Guardmaster Safedge Pressure Sensitive Safety Edge System Installation and User Manual

Bulletin Number 440F

Allen-Bradley
by ROCKWELL AUTOMATION

Guardmaster®

User Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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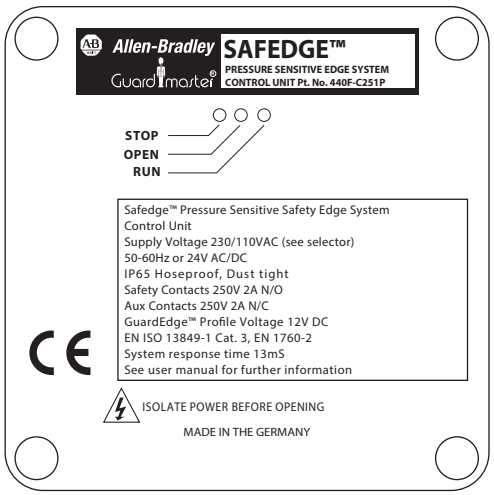
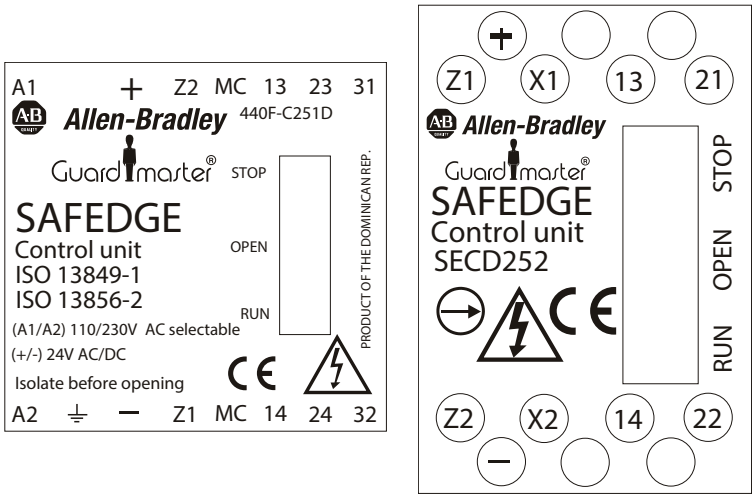
Product Overview

IMPORTANT Read this manual in full before installation. After installation, this manual must be retained in a safe and accessible place.



Surface Mounting



DIN Rail Mounting

The Safedge™ sensitive edge sensing system is ideal as a safety sensor in applications like power operated doors, automated vehicles, and moving machinery beds, for use when objects are detected by touch. It can provide a continuous line of high sensitivity touch sensing along or around practically anything.

System Description

The Safedge system consists of up to 50 meters of profile, a cable connector, a terminating resistor, a “C” rail and a control unit. The control unit can monitor lengths of up to 50 m (164 ft). All profiles have the same principle of operation.

This manual covers the use of the parts of the Safedge system. If joints or corners are required, contact your supplier. Suitably trained and qualified personnel must complete all installation work in accordance with statutory requirements for safety. For further assistance, please contact your supplier.

Storage and Handling

Storage

The Safedge control unit and profiles should be stored within the temperature range of -10...+55°C (-14...+131°F).

Handling and Transport

The Safedge control unit and profile should be transported within the temperature range of -10...+55°C (-14...+131°F) and should not be subjected to any impact or heavy loads. The original packaging should be used to give protection from excessive flexing.

Always unpack carefully and avoid damage that can result from rough handling or the use of knives, box cutters, and so on.

Safedge Selection

The following are the most important factors that influence the selection of a suitable pressure-sensitive edge or pressure-sensitive bar for a specific application.

- Category and performance level according to ISO 13849-1 as required for the application. These are based on the following:
  - the risk assessment for the particular application
  - the requirements of a relevant type-C standard.
- Hazard speed

  The speed at which the hazardous surface is moving. Normally, one surface is moving and the other is stationary. The maximum possible speed should be considered as the hazard speed. If both surfaces are moving, special consideration is required.
- Stopping travel of hazardous parts

  The distance traveled by the hazardous surfaces after the output signal switching device to the machine control system gives a stop signal. This travel depends on the hazard speed, the response time of the machine control system and the efficiency of the machine braking system. This travel can be calculated and/or measured. Where appropriate, a suitable safety factor should be used to account for brake deterioration, measurement tolerances, and so on.
- Recovery of the sensor after deformation

  On applications where the time between successive actuations of the sensor is less than 30 s. A sensor should be selected that recovers sufficiently for normal operation within the time available.

Selection Procedure

After deciding the category and the performance level according to ISO 13849-1, the procedure is as follows.

1. Determine the required operating speed and maximum hazard speed.

   If the maximum hazard speed is not given, it should be measured or calculated. The point in the travel at which the maximum speed occurs depends on the drive mechanism.

   The maximum operating speed of the device should be greater than the maximum hazard speed.

2. Determine the required minimum overtravel distance.

   Determine the stopping travel of the hazardous parts. If this distance is not given, it should be measured and/or calculated. The stopping travel multiplied by a suitable safety factor of at least 1, 2 gives the required minimum overtravel for the application. Where other factors exist, such as a braking system that is subject to deterioration, a higher safety factor should be used.

   A simple way to measure the stopping distance is to temporarily fit a position detection at a position close to where the maximum hazard speed occurs. Normally, closed contacts of this position detection should be connected into the machine control stop circuit at the point at which the output signal switching devices would be connected. The machine should be run several times in the worst anticipated conditions and the distance that is traveled beyond the actuating point of the position detection measured. The maximum distance that is measured should be regarded as the stopping distance.

3. Determine the maximum permissible force.

   When available, the maximum permissible force should be taken from a type-C standard for the specific machine or be in accordance with the risk assessment. The risk assessment should consider the body parts and types of persons to be protected, for example, children or elderly persons. The speed, shape, and material of the sensor and maximum pressure that the device exerts should also be considered. The maximum permissible force should be as low as possible.

4. Select the device.

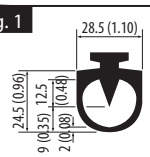
   Using the force/distance relationship data or diagrams that are provided by the manufacturer, select the safeguard with the required maximum operating speed that provides at least the required minimum overtravel distance before the maximum permissible force is reached.

   If a pressure-sensitive edge or pressure-sensitive bar with sufficient overtravel cannot be found, it can then be necessary to improve the stopping performance of the machine.

Safedge Profiles

Dimensions shown in mm (in.).

