Common Precautions for safety switch

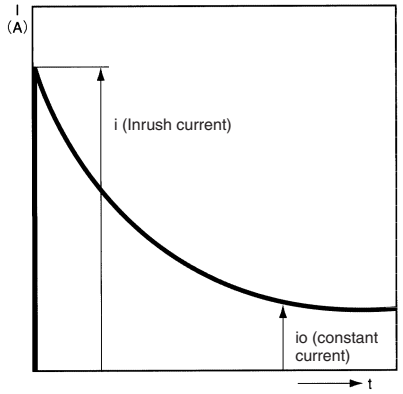
For the individual precautions for each Switch, refer to the precautions for the Switch.

Cautions

- Do not touch the charged switch terminals while the Limit Switch has carry current, otherwise an electric shock may be received.
- Do not assemble the Limit Switch or touch the interior of the Limit Switch while power is connected to the Limit Switch, otherwise an electric shock may be received.

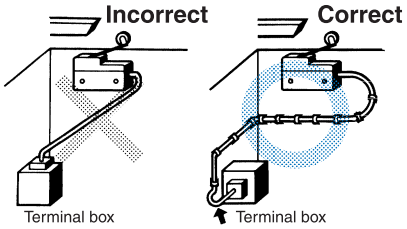
Correct Use

- If the Limit Switch incorporates a ground terminal, be sure to ground it through an appropriate wire, otherwise an electric shock may be received.
- Be sure to connect a fuse with a breaking current 1.5 to 2 times the rated current to the Limit Switch in parallel in order to protect the Limit Switch from damage due to short–circuiting.
- Maintain an appropriate insulation distance between wires connected to the Limit Switch.
- If the Limit Switch has no ground terminal, ground the mounting panel to which the Limit Switch is mounted unless the Limit Switch is of double insulation construction falling under class II. Such models (e.g., the D4D–N, D4D–R or D4DS) ensure good insulation characteristics. Therefore, no ground terminals are incorporated.
- Do not use the Limit Switch in places with flammable or explosive gas without taking any countermeasures taken against explosion or fires. Otherwise switching arcs or heat radiation may cause a fire or explosion.
  Be sure to protect the Limit Switch with appropriate explosion–proof barriers or use a Limit Switch of explosion–proof construction. The Explosion–proof Limit Switch is not available for use in all types of gas or locations. Refer to the *Explosion–proof Device General Catalog* for details.
- The life of the Limit Switch greatly varies with switching conditions. Before using the Limit Switch, be sure to test the Limit 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.
- 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 Limit Switch may become broken or damaged.



Wiring

- If the wiring method is incorrect, the wires may get caught by some object or the lead wires may be pulled excessively. Make sure that the lead wires are connected without extraordinary force and that the wires are supported securely.



- Pay the utmost attention so that each terminal is wired correctly. If the terminal is wired incorrectly, the Limit Switch will not function. Furthermore, not only will the Limit Switch have a bad influence on the external circuit, the Limit Switch itself may become damaged or burnt.

Mounting

- Do not modify the actuator, otherwise the operating characteristics and performance of the actuator will change.
- Do not enlarge the mounting holes of the Limit Switch or modify the Limit Switch, otherwise insulation failures or housing damage may result. If the Limit Switch has a force separation mechanism, a modification of the Limit Switch may cause injury.
- Do not apply oil, grease, or other lubricants to the moving parts of the actuator, otherwise the actuator may not operate correctly. Furthermore, intrusion of oil, grease, or other lubricants inside the Limit Switch may cause failures in the Limit Switch.
- Mount the Limit Switch and secure it with the specified screws tightened to the specified torque along with flat washers and springs. The actuator of the Limit Switch mounted to a panel with excessive tightening torque may not operate correctly if the Limit Switch is a pushbutton model.

- Be sure to wire the Limit Switch so that the conduit opening is free of metal powder or any other impurities.
- If glue or bonding agent is applied, make sure that it does not adhere to the movable parts or intrude inside the Limit Switch, otherwise the Limit Switch may not work correctly or cause contact failure. Some types of glue or bonding agent may generate a gas that may have a bad influence on the Limit Switch. Pay the utmost attention when selecting the glue or locking agent.
- Do not drop or disassemble the Limit Switch, otherwise the Limit Switch will not be capable of full performance. Furthermore, the Limit Switch may become broken or burnt.
- If the contacts are not turned ON or OFF over a long time, the contacts may become oxidized. Consequently, the reliability of the contacts may decrease, which may result in accidents.
- Actuation of the Limit Switch over a long time may deteriorate parts of the Limit Switch and a releasing failure may result. Be sure to check the condition of the Limit Switch regularly.
- Some models allow changes in head directions. When changing the head of such a model, make sure that the head is free of any foreign substance. Tighten each screw of the head to the rated torque.
- Be sure to take measures so that no foreign material, oil, or water will penetrate into the Limit Switch through the conduit opening. Be sure to attach a connector suited to the cable thickness and tighten the connector securely to the rated torque.
- Apply Limit Switch models incorporating a force–separation function, such as the D4BS or D4BL, for safety doors or emergency stop circuits.
- Do not impose shock or vibration on the actuator while it is fully pressed. Otherwise, the actuator will partially abrade and an actuation failure may result.

Limit Switch Operation

- The Limit Switch in actual operation may cause accidents that cannot be foreseen from the design stage. Therefore, the Limit Switch must be practically tested before actual use.
- When testing the Limit Switch, be sure to apply the actual load condition together with the actual operating environment.
- All the performance ratings in this catalog are provided under the following conditions unless otherwise specified.

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

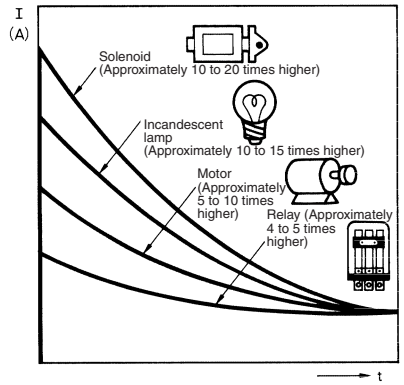
  Lamp load: An inrush current 10 times higher than the normal current

  Motor load: An inrush current 8 times higher than the normal current

  The rated values are obtained from tests conducted in accordance with JIS C4508.

1. Ambient temperature: +5°C to 35°C
2. Ambient humidity: 40% to 70%.

Note: An inductive load causes a problem especially in DC circuitry. Therefore, it is essential to know the time constants (L/R) of the load.

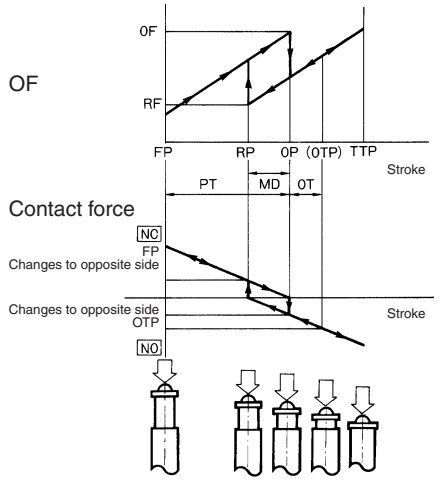


Mechanical Characteristics

Operating Force, Stroke, and Contact Characteristics

- The following graph indicates the relationship between operating force and stroke or stroke and contact force. In order to operate the Limit Switch with high reliability, it is necessary to use the Limit Switch within an appropriate contact force range. If the Limit Switch is used in the normally closed condition, the dog must be installed so that the actuator will return to the FP when the actuator is actuated by the object. If the Limit Switch is used in the normally open condition, the actuator must be pressed to 70% to 100% of the OT (i.e., 60% to 80% of the TT) and any slight fluctuation must be absorbed by the actuator.
- If the full stroke is set close to the OP or RP, contact instability may result. If the full stroke is set to the TTP, the actuator or switch may become damaged due to the inertia of the dog. In that case, adjust the stroke with the mounting panel or the dog. Refer to page G-314, *Dog Design*, page G-315, *Stroke Settings vs. Dog Movement Distance*, and page G-315, *Dog Surface* for details.
- The following graph shows an example of changes in contact force according to the stroke. The contact force near the OP or RP is unstable, and the Limit Switch cannot main-

tain high reliability. Furthermore, the Limit Switch cannot withstand strong vibration or shock.



