Models SC-IM9.. Interface Modules

Datasheet

Interface Modules for Use with the SC22-3 Safety Controller



- Provides isolated safety output contacts for the SC22-3 Safety Controller, which has solid-state outputs and external device monitoring (EDM) capability
- Designed specifically for use with one, two or three Safety Controller safety outputs (see Models table)
- Features three normally open redundant-output channels and one normally closed monitoring output channel for each safety output
- Has contacts rated at 10 amps
- Operates on 24 V dc, supplied by the Safety Controller
- Mounts to standard DIN rail

WARNING: Not a Stand-Alone Safeguarding Device

This Banner device is not a stand-alone **point-of-operation** guarding device, as **defined** by OSHA **regulations.** It is necessary to install point-of-operation guarding devices, such as safety light screens and/or hard guards, to protect personnel from hazardous machinery. Failure to install **point-of-operation** guards on hazardous machinery can result in a dangerous **condition** which could lead to serious injury or death.

Models

Model	Total Outputs	For SC22-3 Safety Output			Contact **Rating** (All Contacts)	Supply Power
		SO1	SO2	SO3		
SC-IM9A	3 N.O., 1 N.C.	3 N.O., 1 N.C.	—	—	10 amps	24 V dc
SC-IM9B	6 N.O., 2 N.C.	3 N.O., 1 N.C.	3 N.O., 1 N.C.	—		
SC-IM9C	9 N.O., 3 N.C.	3 N.O., 1 N.C.	3 N.O., 1 N.C.	3 N.O., 1 N.C.		

Overview

Interface Modules SC-IM9.. operate on 24 V dc inputs and provide isolated redundant output channels for interfacing the Safety Controller's solid-state 24 V dc outputs to ac safety circuits.

The normally open safety contacts of the Interface Module follow the action of the safety outputs from the Safety Controller within 3 milliseconds when going from closed to open (for other response times, see Specifications). All Interface Module contacts are rated for up to 690 V ac/dc at up to 10 amps.

The SC-IM9.. Interface Modules offer a series connection of normally closed contacts (labeled 21-22 on each contactor) for monitoring by the external device monitoring (EDM) function of the Safety Controller. These forced-guided (mechanically-linked) contacts allow the Safety Controller to detect failures of the SC-IM9.. Interface Module, and at a minimum, must be monitored in applications requiring Control Reliability per OSHA/ANSI or Category 3 or 4 per ISO13849-1.

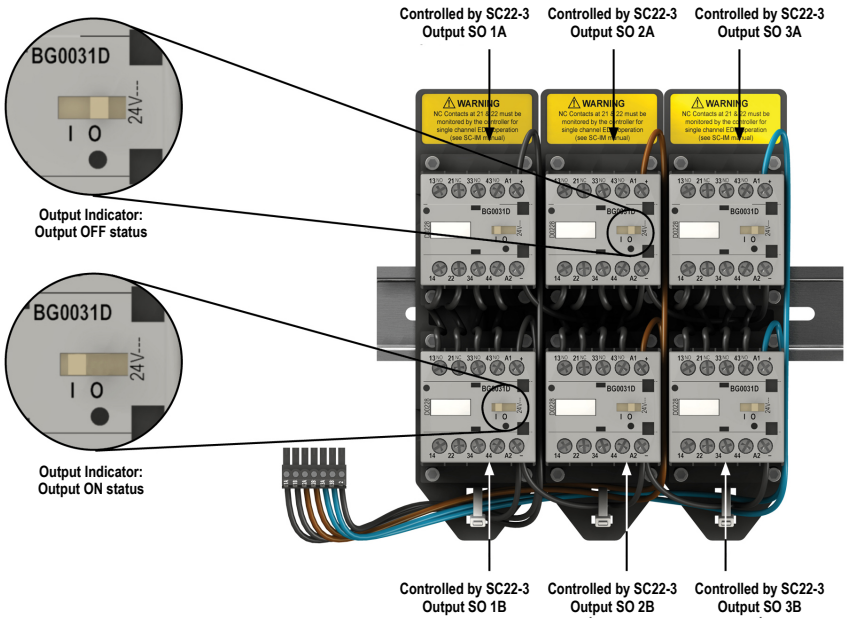


Figure 1. Features – model SC-IM9C shown

Important... Read this before proceeding!

