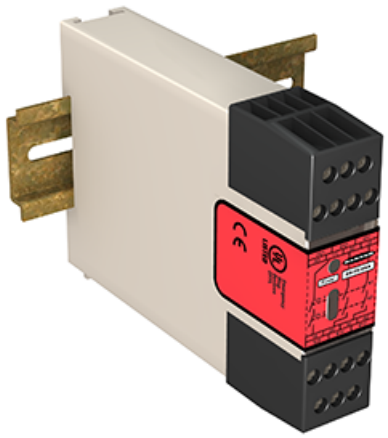
ES-FA-9AA and ES-FA-11AA E-Stop Safety Modules

With 3 normally open safety outputs or 2 normally open safety outputs and 1 normally closed auxiliary output
Original Instructions



- Monitors emergency stop devices, such as palm buttons and rope/cable pulls, and positive-opening safety switches used for guard/gate interlocking
- The safety inputs can monitor:
  - A +24V dc source switched by hard/relay contacts in single-channel hookup, or
  - Hard/relay contacts in a dual-channel hookup using terminals S11-S12 and S21-S22
- The ES-FA-9AA has three normally open output switching channels for connection to control-reliable power interrupt circuits
- The ES-FA-11AA has two normally open output switching channels for connection to control-reliable power interrupt circuits and one normally closed auxiliary output channel
- Automatic reset or monitored manual reset
- Design complies with standards ANSI B11.19, UL991, ISO 13850 (EN418), and ISO 13849-1 (EN954-1) (Safety Category 4)
- For use in functional stop category 0 applications per ANSI NFPA 79 and IEC/EN60204-1
- 6 or 7 amp safety output contacts, depending on model
- Plug-in terminal blocks
- 24V ac/dc operation

Models	Supply Voltage	Outputs	Output Contact Rating
ES-FA-9AA	24V ac/dc	3 Normally Open (NO)	6 A
ES-FA-11AA		2 Normally Open and 1 Normally Closed (NC)	7 A

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.**

Important: Read this First

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 direct any questions regarding the use or installation of this product to the factory applications department at the telephone numbers or address found at *http://www.bannerengineering.com*.

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 U.S. Standards
ANSI B11 Standards for Machine Tools Safety

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

ANSI NFPA 79 Electrical Standard for Industrial Machinery

Contact: 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

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 & -2 (EN 292-1 & -2) Safety of Machinery – Basic Concepts, General Principles for Design

ISO 13849-1 (EN 954-1) Safety-Related Parts of Control Systems

ISO 13850 (EN 418) Emergency Stop Devices, Functional Aspects – Principles for Design

IEC 60204-1 Electrical Equipment of Machines Part 1: General Requirements

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

Certificate of Adequacy

This Safety Module datasheet satisfies the requirements of Machinery Directive 2006/42/EC, Section 1.7.4 — instructions.

Overview

An Emergency Stop Safety Module is used to increase the control reliability of an emergency stop circuit. As shown in the hookup drawings, the models ES-FA-9AA and ES-FA-11AA E-Stop Safety Modules are designed to monitor a 1-channel or 2-channel E-stop switch. A 2-channel E-stop switch has two electrically isolated contacts.

WARNING: Safety Categories
The level of safety circuit integrity can be greatly affected by the design and installation of the safety devices and the means of interfacing of those devices. **A risk assessment must be performed to determine the appropriate safety circuit integrity level or safety category as described by ISO 13849-1 (EN 954-1) to ensure the expected risk reduction is achieved and all relevant regulations and standards are complied with.**

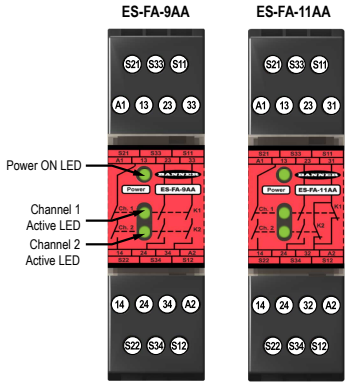


Figure 1. Features and Terminals

Safety Circuit Integrity and ISO 13849-1 (EN954-1) Safety Circuit Principles

Safety circuits involve the safety-related functions of a machine that minimize the level of risk of harm. These safety-related functions can prevent initiation, or stop or remove a hazard. A failure of a safety-related function or its associated safety circuit may result in an increased risk of harm.

The integrity of a safety circuit depends on several factors, including fault tolerance, risk reduction, reliable and well-tried components, well-tried safety principles, and other design considerations.

