OMRON

The SOLUTIONS [General-purpose Relay Edition]

Relay Defects

? Causes & ! Solutions

Correctly obtaining the best performance from relays

Introduction

Thank you for your daily use of OMRON relays.

**It has been more than half a century since OMRON started developing relays. Over that time, we have endeavored to improve the quality of our products through repeated development and revision of a great variety of relays, always with the goal of meeting the needs of our customers.
We have just celebrated the 50th anniversary of the release of the MY Series, OMRON's typical relay, which was first released in 1966. We would like to take this opportunity to thank all our customers for their continued patronage.**

**In this document we have gathered all of our know-how related to best maximizing the performance of relays, accumulated through our experiences at automation work sites around the world.
It will bring us great pleasure if this document, "The SOLUTIONS," is of any help in understanding the causes of and solutions to the defects that occur on your work sites.**

October 2016, OMRON Corporation

Precautions

- This document, "The SOLUTIONS," introduces common examples of defects that have been confirmed by OMRON customers.
  Note that defects that you have confirmed may not correspond to any of the examples contained herein.

- Before requesting that OMRON analyze a relay, we ask that you check the outer appearance and the operation of the relay, and then return the relay to OMRON without disassembling it (such as by opening its case).
  Note that if you disassemble the relay (such as by opening its case) we may not be able to determine the true cause of the defect.

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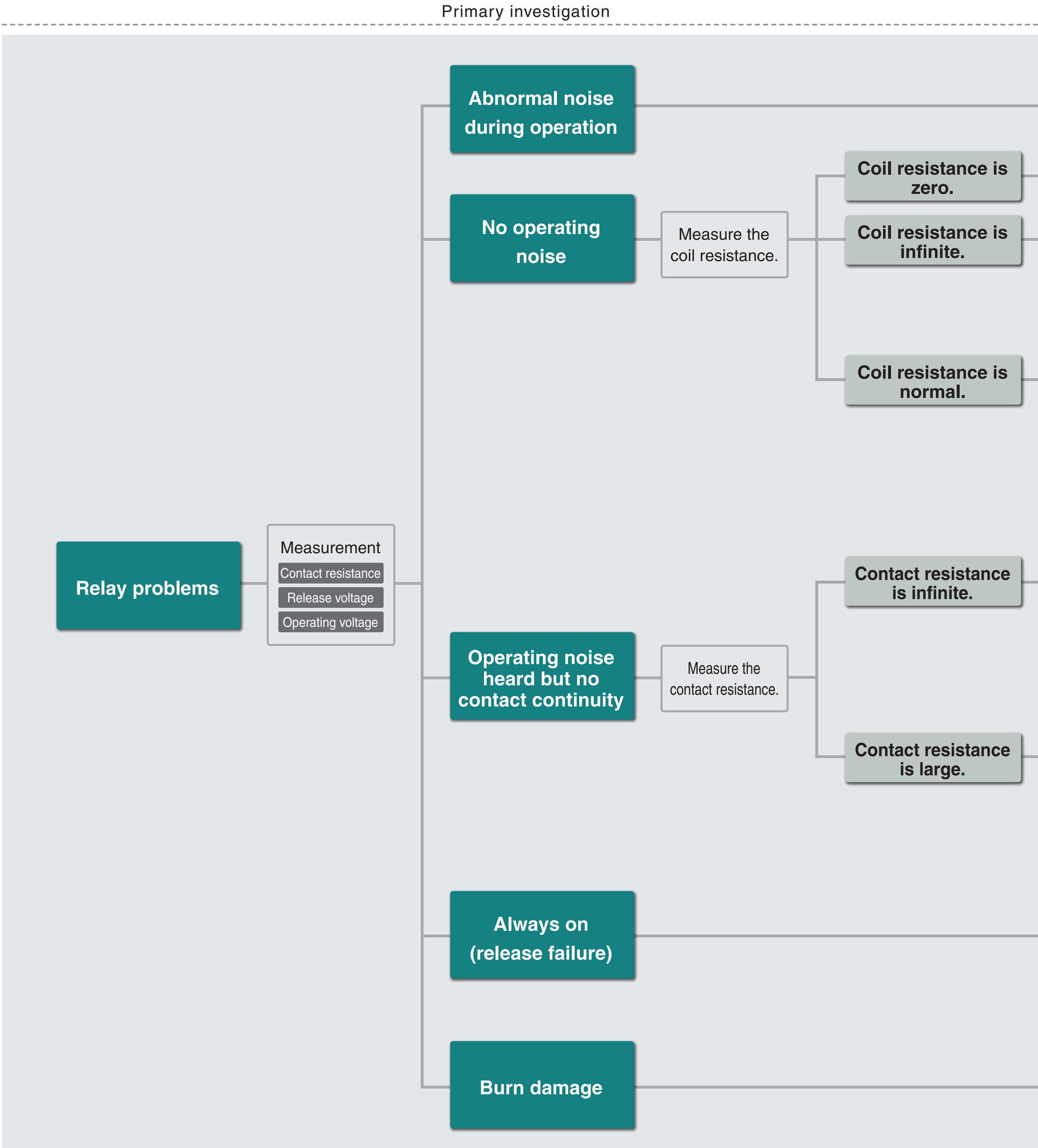

