

HS1E Series Full Size Interlock Switch with Locking Solenoid

HS1E

Key features include:

- Basic unit and solenoid unit in one housing
- Plastic Housing: Light weight
- Ease of Wiring: All the terminal screws are M3.5.
- Available with a red or green indicator
- Choose from 4 circuit configurations
- When mounting the key on a movable door, and the switch on a machine body, the door can be mechanically locked when closed.
- Greater Safety: The door is unlocked by a solenoid lock-release signal from a PLC or other source after the machine has stopped.
- In the event of power failure or for machine maintenance, the door can be unlocked using a special tool.
- Flexible Installation: The key can be accessed from two directions.
- Also available is a manual unlock key type.

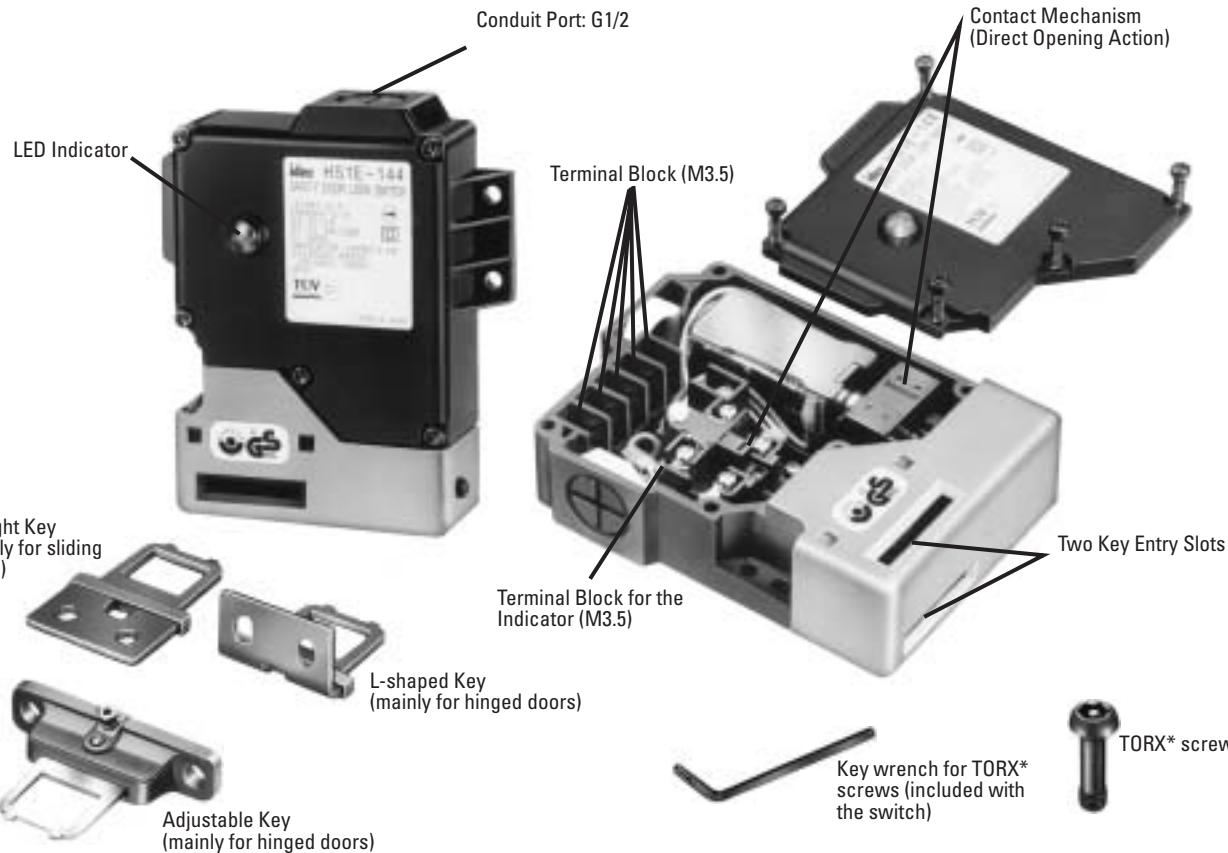


EN1088
EN60947-5-1
IEC60947-5-1

GS-ET-15
BG standard in Germany

Certificate No.
2005010305145656

HS1E Series Functionality



*TORX is a registered trademark of Camcar Textron.