Depending on the level of risk associated with the machine or its operation, an appropriate level of safety circuit performance must be incorporated. *ANSI/RIA R15.06 Industrial Robots*, *ANSI B11 Machine Tools*, *OSHA 29CFR1910.217 Mechanical Power Presses,* and *ISO 13849-1 (EN954-1) Safety-Related Parts of a Control System* standards provide details of the safety performance levels.

Safety Circuit Integrity Levels

Safety circuits in International and European standards have been segmented into categories, depending on their ability to maintain their integrity in the event of a failure. The most recognized standard that details safety circuit integrity levels is ISO 13849-1 (EN954-1), which establishes five levels: Categories B, 1, 2, 3, and the most stringent, Category 4.

In the United States, the typical level of safety circuit integrity has been called ”control reliability.” Control reliability typically incorporates redundant control and self-checking circuitry and has been loosely equated to ISO 13849-1 Categories 3 and 4 (see CSA Z432 and ANSI B11.TR4).

If the requirements described by ISO 13849-1 (EN954-1) are to be implemented, a risk assessment must first be performed to determine the appropriate category, in order to ensure that the expected risk reduction is achieved. This risk assessment must also take into account national regulations, such as U.S. control reliability or European “C” level standards, to ensure that the minimum level of performance that has been mandated is complied with.

Fault Exclusion

An important concept within the category requirements of ISO 13849-1 is the probability of the occurrence of the failure, which can be decreased using the "fault exclusion" method. This method assumes that the possibility of certain well-defined failure(s) can be reduced to a point where the resulting fault(s) can be disregarded.

Fault exclusion is a tool a designer can use during the development of the safety-related part of the control system and the risk assessment process. It allows the designer to eliminate the possibility of various failures and justify it through the risk assessment process to meet the requirements of Categories 2, 3 or 4. See ISO 13849-1/-2 for further information.

Monitoring of Safety Devices

Requirements vary widely for the level of control reliability or safety category per ISO 13849-1 (EN954-1) in safety applications. 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.

Although only two applications are listed, the Module can monitor a variety of devices as long as the input requirements are complied with (see Electrical Installation and Specifications). The Safety Module does not have 500 ms simultaneity between inputs and thus cannot be used for monitoring a two-hand control. In all cases, the safety performance (integrity) must reduce the risk from identified hazards as determined by the machine's risk assessment .



WARNING: Emergency Stop Functions
Do not mute or bypass any Emergency Stop device. ANSI B11.19, ANSI NFPA79 and IEC/EN 60204-1 require that **the Emergency Stop function remain active at all times.**

Emergency Stop Push Buttons and Rope/Cable Pull Switches

The safety inputs can be interfaced with positive-opening switches to monitor an emergency-stop (E-stop) push button or rope/cable pull. The switch must provide one or two contacts for safety which are closed when the switch is armed. Once activated, the E-stop switch must open all its safety-rated contacts, and must require a deliberate action (such as twisting, pulling, or unlocking) to return to the closed-contact, armed position. The switch must be a "positive-opening" (or direct-opening) type, as described by IEC 60947-5-1.

Standards ANSI NFPA 79, IEC/EN 60204-1, and ISO 13850 specify additional emergency stop switch device requirements, including the following:

- Emergency-stop push buttons shall be located at each operator control station and at other operating stations where emergency shutdown is required.
- Stop and emergency-stop push buttons shall be continuously operable and readily accessible from all control and operating stations where located. Do not mute or bypass E-stop buttons or rope/cable pulls.
- Actuators of emergency-stop devices shall be colored red. The background immediately around the device actuator shall be colored yellow (where possible). 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.

For Rope/Cable Pull Installations Only:

- The wire rope should be easily accessible and visible along its entire length. Markers or flags may be fixed on the rope to increase its visibility.
- Mounting points, including support points, must be rigid.
- The rope should be free of friction at all supports. Pulleys are recommended.

Some applications may have additional requirements; comply with all relevant regulations. See the device manufacturer installation instructions for complete information (such as ES-..A-5A p/n 122365, SSA-EB..-.. p/n 111880, or RP-RM83F.. p/n 141245 data sheets).



WARNING: Emergency Stop Functions
Do not mute or bypass any Emergency Stop device. ANSI B11.19, ANSI NFPA79 and IEC/EN 60204-1 require that **the Emergency Stop function remain active at all times.**

Interlocked Guards (Gates)

The safety inputs can be interfaced with positive-opening safety switches to monitor the position of an interlock guard or gate. Each switch must provide electrically isolated contacts: at minimum, one normally closed (N.C.) contact from each individually mounted switch.

