

Datasheet

Spring Locking and Solenoid Locking Models



-  Positive opening safety contacts (IEC 60947-5-1)
- Choice of two locking mechanism types:
 - Spring lock with energized solenoid release
 - Energized solenoid lock with spring unlock
- Models with spring lock/solenoid unlock have a manual release
- Two solenoid voltages available:
 - 24V ac/dc
 - 110V/230V ac
- Choose either of two stainless steel actuator types:
 - Rigid in-line
 - Flexible in-line
- Actuator head rotatable in 90° increments and can be positioned for either horizontal or vertical actuation
- Choice of four switching actuator contact configurations (with actuator engaged):
 - 1 normally-open plus 1 normally-open
 - 2 normally-closed
 - 2 normally-closed plus 1 normally-open
 - 3 normally-closed
- Heavy-duty thermoplastic housing, rated IP67, suitable for demanding industrial environments
-  Insulated device (IEC 60947-5-1)



NOTE:  This symbol is used in the switching diagrams to identify the point in actuator travel where the normally closed safety contact is fully open.



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.

Important Information

Regarding the Use of Safety Interlocking Switches

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 instruction. *Reading the manual completely is highly recommended.* Please direct any questions regarding the application or use of the product to a Banner Engineering Applications Engineer at the locations listed in this document.

Applicable U.S. and International Standards (not all inclusive):

ANSI B11.0 Safety of Machinery - General Requirements and Risk Assessment

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

ISO 12100 Safety of Machinery - General Principles for Design, Risk Assessment and Risk Reduction

IEC 60204-1 Electrical Equipment of Machines: General Requirements

ISO 14119 Safety of Machinery—Interlocking Devices Associated with Guards

ISO 14120 Safety of Machinery - Guards - General requirements for fixed and movable guards

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



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

These and other standards are available from:

- OSHA Documents: www.osha.gov (Tel: 202-512-1800)
- American National Standards Institute (ANSI): www.ansi.org (Tel: 212-642-4900)
- Robotics Industries Association (RIA): www.robotics.org (Tel: 734-994-6088)
- National Fire Protection Association (NFPA): www.nfpa.org (Tel: 800-344-3555)
- NSSN National Resource for Global Standards: www.nssn.org (Tel: 212-642-4980)
- IHS Standards Store: www.global.ihs.com (Tel: 303-397-7956, 800-854-7179)
- Document Center: www.document-center.com/home.cfm (Tel: 650-591-7600)

Overview

SI-LS42 series safety interlocking switches with guard locking capability can be used to secure a guard (or a gate) such that the hazard has time to stop before the guard is opened. This allows the guard to be located closer to the hazard than otherwise possible if the guard can be opened and the hazard can be accessed.

There are two styles available:

- Spring Lock, Solenoid Unlock (Models SI-LS42DMS.. and SI-LS42WMS..)
 - The actuator is mechanically locked when it is fully inserted into the actuator head. The actuator is unlocked by applying voltage to the solenoid.
- Solenoid Lock, Spring Unlock (Models SI-LS42DMM.. and SI-LS42WMM..)
 - The fully inserted actuator is locked when voltage is applied to the solenoid. The actuator is unlocked when voltage is removed from the solenoid.

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 switch actuator is disengaged or moved from its home position. 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.



WARNING: Interlocked Guards

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. At a minimum, the interlocked guard must prevent hazards when not fully closed and must also prevent access to the hazards through any opening in the guard. The safety switches and actuators must be designed and installed so that they cannot be easily defeated, and are not used as a mechanical or end-of-travel stop. At least one switch must be mounted in a positive mode and open the normally closed contact when the guard opens. Failure to follow these guidelines may result in serious bodily injury or death.



CAUTION: End-of-Travel Stop

Do not use the safety switch as a mechanical or end-of-travel stop.

The movement or rotation of the guard must be limited such that damage to the safety switch or the actuator cannot occur. Catastrophic damage can cause the safety switch to fail in an unsafe manner (that is, loss of the switching action).

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.

