ROSS CONTROLS®

M35 Series Safety Exhaust Double Valves Integration Guide

Hanley Controls
Clonmel

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Introduction

ROSS Controls offers a variety of safety valves for use in various safety functions such as safe exhaust, safe cylinder return, and safe load holding/stop. This document focuses specifically on ROSS Controls' M35 Series valves that are used for safe exhaust functions and utilize solid state pressure sensors to provide feedback to a safety control system for external monitoring.

Wiring examples are provided in this document and are shown using specific connections as wired and tested, but there may be other terminals available to use on the various controllers. These are just examples.

This integration guide is intended to assist you in integrating the product into your control circuit. However, programs provided in this integration guide are for reference only. These programs have not been certified or tested unless indicated otherwise.

While all potential electrical safety control suppliers and solutions cannot be covered, this document provides a template for some suppliers and their devices.

Each solution has been designed to meet a specific category and performance level based on ISO 13849. Meeting these levels requires other aspects of the system to meet these requirements such as, but not limited to, plumbing, wiring, and monitoring.

Pulse Testing

In dual channel safety circuits, pulse testing is a method utilized to detect fault conditions that, otherwise, may be undetected. Pulse testing is required in dual channel circuits in order to reach performance level e (PL e). Pulse testing of the solenoids is encouraged and will not affect the performance of the ROSS M35 valve. However, pulse testing of the feedback sensors is not required.

There are two methods of pulse testing outputs. The most common method is to use the native pulse testing instruction embedded by the manufacturer in Safety PLC's and Safety I/O Modules. The other method is to use custom programming code generated by the user. We recommend the use of native pulse testing instructions of the respective manufacturers' safety PLC's or I/O modules because these instructions are fixed and cannot be tampered with. These instructions typically have a frequency of 400ms to 600ms and a duration of 0.4ms to 0.8ms. Pulse testing the outputs to the solenoids on the M35 valve at this frequency and duration does not affect the performance of the valve, but does provide a method to monitor for the occurrence of wiring faults in the output portion of the safety circuit controlling the valve solenoids.

Exhaust Times and Faulted Flow Rates

When designing a safety circuit, the machine stopping time is a critical factor that determines the placement of guarding solutions. One factor in safe distance calculations is the exhaust time of the valve that is responsible for isolating and dumping the pneumatic energy from the machine. The faster your valve exhausts the quicker the machine can stop and the closer your safety devices may be placed to the hazardous area. This can improve overall operating efficiency, and possibly allow the footprint of the machine to be smaller.

Even more important than exhaust time is the "Faulted exhaust flow rate". Faulted exhaust flow rate is the exhaust rate of the valve in its worst state. Double valves (redundant valve systems used for safety applications) will not exhaust quite as quickly when there is an internal fault condition in the valve such as when one of the redundant valve components is actuated and the other one is not actuated. For this reason, double valves used in safety circuits should always be sized using faulted flow rates as the worst case condition.

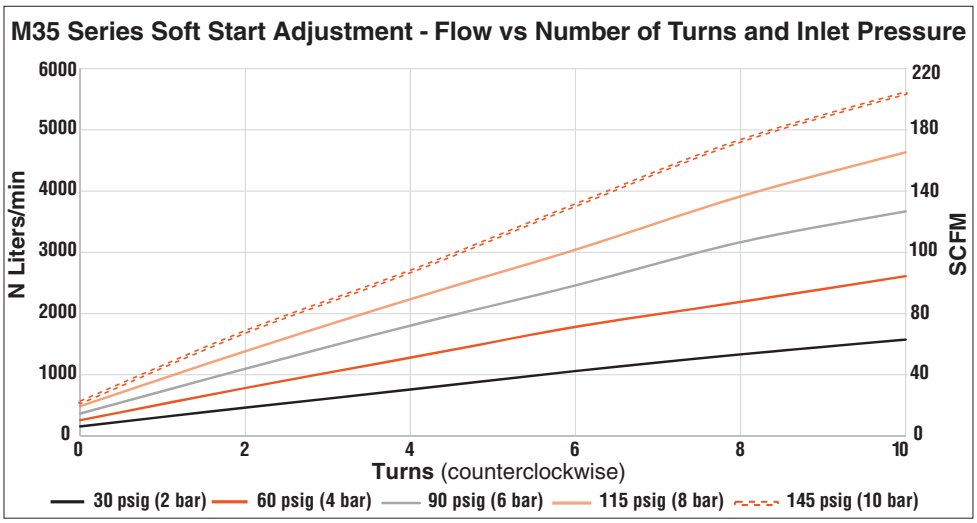
The chart below shows the M35 valve's very high-flow faulted exhaust flow times at various downstream volumes and operating pressures.

Exhaust Time – Normal and Faulted Conditions (s)							
Volume ft^3 (L)	Normal or Faulted	Operating Pressure					
		30 psig (2 bar)		90 psig (6 bar)		145 psig (10 bar)	
		to 15 psig (1 bar)	to 7 psig (0.5 bar)	to 15 psig (1 bar)	to 7 psig (0.5 bar)	to 15 psig (1 bar)	to 7 psig (0.5 bar)
0.071 (2)	N	0.055	0.071	0.094	0.112	0.120	0.135
	F	0.072	0.098	0.147	0.183	0.200	0.247
0.35 (10)	N	0.131	0.208	0.317	0.393	0.424	0.507
	F	0.185	0.301	0.533	0.710	0.789	1.024
0.71 (20)	N	0.226	0.379	0.597	0.746	0.804	0.971
	F	0.326	0.555	1.016	1.368	1.526	1.997
1.41 (40)	N	0.416	0.721	1.155	1.451	1.564	1.899
	F	0.608	1.063	1.983	2.685	3.000	3.941
5.30 (150)	N	1.462	2.604	4.227	5.326	5.743	7.006
	F	2.160	3.855	7.298	9.929	11.107	14.635

Soft Start Adjustment

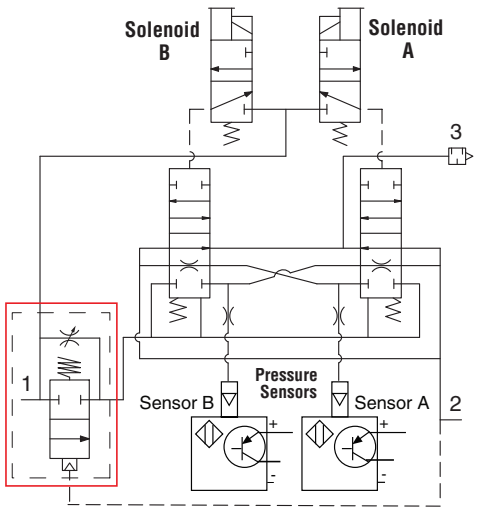
The function of the optional EEZ-ON® (soft start) module is to, on energization, allow outlet pressure to increase at a slower than normal rate until it reaches approximately 60% of inlet pressure, at which point the valve will then open fully to finish filling the system at full flow rate. This feature can be used to lessen the shock of sudden, rapid pressurization of cylinders, and to gradually refill the system.

The EEZ-ON® module has an adjusting screw that is used to control the rate of pressurization according to number of turns and inlet pressure. The chart on the right can be used to approximate the number of turns (clockwise from full open) it will take in order to adjust the soft start for your system. The necessary setting is dependent upon the number of turns, inlet pressure, and downstream volume to be filled by the valve.



General Operation

The ROSS M35 schematic shows patented cross flow technology and solid state pressure sensors for status feedback. The red box highlights the optional soft-start in the unit.

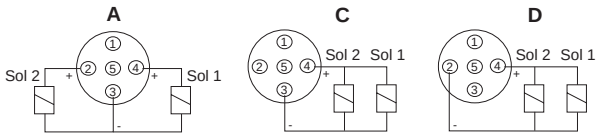
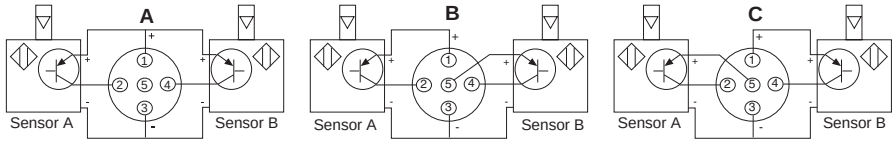


M35 Wiring (Pinouts)

The M35 valve is available with various wiring options for both the solenoid cable and the sensor cable. For example, the following model number is wired internally with the DB wiring option:

Model Number: M35S40GAEXDBGA

This means the valve in this example is wired with the D solenoid configuration and the B Sensor configuration. Use these diagrams to determine the proper pinouts for your valve.

Solenoid M12 Pinouts	
Pressure Sensor M12 Pinouts	

Pin Configuration Combinations		
Solenoid	**Sensor**	
A	A	AA
A	B	AB
A	C	AC
C	C	CC
D	B	DB
D	C	DC

M35 LED Status Lights (Operation)

Solenoid Power LED's: These LED's operate independently to indicate power is applied to the solenoids.
Green: Power applied.
OFF: No power applied.

Sensor Power (SEN PWR): This LED indicates whether or not power is applied to the feedback sensors.
Green: Power applied.
OFF: No power applied.

FAULT (FLT): Flashing Red: Sensors are in different States. The M35 unit will automatically fail to a mechanical safe state (no downstream pressure). The monitoring logic should automatically shut off power to both solenoids.

- ***If FLT light is flashing and either or both solenoid lights are ON –*** it indicates the monitoring logic is not properly detecting this fault. The M35 unit should be powered down and monitoring logic reviewed and re-tested before putting into operation again
- ***If FLT light is flashing and both solenoid lights are OFF*** – it indicates the unit has an internal malfunction and should be replaced before continuing operation.

OFF: Sensors in same state – no issue.

Operation & Monitoring Requirements for M35 Valves

The intent of this document is to provide guidance on how to operate and monitor the M35 valve for safe operation. A test procedure is also provided for verification and validation of the user's external safety control monitoring system.

Valve Operation

The M35 valve is a redundant safety exhaust (dump) valve. Its function is that of a 3/2, normally closed, single-solenoid valve. However, because the valve is redundant it has two operating solenoids that must be operated simultaneously in order to actuate the valve.

Actuating the valve will supply pressure from port 1 (supply) to port 2 (outlet) and close port 3 (exhaust).

De-actuating the valve will close port 1 (supply) and open port 2 (outlet) to port 3 (exhaust). De-actuation of the valve is accomplished by turning off both solenoids simultaneously.

In the event of a valve fault where one of the redundant valve components does not operate synchronously as commanded, the valve will perform its safety function which is to shut off supply and exhaust downstream pressure to atmosphere.

Synchronous operation occurs when both sets of valve internals shift within 150 msec of each other.

Failure of the valve to shift synchronously leads to a fault in the M35 valve. This could happen for a variety of reasons, such as:

- Compromised piston seals
- Main valve elements experiencing a switching delay due to dirt, debris or resinous oil
- Insufficient electrical signals to valve solenoids; suitable voltage not available
- Receipt of signals at solenoids not synchronous
- Pilot valves experiencing a switching delay due to damaged components, dirt, debris or resinous oil
- Excessive water build-up in the valve

Feedback Monitoring

The M35 valve is equipped with feedback pressure sensors that must be monitored by the user's external safety control & monitoring system to detect any fault condition within the valve. Sensor feedback should always agree with the solenoid actuating signals.