The contacts must be of "positive-opening" (direct-opening) design, as described by IEC 60947- 5-1, with one or more normally closed contacts rated for safety. 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.

In higher levels of safety performance, the design of a dual-channel coded magnetic switch typically uses complementary switching, in which one channel is open and one channel is closed at all times. **The inputs of the Safety Module do not support complementary switching, and thus should not be used with coded magnetic safety switches.**

The design and installation of the interlocked guard and the safety switches should comply with ANSI B11.19, ISO14119, and other applicable standards. See the device manufacturer installation instructions for complete information (such as GM-FA-10J p/n 60998, SI-LS83/-LS100 p/n 59622, or SI-HG63 p/n 129465 datasheets).

Mechanical Installation

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 NEMA 3 (IEC IP54) rating, or better. The Safety Module mounts directly to standard 35 mm DIN rail.

Heat Dissipation Considerations. For reliable operation, 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. 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



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 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.

It is not possible to give exact wiring instructions for a Safety Module that interfaces to a multitude of machine control configurations. The following guidelines are general in nature.

The Safety Module has no delay function. Its output relay contacts open within **25 milliseconds** after a safety input opens. This classifies the Safety Module as a functional stop "Category 0" control, as defined by ANSI NFPA 79 and IEC/EN 60204-1.

The safety inputs can be connected to:

- A +24V dc source that is switched by a hard/relay contact in single-channel hookup configuration, or
- Hard/relay contacts in a dual-channel hookup configuration using terminals S11-S12 and S21-S22.

Safety Input Device Hookup Options

The operation of all dual-channel hookup options is concurrent, meaning that input channel 1 and input channel 2 must be in the same state in both the STOP and RUN condition, but with no simultaneity (i.e. timing) requirement between the channels.

The **dual-channel hookup configuration** is able to detect certain failures and faults, such as short circuits, that could result in a loss of the safety function. Once such a failure or fault is detected, the Safety Module will turn OFF (open) its safety outputs until the problem is fixed. This circuit can meet ISO 13849-1 Category 2, 3, or 4 requirements, depending on the safety rating and the installation of the safety input device. This circuit can detect a short circuit between channels or to another source of power, at a minimum, when the device is actuated.

A single device with redundant outputs that can fail in such a manner to lose the safety function, such as a single safety interlocking switch, can typically meet only a Category 2. See below for means to eliminate or minimize the possibility of failures and faults that could result in the loss of the safety function(s).

The **single-channel hookup configuration** cannot detect short circuits to secondary sources of +24V dc or detect the loss of the switching function of the safety input device (i.e., it is not redundant) and thus this circuit typically can meet only ISO 13849-1 Category 2.

It is recommended that in all circumstances the installation of the Safety Module and its associated safety input devices are installed to eliminate or minimize the possibility of failures and faults that could result in the loss of the safety function(s). Methods to eliminate or minimize the possibility of these failures include, but are not limited to:

- Physically separating interconnecting control wires from each other and from secondary sources of power.
- Routing interconnecting control wires in separate conduit, runs, or channels.
- Locating all elements (modules, switches, and devices under control) within one control panel, adjacent to each other, and directly connected with short wires.
- Properly installing multi-conductor cabling and multiple wires through strain-relief fittings. (Over-tightening of a strain-relief can cause short circuits at that point.)
- Using positive-opening components as described by IEC 60947-5-1 that are installed and mounted in a positive mode.
- Periodically checking the functional integrity / safety function and training operators, maintenance personnel, and others associated with the operation of the machine to recognize and immediately correct such failures.

If you have any questions about your intended use, please contact a Banner applications engineer.

Connection of Multiple Switches

Connect the poles of multiple switches, such as e-stop switches, as shown in the figure at right. The switches are shown in the "armed" position with both contacts closed. Multiple switches connected to one Safety Module must be series connected (see figure at right and the warning, Multiple Switching Devices).

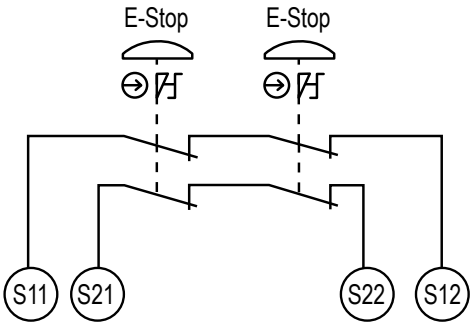


Figure 2. Series Connection of Multiple E-stop Switches

WARNING: Multiple Switching Devices
Whenever two or more devices are connected to the same safety module (controller):

- **Contacts of the corresponding pole of each switch must be connected together in series. *Never connect the contacts of multiple switches in parallel.*** Such a parallel connection defeats the switch contact monitoring ability of the Module and creates an unsafe condition which could result in serious injury or death.
- **Each device must be individually actuated (engaged), then released (or re-armed) and the safety module reset.** This allows the module to check each switch and its wiring to detect faults.

