



# INSTRUCTION & SAFETY MANUAL

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

## Characteristics

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

**D1032D dual channel** type has two input channels and four output relays; the unit has two DIP switch configurable operating modes:

Mode A) input channel actuates in parallel the two output relays. Relay actuation mode can be independently configured for each output in two modes:

NO input/NE relay or NO input/ND relay.

Mode B) input channel actuates output relay A configurable in two modes as in mode A above. Output relay B operates as a fault output (in case of input fault, relay B actuates and the fault LED turns on while relay A repeats the input line as configured). Actuation can be DIP switch configured in two modes:

No input fault/energized relay (it de-energizes in case of fault) or No input fault/de-energized relay (it energizes in case of fault).

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

**Signalling LEDs:** Power supply indication (green), output status (yellow), line fault (red).

**Field Configurability:** NO/NC input for contact/proximity, NE/ND relay operation and fault detection enable/disable.

**EMC:** Fully compliant with CE marking applicable requirements.

**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 (20 to 30 Vdc) reverse polarity protected, ripple within voltage limits  $\leq 5$  Vpp.

**Current consumption @ 24 V:** 75 mA for 4 channels D1032Q, 60 mA for 2 channels D1032D with input closed and relays energized.

**Power dissipation:** 1.8 W for 4 channels D1032Q, 1.4 W for 2 channels D1032D with 24 V supply voltage, input closed and relays energized.

**Max. power consumption:** at 30 V supply voltage, short circuit input and relays energized, 2.4 W for 4 channels D1032Q, 2.0 W for 2 channels D1032D.

**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 1.5 KV; Out 1-3/Out 2-4 1.5 KV.

**Input switching current levels:** ON  $\geq 2.1$  mA, OFF  $\leq 1.2$  mA, switch current  $\approx 1.65$  mA  $\pm 0.2$  mA hysteresis.

**Fault current levels:** open fault  $\leq 0.2$  mA, short fault  $\geq 6.8$  mA

(when enabled both faults de-energize channel relay with quad channel unit D1032Q or actuate fault relay with dual channel unit D1032D).

**Input equivalent source:** 8 V 1 K $\Omega$  typical (8 V no load, 8 mA short circuit).

**Output:** voltage free SPST relay contact.

**Contact material:** AgNi90/10.

**Contact rating:** 2 A 250 Vac 500 VA, 2 A 250 Vdc 80 W (resistive load).

**Mechanical / Electrical life:**  $15 \times 10^6 / 1 \times 10^6$  operation, typical.

**Operate / Release time:** 5 / 2 ms typical.

**Bounce time NO / NC contact:** 1 / 5 ms.

**Response time:** 20 ms.

**Frequency response:** 10 Hz maximum.

**Compatibility:**

CE mark compliant, conforms to Directive:

2014/34/EU ATEX, 2014/30/EU EMC, 2014/35/EU LVD, 2011/65/EU RoHS.

**Environmental conditions:**

**Operating:** temperature limits -20 to +60 °C, relative humidity max 95 %.

**Storage:** temperature limits -45 to +80 °C.

**Safety Description:**



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

**IECEx / INMETRO:** [Ex ia Ga] IIC, [Ex ia Da] IIC, [Ex ia Ma] I, Ex nAC IIC T4 Gc

**UL:** AIS / I, II, III / 1 / ABCDEFG, [AEx ia] IIC

**C-UL:** AIS / I, II, III / 1 / ABCDEFG, [Ex ia] IIC

**FM:** NI / I / 2 / ABCD / T4, NI / I / 2 / IIC / T4, AIS / I, II, III / 1 / ABCDEFG, AEx [ia] IIC

**FMC:** NI / I / 2 / ABCD / T4, NI / I / 2 / IIC / T4, AIS / I, II, III / 1 / ABCDEFG, Ex [ia] IIC

**EAC-EX:** 2Ex nAC [ia Ga] IIC T4 X, [Ex ia Da] IIC X, [Ex ia Ma] I X.

**UKR TR n. 898:** 2Ex nAC [ia Ga] IIC T4 X, Exial X

associated apparatus and non-sparking electrical equipment.

Uo/Voc = 9.6 V, Io/Isc = 10 mA, Po/Po = 24 mW at terminals 13-14, 15-16, 9-10, 11-12.

Um = 250 Vrms, -20 °C  $\leq$  Ta  $\leq$  60 °C.

**Approvals:**

DMT 01 ATEX E 042 X conforms to EN60079-0, EN60079-11, EN60079-26.

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

IMQ 09 ATEX 013 X conforms to EN60079-0, EN60079-15.

IECEx IMQ 13.0011X conforms to IEC60079-0, IEC60079-15.

INMETRO DNV 13.0108 X conforms to ABNT NBR IEC60079-0, ABNT NBR IEC60079-11, ABNT NBR IEC60079-15, ABNT NBR IEC60079-26.

UL & C-UL E222308 conforms to UL913, UL 60079-0, UL60079-11 for UL and

CSA-C22.2 No.157-92, CSA-E60079-0, CSA-E60079-11 for C-UL.

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.

C-IT.MH04.B.00306 conforms to GOST R IEC 60079-0, GOST R IEC 60079-11, GOST R IEC 60079-15.

CL 16.0034 X conforms to DCTY 7113, GOCT 22782.5-78, DCTY IEC 60079-15.

TUV Certificate No. C-IS-236198-03, SIL 2 conforms to IEC61508:2010 Ed.2.

TUV Certificate No. C-IS-236198-09, SIL 3 Functional Safety Certificate conforms to IEC61508:2010 Ed.2, for Management of Functional Safety.

DNV No.A-13778 and KR No.MIL20769-EL001 Certificates for maritime applications.

**Mounting:** T35 DIN Rail according to EN50022.

**Weight:** about 185 g D1032Q, 165 g D1032D.

**Connection:** by polarized plug-in disconnect screw terminal blocks to accommodate terminations up to 2.5 mm<sup>2</sup>.

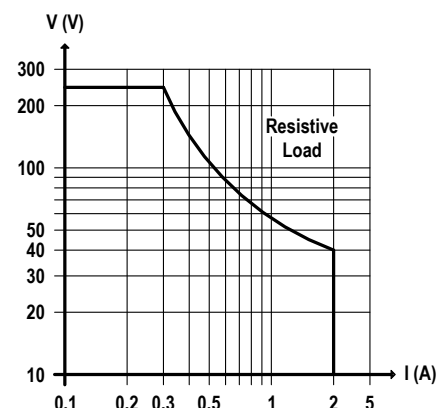
**Location:** Safe Area/Non Hazardous Locations or Zone 2, Group IIC T4, Class I, Division 2, Groups A, B, C, D Temperature Code T4 and Class I, Zone 2, Group IIC, IIB, IIA

T4 installation.

**Protection class:** IP 20.

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

DC Load breaking capacity:



## Ordering information

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

Power Bus and DIN-Rail accessories:

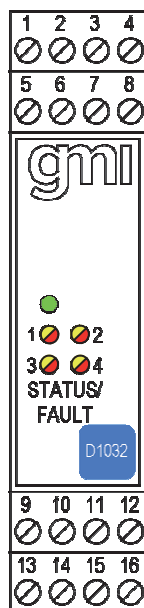
DIN rail anchor MCHP065

DIN rail stopper MOR016

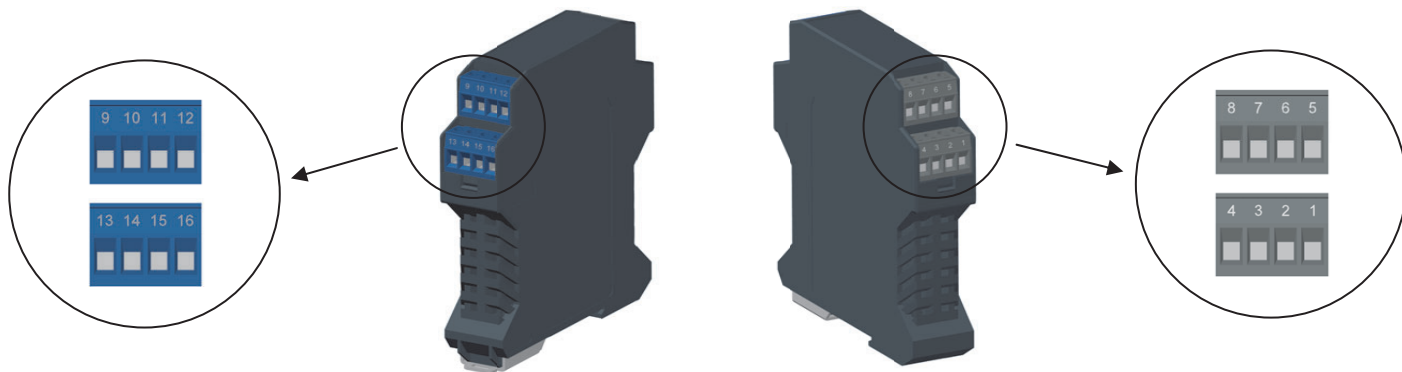
Terminal block male MOR017

Terminal block female MOR022

## Front Panel and Features



- SIL 2 according to IEC 61508:2010 Ed.2 for Tproof = 3 /10 years ( $\leq 10\%$  /  $> 10\%$  of total SIF).
- PFDAvg (1 year)  $2.55 \times 10^{-4}$ , SFF 71.24 %.
- SIL 3 Systematic capability.
- Input from Zone 0 (Zone 20), Division 1, installation in Zone 2, Division 2.
- NO/NC contact/proximity Detector Input.
- Four voltage free SPST Relay contact Output Signals.
- Relay Output for fault detection on dual channel version.
- Line fault detection with common signalling available when using Power Bus enclosure.
- Three port isolation, Input/Output/Supply.
- EMC Compatibility to EN61000-6-2, EN61000-6-4, EN61326-1.
- In-field programmability by DIP Switch.
- ATEX, IECEx, UL & C-UL, FM & FM-C, INMETRO, EAC-EX, UKR TR n. 898, TÜV Certifications.
- TÜV Functional Safety Certification.
- Type Approval Certificate DNV and KR for maritime applications.
- High Reliability, SMD components.
- High Density, four channels per unit.
- Simplified installation using standard DIN Rail and plug-in terminal blocks.
- 250 Vrms (Um) max. voltage allowed to the instruments associated with the barrier.

**D1032Q**

HAZARDOUS AREA		SAFE AREA	
<b>9</b>	+ Input Ch 3 for Proximity or Input Ch 3 for Voltage free Contact	<b>1</b>	Output Ch 1
<b>10</b>	- Input Ch 3 for Proximity or Input Ch 3 for Voltage free Contact	<b>2</b>	Output Common Ch 1 and Ch 3
<b>11</b>	+ Input Ch 4 for Proximity or Input Ch 4 for Voltage free Contact	<b>3</b>	+ Power Supply 24 Vdc
<b>12</b>	- Input Ch 4 for Proximity or Input Ch 4 for Voltage free Contact	<b>4</b>	- Power Supply 24 Vdc
<b>13</b>	+ Input Ch 1 for Proximity or Input Ch 1 for Voltage free Contact	<b>5</b>	Output Ch 2
<b>14</b>	- Input Ch 1 for Proximity or Input Ch 1 for Voltage free Contact	<b>6</b>	Output Common Ch 2 and Ch 4
<b>15</b>	+ Input Ch 2 for Proximity Input Ch 2 for Voltage free Contact	<b>7</b>	Output Ch 3
<b>16</b>	- Input Ch 2 for Proximity Input Ch 2 for Voltage free Contact	<b>8</b>	Output Ch 4

**D1032D**

HAZARDOUS AREA		SAFE AREA	
<b>13</b>	+ Input Ch 1 for Proximity or Input Ch 1 for Voltage free Contact	<b>1</b>	Output Ch 1-A
<b>14</b>	- Input Ch 1 for Proximity or Input Ch 1 for Voltage free Contact	<b>2</b>	Output Common Ch 1-A and Ch 1-B
<b>15</b>	+ Input Ch 2 for Proximity Input Ch 2 for Voltage free Contact	<b>3</b>	+ Power Supply 24 Vdc
<b>16</b>	- Input Ch 2 for Proximity Input Ch 2 for Voltage free Contact	<b>4</b>	- Power Supply 24 Vdc
		<b>5</b>	Output Ch 2-A
		<b>6</b>	Output Common Ch 2-A and Ch 2-B
		<b>7</b>	Output Ch 1-B
		<b>8</b>	Output Ch 2-B

## 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 ( $U_o/V_o$ ,  $I_o/I_o$ ,  $P_o/P_o$ ) of the D1032 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 gas group. See parameters on enclosure side and the ones indicated in the table below:

D1032 Terminals		D1032 Associated Apparatus Parameters	Must be	Hazardous Area/ Hazardous Locations Device Parameters
Ch1	13 -14	$U_o / V_o = 9.6 \text{ V}$	$\leq$	$U_i / V_{max}$
Ch2	15 -16			
Ch3	9 - 10			
Ch4	11 - 12			
Ch1	13 -14	$I_o / I_o = 10 \text{ mA}$	$\leq$	$I_i / I_{max}$
Ch2	15 -16			
Ch3	9 - 10			
Ch4	11 - 12			
Ch1	13 -14	$P_o / P_o = 24 \text{ mW}$	$\leq$	$P_i / P_i$
Ch2	15 -16			
Ch3	9 - 10			
Ch4	11 - 12			

D1032 Terminals		D1032 Associated Apparatus Parameters		Must be	Hazardous Area/ Hazardous Locations Device + Cable Parameters
Ch1	13 -14	$C_o / C_a = 3.5 \mu\text{F}$	IIC (A, B)	$\geq$	$C_i / C_i \text{ device} + C \text{ cable}$
Ch2	15 -16	$C_o / C_a = 25 \mu\text{F}$	IIB (C)		
Ch3	9 - 10	$C_o / C_a = 209 \mu\text{F}$	IIA (D)		
Ch4	11 - 12	$C_o / C_a = 99 \mu\text{F}$	I		
		$C_o / C_a = 25 \mu\text{F}$	IIIC		
Ch1	13 -14	$L_o / L_a = 379 \text{ mH}$	IIC (A, B)	$\geq$	$L_i / L_i \text{ device} + L \text{ cable}$
Ch2	15 -16	$L_o / L_a = 1500 \text{ mH}$	IIB (C)		
Ch3	9 - 10	$L_o / L_a = 3000 \text{ mH}$	IIA (D)		
Ch4	11 - 12	$L_o / L_a = 4900 \text{ mH}$	I		
		$L_o / L_a = 1500 \text{ mH}$	IIIC		
Ch1	13 -14	$L_o / R_o = 1530 \mu\text{H}/\Omega$	IIC (A, B)	$\geq$	$L_i / R_i \text{ device and } L \text{ cable} / R \text{ cable}$
Ch2	15 -16	$L_o / R_o = 6150 \mu\text{H}/\Omega$	IIB (C)		
Ch3	9 - 10	$L_o / R_o = 12310 \mu\text{H}/\Omega$	IIA (D)		
Ch4	11 - 12	$L_o / R_o = 20200 \mu\text{H}/\Omega$	I		
		$L_o / R_o = 6150 \mu\text{H}/\Omega$	IIIC		

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.