Detection of any valve fault should disable the safety control outputs to the valve solenoids and prevent any subsequent attempts to actuate the valve until a safety control system reset is performed.

Refer to EN ISO13849-1 for Cat 3 vs Cat 4 monitoring.

Automatic RESET is not recommended by ROSS.

Actuation Fault Monitoring

Actuation fault monitoring should check for valve actuation synchronicity. After the safety control system outputs provide simultaneous actuation signals to both solenoids, both sensor outputs should switch off within 150 msec of each other. Dependent upon which sensor switches off first, the following faults should be detected.

1. "A" side fault detection – if sensor A does not switch off within 150 msec after sensor B switches off, this should be registered as a fault.
2. "B" side fault detection – if sensor B does not switch off within 150 msec after sensor A switches off, this should be registered as a fault.

De-Actuation Fault Monitoring

De-Actuation fault monitoring should check for valve de-actuation synchronicity. After the safety control system simultaneously removes the actuation signals from both solenoids, both sensor outputs should switch on within 150 msec of each other. Dependent upon which sensor switches on first, the following faults should be detected.

1. "A" side fault detection - sensor A does not switch on within 150 msec after sensor B switches on, this should be registered as a fault.
2. "B" side fault detection – if sensor B does not switch on within 150 msec after sensor A switches on, this should be registered as a fault.

Loss of Supply Pressure While Actuated

The condition of loss of supply pressure while the valve is actuated must be detected by the safety control monitoring system. Loss of supply pressure while actuated should cause both sensors to switch on due to lack of pressure in both valves' outlet port even though the valve is still energized. This fault can be detected when the solenoids are high, and one or both sensors go from low (sensing pressure) to high (not sensing pressure).

No Supply Pressure Applied Before Actuation

Monitoring of supply pressure may also be utilized if deemed beneficial for the application, but is not required. If you choose to detect this condition it would require the addition of an upstream pressure switch or transducer. The condition of the pressure switch or transducer should be monitored to prevent actuation of the valve when supply pressure is insufficient.

Safety System Reset

Any detected fault in the valve system should cause the safety control system to de-actuate the valve by removing power from both solenoids. A reset of the safety control system should only be possible after the valve sensors indicate that the valve is in the de-actuated state (both sensors switched on).

Validation Test Procedure for Valve Operation and External Monitoring Logic

NOTE: This test procedure should only be performed with an M35 valve that is known to be functioning properly. If basic valve function is in question, please refer to Section 8 of the Product Operating Instructions for the Valve Test Procedure.

Valve Operation

1. Energize solenoids A & B simultaneously.
   Valve is on, air pressure is supplied downstream from supply port 1 through outlet port 2, and exhaust port 3 is shut off. Sensors A & B are off.
2. De-energize solenoids A & B simultaneously.
   Valve is off, supply port 1 is blocked, and downstream air is exhausted from outlet port 2 through exhaust port 3. Sensors A & B are on.

Actuation Fault Monitoring (with Fault Latching)

NOTE: *These test procedures require fault simulation. It will be necessary to induce faults electrically by disabling one solenoid or the other at different times, which may require special test cabling in order to complete the test procedure.*
Also, be aware that this would only be possible with solenoid wiring option A. See product data sheet.

3. Energize only solenoid A. This should result in a sensor A switching off while sensor B stays on. Your safety control monitoring system should detect this fault in the valve, where sensor A switches off and sensor B stays on more than 150 msec after sensor A switches off. This fault should trigger the safety outputs to switch off in order to de-energize both solenoids, A & B. The fault should be latched in by the safety control system logic until the system is reset. While the fault exists supply port 1 is blocked, and downstream air from outlet port 2 is open to exhaust port 3. Once the safety control system de-energizes the solenoids, sensors A and B should both be on.
4. Before attempting to reset the safety control system, attempt to energize both solenoids, A & B, simultaneously. Supply port 1 should remain blocked and downstream air from outlet port 2 should remain open to exhaust via exhaust port 3.
5. De-energize both solenoids A & B.
6. Reset the safety control system.
7. Energize only solenoid B. This should result in sensor A staying on while sensor B switches off. Your safety control monitoring system should detect this fault in the valve, where sensor B switches off and sensor A stays on more than 150 msec after sensor B switches off. This fault should trigger the safety outputs to switch off in order to de-energize both solenoids A & B. The fault should be latched in by the safety control system logic until the system is reset. While the fault exists, supply port 1 is blocked, and downstream air from outlet port 2 is open to exhaust port 3. Once the safety control system de-energizes the solenoids, sensors A and B should both be on.
8. Before attempting to reset the safety control system, attempt to energize both solenoids, A & B, simultaneously. Supply port 1 should remain blocked and downstream air from outlet port 2 should remain open to exhaust via exhaust port 3.
9. De-energize both solenoids A & B.
10. Reset the safety control system.

De-Actuation Fault Monitoring (with Fault Latching)

NOTE: *These test procedures require fault simulation. It will be necessary to induce faults electrically by disabling one solenoid or the other at different times, which may require special test cabling in order to complete the test procedure.*
Also, be aware that this would only be possible with solenoid wiring option A. See product data sheet.

11. Energize solenoids A & B, simultaneously. This switches the valve on and should result in air pressure being supplied downstream from supply port 1 through outlet port 2, and exhaust port 3 being shut off. Sensors A & B should both switch off.
12. De-energize only solenoid A. The safety control system should detect the fault in the valve where sensor A switches on and sensor B stays off more than 150 msec after sensor A switches on. This fault should trigger the safety outputs to switch off in order to de-energize both solenoids A and B. The fault should be latched in by the safety control system logic until the system is reset. While the fault exists supply port 1 is blocked and downstream air from outlet port 2 is open to exhaust port 3. Once the safety control system de-energizes the solenoids, sensors A and B should be both on.
13. Before attempting to reset the safety control system, attempt to energize both solenoids A and B simultaneously. Supply port 1 should remain blocked and downstream air from outlet port 2 should remain open to exhaust via exhaust port 3.

De-Actuation Fault Monitoring (with Fault Latching) Continued

14. De-energize both solenoids A & B.
15. Reset the safety control system.
16. Energize both solenoids, A & B simultaneously. This switches the valve on and should result in air pressure being supplied downstream from supply port 1 through outlet port 2, and exhaust port 3 being shut off. Sensors A & B should both switch off.
17. De-energize only solenoid B. The safety control system should detect the fault in the valve where sensor B switches on and sensor A stays off more than 150 msec after sensor B switches on. This fault should trigger the safety outputs to switch off in order to de-energize both solenoids, A & B. The fault should be latched in by the safety control system logic until the system is reset. While the fault exists supply port 1 is blocked, and downstream air from outlet port 2 is open to exhaust port 3. Once the safety control system de-energizes the solenoids, sensors A and B should both be on.
18. Before attempting to reset the safety control system, attempt to energize solenoids, A & B simultaneously. Supply port 1 should remain blocked and downstream air from outlet port 2 should remain open to exhaust via exhaust port 3.
19. De-energize both solenoids A & B.
20. Reset the safety control system.

Monitoring for Loss of Supply Pressure While Actuated

21. Energize both solenoids, A & B, simultaneously. This switches the valve on and should result in air pressure being supplied downstream from supply port 1 through outlet port 2, and exhaust port 3 being shut off. Sensors A & B should both switch off.
22. Remove supply air from supply port 1. Sensors A & B should switch on. External monitoring should detect the condition where both solenoids are on, but one or both sensors go from low (sensing pressure) to high (not sensing pressure). This fault should trigger the safety outputs to switch off in order to de-energize both solenoids, A & B. The fault should be latched in by the safety control system logic until the system is reset. While the fault exists, supply port 1 is blocked, and downstream air from outlet port 2 is open to exhaust port 3. Sensors A and B should remain on.
23. Re-supply air to supply port 1. Supply port 1 is blocked and downstream air from outlet port 2 is open to exhaust via port 3. Sensors A & B should both be on. Re-supplying air while the fault is latched in the safety control system should not result in air being supplied from supply port 1 to outlet port 2.
24. Reset the safety control system.

Integration Guide for Applications Using a Safety Relay with a Standard PLC for External Monitoring

(for applications requiring CAT 3, PL d)

Integration Guide for Rockwell 440R-D22S2

Rockwell 440R-D22S2

Part Number: 440R-D22S2

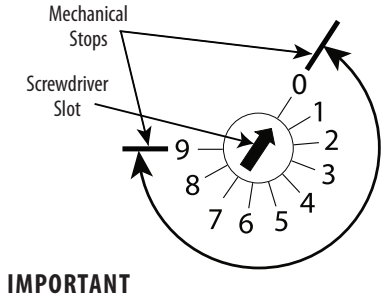
Functional Safety Rating: Cat 4, PL e

- Uses terminals
- Customer will have colored wires
- Can be wired with a PLC for sensors monitoring
- Examples include with and without pin outs and valve schematic

Generic Connection Example (from Rockwell Catalog):

The DIS safety relay has two dual-channel inputs and four solid-state outputs. Two of the four solid-state outputs are designed to operate with high-capacitance loads. In addition, the DIS safety relay has SWS input and output. The DIS safety relay can be set for automatic or monitored manual reset by adjusting the switch on the front panel. The configuration switch also sets the AND/OR logic that is applied to the inputs.

Configuration Switch Adjustment



IMPORTANT
Adjust the switches gently and do not turn past the mechanical stops.

