

Emergency Stop Switch (16-dia.)

A165E

Separate Construction with Smallest Class of Depth in the World

- Direct opening mechanism to open contacts in emergencies, such as when they are welded.
- Conforms to EN418.
- Includes a safety lock to prevent misuse.
- Features separate construction that allows the Switch to be separated for easier wiring and one-piece-like construction that allows easier handling.
- Models available with 3 contacts built into a single block (A165E-U).



Be sure to read the precautions for all pushbutton switches in the *Pushbutton Switches Group Catalog* (Cat. No. X032), as well as the "Safety Precautions" on page 9.

Model Number Structure

List of Models

Diameter of Operation Unit	Function	Model	Shape
30-mm models 40-mm models	Push-Lock, turn-reset	A165E	 (30-mm model)
		A165E-□-03U	 (30-mm model)

Model Number Legend (Completely Assembled).....Shipped as a set that includes the Operation Unit and light source.

A165E-LS-24D-02

IP65 (Oil-resistant)

1. Operation Unit Shape and Functions

Code	Functions	Pushbutton
S	Non-lighted	30 dia.
LS	Lighted	
M	Non-lighted	40 dia.
LM	Lighted	

2. Light Source

Code	Type	Operation voltage	Rated voltage
None	Non-lighted	---	---
24D	LED	24 VDC	24 VDC

3. Contacts

Code	Description
01	SPST-NC
02	DPST-NC
03U	TPST-NC *

* TPST-NC models have one-piece construction with the contact unit. Only non-lighted models are available.

Note: Models with separate construction (SPST-NC and DPST-NC) are for normal loads only. One-piece models (TPST-NC) are for either normal loads or microloads.

Ordering Information

List of Sets

Illumination	Rated voltage	Pushbutton color	Pushbutton size	Terminal	Contact form	Model	
LED	24 VDC	Red	30 dia.	Solder terminal	SPST-NC	A165E-LS-24D-01	
Non-lighted	---				DPST-NC	A165E-LS-24D-02	
					SPST-NC	A165E-S-01	
					DPST-NC	A165E-S-02	
LED	24 VDC		40 dia.		SPST-NC	A165E-LM-24D-01	
Non-lighted	---				DPST-NC	A165E-LM-24D-02	
					SPST-NC	A165E-M-01	
					DPST-NC	A165E-M-02	
Non-lighted	---		30 dia.			TPST-NC	A165E-S-03U
			40 dia.				A165E-M-03U

List of Sets (in Different Colors)

Illumination	Pushbutton color *	Pushbutton size	Terminal	Contact form	Model
Non-lighted	Yellow	30 dia.	Solder terminal	SPST-NC	A165E-SY-01
	Gray				A165E-SGR-01
	Yellow			DPST-NC	A165E-SY-02
	Gray				A165E-SGR-02
	Yellow	40 dia.		SPST-NC	A165E-MY-01
	Gray				A165E-MGR-01
	Yellow			DPST-NC	A165E-MY-02
	Gray				A165E-MGR-02
	Yellow	30 dia.		TPST-NC	A165E-SY-03U
	Gray				A165E-SGR-03U
	Yellow	40 dia.			A165E-MY-03U
	Gray				A165E-MGR-03U

* Models with yellow or gray pushbutton colors cannot be used as emergency switches.

Individual Parts (for Switches with Separate Construction)

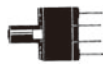
Operation Units

Appearance	Illumination	Model
30 dia. 	Non-lighted	A165E-S
	Lighted	A165E-LS
40 dia. 	Non-lighted	A165E-M
	Lighted	A165E-LM

Lamps

Appearance	LED color		Rated voltage	Model
	Red	Bright	5 VDC	A16-5DSR
			12 VDC	A16-12DSR
			24 VDC	A16-24DSR

Sockets

Appearance	Illumination	Contact form	Model
	Non-lighted	SPST-NC	A165E-01
		DPST-NC	A165E-02
	Lighted	SPST-NC	A165E-01L
		DPST-NC	A165E-02L

Socket Units

Appearance	Illumination	Contact form	Model
	Lighted	SPST-NC	A165E-R-24D-01
		DPST-NC	A165E-R-24D-02

Accessories (Order Separately)

Item	Appearance	Type	Model	Precautions
Yellow Plate		Yellow, 45 dia.	A16Z-5070	Use this as an emergency stop nameplate.
Panel Plug		Round	A16ZT-3003	Used for covering the panel cutouts for future panel expansion. Degree of protection: IP40 Color: Black
Tightening Tool		---	A16Z-3004	Useful for repetitive mounting. Be careful not to tighten excessively.
Extractor			A16Z-5080	Convenient for extracting the Switch and Lamp.

Specifications

Certified Standard Ratings

UL508, CSA C22.2 No.14, CCC(GB14048.5)

Models with Separate Construction

Rated voltage	Resistive load
125 VAC	5 A
250 VAC	3 A
30 VDC	3 A

Models with One-piece Construction

Rated voltage	Resistive load
125 VAC	1 A
250 VAC	0.5 A
30 VDC	1 A

TÜV(EN60947-5-1)

Models with Separate Construction

Rated voltage	Resistive load
250 VAC	3 A
30 VDC	3 A

Models with One-piece Construction

Rated voltage	Resistive load
250 VAC	0.5 A
30 VDC	1 A

Certified Standards

Certification body	Standards	File No.
UL *	UL508, CSA C22.2 No.14	E41515
TÜV Product Service	EN60947-5-1, EN60947-5-5	Inquire
CQC (CCC)	GB14048.5	2003010303070678

* Certification for CSA C22.2 No. 14 is indicated by the  mark.

Switch Ratings

Models with Separate Construction

Rated voltage	Resistive load
125 VAC	5 A
250 VAC	3 A
30 VDC	3 A

Minimum applicable load: 5 VDC, 150 mA

Models with One-piece Construction

Rated voltage	Resistive load
125 VAC	1 A
250 VAC	0.5 A
30 VDC	1 A

Minimum applicable load: 5 VDC, 1 mA

LED Ratings

(Only for Models with LEDs)