When performing troubleshooting, you may perform the primary investigations, but do not open the case.

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CASE 01

Buzzing and Vibration (AC Only)

If an AC operation type (AC model) relay is subjected to a strong impact (such being dropped), buzzing (noise) and vibrations that sound like a buzzer occur when voltage is applied to the coil.
In the worst case scenario, the relay becomes inoperable.

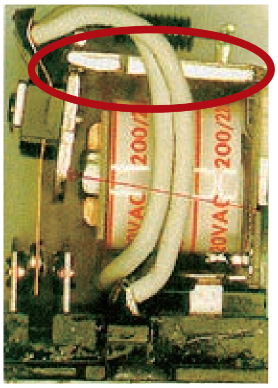
Likely Cause: Strong Impact (Such as Dropping the Relay)

When a relay is subjected to a strong impact (such as being dropped), the core and yoke may be deformed and may be flattened (slanted). This leads to distortion in the precision of the attraction surface between the core and armature, causing a minor gap to occur between these parts. The result is that buzzing (noise) and vibration occur when voltage is applied to the coil.

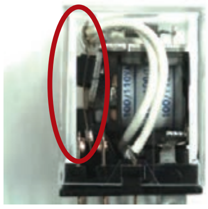
The conditions under which buzzing and vibration occur vary depending on factors such as the size, weight, and structure of the relay as well as the shapes of its core, yoke, and armature in addition to the manner in which the relay was dropped (such as whether the relay itself was dropped or if it was dropped while packaged). However, applying a strong impact to a relay that exceeds the rated value of the relay (such as by dropping the relay) may lead to buzzing (noise) and vibrations.

Reference
DC coil
With DC operation type (DC coil) relays, buzzing and vibrations do not occur. Instead, the armature does not move the relay or stops with the armature not fully attracted to the core.

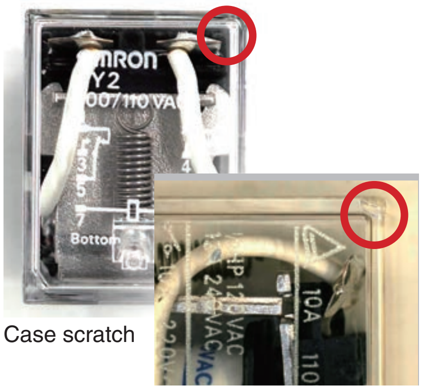
Reference
This phenomenon is especially likely to occur with heavy, power relays (such as the MK and MMK).



