

Covers:

- D2010M
- D2011M
- D2030M
- D2050M
- D2052M
- D2053M



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1 General

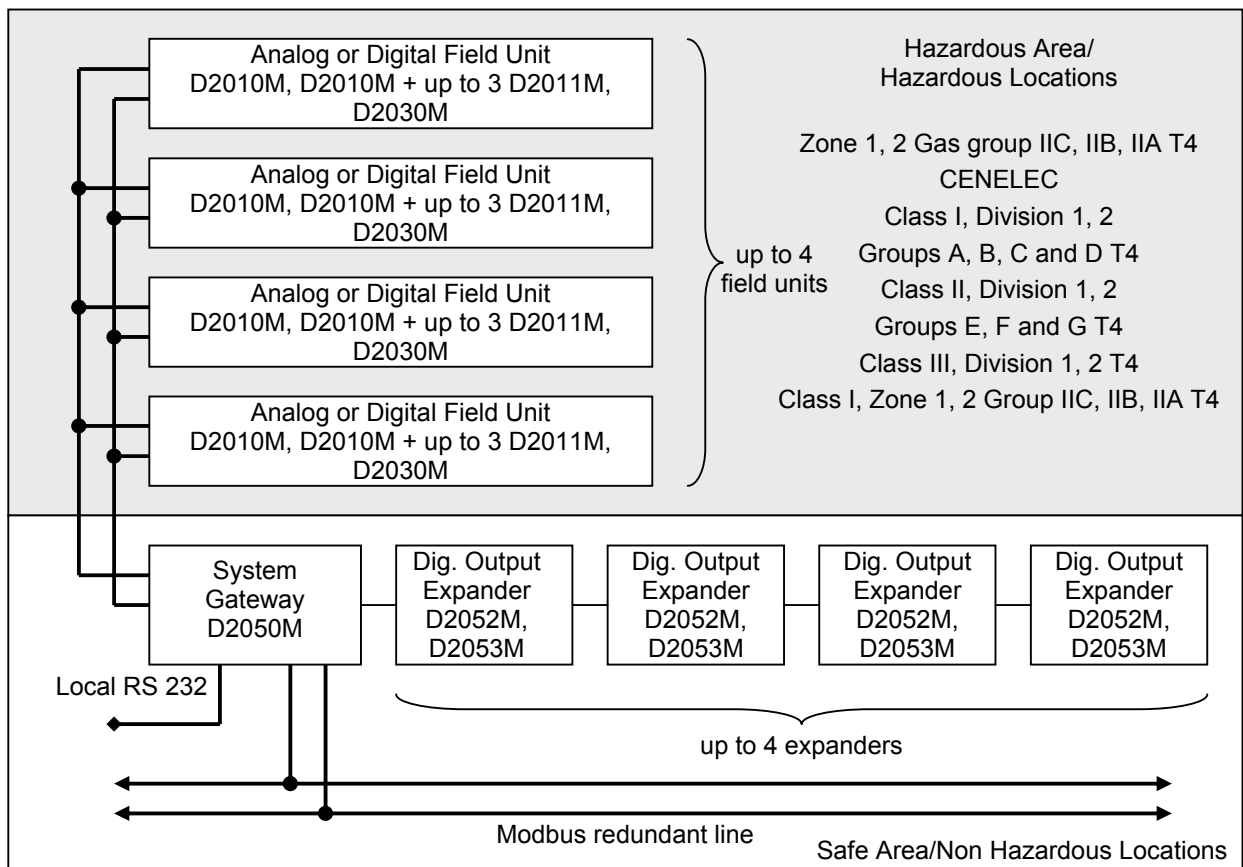
D2000M Series Intrinsically Safe Multiplexing System consists of one to four Analog-Temperature Multiplexer Units model D2010M, up to twelve Expander Units model D2011M, or up to four D2030M Digital Multiplexer Units, mounted in Safe Area/Non Hazardous Locations or Zone 1, 2, Gas Group IIC, IIB, IIA T4 Hazardous Area or Class I, Division 1, 2, Group A, B, C, D, Temperature Code T4 or Class II, Division 1, 2, Group E, F, G, Temperature Code T4 or Class III, Division 1, 2, Temperature Code T4 or Class I, Zone 1, 2, Group IIC, IIB, IIA, Temperature Code T4 Hazardous Locations, connected via a single or redundant 2 wire data communication and supply line to a Modbus Gateway Unit model D2050M, mounted in Safe Area/Non Hazardous Locations and connected to a PLC, DCS or PC.

Analog-Temperature Multiplexer Unit D2010M, Expander Unit D2011M, Digital Multiplexer Unit D2030M, accepts input sensors located in Safe Area/Non Hazardous Locations or Zone 0, 1, 2, Gas Group IIC, IIB, IIA Hazardous Area or Class I, Division 1, 2, Group A, B, C, D or Class II, Division 1, 2, Group E, F, G or Class III, Division 1, 2 or Class I, Zone 0, 1, 2, Group IIC, IIB, IIA Hazardous Locations.

1.1 Overview

The D2000M Multiplexer System is constituted by a series of equipments designed to acquire both analog and digital signals from sensors located in Hazardous Area/Hazardous Locations and to transmit the digitized information via an intrinsically safe redundant bus to a Gateway located in Safe Area/Non Hazardous Locations and able to connect PLCs, DCSs or Computers via a Modbus redundant communication line, additionally the digital signals may be repeated in Safe Area/Non Hazardous Locations by relay contacts or open-collector transistor outputs.

The architecture of the system is depicted in the following block diagram:



Field units may be Analog or Digital. Each Analog unit accepts up to 3 expanders to increase input capabilities.

Up to 4 digital output repeaters can be added to the system in order to reflect the status of digital units in Safe Area/Non Hazardous Locations. Specifications of every module are described in detail in the following sections.

2 D2010M Analog Input Field Unit

2.1 Overview

The D2010M Analog Field Unit is an acquisition system installable in Hazardous Area/Hazardous Locations, connected and powered from the Power Supply / Gateway D2050M through 1 or 2 connection lines carrying both power and signal from Safe Area/Non Hazardous Locations to Hazardous Area/Hazardous Locations.

Any D2010M can connect up to 16 analog signals from thermocouples, thermoresistances, low level mV or mA (with proper external shunt resistor) or V (with proper external voltage divider) signals.

The unit is Intrinsically Safe for installation in Zone 1, 2, Gas Group IIC, IIB, IIA Temperature Classification T4 or Class I, Division 1 and 2, Groups A,B, C and D, Temperature Code T4 or Class II, Division 1 and 2, Groups E,F and G, Temperature Code T4 or Class III, Division 1 and 2, Temperature Code T4 or Class I, Zone 1, 2 Group IIC, IIB, IIA, Temperature Code T4 Hazardous Locations.

Accepts input sensor from Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1 and 2, Groups A,B, C and D or Class II, Division 1 and 2, Groups E,F and G or Class III, Division 1 and 2 or Class I, Zone 0, 1, 2 Group IIC, IIB, IIA Hazardous Locations.

Every analog field unit may be expanded with up to 3 analog input expanders D2011M, allowing a total capability of 64 inputs for every node and a total capability of 256 analog inputs for every system.

Multiplexer D2010M Units, and Expander D2011M Units can be installed in the field, by using proper enclosures (like GM2300 series) that provide a higher degree of protection.

Units are installed close to input sensors, for data acquisition from Hazardous Area/Hazardous Locations and connected to a Safe Area/Non Hazardous Locations PLC/DCS or other devices, via 2 wire communication link thru Gateway D2050M Unit, saving wiring, cables and costs.

D2010M and D2011M units can also be installed in Safe Area/Non Hazardous Locations, providing a proper mean of protection to reach required IP degree.

2.2 Features

The D2010M unit is constituted by a dual supply, a control unit, an analog conversion block and a 16 channel analog multiplexer providing up to 200 V (test voltage) of isolation with mV or thermocouple inputs and up to 60 V (test voltage) of isolation with resistance or thermoresistance inputs.

Additionally a 500 V (test voltage) isolation is provided from inputs to communication line.

Thermoresistance connection may be done with 2, 3, or 4 wires; except for 2 wires connections, the others include line resistance compensation (for 2 wires thermoresistance use 3 wires connection with a wire jumper to connect the third wire).

The programming of the unit is done through the D2050M gateway and allows the individual assignment of a sensor for each channel, including additional operation capabilities (see later).

An internal high accuracy analog to digital converter provides accurate digitalization of input sensors.

The compensation of thermocouples is done using a dedicated channel (channel 16) of each group of 16 channels, the assignment is done automatically when at least one thermocouple with automatic cold junction compensation is selected, this limits the maximum number of TCs for the system to 15, 30, 45 or 60; the compensation channel used is indicated in the following table:

Group	Unit	Channels	Channel for Compensation
1	D2010M	1 to 16	16
2	D2011M - expansion 1	17 to 32	32
3	D2011M - expansion 2	33 to 48	48
4	D2011M - expansion 3	49 to 64	64

If the fixed compensation mode is selected for all the thermocouples within a unit, channel 16 for compensation can be used for other measures.

2.3 Characteristics

The Sensors supported by the D2010M are the following:

Sensor	Measuring limits	Resolution	Linearization and Conformity
-21.000 to +21.000 mV	-21 to +21 mV	2 μ V	Voltage Linear. mV range 1
-21.00 to +80.00 mV	-21 to +80 mV	10 μ V	Voltage Linear. mV range 2 (see Note 1)
Resistance 0.0 to 400.0 Ω	0 to 400 Ω	0.1 Ω	Ohm linear
Thermocouple type B	-10 to +1800 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type E	-250 to +1000 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type J	-200 to +750 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type K	-250 to +1350 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type L – DIN	-200 to +800 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, DIN43710
Thermocouple type L – GOST	-200 to +800 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90 - GOST_R8.585_2001
Thermocouple type N	-200 to +1300 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type R	-50 to +1750 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type S	-50 to +1750 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type S – GOST	-50 to +1600 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68 - GOST
Thermocouple type T	-250 to +400 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, NBS125, GOST_R8.585_2001
Thermocouple type U	-200 to +400 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68 - DIN43710
Thermocouple type A1	-10 to +2500 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, GOST_R8.585_2001
Thermocouple type A2	-10 to +1800 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, GOST_R8.585_2001
Thermocouple type A3	-10 to +1800 $^{\circ}$ C	0.1 $^{\circ}$ C	STI90, GOST_R8.585_2001
Thermoresistance Pt 100 a = 385	-200 to +850 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, IEC 751 - alpha 385
Thermoresistance Pt 200 a = 385	-150 to +400 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, IEC 751 - alpha 385
Thermoresistance Pt 300 a = 385	-150 to +250 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, IEC 751 - alpha 385
Thermoresistance Pt 100 a=390	-200 to +625 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68 - alpha 390
Thermoresistance Pt 100 - GOST	-200 to +650 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, GOST - alpha 391
Thermoresistance Pt 50 - GOST	-200 to +650 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, GOST - alpha 391
Thermoresistance Ni 100	-50 to +180 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68 - DIN43760
Thermoresistance Cu 100 - GOST	-50 to +200 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, GOST
Thermoresistance Cu 53 - GOST	-50 to +180 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, GOST
Thermoresistance Cu 50 - GOST	-50 to +200 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, GOST
Thermoresistance Cu 46 - GOST	-175 to +625 $^{\circ}$ C	0.1 $^{\circ}$ C	SIPT68, GOST
Compensator G.M. option 2091	-40 to +70 $^{\circ}$ C	0.1 $^{\circ}$ C	OPT91

Note 1: in order to acquire a 0/4-20 mA input signal an external shunt resistor is required. See Section 2.3.1 at page 11 for details on this type of connection.

Additional features of the unit allow the selection of the burnout capability for mV and thermocouple inputs. The burnout detection is performed by a separate circuit allowing verification of the cable integrity without affecting the measuring accuracy; burnout detection, if active, is done at every scan of the sensor, the result is passed to the master gateway only if the test is successful, otherwise an error indication is reported.

In all cases a filtering function can be activated, channel by channel, removing excessive flickering of the measure and increasing response time.

The time needed to perform a full scan cycle, regardless of the configuration of input sensors depends on the number of expanders that are installed as follows:

Configuration	Total number of channels	Scan time in ms
D2010M	16 (15 for TC)	425
D2010M + 1 x D2011M	32 (30 for TC)	850
D2010M + 2 x D2011M	48 (45 for TC)	1275
D2010M + 3 x D2011M	64 (60 for TC)	1700

Note: scan time depends on the number of programmed expansions, and not on the number of installed expansions.

Performance: (Field Units powered by D2050M Gateway at 23 ± 1 °C ambient temperature)

Supply	delivered by the D2050M (up to 4 field units)
Power consumption	D2010M: 200 mW; D2011M: 10 mW
RTD line compensation	0 to 10 Ω
Thermometric current for RTD	≤ 200 μ A
Cold junction comp. error	same error of the sensor used for compensation (± 1 °C for OPT2091)
Operating temperature range	-40 to +60 °C
Linearity and Accuracy	$\leq \pm 20$ μ V on mV or thermocouple, 200 m Ω on RTD, ± 0.05 % of input value, whichever is greater
Environmental	relative humidity max 90 % non condensing, up to 35 °C
Storage temperature	-40 to +80 °C
Safety	conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN61010-1 FM & FM-C Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11
Mounting	DIN rail T35 according EN50022
Weight	approx. 500 g.
Connections	by screw terminals for up to 2.5 mm ²
Installation Area	Safe Area/Non Hazardous Locations or Zone 1, 2, Gas Group IIC, IIB, IIA T4 Hazardous Area or Class I, Division 1, 2, Group A, B, C and D, Temperature Code T4 or Class II, Division 1, 2, Group E, F and G, Temperature Code T4 or Class III, Division 1, 2, Temperature Code T4 or Class I, Zone 1, 2, Group IIC, IIB, IIA, Temperature Code T4 Hazardous Location
Input Sensor connection Installation Area	Safe Area/Non Hazardous Locations or Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1, 2, Group A, B, C, D or Class II, Division 1, 2, Group E, F, G or Class III, Division 1, 2 or Class I, Zone 0, 1, 2, Group IIC, IIB, IIA Hazardous Location
Protection Class	IP 20
Dimensions	127 W x 220 L x 78 D mm
Compatibility	CE mark compliant

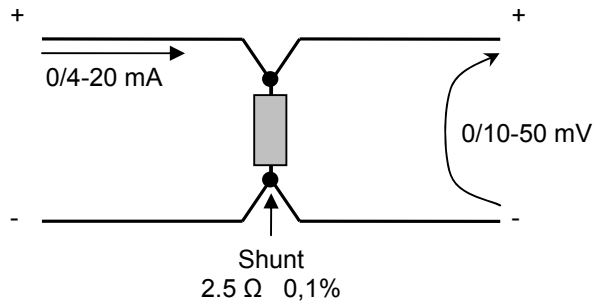
Note: for field mounting see GM2300 Series enclosures.

2.3.1 0/4-20 mA Input Shunt

In order to connect standard 0/4-20 mA signals to the D2010M or D2011M an appropriate external shunt is required. Channel input must be set to -21.00 to +80.00 mV and the channel will read as following:

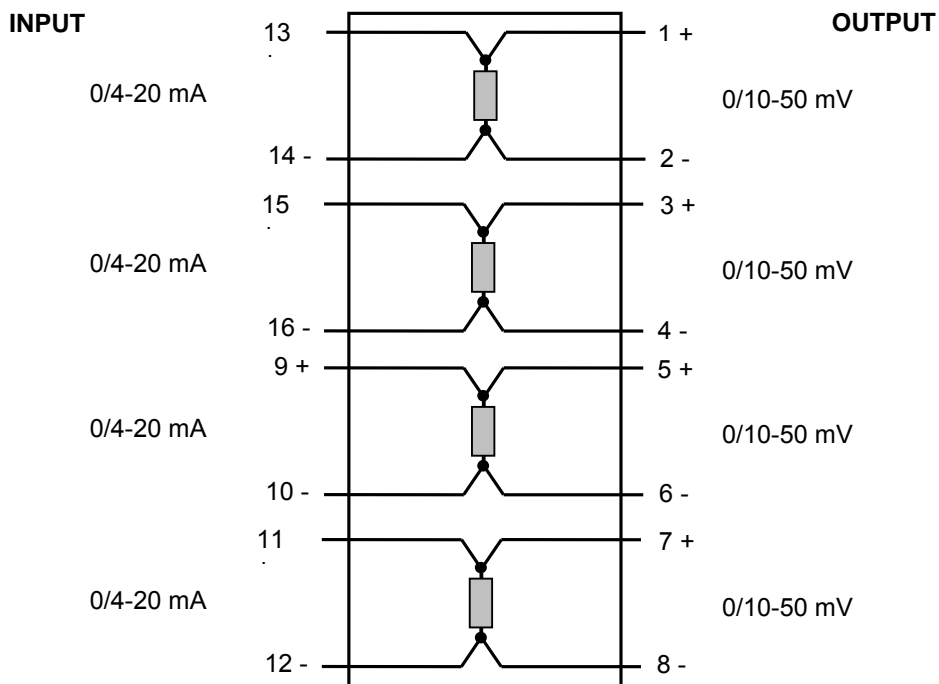
- 0 mV corresponding to 0 mA
- 10 mV corresponding to 4 mA
- 50 mV corresponding to 20 mA

The following figure shows shunt connection and characteristics:



2.3.1.1 D1090Q four channels 0/4-20 mA Shunt

G.M. International D1090Q module is a four channel, 0/4-20 mA shunt suitable for DIN-Rail mounting. The following figure shows shunt terminal blocks connections for each channel:



Dimensions: width 22.5 mm; depth 99 mm; height 114.5 mm

Protection: IP 20 (to be installed in proper IP 54 enclosure if installed in Hazardous Area/Hazardous Locations)

Housing: D1000 Series enclosure

Operating temperature: -40 to +60 °C

The D1090Q module is to be ordered separately.

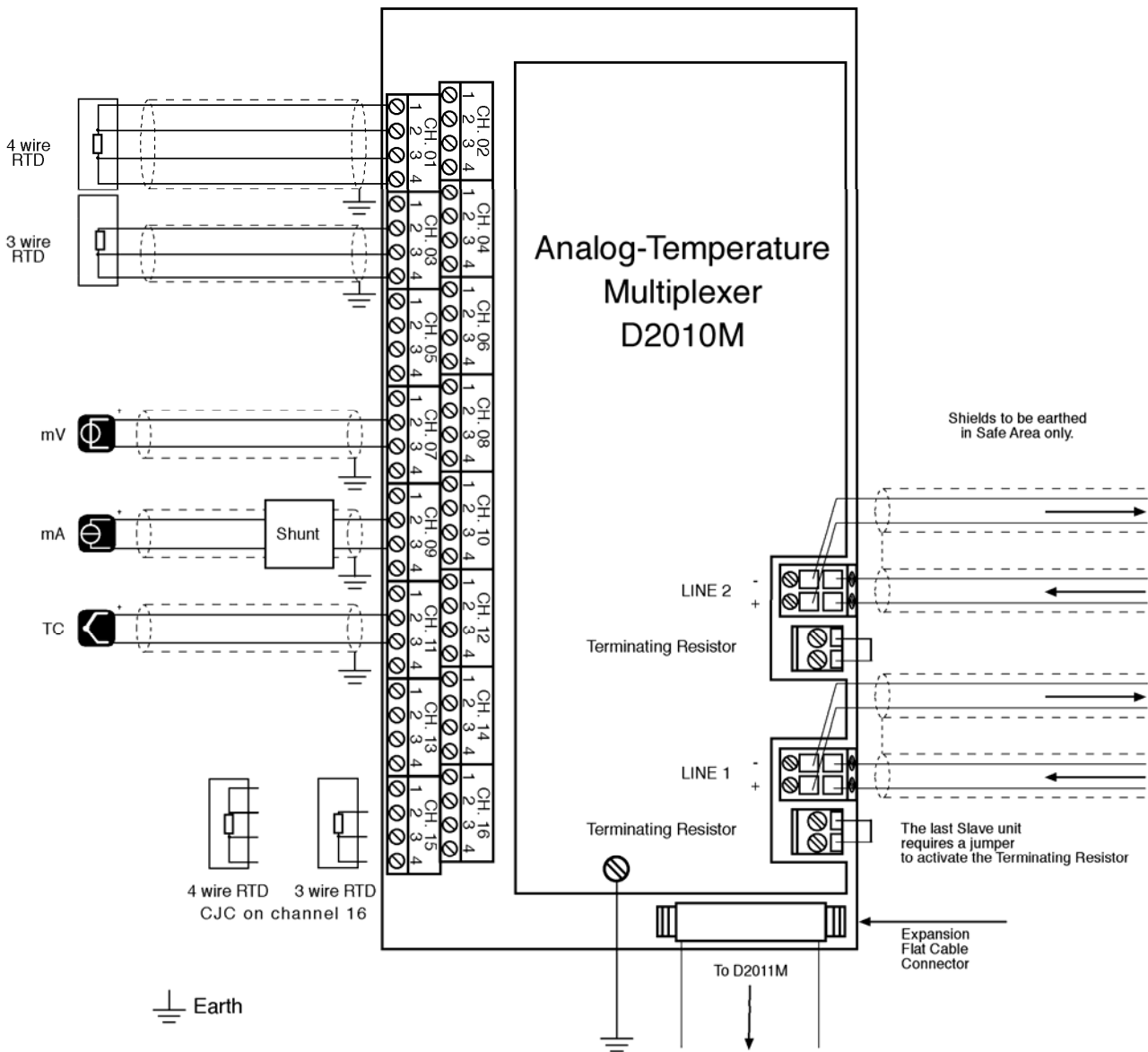
2.4 Connections

The D2010M is connected to the System Gateway (D2050M) via a single or redundant transmission cable, with specific characteristics to comply with safety, powering and transmission requirements (CABF008 or equivalent). The connection topology is the BUS type, with the gateway at one end of the cable; however more than one unit may be connected to a node using limited length connections (for details see the specific section).

Additionally a D2010M can connect the D2011M expanders via a flat cable (see the D2011M section).

A 4 pole connector is provided for every input, allowing direct connection of voltage sources, thermocouples, thermoresistances. Thermoresistance connection may be done with 2, 3, or 4 wires.

DIN Rail mounting simplifies installation.



3 D2011M Analog Input Field Expander

3.1 Overview

The D2011M Analog Field Expander is an acquisition module used to expand the number of channels of a D2010M in groups of 16 inputs. Every D2010M accepts a maximum of 3 expanders, giving input sizes of 16, 32, 48 or 64 channels. Every D2010M unit may be equipped with the desired number of input expanders and every input may be programmed independently.

The unit is Intrinsically Safe for installation in Zone 1, 2, Gas Group IIC, IIB, IIA Temperature Classification T4 or Class I, Division 1 and 2, Groups A,B, C and D, Temperature Code T4 or Class II, Division 1 and 2, Groups E,F and G, Temperature Code T4 or Class III, Division 1 and 2, Temperature Code T4 or Class I, Zone 1, 2 Group IIC, IIB, IIA, Temperature Code T4 Hazardous Locations.

Accepts input sensor from Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1 and 2, Groups A,B, C and D or Class II, Division 1 and 2, Groups E,F and G or Class III, Division 1 and 2 or Class I, Zone 0, 1, 2 Group IIC, IIB, IIA Hazardous Locations.

