



INSTRUCTION MANUAL

Door Interrupt System With FYQLA1-140R-3 Logic Amplifier Original Instructions



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Introduction

Congratulations!

You have chosen a device manufactured by Pepperl+Fuchs. Pepperl+Fuchs develops, produces and distributes electronic sensors and interface modules for the market of automation technology on a worldwide scale.

Before you install this device and put it into operation, please read the instructions thoroughly. The instructions and notes contained in this operating manual will guide you step-by-step through the installation and commissioning procedures to ensure trouble-free use of this product. By doing so, you:

- Can utilize the entire range of device functions
- Reduce costs from downtime
- Increase the effectiveness and operating efficiency of your machine

Store this instruction manual somewhere safe in order to have it available for future reference. Directly after opening the packaging, please ensure that the device is intact and that the package is complete.

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Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

Contact

If you have any questions about the device, its functions, or accessories, please contact your local Pepperl+Fuchs representative.

Declaration of conformity

The FYQLA1-140R-3 was developed and manufactured compliant with the applicable standards and guidelines.



Note



A corresponding declaration of conformity may be requested from the manufacturer.

Information regarding EC conformity

Pepperl+Fuchs declares that the product described in this manual conforms with EC Directives by providing the following information:

Manufacturer	Pepperl+Fuchs GmbH, Lilienthalstraße 200, 68307 Mannheim, Germany, www.pepperl-fuchs.com
Declaration of conformity	www.pepperl-fuchs.com
Directives observed	2006/42/EC (Machinery Directive) 2014/30/EU (EMC Directive) 2014/35/EU (Low Voltage Directive)
Standards observed	EN ISO 13849-1:2015, EN 60664-1:2008, EN 61326-1:2012, EN 61326-3-2:2008
Documentation officer	Pepperl+Fuchs GmbH, Lilienthalstraße 200, D-68307 Mannheim, Germany

Document purpose

Scope

The purpose of this document is to give the user the required information to properly apply and install the door interrupt system. The product model covered under this document includes the FYQLA1-140R-3.

Delivery

Included in the delivery:

- 1 - FYQLA1-140R-3 logic amplifier
- 10 - 22 k resistors
- 1 - Instruction manual



Note

**Must be used with approved devices that are sold separately.
See page 12.**

Definitions

- **Input Device** – Externally mounted dual-channel switching device
- **Input** – Dual channel, redundant monitoring port
- **Qualified Personnel** – Persons trained in the use of the product, machinery, and system

Symbols used



Warning

This symbol warns of a danger.

Failure to observe this warning may result in personal injury or death, property damage or destruction.



Attention

This symbol warns of a possible fault.

Failure to observe the instructions given in this warning may result in the device and any facilities or systems connected to it developing a fault or even failing completely.



Note

This symbol draws your attention to important information.

General statements

Qualified personnel

The door interrupt system is a safety product. However, just adding the door interrupt system to a machine or process will not meet safety standards.

Functional Safety Management (FSM), considering a full lifecycle approach, must be used to guarantee functional safety. Competence is essential in the delivery of functional safety. The application must be planned by qualified personnel that know how to apply the necessary standards and regulations.

The door interrupt system must be installed by qualified personnel who are properly trained in the installation and usage of the FYQLA1-140R-3 product. These persons must have access to all instructions and knowledge of all required safety requirements regarding the application of such devices and machinery equipment.

Requirements:

- Manual must be read by persons using this equipment
- Device users must be trained and qualified in the use of safety-rated devices
- Users must learn and follow all the safety rules and operating principles in this manual
- Users must follow all warnings, cautions, and other safety messages in this manual
- Only original spare parts from Pepperl+Fuchs may be used for repairs
- The unit contains no user serviceable parts

Intended use

The door interrupt system monitors up to six input devices. The external devices are individually wired to the system and the signals are evaluated to determine if one of the input devices is in the open state.