Rated voltage	Rated current	Operation voltage
24 VDC	10 mA	24 VDC±5%

Characteristics

Item		Type	Emergency Stop Switch		
			Non-lighted A165E-S/A165E-M	Lighted A165E-LS/A165-LM	Non-lighted, One-piece construction A165E-U
Allowable operating frequency	Mechanical		20 operations/minute max.		
	Electrical		10 operations/minute max.		
Insulation resistance			100 M Ω min. (at 500 VDC)		
Dielectric strength	Between terminals of same polarity		1,000 VAC, 50/60 Hz for 1 min		
	Between terminals of different polarity		2,000 VAC 50/60 Hz for 1 min		
	Between each terminal and ground		2,000 VAC 50/60 Hz for 1 min		
	Between lamp terminals		1,000 VAC, 50/60 Hz for 1 min *1		---
Vibration resistance	Malfunction		10 to 55 Hz, 1.5-mm double amplitude (malfunction within 1 ms)		
Shock resistance	Destruction		500 m/s ²		
	Malfunction		300 m/s ² max. (malfunction within 1 ms)		150 m/s ² max. (malfunction within 1 ms)
Durability	Mechanical		100,000 operations min.		
	Electrical		100,000 operations min.		
Degree of protection			IP65 Oil-resistant *2	IP65 *2	IP65 Oil-resistant *2
Electric shock protection class			Class II		
PTI (tracking characteristic)			175		
Degree of contamination			3 (EN60947-5-1)		
Weight			Approx. 16 g (in case of DPST-NC Switches)		
Ambient operating temperature			-10 to 55°C (with no icing or condensation)		
Ambient operating humidity			35% to 85%		
Ambient storage temperature			-25 to 65°C (with no icing or condensation)		

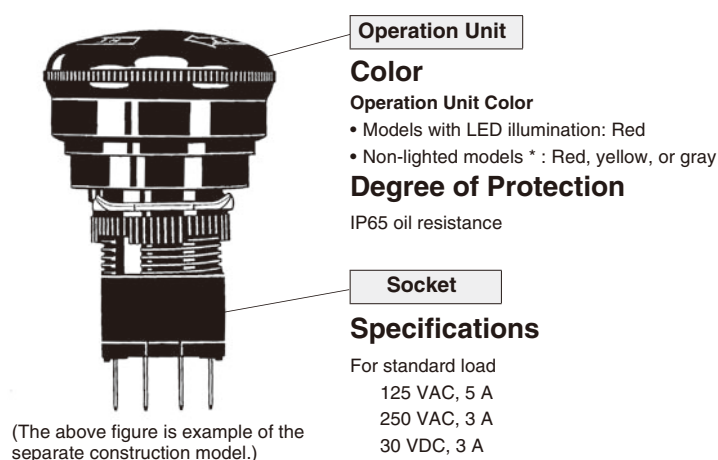
*1. LED not mounted. (Test them with the LED removed.)

*2. Degree of protection from the front of the panel.

Operating Characteristics

Item		Type	Characteristics of models with separate construction	Characteristics of models with one-piece construction
Operating force	OF max.		14.7 N	14.7 N
Releasing force	RF min.		0.1 N·m	0.1 N·m
Pretravel	PT		3.5±0.5 mm	3±0.5 mm

Structure and Nomenclature

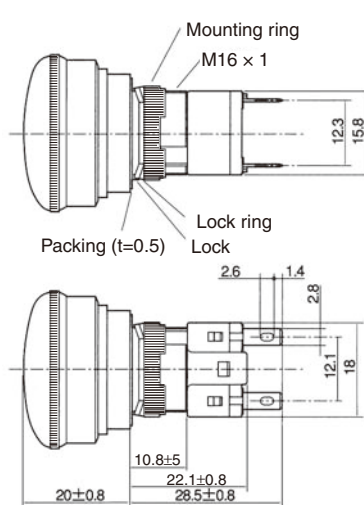
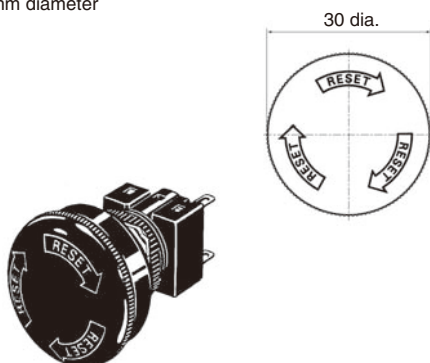


* Models with yellow or gray pushbutton colors cannot be used as emergency switches.

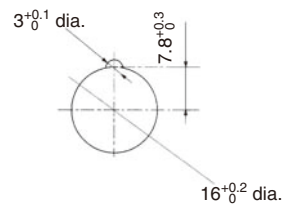
Dimensions

A165E-S

Non-lighted models
30 mm diameter



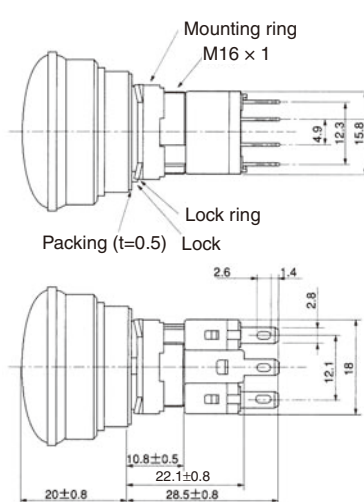
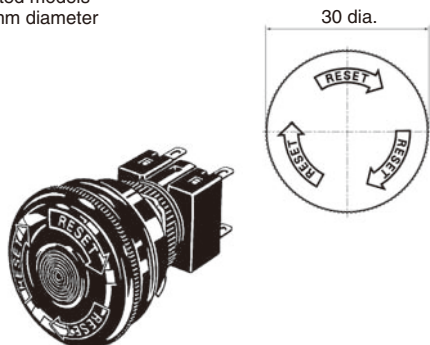
Panel cutout dimensions



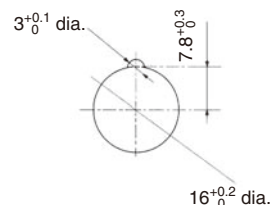
- When applying a coating such as paint to the panel, dimensions after the coating must satisfy the specified dimensions.
- Recommended panel thickness: 0.5 to 3.2 mm.

A165E-LS

Lighted models
30 mm diameter



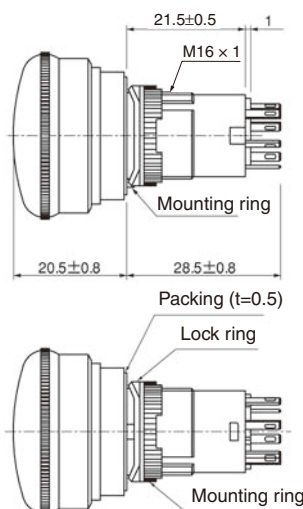
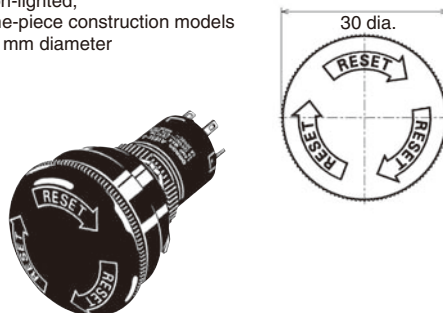
Panel cutout dimensions



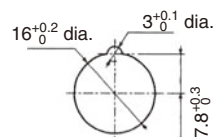
- When applying a coating such as paint to the panel, dimensions after the coating must satisfy the specified dimensions.
- Recommended panel thickness: 0.5 to 3.2 mm.

