

INSTRUCTION MANUAL

I.S. SIL2 Line-Fault Transp. Switch/Prox. Repeater,
DIN-Rail and Termination Board
Models D5039S*, D5039D*, D5039X*



Characteristics

General Description:

The Switch/Proximity Detector Repeater D5039 is a module suitable for applications requiring SIL 2 level in safety related systems for high risk industries. The unit can be configured for switches or proximity detectors, located in Hazardous Area, and repeats the input state to the output in Safe Area. The output port can assume two different impedance values (RL or RH) or it can open completely. The module output repeats the input state according to the following correspondence: low input state -> RL, high input state -> RH. Alternatively, the output can be configured to invert the input state. In both cases, the output opens if any fault (open or short circuit) occurs at the corresponding input.

Functional Safety Management Certification:

G.M. International is certified by TUV to conform to IEC61508:2010 part 1 clauses 5-6 for safety related systems up to and included SIL3.



Technical Data

Supply:

24 Vdc nom (18 to 30 Vdc), reverse polarity protected.
Current consumption: 30 mA (D5039D), 25 mA (D5039X), 15 mA (D5039S), @ 24 Vdc, typical.
Power dissipation: 1.0 W (D5039D), 1.0 W (D5039X), 0.4 W (D5039S), @ 24 Vdc, typical.

Isolation (test voltage):

I.S. In/Out 1.5 kV; I.S. In/Supply 1.5 kV; I.S. In/ I.S In 500 V; Out/Supply 500 V; Out/Out 500 V.

Input:

Input switching current levels: ON \geq 2.1 mA, OFF \leq 1.2 mA.
Open fault: current \leq 0.05 mA.
Short fault: resistance \leq 100 Ω .
No fault: current \geq 0.35 mA and resistance \geq 360 Ω .
Input equivalent source: 8 V 1 k Ω typical (8 V no load, 8 mA short).

Output:

Voltage free SPST solid-state relays, with series (RL) and parallel (RH-RL) resistances, \pm 5% tolerance.
Fault impedance: > 1 M Ω .
Max voltage: 30 Vdc.
Max current: 15 mA.
Response time: 500 μ s.
Frequency response: 1 kHz maximum.

Compatibility:

CE CE mark compliant, conforms to Directives: 2014/34/EU ATEX, 2014/30/EU EMC, 2014/35/EU LVD, 2011/65/EU RoHS.

Environmental conditions:

Operating: temperature limits - 40 to + 70 $^{\circ}$ C, relative humidity 95 %, up to 55 $^{\circ}$ C.
Max altitude: 2000 m a.s.l.
Storage: temperature limits - 45 to + 80 $^{\circ}$ C.

Safety description:



ATEX: II 3(1)G Ex ec [ia Ga] IIC T4 Gc; II (1)D [Ex ia Da] IIIC; I (M1) [Ex ia Ma] I
IECEX: Ex ec [ia Ga] IIC T4 Gc; [Ex ia Da] IIIC; [Ex ia Ma] I
UL: NI / I / 2 / ABCD / T4, AIS / I, II, III / 1 / ABCDEFG, AEx nA [ia Ga] IIC T4 Gc; **C-UL:** NI / I / 2 / ABCD / T4, AIS / I, II, III / 1 / ABCDEFG, Ex nA [ia Ga] IIC T4 Gc X
EAC-EX: 2Ex ec [ia Ga] IIC T4 Gc X, [Ex ia Da] IIIC, [Ex ia Ma] I.
CCC: Ex ec [ia Ga] IIC T4 Gc; [Ex ia Ga] IIC; [Ex ia Da] IIIC
 associated apparatus and non-sparking electrical equipment.
 Uo/Voc = 10.5 V, Io/Isc = 22 mA, Po/Po = 56 mW at terminals 7-8, 9-10
 Um = 250 Vrms or Vdc, -40 $^{\circ}$ C \leq Ta \leq 70 $^{\circ}$ C.