Note

The FYQLA1-140R-3 must be used in accordance with its intended purpose. The system must be installed according to regulations for safeguarding from hazardous locations or areas being entered, or as a safety relay for safety components appropriate for the described conditions. When used differently, the intended function of the system is not guaranteed. Appropriate measures should be taken such that any foreseeable misuse is prevented.

Safety system test



Warning

Only a qualified trained person should perform this test. Any problems detected as a result of this test must be repaired by qualified personnel before operating the equipment! DO NOT operate the equipment if problems are detected or serious injury could result!

The purpose of this test is to verify the function of each switch and control component in the safety system. The person performing the test should be familiar with the different guards and controls on the equipment. This test should be performed daily. If the machine is not in continuous operation, test before each use. See the **Daily inspection** flow diagram, pages 8-9.

Regular maintenance testing

It is recommended to test the door interrupt system regularly to verify proper operation on a daily schedule. These should be performed and documented by qualified personnel. See test sequence, **Daily inspection**, pages 8-9.



Warning

This safety device and associated equipment should be tested regularly by qualified personnel familiar with the principles and procedures in this manual. If the testing indicates a problem with this device or system, the equipment is not safe to operate. Call qualified personnel immediately to locate and repair the fault.



Warning

This safety device and associated equipment should be tested when any change or modification is done to the device and/or setup by qualified personnel familiar with the principles and procedures in this manual. If the testing indicates a problem with this device or system, the equipment is not safe to operate. Call qualified personnel immediately to locate and repair the fault.

Product description

Features

The FYQLA1-140R-3 is a category 3 PL d(ISO 13849-1:2015) logic amplifier.

The basic features of the FYQLA1-140R-3 include inputs for up to six individual two-channel switches for monitoring door access or guarded/monitored functions. Both channels are monitored and cross checked for proper operational switch states. The safety function monitors all switches, and they must have closed state conditions on both channels to allow the safety relay output to be energized.

- Monitored inputs (6)
- N.O. output relay contact
- Internal relay monitoring
- Screw terminals
- LED input indicators
- LED fault indicator
- LED relay status indicators
- LED relay power indicator

Together with the 50FY41 series sensors and 52FY31 series actuators, the FYQLA1-140R-3 can be used to protect one or more points of hazardous areas.

Functions

Power-up sequence

After power is applied to the system, an internal system check is performed verifying the functional logic and connected switch conditions. If any errors are detected at power-up, the safety output relays will remain in the de-energized state. Time to complete this internal verification is approximately two to three seconds.

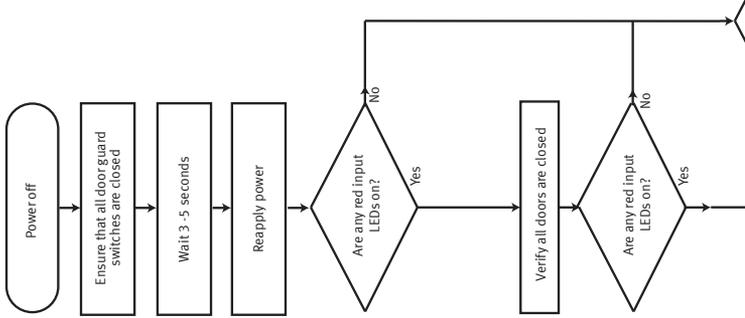
Power-up state (output relay energized):

- All internal function checks were verified and all input switch states are in the closed position

Power-up state safety function (output relay de-energized):

- All internal function checks were verified, but one or more input switch states are in the open position
- One or more internal function checks fail

