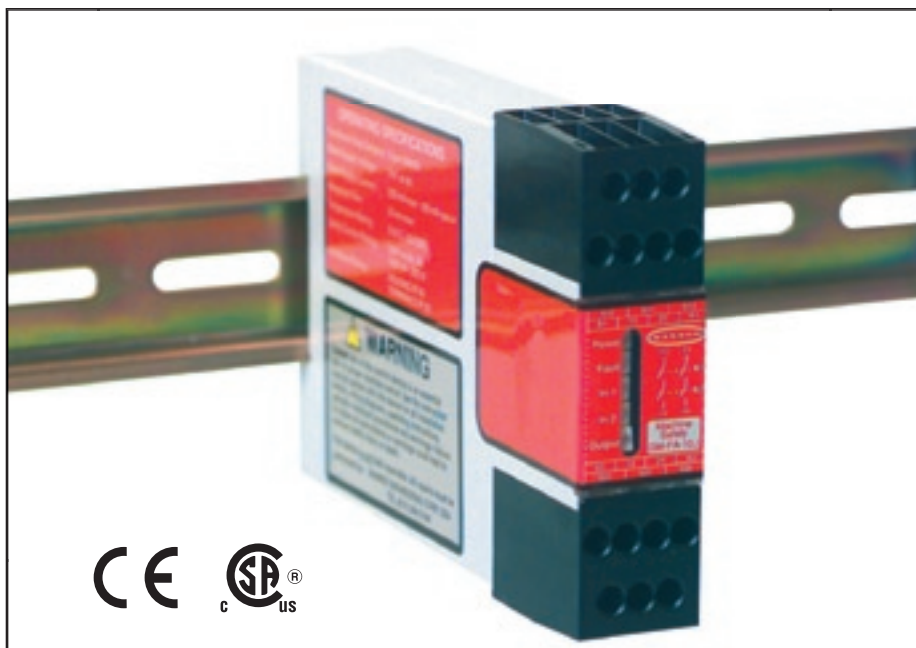


GM-FA-10J Gate Monitoring Safety Module

24V ac/dc operation, 1- or 2-Channel Input



Features

- Monitors one or two safety switches for a contact failure or wiring fault
- Two output switching channels for connection to control-reliable power interrupt circuits
- Auto reset or monitored manual reset
- Design complies with standards UL991, ISO 14119, and ISO 13849-1 (EN954-1) (Safety Category 2, 3 or 4)
- For use in functional stop category 0 applications per NFPA 79 and IEC 204-1
- 6 amp safety output contacts
- Plug-in terminal blocks
- If terminal blocks are swapped, Gate Monitor Module remains functional with no loss of safety function



Important ... read this page before proceeding!

Banner Engineering Corp. has made every effort to provide complete application, installation, operation, and maintenance instructions. In addition, any questions regarding the use or installation of this Safety Module should be directed to the factory applications department at the telephone numbers or address shown on back cover.

The user shall ensure 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 Safety Module, and with the machinery it controls.

The user and any personnel involved with the installation and use of this Safety Module must be thoroughly familiar with all applicable ANSI/NFPA standards. The standards, listed below, directly address the use of this Safety Module. 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.

The user has the responsibility to ensure that all local, state, and national laws, rules, codes, and regulations relating to the use of this Safety Module in any particular application are satisfied. Extreme care is urged that all legal requirements have been met and that all installation and maintenance instructions contained in this manual are followed.

Applicable U. S. Standards

ANSI B11	Standards for Machine Tools Available from: Safety Director AMT – The Association for Manufacturing Technology 7901 Westpark Drive McLean, VA 22102-4269 Tel.: 703-827-2900
NFPA79	“Electrical Standard for Industrial Machinery Available from: National Fire Protection Association 1 Batterymarch Park, P.O. Box 9101 Quincy, MA 02269-9101 Tel.: 800-344-3555
ANSI/RIA R15.06	“Safety Requirements for Industrial Robots and Robot Systems” Available from: Robotic Industries Association 900 Victors Way, P.O. Box 3724 Ann Arbor, MI 48106 Tel.: 734-994-6088

Applicable European Standards

ISO/TR12100-1 & -2 (EN292-1 & -2)	“Safety of Machinery – Basic Concepts, General Principles for Design, Part 1: Basic Terminology, Methodology” and “Part 2: Technical Principles and Specifications”
IEC/EN60204-1	“Electrical Equipment of Machines: Part 1: General Requirements” Also, request a type “C” standard for your specific machinery.
ISO13849-1 (EN954-1)	“Safety of Machinery – Safety Related Parts of Control Systems”
ISO13855 (EN999)	“Safety of Machinery – The Positioning of Protective Equipment”
ISO14119 (EN1088)	“Safety of Machinery – Interlocking Devices Associated with Guards”
Available from:	Global Engineering Documents 15 Inverness Way East Englewood, CO 80112-5704 Tel.: 800-854-7179

Gate Monitoring Safety Module – Model GM-FA-10J

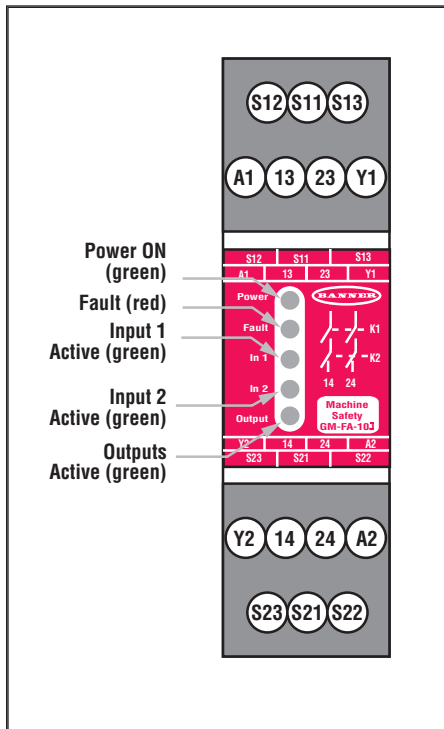


Figure 1. GM-FA-10J features and terminal locations



WARNING . . .

It must not be possible for personnel to reach any hazard point through an opened guard (or any opening) before hazardous machine motion has completely stopped. Please reference the appropriate standards (see page 2) for information on determining safety distances and safe opening sizes for your guarding devices.

Overview

The purpose of the GM-FA-10J Gate Monitor Safety Module is to verify the proper operation of coded magnetic safety switches and positive-opening safety switches by monitoring a normally open (NO) and a normally closed (NC) contact from each switch. In a typical application, two safety switches (individually mounted) indicate the open or closed status of a gate, moveable guard, or barrier (all called “guards” throughout this document).

The Safety Module monitors each switch for complementary switching (each channel must have one open input and one closed input at all times). These inputs must always be in opposite states and must switch state within 1 second of each other. Channel 1 has a “guard closed” condition when S11/S13 is closed and S11/S12 is open. Similarly, Channel 2 has a “guard closed” condition when S21/S23 is closed and S21/S22 is open (see Figures 2 and 3). The Safety Module also will detect and properly respond to a short circuit between the channels and a short circuit to other sources of power. The Safety Module will open the safety outputs within 15 milliseconds of the switching of either channel when the guard opens.

When the guard closes, debounce logic in the Safety Module’s inputs increases the reliability and repeatability of successfully resetting the Safety Module and reduces the necessity of re-cycling the guard. This feature can result in increased efficiency of the machine, even if the guard is misaligned or vibration is present.

