

Emergency Stop Safety Modules

Model ES-FA-9AA (24V ac/dc, 3 N/O)



Features

- Monitors one dual-channel normally closed emergency stop switch circuit for a contact failure or wiring fault
- The ES-FA-9AA has three output switching channels for connection to control-reliable power interrupt circuits
- Auto reset or monitored manual reset
- Design complies with standards UL991, ISO 13850 (EN418), and ISO 13849-1 (EN954-1) (Safety Category 4)
- For use in functional stop category 0 applications per NFPA 79 and IEC/EN60204-1
- 6 amp safety output contacts
- Plug-in terminal blocks
- 24V ac/dc operation



WARNING . . . This Emergency Stop Safety Module is not a point-of-operation guarding device, as defined by OSHA regulations. It is necessary to install point-of-operation guarding devices, such as safety light curtains 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.**

E-Stop Safety Module – ES-FA-9AA



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 Banner Emergency Stop 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 Emergency Stop Safety Module, and with the machinery it controls.

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

U. S. Standards Applicable to Use of Emergency Stop Safety Modules

ANSI B11 Standards for Machine Tools “Safety Requirements for the Construction, Care and Use”

Available from: Safety Director
 AMT – The Association for Manufacturing Technology
 7901 Westpark Drive
 McLean, VA 22102
 Tel.: 703-893-2900

NFPA79 “Electrical Standard for Industrial Machinery (1997)”

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

European Standards Applicable to Use of Emergency Stop Safety Modules

ISO/TR 12100-1 & -2 (EN292-1 & -2) “Safety of Machinery – Basic Concepts, General Principles for Design
Part 1: Basic Terminology, Methodology, and
Part 2: Technical Principals and Specifications”

ISO 13849-1 (EN954-1) “Safety of Machines: Safety Related Parts of Control Systems”

IEC/EN60204-1 “Electrical Equipment of Machines: Part 1: General Requirements”
Also, request a type “C” standard for your specific machinery.

ISO 13850 (EN418) “Safety of Machinery – Emergency Stop Equipment Functional Aspects, Principles for Design”

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

E-Stop Safety Module – ES-FA-9AA

Description

The purpose of an Emergency Stop Safety Module (E-Stop Safety Module) is to increase the control reliability of an emergency stop circuit. As indicated in Figures 2 and 3, the ES-FA-9AA E-Stop Safety Module is designed to monitor a 1-channel or 2-channel E-stop switch. A 2-channel E-stop switch has two electrically isolated contacts.

ISO 13849-1 Safety Categories

Both contacts of a 2-channel E-stop switch are monitored by the Safety Module. If either input is short-circuited, the Safety Module cannot be reset, and the controlled machinery cannot be restarted, following actuation of the E-stop switch. Two-channel E-stop switches used with this Safety Module are suitable for Safety Category 4 applications, per European Standard ISO 13849-1 (EN954-1), of which Category 4 is the highest safety category.

Use of a 1-channel E-stop switch provides no input redundancy, and no ability for the Safety Module to monitor for input short circuits. One-channel E-stop switches used with this Safety Module are generally suitable only for Safety Category 2 applications, per ISO 13849-1 (EN954-1).

IEC/EN60204-1 and NFPA79 Functional Stop Categories

In a functional Category 0 emergency stop circuit, the opening of either of the two E-stop switch contacts (or the one contact, if configured to 1-channel) immediately removes electrical power from the machine control elements, which react to stop hazardous machine motion and/or other machine hazards. This redundancy of stopping control offered by a two-pole E-stop switch is the first step towards control reliability in an emergency stop circuit.

The output of the E-Stop Safety Module ES-FA-9AA consists of three redundant output switching channels, each of which is the series connection of two forced-guided relay contacts that are internally monitored (K1 and K2 in Figure 2). If the Module detects a failure, such as a welded output relay contact, all outputs are disabled and cannot be reset. The four switching output circuits of the E-Stop Safety Module are rated for up to 250V ac at up to 6 amps.

