



INSTRUCTION MANUAL

SIL 3 Digital Output Driver
NE Loads Bus Powered
DIN-Rail Model D1049S

Characteristics

General Description: The single channel DIN-Rail Bus Powered Digital Output Isolator, D1049S, is suitable for driving solenoid valves, visual or audible alarms to alert a plant operator, or other process control devices in Hazardous Area from a driving signal in Safe Area. It can also be used as a controllable supply to power measuring or process control equipment. Its use is allowed in applications requiring up to SIL 3 level (according to IEC 61508) in safety related systems for high risk industries.

The Safety PLC or DCS driving signal controls the field device through the D1049S, which provides isolation and is capable of monitoring the conditions of the line.

Short and open circuit diagnostic monitoring, dip-switch selectable, operates irrespective of the channel condition and provides LED indication and NC transistor output signaling.

When fault is detected output is de-energized until normal condition is restored.

An override input, dip-switch selectable, is provided to permit a safety system to override the control signal. When enabled, a low input voltage always de-energizes the field device regardless of the input signal.

Three basic output circuits are selectable, with different safety parameters, to interface the majority of devices on the market. The selection among the three output characteristics is obtained by connecting the field device to a different terminal block.

Function: 1 channel I.S. digital output to operate Hazardous Area normally energized loads from contacts, logic levels or driven logics in Safe Area.

It provides 3 port isolation (input/output/supply).

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

Field Configurability: Line Fault Detection enable or disable and Override Control Input enable or disable.

EMC: Fully compliant with CE marking applicable requirements.

Technical Data

Supply: 24 Vdc nom (20 to 30 Vdc) reverse polarity protected, ripple within voltage limits ≤ 5 Vpp, 2 A time lag fuse internally protected.

Current consumption @ 24 V: 65 mA with 45 mA output typical in normal operation.

Power dissipation: 1.1 W with 24 V supply, output energized at 45 mA nominal load.

Max. power consumption: at 30 V supply voltage, 1.8 W.

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

In/Supply 500 V; In/Fault 500 V; In/Override 500 V; Supply/Fault 500 V; Supply/Override 500 V; Fault/Override 500 V.

Control Input: voltage free contact, logic level reverse polarity protected.

Trip voltage levels: OFF status ≤ 5.0 V, ON status ≥ 20.0 V (maximum 30 V).

Current consumption @ 24 V: 5 mA.

Override Input: override control signal de-energizes output when enabled by dip-switch.

Override range: 24 Vdc nom (20 to 30 Vdc) to disable (field device controlled by input), 0 to 5 Vdc to de-energize field device, reverse polarity protected.

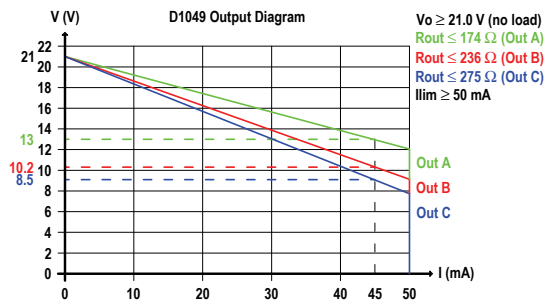
Current consumption @ 24 V: 5 mA.

Output:

45 mA at 13.0 V (21.0 V no load, 174 Ω series resistance) at terminals 13-16 Out A.

45 mA at 10.2 V (21.0 V no load, 236 Ω series resistance) at terminals 14-16 Out B.

45 mA at 8.5 V (21.0 V no load, 275 Ω series resistance) at terminals 15-16 Out C.



Short circuit current: ≥ 50 mA (55 mA typical).

Response time: ≤ 10 ms.

Frequency response: 50 Hz

Fault detection: field device and wiring open circuit or short circuit detection dip-switch selectable. When fault is detected output is de-energized until normal condition is restored.

Short output detection: load resistance $\leq 50 \Omega$ (≈ 2 mA forcing to detect fault).

Open output detection: load resistance > 10 K Ω .

Fault signalling: voltage free NE SPST optocoupled open-collector transistor (output de-energized in fault condition).