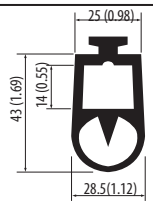
fig. 1



Cushion factor 5 mm (0.20 in.)
440F-E0110S
440F-E0110R : Red profile
440F-E0110N: Increased resistance to oil (NBR)

Level of Protection: IP67
Actuation Angle: ±20°
Weight: 0.501 kg/m (0.031 lb/ft)

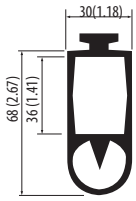
fig. 2



Cushion factor 19 mm (0.75 in.)
440F-E1610S
440F-E1610N : Increased resistance to oil (NBR)

Level of Protection: IP67
Actuation Angle: ±45°
Weight: 0.782 kg/m (0.048 lb/ft)

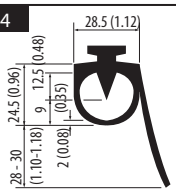
fig. 3



440F-E0310S
Cushion factor 41 mm (1.60 in.)

Level of Protection: IP67
Actuation Angle: ±45°
Weight: 1.198 kg/m (0.074 lb/ft)

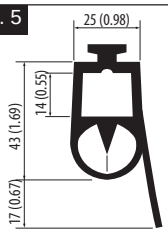
fig. 4



440F-E0510S
Cushion factor 5 mm (0.20 in.) with sealing lip

Level of Protection: IP67
Actuation Angle: ±45°
Weight: 0.596 kg/m (0.037 lb/ft)

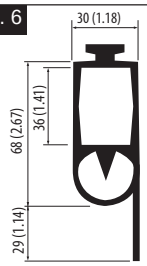
fig. 5



440F-E0804S
Cushion factor 19 mm (0.75 in.) with sealing lip

Level of Protection: IP67
Actuation Angle: ±45°
Weight: 0.972 kg/m (0.060 lb/ft)

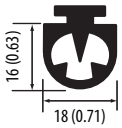
fig. 6



440F-E0210S
Cushion factor 41 mm (1.60 in.) with sealing lip

Level of Protection: IP67
Actuation Angle: ±45°
Weight: 1.288 kg/m (0.080 lb/ft)

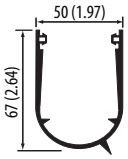
fig. 7



440F-E0118S
Cushion factor 3.75 mm (0.15 in.)

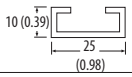
Level of Protection: IP67
Actuation Angle: ±45°
Weight: 0.259 kg/m (0.016 lb/ft)

fig. 8

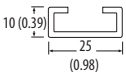


440F-E1111S
Cover profile only, nonfunctioning

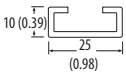
Weight: 0.300 kg/m (0.018 lb/ft)



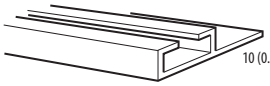
"C" rail-aluminium C112/A
440F-R1212
Suitable for attaching all the Safedge profiles.

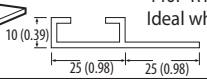


"C" rail-zinc coated steel C112/S
440F-R1112
Suitable for attaching all the Safedge profiles.

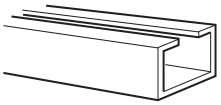


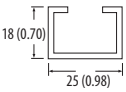
"C" rail PVC
C112/PB = Black 440F-R1212PB
C112/PR = Red 440F-R1212PR
C112/PY = Yellow 440F-R1212PY
Suitable for attaching all the Safedge profiles. Available in 3 colors.



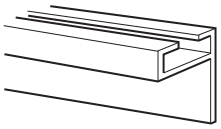


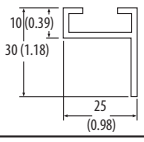
"C" rail-aluminium C112/A3
440F-R1215
Ideal when external fixing of "C" rail is required. Accepts all profiles.





"C" rail-aluminium C112/A4
440F-R1216
This deeper rail allows cables to run through channel under Safedge profile. Accepts all profiles.





"C" rail-aluminium C112/A2
440F-R1214
Ideal when external fixing of "C" rail is required. Accepts all profiles.

A Safedge system consists of the following components:

- Pressure sensitive profiles, which act as sensors.

Profile Model No.	Profile
440F-EA b c d e	440F-E0110S
440F-EB b c d e	440F-E0110R
440F-EC b c d e	440F-E0110N
440F-ED b c d e	440F-E0510S
440F-EE b c d e	440F-E1610S
440F-EF b c d e	440F-E1610N
440F-GF b c d e	440F-E0804S
440F-EH b c d e	440F-E0310S
440F-EI b c d e	440F-E0210S
440F-EJ b c d e	440F-E0510S
440F-EK b c d e	440F-E0804S
440F-EL b c d e	440F-E0210S
440F-EM b c d e	440F-E0118S
440F-EN b c d e	440F-E1111S
440F-EO b c d e	440F-E1111S

where:

b: indicates with or without “c” rail for mounting
c: indicates location of cable entrance
d: indicates the termination of the profile and cable length
e: indicates the length of the profile in mm and is a five-digit number

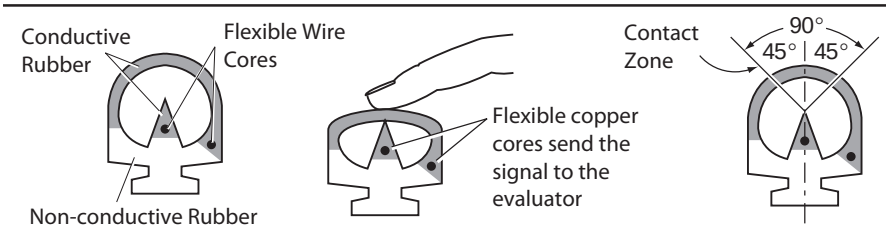
- Control units, which evaluate the sensor signal:

Control Unit Model No.	Description
440F-C251P	Enclosure of surface mounting
440F-C251D	Enclosure for DIN rail mounting
440F-C252D	Enclosure for DIN rail mounting

IMPORTANT All “C” rails are supplied without mounting holes. The “C” rail (440F-R1212) can be supplied curved to meet most applications.

Each profile uses a combination of non-conductive rubber and a flexible wire-cored conductive rubber, which is bonded together to form various energy absorbing profiles. The profile has no rigid internal parts that can break through or cause fatigue failures after prolonged use. The maximum operating voltage of the profile is 12V DC; operators are therefore not exposed to potentially dangerous voltage should the profile be accidentally cut or sheared. The copper wire core throughout the length of the profile helps ensure that there is no significant build-up of resistance over long lengths.