Yoke bending caused by dropping



Movable block (Contact arm) bending caused by dropping



Case scratch

Solution

1. **Exercise caution to prevent the relay from being subjected to impacts such as by dropping the relay.**
2. **Never use a relay that has been dropped or may possibly have been dropped by accident even if it shows no visible abnormalities.**
3. **If the packaging (the external cardboard box or the individual packaging box) shows damage such as dents or signs of the load falling over during transport, there is a possibility that the relay has been dropped or has otherwise been subjected to impacts while packaged, so do not use the relay. Instead, contact the transporting company or OMRON.**

memo

CASE 02

Short Circuit Failure of Diode for Relay Coil Surge Absorber

Among OMRON relays, there are models that have a built-in diode in parallel with the coil to absorb the counter-electromotive voltage (surge) that occurs when the coil turns OFF. With built-in diode relays, if the coil polarity is connected in reverse or if a surge that exceeds the withstand voltage in the reverse direction of the diode is applied, the diode is damaged and the relay enters short-circuit mode in which it cannot operate.

Likely Causes

1. Damage due to a connection that is the reverse of the coil polarity

Relay coils that have built-in diodes have a polarity, so if these coils are connected in the reverse of their polarity, they are damaged due to a current that exceeds the maximum allowable current in the forward direction flowing through the diode.
It is most common for these relays to be completely damaged in open mode as a final step, but sometimes they avoid complete damage and end up in short-circuit mode due to factors such as the capacity of the power supply. <u>Note that roughly half of all diode short circuits are the result of reverse connections.</u>

Caution
Examples of products returned to OMRON

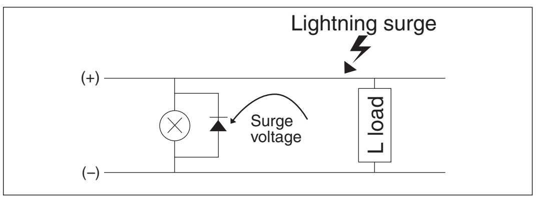
2. Damage due to surge voltage

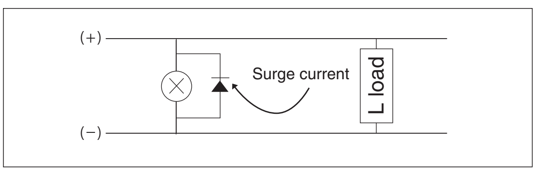
Applying a voltage to a diode that exceeds the withstand voltage in the reverse direction of the diode leads to diode damage. Some possible causes for such a voltage include external surges such as lightning surges, surges generated by other devices in the circuit, and <u>withstand voltage tests of the circuit in which the relay is installed</u>.

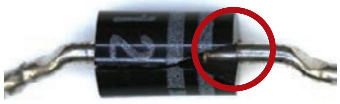
Caution
Withstand voltage test
After wiring the relay, when performing a withstand voltage test of the circuit in which voltage is applied to the relay's primary side (coil side) and secondary side (contact side), the diode may be damaged if both ends of the relay coil are not short-circuited to be isopotential as failing to do this causes a potential difference to occur between the ends of the diode due to the stray capacitance of the coil.

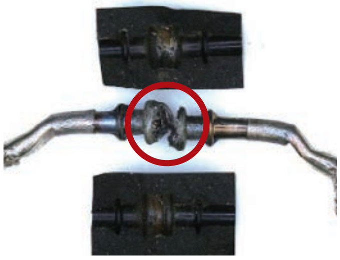
3. Damage due to surge current

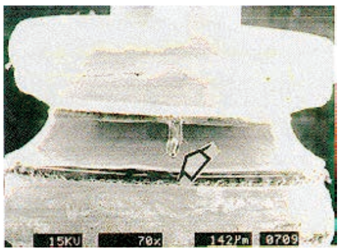
Surge current generated by sources such as other devices in the circuit causes the diode to generate an abnormal amount of heat, which may lead to damage. This damage can occur easily when a surge current flows through the diode due to it being connected to an inductive load of 10 W or more or to a smaller inductive load that continuously generates this surge current with high frequency.