A165E-S-03U

Non-lighted,
One-piece construction models
30 mm diameter



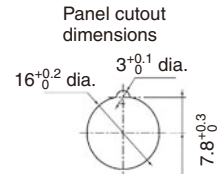
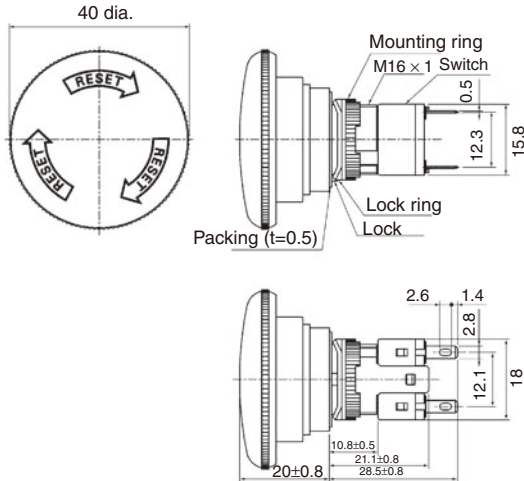
Panel cutout dimensions



- When applying a coating such as paint to the panel, dimensions after the coating must satisfy the specified dimensions.
- Recommended panel thickness: 0.5 to 3.2 mm.

A165E-M

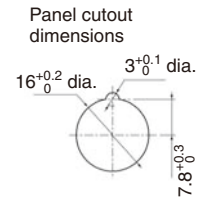
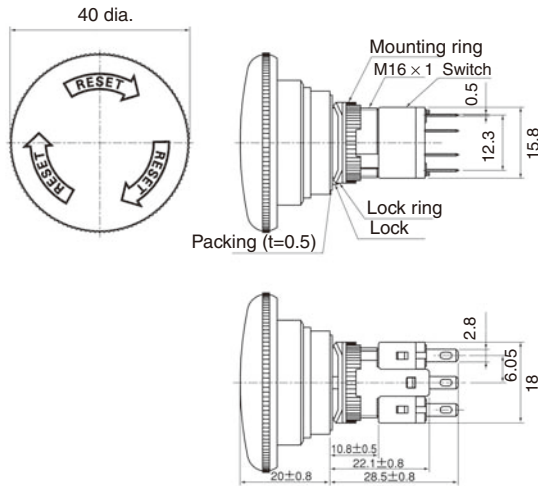
Non-lighted models
40 mm diameter



- When applying a coating such as paint to the panel, dimensions after the coating must satisfy the specified dimensions.
- Recommended panel thickness: 0.5 to 3.2 mm.

A165E-LM

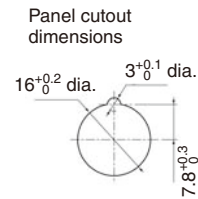
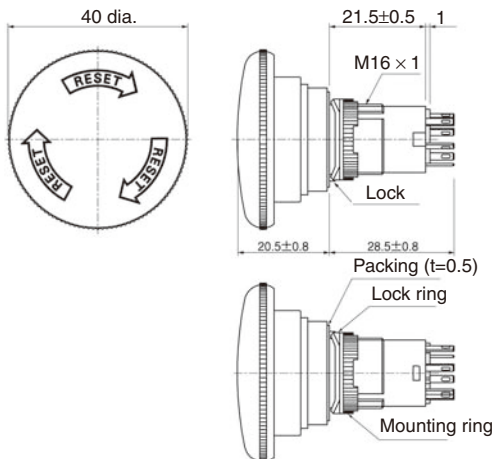
Lighted models
40 mm diameter



- When applying a coating such as paint to the panel, dimensions after the coating must satisfy the specified dimensions.
- Recommended panel thickness: 0.5 to 3.2 mm.

A165E-M-03U

One-piece construction models
40 mm diameter

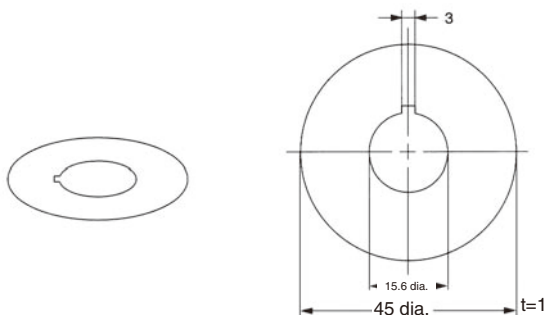


- When applying a coating such as paint to the panel, dimensions after the coating must satisfy the specified dimensions.
- Recommended panel thickness: 0.5 to 3.2 mm.

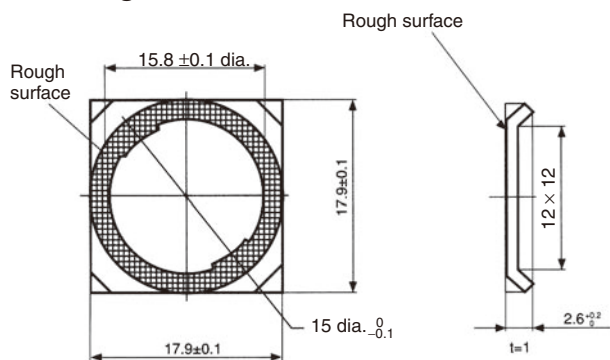
Accessories

Yellow Plate (Vinyl Chloride)

A16Z-5070



Lock Ring



Panel Plugs (Round Type)

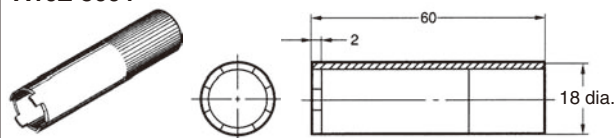
A16ZT-3003



- Select an appropriate Panel Plug according to the panel design and mount from the front side of the panel. Panel cutout dimensions are the same as those for the Switch.

Tightening Tool

A16Z-3004



Terminal Arrangement

SPST Switches	DPST Switches	TPST Switches
SW1	SW1 SW2	NC1 NC2 NC3 Stopper

Note: The L+ and L- terminals are not available with the non-lighted models.