Mechanical Conditions

- The actuator must be selected according to the operating method.
- Check the operating speed and switching frequency.
  1. If the operating speed is extremely low, the switching of the movable contact will become unstable, thus resulting in incorrect contact or contact weld.
     If the operating speed is extremely low or the pushbutton needs to be set between the FP and OP, consult your OMRON representative in advance.
  2. If the operating speed is extremely high, the Limit Switch may break due to shock. If the switching frequency is high, the switching of the contacts cannot catch up with the switching frequency. Make sure that the switching frequency is within the rated switching frequency. If a higher switching frequency is required, use of a proximity sensor is recommended.
- Do not impose excessive force on the actuator, otherwise the actuator may become damaged or not operate correctly.
- Make sure that the stroke is set within the suitable range specified for the model, or otherwise the Limit Switch may break.
- Make sure that the operating direction of the actuator is parallel to the axis of the actuator if the actuator is a pushbutton type. If they are not in parallel, partial abrasion may result and the actuator may soon become damaged. Refer to page G-313, *Operation* for details.

Electrical Characteristics

Electrical Conditions

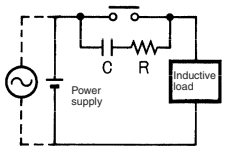
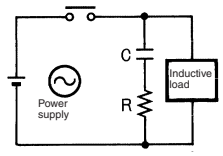
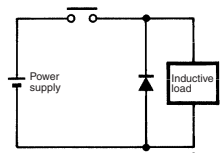
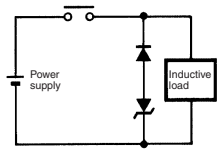
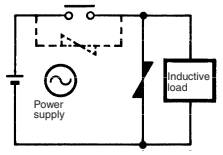
- The switching load capacity of the Limit Switch greatly varies between AC and DC. Always be sure to apply the rated load. The control capacity will drastically drop if it is a DC load. This is because a DC load has no current zero–cross point, unlike an AC load. Therefore, if an arc is generated, it may continue comparatively for a 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.
- 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 Limit Switch within the rated conditions.
- If the load is a minute voltage or current load, use a dedicated Limit Switch for minute loads. The reliability of silver–plated contacts, which are used by standard Limit Switches, will be insufficient if the load is a minute voltage or current load.

Contact Protective Circuit

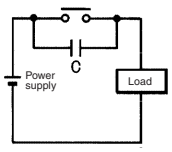
Apply a contact protective circuit to extend the contact life, prevent noise, and suppress the generation of carbide or nitric acid. Be sure to apply the contact protective circuit correctly, otherwise an adverse effect may occur.

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 NOx, which will change into HNO_3 if it reacts with moisture. Consequently, the internal metal parts may corrode and the the Limit Switch may fail. Be sure to select the ideal contact preventive circuit from the following.

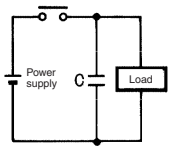
Typical Examples of Contact Protective Circuits

Circuit example		Applicable current		Feature	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 ∝F x switching current (A) R: 0.5 to 1 Ω x 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. Use a capacitor that has a low dielectric strength. 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 at a low Zener voltage.
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.



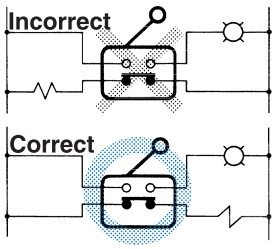
This circuit effectively suppresses arcs when the contacts are OFF. The capacitor will be changed, however, when the contacts are OFF. Consequently, when the contacts are ON again, short-circuited current from the capacitance may cause contact weld.



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.

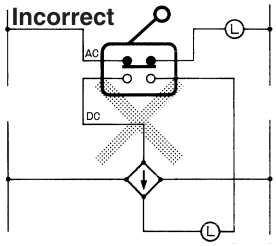
Switching a DC inductive load is usually more difficult than switching a resistive load. By using an appropriate contact protective circuit, however, switching a DC inductive load will be as easy as switching a resistive load.

- Do not contact a single Limit Switch to two power supplies that are different in polarity or type.
  Power Connection Examples
  (Connection of Different Polarities)

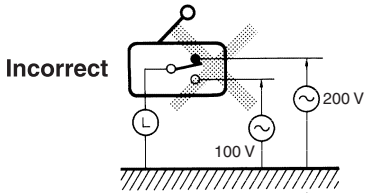


Incorrect Power Connection Example

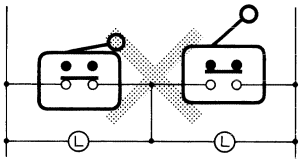
(Connection of Different Power Supplies)
There is a risk of AC and DC mixing.



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



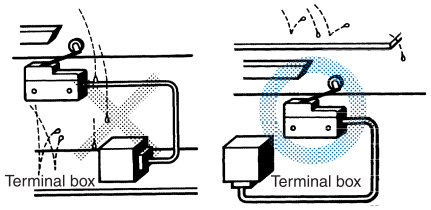
- Do not use a circuit that will short–circuit if an error occurs, otherwise the charged part may melt and break off.



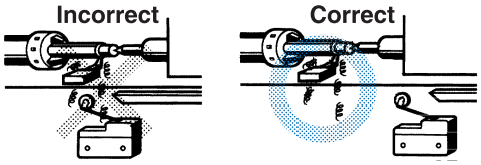
- Application of Limit Switch to a Low–voltage, Low–current Electronic Circuit.
  1. If bouncing or chattering of the contacts results and causes problems, take the following countermeasures.
     (a) Insert an integral circuit.
     (b) Suppress the generation of pulse from the contact bouncing or chattering of the contacts so that it is less than the noise margin of the load.
  3. Conventional silver–plated contacts are not suited to this application. Use gold–plated contacts, which are ideal for handling minute voltage or current loads.
  4. The contacts of the Limit Switch used for an emergency stop must be normally open.
- In order to protect the Limit Switch from damage due to circuit short–circuiting, be sure to connect a quick–response fuse with a breaking current 1.5 to 2 times larger than the rated current to the Limit Switch in parallel. Some models (e.g., the D4B–N and D4BS) specify the types of fuses. In that case, be sure to use the specified fuses.

Operating Environment

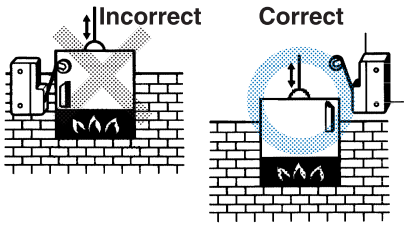
- If the Limit Switch used in locations with oil or water spray or excessive dust is not a water–resistive model or of sealed construction, be sure to protect the Limit Switch with a protective cover so that the Limit Switch will not be directly exposed to them.



- The materials of Limit Switch may change in quality or deteriorate, if the Limit Switch is used outdoors or any other location where the Limit Switch is exposed to special machining oil. Consult your OMRON representative before selecting the model.
- Be sure to install the Limit Switch so that the Limit Switch is free from dust or metal powder. The actuator and the switch casing must be protected from the accumulation of dust or metal powder.

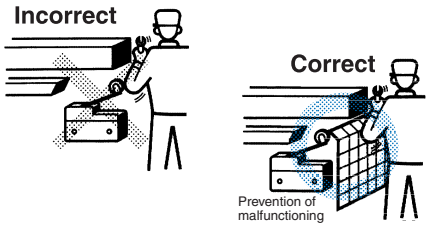


- Do not use the Limit Switch in locations where the Limit Switch is exposed to hot water at a temperature greater than 60°C or steam.
- Do not use the Limit Switch under temperatures or other environmental conditions not within the specified ranges. The rated permissible ambient temperature range varies with the model. Refer to the specifications in this catalog. If the Limit Switch is exposed to radical temperature changes, the thermal shock may deform the Limit Switch and the Limit Switch may malfunction.



- Be sure to protect the Limit Switch with a cover if the Limit Switch is in a location where the Limit Switch may be actu-

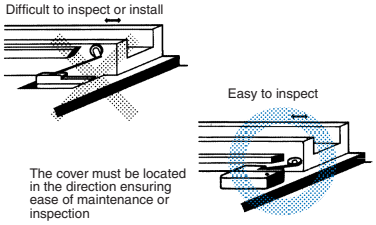
ated by mistake or where the Limit Switch is likely cause an accident.