Approvals:

DEMKO 19 ATEX 2290X conforms to EN60079-0, EN60079-11, EN60079-7.
 IECEX ULD 19.0029X conforms to IEC60079-0, IEC60079-11, IEC60079-7.
 UL & C-UL E222308 conforms to UL 61010-1, UL913, UL 60079-0, UL60079-11, UL60079-15, UL121201 for UL and CAN/CSA C22.2 No. 61010-1-12, CSA-E60079-0, CSA-E60079-11, CSA-E60079-15 and CSA-C22.2 No. 213 for C-UL.
 EAЭC RU C-IT.AA87.B.00765/21 conforms to GOST 31610.0, GOST ,31610.7 GOST 31610.11.
 CCC n. 2020322316000978 conforms to GB/T 3836.1, GB/T 3836.3, GB/T 3834.4
 TUV Certificate No. C-IS-272994-01 SIL 2 conforms to IEC61508:2010 Ed. 2.
 SIL 3 Functional Safety TÜV Certificate conforms to IEC61508:2010 Ed.2, for Management of Functional Safety.
 DNV Type Approval Certificate No. TAA00001U0 Certificate for maritime applications.

Mounting:

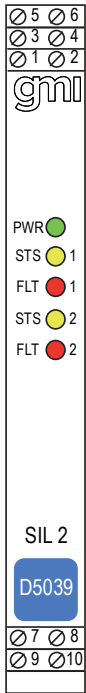
EN/IEC60715 TH 35 DIN-Rail, with or without Power Bus or on customized Termination Board.
Weight: about 135 g (D5039D and D5039X), 120 g (D5039S).
Connection: by polarized plug-in disconnect screw terminal blocks to accommodate terminations up to 2.5 mm² (13 AWG).
Location: installation in Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4 or Class I, Division 2, Group A,B,C,D, T4 or Class I, Zone 2, Group IIC, T4.
Protection class: IP 20.
Dimensions: Width 12.5 mm, Depth 123 mm, Height 120 mm.

Ordering Information

Model:	D5039		
1 channel		S	
2 channels		D	
duplicator		X	
RL = 2.2k Ω , RH = 14.3k Ω			A
RL = 476 Ω , RH = 1.38k Ω			B
RL = 5k Ω , RH = 15k Ω			C
RL = 0 Ω , RH = 33.2k Ω			D

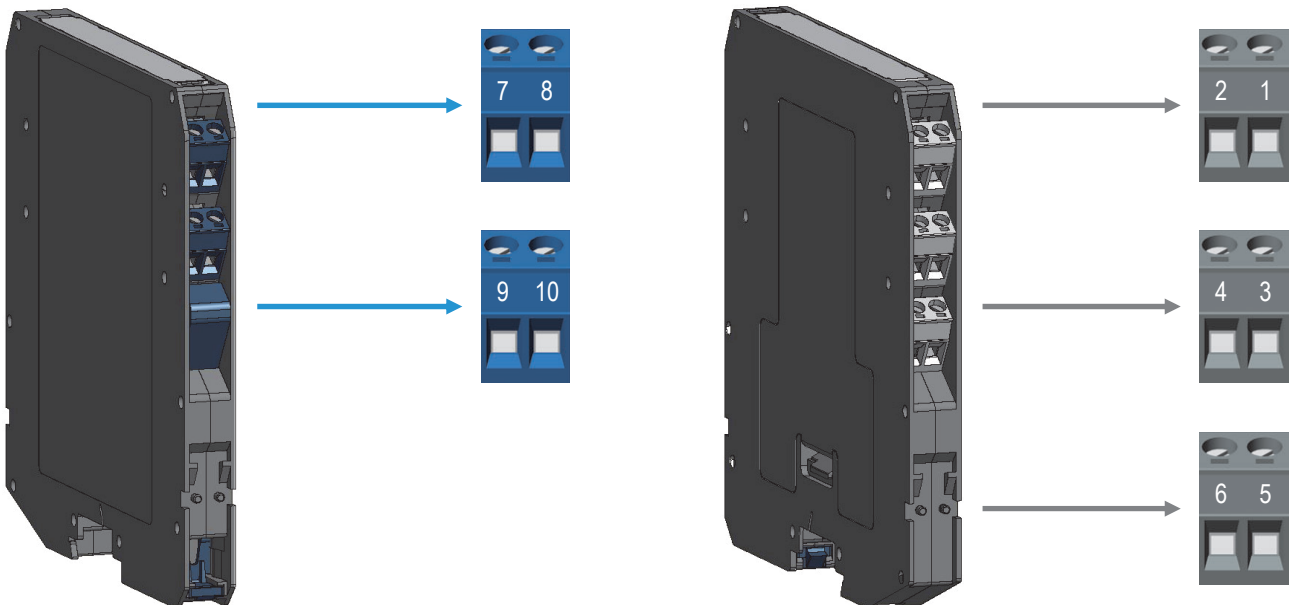
Power Bus and DIN-Rail accessories:
 Bus connector JDFT049 Bus mounting kit OPT5096