Specifications

Specifications	Conforming to Standards		EN1088, IEC60947-5-1, EN60947-5-1(TUV), IISO14119, GS-ET-19 (BG), UL508, CSA C22.2 No. 14 (c-UL)					
	Applicable Use		IEC60204-1, EN60204-1					
	Operating Temperature		-20 to +40°C (no freezing)					
	Storage Temperature		-40 to +80°C					
	Operating Humidity		40 - 85% (no condensation)					
	Altitude		2,000m maximum					
	Rated Insulation Voltage (Ui)		300V (between LED or solenoid and ground: 60V)					
	Impulse Withstand Voltage (Uimp)		4 kV (between LED or solenoid and ground: 2.5 kV)					
	Insulation Resistance (measured with 500V DC megger)		Between live and dead metal parts: 100 MΩ minimum Between live metal part and ground: 100 MΩ minimum Between live metal parts: 100 MΩ minimum Between terminals of the same pole: 100 MΩ minimum					
	Electric Shock Protection		Class II (according to IEC61140)					
	Pollution Degree		3 (IEC60947-5-1)					
	Degree of Protection		IP67 (IEC60529)					
	Vibration Resistance	Operating Extremes	10 to 55 Hz, minimum (amplitude 0.35 mm)					
	Damage Limits		50 m/sec ² (approx. 5G)					
	Shock Resistance		1,000 m/sec ² (approx. 100G)					
	Actuator Tensile Strength when Locked		1,500N minimum (per GS-ET-19)					
	Actuator Operating Speed		1 m/sec maximum					
	Positive Opening Travel		11 mm minimum					
	Positive Opening Force		20N minimum					
	Thermal Current (Ith)		Main circuit: 10A, Auxiliary circuit: 3A					
Solenoid Unit	Rated Operating Current (Ie)	Rated operating voltage (Ue)		30V	125V	250V		
		Main Circuit	AC	Resistive load (AC12) Inductive load (AC15)	10A 10A	10A 5A	6A 3A	
			DC	Resistive load (DC12) Inductive load (DC13)	6A 3A	— 0.9A	— —	
		Auxiliary Circuit	AC	Resistive load (AC12) Inductive load (AC15)	— —	3A —	3A 3A	
			DC	Resistive load (DC12) Inductive load (DC13)	3A —	— 0.9A	— —	
Indicator	Contact Gap		Main circuit: 1.7 mm min., Auxiliary circuit: 1.2 mm min.					
	Operating Frequency		900 operations/hour max.					
	Mechanical Life		1,000,000 operations min. (at full rated load) 900 ops/hr (AC-12/250V, 6A)					
	Electrical Life		100,000 operations (rated load)					
	Conditional Short-Circuit Current		100A (per IEC60947-5-1)					
	Recommended Short Circuit Protection		250V, 10A fuse (Type D01 based on IEC60269-1, 60269-2)					
	Rated Operating Voltage		24V DC					
	Rated Current		235 mA					
	Coil Resistance		102Ω (at 20°C)					
	Pickup Voltage		20.5V maximum (at 20°C)					
	DropOut Voltage		2.4 minimum (at 20°C)					
	Allowable Voltage		26.4V max (continuous)					
	Insulation Class		Class B					
	Rated Operating Voltage		24V DC					
	Rated Current		10 mA					
	Light Source		LED lamp					
	Lens Color		Red or Green (12 mm dia. Lens)					
	Weight		Approx. 500g					

Ordering Information

HS1E - 2 4 4 K R - RIndicator Color:
R (Red)
G (Green)Manual Unlock Key:
K (with key)
Blank (without key)
Indicator Rated Voltage:
4 (24V DC)
0 (without indicator)Circuit Diagram No.
Main Circuit Auxiliary Circuit
Blank: 1NC+1NC 1NO/1NO
1: 1NC+1NC 1NO
2: 1NC+1NC 1NC+1NC
3: 1NC+1NC 1NC

Part Numbers

Part Numbers: Body

Part Number	Indicator	Key	Conduit Port
HS1E-①40R	Without	Without	G1/2
HS1E-①44R-*	With	Without	G1/2
HS1E-①40KR	Without	With	G1/2
HS1E-①44KR-*	With	With	G1/2



1. Special key wrench (HS9Z-T1) for removing the cover and manual unlocking is included with the switch.
2. Specify the circuit diagram No. in place of ①.
3. Specify the indicator color (R or G) in place of *.
4. Order the key separately (not included with the switch).

Circuit Diagram No.		Main Circuit	Auxiliary Circuit
Blank:	$1NC+1NC$	$1NO/1NO$	
1:	$1NC+1NC$	$1NO$	
2:	$1NC+1NC$		$1NC+1NC$
3:	$1NC+1NC$	$1NC$	

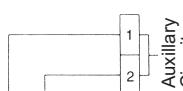
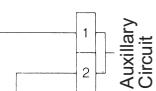
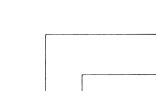
1. “/” indicates paralleled contacts.
 2. “+” indicates series contacts.

Part Numbers: Keys, Wrench & Screwdriver

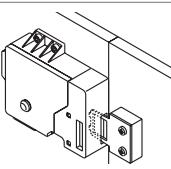
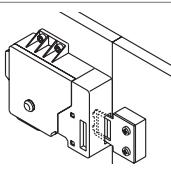
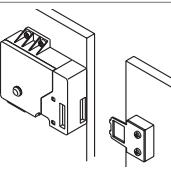
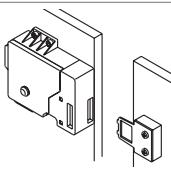
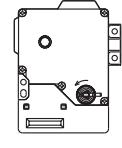
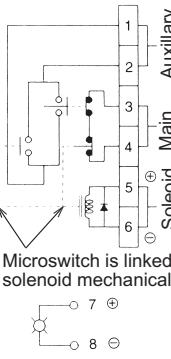
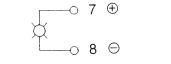
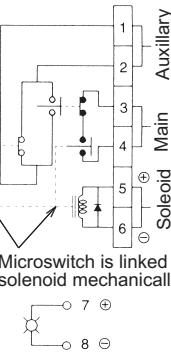
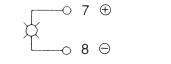
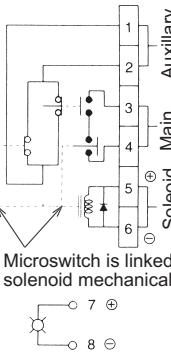
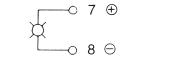
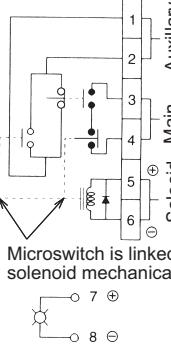
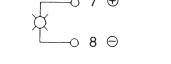
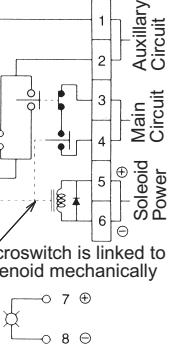
Item	Part Number	Description
	HS9Z-A1	Straight Key (Mainly for sliding doors)
	HS9Z-A2	L-shaped Key (Mainly for rotating doors)
	HS9Z-A3	Adjustable Key
	HS9Z-T1	Key Wrench (included with switch)
	HS9Z-P1	Conduit Opening Plug
Photo Not Available	HS9Z-KEY1	Replacement Manual Unlocking Key