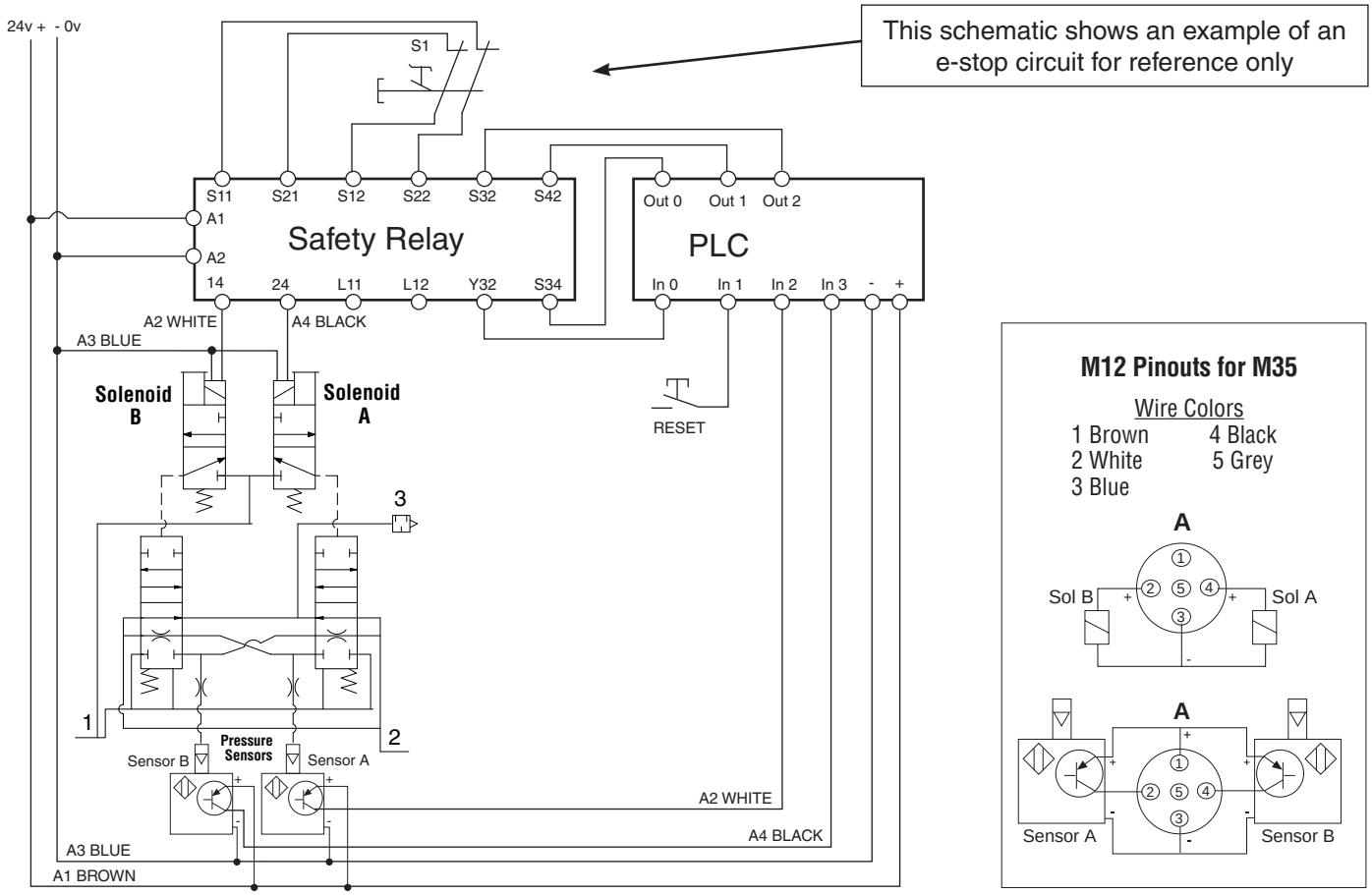
Position	Reset	Function
0	Not Applicable	Start Configuration
2	Monitored Manual	(IN1 or IN2) or L12
3		(IN1 and IN2) or L12
4		(IN1 and IN2) and L12
5	Automatic/Manual	(IN1 or IN2) or L12
6		(IN1 and IN2) or L12
7		(IN1 or IN2) and L12
8		(IN1 and IN2) and L12

Terminal	Function
A1	+24V Supply (+10%, -15%)
A2	24V Common
S11	Pulse Test Output for Channel 1
S21	Pulse Test Output for Channel 2
S12	Safety Input for IN1 Channel 1
S22	Safety Input for IN1 Channel 2
S32	Safety Input for IN2 Channel 1
S34	Reset Input
S42	Safety Input for IN2 Channel 2
Y32	Auxiliary Non-Safety Output
L11	Single Wire Safety Output
L12	Single Wire Safety Input
14, 24	Safety Outputs - OSSD
34, 44	Safety Outputs - OSSD for Capacitive Loads

Integration Guide for Rockwell 440R-D22S2

Rockwell 440R-D22S2 Wiring Schematic with PLC to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Cat 3, PL d if properly implemented.



Rockwell 440R-D22S2 Program*

External monitoring program:

a) Sensor error : In2 <> In3 after discrepancy time at 150 ms.
b) Feedback error : In2 = In3 = In0 after installation discrepancy time.
c) If error Reset Out 1 & Out 2.
Reset error only after maintenance acknowledge.
Reset function.
d) IF No “feedback error” & In1.
Out0 = pulse of 2 s.
c) If error Reset Out 1 & Out 2.
Reset error only after maintenance acknowledge.
Reset function.
d) IF No “feedback error” & In1.
Out0 = pulse of 2 s.

*Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

Integration Guide for Schmersal SRB-E-204ST

Schmersal SRB-E-204ST

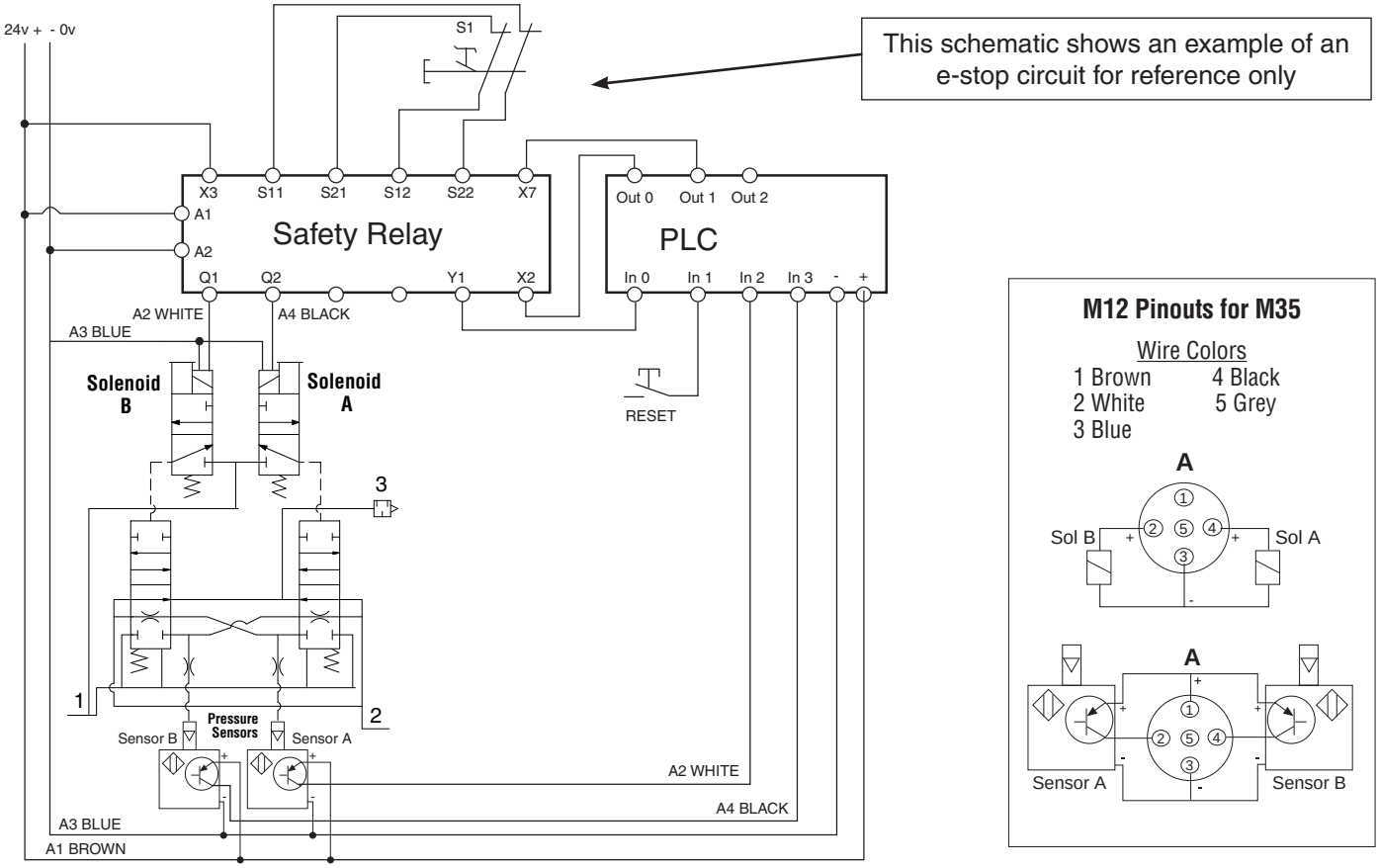
Part Number: SRB-E-20*ST
*=1 or 4 double inputs
Functional Safety Rating: Cat 4, PL e
Uses terminals
Customer will have colored wires
Can be wired with a PLC for sensor monitoring
Examples include with and without pin outs and valve schematic

Generic Connection Example for Schmersal SRB-E-201ST (from Schmersal Catalog):

The safety relay has two dual-channel inputs and four solid-state outputs. Two of the four solid-state outputs are designed to operate with high-capacitance loads. In addition, the safety relay has SWS input and output. The safety relay can be set for automatic or monitored manual reset by adjusting the switch on the front panel. The configuration switch also sets the AND/OR logic that is applied to the inputs.

Schmersal Wiring Schematic for SRB-E-2014ST with PLC to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 3, PL d if properly implemented.



Schmersal - Program*

External monitoring program:

a) Sensor error : In2 <> In3 after discrepancy time at 150 ms.
b) Feedback error : In2 = In3 = In0 after installation discrepancy time.
c) If error Reset Out 1 set error only after maintenance acknowledge.
Reset function.
d) IF No “feedback error” & In1.
Out0 = pulse of 2 s.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

Integration Guide for Siemens 3SK1112

Siemens 3SK1112

Part Number: 3SK1112
Functional Safety Rating: Cat 4, PL e

- Uses terminals
- Customer will have colored wires
- Can be wired with a PLC for sensor monitoring
- Examples include with and without pin outs and valve schematic

Safety Function Information (from Siemens Catalog):

The safety relay has two dual-channel inputs and four solid-state outputs. Two of the four solid-state outputs are designed to operate with high-capacitance loads. In addition, the safety relay has SWS input and output. The safety relay can be set for automatic or monitored manual reset by adjusting the switch on the front panel. The configuration switch also sets the AND/OR logic that is applied to the inputs.

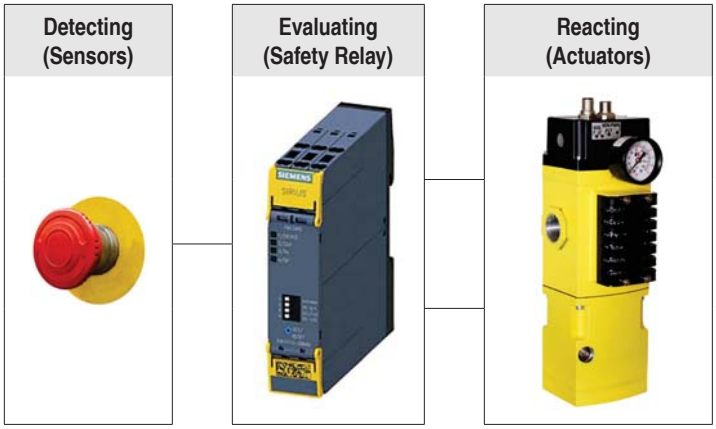
A safety function describes the reaction of a machine/plant to the occurrence of a specific event (e.g., opening of a protective door.) Execution of the safety function(s) is carried out by a safety-related control system. This usually comprises three subsystems, detecting, evaluating and reacting.

Detecting (sensors): Used to detect a safety requirement, e.g., emergency stop or a sensor for monitoring a hazardous area (light array, laser scanner etc) is operated.

Evaluating (safety relay): Detecting a safety requirement and safely initiating the reaction (e.g., switching off the safety related outputs). Monitoring the correct operation of sensors and actuators. Initiating a reaction upon detection of faults.