The E-Stop Safety Module also provides a necessary reset function. U.S. and international standards require that a reset routine be performed after returning the E-stop switch to its closed-contact position. This prevents the controlled machinery from restarting by simply closing the E-stop switch. The Module may also be configured for automatic reset (see Figures 2 and 3). **The automatic reset mode is useful for some automated processes. However, when automatic reset is used, an alternate means must be established to require a reset routine after the E-stop switch is returned to its closed contact position (see WARNING on page 8).**

This E-Stop Safety Module complies with the following design standards:

UL991	Tests for Safety Related Control Employing Solid-State Devices
ISO 13850	Emergency Stop Equipment - Functional Aspects, Principals for Design
ISO 13849-1	Safety of Machines: Safety Related Parts of Control Systems Part 1: General Design Directives (Safety Category 4)

The Safety Module has indicators for input power, fault, and output relay contact status (K1 and K2); see Figure 1. There are no adjustments and no user-serviceable parts. See page 10 for information regarding repair service.

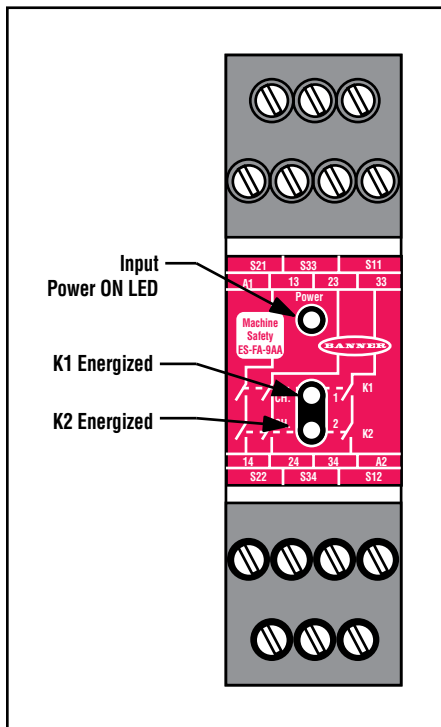


Figure 1. ES-FA-9AA status indicators

E-Stop Safety Module – ES-FA-9AA

E-Stop Switch Requirements

As shown in Figures 2 and 3, the E-stop switch must provide contacts which are closed when the switch is in the “armed” position. Once activated, the E-stop switch must open its contacts and be returned to the closed-contact position *only* by a deliberate action (such as twisting, pulling, or unlocking). The switch should be a “positive-opening type,” as described by IEC60947-5-1. A mechanical force applied to such a button (or switch) is transmitted directly to the contacts, forcing them open. This ensures that the switch contacts will open whenever the switch is activated. NFPA 79 section 13.2, Emergency Stop Devices, specifies the following additional switch (“stop control”) requirements:

- Emergency stop push buttons shall be located at each operator control station and at other operating stations where emergency shutdown shall be required.
- Stop and emergency stop push buttons shall be continuously operable from all control and operating stations where located.
- Actuators of emergency stop devices shall be colored RED. The background immediately around the device actuator shall be colored YELLOW. The actuator of a push-button-operated device shall be of the palm or mushroom-head type.
- The emergency stop actuator shall be a self-latching type.

NOTE: Some applications may have additional requirements. The user must refer to all relevant regulations.

When a 1-channel E-stop is used, the user must guard against failure modes that can result in an unsafe condition, for example the failure of the contact to a short circuit condition. A switch with positive opening operation should be used to reduce the possibility of a failure of the switch to open. A short circuit failure results in loss of switching function. This can occur from a short across the switch contacts, a short across the wires connected to the switch somewhere between the switch and the E-Stop Safety Module, or a short to a secondary source of power. To reduce these possibilities, physically separate the wires from each other and from other sources of power (e.g., in separate wireways or conduit).

According to the definition of European standard ISO 13849-1 (EN954-1), a 1-channel E-stop should generally be used in applications where Safety Category 2 or less (1 or B) has been determined via a risk-assessment procedure.

Two-channel E-stops, with positive open switches, are designed to issue a stop command even in the event of a single failure of this type and provide a high level of safety.