The GM-FA-10J Safety Module may be configured via DIP switches for two-channel (redundant switches on a single guard), or one-channel operation (individual switches on two guards). In two-channel operation, each channel must switch within 3-second simultaneity of the other when the guard closes. If not, the guard must be re-opened and closed until the timing requirement is met. When the guard opens, the two channels operate concurrently (both channels must switch, but without the timing requirement).

In one-channel operation, each channel operates individually, except to reset the device (in which case both guards must be closed). If only one switch is being monitored, the closed input of the unused channel must be jumpered (S11/S13 or S21/S23).

The reset function has two options, selected by DIP switch: Automatic reset or Monitored Manual reset. See Figure 7 for configuration information.

The reset input also can be used for an External Device Monitoring (EDM) circuit. The EDM circuit consists of a normally closed, force-guided contact from each device being controlled by the GM-FA-10J, all wired in series with the Reset button (if used) and terminated at terminals Y1 and Y2. See Figure 6 for further information.

The output of the Gate Monitor Safety Module consists of two redundant output switching channels, each of which is the series connection of two forced-guided relay contacts (K1 and K2 in Figure 6). Each of the switching outputs is rated for up to 250V ac at up to 6 amps.

Gate Monitoring Safety Module – Model GM-FA-10J

Safety Switch Requirements

The following general requirements and considerations apply to the installation of interlocked gates and guards for the purpose of safeguarding. In addition, the user must refer to the relevant regulations and be sure to comply with all necessary requirements.

Hazards guarded by the interlocked guard must be prevented from operating until the guard is closed; a stop command must be issued to the guarded machine if the guard opens while the hazard is present. Closing the guard must not, by itself, initiate hazardous motion; a separate procedure must be required to initiate the motion. The safety switches must not be used as a mechanical or end-of-travel stop.

The guard must be located an adequate distance from the danger zone (so the hazard has time to stop before the guard is opened sufficiently to provide access to the hazard), and it must open either laterally or away from the hazard, not into the safeguarded area. The guard also should not be able to close by itself and activate the interlocking circuitry. The installation must prevent personnel from reaching over, under, around or through the guard to the hazard. Any openings in the guard must not allow access to the hazard (see the appropriate standard). The guard must be strong enough and designed to protect personnel and contain hazards within the guarded area that can be ejected, dropped or emitted by the machine.

The safety switches, actuators and magnets used with the Safety Module must be designed and installed so that they cannot be easily defeated. They must be mounted securely, so that their physical position can not shift, using reliable fasteners that require a tool to remove. Mounting slots in the housings are for initial adjustment only; final mounting holes must be used for permanent location.

Positive-Opening Interlocking Switches

Safety interlock switches used with the GM-FA-10J module must satisfy several requirements. Each switch must provide electrically isolated contacts: at minimum, one normally closed (NC) contact and one normally open (NO) contact to interface with the module.

The contacts must be of “positive-opening” design, with one or more normally closed contacts rated for safety. Positive-opening operation causes the switch to be forced open, without the use of springs, when the switch actuator is disengaged or moved from its home position (see the Banner Safety Catalog for examples). In addition, the switches must be mounted in a “positive mode,” to move/disengage the actuator from its home position and open the normally closed contact, when the guard opens.

Coded Magnetic Safety Switches

Similar to positive-opening safety switches, coded magnetic switches used with the GM-FA-10J module must provide one normally closed contact and one normally open contact (typically a four-wire switch). (See Banner Safety Catalog or page 15 for more information.)

The switch and its magnet must be mounted a minimum distance of 15 mm (0.6") from any magnetized or ferrous materials for proper operation. If either the switch or magnet is mounted on a material that can be magnetized (a ferrous metal, such as iron), the switching distance will be affected. Although the switch and magnet are coded to minimize the possibility of false actuation, they should not be used within known fields of high-level electromagnetic radiation.

Gate Monitoring Safety Module – Model GM-FA-10J

Depending on the model of switch and magnet used, the installation must be designed to provide the correct direction of approach (see page 17). **The speed of approach must be fast enough to meet the simultaneity-monitoring period of 1.0 second, approximately equal to or greater than 0.1 m (4") per second.** If the simultaneity requirement is not met, the Safety Module can not be reset and will not close its safety output contacts.

Switch Hookups, Typical Applications

Requirements vary widely for the level of control reliability or safety category (per ISO 13849) in the application of interlocked guards. While Banner Engineering always recommends the highest level of safety in any application, it is the responsibility of the user to safely install, operate and maintain each safety system and comply with all relevant laws and regulations. The applications shown in Figures 2 and 3 meet or exceed the requirements for control reliability and Safety Category 3 or 4, per ISO 13849 (EN954-1).

Mechanical Installation

Route the switch cable to the Safety Module location. The Safety Module must be installed inside an enclosure; it is not designed for exposed wiring. It is the user's responsibility to house the Safety Module in an enclosure with a NEMA (or IEC) rating suitable for the operating environment. The Safety Module may be mounted directly onto standard 35 mm DIN rail.

For reliable operation, the user must ensure that the operating specifications are not exceeded. The enclosure must provide adequate heat dissipation, so the air closely surrounding the Module does not exceed its maximum operating temperature. Methods to reduce heat build-up include venting, forced airflow (e.g., exhaust fans), adequate enclosure exterior surface area, and spacing between modules and other sources of heat. (See Specifications, Operating Conditions: Temperature.)

Electrical Installation

Each Safety Module is powered by 24V ac/dc (at less than 150 mA). The Safety Module, in turn, supplies power to each switch.

Two functions of the Safety Module are:

- 1) To monitor the contacts and wiring of safety switches for certain failures and to prevent the machine from restarting if the switch or the Module fails, and
- 2) To provide a reset routine after closing the guard and returning the inputs to their "closed" condition – this prevents the controlled machinery from restarting automatically when the guard closes. This necessary reset function is required by ANSI B11 and NFPA 79 machine safety standards.

See Figures 2 through 5 for connection of safety switches.

Gate Monitoring Safety Module – Model GM-FA-10J

Monitoring Series-Connected Safety Switches

When monitoring two individually mounted safety switches (as shown in Figures 2 and 3), a faulty switch will be detected if it fails to switch as the guard opens. In this case, the Gate Monitor Module will de-energize its output relays and disable its reset function until the input requirements are met (i.e., the faulty switch is replaced). However, when a series of interlocking safety switches is monitored by a single Gate Monitor Module, the failure of one switch in the system may be masked or not detected at all (refer to Figures 4 and 5).

Series-connected interlock switch circuits do not meet ISO 13849 (EN954-1) Safety Category 4 and may not meet Control Reliability requirements because of the potential for an inappropriate Gate Monitor reset or a potential loss of the safety stop signal. A multiple connection of this type should not be used in applications where loss of the safety stop signal or an inappropriate reset can lead potentially to serious injury or death. The following two scenarios assume two positive-opening safety switches on each guard:

- 1) **Masking of a failure.** If a guard is opened but a switch fails to open, the redundant safety switch will open and cause the Safety Module to de-energize its outputs. If the faulty guard is then closed, both Safety Module input channels also close, but because one channel did not open, the Safety Module will not reset. However, if the faulty switch is not replaced and a second “good” guard is cycled (opening and then closing both of the Module’s input channels), the Module considers the failure to be corrected. With the input requirements apparently satisfied, the Module allows a reset. This system is no longer redundant and, if the second switch fails, may result in an unsafe condition (i.e., the accumulation of faults results in the loss of the safety function).
- 2) **Non-detection of a failure.** If a good guard is opened, the Safety Module de-energizes its outputs (a normal response). But if a faulty guard is then opened and closed before the good guard is re-closed, the failure on the faulty guard is not detected. This system is no longer redundant and may result in a loss of safety if the second safety switch fails to switch when needed.

