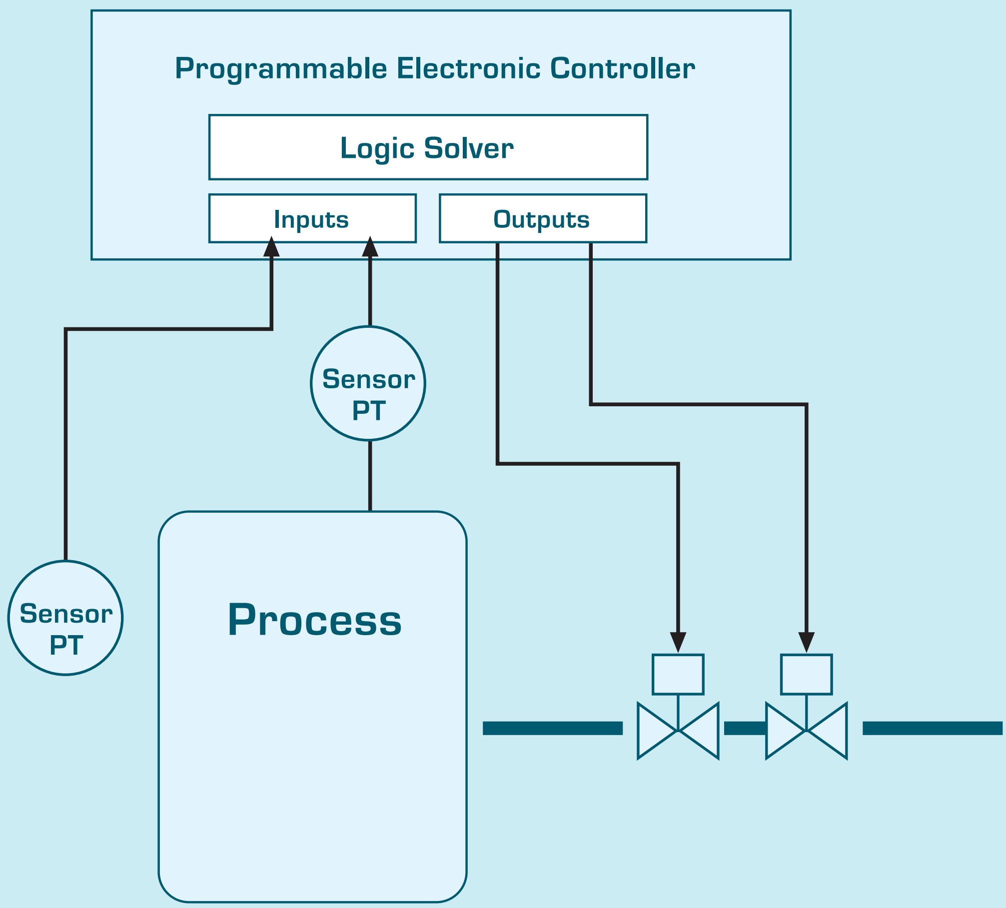


Figure 21 Safety Instrumented Functions

A number of SIFs associated with a particular process are typically implemented within a single SIS. A simple system is shown in Figure 21 with a logic solver and one of the safety instrumented functions, one for each potentially dangerous condition, in one logic solver.
A potentially dangerous condition is known as a "demand". A majority of SIS designs use the "de-energize to trip" concept. When the process is operating normally, inputs and outputs are energized. The programmed action to prevent or mitigate the danger consists of opening or closing valve by de-energizing an electric circuit. This action is called a "trip".
A SIS is composed of process connections, sensors, logic solver and final elements.
Sensors may be temperature measurement devices, pressure measurement devices, flame detectors, toxic gas detectors, emergency switches or many other type devices.
Final elements range from simple solenoid valves to large valves with associated actuators.
A one type of logic solver is a programmable electronic controller (PEC) which consists of input circuitry. A logic solver an output circuitry.
The logic solver is implemented using a microcomputer and software. Different types of input and output circuitry exist to interface both analog and discrete sensors or final elements.

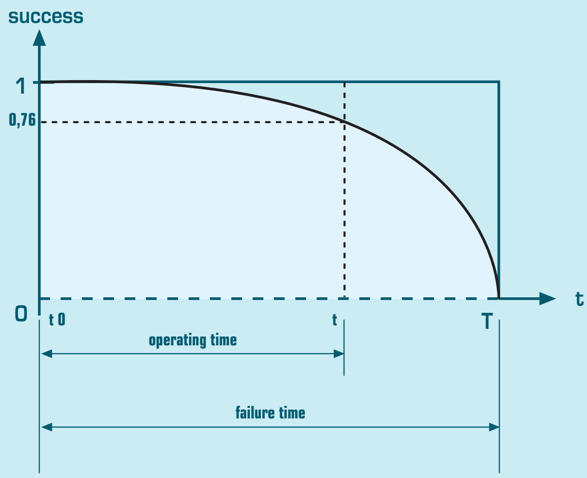
9.4 RELIABILITY

Reliability is a measure of success.
Reliability generally is defined as " the probability that a device will perform its intended function when required to do so if operated within its specified design limits".
This definition includes four important aspects:

1. The device's "intended function" must be known.
2. "When the device is required to function" must be judged.
3. "Satisfactory performance" must be determined.
4. The "specified design limits" must be known.

All four aspects must be addressed when defining a situation to be a success or a failure.
Mathematically, reliability (R) has a precise definition: "The probability that a device will be successful in the time interval from zero to t".
In term of random variable T,

$$R(t) = P(T > t)$$



Reliability Figure

Reliability equals the probability (P) that T, failure time, is greater than t, operating time interval. Consider a newly manufactured and successfully tested device, it operates properly when put into service at time t = 0.
As the time interval increases, it becomes less likely that the device will remain successful.
Since the device will eventually fail, the probability of success for an infinite time interval is zero. Thus, all reliability functions start at probability of one and decrease to a probability of zero.
Reliability is a function of operating time interval.
A statement such as "System reliability is 0,95" is meaningless because the time interval is not known. The statement " The reliability equals 0,99 for a mission time of 10000 hs" makes perfect sense.

9.5 MEASURES OF SUCCESS AND AVAILABILITY

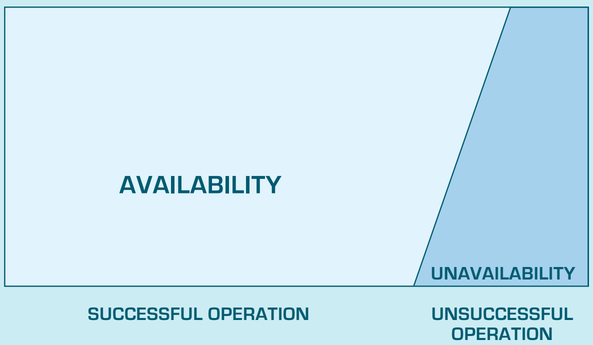
The most popular measures of successful system operation include MTTF (Mean Time To Failure) and availability.

MTTF is an indication of the average successful operating time of a system before a failure in any mode.

The use of MTTF has been inconsistent though. Reliability and safety evaluation generally assume a constant failure rate during the period of time known as "useful life".

Wearout mechanism that rapidly increase the failure rate are excluded.

Because of that the MTTF calculation may exceed the useful life by many times, this resulted in much misunderstanding.



Availability Figure

Nevertheless, the measurement is commonly in use. For a Programmable Electronic Controller (PEC) project, the primary performance measurement is success and failure probabilities, not MTTF.

Reliability is a measure that requires system success for an entire time interval.

No failure (and subsequent repairs) are allowed. Availability is defined as "the probability that a device is successful at time t".

No time interval is involved. If a system is operating is available.

It does not matter whether it has failed in the past and has been repaired, or has been operating continuously from time t = 0 without failure. Availability is a function of failure rates, repair rates, and operating time. An availability rating for a good system is near one.

Availability = 1 - PFDavg

PFDavg = λdd * RT + λdu * TI / 2

For TI of one year the availability is mainly function of failure rates

MTBF (Mean Time between Failures) is a term that applies only to repairable systems.

Like MTTF and MTTR (mean Time to Repair), it is an average value. MTBF is the time between failures, this implies that a component has failed and then has been repaired.

MTBF = MTTF + MTTR

Since MTTR is usually much smaller than MTTF, MTBF is approximately equal to MTTF.

The term MTBF is often substituted for MTTF, which applies to both repairable systems and non-repairable systems.

The availability is the popular measure of the success but the generic term availability simply means uptime divided by the total time.

What might an availability of 99.99% actually mean? The system could have a nuisance trip once a month and be down for only 4.3 minutes. It could trip once a years and be down for 53 minutes. It could trip once every 10 years and be down for 8.8 hours. All work out to 99.99% availability. This is not the sort of information most users really want to know.

A better term for nuisance trip performance is the MTTF, (or MTTF spurious in our case). In other words, will the system cause a nuisance trip, on average, once every 5 years, 50 years, or 500 years? Users know how long their particular process will be down when there is a nuisance trip, and what this it means for them. They want to know how often it is going to happen.

A better term for dangerous system performance is risk reduction factor (RRF). This is the reciprocal of probability of failure on demand (PFD). The difference between 0.1 and 0.001 is difficult to visualize or appreciate. The difference between 10 and 1000 however, is obvious.

9.6 FAILURE RATE

Instantaneous failure rate is a commonly used measure of reliability that gives the number of failures per unit time from a quantity of components exposed to failure.

$$\textbf{Failure rate } (\lambda) = \frac{\textbf{Failure per Unit Time}}{\textbf{Quantity exposed}}$$

It is common practice to use units of "failure per billion (10^9) hours".
This failure unit is known as FIT.
Eg. 300 industrial I/O modules have been operating in a plant for 7 years.
5 failures have occurred.
The average failure rate for this group of modules is
λ = 5/(300 x 7 x 8760) = 0.00000005436= 54 FIT per hour (or failure in time per hour).
An other simple way of indicating the failure rates value is to use years instead of hours.
The above example will be calculated:
5 / 300 x 7 = 0.00238 per year.

The relation between MTBF and Failure Rate is:

$$\text{MTBF} = \frac{1}{\lambda} = \frac{\text{Quantity Exposed}}{\text{Failure per Unit Time}}$$

Eg. for λ = 54 FIT

$$\text{MTBF} = \frac{10^9}{54} = \frac{3703703}{8760} = 420 \text{ years}$$

ore more simply:
MTBF = 1 / λ = 2100 / 5 = 420 years
or
MTBF = 1 / λ = 1 / 0.00238 = 420 years.

9.7 FAILURE RATE CATEGORIES

It is assumed that component failure rate are constant.
It is also assumed that component failures, in non redundant PEC equipment, are statistically independent.
While these assumptions are not always realistic, they are reasonable and conservative for the "useful life" period of the electronic components used in a PEC equipment.
The failures are first grouped into the two significant categories of system failures, safe and dangerous.

$$\lambda\,\text{tot} = \lambda\text{s} + \lambda\text{d}$$

Safe failures are defined as those that would cause an output to falsely de-energize.
Dangerous failure are those that would prevent an output from being de-energized.
Each of the failure categories is further partitioned into failure detected by the on-line diagnostics versus those undetected where:

$$\lambda\text{s} = \lambda\text{sd} + \lambda\text{su}$$
$$\lambda\text{d} = \lambda\text{dd} + \lambda\text{du}$$

Where:

sd represent a "safe detected" failure;
su represent a "safe undetected" failure;
dd represent a "dangerous detected" failure;
dd represent a "dangerous undetected" failure.

"Coverage" is the measure of the built-in-test capability of a system.
It is defined as the probability that a failure will be detected given that it occurs.
It is denoted by the letter C.

A coverage factor must be obtained for each component in the system in order to separate the detected failures from the undetected failures. The four failure categories are calculated as follow:

$\lambda sd = Cs\ \lambda s$

$\lambda su = (1 - Cs)\ \lambda s$

$\lambda dd = Cd\ \lambda d$

$\lambda du = (1 - Cd)\ \lambda d$

9.7.1 DEPENDENT FAILURES AND BETA FACTOR

The dependent, or "common cause" failure is defined as the failure of a multiple components due to a single cause.

These failures have a significant effect on the reliability and safety of a SIS and therefore must be considered in the reliability and safety model. One of the simplest models, called "Beta model", divides the failure rate of each component into common cause (two or more fail) and normal (one fail).

