




# SI-LM40 Series Safety Limit Switch



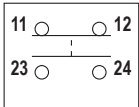
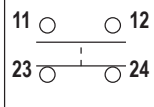
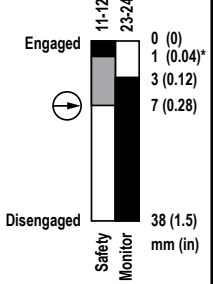
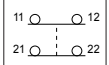
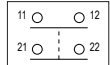
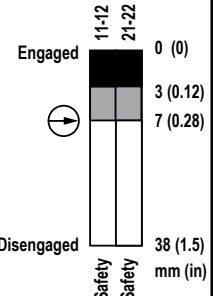
## Datasheet

SI-LM40 Series Limit Switch Style with Flexible In-Line Actuator



-  Positive-opening safety contacts (IEC 60947-5-1) (not dependent upon springs)
  - Standard limit switch design
  - In-line actuator; flexes in all directions
  - Metal housing
  - Spring-loaded actuator base
  -  Protective Earth Terminal (IEC 60947-1) on models with metal housings
-  This symbol for a positive opening safety contact (IEC 60947-5-1) is used in the switching diagrams to identify the point in actuator travel where the normally closed safety contact is fully open.

## Models

Kit Model <sup>1</sup>	Actuator Type	Interlock Body	Contact Configuration (Actuator Engaged)	Contact Configuration (Actuator Removed)	Switching Diagrams <sup>2</sup>
SI-LM40MKVD		SI-LM40KVD with Metal Housing			
SI-LM40MKVE	SI-QM-90A (Flexible, In-Line)	SI-LM40KVE with Metal Housing			

Contacts:  Open  
 Closed  
 Transition



### WARNING:

- Spare actuators**
- Using spare actuators to bypass the safety switch could create an unsafe situation that could result in serious injury or death.
- Do not use spare actuators to bypass or otherwise defeat the protective function of a safety switch.

<sup>1</sup> A kit contains an interlock and actuator. Individual interlock bodies or actuators are for replacement purposes only.  
<sup>2</sup> \* Please note that only 1 mm (0.04 inches) of movement will open the closed contact.



## Important Information Regarding the Use of Safety Switches

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In the United States, the functions that Banner safety switches are intended to perform are regulated by the Occupational Safety and Health Administration (OSHA). Whether or not any particular safety switch installation meets all applicable OSHA requirements depends upon factors that are beyond the control of Banner Engineering Corp. These factors include the details of how the safety switches are applied, installed, wired, operated, and maintained.



### **WARNING: User Responsibility**

The user is responsible for ensuring that all local, state, and national laws, rules, codes, and regulations relating to the use of this device in any particular application are satisfied. Make sure that all legal requirements have been met and that all installation, operation, and maintenance instructions contained in the device documentation are followed.

Banner Engineering Corp. recommends that safety switches be applied according to the guidelines set forth in international (ISO/IEC) standards listed below. Specifically, Banner Engineering Corp. recommends application of these safety switches in a configuration which meets safety category 4, per ISO 13849.

It is the responsibility of the machine designer, controls engineer, machine builder, and/or maintenance electrician to apply and maintain this product in full compliance with all applicable regulations and standards. The product can provide the required safety function only if it is properly installed, properly operated, and properly maintained. This manual attempts to provide complete installation, operational, and maintenance instructions. Reading the manual completely is highly recommended. Please direct any questions regarding the application or use of this product to a Banner Engineering Applications Engineer at the locations listed in this document.

Application Assistance  
Toll Free: 1-888-3-SENSOR (1-888-373-6767)  
Email: sensors@bannerengineering.com  
9714 Tenth Avenue North  
Minneapolis, MN 55441

## U.S. Regulations Applicable to Use of Banner Safety Switches

OSHA Code of Federal Regulations: Title 29, Parts 1900 to 1910

Available from: Superintendent of Documents, Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15250-7954, Tel: 202-512-1800

## U.S. Standards Applicable to Use of Banner Safety Switches

ANSI B11 Standards for Machine Tools Safety

ANSI B11.19 Performance Criteria for Safeguarding

ANSI NFPA 79 Electrical Standard for Industrial Machinery

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

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

## Applicable European and International Standards

EN ISO 12100 Safety of Machinery – Basic Concepts, General Principles for Design

ISO 13852 (EN 294) Safety of Machinery – Safety Distances to Prevent Danger Zones Being Reached by the Upper Limbs