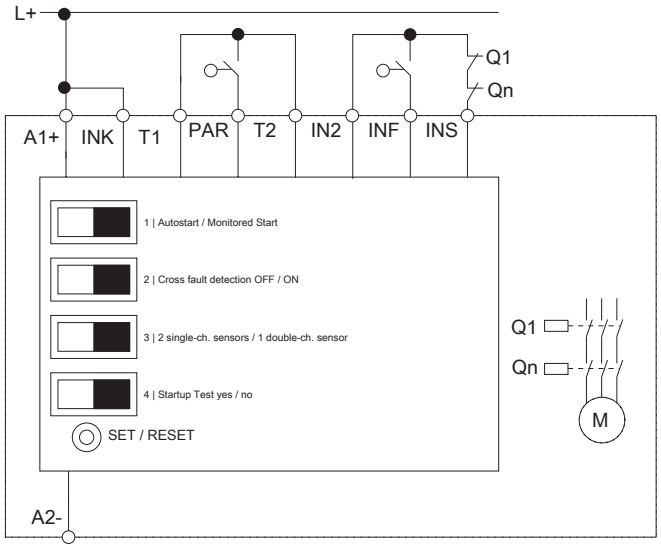
For the 3SKI products described in this guide, this concerns evaluation units for safety functions.

Reacting (actuators): Switching off the hazard by means of downstream actuators.



Generic Siemens Wiring Schematic for 3SK1112 (from Siemens Catalog) Exhaust Valve

Table 7- 14 Typical circuit 14:
1NC/1NO sensor, with cross-circuit detection, with monitored start

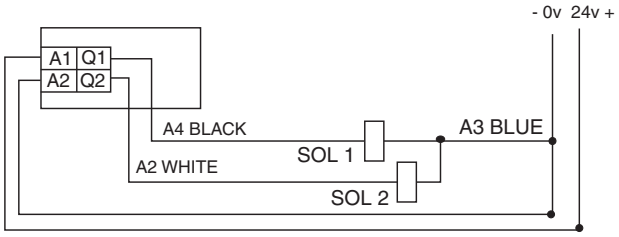


- Monitored start
- With cross-circuit detection
- 1 x two-channel
- Jumper T1/PAR for NC/NO evaluation
- Sensor: NC/NO sensor
- 3SK112/3SK122 Advanced

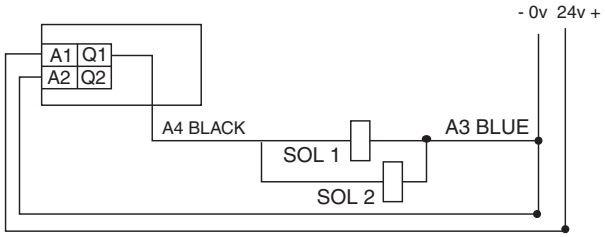
DIP switch			
1	**2**	**3**	**4**
ON right	ON right	ON right	—
Up to PL in accordance with ISO 13849-1			e
Up to Safety Integrity Level (SILCL) to IEC 61508			3

Integration Guide for Siemens 3SK1112

Siemens Wiring Schematic with Dual Output to Interface to Safety Exhaust Valve



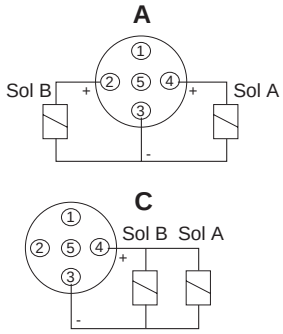
Siemens Wiring Schematic with One Safe Output to Interface to Safety Exhaust Valve



M12 Pinouts for M35 Valve Solenoids (options A & C)

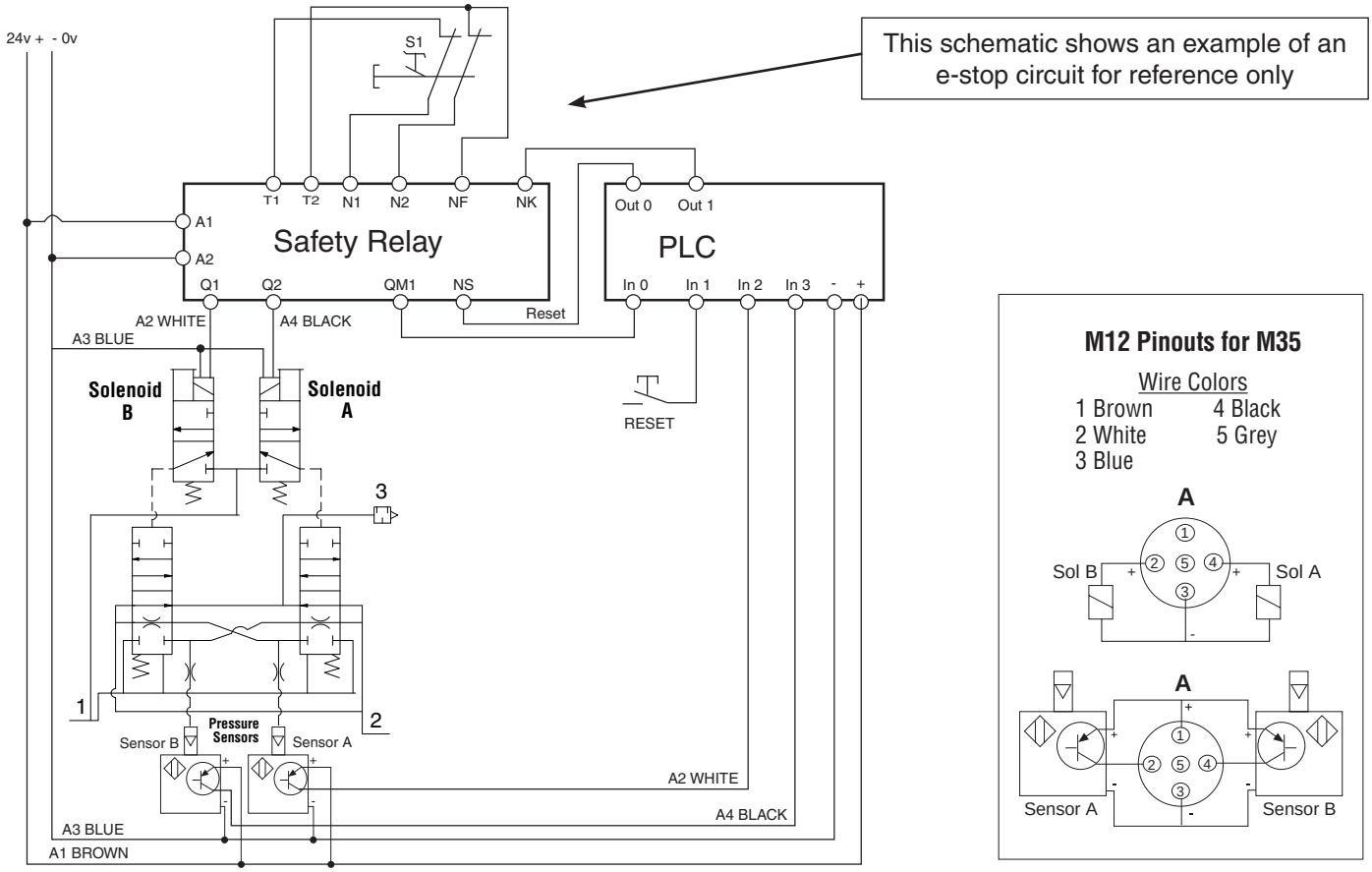
Wire Colors

1 Brown 4 Black
2 White 5 Grey
3 Blue



Siemens Wiring Schematic for 3SK1112-1BB40 with PLC to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 3, PL d if properly implemented.



M12 Pinouts for M35

Wire Colors

1 Brown 4 Black
2 White 5 Grey
3 Blue

Siemens - Program*

External monitoring program:

a) Sensor error : In2 <> In3 after discrepancy time at 150 ms.
b) Feedback error : In2 = In3 = In0 after installation discrepancy time.
c) If error Reset Out 1 set error only after maintenance acknowledge.

Reset function
d) IF No “feedback error” & In1
Out0 = pulse of 2 s

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

Integration Guide for Applications Using a Safety Relay for External Monitoring

(for applications requiring Cat 4, PL e)

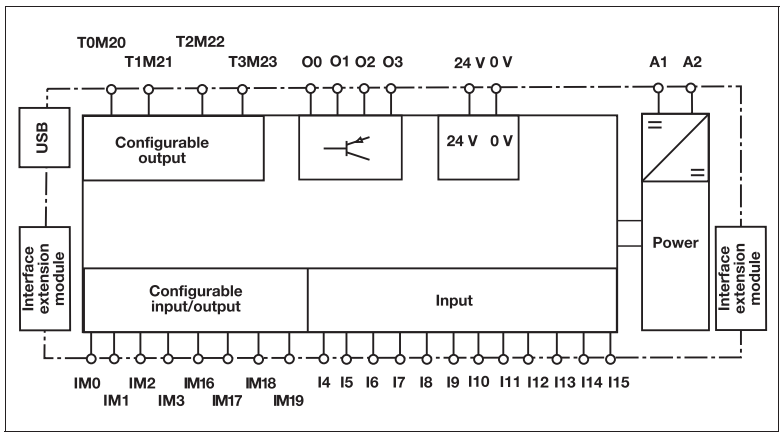
Integration Guide for Pilz PNOZ

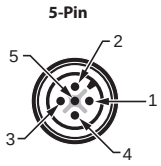
Pilz PNOZ

Part Number: 772100 Pnoz m B0
Functional Safety Rating: Cat 4, PL e

- Uses terminals
- Customer will have colored wires
- Can be wired with and without test pulses on the sensors
- Examples include with and without pin outs and valve schematic

Block diagram

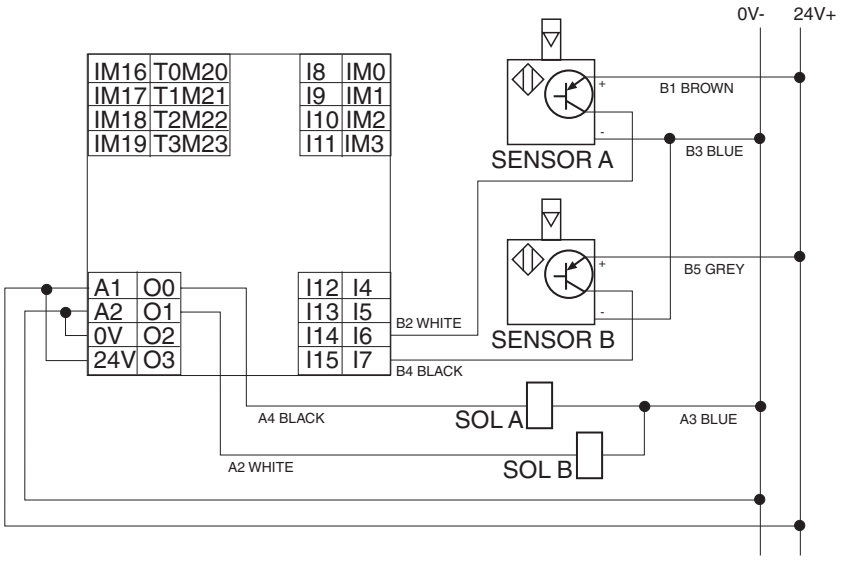


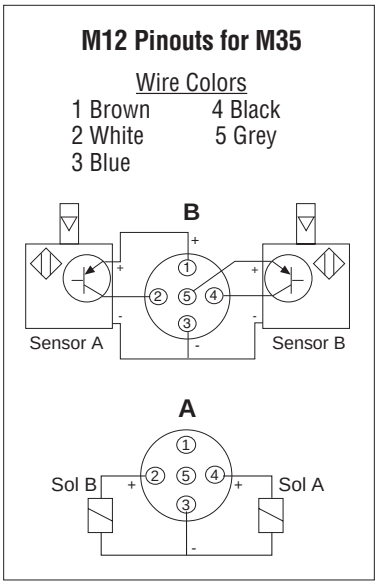


Male	
1 Brown 2 White 3 Blue	4 Black 5 Grey

Pilz Wiring Schematic (without sensor test pulse) to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.