3.2 Features

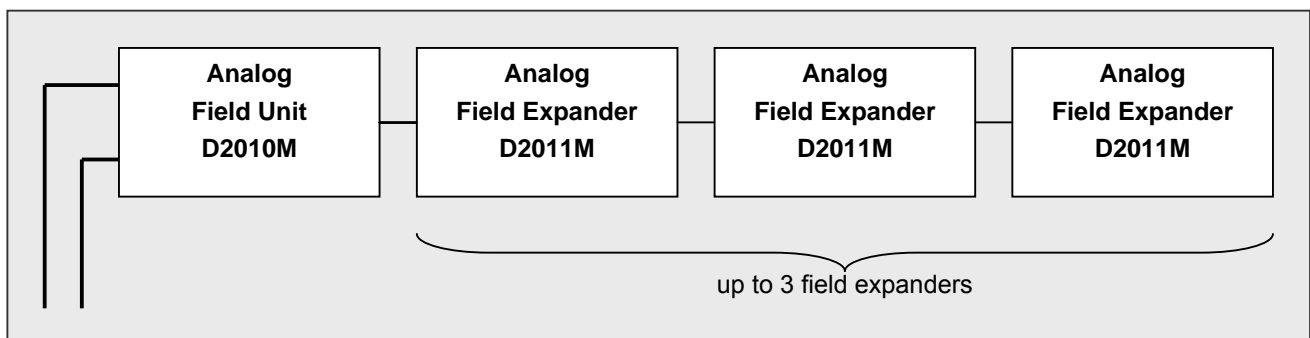
The input expander D2011M contains a 16 channel multiplexing circuit used to expand the input capabilities of the D2010M; the operation is determined by the D2010M unit, only the scanning time is increased taking approximately 425 ms of additional time for every expander installed and configured.

3.3 Characteristics

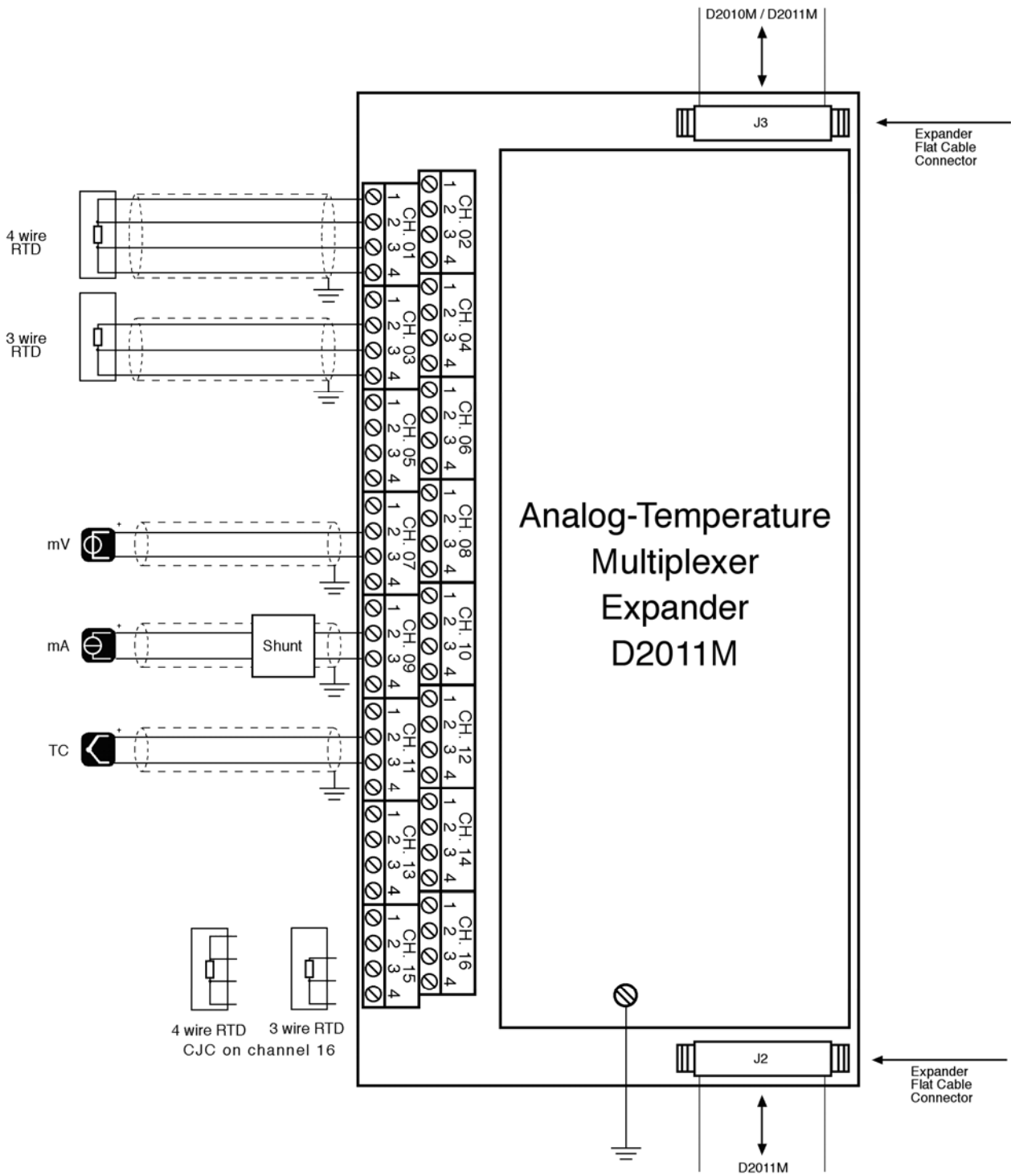
Characteristics of the D2011M are the same as for D2010M, as indicated in the preceding section 2.3. Only the scanning time is increased taking approximately 425 ms of additional time for every expander installed.

3.4 Connections

The D2011M is connected to the D2010M via a flat cable (CABF005 or CABF006 or CABF007), similar connections are used between two D2011M in a daisy chain structure like indicated in the following diagram:



Connections of sensors are the same as for D2010M.



4 D2030M Digital Input Field Unit

4.1 Overview

The D2030M Digital Field Unit is an acquisition system installable in Hazardous Area/Hazardous Locations, connected and powered from the Power Supply / Gateway D2050M through 1 or 2 connection lines carrying both power and signal from Safe Area/Non Hazardous Locations to Hazardous Area/Hazardous Locations.

Any D2030M can connect up to 32 digital signal from EN60947-5-6 proximities or free voltage contacts.

Every sensor is powered for a programmable amount of time, is sensed for status and then powered off, the time is programmable independently for every channel.

The unit is Intrinsically Safe for installation in Zone 1, 2, Gas Group IIC, IIB, IIA Temperature Classification T4 or Class I, Division 1 and 2, Groups A,B, C and D, Temperature Code T4 or Class II, Division 1 and 2, Groups E,F and G, Temperature Code T4 or Class III, Division 1 and 2, Temperature Code T4 or Class I, Zone 1, 2 Group IIC, IIB, IIA, Temperature Code T4 Hazardous Locations.

Accepts input sensor from Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1 and 2, Groups A,B, C and D or Class II, Division 1 and 2, Groups E,F and G or Class III, Division 1 and 2 or Class I, Zone 0, 1, 2 Group IIC, IIB, IIA Hazardous Locations.

The units are primarily intended for acquisition from Hazardous Area/Hazardous Locations of ON/OFF/Fault status from EN60947-5-6 proximities sensor or free voltage switches.

Multiplexer D2030M Unit can be installed in the field, by using proper enclosures (like GM2300 series) that provide a higher degree of protection.

Units are installed close to input sensors, for data acquisition from Hazardous Area/Hazardous Locations and connected to a Safe Area/Non Hazardous Locations PLC/DCS or other devices, via 2 wire communication link thru Gateway D2050M Unit, saving wiring, cables and costs.

D2030M unit can also be installed in Safe Area/Non Hazardous Locations, providing a proper mean of protection to reach required IP degree.

4.2 Features

The D2030M unit is constituted by a dual supply, a control unit, an analog conversion block and a 32 channel multiplexer. The programming of the unit is done thru the D2050M gateway and allows the individual assignment of the excitation time and fault sensing. Additionally a 500 V (test voltage) isolation is provided from inputs to communication line.

The programming of the unit is done through the D2050M gateway and allows the individual assignment of parameters for each channel.

Four D2030M Units reach 128 inputs with a single Modbus Gateway D2050M unit.

Redundant communication is obtained by dual data/supply interface line.

4.3 Characteristics

The excitation times programmable into the D2030M are the following:

Description	Notes
1 ms scan time	Channel will be powered for 1 ms before acquisition
2 ms scan time	Channel will be powered for 2 ms before acquisition
3 ms scan time	Channel will be powered for 3 ms before acquisition
4 ms scan time	Channel will be powered for 4 ms before acquisition
5 ms scan time	Channel will be powered for 5 ms before acquisition
6 ms scan time	Channel will be powered for 6 ms before acquisition
8 ms scan time	Channel will be powered for 8 ms before acquisition
10 ms scan time	Channel will be powered for 10 ms before acquisition
12 ms scan time	Channel will be powered for 12 ms before acquisition
14 ms scan time	Channel will be powered for 14 ms before acquisition
16 ms scan time	Channel will be powered for 16 ms before acquisition
18 ms scan time	Channel will be powered for 18 ms before acquisition
20 ms scan time	Channel will be powered for 20 ms before acquisition
25 ms scan time	Channel will be powered for 25 ms before acquisition
30 ms scan time	Channel will be powered for 30 ms before acquisition
35 ms scan time	Channel will be powered for 35 ms before acquisition

Note: the excitation time for switches is not critical (e.g. 1 ms), for EN60947-5-6 sensors the time must guarantee that the sensor setup time is elapsed: typically small sensors (e.g. 5 mm diameter) usually have a stable output after 1 ms, greater ones may take 10 ms to become stable, please consult manufacturer datasheet for details.

Performance: (Field Units powered by D2050M Gateway at 23 ± 1 °C ambient temperature)

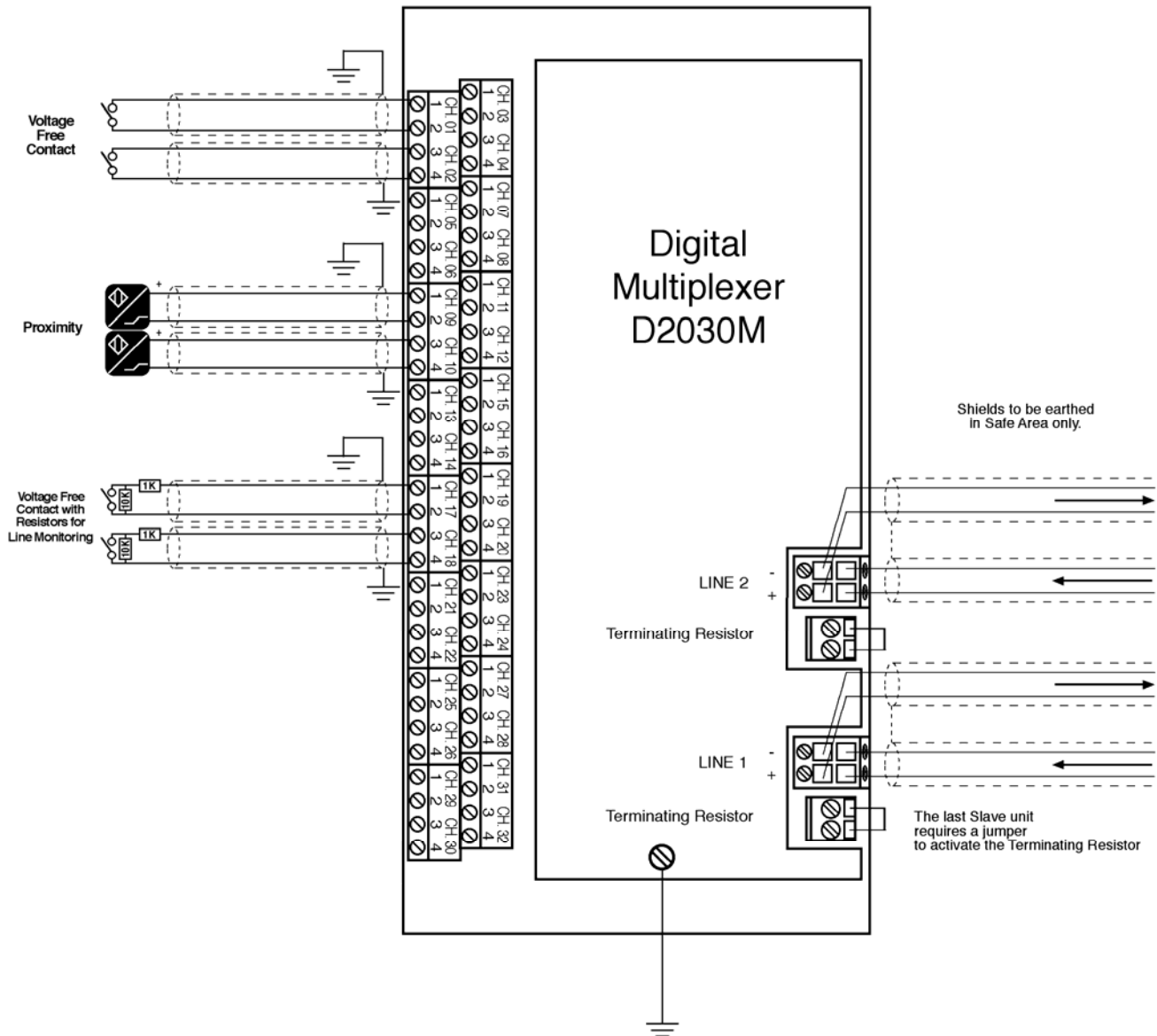
Supply	delivered by the D2050M (up to 4 field units)
Power consumption	D2030M: 200 mW
ON, OFF switching currents	ON ≥ 2.1 mA, OFF ≤ 1.2 mA, threshold ≈ 1.6 mA ± 0.2 mA hysteresis
Input equivalent source	7.5 V, 1 K Ω typical
Scan cycle time	50 ms (at minimum sensor excitation time 1 ms for all channel) or the sum of each channel scan time, whichever is greater
Operating temperature range	-40 to +60 °C
Environmental	relative humidity max 90 % non condensing, up to 35 °C
Storage temperature	-40 to +80 °C
Safety	conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN61010-1 FM & FM-C Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11
Mounting	DIN rail T35 according EN50022
Weight	approx. 500 g.
Connections	by screw terminals for up to 2.5 mm ²
Installation Area	Safe Area/Non Hazardous Locations or Zone 1, 2, Gas Group IIC, IIB, IIA T4 Hazardous Area or Class I, Division 1, 2, Group A, B, C and D, Temperature Code T4 or Class II, Division 1, 2, Group E, F and G, Temperature Code T4 or Class III, Division 1, 2, Temperature Code T4 or Class I, Zone 1, 2, Group IIC, IIB, IIA, Temperature Code T4 Hazardous Location
Input Sensor connection Installation Area	Safe Area/Non Hazardous Locations or Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1, 2, Group A, B, C, D or Class II, Division 1, 2, Group E, F, G or Class III, Division 1, 2 or Class I, Zone 0, 1, 2, Group IIC, IIB, IIA Hazardous Location
Protection Class	IP 20
Dimensions	127 W x 220 L x 78 D mm
Compatibility	CE mark compliant

Note: for field mounting see GM2300 Series enclosures.

4.4 Connections

The D2030M is connected to the System Gateway (D2050M) via a single or redundant transmission cable, with specific characteristics to comply with safety, powering and transmission requirements (CABF008 or equivalent). The connection topology is the BUS type, with the gateway at one end of the cable; however more than one unit may be connected to a node using limited length connections (for details see the specific section).

A 4 poles connector is provided for every two inputs, allowing connection of two proximity sensors or switches. DIN Rail mounting simplifies installation.



5 D2050M Power Supply & Gateway

5.1 Overview

The Power Supply Gateway D2050M Unit, mounted in Safe Area/Non Hazardous Locations, provides Intrinsically Safe protection to the 2 wire communication link, and supplies power to Analog Multiplexer D2010M, Expander D2011M and Digital Multiplexer D2030M units, installed in Hazardous Area/Hazardous Locations, close to input sensors.

The D2050M Power Supply Gateway is a control unit Associated Apparatus, installed in Safe Area/Non Hazardous Locations, which connects and powers the field units, installed in Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1 and 2, Groups A,B, C and D or Class II, Division 1 and 2, Groups E,F and G or Class III, Division 1 and 2 or Class I, Zone 0, 1, 2 Group IIC, IIB, IIA Hazardous Locations.

It manages the single or redundant communication through lines 1 and 2, providing also diagnostic control on shorted or opened connections.

A Modbus redundant line is provided for connection to a DCS, PLC or PC with a communication speed of up to 115200 Bit/s, while an independent RS-232 serial lines is used to connect the host for configuration.

5.2 Features

A total of 256 analog channels or 128 digital channels can be managed by a single D2050M, with single or redundant field connection line.

Additionally up to 31 D2050M units can be connected to a Modbus communication line.

The unit also provides an output connection for contact repeaters that can accommodate up to four contact repeaters type D2052M (relay contact output) or D2053M (optocoupled open collector transistor output).

The isolation between field lines and other connections is rated at 1500 V (test voltage), according to Intrinsic Safety Standards, while the other communication lines are isolated at 500 V (test voltage).

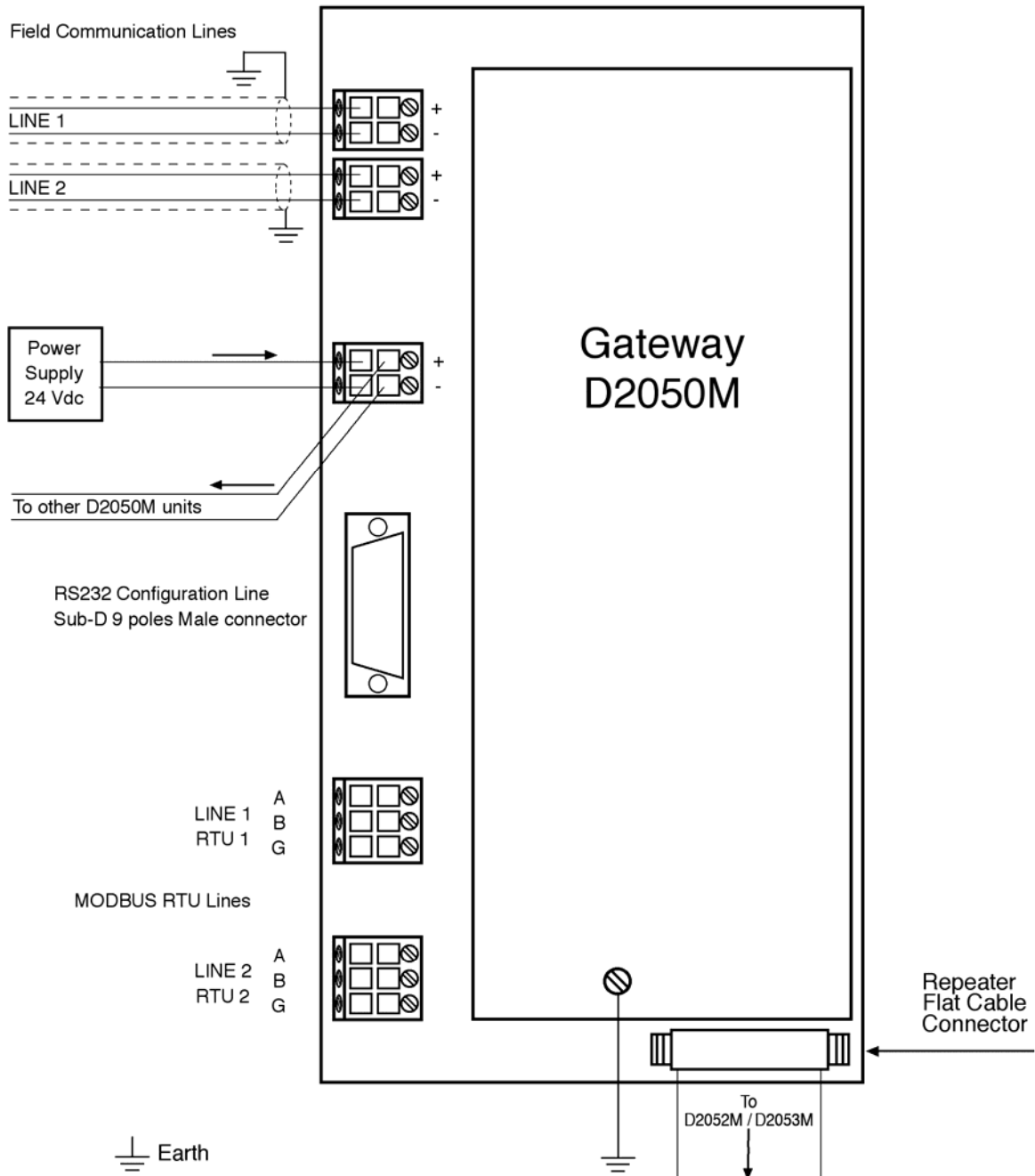
5.3 Characteristics

Performance: (Power supply 24 Vdc \pm 10%, 1 to 4 units connected, 23 \pm 1 °C ambient temperature)

Supply	24 Vdc nominal (20 to 30 Vdc range) reverse polarity protected, ripple within voltage limits \leq 5 Vpp.
Power consumption	maximum 8.5 W
Modbus communication speed	9600 to 115200 baud
Serial RS-232 speed	19200 baud
Scan cycle time	50 ms for four D2030M units, 425 to 1700 ms for D2010M/D2011M units
Operating temperature range	-40 to +60 °C
Environmental	relative humidity max 90 % non condensing, up to 35 °C
Storage temperature	-40 to +80 °C
Safety	conforms to 94/9/EC Atex Directive and to 89/336/CEE EMC Directive, EN61010-1 FM & FM-C Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11
Mounting	DIN rail T35 according EN50022
Weight	approx. 500 g.
Connections	by screw terminals for up to 2.5 mm ²
Installation Area	Safe Area/Non Hazardous Locations
Field communication connection lines	Safe Area/Non Hazardous Locations or Zone 0, 1, 2, Gas Group IIC, IIB, IIA or Class I, Division 1, 2, Group A, B, C, D or Class II, Division 1, 2, Group E, F, G or Class III, Division 1, 2 or Class I, Zone 0, 1, 2, Group IIC, IIB, IIA Hazardous Location
Protection Class	IP 20
Dimensions	127 W x 220 L x 78 D mm
Compatibility	CE mark compliant

5.4 Connections

The D2050M is connected to the Field Units via a single or redundant transmission cable (Line 1, Line 2), with specific characteristics to comply with safety, powering and transmission requirements (CABF008 or equivalent). The connection topology is the BUS type, with the Gateway at one end of the cable; however more than one field unit may be connected to a node using limited length connections (for details see the specific section). Two 3 pole connectors are provided for the Modbus connections, a 2 poles connectors is provided for the power supply, while a 9 pole Sub D male connector is available for the service RS-232 connection. Connection to Digital Output Repeaters D2052M/D2053M is accomplished using the 10 pole flat cable types CABF022 (15 cm), CABF023 (30 cm), CABF024 (50 cm).



5.5 Safety consideration on field communication lines

D2050M field lines conform to the IEC 60079-27 (FISCO) standard requirements and need specific connection cable (see Section 8) to connect to D2010M or D2030M units.

The D2050M is intended to be installed in Safe Area/Non Hazardous Locations, while the D2010M, D2011M and D2030M can be installed in Zone 1, 2, Gas Group IIC, IIB, IIA Temperature Classification T4 or Class I, Division 1 and 2, Groups A,B, C and D, Temperature Code T4 or Class II, Division 1 and 2, Groups E,F and G, Temperature Code T4 or Class III, Division 1 and 2, Temperature Code T4 or Class I, Zone 1, 2 Group IIC, IIB, IIA, Temperature Code T4 Hazardous Locations.

5.6 Software features of D2050M

5.6.1 Management of the communication lines (field communication)

The D2050M has an embedded management system for the monitoring of field communication lines.

This allows communication efficiency and safety, avoiding host from taking care of detectable and recoverable malfunctions of the communication line especially when redundant field lines are used.

In the case of a single line no recovery actions are possible and operability is limited to the reporting of the malfunction. If two lines are installed, the management is more sophisticated and can be described as follows:

- ❑ when both lines are installed and operative, the system switches between the two lines at a predefined cadence; this is done to verify that both lines are working properly.
- ❑ if an error is detected, a retry function is activated to verify if the malfunction is only temporary (e.g. caused by strong disturbances on the line).
- ❑ if, after retrying, the malfunction remains, the gateway considers the line as broken or unreliable. It then enters a recovery status, switches to the operating line, stops line exchange and reports an error.

After a repair of the damaged line a software command or a system reboot will reactivate the previous operating mode.