This check must be performed during the prescribed checkouts. **Failure to test each device individually in this manner could result in undetected faults and create an unsafe condition which could result in serious injury or death.**

Connection of Safety Switches

The Safety Module may be used to monitor safety interlocking switches that determine the position of a guard or gate. To achieve Category 4 operation per ISO 13849-1 (EN 954-1), two positive-opening safety switches must operate concurrently when the guard or gate is opened.

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

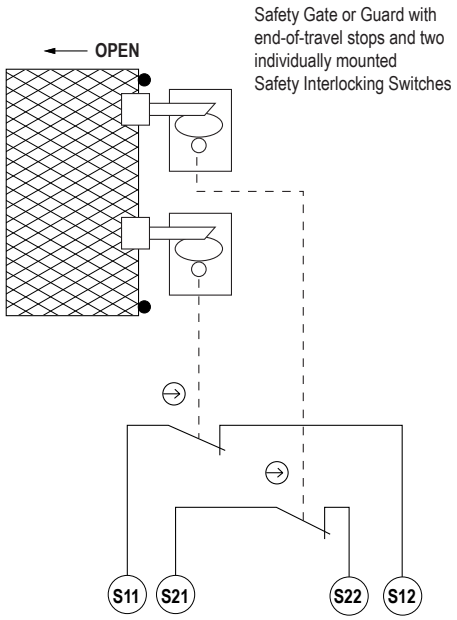


Figure 3. Wiring using contacts from two safety switches

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 8 to 12V dc at 10 to 15 milliamps. As shown in the hookup drawings, the reset switch connects between Safety Module terminals S33 and S11.

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. See warning below.

WARNING: Reset Switch Location
All reset switches must be accessible only from outside, and in full view of, the hazardous area. Reset switches must also be out of reach from within the safeguarded space, and must be protected against unauthorized or inadvertent operation (for example, through the use of rings or guards). If any areas are not visible from the reset switch(es), additional means of safeguarding must be provided. **Failure to do so could result in serious bodily injury or death.**

Automatic Reset Mode

The Safety Module may be configured (via hookup) for automatic reset. If no MSC contacts are monitored, install a jumper between terminals S33 and S34. The Safety Module will reset (and its outputs energize) as soon as the switch returns to its armed (closed-contact) position.

Automatic reset is useful for some automated processes. However, if automatic reset is used, it is necessary to provide a means of preventing resumption of hazardous machine motion, until an alternate reset procedure is performed. The alternate procedure must include a reset/restart 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. See Warning below.

WARNING: Reset Routine Required
U.S. and international standards require that a reset routine be performed after clearing the cause of a stop condition (for example, arming an E-stop button, closing an interlocked guard, etc.). **Allowing the machine to restart without actuating the normal start command/device can create an unsafe condition which could result in serious injury or death.**

NOTE: The minimum 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 occurs if the Module is cycled too quickly. To clear the lockout, the Module must be recycled, meeting the minimum OFF time requirements.