Figure 1 - Profile Operation and Contact Zone



The Safedge control unit monitors the circuit through the profile. When 6KΩ resistance (that is, normal run conditions) is detected, the control unit produces a signal to the machine control circuit. When the profile is pressed, from any direction through 90° as shown in Figure 1 on page 8, the top conductive rubber strip compresses and touches the middle conductive rubber, which creates a "short circuit" which drops the overall resistance. The control unit monitors this action and initiates the machine shutdown. Any single fault in the profile or the wiring connections to the profile is detected; in that case the control unit outputs go to a safe (OFF) state.

Individual profiles connect to each other via wires, axial connectors or standard 90° connectors. Two wires connect the profiles to the control units. The control unit has fully cross-monitored safety relays; it is therefore possible to configure the unit to detect an external contactor fault.

Compliance with the requirements of EN ISO 13856-2:2013 is achieved for the control unit regarding electrical faults and can be met for the associated part of the machine control system. B10d for profile is 10,000.

The Safedge system complies with the requirements of the European EMC Directive. Normal operation under interference conditions likely in industrial environments is assured, as it has been tested and certified.

Faults are excluded per ISO 13849.

- Edges must be installed in an environment that does not cause degradation of profile material.
- Edges must be properly sealed to help prevent non-conductive fluids from filling the profile cavity that would prevent pressing the profile.
- Profile must be connected to qualified controller.

IMPORTANT Special measures may be required in the presence of abnormally high levels of EMI. For example, near welding or induction heating equipment or near radio transmitters or transceivers.

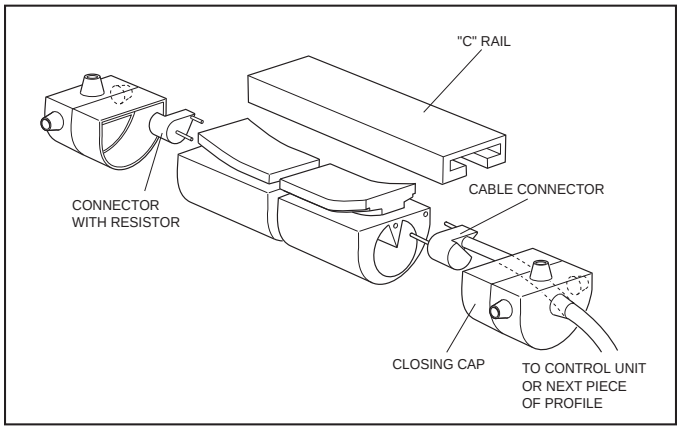
ATTENTION: Because fault exclusion is used, Safedge systems can achieve up to PLd Cat. 3.
Each application/installation user shall determine required PL level. The system as installed must meet required PL level.

Installation of the Safedge System

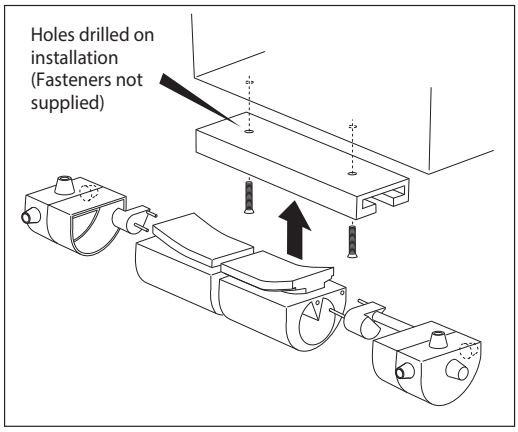
IMPORTANT Only use 440F-A0020 cyanoacrylate.

This type of cyanoacrylate adhesive achieves a lasting sealing and high protection in accordance with the IP65 rating.

Installation of "C" Rail

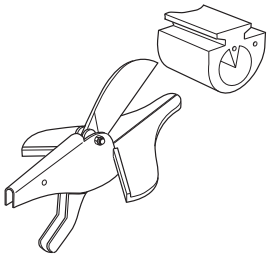


Mounting the "C" Rail

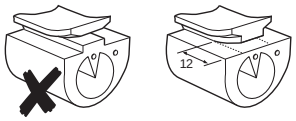


Assembly and Installation of the Safedge Profile

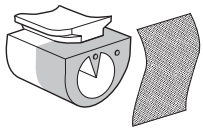
1. Cut the Safedge profile to length.
   Profiles without coasting chamber should be cut with rubber shears.
   Profiles with coasting chamber should be cut with a fine tooth saw.



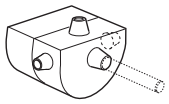
2. When using the 440F-A1302 closing cap with sealing lip, the profile base must be cut back to a length of 12 mm (0.46 in.). The cut must be precisely made to verify that the profile base is completely trimmed off, leaving a flush surface.



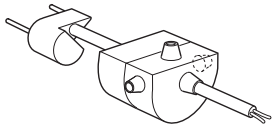
3. The shaded areas must be roughened with emery/sand paper.



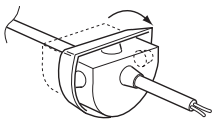
4. The closing caps are molded with four grommets, each with a rubber plug. When fitting a resistor, leave the plugs intact. When making a cable connection, select the appropriate cable exit, and remove the plug from the grommet with a hole punch.

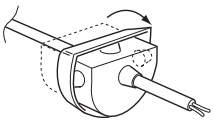


5. Pull the connecting cable through the hole.



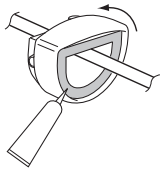
6. Pierce each of the copper wires with one of the needles. Press the needle contacts of the connector in the direction shown: wedge outwards, straight into the copper wires.





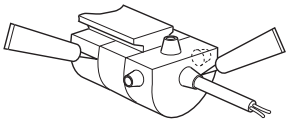
ATTENTION: The narrow side (wedge) of the connector must show outwards.

7. Fold back the sealing lip of the cap, then:
   a. Apply adhesive to shaded area of closing cap as illustrated, then affix to edge of profile. Apply pressure for 10 seconds to enable adhesion.
   b. Apply adhesive to remainder of shaded area and allow sealing lip to contact the profile.



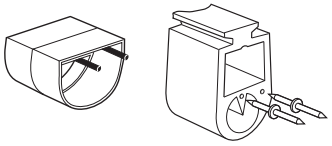
IMPORTANT Spread the adhesive evenly over the shaded area! Verify that no adhesive enters the profile.

8. To achieve complete seal, apply more adhesive to the Safedge profile, especially around the grommet/cable exit and sealing lip of the closing cap.



9. The axial profile connector 440F-A0061S is used for extensions and repairs (see previous steps) for the 440F-E0110 series of profiles only. For other types, use straight pin connectors.