Models

For kit models and interlock body models, insert "S" for Spring Lock/Solenoid Unlock or "M" for Solenoid Lock/Spring Unlock. Example: SI-LS42DM_G can become SI-LS42DMSG or SI-LS42DMMG

Kit Model ¹	Solenoid Voltage	Actuator Type	Interlock Body	Contact Configuration		Switching Diagram ²
				(Actuator Engaged and Locked)	(Actuator Unlocked and Removed)	
SI-LS42DM_G	24V ac/dc	SI-QM-SSA Rigid in-line	SI-LS42D_G	Actuator Contacts	Actuator Contacts	
SI-LS42WM_G	110V/230V ac		SI-LS42W_G			
SI-LS42DM_GF	24V ac/dc		SI-LS42D_G			
SI-LS42WM_GF	110V/230V ac	SI-QM-SMFA Flexible in-line	SI-LS42W_G	Solenoid Monitor Contacts	Solenoid Monitor Contacts	
SI-LS42DM_H	24V ac/dc	SI-QM-SSA Rigid in-line	SI-LS42D_H	Actuator Contacts	Actuator Contacts	
SI-LS42WM_H	110V/230V ac		SI-LS42W_H			
SI-LS42DM_HF	24V ac/dc		SI-LS42D_H			
SI-LS42WM_HF	110V/230V ac	SI-QM-SMFA Flexible in-line	SI-LS42W_H	Solenoid Monitor Contacts	Solenoid Monitor Contacts	
SI-LS42DM_I	24V ac/dc	SI-QM-SSA Rigid in-line	SI-LS42D_I	Actuator Contacts	Actuator Contacts	
SI-LS42WM_I	110V/230V ac		SI-LS42W_I			
SI-LS42DM_IF	24V ac/dc		SI-LS42D_I			
SI-LS42WM_IF	110V/230V ac	SI-QM-SMFA Flexible in-line	SI-LS42W_I	Solenoid Monitor Contacts	Solenoid Monitor Contacts	

¹ A kit contains an interlock and actuator. Individual pieces are for replacement purposes only. See [Warning](#).

² Contacts: Open Closed Transition

Kit Model ¹	Solenoid Voltage	Actuator Type	Interlock Body	Contact Configuration		Switching Diagram ²
				(Actuator Engaged and Locked)	(Actuator Unlocked and Removed)	
SI-LS42DM_J	24V ac/dc	SI-QM-SSA Rigid in-line	SI-LS42D_J	Actuator Contacts 11 ○ — ○ 12 21 ○ — ○ 22 31 ○ — ○ 32 Solenoid Monitor Contacts 41 ○ — ○ 42 E1 — E2 + — -	Actuator Contacts 11 ○ — ○ 12 21 ○ — ○ 22 31 ○ — ○ 32 Solenoid Monitor Contacts 41 ○ — ○ 42 E1 — E2 + — -	
SI-LS42DM_JF		SI-QM-SMFA Flexible in-line				

Specifications

Contact Rating

Utilization categories: AC-15, U_e/I_e 24 V / 1 A (IEC/EN 90497-5-1)

U_i = 250V

I_{th} = 5A

U_{imn} = 2.5 kV

Contact Material

Silver-nickel alloy

Short Circuit Protection

4A general purpose fuse (rated gL per IEC DIN EN 60269-1)

Electrical Protection Class

II, double insulated

Solenoid Power Consumption

Switch operations: 600/h max

Temperature class: F (155 °C)

Operating voltage: 110/230 V AC

· Inrush power consumption 65 VA (0.1 s)

· Permanent power consumption 8 VA

Operating voltage: 24 V AC/DC

· Inrush power consumption 12 VA (0.2 s)

· Permanent power consumption 4.4 VA

Maximum Actuator Speed

0.5 m/second (19.7"/second)

Environmental Rating

IEC IP67 (acc. to IEC/EN 60529)

Operating Conditions

Temperature: -25 °C to +70 °C (-13 °F to +158 °F)