The user is responsible for **satisfying** all local, state, and **national** laws, rules, codes, and regulations relating to the use of this product and its application. Banner Engineering Corp. has made every effort to provide complete application, installation, operation, and maintenance instructions. Please contact a Banner Applications Engineer with any questions regarding this product.

The user is responsible for making sure that all machine operators, maintenance personnel, electricians, and supervisors are thoroughly familiar with and understand all instructions regarding the installation, maintenance, and use of this product, and with the machinery it controls. The user and any personnel involved with the installation and use of this product must be thoroughly familiar with all applicable standards, some of which are listed within the specifications. Banner Engineering Corp. makes no claim regarding a specific recommendation of any organization, the accuracy or effectiveness of any information provided, or the appropriateness of the provided information for a specific application.

Applicable US Standards

ANSI B11 Standards for Machine Tools Safety

ANSI NFPA 79 Electrical Standard for Industrial Machinery

ANSI/RIA R15.06 Safety Requirements for Industrial Robots and Robot Systems

Contact: Robotic Industries Association, 900 Victors Way, P.O. Box 3724, Ann Arbor, MI 48106, Tel.: 734-994-6088

Applicable **International** Standards

ISO 12100-1 (EN292-1) Safety of Machinery – Basic Concepts, General Principles for Design, Part 1: Basic Terminology, Methodology

ISO 12100-2 (EN 292-2) Safety of Machinery – Basic Concepts, General Principles for Design, Part 2: Technical Principles and Specifications

IEC 60204-1 Electrical Equipment of Machines: Part 1: General Requirements. (Also request a type “C” standard for specific machinery.)

ISO 13849-1 (EN954-1) Safety of Machinery – Related Parts of Control Systems: Part 1 General Principles for Design

Contact: Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5704, Tel.: 800-854- 7179

Primary Safety Device Requirements

These Interface Modules are driven by the safety output channels of the SC22-3 Safety Controller (model SC-IM9A by two safety output channels, SC-IM9B by four, and SC-IM9C by six). These Interface Modules must be used only with the SC22-3 Safety Controller and must be monitored via the Controller's EDM inputs (see *Figure 2* on page 4 and the warning regarding MPCE Monitoring). Refer to the SC22-3 Safety Controller manual (p/n 133487) for more information about the External Device Monitoring (EDM) function.

Note: Because the Safety Controller's output signal switching device (OSSD) solid-state outputs are pulsed, the Interface Module's relay coils may buzz; this will not affect its function.

Installation

Mechanical **Installation**

The SC-IM9.. Interface Modules must be installed inside an enclosure. They are not designed for exposed wiring. It is the user's responsibility to house the Interface Modules in an enclosure with NEMA 3 (IEC IP54) rating or better.

The Interface Modules are pre-wired to a terminal block that plugs into the Controller's safety outputs. Therefore, the Interface Module must be installed next to the Safety Controller on a 35 mm DIN rail.

See Dimensions for Interface Module dimensions.

For reliable operation, do not exceed the operating specifications. Verify that the enclosure provides adequate heat dissipation, so that the air closely surrounding the Module does not exceed its maximum operating temperature. Methods to reduce heat build-up include venting, forced airflow (for example, exhaust fans), adequate enclosure exterior surface area, and spacing between modules and other sources of heat. (See Specifications.)

Electrical **Installation**

Because the Interface Modules can interface to a multitude of machine control configurations, it is not possible to give exact wiring instructions for the output contacts. The following guidelines are general in nature.

Installation and wiring must be made by qualified personnel and must comply with the NEC (National Electrical Code), ANSI NFPA79 or IEC 60204-1, and all applicable local standards and codes.