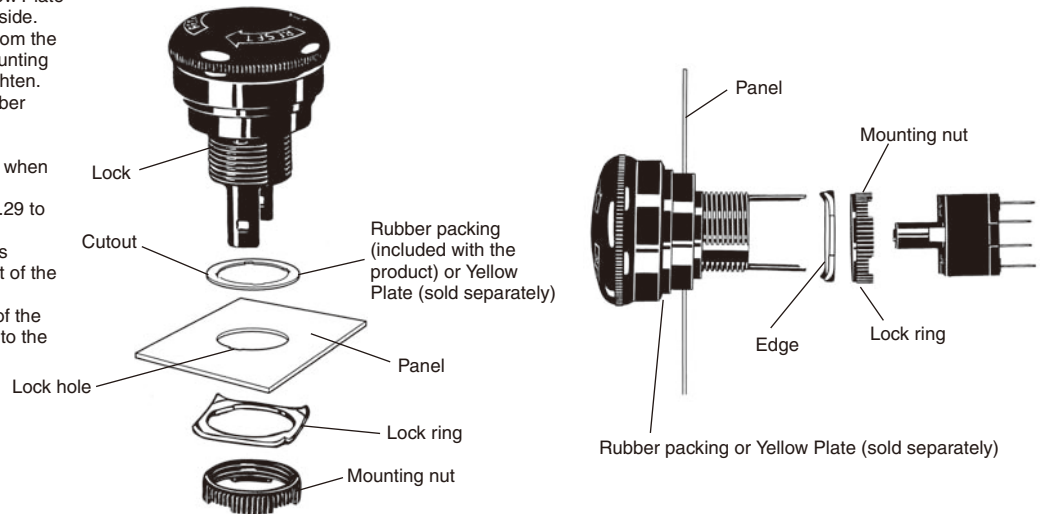
Installation

Mounting to the Panel (Models with Separate Construction)

After installing the Operation Unit, snap in the Switch from the back of the panel.

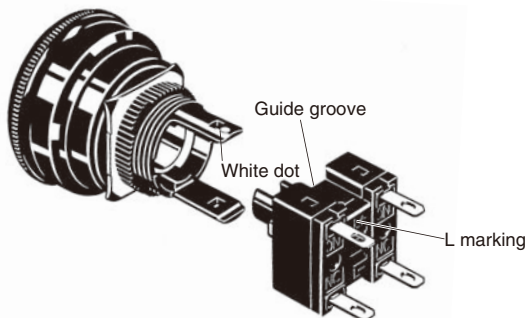
(1) Installing the Operation Unit

- Attach rubber packing or the Yellow Plate onto the Switch from its terminal side. Insert the Switch into the panel from the front. Install the lock ring and mounting nut from the terminal side and tighten.
- Adjust the slits on the hole of rubber packing and Yellow Plate to the protruding part of the Unit.
- Rubber packing is not necessary when the Yellow Plate is used.
- Tighten the nut to the torque of 0.29 to 0.49 N·m.
- Casing should be installed with its protruding part adjusted to the slit of the panel hole.
- Align the lock ring to the groove of the casing so that the edge is drawn to the panel side.



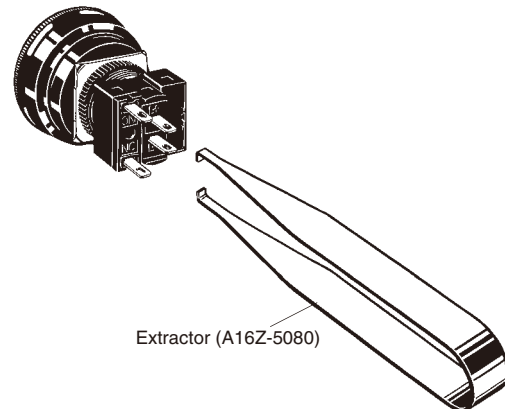
(2) Mounting the Switch

- Snap on the Switch to the Operation Unit.
- Make sure that the Switch has the correct orientation when snapping it onto the Operation Unit.
- Align the white dot on the Operation Unit with the guide groove on the side of the Switch marked with an "L" as shown below, and push the Switch into the Operation Unit until it clicks into place. Confirm that the Switch is securely in place before using.



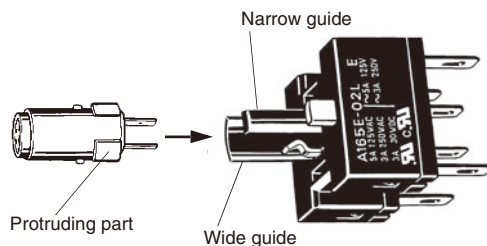
(3) Removing the Switch

- Insert the prongs of the A16Z-5080 Extractor between the Switch and the Operation Unit, grip the Switch, and pull to remove.



(4) Installing the LED Lamp

- When mounting the Lamp, make sure it is facing the direction shown in the following diagram. Insert the Lamp while matching the protruding part of the Lamp and the small guides on the outer surface of the casing.



Safety Precautions

Be sure to read the precautions for all pushbutton switches in the *Pushbutton Switches Group Catalog* (Cat. No. X032).

CAUTION

If the Operation Unit is separated from the Socket Unit, the equipment will not stop, creating a hazardous condition. Always confirm that safety functions are operating before starting operation.



Precautions for Correct Use

Mounting

- Always make sure that the power is turned OFF before mounting, removing, or wiring the Switch, or performing maintenance. Electrical shock or fire may result if the power is not turned OFF.
- The tightening torque is 0.29 to 0.49 N·m.

Wiring

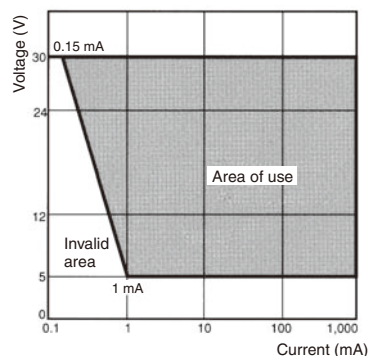
- Be sure to use electrical wires that are a size appropriate for the applied voltage and carry current. Perform soldering according to the conditions given below. If the soldering is not properly performed, abnormal heating may result, possibly resulting in fire.
 - Hand soldering: 30 W, within 5 s
 - Dip soldering: 240°C, within 3 s
 Wait for one minute after soldering before exerting any external force on the solder.
- Use non-corrosive resin fluid as the flux.
- Make sure that the electric cord is wired so that it does not touch the Unit. If the electric cord will touch the Unit, then electric wires with a heat resistance of 100°C min. must be used.
- After wiring the Switch, maintain an appropriate clearance and creepage distance.

Operating Environment

- The IP65 model is designed with a degree of protection so that it will not sustain damage if it is subjected to water from any direction to the front of the panel.
- The Switch is intended for indoor use only. Using the Switch outdoor may cause it to fail.