- Make sure to install the Limit Switch in locations free of vibration, shock, or resonance. If vibration or shock is continuously imposed on the Limit Switch, contact failure, malfunction, or decrease in service life may be caused by abrasive powder generated from the internal parts. If excessive vibration or shock is imposed on the Limit Switch, the contacts may malfunction or become damaged.
- Do not use the Limit Switch with silver–plated contacts for long periods if the switching frequency of the Limit Switch is comparatively low or the load is minute. Otherwise, sulfuric film will be generated on the contacts and contact failures may result. Use the Limit Switch with gold–plated contacts or use a dedicated Limit Switch for minute loads instead.
- Do not use the Limit Switch in locations with corrosive gas, such as sulfuric gas (H_2S or SO_2), ammonium gas (NH_3), nitric gas (HNO_3), or chlorine gas (Cl_2), or high temperature and humidity. Otherwise, contact failure or corrosion damage may result.
- If the Limit Switch is used in locations with silicone gas, arc energy may create silicon dioxide (SiO2) on the contacts and a contact failure may result. If there is silicone oil, silicone sealant, or wire covered with silicone close to the Limit Switch, attach a contact protective circuit to suppress the arcing of the Limit Switch or eliminate the source of silicone gas generation.

Regular Inspection and Replacement

- If the Limit Switch is normally closed with low switching frequency (e.g., once or less than once a day), a reset failure may result due to the deterioration of the parts of the Limit Switch. Regularly inspect the Limit Switch and make sure that the Limit Switch is in good working order.
- In addition to the mechanical life or electrical life of the Limit Switch described previously, the life of the Limit Switch may decrease due to the deterioration of each part, especially rubber, resin, and metal. Regularly inspect the Limit Switch and replace any part that has deteriorated in order to prevent accidents from occurring.
- Be sure to mount the Limit Switch securely in a clean location to ensure ease of inspection and replacement. The Limit Switch with operation indicator is available, which is ideal if the location is dark or does not allow easy inspection or replacement.



Storage of Limit Switch

- When storing the Limit Switch, make sure that the location is free of corrosive gas, such as H_2S, SO_2, NH_3, HNO_3, or Cl_2, or dust and does not have a high temperature or humidity.
- Be sure to inspect the Limit Switch before use if it has been stored for three months or more.

Typical Problems, Probable Causes, and Remedies

Problem		Probable Cause	Remedy
Mechanical failure	1. The actuator does not operate. 2. The actuator does not return to the free position (FP). 3. The actuator has been deformed. 4. The actuator is worn. 5. The actuator has been damaged.	The shape of the cam is incorrect.	• Change the design of the cam and smooth the contacting surface of the cam. • Scrutinize the suitability of the actuator. Make sure that the actuator does not bounce.
		The contacting surface of the dog is rough.	
		The actuator in use is not suitable.	
		The operating direction of the actuator is not correct.	
		The operation speed is excessively high.	• Attach a decelerating device or change the mounting position of the Limit Switch.
		Excessive stroke.	• Change the stroke.
		The rubber or grease hardened due to low temperature.	• Use a cold–resistive switch.
		The accumulation of sludge, dust, or cuttings.	• Use a drip–proof model or one with high degree of protection. • Use a protection cover and change the solvent and materials.
		Dissolution, expansion, or swelling damage to the rubber parts of the driving mechanism.	
	There is a large deviation in operating position (with malfunctioning involved).	Damage to and wear and tear of the internal movable spring.	• Regularly inspect the Limit Switch. • Use a better quality switch. • Tighten the mounting screws securely. Use a mounting board.
		Wear and tear of the internal mechanism.	
		The loosening of the mounting screws.	
	The terminal part wobbles. (The mold part has been deformed.)	Overheating due to a long soldering time.	• Solder the Limit Switch quickly. • Change the lead wire according to the carry current and ratings.
		The Limit Switch has been connected to and pulled by thick lead wires with excessive force.	
		High temperature or thermal shock resulted.	• Use a temperature–resistive switch or change mounting positions.

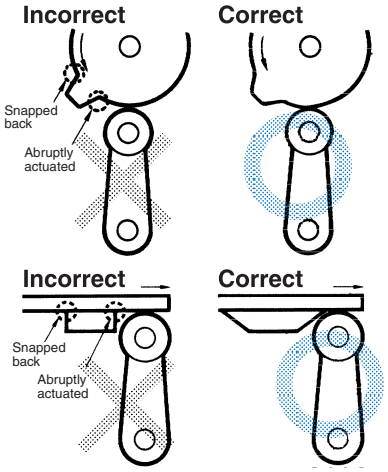
Problem		Probable Cause	Remedy
Failures related to chemical or physical characteristics	Contact chattering	Vibration or shock is beyond the rated value.	• Attach an anti–vibration mechanism. • Attach a rubber circuit to the solenoid. • Increase the operating speed (with an accelerating mechanism).
		Shock has been generated from a device other than the Limit Switch.	
		Too–slow operating speed.	
	Oil or water penetration	The sealing part has not been tightened sufficiently.	• Use a drip–proof or waterproof switch. • Use the correct connector and cable. (Use a sealed connector for sealed switches.) • Use a switch with terminals sealed with resin.
		The wrong connector has been selected and does not conform to the cable.	
		The wrong switch has been selected.	
		The terminal part is not molded.	
		The Limit Switch has been burnt or carbonated due to the penetration of dust or oil.	
	Deterioration of the rubber part	The expansion and dissolution of the rubber caused by solvent or lubricating oil.	• Use an oil–resistant rubber or Teflon bellows. • Use a weather–resistant rubber or protective cover. • Use a switch with a protective cover or a metal bellows.
		Cracks due to direct sunlight or ozone.	
		Damage to the rubber caused by scattered or heated cuttings.	
	Corrosion (cracks)	The oxidation of metal parts resulted due to corrosive solvent or lubricating oil.	• Use an anti–corrosive switch. • Change the lubricating oil. • Change mounting positions. • Use a crack–resistant material.
		The Limit Switch has been operated in a corrosive environment, near the sea, or on board a ship.	
		The electrical deterioration of metal parts of the Limit Switch resulted due to the ionization of cooling water or lubricating oil.	
		The cracking of alloyed copper due to rapid changes in temperature.	
Failures related to electric characteristics	No actuation or no current breakage caused by contact weld.	Inductive interference in the DC circuit.	• Add an erasing circuit.
		Carbon generated on the surface of the contacts due to switching operations.	• Use a switch with a special alloy contact or use a sealed switch.
		A short–circuit or contact weld due to the deformation and relocation of the contacts.	• Reduce the switching frequency or use a switch with a large switching capacity.
		Contact weld due to an incorrectly connected power source.	• Change the circuit design.
		Foreign materials or oil penetrated into the contact area.	• Use a protective box.

Outdoor Use

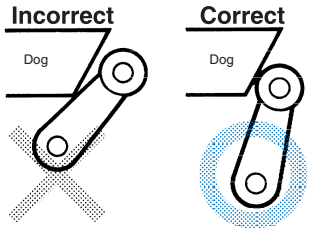
- When using the Limit Switch outdoors, make sure that the Limit Switch is a sealed model. The Limit Switch with IP67 sealing construction does not necessarily mean that the mechanical parts are also of IP67 construction.
- The rubber material exposed to ozone may deteriorate. Check that the rubber parts are environment–resistive, such as chloroprene, silicone, or fluorine rubber.
- If the Limit Switch is used in places with sludge or dust powder sprays, make sure that the mechanical parts are sealed with a rubber cap.
- Due to capillary attraction, rainwater may enter the Limit Switch through the lead wires or sheath. Be sure to cover the wire connections in a terminal box so that they are not directly exposed to rainwater.
- If the Limit Switch is used outdoors, the steel parts of the Limit Switch (such as the screws and plunger parts) may corrode. Consider the use of outdoor models or proximity sensors in such cases.
- The expression “Limit Switch is used outdoors” refers to an environment where the Limit Switch is exposed directly to rainwater or sunlight (e.g., multi–story parking lots) excluding locations with corrosive gas or salty breezes.
  The Limit Switch used outdoors may not release due to icing and may not satisfy standards for indoor use.

Operation

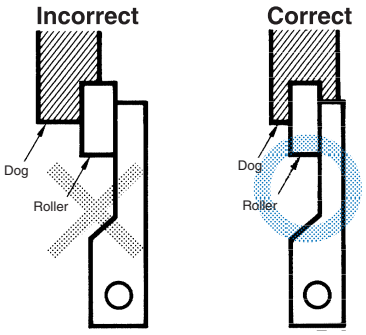
- Carefully determine the position and shape of the cam so that the actuator will not abruptly snap back, thus causing shock. In order to operate the Limit Switch at a comparatively high speed, use an object or cam that keeps the Limit Switch turned ON for a sufficient time so that the relay or valve will be sufficiently energized.
- The shape of the object or cam has a large influence on the life and operating accuracy of the Limit Switch. The cam must be smooth in shape.