   When inserting the profile into the "C" rail, a lubricant may be used to reduce friction. When installing, do not pull on connecting cable or on rubber profile.



Sensing Surface of Safedge System

The sensing surface of the Safedge system is active along almost the full length of the edge. The 10 mm (0.4 in.) at the beginning and end are not active.

Technical Specifications

Attribute	440F-C251P Surface Mount	440F-C251D DIN Rail	440F-C252D DIN Rail
Conformity	EN 13849 PLd, Cat. 3, EN ISO 13856-2: 2013		
System response time	13 ms		
Environmental protection	IP65	Enclosure IP40 DIN0470 Terminals IP20 DIN0470	Enclosure IP40 DIN0470 Terminals IP20 DIN0470
Safedge profile voltage, max	12V DC (open circuit)		
Operating voltage, nom	4V (run condition)		
Output fuse, max	2 A quick acting		5 A quick acting
Impulse withstand voltage	2500V		
Over voltage	Category 2		
Contamination level	III		
Switched current/voltage, min	10 mA/10V		
Power consumption	<6VA		
Relay outputs	2 x independent volt free N.O. safety contacts 1 x volt free N.C. auxiliary contact NOTE: Auxiliary should not be used for safety.		1 x independent volt free N.O. safety contacts 1 x volt free N.C. auxiliary contact NOTE: Auxiliary should not be used for safety.
Utilization category	AC - 15; 2 A / 250V DC DC - 13; 2 A / 30V DC		
Safety inputs	Safedge profile (open resistance 6 KΩ)		
Status indicator 1	Green: RUN		
Status indicator 2	Yellow: OPEN		
Status indicator 3	Red: STOP		
Internal controls	AC voltage selector		
Internal fuses	2 A safety fuses, replaceable (2 off); 500 mAT supply fuse, replaceable (1 off)	500 mAT supply fuse (reset ability) (1 off)	
Output fuse, max	—		4 A on AC/2 A on DC
Ambient temp. range—control unit	-10...+55 °C (-14...+131 °F)		
Ambient temp. ranges—profile	-5...+55 °C (23...131 °F) EPDM (Ethylene Propylene Diene Modified Rubber) excluding 110 N & 01610N: 0...55 °C (32...131 °F) NBR/CR (Acrylonitrile (34% nitrile) Butadiene Rubber/Chloropriene Rubber)		
Humidity	Up to 90% RH at 55 °C (131 °F).		
Vibration	Tested in accordance with IEC 68-2-6, frequency range 10...55 Hz, displacement 0.15 mm (0.01 in.), 10 cycles per axis, sweep rate 1 octave per minute		
MC-MC contactor monitor loop	N/C (normally closed) contactor loop		
Conductor size, max	1 x 1 sq. mm (0.001 sq in.) stranded with sleeves stripped 5 mm (0.2 in.), 1 x 1.5 sq. mm (0.002 sq in.) solid conductor		1 x 2.5 sq. mm (0.004 sq in.) stranded with sleeves stripped 8 mm (0.31 in.), 1 x 4 sq. mm (0.006 sq in.) solid conductor
Terminals	Minus terminal screws M2 spring action		Plus-minus terminal screws M3.5 with self-lifting connection, washer terminal boards separately removable
Installation group	C in accordance with VDE 0110.		
Material—control unit	Polycarbonate		
Mounting details	4 x M4 holes	45 mm DIN rail	22.5 mm DIN rail
Housing	• Depth: 75 mm (2.95 in.) • Height: 130 mm (5.12 in.) • Width: 130 mm (5.12 in.)		• Depth: 120 mm (4.72 in.) • Height: 73 mm (2.87 in.) • Width: 45.5 mm (1.79 in.) 16 way
Weight	650 g (22.9 oz)		450 g (14.1 oz)
Miscellaneous	The Safedge profile must be terminated with a 6 KΩ resistor.		
Bend radius, min	500 mm (19.8 in.)		

Attribute	440F-E0110N	440F-E0510S 440F-E0110R 440F-E0110S	440F-E0210S 440F-E0310S	440F-E1610N 440F-E0118S	440F-E0804S 440F-E1610S
Actuating distance	6.4 mm (0.25 in.)	6.6 mm (0.26 in.)	8.0 mm (0.31 in.)	7.8 mm (0.30 in.)	9.4 mm (0.37 in.)
Response distance	1.2 mm (0.05 in.)	1.9 mm (0.07 in.)	27.2 mm (1.07 in.)	8.4 mm (0.33 in.)	5.0 mm (0.20 in.)

440F-E1111S is a cover profile only and is nonfunctioning.

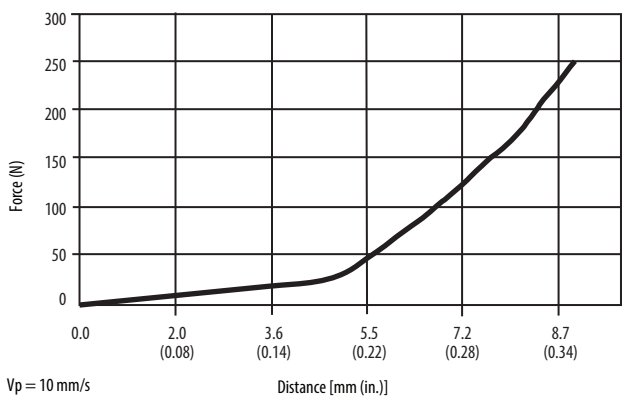
- Speed, max: 100 mm/s
- Suitable for the detection of fingers

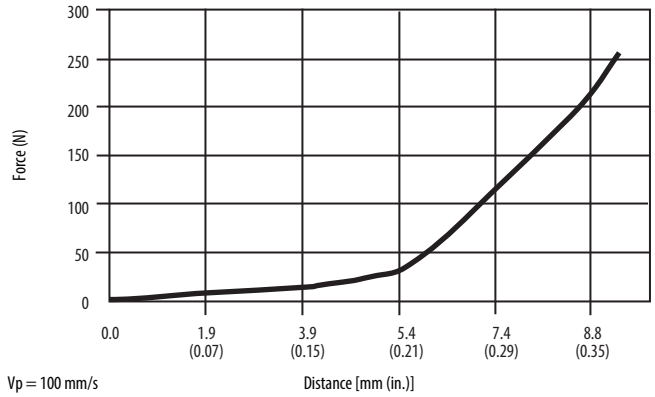
The control unit must not be mounted inside the hazard zone. Access to the control unit is required for manual reset or for routine indicator observation, so it must be visible when in operation. The control unit can be mounted on either side of the power doors, as long as the only hazard is the actual doors. In all other cases, the control unit can be mounted anywhere convenient outside the hazard zone, with consideration for access requirements for test and maintenance.

