

SI-LS31R Machine Safety Switch



Datasheet

SI-LS31R Series 31mm Limit-Switch Style with Rotary Hinge Actuator



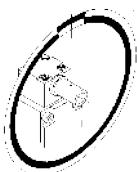
- Limited switch design (EN 50047)
- Rotating shaft connects directly to door hinge
- Positive opening safety contacts (IEC 60947-5-1), not dependent on springs
- Glass-reinforced thermoplastic switch housing with plated steel actuator
- Insulated device (IEC 60947-5-1) on all models with plastic housings
- Actuator head is rotatable in 90 degree increments



Note: 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

Model	Actuator	Contact Configuration (Axle in home position = 0°)	Contact Configuration (Axle rotated 45° in either direction)	Switching Diagram
SI-LS31RTD	Rotary Shaft	<p>0°/360°</p> <p>11 ○ ○ 12</p> <p>23 ○ ○ 24</p>	<p>>45°</p> <p>11 ○ ○ 12</p> <p>23 ○ ○ 24</p>	<p>Safety Monitor</p>
SI-LS31RTE		<p>0°/360°</p> <p>11 ○ ○ 12</p> <p>21 ○ ○ 22</p>	<p>>45°</p> <p>11 ○ ○ 12</p> <p>21 ○ ○ 22</p>	<p>Safety Safety</p>



The closed contact (11-12) fully opens (i.e., positive break occurs) within $\pm 30^\circ$ of the neutral shaft position.

Contacts: Open
 Closed
 Transition



Important Information Regarding the Use of Safety Switches

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:

- **Read this Section Carefully Before Installing the System**
- **Failure to follow these instructions could result in serious injury or death.**
- If all mounting, installation, interfacing, and checkout procedures are not followed properly, this Banner Engineering Corp. device cannot provide the protection for which it was designed.
- The user is responsible for ensuring that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this control system in any particular application are satisfied. Ensure that all legal requirements have been met and that all technical installation and maintenance instructions contained in this manual are followed.
- The user has the sole responsibility to ensure that this Banner Engineering Corp. device is installed and interfaced to the guarded machine by Qualified Persons, in accordance with this manual and applicable safety regulations. A Qualified person is 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.

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

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 Jones Branch Drive, Suite 900, McLean, VA 22102-4206 USA, www.amtonline.org

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

Installation

Mechanical Installation



WARNING:

- **The hazard must be accessible only through the sensing field**
- Incorrect system installation could result in serious injury or death.
- The installation of the SI-LS31R must prevent any individual from reaching around, under, over or through the defined area and into the hazard without being detected.
- See OSHA CFR 1910.217, ANSI B11.19, and/or ISO 14119, ISO 14120 and ISO 13857 for information on determining safety distances and safe opening sizes for your guarding device. Mechanical barriers (for example, hard (fixed) guarding) or supplemental safeguarding might be required to comply with these requirements.

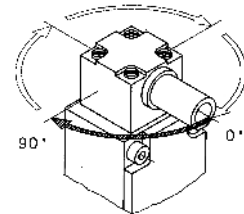


Important: Install a safety switch in a manner that discourages tampering or defeat. Mount switches to prevent bypassing of the switching function at the terminal chamber.

The actuator head can be rotated to any of four positions in 90° increments. See [Figure 1](#) on page 3. To reposition the actuator head, follow these steps.

1. With the actuator at 0°, loosen the four screws holding the actuator head to the switch body.
2. Lift the actuator head away from the spring and gasket and rotate it to the desired position.
3. Press the actuator head down firmly to compress the spring, and re-fasten the four screws.

Figure 1. Loosen four screws to rotate actuator head to any of four 90° positions



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 mounting holes in the switch body accept M4 (#8) screws.

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.

Figure 2. Features

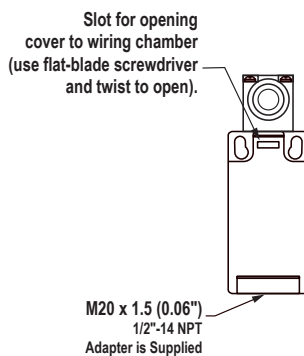
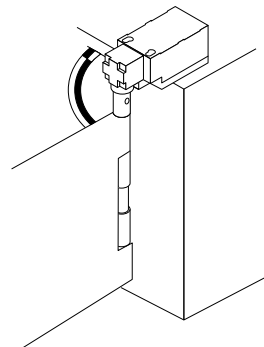


Figure 3. Typical alignment on a door



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.

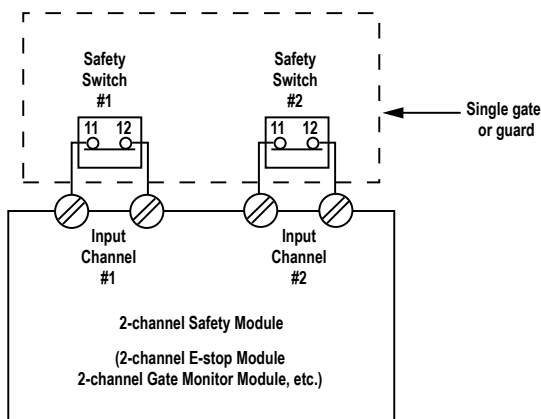
Access to the Wiring Chamber

Access the wiring chamber using the hinged door. Insert a flat-blade screwdriver and pry gently down to open. A conduit adapter is supplied to convert the German M20 × 1.5 thread to ½ 14 NPT. An accessory cable gland that fits the M20 × 1.5 thread is available.

Connection to a Machine

Two types of contacts are offered. The contacts between terminals 11–12 and 21–22 are the safety contacts, which are closed (i.e., they conduct) when the actuator is engaged. The contacts located between terminals 23–24 are considered monitoring contacts, which should not be used for safety switching.