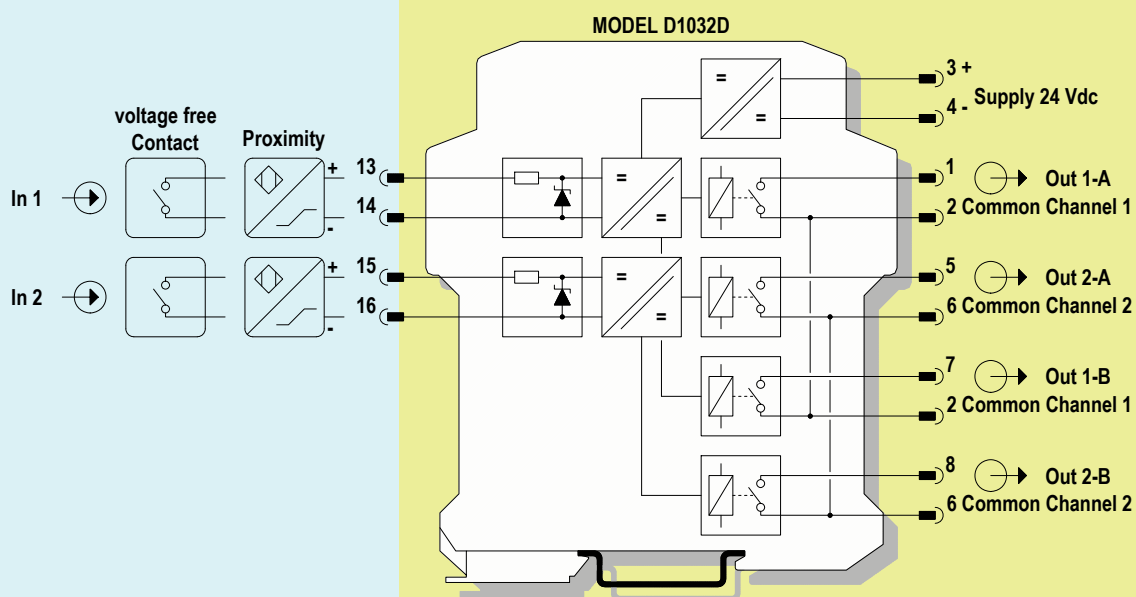
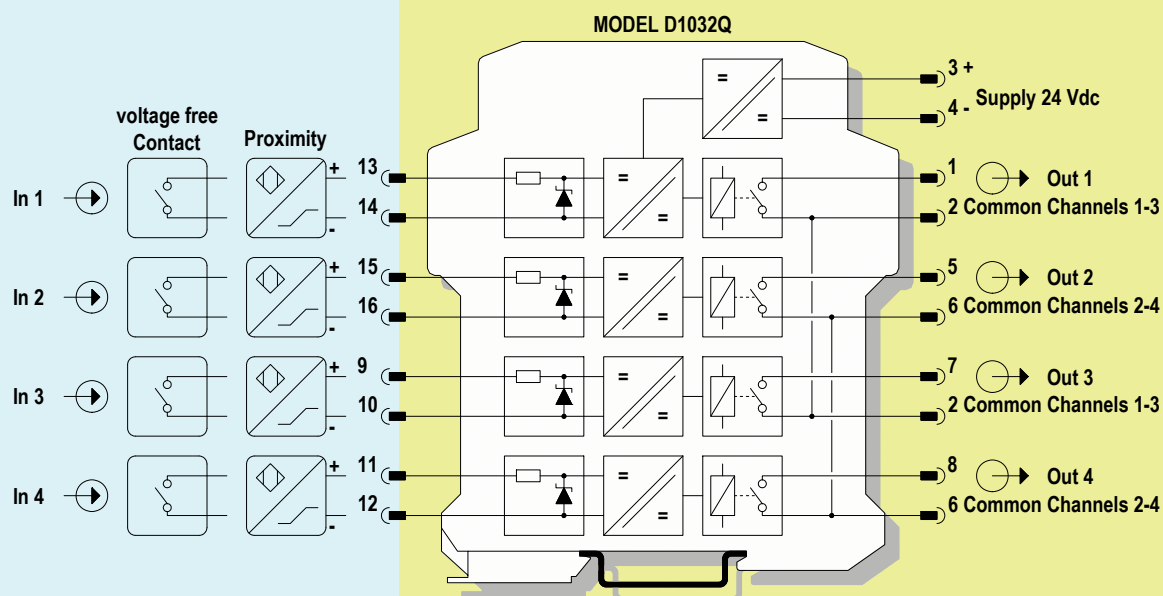
For Division 1 and Zone 0 installations, the configuration of Intrinsically Safe Equipment must be FM approved under Entity Concept (or third party approved);

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

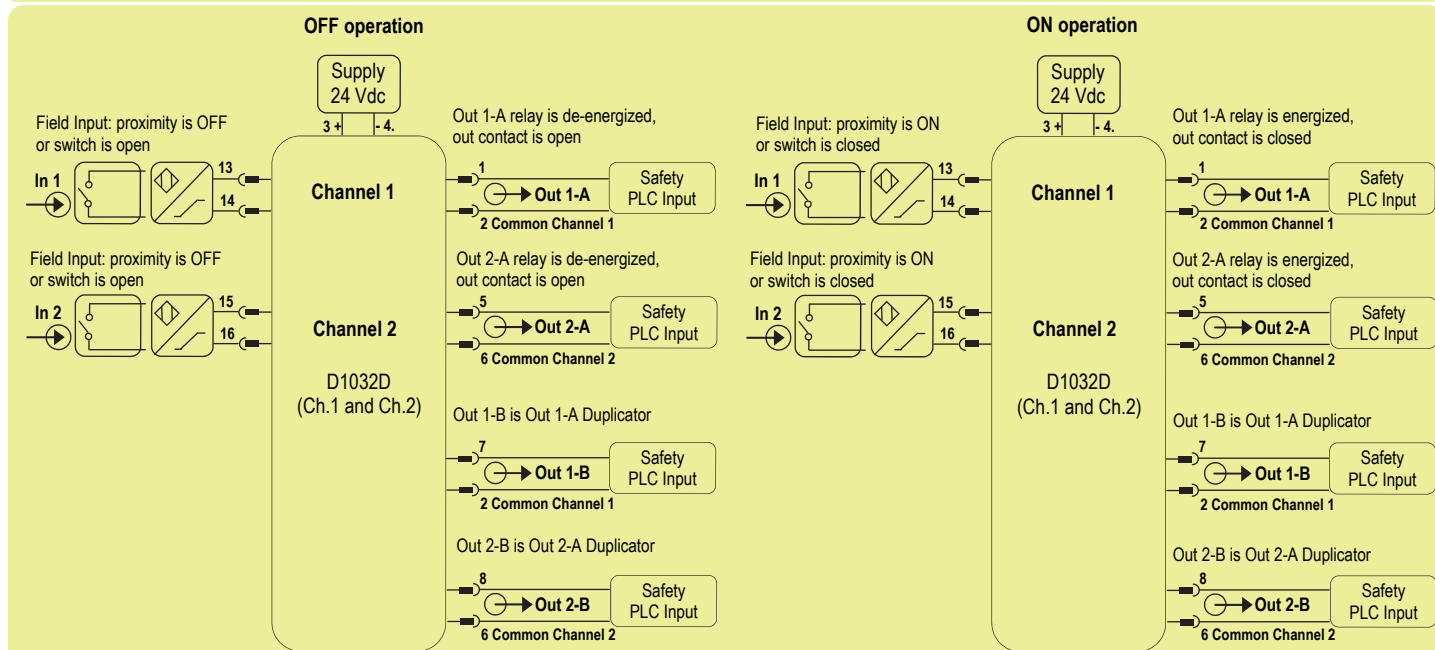
HAZARDOUS AREA ZONE 0 (ZONE 20) GROUP IIC,  
HAZARDOUS LOCATIONS CLASS I, DIVISION 1, GROUPS A, B, C, D,  
CLASS II, DIVISION 1, GROUPS E, F, G, CLASS III, DIVISION 1,  
CLASS I, ZONE 0, GROUP IIC

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



Relay contact shown in de-energized position

# Application for D1032D



## Description:

For this application, input line fault (open or short) detection is enabled, the output relays are actuated in parallel and the direct input to output transfer function is selected, setting the internal dip-switches in the following mode (see pages 13-14 for more information):

4 positions	Dip-switch position	1	2	3	4	8 positions	Dip-switch position	1	2	3	4	5	6	7	8
Dip-switch:	ON/OFF state	ON	OFF	ON	OFF	Dip-switch:	ON/OFF state	ON	ON	ON	ON	OFF	ON	OFF	ON