Applicable Standards

IEC 60947-1

DIN EN 60947-1

IEC 60947-5-1

DIN EN 60947-5-1

VDE 0660 T100/T200

GS-ET-19

Certifications

All models	SI-LS42DM_G, SI-LS42DM_H, SI-LS42DM_I, SI-LS42DM_J models only
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B300 (same polarity)

Minimum Actuator Engagement Radius

In-line actuators: 400 mm (16 in)

Flexible actuators: 150 mm (6 in)

Actuator Extraction Force

≤1500 Newtons (337 lbf) when locked (acc. to GS-ET-19)

Mechanical Life

1 x 10⁶ switching cycles

Wire Connections

10 spring-clamp connections

0.5 - 1.5 mm max. flexible (stranded) (16 AWG max)

Cable Entry

M20 x 1.5 threaded entrance (x3 ports)

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

Construction

Enclosure: Thermoplastic GV (UL94-V0)

Actuating Head: Thermoplastic GV (exterior) / Zn-GD (internal cam)

(GV = Glass fiber-reinforced polyimide thermoplastic housing, UL 94-V0 rating)

(Zn-GD = Zinc-diecast)

Weight

approximately 0.34 kg

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 <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

¹ A kit contains an interlock and actuator. Individual pieces are for replacement purposes only. See [Warning](#).

² Contacts: Open Closed Transition

Mechanical Installation Guidelines

Horizontal or Vertical Actuation

Before installation, orient the switch actuator head for either horizontal (at a right angle to the switch length) or vertical (in-line with the switch length) actuation. If vertical actuation is required, remove the head by pulling straight up and off ([Figure 2](#) on page 5). Re-orient the actuator head, and slide it back on in the new position until it snaps into place. Once the desired orientation is configured, install the M3 x 15 mm tamper-proof (one-way) screw, which is found in a plastic bag, stored in the wiring chamber (see [Figure 1](#) on page 5 and [Electrical Installation](#) for more information on opening the wiring chamber access door).

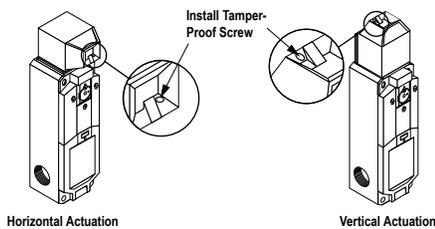


Figure 1.

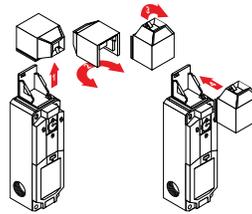


Figure 2.

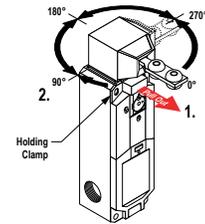


Figure 3.

Rotating Actuator Head to Desired Position

The actuator head may be rotated in increments of 90° to create eight possible actuator engagement positions (i.e., four horizontal plus four vertical positions). To rotate the head, pull the holding clamp forward, rotate the head (in either direction) to the desired position, and push the holding clamp back in to lock. The head may be rotated with the actuator either engaged or removed ([Figure 3](#) on page 5).

Installing the Switch and Actuator



NOTE: All mounting hardware is supplied by the switch user. The fasteners must be of sufficient strength to avoid incidental breakage. Use of permanent fasteners or locking hardware is recommended to prevent loosening or displacement of the actuator and switch body. The mounting holes in the switch body accept M5 (#10) screws. There are four holes on a mounting pattern of 30 x 124 mm (see [Dimensions](#)).

Position the switch, with its actuator fully engaged, at the mounting location and mark the mounting holes. Fasten the switch body and the actuator in place. The rigid in-line actuator includes floating sleeves in the mounting holes to allow some forgiveness for switch-to-actuator alignment. If the rigid in-line actuator is used, take care to not overtighten the actuator fasteners so as to allow this movement. After the mounting hardware is secure, check the actuator/switch engagement for misalignment and binding.



Important: A safety switch must be installed in a manner which discourages tampering or defeat. Mount each switch to prevent bypassing of the switching function at the wiring chamber. A switch and its actuator must never be used as a mechanical stop.