5.6.2 Mapping of output contact repeaters

Both types of contact repeaters are treated by the gateway in the same mode. Each repeater can be mapped to any digital field unit D2030M; multiple associations are possible in order to allow the repeating of one D2030M to up to four D2052M, D2053M repeaters. This process is transparent to the serial protocols, so the user can access the information on all input units regardless if they are repeated, partially repeated or not repeated at all.

6 D2052M Digital Input Repeater with Relay Contact Outputs

6.1 Overview

The D2052M is a contact repeater intended for replication of EN60947-5-6 proximity sensor or free voltage contact status of devices located in Hazardous Area/Hazardous Locations in the Safe Area/Non Hazardous Locations. The unit is driven by the D2050M via a dedicated bus.

Application of this devices allows the reduction in cabling complexity where digital status are to be repeated in discrete form, in addition to the capability of analyzing them via Modbus.

The repeaters have the same channel capability as the digital field devices, so that every input unit can be repeated on an output unit. The assignment between input (field) and output(Safe Area/Non Hazardous Locations) devices is managed by the software of the D2050M and corresponding internal settings.

The relay output is of the changeover type (form 1C) allowing the use of normally close or normally open contacts.

6.2 Features

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.

Up to 4 D2052M or D2053M can be connected to a D2050M allowing up to 128 repeated outputs.

6.3 Characteristics

Supply	24 Vdc nominal (20 to 30 Vdc range) reverse polarity protected, ripple within voltage limits ≤ 5 Vpp.
Power consumption	maximum 8 W
Relay output	SPDT, contact rating 2 A, 42 Vpeak or 60 Vdc
Isolation test voltage	500 V
Operating temperature range	-40 to +60 °C
Environmental	relative humidity max 90 % non condensing, up to 35 °C
Storage temperature	-40 to +80 °C
Safety	conforms to 89/336/CEE EMC Directive, EN61010-1
Mounting	DIN rail T35 according EN50022
Weight	approx. 500 g.
Connections	by screw terminals for up to 2.5 mm ²
Installation Area	Safe Area/Non Hazardous Locations
Protection Class	IP 20
Dimensions	127 W x 220 L x 78 D mm
Compatibility	CE mark compliant

6.4 Connections

See section 7.4

7 D2053M Digital Input Repeater with Transistor Outputs

7.1 Overview

The D2053M is a contact repeater intended for replication of EN60947-5-6 proximity sensor or free voltage contact status of devices located in Hazardous Area/Hazardous Locations in the Safe Area/Non Hazardous Locations. The unit is driven by the D2050M via a dedicated bus.

Application of this devices allows the reduction in cabling complexity where digital status are to be repeated in discrete form, in addition to the capability of analyzing them via Modbus.

The repeaters have the same channel capability as the digital field devices, so that every input unit can be repeated on an output unit. The assignment between input (field) and output(Safe Area/Non Hazardous Locations) devices is managed by the software of the D2050M and corresponding internal settings.

7.2 Features

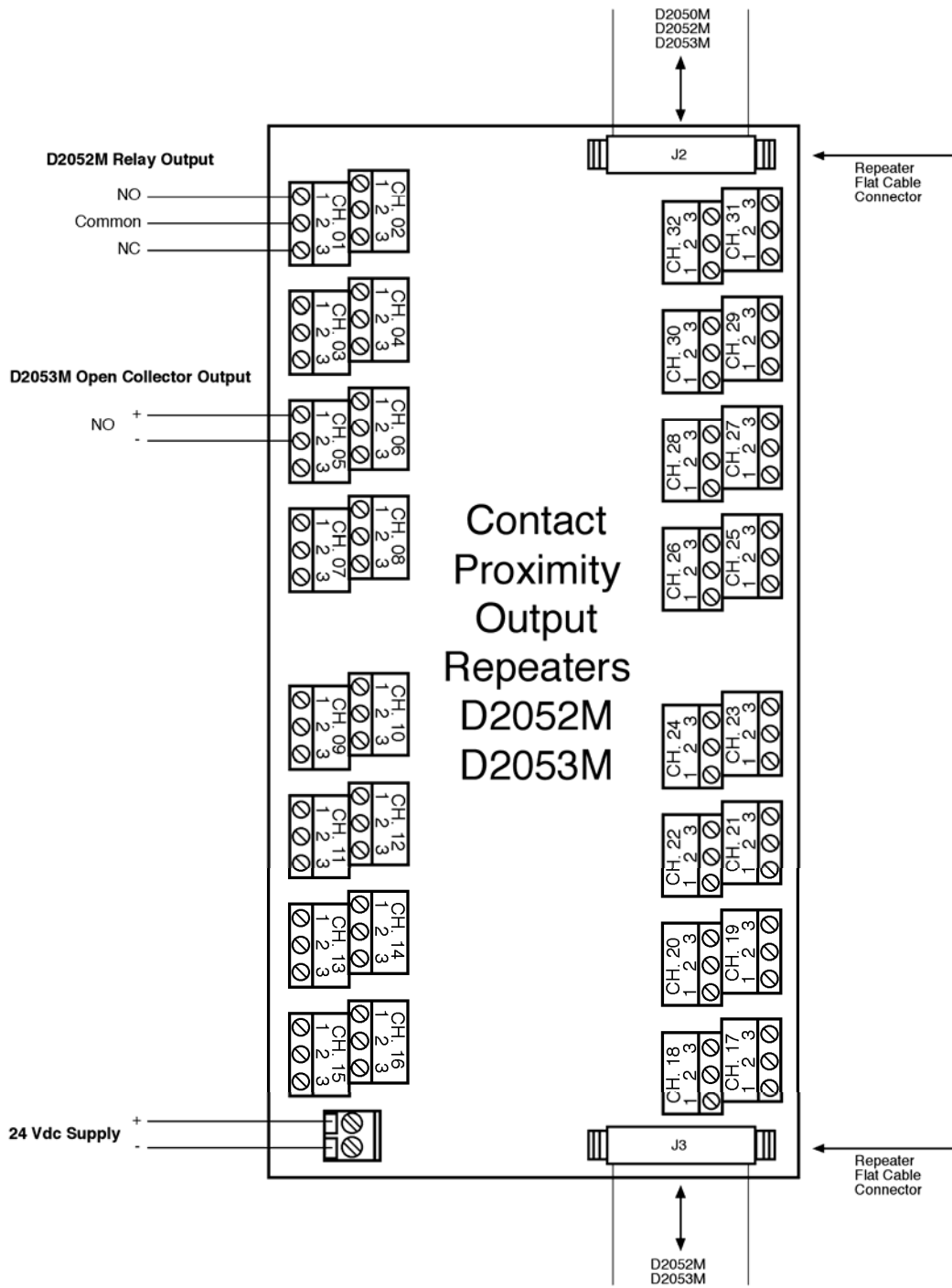
The D2053M Unit is equipped with 32 optocoupled open collector transistor outputs. When connected to D2050M Unit, it repeats the status of each D2030M digital input Multiplexer Unit.

Up to 4 D2053M or D2052M can be connected to a D2050M allowing up to 128 repeated outputs.

7.3 Characteristics

Supply	24 Vdc nominal (20 to 30 Vdc range) reverse polarity protected, ripple within voltage limits ≤ 5 Vpp.
Power consumption	maximum 5 W
Open collector output	100 mA at 35 V (<1 V drop)
Isolation test voltage	500 V
Operating temperature range	-40 to +60 °C
Environmental	relative humidity max 90 % non condensing, up to 35 °C
Storage temperature	-40 to +80 °C
Safety	conforms to 89/336/CEE EMC Directive, EN61010-1
Mounting	DIN rail T35 according EN50022
Weight	approx. 500 g.
Connections	by screw terminals for up to 2.5 mm ²
Installation Area	Safe Area/Non Hazardous Locations
Protection Class	IP 20
Dimensions	127 W x 220 L x 78 D mm
Compatibility	CE mark compliant

7.4 Connections



8 System Wiring

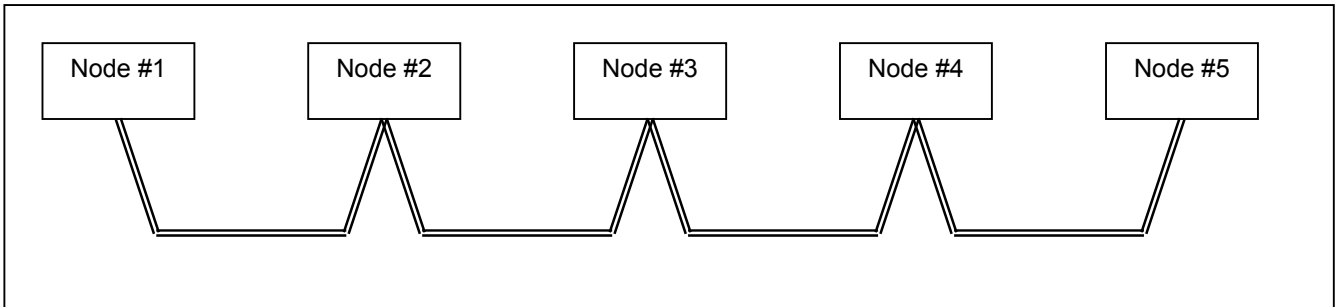
8.1 General

The D2000M Multiplexer System uses a physical support for operation (ISO OSI - Physical Layer) derived by the FISCO specifications as defined in the standard IEC 60079-27 and used for some fieldbus applications.

According to this standard the units may be installed in Hazardous Area/Hazardous Locations, provided that the connection complies with the specific requirements listed in the following sections.

8.2 Connection Topology

The topology of the connection is the BUS type: one single line connecting all nodes as follows:



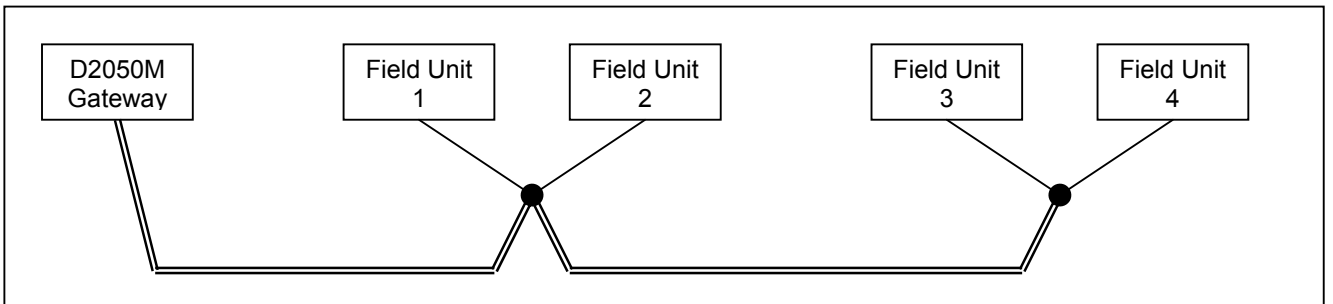
The units are connected to the nodes so that the line appears as a continuous connection starting from the first node and ending at the last node.

For the D2000M Multiplexer the communication line **MUST** be done with a cable with specific properties, with a total length (first to last node) not exceeding 1 km for Gas Group IIC (Groups A and B) or 5 km for Gas Group IIB, IIA (Groups C, D, E, F and G).

The D2050M Gateway must be installed at one end of the cable and it provides the cable termination network.

Field units are installed along the cable, the last unit must have the terminating resistance activated.

If two or more Units are connected close together, they may be connected to a node as follows:



The length of the connections from a node to a unit must not exceed 30 m and the terminating resistor must be activated in the unit at the end of the BUS line (called the trunk) e.g. in unit 4 (see Section 8.4).

When a redundant connection is used the, wiring layout is replicated in an identical way in two independent and isolated groups.

Note: it is a good practice that the master and redundant cables are not installed in the same location in order to reduce the possibilities of simultaneous breakage of the lines.

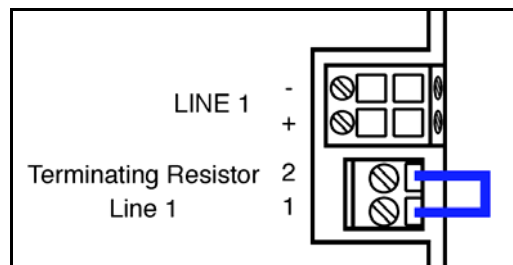
8.3 Cable Specifications

According to IEC 60079-27 standard, (FISCO concept), cable parameters must comply with the following:

- Loop Resistance: from 15 Ω /km to 150 Ω /km
- Loop Inductance: from 0.4 mH/km to 1 mH/km
- Capacitance: from 45 nF/km to 200 nF/km (capacitance must be considered
 $C = C_{\text{wire/wire}} + 0.5 \times C_{\text{wire/screen}}$ for fieldbus circuit insulated or
 $C = C_{\text{wire/wire}} + C_{\text{wire/screen}}$ for screen connected to the output of the fieldbus power supply.
- Maximum Length of each Spur: 30 m in Group IIC (A, B) or IIB, IIA (C, D, E, F and G)
- Maximum Length of the Trunk: 1 km in Group IIC (A, B) or 5 km in Group IIB, IIA (C, D, E, F and G), including length of all spur cables.

8.4 Activation of Terminating Resistors

Inside a D2050M a terminating resistor is already activated and it provides the termination at one end of the cable; the termination of the other end must be activated installing a shorting wire in the terminal blocks of the last slave unit.



9 Safety and Installation Instructions

9.1 General

D2010M, D2011M, D2030M are Intrinsically Safe Apparatus installed in Safe Area/Non Hazardous Locations or Zone 1, 2, Group IIC, IIB, IIA Temperature Classification T4 or Class I, Division 1, 2, Groups A, B, C, D T-Code T4 or Class II, Division 1, 2, Groups E, F, G T-Code T4 or Class III, Division 1, 2 T-Code T4 or Class I, Zone 1, 2, Group IIC, IIB, IIA Temperature Code T4 Hazardous Area/Hazardous Locations according to EN50014, EN50020, EN50284, EN/IEC60079-0, EN/IEC60079-11, EN/IEC60079-25, EN/IEC60079-27 and FM & FM-C Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11.

They provide Intrinsically Safe circuit for connection of device located in Zone 0, 1, 2, Group IIC, IIB, IIA or Class I, Division 1, 2, Groups A, B, C, D or Class II, Division 1, 2, Groups E, F, G or Class III, Division 1, 2 or Class I, Zone 0, 1, 2, Group IIC, IIB, IIA Hazardous Area/Hazardous Locations according to EN50014, EN50020, EN50284, EN/IEC60079-0, EN/IEC60079-11, EN/IEC60079-25, EN/IEC60079-27 and FM & FM-C Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11.





D2050M is an isolated Intrinsically Safe Associated Apparatus installed in Safe Area/Non Hazardous Locations and provide Intrinsically Safe circuit for connection of device located in Zone 0, 1, 2, Group IIC, IIB, IIA or Class I, Division 1, 2, Groups A, B, C, D or Class II, Division 1, 2, Groups E, F, G or Class III, Division 1, 2 or Class I, Zone 0, 1, 2, Group IIC, IIB, IIA Hazardous Area/Hazardous Locations according to EN50014, EN50020, EN50284, EN/IEC60079-0, EN/IEC60079-11, EN/IEC60079-25, EN/IEC60079-27 and FM & FM-C Class 3600, 3610, 3810 and C22.2 No.142, C22.2 No.157, E60079-0, E60079-11.

The following rules must be applied for safe operation:

- ❑ The temperature limits Tamb of $-40\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$ must not be exceeded.
- ❑ To avoid the impairing of isolation characteristics of the equipment and consequentially the safety, the Um of 250 Vrms limit indicated must not be exceeded. Not to be connected to control equipment that uses or generates more than 250 Vrms or Vdc with respect to earth ground.
- ❑ D2000M Series must be installed, operated and maintained only by qualified personnel, in accordance to the relevant national/international installation standards (e.g. IEC/EN60079-14 Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines), BS 5345 Pt4, VDE 165, ANSI/ISA RP12.06.01 Installation of Intrinsically Safe System for Hazardous (Classified) Locations, National Electrical Code NEC ANSI/NFPA 70 Section 504 and 505, and the Canadian Electrical Code CEC) following the established installation rules, particular care shall be given to segregation and clear identification of I.S. conductors from non I.S. ones.
- ❑ Explosion Hazard: to prevent ignition of flammable or combustible atmospheres, disconnect power before servicing or unless area is known to be nonhazardous.
- ❑ Warning: substitution of components may impair Intrinsic Safety.
- ❑ Covers provided to guarantee the IP20 degree of protection must not be removed in order to not invalidate the safety characteristics. If removed for configuration or test, must be installed before the use of the unit (typical case is the SUB D 9 poles connector for RS-232 or flat cable for expansion).
- ❑ For the safety of the equipment an over-voltage category I and pollution degree 1 or 2 installation environment must be guaranteed for the lines connecting the D2050M.
- ❑ Failure to properly installation or use of the equipment may risk to damage the unit or severe personal injury.

9.1.1 Marking

D2000M Series are protected with the following methods:

-  II (1) 2 G EEx ia IIC T4 for D2010M, D2011M, D2030M (field devices)
-  For use in Class I, Division 1/2, Groups A/B/C/D, T-Code T4, Class II, Division 1/2, Groups E/F/G, T-Code T4, Class III, Division 1/2, T-Code T4, Class I, Zone 1/2, AEx ia IIC/IIB/IIA T4, Class I, Zone 1/2, Ex ia IIC/IIB/IIA T4 Hazardous Locations.
Provides intrinsically safe circuits for use in Class I, Division 1/2, Groups A/B/C/D; Class II, Division 1/2, Groups E/F/G; Class III, Division 1/2 and Class I, Zone 0/1/2, Group IIC/IIB/IIA Hazardous Locations.
-  II (1) G [EEx ia] IIC for D2050M (power supply – gateway)
-  Associated apparatus for use in Non Hazardous Locations, AEx [ia], Ex [ia]. Provides intrinsically safe circuits for use in Class I, Division 1/2, Groups A/B/C/D; Class II, Division 1/2, Groups E/F/G; Class III, Division 1/2 and Class I, Zone 0/1/2, Group IIC/IIB/IIA Hazardous Locations.

9.2 Intrinsic Safety Analysis

In the system safety analysis, always check the Hazardous Area/Hazardous Locations devices to conform with the related system documentation, if the device is Intrinsically Safe check its suitability for the Hazardous Area/Hazardous Locations and group encountered and that its maximum allowable voltage, current, power (U_i/V_{max} , I_i/I_{max} , P_i/P_i) are not exceeded by the safety parameters (U_o/V_{oc} , I_o/I_{sc} , P_o/P_o) of the D2000M series connected to it. Also consider the maximum operating temperature of the field device, check that added connecting cable and field device capacitance and inductance do not exceed the limits (C_o/C_a , L_o/L_a , L_o/R_o) given in the Apparatus parameters for the effective gas group, indicated in the tables below:

D2010M, D2011M Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters	D2010M, D2011M Parameters	Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters
Terminals 1-2-3-4 Ch.1 to 16 $U_o / V_{oc} = 10.7 \text{ V}$	\leq	U_i / V_{max}	Terminals 1-2-3-4 Ch.1 to 16 $C_o / C_a = 2.23 \mu\text{F}$ (IIC-A, B) $C_o / C_a = 15.6 \mu\text{F}$ (IIB-C, E) $C_o / C_a = 69.0 \mu\text{F}$ (IIA-D, F, G)	\geq	C_i / C_i device + C cable
Terminals 1-2-3-4 Ch.1 to 16 $I_o / I_{sc} = 7 \text{ mA}$	\leq	I_i / I_{max}	Terminals 1-2-3-4 Ch.1 to 16 $L_o / L_a = 725 \text{ mH}$ (IIC-A, B) $L_o / L_a = 2902 \text{ mH}$ (IIB-C, E) $L_o / L_a = 5804 \text{ mH}$ (IIA-D, F, G)	\geq	L_i / L_i device + L cable
Terminals 1-2-3-4 Ch.1 to 16 $P_o / P_o = 19 \text{ mW}$	\leq	P_i / P_i	Terminals 1-2-3-4 Ch.1 to 16 $L_o / R_o = 1888 \mu\text{H}/\Omega$ (IIC-A, B) $L_o / R_o = 7552 \mu\text{H}/\Omega$ (IIB-C, E) $L_o / R_o = 15105 \mu\text{H}/\Omega$ (IIA-D, F, G)	\geq	L_i / R_i device and L cable / R cable

D2030M Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters	D2030M Parameters	Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters
Terminals 1-2 or 3-4 Ch.1 to 32 $U_o / V_{oc} = 10.7 \text{ V}$	\leq	U_i / V_{max}	Terminals 1-2 or 3-4 Ch.1 to 32 $C_o / C_a = 2.23 \mu\text{F}$ (IIC-A, B) $C_o / C_a = 15.6 \mu\text{F}$ (IIB-C, E) $C_o / C_a = 69.0 \mu\text{F}$ (IIA-D, F, G)	\geq	C_i / C_i device + C cable
Terminals 1-2 or 3-4 Ch.1 to 32 $I_o / I_{sc} = 14 \text{ mA}$	\leq	I_i / I_{max}	Terminals 1-2 or 3-4 Ch.1 to 32 $L_o / L_a = 181 \text{ mH}$ (IIC-A, B) $L_o / L_a = 725 \text{ mH}$ (IIB-C, E) $L_o / L_a = 1451 \text{ mH}$ (IIA-D, F, G)	\geq	L_i / L_i device + L cable
Terminals 1-2 or 3-4 Ch.1 to 32 $P_o / P_o = 38 \text{ mW}$	\leq	P_i / P_i	Terminals 1-2 or 3-4 Ch.1 to 32 $L_o / R_o = 946.5 \mu\text{H}/\Omega$ (IIC-A, B) $L_o / R_o = 3786 \mu\text{H}/\Omega$ (IIB-C, E) $L_o / R_o = 7572 \mu\text{H}/\Omega$ (IIA-D, F, G)	\geq	L_i / R_i device and L cable / R cable

For installations in which both the Ci and Li of the Intrinsically Safe apparatus exceeds 1 % of the Co and Lo parameters of the D2000M Apparatus (excluding the cable), then 50 % of Co and Lo parameters are applicable and shall not be exceeded (50 % of the Co and Lo become the limits which must include the cable such that Ci device + C cable \leq 50 % of Co and Li device + L cable \leq 50 % of Lo).

If the cable parameters are unknown, the following value may be used:

Capacitance 60 pF per foot (180 pF per meter), Inductance 0.20 μ H per foot (0.60 μ H per meter).

The Intrinsic Safety Entity Concept allows the interconnection of Intrinsically Safe devices approved with entity parameters not specifically examined in combination as a system when the above conditions are respected.

For Division 1 and Zone 0, 1 installations, the configuration of Intrinsically Safe Equipment must be FM approved under Entity Concept, UL Listed or third party approved;

for Division 2 installations, the configuration of Intrinsically Safe Equipment must be FM approved under non-incendive field wiring or Entity Concept, UL Listed or third party approved.

9.2.1 Safety consideration on field communication lines

D2050M field communication and supply lines conform to the IEC 60079-27 (FISCO) standard requirements and need specific connection cable to connect D2010M or D2030M units.

The cable parameters must comply with the following:

- Loop Resistance: from 15 Ω /km to 150 Ω /km
- Loop Inductance: from 0.4 mH/km to 1 mH/km
- Capacitance: from 45 nF/km to 200 nF/km (capacitance must be considered
 $C = C_{\text{wire/wire}} + 0.5 \times C_{\text{wire/screen}}$ for fieldbus circuit insulated or
 $C = C_{\text{wire/wire}} + C_{\text{wire/screen}}$ for screen connected to the output of the fieldbus power supply.
- Maximum Length of each Spur: 30 m in Group IIC (A, B) or IIB, IIA (C, D, E, F and G)
- Maximum Length of the Trunk: 1 km in Group IIC (A, B) or 5 km in Group IIB (C, D, E, F and G), including length of all spur cables.

Note: NOT ONLY the maximum but ALSO the minimum values are mandatory.