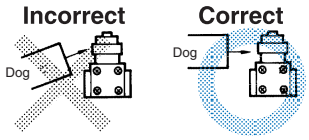
- Appropriate force must be imposed on the actuator by the cam or another object in both rotary operation and linear operation. If the object touches the lever as shown below, the operating position will not be stable.



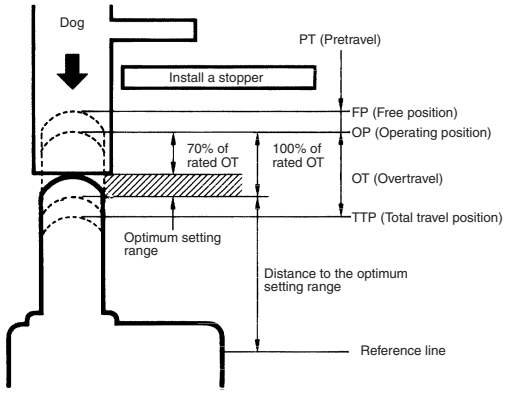
- Unbalanced force must not be imposed on the actuator. Otherwise, wear and tear on the actuator may result.



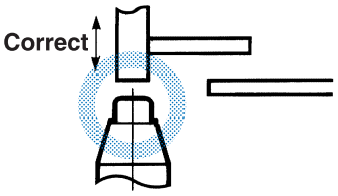
- In the case of a roller–type actuator, the object must touch the actuator at a right angle. Otherwise, the actuator or shaft may deform or break.



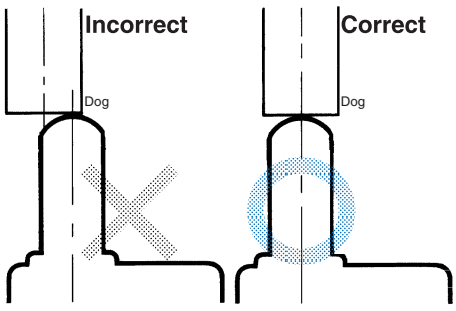
- Make sure that the actuator does not exceed the OT (overtravel) range, otherwise the Limit Switch may malfunction. When mounting the Limit Switch, be sure to adjust the Limit Switch carefully while considering the whole movement of the actuator.



- The Limit Switch may soon malfunction if the OT is excessive. Therefore, adjustments and careful consideration of the position of the Limit Switch and the expected OT of the actuator are necessary when mounting the Limit Switch.

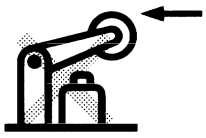


- When using a pin–plunger–type actuator, make sure that the stroke of the actuator and the movement of the object are located along a single straight line.

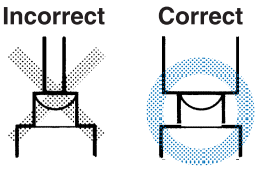


- Be sure to use the Limit Switch according to the characteristics of the actuator. If a roller arm lever actuator is used,

do not attempt to actuate the Limit Switch in the direction shown below.



- Do not modify the actuator to change the OP.
- In the case of a long actuator of an adjustable roller lever type, the following countermeasures against lever shaking are recommended.
  1. Make the rear edge of the object smooth with an angle of 15° to 30° or make it in the shape of a quadratic curve.
  2. Design the circuit so that no error signal will be generated.
  3. Use or set a switch that is actuated in one direction only.
- In the case of a bevel plunger–type actuator, make sure that the width of the object is wider than that of the plunger.



Dog Design

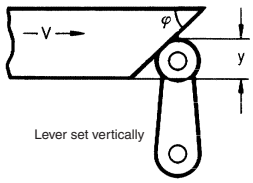
Operating Speed, Dog Angle, and Relationship with Actuator

Before designing a dog, carefully consider the operating speed and angle of the dog and their relationship with the shape of the actuator. The optimum operating speed of a standard dog at an angle of 30° to 45° is 0.5 m/s maximum.

Roller Lever Models

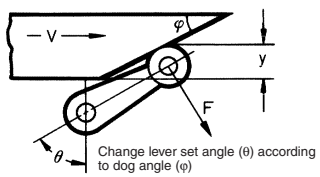
1.Non–overtravel Dog

Dog speed: 0.5 m/s max. (standard speed)



φ	$V_{max.}$ (m/s)	y
30° 45° 60° 60° to 90°	0.4 0.25 0.1 0.05 (low speed)	0.8 (TT) 80% of total travel

Dog speed: 0.5 m/s x V x 2 m/s

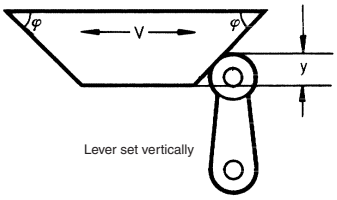


θ	φ	$V_{max.}$ (m/s)	y
45°	45°	0.5	0.5 to 0.8 (TT)
50°	40°	0.6	0.5 to 0.8 (TT)
60° to 55°	30° to 35°	1.3	0.5 to 0.7 (TT)
75° to 65°	15° to 25°	2	0.5 to 0.7 (TT)

Note: The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 50% and 80% (or 50% and 70%).

2.Overtravel Dog

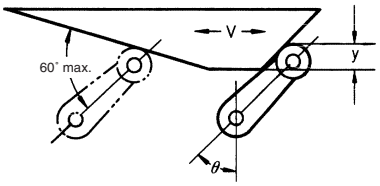
Dog speed: 0.5 m/s max.



φ	$V_{max.}$ (m/s)	y
30° 45° 60° 60° to 90°	0.4 0.25 0.1 0.05 (low speed)	0.8 (TT) 80% of total travel

Dog speed: 0.5 m/s min.

If the speed of the overtravel dog is comparatively high, make the rear edge of the object smooth at an angle of 15° to 30° or make it in the shape of a quadratic curve. Then lever shaking will be reduced.



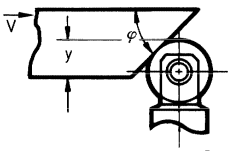
θ	φ	$V_{max.}$ (m/s)	y
45°	45°	0.5	0.5 to 0.8 (TT)
50°	40°	0.6	0.5 to 0.8 (TT)
60° to 55°	30° to 35°	1.3	0.5 to 0.7 (TT)
75° to 65°	15° to 25°	2	0.5 to 0.7 (TT)

Note: The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 50% and 80% (or 50% and 70%).

Plunger Models

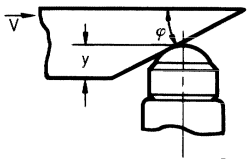
If the dog overrides the actuator, the front and rear of the dog may be the same in shape, provided that the dog is not designed to be separated from the actuator abruptly.

Roller Plunger



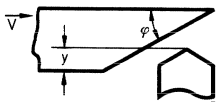
φ	$V_{max.}$ (m/s)	y
30° 20°	0.25 0.5	0.6 to 0.8 (TT) 0.5 to 0.7 (TT)

Ball Plunger



φ	$V_{max.}$ (m/s)	y
30°	0.25	0.6 to 0.8 (TT)
20°	0.5	0.5 to 0.7 (TT)

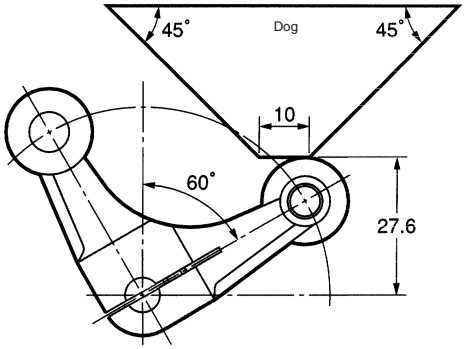
Bevel Plunger



φ	$V_{max.}$ (m/s)	y
30°	0.25	0.6 to 0.8 (TT)
20°	0.5	0.5 to 0.7 (TT)

Note: The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 60% and 80% (or 50% and 70%).

Fork Lever Lock Models

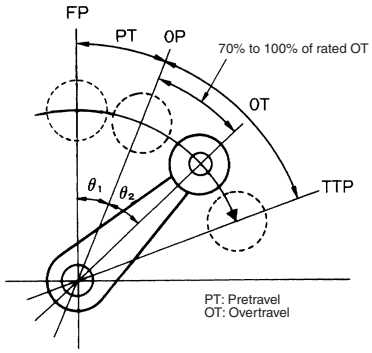


Note: Design the shape of the dog so that it does not come in contact with the other roller lever when the actuator is inverted.