Open-collector rating: 100 mA at 35 Vdc (≤ 1.5 V voltage drop).

Leakage current: ≤ 50 μ A at 35 Vdc.

Response time: ≤ 5 ms.

Compatibility:

CE CE mark compliant, conforms to 94/9/EC Atex Directive and to 2004/108/CE EMC Directive.

Environmental conditions: Operating: temperature limits -20 to + 60 $^{\circ}$ C, relative humidity max 90 % non condensing, up to 35 $^{\circ}$ C.

Storage: temperature limits - 45 to + 80 $^{\circ}$ C.

Safety Description:



ATEX: II 3(1) G Ex nA [ia Ga] IIC T4 Gc, II (1) D [Ex ia Da] IIIC, I (M1) [Ex ia Ma] I

IECEx: Ex nA [ia Ga] IIC T4 Gc, [Ex ia Da] IIIC, [Ex ia Ma] I, associated apparatus and non-sparking electrical equipment.

Uo/Voc = 24.8 V, Io/Isc = 147 mA, Po/Po = 907 mW at terminals 13-16 Out A.

Uo/Voc = 24.8 V, Io/Isc = 108 mA, Po/Po = 667 mW at terminals 14-16 Out B.

Uo/Voc = 24.8 V, Io/Isc = 93 mA, Po/Po = 571 mW at terminals 15-16 Out C.

Um = 250 Vrms, -20 $^{\circ}$ C \leq Ta \leq 60 $^{\circ}$ C.

Approvals: DMT 01 ATEX E 042 X conforms to EN60079-0, EN60079-11, EN60079-15, EN60079-26, EN61241-11,

IECEx BVS 07.0027X conforms to IEC60079-0, IEC60079-11, IEC60079-15, IEC60079-26, IEC61241-11,

FM & FM-C No. 3024643, 3029921C, conforms to Class 3600, 3610, 3611, 3810 and C22.2 No.142, C22.2 No.157, C22.2 No.213, E60079-0, E60079-11, E60079-15.

TUV Certificate No. C-IS-204194-01, SIL 2 / SIL 3 conforms to IEC61508. Please refer to Functional Safety Manual for SIL applications.

Mounting: T35 DIN Rail according to EN50022.

Weight: about 130 g.

Connection: by polarized plug-in disconnect screw terminal blocks to accommodate terminations up to 2.5 mm².

Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA T4 installation.

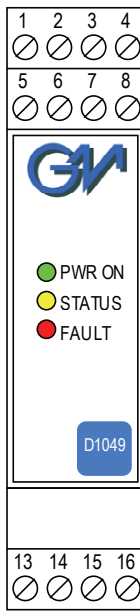
Protection class: IP 20.