Wiring

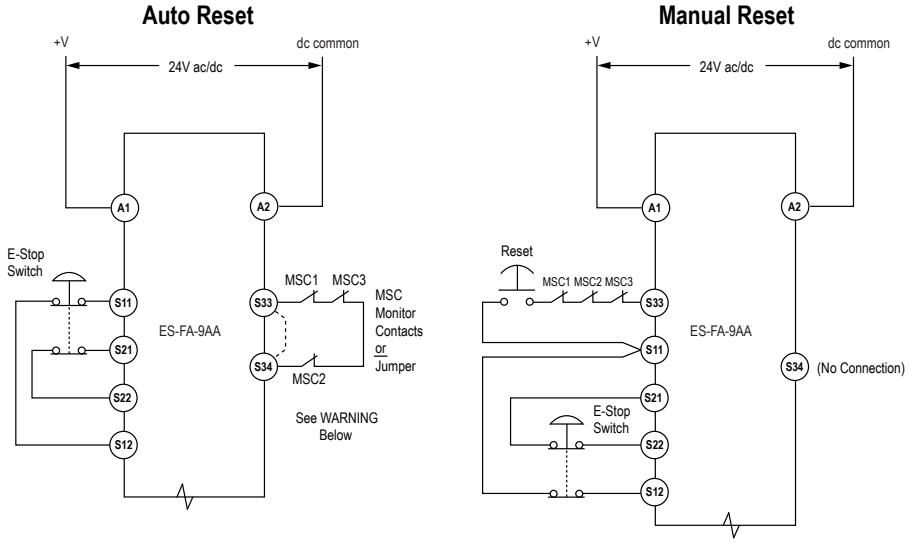


Figure 4. Dual-Channel E-Stop Applications

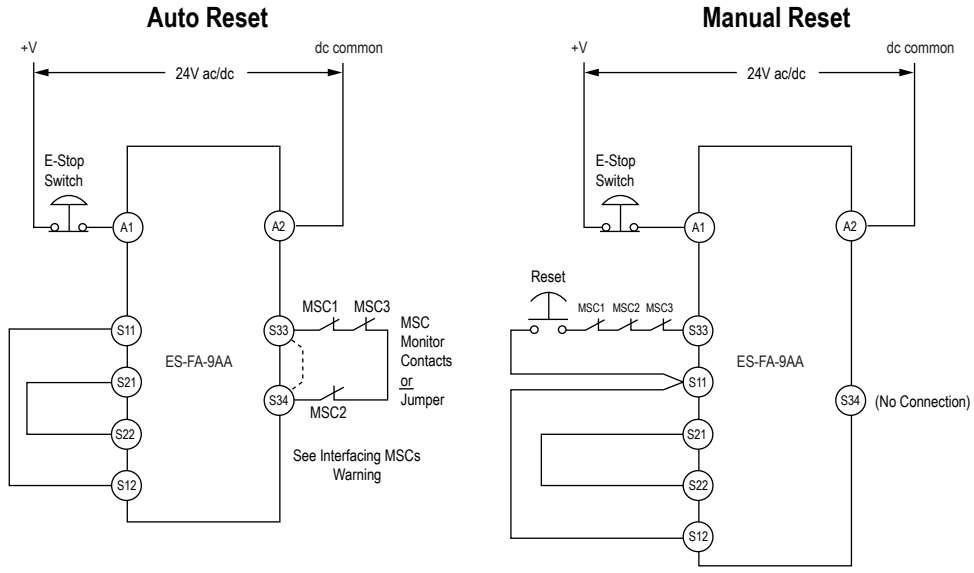


Figure 5. Single-Channel E-Stop Applications

Connection to the Machine to be Controlled

The machine hookup diagram shows a generic connection of the Safety Module's redundant output circuits to the master stop control elements (MSCs). An MSC is defined as an electrically powered device, external to the 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. This stopping action is accomplished by removing power to the actuator of either MSC.

External Device Monitoring

To satisfy the requirements of Control Reliability (OSHA and ANSI), Category 3 and 4 of ISO 13849-1 (EN 954-1), the master stop control elements (MSCs) must each offer a normally closed, forced-guided (mechanically linked) monitor contact. Connect one normally closed monitor contact from each master stop control element as shown in the single-channel wiring diagrams.

In operation, if one of the switching contacts of either MSC fails in the energized condition, the associated monitor contact will remain open. Therefore, it will not be possible to reset the Safety Module. If no MSC-monitor contacts are monitored, a jumper must be installed as shown in the wiring diagrams. It is the user's responsibility to ensure that any single failure will not result in a hazardous condition and will prevent a successive machine cycle.

Overvoltage Category II and III Installations (EN 50178 and IEC 60664-1)

The Safety Module is rated for Overvoltage Category III when voltages of 1V to 150V ac/dc are applied to the output relay contacts. It is rated for Overvoltage Category II when voltages of 151V to 250V ac/dc are applied to the output relay contacts and no additional precautions are taken to attenuate possible overvoltage situations in the supply voltage. The Module can be used in an Overvoltage Category III environment (with voltages of 151V to 250V ac/dc) if care is taken either to reduce the level of electrical disturbances seen by the Module to Overvoltage Category II levels by installing surge suppressor devices (e.g., arc suppressors), or to install extra external insulation in order to isolate both the Safety Module and the user from the higher voltage levels of a Category III environment.

For Overvoltage Category III installations with applied voltages from 151V to 250V ac/dc applied to the output contact(s): the Safety Module may be used under the conditions of a higher overvoltage category where appropriate overvoltage reduction is provided. Appropriate methods include:

- An overvoltage protective device
- A transformer with isolated windings
- A distribution system with multiple branch circuits (capable of diverting energy of surges)
- A capacitance capable of absorbing energy of surges
- A resistance or similar damping device capable of dissipating the energy of surges

When switching inductive ac loads, it is good practice to protect the Safety Module outputs by installing appropriately-sized arc suppressors. However, if arc suppressors are used, they must be installed across the load being switched (e. g., across the coils of external safety relays), and never across the Safety Module's output contacts (see WARNING, Arc Suppressors).

