INSTRUCTION MANUAL

SIL 3 Digital Output Driver, NE Loads, Bus Powered DIN Rail and Termination Board, Model D5049S

GM INTERNATIONAL
TECHNOLOGY FOR SAFETY

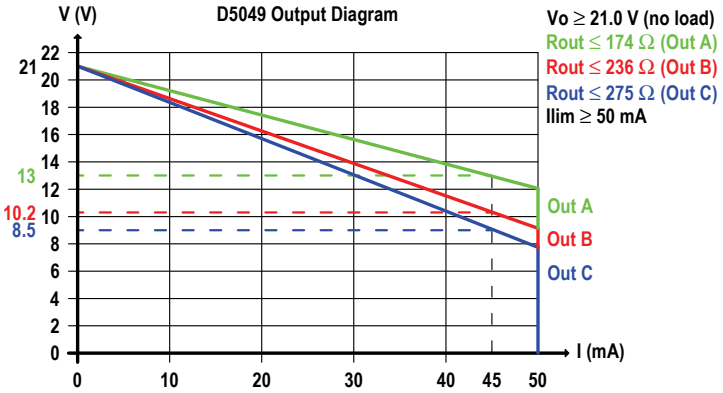
Characteristics

General Description: The single channel Bus Powered Digital Output Isolator, D5049S, 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 D5049S, 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.

Mounting on standard DIN-Rail, with or without Power Bus, or on customized Termination Boards, in Safe Area or in Zone 2.

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.
Isolation (Test Voltage): I.S. Out/In 2.5 KV; I.S. Out/Supply 2.5 KV; I.S. Out/Fault-Override 2.5 KV; In/Supply 500 V; In/Fault-Override 500 V; Supply/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 7-10 Out A.
45 mA at 10.2 V (21.0 V no load, 236 Ω series resistance) at terminals 8-10 Out B.
45 mA at 8.5 V (21.0 V no load, 275 Ω series resistance) at terminals 9-10 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 ≤ 50 Ω (≈ 2 mA forcing to detect fault).
Open output detection: load resistance > 10 KΩ.
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 µA at 35 Vdc.
Response time: ≤ 5 ms.
Compatibility:
CE mark compliant, conforms to 94/9/EC Atex Directive and to 2004/108/CE EMC Directive.
Environmental conditions:
Operating: temperature limits – 40 to + 70 °C, relative humidity 95 %, up to 55 °C.
Storage: temperature limits – 45 to + 80 °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 7-10 Out A.
Uo/Voc = 24.8 V, Io/Isc = 108 mA, Po/Po = 667 mW at terminals 8-10 Out B.
Uo/Voc = 24.8 V, Io/Isc = 93 mA, Po/Po = 571 mW at terminals 9-10 Out C.
Um = 250 Vrms, -40 °C ≤ Ta ≤ 70 °C.
Approvals: BVS 10 ATEX E 113 X conforms to EN60079-0, EN60079-11, EN60079-15, EN60079-26, EN61241-11, EN50303,
IECEx BVS 10.0072 X conforms to IEC60079-0, IEC60079-11, IEC60079-15, IEC60079-26, IEC1241-11.
Russia according to GOST 12.2.007.0-75, R 51330.0-99, R 51330.10-99, R 51330.14-99 2ExnA[ia]IICT4 X.
Ukraine according to GOST 12.2.007.0, 22782.0, 22782.3, 22782.5 2Exs[ia]IICT4 X.
TUV Certificate No. C-IS-204194-01, SIL 2 / SIL 3 conforms to IEC61508.
Mounting: T35 DIN-Rail according to EN50022, with or without Power Bus or on customized Termination Board.
Weight: about 130 g.
Connection: by polarized plug-in disconnect screw terminal blocks to accomodate terminations up to 2.5 mm².
Location: Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4 installation.
Protection class: IP 20.
Dimensions: Width 12.5 mm, Depth 123 mm, Height 120 mm.