A fractional multiplication factor, known as the "Beta factor", is used to subdivide these failure rates. (sostituire L con lamda e B con beta).

$\lambda c = \beta\lambda$ (common cause portion of the total failure rate)

$\lambda n = (1-\beta)\lambda$ (normal portion of the total failure rate)

Therefore further failure rate categories can be derived:

- **SDN** – Safe detected normal
- **SDC** – Safe detected common cause
- **SUN** – Safe undetected normal
- **SUC** – Safe undetected common cause
- **DDN** – Dangerous detected normal
- **DDC** – Dangerous detected common cause
- **DUN** – Dangerous undetected normal
- **DUC** – Dangerous undetected common cause

The four failure rates **SU, SD, DU** and **DD** are divided using the Beta model

$\lambda sdn = (1-\beta)\ \lambda sd$

$\lambda sdc = \beta\lambda sd$

$\lambda sun = (1-\beta)\lambda su$

$\lambda suc = \beta\lambda su$

$\lambda ddn = (1-\beta)\ \lambda dd$

$\lambda ddc = \beta\lambda dd$

$\lambda dun = (1-\beta)\ \lambda du$

$\lambda duc = \beta\lambda du$

9.7.2 BASIC SIMPLIFIED FORMULAS

MTTF spurious

1oo1 : $1 / \lambda s$

1oo2 : $1 / 2\ \lambda s$

2oo2 : $1 / (2\ \lambda s^2 * MTTR)$

2oo3 : $1 / (6\ \lambda s^2 * MTTR)$

Where λs is the spurious failure rate of the SIF (Safety Intrumented Function)

PFD avg

1oo1: $\lambda du * TI / 2$

1oo2: $\lambda du^2 * TI^2 / 3$

2oo2: $\lambda du * TI$

2oo3: $\lambda du^2 * TI^2$

Where TI is the Test Interval (Proof Test Interval), and λdu is the dangerous undetected failure rate of the SIF.

For TI = 1 year, the above formula can be further simplified:

1oo1: $\lambda du / 2$

1oo2: $\lambda du^2 / 3$

2oo2: λdu

2oo3: λdu^2

NOTE: The above equations takes no credit for automatic diagnostic and also assumes that manual testing is 100% effective to detect all the dangerous undetected failures. For case where testing effectiveness is less than 100%, the following formula can be used:

1oo1: $(Et * \lambda du * TI / 2) + [(1-Et) * \lambda du * SL / 2]$

Where **Et** is the test effectiveness (e.g. 95%), and **SL** the instruments life time (e.g. 20 years). For **TI** = 1 year , and **SL** = 20 years the equation is further simplified:

(Et * λdu / 2) + [(1-Et) * λdu * 10]

e.g. 1)

λdu = 0.025 / year

E t = 95% = 0.95

SL = 20 years

PFD avg = (0.95 * 0.025 / 2) + (0.05 * 0.025 .10) = 0.035

RRF = 1 / PFD avg = 1 / 0.035 = 28

(suitable for SIL 1 application)

e.g. 2)

λdu = 0.03 / year

E t = 99% = 0.99

SL = 20 years

PFD avg = (0.99 * 0.03 / 2) + (0.01 * 0.03 * 10) = 0.0013

RRF = 1 / PFD avg = 1 / 0.0013 = 769

(suitable for SIL 2 application)

e.g. 3)

λdu = 0.001 / year

E t = 99% = 0.99

SL = 20 years

PFD avg = (0.99 * 0.001 / 2) + (0.01 * 0.001 * 10) = 0.0006

RRF = 1 / PFD avg = 1 / 0.0006 = 1666

(suitable for SIL 3 application)

What makes the differance between the above 3 examples is the value of **λdu.**

IMPACT DUE TO MANUAL TEST PROOF DURATION

Testing a safety-related system online (while the process is still running), a portion of the safety system must be placed in bypass in order to prevent shutting something down. The duration of the manual test proof can have a significant impact on the overall performance of the safety-related system.

During the test. A non redundant (simplex) system must be taken offline. Its availability during test duration is zero. Redundant systems, however, do not have to be completely placed in bypass for testing. One leg, of the redundant system, can be placed in bypass at a time. In effect an architecture of 1oo2 is reduced to 1oo1 during the test, and a 2oo3 is reduced to 2oo2. The PFDavg formulae can be modified as follow:

1oo1: λdu * (TI / 2) + TD / TI

(where TD is the test duration and TI the test interval).

1oo2: λdu² * (TI² / 3) + [2 * TD + λdu * (TI / 2 + MTTR) / TI]

2oo2: λdu * TI + [2 * (TD / TI)]

2oo3: λdu² * TI² + [6 * TD * λdu * (TI / 2 + MTTR) / TI]

For TI of one year the PFDavg is:

1oo1: λdu / 2 + TD

1oo2: λdu² / 3 + [2 * TD + λdu * (0.5 + MTTR)]

2oo2: λdu + (2 * TD)

2oo3: λdu² + [6 * TD * λdu * (0.5 + MTTR)]

Examples for architecture 1oo1 with TI of one year:

λdu = 0.002 (failure per year)

TD = 8 hour = 0.0009 Year

PFDavg = 0.002 / 2 + 0.0009 = 0.0019

(RRF = 526)

λdu = 0.002 (failure per year)

TD = 48 hour = 0.0055 Year

PFDavg = 0.002 / 2 + 0.005 = 0.006

(RRF = 166).

9.7.3 BASIC SIMPLIFIED CALCULATION FOR SINGLE SUB-SYSTEMS

Table 7 for a typical Transmitter

Transmitter: MTTF = 100 years; λdu = 0.01/year.

Architecture	PFDavg	RRF (1/PFDavg)	Max SIL claimed
1oo1	0.05	200	SIL 2
1oo2	0.00003	33333	SIL 4
2oo2	0.01	100	SIL 1 or 2
2oo3	0.0001	10000	SIL 3 or 4

Table 8 for a typical I.S. Isolator

I. S. Barrier: MTTF = 300 years; λdu = 0.003/year.

Architecture	PFDavg	RRF (1/PFDavg)	Max SIL claimed
1oo1	0.0015	666	SIL 2
1oo2	0.000003	≥ 100.000	SIL 4
2oo2	0.003	333	SIL 2
2oo3	0.000009	≥ 100.000	SIL 4

Table 9 for a typical Safety PLC

Safety PLC: MTTF = 1000 years; λdu = 0.001/year.

Architecture	PFDavg	RRF (1/PFDavg)	Max SIL claimed
	0.0005	2000	SIL

Table 10 for a typical Shutdown Valve

Shutdown Valve: MTTF = 40 years; λdu = 0.025/year.

Architecture	PFDavg	RRF (1/PFDavg)	Max SIL claimed
1oo1	0.0125	80	SIL 1
1oo2	0.0002	5000	SIL 3
2oo2	0.025	40	SIL 1
2oo3	0.0006	1666	SIL 3

9.7.4 BASIC SIMPLIFIED CALCULATION FOR A COMPLETE SIF IN A 1oo1 ARCHITECTURE

Table 11 SIF 1oo1 Architecture

Sub System	MTTF (years)	λdu/year (1/MTTF)	PFDawg	% PFDawg	RRD (1/PFDavg)	Max SIL can be claimed
Transmitter	100	0.010	0.0050	26	200	SIL 2 note 1
I.S. Barrier	300	0.003	0.0015	7.5	666	SIL 2 note 2
Safety PLC	1000	0.001	0.0005	2.5	2000	SIL 3 note 3
Shutdown Valve	40	0.025	0.0125	64	80	SIL 1 note 4
Total	**26**	**0.039**	**0.0195**	**100**	**51**	**SIL 1**

Note 1: providing SFF is > 90 % - 99 % (according table 5).

Note 2: providing SFF is > 60 % - 90 % (according table 4).

Note 3: providing SFF is > 99 % (according table 5).

Note 4: providing SFF is < 60 % (according table 4).

(see table 4-5 at page 297)

$$SFF = 1 - \frac{\lambda du}{\quad} \%$$

9.7.5 BASIC SIMPLIFIED CALCULATION FOR A COMPLETE SIF IN A 1oo2 ARCHITECTURE

Table 12 SIF 1oo2

Sub System	MTTF (years)	λdu/year (1/MTTF)	PFDawg 1oo1	% PFDawg	RRD (1/PFDavg)	Max SIL can be claimed
Transmitter 1	100	0.010	1oo2			
(1oo2)		0.020	0.00010	7	10000	SIL 3
Transmitter 2	100	0.010				note 1
I.S. Barrier 1	300	0.003	1oo2			
(1oo2)		0.006	0.00001	0.7	100000	SIL 3
I.S. Barrier 2	300	0.003				note 2
Safety PLC	1000	0.001	0.0005	33.5	2000	SIL 3 note 3
Shutdown Valve A	40	0.025	1oo2			SIL 3
1oo2		0.050	0.00080	57	1250	note 4
Shutdown Valve B	40	0.025				
Total	**13**	**0.077**	**0.00141**	**100**	**709**	**SIL 2**

Note 3: providing SFF is > 99 % (according table 5).

Note 4: providing SFF is > 90 % - 99 % (according table 4).

Table 13 SIF 1oo2

If a SIL 3 for the SIF function is required the shutdown valve has to be changed with one having a better MTTF figure.

Sub System	MTTF (years)	λdu/year (1/MTTF)	PFDawg 1oo1	% PFDawg	RRD (1/PFDavg)	Max SIL can be claimed
Transmitter A	100	0.010	1oo2			
(1oo2)		0.020	0.00010	10.5	10000	SIL 3
Transmitter B	100	0.010				note 3
I.S. Barrier A	300	0.003	1oo2			
(1oo2)		0.006	0.00001	1	100000	SIL 3
I.S. Barrier B	300	0.003				note 4
Safety PLC	1000	0.001	0.0005	52.5	2000	SIL 3 note 3
Shutdown Valve A	60	0.016	1oo2			SIL 3
1oo2		0.032	0.00034	36	2941	note 3
Shutdown Valve B	60	0.016				
Total	**17**	**0.059**	**0.00095**	**100**	**1052**	**SIL 3**

Note 3: providing SFF is > 99 % (according table 5).

Note 4: providing SFF is > 90 % - 99 % (according table 4).

(see table 4-5 at Page 297).

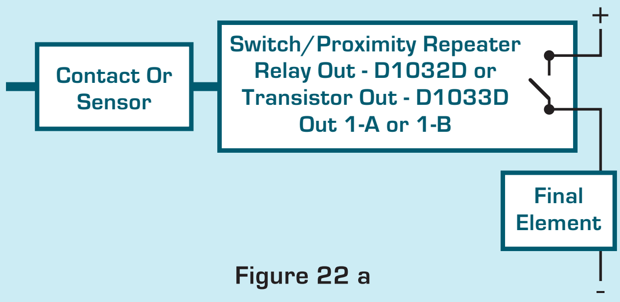


Figure 22 a

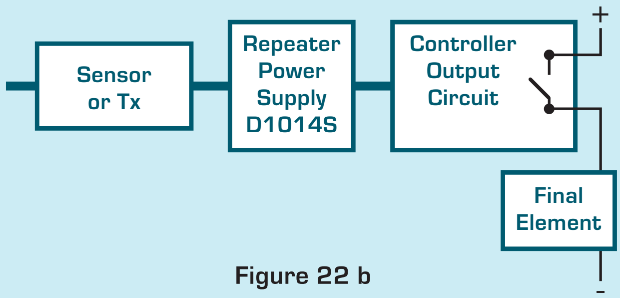


Figure 22 b

9.7.6 1oo1 ARCHITECTURE

The key metric that indicate the safety of a system is probability of failure on demand (PFD). A very low number for PFD is desired. Assuming that the SIS (Safety Instrumented System) is designed correctly, it will fail to prevent an accident only when it is in the fail-to-functional/fail-danger state.

The probability of this is the PFD.

The SIS will prevent an accident when it is operating successfully.

Therefore the risk is reduced by a factor proportional to total operating time divided by time in the fail-to-function state.

A single PEC (Programmable Electronic Controller) represent a minimum system in an architecture 1oo1.

No fault tolerance is provided by this system.

No failure mode protection is provided.

The electronic circuit can fail safely (output de-energized, open circuit) or dangerously (output frozen or energized, short circuit).