Front Panel and Features



- SIL 2 (low demand mode of operation) according to IEC 61508:2010 Ed.2 with Tproof = 6 / 12 yrs (≤ 10 / >10 % of total SIF).
- SC 3: Systematic Capability SIL 3
- Input from Zone 0/Div. 1
- Installation in Zone 2/Div. 2
- Field open and short circuit detection
- Field fault universal mirroring to PLC DI
- Line monitoring transparency
- In-field programmability by DIP Switch
- Three port isolation, Input/Output/Supply
- High Density, two channels per unit

Terminal block connections



HAZARDOUS AREA

7	+ Input Ch 1 for proximity or voltage free contact
8	- Input Ch 1 for proximity or voltage free contact
9	+ Input Ch 2 for proximity or voltage free contact
10	- Input Ch 2 for proximity or voltage free contact
11	-
12	-

SAFE AREA

1	Output Ch 1
2	Output Ch 1
3	Output Ch 2
4	Output Ch 2
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 (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 D5039 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 (C_o/C_a , L_o/L_a , L_o/R_o) given in the Associated Apparatus parameters for the effective group. See parameters indicated in the table below:

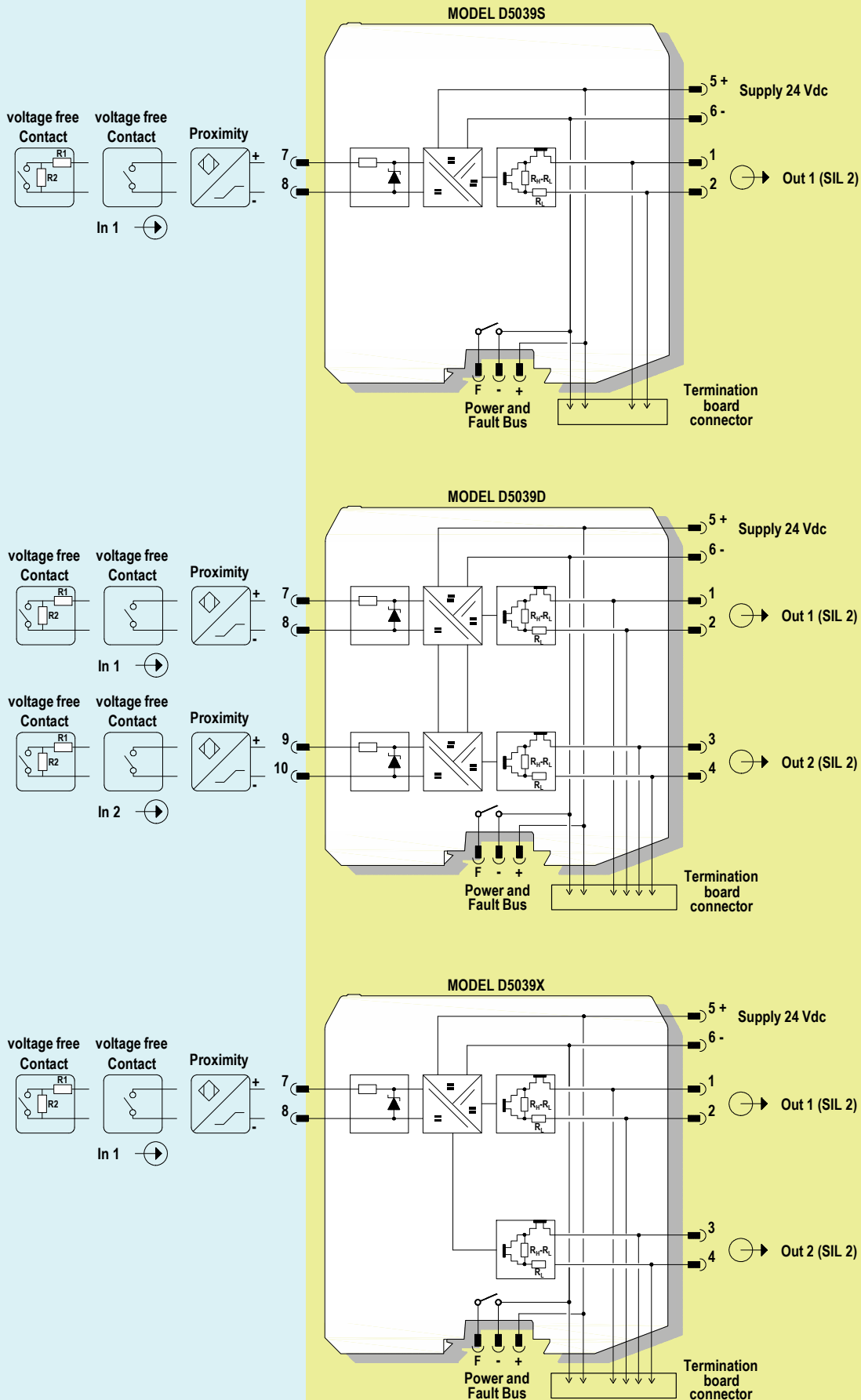
D5039 Terminals		D5039 Associated Apparatus Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters
Ch1	7 - 8	$U_o / V_{oc} = 10.5 \text{ V}$	\leq	U_i / V_{max}
Ch2	9 - 10			
Ch1	7 - 8	$I_o / I_{sc} = 22 \text{ mA}$	\leq	I_i / I_{max}
Ch2	9 - 10			