Force Travel Relationship

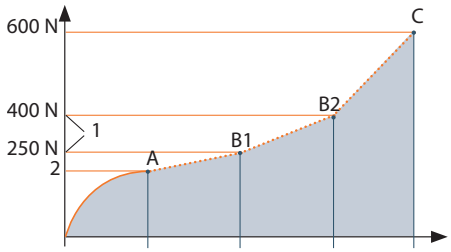
Since the Safedge system is a contact device, a force is required to operate the device. This force is dependent on the shape of the object that applies the force, the speed of the object and deformation distance on the profile. To help understand the force requirements, the European standard ISO 13856-2 2013 provides three test objects that are traveling at two speeds. Figure 2 shows the force that is applied over the deformation distance on the surface of the profile. The force required to operate the corners is greater than the force required along the straight section of the profile. This force must be used as a guideline, as the inanimate object cannot be harmed.

Figure 2 - Force vs Distance





Deformation Travels



1:Threshold forces 2:Min. actuation force

Force/deformation path diagram

Attribute	Cat. No. 440F-E0110N			Cat. No.440F-E0110R, 440F-E0110S, 440F-E0510S		
Test temperature 20 °C (68 °F)/Speed:	10 mm/s	100 mm/s	200 mm/s	10 mm/s	100 mm/s	200 mm/s
Actuation force	36.5 N	51.4 N	71.7 N	41.7 N	51.1 N	60.6 N
Response travel A [mm (in.)]	5.3 (0.21)	5.6 (0.22)	7.4 (0.29)	5.7 (0.22)	5.8 (0.23)	4.9 (0.19)
Total deformations at 250 N B1 [mm (in.)]	9.4 (0.37)	8.9 (0.35)	10.0 (0.39)	9.5 (0.37)	8.6 (0.34)	7.6 (0.30)
Total deformations at 400 N B2 [mm (in.)]	11.4 (0.45)	11.0 (0.43)	11.8 (0.46)	11.0 (0.43)	10.6 (0.42)	9.3 (0.37)
Total deformations at 600 N B2 [mm (in.)]	13.2 (0.52)	12.9 (0.51)	13.7 (0.52)	13.3 (0.52)	12.6 (0.50)	11.3 (0.44)
Compensation travel at 250 N [mm (in.)]	4.1 (0.16)	3.3 (0.13)	2.6 (0.10)	3.8 (0.15)	2.8 (0.11)	2.6 (0.10)
Compensation travel at 400 N [mm (in.)]	6.0 (0.24)	5.4 (0.21)	4.4 (0.17)	5.3 (0.21)	4.7 (0.19)	4.3 (0.17)
Stopping distance, max [mm (in.)]	5.0 (0.20)	4.5 (0.18)	3.6 (0.14)	4.4 (0.17)	3.9 (0.15)	3.6 (0.14)
Attribute	**Cat. No. 440F-E1610N, 440F-E0118S**			**Cat. No. 440F-E1610S, 440F-E0804S**		
Test temperature 20 °C (68 °F)/Speed:	10 mm/s	100 mm/s	200 mm/s	10 mm/s	100 mm/s	200 mm/s
Actuation force	63.6 N	76.9 N	84.6 N	13.5 N	19.5 N	20.6 N
Response travel A [mm (in.)]	9.7 (0.38)	9.6 (0.38)	9.4 (0.37)	7.3 (0.29)	7.2 (0.28)	6.9 (0.27)
Total deformations at 250 N B1 [mm (in.)]	22.3 (0.88)	19.5 (0.77)	18.5 (0.73)	28.1 (1.10)	25.4 (1)	25.4 (1)
Total deformations at 400 N B2 [mm (in.)]	28.7 (1.13)	27.6 (1.09)	26.7 (1.05)	32.4 (1.28)	31.1 (1.22)	30.6 (1.20)
Total deformations at 600 N B2 [mm (in.)]	31.2 (1.23)	29.9 (1.18)	28.9 (1.14)	34.9 (1.37)	33.8 (1.33)	32.9 (1.30)
Compensation travel at 250 N [mm (in.)]	12.7 (0.50)	9.9 (0.39)	9.1 (0.36)	20.8 (0.82)	18.2 (0.72)	18.4 (0.72)
Compensation travel at 400 N [mm (in.)]	19.1 (0.75)	17.9 (0.70)	17.3 (0.68)	25.0 (0.98)	23.9 (0.94)	23.7 (0.93)
Stopping distance, max [mm (in.)]	15.9 (0.63)	15.0 (0.59)	14.4 (0.57)	20.8 (0.82)	19.9 (0.78)	19.7 (0.78)
Attribute	**Cat. No. 440F-E0310S, 440F-E0210S**					
Test temperature 20 °C (68 °F)/Speed:	10 mm/s	100 mm/s	200 mm/s			
Actuation force	41.6 N	68.5 N	87.0 N			
Response travel A [mm (in.)]	6.8 (0.27)	9.6 (0.38)	8.6 (0.34)			
Total deformations at 250 N B1 [mm (in.)]	38.1 (1.50)	21.7 (0.85)	22.0 (0.87)			
Total deformations at 400 N B2 [mm (in.)]	44.6 (1.76)	44.0 (1.73)	42.5 (1.67)			
Total deformations at 600 N B2 [mm (in.)]	49.5 (1.95)	49.2 (1.95)	47.6 (1.87)			
Compensation travel at 250 N [mm (in.)]	31.3 (1.23)	12.2 (0.48)	13.4 (0.53)			
Compensation travel at 400 N [mm (in.)]	37.8 (1.49)	34.4 (1.35)	33.9 (1.33)			
Stopping distance, max [mm (in.)]	31.5 (1.24)	28.7 (1.13)	28.3 (1.11)			

Select the Cushion Factor

One of the important characteristics of edge systems is called cushion factor. The cushion factor is the distance that the profile can be depressed after the signal is generated. This characteristic is important when the profile is mounted on automated doors.

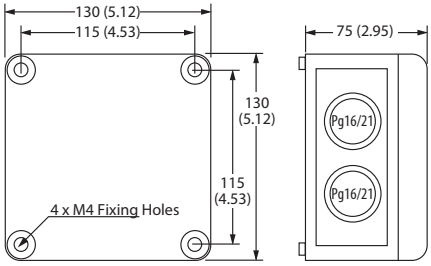
Automated doors continue to close for some finite time after the profile sends the initial stop signal, which is known as the system response time. The system response time is the sum of the Safedge control unit response time, the control

system response time, and the mechanical stopping time. Systems with longer response time should use larger cushion factors. You must validate that injury does not occur if parts of the body get jammed, for example between the sensing edge and the fixed part of a machine.