Manual Release to Spring Lock Models

Models with spring lock/solenoid unlock may be unlocked manually by rotating the unlock mechanism, using an M3 Allen wrench (not supplied). First loosen the security screw (see [Dimensions](#)), then turn the unlock mechanism in either direction to the  position.



Important: After the switch is installed, check to be certain that the unlock mechanism is in the  position, and that the security screw is tight and covered with tamper-resistant lacquer (user-supplied).

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 Personnel³ 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.

Access to Wiring Chamber

Access the wiring chamber using the hinged door. Insert a flat-blade screwdriver, as shown below, and pry gently down to open. Select the best wiring entrance and, if required, thread in the ½" × 14 NPSM conduit adapter (supplied with kit), or the optional M20 × 1.5 cable gland (see [Accessories](#) on page 8). The switch knockout breaks loose with the final turn of the conduit adapter or cable gland.

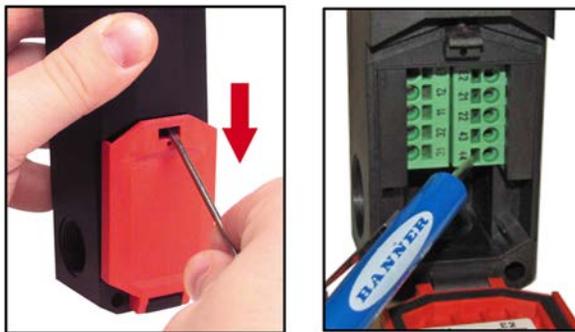


Figure 4. Opening the wiring chamber

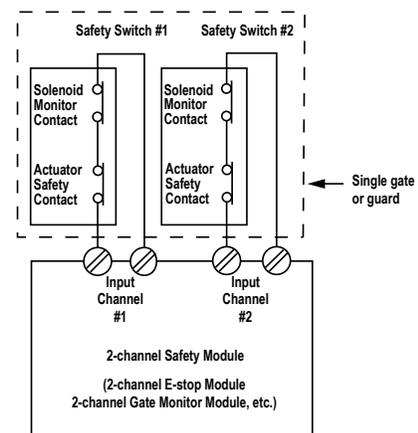


Figure 5. Wiring

To open wiring chamber:

1. Insert the screwdriver blade into the slot in the cover to pry cover open.

To connect wires to terminals:

1. Insert the screwdriver blade into the slot below the desired wiring terminal.
2. Twist the screwdriver blade in the slot to open the terminal jaws; insert wire.
3. Hold the wire in place and remove the screwdriver.

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.

Connection to a Machine

A risk assessment must be accomplished to determine the means of interfacing the switch(es) with the machine control circuit. 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.

To ensure the highest level of reliability (e.g. Control Reliable or Category 4), it is recommended to wire the safety contacts (i.e., safety contacts that are closed when the actuator is engaged and the solenoid is in its locking state) from each of two safety switches per interlock guard in a dual channel hookup to a safety module (e.g. ES-FA-9AA) safety controller (e.g. SC22-3), or the safety related part of the machine control that complies with the required level of safety performance as shown in [Figure 5](#) on page 6.

³ A person who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.

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 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 B11.0 and ANSI/NFPA 79 machine safety standards.

Use only positively-driven, normally-closed safety contacts from each switch for connection to the safety module. *The normally-open contacts 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.

See the Switching Diagrams in [Models](#) for contact state information.

Solenoid voltage connects to terminals E1 (+) and E2 (-).



CAUTION: Electrical Installation

Two safety switches must be used for each interlock guard to achieve control reliability or Safety Category 4 (per ISO 13849-1, EN 954-1) of a machine stop circuit. Use of only one safety switch per interlock guard is not recommended.

In addition, normally-closed safety contacts from each of the two safety switches should be connected to the two separate inputs of a 2-channel safety module or safety interface. This is required to provide monitoring for safety switch contact failure, and to provide the necessary reset routine, as required by IEC 60204-1 and NFPA 79 machine safety standards.