Since the effects of on-line diagnostics should be modelled, four failure category are included, dd (dangerous detected), du (dangerous undetected), sd (safe detected) and su (safe undetected).

CORRELATION BETWEEN PROBABILITY OF FAILURE ON DEMAND AND RISK REDUCTION FACTOR

$$\text{PFD avg} = \frac{\text{Tolerable frequency of the accident}}{\text{Frequency of the accident with no protection}} = \frac{1}{\text{Risk Reduction Factor}}$$

$$\text{Risk Reduction Factor} = \frac{\text{Frequency of the accident with no protection}}{\text{Tolerable frequency of the accident}} = \frac{1}{\text{PFD avg}}$$

Figure 20

Using a first order approximation techniques, a simple formula can be generated for the PFDavg (TI), the PFDavg corresponding to the time (TI) between two maintenance periods (Tproof test interval).

PFDavg (TI) = λdd * RT + λdu * TI/2

Because RT (repair time) is assumed 8 hs and TI/2 for one year is 4380, for 5 years is 21900, and for 10 years is 43800, the **λ**dd * RT is negligible compared to TI/2, therefore the further approximation is

PFDavg = λdu * TI/2

Where **λdu** for the circuit in Figure 22a is the **λdu** of D1032 or D1033 repeater, while in Figure 22b **λdu** is the total of all instruments in the control loop (transmitter + interface-repeater D1032/D1033 + controller + final element).

PFD calculation for Figure 22a

From the table 10.2 in the safety-manual we obtain:

λdu = 28 FIT

λ total = 238 FIT

MTBF = 420 years

PFD = 0.000000028 * 8760 = 0.00024528

PFDavg = 0.000000028 * (8760/2) = 0.00012096

MTTF = 1/0.000000238 = 420 years

MTBF is a bit less because of repair time

PFD calculation for Figure 22b

Assuming for the entire loop the following parameters:

λdu transmitter = 30 FIT

λdu Isolator D1014 = 34 FIT (see table10.2 in the safety-manual)

λdu controller 25 FIT

λdu final element 23 FIT

λdu total = 112 FIT

and for **λtotal** (**λ**sd + **λ**su + **λ**dd + **λ**du of all sub-systems) = 16162 FIT

PFD = 0.000000112 * 8760 = 0.000981

PFDavg = 0.000000112 * (8760/2) = 0.000490

MTTF = 1/0.000016162 = 61874 Hours

MTBF will be a bit less than MTTF because of repair time.

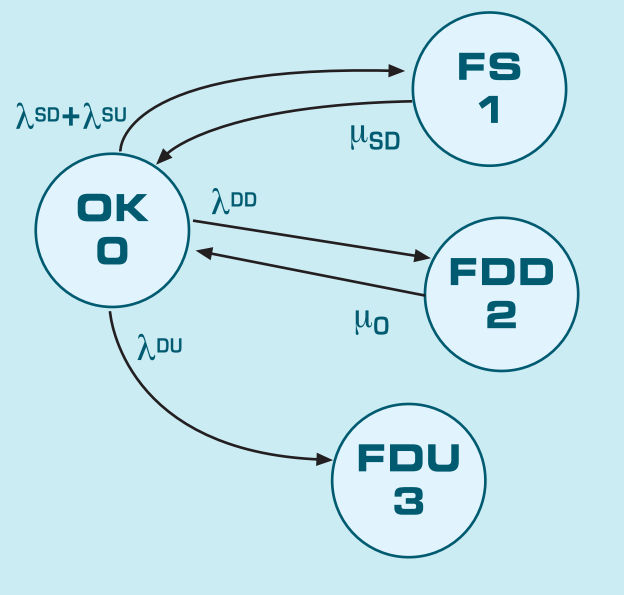


Figure 24

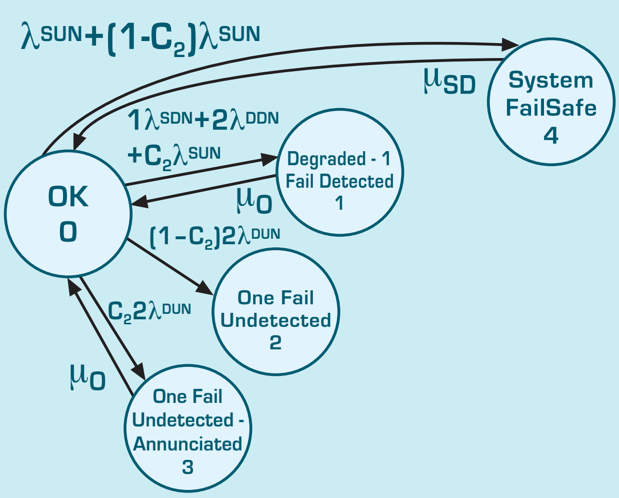


Figure 25

Figures 24 and 25 show the Markow diagrams for 1oo1 and 1oo2 circuit architectures.

9.7.7 - 1oo2 ARCHITECTURE

To minimize the the effect of dangerous failures two circuit can be connected in redundant to form an architecture 1oo2.

The system offers low probability of failure on demand (du and dd), but it increases the probability of a fail safe failure (su and sd).

In this case the approximation equation for

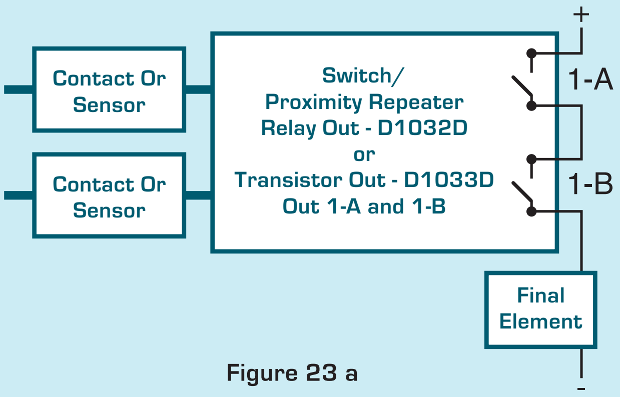


Figure 23 a

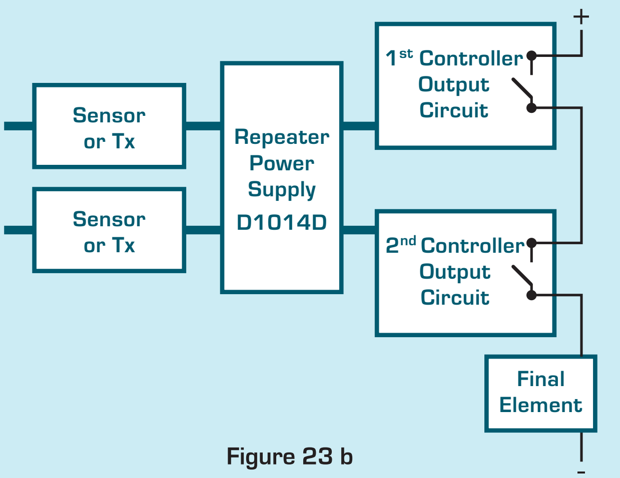


Figure 23 b

PFDavg is

$PFDavg = \lambda duc * (TI/2) + \lambda ddc * RT + (\lambda ddn * RT)^2 + (lddn * RT * \lambda dun * TI)^2/2 + (\lambda dun * TI)^2/3$

For D1014D isolator it is assumed no common failure but normal only (very possible in a table A type circuit). The semplified formula is:

$PFDavg = (\lambda ddn * TI)^2/3$

The above formula is valid when MTBF ($1/\lambda ddn$) is much greater than TI.

In Figure 23b the complete redundance includes two controllers to minimize the effect of dangerous failure.

For de-energized-to-trip systems, a series connection of the two output circuits requires that both controllers fails in a dangerous manner for the system to fail dangerously.

The 1oo2 configuration typically utilizes two independent main processors with their own independent I/O.

The system offers low probability of failure on demand, but it increases the probability of a fail-safe failure.

The “false trip” rate is increased in order to improve the ability of the system to shut down the process.

PFD calculation for Figure 23a

From the Table 10.2 in the safety-manual we obtain:

λdu = 28 FIT

$\lambda total$ = 238 FIT

MTBF = 420 years

From the approximation formula we obtain:

$PFDavg = (\lambda dun * TI)^2/3.$

$PFD = (0.000000028 * 8760)^2 = 0,000000060$ per hour

$PFDavg = (0.000000028 * 8760)^2 /2 + (0.000000028 * 8760)^2 /3 = 0.000000005$ per hour.

Comparing the PFDavg for the configuration 1oo1 of the circuit in Figure 22a and the one for the configuration 1oo2 in Figure 23a it is very evident the difference between the two values of PFDavg (12096 FIT agains 5 FIT).

The advantage of the circuit in Figure 23a (1oo2) respect to the circuit in figure 22a configured 1oo2.

Note: The simplified equations derived by approximation techniques are only valid for low failure rates.
Therefore more applicable for a subsystem (Isolators type D1014 – D1032) than the safety function of a complete SIF of the safety-related system for wich the complete formulas must be used.

9.7.8 2oo3 ARCHITECTURE

An architecture designed to tolerate both "safe" and "dangerous" failures is 2oo3 (two units out of three required for the system to operate). This architecture provides both safety and high availability with three controller units. Two outputs from each controller units are required for each output channel.
The two outputs from the three controllers are wired in a "voting" circuit, which determines the actual output (Fig. 26). The output will equal the "majority". When two sets of outputs conduct, the load is energized. When two sets of outputs are off, the load is de-energized.
A closed examination of the voting circuit shows that it will tolerate a failure of either failure mode: dangerous (short circuit) or safe (open circuit).
When the unit fail open circuit, the system effectively degrades to a 1oo2 configuration. If one unit fails short circuit the system effectively degrades to a 2oo2 configuration. In both cases, the system remains in successful operation.

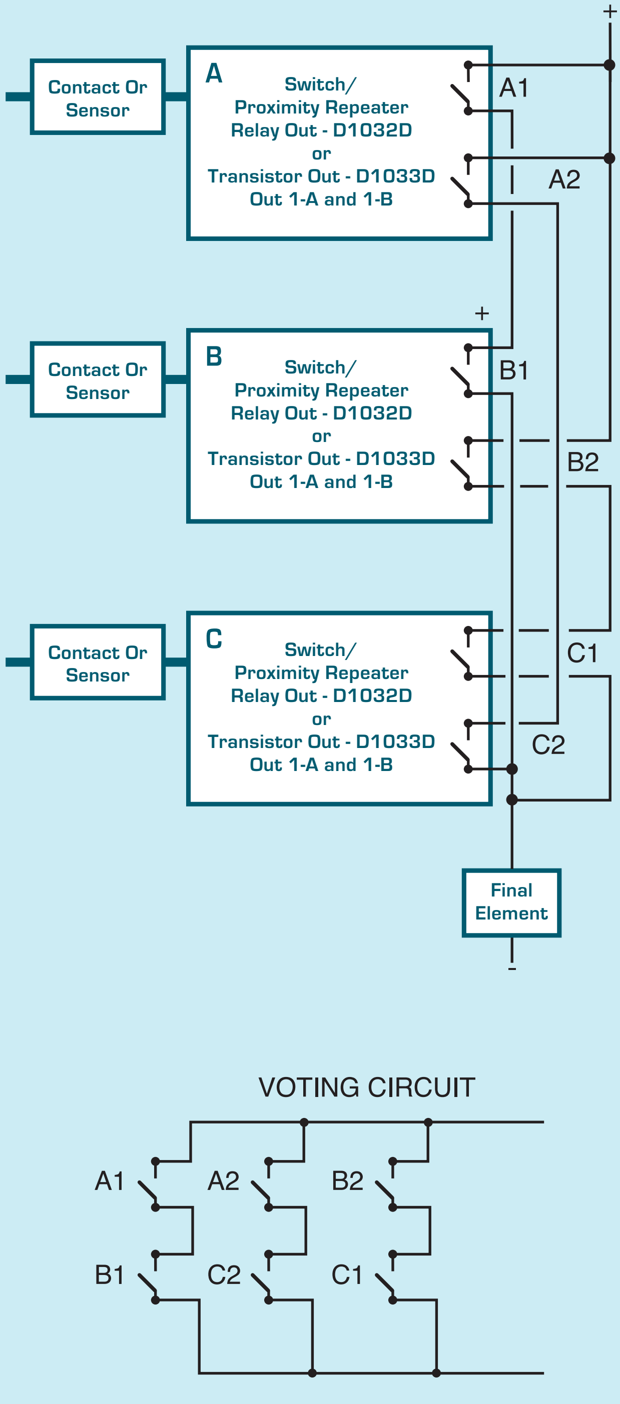


Figure 26

The equation for **PFDavg** for the architecture 2oo3 is = $\lambda duc * TI/2 + 3\lambda ddc * RT + 3 [(\lambda ddn * RT)^2 + +(\lambda ddn * RT * \lambda dun * TI)/2 + (\lambda dun * TI)^2/3]$.