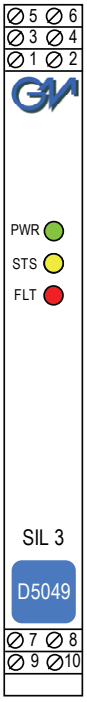
Ordering information

Model:	D5049S

Power Bus and DIN-Rail accessories:

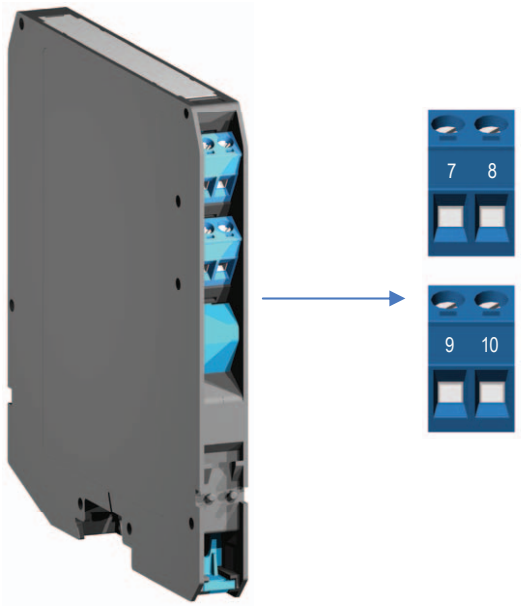
Connector JDFT049	Cover and fix MCHP196
Terminal block male MOR017	Terminal block female MOR022

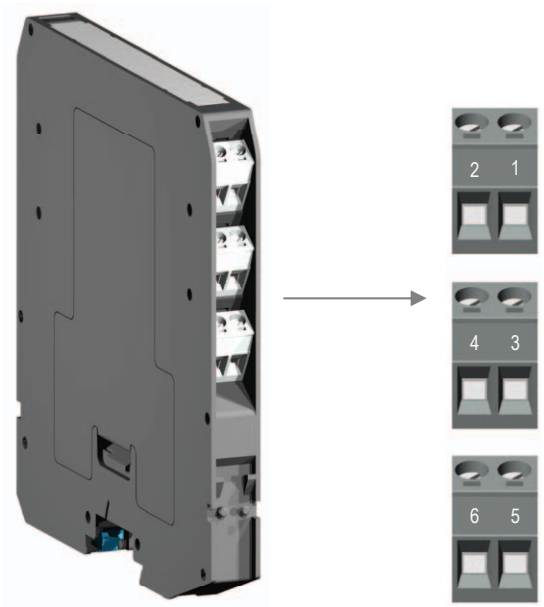
Front Panel and Features



- 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) 8.32 E-06, SFF 99.57 %.
- Output to Zone 0 (Zone 20), installation in Zone 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, EN61326-1, EN61326-3-1 for safety system.
- In-field programmability by DIP Switch.
- ATEX, IECEx, Russian and Ukrainian Certifications.
- Simplified installation using standard DIN-Rail and plug-in terminal blocks, with or without Power Bus, or customized Termination Boards.
- 250 Vrms (Um) max. voltage allowed to the instruments associated with the barrier.

Terminal block connections





HAZARDOUS AREA

7	+ Output A for Solenoid Valve
8	+ Output B for Solenoid Valve
9	+ Output C for Solenoid Valve
10	- Output for Solenoid Valve

SAFE AREA

1	+ Control Input
2	- Control Input
3	+ Transistor Fault Output or + Input Override
4	- Transistor Fault Output or - Input Override
5	+ Power Supply 24 Vdc
6	- Power Supply 24 Vdc

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 group encountered and that its maximum allowable voltage, current, power (Ui/Vmax, Ii/Imax, Pi/Pi) are not exceeded by the safety parameters (Uo/Voc, Io/Isc, Po/Po) of the D5049 series 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 (Co/Ca, Lo/La, Lo/Ro) given in the Associated Apparatus parameters for the effective group. See parameters indicated in the table below:

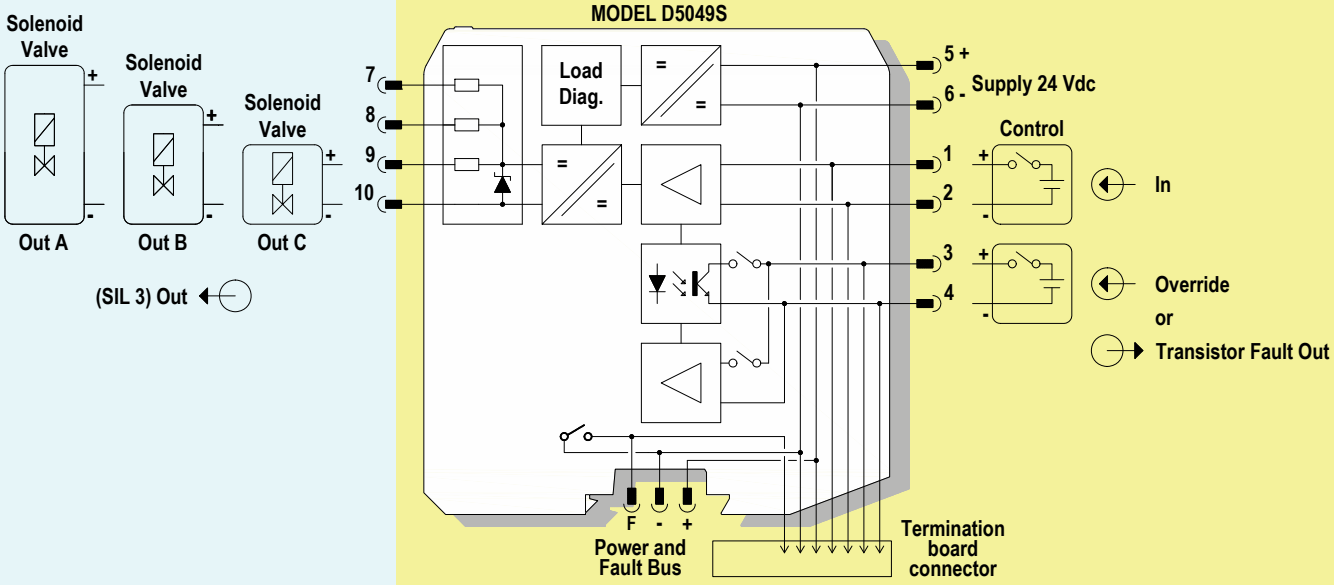
D5049 Terminals		D5049 Associated Apparatus Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters
Out A	7 - 10	Uo / Voc = 24.8 V	≤	Ui / Vmax
Out B	8 - 10			
Out C	9 - 10			
Out A	7 - 10	Io / Isc = 147 mA	≤	Ii/ Imax
Out B	8 - 10	Io / Isc = 108 mA		
Out C	9 - 10	Io / Isc = 93 mA		
Out A	7 - 10	Po / Po = 907 mW	≤	Pi / Pi
Out B	8 - 10	Po / Po = 667 mW		
Out C	9 - 10	Po / Po = 571 mW		