Circuit Diagrams

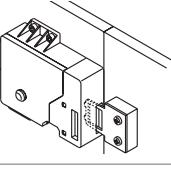
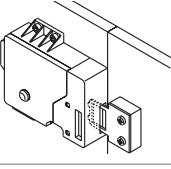
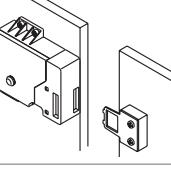
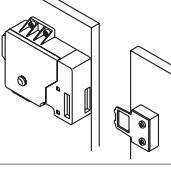
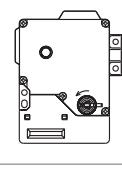
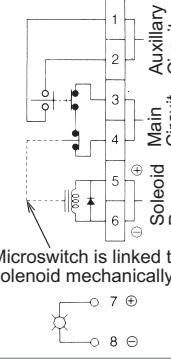
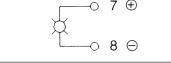
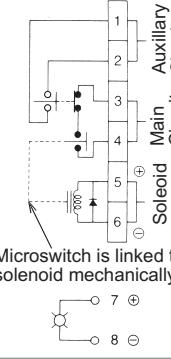
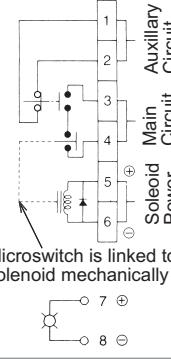
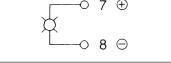
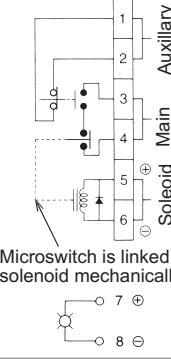
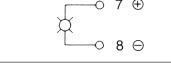
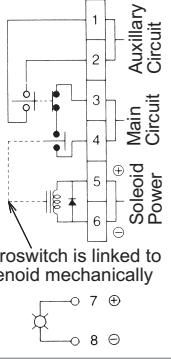
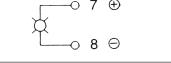
Circuit Diagrams

Circuit Diagram No. Blank	Circuit Diagram No. 1	Circuit Diagram No. 2	Circuit Diagram No. 3
 <p data-bbox="416 1345 476 1436"> Microswitch is linked to solenoid mechanically </p> 	 <p data-bbox="719 1345 781 1436"> Microswitch is linked to solenoid mechanically </p> 	 <p data-bbox="962 1345 1024 1436"> Microswitch is linked to solenoid mechanically </p> 	 <p data-bbox="1206 1345 1268 1436"> Microswitch is linked to solenoid mechanically </p> 

Application Examples and Circuit Diagrams
Circuit Diagram No. Blank (Main Circuit: 1NC-1NC, Auxiliary Circuit: 1NO/1NO)

	Status 1	Status 2	Status 3	Status 4	Unlocked Manually
Switch/Door Status	•Door closed •Machine ready to operate •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid energized	•Door opened •Machine cannot be started •Solenoid energized	•Door opened •Machine cannot be started •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid de-energized
Door					
Circuit Diagram	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 
Main Cir.	3-4: Closed	3-4: Open	3-4: Open	3-4: Closed	3-4: Open
Aux. Cir.	1-2: Open	1-2: Closed	1-2: Closed	1-2: Closed	1-2: Open
Solenoid	5-6: Power OFF	5-6: Power ON	5-6: Power ON	5-6: Power OFF	5-6: Power OFF

Circuit Diagram No. 1 (Main Circuit: 1NC-1NC, Auxiliary Circuit: 1NO)

	Status 1	Status 2	Status 3	Status 4	Unlocked Manually
Switch/Door Status	•Door closed •Machine ready to operate •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid energized	•Door open •Machine cannot be started •Solenoid energized	•Door opened •Machine cannot be started •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid de-energized
Door					
Circuit Diagram	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 	 Microswitch is linked to solenoid mechanically 
Main Cir.	3-4: Closed	3-4: Open	3-4: Open	3-4: Open	3-4: Open
Aux. Cir.	1-2: Open	1-2: Open	1-2: Closed	1-2: Closed	1-2: Open
Solenoid	5-6: Power OFF	5-6: Power ON	5-6: Power ON	5-6: Power OFF	5-6: Power OFF