Ch1	7 - 8	$P_o / P_o = 56 \text{ mW}$	\leq	P_i / P_i
Ch2	9 - 10			
D5039 Terminals		D5039 Associated Apparatus Parameters Cenelec (US)	Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters
Ch1	7 - 8	$C_o / C_a = 2.4 \mu\text{F}$ $C_o / C_a = 16.7 \mu\text{F}$ $C_o / C_a = 74.9 \mu\text{F}$ $C_o / C_a = 94.9 \mu\text{F}$ $C_o / C_a = 16.7 \mu\text{F}$	\geq	$C_i / C_i \text{ device} + C \text{ cable}$
Ch2	9 - 10			
Ch1	7 - 8	$L_o / L_a = 78.3 \text{ mH}$ $L_o / L_a = 313.5 \text{ mH}$ $L_o / L_a = 627.1 \text{ mH}$ $L_o / L_a = 1028.8 \text{ mH}$ $L_o / L_a = 313.5 \text{ mH}$	\geq	$L_i / L_i \text{ device} + L \text{ cable}$
Ch2	9 - 10			
Ch1	7 - 8	$L_o / R_o = 635 \mu\text{H}/\Omega$ $L_o / R_o = 2543 \mu\text{H}/\Omega$ $L_o / R_o = 5087 \mu\text{H}/\Omega$ $L_o / R_o = 8347 \mu\text{H}/\Omega$ $L_o / R_o = 2543 \mu\text{H}/\Omega$	\geq	$L_i / R_i \text{ device and}$ $L \text{ cable} / R \text{ cable}$
Ch2	9 - 10			

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 $C_i \text{ device} + C \text{ cable} \leq 50\%$ of C_o and $L_i \text{ device} + L \text{ cable} \leq 50\%$ of L_o). The reduced capacitance of the external circuit (including cable) shall not be greater than $1 \mu\text{F}$ for Groups I, IIA, IIB and 600 nF for Group IIC. If the cable parameters are unknown, the following value may be used: Capacitance 200 pF per meter (60 pF per foot), Inductance $1 \mu\text{H}$ per meter ($0.20 \mu\text{H}$ per foot).