D5049 Terminals		D5049 Associated Apparatus Parameters Cenelec (US)		Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters
Out A	7 - 10	Co / Ca = 113 nF	IIC (A, B)	≥	Ci / Ci device + C cable
		Co / Ca = 860 nF	IIB (C)		
Out B	8 - 10	Co / Ca = 3.05 µF	IIA (D)		
		Co / Ca = 4.35 µF	I		
Out C	9 - 10	Co / Ca = 860 nF	iaD (E, F, G)		
Out A	7 - 10	Lo / La = 1.65 mH	IIC (A, B)	≥	Li / Li device + L cable
		Lo / La = 6.63 mH	IIB (C)		
		Lo / La = 13.27 mH	IIA (D)		
		Lo / La = 21.78 mH	I		
		Lo / La = 6.63 mH	iaD (E, F, G)		
Out B	8 - 10	Lo / La = 3.07 mH	IIC (A, B)		
		Lo / La = 12.30 mH	IIB (C)		
		Lo / La = 24.60 mH	IIA (D)		
		Lo / La = 40.36 mH	I		
		Lo / La = 12.30 mH	iaD (E, F, G)		
Out C	9 - 10	Lo / La = 4.19 mH	IIC (A, B)		
		Lo / La = 16.79 mH	IIB (C)		
		Lo / La = 33.58 mH	IIA (D)		
		Lo / La = 55.09 mH	I		
		Lo / La = 16.79 mH	iaD (E, F, G)		
Out A	7 - 10	Lo / Ro = 39.2 µH/Ω	IIC (A, B)	≥	Li / Ri device and L cable / R cable
		Lo / Ro = 156.8 µH/Ω	IIB (C)		
		Lo / Ro = 313.6 µH/Ω	IIA (D)		
		Lo / Ro = 514.6 µH/Ω	I		
		Lo / Ro = 156.8 µH/Ω	iaD (E, F, G)		
Out B	8 - 10	Lo / Ro = 53.3 µH/Ω	IIC (A, B)		
		Lo / Ro = 213.5 µH/Ω	IIB (C)		
		Lo / Ro = 427.0 µH/Ω	IIA (D)		
		Lo / Ro = 700.6 µH/Ω	I		
		Lo / Ro = 213.5 µH/Ω	iaD (E, F, G)		
Out C	9 - 10	Lo / Ro = 62.3 µH/Ω	IIC (A, B)		
		Lo / Ro = 249.4 µH/Ω	IIB (C)		
		Lo / Ro = 498.9 µH/Ω	IIA (D)		
		Lo / Ro = 818.5 µH/Ω	I		
		Lo / Ro = 249.4 µH/Ω	iaD (E, F, G)		

For installations in which both the Ci and Li of the Intrinsically Safe apparatus exceed 1 % of the Co and Lo parameters of the Associated 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 ≤ 50 % of Co and Li device + L cable ≤ 50 % of Lo).
If the cable parameters are unknown, the following value may be used: Capacitance 180pF per meter (60pF per foot), Inductance 0.60µH per meter (0.20µH per foot).

Function Diagram

HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC | SAFE AREA, ZONE 2 GROUP IIC T4



Terminals 3-4 dip-switch selectable for fault output signaling or override control

Warning

D5049S is isolated Intrinsically Safe Associated Apparatus installed into standard EN50022 T35 DIN Rail located in Safe Area or Zone 2, Group IIC, Temperature T4, Hazardous Area (according to EN/IEC60079-15) within the specified operating temperature limits Tamb –40 to +70 °C, and connected to equipment with a maximum limit for AC power supply Um of 250 Vrms.
Not to be connected to control equipment that uses or generates more than 250 Vrms or Vdc with respect to earth ground.
D5049S 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)), 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 or unless area is known to be nonhazardous.
Warning: substitution of components may impair Intrinsic Safety and suitability for 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 Bus Powered Digital Output Isolator, D5049S, 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 D5049S, 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, status of output, 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

D5049S is a Digital Output Driver housed in a plastic enclosure suitable for installation on T35 DIN-Rail according to EN50022, with or without Power Bus or on customized Termination Board. D5049S 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 **(for Zone 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. 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 positive at terminal "5" and negative at terminal "6".
Connect positive input at terminal "1" and negative input at "2".
Connect positive transistor fault output or positive input override at terminal "3" and negative at "4".
Connect positive output A for solenoid valve at terminal "7" and negative at "10" or output B at terminal "8" and negative at "10" or output C at terminal "9" and negative at "10".