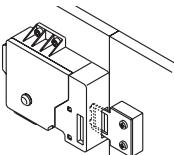
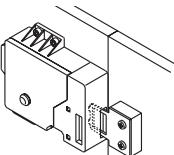
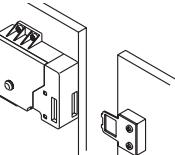
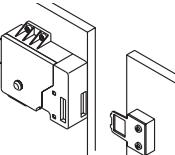
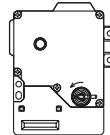
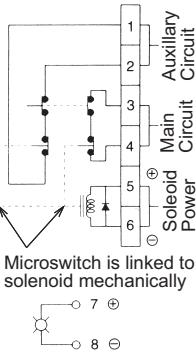
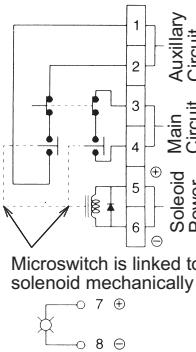
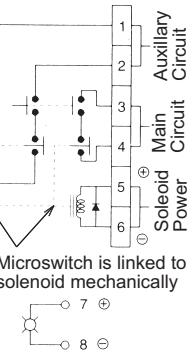
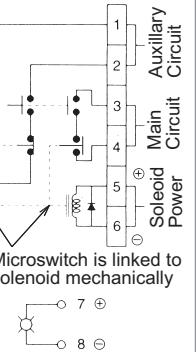
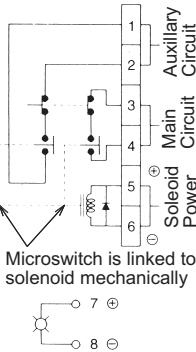
1. **Main Circuit:** used to enable the machine to start only when the main circuit is closed.

2. **Auxiliary Circuit:** used to indicate whether the machine circuit or door is open or closed.

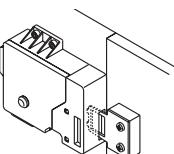
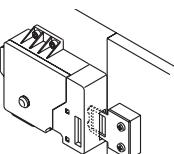
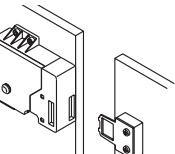
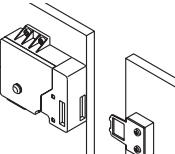
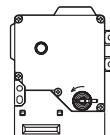
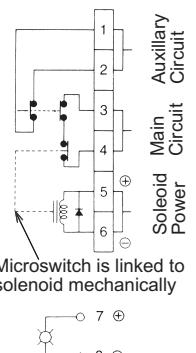
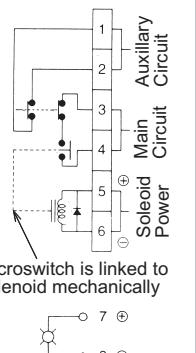
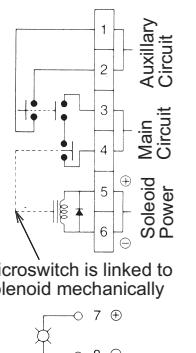
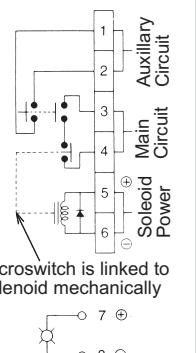
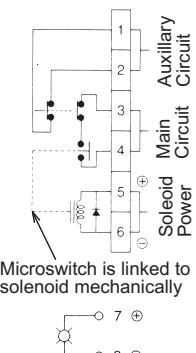
3. Terminals 7 and 8 are used for the LED indicator, and are isolated from solenoid and door status.

Application Examples and Circuit Diagrams con't

Circuit Diagram No. 2 (Main Circuit: 1NC+1NC, Auxiliary Circuit: 1NC+NC)

	Status 1	Status 2	Status 3	Status 4	Unlocked Manually
Switch/Door Status	•Door closed •Machine ready to operate •Solenoid de-energized	•Door close •Machine cannot be started •Solenoid energized	•Door open •Machine cannot be started •Solenoid energized	•Door opened •Machine cannot be started •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid de-energized
Door					
Circuit Diagram					
Main Cir.	3-4: Closed	3-4: Open	3-4: Open	3-4: Open	3-4: Open
Aux. Cir.	1-2: Closed	1-2: Open	1-2: Open	1-2: Open	1-2: Open
Solenoid	5-6: Power OFF	5-6: Power ON	5-6: Power ON	5-6: Power OFF	5-6: Power OFF

Circuit Diagram No. 3 (Main Circuit: 1NC+1NC, Auxiliary Circuit: 1NC)