If the Module is configured for 2-channel E-stop, the immediate normally open output contacts (13-14, 23-24, and 33-34) will open as soon as at least one of the two E-stop contacts opens. Although simultaneity is not required, the E-stop contacts must both be open at the same time and then both be closed, to reset the output contacts. If not, the unit will go into a lockout condition that results in the outputs opening and requiring a reset after the fault has been corrected.



WARNING . . .

1-Channel Input

If a 1-channel E-stop button is used, a single fault (such as a short across the single E-stop contact or from the contact to a secondary source of power) can lead to the complete loss of safety.

A 1-channel E-stop should be used only in applications where such a fault can be excluded, or the resulting loss of safety cannot result in serious injury or death (Safety Category 2, 1 or B; see page 3).

If a 1-channel E-stop is used, separate the wires from each other and from other sources of power, by routing them through separate wireways or conduit in order to increase the reliability of the interface.

E-Stop Safety Module – ES-FA-9AA

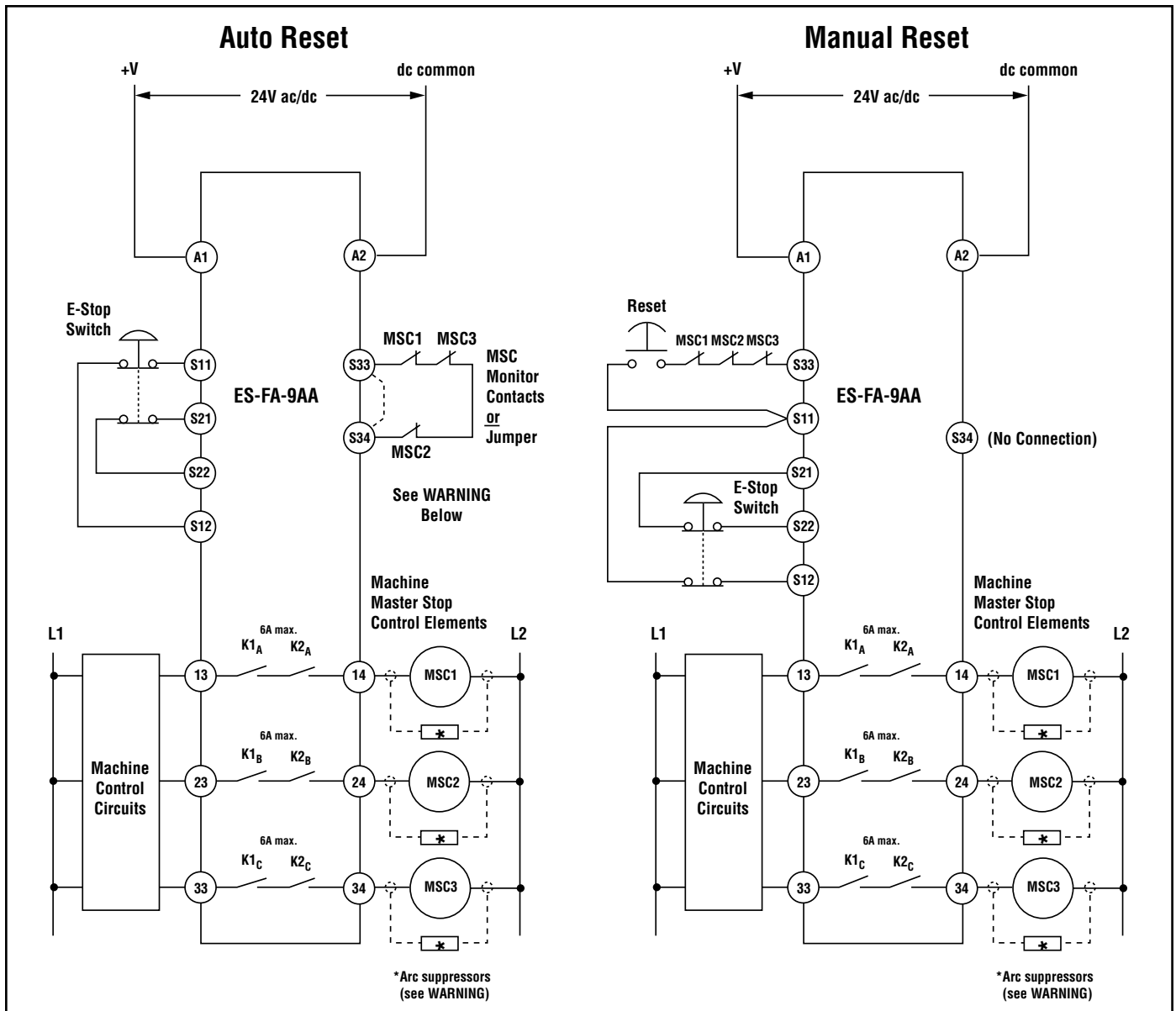


Figure 2. Hookup: 2-Channel E-Stop Applications



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 (MSC1 to MSC4). **NEVER** install suppressors directly across the output contacts of the E-stop 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 MSCs

NEVER wire an intermediate device (for example, a programmable logic controller), other than a Safety Relay, between E-stop Safety Module outputs and the Master Stop 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 a Safety Relay is added as an intermediate switching device, a normally closed forced-guided monitor contact of that relay must be added to the series feedback loop between Safety Module terminals S33 and S34. (Reference ANSI B11.1 – 1988, Appendix B4)