The systems in either scenario do not inherently comply with the safety standard requirements of detecting single faults and preventing the next cycle. In multiple-guard systems using series-connected safety switches, it is important to periodically check the functional integrity of each interlocked guard individually. **Operators, maintenance personnel, and others associated with the operation of the machine must be trained to recognize such failures and be instructed to correct them immediately.**

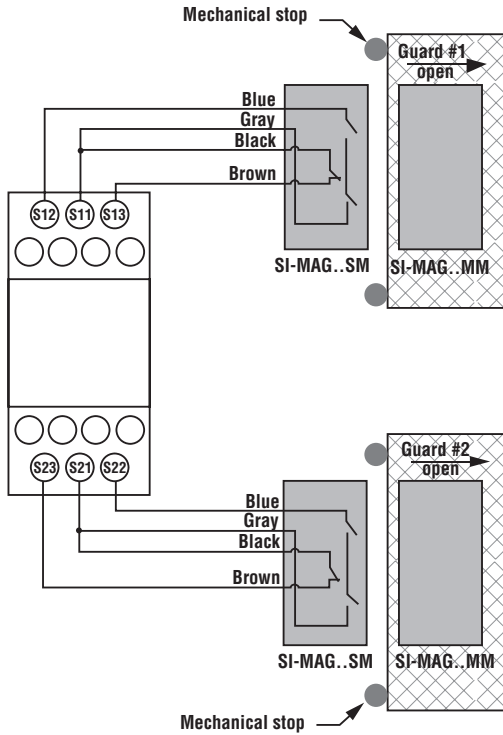
Open and close each guard separately while verifying that the Gate Monitor outputs operate correctly throughout the check procedure. Follow each gate closure with a manual reset, if needed. If a contact set fails, the Safety Module will not enable its reset function. If the Safety Module does not reset, a switch may have failed; that switch must be immediately replaced.

This check must be performed and all faults must be cleared, at a minimum, during periodic checkouts. **If the application can not exclude these types of failures and such a failure could result in serious injury or death, then the series connection of safety switches must not be used.**

Gate Monitoring Safety Module – Model GM-FA-10J

One-Channel Monitoring

Configured for one-channel monitoring of either one or two guards. This application is considered to meet or exceed requirements for Control Reliability and Safety Categories 3 and 4 per ISO 13849-1 (EN954-1).

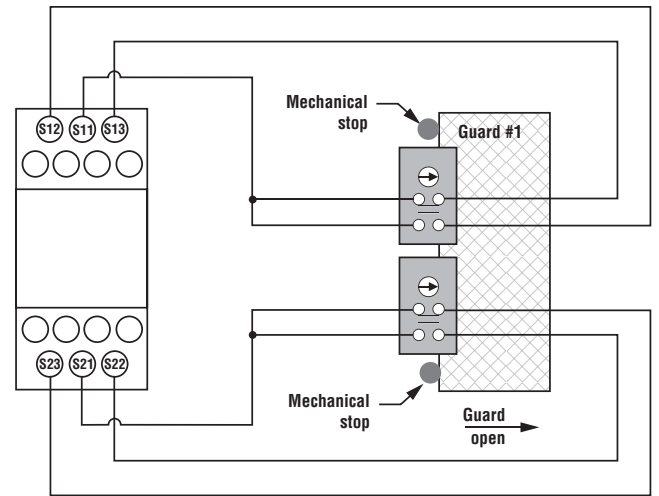


NOTE: If only one magnetic safety switch is used, select 1-channel input and jumper S23 to S21.

Figure 2. Hookup to two 4-wire coded magnetic safety switches

Two-Channel Monitoring

Configured for two-channel monitoring of one guard. This application is considered to meet or exceed requirements for Control Reliability and Safety Categories 3 and 4 per ISO 13849-1 (EN954-1).



NOTE: Guard shown in closed position.

Figure 3. Hookup to two positive-opening safety interlock switches

Gate Monitoring Safety Module – Model GM-FA-10J

One-Channel Monitoring

Configured for one-channel monitoring of multiple guards with single switches at each guard (see Warning). Up to 10 Banner magnetic switches may be connected to each channel in this series/parallel method.



WARNING . . . Not a Safety Category 4 Application

When monitoring multiple guards with a series connection of multiple safety interlock switches, a single failure may be masked or not detected at all.

When such a configuration is used, procedures must be performed regularly to verify proper operation of each switch. See “Monitoring Series-Connected Safety Switches” (page 6) for more information.

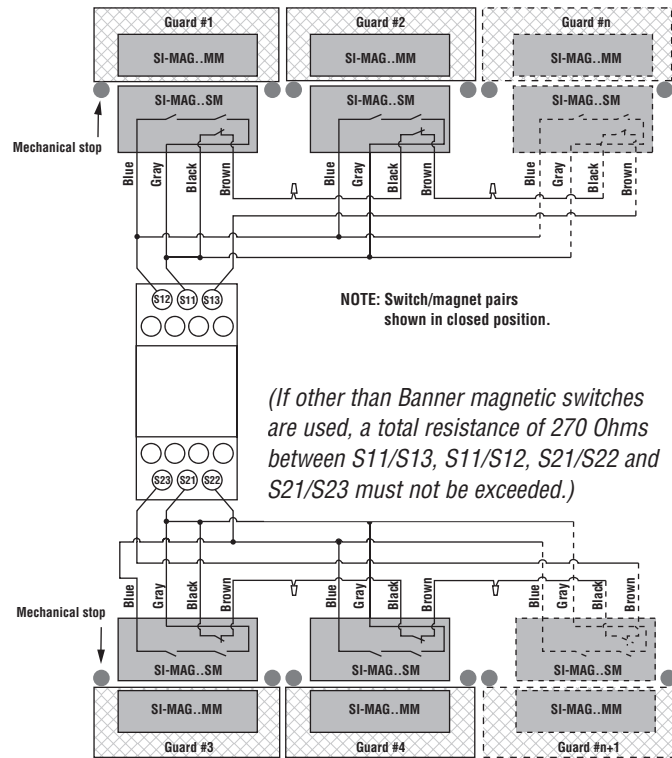


Figure 4. Alternate hookup for one-channel monitoring of multiple guards

Two-Channel Monitoring

Configured for two-channel monitoring of multiple guards with two safety switches mounted individually on each guard (see Warning).

The number of mechanical switches is limited by the max. resistance of 270 ohm between S11/S13, S11/S12, S21/S22 and S21/S23. The total resistance is calculated by adding the resistance of all guard switch contacts and the resistance of the cables that connect the switches and the switches to the module.



WARNING . . . Not a Safety Category 4 Application

When monitoring multiple guards with a series connection of multiple safety interlock switches, a single failure may be masked or not detected at all.

When such a configuration is used, procedures must be performed regularly to verify proper operation of each switch. See “Monitoring Series-Connected Safety Switches” (page 6) for more information.