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

Ordering information

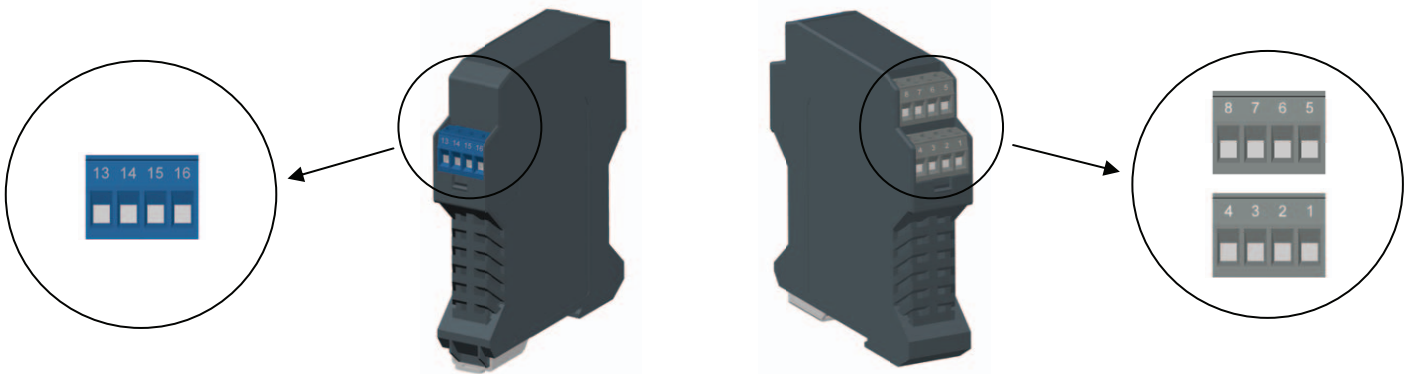
Model:	D1049S
Power Bus enclosure	/B

Front Panel and Features



- SIL 3 according to IEC 61508 for Tproof = 12 / 20 yrs (10 / 20 % of total SIF).
- SIL 2 according to IEC 61508 for Tproof = 20 yrs (10 of total SIF).
- PFDavg (1 year) 9.39 E-05, SFF 93.92 %.
- Output to Zone 0 (Zone 20), Division 1, installation in Zone 2, Division 2.
- Bus powered for NE loads.
- Short and open circuit line diagnostic monitoring with LED, transistor output.
- Output short circuit proof and current limited.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4.
- In-field programmability by DIP Switch.
- ATEX, IECEx, FM & FM-C Certifications.
- High Reliability, SMD components.
- Simplified installation using standard DIN-Rail and plug-in terminal blocks.
- 250 Vrms (Um) max. voltage allowed to the instruments associated with the barrier.

Terminal block connections



HAZARDOUS AREA

- | | |
|-----------|-------------------------------|
| 13 | + Output A for Solenoid Valve |
| 14 | + Output B for Solenoid Valve |
| 15 | + Output C for Solenoid Valve |
| 16 | - Output for Solenoid Valve |

SAFE AREA

- | | |
|----------|---------------------------|
| 1 | + Output Transistor Fault |
| 2 | - Output Transistor Fault |
| 3 | + Power Supply 24 Vdc |
| 4 | - Power Supply 24 Vdc |
| 5 | + Input for Control |
| 6 | - Input for Control |
| 7 | + Input for Override |
| 8 | - Input for Override |

Parameters Table

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 gas 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 D1049 Associated Apparatus 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 Associated Apparatus parameters for the effective gas group. See parameters on enclosure side and the ones indicated in the table below:

D1049 Terminals		D1049 Associated Apparatus Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters
Out A	13 - 16	$U_o / V_{oc} = 24.8 \text{ V}$	\leq	U_i / V_{max}
Out B	14 - 16			
Out C	15 - 16			
Out A	13 - 16	$I_o / I_{sc} = 147 \text{ mA}$	\leq	I_i / I_{max}
Out B	14 - 16			
Out C	15 - 16			
Out A	13 - 16	$P_o / P_o = 907 \text{ mW}$	\leq	P_i / P_i
Out B	14 - 16			
Out C	15 - 16			

D1049 Terminals		D1049 Associated Apparatus Parameters		Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters	
Out A	13 - 16	$C_o / C_a = 113 \text{ nF}$	(IIC-A, B)	\geq	$C_i / C_i \text{ device} + C \text{ cable}$	
Out B	14 - 16					(IIB-C)
Out C	15 - 16					(IIA-D)
Out A	13 - 16	$L_o / L_a = 1.65 \text{ mH}$	(IIC-A, B)	\geq	$L_i / L_i \text{ device} + L \text{ cable}$	
						(IIB-C)
						(IIA-D)
Out B	14 - 16	$L_o / L_a = 12.30 \text{ mH}$	(IIB-C)	\geq	$L_i / L_i \text{ device} + L \text{ cable}$	
						(IIB-C)
						(IIA-D)
Out C	15 - 16	$L_o / L_a = 33.58 \text{ mH}$	(IIA-D)	\geq	$L_i / L_i \text{ device} + L \text{ cable}$	
						(IIB-C)
						(IIA-D)
Out A	13 - 16	$L_o / R_o = 39.2 \text{ } \mu\text{H}/\Omega$	(IIC-A, B)	\geq	$L_i / R_i \text{ device and } L \text{ cable} / R \text{ cable}$	
						(IIB-C)
						(IIA-D)
Out B	14 - 16	$L_o / R_o = 213.5 \text{ } \mu\text{H}/\Omega$	(IIB-C)	\geq	$L_i / R_i \text{ device and } L \text{ cable} / R \text{ cable}$	
						(IIB-C)
						(IIA-D)
Out C	15 - 16	$L_o / R_o = 498.9 \text{ } \mu\text{H}/\Omega$	(IIA-D)	\geq	$L_i / R_i \text{ device and } L \text{ cable} / R \text{ cable}$	
						(IIB-C)
						(IIA-D)