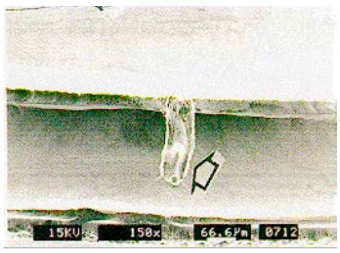



Crack that occurred on the diode surface due to damage


Damaged diode



Magnified photograph of a diode short-circuit



Magnified photograph of a diode short-circuit


Magnified photograph of a diode short-circuit

Solution

1. Coil polarity

When wiring the coils of built-in diode relays, exercise sufficient caution regarding the polarity of the coils. The coil polarity is displayed on the internal connection diagram shown on the relay. The internal connection diagram shown on the relay is displayed in "Bottom View."

If you connect a relay in reverse even once, its diode may be broken, so do not use these relays again.

2. Surge voltage

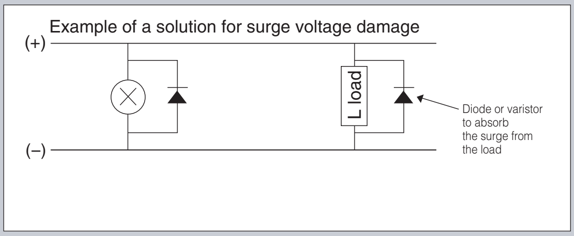
The relay's built-in diode is designed to absorb the surges that are generated by self-coiling and to prevent these surges from affecting the other devices in the circuit.

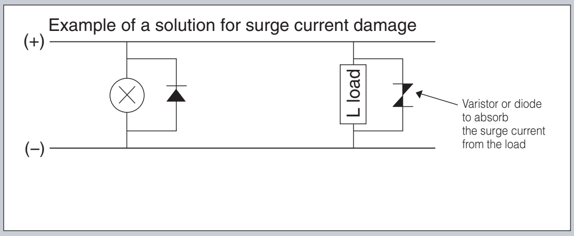
It does not have functions for absorbing external surges such as lightning surges or surges generated by other devices in the circuit, so implement appropriate surge countermeasures (installing diodes and varistors) to prevent these surges from affecting the relay and the other electronic components.

Also, when performing a withstand voltage test after wiring the relay, short both ends of the relay coil so that they are isopotential. Never perform a test with a connection method that causes high voltages to be applied to both ends of the relay coil.

3. Surge current

Install a varistor or a diode in parallel with the load to reduce the surge current generated from the load.





Abnormal Heat Generation

1. If switching arcs occur continuously due to contact chattering, the contact parts generate an abnormal amount of heat, which can lead to contact fusing, dissolution, and welding. This leads to operation failure.
2. The contact's rated carry current being exceeded will lead to fusing and contact welding within the relay, which will lead to operation failure.
3. Applying an overvoltage to a coil causes a layer short in the coil, which leads to coil fusing and break down. This leaves behind evidence of the coil generating abnormal heat.
4. Abnormal heat is also generated by wiring and installation failures.

Likely Causes

1. Contact chattering

Switching arcs (with temperatures of approximately 6000°C) continuously occur due to vibrations caused by the voltage drop (power supply voltage drop) of the voltage applied to the coil or due to chattering caused by malfunctions of the sensor, switch, or microcomputer that controls turning the relay coil ON/OFF. This leads to abnormal heat generation focused on the contact section.

2. Carry current that exceeds the contact's rating

When, due to some accident, an overcurrent that exceeds the rating of the contact flows, the relay's internal circuit generates abnormal heat due to joule heating.

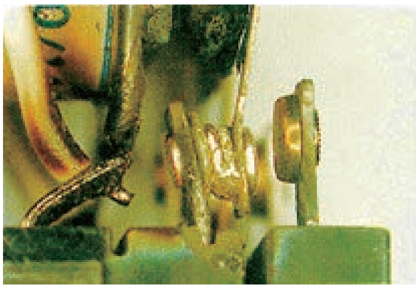
Caution
Short-circuit current is also included.

