



# INSTRUCTION MANUAL

5 A SIL 3 Relay Output Module for NE or ND Loads,  
with NE or ND Relay condition,  
DIN-Rail and Termination Board,  
Model D5290S-078



## Characteristics

### General Description:

The D5290S-078 is a relay module suitable for the switching of safety related circuits, up to SIL 3 level according to IEC 61508 for high risk industries. It provides isolation between input channel and output contacts.

Three mutually exclusive (by DIP-Switch programming) monitoring circuits are provided:

- 1) line input monitoring, to allow DCS/PLC line monitoring function: when enabled, the module permits a wide compatibility towards different DCS/PLC. Driving line pulse testing, executed by DCS/PLC, is permitted by a dedicated internal circuit, to prevent relay and LED flickering;
- 2) low voltage input monitoring: when enabled, the module reflects a high impedance state to the control unit when the driving voltage is below the specified threshold;
- 3) short circuit fault detection (only for Functional Safety applications with NE Relay condition): when enabled, it allows DCS/PLC to detect short circuit fault of module.

See the following pages for Functional Safety applications with related SIL value.

Mounting on standard DIN-Rail or on customized Termination Boards, in Safe Area or in Zone 2.

## Technical Data

Input: 24 Vdc nom (21.6 to 27.6 Vdc) reverse polarity protected, ripple within voltage limits  $\leq 5$  Vpp.

*The following monitoring circuits are mutually exclusive:*

- 1) *Line input monitoring (DIP-Switch selectable):* to allow DCS/PLC line monitoring function (pulse test).
- 2) *Voltage monitoring (DIP-Switch selectable):*  $\geq 21.6$  Vdc for normal operation,  $\leq 17$  Vdc reflects a high impedance ( $\leq 10$  mA consumption) to the control device.
- 3) *Short circuit fault detection (DIP-Switch selectable and only for Functional Safety applications with NE Relay condition):* to allow DCS/PLC to detect short circuit fault of module.

*Current consumption @ 24 V:* 60 mA with relay energized, typical.

*Power dissipation:* 1.5 W with 24 V input voltage, relay energized, typical.

Isolation (Test Voltage): Input / All Outputs: 2.5 KV; Out S\_1 & Out P\_1 / Out S\_3 & Out P\_2, Out S\_2, Out S\_4: 500 V;

Out S\_3 & Out P\_2 / Out S\_2, Out S\_4: 500 V; Out S\_2 / Out S\_4: 500 V.

Output: 2 voltage free SPDT (= NO contact + parallel of 2 NC contacts) relay contacts identified with outputs: Out S\_1 & Out P\_1 and Out S\_3 & Out P\_2;

2 voltage free SPST (NO) relay contacts identified with: Out S\_2 and Out S\_4.

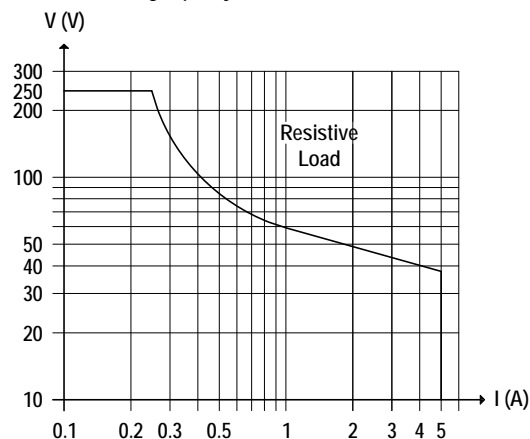
Terminals 13-14 (Out S\_1), 15-16 (Out S\_2), 21-22 (Out S\_4) and 23-24 (Out S\_3) are: open when relay is de-energized, closed in energized relay condition.

Terminals 17-18 (Out P\_1) and 19-20 (Out P\_2) are: closed when relay is de-energized, open in energized relay condition.

*Contact material:* Ag Alloy (Cd free) or AgSnO<sub>2</sub>.

*Contact rating:* 5 A 250 Vac 1250 VA, 5 A 250 Vdc 175 W (resistive load).

*DC Load breaking capacity:*



*Mechanical / Electrical life:*  $10 * 10^6 / 5 * 10^4$  operation, typical.

*Bounce time NO / NC contact:* 4 / 10 ms, typical.

*Frequency response:* 10 Hz maximum.

Compatibility:

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

Environmental conditions:

*Operating:* temperature limits - 40 to + 60 °C, relative humidity 95 %, up to 55 °C.

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

Safety Description:



*ATEX:* II 3G Ex nA nC IIC T4 Gc

*IECEx:* Ex nA nC IIC T4 Gc

non-sparking electrical equipment.

-40 °C  $\leq$  Ta  $\leq$  60 °C.

Approvals:

ATEX conforms to EN60079-15, IECEx conforms to IEC60079-15.

SIL 2 / SIL 3 conforms to IEC61508.

Mounting:

T35 DIN-Rail according to EN50022 or on customized Termination Board.

*Weight:* about 145 g.

*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 installation.

*Protection class:* IP 20.