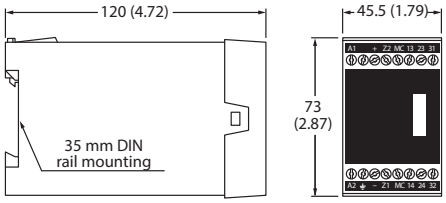
You might also consider a reversing option. When the profile is depressed, the Safedge control unit sends a signal to a reversing relay. Since the reversing relay is not a safety rated device, you must still confirm that injury does not occur if parts of the body get jammed.

Mounting

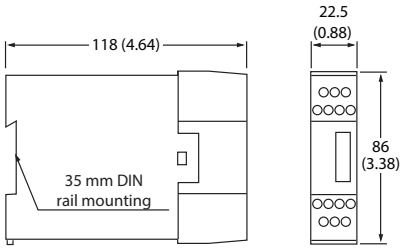
Dimensions shown in mm (in.).



440F-C251P (surface mounted)



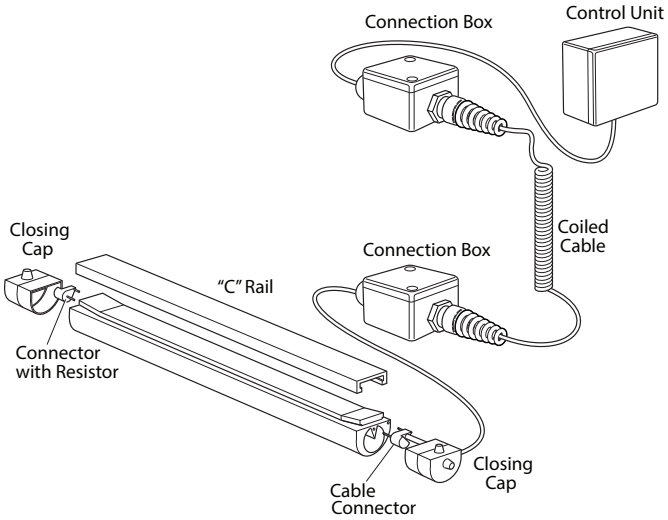
440F-C251D (mounted on DIN rail)



440F-C252D (mounted on DIN rail)

Terminal Connections

To help prevent strain on terminal connections, use connection boxes and coiled cables.

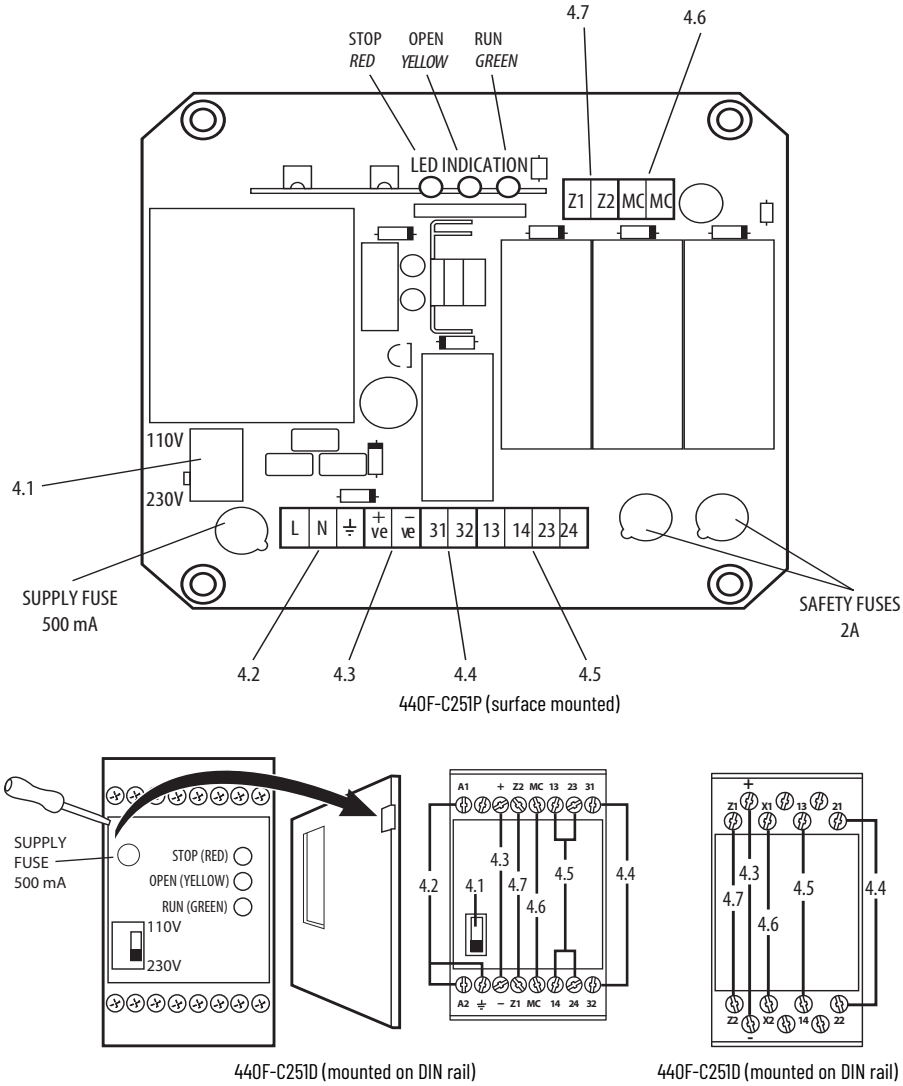


Installation and Wiring

IMPORTANT Wiring must be in accordance with the [British] National Electric Code and applicable local codes and ordinances. Carefully follow the instructions on page 17 for correct installation.

Electrical Connections

Figure 3 - Safedge Control Unit



See table on page 17 for callout explanations.