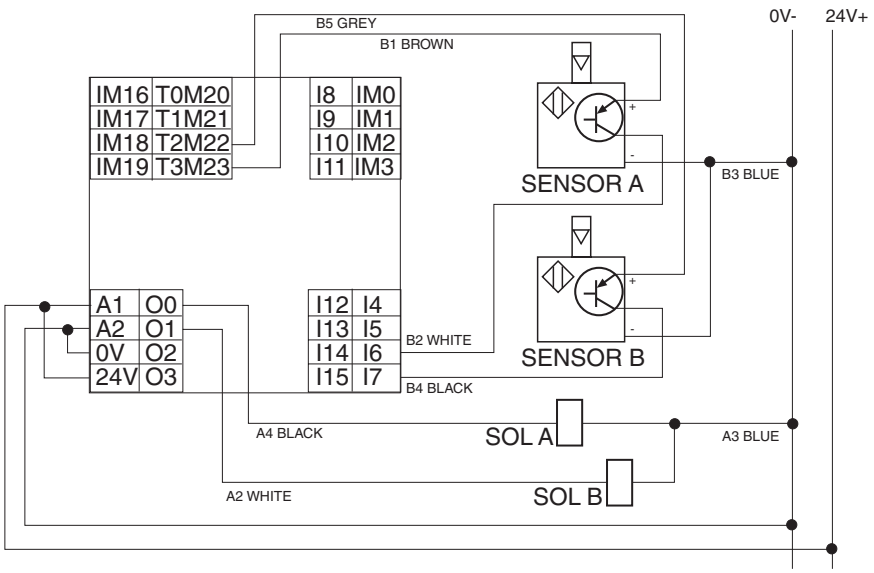


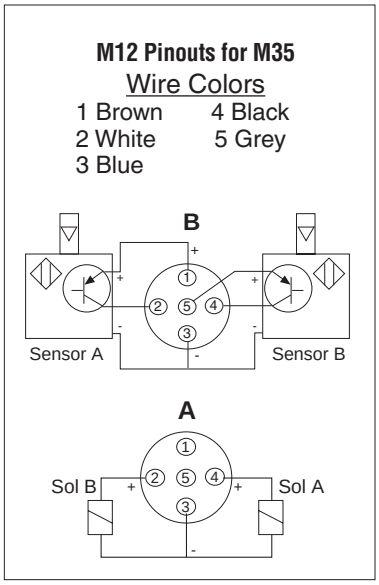


Integration Guide for Pilz PNOZ

Pilz Wiring Schematic (with sensor test pulse) to interface to Safety Exhaust Valve

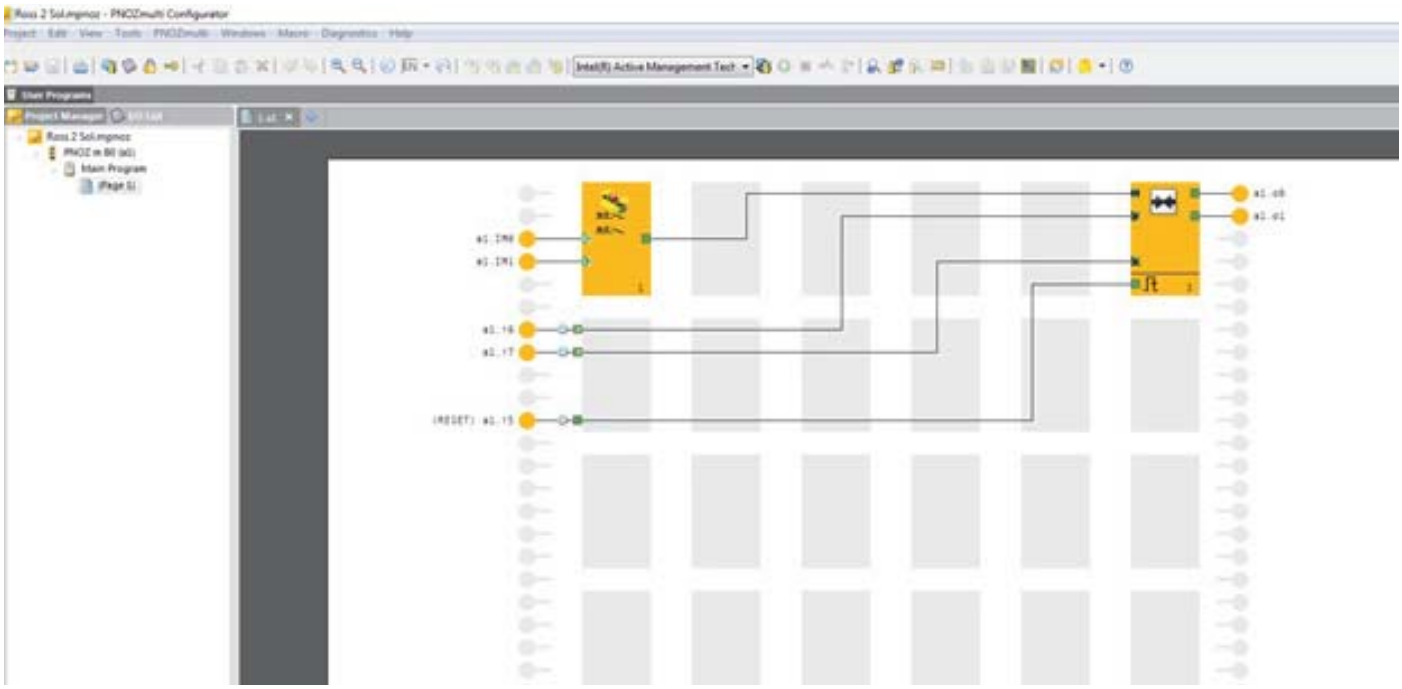
With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.





Pilz - Program*

Contains pinouts; these can vary based on wiring, i.e., feedback listed as I6 & I7, could be I4, I5, I6, or I7



* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

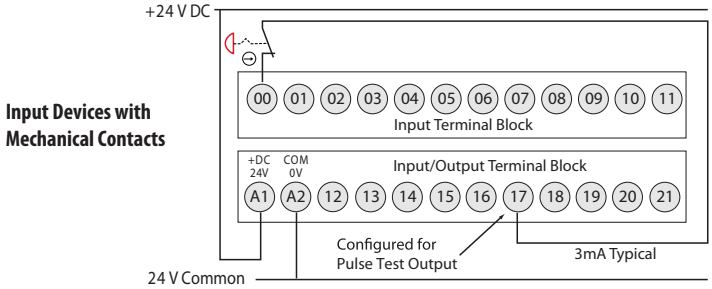
Integration Guide for Rockwell 440C-CR30

Rockwell 440C-CR30

Part Number: 440C-CR30-22BBB
Functional Safety Rating: Cat 4, PL e

- Software configured safety relay
- 22 safety I/O with embedded serial port
- USB programming port
- 2 plug-in slots
- 24 V DC

Generic Connection Example (from Rockwell Catalog):



Circuit Status

The E-stop is released and all output devices D1....D4 are OFF. The Feedback Closed indicator is ON.

Operational Sequence

1. Press the Reset button.
   All four output devices D1....D4 turn ON and the Feedback Closed indicator turns OFF.
2. Press the E-stop button.
   All four output devices D1....D4 turn OFF and the Feedback Closed indicator turns ON.

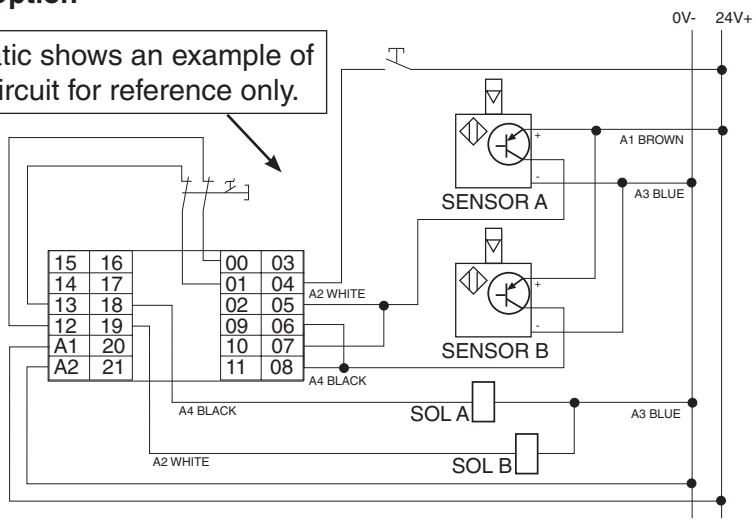
With a short circuit across one of the output device contacts:

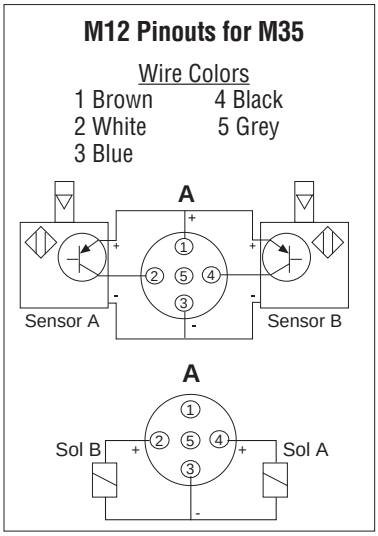
1. Press the Reset button.
   All four output devices D1....D4 turn ON and the Feedback Closed indicator remains ON.
   After approximately 50 ms, the output devices D1....D4 turn OFF and the Feedback Closed indicator remains ON.

Each time the reset button is pressed, the output turns ON momentarily and then turns OFF. The CR30 Safety relay detects the short circuit with the XOR logic in the LL2A function block. This block allows either the Feedback_OK or Feedback_Fault to turn on the output devices, but not both signals.

Rockwell Wiring Schematic (without sensor test pulse) to Interface to Safety Exhaust Valve (AA) Wiring Option

This schematic shows an example of an e-stop circuit for reference only.