The module is powered by connecting 24 Vdc power supply to Pins 3 (+ positive) - 4 (- negative). The green LED is lit in presence of the power supply line. Input signals from field are applied to Pins 13-14 (In 1 - Ch.1) and Pins 15-16 (In 2 - Ch.2). The relay contact outputs (Out 1-A and Out 2-A) are both normally open (or relay de-energized as safe state condition) for OFF operation, while they are both closed (or relay energized) for ON operation. Only Out 1-A and 2-A are functional safety related, while Out 1-B as Out 1-A Duplicator and Out 2-B as Out 2-A Duplicator are only for service purpose, not functional safety related. The following table describes, for each channel, the state (open or closed) of its output when its input signal is in OFF or ON state, and it gives information about turn-on or turn-off of the related channel status LED and channel fault LED:

Input signal state Pins 13-14 (In 1 - Ch.1) or 15-16 (In 2 - Ch.2)	Output relay contact state Out 1-A or Out 2-A (Functional safety related output)	1-A or 2-A Ch. status yellow LED state	1-A or 2-A Ch. fault red LED state	Output relay contact state Out 1-B or Out 2-B (for service purpose, not safety related output)	1-B or 2-B Ch. status yellow LED state	1-B or 2-B Ch. fault red LED state
Proximity sensor is OFF or switch is open	Open (De-energized relay)	OFF	OFF	Open	OFF	OFF
Proximity sensor is ON or switch is closed	Closed (Energized relay)	ON	OFF	Closed	ON	OFF
The input line is broken	Open (De-energized relay as safe state condition)	OFF	ON	Open	OFF	OFF
The input line is in short circuit	Open (De-energized relay as safe state condition)	OFF	ON	Closed	ON	OFF

## Safety Function and Failure behavior:

D1032D is considered to be operating in Low Demand mode, as a Type A module, having Hardware Fault Tolerance (HFT) = 0.

The failure behaviour of D1032D is described by the following definitions:

- fail-Safe State: it is defined as the output being de-energized (so that the output relay is de-energized).
- fail Safe: failure mode that causes the module / (sub)system 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 plays a part in implementing the safety function but is neither a safe failure nor a dangerous failure. When calculating the SFF, this failure mode is not taken into account;
- fail "Not Part": failure mode of a component which is not part of the safety function but which is part of the circuit diagram and is listed for completeness. When calculating the SFF, this failure mode is not taken into account.

Failure rate data: taken from Siemens Standard SN29500.

## Failure rate table:

Failure category	Failure rates (FIT)
$\lambda_{dd}$ = Total Dangerous Detected failures	0.00
$\lambda_{du}$ = Total Dangerous Undetected failures	58.13
$\lambda_{sd}$ = Total Safe Detected failures	0.00
$\lambda_{su}$ = Total Safe Undetected failures	144.00
$\lambda_{tot\ safe}$ = Total Failure Rate (Safety Function) = $\lambda_{dd} + \lambda_{du} + \lambda_{sd} + \lambda_{su}$	202.13
MTBF (safety function, one channel) = $(1 / \lambda_{tot\ safe}) + MTTR$ (8 hours)	564 years
$\lambda_{no\ effect}$ = "No Effect" failures	131.37
$\lambda_{not\ part}$ = "Not Part" failures	154.30
$\lambda_{tot\ device}$ = Total Failure Rate (Device) = $\lambda_{tot\ safe} + \lambda_{no\ effect} + \lambda_{not\ part}$	487.80
MTBF (device, one channel) = $(1 / \lambda_{tot\ device}) + MTTR$ (8 hours)	234 years

## Failure rates table according to IEC 61508:2010 Ed.2 :

$\lambda_{sd}$	$\lambda_{su}$	$\lambda_{dd}$	$\lambda_{du}$	SFF
0.00 FIT	144.00 FIT	0.00 FIT	58.13 FIT	71.24%

PFDavg vs T[Proof] table (assuming Proof Test coverage of 99%), with determination of SIL supposing module contributes  $\leq 10\%$  of total SIF dangerous failures:

T[Proof] = 1 year	T[Proof] = 3 years
PFDavg = 2.55 E-04 - Valid for SIL 2	PFDavg = 7.65 E-04 - Valid for SIL 2

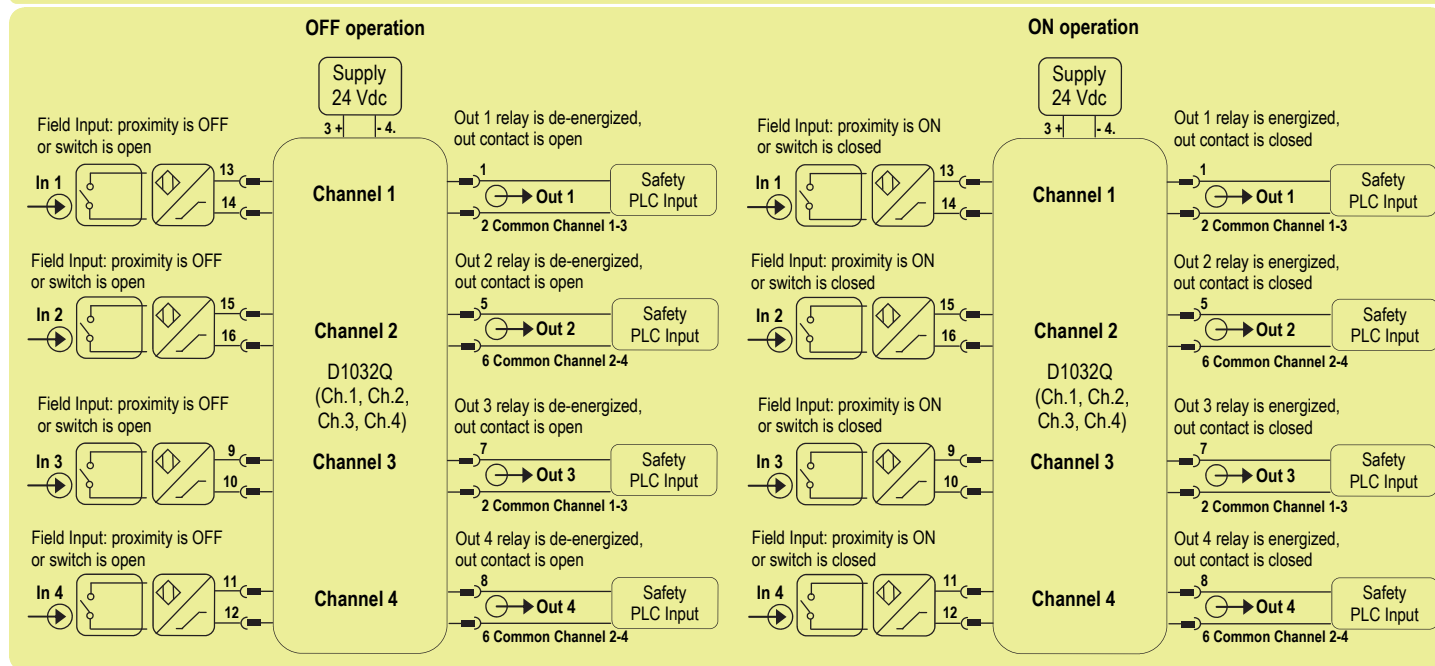
PFDavg vs T[Proof] table (assuming Proof Test coverage of 99%), with determination of SIL supposing module contributes  $> 10\%$  of total SIF dangerous failures:

T[Proof] = 10 years
PFDavg = 2.55 E-03 - Valid for SIL 2

## Systematic capability SIL 3.



## Application for D1032Q

**Description:**

For this application, input line fault (open or short) detection is enabled and the direct input to output transfer function is selected, setting the internal dip-switches in the following mode (see pages 11-12 for more information):

Dip-switch position	1	2	3	4	5	6	7	8
ON/OFF state	ON	ON	ON	ON	ON	ON	ON	ON

The module is powered by connecting 24 Vdc power supply to Pins 3 (+ positive) - 4 (- negative). The green LED is lit in presence of the power supply line. Input signals from field are applied to Pins 13-14 (In 1 - Ch.1), Pins 15-16 (In 2 - Ch.2), Pins 9-10 (In 3 - Ch.3), Pins 11-12 (In 4 - Ch.4). The relay contact outputs are both normally open (or relay de-energized as safe state condition) for OFF operation, while they are both closed (or relay energized) for ON operation.