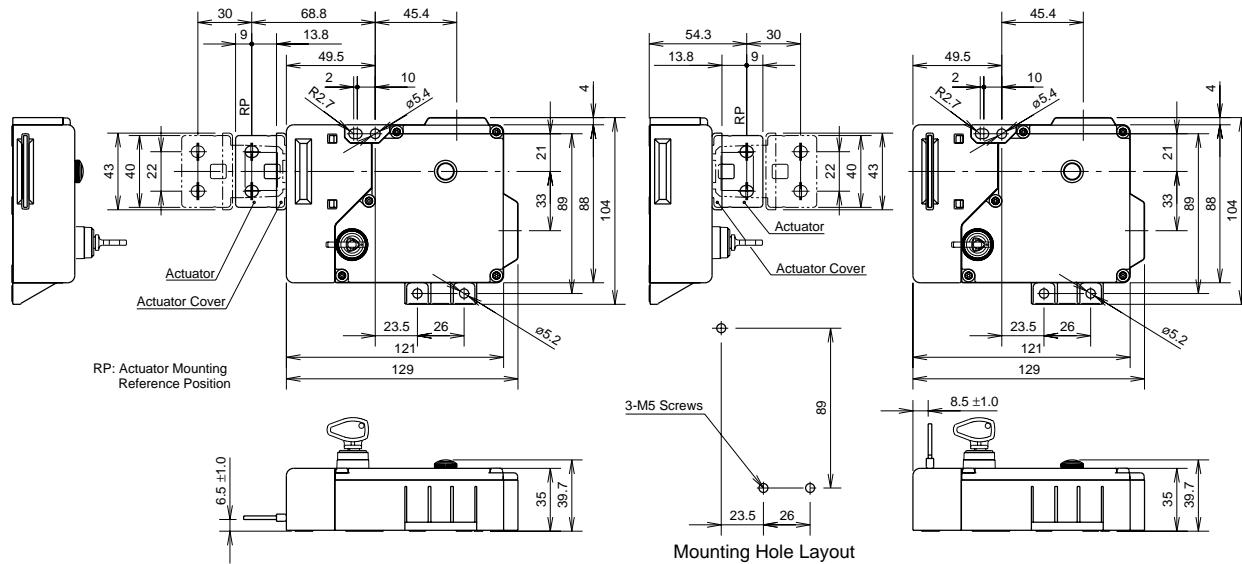
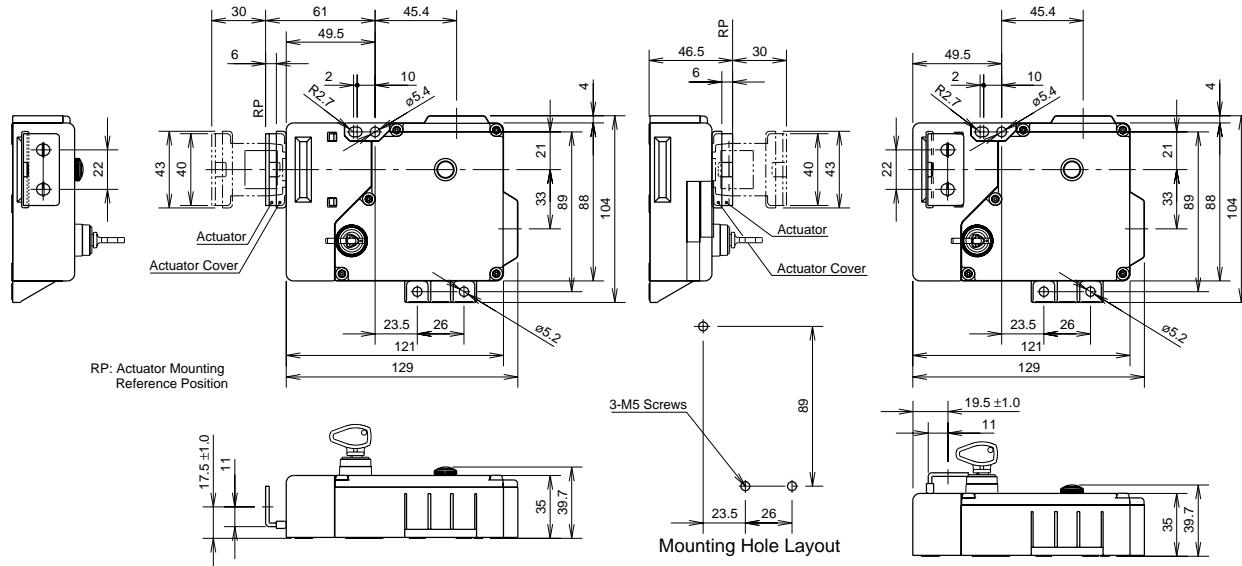
	Status 1	Status 2	Status 3	Status 4	Unlocked Manually
Switch/Door Status	•Door closed •Machine ready to operate •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid energized	•Door opened •Machine cannot be started •Solenoid energized	•Door opened •Machine cannot be started •Solenoid de-energized	•Door closed •Machine cannot be started •Solenoid de-energized
Door					
Circuit Diagram					
Main Cir.	3-4: Closed	3-4: Open	3-4: Open	3-4: Open	3-4: Open
Aux. Cir.	1-2: Closed	1-2: Closed	1-2: Open	1-2: Open	1-2: Closed
Solenoid	5-6: Power OFF	5-6: Power ON	5-6: Power ON	5-6: Power OFF	5-6: Power OFF



1. Main Circuit: used to enable the machine to start only when the main circuit is closed.

2. Auxiliary Circuit: used to indicate whether the machine circuit or door is open or closed.

3. Terminals 7 and 8 are used for the LED indicator, and are isolated from solenoid or door status.

Dimensions
HS1E with indicator - using the straight key (HS9Z-A1)

HS1E with indicator - using the L-shaped key (HS9Z-A2)


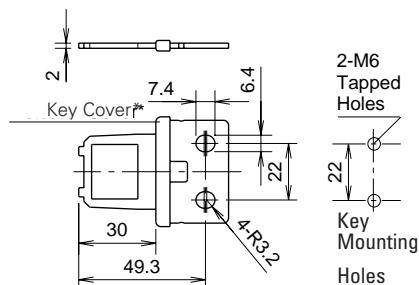
All dimensions in mm.