WARNING: Series Connection of Safety Switches

Monitoring multiple guards with a series connection of safety interlock switches may result in a failure being masked or not detected at all. When such a configuration is used, periodic checks must be performed regularly to verify proper operation. All failures must be immediately corrected (for example, immediately replacing a failed switch), or the loss of the safety stop signal or an inappropriate reset may lead to serious injury or death.



WARNING: Hazard Point

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 OSHA CFR 1910.217 and ANSI B11 standards for information on determining safety distances and safe opening sizes for your guarding devices.

Checkout Procedures

Initial and Daily Checks

Verify the functioning of the safety switch(es) and the interlocked guard (if applicable) at designated periods. Verify at initial installation by a *qualified person*, verify daily or before each use by a *designated person*, and as part of the regular periodic checkout procedure listed below to ensure proper operation.

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. A *designated person* is identified in writing by the employer as being appropriately trained to perform a specified checkout procedure.

1. Inspect for breakage of the switch body or actuator
2. Verify good alignment and full engagement of the actuator
3. Confirmation that the safety switch is not being used as an end stop
4. Inspect for loosening, corrosion, or damage to the mounting hardware of the switch actuator
5. Verify that it is not possible to reach any hazard point through an opened guard (or any opening) before hazardous machine motion has completely stopped
6. Verify switch(es) operation per specific application. For example, the machine cycle stops and/or can not be initiated when the actuator is removed from the switch body.
7. If more than one safety switch(es) and the interlocked guard is used, perform this procedure individually for EACH device.

Periodic Checks

A *qualified person* (as defined above) 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. At a minimum, this should take place once a year (lockout/tagout procedures for controlling hazardous energy may be required):

1. Inspect the wiring chamber for signs of contamination, deterioration, loose connections, or damage
2. Inspect the sealing at the cable entry and all electrical wiring for continuity and damage
3. Verify that wiring and installation conforms to the instructions in this document and that there are no signs of tampering or defeat
4. Perform the initial/daily checkout listed above

See also the machine manufacturer's recommendations for additional instructions. If any of these checks cannot be verified, do not attempt to use the enabling device until the defect or problem has been corrected.



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 may result in undetected faults and create an unsafe condition which may result in serious injury or death.

Repairs

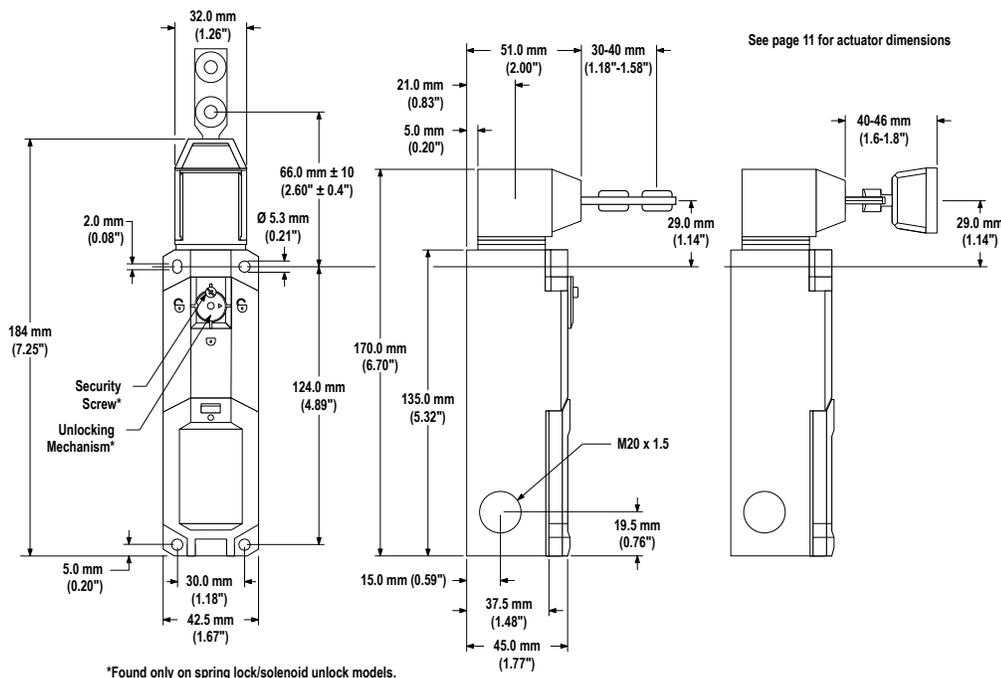
Do not attempt any repairs to the safety interlocking switch. It contains no field-replaceable components. Return it to Banner Engineering for warranty repair or replacement.