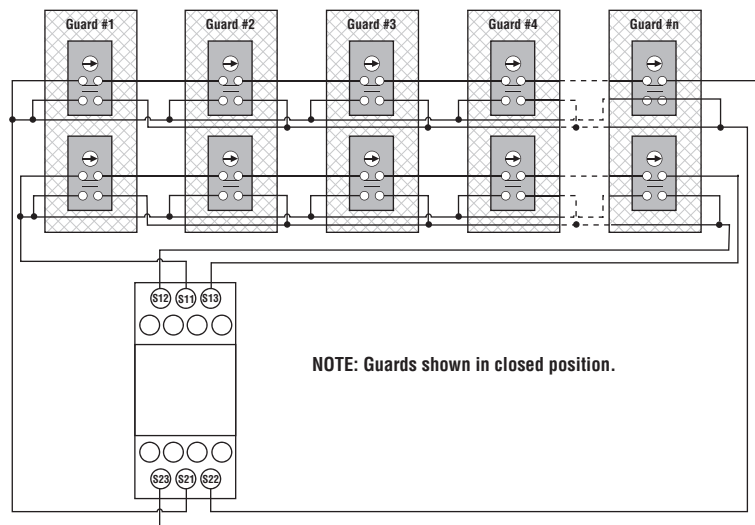


Figure 5. Alternate hookup for two-channel monitoring of multiple guards

Gate Monitoring Safety Module – Model GM-FA-10J



WARNING . . . Wiring of Arc Suppressors

If arc suppressors are used, they **MUST** be installed as shown across the actuator coil of the master stop control elements (MPCE1 and MPCE2). **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 will create an unsafe condition which could result in serious injury or death.**



WARNING . . . Interfacing MPCEs

NEVER wire an intermediate device (for example, a programmable logic controller), other than a Safety Relay, between Safety Module outputs and the Machine Primary Control Element it switches. To do so sacrifices the control reliability of the control-to-machine interface and creates an unsafe condition, which could result in serious injury or death. Whenever forced-guided, mechanically linked relays are added as intermediate switching devices, a normally closed monitor contact of those relays must be added to the series feedback loop between Safety Module terminals Y1 and Y2.

Connection to the Guarded Machine

The machine interface hookup diagram (Figure 6) shows a generic connection of the Gate Monitor Safety Module's two redundant output circuits to machine primary control elements MPCE1 and MPCE2. A machine primary control element is an electrically powered device, external to the Safety Module, which stops the guarded machinery by immediately removing electrical power to the machine and (when necessary) by applying braking to dangerous motion. The stop is accomplished by removing power to the actuator coil of either MPCE.

To satisfy the Safety Category 4 requirements of ISO 13849 (EN 954-1), each MPCE must offer a normally closed, forced-guided monitor contact. One normally closed monitor contact from each MPCE is wired in series to the Y1-Y2 feedback/reset input (see Figure 6). In operation, if one of the switching contacts of either MPCE fails in the shorted condition, the associated monitor contact will remain open, preventing the reset of the Gate Monitor Safety Module.

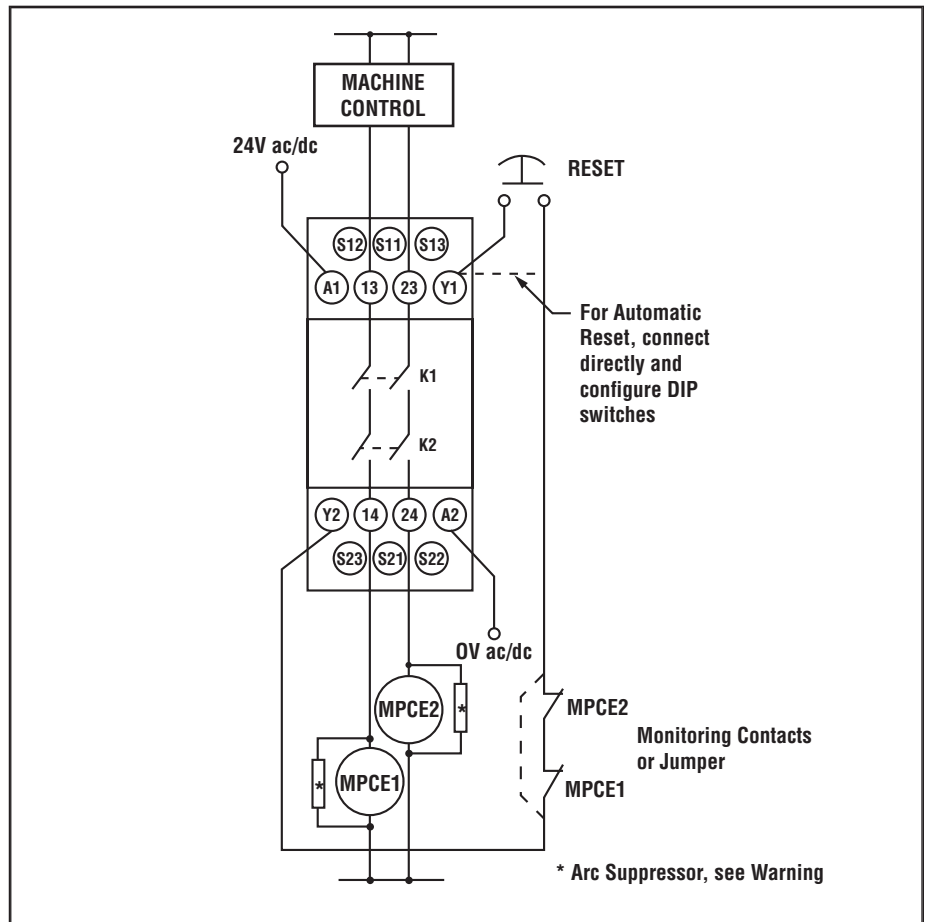


Figure 6. Hookup to the guarded machine

Gate Monitoring Safety Module – Model GM-FA-10J

Manual Reset and Reset Switch Connection

The Safety Module may be configured for Manual Reset by setting switches S1.2 and S2.2 in Banks A and B to OFF. The Reset switch may be any mechanical normally open switch, but should be a momentary switch or a two-position keyed switch. To reset the Safety Module, both guards must be closed, at which time the output LED will flash (signaling that the Reset switch must be cycled). This action is a monitored manual reset (open-closed-open), where the “closed” phase is approximately 0.25 to 2 seconds long.

The Reset switch must be capable of reliably switching 15 to 30V dc at 5 to 50 mA. As shown in Figure 6, the Reset switch connects between terminals Y1 and Y2 of the Safety Module. The Reset switch must be located outside of – and not accessible from – the area of dangerous motion, and it must be positioned so the switch operator can see all areas of dangerous motion during the Reset procedure.

Configuration

Automatic Reset Mode

The Safety Module may be configured for Automatic Reset by setting switches S1.2 and S2.2 in Banks A and B to ON. If no MPCE contacts are monitored, a jumper must be installed between terminals Y1 and Y2 (see Figure 6). The Safety Module will reset (and its outputs will energize) as soon as the guards return to their closed position.

Automatic Reset is useful for some automated processes. However, if Automatic Reset is used, an alternate means must be provided to prevent resumption of hazardous machine motion until an alternate reset procedure is performed. The alternate means must include a Reset switch, located outside the area of dangerous motion, and positioned so that the switch operator can see all areas of dangerous motion during the reset procedure.

1-Channel or 2-Channel Input

Model GM-FA-10J may be configured for 1-channel or 2-channel operation by setting DIP switches S1.1 and S2.1 in Banks A and B. In 1-channel operation (S1.1 and S2.1 – ON), the input channels function independently. The two guards can be monitored individually, but both channels must be in the closed position for the Safety Module to be reset.

In 2-channel operation (S1.1 and S2.1 – OFF) the input channels must function together. Both channels must switch within a 3-second simultaneity of the other when the guard closes. If not, the guard must be re-opened and closed until the timing requirement is met. When the guard opens, the channels function concurrently (both must open, but without the timing requirement).