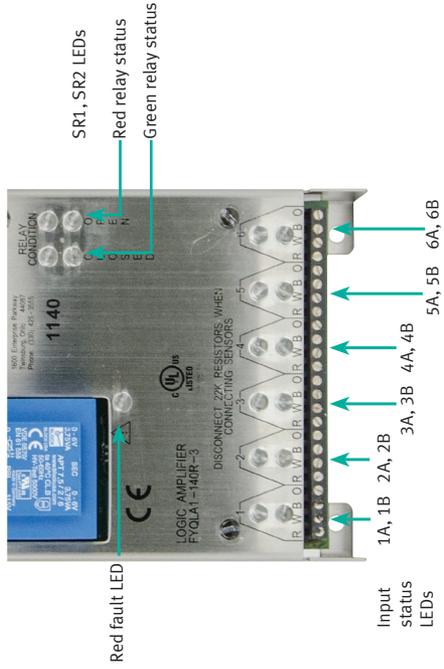
Daily inspection



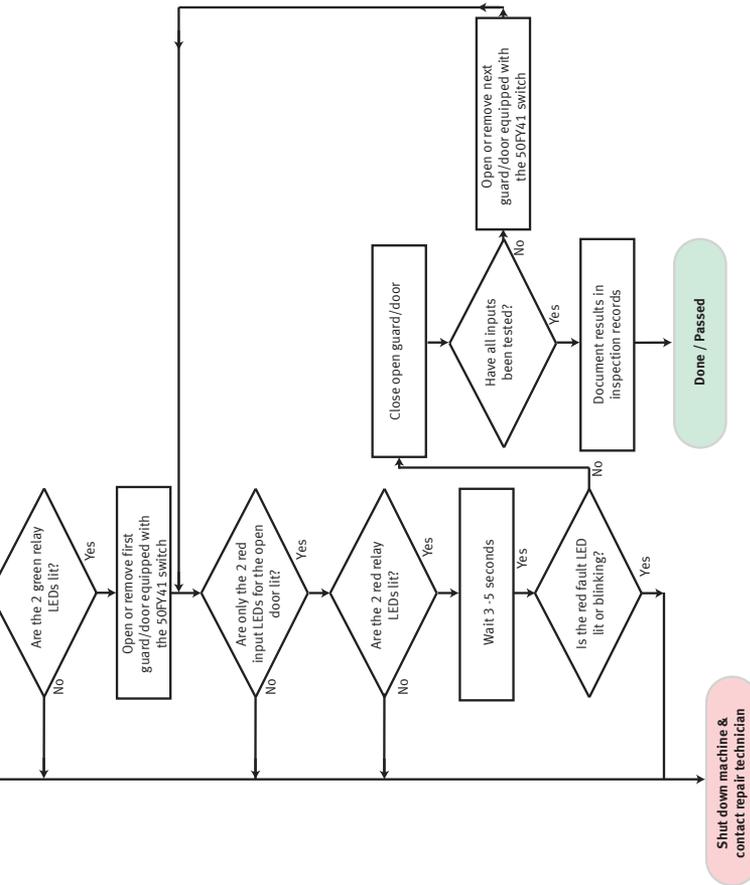
▶ Green LED
■ Red LED

Description	SRT1 Grn LED	SR2 Grn LED	SRT1 Red LED	SR2 Red LED	Input 1a LED	Input 1b LED	Input 2a LED	Input 2b LED	Input 3a LED	Input 3b LED	Input 4a LED	Input 4b LED	Input 5a LED	Input 5b LED	Input 6a LED	Input 6b LED	Fault LEDs
All guards closed	▶	▶	■	■													
Only input 1 open			■	■	■	■											■
Only input 2 open			■	■		■	■										■
Only input 3 open			■	■				■	■								■
Only input 4 open			■	■						■	■						■
Only input 5 open			■	■								■	■				■
Only input 6 open			■	■										■	■		■

Off at all times other than momentarily at power up



Door Interrupt System with FYQLA1-140R-3 Logic Amplifier



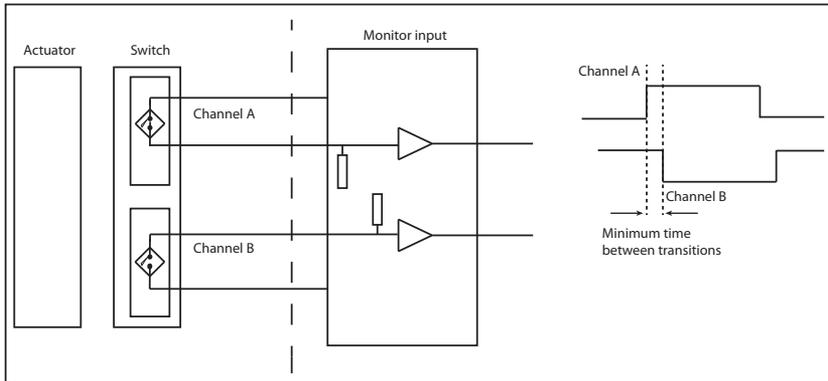
Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