E-Stop Safety Module – ES-FA-9AA

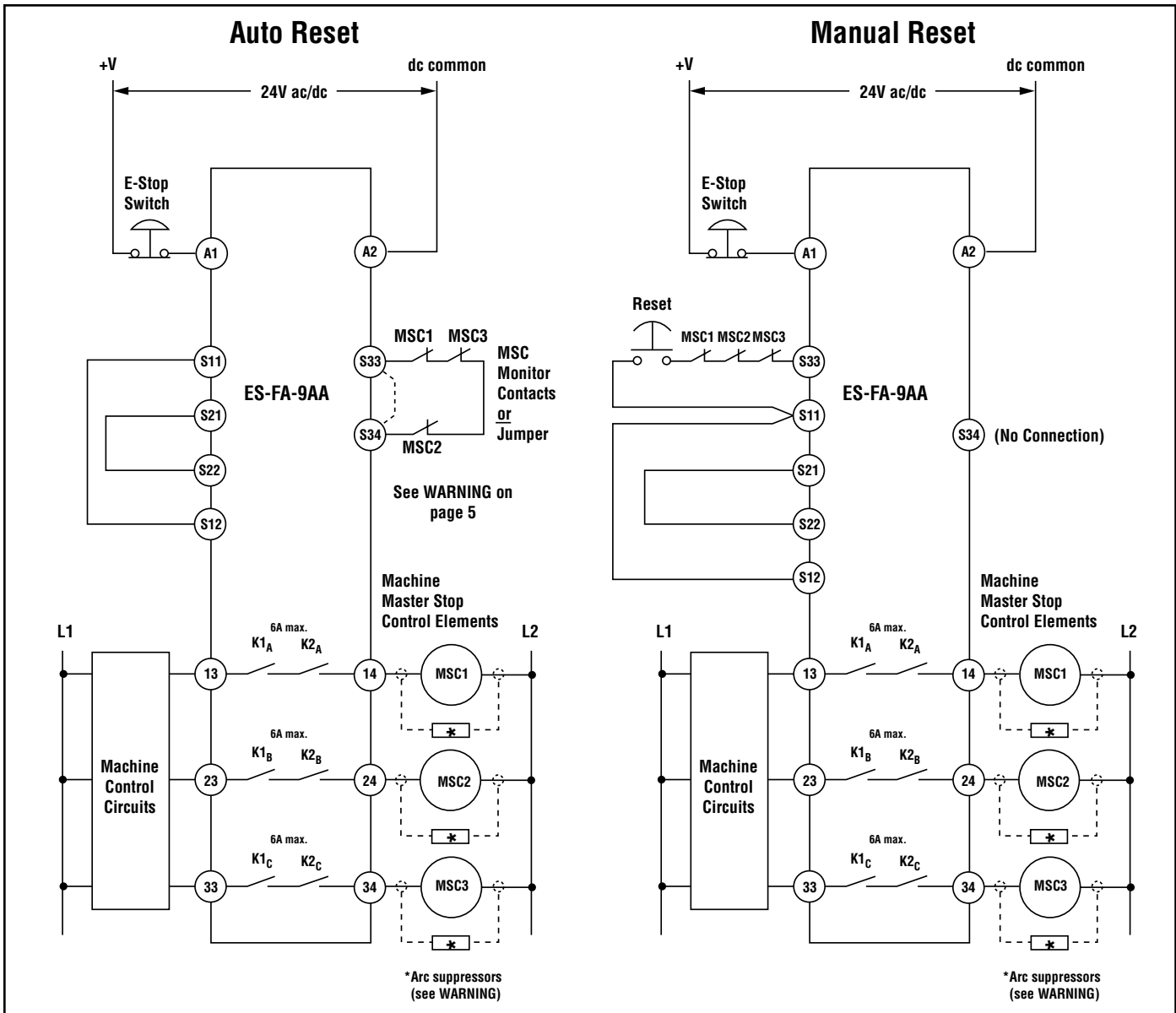


Figure 3. Hookup: 1-Channel E-Stop Applications



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 (MSC1 to MSC4). **NEVER** install suppressors directly across the output contacts of the E-stop 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.



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Mechanical Installation

The E-Stop 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 NEMA 3 (IEC IP54) rating, or better.

Dimensions of the Safety Module are shown in the diagram on page 10. The Safety Module mounts directly to standard 35 mm DIN rail.

Heat Dissipation Considerations

For reliable operation, the user must ensure that the operating specifications are not exceeded. The enclosure must provide adequate heat dissipation, so that the air closely surrounding the Module does not exceed the maximum operating temperature stated in the Specifications (page 11). 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.

Electrical Installation

It is not possible to give exact wiring instructions for a device such as an E-Stop Safety Module which interfaces to a multitude of machine control configurations. The following guidelines are general in nature.

The ES-FA-9AA Module has no delay function. Its output relay contacts open within 25 milliseconds after an E-stop switch contact opens. This classifies these E-Stop Safety Modules as functional "Category 0" E-stop controls, as defined by NFPA 79 (National Fire Protection Association Standard for Industrial Machinery) and IEC/EN60204-1 (European Standard: "Safety of Machinery, Emergency Stop Equipment, Functional Aspects – Principles of Design").

Connection of E-Stop Switch

Connect the poles of the E-stop switches as shown in Figures 2 and 3. The switches are shown in the "armed" position with both contacts closed. Multiple E-stop switches connected to one E-Stop Safety Module must be series connected (see Figure 4 and the warning on page 8).

Connection of Safety Switches

The ES-FA-9AA may be used as a safety gate monitoring module. To achieve Category 4 operation per ISO 13849-1 (EN954-1), two positive-opening safety switches operate concurrently when the gate or guard is opened (see Figure 5).

The Safety Modules verify concurrent opening of two contacts – one from each safety switch. Reset of the Safety Modules is not possible if one switch fails to open, or if a short circuit between the safety switches occurs.

Please contact the Banner Factory Applications Group at the numbers listed on the last page to discuss your intended use.



CAUTION . . .

Shock Hazard

Always disconnect power from the E-Stop Safety Module and all power from the machine being controlled before making any wire connections.

Electrical installation and wiring must be made by qualified personnel and must comply with the NEC (National Electrical Code), EN60204-1 and -2, and all applicable local standards and codes.