The following table describes, for each channel, the state (open or closed) of its output when its input signal is in OFF or ON state, and it gives information about turn-on or turn-off of the related channel status LED and channel fault LED:

Input signal state Pins 13-14 (In 1 - Ch.1) or 15-16 (In 2 - Ch.2) or 9-10 (In 3 - Ch.3) or 11-12 (In 4 - Ch.4)	Output relay contact state Out 1 or Out 2 or Out 3 or Out 4	Channel status yellow LED state	Channel fault red LED state
Proximity sensor is OFF or switch is open	Open (De-energized relay)	OFF	OFF
Proximity sensor is ON or switch is closed	Closed (Energized relay)	ON	OFF
The input line is broken	Open (De-energized relay as safe state condition)	OFF	ON
The input line is in short circuit	Open (De-energized relay as safe state condition)	OFF	ON

**Safety Function and Failure behavior:**

D1032Q is considered to be operating in Low Demand mode, as a Type A module, having Hardware Fault Tolerance (HFT) = 0.

The failure behaviour of D1032Q is described by the following definitions:

- fail-Safe State: it is defined as the output being de-energized (so that the output relay is de-energized).
- fail Safe: failure mode that causes the module / (sub)system 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 plays a part in implementing the safety function but is neither a safe failure nor a dangerous failure. When calculating the SFF, this failure mode is not taken into account;
- fail "Not Part": failure mode of a component which is not part of the safety function but which is part of the circuit diagram and is listed for completeness. When calculating the SFF, this failure mode is not taken into account.

Failure rate date: taken from Siemens Standard SN29500.

**Failure rate table:**

Failure category	Failure rates (FIT)
$\lambda_{dd}$ = Total Dangerous Detected failures	0.00
$\lambda_{du}$ = Total Dangerous Undetected failures	58.13
$\lambda_{sd}$ = Total Safe Detected failures	0.00
$\lambda_{su}$ = Total Safe Undetected failures	149.34
$\lambda_{tot\ safe}$ = Total Failure Rate (Safety Function) = $\lambda_{dd} + \lambda_{du} + \lambda_{sd} + \lambda_{su}$	207.47
MTBF (safety function, one channel) = $(1 / \lambda_{tot\ safe}) + MTTR$ (8 hours)	550 years
$\lambda_{no\ effect}$ = "No Effect" failures	151.43
$\lambda_{not\ part}$ = "Not Part" failures	296.50
$\lambda_{tot\ device}$ = Total Failure Rate (Device) = $\lambda_{tot\ safe} + \lambda_{no\ effect} + \lambda_{not\ part}$	655.40
MTBF (device, one channel) = $(1 / \lambda_{tot\ device}) + MTTR$ (8 hours)	174 years

**Failure rates table according to IEC 61508:2010 Ed.2 :**

$\lambda_{sd}$	$\lambda_{su}$	$\lambda_{dd}$	$\lambda_{du}$	SFF
0.00 FIT	149.34 FIT	0.00 FIT	58.13 FIT	71.98%

PFDavg vs T[Proof] table (assuming Proof Test coverage of 99%), with determination of SIL supposing module contributes  $\leq 10\%$  of total SIF dangerous failures:

T[Proof] = 1 year	T[Proof] = 3 years
PFDavg = 2.55 E-04 - Valid for SIL 2	PFDavg = 7.65 E-04 - Valid for SIL 2

PFDavg vs T[Proof] table (assuming Proof Test coverage of 99%), with determination of SIL supposing module contributes  $> 10\%$  of total SIF dangerous failures:

T[Proof] = 10 years
PFDavg = 2.55 E-03 - Valid for SIL 2

Systematic capability SIL 3.



## Testing procedure at T-proof

The proof test must be performed to reveal dangerous faults which cannot be otherwise detected. This means that it is necessary to specify how dangerous undetected faults, which have been noted during the FMEDA analysis, can be revealed during the proof test.

**Note for input contacts:** to detect a wire break or a short circuit condition, it is necessary to mount, in the input connections and close to the contacts, a 1kΩ resistor in series and a 10 kΩ resistor in parallel to the contacts.

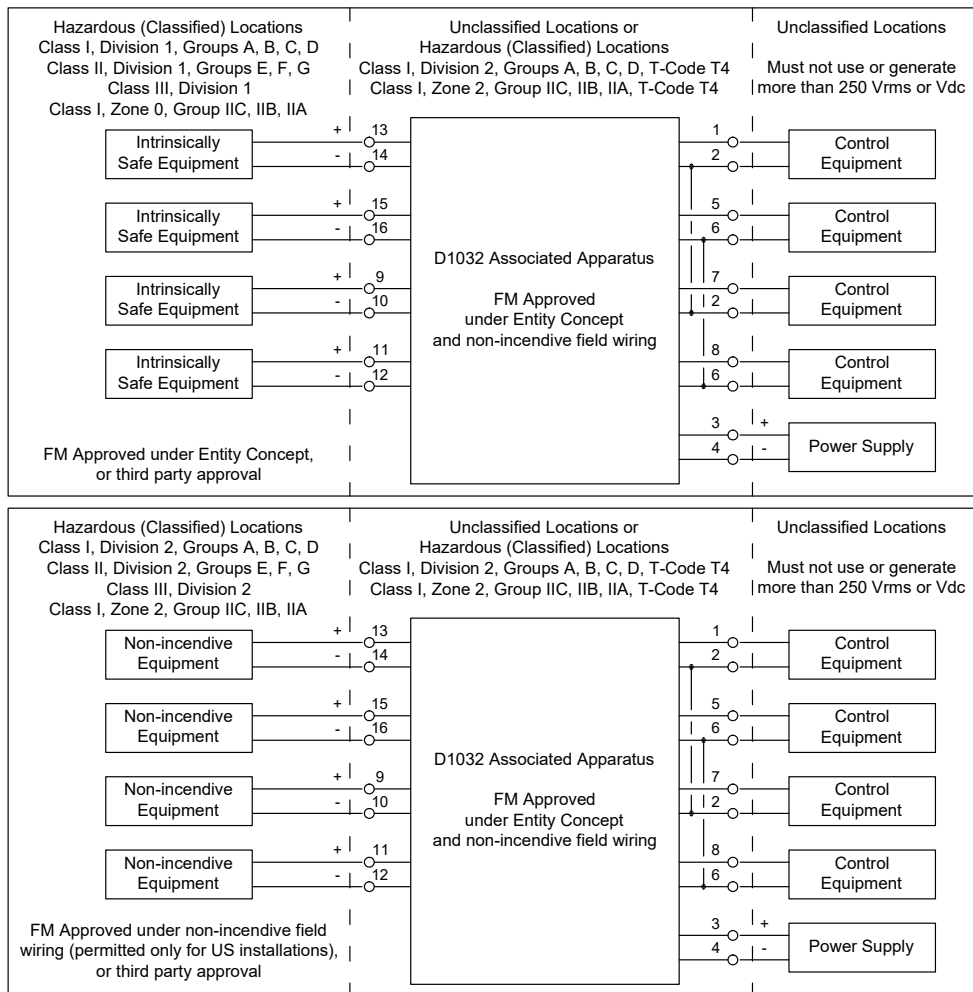
The **Proof test** consists of the following steps:

Steps	Action
1	Bypass the Safety-related PLC or take any other appropriate action to avoid a false trip.
2	Vary the state conditions of the input sensors / contacts coming from field and verify that the transistor outputs change their state from energized to de-energized and vice-versa; also check that the de-energized state condition corresponds to the required Safety-related function.
3	Disconnect the input wiring coming from the field sensor / contact and check that the corresponding wire break alarm output is de-energized.
4	Short the input connections and verify that the corresponding outputs remains de-energized. In both cases, the corresponding alarm LEDs on the front panel must be turned red.
5	Restore the loop to full operation.
6	Remove the bypass from the Safety-related PLC or restore normal operation.

This test will detect approximately 99% of possible Dangerous Undetected failures in the repeater.

## Warning

D1032 series are 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 D1032 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.