Master (Line 1) and redundant (Line 2) connections MUST NOT be shorted together modifying cable parameters.

Particular care should be given when connecting Line 1 and Line 2 shields to earth. For D2050M installation in Safe Area/Non Hazardous Locations the connection to earth must be done in Safe Area only, and in a single point only. For D2050M installation in Hazardous Area/Hazardous Locations (mounted in an enclosure providing a suitable type of explosion protection), the connection to earth must be done only in a single point and only at one side of the communication line.

9.3 Installation

These general rules must be applied for proper safety of the installation:

- D2000M series are Multiplexer System housed in a plastic enclosure suitable for installation on T35 DIN Rail according to EN50022. The top part of the unit is protected by a metallic cover. Unit can be mounted with any orientation over the entire ambient temperature range.
- Electrical connection of conductors up to 2.5 mm² are accommodated by polarized plug-in removable screw terminal blocks which can be plugged in/out into a powered unit without suffering or causing any damage. The field wiring cables have to be proportionate in base to the current and the length of the cable. If Modbus output lines are shielded, the shield must be earthed in a single point only. If earthed at DCS/PLC side they must not be earthed at the D2050M side, and vice versa.
- Intrinsically Safe conductors must be identified and segregated from non I.S. and wired in accordance to the relevant national/international installation standards (e.g. IEC/EN60079-14 Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas, BS 5345 Pt4, VDE 165, ANSI/ISA RP12.06.01 Installation of Intrinsically Safe System for Hazardous (Classified) Locations, National Electrical Code NEC ANSI/NFPA 70 Section 504 and 505, and the Canadian Electrical Code CEC), make sure that conductors are well isolated from each other and do not produce any unintentional connection. The proper construction and isolation of the cable must be satisfied so that a short may be excluded to occur.
- The enclosure provides, according to EN60529, an IP20 minimum degree of mechanical protection (or similar to NEMA Standard 250 type 1) for indoor installation, outdoor installation requires an additional enclosure with higher degree of protection (i.e. IP54 to IP65 or NEMA type 12-13) consistent with the effective operating environment of the specific installation.
 G.M. International provides stainless steel enclosures for field installation (GM2300 Series).

- ❑ Units must be protected against dirt, dust, extreme mechanical (e.g. vibration, impact and shock) and thermal stress, and casual contacts. If enclosure needs to be cleaned use only a cloth lightly moistened by a mixture of detergent in water. Any penetration of cleaning liquid must be avoided to prevent damage to the unit. Any unauthorized card modification must be avoided.
- ❑ Electrostatic Hazard: to avoid electrostatic hazard, the enclosure of D2000M must be cleaned only with a damp or antistatic cloth. Grounding facilities, needed to avoid electrostatic discharge must be earthed properly.
- ❑ According to EN61010, D2050M must be connected to SELV or SELV-E supplies.
- ❑ D2050M can be installed in Hazardous Area/Hazardous Locations (apparatus category 2 G) mounted in an enclosure providing a suitable type of explosion protection.

9.3.1 GM2300 Series Enclosures for field mounting

GM2300 Series enclosures allow the mounting of multiplexer units in the field, enhancing degree of protection to IP65. The user has the possibility to choose between 10 standard enclosures for quick delivery and/or to customize the enclosure according specific requirements. Among the standard enclosures it is possible to choose between AISI 316 stainless steel material and painted carbon steel.

9.3.1.1 Standard GM2300 enclosures

Model GM2320-SS-20-NB-M20



Model GM2320-CS-20-PA-PG13



Included enclosure mounting brackets



9.3.1.1.1 GM2320-SS-20-NB-M20

Suitable for: 1 unit D2010M

Material: AISI 316 stainless steel

Dimensions: 400x300x200mm

Cover: fully hinged

Protection: IP 65

Accessories included:

- bottom plate
- 20 cable glands nickel plated brass, size M20 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 4 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- tool for cover locking
- 4 enclosure mounting brackets

9.3.1.1.2 GM2320-SS-36-NB-M20

Suitable for: 1 unit D2030M

Material: AISI 316 stainless steel

Dimensions: 400x300x200mm

Cover: fully hinged

Protection: IP 65

Accessories included:

- bottom plate
- 36 cable glands nickel plated brass, size M20 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 4 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- tool for cover locking
- 4 enclosure mounting brackets

9.3.1.1.3 GM2330-SS-36-NB-M20

Suitable for: 2 units D2010M or
1 unit D2010M + 1 unit D2011M

Material: AISI 316 stainless steel

Dimensions: 600x400x200mm

Cover: fully hinged

Protection: IP 65

Accessories included:

- bottom plate
- 36 cable glands nickel plated brass, size M20 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 6 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- tool for cover locking
- 4 enclosure mounting brackets

9.3.1.1.4 GM2330-SS-52-NB-M20

Suitable for: 1 unit D2010M + 1 unit D2030M or
1 unit D2010M + 2 units D2011M

Material: AISI 316 stainless steel

Dimensions: 600x400x200mm

Cover: fully hinged

Protection: IP 65

Accessories included:

- bottom plate
- 52 cable glands nickel plated brass, size M20 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 8 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- tool for cover locking
- 4 enclosure mounting brackets

9.3.1.1.5 GM2330-SS-68-NB-M20

Suitable for: 1 unit D2010M + 3 units D2011M or
2 units D2010M + 2 units D2011M or
2 units D2030M

Material: AISI 316 stainless steel

Dimensions: 600x400x200mm

Cover: fully hinged

Protection: IP 65

Accessories included:

- bottom plate
- 68 cable glands nickel plated brass, size M20 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 10 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- tool for cover locking
- 4 enclosure mounting brackets

9.3.1.1.6 GM2320-CS-20-PA-PG13

Suitable for: 1 unit D2010M

Material: carbon steel

Painting: epoxy color RAL 5015 blue

Dimensions: 400x300x120mm

Protection: IP 65

Accessories included:

- bottom plate
- 20 cable glands blue polyamide, size PG13 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 4 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- 4 screws and washers to fix cover
- 4 enclosure mounting brackets

9.3.1.1.7 GM2320-CS-36-PA-PG13

Suitable for: 1 unit D2030M
Material: carbon steel
Painting: epoxy color RAL 5015 blue
Dimensions: 400x300x120mm
Protection: IP 65

Accessories included:

- bottom plate
- 36 cable glands blue polyamide, size PG13 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 4 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- 4 screws and washers to fix cover
- 4 enclosure mounting brackets

9.3.1.1.8 GM2330-CS-36-PA-PG13

Suitable for: 2 units D2010M or
1 unit D2010M + 1 unit D2011M
Material: carbon steel
Painting: epoxy color RAL 5015 blue
Dimensions: 600x400x120mm
Protection: IP 65

Accessories included:

- bottom plate
- 36 cable glands blue polyamide, size PG13 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 6 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- 4 screws and washers to fix cover
- 4 enclosure mounting brackets

9.3.1.1.9 GM2330-CS-52-PA-PG13

Suitable for: 1 unit D2010M + 1 unit D2030M or
1 unit D2010M + 2 units D2011M

Material: carbon steel

Painting: epoxy color RAL 5015 blue

Dimensions: 600x400x120mm

Protection: IP 65

Accessories included:

- bottom plate
- 52 cable glands blue polyamide, size PG13 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 8 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- 4 screws and washers to fix cover
- 4 enclosure mounting brackets

9.3.1.1.10 GM2330-CS-68-PA-PG13

Suitable for: 1 unit D2010M + 3 units D2011M or
2 units D2010M + 2 units D2011M or
2 units D2030M

Material: carbon steel

Painting: epoxy color RAL 5015 blue

Dimensions: 600x400x120mm

Protection: IP 65

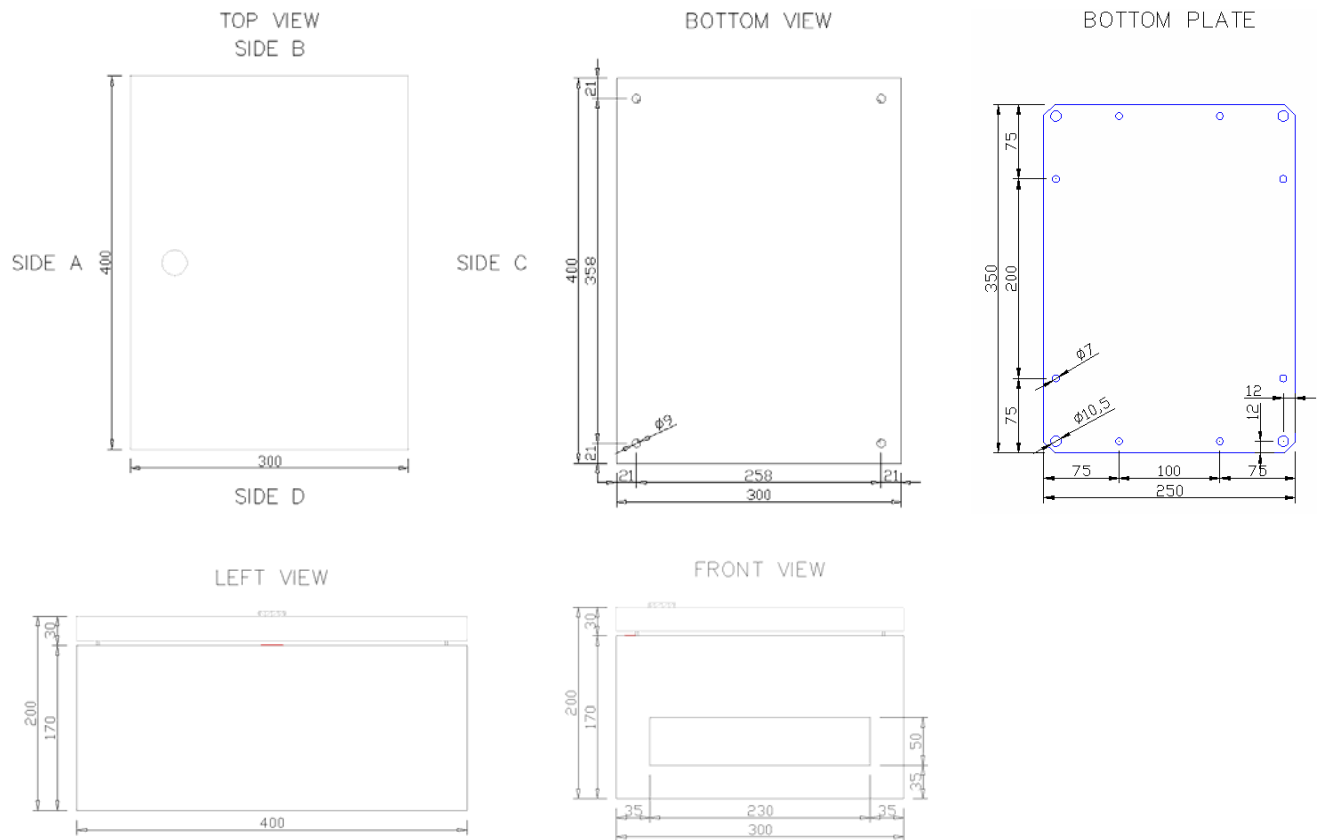
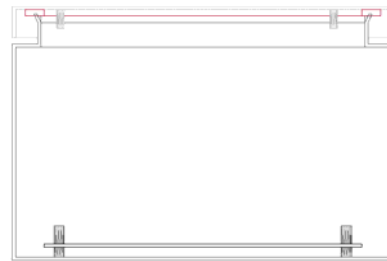
Accessories included:

- bottom plate
- 68 cable glands blue polyamide, size PG13 suitable for cable diameters from 8 to 13 mm
- copper bar for input wiring shield grounding
- DIN Rail T35 for D2000M modules installation
- 5 MOR 045 terminal blocks for lines and shield terminations
- 10 MOR 016 DIN Rail stoppers
- internal wiring, flat cables and cable tray
- grounding connections
- 4 screws and washers to fix cover
- 4 enclosure mounting brackets

9.3.1.2 Customized GM2300 enclosures

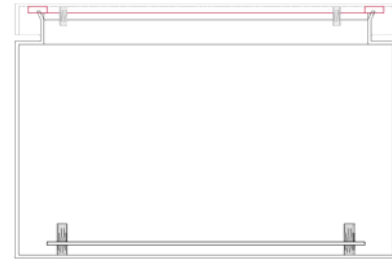
Customized enclosures are constituted basically by 2 different versions that can be customizable by the user or by G.M. International following the customer instructions. The enclosure can be equipped with cable gland, DIN rail, earth rail, terminal blocks to provide connections facility for D2000M Multiplexer system.

The following drawings indicate general dimensions and characteristics.

9.3.1.2.1 GM2320 Enclosure


NOTE: gland plate on side D only for carbon steel enclosure, not available for stainless steel enclosure.

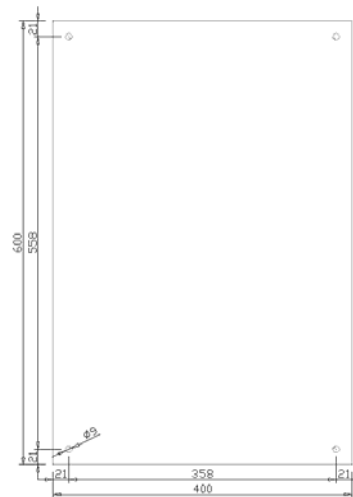
9.3.1.2.2 GM2330 Enclosure



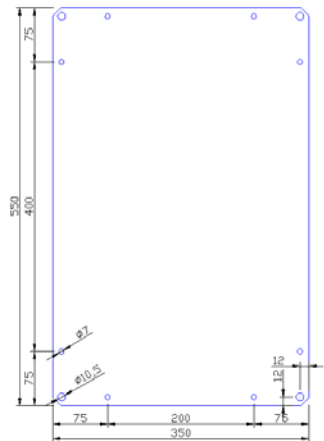
TOP VIEW
SIDE B



BOTTOM VIEW



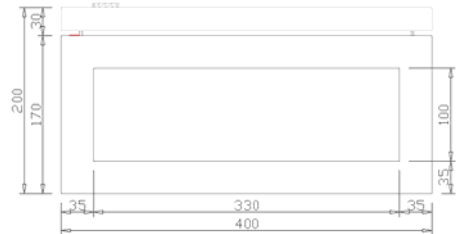
BOTTOM PLATE



LEFT VIEW



FRONT VIEW



NOTE: gland plate on side D only for carbon steel enclosure, not available for stainless steel enclosure.

9.3.1.3 GM2300 Series General Characteristics

- Material: carbon steel, stainless steel AISI 304, stainless steel AISI 316
- Protection: IP 65 degree of protection
- Thickness: 1.5 mm enclosure/door, 2.5 mm flat mounting plate
- Overall dimensions: 400 x 300 x 200 mm for GM2320, 600 x 400 x 200 mm for GM2330
- Weight: 11 Kg for GM2320, 18 Kg for GM2330 (excluding accessories).

The following tables indicate the maximum number of cable glands that can be installed:

Model GM2320 Enclosure

Side	PG7	PG9	PG11	PG13.5	PG16	PG21	PG29	PG36	PG42	PG48
A-C	27	27	23	23	23	12	10	5	3	3
B-D	18	18	14	14	14	8	6	3	2	2

Side	M12	M16	M20	M25	M32	M40	M50	M63
A-C	27	27	23	12	10	5	3	3
B-D	18	18	14	8	6	3	2	2

Side	Size 0	Size 1	Size 2	Size 3	Size 4	Size 5	Size 6	Size 7
A-C	23	12	10	5	5	3	3	3
B-D	14	8	6	3	3	2	2	2

Model GM2330 Enclosure

Side	PG7	PG9	PG11	PG13.5	PG16	PG21	PG29	PG36	PG42	PG48
A-C	42	42	35	35	35	20	16	8	5	5
B-D	27	27	23	23	23	12	10	5	3	3

Side	M12	M16	M20	M25	M32	M40	M50	M63
A-C	42	42	35	20	16	8	5	5
B-D	27	27	23	12	10	5	3	3

Side	Size 0	Size 1	Size 2	Size 3	Size 4	Size 5	Size 6	Size 7
A-C	35	20	16	8	8	5	5	5
B-D	23	12	10	5	5	3	3	3

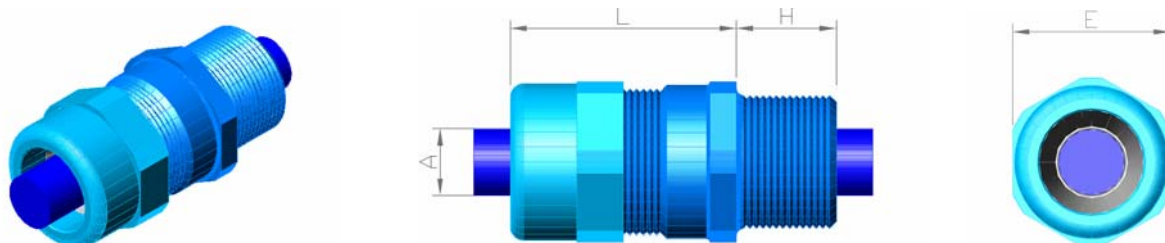
9.3.1.4 Cable Gland

GMPA Series are blue (RAL5012) polyamide cable gland for unarmored cable.

Type of protection is II 2 G EEx e II in conformity to 94/9/EC directive, providing IP66 degree of protection.

They can be used in Zone 1, 2 over the -20 to +80 °C ambient temperature (NOTE: for installation requiring the -40 °C lower limit please use the metallic version of cable gland).

Standard thread is PG according to guide UTE C 68-311 or metric according to ISO 965/1.



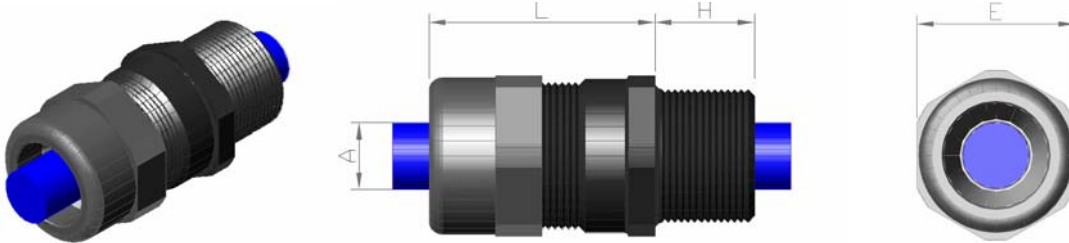
Type	Thread	Fixing Hole (mm)	Ø A Cable (mm)	L (mm)	H (mm)	E Spanner (mm)
GMPAPG07	PG7	12.5	3.5 to 6	18	9	15
GMPAPG09	PG9	15.5	5 to 8	22	9	19
GMPAPG11	PG11	19	6 to 10	22	9	22
GMPAPG13	PG13.5	20.5	8 to 13	23	10	24
GMPAPG16	PG16	22.5	10 to 15	23	10	26
GMPAPG21	PG21	29	13 to 19	29	11	32
GMPAPG29	PG29	37	18 to 25	29	12	41
GMPAPG36	PG36	47	24 to 32	35	14	52
GMPAPG42	PG42	54	29 to 38	40	16	59
GMPAPG48	PG48	60	36 to 44	42	18	65
GMPAM12	M12	13	3.5 to 6	18	9	15
GMPAM16	M16	17	5 to 8	22	12	19
GMPAM16-2	M16	17	6 to 10	22	9	22
GMPAM20	M20	21	8 to 13	23	12	24
GMPAM20-2	M20	21	10 to 15	23	10	26
GMPAM25	M25	26	13 to 19	29	13	32
GMPAM32	M32	33	18 to 25	29	15	41
GMPAM40	M40	41	24 to 32	35	15	52
GMPAM50	M50	51	29 to 38	40	16	59
GMPAM63	M63	63	36 to 44	42	16	65

GMPN Series are black (RAL9005) polyamide cable gland for unarmored cable.

Type of protection is II 2 G EEx e II in conformity to 94/9/EC directive, providing IP66 degree of protection.

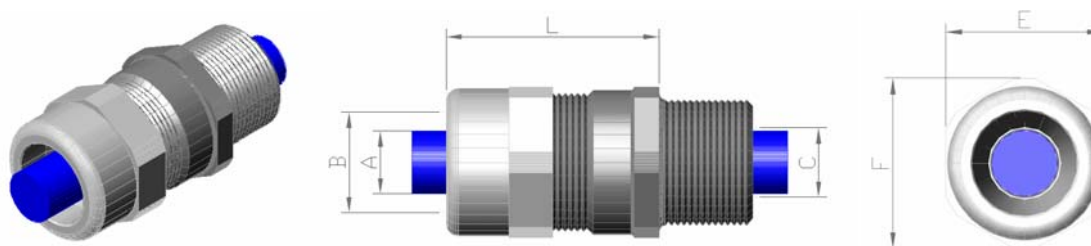
They can be used in Zone 1, 2 over the -20 to +80 °C ambient temperature (NOTE: for installation requiring the -40 °C lower limit please use the metallic version of cable gland).

Standard thread is PG according to guide UTE C 68-311 or metric according to ISO 965/1.



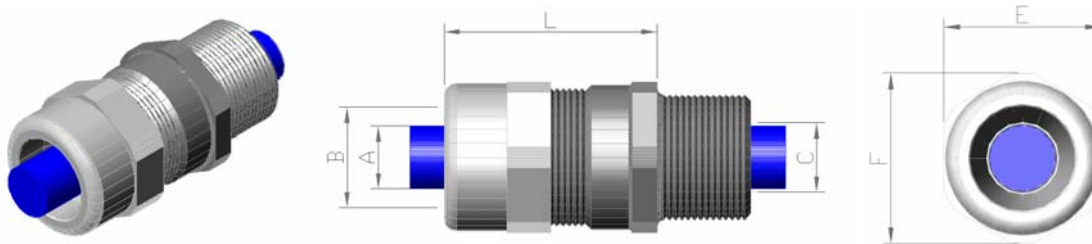
Type	Thread	Fixing Hole (mm)	Ø A Cable (mm)	L (mm)	H (mm)	E Spanner (mm)
GMPNPG07	PG7	12.5	3.5 to 6	18	9	15
GMPNPG09	PG9	15.5	5 to 8	22	9	19
GMPNPG11	PG11	19	6 to 10	22	9	22
GMPNPG13	PG13.5	20.5	8 to 13	23	10	24
GMPNPG16	PG16	22.5	10 to 15	23	10	26
GMPNPG21	PG21	29	13 to 19	29	11	32
GMPNPG29	PG29	37	18 to 25	29	12	41
GMPNPG36	PG36	47	24 to 32	35	14	52
GMPNPG42	PG42	54	29 to 38	40	16	59
GMPNPG48	PG48	60	36 to 44	42	18	65
GMPNM12	M12	13	3.5 to 6	18	9	15
GMPNM16	M16	17	5 to 8	22	12	19
GMPNM16-2	M16	17	6 to 10	22	9	22
GMPNM20	M20	21	8 to 13	23	12	24
GMPNM20-2	M20	21	10 to 15	23	10	26
GMPNM25	M25	26	13 to 19	29	13	32
GMPNM32	M32	33	18 to 25	29	15	41
GMPNM40	M40	41	24 to 32	35	15	52
GMPNM50	M50	51	29 to 38	40	16	59
GMPNM63	M63	63	36 to 44	42	16	65

GMPI Series are AISI 316 stainless steel cable gland for unarmored cable.
 Type of protection is II 2 G EEx e II and II 2 G EEx d IIC IP66 in conformity to 94/9/EC directive, providing IP66 degree of protection. They can be used in Zone 1, 2 over the -40 to +80 °C ambient temperature.
 Standard thread is ISO Mx1.5 according to ISO 261, other types on request.