The semplified formula is:

PFDavg = $(\lambda ddn)^2 * TI^2$

9.8 FAILURE MODE AND EFFECTS ANALYSIS (FMEA) AND FAILURE MODES AND EFFECTS DIAGNOSTIC ANALYSIS (FMEDA)

A FMEA is a bottom up analysis technique that is very effective in identifying critical component failure in a PEC design.
FMEA can be described as a systematic way to identify and evaluate the effects of each potential component failure mode, to classify the severity of the potential failure mode, to determine what could eliminate or reduce the chance of failure, and to document the system in consideration.

The format for the FMEA is from the MIL STD 1629A, Failure Modes and Effects Analysis (MIL84) standard.
The FMEDA is a FMEA extension. It combines standard FMEA information with extensions to identify online diagnostic capability. It is a technique recommended to generate failure rates for each important category (safe detected, safe undetected, dangerous detected, dangerous undetected) in the reliability and safety modes. A FMEDA can be used during the new product design process most effective after the circuit design step as a tool to verify that the circuit design goals have been met.

Table 6

FMEA chart for type A subsystem.

Component Identification	Type of Component	λ (FIT)	% of the Failure Rate	Simulated Failure Mode	Effet on Output Signal	λSD (FIT)	λSU (FIT)	λDD (FIT)	λDU (FIT)
C1A	Cond. MC 10 nF 50V 10% x7R 0805 SMD	31,8	80 20	Open Short	SD SU	25,4	 6,36		
C2A	Cond. MC 10 nF 50V 10% x7R 0805 SMD	31,8	80 20	Open Short	DU SU		 6,36		15,4
C12A	Cond. MC 4.7 nF 50V 10% x7R 0805 SMD	28,6	80 20	Open Short	DD SU		 5,72	22,88	
R48A	Res. TF 392KR 1/8W 1% 100ppm 0805 SMD	9,6	20 40 15 25	Open Short 0,5 x R 2 x R	SU SD SD SD	 3,88 1,46 2,43	1,94		
R52A	Res. TF 1KR 1/8W 1% 100ppm 0805 SMD	9,6	20 40 15 25	Open Short 0,5 x R 2 x R	DU DD SU SU		 1,46 2,43	 3,88	1,94
T1A	Tras. EF16 1p/1s 45/95s Vds 90 V Ids 300 mA 2,8/12,6 mH		50 50	Open Short	SD DD	8,9		 8,9	
TR5A	Trans. 2N7002 N-MOS Vds 60V Ids 300mA Rds 0,5R SOT23 SMD	25	50 50	Open Short	SD SU	12,5	 12,5		
TR7A	Trans. 2N7002 N-MOS Vds 60V Ids 300mA Rds 0,5R SOT23 SMD	25	50 50	Open Short	DU DD			 12,5	7,5
IC3A	Integ. TLC272 Ampl. Operaz. SO8 SMD	2,7	40 40 20	Open Short Unstable	SD SU DU		1,08 1,08		15,4 0,054
IC4A	Integ. TLC272 Ampl. Operaz. SO8 SMD	2,7	40 40 20	Open Short Unstable	SU SD DU	 1,08	1,08		 0,054
			Total Failure rates			55,65	40,01	48,16	24,95

The method can be used on an entire circuit although a preferred method analyses one sub-circuit (a functional block) at a time.
Results from each sub-circuit can be combined to obtain results for each circuit.
The following table is an example of an hypothetic sub-circuit FMEDA analysis.
This example is intended to show how important is the FMEDA analysis during the development phase to obtain a better SFF and PDF avg figures. For this hypothetic circuit as example, we have defined the following meaning of the "output values".

Output signal value < down scale value:
fault safe detected (SD).

Output signal value < 5% of the span:
fault safe undetected (SU).

Output signal value > 5% of the span but within the range:
fault dangerous undetected (DU).

Output signal value > full scale value:
fault dangerous detected (DD).

Let us calculate the SFF value:

$$\mathbf{SFF = 1 - \frac{\lambda du}{\lambda dd + \lambda du + \lambda sd + \lambda su} =}$$

$$\mathbf{1 - \frac{24{,}95}{168{,}77} = 85\%}$$

(suitable for SIL 2 application)

To increase the SFF value we have to reduce the FIT value for the dangerous undetected failure rate (λdu). This is possible introducing two hardware changes:

1. Capacitor C2A, value 10 nF, has an important effect on the **λdu** failure rates when fail open circuit. If this capacitor is changed in two 5 nF capacitors in parallel, when one of the two capacitors would fail open the total value of capacitor is reduced to 5 nF instead of infinit (open) value. It has been verified that the fault is now classified su instead of **du**.
2. The same procedure is valid for the resistor R52 (1 KR) which generate a dangerous fault in open circuit failure mode.
   Two resistor in parallel of 2KR value can be the change. After these two changes, the **λ**du = 7,6 FIT, and the SFF value is now 95% (suitable for SIL 3 applications, or SIL 2 with a proof test of 5 years). The same consideration can be done for the PFD avg, which is approximately = **λdu** x 4380.
   The value of the PFDavg, for the two examples, **λdu** = 24,95 FIT and **λdu** = 7,6 FIT is:
   2. PFDavg = 1,09 x 10^{-4}
   3. PFDavg = 0,33 x 10^{-4} (3 times better and suitable for SIL 3 applications).

9.9 SAFETY MANUAL

Management summary

The purpose of this section is to provide a "check-list" of requirements for a Safety Manual that meets the requirements of IEC 61508.
A Safety Manual is a document provided to users of a product that specifies their responsibilities for installation and operation in order to maintain the design safety level. The manufacturer of a product is required to provide such a manual by IEC 61508. Many users consider the document to be a pre-sales document as they want to see if there are any serious limitations in the use of a product before purchasing.

9.9.1. Safety Manual Requirements

IEC 61508 has requirements that the manufacturer:

1. Advise all procedures required for a test to detect known "dangerous failures" as identified by the FMEDA of the product.
   The procedures must include a statement that the results of such testing be recorded.

Any tools required must be identified.
The expected skill level of those doing the work must be specified. Diagnostic coverage factor for the specified test must be stated.

2. Advise procedures to repair or replace the product. This must include a statement that all failures must be reported to the manufacturer. Any tools required must be identified. The expected skill level of those doing the work must be specified.
3. Advise any necessary installation and site acceptance test procedures required in order to achieve safety.
4. If firmware upgrade is possible in the product, procedures must be given with any needed tools identified.
   The expected skill level of those doing the work must be specified.
5. The Safety Manual must contain the estimated failure rates (or a reference to the FMEDA report) and an estimate of the beta factor for use when redundant transmitters are designed into the safety instrumented function.
   NOTE - although not required, this would be a good place to include a discussion of impulse line clogging and the common cause implications of that. The achievable SIL must be stated (or a reference to the FMEDA report).
6. If there are any known product lifetime limits, these must be stated.
   Otherwise a statement that there are no known wear-out mechanisms.
   NOTE - although not required, it may be advisable to make some statement about product lifetime even if there are no known wear-out mechanisms.
7. All required parameter settings assumed for safety must be stated.
8. Any application limitations and environmental limits must be stated (or a reference pointing to another document).
9. Worst case diagnostic test time must be stated for the claimed diagnostic test coverage.

IEC 61508-2 specifies particularly in **section 7.4.7.3** the following information which shall be available for each safety-related subsystem:

1. A functional specification of those functions and interfaces of the subsystem which can be used by safety functions.
2. The estimated rates of failure (due to random hardware failures) in any modes which would cause a dangerous failure of the E/E/P E safety-related system, which safe detected by diagnostic tests.
3. The estimated rates of failure (due to random hardware failures) in any modes which would cause a dangerous failure of the E/E/P E safety-related system, which safe undetected by diagnostic tests.
4. Any limits on the environment of the subsystem which should be observed in order to maintain the validity of the estimated rates of failure due to random hardware failures.
5. Any limit on the lifetime of the subsystem which should not be exceeded in order to maintain the validity of the estimated rates of failure due to random hardware failures.
6. Any periodic proof test and/or maintenance requirements.
7. The diagnostic coverage.
8. The diagnostic test interval.
9. Any additional information (for example repair times) which is necessary to allow the derivation of a mean time to restoration (MTTR) following detection of a fault by the diagnostics.
10. All information which is necessary to enable the derivation of the safe failure fraction (SFF) of the subsystem as applied in the E/E/P E safety-related system.

11. The hardware fault tolerance of the subsystem.
12. Any limits on the application of the subsystem which should be observed in order to avoid systematic failures.
13. The highest safety integrity level that can be claimed for a safety function which uses the subsystem on the basis of:
    - measures and techniques used to prevent systematic faults being introduced during the design and implementation of the hardware and software of the subsystem,
    - the design features which make the subsystem tolerant against systematic faults.

    NOTE: This is not required in the case of those subsystems which safe considered to have been proven in use.
14. Any information which is required to identify the hardware and software configuration of the subsystem in order to enable the configuration management of the E/E/P E safety related system in accordance with IEC 61508-1, 6.2.1.
15. Documentary evidence that the subsystem has been validated.

IEC 61511-1 defines the following requirements in **section 12.4.4.7** which the safety manual shall address:

1. Use of diagnostics to perform safe functions.
2. List of certified/verified safety libraries.
3. Mandatory test and system shutdown logic.
4. Use of watchdogs.
5. Requirements for, and limitations of, tools and programming languages.
6. Safety integrity levels for which the device or system is suitable.

10.0 FUNCTIONAL SAFETY MANUAL

for the G.M. International Intrinsically Safe Interface Modules D1000 Series Safety - Related System, SIL 2 - SIL 3, Applications according IEC 61508 & IEC 61511 Standards.

Contents:

10.1 GENERAL

This Safety Manual summarizes the results of hardware assessment carried out on the Repeater – Driver – Interface, Intrinsically safe modules, model D1010, D1014, D1020, D1021, D1032, D1033, D1034, D1040, D1042, D1043, PSD1001, PSD1001C and Temperature Converter D1072S.

Table 1 gives an overview of the different types and specify their Safety Function. The failure rates used in this analysis are the basic failure rates from the Siemens standard SN 29500. According the table 2 of IEC 61508-1 the average PFD for systems operating in low demand mode has to be ≥ $1x10^{-3}$ to < $1x\ 10^{-2}$ for SIL 2 safety functions. However, as the modules under consideration are only one part of an entire safety function they should not claim more then 10% of this range. For SIL 2 application the total PFDavg value of the SIF must be smaller than $1x\ 10^{-2}$, hence the maximum allowable PFDavg value for the given modules would then be $1x\ 10^{-3}$. The listed modules are considered to be Type A (*) components, with a hardware fault tolerance of 0. For type A components the SFF has to be between 60% and 90% for SIL 2 (sub-) systems with a hardware fault tolerance of 0 according to table 2 of IEC 61508-2. Assuming that a connected logic solver can detect both over-range (fail high) and under-range (fail-low), high and low failures can be classified as safe detected failures or dangerous detected failures depending on the application. The summary EXIDA tables, on pages 329 and 330, show how the above stated requirements are fulfilled (considering one input / one output being part of the safety function).

(*) Type A component: **"Non-complex"** component with all failure modes well defined; for details see 7.4.3.1.2 of IEC 61508.

Table 10.1

Model - Output channels - Safety Function Table.