Using the Microload

- Insert a contact protection circuit, if necessary, to prevent the reduction of life expectancy due to extreme wear on the contacts caused by loads where inrush current occurs when the contact is opened and closed.
- The A165E-□U (one-piece construction) allows both a standard load (125 V at 1 A, 250 V at 0.5 A) and a microload. If a standard load is applied, however, the microload area cannot be used. If the microload area is used with a standard load, the contact surface will become rough, and the opening and closing of the contact for a microload may become unreliable.
- The minimum applicable load is the N-level reference value. This value indicates the malfunction reference level for the reliability level of 60% (λ_{60}) (conforming to JIS C5003). The equation, $\lambda_{60} = 0.5 \times 10^{-6}/\text{time}$ indicates that the estimated malfunction rate is less than 1/2,000,000 with a reliability level of 60%.



LEDs

- The LED current-limiting resistor is built-in, so external resistance is not required.

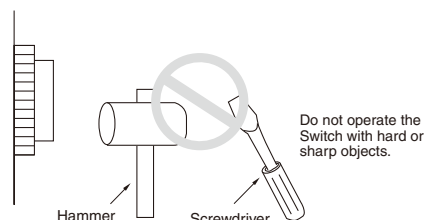
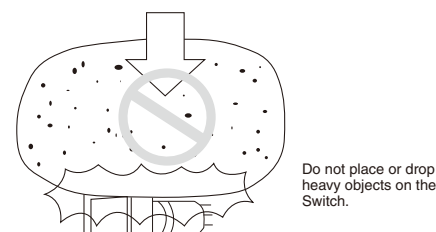
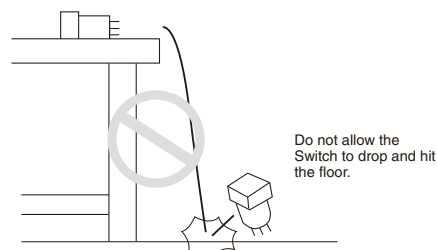
Rated voltage	Internal limiting resistor
24 VDC	2000 Ω

Operating Torque

- Do not exceed an operating torque of 0.49 N·m in the direction of rotation.
- Do not pull the operating button or apply excessive force to any side of the button. Otherwise it may be damaged.

Others

- The oil-resistant IP65 uses NBR rubber and is resistant to general cutting oil and cooling oil. Some special oils cannot be used with the oil-resistant IP65, however, so contact your OMRON representative for details.
- If the panel is to be coated, make sure that the panel meets the specified dimensions after coating.
- Due to the structure of the Switch, severe shock or vibration may cause malfunctions or damage to the Switch. Also, most Switches are made from resin and will be damaged if they come into contact with sharp objects. Particularly scratches on the Operation Unit may create visual and operational obtrusions. Handle the Switches with care, and do not throw or drop them.



Safety Precautions for All Pushbutton Switches

For the individual precautions for a Switch, refer to the *Safety Precautions* in the section for that Switch.

WARNING

Do not perform wiring with power supplied to the Switch. Do not touch the terminals or other charged parts of the Switch while power is being supplied. Doing so may result in electric shock.



Caution

Do not apply a voltage between the incandescent lamp and the terminal that is greater than the rated voltage. Doing so may damage the lamp or LED and cause the Operation Unit to pop out.



Always turn OFF the power and wait for 10 minutes before replacing the incandescent lamp. If the lamp is replaced immediately after the power is turned OFF, the remaining heat may cause burns.



Precautions for Correct Use

For details, refer to the *Precautions for Correct Use* in the *Technical Guide for Pushbutton Switches*.

Technical Guide for Pushbutton Switches

Precautions for Correct Use of Pushbutton Switches

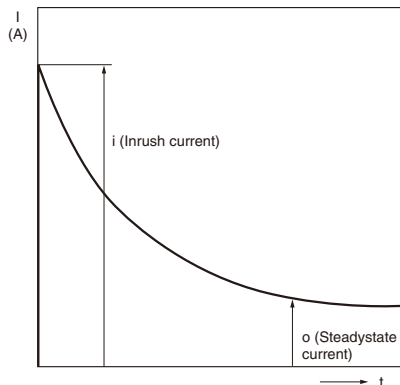
●For the individual precautions for a Switch, refer to the precautions in the section for that Switch.

Electrical Characteristics

1. Operating Load

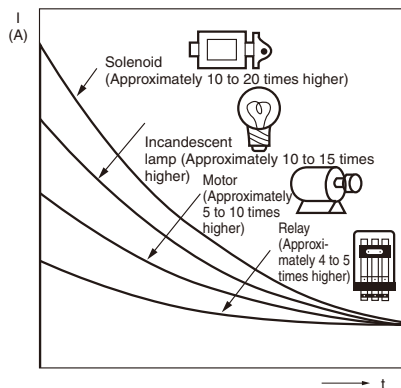
- The switching load capacity of the Switch greatly varies between AC and DC. Always be sure to apply the rated load. The control capacity will drastically drop if it is a DC load. This is because a DC load has no current zero-cross point, unlike an AC load. Therefore, if an arc is generated, it may continue for a comparatively long time. Furthermore, the current direction is always the same, which results in a contact relocation phenomena whereby the contacts easily stick to each other and do not separate when the surfaces of the contacts are uneven.
- Some types of load have a great difference between normal current and inrush current. Make sure that the inrush current is within the permissible value. The greater the inrush current in the closed circuit is, the greater the contact abrasion or shift will be. Consequently, contact weld, contact separation failures, or insulation failures may result. Furthermore, the Switch may be broken or damaged.
- If the load is inductive, counter-electromotive voltage will be generated. The higher the voltage is, the higher the generated energy will be, which will increase the abrasion of the contacts and contact relocation phenomena. Be sure to use the Switch within the rated conditions.

Inrush Current



- Approximate control capacities are given in ratings tables, but these alone are insufficient to guarantee correct operation. For special types of load, with unusual switching voltage or current waveforms, test whether correct operation is possible with the actual load before application.
- When switching for microloads (voltage or current), use a Switch with microload specifications. The reliability of silver-plated contacts, which are used in Switches for standard loads, will be insufficient for microloads.
- When switching microloads or very high loads that are beyond the switching capacity of the Switch, connect a relay suitable for the load.

Type of Load vs. Inrush Current



All the performance ratings given are for operation under the following conditions unless otherwise specified.