In either configuration, the “closed” inputs of each channel must be closed before the Safety Module can be reset (continuity S11 to S13 and S21 to S23). If in 1-channel mode and monitoring only one switch, a jumper must be installed at the unused input (e.g., S21 to S23; see Figure 2).

NOTE: “1-channel” is also known as “single channel,” and “2-channel” is also known as “dual channel.”

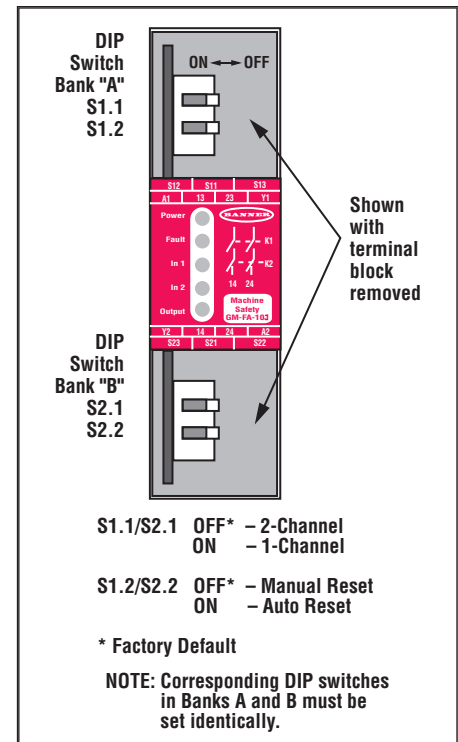


Figure 7. DIP switch configuration settings for reset mode and 1- or 2-channel operation

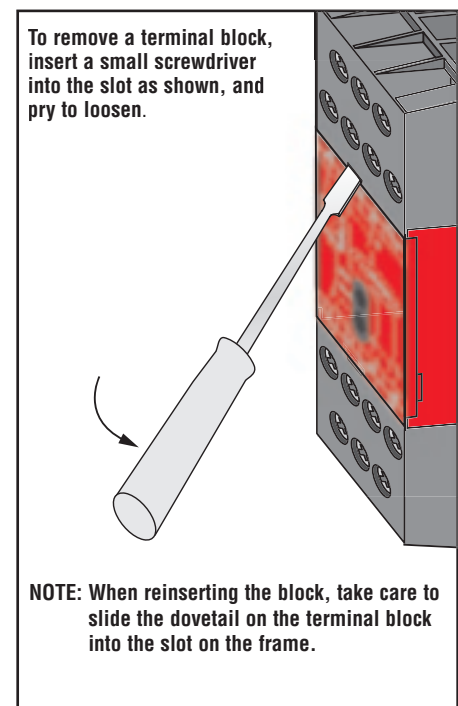


Figure 8. Removal of terminal blocks



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 E-stop 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.

Initial Checkout Procedure

- 1) Remove power from the machine control elements.
- 2) Close all monitored guards. If the Module is wired to 1-channel input, the second input (S21/S23 or S11/S13) must be jumpered if unused.
- 3) Apply input power (only) to the Gate Monitor Module at terminals A1 and A2 (see Figure 6). The following LEDs should come ON:
 - Power
 - Input 1
 - Input 2

If the Power LED comes ON, but either or both Input LEDs are not ON, disconnect input power and check the wiring of the connected switch(es) and/or the jumper. Check if the jumper is installed correctly on the unused input. Return to step 2 after the cause of the problem has been corrected.

- 4) **If the Module is set to 1-channel operation:** After the Power, Input 1, and Input 2 LEDs all are ON, open and close all connected guards one at a time. When each individual guard opens, the corresponding Input LED must turn OFF, and when the guard closes its LED must come ON again.

If the Module is set to 2-channel operation: After the Power, Input 1, and Input 2 LEDs all are ON, open the guard; both switches must open within 3 seconds, and both Input LEDs must turn OFF. If the red Fault LED comes ON, simultaneity between the switches or within one switch (between its NO and NC contacts) was not met. Check all wiring and the switches.

If the Module is set to Auto Reset (Y1/Y2 closed and DIP switches set to Auto Reset), the output LED will come ON as soon as both Input LEDs are ON (output contacts 13/14 and 23/24 close).

If the Module is set to Manual Monitored Reset the Output LED should come ON only if Input 1 and 2 LEDs are ON and the Reset button connected to Y1 and Y2 went from open to closed and back to open position.

- 5) Repeat step 4 individually for each guard that is being monitored.
- 6) Close the guard. Apply power to the machine control elements and perform the Periodic Checkout Procedure on page 12.

NOTE: Make sure that both Input 1 and 2 LEDs are ON *only when ALL connected guards are closed*. If the guards are closed and the Input LEDs are OFF, the guard switches may be wired incorrectly, which could reset the Module inappropriately (safety output contacts close as soon as one of the connected guards opens).

Do not continue operation until all checks are completed and all problems are corrected. See the Warning on page 12, and Repair and Troubleshooting on pages 18 and 19 for further information.

Gate Monitoring Safety Module – Model GM-FA-10J

Periodic Checks

At each shift change or machine setup, a Designated Person* should do the following checks on all safety switches:

- 1) Breakage or damage of the switch, actuator, or magnet.
- 2) Good alignment between the switch and actuator or magnet.
- 3) Confirmation that the switches are not being used as an end-of-travel stop.
- 4) Loosening of the mounting hardware.
- 5) Verification that it is not possible to reach any hazard point through an opened guard (or any opening) before hazardous machine motion stops completely.
- 6) Open and close each guard separately while verifying that the Gate Monitor outputs operate correctly throughout the check procedure. Follow each gate closure with a manual reset, if needed. If a contact set fails, the Safety Module will not enable its reset function. If the Safety Module does not reset, a switch may have failed; that switch must be immediately replaced.

In addition, a Qualified Person* should do the following on a periodic schedule (determined by the user, based upon the severity of the environment and the frequency of switch actuations):

- 1) Inspect the electrical wiring for continuity and damage.
- 2) Confirm that wiring conforms to the instructions given in this installation manual.

Do not continue operation until all checks are completed and all problems are corrected. See Repair and Troubleshooting on pages 18 and 19 for further information.

* A Designated Person is identified in writing by the employer as being appropriately trained to perform a specified checkout procedure. A Qualified Person possesses a recognized degree or certificate or has extensive knowledge, training, and experience to be able to solve problems relating to safety switch installation.





WARNING . . . Do Not Use Machine Until System Is Working Properly

If all of these checks cannot be verified, do not attempt to use the guarded machine until the defect or problem has been corrected.

Attempts to use the guarded machine under such conditions could result in serious bodily injury or death.