NOTE for USA and Canada:
IIC equal to Gas Groups A, B, C, D, E, F and G,
IIB equal to Gas Groups C, D, E, F and G,
IIA equal to Gas Groups D, E, F and G

For installations in which both the C_i and L_i of the Intrinsically Safe apparatus exceed 1 % of the C_o and L_o parameters of the Associated Apparatus (excluding the cable), then 50 % of C_o and L_o parameters are applicable and shall not be exceeded (50 % of the C_o and L_o become the limits which must include the cable such that $C_i \text{ device} + C \text{ cable} \leq 50 \% \text{ of } C_o$ and $L_i \text{ device} + L \text{ cable} \leq 50 \% \text{ of } L_o$).

If the cable parameters are unknown, the following value may be used: Capacitance 60pF per foot (180pF per meter), inductance 0.20μH per foot (0.60μH 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.

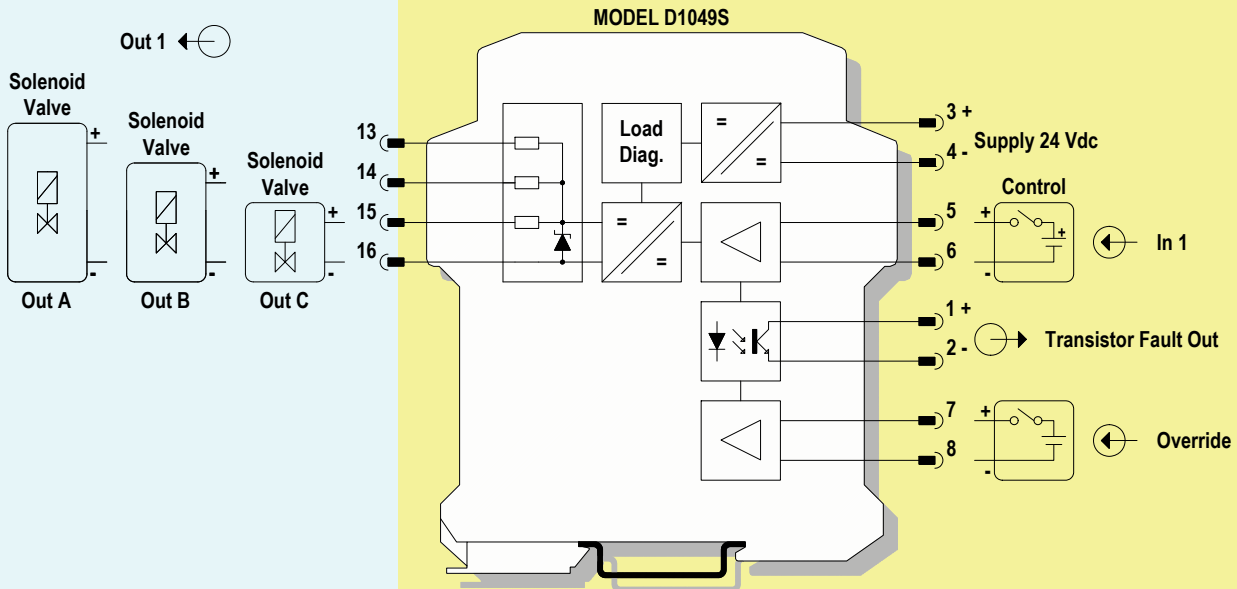
For Division 1 and Zone 0 installations, the configuration of Intrinsically Safe Equipment must be FM approved under Entity Concept (or third party approved);