Accessories

Straight Key (mainly for sliding doors)
HS9Z-A1



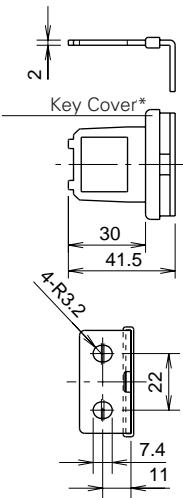
weight: 22g

**B1**

L-Shaped Key (mainly for hinged doors)
HS9Z-A2



weight: 22g

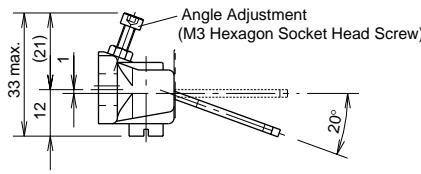
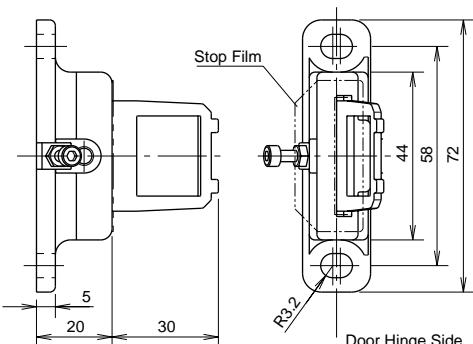


*After installing the key, remove the key cover.

Adjustable Key

- The key angle is adjustable (0° to 20°) for hinged doors.
- The minimum radius of the door opening can be as small as 100mm.

For HS1/HS2 Series (HS9Z-A3)



All dimensions in mm.

Accessories con't

Key Angle Adjustment

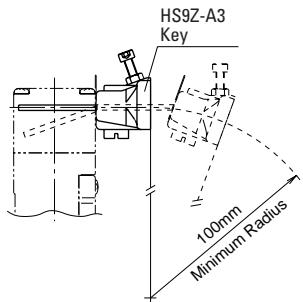
- Using the screw (M3 hex socket head screw), the actuator angle can be adjusted (refer to the dimensional drawing). Adjustable angle: (0°) to 20°
- The larger the adjusted angle of the actuator, the smaller the applicable radius of the door opening.

B1

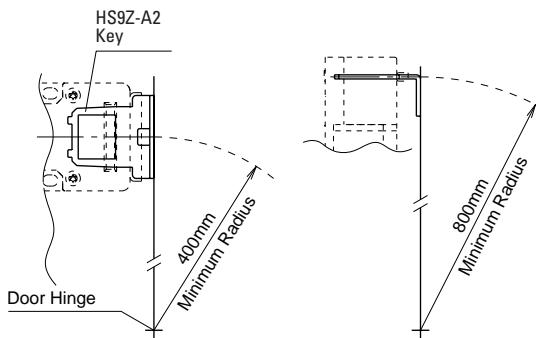
- After installing the actuator, open the door. Then adjust the actuator so that its edge can be inserted properly into the entry slot of the safety switch.
- Recommended tightening torque: 0.8 N·m (approx. 8.0 kgf·cm)
- After adjusting the actuator angle, apply loctite or the like to the adjustment screw so as to prevent its loosening.

Comparison between Adjustable and Non-adjustable Keys

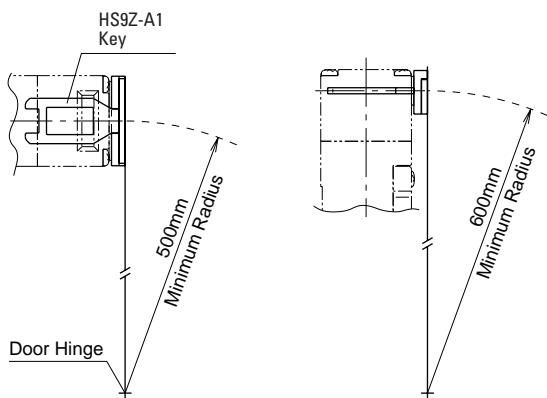
Adjustable Key HS9Z-A3



Non-adjustable Key HS9Z-A2



Non-adjustable Key HS9Z-A1



Interlock Switch Safety Precautions

- In order to avoid electric shock or a fire, turn the power off before installation, removal, wire connection, maintenance, or inspection of the switch.
- If relays are used in the circuit between the safety switch and the load, consider degrees of the danger and use safety relays, since welded or sticking contacts of standard relays may invalidate the functions of the safety switch.

- Do not place a PLC in the circuit between the safety switch and the load. The safety security can be endangered in the event of a malfunction of the PLC.
- Do not disassemble or modify the switch. It may cause a breakdown or an accident.

Operation Precautions - for all series

B1

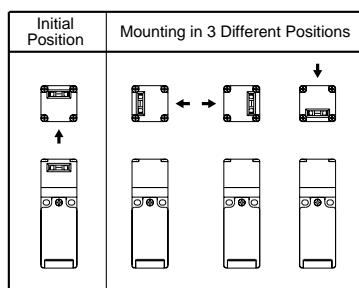
- Regardless of door types, do not use the safety switch as a door stop. Install a mechanical door stop at the end of the door to protect the safety switch against excessive force.
- Do not apply an excessive shock to the switch when opening or closing the door.
- A shock to the door exceeding $1,000 \text{ m/sec}^2$ (approx. 100G) may cause the contacts of the switch to chatter, and a malfunction of the switch may occur.
- For connection of wires, unscrew the cover. Unnecessary loosening of other screws may cause a malfunction of the switch.