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



Warning

D5039 series is isolated Intrinsically Safe Associated Apparatus installed into standard EN/IEC60715 TH 35 DIN-Rail located in Safe Area or Zone 2, Group IIC, Temperature T4 or Class I, Division 2, Group A, B, C, D, T4 Hazardous Area within the specified operating temperature limits Tamb -40 to +70 °C, and connected to equipment with a maximum limit for power supply Um of 250 Vrms or Vdc.

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

D5039 series must be installed, operated and maintained only by qualified personnel, 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)), 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

D5039 series can accept on input connections switches or proximity detectors (EN60947-5-6, NAMUR). The output port can assume two different impedance values (RL or RH) or it can open completely. The module output repeats the input state according to the following correspondence: low input state -> RL, high input state -> RH. Alternatively, the output can be configured to invert the input state. In both cases, the output opens and the fault LED turns on if any fault (open or short circuit) occurs at the corresponding input.

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

Note: use of voltage free electrical contacts with fault detection enabled (control equipment) requires, near the switch at the end of the line a R1=1 kΩ typical (470 Ω to 2 kΩ range) resistor in series and a R2=10 kΩ typical (5 kΩ to 15 kΩ range) resistor in parallel to the contacts in order to allow the fault detection circuit to distinguish between a condition of contact close/open and a line open/short circuit fault.

Installation

D5039 series is switch/proximity repeater housed in a plastic enclosure suitable for installation on EN/IEC60715 TH 35 DIN-Rail, with or without Power Bus or on customized Termination Board. D5039 series can be mounted with any orientation over the entire ambient temperature range.

Electrical connections 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)**. Connect only one individual conductor per each clamping point, use conductors up to 2.5 mm² (13 AWG) and a torque value of 0.5-0.6 Nm. Use only cables that are suitable for a temperature of at least 85°C. 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.

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. Isolation in accordance with EN/IEC 60079-11 clause 6.3.13 is provided between non-intrinsically safe circuits and intrinsically safe circuits.

The enclosure provides, according to EN60529, an IP20 minimum degree of protection (or similar to NEMA Standard 250 type 1). The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1. When installed in EU Zone 2, the unit shall be installed in an enclosure that provides a minimum ingress protection of IP54 in accordance with IEC 60079-0. When installed in a Class I, Zone 2 Hazardous Location, the unit shall be mounted in a supplemental AEx or Ex enclosure that provides a degree of protection not less than IP54 in accordance with UL/CSA 60079-0. When installed in a Class I, Division 2 Hazardous Location, the unit shall be mounted in a supplemental enclosure that provides a degree of protection not less than IP54. The enclosure must have a door or cover accessible only by the use of a tool. The end user is responsible to ensure that the operating temperature of the module is not exceeded in the end use application.

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 D5039 series 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 modification must be avoided.

D5039 series must be connected to SELV or PELV supplies.

All circuits connected to D5039 series must comply with the overvoltage category II (or better) according to EN/IEC60664-1.

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 and fault led on each channel must be in accordance with condition of the corresponding input line. If possible close and open input lines one at time checking the corresponding status and fault leds condition as well as output to be correct.

Configuration

A configuration DIP switch is located on component side of PCB. This switch allows the configuration of input/output relationship, fault detection functions and operating mode. Configuration of channel 2 is relevant only for D5039D*.

Dip switch factory settings.

Switches 1 and 3 are ON, switches 2 and 4 are OFF