3. Overvoltage applied to the coil

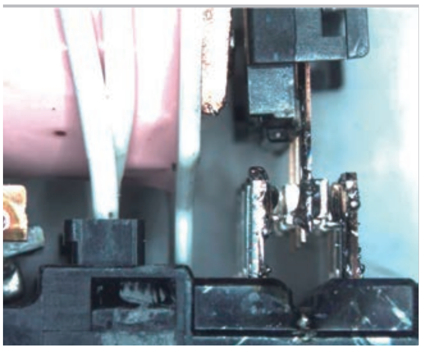
When a voltage that exceeds the maximum voltage is applied to a coil, the coil generates an abnormal amount of heat, which causes the insulating covering (generally made of polyurethane, which is resistant to heat up to 120°C) on the coil wire to melt, thereby eliminating the insulating function. This leads to conducting between coil wires, which causes an overcurrent to flow through the coil wires, further increasing the abnormal heat generation. The result is wire break down.

4. Wiring failure

The parts that fit together and the contacts generate abnormal heat due to terminal screw tightening failure and defective insertion of the relay into the socket.



Abnormal heat generation due to contact chattering



Abnormal heat generation (contact melting) due to contact chattering

Solution

1. Contact chattering

   Chattering and vibrations are caused by drops in the power supply voltage and the applied coil voltage and lead to abnormal heat generation. Give special consideration to ensure that the voltage does not drop to 90% of the rated voltage or lower for relays with AC specifications.

   Give special consideration to ensure that the voltage does not drop to approximately 80% (this varies slightly depending on the relay model) of the rated voltage or lower for relays with DC specifications.

   (Example: The power supply voltage may drop at the instant that a motor or other large-current load is operated.)

   Consider ways to prevent high-frequency switching between relay coils due to malfunctions of the sensor, switch, or microcomputer that controls turning the relay coils ON/OFF.

2. Carry current that exceeds the contact's rating

   Design the circuit safely to prevent a current that exceeds the rated current of the contact circuit from flowing.

3. Overvoltage applied to the coil

   Ensure that the voltage applied to the coil does not exceed the maximum voltage.

4. Wiring failure

   Securely tighten the terminal screws. Check that the relay is securely connected to the socket.

Layer Short Circuit

When a relay coil generates an abnormal amount of heat, the coil resistance decreases, which eventually leads to wire break down.
In minor cases, this fault presents as discoloration of the coil wire surface and melting of the coil's packaging tape. However, in major cases this fault can lead to melting of the coil wire covering (generally made of polyurethane), melting or deformation of the coiled spool, and the case appearing swollen.

Likely Cause: Overvoltage

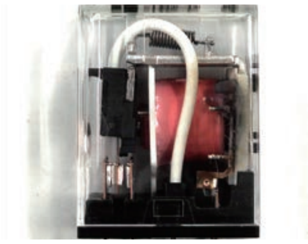
When power is supplied to a relay coil, the coil wires generate heat due to joule heating, which causes the temperature to rise.
When an overvoltage is applied, excessive heat is generated, which causes the covering (generally made of polyurethane) to melt. This leads to the coil wires short-circuiting, which decreases the coil resistance.
When the coil resistance decreases, the current that flows through the coil wires increases, which causes even more heat to be generated. This results in an accelerating cycle in which the covering melts, the coil wires short-circuit, the coil resistance decreases, and the heat generated increases. Finally, the coil wires are burnt through, which causes wire break down and fusing.

The maximum voltage of the coil is determined for each relay, so applying a voltage that exceeds this value leads to an abnormal rise in temperature, the melting of the covering, and a layer short.

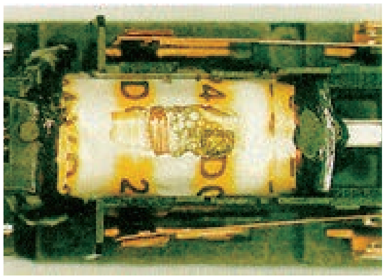
Reference

Heat resistance temperature of polyurethane-coated copper wires

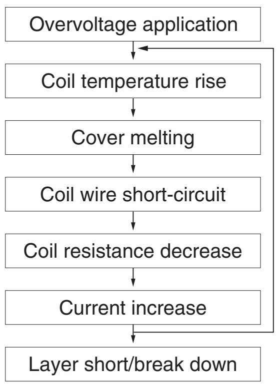
The heat resistance temperature of the polyurethane-coated copper wires that are generally used in relays is 120°C. Relay coils are designed so that the heat generated when the rated voltage is applied to them is less than or equal to this temperature.