Figure 4. Connect two redundant safety switches per interlock guard to an appropriate 2-channel input safety module.



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. See Figure 4 on page 4. Examples of appropriate safety modules include 2-channel emergency stop (E-stop) safety modules and gate monitor safety modules.

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.

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.

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

Maximum Making Current:

SI-LS31RTD: 10 A

SI-LS31RTE: 5 A

Rated Impulse Withstand Voltage (U_{imp}): 2.5 kV
NEMA A300 (same polarity)

Contact Material

Silver-nickel alloy

Maximum Switching Speed

50 operations per minute

Short Circuit Protection

10 amp fuse (gL/gG)

Recommended external fusing or overload protection

Mechanical Life

1 million operations

Weight

0.09 kg (0.20 lbs)

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

Cable Entry

M20 × 1.5 threaded entrance

Adapter supplied to convert M20 × 1.5 to ½"-14 NPT threaded entrance

Certifications



Banner Engineering
Europe Park Lane,
Culliganlaan 2F bus 3,
1831 Diegem, BELGIUM

Turck Banner LTD
Blenheim House, Blenheim
Court, Wickford, Essex
SS11 8YT, Great Britain



Construction

Glass fiber-reinforced thermoplastic UL94-VO rating; plated steel actuator

Environmental Rating

IP65

Operating Conditions

-30 °C to +80 °C (-22 °F to +176 °F)

European Rating

Utilization categories: AC-15

SI-LS31RTD: U_e/I_e 240 V/3 A

SI-LS31RTE: U_e/I_e 240 V/1.5 A

Rated Insulation Voltage (U_i): 250 V AC

Conventional Thermal Current:

SI-LS31RTD: 10 A

SI-LS31RTE: 5 A

Actuation Extraction Force

10 N cm (0.9 lbf-in)

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.

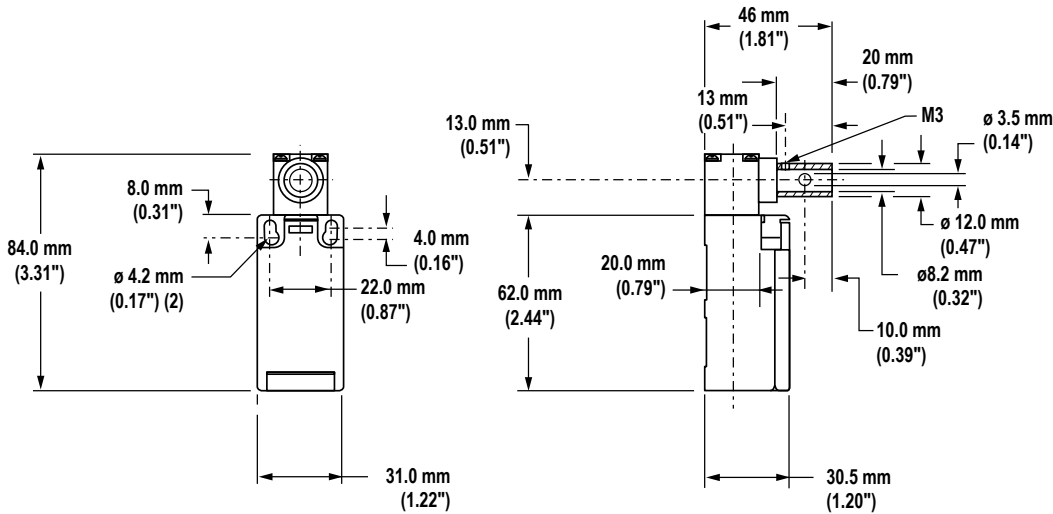
Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

B10d

2×10^6 cycles at DC-13; 24 V; $I_{e2} = 0.2$ A based on ISO 13849-1

Dimensions

All measurements are listed in millimeters [inches], unless noted otherwise.



Accessories

Cable Glands

Model	Size	For Cable Diameter	Dimensions	Used With
SI-QS-CGM20	M20 x 1.5 Plastic	5.0 to 12.0 mm (0.20 to 0.47 inches)		RP-LS42 Rope Pull Switch SI-GL42 Safety Interlock Switch SI-LS31 Safety Interlock Switch SI-LS42 Safety Interlock Switch SI-LS100 Safety Interlock Switch SI-QS90 Safety Interlock Switch

Replacement Parts

Plastic Conduit Adapter

Model	Size	Thread Conversion	Dimensions	Used With
SI-QS-M20	½ in-14 NPT Plastic	M20 x 1.5 to ½ in-14 NPT		SI-GL42 Safety Interlock Switch SI-LS31 Safety Interlock Switch SI-LS42 Safety Interlock Switch SI-LS100 Safety Interlock Switch SI-QS90 Safety Interlock Switch RP-LS42 Rope Pull Switch

EU/UK Declaration of Conformity (DoC)

Banner Engineering Corp. herewith declares that these products are in conformity with the provisions of the listed directives, regulations, and all essential health and safety requirements have been met. For the complete DoC, please go to www.bannerengineering.com.

Product	Directive
SI-LS31RT Series Limit Switch Style with Rotary Hinge Actuator	EU: Machinery Directive 2006/42/EC UK: Machinery (Safety) Regulations 2008

Representative in EU: Spiridon Lachanidis, Managing Director, **Banner Engineering Europe** Park Lane, Culliganlaan 2F bus 3, 1831 Diegem, BELGIUM

Representative in UK: Tony Coghlan, Managing Director, **Turck Banner LTD** Blenheim House, Blenheim Court, Wickford, Essex SS11 8YT, Great Britain

Banner Engineering Corp. Limited Warranty

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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This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. **IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.**

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more sensors, more solutions