D1032 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, 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.**

**Warning: de-energize main power source (turn off power supply voltage) and disconnect plug-in terminal blocks before opening the enclosure to avoid electrical shock when connected to live hazardous potential.**

**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

D1032 accepts as an input from Hazardous Area/Hazardous Locations a proximity sensor or voltage free electrical contact and repeats their status to Safe Area/Non Hazardous Locations by a voltage free SPST relay contact. 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). D1032Q (quad channel type) has four independent isolated input channels and actuates the corresponding output relay SPST contact; two actuation modes can be independently DIP switch configured for each input channel:

Normally open input / Normally energized relay or Normally close input / Normally energized relay Contact or proximity sensor and its connection line short or open circuit fault detection is also DIP switch configurable. Fault detection can be enabled (in case of fault de-energizes the corresponding output channel relay (open) and turns ON the fault LED) or be disabled (in case of fault the corresponding output channel relay repeats the input line open or close status as configured).

D1032D (dual channel type) has two isolated input channel and four output relays; the unit has two DIP switch configurable operating modes:

A) Input channel actuates in parallel output relays SPST contacts (providing a DPST type of output). Relay actuation can be independently configured for each output in two modes: Normally open input / Normally energized relay or Normally close input / Normally energized relay

B) Input channel actuates output relay (A) SPST contact configurable in two modes as above. Output relay B operates as fault output (in case of input fault, relay B actuates and the fault LED turns on while relay A repeats the input line as configured). Actuation can be configured in two modes:

No input fault / Energized relay (it de-energizes in case of fault) or No input fault / De-energized relay (it energizes in case of fault).

Note: use of voltage free electrical contacts with fault detection enabled requires, near the switch at the end of the line, a 1 K $\Omega$  series connected resistor and a 10 K $\Omega$  parallel connected resistor 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

D1032 series are switch/proximity detector repeaters housed in a plastic enclosure suitable for installation on T35 DIN Rail according to EN50022.

D1032 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 mm<sup>2</sup> 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 number of channels of the specific card (e.g. D1032D is a dual channel model and D1032Q is a quad channel model), 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 "3" and negative at terminal "4".

For Model D1032Q connect common output of channel 1-3 at terminal "2" and voltage freecontact output at terminal "1" for channel 1 and "7" for channel 3.

For Model D1032Q connect common output of channel 2-4 at terminal "6" and voltage free contact output at terminal "5" for channel 2 and "8" for channel 4.

For Model D1032D connect proximity sensor or voltage free contact at terminal "13" positive and "14" negative for channel 1, connect at terminal "15" and "16" respectively for channel 2.

For Model D1032Q in addition to channel 1-2 connections above, connect terminal "9" positive and "10" negative for channel 3 and "11" positive and "12" negative for channel 4.

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 relay contacts checking the load rating to be within the contact maximum rating (2 A, 250 V, 500 VA 80 W 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 D1032 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, D1032 series must be connected to SELV or SELV-E supplies.

Relay output contact must be connected to loads non exceeding category I, pollution degree I overvoltage limits.

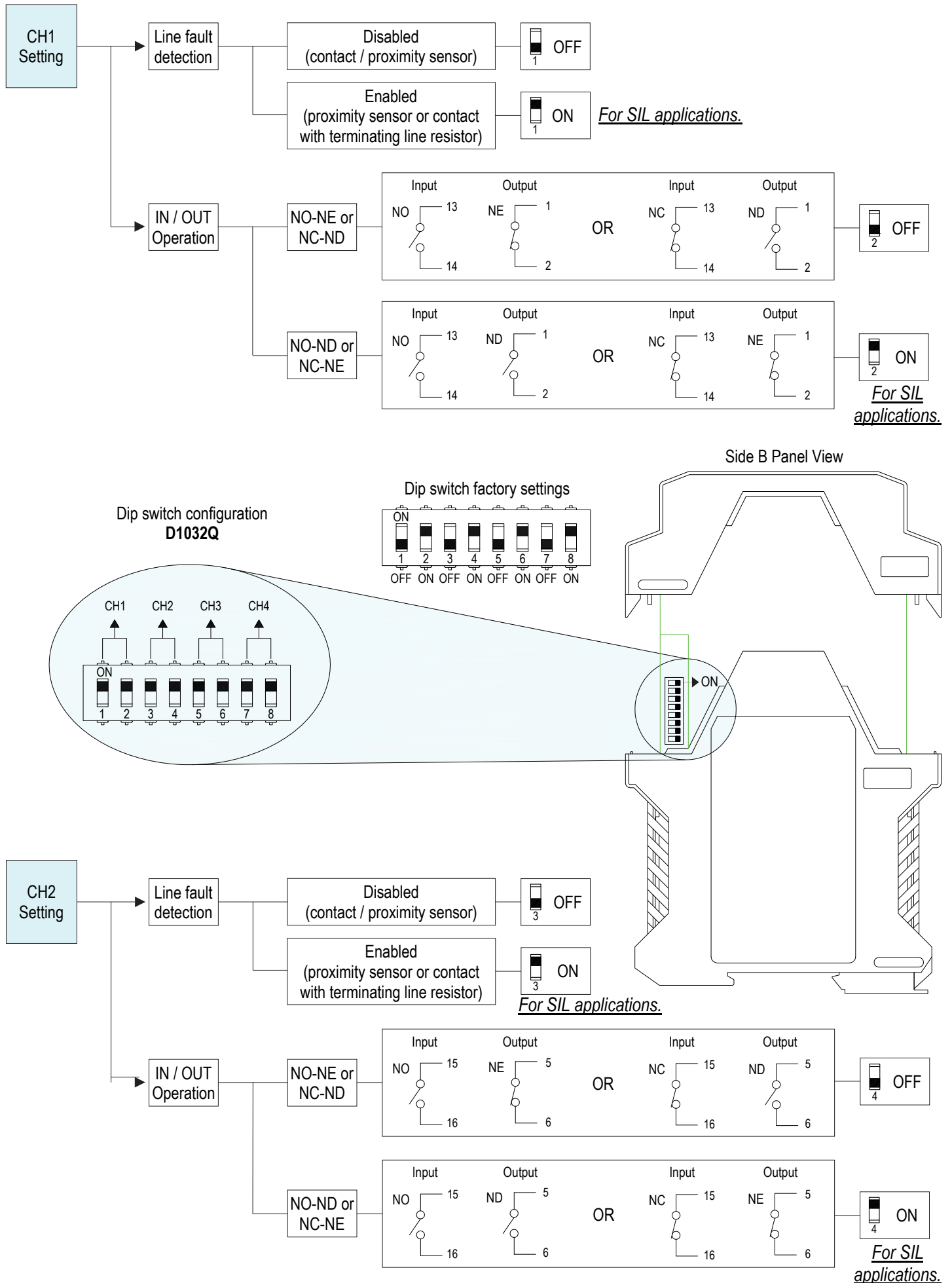
**Warning: de-energize main power source (turn off power supply voltage) and disconnect plug-in terminal blocks before opening the enclosure to avoid electrical shock when connected to live hazardous potential.**