Type	Size	Thread	Fixing Hole (mm)	Ø A Cable (mm)	B (mm)	C (mm)	L (mm)	E Spanner (mm)	F (mm)
GMPI0M16	0	M16x1.5	17	4 to 7	16	11	33	24	26
GMPI0M20		M20x1.5	21	7 to 10					
GMPI1M20	1	M20x1.5	21	5.5 to 8	20	14	41	32	35
GMPI1M20-2				8 to 10.5					
GMPI1M25		M25x1.5	26	10.5 to 13					
GMPI2M25	2	M25x1.5	26	10.5 to 13	25	19	41	36	39
GMPI2M25-2				13 to 15.5					
GMPI2M25-3				15.5 to 18					
GMPI3M32	3	M32x1.5	33	15 to 18	32	25	52	45	49
GMPI3M32-2				18 to 21					
GMPI3M32-3				21 to 24					
GMPI4M40	4	M40x1.5	41	21 to 24	38	31	53	50	55
GMPI4M40-2				24 to 27					
GMPI4M40-3				27 to 30					
GMPI5M50	5	M50x1.5	51	24 to 27	44	37	53	57	62
GMPI5M50-2				27 to 30					
GMPI5M50-3				30 to 33					
GMPI5M50-4				33 to 36					
GMPI6M63	6	M63x1.5	64	36 to 39	54	47	53	67	73
GMPI6M63-2				39 to 42					
GMPI6M63-3				42 to 45					
GMPI7M75	7	M75x1.5	75	45 to 48	65	57	53	80	88
GMPI7M75-2				48 to 51					
GMPI7M75-3				51 to 54					

GMPO Series are CW614N nickel/chrome plated brass cable gland for unarmored cable. Type of protection is II 2 G EEx e II and II 2 G EEx d IIC IP66 in conformity to 94/9/EC directive, providing IP66 degree of protection. They can be used in Zone 1, 2 over the -40 to +80 °C ambient temperature. Standard thread is ISO Mx1.5 according to ISO 261, other types on request.

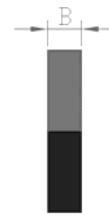
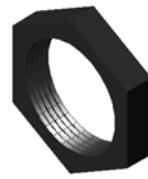


Type	Size	Thread	Fixing Hole (mm)	Ø A Cable (mm)	B (mm)	C (mm)	L (mm)	E Spanner (mm)	F (mm)
GMPO0M16	0	M16x1.5	17	4 to 7	16	11	33	24	26
GMPO0M20		M20x1.5	21	7 to 10					
GMPO1M20	1	M20x1.5	21	5.5 to 8	20	14	41	32	35
GMPO1M20-2				8 to 10.5					
GMPO1M25		M25x1.5	26	10.5 to 13					
GMPO2M25	2	M25x1.5	26	10.5 to 13	25	19	41	36	39
GMPO2M25-2				13 to 15.5					
GMPO2M25-3				15.5 to 18					
GMPO3M32	3	M32x1.5	33	15 to 18	32	25	52	45	49
GMPO3M32-2				18 to 21					
GMPO3M32-3				21 to 24					
GMPO4M40	4	M40x1.5	41	21 to 24	38	31	53	50	55
GMPO4M40-2				24 to 27					
GMPO4M40-3				27 to 30					
GMPO5M50	5	M50x1.5	51	24 to 27	44	37	53	57	62
GMPO5M50-2				27 to 30					
GMPO5M50-3				30 to 33					
GMPO5M50-4				33 to 36					
GMPO6M63	6	M63x1.5	64	36 to 39	54	47	53	67	73
GMPO6M63-2				39 to 42					
GMPO6M63-3				42 to 45					
GMPO7M75	7	M75x1.5	75	45 to 48	65	57	53	80	88
GMPO7M75-2				48 to 51					
GMPO7M75-3				51 to 54					

9.3.1.5 Locknut

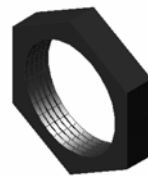
GMDO Series are nickel plated brass locknut for use in combination with cable glands.

Type	Thread	A Spanner (mm)	B (mm)
GMDOPG07	PG7	15	2.8
GMDOPG09	PG9	18	2.8
GMDOPG11	PG11	21	3
GMDOPG13	PG13.5	23	3
GMDOPG16	PG16	26	3
GMDOPG21	PG21	32	3.5
GMDOPG29	PG29	41	4
GMDOPG36	PG36	51	5
GMDOPG42	PG42	58	5
GMDOPG48	PG48	64	5.5
GMDOM16	M16	18	3
GMDOM20	M20	23	3
GMDOM25	M25	28	3
GMDOM32	M32	36	3.5
GMDOM40	M40	44	4
GMDOM50	M50	54	5
GMDOM63	M63	70	6
GMDOM75	M75	85	8



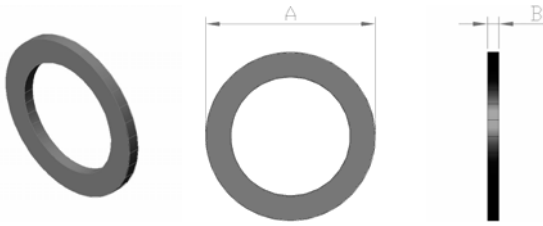
GMDI Series are AISI 316 stainless steel locknut for use in combination with cable glands.

Type	Thread	A Spanner (mm)	B (mm)
GMDIM16	M16	19	3
GMDIM20	M20	23	3
GMDIM25	M25	29	3
GMDIM32	M32	36	3.5
GMDIM40	M40	44	4
GMDIM50	M50	54	5
GMDIM63	M63	70	6
GMDIM75	M75	85	8



9.3.1.6 Washer

GMDW Series are sealing washer for use in combination with cable glands.



Type	Thread	A (mm)	B (mm)
GMDWPG07	PG7	17	1.2
GMDWPG09	PG9	21	1.2
GMDWPG11	PG11	24	1.2
GMDWPG13	PG13.5	27	1.2
GMDWPG16	PG16	30	1.2
GMDWPG21	PG21	35	1.5
GMDWPG29	PG29	45	1.5
GMDWPG36	PG36	60	1.5
GMDWPG42	PG42	65	1.5
GMDWPG48	PG48	71	1.5
GMDWM16	M16	22	1.2
GMDWM20	M20	24	1.2
GMDWM25	M25	30	1.5
GMDWM32	M32	42	1.5
GMDWM40	M40	52	1.5
GMDWM50	M50	63	1.5
GMDWM63	M63	77	2

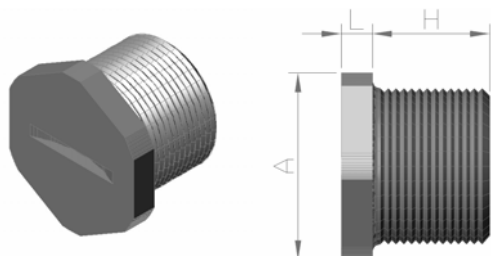
9.3.1.7 Plug

GMTN Series are black (RAL9005) polyamide plug.

Type of protection is II 2 G EEx e II in conformity to 94/9/EC directive, providing IP66 degree of protection.

They can be used in Zone 1, 2 over the -20 to +80 °C ambient temperature (NOTE: for installation requiring the -40 °C lower limit please use the metallic version of plug).

Standard thread is PG according to guide UTE C 68-311 or metric according to ISO 965/1.



Type	Thread	Fixing Hole (mm)	A Spanner (mm)	L (mm)	H (mm)
GMTNPG07	PG7	12.5	15	4	8
GMTNPG09	PG9	15.5	19	4.5	10
GMTNPG11	PG11	19	22	4.5	10.5
GMTNPG13	PG13.5	20.5	24	5	11
GMTNPG16	PG16	22.5	27	5	12
GMTNPG21	PG21	29	32	5.5	12.5
GMTNPG29	PG29	37	40	5.5	13.5
GMTNPG36	PG36	47	54	6	15
GMTNPG42	PG42	54	59	6.5	15
GMTNPG48	PG48	60	64	6.5	15.5
GMTNM16	M16	17	19	4	15
GMTNM20	M20	21	23	4	15
GMTNM25	M25	26	28	5	15
GMTNM32	M32	33	36	5.5	15
GMTNM40	M40	41	44	5.5	15
GMTNM50	M50	51	54	6	15
GMTNM63	M63	64	67	6.5	15

9.3.2 Installation Guidelines

9.3.2.1 Mounting for 1 unit

The layout in figure refers to the installation of one units as the following possibilities:

- ❑ D2010M maximum cable gland: 16 for inputs + 4 for communication/supply lines
- ❑ D2030M maximum cable gland: 32 for inputs + 4 for communication/supply lines

Indicative layout guidelines for GM2320 enclosures: see figure in following pages.

9.3.2.2 Mounting for 2 units

The layout in figure refers to the installation of up to two units as the following possibilities:

- ❑ Nr. 2 of D2010M or Nr. 1 of D2010M + Nr. 1 of D2011M
maximum cable gland: 32 for inputs + 4 for communication/supply lines
- ❑ Nr. 1 of D2010M + Nr. 1 of D2030M
maximum cable gland: 48 for inputs + 4 for communication/supply lines
- ❑ Nr. 2 of D2030M
maximum cable gland: 64 for inputs + 4 for communication/supply lines

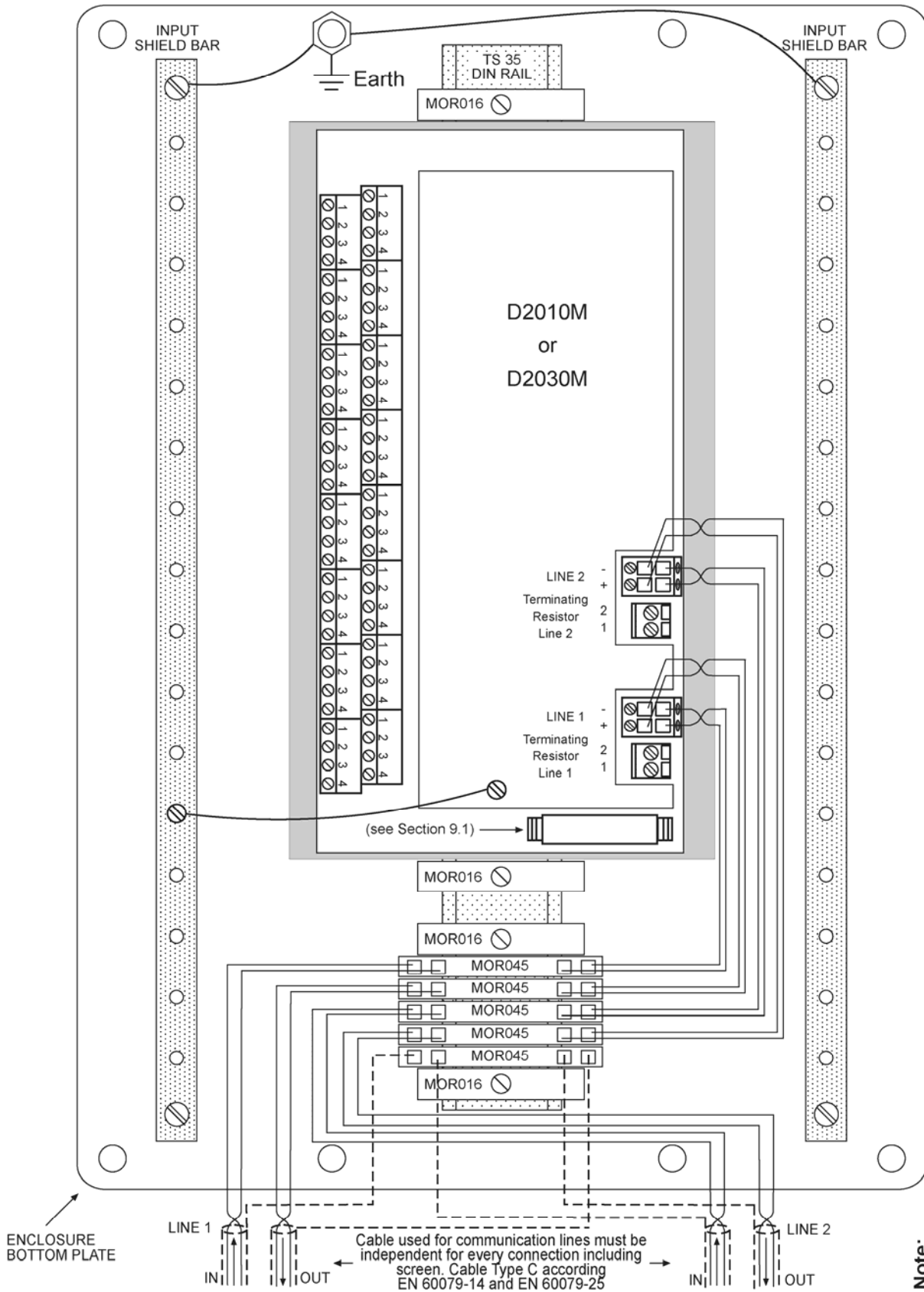
Indicative layout guidelines for GM2330 enclosures: see figure in following pages.

9.3.2.3 Mounting for 4 units

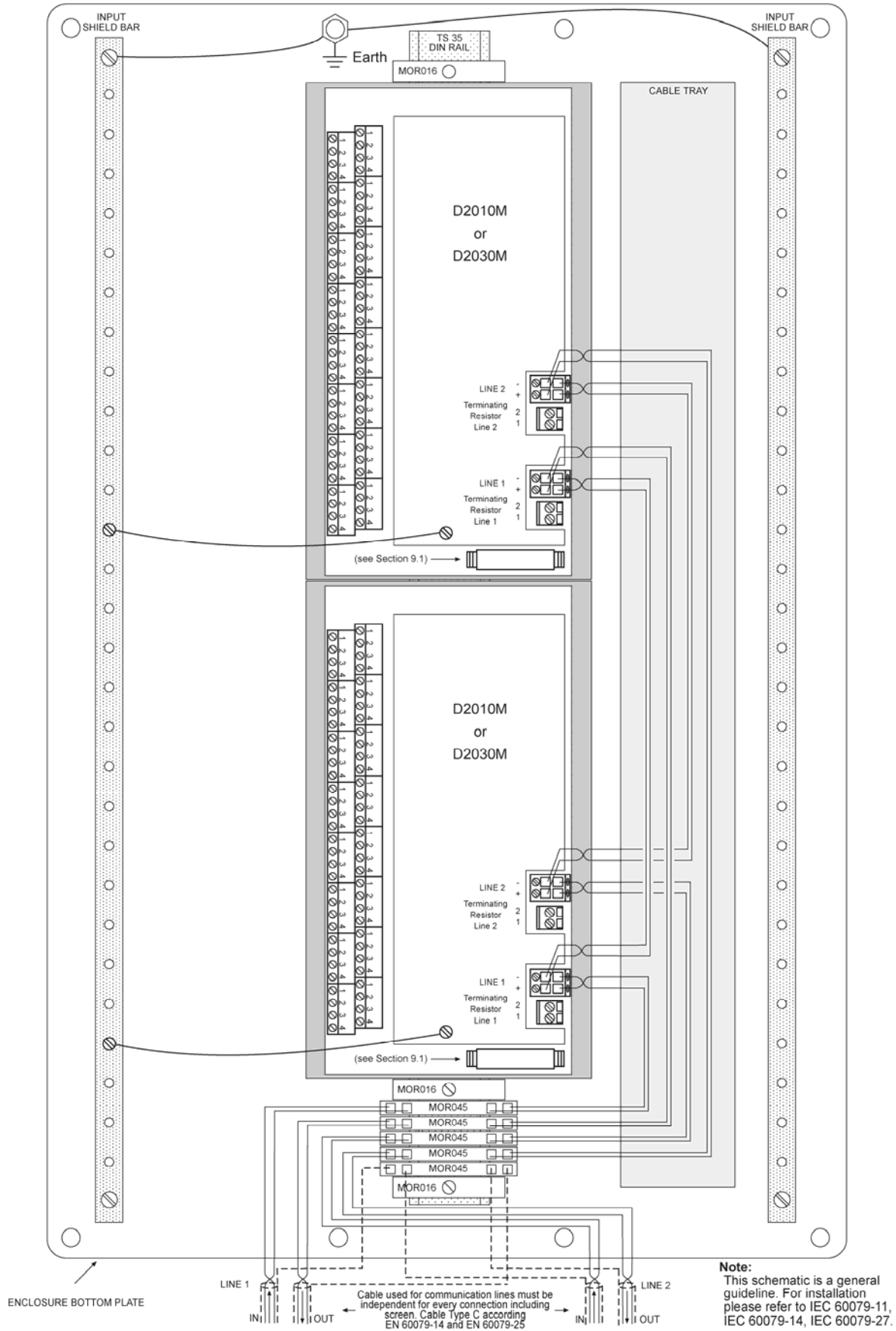
The layout in figure refers to the installation of up to four units as the following possibilities:

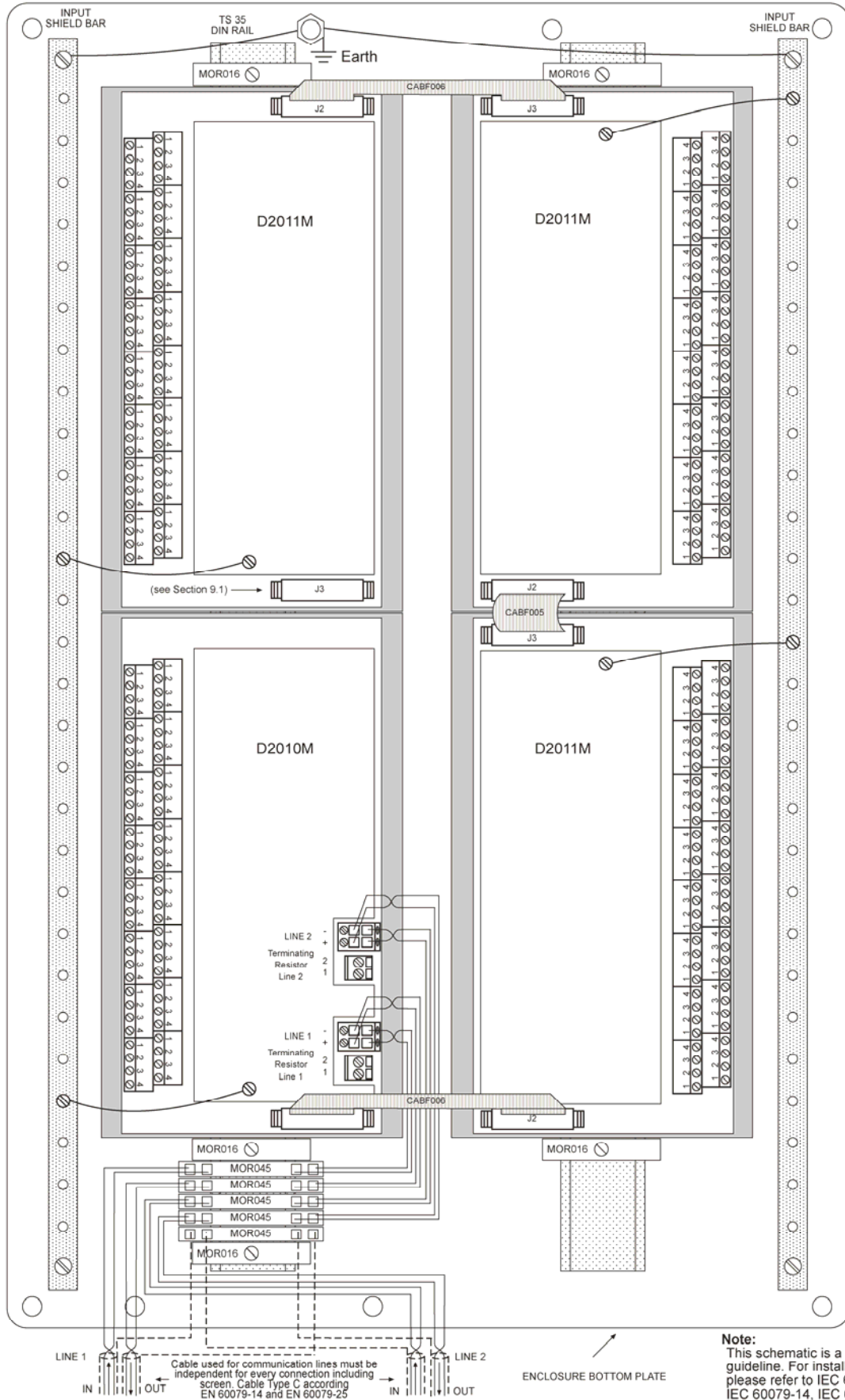
- ❑ Nr. 4 of D2010M or Nr. 1 of D2010M + 3 of D2011M or Nr. 2 of D2010M + Nr. 2 of D2011M
maximum cable gland: 64 for inputs + 4 for communication/supply lines
- ❑ Nr. 2 of D2010M + Nr. 1 of D2030M
maximum cable gland: 64 for inputs + 4 for communication/supply lines
- ❑ Nr. 1 of D2010M + Nr. 1 of D2011M + Nr. 1 of D2030M
maximum cable gland: 64 for inputs + 4 for communication/supply lines

Indicative layout guidelines for GM2330 enclosures: see figure in following pages.



Note: This schematic is a general guideline. For installation please refer to IEC 60079-11, IEC 60079-14, IEC 60079-27.





9.4 Repair

The unit cannot be repaired by the end user and must be returned to the manufacturer or his authorized representative.

Damaged or non-functioning equipments must be returned to G.M. International or his authorized representative.

Any unauthorized modification must be avoided.

Recalibration of equipments is however admitted if performed by qualified operators and carried out in safety.

9.5 Storage

If after an incoming inspection the unit is not installed directly on a system (parts for spare or expansion with long storage periods) it must be conveniently stocked.

Stocking area characteristics must comply with the following parameters:

- Temperature -40 to $+60$ °C the -40 to $+80$ °C in the data sheet is meant for limited periods, mainly to arrange for air transport, -10 °C to $+30$ °C are preferred.
- Humidity 0 to 90 % long period high humidity affects the package integrity, 0 to 60 % humidity is preferred.
- Vibration: no prolonged vibration should be perceivable in the stocking area to avoid loosening of parts or fatigue ruptures of components terminals.
- Pollution: presence of pollutant or corrosive gases or vapors must be avoided to prevent corrosion of conductors and degradation of insulating surfaces.

9.6 Disposal (Waste Electrical and Electronic Equipment)



This marking shown on the products indicates that it should not be disposed with other wastes at the end of its working life. It may contain hazardous substances for the health and the environment, to prevent possible harm from uncontrolled waste disposal, please separate this equipment from other types of wastes and recycle it responsibly to promote the sustainable reuse of material resources.

Users should contact either the supplier or their local government office for details of where and how they can take this equipment for environmentally safe recycling. This product should not be mixed with other commercial wastes for disposal.

10 Service Protocol (RS-232 Serial Port)

10.1 General

The D2050M gateway supports a textual ASCII protocol via an RS-232 serial port intended for:

- programming of the operating parameters
- verification of programming parameters
- monitoring of the system and units

This protocol is based upon a proprietary syntax described in this section.

The settings of the serial port are fixed so that, even in the case that the gateway is not programmed or the internal parameter setting was lost, a communication with the gateway may still be done.

The settings are:

- baud rate 19200
- parity none
- length 8 data bit, 1 stop bit

The communication connector is a 9 pin Sub D male connector with the following pin assignment:

Pin	Function
1	not connected
2	data receive (from external host to the D2050M)
3	data receive (to external host from the D2050M)
4	not connected
5	common (transmission line ground)
6	not connected
7	not connected
8	not connected
9	not connected

The message exchange uses ASCII strings formatted as required by the specific command and is terminated by the CR character (13 decimal, 0x0D hexadecimal).

Valid characters are all printable ASCII characters, starting from the character "space" (32 decimal, 0x20 hexadecimal) and ending with the character "~" (126 decimal, 0x7E hexadecimal), plus the CR. Other characters are not allowed and will generate an error.

The maximum length of the incoming message (to the D2050M gateway) is internally limited: the gateway will reject longer frames issuing an error message.

The handshake is master-slave: the host is a master and the D2050M gateway is a slave.

After a command has been sent to the D2050M, the host must wait for an answer or a timeout, before issuing the next command. Answer time of the D2050M is lower than 2 ms: this time is calculated from the end of the transmitted message to the beginning of the answer message (in detail from the end of stop bit of the last character of the command message to the start bit of the first character of the answer message).

The total exchange time must take in account the timing of a character at 19200 baud and the length of both command and answer messages.