Stroke Settings vs. Dog Movement Distance

- The following provides information on stroke settings based on the movement distance of the dog instead of the actuator angle.
  The following is the optimum stroke of the Limit Switch

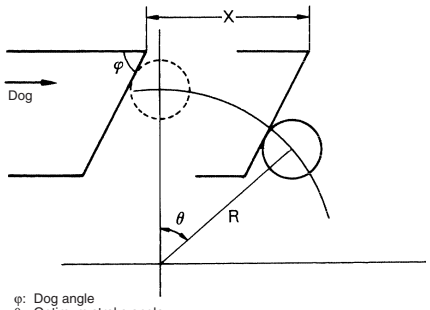
  Optimum stroke: PT + (Rated OT x 0.7 to 1.0)
  The angle converted from the above: $\theta_1 + \theta_2$



- The movement distance of the dog based on the optimum stroke is expressed by the following formula.

  Movement distance of dog

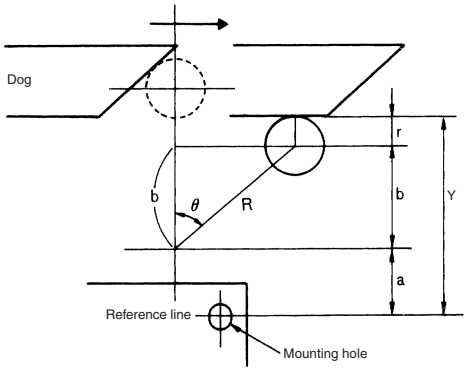
$$X = R\sin\theta + \frac{R(1-\cos\theta)}{\tan\varphi} \text{ (mm)}$$



φ: Dog angle
θ: Optimum stroke angle
R: Actuator length
X: Dog movement distance

- The distance between the reference line and the bottom of the dog based on the optimum stroke is expressed by the following formula.

$$Y = a + b + r \text{ (mm)}$$



a: Distance between reference line and actuator fulcrum
b: R cosθ
r: Roller radius
Y: Distance between reference line and bottom of dog

Dog Surface

- The surface of dog touching the actuator should be 6.3 S in quality and hardened at approximately H450V.
- For smooth operation of the actuator, apply molybdenum disulfide grease to the actuator and the dog touching the actuator. This is ideal for Limit Switches of drip–proof construction and Multiple Limit Switch models.

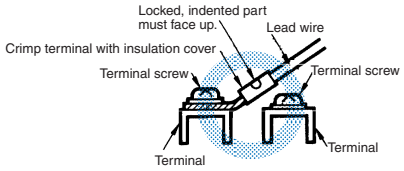
Maintenance and Repairs

- The user must not maintain or repair the system. Consult the manufacturer of the system for maintenance or repairs.

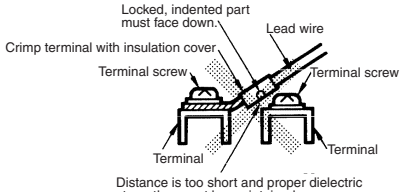
Others

- The Limit Switch has contacts that must be free of silicone gas, otherwise a contact failure may result. Therefore, do not apply cable covered with silicone, silicone sealant, or silicone grease to the Limit Switch.
- The sealing of the standard Limit Switch uses nitrile butadien rubber (NBR), which is highly oil resistive. The NBR exposed to different types of oil or chemical may, however, deteriorate, swell, or shrink. Contact your OMRON representative for details.
- OMRON shall not guarantee the performance and characteristics of any actuator, plunger, or lever modified by the user.
- When using the Limit Switch with a long lever or long rod lever, make sure that the lever is in the downward direction.
- In order to ensure high contact reliability, the correct Limit Switch must be selected according to the load. For details, refer to the precautions for minute load models in this catalog.
- The leads must be wired as shown below.

Correct Method



Wrong Method



SI Units

To conform to the international standards, this datasheet adopts the SI international system for units (SI: Systeme International d'Unites). Refer to the following tables to convert values indicated in conventional units.

SI Unit Conversion

(Shaded units are non–SI units.)

Acceleration	m/s^2	G
	1	$1.01972\ 10^{-1}$
	9.80665	1

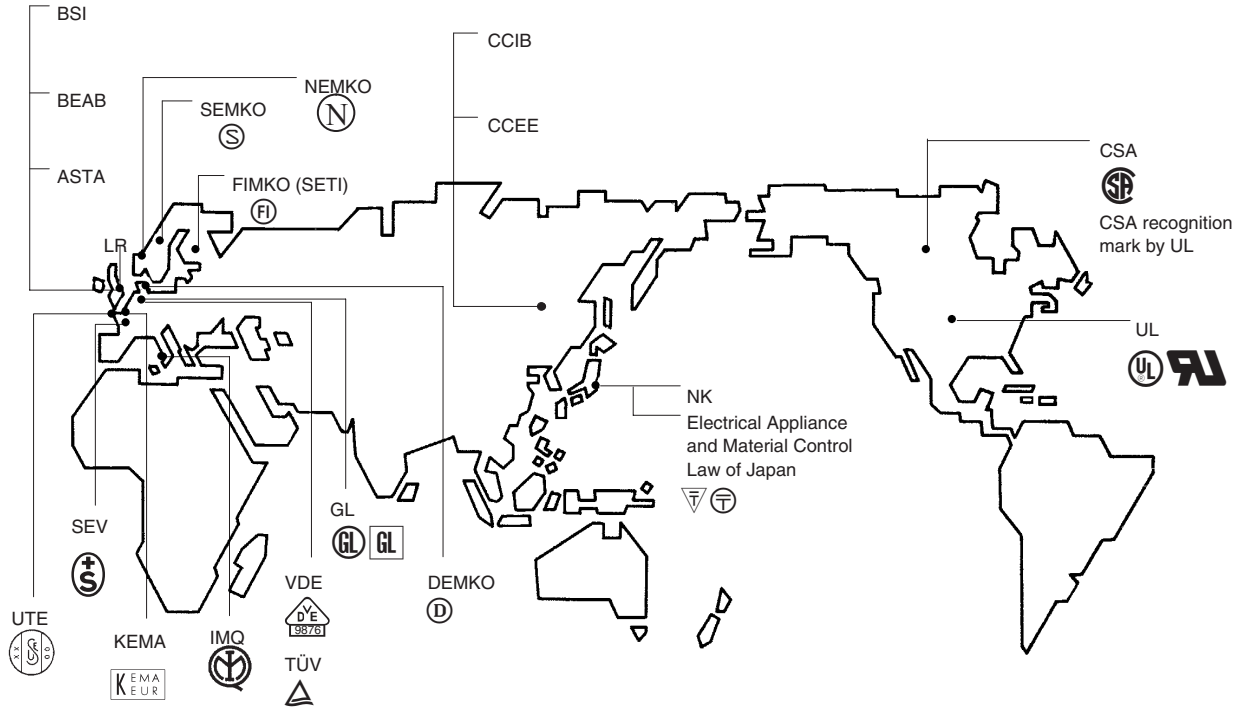
Force	N	kgf
	1	$1.01972\ 10^{-1}$
	9.80665	1

Torque	Nm	kgf•cm	kgf•m
	1	1.01972 10	$1.01972\ 10^{-1}$
	$9.80665\ 10^{2}$	1	$1\ 10^{-2}$
	9.80665	$1\ 10^{2}$	1

Pressure	Pa	kPa	kgf/cm^2	mmHg (Torr)	mmH_2O
	1	$1\ 10^{-3}$	$1.01972\ 10^{-5}$	$7.50062\ 10^{-3}$	$1.01972\ 10^{-1}$
	$1\ 10^{3}$	1	$1.01972\ 10^{-2}$	7.50062	$1.01972\ 10^{2}$
	$9.80665\ 10^{4}$	9.80665 10	1	$7.35559\ 10^{2}$	$1\ 10^{4}$
	$1.33322\ 10^{2}$	$1.33322\ 10^{-1}$	$1.35951\ 10^{-3}$	1	1.35951 10

Standards

National Standards



Note: For detailed information about applicable standards, refer to the relevant catalog.

International Standards

IEC (International Electrotechnical Commission)

The IEC is a standardization commission founded in 1908 to promote unification and coordination of international standards relating to electricity. It is headquartered in Geneva, Switzerland.

IEC standards are provided to accomplish the aim of the above. The IEC strongly recommends all the member nations of the IEC to establish domestic standards that conform with those of the IEC.