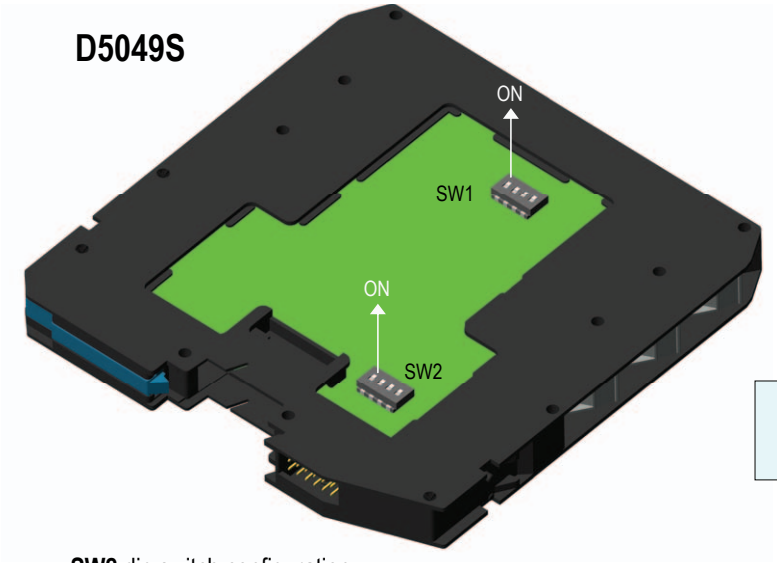
Intrinsically Safe conductors must be identified and segregated from non I.S. and wired in accordance to the relevant national/international installation standards (e.g. EN/IEC60079-14 Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines)), make sure that conductors are well isolated from each other and do not produce any unintentional connection.
Connect SPST fault output transistors checking the load rating to be within the maximum rating (100 mA at 35 Vdc (≤ 1.5 V voltage drop)).
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 D5049S 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, D5049S must be connected to SELV or SELV-E supplies.

Start-up

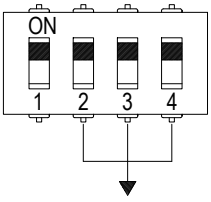
Before powering the unit check that all wires are properly connected, particularly supply conductors and their polarity, input and output wires, also check that Intrinsically Safe conductors and cable trays are segregated (no direct contacts with other non I.S. conductors) and identified either by color 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 must be in accordance with condition of the input line. If possible close and open input line checking the corresponding status and fault leds condition as well as output to be correct.

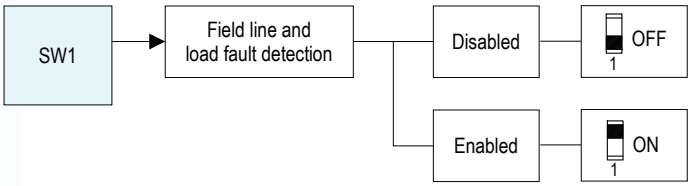
Configuration

A configuration DIP switches are located on component side of pcb. These switches allows the configuration of input/output relationship, override input and fault detection functions.