Inductive load: A minimum power factor of 0.4 (AC) and a maximum time constant of 7 ms (DC)

Lamp load: An inrush current 10 times higher than the steady-state current

Motor load: An inrush current 6 times higher than the steady-state current

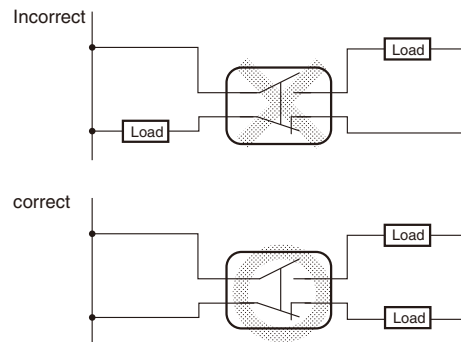
Note: Inductive loads can cause problems especially in DC circuitry. Therefore, it is essential to know the time constants (L/R) of the load.

2. Load Connections

Do not connect a single Switch to two power supplies that are different in polarity or type.

Connection of Different Polarities

The power supply may short-circuit if the loads are connected in the way shown in the "incorrect" example below.

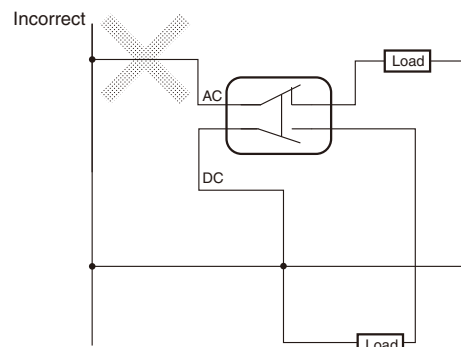


Connect the load to the same polarity.

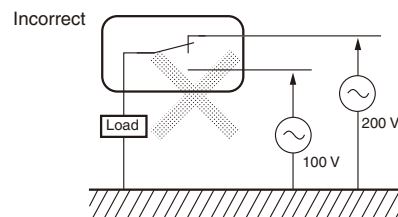
Even in the "correct" example, note that the insulation performance of the switch may deteriorate and the switch life may be shortened because loads are connected to both contacts.

Connection of Different Power Supplies

The DC and AC power may be mixed for the circuit shown below.



Do not design a circuit where voltage is imposed between contacts, otherwise contact weld may result.



Technical Guide for Pushbutton Switches

3. Contact Protective Circuit

Apply a contact protective circuit to extend the contact life, prevent noise, and suppress the generation of carbide or nitric acid. Be sure to apply the contact protective circuit correctly, otherwise an adverse effect may occur. The following provides typical examples of contact protective circuits. If the Limit Switch is used in an excessively humid

location for switching a load that easily generates arcs, such as an inductive load, the arcs may generate NO_x, which will change into HNO₃ if it reacts with moisture. Consequently, the internal metal parts may corrode and the Limit Switch may fail. Be sure to select the ideal contact preventive circuit from the following.

Typical Examples of Contact Protective Circuits

Circuit example		Applicable current		Feature and details	Element selection
		AC	DC		
CR circuit		*	Yes	*When AC is switched, the load impedance must be lower than the CR impedance.	C: 1 to 0.5 μF × switching current (A) R: 0.5 to 1 Ω × switching voltage (V) The values may change according to the characteristics of the load. The capacitor suppresses the spark discharge of current when the contacts are open. The resistor limits the inrush current when the contacts are closed again. Consider the roles of the capacitor and resistor and determine ideal capacitance and resistance values through testing. Basically, use a capacitor with a dielectric strength between 200 and 300 V. When AC is switched, make sure that the capacitor has no polarity.
		Yes	Yes	The operating time will be greater if the load is a relay or solenoid. Connecting the CR circuit in parallel to the load is effective when the power supply voltage is 24 or 48 V and in parallel to the contacts when the power supply voltage is 100 to 200 V.	
Diode method		No	Yes	Energy stored in the coil is changed into current by the diode connected in parallel to the load. Then the current flowing to the coil is consumed and Joule heat is generated by the resistance of the inductive load. The reset time delay with this method is longer than that in the CR method.	The diode must withstand a peak inverse voltage 10 times higher than the circuit voltage and a forward current as high or higher than the load current.
Diode and Zener diode method		No	Yes	This method will be effective if the reset time delay caused by the diode method is too long.	Use a Zener diode with a Zener voltage that is approximately 1.2 × power supply voltage as, depending on the environment, the load may not operate.
Varistor method		Yes	Yes	This method makes use of constant-voltage characteristic of the varistor so that no high-voltage is imposed on the contacts. This method causes a reset time delay. Connecting a varistor in parallel to the load is effective when the supply voltage is 24 to 48 V and in parallel to the contacts when the supply voltage is 100 to 200 V.	---

Do not apply contact protective circuits as shown below.

	This circuit effectively suppresses arcs when the contacts are OFF. The capacitor will be charged, however, when the contacts are OFF. Consequently, when the contacts are ON again, short-circuited current from the capacitance may cause contact weld.		This circuit effectively suppresses arcs when the contacts are OFF. When the contacts are ON again, however, charge current will flow to the capacitor, which may result in contact weld.	Switching a DC inductive load is usually more difficult than switching a resistive load. By using an appropriate contact protective circuit, however, switching a DC inductive load will be as easy as switching a resistive load.
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4. Switching

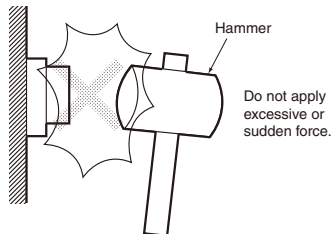
- Do not use the Switch for loads that exceed the rated switching capacity or other contact ratings. Doing so may result in contact weld, contact separation failures, or insulation failures. Furthermore, the Switch may be broken or damaged.
- Do not touch the charged switch terminals while power is supplied, otherwise an electric shock may be received.
- The life of the Switch varies greatly with switching conditions. Before using the Switch, be sure to test the Switch under actual conditions. Make sure that the number of switching operations is within the permissible range. If a deteriorated Switch is used continuously, insulation failures, contact weld, contact failures, switch damage, or switch burnout may result.

- Do not apply excessive or incorrect voltages to the Switch or incorrectly wire the terminals. Otherwise, the Switch may not function properly and have an adverse effect on external circuitry. Furthermore, the Switch itself may become damaged or burnt.
- Do not use the Switch in locations where flammable or explosive gases are present. Otherwise switching arcs or heat radiation may cause a fire or explosion.
- Do not drop or disassemble the Switch, otherwise it may not be capable of full performance. Furthermore, it may be broken or burnt.