At present, there are 50 member nations in the IEC. Based on reports from member nations on the latest science technologies in those nations, IEC standards are issued as technological standards relating to electricity. Established international safety standards provided by various countries and accepted worldwide are based on IEC standards.

In order to simplify approval procedures for electrical devices and promote smooth international trade, there is an international scheme called CB Scheme (Certification Body Scheme), which is authorized by IEC standards. Based on the CB Scheme, safety tests on electrical devices are conducted and certificates are issued if the devices are proved to meet IEC standards. Products issued with such certificates are acceptable in 30 countries in the world.

North America

UL Standards (Underwriters Laboratories INC.)

A nonprofit organization established in 1894 by the American association of fire insurance companies.

Underwriters Laboratories (abbreviated to UL hereafter) conducts approval testing on all kinds of electrical products. In many U.S. cities and states, UL approval is legally required on all electrical items sold.

In order to obtain UL approval on an electrical product, all major internal components also require UL approval.

UL offers two classifications of approvals, the listing mark and the recognition mark.

A Listing Mark constitutes a entirely approval of a product. Products display the Listing Mark shown below.

Listing Mark

The Recognition Mark applies to the components used in a product, and therefore constitutes a more conditional approval of a product. Products display the Recognition Mark shown below.

Recognition Mark

The UL and CSA are unifying their standards with the adoption of a mutual approval system. Furthermore, they are adjusting their standards so that they will be in conformity with IEC standards.

Since October 1992, UL has been approved as a CO (council organization) and TO (test organization) by the SCC (Standard Council of Canada). This authorizes UL to conduct safety tests and certify products conforming to Canadian standards. The above marks are UL marks for products certifying that the products meet Canadian standards.

The designs of the listing marks and recognition marks have been revised as shown below. These marks have been effective since November 1998. The previous marks are valid until November 2007.

LISTING MARKS

	Marks for US	Marks for Canada	Marks for US and Canada
Previous mark			
New mark			

RECOGNITION MARKS

	Marks for US	Marks for Canada	Marks for US and Canada
Previous mark			
New mark			

CSA Standards (Canadian Standards Association)

This association descended from a nonprofit, non–government standardization organization established in 1919. In addition to industrial standardization, the association now carries out safety testing on electrical products.

CSA has closer ties to government agencies than UL, so that electrical products not approved by CSA cannot be sold in Canada. Non–approved goods being sold illegally may have to be withdrawn.

CSA approval is known as “certification,” and consequently, CSA–approved equipment is referred to as “certified equipment.” Products display the mark shown below. For a conditional certification, products display component acceptance mark.

The CSA is adjusting its standards so that they will be in conformity with UL and IEC standards.

Certification Mark

China

GB (Guojia Biaozhun) Chinese National Standards

The GB are established Chinese national standards based on IEC standards.

Products such as home electronics appliances (e.g., televisions, washing machines, and microwave ovens), for which GB standards are obligatory, must be approved by CCIB (China Commodity Inspection Bureau) and CCEE (China Commission for Conformity Certification of Electrical Equipment). The marks shown below are respective marks of recognition.

CCIB Mark CCEE Mark

Shipping Standards

LR (Lloyd’s Register of Shipping)

These are the standards of the Lloyd’s Register of Shipping, headquartered in London. All of the OMRON control components approved in LR are UMS ships, the unmanned engine-room ship classification in the Lloyd’s Register.

Unlike the safety standards such as UL, the devices are checked to ensure that they can function sufficiently under the environmental conditions when they are used in ships.

When a device is approved, Lloyd’s Register doesn’t apply the passing mark on the product, but includes it on the list of approved products that it publishes every year.

NK (Nippon Kaiji Kyokai)

Nippon Kaiji Kyokai (NK), which was established in 1899 under a different name for the purpose of ensuring the safety of vessels and the maintenance of maritime environmental conditions, has been using the present name since 1946.

Automation equipment and devices receive tests and inspections based on the provisions of the steel–ship regulations and can be formally approved if the tests are passed.

Testing at the production factory can be partially or entirely omitted when automation equipment and devices that have been formally approved are installed on ships.

As a general rule, manufacturers of approved products indicate that the products being shipped have been approved. (It is also acceptable to affix a label to products which require it.)

Japan

Electrical Appliance and Material Control Law of Japan

The EAMCL was substantially revised in July 1995 in conformity with IEC standards, such as IEC335. Consequently, the previously–used symbol for second–grade appliances was abolished while the symbol for first–grade appliances remained unchanged. Furthermore, the range of applicable products has been greatly revised.

	First–grade appliance	Second–grade appliance
Previous symbol	282 products	216 products
Present symbol	165 products	333 products (no markings)

Europe

EN (European Norm) Standards

As part of EC unification, 18 European countries are going to integrate their national safety standards into EN standards. When EN standards come into effect, they shall apply as the unified standards in Europe in place of the current safety standards.

EN standards related to electricity are based on IEC standards and include requirements relating to countermeasures against electric shocks. EN codes consist of the prefix “EN” followed by five figures beginning with the figure 6 (e.g., EN60204).

Industrial products exported to Europe must satisfy IEC standards if the products do not fall under EN standards.

Industrial products exported to European countries from Japan or North America or traded between European countries must satisfy EN standards. Furthermore, 12 types of industrial products, such as machines, low–voltage devices, and EMC equipment, must bear CE markings. CE markings on a product indicate that the product meets safety standards specified by all related EC directives. For example, an industrial machine must satisfy the EC Machinery Directive, Low–voltage Directive (LVD), and EMC requirements.

CE Marking

The following marks of recognition are used in European countries in accordance with EN standards.

VDE (Verband Deutscher Elektrotechniker e.V.) in Germany (applicable to electrical appliances only)		TÜV (applicable to electrical appliances, machines and automobiles	
VDE Mark	Monitoring Mark	TÜV Rheinland	TÜV Product Service
DEMKO (Danmarks Elektriske Materielkontrol)		KEMA (Keuring van Electrotechnische Materialen Nederland B.V.)	
NEMKO (Norges Elektriske Materiellkontroll)		UTE (Union Technique De Electricite)	
FIMKO (Finlands Material Kontroll)		IMQ (Instituto Italiano del Marchio di Qualita)	
BSI (British Standards Institution) Britain (applicable to industrial products)		SEMKO (Svenska Elektriska Materielkontroll Anstalten)	
BEAB (British Electrotechnical Approval Board) Britain (applicable to home electronics products)		SEV (Schweizer Elektrotechnischer Verein)	
ASTA (ASTA Certification Services) Britain (applicable to general products)			

List of Approved Models

UL Standards

Safety Switches

Model	Rating	Standard No.	File No.
D4N	A300 (Carry current: 10 A) Q300 (Carry current: 2.5 A)	UL508	E76675
D4F	C300 (Carry current: 2.5 A), Q300 (Carry current: 2.5 A)		
D4B–N	A600 (Carry current: 10 A)		
D4BS	A600 (Carry current: 10 A)		
D4BL	A300 (Carry current: 10 A)		
D4N–R	A300 (Carry current: 10 A) Q300 (Carry current: 2.5 A)		
D4NS	A300 (Carry current: 10 A) Q300 (Carry current: 2.5 A)		
D4NL	A300 (Carry current: 10 A)		
D4GL	C300 (Carry current: 2.5 A), Q300 (Carry current: 2.5 A)		
D4NH	A300 (Carry current: 10 A) Q300 (Carry current: 2.5 A)		
D4GS–N	C300 (Carry current: 2.5 A), Q300 (Carry current: 2.5 A)		

Note: 1. Approval on some models may have been given on representative models. For further information on standard approvals, contact your OMRON sales representative.
2. The standard number shown above is the number the applicable standard and the file number is the approval report number.