- Prevent foreign objects such as dust and liquids from entering the switch while connecting a conduit or wiring.
- If the operating atmosphere is contaminated, use a protective cover to prevent the entry of foreign objects into the switch through the actuator entry slots.
- Entry of a considerable amount of foreign objects into the switch may affect the mechanism of the switch and cause a breakdown.
- Do not store the switches in a dusty, humid, or organic-gas atmosphere.

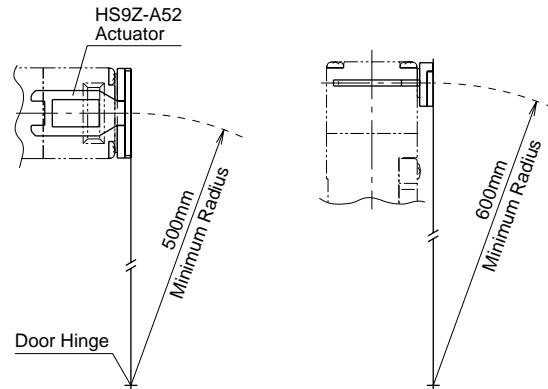
HS5B Precautions

For Rotating Head Directions

- The head of the HS5B can be rotated in 90° increments after removing the 4 screws on the corners of the head. Prevent entry of foreign objects into the switch during removal of the head. Tighten these screws with torque designated in the instruction sheet. Improper torque may cause errors.



Minimum Radius of Hinged Doors

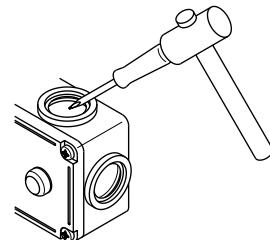


HS2B Precautions

Wire Connection

- The HS2B has 3 conduit ports, which are closed as a part of the molded switch housing.
- Make an opening for wire connection by breaking one of the conduit-port knockouts on the switch housing using a screwdriver.
- When breaking the conduit port, take care not to damage the contact block or other parts inside the switch.
- Cracks or burrs on the conduit entry may deteriorate the housing protection against water.

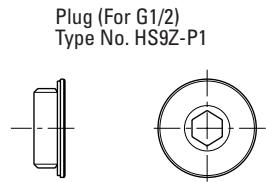
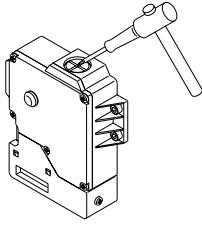
- When changing to another conduit port, close the unused opening with an optional plug (Type No. HS9Z-P1).



HS1E Precautions

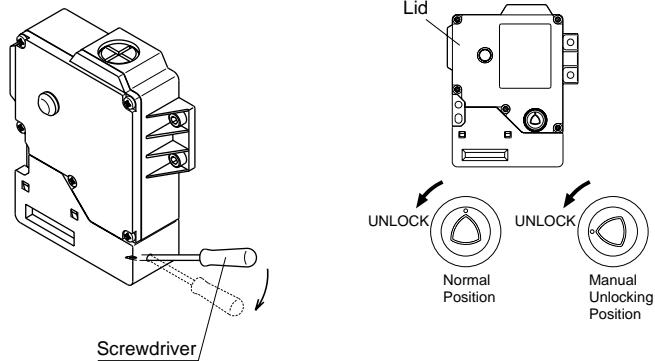
Wire Connection

- Make an opening for wire connection by breaking one of the conduit-port knockouts on the switch housing using a screwdriver.
- Before breaking the knockout, temporarily remove the connector-fixing lock nut from the switch.
- When breaking the knockout, take care not to damage the contact block or other parts inside the switch.
- Cracks or burrs on the conduit entry may deteriorate the housing protection.
- When changing to the other conduit port, close the unused opening with an optional plug (accessory).



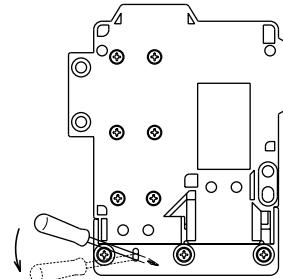
1. This unlocking method is intended for an escape from a machine when a person is locked in. For access to the unlocking entry, an access hole should be opened on the mounting panel. When opening the hole, apply proper protection against water or other foreign objects.

2. Caution: After the unlocking operation, put the screw back into the unlocking entry for safety.



Manual Unlocking

- Remove the screw located on the unlocking entry at the side of the switch using the key wrench included with the switch. Then insert a small screwdriver into the switch to push the lever inside of the switch toward the indicator until the actuator is unlocked (refer to the diagram on the right).
- Insert a small screwdriver into the elliptical hole on the back of the switch, then push the lever inside of the switch toward the indicator until the key is unlocked (refer to the diagram on the right).