Because the SC-IM9.. can switch high levels of energy, the user must consider and prevent the possibility of arc flash hazards. Arc flash can release dangerous amounts of heat and blast energy. When using low-voltage equipment (240 V or less) being fed by small transformers (125 kVA or less) the potential hazard is small, but the risk increases with higher voltage or larger transformers. The SC22-3 and the SC-IM9.. may be required to be located in such a manner that minimizes arc flash hazards. Refer to ANSI NFPA70E for more information.



WARNING: Use of Arc Suppressors

If arc suppressors are used, they MUST be installed as shown across the coils of the Machine Primary Control Elements (MPCEs). NEVER install suppressors directly across the output contacts of the Safety Module. It is possible for suppressors to fail as a short circuit. If installed directly across the output contacts of the Safety Module, a short-circuited suppressor creates an unsafe **condition** which may result in serious injury or death.

Connection to the Machine To Be Controlled



WARNING: Shock Hazard and Hazardous Energy

Always disconnect power from the safety system (for example, device, module, interfacing, etc.) and the machine being controlled before making any **connections** or replacing any component.

Electrical installation and wiring must be made by Qualified Personnel[1] and must comply with the relevant electrical standards and wiring codes, such as the NEC (National Electrical Code), ANSI NFPA79, or IEC 60204-1, and all applicable local standards and codes.

Lockout/tagout procedures may be required. Refer to OSHA 29CFR1910.147, ANSI Z244-1, ISO 14118, or the appropriate standard for controlling hazardous energy.



WARNING: Not for Use As a Stand-Alone Safety Module

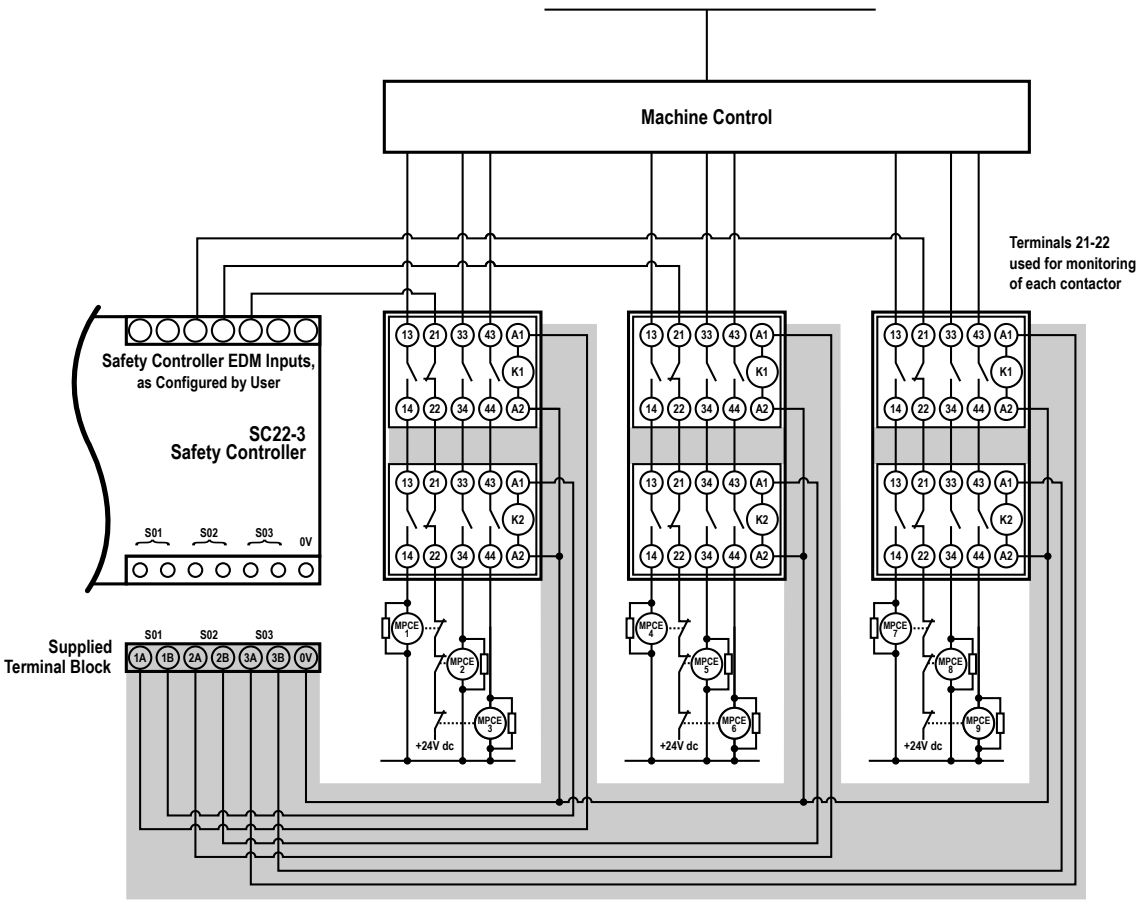
1. DO NOT connect E-stop switches, 2-hand-control switches, safety interlock switches, or similar devices directly to this Interface Module.
2. ALWAYS connect terminals 21–22 of this Interface Module to the monitoring input of the SC22-3 Safety Controller (see *Figure 2* on page 4) .