ISO 13853 (EN 811) Safety of Machinery – Safety Distances to Prevent Danger Zones Being Reached by the Lower Limbs

ISO 13857 Safety of Machinery – Safety Distances to Prevent Hazard Zones Being Reached

EN ISO 13849-1 Safety-Related Parts of Control Systems

EN 13855 (EN 999) The Positioning of Protective Equipment in Respect to Approach Speeds of Parts of the Human Body

ISO 14119 (EN 1088) Interlocking Devices Associated with Guards – Principles for Design and Selection

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

IEC 60947-5-1 Low Voltage Switchgear – Electromechanical Control Circuit Devices

ISO 14120 Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards

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

## Installation Instructions

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### Installation 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 comply with all necessary requirements. See ANSI B11.19, or ISO 14119 and ISO 14120, or the appropriate standard.

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.

Locate the guard 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). The guard 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 access the hazard. Any openings in the guard must not allow access to the hazard—see ANSI B11.19, ISO 13857, or 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.

Design and install the safety interlocking switches and actuators so that they cannot be easily defeated. Mount them securely so that their physical position cannot shift, using reliable fasteners that require a tool to remove. Mounting slots in the housing, if provided, are for initial adjustment only; final mounting holes (round) must be used for permanent location.

The normally closed safety contacts are of a "positive-opening" design. Positive-opening operation causes the contacts to be forced open, without the use of springs, when the actuator is disengaged or moved from its home position. In addition, the switch(es) must be mounted in a "positive mode", to move/disengage the actuating system and actuator from its home position and open the normally closed contact, when the guard opens.



**WARNING:**

- **Properly Install the Interlocked Guards**
- Failure to follow these guidelines could result in serious injury or death.
- At a minimum, the interlocked guard must prevent hazards when not fully closed and must prevent access to the hazards through any opening in the guard.
- Install the safety switches and actuators so they cannot be easily defeated and are not used as a mechanical or end-of-travel stop. Mount at least one switch in a positive mode and verify it opens the normally closed contact when the guard opens.
- The user must refer to the relevant regulations and comply with all necessary requirements. See ANSI B11.19, or ISO 14119 and ISO 14120, or the appropriate standard.



**CAUTION:**

- **Do not use the safety switch as a mechanical or end-of-travel stop.**
- Catastrophic damage can cause the safety switch to fail in an unsafe manner (that is, loss of the switching action).
- Limit the movement or rotation of the guard to prevent damage to the safety switch or the actuator.

See Mechanical Installation, Switching Diagram, Specifications for additional information.

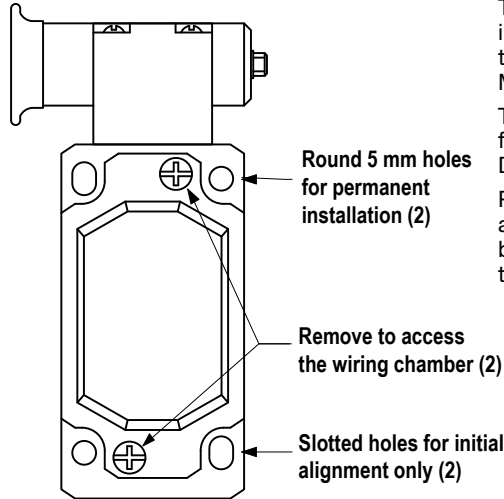


**WARNING: Safety Distances and Safe Openings**

It must not be possible for personnel to reach any hazard through an opened guard or by reaching over, under, around, or through any opening in the guard before the hazardous situation has ceased. See ANSI B11.19 or ISO 14119, ISO 14120 and ISO 13857 for information on determining safety distances and safe opening sizes for your guarding device.

## Mechanical Installation

All mounting hardware is supplied by the user. The fasteners must be of sufficient strength to guard against incidental breakage. Use of permanent fasteners or locking hardware is recommended to prevent loosening or displacement of the actuator and switch body.



The slotted holes in the switch body must ONLY be used for alignment during installation. The round 5 mm holes (only) must be used for permanent mounting to prevent loosening or displacement of the actuator and the switch body. Only M5 (#10) screws (customer supplied), should be used.