Gate Monitoring Safety Module – Model GM-FA-10J

Specifications	
Supply Voltage and Current	24V ac/dc \pm 20% Power consumption: approx. 3 VA / 3 W
Supply Protection Circuitry	Protected against transient voltages and reverse polarity
Output Configuration	Each normally open output channel is a series connection of contacts from two forced-guided (mechanically linked) relays, K1-K2. Contacts: AgNi, 5 μ m gold-plated Low Current Rating Caution: The 5 μm gold-plated contacts allow the switching of low current/low voltage. In these low-power applications, multiple contacts can also be switched in series (e.g., “dry switching”). To preserve the gold plating on the contacts, do not exceed the following max. values at any time: Min. voltage: 1V ac/dc Max. voltage: 60V Min. current: 5 mA ac/dc Max. current: 300 mA Min. power: 5 mW (5 mVA) Max. power: 7 W (7 VA) High Current Rating If higher loads must be switched through one or more of the contacts, the minimum and maximum values of the contact(s) changes to: Min. voltage: 15V ac/dc Max. voltage: 250V ac/dc Min. current: 250 mA ac/dc Max. current: 6 A Min. power: 5 W (5 VA) Max. power: 200 W (1,500 VA) Mechanical life: 50,000,000 operations Electrical life: 150,000 cycles typical, @ 200 W (1,500 VA) switched power, resistive load NOTE: Transient suppression is recommended when switching inductive loads. Install suppressors across load. Never install suppressors across output contacts (see Warning, page 9).
Output Response Time	15 ms
Input Requirements	Each switch or sensor must have a normally closed contact and a normally open contact capable of switching 5 to 50 mA @ 15 to 30 V dc. Reset switch must have one normally open contact capable of switching 5 to 50 mA @ 15 to 30 V dc. Max. external resistance between terminals S11/S12, S11/S13, S21/S22 and S21/S23: 270 ohms each.
Simultaneity Monitoring	2-Channel operation: 3 seconds 1-Channel operation: infinite
Status Indicators	1 red LED: Fault (see “Troubleshooting,” page 18) 4 green LEDs: Power – power is supplied to Safety Module Channel 1 – inputs satisfied (guard closed) Channel 2 – inputs satisfied (guard closed) Output – K1 and K2 energized, safety outputs closed
Housing	Polycarbonate Rated NEMA 1, IEC IP40, Terminals IP20
Mounting	Mounts to standard 35 mm DIN rail track. Safety Module must be installed inside an enclosure rated NEMA 3 (IEC IP54), or better.
Vibration Resistance	10 to 55 Hz @ 0.35 mm displacement per IEC 68-2-6
Operating Conditions	Temperature: 0° to +50°C (+32° to 122°F) Maximum Relative Humidity: 90% @ +50°C (non-condensing)
Dimensions	See Figure 9.
Safety Category	4 per ISO 13849-1 (EN954-1) (depending on application)
Certifications	 

Gate Monitoring Safety Module – Model GM-FA-10J

Dimensions

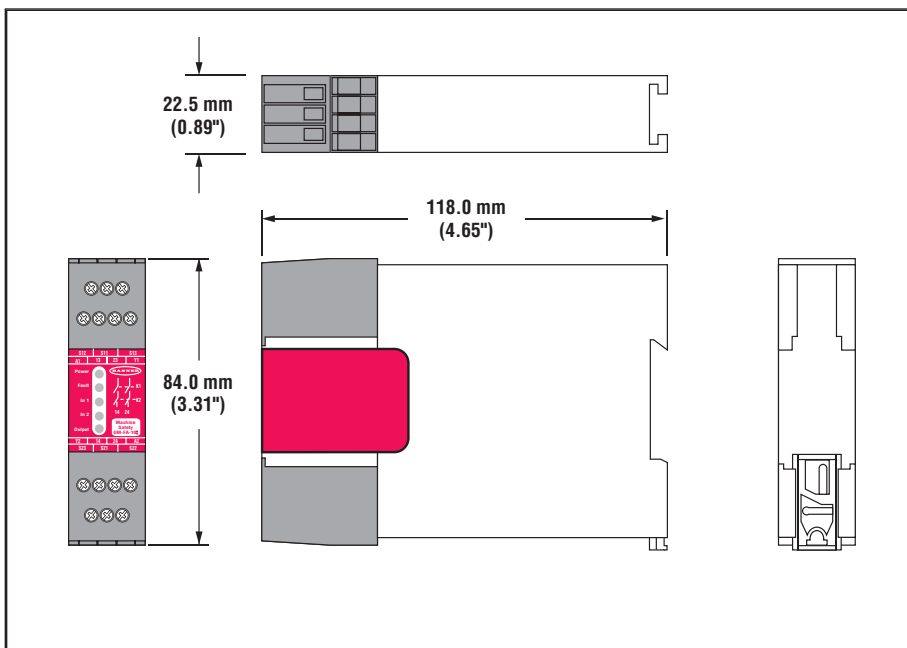


Figure 9. Model GM-FA-10J Gate Monitoring Safety Module enclosure dimensions

Accessories







Mechanical-Style Safety Switch Models

A full selection of appropriate safety interlock switches is available from Banner. See your current Banner Safety Products catalog or the website at www.bannerengineering.com for complete information.



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Magnetic Switch Models

Magnet Sensor*		Coded Magnet		Control Module	Sensor Cable	Switching Distance	
						Min. ON	Max. OFF
SI-MAG1SM SI-MAG1SMCO†		SI-MAG1MM SI-MAG1MM90††		SI-MAG1C	3 m (10')	3 mm (0.12")	14 mm (0.55")
		SI-MAG1MMHF				8 mm (0.31")	16 mm (0.63")
SI-MAG2SM		SI-MAG2MM				4 mm (0.16")	8 mm (0.32")
SI-MAG3SM		SI-MAG3MM				3 mm (0.12")	7 mm (0.28")

* 9 m (30') cables are available for magnet sensors by adding suffix "w/30" to the model number (e.g., **SI-MAG1SM w/30**).

† Cable opposite see Figure 10b, page 16)

†† 90° orientation (see Figure 13a, page 17)

Magnetic Switch Specifications

Switching Elements	Three pole-stable reed switches
Repeat Switching Accuracy	±0.1 mm (±0.004")
Construction	Epoxy-encapsulated circuit in polyamide housing
Environmental Rating	NEMA 4X, IEC IP67
Switching Capacity	30V dc max @ 0.25W
Operating Temperature	-5° to +70°C (+23° to +158°F)
Connections	Integral PVC-jacketed 3 m (10') 4-wire cable. Cable O.D. is 5 mm (0.2"). Wires are 24 AWG (0.25 mm ²).
Hardware	All mounting hardware is supplied by user. Use of permanent fasteners or locking hardware is recommended to prevent loosening or displacement of the actuator and switch body. Mounting holes in the magnet and sensor accept M4 (#6) hardware (see drawings on page 16).