*Dimensions:* Width 22.5 mm, Depth 123 mm, Height 120 mm.

## Ordering Information

Model: D5290S-078

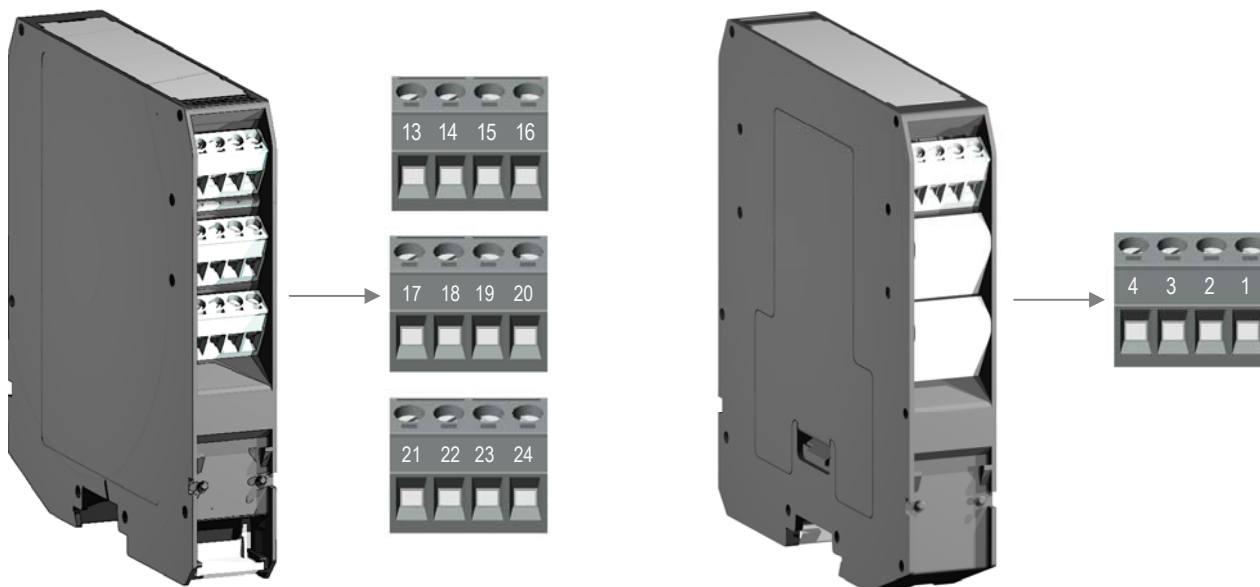
DIN-Rail accessories: Cover and fix MCHP196

## Front Panel and Features



- SIL 3 according to IEC 61508 for Tproof = 10 / 20 years (10 / 20 % of total SIF) with PFDavg (1 year) 7.01 E-06, SFF = 99.26 % for two NE or ND loads with NE relay condition (see application n° 1, 2 and 4).
- SIL 2 according to IEC 61508 for Tproof = 7 / 14 years (10 / 20 % of total SIF) with PFDavg (1 year) 1.40 E-04, SFF = 75.83 % for four NE loads with NE relay condition (see application n° 3).
- SIL 3 according to IEC 61508 for Tproof = 6 / 12 years (10 / 20 % of total SIF) with PFDavg (1 year) 1.58 E-05, SFF = 99.10 % for ND load with ND relay condition (see application n° 5).
- SIL 2 according to IEC 61508 for Tproof = 20 years (10 % or more of total SIF) with PFDavg (1 year) 1.54 E-05, SFF = 98.77 % for two ND loads with ND relay condition (see application n° 6).
- Installation in Zone 2.
- 5 A SIL 3 / SIL 2 contacts for NE or ND loads with NE or ND Relay condition.
- Line input monitoring in-field DIP Switch selectable.
- Driving input voltage monitoring.
- Input/Output isolation.
- EMC Compatibility to EN61000-6-2, EN61000-6-4, EN61326-1, EN61326-3-1 for safety system.
- ATEX, IECEx Certifications.
- Simplified installation using standard DIN-Rail and plug-in terminal blocks or customized Termination Boards.