There are four holes on a mounting pattern of 30 x 60 mm. The actuator has four M4 tapped mounting holes on a 26 mm (1.02 in) square pattern (see Dimensions).

Position the switch, with its actuator fully engaged, in the mounting location and mark the mounting holes. Drill the required holes and fasten the switch body and the actuator in place. After the mounting hardware is secure, check the actuator/switch engagement for misalignment and binding.

The actuator is spring-loaded to allow positive pressure to be applied when the guard is closed. However, the switch must never serve as the mechanical end stop for a guard door or gate. Positive pressure for the actuator engagement is desirable, because only 1 mm (0.04 in) of actuator travel from the point of full engagement is required to open the safety contact.



### Important:

1. A safety switch must be installed in a manner that discourages tampering or defeat. Mount each switch to prevent bypassing of the switching function at the terminal chamber.
2. A switch and its actuator must never be used as a mechanical stop.
3. Ensure proper placement of gasket when rotating the head. Failure to do so will reduce the environmental rating.

## Electrical Installation



### WARNING:

- **Connecting safety switches in series**
- Monitoring multiple guards with a series connection of multiple safety interlock switches is not a Safety Category 4 Application (per ISO 13849-1). A single failure can be masked or not detected at all. The loss of a safety stop signal or an inappropriate reset can lead to serious injury or death.
- When such a configuration is used, procedures must be performed regularly to verify proper operation of each switch. Correct all failures immediately (for example, immediately replace a failed switch).



### CAUTION:

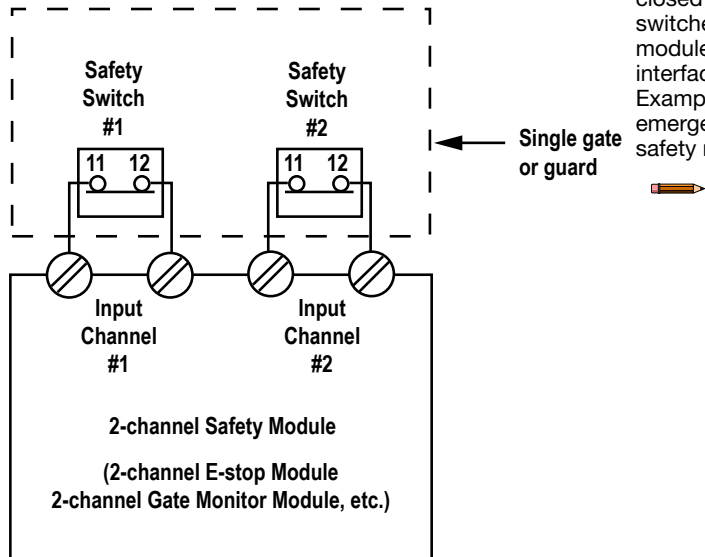
- **Safety switch installation**
- Using only one safety switch per interlock guard is not recommended.
- Use two safety switches for each interlock guard to achieve control reliability or Safety Category 4 (per ISO 13849-1) of a machine stop circuit.
- In addition, normally-closed (N.C.) safety contacts from each of the two safety switches should be connected to the two separate inputs of a two-channel safety monitoring device. This is required to monitor for safety switch contact failure and to provide the necessary reset routine, as required by IEC 60204-1 and NFPA 79 machine safety standards.

## Accessing the Wiring Chamber

The wiring chamber is accessed via a cover plate. The metal switch body uses two screws to hold the cover plate on. A conduit adapter is supplied to convert the M20 x 1.5 thread to ½"-14 NPT. An accessory cable gland that fits the M20 x 1.5 thread is available.

## Connection to a Machine

Two contacts are offered. The contact between terminals 11 and 12 or 21 and 22 is the safety contact, which is closed (i.e., it conducts) when the actuator is engaged. The normally open contact located between terminals 23 and 24 is considered a monitoring contact, which should not be used for safety switching.



A normally closed safety contact (i.e., a safety contact that is closed when the actuator is engaged) from each of two safety switches per interlock guard must connect to a 2-channel safety module or safety interface in order to achieve a control reliable interface to the master stop control elements of a machine. Examples of appropriate safety modules include 2-channel emergency stop (E-stop) safety modules and gate monitor safety modules.