Pushbutton Switches

Model	Rating	Standard No.
A165E	5 A, 125 VAC 3 A, 250 VAC 3 A, 30 VDC	UL508
A165E□03U	1 A, 125 VAC 0.5 A, 250 VAC 1 A, 30 VDC	UL508
A22E	6 A, 250 VAC 10 A, 105 VAC	UL508

Safety Relay Units

Model	Number of poles	Operating coil	Contact rating	File No.
G9S-2001 G9S-2002	DPST-NO	24 VDC	5 A, 240 VAC (Resistive)	E95399
G9S-301	3PST-NO/ SPST-NC	24 VDC, 24, 100, 120, 240 VAC		
G9S-501	5PST-NO/ SPST-NC			
G9S-321-T□ (see note 1)	3PST-NO/ SPST-NC+ DPST-NO (OFF-delay)			
G9SA-301	3PST-NO/ SPST-NC	24 VDC, 24 VAC	5 A, 250 VAC (Resistive)	E41515
G9SA-501	5PST-NO/ SPST-NC			
G9SA-321-T□ (see note 2)	3PST-NO/ SPST-NC+ DPST-NO (OFF-delay)			
G9SA-TH301	3PST-NO/ SPST-NC			
G9SA-EX301				
G9SA-EX031-T□ (see note 2)	3PST-NO+ SPST-NC (OFF-delay)			
G9SX-EX□	4PST-NO	24 VDC	3 A, 250 VAC (Resistive)	see datasheet
G9SB-200□-□	DPST-NO	24 VDC, 24 VAC	5 A, 250 VAC (Resistive)	E76675
G9SB-301□-□	3PST-NO/ SPST-NC			
G9SB-3010		24 VDC		
CQM1-SF200	DPST-NO	24 VDC	5 A, 250 VAC (Resistive)	
CS1W-SF200				

Note: 1. T□: T01, T015, T03, T04, T05, T06, T10, T30
2. T□: T075, T15, T30

Safety Relays

Model	Number of poles	Operating coil	Contact rating	File No.
G7S–4A2B	4PST–NO/ DPST–NC	24 VDC	6 A per pole, 20 A total, 277 VAC (Resistive)	E41515
G7S–3A3B	3PST–NO/ 3PST–NC			
G7SA–3A1B	3PST–NO/ SPST–NC		6 A, 250 VAC (Resistive) 6 A, 30 VDC (Resistive)	
G7SA–2A2B	DPST–NO/ DPST–NC			
G7SA–5A1B	5PST–NO SPST–NC			
G7SA–4A2B	4PST–NO DPST–NC			
G7SA–3A3B	3PST–NO/ 3PST–NC			

Safety Area Sensors (Listing Certified)

Model	File No,	Ratings/remarks
F3SN-A F3SH-A	E199694	Input: 24 VDC Output: PNP open collector, 300 mA (24 VDC) Type 4 ESPE/AOPD
F3S-B	E199694	Input: 24 VDC Output: PNP open collector or NPN open collector, 200 mA (24 VDC) Type 2 ESPE/AOPD
F3SS	NRTL certification by CSA	---
F3SL	E199694	Type 4 ESPE/AOPD

CSA Standards

Safety Switches

Model	Rating	Standard No.	File No.
D4BS	A600 (Carry current: 10 A)	CSA C22.2 No. 14	LR45746
D4DS	A600 (Carry current: 10 A)		
D4BL	A300 (Carry current: 10 A)		
D4DL	A300 (Carry current: 10 A)		
D4DH	A600 (Carry current: 10 A)		

Note: 1. Approval on some models may have been given on representative models. For further information on standard approvals, contact your OMRON sales representative.
2. The standard number shown above is the number the applicable standard and the file number is the approval report number.

Safety Relay Units

Model	Number of poles	Operating coil	Contact rating	File No.
G9S-2001 G9S-2002	DPST-NO	24 VDC	5 A, 240 VAC (Resistive)	LR35535
G9S-301	3PST-NO/ SPST-NC	24 VDC, 24, 100, 120, 240 VAC		
G9S-501	5PST-NO/ SPST-NC			
G9S-321-T□ (see note 1)	3PST-NO/ SPST-NC+ DPST-NO (OFF-delay)			
G9SA-301	3PST-NO/ SPST-NC	24 VDC, 24 VAC	5 A, 250 VAC (Resistive)	
G9SA-501	5PST-NO/ SPST-NC			
G9SA-321-T□ (see note 2)	3PST-NO/ SPST-NC+ DPST-NO (OFF-delay)			
G9SA-TH301	3PST-NO/ SPST-NC			
G9SA-EX301				
G9SA-EX031-T□ (see note 2)	3PST-NO+ SPST-NC (OFF-delay)			
G9SB-200□-□	DPST-NO	24 VDC, 24 VAC	5 A, 250 VAC (Resistive)	203880 (LR35535)
G9SB-301□-□	3PST-NO/ SPST-NC			
G9SB-3010		24 VDC		
CQM1-SF200	DPST-NO	24 VDC	5 A, 250 VAC (Resistive)	
CS1W-SF200				
G9SX-EX□	4PST-NO	24 VDC	3 A, 250 VAC (Resistive)	see datasheet

Note: 1. T□: T01, T015, T03, T04, T05, T06, T10, T30
2. T□: T075, T15, T30
3. Approval of G9SA models with AC power supplies is pending (as of June 2001).

Safety Area Sensors

Model	File No,	Ratings/remarks
F3SN-A F3SH-A	(cUL listing based on Canadian safety standards) Refer to UL standards.	Input: 24 VDC Output: PNP open collector, 300 mA (24 VDC) Type 4 ESPE/AOPD
F3S-B	(cUL listing based on Canadian safety standards) Refer to UL standards.	Input: 24 VDC Output: PNP open collector or NPN open collector, 200 mA (24 VDC) Type 2 ESPE/AOPD
F3SS	LR90200 (CSA C22.2 No. 205)	---
F3SL	(cUL listing based on Canadian safety standards) Refer to UL standards.	Type 4 ESPE/AOPD

Safety Relays

Model	Number of poles	Operating coil	Contact rating	File No.
G7SA-3A1B	3PST-NO/ SPST-NC	24 VDC	6 A, 250 VAC (Resistive) 6 A, 30 VDC (Resistive)	LR35535 (CSA C22.2 N0. 14)
G7SA-2A2B	DPST-NO/ DPST-NC			
G7SA-5A1B	5PST-NO SPST-NC			
G7SA-4A2B	4PST-NO DPST-NC			
G7SA-3A3B	3PST-NO/ 3PST-NC			
G7S-4A2B	4PST-NO/ DPST-NC	24 VDC	6 A per pole, 20 A total, 277 VAC (Resistive)	
G7S-3A3B	3PST-NO/ 3PST-NC			
G7SA-4A2B-E	4PST-NO DPST-NC	24 VDC	NO contact: 10 A per pole, 20 A total, 277 VAC (Resistive) NC contact: 6 A per pole, 20 A total, 277 VAC (Resistive)	
G7SA-3A3B-E	3PST-NO/ 3PST-NC			

Safety Limit Switches

Model	Rating	Standard No.	File No.
D4B-N	A600 (Carry current: 10 A)	CSA C22.2 No. 14	LR45746

VDE Standards

Safety Relays

Model	Number of poles	Operating coil	Contact rating	Approval No.
G7S–4A2B	4PST–NO/ DPST–NC	24 VDC	6 A 240 VDC (Resistive)	No. 6611 (IEC255) (VDE0435) (EN50205)
G7S–3A3B	3PST–NO/ 3PST–NC			
G7SA–3A1B	3PST–NO/ SPST–NC		6 A, 250 VAC (Resistive) 6 A, 30 VDC (Resistive)	No. 125547 (EN61810–1) (EN50205) (EN60255–23)
G7SA–2A2B	DPST–NO/ DPST–NC			
G7SA–5A1B	5PST–NO/ SPST–NC			
G7SA–4A2B	4PST–NO/ DPST–NC			
G7SA–3A3B	3PST–NO/ 3PST–NC			

Note: Applicable standard numbers are given in parentheses.

TÜV Standards

Limit Switches

Model	Rating	Standard No.	Approval No.
D4N–R	AC–15 3 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1 EN81, EN115 pending	B031139656061
D4BS	AC–15 2 A 400 V 50/60 Hz	EN60947–5–1 IEC947–5–1	R9351022
D4N	AC–15 3 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1	B031139656061
D4F	AC–15 0.75 A 240 V 50/60 Hz	EN60947–5–1 GS–ET–15	B0203 39656029
D4B–N	AC–15 2 A 400 V 50/60 Hz	EN60947–5–1 IEC947–5–1	Slow–action: R9151643 Snap–action: J9851083
D4NH	AC–15 3 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1	B031139656061
D4NS	AC–15 3 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1	B030639656052
D4GL	AC–15 0.75 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1 GS–ET–19	B0207 39656039
D4NL	AC–15 3 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1 GS–ET–19	B0207 39656040
D4BL	AC–15 3 A 250 V 50/60 Hz (LED type: AC–15 6 A 115 V 50/60 Hz	EN60947–5–1 IEC947–5–1 GS–ET–19	R9451050
D4GS–N	AC–15 0.75 A 240 V 50/60 Hz DC–13 0.27 A 250 V	EN60947–5–1	J2051125