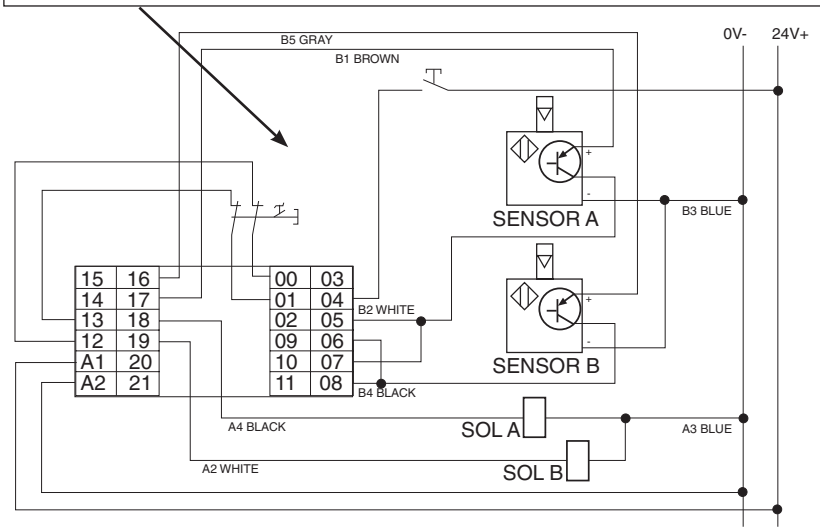


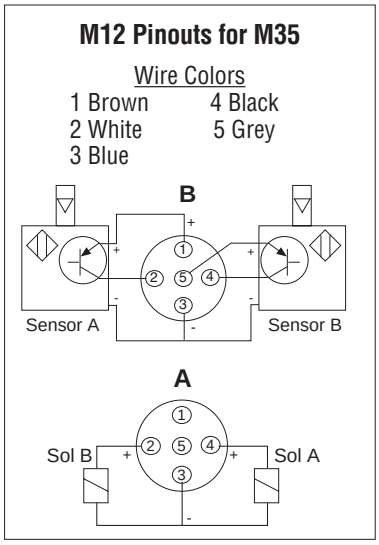
With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.

Integration Guide for Rockwell 440C-CR30

Rockwell Wiring Schematic (with sensor test pulse) to Interface to Safety Exhaust Valve (BA) Wiring Option

This schematic shows an example of an e-stop circuit for reference only

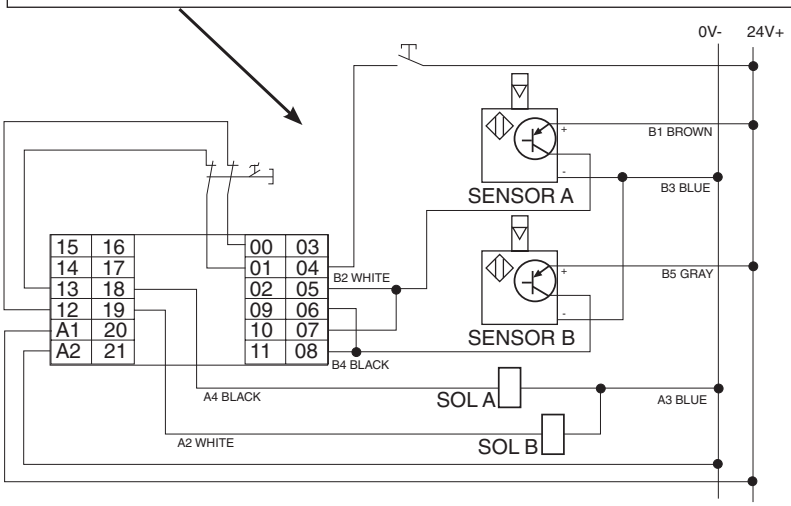


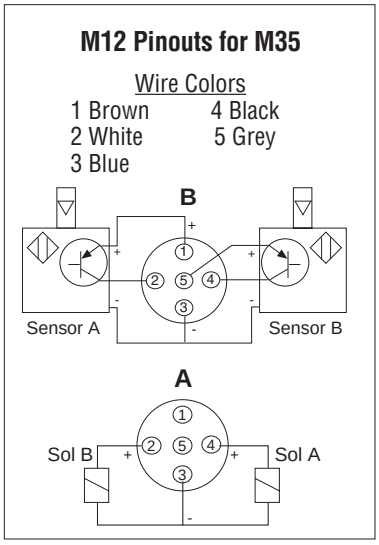


With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.

Rockwell Wiring Schematic (without sensor test pulse) to Interface to Safety Exhaust Valve (BA) Wiring Option

This schematic shows an example of an e-stop circuit for reference only





With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.

Rockwell - Program*

External monitoring program:

a) IF I.5 = I.6 = I.4 THEN set O.18 = O.19 = 1.

b) Sensor discrepancy error: I.5 <> I.6 (max. discrepancy time = 150 msec).

c) Loss of pressure error: I.7 = I.8 = 0 AND O.18 = O.19=1 followed by I.7=I.8=O.18=O.19=1.

d) IF sensor discrepancy error OR loss of pressure error THEN reset O.18 = O.19 =0.

Errors must be reset only after maintenance acknowledgement.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

Integration Guide for Applications Using a Safety PLC for External Monitoring and Safe IO

(for applications requiring Cat 4, PL e)

Integration Guide for Rockwell 1732ES-IB8XOB8

Rockwell 1732ES-IB8XOB8

Part Number: 1732ES-IB9X0B8

Functional Safety Rating: Cat 4, PL e

- Uses M12
- Direct M12 cable
- Central or IO modules
- Dual output

The Guard I/O modules implement the CPI Safety protocol extensions over EterNET/IP networks and provide various features for a safety system.

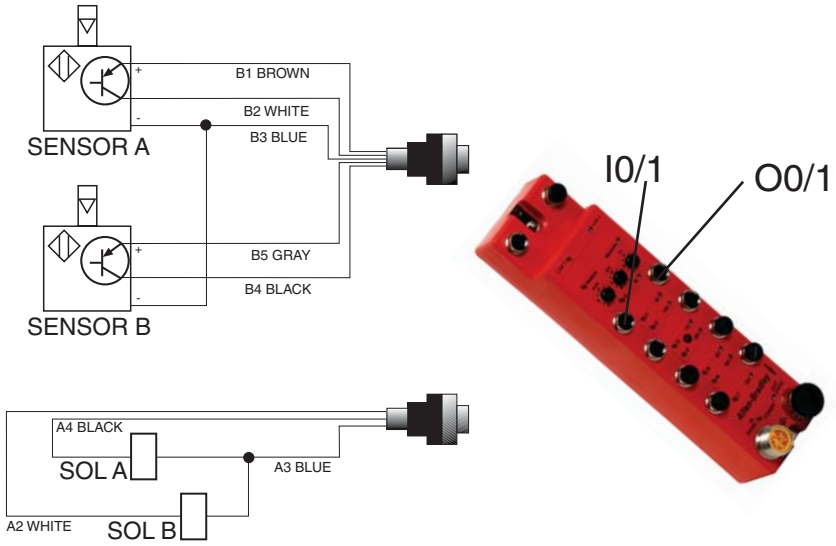
Use the module to construct a safety-control network system that meets the following requirements, up to and including:

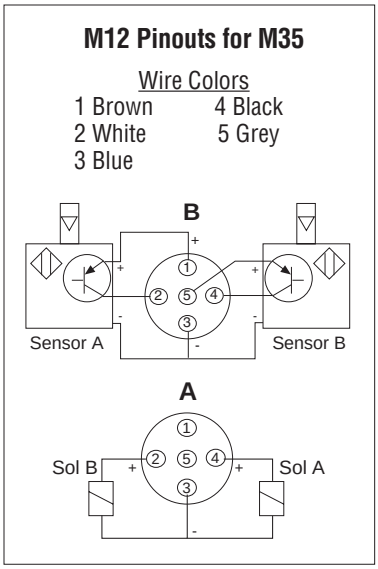
Safety Integrity Level Claim Limit 3 (SIL CL 3), as defined in IEC 61508

Category 4 (CAT.4), Performance Level e (PLe), as defined in ISO-13849-1

Rockwell 1732ES-IB8XOB8 Wiring Schematic (from Rockwell Catalog) to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.





Rockwell - Program*

External monitoring program:

a) IF I.0 = I.1 = 1 THEN set O.0 = O.1 = 1 when commanded.

b) Sensor discrepancy error: I.0 <> I.1 (max. discrepancy time = 150 msec).

c) Loss of pressure error: I.0 = I.1 = 0 AND O.0 = O.1=1 followed by I.0=I.1=O.0=O.1=1.

d) IF sensor discrepancy error OR loss of pressure error THEN reset O.0 = O.1=0.

Errors must be reset only after maintenance acknowledgement.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

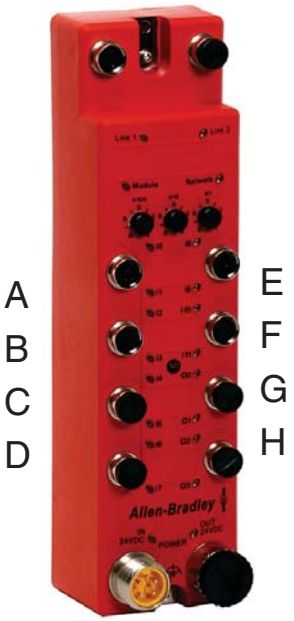
Integration Guide for Rockwell 1732ES- IB8X0BV4

Rockwell 1732ES-IB8XOBV4

Part Number: 1732ES-IB8X0BV4

Functional Safety Rating: Cat 4, PL e

- Uses M12
- Direct M12 cable
- Central or IO modules
- Safe output



The Guard I/O modules implement the CPI Safety protocol extensions over EterNET/IP networks and provide various features for a safety system.

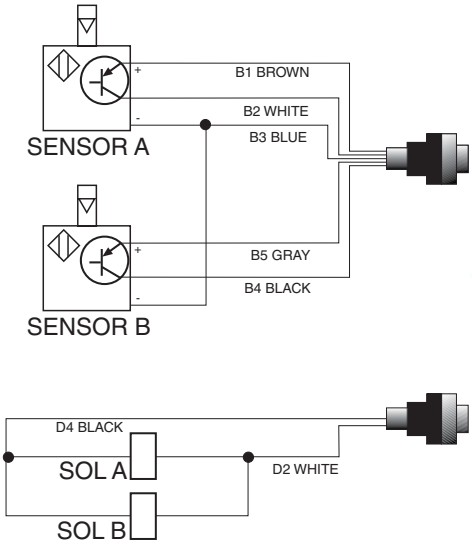
Use the module to construct a safety-control network system that meets the following requirements, up to and including:

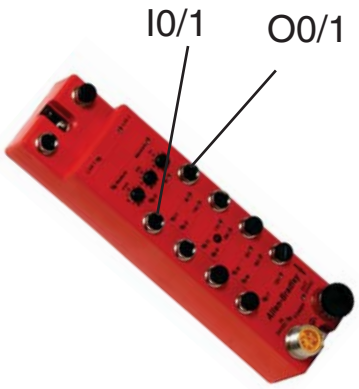
Safety Integrity Level Claim Limit 3 (SIL CL 3), as defined in IEC 61508

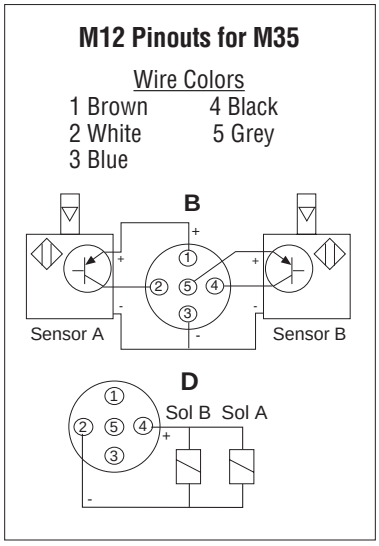
Category 4 (CAT.4), Performance Level e (PLe), as defined in ISO-13849-1

Rockwell 1732ES-IB8XOBV4 Wiring Schematic (from Rockwell Catalog) to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.