This Module does not have the circuitry required to perform a self-check. A single fault inside the unit can go undetected and create an unsafe condition. Failure to properly connect this Module to the SC22-3 Safety Controller could result in serious injury or death.

The safety outputs of the Interface Module have no delay function by themselves. They open within 3 milliseconds from the time that the Safety Controller's SO outputs turn OFF.

The wiring diagram in *Figure 2* on page 4 shows a generic connection to the machine primary control elements (MPCEs) from an SC-IM9C Interface Module. A machine primary control element is an electrically powered device, external to the interface module, which stops the machinery being controlled by immediately removing electrical power and (when necessary) applying a braking action. Refer to the SC22-3 Safety Controller manual (p/n 133487) for more information.

[1] A person who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.



Note:

- Gray-shaded areas are pre-wired and require no further connections. The user is responsible for wiring SC-IM9.. Safety Outputs (13/14, 33/34, 43/44) and N.C. monitoring contacts (21/22).
- Model SC-IM9C shown; hookup for models SC-IM9A and SC-IM9B is similar.

Figure 2. Generalized one-channel EDM-monitoring hookup of the SC-IM9C

WARNING: MPCE Monitoring

All machine control primary elements (MPCEs) must be of forced-guided (mechanically-linked) design to allow the EDM circuit to detect unsafe failures. This monitoring extends the safe switching point of the Safety Controller and the SC-IM9.. Interface Module to the MPCE elements. For this monitoring to be effective, a minimum of two redundant MPCEs are required to control each hazard. This is to detect the unsafe failure of one MPCE (for example, a welded contact), while stopping the hazard and preventing a successive machine cycle with the second MPCE.

If the MPCEs are the last electrically controlled device generating the hazard (that is, not relays or contactors) and they do not have forced-guided, captive contacts to monitor (such as a solenoid), then the user must ensure that failure or fault of any single component of the MPCEs will prevent a successive machine cycle and will not result in a hazardous situation.

Because the SC-IM9.. Module contacts are rated at 10 amps, they can be used as MPCEs to directly start and stop dangerous motion, or they may be used to power larger MPCE devices. It is important to note that any MPCE element must be part of the EDM loop.

To satisfy the requirements of Safety Category 3 or 4 of ISO 13849-1 (EN 954-1) and control reliability (OSHA/ANSI), all MPCEs must each offer at least one normally closed forcedguided monitor contact. One normally closed monitor contact from each MPCE is connected to the Safety Controller's monitoring contact feedback input, as shown in the wiring diagrams. (Each of the Safety Controller's 22 safety inputs—S1 through S22—can be configured as external device monitoring inputs. Refer to the SC22-3 manual and PCI software interface for more information.) Both single N.C. contacts (21–22) from each contactor are pre-wired in series in each contactor pair for single-channel EDM monitoring.