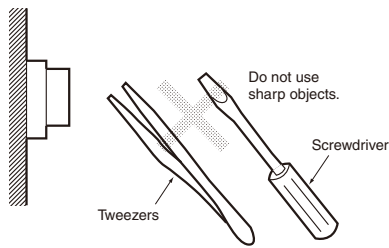
Mechanical Conditions

Operating Force and Operating Method

- Fingertip operation is an important feature of Pushbutton Switches. In terms of Switch operation, Pushbutton Switches differ greatly from detection switches such as Microswitches. Operating the Switch using a hard object (e.g., metal), or with a large or sudden force, may deform or damage the Switch, resulting in faulty or rough operation, or shortening of the Switch life. The strength varies with the size and construction of the Switch. Use the appropriate Switch for the application after confirming the operating method and operating force with this catalog.



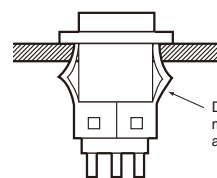
- The pushbutton surface is composed of resin. Therefore, do not attempt to operate the pushbutton using a sharp object, such as a screwdriver or a pair of tweezers. Doing so may damage or deform the pushbutton surface and result in faulty operation.



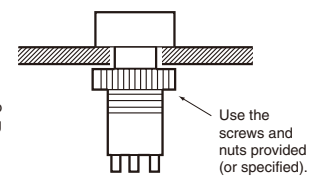
Mounting

- Switches can be broadly divided into two categories according to mounting method: panel-mounting models and PCB-mounting models. Use the appropriate model for the mounting method required. Basically, panel-mounting Switches can withstand a greater operating force than PCB-mounting Switches. If, however, the panel thickness or the panel-cutout dimensions are not suitable for the Switch, it may not be able to withstand the normal operating force. With continuous mounting in particular, select a panel of a thickness that is easily sufficient to withstand the total operating force.
- Panel-mounting Switches can be divided into two categories according to the mounting method: snap-in mounting models and screw-mounting models. Snap-in mounting Switches are held in place with the elasticity of resin or a metal leaf spring. Do not attempt to modify the spring after mounting. Doing so may result in faulty operation or damage the mounting structure. Mount screw-mounting models using the screws and nuts provided (or individually specified). Tighten the screws to the specified torque. Mounting with different screws or nuts, or tightening beyond the specified torque may result in distortion of the inside of the case or damage to the screw section.

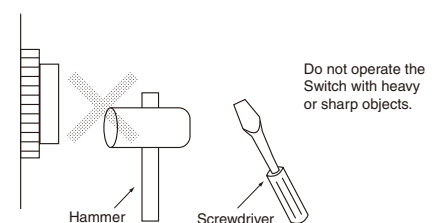
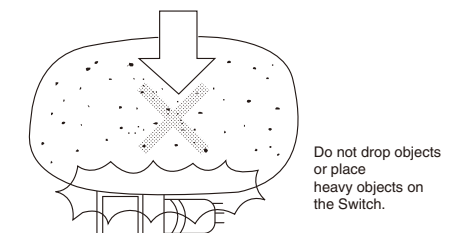
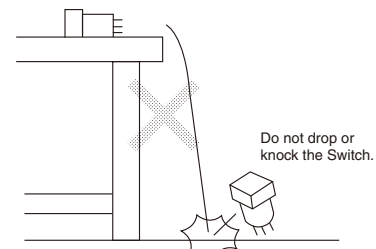
Snap-in Mounting



Screw Mounting



- Subjecting the Switch to severe vibrations or shock may result in faulty operation or damage. Also, many of the Switches are composed of resin so contact with sharp objects may result in damage to the surface. This kind of damage may spoil the appearance of the Switch or result in faulty operation. Do not throw or drop the Switch.

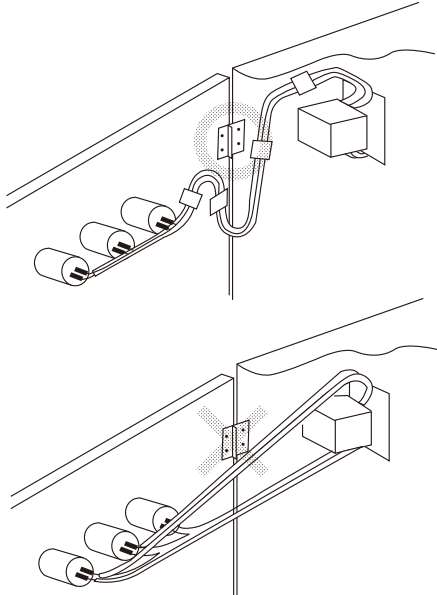


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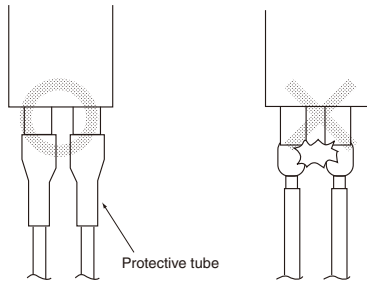
Mounting Precautions

Wiring

- Perform wiring so that the lead wires will not be caught on other objects as this will cause stress on the Switch terminals. Wire the Switch so that there is slack in the lead wires and fix lead wires at intermediate points. If the panel to which the Switch is mounted needs to be opened and closed for maintenance purposes, perform wiring so that the opening and closing of the panel will not interfere with the wiring.



- With miniature Switches, the gap between the terminals is very narrow. Use protective or heat-absorbing tubes to prevent burning of the wire sheath or shorting.



Soldering

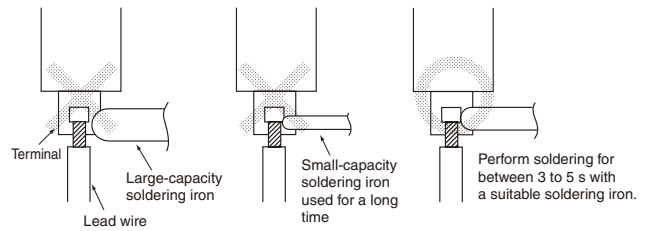
- There are two methods for soldering the Switch: hand soldering and automatic soldering. In addition, automatic soldering itself can be divided into two types : dip soldering and reflow soldering. Use the soldering method appropriate for the mounting method.

Typical Soldering Example

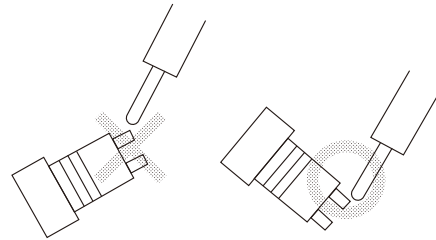
Method		Soldering device	Application
Hand soldering		Soldering iron	Small quantities Different materials Lead wire terminals
Automatic soldering	Dip soldering	Jet soldering bath Dip soldering bath	Large quantities of discrete terminals
	Reflow soldering	Infrared reflow (IR) soldering bath Vapor-phase (VPS) reflow soldering bath	Large quantities of miniature SMD terminals

- Do not use soldering flux that contains chlorine. Doing so may result in metal corrosion.