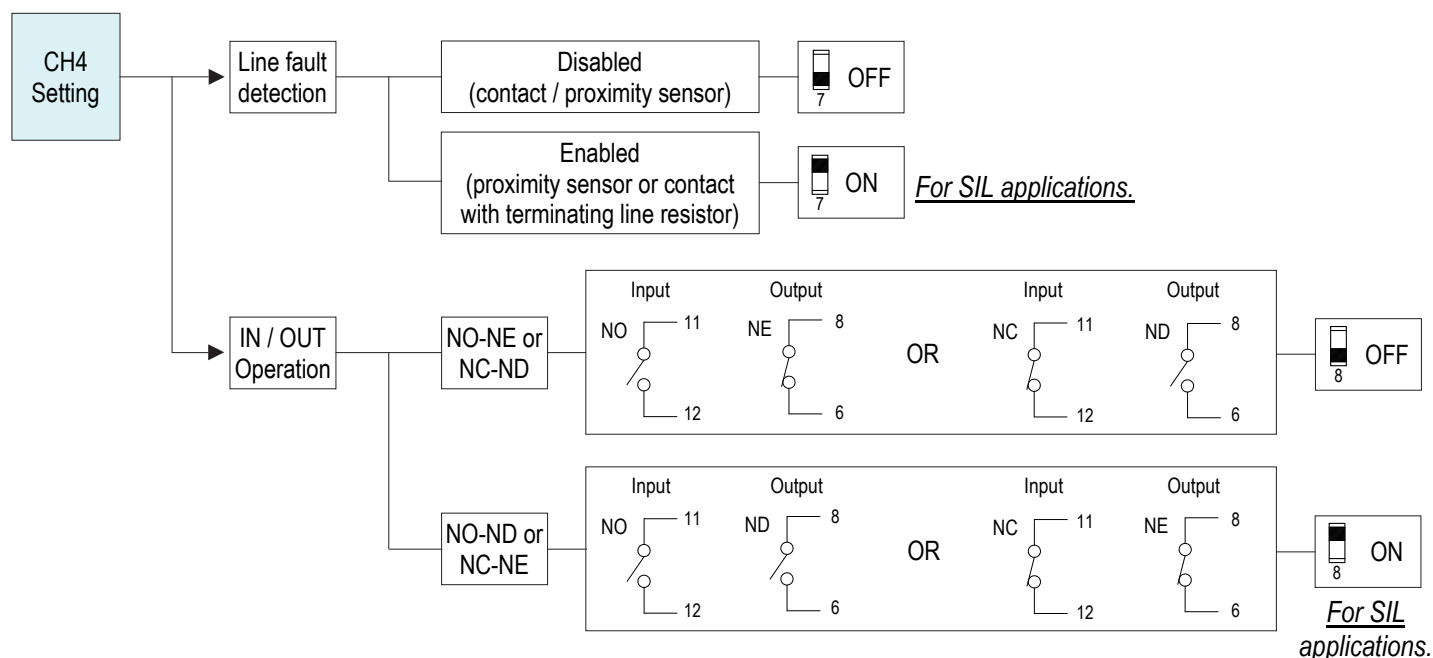
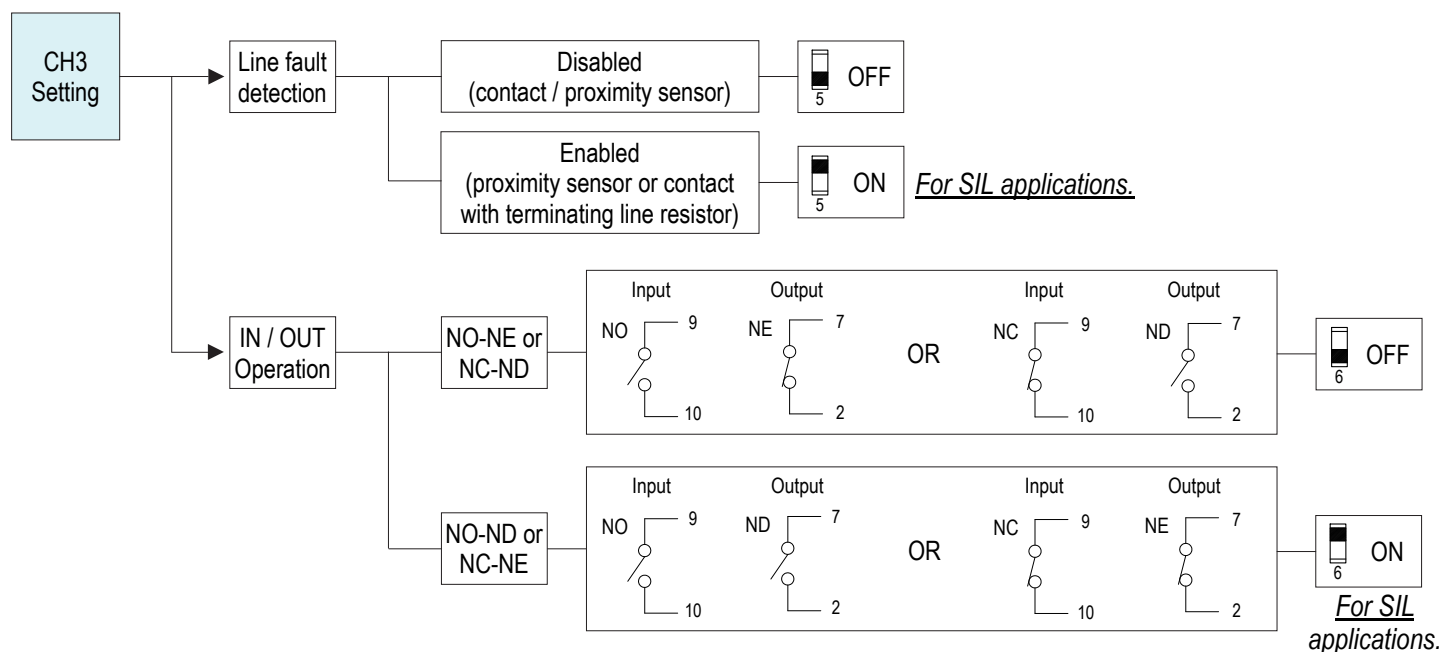
## Start-up

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.



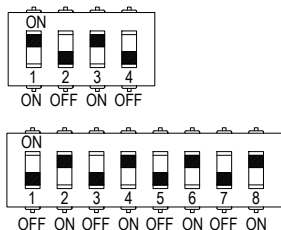


**D1032Q Configuration Summary Table**

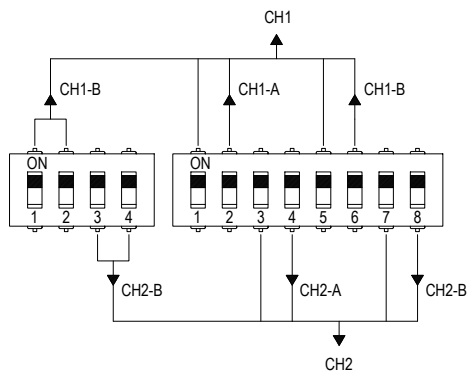
Channel	1	2	3	4	Channel	1	2	3	4
IN/OUT Operation	SW1-2	SW1-4	SW1-6	SW1-8	Line fault detection	SW1-1	SW1-3	SW1-5	SW1-7
NO-NE or NC-ND	OFF	OFF	OFF	OFF	Disabled (contact/proximity sensor)	OFF	OFF	OFF	OFF
NO-ND or NC-NE	ON	ON	ON	ON	Enabled (proximity sensor or contact with terminating line resistor)	ON	ON	ON	ON