Rockwell - Program*

External monitoring program:

a) IF I.0 = I.1 = 1 THEN set O.0 = O.1 = 1 when commanded.

b) Sensor discrepancy error: I.0 <> I.1 (max. discrepancy time = 150 msec).

c) Loss of pressure error: I.0 = I.1 = 0 AND O.0 = O.1=1 followed by I.0=I.1=O.0=O.1=1.

d) IF sensor discrepancy error OR loss of pressure error THEN reset O.0 = O.1=0.

Errors must be reset only after maintenance acknowledgement.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

Integration Guide for Siemens ET200PRO Safe

Siemens ET200PRO Safe

Part Number: ET200PRO Safe

Functional Safety Rating: Cat 4, PL e

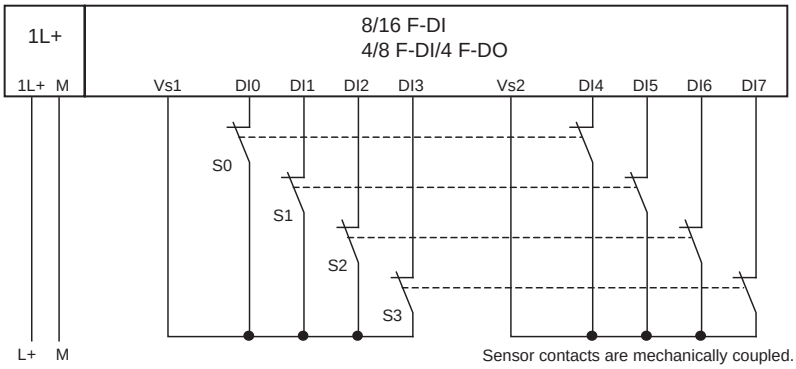
- Uses M12
- Direct M12 cable
- Central or IO modules

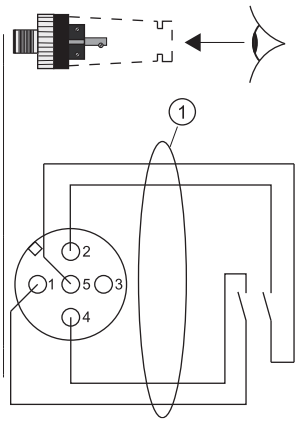
Examples include with and without pin outs and valve schematic

Generic Connection Example (from Siemens Catalog):

Wiring Diagram - Connecting One Two-Channel Sensor via Two Channels

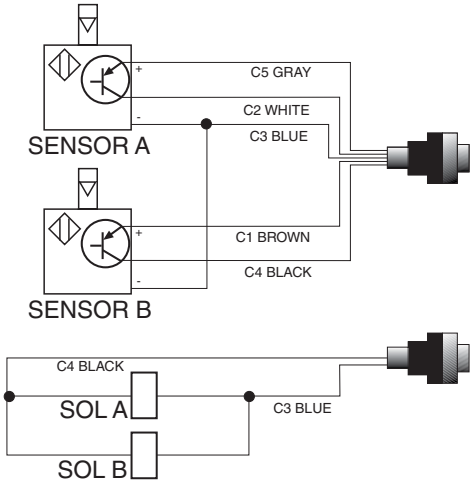
One two-channel sensor is connected via two channels to two inputs of the F-module fc
each process signal (1oo2 evaluation).
The wiring is carried out at the appropriate connection module.
The figure below illustrate an example wiring diagram for channel groups 1 and 2.

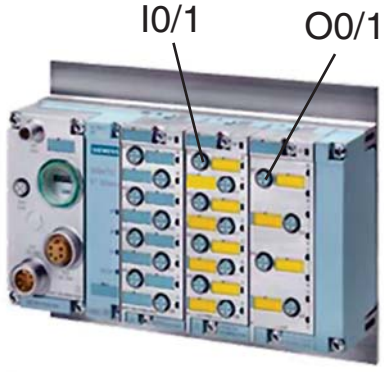


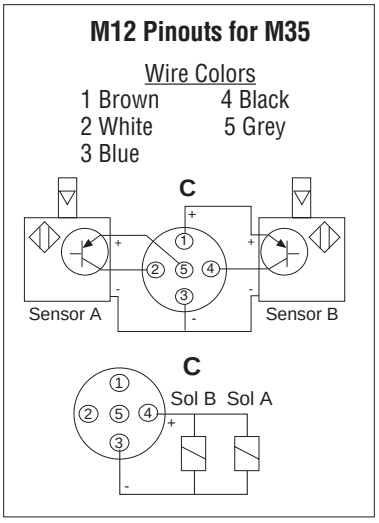


Siemens Wiring Schematic for ET200PRO Safe to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.







Siemens - Program*

External monitoring program:

a) Sensor error : I.0 <> I.1.
Adjust discrepancy time at 150 ms.

c) Feedback error : I.0 = I.1 = Out 0.
Adjust discrepancy time.

d) IF feedback or sensor error THEN reset Out 0.

Errors must be reset only after maintenance acknowledgement.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

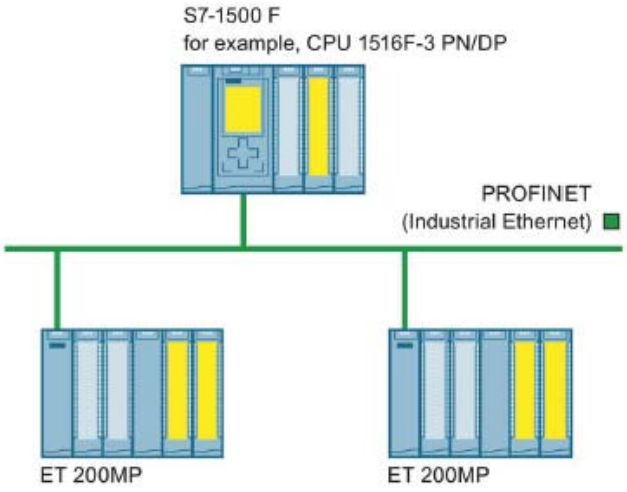
Integration Guide for Siemens Simatic S7

Siemens Simatic S7

Part Number: Simatic S7

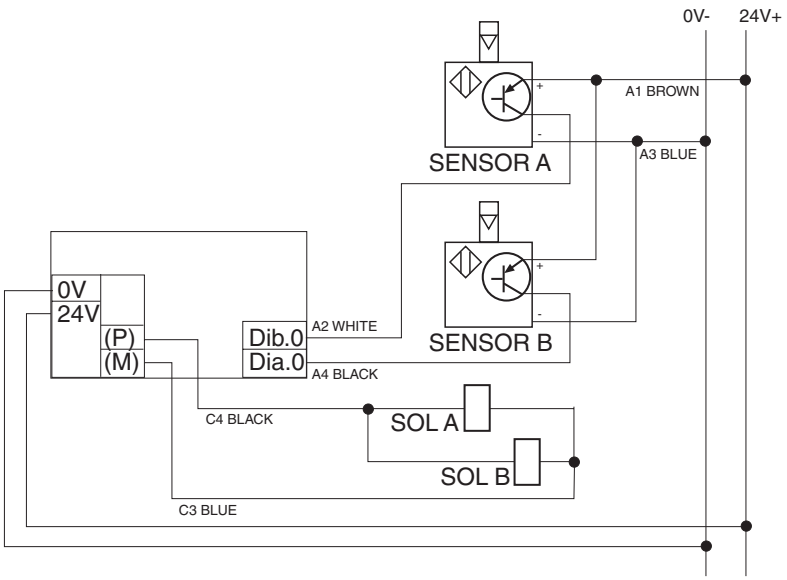
Functional Safety Rating: Cat 4, PL e

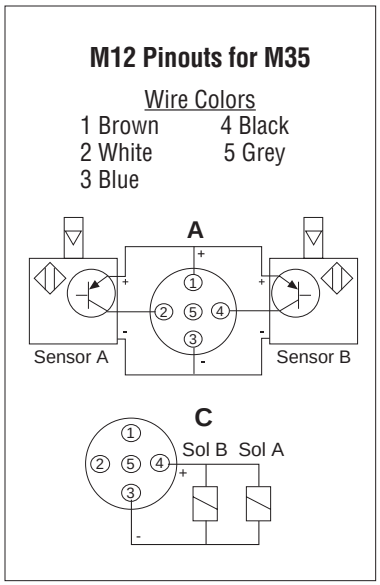
- Uses Terminals
- Customer will have colored wires
- Central or IO modules
- Examples include with and without pin outs and valve schematic



Siemens Wiring Schematic Safe Output without Sensor Test Pulse Version AC to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.

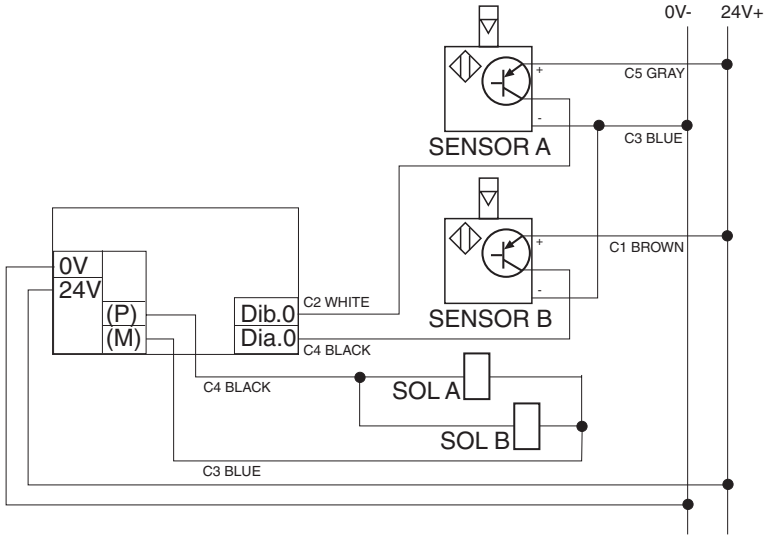


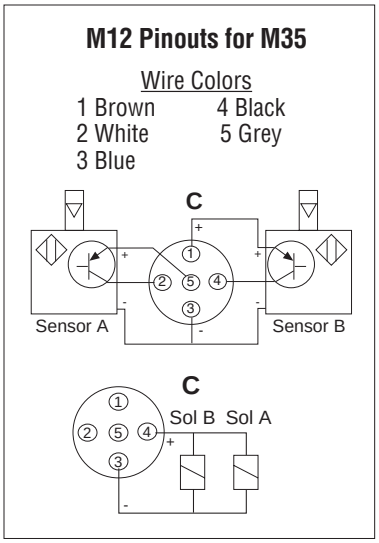


Integration Guide for Siemens Simatic S7

Siemens Wiring Schematic Safe Output without Sensor Test Pulse Version CC to Interface to Safety Exhaust Valve

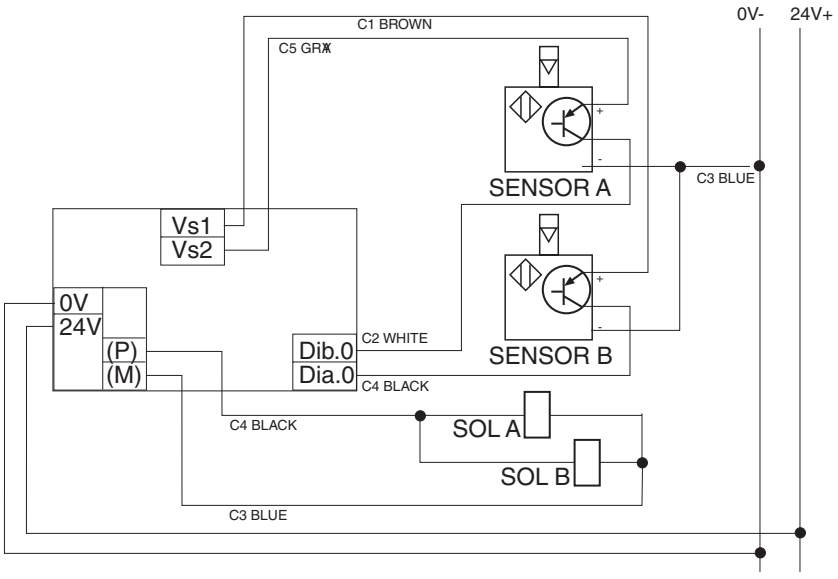
With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.