The structure of commands is build up by concatenated fields.

Fields are separated by symbols; between symbols spaces are allowed, except for in the tag field where they are automatically removed by the command interpreter of the D2050M.

In example, the following formats are equivalent (the symbols < and > are added for clarity):

C1.4=1234

C 1 . 4 = 1234

Both write the configuration code 1234 to the channel 4 of field unit 1.

Even the following are equivalent:

T1.4=Water_In_20

T 1 . 4 =Water_In_20

Both write the tag name <Water_In_20> to the tag of channel 4 of unit 1.

The following are **NOT** equivalent:

T1.4=Water_In_20

T1.4= Water _In _20

The first writes the tag name <Water_In_20> to the tag of channel 4 of unit 1.

The second writes < Water _In _20> to the same channel tag.

The commands start with a letter, followed by the required fields; commands supported are:

Command Code	Description	Syntax for Read	Syntax for Write
C	channel configuration read/write	Cu.c↵	Cu.c=w↵
D	channel data read/write	Du.c↵	Du.c=w↵
S	system configuration read/write	Su.n↵	Su.n=w↵
T	Channel tag read/write	Tu.c↵	Tu.c=t↵

where:

- U unit number from 0 to 4 (0 for master, used only with Su.n and Tu.c commands)
- C channel number from 1 to 64
- N parameter number from 1 to 16
- W word value from 0 to 65535 (see valid word values for every application)
- T tag name from 0 (string empty) to 16 printable ASCII characters
- ↵ carriage return symbol

10.2 Commands

10.2.1 Field Unit Channel Configuration Command – Cu.c

This command reads or writes a configuration word of a channel: configuration word defines channel operation:

the syntax for reading is: **Cu.c**↵

the syntax for writing is: **Cu.c=w**↵

The value for the word must be in integer decimal format, the value must comply with the values admitted for analog and digital channels, no check is done on the word value, except that the word must be an integer value between 0 and 65535.

The answer message will be **Cu.c=w**↵

if the command was executed, otherwise an error message is issued as defined in the error section.

Examples:

Command	C2.3 ↵	reads configuration word (value 8192) of unit 2 channel 3
Response:	C2.03=08192 ↵	
Command	C2.3=8200 ↵	assigns 8200 to the configuration word of unit 2 channel 3
Response:	C2.03=08200 ↵	

Note: response contains 1 digit for unit number, 2 digits for channel numbers and 5 digits for configuration word.

10.2.2 Field Unit Channel Data Read/Write Command – Du.c

This command reads or writes a data word of a channel value:

the syntax for reading is: **Du.c**↵

the syntax for writing is: **Du.c=w**↵

The value for the data must be in integer decimal format, the value must comply with the values admitted for analog and digital channels, no check is done on the word value, except that the word must be an integer value between 0 and 65535, represented as a 16 bit binary value.

The answer message will be **Du.c=w**↵

if the command was executed, otherwise an error message is issued as defined in the error section.

Examples:

Command	D1.4 ↵	reads data value (value 6000) of unit 1 channel 4
Response:	D1.4=6000 ↵	(assuming a TC type K input, data = 600.0 °C)
Command	D1.4=5400 ↵	assigns 5400 to the data value of unit 1 channel 4
Response:	D1.4=05400 ↵	(assuming a TC type K input, data will be set to 540.0 °C)

Note 1: data write command changes the value in the D2050M buffer, if the corresponding channel is active the value will be overwritten at the next scan cycle.

Note 2: response contains 1 digit for unit number, 2 digits for channel numbers and 5 digits for data word.

10.2.2.1 Field Unit D2010M/D2011M data format

Analog inputs data formatting uses one word for every channel in offset binary format, the representation of a channel value depends on the unit associated with the measure of every channel as follows:

Range	Unit	Resolution	Format
Channel OFF	-	-	always reads as 0
mV range 1	mV	2 μ V	LSB is equal to 1 μ V (e.g. 12425 = 12.425 mV)
mV range 2	mV	10 μ V	LSB is equal to 10 μ V (e.g. 6532 = 65.32 mV)
Ohm range	Ω	0.1 Ω	LSB is equal to 0.1 Ω (e.g. 2851 = 285.1 Ω)
Thermocouples	$^{\circ}$ C	0.1 $^{\circ}$ C	LSB is equal to 0.1 $^{\circ}$ C (e.g. 12425 = 1242.5 $^{\circ}$ C)
Thermoresistances	$^{\circ}$ C	0.1 $^{\circ}$ C	LSB is equal to 0.1 $^{\circ}$ C (e.g. 7654 = 765.4 $^{\circ}$ C)
Compensator	$^{\circ}$ C	0.1 $^{\circ}$ C	LSB is equal to 0.1 $^{\circ}$ C (e.g. 1242 = 124.2 $^{\circ}$ C)

Over range, under range and burnout conditions return the following values depending on sensor configuration word (see Section 10.2.5.1):

Condition	No burnout, burnout upscale or downscale	Coded burnout
Under range	lower limit - 1	32000 (0x7D00)
Over range	higher limit + 1	32001 (0x7D01)
Burnout down scale	lower limit - 1	32002 (0x7D02)
Burnout up scale	higher limit + 1	32003 (0x7D03)

10.2.2.2 Field Unit D2030M data format

Digital inputs data formatting uses a 16 bit word to represent the status of 8 discrete inputs, including line fault information. Every channel data word therefore represents a set of inputs as in the following table:

Data Channel	Inputs
1	01 to 08
2	09 to 16
3	17 to 24
4	25 to 32

The input information is constituted by 2 bits: a OFF/ON value and an fault value, as follows:

OFF/ON bit	Status bit	Input condition
0	0	OFF status
1	0	ON status
0	1	line opened (fault)
1	1	line shorted (fault)

The bit organization within a data word is the following (word of channel 1 shown):

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OFF/ON bit of input									8	7	6	5	4	3	2	1
Status bit of input	8	7	6	5	4	3	2	1								

Examples:

Response:	D1.1=00000 ↓	inputs 1 to 8 are OFF, no line faults
	D1.1=00001 ↓	input 1 is ON, inputs 2 to 7 are OFF, no line faults
	D1.1=00256 ↓	input 1 line is opened, inputs 2 to 7 are OFF
	D1.1=00257 ↓	input 1 line is shorted, inputs 2 to 7 are OFF

10.2.3 Gateway & System Control Command – Su.n

This command reads or writes a system word parameter; a system parameter defines the system operation:

the syntax for reading is: **Su.n**↵

the syntax for writing is: **Su.n=w**↵

The value for the word must be in integer decimal format, the value must comply with the values admitted for system parameters, no check is done on the format, except that the word must be an integer value between 0 and 65535.

The answer message will be **Su.n=w**↵

if the command was executed, otherwise an error message is issued as defined in the error section.

Examples:

Command	S0.15 ↵	reads master system parameter 15 (value 4108)
Response:	S0.15=04108 ↵	
Command	S0.15=4232 ↵	assigns 4232 to the master system parameter 15
Response:	S0.15=04232 ↵	

10.2.4 Field Unit Channel Tag Read/Write Command – Tu.c

This command reads or writes a tag name of the system or of a channel, the tag name identifies the D2050M or a channel:

the syntax for reading is: **Tu.c**↵

the syntax for writing is: **Tu.c=t**↵

The value for the tag name must be a string of 0 to 16 chars, if after the symbol '=' no characters are entered, but only CR, a string of 16 spaces is assigned to the tag name; if the length string is lower than 16 characters the tag name is right filled with spaces up to the length of 16 characters; if instead the length is higher than 16 chars, an error message is issued and the previous value remains unchanged.

The answer message will be **Tu.c=t**↵

if the command was executed, otherwise an error message is issued as defined in the error section.

Examples:

Command	T1.04 ↵	reads tag name (Water_Pump_01) of unit 1 channel 4
Response:	T1.04=Water_Pump_01 ↵	
Command	T1.04=Water_Pump_02 ↵	assigns "Water_Pump_02" to tag name of unit 1 channel 4
Response:	T1.04=Water_Pump_02 ↵	

Note: only one tag is used for master (gateway D2050M) with the syntax T0.1↵ for read or T0.1=Tag↵ for write.

10.2.5 Structure of the Channel Configuration Word

10.2.5.1 Analog Channels (D2010M and D2011M)

The configuration of an analog channel (D2010M and D2011M) is based upon a 16 bit control word divided in bit fields; the division is summarized in the following table:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field				Filter			Mode			Sensor type						

- Sensor type (bit 5..0): up to 64 types of sensors as defined below
 Sensor mode (bit 9..7): 8 operating modes for thermocouples and thermoresistances
 Sensor filtering (bit 12..11): 4 filtering modes
 Bit 15, 14, 13, 10, 6 are reserved for future expansions and must be set to 0

Sensor Table

Code	Description
0	channel OFF
1	-21.000 to +21.000 mV
2	-21.00 to +80.00 mV
3	resistance 0.0 to 400.0 Ω
4	thermocouple type B
5	thermocouple type E
6	thermocouple type J
7	thermocouple type K
8	thermocouple type L – DIN
9	thermocouple type L – GOST
10	thermocouple type N
11	thermocouple type R
12	thermocouple type S
13	thermocouple type S – GOST
14	thermocouple type T
15	thermocouple type U
16	thermocouple type A1
17	thermocouple type A2
18	thermocouple type A3
19	thermoresistance Pt 100 a = 385
20	thermoresistance Pt 200 a = 385
21	thermoresistance Pt 300 a = 385
22	thermoresistance Pt 100 a = 390
23	thermoresistance Pt 100 – GOST
24	thermoresistance Pt 50 - GOST
25	thermoresistance Ni 100
26	thermoresistance Cu 100 - GOST
27	thermoresistance Cu 53 - GOST
28	thermoresistance Cu 50 - GOST
29	thermoresistance Cu 46 – GOST
30	thermocouple compensator G.M. option 2091

Operating Modes for mV and thermocouples (sensor codes 1, 2 and 4 to 18)

Code	Description	Notes
0	no burnout automatic cold junction	no burnout detection will be performed automatic cold junction compensation
1	down scale burnout automatic cold junction	burnout detection will move reading to lowest value of scale automatic cold junction compensation
2	up scale burnout automatic cold junction	burnout detection will move reading to highest value of scale automatic cold junction compensation
3	coded burnout automatic cold junction	burnout detection will be coded as special value automatic cold junction compensation
4	no burnout fixed cold junction	no burnout detection will be performed cold junction compensation with fixed reference
5	down scale burnout fixed cold junction	burnout detection will move reading to lowest value of scale cold junction compensation with fixed reference
6	up scale burnout fixed cold junction	burnout detection will move reading to highest value of scale cold junction compensation with fixed reference
7	coded burnout fixed cold junction	burnout detection will be coded as special value cold junction compensation with fixed reference

Special values for coded burnout are:

Condition	Decimal value	Hexadecimal value
Under range	32000	7D00
Over range	32001	7D01
Burnout of sensor	32002	7D02
Burnout of compensator	32003	7D03

Operating Mode for thermoresistances (sensor codes 3 and 19 to 30)

Code	Description	Notes
0	3 wire connection	connection will be a 3 wire connection
1	4 wire connection	connection will be a 4 wire connection

Filter Setting

Code	Description	Notes
0	no filter	measure value from A/D converter is not filtered
1	fast filter	smart averaging of 2 readings is performed
2	medium filter	smart averaging of 4 readings is performed
3	slow filter	smart averaging of 8 readings is performed

A way to construct a word value, using decimal notation, is the following:

- 1 determine the codes of the desired configuration (sensor, mode and filter)
- 2 construct the word as:
 $W = 2048 \times \text{filter_code} + 128 \times \text{mode_code} + \text{sensor_code}$

10.2.5.2 Digital Channels (D2030M)

The configuration of a digital channel (D2030M) is based upon a 16 bit control word divided in bit fields, the division is summarized in the following table:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Scan Time					Mode	

Sensor mode (bit 1, 0): 4 operating modes for sensors processing
 Sensor scan time (bit 6..3): 16 scan times for sensor setup
 Bit 15 to 7 and 2 are reserved for future expansions and must be set to 0

Operating Mode

Code	Description	Notes
0	channel OFF	channel not active, reads as 0
1	channel active fault detection disabled	channel active fault detection inactive
2	not used (channel OFF)	channel not active, reads as 0
3	channel active fault detection enabled	channel active fault detection active

Scan Time

Code	Description	Notes
0	1 ms scan time	channel will be powered for 1 ms before acquisition
1	2 ms scan time	channel will be powered for 2 ms before acquisition
2	3 ms scan time	channel will be powered for 3 ms before acquisition
3	4 ms scan time	channel will be powered for 4 ms before acquisition
4	5 ms scan time	channel will be powered for 5 ms before acquisition
5	6 ms scan time	channel will be powered for 6 ms before acquisition
6	8 ms scan time	channel will be powered for 8 ms before acquisition
7	10 ms scan time	channel will be powered for 10 ms before acquisition
8	12 ms scan time	channel will be powered for 12 ms before acquisition
9	14 ms scan time	channel will be powered for 14 ms before acquisition
10	16 ms scan time	channel will be powered for 16 ms before acquisition
11	18 ms scan time	channel will be powered for 18 ms before acquisition
12	20 ms scan time	channel will be powered for 20 ms before acquisition
13	25 ms scan time	channel will be powered for 25 ms before acquisition
14	30 ms scan time	channel will be powered for 30 ms before acquisition
15	35 ms scan time	channel will be powered for 35 ms before acquisition

Note: if the channel is disabled the scan time is 500 μ S regardless of the scan time setting.

A way to construct a word value, using decimal notation, is the following:

- 1 determine the codes of the desired configuration (mode and time)
- 2 construct the word as:
 $W = 8 \times \text{time_code} + \text{mode_code}$

10.2.6 Address and Structure of the System Parameter Control Word

The configuration of the system is based upon a set of 16 bit control words arranged in groups and divided in bit fields, the grouping and the division in bit fields is summarized in the following tables:

Slave System Parameters (unit code 1 to 4)

Parameter	Description	Notes
1	slave real configuration	real configuration of slave
2	slave software revision	software revision of slave
3	slave required configuration	configuration register of slave (required configuration)
4	reserved	
5	slave qualifier line #1	communication qualifier of line #1
6	slave qualifier line #2	communication qualifier of line #2
7	reserved	
8	reserved	
9	slave zero correction	A/D input zero correction (D2010M only)
10	slave span correction	A/D input span correction (D2010M only)
11	slave resistance correction	A/D input resistance correction (D2010M only)
12	reserved	
13	reserved	
14	reserved	
15	slave average limit	smart filter averaging limit (D2010M only)
16	slave cold junction reference	cold junction fixed reference value (D2010M only)

Note 1: reserved parameters should not be used to maintain compatibility with future releases.

Note 2: the slave required configuration contains the system's topology as required by the host; the real configuration, instead, contains the actual implementation of slaves: more precisely, the real configuration is managed by the system and can only be read by the user/host; during normal operation the two values should be coincident. A difference between the two indicates that the gateway has detected that connected units topology differs from the desired one. This may happen when a unit is added or removed.

Slave Real Configuration

The configuration of a slave is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Type				Expansion		

Number of expansions (bit 2..0):

- 0 no D2011M expansions (16 channels)
- 1 nr. 1 D2011M expansion (32 channels)
- 2 nr. 2 D2011M expansion (48 channels)
- 3 nr. 3 D2011M expansion (64 channels)

Type of Slave (bit 7..4):

- 0 no slave installed
- 1 D2010M
- 3 D2030M

This Register is read only.

Slave Software Revision

The software release of the slave is coded as:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Revision			Sub_Revision			

This register is read only.

Slave Required Configuration

This register has the same structure as the "Slave Real Configuration" register.

Slave Qualifier Line # 1 and # 2

These registers contain the actual percentage of successful communication toward the slave, they are read only, any attempt to write to them results in register clear.

Slave Zero, Span, Resistance Correction (D2010M)

The correction registers control the calibration of the slave unit, **MUST NOT BE CHANGED.**

Slave Average Limit (D2010M)

The average limit register defines the band (in 2 μ V multiples) of the averaging of all inputs.

Slave Cold Junction Reference (D2010M)

This register defines the reference temperature of the cold junction compensation when the fixed compensation mode is selected, the value is in 0.1 $^{\circ}$ C increments (324 = 32.4 $^{\circ}$ C).

Master System Parameters (unit code 0)

Parameter	Description	Notes
1	master type	type of master (HEX 50 for D2050M)
2	master software revision	software revision of master
3	configuration of master	master configuration register
4	repeaters configuration register	configuration of digital output repeaters
5	status and command	status and command register
6	Reserved	
7	Reserved	
8	Reserved	
9	modbus address	modbus address of master (1 to 247)
10	modbus baud rate	index of modbus baud rate
11	modbus format	index of modbus format
12	Reserved	
13	Reserved	
14	Reserved	
15	modbus error counter	modbus communication error counter
16	slaves error counter	slaves communication error counter

Note: reserved parameters read as 0, writing them has no effect.

Master type

The type of master is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Type						

Type of Master (bit 7..0):

50 D2050M

This Register is read only.

Master Software Revision

The software release of the master is coded as:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Revision			Sub_Revision			

This register is read only.

Configuration of Master (D2050M)

The master configuration register (D2050M) is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field													MM	LF	RL1	RL0

- Bit 1, 0 field lines (0 = use line 1; 1 = use line 2; 2 = smart mode) read/write
- Bit 2 operating line frequency (0 = 50 Hz; 1 = 60 Hz) read/write
- Bit 3 modbus can change configuration (0 = no; 1 = yes) read/write
- Bit 15 to 4 reserved

Note: for security reasons access to configuration registers via modbus line can be disabled.

Repeaters Configuration Register

The digital output repeaters configuration register is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field		NE2	NE1	NE0		M41	M40		M31	M30		M21	M20		M11	M10

- Bit 1, 0 repeater #1 mapping code
- Bit 4, 3 repeater #2 mapping code
- Bit 7, 6 repeater #3 mapping code
- Bit 10, 9 repeater #4 mapping code
- Bit 14..12 number of installed repeaters
- Bits 15, 11, 8, 5, 2 reserved

The mapping code is:

- 00 repeater mapped to slave #1
- 01 repeater mapped to slave #2
- 10 repeater mapped to slave #3
- 11 repeater mapped to slave #4

Note: repeaters may be assigned to digital field units independently and more than one repeater can be assigned to the same field unit.

Status and Command (D2050M)

The master status and command register (D2050M) is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field			LO	DM	DC	UC	RA	RS	L2	L1					SL1	SL0

Bit 1, 0	slave code (used for download command)	
Bit 6	line #1 is operating	read only
Bit 7	line #2 is operating	read only
Bit 8	restart slaves	write only
Bit 9	restart system	write only
Bit 10	upload calibration	write only
Bit 11	download calibration	write only
Bit 12	diagnostic mode	read/write
Bit 13	line override	read only
Bit 14, 15, 5 to 2		reserved

Modbus address

The modbus address of master is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field												Address				

Modbus address (bit 7..0):

Modbus Baud Rate (D2050M)

The baud rate of the modbus communication is defined by an index; the word structure and index value are indicated below:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field														B2	B1	B0

Bit 2..0	index
Bit 15 to 3	reserved

Index	B2	B1	B0	Baud Rate
0	0	0	0	4800
1	0	0	1	9600
2	0	1	0	19200
3	0	1	1	38400
4	1	0	0	57600
5	1	0	1	115200

Note: combinations of B0, B1, B2 exceeding the value of 5 (115200 baud) must not be used.

Modbus Format (D2050M)

The format of the modbus communication is defined by an index;
 the word structure and index value are indicated below:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field															B1	B0

Bit 1, 0 index

Bit 15 to 2 reserved

Index	B1	B0	Format
0	0	0	8 data bit, no parity, 1 stop bit
1	0	1	8 data bit, even parity, 1 stop bit
2	1	0	8 data bit, odd parity, 1 stop bit
3	1	1	8 data bit, no parity, 2 stop bit

Modbus and Slaves Error Counters

These register contain the actual count of communication errors of the modbus and slave lines,
 any attempt to write to them results in register clear.

10.2.7 Error Messages

If errors are detected by the command line interpreter of the D2050M, commands are not executed and an error message is returned. The returned messages are coded as follows:

Message	Error	Description
E001.┘	invalid command	a issued command mnemonic was not found in the supported set
E002.┘	invalid unit	unit number is either wrong in format or out of bounds
E003.┘	invalid channel	channel number is either wrong in format or out of bounds
E004.┘	invalid parameter	parameter number is either wrong in format or out of bounds
E005.┘	invalid value	the value to be assigned is either wrong in format or out of bounds
E006.┘	invalid tag	the tag value is wrong in format or contains invalid characters
E007.┘	invalid dot separator	dot separator was not found where expected
E008.┘	invalid equal separator	equal separator was not found where expected
E999.┘	not defined	not actually detailed error

Examples:

Command **T5.6.┘** unit number must be between 1 and 4
 Response: **E002.┘**

Command **T2.68.┘** channel number must be between 1 and 64
 Response: **E003.┘**

11 Modbus Protocol

Modbus is a registered trademark of Schneider Automation Incorporated.

11.1 General Description

The modbus protocol is widely used to exchange data between master and slave units in industrial environments, the advantage is that common physical supports such as RS-485 or RS-232 communication lines can be used; additionally the protocol's simplicity and wide application allows its use with many computers or PLC and a variety of application programs are available. Today's line drivers ranging up to a speed of 115200 bit/s allow fast and efficient data transfer.

11.2 The Frame Format

The format used by the D2050M gateway is the RTU (Remote Terminal Unit) format, exchanging data using 8 bit bytes. The advantage of this mode is that its density allows high data throughput for the baud rate used.

The message is transmitted in a continuous stream, an interval of 1.5 character defines the end of a frame.

A typical modbus frame is constituted by the following fields:

Address	Function	Data	CRC-CHECK
8 bit slave address	8 bit function code	N x 8 bit data field	16 bit crc field

The address field of a message frame contains a eight bits slave addresses in the range 0 to 247 decimal.

The individual slave is assigned addresses in the range of 1 to 247.

A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response frame.

Address 0 is used for the broadcast address, which is recognized by all slaves.

The function code field of a message frame contains a byte defining the function code.

When a message is sent from a master to a slave, the function code tells the slave the kind of action to perform.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called exception response). In addition the slave places a unique code into the data field of the response message: this tells the master what kind of error occurred.

The data field has different size and format as a function of the command involved, detailed data formats for master/slave and slave/master messages are defined for every type of command.

If no error occurs, the data field of a response from a slave to a master contains the data requested.

If an error occurs, the field contains an exception code that the master application can use to determine the type of error.

The error checking field contains a 16-bit value. The error check value is the result of a cyclical redundancy check calculation performed on the message contents. The CRC field is appended to the message as the last field in the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

11.3 Supported Commands

Command codes supported by the D2050M software are a subset of the modbus commands, other commands will generate an exception response:

Function Code	Function Name	Notes
03 (0x03)	read holding registers	reads a stream of words from the D2050M memory
04 (0x04)	read input registers	same as command code 03
06 (0x06)	preset single register	writes a word in the D2050M memory
16 (0x10)	preset multiple registers	writes a stream of words in the D2050M memory

11.3.1 Command 3, 4 – Read Holding, Input Registers

This function code is used to read the contents of a contiguous block of registers from the D2050M. The starting address and the number of registers start from zero.

The register data in the response message are packed as two bytes per register. For each register, the first byte contains high order bits and the second contains low order bits.

The format of the request is:

Name	Size	Value
Function Code	1 byte	0x03 or 0x04
Starting Address	2 bytes	see word address section
Number of Registers	2 bytes	decimal 1 to 64 (0x0001 to 0x0040)

The format of the response is:

Name	Size	Value
Function Code	1 byte	0x03 or 0x04
Byte Count	1 byte	2 x number of registers
Data	2 x N bytes	2 bytes for every register

11.3.2 Command 6 – Preset Single Register

This function code is used to write the contents of a register to the D2050M. Addresses start from zero.

The register data must be packed as two bytes, the first byte contains high order bits and the second contains low order bits. The normal response is an echo of the request.