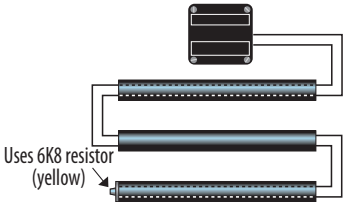
Item [1]	Description
4.1	**Main selector switch:** If using a 110V AC or a 230V AC supply, set the voltage selector switch before turning on the power. The default factory setting of the unit is 230V AC.
4.2	**Main input terminal LN PE (A1, A2, PE)**: If using a 110V AC or 230V AC supply, the power supply should be wired together with a protective earth (ground) to the terminals shown. The size of the protective earth (PE, ground) wire should at least be equal to that of the supply wire. Also check the main selector switch. If these terminals are used, ignore the following items.
4.3	**24V AC/DC input terminal +ve and -ve or + and -:** If a 24V AC/DC supply is used, the supply should be connected to these terminals, verifying that the correct polarity is observed. Do not make any connections to the terminals of main input terminal. When a 24V AC or DC supply is used, it must be isolated from the main supply in accordance with international electrical safety practice (IEC 364-4-41). One pole should be grounded to the earth. For 24V DC, the negative pole should be grounded. With 24V AC, the ground of the power supply should be connected to the negative terminal.
4.4	**Aux. Output terminals 31 and 32 or 21 and 22 in 440F-C:** This terminal provides an auxiliary normally closed contact (that is closed when the green RUN status indicator is off) which is suitable for indication or for alarm devices. As it is an auxiliary, it must not be connected to the safety circuit.
4.5	**Safety Output terminals 13, 14, 23 and 24:** These terminals are volt-free contacts for connection to the machine safety circuits—in other words, they are connected in series with the machine contactor control circuit (max rating 2 A at 250V AC). Both of these safety circuits are internally fused but must also be externally protected with a 2 A quick-acting fuse. If you are using only one contactor, terminals 13 and 24 are required and terminals 14 and 23 should be jumpered together. For two contactors with two independent control circuits (that is a dual channel system), use 13-14 for one contactor and 23-24 for the other. For two contactors, also see Applications on page 19.
4.6	**Reset terminal MC-MC or X1 - X2 on the 440F-C2522:** These terminals are used for a number of different functions (the surface mount version is supplied with jumpers, while the DIN rail version is supplied without a jumper). Without the jumper, the terminals can be connected to positively guided normally closed auxiliary contacts on the machine contactors to provide monitoring of the contactors in dual channel control systems. If one contactor fails to isolate the power at de-energization of its control coil, the Safedge™ system does not allow the other contactor to be energized until the fault has been rectified. Fit a jumper between these terminals on the DIN rail unit if this function is not required. This terminal is also used for auto/manual reset. If the MC-MC terminal remains jumpered or connected only to the normally closed contact of the contactor, the unit is in automatic reset mode. In automatic reset mode, the output is achieved solely by removal of the actuating force. The output is also achieved at power up of the actuator (when there is no actuation force present). If a spontaneous restart can generate a risk, based on the result of a risk assessment to ISO12100, then this mode must not be used. See IEC60204-1 and EN ISO13849-1. For manual reset mode, a normally open spring return (not latching) push button must be connected across the MC-MC terminals or in series with the normally closed contactors. When the actuating force is removed, the unit does not operate until the button is pressed. The button also has to be pressed after powering up the control unit.
4.7	**Profile connection to control units:** These terminals are used to connect the profile to the: • Z1 = Brown (inner conductor) • Z2 = White (outer connector) See Applications on page 19. A profile must be terminated with a 6KΩ resistor (yellow) for series connection. If two profiles are connected directly to Z1 and Z2 (in parallel), each profile should be terminated with a 15K resistor (blue).

(1) From Figure 3 on page 16.

Profile Connection

Connect in Series

Installations that involve several profiles are normally connected in series.



Connect in Parallel

A maximum of two profiles can be connected in parallel to facilitate the wiring of certain applications.

Commissioning and Sequence of Operation

When the unit is installed, check the following sequence of operation.

Manual Reset Mode

1. Turn on the power.
   a. No status indicators illuminate.
2. Press the reset switch
   a. The green RUN status indicator illuminates.
   b. Safety contacts close.
   c. Auxiliary contacts open.
   d. Contactors energize.
3. Press the profile.
   a. The green RUN status indicator turns off.
   b. The red STOP status indicator illuminates.
   c. Safety contacts open.
   d. Auxiliary contacts close.
   e. Contactors de-energize.
4. Release the profile.
   a. The red STOP status indicator turns off.
   b. System has returned to step 1.
5. If profile is pressed before reset
   a. The red STOP status indicator illuminates each time that the profile is pressed but the safety contacts do not energize.

Automatic Reset Mode

1. Turn on the power.
   a. The green RUN status indicator illuminates.
   b. Safety contacts close.
   c. Auxiliary contacts open.
   d. Contactors energize.
2. Press the profile.
   a. The green RUN status indicator turns off.
   b. The red STOP status indicator illuminates.
   c. Safety contacts open.
   d. Auxiliary contacts close.
   e. Contactors de-energize.
3. Release the profile.
   a. System has returned to step 1.

IMPORTANT
- Terminal block tightening torque rating is 7 in•lb, suitable for wire sizes 16 AWG.
- Use 16 AWG min.
- Use copper conductors only.
- Temperature rating of field wiring must not be less than ambient.

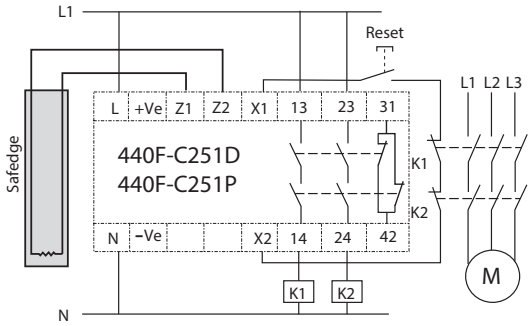
Comparative Properties

	NBR/CR Profiles 440F-E0110N and 440F-E1610N	EPDM Profiles 440F-E0110S, 440F-E0110R, 440F-E0510S, 440F-E1610S, 440F-E0804S, 440F-E0310S, 440F-E0210S, and 440F-E0118S
Tensile strength (reinforced) mPA	26	20
Resilience (20 °C [68 °F])	Fair	Good
Low temperature flexibility	Fair	Good
Resistance to sunlight	Good	Good
Resistance to heat aging	Good	Good
Resistance to oxidation	Fair	Good
Resistance to ozone	Fair	Good
Resistance to H_2O	Good	Good
Resistance to dilute acids	Fair	Good
Resistance to concentrated acids	Fair	Good
Resistance to oils and greases	Good	Poor

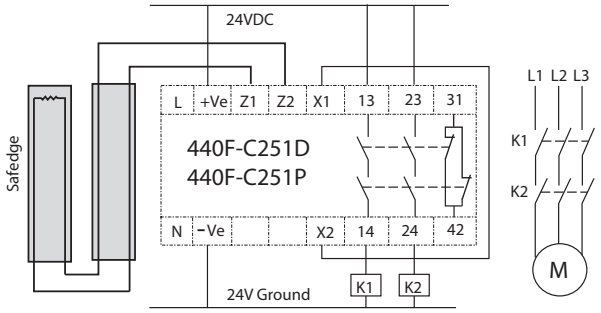
440F-E1111S is a cover profile only and is nonfunctioning.