BIA Standards

Limit Switches

Model	Models rated	Standard No.	Approval No.
D4B–N	Positive opening models approved except adjustable levers, coils, springs, and plastic rods	GS–ET–15, EN60947–5–1	9202158 and 9309655
D4BS	All D4BS models	GS–ET–15, EN60947–5–1	9303323
D4BL	All D4BL models	GS–ET–19, EN60947–5–1	Mechanical: 9402293 Solenoid: 1998, 20462–01

Safety Relay Units

Model	Number of poles	Operating coil	Contact rating	File No.
G9S–2001 G9S–2002	DPST–NO	24 VDC	5 A, 240 VAC (Resistive)	R974021 (EN60204–1) (EN954–1)
G9S–301	3PST–NO/ SPST–NC	24 VDC, 24, 100, 120, 240 VAC		
G9S–501	5PST–NO/ SPST–NC			
G9S–321–T□ (see note)	3PST–NO/ SPST–NC+DPST–NO (OFF–delay)			

Note: T□: T01, T015, T03, T04, T05, T06, T10, T30

SUVA Standards

Limit Switches

Model	Models rated	Approved No.
D4B–N	Positive opening models approved except adjustable levers, coils, springs, and plastic rods	E6188.d and E6189.d
D4BS	All D4BS models	E6187.d
D4BL	All D4BL models	E6186/1.d

BG Standards

Safety Relay Units

Model	Number of poles	Operating coil	Contact rating	File No.
G9SA–301	3PST–NO/ SPST–NC	24 VDC, 24 VAC	5A, 250 VAC (Resistive)	000115
G9SA–501	5PST–NO/ SPST–NC			000135
G9SA–321–T□ (see note 1)	3PST–NO/ SPST–NC+ DPST–NO (OFF–delay)			000137
G9SA–TH301	3PST–NO/ SPST–NC			
G9SA–EX301	3PST–NO/ SPST–NC			000135
G9SA–EX031–T□ (see note 1)	SPST–NC+ 3PST–NO (OFF–delay)			000137

Note: 1. T□: T075, T15, T30

List of Models Conforming to EN/IEC Standards

Safety Door Switches

Model	CE marking	Safety category	Basic requirements of Machinery Directive/Low–voltage Directive				Basic requirements of EMC Directive			
			Applicable standard No.	Application standard No.	Approving agency	File No./ Applicable period	EMI standard No.	EMS standard No.	Approving agency	File No./ Applicable period
D4BS	YES	up to 4	EN60947-5-1 IEC60947-5-1	---	TÜV, Rheinland	R9351022	Not applicable			
D4BL						R9451050				
D4GS-N						J2051125				
D4N			EN60947-5-1		TÜV, Product Service	B031139656061				
D4N-B										
D4NH										
D4NS						B03063965052				
D4GL						B020739656039				
D4NL						B020739656040				

Safety Sensor

Model	CE marking	Safety category	Machinery Directive			Basic requirements of EMC Directive		
			Applicable directive	Approving agency	File No.	Applicable directive	Approving agency	File No.
F3SN-A F3SH-A	YES (EMC Directive)	4	EN61496-1 ESPE Type 4 IEC61496-1 ESPE Type 4 IEC61496-2 AOPD Type 4	DEMKO	Certificate No. 129794-01	89/336/EEC	DEMKO	Certificate No. 129794-02
F3S-B		2	EN61496-1 ESPE Type 2 IEC61496-1 ESPE Type 2 IEC61496-2 AOPD Type 2	TÜV Hannover/Sachsen Anhalt			TÜV Nord	Certificate 08/205/B1-PM28890
F3SS		4	IEC61496-1 ESPE Type 4 IEC61496-2	TÜV Rheinland	BB9911039	IEC61496-1 compatibility according to TÜV Rheinland. Declaration of conformity to EMC Directive based on certification. Declaration of conformity certificate numbers: MSCS 128A (F3SS) MSCS 129A (F3SL)		
F3SL					BB9910071			
E3FS		2	98/37/EC EN61469-1 prEN91496-2 type2	TÜV Product Service	Z20108426690 01	89/336/EEC	TÜV Product Service	
F3SP-U1P F3SP-U3P F3SP-U5P			98/37/EC IEC61496-1		Z10030718453 015			
F3SP-U2P F3SP-U4P		4	98/37/EC IEC61496-1					
F3SP-P1P			98/37/EC IEC61496-1 IEC61496-2					

Safety Relay Unit

Model	CE marking	Safety category	Basic requirements of Machinery Directive/Low–voltage Directive				Basic requirements of EMC Directive			
			Applicable standard No.	Application standard No.	Approving agency	File No./ Applicable period	EMI standard No.	EMS standard No.	Approving agency	File No./ Applicable period
G9SA	YES	4 (see note 1)	EN60204-1 EN954-1	---	BG	(see note 4)	EN55011	EN50082-2	TÜV, Product Service	E8 00 04 39656 001
G9S		4 (see note 2)			BIA	R974021				(see note 5)
G9SA (24 VAC/ VDC)		4 (see note 1)			BG	(see note 6)		EN61000-6-2		E8 02 03 39656 035
G9SA (100 to 240 VAC)									TÜV, Rheinland	Report No. 02062204 002 Registration No. AE205132702

Model	CE marking	Safety category	Basic requirements of Machinery Directive/Low–voltage Directive				Basic requirements of EMC Directive			
			Applicable standard No.	Application standard No.	Approving agency	File No./ Applicable period	EMI standard No.	EMS standard No.	Approving agency	File No./ Applicable period
G9SB-200□-□ G9SB-301□-□	YES	4	EN60204-1 EN954-1	---	TÜV, Rheinland	968/EZ 120.00/01	EN55011	EN61000-6-2	TÜV, Rheinland	Report No. 02160619 002 Registration No. AV2-50003726
G9SB-3010		3 (see note 3)								
CQM1-SF200		4				968/EZ 110.00/00				Report No. P2062560E 01 Registration No. AE205121901
CS1W-SF200										Report No. P2062873E 01 Registration No. AE205122001
G9SX						see datasheet	EN61000-6	EN61000-6-2		see datasheet J150-E2-Cat04-01

Note: 1. OFF-delay contact of G9SA-321/EX031 falls in Category 3.
2. OFF-delay output of G9S-321 and G9S-2001 falls in Category 3.
3. G9SB-3010 falls in Category 3 with double breaking.
4. G9SA-301: 00115, 501/EX301: 00135, 321/EX031: 00137, TH301: 01013
5. G9S-301/501/321: E8 97 05 22868 026; G9S-2001/2002: E8 98 03 32014 005
6. G9SA-301: 00115, 501/EX301: 00135, 321/EX031: 00137, TH301: 01013 (24 VAC/VDC)
G9SA-301: 02067, 501: 02063, 321: 02065, TH301: 01013 (100 to 240 VAC)

Safety Relays

Model	CE marking	Safety category	Basic requirements of Machinery Directive/Low–voltage Directive				Basic requirements of EMC Directive			
			Applicable standard No.	Application standard No.	Approving agency	File No./ Applicable period	EMI standard No.	EMS standard No.	Approving agency	File No./ Applicable period
G7SA	Not applicable	For Systems up to cat. 4	EN61810-1	EN50205	VDE	No. 125547	Not applicable			
G7S			IEC60255 (VDE0435)	prEN50205		No. 6611				

Safety Limit Switches

Model		CE marking	Safety category	Basic requirements of Machinery Directive/Low–voltage Directive				Basic requirements of EMC Directive			
				Applicable standard No.	Application standard No.	Approving agency	File No./ Applicable period	EMI standard No.	EMS standard No.	Approving agency	File No./ Applicable period
D4B-□N	Snap-action	YES	4	EN60947-5-1 IEC60947-5-1	---	TÜV, Rheinland	J9851083	Not applicable			
D4D-□N	Snap-action				EN81 (Elevators) EN115 (Escalators, conveyors)		JJ9950233				
D4B-□N	Slow-action						R9151643				
D4N-□R						TÜV, Product Service	Pending				
D4F							B02033965 6029				

Emergency Stop Switches

Model	CE marking	Safety category	Basic requirements of Machinery Directive/Low–voltage Directive				Basic requirements of EMC Directive			
			Applicable standard No.	Application standard No.	Approving agency	File No./ Applicable period	EMI standard No.	EMS standard No.	Approving agency	File No./ Applicable period
A165E Series (separate construction)	YES	4	EN60947-5-1	---	TÜV, Product Service	B021039656 044	Not applicable			
A22E Series						B021039656 043				
A165E-□-03U (one-body construction)						B021039656 045				