*For SIL applications, all DIP-SWITCHES must be ON.*

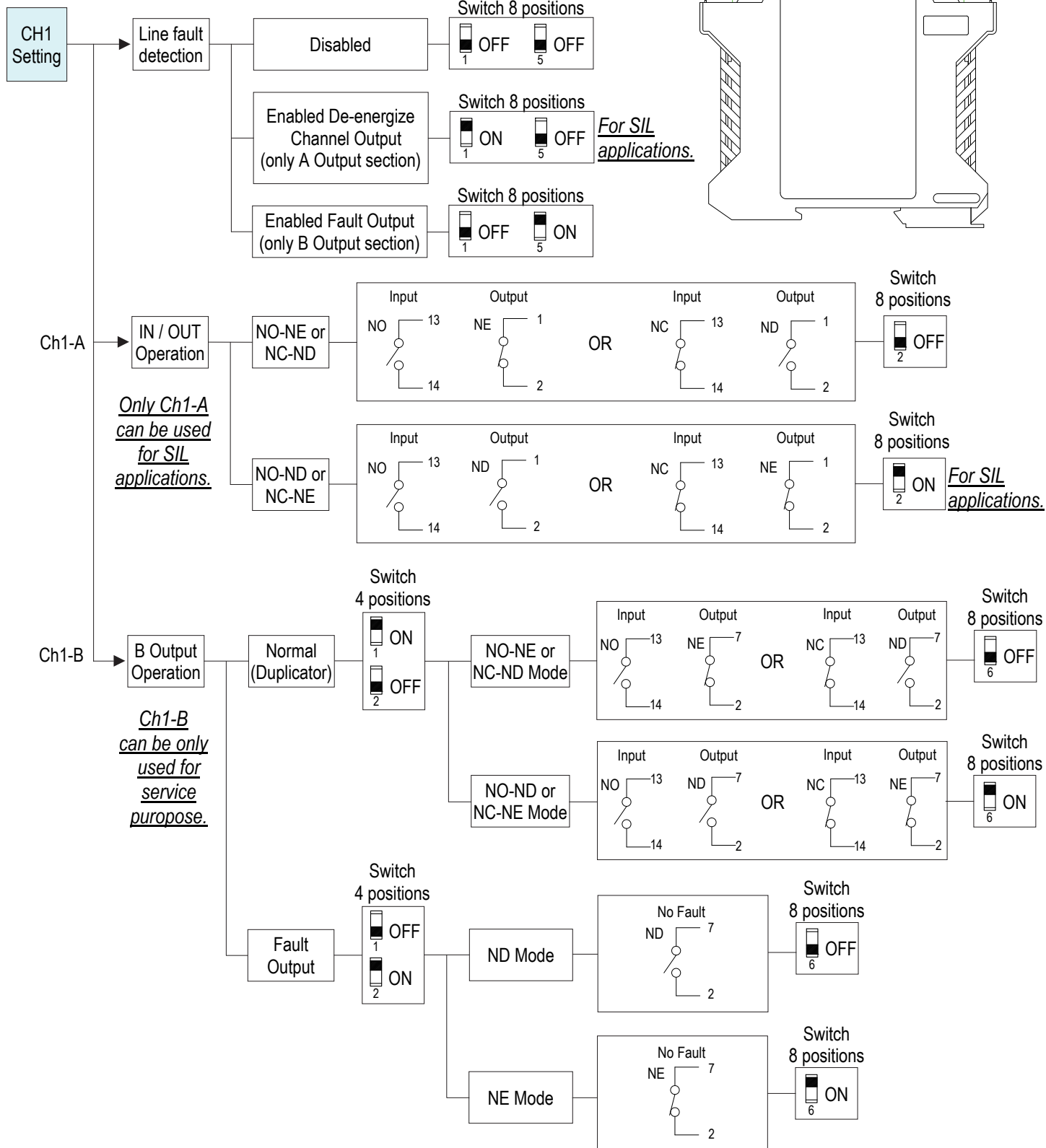
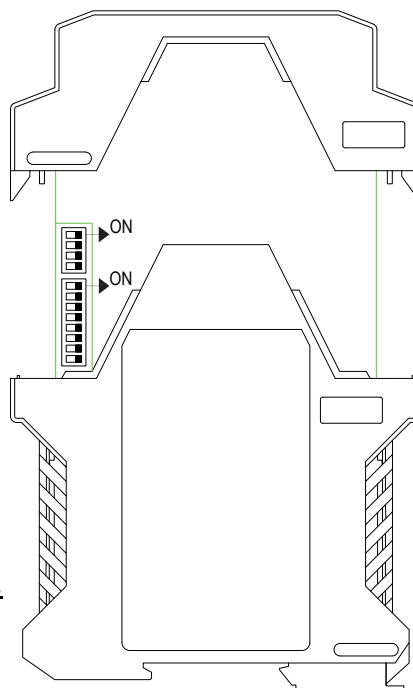
Dip switch factory settings

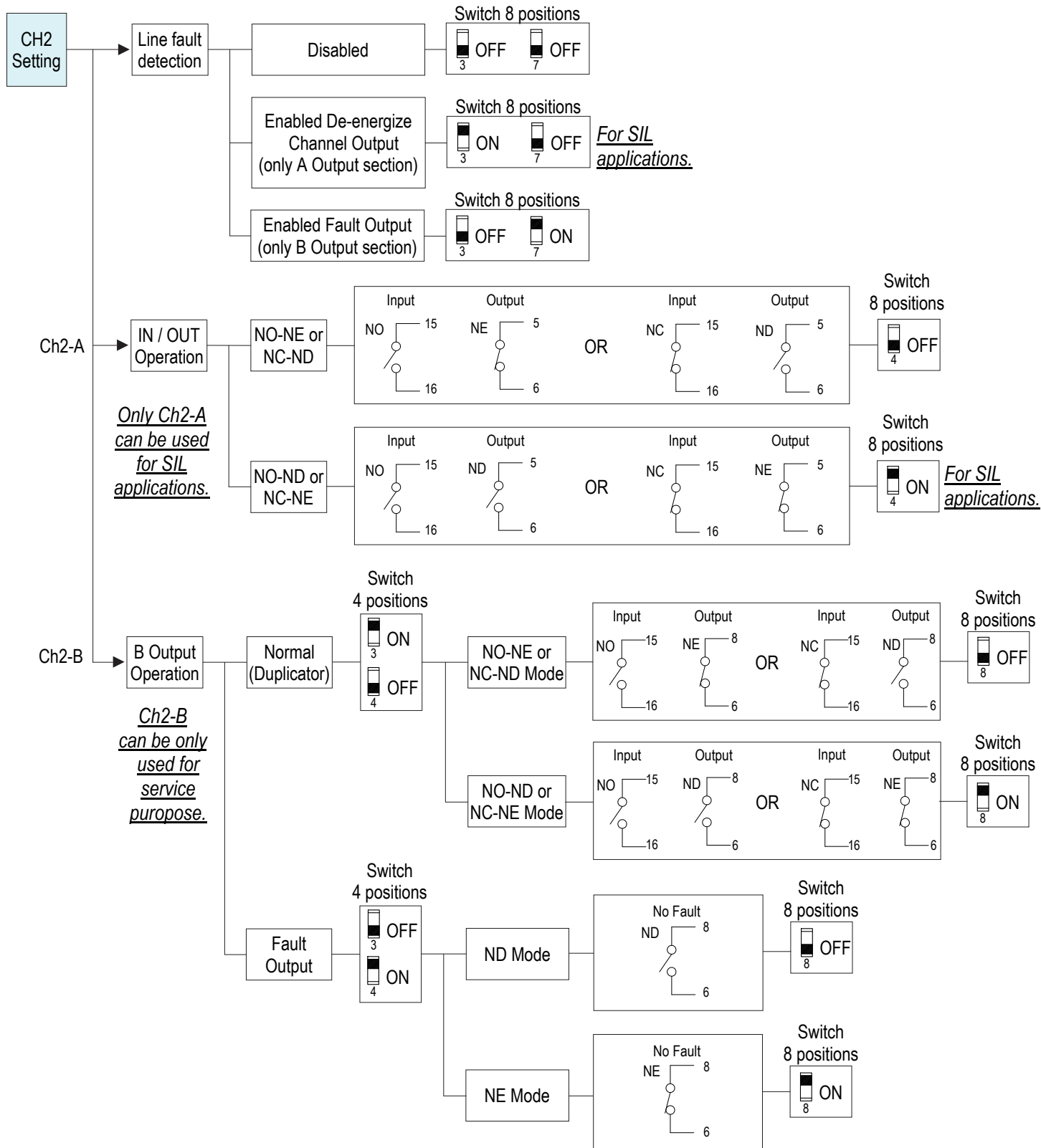


Dip switch configuration D1032D



Side B Panel View





**D1032D Configuration Summary Table**

Channel	1A	2A
IN/OUT Operation	SW1-2	SW1-4
NO-NE or NC-ND	OFF	OFF
NO-ND or NC-NE	ON	ON

*For SIL applications.*

Channel	1B		2B		Mode	1B	2B
B Output Operation	SW2-1	SW2-2	SW2-3	SW2-4		SW1-6	SW1-8
Normal (Duplicator)	ON	OFF	ON	OFF	NO-NE or NC-ND	OFF	OFF
					NO-ND or NC-NE	ON	ON
Fault Output	OFF	ON	OFF	ON	ND	OFF	OFF
					NE	ON	ON

Channel	1	2
Line fault detection	SW1-1 SW1-5	SW1-3 SW1-7
Disabled	OFF	OFF
Enabled De-energize Channel Output (only A Output section)	ON	OFF
Enabled Fault Output (only B Output section)	OFF	ON

*For SIL applications.*