## Terminal block connections

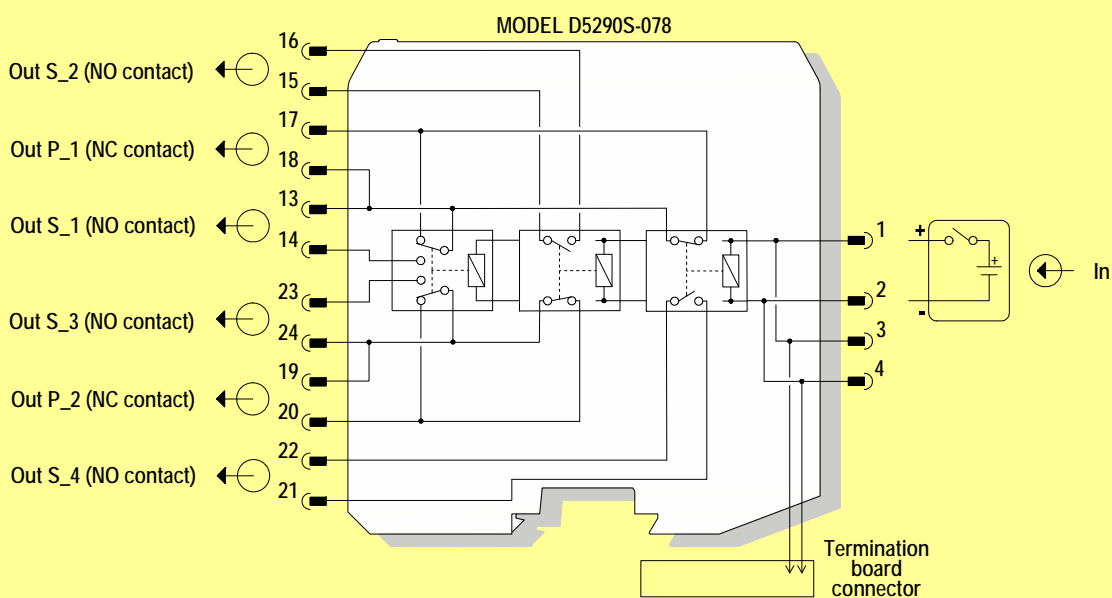


## SAFE AREA

13	Normally Open (NO) contact (Out S_1)
14	
15	Normally Open (NO) contact (Out S_2)
16	
17	Normally Closed (NC) contact (Out P_1)
18	
19	Normally Closed (NC) contact (Out P_2)
20	
21	Normally Open (NO) contact (Out S_4)
22	
23	Normally Open (NO) contact (Out S_3)
24	

1	Input +
2	Input -
3	Input +
4	Input -

SAFE AREA, ZONE 2 GROUP IIC T4



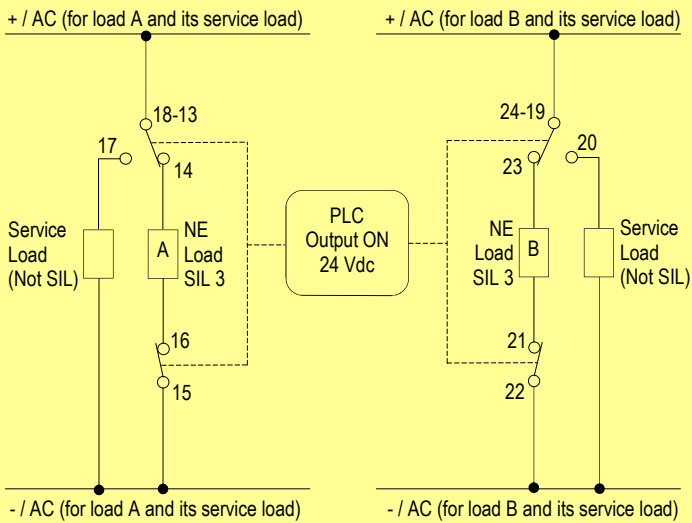
See the following pages for Functional Safety applications with related SIL value.

Relay contacts shown in de-energized position.  
 Terminals 13-14, 15-16, 21-22 and 23-24 are open.  
 Terminals 17-18 and 19-20 are closed.

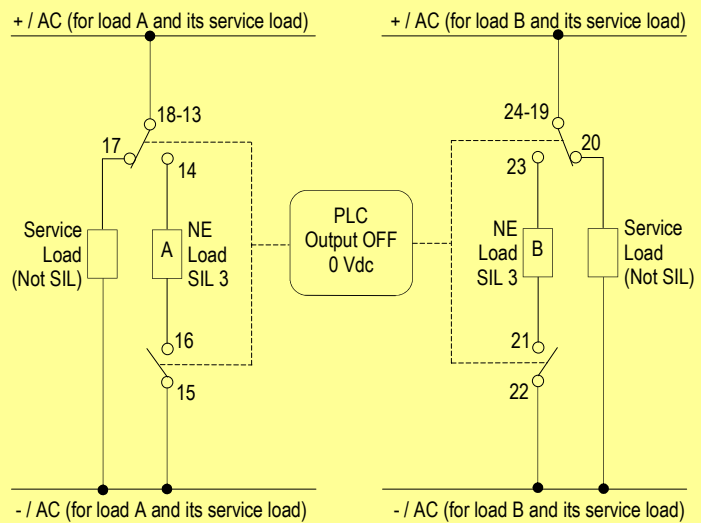
To prevent relay contacts from damaging, connect an external protection (fuse or similar),  
 chosen according to the relay breaking capacity diagram.

**1)** Application D5290S-078 - SIL 3 Load Normally Energized Condition (NE) and Normally Energized Relay: one common driving signal from PLC for both NE loads (A and B), with interruption of both load supply lines

Normal state operation



De-energized to trip operation



Contacts 13-14 and 15-16: in normal operation relays are energized, contacts are closed, NE load (A) is energized.  
 Contact 17-18 (double contact in parallel): in normal operation relay is energized, contact is open, service load for NE load (A) is de-energized.