If the MPCEs are controlled by the SC-IM9.. Module, the normally closed contacts of both the Module and the MPCE can be switched in series to the same EDM input. In operation, if the MPCE fails in the energized condition, the associated monitor contact remains open. As a result, the Safety Controller detects the MPCE failure and prevents successive machine cycles. It is the user's responsibility to monitor the contactors' N.C. contacts, to ensure that any single failure will not result in a hazardous **condition** and will prevent a successive machine cycle.

Many types of mechanisms are used to arrest dangerous machine motion. Examples include mechanical braking systems, clutch mechanisms, and combinations of brakes and clutches. Additionally, control of the arresting scheme may be hydraulic or pneumatic. As a result, an MPCE may be one of several control types, including a wide variety of contactors and electromechanical valves. If your machine documentation leaves any doubt about the proper connection points for the Interface Module output contacts, do not make any connections. Contact the machine builder for clarification regarding connection to the MPCEs.

Notice Regarding MPCEs

To achieve control reliability, two machine primary control elements (MPCEs) are required to control each machine hazard. Each MPCE must be capable of immediately stopping the dangerous machine motion, irrespective of the state of the other. Some machines offer only one primary control element. For such machines, it is necessary to duplicate the circuit of the single MPCE to add a second MPCE.

MPCEs must offer at least one forced-guided auxiliary contact which is wired to the Safety Controller's monitoring contact feedback input (see *Figure 2* on page 4).

Checkout Procedures

Initial Checkout Procedure

Note: The Interface Module can be used safely only when it is connected to the Controller's safety output (according to the wiring diagrams in *Figure 2* on page 4) and monitored via the SC22-3 Safety Controller's EDM input.

Checkout procedure:

1. Remove the power controlling (and switched by) the machine control elements.

   CAUTION: Disconnect Power Prior to Checkout

   Before performing the **initial** checkout procedure, make certain all power is disconnected from the machine to be controlled.

   Dangerous voltages may be present along the Safety Module wiring barriers whenever power to the machine control elements is On. Exercise extreme **caution** whenever machine control power is or may be present. Always disconnect power to the machine control elements before opening the enclosure housing of the Safety Module.

2. Verify that the Safety Controller that controls the Interface Module is operating correctly, according to its product documentation and configuration.
3. Confirm proper connection of the Interface Module to the Safety Controller, according to the wiring diagram.
4. Verify that all Interface Module output contacts follow exactly the operation of the safety outputs of the controlling Safety Controller, when it is operated according to its product documentation and manufacturer's recommendations.

Periodic Checkout

Perform the Initial Checkout procedure according to the intervals specified by the product documentation of the Safety Controller controlling this Interface Module.

Repairs

Contact Banner Engineering for troubleshooting of this device. Do not **attempt** any repairs to this Banner device; it contains no **field-replaceable** parts or components. If the device, device part, or device component is determined to be defective by a Banner Applications Engineer, they will advise you of Banner's RMA (Return Merchandise Authorization) procedure.

Important: If instructed to return the device, pack it with care. Damage that occurs in return shipping is not covered by warranty.

Specifications

Input Voltage and Current
24 V dc, +/-15% no polarity, supplied by Safety Controller
Operating voltage limits
Pick-up: (0.7–1.15) × Un
Drop-out: (0.1–0.2) × Un

Average **Consumption** at 20° C (In-Rush Holding)
3.2 W

Output **Configuration**

	SC-IM9A	SC-IM9B	SC-IM9C
Number of Redundant N.O. Contacts	1 × 3	2 × 3	3 × 3
Number of N.C. Contacts	1 × 1	2 × 1	3 × 1

Minimum switching voltage: 1 V ac/dc
Maximum switching voltage: 575 V
Minimum switching current: 30 mA ac/dc
Maximum switching current: 10 A ac/dc
Minimum switching power: 50 mW (50 mVA)
Maximum switching power: 275 W (7200 VA)
Mechanical life: 20,000,000 operations
Electrical life (AC3):
500,000 cycles at 10 A
3,800,000 cycles at 2 A