The format of the request is:

Name	Size	Value
Function Code	1 byte	0x06
Register Address	2 bytes	see word address section
Register Value	2 bytes	decimal 0 to 65535 (0x0000 to 0xFFFF)

The format of the response is:

Name	Size	Value
Function Code	1 byte	0x06
Register Address	2 bytes	copy of request
Register Value	2 bytes	copy of request

11.3.3 Command 16 – Preset Multiple Registers

This function code is used to write the contents of a contiguous block of registers into the D2050M. The starting address and the number of registers are addressed starting from zero. Register data are packed as two bytes for each register, the first byte contains high order bits and the second contains low order bits.

The format of the request is:

Name	Size	Value
Function Code	1 byte	0x10
Starting Address	2 bytes	see word address section
Number of Registers	2 bytes	decimal 1 to 64 (0x0001 to 0x0040)
Data to be written	2 x N	2 bytes for every register

The format of the response is:

Name	Size	Value
Function Code	1 byte	0x10
Starting Address	2 bytes	copy of request
Number of Registers	2 bytes	copy of request

11.4 Errors – Exception Responses

If the D2050M does not receive the request due to a communication error, or detects a wrong CRC value, no response is returned. The host should eventually process a timeout condition for the request.

If the D2050M receives the request without a communication error, but cannot handle it (e.g. if the request is to read a non-existing register), it will return an exception response informing the host of the nature of the error.

The format of the exception response is:

Name	Size	Value
Function Code	1 byte	0x80 + function code of request
Exception Code	1 byte	0x01, 0x02, 0x03

In a normal response, the D2050M echoes the requested function code in the function code field of the response. All function codes have the most-significant bit (MSB) equal to 0 (values below 0x80).

In an exception response, the D2050M sets the MSB of the function code to 1: this makes the function code value in an exception response exactly 0x80 higher than the value of a normal response.

In a normal response, the D2050M can return data in the data field, in an exception response, the D2050M returns an exception code in the data field, this defines the condition that caused the exception.

Handled exceptions are:

Code	Name	Notes
01	Illegal Function	function code received in the query is not executable by the D2050M (code different from 03, 04, 06, 16)
02	Illegal Data Address	data address received in the query is not an allowable address, more specifically the combination of starting address and data length is invalid
03	Illegal Data Value	a value contained in the query data field is not an allowable value

11.5 Register Addresses

Register addresses used by modbus are unsigned integer indexes starting from zero, ranging from 0 to 65535. Addresses used by the D2050M, are defined in the following tables.

11.5.1 Data Registers

Data registers contain information on input measuring circuits; they are located at the following addresses:

From	To	Description	Note
0000	0003	data of channels 01 to 03 for D2010M or 01 to 32 for D2030M of slave #1	D2010M and D2030M
0004	000F	data of channels 04 to 16 for D2010M of slave #1	D2010M
0010	001F	data of channels 17 to 32 of slave #1	D2011M expansion #1
0020	002F	data of channels 33 to 48 of slave #1	D2011M expansion #2
0030	003F	data of channels 49 to 64 of slave #1	D2011M expansion #3
0040	0043	data of channels 01 to 03 for D2010M or 01 to 32 for D2030M of slave #2	D2010M and D2030M
0044	004F	data of channels 04 to 16 for D2010M of slave #2	D2010M
0050	005F	data of channels 17 to 32 of slave #2	D2011M expansion #1
0060	006F	data of channels 33 to 48 of slave #2	D2011M expansion #2
0070	007F	data of channels 49 to 64 of slave #2	D2011M expansion #3
0080	0083	data of channels 01 to 03 for D2010M or 01 to 32 for D2030M of slave #3	D2010M and D2030M
0084	008F	data of channels 04 to 16 for D2010M of slave #3	D2010M
0090	009F	data of channels 17 to 32 of slave #3	D2011M expansion #1
00A0	00AF	data of channels 33 to 48 of slave #3	D2011M expansion #2
00B0	00BF	data of channels 49 to 64 of slave #3	D2011M expansion #3
00C0	00C3	data of channels 01 to 03 for D2010M or 01 to 32 for D2030M of slave #4	D2010M and D2030M
00C4	00CF	data of channels 04 to 16 for D2010M of slave #4	D2010M
00D0	00DF	data of channels 17 to 32 of slave #4	D2011M expansion #1
00E0	00EF	data of channels 33 to 48 of slave #4	D2011M expansion #2
00F0	00FF	data of channels 49 to 64 of slave #4	D2011M expansion #3

11.5.1.1 Analog inputs data registers

Analog inputs data formatting uses one word for every channel, in offset binary format, the representation of a channel value depends on the unit associated with the measure of every channel as follows:

Range	Unit	Resolution	Format
Channel OFF	-	-	always reads as 0
mV range #1	mV	2 μ V	LSB is equal to 1 μ V (e.g. 12425 = 12.425 mV)
mV range #2	mV	10 μ V	LSB is equal to 10 μ V (e.g. 6532 = 65.32 mV)
Ohm range	Ω	0.1 Ω	LSB is equal to 0.1 Ω (e.g. 2851 = 285.1 Ω)
Thermocouples	$^{\circ}$ C	0.1 $^{\circ}$ C	LSB is equal to 0.1 $^{\circ}$ C (e.g. 12425 = 1242.5 $^{\circ}$ C)
Thermoresistances	$^{\circ}$ C	0.1 $^{\circ}$ C	LSB is equal to 0.1 $^{\circ}$ C (e.g. 7654 = 765.4 $^{\circ}$ C)
Compensator	$^{\circ}$ C	0.1 $^{\circ}$ C	LSB is equal to 0.1 $^{\circ}$ C (e.g. 1242 = 124.2 $^{\circ}$ C)

Over range, under range and burnout conditions return the following values depending on sensor configuration word (see Section 11.5.2.1):

Condition	No burnout, burnout upscale or downscale	Coded burnout
Under range	lower limit - 1	32000 (0x7D00)
Over range	higher limit + 1	32001 (0x7D01)
Burnout down scale	lower limit - 1	32002 (0x7D02)
Burnout up scale	higher limit + 1	32003 (0x7D03)

11.5.1.2 Digital input data registers

Digital inputs data formatting uses a 16 bit word to represent the status of 8 discrete inputs, including line fault information. Every channel data word therefore represents a set of inputs as in the following table:

Data Address	Inputs
Slave Base Address + 0x00	01 to 08
Slave Base Address + 0x01	09 to 16
Slave Base Address + 0x02	17 to 24
Slave Base Address + 0x03	25 to 32

The input information is constituted by 2 bits: a OFF/ON value and a fault value, as follows:

OFF/ON bit	Status Bit	Input Condition
0	0	OFF status
1	0	ON status
0	1	line opened (fault)
1	1	line shorted (fault)

The bit organization within a data word is the following (word of channel 1 shown):

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OFF/ON bit of input									8	7	6	5	4	3	2	1
Status bit of input	8	7	6	5	4	3	2	1								

11.5.2 Configuration Registers

Configuration registers contain input measuring circuits settings; they are located at the following addresses:

From	To	Description	Note
0200	020F	configuration of channels 01 to 16 of slave #1	D2010M and D2030M
0210	021F	configuration of channels 17 to 32 of slave #1	D2011M expansion #1 and D2030M
0220	022F	configuration of channels 33 to 48 of slave #1	D2011M expansion #2
0230	023F	configuration of channels 49 to 64 of slave #1	D2011M expansion #3
0240	024F	configuration of channels 01 to 16 of slave #2	D2010M and D2030M
0250	025F	configuration of channels 17 to 32 of slave #2	D2011M expansion #1 and D2030M
0260	026F	configuration of channels 33 to 48 of slave #2	D2011M expansion #2
0270	027F	configuration of channels 49 to 64 of slave #2	D2011M expansion #3
0280	028F	configuration of channels 01 to 16 of slave #3	D2010M and D2030M
0290	029F	configuration of channels 17 to 32 of slave #3	D2011M expansion #1 and D2030M
02A0	02AF	configuration of channels 33 to 48 of slave #3	D2011M expansion #2
02B0	02BF	configuration of channels 49 to 64 of slave #3	D2011M expansion #3
02C0	02CF	configuration of channels 01 to 16 of slave #4	D2010M and D2030M
02D0	02DF	configuration of channels 17 to 32 of slave #4	D2011M expansion #1 and D2030M
02E0	02EF	configuration of channels 33 to 48 of slave #4	D2011M expansion #2
02F0	02FF	configuration of channels 49 to 64 of slave #4	D2011M expansion #3

11.5.2.1 Configuration of Analog Channels (D2010M and D2011M)

The configuration of an analog channel (D2010M and D2011M) is based upon a 16 bit control word divided in bit fields. The structure is summarized in the following table:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field				Filter			Mode			Sensor type						

- Sensor type (bit 5..0): up to 64 types of sensors as defined below
 Sensor mode (bit 9..7): 8 operating modes for thermocouples and thermoresistances
 Sensor filtering (bit 12..11): 4 filtering modes
 Bit 15, 14, 13, 10, 6 are reserved for future expansions and must be set to 0

Sensor Table

Code	Description
0	channel OFF
1	-21.000 to +21.000 mV
2	-21.00 to +80.00 mV
3	resistance 0.0 to 400.0 Ω
4	thermocouple type B
5	thermocouple type E
6	thermocouple type J
7	thermocouple type K
8	thermocouple type L - DIN
9	thermocouple type L - GOST
10	thermocouple type N
11	thermocouple type R
12	thermocouple type S
13	thermocouple type S - GOST
14	thermocouple type T
15	thermocouple type U
16	thermocouple type A1
17	thermocouple type A2
18	thermocouple type A3
19	thermoresistance Pt 100 a = 385
20	thermoresistance Pt 200 a = 385
21	thermoresistance Pt 300 a = 385
22	thermoresistance Pt 100 a = 390
23	thermoresistance Pt 100 - GOST
24	thermoresistance Pt 50 - GOST
25	thermoresistance Ni 100
26	thermoresistance Cu 100 - GOST
27	thermoresistance Cu 53 - GOST
28	thermoresistance Cu 50 - GOST
29	thermoresistance Cu 46 - GOST
30	compensator G.M. option 2091

Operating Mode for mV and thermocouples (sensor codes 1, 2 and 4 to 18)

Code	Description	Notes
0	no burnout automatic cold junction	no burnout detection will be performed automatic cold junction compensation
1	down scale burnout automatic cold junction	burnout detection will move reading to lowest value of scale automatic cold junction compensation
2	up scale burnout automatic cold junction	burnout detection will move reading to highest value of scale automatic cold junction compensation
3	coded burnout automatic cold junction	burnout detection will be coded as special value automatic cold junction compensation
4	no burnout fixed cold junction	no burnout detection will be performed cold junction compensation with fixed reference
5	down scale burnout fixed cold junction	burnout detection will move reading to lowest value of scale cold junction compensation with fixed reference
6	up scale burnout fixed cold junction	burnout detection will move reading to highest value of scale cold junction compensation with fixed reference
7	coded burnout fixed cold junction	burnout detection will be coded as special value cold junction compensation with fixed reference

Special values for coded burnout are:

Condition	Decimal value	Hexadecimal value
Under range	32000	7D00
Over range	32001	7D01
Burnout of sensor	32002	7D02
Burnout of compensator	32003	7D03

Operating Mode for thermoresistances (sensor codes 3 and 19 to 30)

Code	Description	Notes
0	3 wire connection	connection will be a 3 wire connection
1	4 wire connection	connection will be a 4 wire connection

Filter Setting

Code	Description	Notes
0	no filter	measured value from A/D converter is not filtered
1	fast filter	smart averaging of 2 readings is performed
2	medium filter	smart averaging of 4 readings is performed
3	slow filter	smart averaging of 8 readings is performed

11.5.2.2 Configuration of Digital Channels (D2030M)

The configuration of a digital channel (D2030M) is based upon a 16 bit control word divided in bit fields as:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Scan Time					Mode	

Sensor mode (bit 1, 0): 4 operating modes for sensors processing

Sensor scan time (bit 6..3): 16 scan times for sensor setup

Bit 15 to 7 and 2 are reserved for future expansions and must be set to 0

Operating Mode

Code	Description	Notes
0	channel OFF	channel not active, reads as 0
1	channel active - fault detection disabled	channel active, fault detection inactive
2	not used (channel OFF)	channel not active, reads as 0
3	channel active - fault detection enabled	channel active, fault detection active

Scan Time

Code	Description	Notes
0	1 ms scan time	channel will be powered for 1 ms before acquisition
1	2 ms scan time	channel will be powered for 2 ms before acquisition
2	3 ms scan time	channel will be powered for 3 ms before acquisition
3	4 ms scan time	channel will be powered for 4 ms before acquisition
4	5 ms scan time	channel will be powered for 5 ms before acquisition
5	6 ms scan time	channel will be powered for 6 ms before acquisition
6	8 ms scan time	channel will be powered for 8 ms before acquisition
7	10 ms scan time	channel will be powered for 10 ms before acquisition
8	12 ms scan time	channel will be powered for 12 ms before acquisition
9	14 ms scan time	channel will be powered for 14 ms before acquisition
10	16 ms scan time	channel will be powered for 16 ms before acquisition
11	18 ms scan time	channel will be powered for 18 ms before acquisition
12	20 ms scan time	channel will be powered for 20 ms before acquisition
13	25 ms scan time	channel will be powered for 25 ms before acquisition
14	30 ms scan time	channel will be powered for 30 ms before acquisition
15	35 ms scan time	channel will be powered for 35 ms before acquisition

Note: if the channel is disabled the scan time is 500 μ S regardless of the scan time setting.

11.5.3 System Registers

System registers are divided in 5 groups, the first group contains the registers related to the D2050M, while other four groups contain registers of slaves 1 to 4.

11.5.3.1 Master Registers

The registers of the D2050M master are:

0400	master type	type of master (HEX 50 for D2050M)
0401	master software revision	software revision of master
0402	configuration of master	master configuration register
0403	repeaters configuration register	configuration of digital output repeaters
0404	status and command	status and command register
0405	reserved	
0406	reserved	
0407	reserved	
0408	modbus address	modbus address of master (1 to 247)
0409	modbus baud rate	index of modbus baud rate
040A	modbus format	index of modbus format
040B	reserved	
040C	reserved	
040D	reserved	
040E	modbus error counter	modbus communication error counter
040F	slaves error counter	slaves communication error counter
0410 to 041F	reserved	

Note: reading a reserved word returns zero, while writing has no effect.

Master type

The type of master is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Type						

Type of Master (bit 7..0):

50 D2050M

This Register is read only.

Master Software Revision

The software release of the master is coded as:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Revision			Sub_Revision			

This register is read only.

Configuration of Master

The master configuration register is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field														LF	RL1	RL0

- Bit 1, 0 field lines (0 = use line 1; 1 = use line 2; 2 = smart mode) read/write
- Bit 2 operating line frequency (0 = 50 Hz, 1 = 60 Hz) read/write
- Bit 3 to 15 reserved

Repeaters Configuration Register

The digital output repeaters configuration register is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field		NE2	NE1	NE0		M41	M40		M31	M30		M21	M20		M11	M10

- Bit 1, 0 repeater #1 mapping code
- Bit 4, 3 repeater #2 mapping code
- Bit 7, 6 repeater #3 mapping code
- Bit 10, 9 repeater #4 mapping code
- Bit 14..12 number of installed repeaters
- Bits 15, 11, 8, 5, 2 reserved

The mapping code is:

- 00 repeater mapped to slave #1
- 01 repeater mapped to slave #2
- 10 repeater mapped to slave #3
- 11 repeater mapped to slave #4

Note: repeaters may be assigned to digital field units independently and more than one repeater can be assigned to the same field unit.

Status and Command

The master status and command register (D2050M) is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field			LO	DM	DC	UC	RA	RS	L2	L1					SL1	SL0

- Bit 1, 0 slave code (used for download command)
- Bit 6 line #1 is operating read only
- Bit 7 line #2 is operating read only
- Bit 8 restart slaves write only
- Bit 9 restart system write only
- Bit 10 upload calibration write only
- Bit 11 download calibration write only
- Bit 12 diagnostic mode read/write
- Bit 13 line override read only
- Bit 14, 15, 5 to 2 reserved reserved

Modbus address

The modbus address of master is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field																
	Address															

Modbus address (bit 7..0):

Modbus Baud Rate

The baud rate of the modbus communication is defined by an index; the word structure and index value are indicated below.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field														B2	B1	B0

Bit 2..0 index

Bit 15 to 3 reserved

Index	B2	B1	B0	Baud Rate
0	0	0	0	4800
1	0	0	1	9600
2	0	1	0	19200
3	0	1	1	38400
4	1	0	0	57600
5	1	0	1	115200

Note: combinations of B0, B1, B2 exceeding the value of 5 (115200 baud) must not be used.

Modbus Format

The format of the modbus communication is defined by an index; the word structure and index value are indicated below.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field															B1	B0

Bit 1, 0 index

Bit 15 to 2 reserved

Index	B1	B0	Format
0	0	0	8 data bit, no parity, 1 stop bit
1	0	1	8 data bit, even parity, 1 stop bit
2	1	0	8 data bit, odd parity, 1 stop bit
3	1	1	8 data bit, no parity, 2 stop bit

Modbus and Slaves Error Counters

These registers contain the actual count of communication errors of the modbus and slave lines, any attempt to write to them results in register clear.

11.5.3.2 Slaves Registers

The register groups of the slaves are allocated at the following addresses:

Slave	Base Address
1	0x0420
2	0x0440
3	0x0460
4	0x0480

The registers are allocated as follows:

Base + 0x00	slave real configuration	real configuration of slave
Base + 0x01	slave software revision	software revision of slave
Base + 0x02	slave required configuration	configuration register of slave (required configuration)
Base + 0x03	reserved	
Base + 0x04	slave qualifier line #1	communication qualifier of line #1
Base + 0x05	slave qualifier line #2	communication qualifier of line #2
Base + 0x06	reserved	
Base + 0x07	reserved	
Base + 0x08	slave zero correction	A/D input zero correction (D2010M only)
Base + 0x09	slave span correction	A/D input span correction (D2010M only)
Base + 0x0A	slave resistance correction	A/D input resistance correction (D2010M only)
Base + 0x0B	reserved	
Base + 0x0C	reserved	
Base + 0x0D	reserved	
Base + 0x0E	slave average limit	smart filter averaging limit (D2010M only)
Base + 0x0F	slave cold junction reference	cold junction fixed reference (D2010M only)
Base + 0x10 to 0x1F	reserved	

Note 1: reading a reserved word returns zero, while writing has no effect.

Note 2: The slave required configuration contains the system's topology as required by the host; the real configuration, instead, contains the actual implementation of slaves: more precisely, the real configuration is managed by the system and can only be read by the user/host; during normal operation the two values should be coincident. A difference between the two indicates that the gateway has detected that connected units topology differs from the desired one. This may happen when a unit is added or removed.

Slave Real Configuration

The configuration of a slave is based upon a 16 bit control word divided in bit fields:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Type				Expansion		

Number of expansions (bit 2..0):

0	no D2011M expansions (16 channel)
1	nr. 1 D2011M expansion (32 channel)
2	nr. 2 D2011M expansion (48 channel)
3	nr. 3 D2011M expansion (64 channel)

Type of slave (bit 7..4):

0	no slave installed
1	D2010M
3	D2030M

This register is read only.

Slave Software Revision

The software release of the slave is coded as:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Field										Revision			Sub_Revision			

This register is read only.

Slave Required Configuration

This register has the same structure as the "Slave Real Configuration" register.

Slave Qualifier Line # 1 and # 2

These registers contain the actual count of communication errors towards the slave: they are read-only in diagnostic mode, any attempt to write them results in register clear.

Slave Zero, Span, Resistance Correction (D2010M)

The correction registers control the calibration of the slave unit, **MUST NOT BE CHANGED**.

Slave Average Limit (D2010M)

The average limit register defines the band (in 2 μ V multiples) of the averaging of all inputs.

Slave Cold Junction Reference (D2010M)

This register defines the reference temperature of the cold junction compensation when the fixed compensation mode is selected, the value is in 0.1 $^{\circ}$ C increments (324 = 32.4 $^{\circ}$ C).

12 Hardware and Software installation

This section contains suggestions and information for a proper installation of the equipments, part of the D2000M multiplexer system.

An overview on the installation of the SWC2090 software for system configuration is also present.

12.1 Hardware Installation

Before starting the installation it is recommended to prepare a preliminary topology of the system, including field equipments or contact repeaters to be installed in the future. Contact repeaters do not require special consideration for safety, while field device connections must comply with the regulatory requirements.

The connection between field units and the gateway must be carried out according regulatory requirements (e.g. IEC 60079-27).

Note: it is highly recommended, when using redundant field communication lines, that they are routed along different paths, in order to improve reliability by reducing the probability of simultaneous breakages.

A laboratory trial test in Safe Area/Non Hazardous Locations can be performed using a common wiring cable to connect field units, without particular requirements, given that the global distance between units is kept lower than 30 meters.

12.1.1 Field Units Addressing

Field Units D2010M and D2030M need address setting for proper operation.

Each unit must be assigned with a unique address in the range of 1 to 4. This is done via an internal DIP-switch. Remove the cover by unscrewing the four screws on the top to access the switch.

The setting of the DIP-switch must be done according to the following table:

Address	Unit	Switch 1	Switch 2	Switch 3	Switch 4
0	1	OFF	OFF	OFF	OFF
1	2	ON	OFF	OFF	OFF
2	3	OFF	ON	OFF	OFF
3	4	ON	ON	OFF	OFF

Note 1: Do not assign the same address to more than one slave unit in the same system.

Note 2: If the unit is located in Hazardous Area/Hazardous Locations, this operation should be done after having disconnected both communication lines and without removing the earthing connection of the cover.

12.1.2 D2050M Installation

The D2050M must be installed in Safe Area/Non Hazardous Locations; it requires a 24 Vdc supply; the service serial port has a 9 pole Sub D male connector. Modbus lines are accessible via two 3 pole screw connectors providing the two line poles and the screen terminal. For reliability the lines should be routed along different paths. Line termination on the gateway side is built in the D2050M.

The two Intrinsically Safe field lines must comply with the requirements of the FISCO standard in order to maintain system safety.

When redundant field communication is used, a possible startup sequence, when using the configuration program, could be the following:

- ❑ Configure the D2050M to use the primary line only (menu <Configure> + <D2050M>)
- ❑ Verify, using the <Test Status> function, that field devices are 'seen' correctly by the D2050M
- ❑ Configure the D2050M to use the secondary line only (menu <Configure> + <D2050M>)
- ❑ Verify, using the <Test Status> function, that field devices are correctly 'seen' by the D2050M
- ❑ Now configure the D2050M to use both lines or the smart mode as desired (see Section 5.6.1)

12.1.3 D2010M and D2011M Installation

Analog input acquisition units can be installed in Hazardous Area/Hazardous Locations following both the requirements of FISCO standard for the communication cable and the regulatory requirements standard for the connections of the sensor and the installation of the equipment.

When connecting the communication lines verify the polarity of the cable wires and activate the terminating resistor on the last unit; refer to the proper section for cabling rules.

When the configuration software is used during startup, the test status function allows the verification of the connection to the gateway, while the test single channel function allows the verification of the sensor connections.

12.1.4 D2030M Installation

Digital input acquisition units can be installed in Hazardous Area/Hazardous Locations following both the requirements of FISCO standard for the communication cable and the regulatory requirements standard for the connections of the sensor and the installation of the equipment.

When connecting the communication lines verify the polarity of the cable wires and activate the terminating resistor on the last unit, refer to the proper section for cabling rules.

When the configuration software is used during startup the test status function allows the verification of the connection to the gateway, while the test single channel function allows the verification of the sensor connections.

12.1.5 D2052M and D2053M Installation

Contact repeaters require a nominal 24 Vdc supply. They use a daisy-chain connection topology, starting from the D2050M. This connection is performed using a 10 pole flat cable. Output connections are done using the screw terminal blocks.

For proper operation the correct mapping of the units must be done, using the configuration software to assign every repeater to its in-field data source (D2030M).