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Magnetic Switch Dimensions

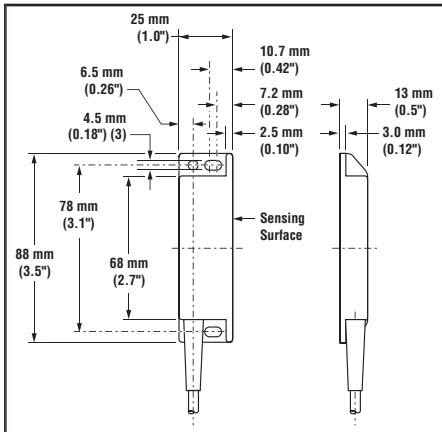


Figure 10a. SI-MAG1SM Sensor

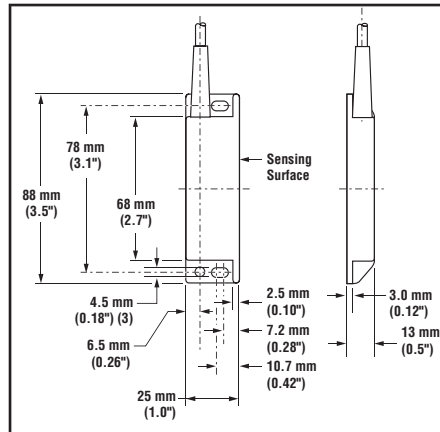


Figure 10b. SI-MAG1SMCO Sensor

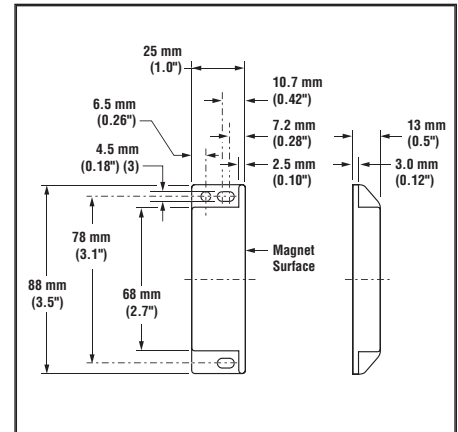


Figure 10c. SI-MAG1MM/MM90/MMHF Magnet

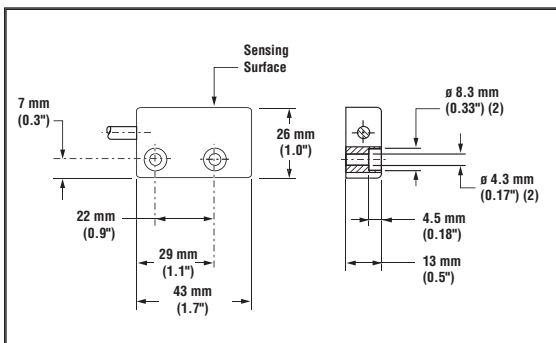


Figure 11a. SI-MAG2SM Sensor

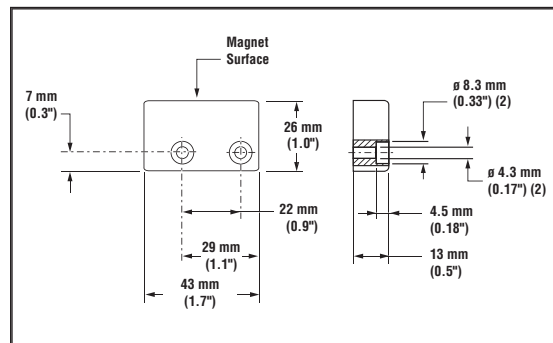


Figure 11b. SI-MAG2MM Magnet

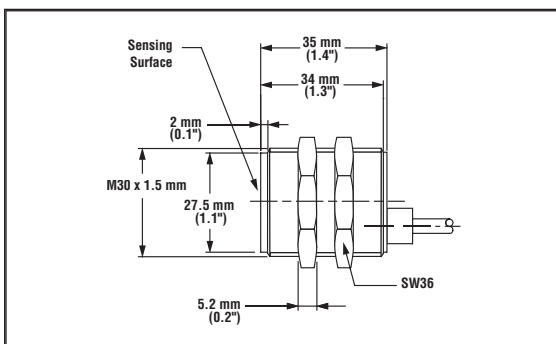


Figure 12a. SI-MAG3SM Sensor

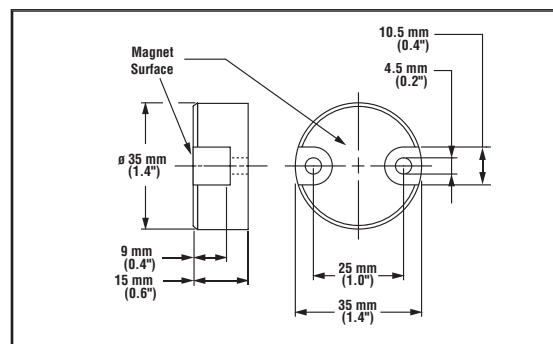


Figure 12b. SI-MAG3MM Magnet

“Direction of Approach” Options for Sensor/Magnet Pairs

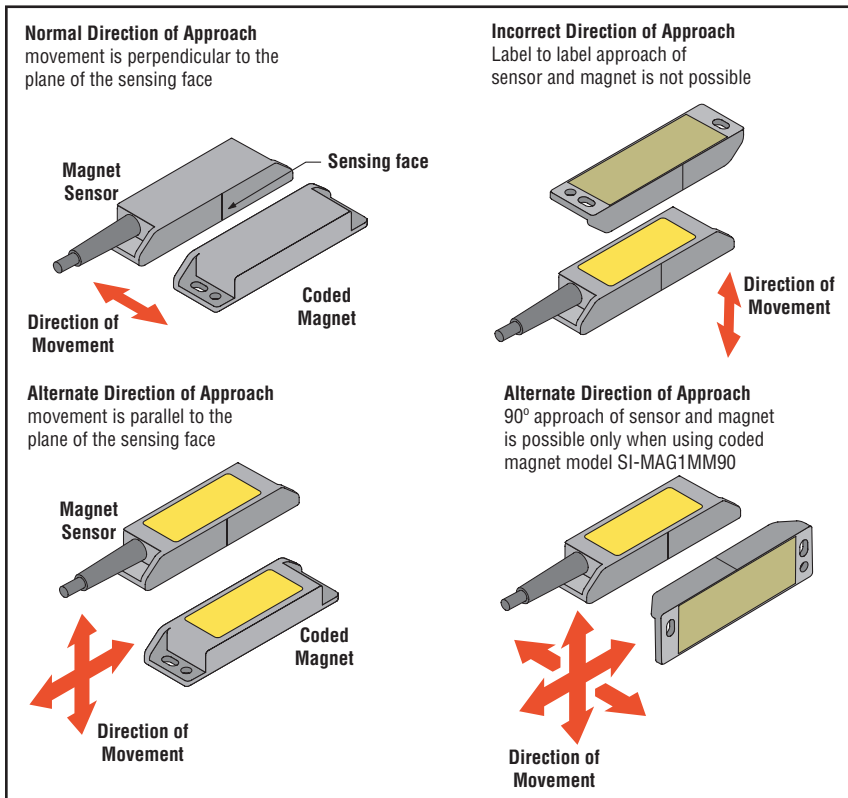


Figure 13a. Direction of Approach for SI-MAG1.. sensor/magnet pairs

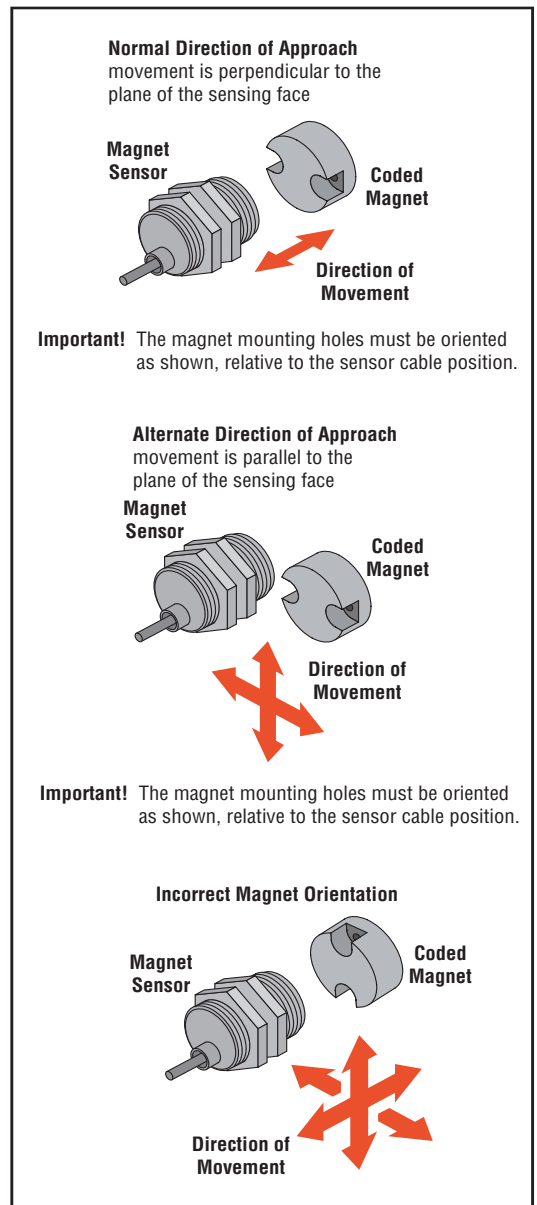


Figure 13c. Direction of Approach for SI-MAG3.. sensor/magnet pairs

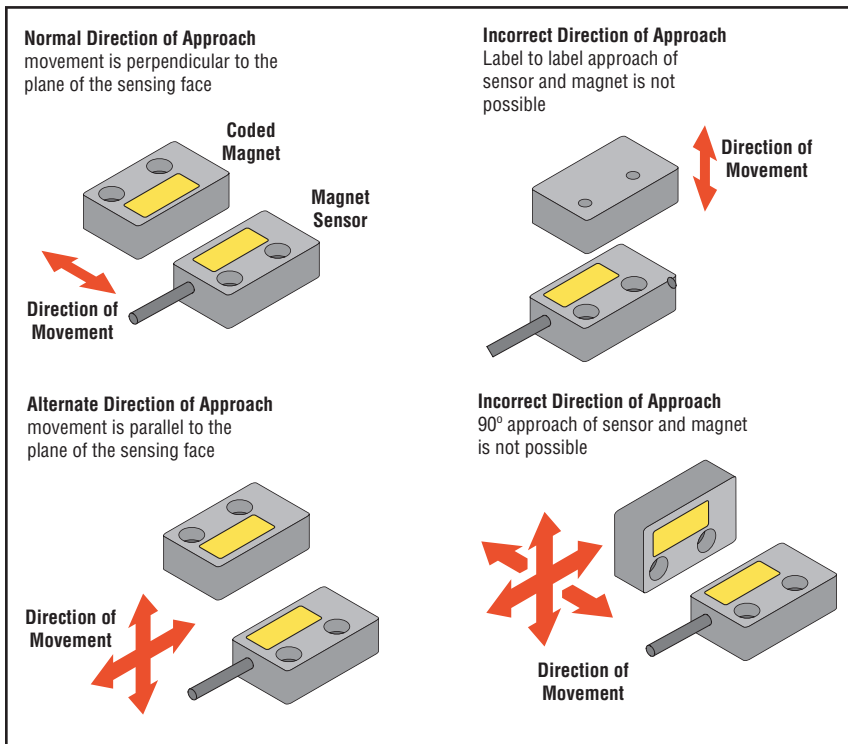


Figure 13b. Direction of Approach for SI-MAG2.. sensor/magnet pairs

NOTE: For all magnet style switches, approach speed must be greater than 0.1 m/s to allow for proper switching. (See page 5.)

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Repairs

Do not attempt any repairs to the GM-FA-10J Safety Module. It contains no field replaceable components. Return the Interface Module to the factory for warranty repair or replacement.

If it ever becomes necessary to return a Safety Module to the factory, contact the Banner Factory Application Engineering Group at the address or numbers listed at the bottom of the back page. They will attempt to troubleshoot the system from your description of the problem. If they conclude that a component is defective, they will issue an RMA (Return Merchandise Authorization) number for your paperwork and give you the proper shipping address. Pack the Safety Module carefully. Damage which occurs in return shipping is not covered by warranty.



CAUTION . . . Abuse of Module After Failure

If an Internal Fault occurs and the Module will not reset, do not tap, strike, or otherwise attempt to correct the fault by a physical impact to the housing. An internal relay may have failed in such a manner that its replacement is required. **If the Module is not immediately replaced or repaired, multiple simultaneous failures may accumulate and the safety function can not be guaranteed.**

Troubleshooting

Model GM-FA-10J Gate Monitoring Safety Module provides 5 LED indicators.

LED	LED Indicators
Power (green)	ON - Power is connected to terminals A1-A2. OFF - No power or low power to terminals A1-A2, or internal power supply failure.
Fault (red)	ON - External fault or configuration fault. The corresponding function LED will flash to indicate the area where the fault has been detected. See page 19 for probable cause. Flashing (only) - Internal Fault. See page 12 for repair. Flashing (with flashing power LED) - DIP Switch configuration fault. Check that switch positions are the same for both Banks A and B.