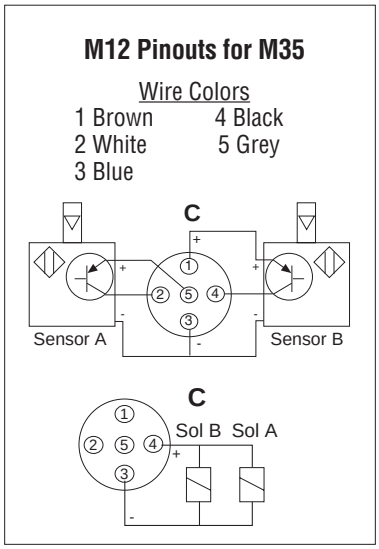




Siemens Wiring Schematic Safe Output with Sensor Test Pulse to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.





Siemens - Program*

External monitoring program

a) Sensor error : Dia.0 <> Dib.0.
Adjust discrepancy time at 150 ms.

b) Feedback error : Dia.0 = Dib.0 = Out 0.
Adjust discrepancy time.

c) IF feedback or sensor error THEN reset Out 0.
Errors must be reset only after maintenance acknowledgement.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

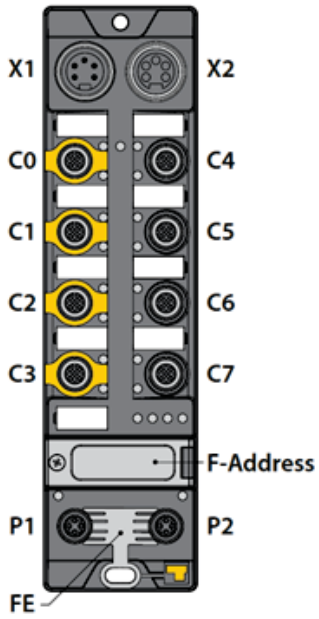
Integration Guide for Turck TBPN-L1-FDIO1-2IOL

Turck TBPN-L1-FDIO1-2IOL

Functional Safety Rating: Cat 4, PL e

- Uses M12 connections
- Direct M12 cables
- Central or IO modules

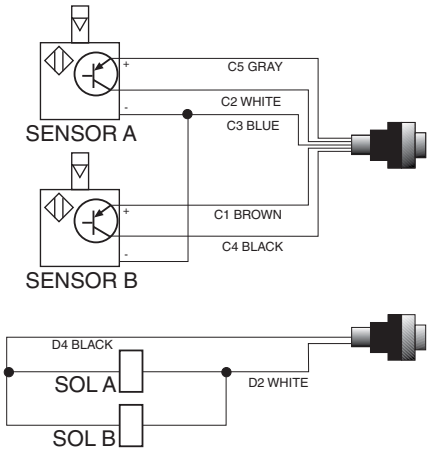
Generic Connection Example (from Siemens Catalog):

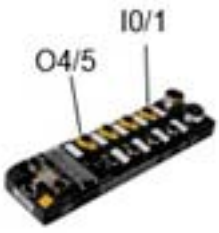


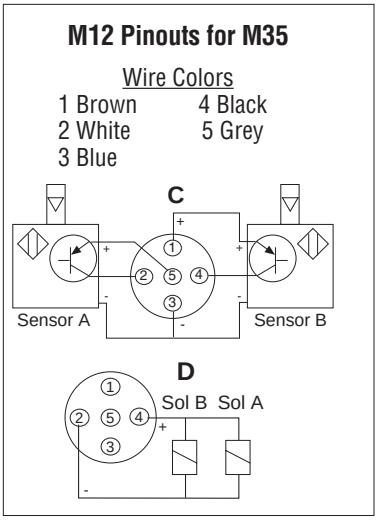
Meaning	Power IN
X2	Power OUT
C0	FDI0/1, safety input
C1	FDI2/3, safety input
C2	FDX4/5, safety in-/output
C3	FDX6/7, safety in-/output
C4	DXP8/9, standard in-/outputs (safe shutdown via FSO0)
C5	DXP10/11, standard in-/outputs (safe shutdown via FSO0 possible)
C6	IOL, IO-Link port1
C7	IOL, IO-Link port2 (safe shutdown via FSO1 possible)
F-Address	Rotary coding switch for address setting for PROFIsafe (F-address setting)
P1	Ethernet 1
P2	Ethernet 2
FE	Functional earth

Turck Wiring Schematic TBPN-L1-FDIO1-2IOL to Interface to Safety Exhaust Valve

With this schematic it is possible to achieve up to Category 4, PL e if properly implemented.







Turck TBPN - Program*

External monitoring program:

a) Sensor error : I.0 <> I.1.
Adjust discrepancy time at 150 ms.

b) Feedback error : I.0 = I.1 = Out 4.
Adjust discrepancy time.

c) IF feedback or sensor error THEN reset Out 4.
Errors must be reset only after maintenance acknowledgement.

* Programs provided in this integration guide are for reference only. These programs have not been certified or tested unless stated otherwise.

CAUTIONS, WARNINGS and STANDARD WARRANTY

PRE-INSTALLATION or SERVICE

1. Before servicing a valve or other pneumatic component, be sure that all sources of energy are turned off, the entire pneumatic system is shut off and exhausted, and all power sources are locked out (ref: OSHA 1910.147, EN 1037).

2. All ROSS products, including service kits and parts, should be installed and/or serviced only by persons having training and experience with pneumatic equipment. Because any installation can be tampered with or need servicing after installation, persons responsible for the safety of others or the care of equipment must check every installation on a regular basis and perform all necessary maintenance.

3. All applicable instructions should be read and complied with before using any fluid power system in order to prevent harm to persons or equipment. In addition, overhauled or serviced valves must be functionally tested prior to installation and use.

4. Each ROSS product should be used within its specification limits. In addition, use only ROSS parts to repair ROSS products.

WARNING: Failure to follow these directions can adversely affect the performance of the product or result in the potential for human injury or damage to property.

FILTRATION and LUBRICATION

5. Dirt, scale, moisture, etc. are present in virtually every air system. Although some valves are more tolerant of these contaminants than others, best performance will be realized if a filter is installed to clean the air supply, thus preventing contaminants from interfering with the proper performance of the equipment. ROSS recommends a filter with a 5-micron rating for normal applications.

6. All standard ROSS filters and lubricators with polycarbonate plastic bowls are designed for compressed air applications only. Do *not* fail to use the metal bowl guard, where provided, to minimize danger from high pressure fragmentation in the event of bowl failure. Do not expose these products to certain fluids, such as alcohol or liquefied petroleum gas, as they can cause bowls to rupture, creating a combustible condition, hazardous leakage, and the potential for human injury or damage to property. Immediately replace a crazed, cracked, or deteriorated bowl. When bowl gets dirty, replace it or wipe it with a clean dry cloth.

7. Only use lubricants which are compatible with materials used in the valves and other components in the system. Normally, compatible lubricants are petroleum based oils with oxidation inhibitors, an aniline point between 180°F (82°C) and 220°F (104°C), and an ISO 32, or lighter, viscosity. Avoid oils with phosphate type additives which can harm polyurethane components, potentially leading to valve failure which risks human injury, and/or damage to property.

AVOID INTAKE/EXHAUST RESTRICTION

8. Do not restrict the air flow in the supply line. To do so could reduce the pressure of the supply air below the minimum requirements for the valve and thereby cause erratic action.

9. Do not restrict a valve's exhaust port as this can adversely affect its operation. Exhaust silencers must be resistant to clogging and must have flow capacities at least as great as the exhaust capacities of the valves. Contamination of the silencer can result in reduced flow and increased back pressure.

WARNING: ROSS expressly disclaims all warranties and responsibility for any unsatisfactory performance or injuries caused by the use of the wrong type, wrong size, or an inadequately maintained silencer installed with a ROSS product.

POWER PRESSES

10. Mechanical power presses and other potentially hazardous machinery using a pneumatically controlled clutch and brake mechanism must use a press control double valve with a monitoring device. A double valve without a self-contained monitoring device should be used only in conjunction with a control system which assures monitoring of the valve. All double valve installations involving hazardous applications should incorporate a monitoring system which inhibits further operation of the valve and machine in the event of a failure within the valve mechanism.

ENERGY ISOLATION/EMERGENCY STOP

11. Per specifications and regulations, ROSS **L-O-X®** and **L-O-X®** with **EEZ-ON®** operation products are defined as energy isolation devices, NOT AS EMERGENCY STOP DEVICES.

STANDARD WARRANTY

All products sold by ROSS CONTROLS are warranted for a one-year period [with the exception of all Filters, Regulators and Lubricators ("FRLs") which are warranted for a period of seven years] from the date of purchase to be free of defects in material and workmanship. ROSS' obligation under this warranty is limited to repair or replacement of the product or refund of the purchase price paid solely at the discretion of ROSS and provided such product is returned to ROSS freight prepaid and upon examination by ROSS is found to be defective. This warranty becomes void in the event that product has been subject to misuse, misapplication, improper maintenance, modification or tampering.

THE WARRANTY EXPRESSED ABOVE IS IN LIEU OF AND EXCLUSIVE OF ALL OTHER WARRANTIES AND ROSS EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES EITHER EXPRESSED OR IMPLIED WITH RESPECT TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ROSS MAKES NO WARRANTY WITH RESPECT TO ITS PRODUCTS MEETING THE PROVISIONS OF ANY GOVERNMENTAL OCCUPATIONAL SAFETY AND/OR HEALTH LAWS OR REGULATIONS. IN NO EVENT IS ROSS LIABLE TO PURCHASER, USER, THEIR EMPLOYEES OR OTHERS FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A BREACH OF THE WARRANTY DESCRIBED ABOVE OR THE USE OR MISUSE OF THE PRODUCTS. NO STATEMENT OF ANY REPRESENTATIVE OR EMPLOYEE OF ROSS MAY EXTEND THE LIABILITY OF ROSS AS SET FORTH HEREIN.

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