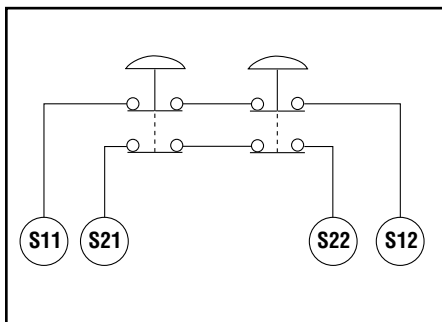


Figure 4. Series connection of multiple E-stop switches

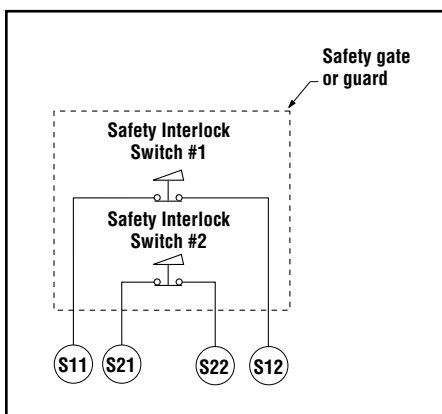


Figure 5. Hookup using contacts from two safety switches

E-Stop Safety Module – ES-FA-9AA

External Device Monitoring

To satisfy the requirements of Safety Category 4 of ISO 13849-1(EN 954-1), the Master Stop Control Elements must each offer a normally closed, forced-guided monitor contact. One normally closed monitor contact from each Master Stop Control Element is wired in series to the feedback input (S33/S34 auto reset, S11/S33 manual reset; see Figures 2 and 3). In operation, if one of the switching contacts of either master stop control element fails in the shorted condition, the associated monitor contact will remain open. Therefore, it will not be possible to reset the E-Stop Safety Module. If no MSC-monitor contacts are monitored in auto reset, a jumper must be installed between terminals S33 and S34 (see Figures 2 and 3). **It is the responsibility of the user to ensure that any single failure will not result in a hazardous condition and will prevent a successive machine cycle.**

Connection to the Machine to be Controlled

The hookup diagrams (Figures 2 and 3) show a generic connection of the E-Stop Safety Module's redundant output circuits to Master Stop Control Elements. A Master Stop Control Element is defined as an electrically powered device, external to the E-Stop Safety Module, which stops the machinery being controlled by immediately removing electrical power to the machine and (when necessary) by applying braking to dangerous motion (reference ANSI B11.19, section 5.2: "Stop Control"). This stopping action is accomplished by removing power to the actuator coil of either Master Stop Control Element.

Connection of Reset Switch

The Reset Circuit switch can be any mechanical switch such as a normally open momentary switch, or a two-position key switch. The Reset switch must be capable of reliably switching 12 to 18V dc at 40 to 100 milliamps. As shown in Figures 2 and 3, the Reset switch connects between terminals S33 and S11 of the Safety Module.

The Reset switch must be located outside of – and not be accessible from – the area of dangerous motion, and must be positioned so that any area of dangerous motion may be observed by the switch operator during the Reset procedure.

Automatic Reset Mode

The ES-FA-9AA module may be used also with automatic reset. If no MSC-monitor contacts are monitored, a jumper must be installed between terminals S33 and S34 (see Figures 2 and 3). The E-Stop Safety Module will reset (and the outputs energize) as soon as the E-stop switch returns to its closed-contact position.

The automatic reset mode is useful for some automated processes. **However, if automatic reset is used, it is necessary to provide an alternate means of preventing resumption of hazardous machine motion, until an alternate reset procedure is performed.** The alternate procedure must include a Reset switch, located outside the area of dangerous motion, which is positioned so that any area of dangerous motion may be observed by the switch operator during the reset procedure.

NOTE: The minimum amount of time required for the Module to be in a STOP or OFF condition is 250 ms. This "recovery time" (OFF-state) is required for the internal circuitry of the Safety Module to normalize, allowing a reliable reset to occur. A lockout will occur if the Module is cycled too quickly. To clear the lockout, the Module must be re-cycled, meeting the minimum OFF time requirements.