Auxiliary Monitor Contact (Model ES-FA-11AA Only)

The action of the auxiliary monitor contact, terminals 31-32, inversely "follows" the action of the safety outputs. The 31-32 auxiliary monitor contact is to be used only for control functions that are NOT safety-related. A typical use is to communicate the status of the Safety Module output to a programmable logic controller (PLC).



WARNING: Interfacing MSCs
NEVER wire an intermediate device(s) (for example, PLC, PES, PC) between the Safety Module outputs and the Master Stop Control Element it switches in such a manner that in the event of a failure there is a loss of the safety stop command, OR in such a manner that the safety function can be suspended, overridden, or defeated, unless accomplished with the same or greater degree of safety.

Whenever forced-guided, mechanically linked relays are added as intermediate switching devices, a normally closed (N.C.) forced-guided monitor contact from each relay must be added to the series feedback loop between Safety Module terminals S31 and S32.



WARNING: Wiring of Arc Suppressors
If arc suppressors are used, they MUST be installed as shown across the actuator coil of the stop control elements (MSCs or MPCEs). **NEVER install suppressors directly across the output contacts of the Safety Device or Module.** It is possible for suppressors to fail as a short circuit. If installed directly across the output contacts, **a short-circuited suppressor will create an unsafe condition which could result in serious injury or death.**

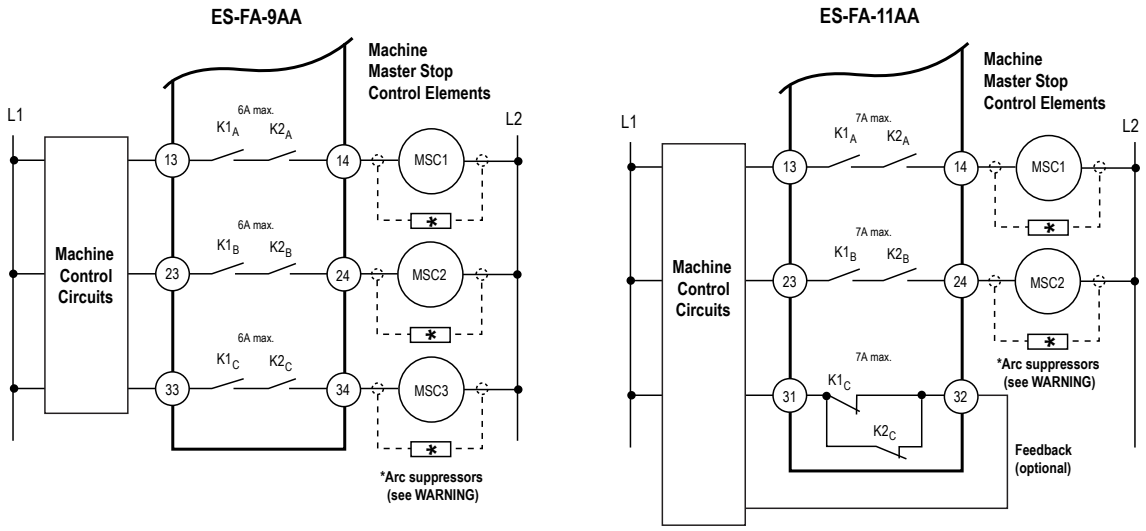


Figure 6. Machine Control Circuit Connections

Initial Checkout Procedures

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.**

1. Remove power from the machine control elements.
2. Ensure the safety device is in a STOP or "open-contact" state (e.g., actuate the E-stop switch to open its contacts).
3. Apply power to the Safety Module at terminals A1 and A2 (see wiring diagrams). Verify that only the Input Power indicator (see *Figure 1. Features and Terminals* on page 2) is ON. If either input channel 1 (K1) or input channel 2 (K2) indicators are 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. Reset or otherwise cause the safety device to reach an ON or "closed-contact" state (e.g., arm the E-stop switch to close its contacts).
   Automatic reset: Ch1 (K1) and Ch2 (K2) indicators should come ON, and the safety output contacts should close.