Models	Output Channels	Safety Function
D1010S	1	Isolating Repeater Power Supply Powered, HART compatible.
D1010D	2	Isolating Repeater Power Supply Powered, HART compatible.
D1014S	1	Isolating Repeater Power Supply Powered, HART compatible.
D1014D	2	Isolating Repeater Power Supply Powered, HART compatible.
D1020S	1	Isolating Valve Driver Powered, HART compatible.
D1020D	2	Isolating Valve Driver Powered, HART compatible.
D1021S	1	Isolating Valve Driver Powered, HART compatible.
D1032D	2	Switch-Proximity Detector Repeater Relay output.
D1032Q	4	Switch-Proximity Detector Repeater Relay output.
D1033D	2	Switch-Proximity Detector Repeater O.C. Transistor output.
D1033Q	4	Switch-Proximity Detector Repeater O.C. Transistor output.
D1034S	1	Switch-Proximity Detector Interface mA output.
D1034D	2	Switch-Proximity Detector Interface mA output.
D1040Q	4	Isolating Driver, 22 mA at 13,2 V (per channel).
D1042Q	4	Isolating Driver, 22 mA at 14,5 V (per channel).
D1043Q	4	Isolating Driver, 22 mA at 10,5 V (per channel).
PSD1001	4	Power Supply 20 mA at 15 V (per channel).
PSD1001C	1	Power Supply 100 mA at 13,5 V / 150 mA at 10 V.
D1072S	1	Temperature Transmitter Fully Programmable.

10.2 G.M. D1000 SERIES PRODUCTS - FUNCTIONAL SAFETY SPECIFICATIONS FROM EXIDA ANALYSIS AND REPORT ACCORDING IEC 61508 - IEC 61511

Table 10.2

Functional Safety Specifications.

Model Nr.	Safety Function	SFF	PFDavg	T Proof Test & Maintenance	Hardware Fault Tolerance	Highest SIL that can be claimed	Note On page 338	Fail-Safe Output State	λ_{DU} (FIT)	λ_{Total} (FIT)	MTBF (years)
D1010S 1 Channel	Repeater Power Supply	81%	3,07 E-04	1 Year- 8 hour	0	SIL 2		<4 mA >20 mA	70 FIT	70 FIT	280
D1010D 1 Channel	Repeater Power Supply	81%	3,07 E-04	1 Year- 8 hour	0	SIL 2	1	<4 mA >20 mA	70 FIT	385 FIT	280
D1014S 2 Channel	Repeater Power Supply	90%	1,47 E-04	1 Year- 8 hour	0	SIL 2		<4 mA >20 mA	34 FIT	351 FIT	312
D1014D 2 Channel	Repeater Power Supply	90%	1,47 E-04	1 Year- 8 hour	0 - 1	SIL 2 SIL 3	2	<4 mA >20 mA	34 FIT	351 FIT	312
D1020S 1 Channel	Powered Isolating Driver	70%	5,00 E-04	1 Year- 8 hour	0	SIL 2		<4 mA	114 FIT	393 FIT	276
D1020D 2 Channel	Powered Isolating Driver	70%	5,00 E-04	1 Year- 8 hour	0	SIL 2	1	<4 mA	114 FIT	393 FIT	276
D1021S 1 Channel	Powered Isolating Driver	70%	5,18 E-04	1 Year- 8 hour	0	SIL 2		<4 mA	118 FIT	403 FIT	216
D1032D 2 Channel	Switch-Proximity Detector Repeater Relay out	88%	1,20 E-04	1 Year- 8 hour	0	SIL 2	1	ND	28 FIT	238 FIT	430
D1032Q 4 Channel	Switch-Proximity Detector Repeater Relay out	88%	1,20 E-04	1 Year- 8 hour	0	SIL 2	1	ND	28 FIT	238 FIT	430
D1033D 2 Channel	Switch-Proximity Detector Repeater O.C. out	85%	1,55 E-04	1 Year- 8 hour	0	SIL 2	1	ND	35 FIT	247 FIT	415
D1033Q 4 Channel	Switch-Proximity Detector Repeater O.C. out	85%	1,55 E-04	1 Year- 8 hour	0	SIL 2	1	ND	35 FIT	247 FIT	415
D1034S 1 Channel	Switch-Proximity Detector Interface mA out	89%	1,39 E-04	1 Year- 8 hour	0	SIL 2		<1.2 mA >7 mA	32 FIT	307 FIT	365
D1034D 2 Channel	Switch-Proximity Detector Interface mA out	89%	1,39 E-04	1 Year- 8 hour	0 - 1	SIL 2 SIL 3	2	<1.2 mA >7 mA	32 FIT	307 FIT	365

Table 10.2

Functional Safety Specifications.

Model Nr.	Safety Function	SFF	PFDavg	T Proof Test & Maintenance	Hardware Fault Tolerance	Highest SIL that can be claimed	Note On page 338	Fail-Safe Output State	λ_{DU} (FIT)	λ_{Total} (FIT)	MTBF (years)
D1040Q 4 Channel Bus Powered	**Solenoid Valve Driver**	**83%**	**3,64 E-04**	**1 Year- 8 hour**	**0**	**SIL 2 SIL 3**	**1**	**NE**	**83 FIT**	**428 FIT**	**280**
D1042Q 4 Channel Bus Powered	**Solenoid Valve Driver**	**83%**	**3,64 E-04**	**1 Year- 8 hour**	**0**	**SIL 2 SIL 3**	**1**	**NE**	**83 FIT**	**428 FIT**	**280**
D1043Q 4 Channel Bus Powered	**Solenoid Valve Driver**	**83%**	**3,64 E-04**	**1 Year- 8 hour**	**0**	**SIL 2 SIL 3**	**1**	**NE**	**83 FIT**	**428 FIT**	**280**
PSD1001 4 Channel Bus Power.	**Power Supply**	**83%**	**3,64 E-04**	**1 Year- 8 hour**	**0**	**SIL 2 SIL 3**	**1**	**NE**	**83 FIT**	**428 FIT**	**280**
PSD1001C 1Channel Bus Power.	**Power Supply**	**83%**	**3,64 E-04**	**1 Year- 8 hour**	**0**	**SIL 2 SIL 3**	**1**	**NE**	**83 FIT**	**428 FIT**	**280**
D1040Q 1 Channel Loop Powered	**Solenoid Valve Driver**	**100%**	**0**	**1 Year- 8 hour**	**0**	**SIL 3**	**1**	**ND**	**0 FIT**	**428 FIT**	**283**
D1042Q 1 Channel Loop Powered	**Solenoid Valve Driver**	**100%**	**0**	**1 Year- 8 hour**	**0**	**SIL 3**	**1**	**ND**	**0 FIT**	**428 FIT**	**283**
D1043Q 1 Channel Loop Powered	**Solenoid Valve Driver**	**100%**	**0**	**1 Year- 8 hour**	**0**	**SIL 3**	**1**	**ND**	**0 FIT**	**428 FIT**	**283**
PSD1001 1 Channel Loop Power	**Power Supply**	**100%**	**0**	**1 Year- 8 hour**	**0**	**SIL 3**	**1**	**ND**	**0 FIT**	**428 FIT**	**283**
PSD1001C 1Channel Loop Power.	**Power Supply**	**100%**	**0**	**1 Year- 8 hour**	**0**	**SIL 3**	**1**	**ND**	**0 FIT**	**428 FIT**	**283**
D1072S 1 Channel	**Temperature Converter Fully Programmable mA out**	**80%**	**4,16 E-04**	**1 Year- 8 hour**	**0**	**SIL 2**	**1**	**< 4 mA > 20 mA**	**95 FIT**	**497 FIT**	**208**

10.3 DEFINITIONS AND DESCRIPTION OF FAILURE CATEGORIES

In order to judge the failure behavior of the considered modules, the following definitions for product failure must be considered.

Fail-Safe State for D1010 - D1014 - D1072:
Depending on the application the fail-safe state is defined as the output going to a fail low or fail high.

Fail-Safe State for D1020-D1021:
The fail-safe state is defined as the output going to fail low.

Fail-Safe State for D1032-D1033:
The fail-safe state is defined as the output being de-energized.

Fail-Safe State for D1034:
The fail-safe state is defined as the output being below 1.2 mA or above 7 mA.
Fail-safe state for D1040 - D1042 - D1043 - PSD1001 - PSD1001C is defined as the output being de-energized.

Fail-Safe for D1010 - D1014 - D1020 - D1021 - D1032 - D1033 - D1034 - D1072:
Failure that causes the module / (sub)system to go to the defined fail-safe state without a demand from the process.

Fail Dangerous for D1010 - D1014 - D1020 - D1021 - D1072:
Failure that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state) or deviates the output current by more than 3% of full span (± 0,6 mA).

Fail Dangerous for D1032 - D1033 - D1040 - D1042 - D1043 - PSD1001 - PSD1001C:
Failure that does not respond to a demand from the process (i.e. being unable to go to the defined fail- safe state).

Fail Dangerous for D1034:
Failure that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state); the output current remains between 2,1 mA and 7 mA.

Fail High for D1010 - D1014 - D1020 - D1021 - 1072:
Failure that causes the output signal to go to the maximum output current (i.e. > 21,5 mA).

Fail High for D1034:
Failure that causes the output signal to go above 7 mA (short circuit).

Fail Low for D1010 - D1014 - D1020 - D1021 - 1072:
Failure that causes the output signal to go to the minimum output current (i.e. < 3,6 mA).

Fail Low for D1034:
Failure that causes the output signal to go below 0,35 mA (lead breakage).

Fail No Effect for D1010 - D1014 - D1020 - D1021 - D1072:
Failure of a component that is part of the safety function but that has no effect on the safety function or deviates the output current by no more than 3% of full span.
For the calculation of SFF it is treated like a safe undetected failure.

Fail No Effect for D1032 - D1033 - D1034 - D1040 - D1042 - D1043 - PSD1001 - PSD1001C:
Failure of a component that is part of the safety function but that has no effect on the safety function. For the calculation of SFF it is treated like a safe undetected failure.

GENERAL
Annunciation Undetected:
Failure that does not directly impact safety but does impact the ability to detect a future fault (such as a fault in a diagnostic circuit) and that is not detected by internal diagnostics.
For the calculation of the SFF it is treated like a safe undetected failure.

No Part:
Failure of a component which is not part of the safety function but part of the circuit diagram and is listed for completeness.
When calculating the SFF this failure mode is not taken into account. It is also not part of the total failure rates. The failure categories listed above expand on the categories listed in the IEC 61508 which are only safe or dangerous, both detected and undetected. The reason for this is that, depending on the application programming of the safety logic solver, a fail low or fail high can either be dangerous detected or safe detected. Consequently during a SIL verification assessment the fail high and fail low need to be classified as either safe detected (SD) and dangerous detected (DD).
The Annunciation Undetected failures are provided for those who wish to do reliability modeling more detailed that required by IEC 61508.
In the IEC 61508 the "No Effect" and "Annunciation Undetected" failures are defined as safe undetected failure even though they will not cause the safety function to go to a safe state. Therefore they need to be considered in the Safe Failure Fraction calculation.

TERMS AND DEFINITIONS

DC: Diagnostic coverage (safe or dangerous failure) of the safety logic solver for the considered module

DCs = λsd / (λsd + λsu).

DCd = λdd / (λdd + λdu).

FIT: Failure In Time (1×10^{-9} failures per hour).

Low demand mode:
Mode, where the frequency of demands for operation made on Safety-related system is no greater than one per year and no greater than twice the proof test frequency.

MTBF: Mean Time Before Failure.

MTTF: Mean Time To Failure.

MTTR: Mean Time To Repair.

PFDavg:
Average Probability of Failures on Demand.

SFF: Safe Failure Fraction, according IEC 61508 summarizes the fraction of failures, which lead to a safe state and the fraction of failure which will be detected by diagnostic measures and lead to a defined safety action.

$$SFF = 1 - \frac{\lambda du}{\lambda dd + \lambda du + \lambda sd + \lambda su}$$

Where **λdd** Dangerous Detected failure rates;
λdu Dangerous Undetected failure rate
λsd Safe Detected failure rate;
λsu Safe Undetected failure rate

SIL: Safety Integrity Level.

T Proof Test & Maintenance:
Proof test Interval (f.e. 1, 5 or 10 years with 8 hours maintenance).

10.4 ASSUMPTIONS

The following assumptions have been made during the Failure Modes, Effects, and Diagnostic Analysis of the Repeater / Driver / Interface Modules D1010, D1014, D1020, D1021, D1032, D1033, D1034, D1040, D1042, D1043, PSD1001, PSD1001C and D1072.

10.4.1 Failure rates are constant, wear out mechanisms are not included.

10.4.2 Propagation of failures is not relevant.

10.4.3 The HART protocol is only used for setup, calibration, and diagnostic purposes, not for safety critical operation.