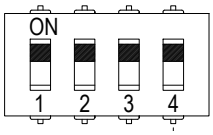


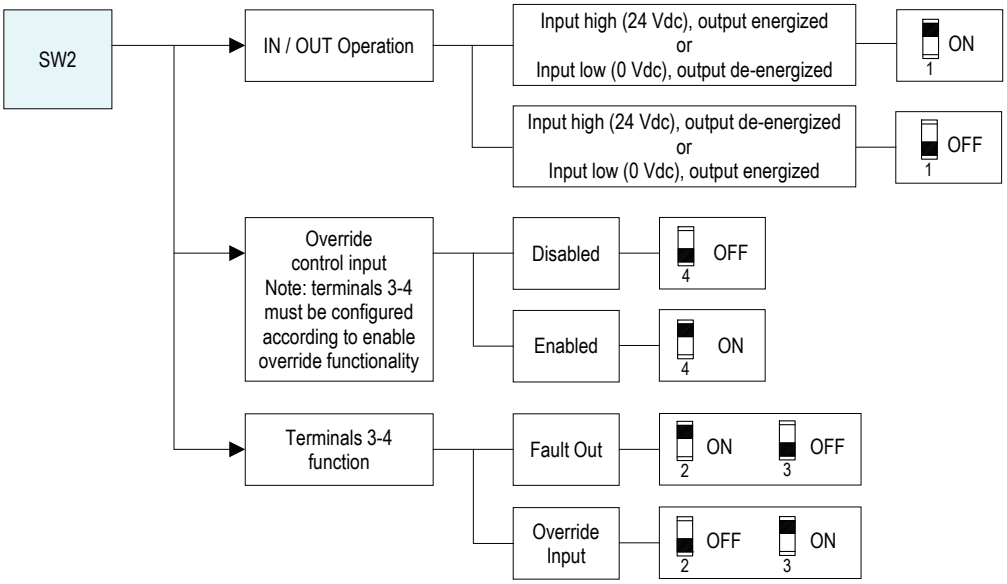
SW1 dip switch configuration





SW2 dip switch configuration





Testing procedure at T-proof

The proof test shall be performed to reveal dangerous faults which are undetected by diagnostic. This means that it is necessary to specify how dangerous undetected fault, which have been noted during the FMEDA, can be detected during proof test. **The Proof test** consists of the following steps:

Steps	Action
1	Bypass the safety-related PLC or take other appropriate action to avoid a false trip.
2	Set the following configuration for: ● SW1 dip-switch: SW1-1 = OFF (to disable the field line and load fault detection), SW1-2 = SW1-3 = SW1-4 = ON or OFF (because not used); ● SW2 dip-switch: SW2-1 = ON (direct IN/OUT transfer function), SW2-2 = ON , SW2-3 = OFF , SW2-4 = OFF (to enable fault output and disable override input functionality). The series connection of 1 kΩ load resistor with an ammeter must be connected in parallel with a voltmeter to an output of module (starting with Out A, then going on with Out B and finally proceeding with Out C). Supply the D5049S module at 24 Vdc. Then, apply the control signal to the input channel of module, which can have the following two states: ● OFF = 0 Vdc, implying that load current is 0 mA and load voltage is 0 V because the 1 kΩ load resistor must be de-energized in accordance with OFF state of control input signal; ● ON = 24 Vdc, so that the 1 kΩ load resistor must be energized, with the following current and voltage values: 17.5÷18.5 mA and 17.5÷18.5 V (for Out A); 16.5÷17.5 mA and 16.5÷17.5 V (for Out B); 16÷17 mA and 16÷17 V (for Out C). In addition, disconnect the 1 kΩ load resistor from the output channel in order to generate an open / short output circuit, when line and load fault detection is disabled and control signal = ON: ● open circuit: connect only the voltmeter in parallel to output, so that out voltage is 21÷21.5 V; ● short circuit: connect only the ammeter in parallel to output, so that out current is 53÷57 mA.
3	Consider the configuration setup defined in the previous proof test step (**2**) and change the dip-switch SW1-1 from OFF to ON position in order to enable the field line and load fault detection. Supply the D5049S module at 24 Vdc, apply 24 Vdc = ON control signal to the input channel of module, then connect an ohmmeter to the fault output and another one to the fault bus output. In presence of the 1 kΩ load resistor connected to the output channel, the fault red LED is turned off, the fault output is closed (presence of ohmic continuity) and the fault bus output is open (absence of ohmic continuity) because no line or load fault is detected. Now, disconnect the 1 kΩ load resistor from the output channel in order to generate a line or load fault (open / short circuit fault), so that fault red LED is turned on, the fault output is open (absence of ohmic continuity) and the fault bus output is closed (presence of ohmic continuity). Therefore, generate an open or short output circuit fault executing the following setup changes: ● open circuit: connect only the voltmeter in parallel to output of module, so that load voltage is 4÷4.5 V (diagnostic open circuit voltage); ● short circuit: connect only the ammeter in parallel to output of module, so that load current is < 1 mA (diagnostic short circuit current). These results are also valid when the control signal state = OFF and the channel is turned off, because fault diagnostic circuit (if enabled) is always active independently from channel state.
4	Consider the configuration setup defined in the previous proof test step (**2**) and change the dip-switch SW1-1 from OFF to ON position in order to enable the field line and load fault detection. Substitute the series connection of 1 kΩ load resistor and an ammeter with a current calibrator (set to 45 mA). This generator and a voltmeter are connected in parallel to an output (starting with Out A, then going on with Out B and finally proceeding with Out C). Supply the D5049S module at 24 Vdc and apply 24 Vdc = ON control signal to the input channel of module, verifying the following load voltage values: 13÷13.5 V (for Out A), 10.2÷10.7 V (for Out B) and 8.5÷9 V (for Out C).
5	Restore the loop to full operation.
6	Remove the bypass from the safety-related PLC or restore normal operation.