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

Function Diagram

HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC,
HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D,
CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1,
CLASS I, ZONE 0, GROUP IIC

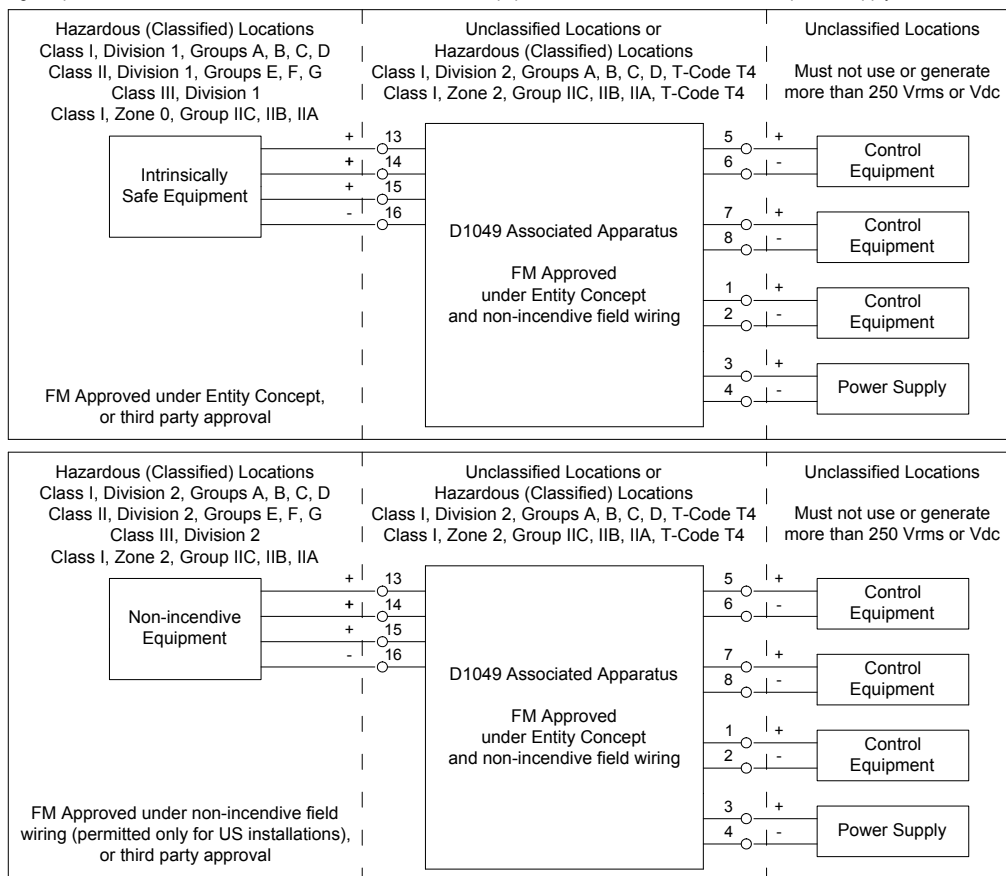
SAFE AREA, ZONE 2 GROUP IIC T4,
NON HAZARDOUS LOCATIONS, CLASS I, DIVISION 2,
GROUPS A, B, C, D T-Code T4, CLASS I, ZONE 2, GROUP IIC T4



Use only one output at a time
(Out A or Out B or Out C)

Warning

D1049 is an isolated Intrinsically Safe Associated Apparatus installed into standard EN50022 T35 DIN Rail located in Safe Area/ Non Hazardous Locations or Zone 2, Group IIC, Temperature Classification T4, Class I, Division 2, Groups A, B, C, D, Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA Temperature Code T4 Hazardous Area/Hazardous Locations (according to EN/IEC60079-15, FM Class No. 3611, CSA-C22.2 No. 213-M1987, CSA-E60079-15) within the specified operating temperature limits Tamb -20 to +60 °C, and connected to equipment with a maximum limit for AC power supply Um of 250 Vrms.