10.4.4 The time to restoration after a safe failure is 8 hours.

10.4.5 The test time of the logic solver to react on a dangerous failure is 1 hour.

10.4.6 The average temperature over a long period of time is 40 °C.

10.4.7 The stress levels are average for an industrial environment and can be compared to the Ground Fixed classification of MIL-HNBK-217F. Alternatively, the assumed environment is similar to: IEC 60654-1. Class C (Sheltered location) with temperature limits within the manufacturer's rating and an average temperature over a long period of time of 40 °C. Humidity levels are assumed within manufacturer's rating.

10.4.8 All modules are operated in the low demand mode of operation.

10.4.9 At the D1010, D1014, D1020, D1021, D1034 and D1072 modules only the current output is used for safety applications.

10.4.10 For D1032, D1033, D1040, D1042, D1043, PSD1001, PSD1001C modules the de-energized state is assumed to be the safe state.

10.4.11 For D1020 and D1021 modules the default fail-safe state is "fail low".

10.4.12 External power supply failure rates are not included.

10.4.13 Only one input and one output are part of the safety function.

10.4.14 The application program in the safety logic solver is constructed in such a way that fail low and fail high failures are detected regardless of the effect, safe or dangerous, on the safety function.

10.4.15 Sufficient test are performed prior to schipment to verify the absence of vendor and/or manufacturing defects that prevent proper operation of specified functionality to product specifications or cause operation different from design analyzed.

10.5 SUMMARY OF DATA FROM EXIDA

10.5.1 SUMMARY FOR D1010 ISOLATED POWER SUPPLY REPEATER

Table 10.5.1 / 2

Failure Rates

Failure Category	Failure Rates in FIT
Fail High (detected by the logic solver)	38
Fail Low (detected by the logic solver)	97
Fail Dangerous Undetected	70
No Effect	180
Annunciation Undetected	0
No Part	23
MTBF = MTTF + MTTR	280 years

Table 10.5.1 / 3

Failure Rates According to IEC 61508

Failure Categories	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	DCs	DCd
λlow - λsd $\lambda high$ - λdd	97 FIT	180 FIT	38 FIT	70 FIT	81%	35%	35%
λlow - λdd $\lambda high$ - λsd	38 FIT	180 FIT	97 FIT	70 FIT	81%	17%	58%
λlow - λsd $\lambda high$ - λsd	135 FIT	180 FIT	0 FIT	70 FIT	81%	45%	0%

Table 10.5.1 / 4

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 3,07E-04 (see note 3)	PFDavg = 1,54E-03 (see note 4)	PFDavg = 3,07E-03 (see note 4)

10.5.2 SUMMARY FOR D1014 ISOLATED POWER SUPPLY REPEATER

Table 10.5.2/ 5

Failure Rates

Failure Category	Failure Rates in FIT
Fail High (detected by the logic solver)	63
Fail Low (detected by the logic solver)	126
Fail Dangerous Undetected	34
No Effect	128
Annunciation Undetected	0
No Part	15
MTBF = MTTF + MTTR	312 years

Table 10.5.2 / 6

Failure Rates According to IEC 61508

Failure Categories	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	DCs	DCd
λ_{low} - λ_{sd} λ_{high} - λ_{dd}	126 FIT	128 FIT	63 FIT	34 FIT	90%	50%	65%
λ_{low} - λ_{dd} λ_{high} - λ_{sd}	63 FIT	128 FIT	126 FIT	34 FIT	90%	33%	79%
λ_{low} - λ_{sd} λ_{high} - λ_{sd}	189 FIT	128 FIT	0 FIT	34 FIT	90%	60%	0%

Table 10.5.2 / 7

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 1,47E-04 (see note 3)	PFDavg = 7,36E-04 (see note 3)	PFDavg = 1,47E-03 (see note 4)

10.5.3 SUMMARY FOR D1020 ISOLATED DRIVER FOR I/P

Table 10.5.3 / 8

Failure Rates According to IEC 61508

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF
0 FIT	279 FIT	0 FIT	114 FIT	70%

Table 10.5.3 / 9

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 5,00E-04 (see note 3)	PFDavg = 2,5E-03 (see note 4)	PFDavg = 4,99E-03 (see note 4)

10.5.4 SUMMARY FOR D1021 ISOLATED DRIVER FOR I/P

Table 10.5.4 / 10

Failure Rates According to IEC 61508

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF
0 FIT	285 FIT	0 FIT	118 FIT	70%

Table 10.5.4 / 11

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 5,18E-04 (see note 3)	PFDavg = 2,59E-03 (see note 4)	PFDavg = 5,16E-03 (see note 4)

10.5.5 SUMMARY FOR D1032 ISOLATED CONTACT-PROXIMITY DETECTOR REPEATER RELAY OUTPUT

Table 10.5.5 / 12

Failure Rates According to IEC 61508

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF
0 FIT	210 FIT	0 FIT	28 FIT	88%

Table 10.5.5 / 13

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 1,20E-04 (see note 3)	PFDavg = 6,02E-04 (see note 3)	PFDavg = 1,20E-03 (see note 4)

10.5.6 SUMMARY FOR D1033 ISOLATED CONTACT-PROXIMITY DETECTOR REPEATER OPEN COLLECTOR TRANSISTOR OUTPUT

Table 10.5.6 / 14

Failure Rates According to IEC 61508

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF
0 FIT	212 FIT	0 FIT	35 FIT	85%

Table 10.5.6 / 15

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 1,55 E-04 (see note 3)	PFDavg = 7,72E-04 (see note 3)	PFDavg = 1,54E-03 (see note 4)

10.5.7 SUMMARY FOR D1034 ISOLATED CONTACT-PROXIMITY DETECTOR INTERFACE CURRENT OUTPUT

Table 10.5.7/ 16

Failure Rates

Failure Category	Failure Rates in FIT
Fail High (detected by the logic solver)	41
Fail Low (detected by the logic solver)	66
Fail Dangerous Undetected	32
No Effect	168
Annunciation Undetected	0
No Part	6
MTBF = MTTF + MTTR	365 years

Table 10.5.7 / 17

Failure Rates According to IEC 61508

Failure Categories	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	DCs	DCd
λlow - λsd λhigh - λdd	66 FIT	168 FIT	41 FIT	32 FIT	89%	28%	56%
λlow - λdd λhigh - λsd	41 FIT	168 FIT	66 FIT	32 FIT	89%	20%	67%
λlow - λsd λhigh - λsd	107 FIT	168 FIT	0 FIT	32 FIT	89%	39%	0%

Table 10.5.7 / 18

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 1,39E-04 (see note 3)	PFDavg = 6,97E-04 (see note 3)	PFDavg = 1,39E-03 (see note 4)

10.5.8 SUMMARY FOR D1040 - D1042 - D1043- PSD1001 - PSD1001C SOLENOID VALVE DRIVERS AND POWER SUPPLIES

Table 10.5.8/ 19

Failure Rates

Failure Category	Failure Rates in FIT
No Effect	135
Annunciation Undetected	240
No Part	426
MTBF = MTTF + MTTR	248 years

Table 10.5.8 / 20

Failure Rates According to IEC 61508 for Bus Powered Mode

λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	DCs	DCd
0 FIT	334 FIT	1 FIT	83 FIT	80,12%	0%	0%

Table 10.5.8 / 21

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 3,64 E-04 (see note 3)	PFDavg = 1,82 E-03 (see note 4)	PFDavg = 3,63 E-03 (see note 4)

Because the loop powered modules are directly driven from the digital output of a safety PLC there is no additional power supply which can keep the output energised in case of an internal fault. Thus all internal faults have either no effect on the safety function or lead to a safe state. The Digital Output Modules D1040, D1042, D1043, PSD1001, PSD1001C, when configured in loop powerde mode can be used for SIL 3 safety applications.
The following show how the above stated requirements are fulfilled.

Table 10.5.8 / 22

Sommary - Loop Powered Mode

λ_{SAFE}	$\lambda_{DANGEROUS}$	SFF	PFD_{AWG}
418 FIT	0 FIT	100%	0

10.5.9 SUMMARY FOR D1072 ISOLATED TEMPERATURE CONVERTER

Table 10.5.9/ 23

Failure Rates

Failure Category	Failure Rates in FIT
Fail Dangerous detected	267
Fail detected by internal diagnostic	65
Fail High (detected by the logic solver)	82
Fail Low (detected by the logic solver)	120
Fail Dangerous Undetected	95
No Effect	134
Annunciation Undetected	1
No Part	51
MTBF = MTTF + MTTR	208 years

Table 10.5.9 / 24

Failure Rates According to IEC 61508

Failure Categories	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	DCs	DCd
λlow - λsd λhigh - λdd	0 FIT	135 FIT	267 FIT	95 FIT	80%	0%	73%

Table 10.5.9 / 25

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 4,16E-04 (see note 3)	PFDavg = 2,08E-03 (see note 4)	PFDavg = 4,15E-03 (see note 4)

10.6 NOTES

Note 1: The 2 channels of D1010D and D1020D and the 4 channels of D1032Q and D1033Q modules should not be used to increase the hardware fault tolerance, needed for a higher SIL of a certain Safety Function, as they contain common components.

Note 2: The 2 channels of D1014D and D1034D modules could be used to increase the hardware fault tolerance, needed for a higher SIL of a certain Safety Function, as they do not contain common components.

Note 3: The calculated PFDavg values are within the allowed range for SIL 2 according to table 2 of IEC 61508-1 and table 3.1 of ANSI/ISA-84.01-1996 and do fulfill the requirement to not claim more then 10% of the required range, i.e. to be better than or equal to 1,00E-03.

Note 4: The calculated PFDavg values are within the allowed range for SIL 2 according to table 2 of IEC 61508-1 but do not fulfill the requirement to not claim more than 10% of the required range, i.e. to be better than or equal to 1,00E-03.

Note 5: A user of the modules D1010, D1014, D1020, D1020, D1021, D1032, D1033 and D1034 can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full table of failure rates for different operating conditions is presented in page 333-335 along with assumptions.

Note 6: It is important to realize that the “don’t care” failures and the “annunciation” failures on their own will not effect system reliability or safety, and should not be included in spurious trip calculations.

Note 7: Usually, isolators have a PFD, which claims 10% of the total PFD value of the required SIL in the functional safety-related loop. All PFD value in the manual are less than 10% of PFD max.

10.7 PROOF TEST

10.7.1 POSSIBILITIES TO REVEAL DANGEROUS UNDETECTED FAULTS DURING THE PROOF TEST

According to section 7.4.3.2.2 f) of IEC 61508-2 proof test shall be undertaken to reveal dangerous faults which are undetected by diagnostic tests.

This means that it is necessary to specify how dangerous undetected faults which have been noted during the FMEDA can be detected during proof testing.

10.7.2 POSSIBLE PROOF TEST TO DETECT DANGEROUS UNDETECTED FAULTS IN THE D1010 - D1014 MODULES

Proof test 1 consists of the following steps, as described in Table 10.7.2/1 below.

Table 10.7.2 / 1

Steps for the Proof Test 1

Steps	Action
1	Bypass the safety-related PLC or take other appropriate action to avoid a false trip.
2	Send a HART command to the repeater to go to the high alarm current output and verify that the analog current reaches that value. This test for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.
3	Send a HART command to the repeater to go to the low alarm current output and verify that the analog current reaches that value. This test for possible quiescent current related failures.
4	Restore the loop to full operation.
5	Remove the bypass from the safety-related PLC or otherwise restore normal operation.

This test will detect approximately 50% of possible “du” failures in the repeater.

Proof test 2 consists of the following steps, as described in Table 10.7.2/2.

Table 10.7.2 / 2

Steps for the Proof Test 2

Steps	Action
1	Bypass the safety-related PLC or take other appropriate action to avoid a false trip.
2	Perform step 2 and 3 of the Proof Test 1 (on table 26).
3	Perform a two-point calibration (i.e. down and full scale) of the connected transmitter and verify that the current output value stay within the specified values. This requires that the transmitter has already been tested without the repeater and does not contain any further dangerous undetected faults.
4	Restore the loop to full operation.
5	Remove the bypass from the safety-related PLC or otherwise restore normal operation.

This test will detect approximately 99% of possible "du" failures in the repeater.

10.7.3 POSSIBLE PROOF TEST TO DETECT DANGEROUS UNDETECTED FAULTS IN THE D1032 - D1033 MODULES

Proof test 1 consists of the following steps, as described in Table 10.7.3 below.