WARNING . . . Multiple E-Stop Switches

- Whenever two or more E-stop switches are connected to the same E-Stop Safety Module, the contacts of both switches must be connected together in series. This series combination is then wired to the respective Safety Module input. **Never connect the contacts of multiple E-stop switches in parallel to the E-Stop Safety Module inputs; this defeats the switch contact monitoring ability of the Safety Module, and creates an unsafe condition which could result in serious injury or death.**
- **Also, when two or more E-stop switches are used, each switch must be individually actuated (engaged), then re-armed and the E-Stop Safety Module reset** (if using manual reset mode). This allows the monitoring circuits to check each switch and its wiring to detect faults. **Failure to test each switch individually in this manner could result in undetected faults and create an unsafe condition which could result in serious injury or death.**



WARNING . . . Reset Routine Required

U.S. and international standards require that a reset routine be performed after returning the E-stop switch to its closed-contact position (when arming the E-stop switch). When automatic reset is used, an alternate means must be established to require a reset routine, after the E-stop switch is armed. **Allowing the machine to restart as soon as the E-stop switch is armed creates an unsafe condition which could result in serious injury or death.**



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 E-Stop Safety Module.

Initial Checkout Procedure

Checkout procedure:

1. Remove power from the machine control elements.
2. Activate the E-stop switch (open its contacts).
3. Apply power to the E-Stop Safety Module at terminals A1 and A2 (see Figures 2 and 3). Verify that only the Input Power indicator (Figure 1) is ON. If either of the other two indicators is ON at this point, disconnect the input power and check all wiring. Return to step 2 after the cause of the problem has been corrected.
4. Arm the E-stop switch (close its contacts).
5. **Automatic reset:** K1 and K2 indicators should come ON, and the safety output contacts should close.
Manual reset: Close the Reset switch. The K1 and K2 indicators should continue flashing. Open the Reset switch. The K1 and K2 indicators should both come ON solid at this time. If either indicator comes ON solid before the Reset switch is opened, disconnect the input power and check all wiring. Return to step 2 after correcting the problem.
6. Activate the E-stop switch (open its contacts). The K1 and K2 indicators should turn OFF simultaneously. If either indicator remains ON, disconnect the input power and check all wiring. Return to step 2 after the cause of the problem has been corrected.
7. Close the enclosure. Apply power to the Machine Control Elements and perform the Periodic Checkout Procedure.

NOTE: If more than one E-stop switch is series-connected to one E-Stop Safety Module, the above checkout procedure must be run individually for EACH switch.

Periodic Checkout Procedure

The functioning of the E-stop system must be verified on a regular periodic basis to ensure proper operation (see also the machine manufacturer's recommendations).

Procedure:

1. With the machine running, engage the E-stop switch (open its contact). Verify that the machine stops.
2. Return the E-stop switch to its closed-contact position. Verify that the machine does not restart.
3. Close and then open the Reset switch (if using manual reset mode). Verify that the machine restarts.

NOTE: If two or more E-stop switches are series-connected to one E-Stop Safety Module, this test must be run individually for EACH switch.

E-Stop Safety Module – ES-FA-9AA

Repairs

NOTE: Do not attempt any repairs to the Emergency Stop Safety Module. It contains no field-replaceable components. Return the Safety Module to the factory for warranty repair or replacement.

If it ever becomes necessary to return an E-Stop Safety Module to the factory, please do the following:

1. Contact the Banner Factory Application Engineering Group at the address or at the 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.
2. Pack the E-Stop Safety Module carefully. Damage which occurs in return shipping is not covered by warranty.



CAUTION ... Abuse of Module After Failure

If an internal fault has occurred 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 such that the safety function can not be guaranteed.