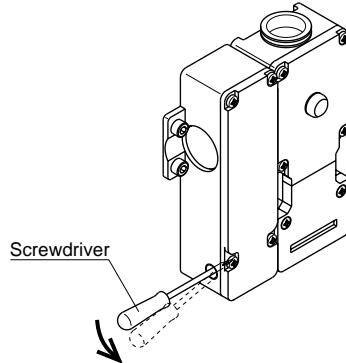


HS1C Precautions

- Regardless of door type, do not use the safety switch as a locking device. Install a locking device independently, for example, using a metal latch (also applicable to Type HS1E).
- The safety switch cover can be only removed with the special key wrench supplied with the switch or with the optional screwdriver (applicable to HS1B and HS1E).
- Remove the screw located on the unlocking entry at the side of the switch using the key wrench included with the switch. Then insert a small screwdriver into the switch to push the lever inside of the switch toward the indicator until the actuator is unlocked (refer to the diagram on the right).



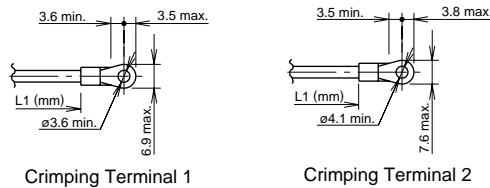
Caution: After the unlocking operation, put the screw back into the unlocking entry for safety.



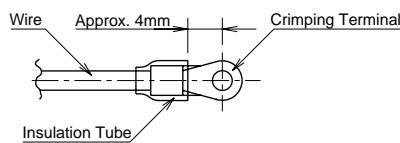
Operation Precautions

Applicable Crimping Terminals

- (Refer to the Crimping Terminal 1 or 2 shown in the drawing below.)
- HS1C
Terminals No. 1 to 6: Use solid or stranded wires only (crimping terminals not applicable).
- Terminals No. 7 and 8: Crimping Terminal 1
Ground Terminal: Crimping Terminal 2
- HS1B
Ground Terminal: Crimping Terminal 2
Other Terminals: Crimping Terminal 1
HS2B, HS5B, and HS1E
Crimping Terminal 1

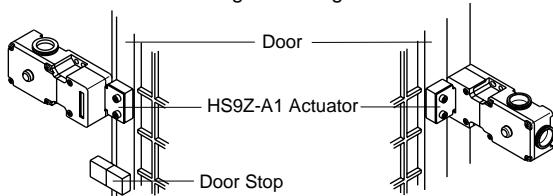


Use an insulation tube on the crimping terminal.

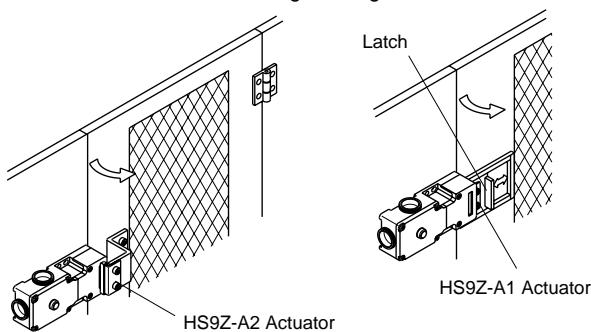


Installation Examples (see the diagrams below)

Mounting on Sliding Doors

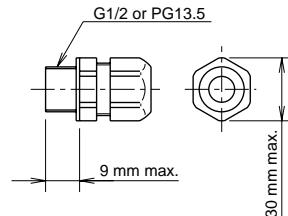


Mounting on Hinged Doors



Applicable Connectors (As shown below)

- Use connectors which maintain the IP67 protection.
- Applicable Connector Dimensions
- Flex Conduit: VF03 (Japan Flex) www.nipolex.co.jp
- Steel Connector (G1/2): ALC-103
(PF13.5): RBC-103PG13.5



Recommended Screw Tightening Torque

- HS1C: 5.0 ± 0.5 N·m (approx. 50 ± 5 kgf·cm)
(4 or 6 pcs of M5 hex socket head cap screws)
- HS1B: 5.0 ± 0.5 N·m (approx. 50 ± 5 kgf·cm)
(2 or 4 pcs. of M5 hex socket head cap screws)
- HS2B: 5.0 ± 0.5 N·m (approx. 50 ± 5 kgf·cm)
(2 pcs of M5 hex socket head cap screws)
- HS5B: 4.0 ± 0.4 N·m (approx. 40 ± 4 kgf·cm)
(2 pcs of M4 hex socket head cap screws)
- HS1E: 5.0 ± 0.5 N·m (approx. 50 ± 5 kgf·cm)
(4 or 6 pcs of M5 hex socket head cap screws)
- Key (HS9Z-A1/A2)
 5.0 ± 0.5 N·m (approx. 50 ± 5 kgf·cm)
(2 pcs. of M6 hex socket head cap screws)
- (2 pcs. of M6 hex socket head cap screws)
Key (HS9Z-A51/A52)
- 2.0 ± 0.2 N·m (approx. 20 ± 2 kgf·cm)
(2 pcs of M4 hex socket head cap screws)
- 1.0 ± 0.2 N·m (approx. 10 ± 2 kgf·cm)
(2 pcs of M4 Phillips screws)



The screws are supplied by the user.

Applicable Wire Size

- HS1C: 0.5 to 0.75 mm² (Terminals No.1, 2, 5 to 8)
1.0 to 1.25 mm² (Terminals No.3, 4, and grounding terminal)
- HS5B: 0.5 to 1.25 mm²
- HS1E: 0.5 to 1.25 mm²