Note for contacts input:

To detect a wire break, or a short circuit condition, in the input connections it is necessary to mount, close to the contacts, 1 K Ω resistor in series and 10 K Ω resistor in parallel to the contacts.

Table 10.7.3

Steps for the Proof Test

Steps	Action
1	Bypass the safety-related PLC or take other appropriate action to avoid a false trip.
2	Vary the state conditions of the input sensors/contacts coming from field and verify that relay/transistor outputs change from energized to de-energized and vice versa, and check that the de-energized state condition correspond to the required safety-related function.
3	Disconnect the input wiring coming from the field sensor/contact and check that the proper wire break alarm output is de-energized. Short the input connections and verify that the same output remains de-energized. In both case the proper alarm LEDs , on the front panel, will become red.
4	Restore the loop to full operation.
5	Remove the bypass from the safety-related PLC or otherwise restore normal operation.

This test will detect approximately 99% of possible "du" failures in the repeater.

10.7.4 POSSIBLE PROOF TEST TO DETECT DANGEROUS UNDETECTED FAULTS IN THE D1034 MODULES

Proof test 1 consists of the following steps, as described in Table 10.7.4.

Note for contacts input: To detect a wire break, or a short circuit condition, in the input connections it is necessary to mount, close to the contacts, 1 K Ω resistor in series and 10 K Ω resistor in parallel to the contacts.

Table 10.7.4

Steps for the Proof Test

Steps	Action
1	Take appropriate action to avoid a false trip.
2	Contacts input: Vary the state conditions of the input sensors/contacts connected in the field and verify that. The value of output current is about 4 mA for closed contacts and about 0,66 mA for open contacts. Proximity input: Vary the state conditions of the proximity switches connected in the field from ON to OFF conditions and verify that the these conditions are correctly transferred to the PLC.
3	Disconnect the input wiring coming from the field sensor/contact and check that the output for open connection conditions is equal or less than 0,35 mA, and for short circuit conditions equal or above 6,8 mA.
4	Restore the loop to full operation.
5	Restore normal operation.

This test will detect approximately 99% of possible “du” failures in the driver.

10.7.5 POSSIBLE PROOF TEST TO DETECT DANGEROUS UNDETECTED FAULTS IN THE D1020 – D1021 MODULES

Proof test 1 consists of the following steps, as described in Table 10.7.5/1 below.

Table 10.7.5 / 1

Steps for the Proof Test 1

Steps	Action
1	Take appropriate action to avoid a false trip.
2	Provide a 20 mA control signal to the driver to open/close the valve and verify that the valve is open/closed. This test for compliance voltage problems such as a loop power supply voltage or increased wiring resistance. This also tests for other possible failures. It requires, however, that the positioner has already been tested without the driver and does not contain any further dangerous undetected faults.
3	Provide a 4 mA control signal to the driver to close/open the valve and verify that the valve is closed/open. This test for possible quiescent current related failures. It requires, however, that the positioner has already been tested without the driver and does not contain any further dangerous undetected faults.
4	Restore the loop to full operation.
5	Restore normal operation.

This test will detect approximately 70% of possible “du” failures in the driver.

Proof test 1 consists of the following steps, as described in Table 10.7.5/2 below.

Table 10.7.5 / 2

Steps for the Proof Test 2

Steps	Action
1	Take appropriate action to avoid a false trip.
2	Perform Step 2 and 3 of Proof Test 1.
3	Perform a two-point calibration of the positioner (i.e. 4mA and 20mA) and verify that the output current from the module is within the specified accuracy. It requires, however, that the positioner has already been tested without the driver and does not contain any further dangerous undetected faults.
4	Restore the loop to full operation.
5	Restore normal operation.

This test will detect approximately 95% of possible “du” failures in the driver.

10.7.6 POSSIBLE PROOF TEST TO DETECT DANGEROUS UNDETECTED FAULTS IN THE D1040 – D1042 - D1043 - PSD1001 - PSD1001C MODULES

Table 10.7.6

Steps for the Proof Test

Steps	Action
1	Take appropriate action to avoid a false trip.
2	Provide a control signal to the Digital Output Modules D104* and PSD1001 (C) to open/close the driven output and verify that the driven output is open/closed.
3	Restore the loop to full operation.
4	Restore normal operation.

This test will detect approximately 99% of possible “du” failures D1040 - D1042 - D1043 - PSD1001 - PSD1001C Modules.

10.7.7 POSSIBLE PROOF TEST TO DETECT DANGEROUS UNDETECTED FAULTS IN THE D1072 TEMPERATURE CONVERTER MODULES

Table 10.7.7

Steps for the Proof Test 1

Steps	Action
1	Bypass the safety PLC or take other appropriate action to avoid a false trip.
2	Send a command to the temperature converter to go to the high alarm current output and verify that the analog current reaches that value. This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for others possible failures.
3	Send a command to the temperature converter to go to the low alarm current output and verify that the analog current reaches that value. This tests for possible quiescent current failures..
4	Restore the loop to full operation.
5	Restore normal operation.

This test will detect approximately 50% of possible “du” failures in the temperature converter D1072S.

Table 10.7.7

Steps for the Proof Test 1

Steps	Action
1	Bypass the safety PLC or take other appropriate action to avoid a false trip.
2	Send a command to the temperature converter to go to the high alarm current output and verify that the analog current reaches that value. This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for others possible failures.
3	Send a command to the temperature converter to go to the low alarm current output and verify that the analog current reaches that value. This tests for possible quiescent current failures..
4	Restore the loop to full operation.
5	Restore normal operation.

This test will detect approximately 90% of possible “du” failures in the temperature converter D1072S.

10.8 IMPACT OF LIFETIME OF CRITICAL COMPONENTS ON THE FAILURE RATE

Although a constant failure rate is assumed by the probabilistic estimation method (see 3 and 4 section) this only applies provided that the useful lifetime of components is not exceeded. Beyond this useful lifetime, the result of the probabilistic calculation method is meaningless as the probability of failure significantly increases with time. The useful lifetime is highly dependent on the component itself and its operating conditions – temperature in particular (for example, electrolyte capacitors can be very sensitive to temperature).

This assumption of a constant failure rate is based on the bathtub curve, which shows the typical behavior for electronic components. Therefore it is obvious that PFDavg calculation is only valid for components that have this constant domain and that the validity of the calculation is limited to the useful lifetime of each component.

It is assumed that early failures are detected to a huge percentage during the installation period and therefore the assumption of a constant failure rate during the useful lifetime is valid. However, according to section 7.4.7.4 of IEC 61508-2, a useful lifetime, based on experience, should be assumed. According to section 7.4.7.4 note 3 of the IEC 61508-2 experience has shown that the useful lifetime often lies within a range of about 10-15 years.

11.0 HOW TO USE THE INFORMATION AVAILABLE IN THE SAFETY MANUALS IN A FUNCTIONAL SAFETY CONTROL LOOP DESIGN, VERIFICATION OR VALIDATION ASSESSMENT

Safety Integrity Level (SIL)	Probability of failure on Demand per year (or low demand) (PFD)	Safety Availability (1 - PFD)	Risk Reduction Factor (RRF = 1/PFD)	Probability of Dangerous failure per hour (continuous mode or high demand) (PFD)
SIL 4	$>= 10^{-5}$ to $< 10^{-4}$	99,99 - 99,999%	from 100000 to 10000	$>= 10^{-9}$ to $< 10^{-8}$
SIL 3	$>= 10^{-4}$ to $< 10^{-3}$	99,9 - 99,99%	from 10000 to 1000	$>= 10^{-8}$ to $< 10^{-7}$
SIL 2	$>= 10^{-3}$ to $< 10^{-2}$	99 - 99,9%	from 1000 to 100	$>= 10^{-7}$ to $< 10^{-6}$
SIL 1	$>= 10^{-2}$ to $< 10^{-1}$	90 - 99%	from 100 to 10	$>= 10^{-6}$ to $< 10^{-5}$

Figure 3: SIL Table for Demand and Continuous mode of operation.

Table 4

Type A Safe Failure Fraction chart.

Safe failure fraction	Hardware fault tolerant		
	0	1	2
< 60%	SIL1	SIL2	SIL3
60% - < 90%	SIL2	SIL3	SIL4
90% - <99%	SIL3	SIL4	SIL4
≥99%	SIL3	SIL4	SIL4

Table 5

Type B Safe Failure Fraction chart.

Safe failure fraction	Hardware fault tolerant See Note1		
	0	1	2
< 60%	Not allowed	SIL1	SIL2
60% - < 90%	SIL1	SIL2	SIL3
90% - <99%	SIL2	SIL3	SIL4
≥99%	SIL3	SIL4	SIL4

Note1: a hardware fault tolerance of N means that N+1 faults could cause a loss of the safety function.

In Figure 3, the value of PFDavg required for each SIL level according to the standard IEC 61508 has been indicated.
The SFF value has to be related to the types of components (A or B) according the Table 4 and 5.
These values of SFF and PFDavg, are related to a safety function in the safety-related system.

11.1 CALCULATING AVERAGE PFD (PFDavg)

The value of reliability for a control loop will be determined by experience proven in use of components and sub-systems, by failure rates estimated during project phase and obtained from FMEDA analysis, by operating conditions, by type of process under control and so on.
For the specific case in Fig. 26 we have a SIL2 differential pressure transmitter, a SIL2 isolated barrier D1014, a SIL2 or SIL3 control unit and a SIL1 valve.

NOTE: All the sub-systems in the loop are connected in series (architecture 1oo1), SIL level is determined by the lowest SIL level among them.
Therefore, in this case, the level of the safety function will be SIL1.
If it is wanted a SIL2 for the entire function, choices is to use a SIL2 valve, or to insert a redundant final element with a 1oo2 architecture; and this can happen only if reliability data allows this connection.

For calculating the entire loop's reliability, the PFDavg, PFDavg values for each of the sub-systems must first be found and then be given a proportional value compared to the total 100% PFDavg of the entire safety function.

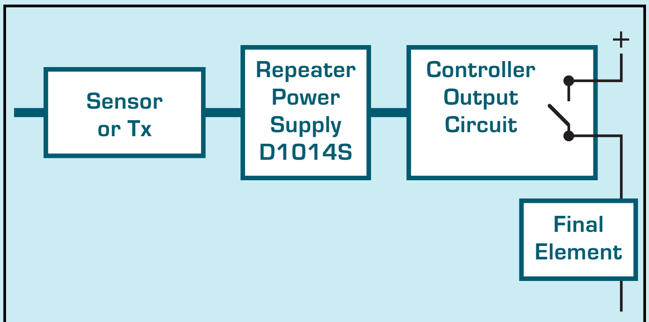


Figure 26

Following could be typical values:

Differential pressure transmitter:	25%
Intrinsically safe Isolator (D1014)	10%
PLC or controller	30%
Valve + actuator	35%
Loop	100%

These values must be assigned by responsible for the project together with personnel in charge of the process and plant maintenance where the safety-related system is situated.
HAZOP, LOPA (Layers of Protection Analysis) and other analysis may be used for help.

PFDavg values for every G.M. International isolators were made considering them the 10% of the total value.
This means that these values are 10 times lower than the maximum allowed by tables in IEC 61508 and IEC 61511. (see fig. 3)

For the 1oo1 architecture, the following equation is to be used:

$$PFDavg\ (T1) = \boldsymbol{\lambda dd} * RT + \boldsymbol{\lambda du} * T1/2$$

Where: **RT** is repairing time in hours (conventionally set to 8 hours).

T1 is the “Tproof test”, meaning the time between circuit functional tests (one, five or ten years).

λdd is the failure rate for dangerous detected failures (of the entire safety function).

λdu is the failure rate for dangerous detected failures (of the entire safety function).

The above equation therefore can be simplified in:

$$PFDavg = \boldsymbol{\lambda dd} * 8 + \boldsymbol{\lambda du} * 4380$$

λdd * 8 is often a negligible quantity compared to **λdu** * 4380. This is even more plausible for small **λdd** failure rates and for greater "Proof tests". Approximation techniques generate the following formula:

PFDavg = **λdu** * T1/2

That is:

PFDavg = **λdu** * 4380 (T1 = 1 year).
= **λdu** * 21900 (T1 = 5 years).
= **λdu** * 43800 (T1 = 10 years).

G.M. International is a manufacturer of intrinsically safe interfaces for potentially explosive process areas, suitable both for analog and digital inputs and outputs.