   Manual reset: From an open condition, close the reset switch for approximately ¼ second, and then re-open. The Ch1 (K1) and Ch2 (K2) indicators should both come ON steady at this time. If either indicator comes ON before the reset switch is opened, disconnect the input power and check all wiring. Return to step 2 after correcting the problem.
5. Cause the safety device to generate a STOP or "open-contact" state (e.g., actuate the E-stop switch to open its contacts). The Ch1 (K1) and Ch2 (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.
6. If more than one safety device is series-connected to the Safety Module, run the above checkout procedure individually for EACH device.
7. Close and secure the enclosure in which the Safety Module is mounted. Apply power to the machine control elements and perform the Periodic Checkout Procedure.

WARNING: Multiple Safety Devices
When two or more safety devices are used, each device must be individually actuated, causing a STOP or open-contact condition, then reset/rearmed and the Safety Module reset (if using manual reset mode). This allows the monitoring circuits to check each device and its wiring to detect faults. **Failure to test each device individually in this manner could result in undetected faults and create an unsafe condition which could result in serious injury or death.**

Periodic Checkout Procedure

The functioning of the Safety Module and the device(s) connected to it must be verified on a regular periodic basis to ensure proper operation (see also the machine manufacturer's recommendations).

1. With the machine running, cause the safety device to generate a STOP or "open-contact" state (e.g., actuate the E-stop switch to open its contacts). Verify that the machine stops.
2. Reset or otherwise cause the safety device to reach an ON or "closed-contact" state. Verify that the machine does not restart.
3. If using manual reset mode, close and then open the reset switch within 3 seconds. Verify that the machine can be restarted by normal initiation.
4. If more than one safety device is series-connected to the Safety Module, run the above checkout procedure individually for EACH device.

Repairs

Do not attempt any repairs to the Module. It contains no field-replaceable components. Return it to the factory for warranty repair or replacement by contacting Banner Factory Application Engineering. They will attempt to troubleshoot the system from your description of the problem. If they conclude a component is defective, they will issue a return merchandise authorization (RMA) number for your paperwork and give you the proper shipping address.

Pack the Module carefully. Damage that 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.

Specifications

Power

Supply Voltage and Current
24V dc ±10% (SELV-rated supply according to EN IEC 60950, NEC Class 2)
24V ac ±10% , 50/60Hz (NEC Class 2-rated transformer)
Power consumption: approx. 2W/2VA

Overvoltage Category
Output relay contact voltage of 1V to 150V ac/dc: category III
Output relay contact voltage of 151V to 250V ac/dc: category III, if appropriate overvoltage reduction is provided, as described in *Overvoltage Category II and III Installations (EN 50178 and IEC 60664-1)* on page 8.

Pollution Degree

General

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 @ 0.35 mm displacement per IEC 60068-2-6

Power

2

Supply Protection Circuitry

Protected against transient voltages and reverse polarity

General

Operating Conditions

Temperature: 0° to +50°C (+32° to 122°F)

Max. Relative Humidity: 90% @ +50°C (non-condensing)

Output Configuration

Output Configuration

ES-FA-9AA: 3 normally open (N.O.) output channels

ES-FA-11AA: 2 normally open (N.O.) output channels and 1 normally closed (N.C.) auxiliary output

Contacts

AgNi, 5 µm gold-plated

Each normally open output channel is a series connection of contacts from two forced-guided (mechanically linked) relays, K1-K2. The normally closed Aux. output channel of the ES-FA-11AA is a parallel connection of contacts from two forced-guided relays, K1-K2.

Low Current Rating: 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:

	Minimum	Maximum
Voltage	1V ac/dc	60V
Current	5 mA ac/dc	300 mA
Power	5 mW (5 mVA)	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:

	Minimum	Maximum
Voltage	15V ac/dc	250V ac/dc
Current	30 mA ac/dc	ES-FA-9AA: 6A ES-FA-11AA: 7A
Power	0.45 W (0.45 VA)	ES-FA-9AA: 200 W (1,500 VA) ES-FA-11AA: 200 W (1,750 VA)

Mechanical life

> 20,000,000 operations

Electrical life (switching cycles of the output contacts, resistive load)

150,000 cycles @ 1,500 VA; 1,000,000 cycles @ 450 VA; 2,000,000 cycles @ 250 VA; 5,000,000 cycles @ 125 VA

NOTE: Transient suppression is recommended when switching inductive loads. Install suppressors across load. Never install suppressors across output contacts (see Wiring of Arc Suppressors warning in *Auxiliary Monitor Contact (Model ES-FA-11AA Only)* on page 8).

Output Response Time

25 milliseconds typical

Input Requirements

Safety input switch: Dual-Channel (contacts) hookup – 10 to 20 mA steady state @ 12V dc. NOTE: Inputs are designed with a brief contact-cleaning current of 100 mA when initially closed.