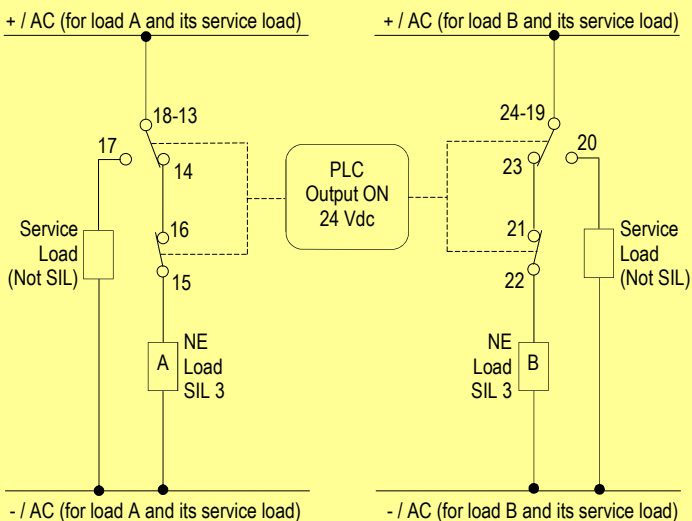
Contacts 21-22 and 23-24: in normal operation relays are energized, contacts are closed, NE load (B) is energized.  
 Contact 19-20 (double contact in parallel): in normal operation relay is energized, contact is open, service load for NE load (B) is de-energized.

Contacts 13-14 and 15-16: the SIL 3 Safety Function is met when the relays are de-energized, contacts are open, NE load (A) is de-energized.  
 Contact 17-18 (double contact in parallel): in safe state the relay is de-energized, contact is closed, service load for NE load (A) is energized.

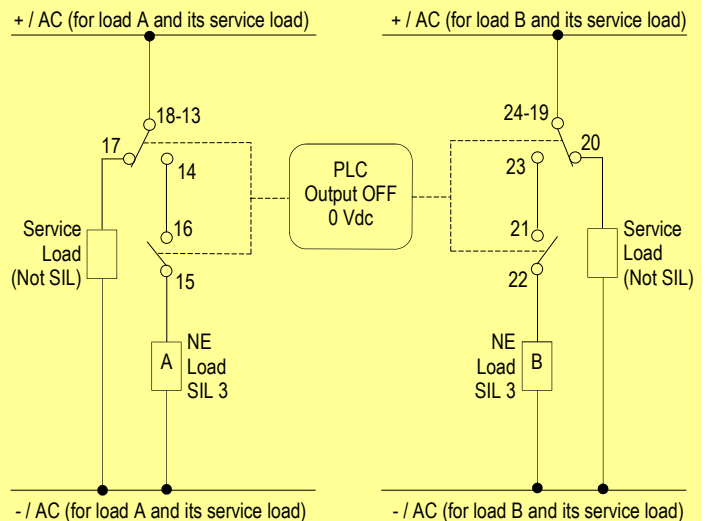
Contacts 21-22 and 23-24: the SIL 3 Safety Function is met when the relays are de-energized, contacts are open, NE load (B) is de-energized.  
 Contact 19-20 (double contact in parallel): in safe state the relay is de-energized, contact is closed, service load for NE load (B) is energized.

**2)** Application D5290S-078 - SIL 3 Load Normally Energized Condition (NE) and Normally Energized Relay: one common driving signal from PLC for both NE loads (A and B), with interruption of only one load supply line

Normal state operation



De-energized to trip operation



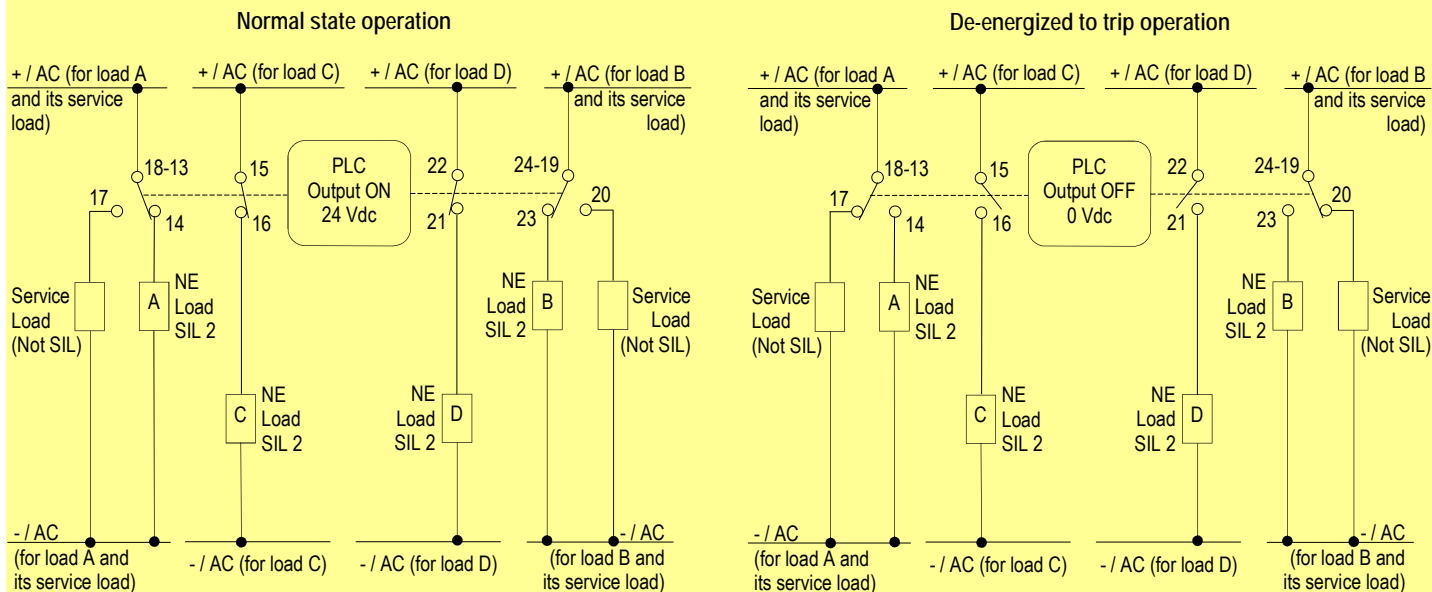
Contacts 13-14 and 15-16: in normal operation relays are energized, contacts are closed, NE load (A) is energized.  
 Contact 17-18 (double contact in parallel): in normal operation relay is energized, contact is open, service load for NE load (A) is de-energized.