12.2 Software Installation

12.2.1 Checking PC system minimum requirements

The following minimum requirements apply to the machine on which the SWC2090 will be installed:

- Pentium class processor or faster;
- 64MB RAM;
- 800 x 600 minimum screen resolution;
- 1 COM Port or 1 USB Port;
- Windows 98 (Windows 98 SE if USB to RS-232 adapter is used);
- 8 MB of free space on hard disk

12.2.2 Installing the SWC2090 Configuration Software

In order to start the setup of the SWC2090 configuration software please insert the provided CD-ROM, and wait for the initial screen to appear. If autorun is disabled search for the CD-ROM letter in your PC resources, choose "Explore" by right-clicking on the drive icon and then double-click on "Start.exe".

Choose "Install SWC2090 Configuration software".

If instead the installation package was retrieved from the internet, please double-click on the SWC2090.exe.

Follow the instructions and finish the installation process.

A folder named "SWC2090 Configurator" will be created in your main program menu together with an icon on your desktop.

- After installation of the SWC2090.exe and its associated files it can be started by double clicking on the icon on the desktop, for initial operation the configuration of the serial ports is not mandatory and can be done later.
- The main window should show up and the license agreement will be shown at first operation, if the accept button is not pressed the software will not run.

- ❑ When the main window appears a synoptic of a default configuration will be displayed, and the editing functions of the software are available.
- ❑ To connect a D2050M gateway the serial port setup procedure must be performed:
 - Install the cable from the PC COM port to the D2050M 9 pole connector.
 - Enter the <Settings> menu and then the < Serial Port Setup>: two messages indicating that the COM ports for serial and modbus are not available will be prompted, this because no setup was performed.
 - Select a valid COM port for serial RS-232 port (drop-down list on the top).
 - Using the <Test RS232 Serial> button, verify the connection.

Note: the communication must operate without additional settings; if this doesn't happen verify that the selected COM port connector is correct and the quality on the interconnection cable.

Note: refer to 13.6.2 for the *Test Status function* that can be useful for initial setup.

- ❑ Enter the menu <File> then <Read configuration from D2050M> and verify if the configuration is transferred correctly from the gateway (this is indicated by the odometer on the bottom right of the status line and terminates correctly if no error messages are reported).

The serial port is now operating and the configuration software runs correctly.

If the modbus connection must be implemented proceed as follows:

- ❑ Prepare the installation as described in the following section.
- ❑ Enter the menu <File> then <Read configuration from D2050M> and copy the configuration from the D2050M.
- ❑ Enter the gateway setup function by using the menu <Configure> and <D2050M>.
- ❑ Set the address, baud rate and format for the communication.
- ❑ Enter the menu <File> then <Write configuration to D2050M> and update the gateway configuration.
- ❑ Enter the <Settings> menu and then the < Serial Port Setup>: a message indicating that the COM port for modbus is not available will be prompted; this happens because no setup was performed.
- ❑ Select a valid COM port for modbus port (bottom drop-down list).
- ❑ Using the <Test Modbus> button, verify the connection.

Note: the communication must operate without additional settings, if this doesn't happen verify the selected COM port connector and the quality on the interconnection cable.

12.3 RS-485 Modbus Line Installation

The modbus line is a standard RS-485 communication type and must be connected according to the RS-485 specifications: the cable must have a 100 Ω nominal impedance and must be terminated at both ends with a 100 Ω resistor; care must be exercised for the proper polarity of all units connected to the bus, additionally all equipments must operate at the same baud rate and with the same parity (if used).

The settings of the D2050M are modifiable by the configuration software and retained in the EEPROM, while the terminating resistor can be activated by the switches on the board (accessible removing the cover). The two RX and TX LEDs monitor line activity and help the user during startup or maintenance.

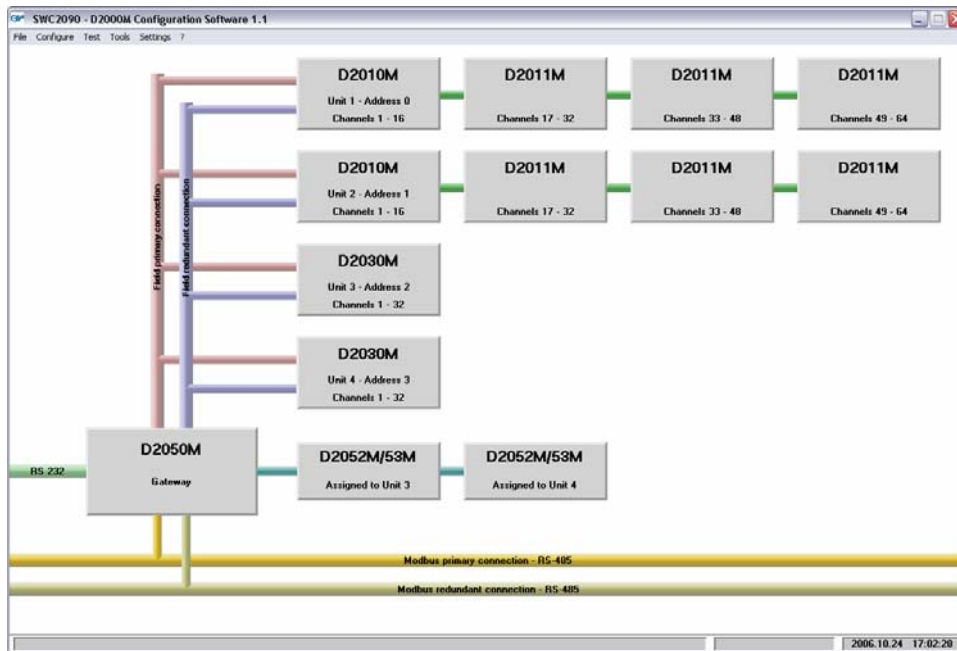
12.3.1 Using modbus with the configuration program

When a monitoring of the modbus connection is done by the PC configuration software, an RS-232 to RS-485 translator is required (e.g. D1061S barrier).

In this case the connection on the RS-485 side must comply with the indication of the previous section, while the connections on the RS-232 side must comply with the requirements of the PC serial port or the requirements of the adapter when an USB to RS-232 converter is used.

Typically the user should set the correct baud rate and parity of the converter according to master and slave parameters.

13 The SWC2090 Configuration Software



13.1 Introduction and User Interface

The SWC2090 is designed to provide a PC user interface to the D2000M Multiplexer system. Its functionalities allow the user to:

- create and modify customized system configurations;
- read and write internal parameters of the D2000M Multiplexer system;
- store and retrieve data to local hard drive for backup or archive;
- test and monitor all system functionalities;
- monitor single channels on-the-fly, and global system;
- print a report sheet containing details on the system.

The SWC2090 main screen consists of a menu on the top that gives access to main functions and a graphical representation of the system's architecture, showing all functional parts of the system.

The editing is controlled by the mouse as follows:

- click on the menu items to activate the function;
- double click on the units to add, remove, change or configure the item;

Specific editing functions are managed via dedicated popup windows.

- the editing process may be done in online or offline mode;
- the online mode requires a connection with a D2050M gateway;
- the capabilities of storing and retrieving configuration from files are accessible in both operating modes;

13.2 Offline System Configuration

The offline mode is typically used when a system is not physically available and it allows the preparation or modification of configurations using file read/write functions.

The configuration used for editing can be loaded from or saved to file: saved configurations can be later written to a connected multiplexer.

Detailed editing functions are described in the proper section of this document.

13.3 Online System Configuration

The online mode is used when the PC is connected to the D2050M and it allows the preparation or modification of configurations using both file read/write and gateway read/write functions.

The configuration used for editing can be loaded from file or read from gateway and saved to file or written to gateway choosing the corresponding items from the *File* menu.

Detailed editing functions are described in the following section of this document.

13.4 RS-232 serial and RS-485 modbus transmission protocols

The D2050M Gateway may be operated using the following protocols:

- RS-232 Serial Line
- RS-485 Modbus Line

Commands and instructions for both protocols are specified in this manual (Sections 10 and 11).

The SWC2090 software implements RS-232 serial commands able to acquire data from the gateway and write configuration parameters to it.

A limited set of modbus commands is also implemented to allow the reading of channel values (*Global System Test*). These commands are given by the PC to an RS-232/RS-485 translator (e.g. G.M. International D1061S module) which is connected to the modbus line of the gateway.

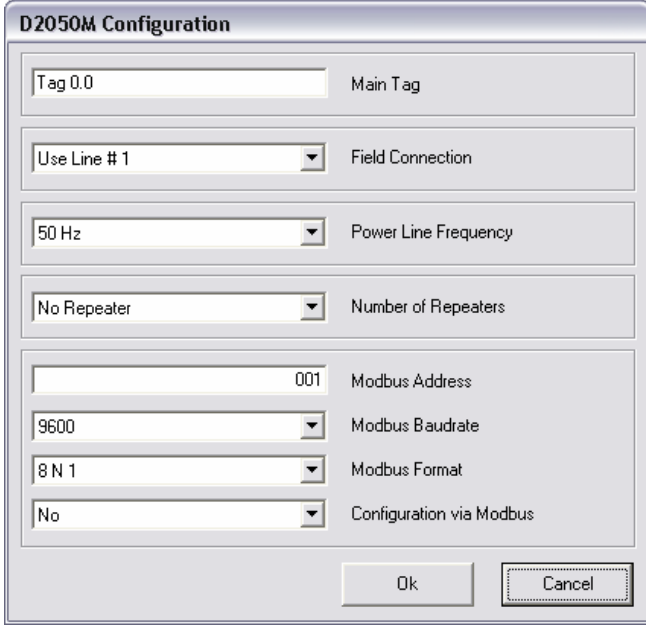
The configuration of the gateway via modbus line, can be allowed or denied by the user through the dedicated parameter in the *System Parameters* (see 13.5.1).

13.5 System architecture and parameters modification

Multiplexer parameters are grouped in windows corresponding to the relevant modules constituting the system, activation of the editing window is done by double clicking on the corresponding module, or through the *Configure* menu.

13.5.1 Configuring the D2050M gateway

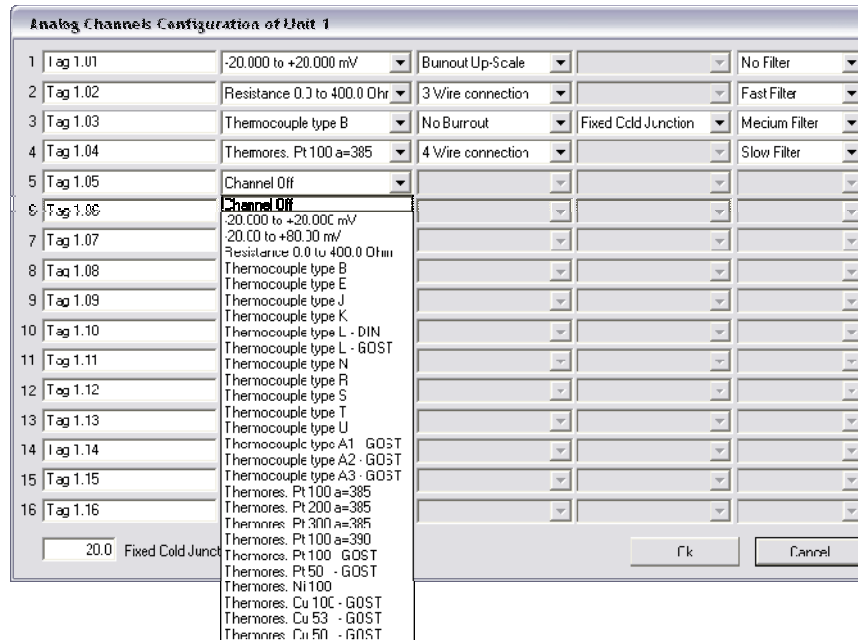
Gateway parameters allow the selection of the following:



- ❑ D2050M Unit *Main Tag* (16 alphanumeric chars);
- ❑ *Field Connection* topology:
 - *Use Line # 1*
 - *Use Line # 2*
 - *Use both lines*: The gateway switches between line 1 and line 2 at regular intervals.
 - *Use both lines in Smart Mode*: The gateway switches between line 1 and line 2; if one of the two lines experiences a deterioration in communication quality, the gateway switches to the other line and stops line swapping. Normal operation is resumed rebooting the system or issuing a software command. This command can be found in the *Test Status* function (see 13.6.2)
- ❑ *Power line frequency*: (50Hz or 60Hz);
- ❑ *Number of Repeaters*;
- ❑ Modbus communication parameters.
 - *Modbus address*
 - *Modbus Baud rate*
 - *Modbus Format*
- ❑ *Configuration via Modbus*: the system administrator can allow or deny the configuration of the system via modbus Line.

Note: as stated in 13.4, the SWC2090 is able to configure the D2050M only via RS-232 serial line.

13.5.2 Configuring Analog Slave units D2010M and D2011M expanders



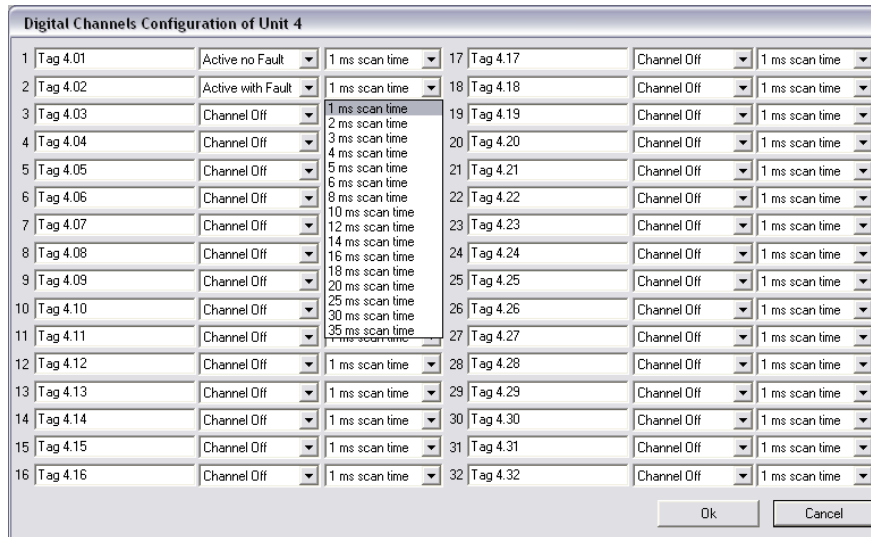
Channel	Tag	Sensor	Wires	Burnout	Compensation	Filter
1	Tag 1.01	-20.000 to +20.000 mV		Burnout Up-Scale		No Filter
2	Tag 1.02	Resistance 0.0 to 400.0 Ohm	3 Wire connection			Fast Filter
3	Tag 1.03	Thermocouple type B	No Burnout	Fixed Cold Junction		Medium Filter
4	Tag 1.04	Thermores. Pt 100 a=385	4 Wire connection			Slow Filter
5	Tag 1.05	Channel Off				
6	Tag 1.06	Channel Off				
7	Tag 1.07	-20.000 to +20.000 mV				
8	Tag 1.08	Resistance 0.0 to 400.0 Ohm				
9	Tag 1.09	Thermocouple type B				
10	Tag 1.10	Thermocouple type E				
11	Tag 1.11	Thermocouple type J				
12	Tag 1.12	Thermocouple type K				
13	Tag 1.13	Thermocouple type L - DIN				
14	Tag 1.14	Thermocouple type L - GOST				
15	Tag 1.15	Thermocouple type N				
16	Tag 1.16	Thermocouple type R				

Analog input units D2010M and D2011M are configurable in groups of 16 channels; for every channel the following configuration options are available:

- ❑ **Tag:** channel identification tag, up to 16 characters long;
- ❑ **Sensor:** type of analog input sensor;
- ❑ **Wires:** 3 or 4 wire connection;
- ❑ **Burnout Operation Mode:**
 - **None:** no action is taken;
 - **Upscale:** value is set to sensor upscale;
 - **Downscale:** value is set to sensor downscale;
 - **Coded:** value is set by the system to a symbolic number, out of the sensor maximum range. Refer to specific section of this manual for a detailed descriptions of codes and their meanings.
- ❑ **Cold Junction Compensation:**
 - **Automatic:** refers to the value of the last channel in the unit. This channel, differently from the others, has the possibility to be configured with the GM OPT2091 Cold Junction Compensator.
 - **Fixed:** The value is defined by the user on the lower left of the panel. This parameter is unique for all the D2011M that are eventually connected to the Slave D2010M.
- ❑ **Filtering option:** level of smart averaging that is performed by the system on the input value.

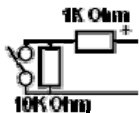
Note: changes done to the configuration of the system units become operative only after being saved (written) into the gateway: this is accomplished choosing *Write Configuration to Gateway* from the *File* menu.

13.5.3 Configuring Digital Slave units D2030M



Digital input units D2030M are configurable in groups of 32 channels; for every channel the following configuration options are available:

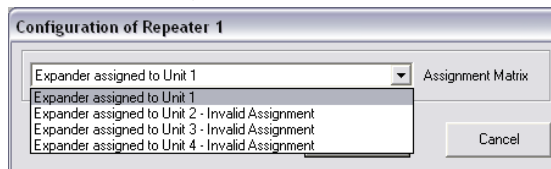
- Tag:** channel identification tag, up to 16 characters long;
- Channel status:**
 - **Off:** channel is disabled;
 - **Active with Fault :** fault detection is active and channel status will show open or short circuits.
Note: use of voltage free electrical contacts with fault detection enabled requires, near the switch at the end of the line, a 1 K Ω series connected resistor and a 10 K Ω in parallel connected resistor to allow the fault detection circuit to distinguish between a condition of contact close/open and a line open/short circuit fault.



- **Active without Fault:** line monitoring is deactivated.
- Scan time:** indicates the amount of time (from 1 to 35 ms) for which the channel is supplied before acquisition.

Note: changes done to the configuration of the system modules become operative only after being saved and written into the gateway: this is accomplished choosing *Write Configuration to Gateway* from the *File* menu.

13.5.4 Configuring Contact/Proximity repeaters D2052/D2053M



This window allows the assignment of a repeater to the desired digital input module. In order for a D2052/D2053M repeater to be correctly configured, the assigned digital input D2030M must be activated.

Additional repeaters may be added through the D2050M configuration window.

Note: changes done to the configuration of the system modules become operative only after being saved and written into the gateway: this is accomplished choosing *Write Configuration to Gateway* from the *File* menu.

13.6 System Testing functions

Test functions are provided to verify:

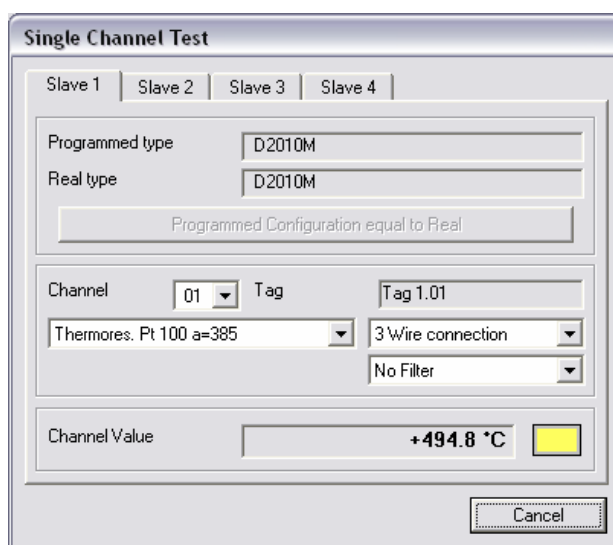
- ❑ single channel setting and operation via serial RS-232;
- ❑ system status and communication diagnostic;
- ❑ global system monitoring via serial RS-232 or modbus RS-485;

13.6.1 Single channel setting and operation via serial RS-232

This function allows 'on the fly' modification and testing of a single channel of a slave unit.

The purpose is to help the user to operate with the D2000M Multiplexer system, allowing him to change the configuration of an analog or digital channel and verify their operation immediately.

The function is activated by choosing *Test Single Channel* from the *Test* menu.



The Single Channel Test panel shows:

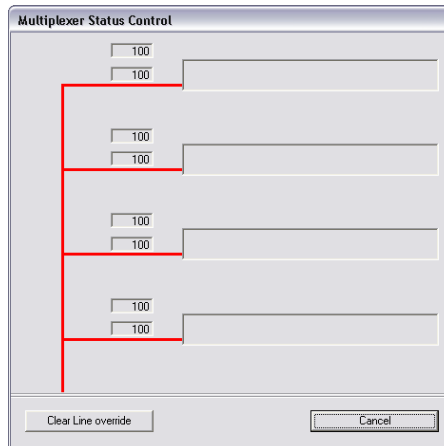
- ❑ information on chosen slave model:
 - Programmed type: model that was configured by the user in that position;
 - Real type: model that is actually present in that position.
 - Note: *Programmed* and *Real* type must be the same in order to proceed with the Single Channel testing. In case these two conditions differ, the user has the possibility to temporarily force them to be equal.
- ❑ Single Channel Configuration Parameters:
 - *Channel*: number of the channel to test;
 - *Tag*: tag name;
 - *Configuration Parameters*: depending on the type of slave;
- ❑ *Channel Value*: corresponds to the input value of the channel.

Note 1: if the light is blinking in yellow, the channel is being acquired.

Note 2: when the function ends the initial configuration of the channel is restored to avoid any interference with the configuration activity outside of the testing window.

13.6.2 System status and communication diagnostic

This function is activated choosing the *Test Status* selection of the *Test* menu.



Values located close to the communication lines indicate the percentage of good transactions between gateway and single slave unit (e.g. 100 % indicates optimal communication).

On the right, detected slaves are shown as in the 'Real Configuration'.

The *Clear Line Override* button is enabled whenever the 'Use both lines in Smart Mode' setting is chosen; by clicking the button, normal operation (line swapping) is resumed after detection of a line malfunction.

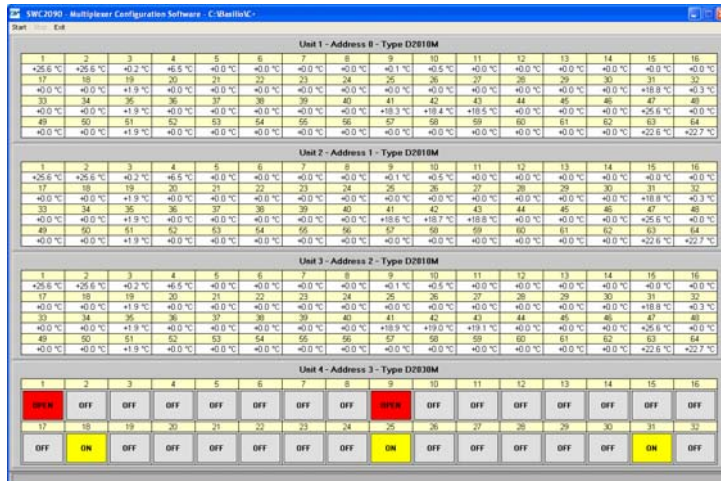
13.6.3 Global system monitoring via serial RS-232 or modbus RS-485

This function is activated choosing the *Test Global System with Serial* or *Test Global System with Modbus* selections of the *Test* menu. The two choices are equivalent as operation but use different physical supports for communication: the serial RS-232 or the RS-485.

Relevant differences between the two modes are the unavailability of tag information while using modbus and the lower polling speed of RS-232.

When the function is activated, a full screen window will appear.

The screen is divided into 4 main frames containing information on slave units and a bottom frame for acquisition control as in figure below.



Each slave frame's appearance changes depending on the type of slave configured and on the field unit actually installed.

To start acquisition press the *Start* button. The bottom status line indicates slave polling status.

Note: PC acquisition timing is different from internal multiplexer scan time.

13.7 System Configuration Report

A print report function is provided in order to give to the user the possibility to have a printed report of the current configuration, giving information on:

- Customer Organization
- Operator who has performed the configuration
- Date of configuration
- System Topology
- Individual Channel settings

General informative data may be changed using the *Settings - Preferences* menu, while printing is activated by the *Print* sub-menu of the *File* Menu. The selection of the printer is obtained via the classic Windows dialog box.