Input 1 (green)	ON - Guard 1 is closed and the inputs of Channel 1 are satisfied. OFF - Guard 1 is open or the inputs of Channel 1 are not satisfied. Flashing (Fault LED ON) - See page 19 for probable cause.
Input 2 (green)	ON - Guard 2 is closed and the inputs of Channel 2 are satisfied. OFF - Guard 2 is open or the inputs of Channel 2 are not satisfied. Flashing (Fault LED ON) - See page 19 for probable cause.
Output (green)	ON - Both internal relays K1 and K2 are energized (13/14 and 23/24 are closed). OFF - Both internal relays K1 and K2 are de-energized (13/14 and 23/24 are opened). Flashing - Reset requested. The Reset input (button) must be cycled (open, closed, open), to enter RUN mode. Flashing (Fault LED ON) - See page 19 for probable cause.

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Clearing Faults

To clear a fault condition, first correct the problem and then cycle the input channels to the module (open and close the guards). When the Fault LED lights, the corresponding Function LED will flash to indicate the problem. If the Fault LED is flashing, refer to “Repairs,” page 18.

LED			Fault, Probable Cause and Procedures
Power	ON	●	INPUT CHANNEL 1 FAULT (S11/S12/S13) a) S13 Open (guard closed) b) S12 Open (guard open) c) S11 Open (guard is open or closed) d) Short between S11 and S12
Fault	ON	●	
Input 1	FLASHING	☀	
Input 2	ON or OFF	●○	
Output	OFF	○	
Power	ON	●	INPUT CHANNEL 2 FAULT (S21/S22/S23) a) S23 Open (guard closed) b) S22 Open (guard open) c) S21 Open (guard is open or closed) d) Short between S21 and S22
Fault	ON	●	
Input 1	ON or OFF	●○	
Input 2	FLASHING	☀	
Output	OFF	○	
Power	ON	●	SHORT BETWEEN INPUT CHANNELS a) Short between S11 and S21
Fault	ON	●	
Input 1	FLASHING	☀	
Input 2	FLASHING	☀	
Output	OFF	○	
Power	ON	●	SIMULTANEITY FAULT a) 2-channel simultaneity > 3 seconds (configured for 2-channel operation) b) Channel simultaneity > 1 second (NO/NC did not switch within 1 second) See page 3 for description of complementary switching and 2-channel operation.
Fault	ON	●	
Input 1	ON or OFF	●○	
Input 2	ON or OFF	●○	
Output	OFF	○	
Power	FLASHING	☀	DIP-SWITCH ERROR a) DIP-switch settings are incorrect; Bank A does not match Bank B See page 10 for DIP-switch configuration.
Fault	FLASHING	☀	
Input 1	OFF	○	
Input 2	OFF	○	
Output	OFF	○	
Power	ON	●	OPEN RESET FAULT a) Y1/Y2 open when configured for Auto Reset See page 10 for Manual/Auto Reset information.
Fault	ON	●	
Input 1	ON	●	
Input 2	ON	●	
Output	FLASHING	☀	
Power	ON	●	INTERNAL FAULT (See page 18 for Repairs) a) Incorrect check sum b) Internal relay failure (e.g., welded contact due to inductive load arcing.) c) Low input power d) Other internal fault
Fault	FLASHING	☀	
Input 1	OFF	○	
Input 2	OFF	○	
Output	OFF	○	

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WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.