Contacts 21-22 and 23-24: in normal operation relays are energized, contacts are closed, NE load (B) is energized.  
 Contact 19-20 (double contact in parallel): in normal operation relay is energized, contact is open, service load for NE load (B) is de-energized.

Contacts 13-14 and 15-16: the SIL 3 Safety Function is met when the relays are de-energized, contacts are open, NE load (A) is de-energized.  
 Contact 17-18 (double contact in parallel): in safe state the relay is de-energized, contact is closed, service load for NE load (A) is energized.

Contacts 21-22 and 23-24: the SIL 3 Safety Function is met when the relays are de-energized, contacts are open, NE load (B) is de-energized.  
 Contact 19-20 (double contact in parallel): in safe state the relay is de-energized, contact is closed, service load for NE load (B) is energized.

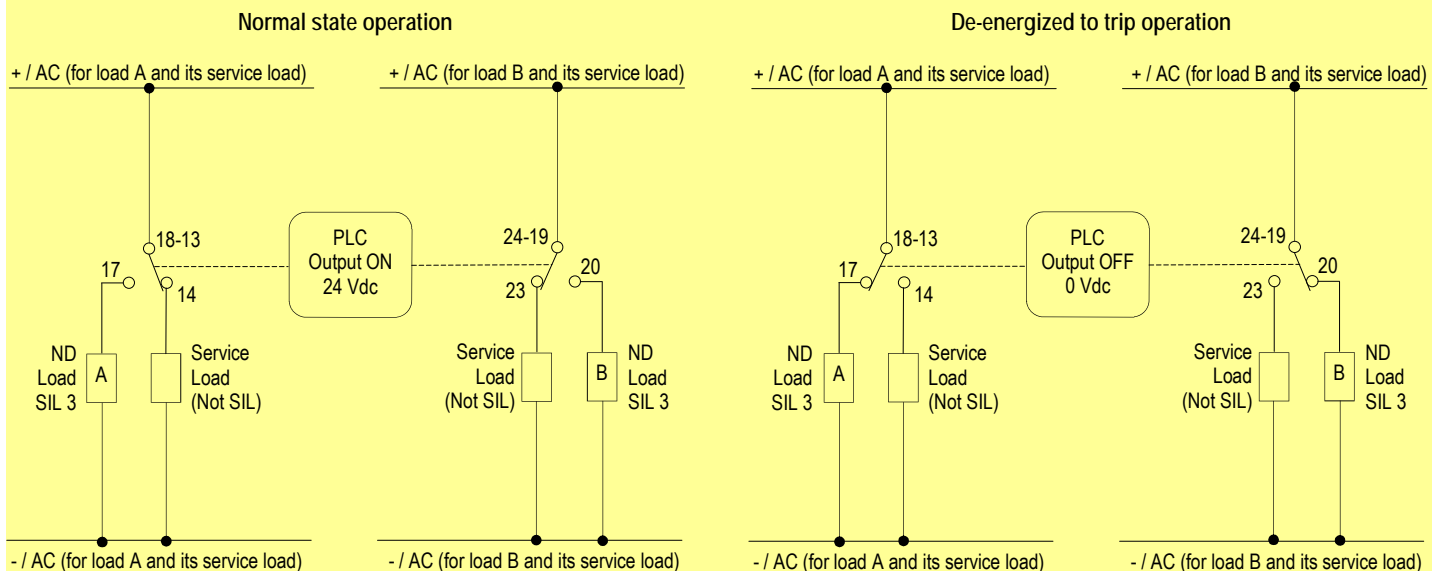
3) Application D5290S-078 - SIL 2 Load Normally Energized Condition (NE) and Normally Energized Relay: one common driving signal from PLC for all NE loads (A, B, C and D), with interruption of only one load supply line



Contacts 13-14, 15-16, 21-22 and 23-24: in normal operation relays are energized, contacts are closed, NE loads (A, B, C and D) are energized.  
 Contact 17-18 and 19-20 (double contact in parallel): in normal operation relays are energized, contacts are open, service loads for NE loads (A and B) are de-energized.