Non-incendive field wiring is not recognized by the Canadian Electrical Code, installation is permitted in the US only.

For installation of the unit in a Class I, Division 2 or Class I, Zone 2 location, the wiring between the control equipment and the D1049 associated apparatus shall be accomplished via conduit connections or another acceptable Division 2, Zone 2 wiring method according to the NEC and the CEC.

Not to be connected to control equipment that uses or generates more than 250 Vrms or Vdc with respect to earth ground.

D1049 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,

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. De-energize power source (turn off power supply voltage) before plug or unplug the terminal blocks when installed in Hazardous Area/Hazardous Locations or unless area is known to be nonhazardous.

Warning: substitution of components may impair Intrinsic Safety and suitability for Division 2, Zone 2.

Explosion Hazard: to prevent ignition of flammable or combustible atmospheres, disconnect power before servicing or unless area is known to be nonhazardous.

Failure to properly installation or use of the equipment may risk to damage the unit or severe personal injury.

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

Operation

The single channel DIN-Rail Bus Powered Digital Output Isolator, D1049S, is suitable for driving solenoid valves, visual or audible alarms to alert a plant operator, or other process control devices in Hazardous Area from a driving signal in Safe Area. It can also be used as a controllable supply to power measuring or process control equipment. Its use is allowed in applications requiring up to SIL 3 level (according to IEC 61508) in safety related systems for high risk industries.

The Safety PLC or DCS driving signal controls the field device through the D1049S, which provides isolation and is capable of monitoring the conditions of the line.

Short and open circuit diagnostic monitoring, dip-switch selectable, operates irrespective of the output condition and provides LED indication and NC transistor output signaling.

When fault is detected output is de-energized until normal condition is restored.

An override input, dip-switch selectable, is provided to permit a safety system to override the control signal. When enabled, a low input voltage always de-energizes the field device regardless of the input signal.

Three basic output circuits are selectable, with different safety parameters, to interface the majority of devices on the market. The selection among the three output characteristics is obtained by connecting the field device to a different terminal block.

Presence of supply power, output status, as well as integrity or fault condition of device and connecting line are displayed by signaling LEDs (green for power, yellow for status, red for fault).

Installation

D1049 is a digital output isolator housed in a plastic enclosure suitable for installation on T35 DIN Rail according to EN50022.

D1049 unit can be mounted with any orientation over the entire ambient temperature range, see section "Installation in Cabinet" and "Installation of Electronic Equipments in Cabinet" Instruction Manual D1000 series for detailed instructions.

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 (**for Zone 2 or Division 2 installations check the area to be nonhazardous before servicing**).

The wiring cables have to be proportionate in base to the current and the length of the cable.

On the section "Function Diagram" and enclosure side a block diagram identifies all connections and configuration DIP switches.

Identify the function and location of each connection terminal using the wiring diagram on the corresponding section, as an example:

Connect 24 Vdc power supply at terminal "3" positive and at terminal "4" negative.

Connect control input signal positive at terminal "5" and negative at terminal "6".

Connect fault open collector transistor output positive at terminal "1" and negative at terminal "2".

Connect override input at terminal "7" positive and at terminal "8" negative.

Connect positive output at terminal "13" and negative output at "16" using "Out A" diagram or positive output at terminal "14" and negative at terminal "16" using "Out B" diagram or positive output at terminal "15" and negative at "16" using "Out C" diagram.

NOTE: use only one output at a time, Out A or Out B or Out C not contemporary.

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. EN/IEC60079-14 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,

Canadian Electrical Code CEC), make sure that conductors are well isolated from each other and do not produce any unintentional connection.

Connect SPST output transistors checking the load rating to be within the maximum rating (100 mA, 35 Vdc resistive load).

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.

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.

Electrostatic Hazard: to avoid electrostatic hazard, the enclosure of D1049 must be cleaned only with a damp or antistatic cloth.

Any penetration of cleaning liquid must be avoided to prevent damage to the unit. Any unauthorized card modification must be avoided.

According to EN61010, D1049 must be connected to SELV or SELV-E supplies.