This test detects almost 100 % of all possible Dangerous Undetected failures in the digital output module.

D5049S Bus Powered and NE load

- Safety function
  The 1st operating mode (direct In / Out transfer function: "input high 24 Vdc → output is energized" or "input low 0 Vdc → output is de-energized") has been chosen and the override functionality has been disabled, so that the Safety PLC or DCS control signal is the only signal that operates on the input channel of the module.
  The failure behaviour is described from the following definitions:
  - □ fail-Safe State: is defined as the output being de-energized;
  - □ fail Safe: failure mode that causes the module to go to the defined fail-safe state without a demand from the process;
  - □ fail Dangerous: failure mode that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state), so that the output remains energized;
  - □ fail "No Effect": failure mode of a component that is part of the safety function but that has no effect on the safety function.
    For the calculation of the SFF it is considered a safe undetected failure;
  - □ fail "Not part": failure mode of a component which is not part of the safety function but part of the circuit diagram and is listed for completeness.
    When calculating the SFF this failure mode is not taken into account. It is also not considered for the total failure rate (safety function) evaluation.

- Failure rates table:

Failure category	Failure rates (FIT)
λ_{dd} = Total Dangerous Detected failures	0.00
λ_{du} = Total Dangerous Undetected failures	1.90
λ_{sd} = Total Safe Detected failures	0.00
λ_{su} = Total Safe Undetected failures = $\lambda_{su\ int}$ + $\lambda_{no\ effect}$	441.90
↳ $\lambda_{su\ int}$ = Safe Undetected failures	189.19
↳ $\lambda_{no\ effect}$ = "No Effect" failures	252.71
$\lambda_{tot\ safe}$ = Total Failure Rate (Safety Function) = λ_{dd} + λ_{du} + λ_{sd} + λ_{su}	**443.80**
$\lambda_{not\ part}$ = "Not Part" failures	31.60
$\lambda_{tot\ device}$ = Total Failure Rate (Device) = $\lambda_{tot\ safe}$ + $\lambda_{not\ part}$	**475.40**
MTBF (single channel) = (1 / $\lambda_{tot\ device}$) + MTTR	**240 years**
$MTTF_S$ (Total Safe) = 1 / (λ_{sd} + λ_{su})	258 years
$MTTF_D$ (Dangerous) = 1 / λ_{du}	60081 years

- Failure rates table according to IEC 61508:

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	SFF
0.0 FIT	441.90 FIT	0.00 FIT	1.90 FIT	99.57%

- PFDavg vs T[Proof] table, with determination of SIL supposing module contributes 10% of entire safety function:

T[Proof] = 1 year	T[Proof] = 12 years	T[Proof] = 20 years
PFDavg = 8.32 E-06 Valid for **SIL 3**	PFDavg = 9.99 E-05 Valid for **SIL 3**	PFDavg = 1.66 E-04 Valid for **SIL 2**

- PFDavg vs T[Proof] table, with determination of SIL supposing module contributes 20% of entire safety function:

T[Proof] = 20 years
PFDavg = 1.66 E-04 Valid for **SIL 3**