Conventional Free Air Thermal Current Ith (≤ 40° C)
10 A

Rated **Insulation** Voltage (Ui)
690 V

Frequency Limit
25–40 Hz (derating for use at 61–400 Hz)

Terminal Tightening Torque Min/Max
0.8–1 Nm (0.59–0.74 lbft)

Max Wire Gauge (for 1 or 2 Wires)
18–12 AWG
Flexible w/o Ferrule: 0.75–2.5 mm²
Flexible w/Ferrule: 2 x 1 or 1 x 2.5 mm²

Output Response Time
N.O. contacts 13–14, 33–34, 43–44: 18–25 ms closing, 3 ms opening
N.C. contacts 21–22: 3-5 ms closing, 17 ms opening

Status Indicators
Output ON/OFF indicator on the front of each contactor

Environmental **Rating**
NEMA 1, IEC IP20
Interface Module must be installed inside an enclosure rated IEC IP54, or better

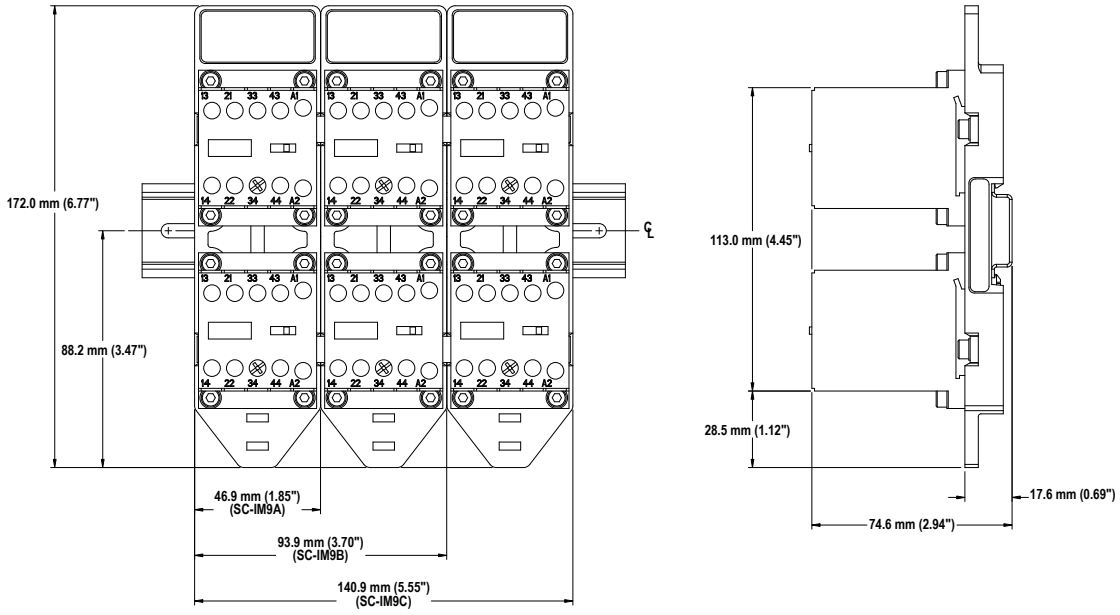
Mounting
Mounts to standard 35 mm DIN-rail track. Must mount adjacent to Safety Controller.

Operating Conditions
Operating Temperature: –40 °C to +50 °C (–40 °F to +122 °F)
Storage Temperature: –40 °C to +70 °C (–40 °F to +158 °F)
90% at +50 °C maximum relative humidity (non-condensing)

Application Notes
There are no adjustments and no user-serviceable parts

Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise.



Accessories

11-BGX10-40

- Non-Safety Auxiliary Contacts: Adds normally open contacts to the primary contactor(s).
- Contacts: 4 N.O.
- Positively Guided: No (Aux. only)



11-BGX77-048

- Suppressor for Mechanically Linked Contactors: Extends the life of the actuating device—such as a light screen or control module—that uses a mechanically linked contactor. (Two required for each pair of relays.)
- Voltage: 48V dc (maximum)



Banner Engineering Corp. Limited Warranty

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