**Note:** Refer to the installation instructions provided with the safety module for information regarding the interface of the safety module to the machine stop control elements.

Figure 1. Connect two redundant safety switches per interlock guard to an appropriate 2-channel input safety module.

Two functions of the safety module or safety interface are:

1. to provide a means of monitoring the contacts of both safety switches for contact failure, and to prevent the machine from restarting if either switch fails; and
2. to provide a reset routine after closing the guard and returning the safety switch contacts to their closed position. This prevents the controlled machinery from restarting by simply reinserting the safety switch actuators. This necessary reset function is required by ANSI B11 and NFPA 79 machine safety standards.

Use only a positively driven, normally closed safety contact from each switch for connection to the safety module. The normally open contact may be used for control functions that are not safety-related. A typical use is to communicate with a process controller. Refer to the installation instructions provided with the safety modules for more information regarding the interface of the safety module to the machine stop control elements.

## Maintenance

### Periodic Checks

Safety switches should be checked at each shift change or machine setup by a designated person for:

1. Breakage of the switch body or actuator,
2. Good alignment and full engagement of the actuator with the receptor,
3. Confirmation that the safety switch is not being used as an end stop,
4. Loosening of the switch or actuator mounting hardware, and
5. Verification that it is not possible to reach any hazard point through an opened guard (or any opening) before hazardous machine motion has completely stopped.

In addition, a qualified person should check for the following on a periodic schedule determined by the user based upon the severity of the operating environment and the frequency of switch actuations:

1. Check the wiring chamber for signs of contamination.
2. Check the contacts for signs of deterioration or damage.
3. Inspect the electrical wiring for continuity and damage.
4. Verify the wiring conforms to the instructions given in this datasheet.

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 the safety switch installation (ANSI B30.2).

## Repairs

**Do not attempt any repairs to the safety interlocking switch. It contains no field-replaceable components. Return it to Banner Engineering for warranty repair or replacement.**

Contact Banner Factory Application Engineering. They will attempt to troubleshoot the system from your description of the problem. If they conclude that a component is defective, they will issue a return merchandise authorization (RMA) number for your paperwork, and give you the proper shipping address.



**Important:** Pack the safety switches carefully. **Damage that occurs in return shipping is not covered by warranty.**

## Specifications

### Contact Rating

10 A at 24 V ac, 10 A at 110 V ac, 6 A at 230 V ac  
6 A at 24 V dc  
2.5 kV maximum transient tolerance  
NEMA A300 P300

### Contact Material

Silver-nickel alloy

### Maximum Switching Speed

10 operations per minute

### Maximum Actuator Speed

0.5 m/second (20 inches/second)

### Minimum Actuator Engagement Radius

500 mm (19.7 inches)

### Actuator Extraction Force

20 N (4.4 lbf)

### Short Circuit Protection

6 amp Slow Blow, 10 amp Fast Blow. Recommended external fusing or overload protection.

### Cable Entry

M20 x 1.5 threaded entrance. Adapter supplied to convert M20 x 1.5 to 1/2" - 14 NPT threaded entrance

### Construction

Aluminum alloy die-cast housing

### Weight

0.31 kg (0.68 lb)

### Environmental Rating

IEC IP65

### Operating Conditions

-30 °C to +80 °C (-22 °F to +176 °F)

### Certifications



### European Rating

Use categories: AC15 and DC13 (IEC 60947-5-1)  
 $U_i = 500$  V ac  
 $I_{th} = 10$  A