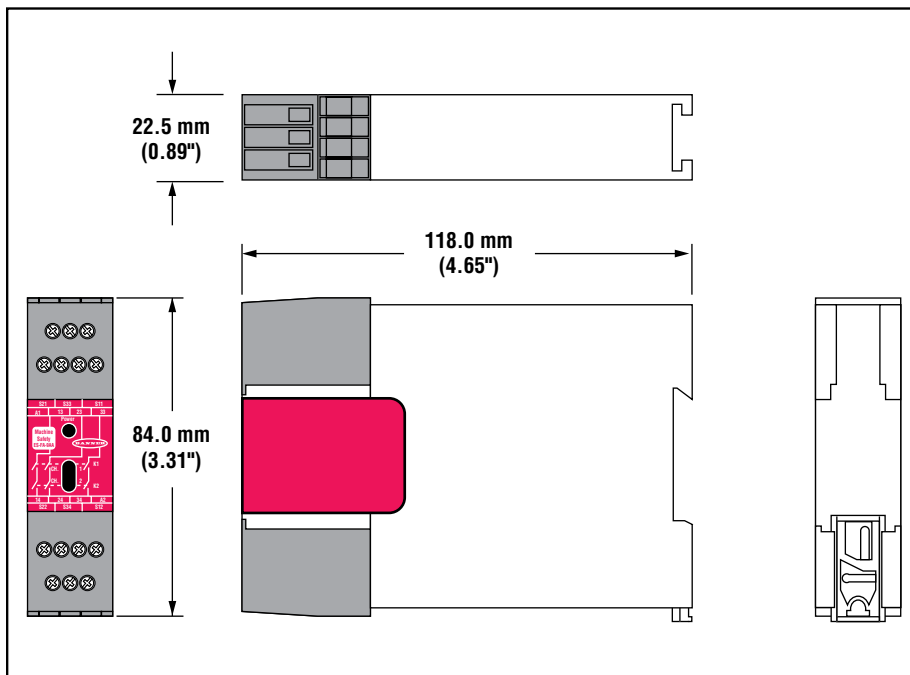


Figure 6. Model ES-FA-9AA E-Stop Safety Module enclosure dimensions

E-Stop Safety Module – ES-FA-9AA

Specifications

Supply Voltage and Current	24V ac/dc, +/- 10%; 50/60Hz Power consumption: approx. 2W/2VA												
Supply Protection Circuitry	Protected against transient voltages and reverse polarity												
Output Configuration	<p>3 normally open (N/O) output channels</p> <p>Each normally open output channel is a series connection of contacts from two forced-guided (positive-guided) relays, K1-K2.</p> <p>Contacts: AgNi, 5 µm gold-plated</p> <p>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”).</p> <p>To preserve the gold plating on the contacts, the following max. values should not be exceeded at any time:</p> <table> <tr> <td>Min. voltage: 1V ac/dc</td> <td>Max. voltage: 60V</td> </tr> <tr> <td>Min. current: 5 mA ac/dc</td> <td>Max. current: 300 mA</td> </tr> <tr> <td>Min. power: 5 mW (5 mVA)</td> <td>Max. power: 7 W (7 VA)</td> </tr> </table> <p>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:</p> <table> <tr> <td>Min. voltage: 15V ac/dc</td> <td>Max. voltage: 250V ac/dc</td> </tr> <tr> <td>Min. current: 250 mA ac/dc</td> <td>Max. current: 6 A</td> </tr> <tr> <td>Min. power: 5 W (5 VA)</td> <td>Max. power: 200 W (1,500 VA)</td> </tr> </table> <p>Mechanical life: 50,000,000 operations Electrical life: 150,000 operations (typical, @ 200 W (1,500 VA) switched power, resistive load)</p> <p>Note: Transient suppression is recommended when switching inductive loads. Install suppressors across load. Never install suppressors across output contacts (see Warning, page 5).</p>	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)	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)
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)												
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)												
Output Response Time	25 milliseconds typical												
Input Requirements	E-stop switch must have one or two normally closed contacts capable of switching 40 to 100mA @ 13 to 27V ac/dc. Reset switch must have one normally open contact capable of switching 20 to 30mA @ 13 to 27V ac/dc.												
Minimum OFF-State Recovery Time	250 ms												
Indicators	3 green LED indicators: Power ON K1 energized K2 energized												
Construction	Polycarbonate housing. 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 55Hz @ 0.35mm displacement per IEC 68-2-6												
Operating Conditions	Temperature: 0° to +50°C (+32° to 122°F) Max. Relative Humidity: 90% @ +50°C (non-condensing)												
Dimensions	See Figure 6.												

E-Stop Safety Module – ES-FA-9AA



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.