Contacts 13-14, 15-16, 21-22 and 23-24: the SIL 2 Safety Function is met when the relays are de-energized, contacts are open, NE loads (A, B, C and D) are de-energized.  
 Contact 17-18 and 19-20 (double contact in parallel): in safe state the relays are de-energized, contacts are closed, service loads for NE loads (A and B) are energized.

4) Application D5290S-078 - SIL 3 Load Normally De-energized Condition (ND) and Normally Energized Relay: one common driving signal from PLC for both ND loads (A and B), with interruption of only one load supply line



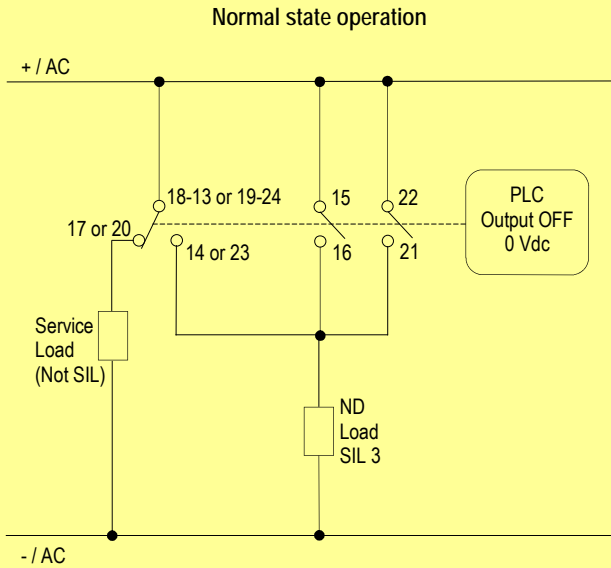
Contact 17-18 (double contact in parallel): in normal operation relay is energized, contact is open, ND load (A) is de-energized.  
 Contact 13-14: in normal operation relay is energized, contact is closed, service load for ND load (A) is energized.

Contact 19-20 (double contact in parallel): in normal operation relay is energized, contact is open, ND load (B) is de-energized.  
 Contact 23-24: in normal operation relay is energized, contact is closed, service load for ND load (B) is energized.

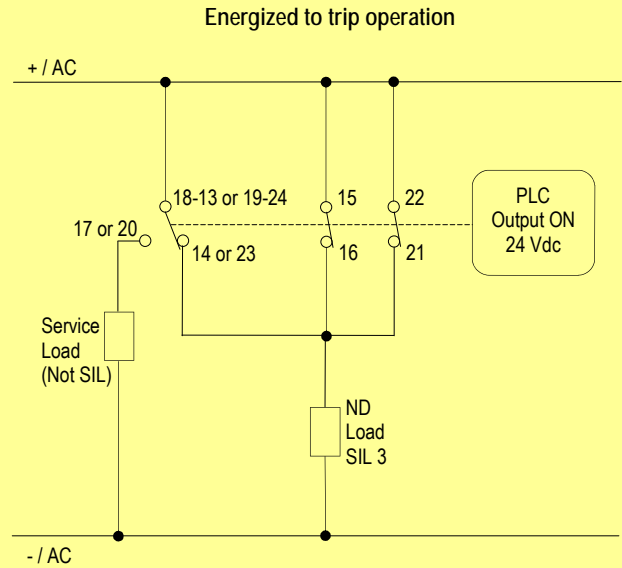
Contact 17-18 (double contact in parallel): the SIL 3 Safety Function is met when the relay is de-energized, contact is closed, ND load (A) is energized.  
 Contact 13-14: in safe state the relay is de-energized, contact is open, service load for ND load (A) is de-energized.

Contact 19-20 (double contact in parallel): the SIL 3 Safety Function is met when the relay is de-energized, contact is closed, ND load (B) is energized.  
 Contact 23-24: in safe state the relay is de-energized, contact is open, service load for ND load (B) is de-energized.