System inputs

The six device inputs allow the user to monitor up to six functional switch devices. Each device must have two channels of output, one sourcing output and one sinking output. These outputs must operate in tandem for a valid switch function to be recognized by the FYQLA1-140R-3. If the output channels of the switches are not functioning in a synchronized manner the amplifier will not accept the switch closure as a valid. The allowable timing between closure of switch channel A and channel B is approximately one second. If any given pair of switch channels does not transition to the proper state in the minimum time, then the monitor will issue a fault on that switch channel and prevent the output from closing.

Reset faulted state

If an invalid door switch sequence is detected by the Channel A and Channel B synchronization, the output safety relays will open and red fault LED will blink. Reset is accomplished by a power down/power up sequence.



Output relays to de-energize equipment



Attention

When an invalid input condition is recognized by the door interrupt system, the output safety relay will be de-energized. This will cause the relay contact pair to open. Be sure to verify the contact power ratings when applying these relay outputs to energize/de-energize associated equipment.

Hardware

Inputs

- Six switch inputs compatible with dual channel devices
 - ▶ Pepperl+Fuchs' 50FY41 series magnetic sensors

Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

Indicators

The FYQLA1-140R-3 has indicators on front of the device for the following functions:

- State of the connected input switches
 - ▶ Two indicators per switch input (channel A & channel B)
 - ▶ Indicator is illuminated (on) when the switch state is open
- Relay output status
 - ▶ Two indicators available, one per relay state:
 - Red indicator illuminated when de-energized
 - Green indicator illuminated when energized
- Fault Indicator
 - ▶ Fault indicator flashes under the following conditions:
 - Input switch sequence error (channel A and channel B timing)
 - Output relay contact monitor fault

Indicator status table

Condition		Switch Status		Relay 1 Status		Relay 2 Status		Red Fault LEDs	SR1 Contact Status
		Red Channel 1 LED	Red Channel 2 LED	Red Open LED	Green Closed LED	Red Open LED	Green Closed LED		
Normal Operation	Door Sensor Open	■	■	■		■			
	Door Sensor Closed				▲		▲		
Faults	Door Sensor Fault ¹	■	■	■		■			
	Relay 1 Welded Contact Fault ²				▲	■			
	Relay 2 Welded Contact Fault ²			■			▲		
	Internal Relay Fault ²			■		■			
Power Off									

- 1) Indicator status changes to fault 1-2 seconds after input sequence fault is detected
 2) Fault may require the next operational cycle to start before fault is indicated

 Green LED ON	 Red BLINKING	 OPEN
 Red LED ON	 OFF	 CLOSED

Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

Guided relays

The door interrupt system incorporates two force-guided safety relays that are monitored for proper operation and generate a redundant output for application use.

Input devices

Magnetic switches

The 50FY41 series hall effect door switches are a noncontact, magnetic actuation system consisting of a sensor and a magnetically keyed actuator. The sensor contains two hall-effect integrated circuits that are connected independently. When exposed to this magnetic actuator and properly aligned, the sensor responds with an output.

Approved devices



- 50FY41 series Hall effect door interrupt sensor
- 52FY31 series Keyed hall effect magnetic-actuator

NOTE: These are the only approved devices that should be used.

50FY41 sensor alignment



Attention

Ensure the alignment of the sensor and magnetic actuator are correct for proper operation. A 10 mm (0.39 in) separation distance between sensor and actuator will cause an OFF condition, independent of axial offset distance.