Safety input switch: Single-Channel hookup – 40 to 100 mA @ 24V ac/dc +/- 10%; 50/60 Hz

Reset switch: 20 mA @ 12V dc, hard contact only

Minimum OFF-State Recovery Time

250 ms

Design Standards

Cat. 4 PL e per EN ISO 13849-1; SIL 3 per IEC 61508 and IEC 62061

Certifications

CE

UL LISTED EMERGENCY STOP DEVICE 29YL

Dimensions

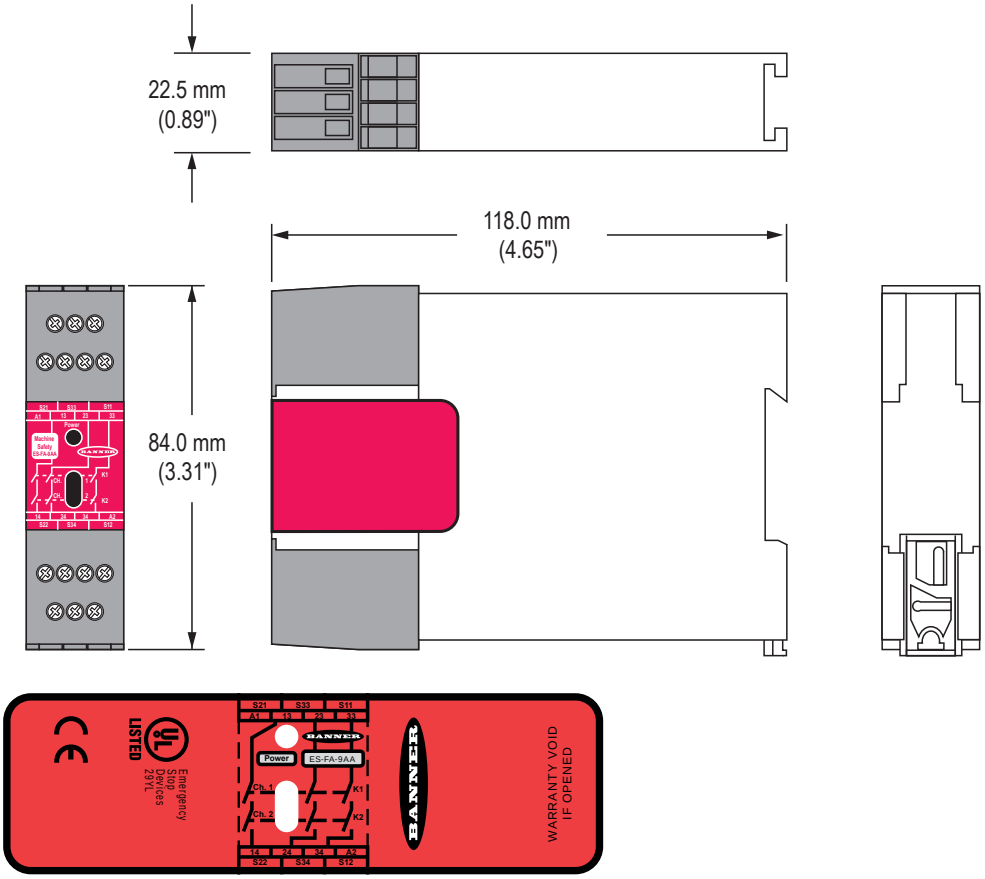
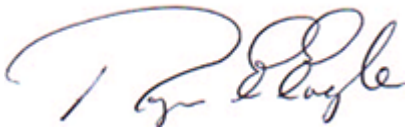


Figure 7. Product Label — Model ES-FA-9AA Shown

EC Declaration of Conformity

Banner Engineering Corp.
9714 Tenth Avenue North
Minneapolis, MN 55441-5019 USA

We herewith declare that ES-FA-9AA and ES-FA-11AA Emergency Stop Modules for industrial control are in conformity with the provisions of the Machinery Directive (Directive 98/37/EEC), and all essential Health and Safety Requirements have been met.



Date: 17 Aug 2009

R. Eagle / Engineering Manager
Banner Engineering Corp.
9714 Tenth Avenue North
Minneapolis, MN 55441-5019 USA

Date: 17 Aug 2009

P. Mertens / Managing Director
Banner Engineering Europe
Park Lane, Culliganlaan 2F
1831 Diegem, Belgium

Download the complete EC Declaration of Conformity as a PDF file at *www.bannerengineering.com/ESmodule*

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