For this reason, as an example, below are described the criteria for the choice of an isolated repeater power supply D1014 suitable for SIL2 level, with a T proof of up to 5 years and for SIL3 with T proof of 8 mounth or up to 5 years with 2 channel in redundant configuration.

Considerations made for the D1014 interface may be extended to all other sub-systems which compose the control loop.

The procedure of reading the instruction manuals supplied by the various manufacturers is the same, on condition that every necessary information are given.

Eg. To obtain a SIL2 level for the entire control loop, in other words, the average PFD level, has to be between $1 * 10^{-3}$ and $1 * 10^{-2}$ per year, in a low demand mode, and between $1 * 10^{-7}$ and $1 * 10^{-6}$ per hour in high demand mode (see table 3).

PFDavg (sys) = PFDavg (tx) + PFDavg (i) +
+ PFDavg (c) + PFDavg (fe)

Since the isolator's PFDavg (i) must not exceed 10% of the total, it will have to remain between $1 * 10^{-4}$ and $1 * 10^{-3}$ per year in a low demand mode, and between $1 * 10^{-8}$ and $1 * 10^{-7}$ per hour in a high demand mode.

Similar calculations can be done for every other sub-systems, in accordance to their "weight" in the loop.

Failure rates and PFDavg values referred to D1014 are found in the safety manual.

Table 10.5.2/ 5

Failure Rates

Failure Category	Failure Rates in FIT
Fail High (detected by the logic solver)	63
Fail Low (detected by the logic solver)	126
Fail Dangerous Undetected	34
No Effect	128
Annunciation Undetected	0
No Part	15
MTBF = MTTF + MTTR	312 years

Table 10.5.2 / 6

Failure Rates According to IEC 61508

Failure Categories	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}	SFF	DCs	DCd
λlow - λsd λhigh - λdd	126 FIT	128 FIT	63 FIT	34 FIT	90%	50%	65%
λlow - λdd λhigh - λsd	63 FIT	128 FIT	126 FIT	34 FIT	90%	33%	79%
λlow - λsd λhigh - λsd	189 FIT	128 FIT	0 FIT	34 FIT	90%	60%	0%

Table 10.5.2 / 7

PFDavg values

T [Proof] = 1 year	T [Proof] = 5 years	T [Proof] = 10 years
PFDavg = 1,47E-04	PFDavg = 7,36E-04	PFDavg = 1,47E-03

Remembering that FIT (Failure in Time) is equal to $1 * 10^{-9}$ per hour and reading values from the above tables, the following conclusions can be derived:

1. D1014 is a type A component with a 90% SFF value and therefore can be used both in SIL2 and SIL3 applications.
2. PFDavg having "T proof" up to 8 mounth allows D1014 to be used in SIL3 safety functions in single channel (D1014S).
3. PFDavg having "T proof" up to 5 years allows D1014 to be used in SIL3 safety functions when the two channels are used in a redundant configuration (1oo2).
4. PFDavg having "T proof" up to 5 years allows D1014 to be used in SIL2 safety functions.
5. PFDavg having "T proof" from 5 to 10 years allows D1014 to be used in SIL1 safety functions;

What will have to be done at "Tproof" ends, after 1 - 5 - 10 years, to verify "dangerous undetected" failures?

Indications are given in tables 10.7.2/1 and 10.7.2/2, referring to D1014, in the safety manual:

This test will detect approximately 50% of possible "du" failures in the repeater.

This test will detect approximately 99% of possible "du" failures in the repeater.

Table 10.7.2 / 1

Steps for the Proof Test 1

Steps	Action
1	Bypass the safety-related PLC or take other appropriate action to avoid a false trip.
2	Send a HART command to the repeater to go to the high alarm current output and verify that the analog current reaches that value. This test for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.
3	Send a HART command to the repeater to go to the low alarm current output and verify that the analog current reaches that value. This test for possible quiescent current related failures.
4	Restore the loop to full operation.
5	Remove the bypass from the safety-related PLC or otherwise restore normal operation.

Table 10.7.2 / 2

Steps for the Proof Test 2

Steps	Action
1	Bypass the safety-related PLC or take other appropriate action to avoid a false trip.
2	Perform step 2 and 3 of the Proof Test 1 (on table 26).
3	Perform a two-point calibration (i.e. down and full scale) of the connected transmitter and verify that the current output value stay within the specified values. This requires that the transmitter has already been tested without the repeater and does not contain any further dangerous undetected faults.
4	Restore the loop to full operation.
5	Remove the bypass from the safety-related PLC or otherwise restore normal operation.

What was done for D1014 must also be done for the transmitter, the controller and for the valve.
If the total PFDavg does not reach the wanted SIL2 level value for the safety function, or the end user desires to reach a higher SIL3 level for the safety function, it is necessary to switch from a 1oo1 to a 1oo2 architecture.
This is to reduce most of the effects given by dangerous undetected failure rates **λdu**.
Both **λduc** (common dangerous undetected failure rates) and **λdun** (normal dangerous undetected failure rates).
For the de-energize-to-trip systems, a series connection of two output circuits requires that both controllers fail in a dangerous manner for the system to fail dangerously.
The 1oo2 architecture system offers very low probability of failure on demand, but it increases the probability of a fail-safe failure.
PFDavg for the entire safety function is calculated with the following formula:

$$PFDavg=\lambda duc*(T1/2)+\lambda ddc*RT+(\lambda ddn*RT)^2+$$
$$+(\lambda ddn*RT*\lambda dun*T1)^2/2+(\lambda dun*T1)^2/3$$

The above formula can be simplified in case of very low failure rates as follows:

$$PFDavg=(\lambda ddn*RT)^2 *$$
$$(\lambda ddn*RT*\lambda dun*T1)^2/2 + \quad +(\lambda dun*T1)^2/3$$

As example and to highlight its benefits, it is possible to verify the values of PFDavg for sub-system D1014 in 1oo1 and 1oo2 architectures.

Similarly it will be possible to calculate PFDavg of other sub-systems and of the entire function.
From table 10.5.2 in the safety manual, D1014 dangerous undetected failure rates are 34 FIT.
Substituting this value in the formulas for calculating PFDavg (considering Tproof = 1year):

PFDavg (1oo1) = 34* 10 E-9 * 4380 =
= 0.000148920 = 148920 FIT

PFDavg (1oo2) = 0.000000045 +
+ 0.000000030 =
= 0.000000075 = 75 FIT

There is a big difference between the two values.
Probability of failure on demand per hour drops from 0,000148920 down to 0,000000075 FIT.
PFDavg (1oo2) is about 2000 times smaller than PFDavg (1001).
The need to insert a redundant circuit is to be considered every time a SIL level “step-up” is necessary.
This assumes the use of two transmitters on the inputs and a “voting” circuit in the final element, able to identify which of the two D1014 channels is in the state of functional failure.
It will not always be necessary to introduce redundant elements in every sub-systems in the control loop.
If, for instance, the SIL level of the sub-systems is:

Transmitter:	SIL 2
Isolator:	SIL 2
Controller:	SIL 3
Actuator + control valve:	SIL 1

In this case only the final element will need redundancy.
A more frequent case is the request for a SIL3 lever for a safety function using:

Transmitter:	SIL 2
Isolator:	SIL 2
Controller:	SIL 3
Actuator + control valve:	SIL 2

This application requires: two redundant SIL2 transmitters on the same point of measure; a double isolator with two completely independent circuits, like D1014D; one SIL3 controller and two final elements set as redundant on the same output control circuit.

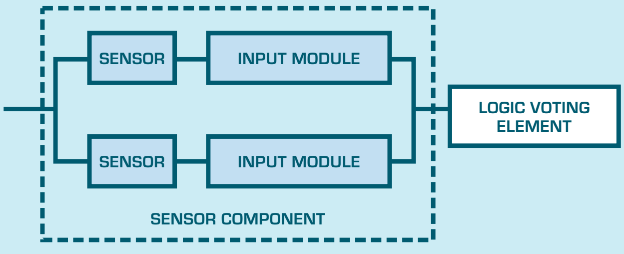


Figure 27

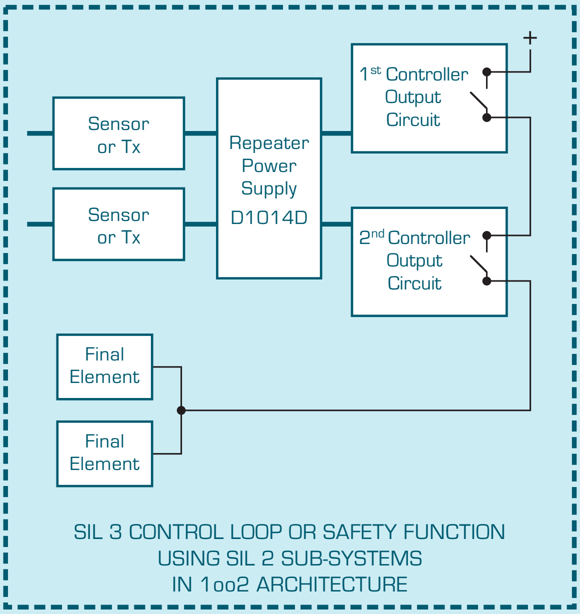


Figure 28

Final considerations:

1. Because for each application it has to be calculated the values of SFF and PFDavg, it is important to have all the necessary data and specifications that should be available in the safety manual for each sub-system.

2. In valuating alternative suppliers for the same sub-system it is important to check which of them have:
   - The highest level of SIL.
   - The highest value of SFF.
   - The highest value of T proof for the same SIL level.
   - The lowest value of PFDavg for the same T proof.

3. For sub-systems (like isolator D1014D) which have two, or more, independent channel in one unit, it is important to check which of the alternative suppliers have two independent power supply circuits in the unit. If they have only one power supply for the two channels, the safety function allows only one of the two channels. Instead, if the two units have two independent power supplies, the safety function allows the use of both of them.
   Typical application is the architecture 1oo2 in Figure 28.

4. According to section 7.4.3.2.2 f) of IEC 61508-2 a proof test shall to reveal dangerous faults which are undetected by diagnostic tests.
   This means that it is necessary to specify, in the safety manual, how dangerous undetected faults, which have been noted during the FMEDA, can be detected during proof testing, by means of test procedures.

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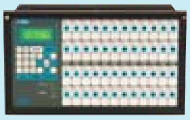
If requested, an estimate of repair charges will be supplied which are not covered under the terms of this warranty.

NOTES:



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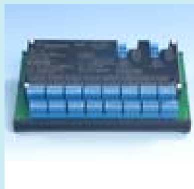

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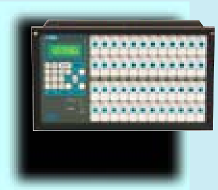

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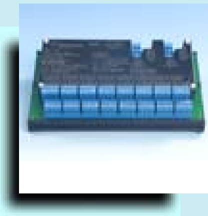

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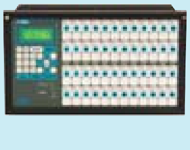

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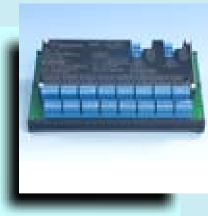

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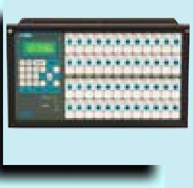

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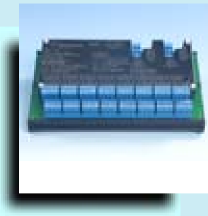

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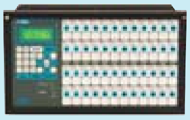

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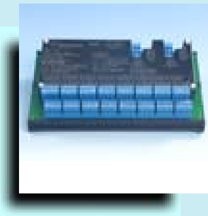


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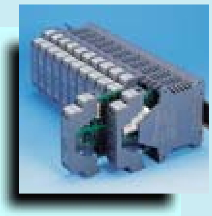
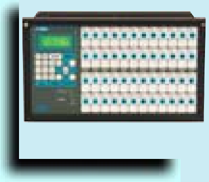






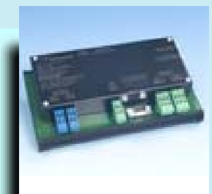


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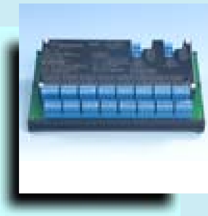

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