Cable length

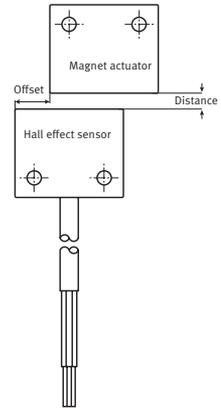


Attention

Sensor cable length must not exceed 25 m (80 ft).

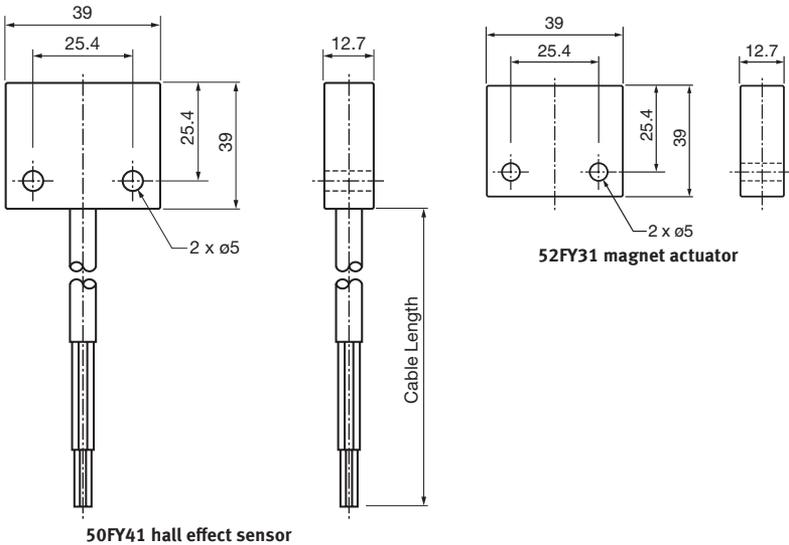
Nominal offset distances

Sensing distance mm (in)		
Offset	Max. Actuator Distance	Off Distance
0 (zero)	2.5 (0.1)	10 (0.4)
3.8 (0.15)	1.3 (0.05)	10 (0.4)
7.5 (0.3)	0 (zero)	10 (0.4)



Device dimensions

(for reference only—dimensions in mm)



Installation

Installation requirements

Panel mounted inside an enclosure using the four mounting feet in the stainless steel housing. The FYQLA1-140R-3 is intended to be installed in a clean and dry environment. A control cabinet must be used to guarantee that the unit is exposed to no worse than an IP20 environment. The unit is designed to meet the requirements for industrial environments. Suitability for other environments cannot be ensured.



Clearance around device

Adequate clearance should be provided around the device to allow for proper cooling and ventilation of the control unit.

General safety notes

Installation and testing

After installation, the FYQLA1-140R-3 and all connected devices must be tested to ensure proper wiring and operation. All wiring should be verified before applying power to the unit. Once power is applied, each door switch should be opened to verify proper operation of the system.



Note

Periodic inspection and testing of the door interrupt system is recommended. The device must be cycled and safety operation verified once per day, or between equipment usage cycles. During this time, proper operation of the safety switches and the correct response of output safety relays must be verified. Inspection records of the performed inspections must be maintained.

Electrical installation



Warning

Switch the main machine power OFF prior to installation!
The machine could inadvertently start during installation.
The door interrupt system fulfills the EMC requirements in accordance with EN/IEC 61326-3-2:2008 for safety related systems.

Powering the device



Warning

The **FYQLA1-140R-3** is to be powered only with **120 VAC** with a supply tolerance of no greater than 15% and a frequency of 45-65 Hz.

All connected downstream devices and wiring/installation must correspond to the required category according to ISO 13849-1:2015.