40-60 Hz		
$U_e$ (V)	$I_e/AC-15$ (A)	$I_e/DC-13$ (A)
24	10	6
110	10	1
230	6	0.4

### Mechanical Life

$1 \times 10^6$  operations  
 $B_{10d}$  is  $2 \times 10^6$

### Wire Connections

Screw terminals with pressure plates accept the following wire sizes –

Stranded and solid: 20 AWG (0.5 mm2) to 16 AWG (1.5 mm2) for one wire

Stranded: 20 AWG (0.5 mm2) to 18 AWG (1.0 mm2) for two wires

### Required Overcurrent Protection



**WARNING:** Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.

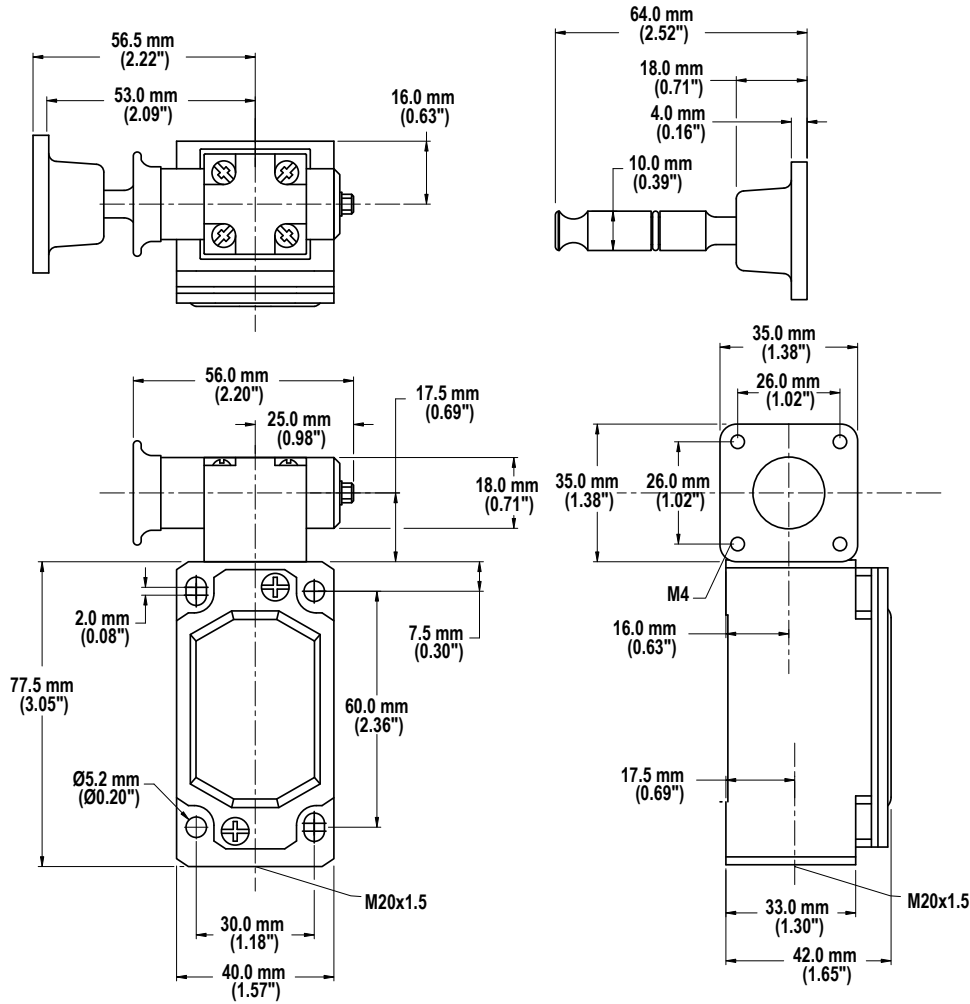
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.

Supply wiring leads < 24 AWG shall not be spliced.

For additional product support, go to [www.bannerengineering.com](http://www.bannerengineering.com).

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

Dimensions



Accessories

Cable Glands

Model	Size	For Cable Diameter	Dimensions	Used With
SI-QM-CGM20	M20 x 1.5 Metal	5.0 to 12.0 mm (0.20 to 0.47 inches)		SI-LM40 Safety Interlock Switches SI-QM100 Safety Interlock Switches RP-RM83 Rope Pull Switches RP-LM40 Rope Pull Switches RP-QM72/QMT72 Rope Pull Switches RP-QM90 Rope Pull Switches

Conduit Adapter Replacement Part

Model	Size	Thread Conversion	Dimensions	Used With
SI-QM-M20	½ in-14 NPT Metal	M20 x 1.5 to ½ in-14 NPT		SI-LM40 Safety Interlock Switches SI-QM100 Safety Interlock Switches RP-RM83 Rope Pull Switches RP-LM40 Rope Pull Switches RP-QM72/QMT72 Rope Pull Switches RP-QM90 Rope Pull Switches

One conduit adapter is supplied with each switch.

## Banner Engineering Corp. Limited Warranty

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Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

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For patent information, see [www.bannerengineering.com/patents](http://www.bannerengineering.com/patents).