5) Application D5290S-078 - SIL 3 Load Normally De-energized Condition (ND) and Normally De-energized Relay, with interruption of only one load supply line

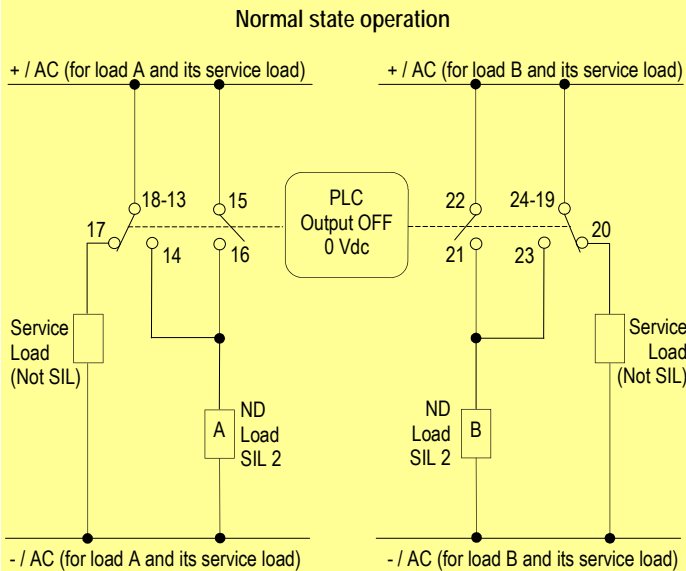


Contacts 13-14 or 23-24, 15-16, 21-22: in normal operation relays are de-energized, contacts are open, ND load is de-energized.  
 Contact 17-18 or 19-20 (double contact in parallel): in normal operation relay is de-energized, contact is closed, service load for ND load is energized.

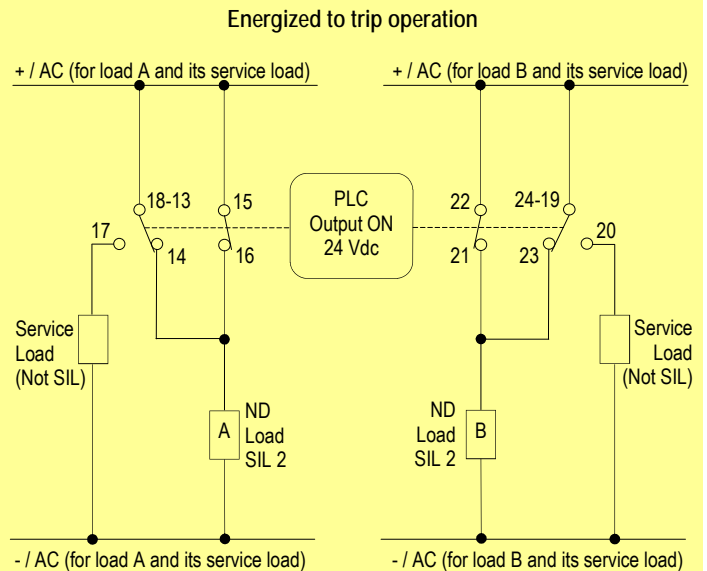


Contacts 13-14 or 23-24, 15-16, 21-22: the SIL 3 Safety Function is met when the relays are energized, contacts are closed, ND load is energized.  
 Contact 17-18 or 19-20 (double contact in parallel): in safe state the relay is energized, contact is open, service load for ND load is de-energized.

6) Application D5290S-078 - SIL 2 Load Normally De-energized Condition (ND) and Normally De-energized Relay: one common driving signal from PLC for both ND loads (A and B), with interruption of only one load supply line



Contacts 13-14, 15-16: in normal operation relays are de-energized, contacts are open, ND load (A) is de-energized.  
 Contact 17-18 (double contact in parallel): in normal operation relay is de-energized, contact is closed, service load for ND load (A) is energized.  
 Contacts 21-22, 23-24: in normal operation relays are de-energized, contacts are open, ND load (B) is de-energized.  
 Contact 19-20 (double contact in parallel): in normal operation relay is de-energized, contact is closed, service load for ND load (B) is energized.



Contacts 13-14, 15-16: the SIL 2 Safety Function is met when the relays are energized, contacts are closed, ND load (A) is energized.  
 Contact 17-18 (double contact in parallel): in safe state the relay is energized, contact is open, service load for ND load (A) is de-energized.  
 Contacts 21-22, 23-24: the SIL 2 Safety Function is met when the relays are energized, contacts are closed, ND load (B) is energized.  
 Contact 19-20 (double contact in parallel): in safe state the relay is energized, contact is open, service load for ND load (B) is de-energized.

## Warning

D5290S-078 is an electrical apparatus installed into standard EN50022 T35 DIN-Rail located in Safe Area or Zone 2, Group IIC, Temperature Classification T4, Hazardous Area (according to EN/IEC60079-15) within the specified operating temperature limits Tamb - 40 to +60 °C.  
D5290S-078 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.  
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.  
**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

D5290S-078 relay module is suitable for the switching of safety related circuits, providing isolation between the input and output contacts.  
See the previous pages for Functional Safety applications with related SIL value.  
A "RELAY STATUS" yellow led lights when input is powered, showing that relay is energized.