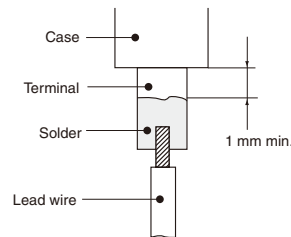
- Perform hand soldering using the appropriate soldering iron.



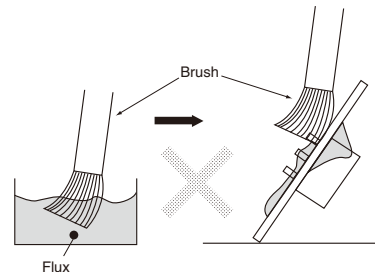
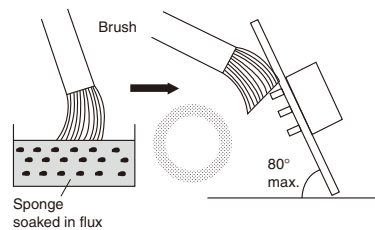
- With the exception of PCB-mounting Switches, when performing hand soldering, hold the Switch so that the terminals point downwards so that flux does not get inside the Switch.



- Leave a gap of at least 1 mm between the soldered parts and the surface of the case so that flux does not get inside the Switch.

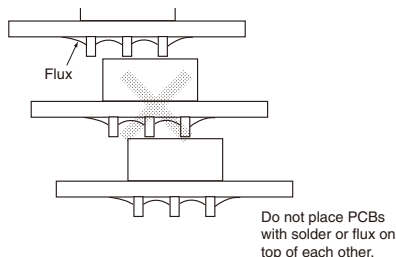


- When applying flux using a brush, use a sponge soaked in flux as shown below. Do not apply more than is necessary. Also, apply the flux with the PCB inclined at an angle of less than 80° so that flux does not flow onto the mounting surface of the Switch.

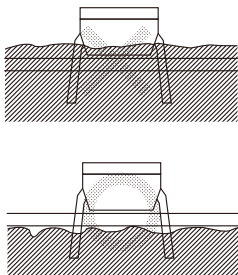


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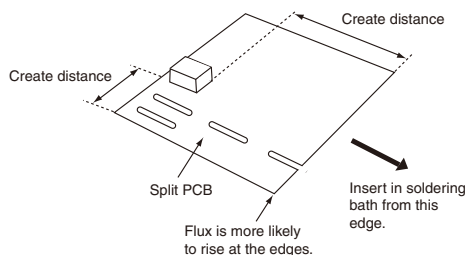
- Do not place PCBs that have had flux applied or have been soldered on top of each other. Otherwise, the flux on the PCBs solder surface may stain the upper part of the Switch or even permeate the inside of the Switch and cause contact failure. Be sure to insert a special PCB stocker.



- When performing soldering with a dip soldering bath, ensure that the flux does not reach a higher level than the PCB.

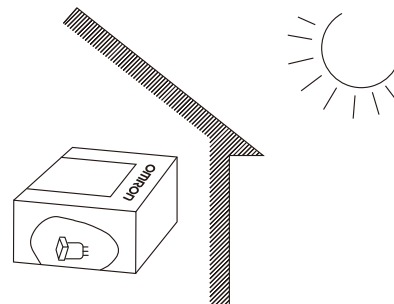


- Flux is especially likely to rise up at the edges of the PCB. If the Switch is mounted near the edge of the PCB, create a gap between the edge by using a split PCB, and insert the PCB in the soldering bath so that the edge that is farthest from the Switch enters the bath first.



Storage

- When the Switch is left unused or stored for long periods, the ambient conditions can have a great effect on the condition of the Switch. In certain environments, leaving the Switch exposed may result in deterioration (i.e., oxidation, or the creation of an oxide film) of the contacts and terminals, causing the contact resistance to increase, and making it difficult to solder the lead wires. Therefore, store in a well-ventilated room, inside, for example, a non-hygroscopic case, in a location where no corrosive gases are present.



- If the Switch is stored in a location where it will be exposed to direct light, colored resin in the colored plate may fade. Therefore, do not store the Switch in locations where it will be exposed to direct light.



WARNING

This catalog is a guide to help customers select the proper safety products. Observe the following items when choosing products, select the right products for your devices or equipment, and develop a safety-related system to fully utilize product functions.

Setting Up a Risk Assessment System

The items listed in this catalog must be used properly in terms of product location as well as product performance and functionality. Part of the process of selecting and using these products should include the introduction and development of a risk assessment system early in the design development stage to help identify potential dangers in your equipment that will optimize safety product selection. A badly designed risk assessment system often results in poor choices when it comes to safety products.

- Related International Standards:
ISO 14121 Principles of Risk Assessment

Safety Policy

When developing a safety system for the devices and equipment that use safety products, make every effort to understand and conform to the entire series of international and industrial standards available, such as the examples given below.

- Related International Standards:
ISO 12100 Basic Concepts, General Principles for Design
IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Role of Safety Products

Safety products have functions and mechanisms that ensure safety as defined by standards. These functions and mechanisms are designed to attain their full potential within safety-related systems. Make sure you fully understand all functions and mechanisms, and use that understanding to develop systems that will ensure optimal usage.

- Related International Standards:
ISO 14119 Interlocking Devices Associated with Guards-Principles for Design and Selection

Installing Safety Products

Make sure that properly educated and trained engineers are selected to develop your safety-related system and to install safety products in devices and equipment.

- Related International Standards:
ISO 12100 Basic Concepts, General Principles for Design
IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Observing Laws and Regulations

Safety products should conform to pertinent laws, regulations, and standards, but make sure that they are used in accordance with the laws, regulations, and standards of the country where the devices and equipment incorporating these products are distributed.

- Related International Standards:
IEC 60204 Electrical Equipment of Machines

Observing Usage Precautions

Carefully read the specifications and precautions listed in this catalog for your product as well as all items in the Operating Manual packed with the product to learn usage procedures that will optimize your choice. Any deviation from precautions will lead to unexpected device or equipment failure not anticipated by safety-related systems or fire originating from equipment failure.

Transferring Devices and Equipment

When transferring devices and equipment, be sure to keep one copy of the Operating Manual and pack another copy with the device or equipment so the person receiving it will have no problem operating it.

- Related International Standards:
ISO 12100 Basic Concepts, General Principles for Design
IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

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- Systems, machines, and equipment that could present a risk to life or property.

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