Wiring requirements

- GREEN terminal block: Input supply power/Relay contact output
- BLACK terminals: CH1 ... CH 6, 50FY41 switch inputs



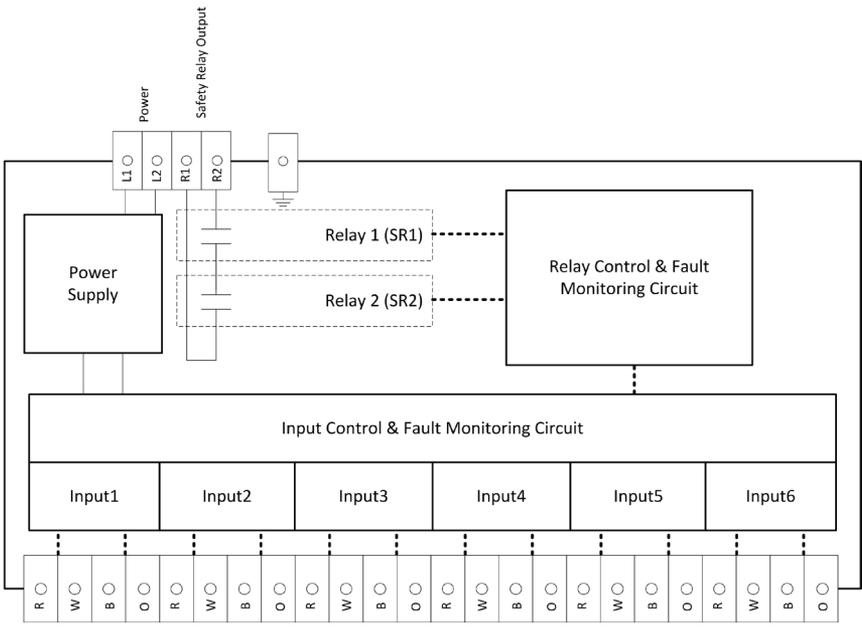
Warning

Improper installation

This product is designed to conform to the technical requirements of ISO 13849-1:2015. To ensure compliance with these requirements, 50FY41 series sensors and 52FY31 series actuators **MUST** be used with the FYQLA1-140R-3.

Consult with the local safety agency and its requirements when designing a machine control system, interface, and all control elements that affect safety. Strictly adhere to all installation instructions. **Failure to comply with these instructions could result in death or serious injury.**

Wiring diagram

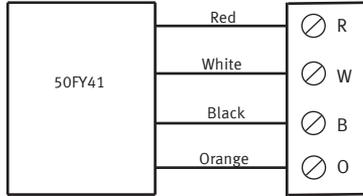


FYQLA1-140R-3

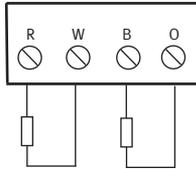
Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

Electrical connection

Monitor terminals	50FY41	Unused inputs
R (positive)	RED - positive	Use two, 22 K resistors (included)
W (normally open, sourcing)	WHITE - output	
B (negative)	BLACK - ground	
O (normally open, sinking)	ORANGE - output	



If less than six sensors are connected to the safety monitor, install two, 22 K resistors (one between R-W and one between B-O) into the unused inputs.



Warning

Do not connect or remove wires with power applied.

Commissioning and startup



Warning

Do not commission without a check by qualified safety personnel!

The door interrupt system must be installed by qualified personnel who are properly trained in the installation, application, and usage of the FYQLA1-140R-3 product.



Warning

You must ensure that no one is located in the hazardous area before commissioning!

Check the hazardous area and secure it so that people cannot enter. For example, set up warning signs, attach blocking ropes or similar. Observe the relevant laws and local regulations.

Validation of the application

You may commission the system only if all pretests were successful. Validation may be performed only by qualified personnel. The general acceptance comprises the following tests:

- Check whether the components used correspond to the required Performance Level in accordance with EN ISO 13849-1:2015.
- Check that the devices connected to the door interrupt system are in accordance with this user manual.
- Clearly mark all connection cables and plugs.
- Perform a complete verification of the safety functions of the system in each operating mode and error simulation. Observe the response times of the system in response to tested functions.

Diagnostics

Faults

The door interrupt system has multiple LEDs mounted on the top of the device to provide diagnostic and troubleshooting assistance. LEDs are provided for each switch input pair, indicating the status of the individual channel. Also provided are output LEDs indicating the status of each of the safety relays. In addition, a fault LED provides indication of when an input switch error has occurred, resulting in a fault condition and opening of the safety relay. Fault conditions can be cleared only upon power down-power up, of the door interrupt system.