IMPORTANT Profile must be selected according to intended environment.

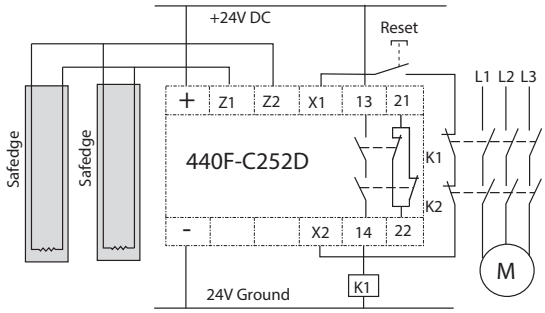
Applications



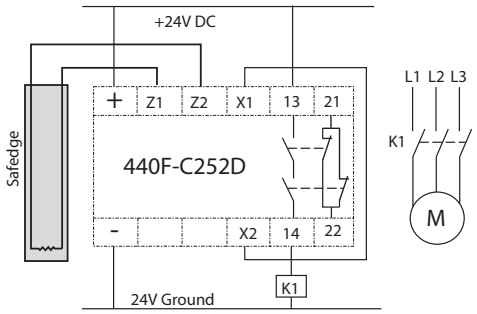
Series Terminated, Safedge Input, Manual Reset, Dual Channel Output, Monitored Output



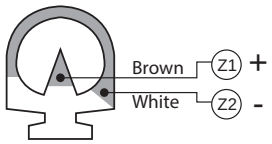
Series Terminated, Cascaded, Safedge Input, Automatic Reset, Dual Channel Output, No Output Monitoring



Parallel Terminated, Safedge Input, Manual Reset, Single Channel Output, Monitored Output



Series Terminated, Safedge Input, Automatic Reset, Single Channel Output, No Output Monitoring



The wiring diagram on the left shows a 110/230V AC application with one contactor (with profile pressed). The right side of the illustration above shows a 110/230V AC application with two contactors, contactor monitoring and START/STOP circuit (also with profile pressed).

Maintenance and Service

Troubleshooting

Symptom	Probable Cause	Check
The yellow OPEN status indicator illuminates.	Open circuit in profile or connecting wiring	Verify that Z1-Z2 terminals are secure. Check cable for breaks. Check profile for damage.
No status indicators illuminate even if profile is pressed.	Supply failure.	Make sure that voltage selector switch is set correctly. Check supply fuse. Verify that supply voltage is present.
No status indicators illuminate unless profile is pressed and then the red STOP status indicator illuminates.	Failure to reset.	If contactor monitoring is used, verify that each contactor is functioning correctly. Confirm that MC-MC terminals are secure. Check that link is in place and that Reset button functions correctly.
Unit appears to work correctly but there is no output.	Blown fuse. Damaged or incorrect wiring. Fault on Safedge™ causes the outputs to fail safe	Check output fuses. Inspect all wiring for damage. Check for movement on any internal relays. Replace controller.
Machine does not stop when profile is pressed. The green RUN status indicator goes off.	Incorrect external connections	Inspect all wiring to contactors for mistakes.
Machine does not stop when profile is pressed. The green RUN status indicator stays on.	Do not allow the use of the machine. Replace controller.	

Maintenance

Carefully read this section, in full, before attempting any maintenance work.

ATTENTION: During maintenance operations, disconnect the prime mover of the machine before working on the Safedge system. Observe all applicable electrical safety precautions.

Profile Cleaning

The profiles should be kept clean of deposits such as swarf (fine metallic filings or shavings that are removed by cutting, grinding, or any other mechanical process), debris, and other foreign materials to help prevent damage or dead-zones. It is permissible to use warm water and a mild detergent to clean the surface area.

Routine Maintenance Inspection and Test

This inspection and test is recommended weekly or after repair.

IMPORTANT Do not use solvents.

1. Stop the machine, clean the profile or profiles and allow them to dry off. Inspect the surface of the profile for damage. Any damage that punctures the profile could let material or liquid in. It must be dealt with immediately.
2. Check that all end caps, corners, and joints are secure and free from damage. Damaged parts must be replaced immediately.
3. Test the profile operation. Two people may be required, one to press the profile and one to observe the operation of the control unit. On systems that use manual reset mode, the Reset button must be pressed continuously. Check that the green RUN status indicator is illuminated when the profile is not pressed and that the red STOP status indicator is illuminated when it is. Start the machine, press the profile and check that the machine stops immediately.

If these checks reveal any problem, do not allow use of the machine until the problems are rectified. Record all inspections and tests in a written log.

Thorough Examination and Test

This examination and test is recommended twice yearly or after repair

ATTENTION: Suitably trained and qualified personnel are required for this examination and test.

1. Conduct tests as listed in Routine Maintenance Inspection and Test.
2. Isolate the power source to the machine and Safedge system. Observe usual electrical safety precautions.
3. Inspect the profile and components thoroughly for mechanical damage.
4. Disconnect the wires to the profile at terminals Z1-Z2.
5. Connect the wires from the profile to the input of an ohmmeter. One person should press the profile with one hand at every point on the strip. The resistance should measure 6KΩ ±10% when the profile is not pressed, and no greater than 1K when it is.

If these checks reveal any problems, do not allow the use of the machine until they are rectified.

Record the inspection and test in a written log (see Written Log on page 23).

Repair

Before working on a Safedge system or machine control system, isolate the power source to the machine and Safedge system. Observe all applicable electrical safety precautions.

User repairs are limited to replacement with new Safedge system parts. In the event of any problems, the units should be returned to the supplier.

Any repairs to the connecting wires should be made using heat shrink butt splice connectors.

After replacing any part of the system, the inspection and test procedures detailed in the Routine Maintenance Inspection and Test and Thorough Examination and Test on page 21 must be conducted with special attention given to those parts replaced.

IMPORTANT	Tampering with component parts invalidates warranty. Warranty is invalid if quality seal is broken on the DIN rail (440F-C251D) control unit.

IMPORTANT	After maintenance or repair operations, all fastenings, cable protection, and so on, must be correctly refitted. Failure to do so, or the use of non-approved parts can result in the Safedge system failing to achieve its specified performance.

Routine Inspection and Test

Written Log

Date	Inspected by	Comments

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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