Start-up

Before powering the unit check that all wires are properly connected, particularly supply conductors and their polarity, input and output wires, also check that Intrinsically Safe conductors and cable trays are segregated (no direct contacts with other non I.S. conductors) and identified either by color coding, preferably blue, or by marking.

Check conductors for exposed wires that could touch each other causing dangerous unwanted shorts.

Turn on power, the "power on" green led must be lit, "status" led and fault led must were in accordance with condition of the corresponding output line.

If possible change the status of driving signal and connection line one at time checking the corresponding status and fault leds condition as well as output to be correct.

Installation in Cabinet

Power Dissipation of D1049 Isolators

Section "Technical Data" of D1049 isolator specifies the current consumption (maximum current from the nominal power supply, typical 24 Vdc, in normal operation);

this data serves to dimension the current rating of the power supply unit. Section "Technical Data" indicates also the maximum power consumption (maximum power required from the power supply in the worst (abnormal) operating conditions like for example supply voltage at 30 Vdc, short circuit on the outputs terminals).



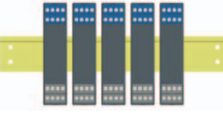
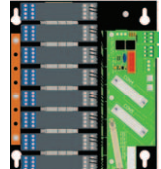
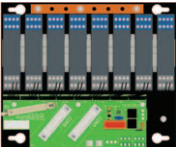
The power dissipated **P_d** inside the enclosure is: **P_d = Current Consumption (A) * Supply Voltage (V) - Power Dissipated into the output load**

Isolators are not running at the maximum current all at the same time, the average power consumption of a multitude of isolators can be considered to be only 70 % of the value obtained from the section "Technical Data". Considering the power dissipated by the load (typical 1/3 of input power), and the 70 % above discussed, the power effectively dissipated internally by the isolators can therefore become 1/2 of the actual power delivered by the power supply.

The following tables give advises for DIN-Rail orientation (vertical or horizontal) of barriers mounting, or installation on custom board assembly.




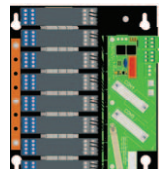
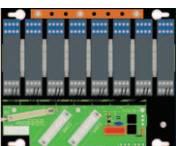
A) Cabinet with Natural Ventilation

Maximum recommended ambient temperature in °C depending on installation method:

Type of Isolator	Single unit Installation	Installation of Multiple units with DIN-Rail Bus		Installation on Custom Boards	
	Any orientation	Vertical	Horizontal	Vertical	Horizontal
					
D1049S	60°C	35°C	40°C	40°C	45°C

B) Cabinet with Forced Ventilation

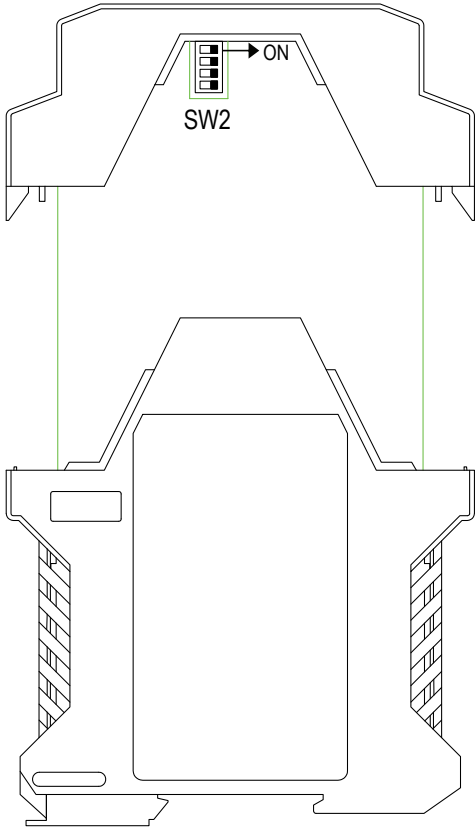
Maximum recommended ambient temperature in °C depending on installation method:

Type of Isolator	Single unit Installation	Installation of Multiple units with DIN-Rail Bus		Installation on Custom Boards	
	Any orientation	Vertical	Horizontal	Vertical	Horizontal
					
D1049S	60°C	45°C	50°C	50°C	60°C

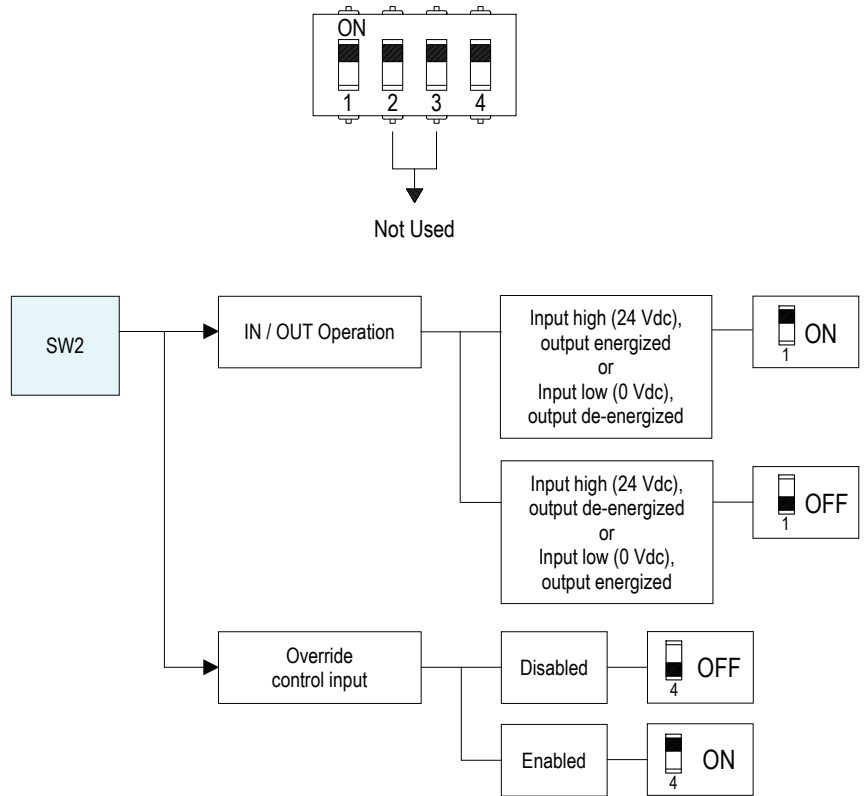
Configuration

Configuration DIP switches are located on component side of pcb. These switches allows the configuration of phase reversal, override input and fault detection functions.

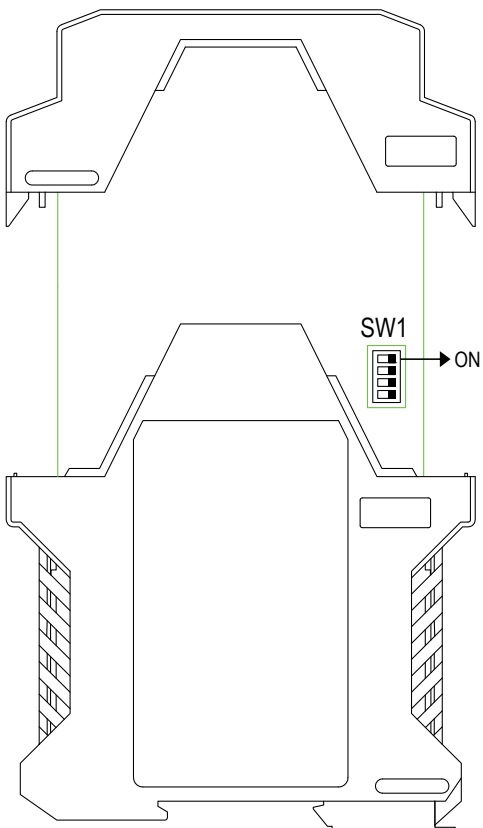
Side A Panel View



SW2 dip switch configuration



Side B Panel View



SW1 dip switch configuration