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.

Dimensions



Accessories

Replacement Parts

Plastic Conduit Adapter

Model	Size	Thread Conversion	Dimensions	Used With
SI-QS-M20	½ in-14 NPT Plastic	M20 × 1.5 to ½ in-14 NPT		SI-QS90 Safety Interlock Switches SI-LS100 Safety Interlock Switches SI-LS31 Safety Interlock Switches SI-LS42 Safety Interlock Switches RP-LS42 Rope Pull Switches

Model	Description	Used with Switch Models	Dimensions
SI-LS42-COVER	Replacement Terminal Cover	All	N/A

Cable Glands

Model	Size	For Cable Diameter	Dimensions	Used With
SI-QS-CGM20	M20 × 1.5 Plastic	5.0 to 12.0 mm (0.20 to 0.47 inches)		SI-QS90 Safety Interlock Switches SI-LS100 Safety Interlock Switches SI-LS31 Safety Interlock Switches SI-LS42 Safety Interlock Switches RP-LS42 Rope Pull Switches

Accessory Actuators

Model	Application	Dimensions
SI-QM-SB	Rigid in-line metal actuator used for doors or covers. Slide-bolt design for use in heavy-duty applications where alignment is difficult to maintain.	



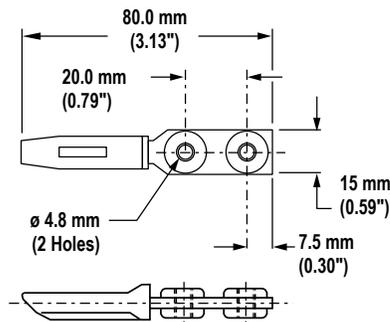
WARNING: Spare Actuators

Spare actuators must NEVER be used to bypass or otherwise defeat the protective function of a safety switch. To do so may create an unsafe situation which may lead to serious injury or death.

Actuator Dimensions

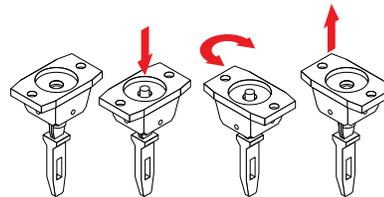
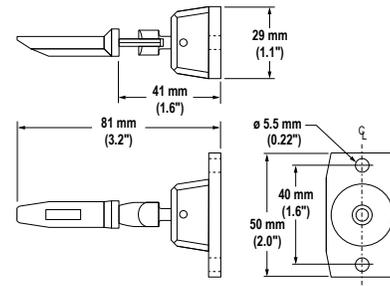
SI-QM-SSA Rigid In-line Actuator

400 mm (16") minimum actuator engagement radius



SI-QM-SMFA Flexible In-line Actuator

150 mm (6") minimum actuator engagement radius



The flexible actuator mounting flange may be rotated 90° with respect to the actuator position. To rotate, push the flange in the direction of actuation, turn the flange either direction, and release to lock the flange in the new position; see the diagram above.

EU Declaration of Conformity (DoC)

Banner Engineering Corp. herewith declares that the SI -LS42 Series Safety Interlocking Switches is in conformity with the provisions of the Machinery Directive 2006/42/EC and all essential health and safety requirements have been met.

Representative in EU: Peter Mertens, Managing Director Banner Engineering Europe. Address: Park Lane, Culliganlaan 2F, 1831 Diegem, Belgium.

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