Technical support

Troubleshooting

Problem	Probable cause	Remedy
No LEDs illuminated	No supply power	Verify incoming power is present
	Blown internal fuse	Verify input power is within spec, and then replace fuse
Fault LED is flashing and single LED is lit for a sensor input while actuated or de-actuated	Misaligned sensor and actuator	Check alignment and realign as needed
	Input screw terminal loose	Fully install screw terminal
	Defective sensor	See Fault diagnosis (next page) to help determine problems
	Internal failure in door switch monitor	
All inputs activated (all input LEDs are off) and the relays do not activate	Defective unit	Replace unit

Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

Fault diagnosis

If fault LED flashes and no sensor alignment problem can be found:

- Turn off power
- Unwire sensors from input terminals
- Power up unit
-

If fault LED begins to flash repeatedly after 2-3 seconds, the system needs to be replaced. If the fault LEDs do not begin to flash:

- Remove power, then wire one sensor (R,W,B,O) connection at a time. Apply power, waiting 2-3 seconds. Repeat sequence with all sensors until fault LED begins to flash. This will be the sensor/actuator that is generating the fault condition. Reevaluate alignment and terminal connections. If no problem is found, replace the sensor and/or actuator in question

Approvals

UL508



Product specifications

Input specifications	
FYQLA1-140R-3	120 VAC ± 15% <0.25A @ 45 to 65 Hz
Input devices	(6) dedicated noncontact hall effect door sensors (50FY41 series)
Switch voltage input	12 VDC (2 channel, sink/source)
Typical response time	20 ms (switch open to contact open)
Power up time	3 s
Output specifications	
Contact material	AgCuNi + 0.2 um Au
Continuous current	5 mA to 5 A (N.O. contact)
Relay type	1 relay output, force guided connection, normally open contacts
Inrush current (max)	30 A for 20 ms
Maximum switching characteristics (Determined acc. to EN60947-4-1/EN60947-5-1)	AC-1: 250 V/5 A (100,000 cycles) AC-15: 230 V/3 A (150,000 cycles) DC-1: 24 V/5 A (100,000 cycles)
External fusing should be added to protect the application and unit from unforeseen circumstances	DC-13: 24 V/1 A /0.1 Hz (100,000 cycles)

Product specifications (cont.)

Functional safety related parameters*	
Safety function	Relay output closed only when sensors activated by appropriate target
Safe state	Relay output open
Standards/regulations	ISO 13849-1 :2015/UL 508
Performance level acc. to ISO 13849-1	PL d
Structure acc. to ISO 13849-1	Category 3
MTTF _d (years)	75850
DC _d	98.6 %
PFH	2.06 x 10E ⁻⁷
CCF	5 %
T _M (years)	20
Pollution degree	2
Over-voltage category	(OC) II
Rated insulation voltage	250 V
Protection degree	IP20, Class 1 "indoor use only"
Housing material	304 stainless steel
Internal hardware diagnostic fault detection	< 4 s

*The following assumptions were made during the failure modes, effects, and diagnostic analysis (FMEDA) of the FYQLA1-140R-3:

- Failure rates are constant, wear out mechanisms are not included.
- Failure rates are based on the Siemens standard SN29500.
- Power supply failures are not included in the FMEDA, a loss of power introduces the safe state.
- It was assumed that the appearance of a safe error (e. g., output in safe state) would be repaired within 8 hours (e. g., remove sensor burnout).
- During the absence of the device for repairing, measures have to be taken to ensure the safety function (for example: substitution by an equivalent device).
- The stress levels are average for an industrial environment and can be compared to the Ground Fixed Classification of MIL-HDBK-217F. Alternatively, the assumed environment is similar to IEC 60654-1 Class C (sheltered location) with temperature limits within the manufacturer's rating and an average temperature over a long period of time of 40 °C. Humidity levels are assumed within manufacturer's rating. For a higher average temperature of 60 °C, the failure rates should be multiplied with an experience based factor of 2.5. A similar multiplier should be used if frequent temperature fluctuation must be assumed.

Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

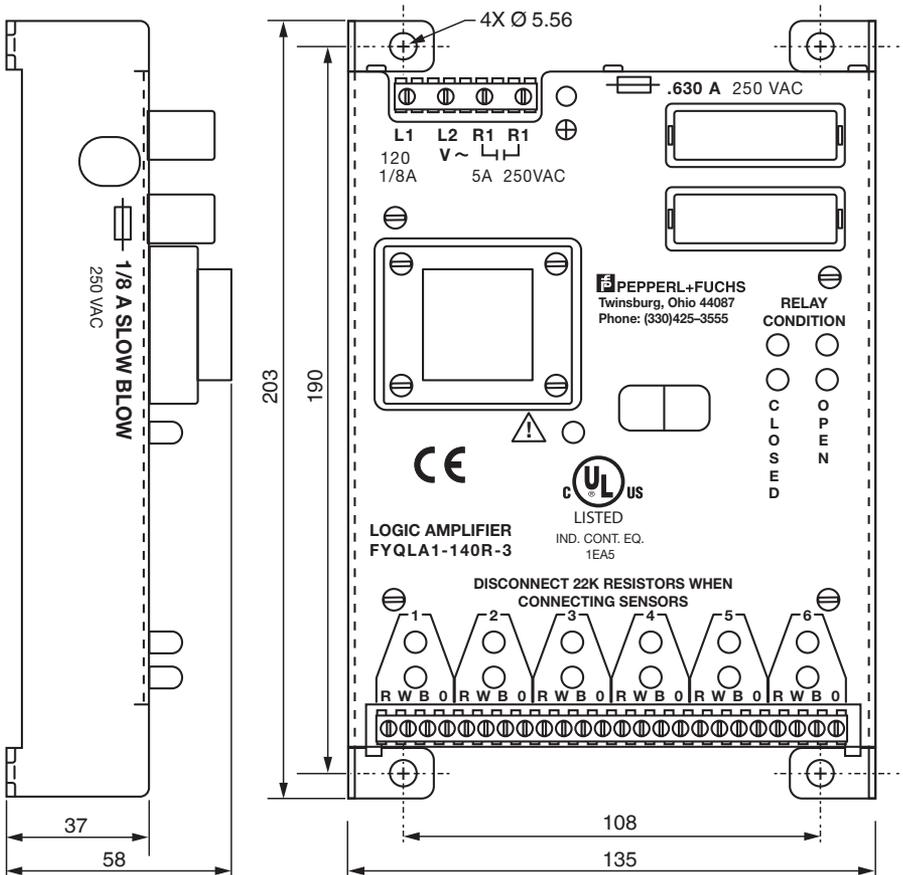
Product specifications (cont.)

Ambient conditions	
Operating temperature	-25 °C to +70 °C noncondensing
Storage temperature	-25 °C to +70 °C noncondensing
Terminal block - power and relays	
Conductor cross section capacity	0.2 mm ² to 2.5 mm ² (22 to 14 AWG) Cu
Tightening torque	0.5 Nm (4.5 lb-in)
Strip length	7 mm
Connection method	Terminal block - screw connection
Terminal block - sensor inputs	
Conductor cross section capacity	0.5 mm ² to 2.5 mm ² (22 to 14 AWG) Cu
Tightening torque	0.5 to 0.6 Nm (4.5 to 5.3 lb-in)
Strip length	6 mm
Connection method	Terminal block - screw connection
General data	
Dimensions - FYQLA1-140R-3	203.0 mm H x 135.0 mm W x 58.0 mm D
Mechanical service life (approx.)	> 1,000,000 operations
Indicators Sensor status Relay status Fault status	LED red, one per channel / two per input LED green (2), red (2) LED red, flashing (See indicator status table, pg 11, for indication definitions)

Door Interrupt System with FYQLA1-140R-3 Logic Amplifier

Dimensions

(for reference only—dimensions in mm)



Your automation, our passion.

Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity



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