## Installation

D5290S-078 is a relay output module housed in a plastic enclosure suitable for installation on T35 DIN-Rail according to EN50022 or on customized Termination Board.  
D5290S-078 unit can be mounted with any orientation over the entire ambient temperature range.  
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 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 (#1 application):  
Connect positive input at terminal "1" and negative input at "2" (positive input at terminal "3" and negative input at "4" are provided for daisy chain connection to the next module).  
For Load A and its service load:  
- connect positive or AC load supply line to terminals "13" and "18";  
- connect SIL 3 Normally Energized (NE) Load between terminals "14" and "16";  
- connect Not SIL Service Load between terminal "17" and negative or AC load supply line;  
- connect terminal "15" to negative or AC load supply line.  
For Load B and its service load:  
- connect positive or AC load supply line to terminals "19" and "24";  
- connect SIL 3 Normally Energized (NE) Load between terminals "23" and "21";  
- connect Not SIL Service Load between terminal "20" and negative or AC load supply line;  
- connect terminal "22" to negative or AC load supply line.

Installation and wiring must be in accordance to the relevant national or international installation standards (e.g. IEC/EN60079-14 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 relay contacts checking the load rating to be within the contact maximum rating (5 A 250 Vac 1250 VA, 5 A 250 Vdc 175 W (resistive load)).  
To prevent relay contacts from damaging, connect an external protection (fuse or similar), chosen according to the relay breaking capacity diagram on data sheet.  
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 D5290S-078 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.  
Relay output contact must be connected to load non exceeding category II 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

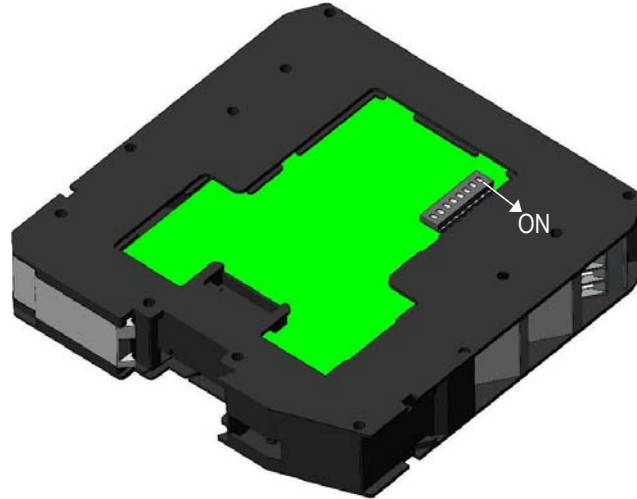
Before powering the inputs of unit check that all wires are properly connected, also verifying their polarity. Check conductors for exposed wires that could touch each other causing dangerous unwanted shorts. Enabling input, the "RELAY STATUS" yellow led must be lit, all relays must be energized, so that: contacts of terminals "13"-14" (Out S\_1), "15"-16" (Out S\_2), "21"-22" (Out S\_4) and "23"-24" (Out S\_3) must be closed, while contacts of terminals "17"-18" (Out P\_1) and "19"-20" (Out P\_2) must be open. Instead, disabling input, the "RELAY STATUS" yellow led must be turned off, all relays must be de-energized, so that: contacts of terminals "13"-14" (Out S\_1), "15"-16" (Out S\_2), "21"-22" (Out S\_4) and "23"-24" (Out S\_3) must be open, while contacts of terminals "17"-18" (Out P\_1) and "19"-20" (Out P\_2) must be closed.



## Configuration

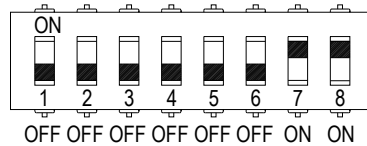
An eight position DIP Switch is located on component side of pcb in order to set four mutually exclusive configurations:

- 1) line input monitoring, to allow DCS/PLC line input monitoring function (driving line pulse testing);
- 2) low voltage input monitoring (UVLO—under voltage lock out): module reflects a high impedance state to the control unit when the driving voltage is below the specified threshold;
- 3) short circuit fault detection: it allows DCS/PLC to detect short circuit fault of module;
- 4) T-proof relay testing.

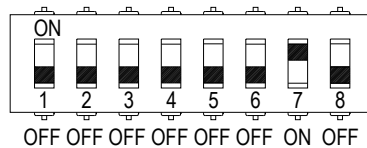


DIP switch configurations:

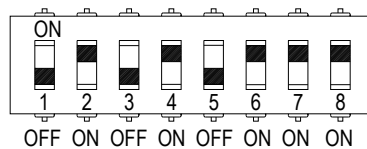
1) line input monitoring:



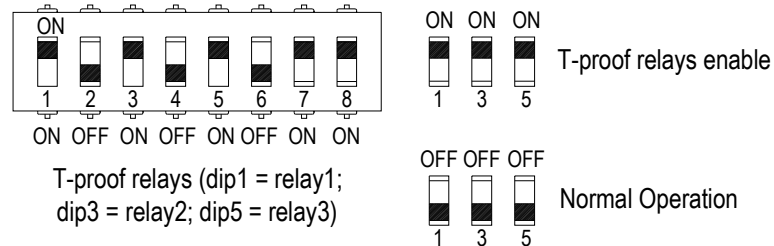
2) low voltage input monitoring:



3) short circuit fault detection:



4) T-proof relay testing:



Please, see next page for testing procedure at T-proof.

**WARNING:** after T-proof test, dip-switch 1-3-5 must be set to "OFF" position for normal operation.