Layer short (overall) due to overvoltage applied to the coil



Layer short due to overvoltage applied to the coil



Solution

Use each relay within its maximum voltage specification.

Generally, the maximum voltage is 110% of the rated voltage. (For some relays, this can be a different value such as 130% or 150%, so check the maximum voltage in the Datasheet or product specifications.)

(The maximum voltage is the instantaneous capacity with the expectation that voltage fluctuations will occur. It is not the continuous capacity.)

Exercise special caution to prevent errors such as connecting 200 VAC to 100 VAC relays. This is because AC operation type (AC coil) relays generate more heat than DC operation type (DC coil) relays.

Contact Welding

A large inrush current, or continuous arc heating due to high-frequency switching leads to welding or melting of the contact surface, which makes it impossible to open the contact. This results in a release failure.

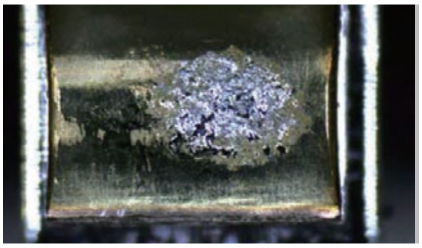
Likely Causes

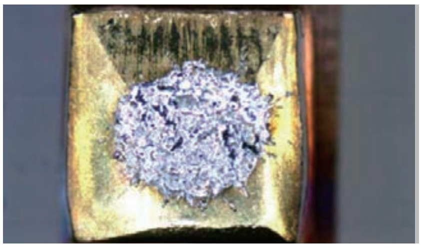
1. **Inrush current**
   The presence of an inrush current that is a multiple of the rated current increases the possibility of welding.
2. **Chattering and vibration**
   Even with a load current that is within the contact's rated current, contact welding occur due to factors such as those shown below. Welding may be caused by the heat generated when chattering occurs due to incomplete operations arising from power supply voltage drops or when vibrations occur due to coil voltage drops.
3. **High-frequency switching**
   High-frequency switching is caused by malfunctions in the sensor, switch, microcomputer, or other device that is used to control turning the relay coil ON and OFF.
4. **Load short-circuit current**

Reference
The power supply voltage may drop at the instant that a motor or contactor is operated.

Reference
Solution using a relay
The capacity of a contact to withstand welding varies depending on the contact materials (as shown below). Select the appropriate relay model and contact materials according to the inrush current/carry current (breaking current) and required service life (number of operations).

Ag -> AgNi -> AgSnIn
→ Resistant to welding


Fixed contact


Moving contact


Fixed contact


Moving contact

Solution

1. **When switching to loads with a large inrush current, first contact OMRON (because the inrush current limit value regarding welding varies depending on the relay model), and then check the operation using the actual devices.**
2. **Consider ways to prevent the chattering and vibrations caused by drops in the power supply voltage and the applied coil voltage. Exercise special caution when using relays with AC specifications.**
3. **Consider ways to prevent high-frequency switching between relay coils due to malfunctions of the sensor, switch, microcomputer, or other device that controls the turning ON/OFF of the relay coils or due to vibrations and impacts.**
   - **For high-frequency switching, consider using SSRs.**
4. **Exercise caution to prevent loads from being short-circuited.**

CASE 06

Contact Sticking (Contact Gluing)

Contact sticking (contact gluing) refers to the state in which contact surfaces facing each other in contacts that have undergone gold cladding adhere together due to vibrations caused by factors such as ultrasonic cleaning and cannot open.

Likely Cause: Contact Material (Gold Cladding) and High-speed Vibration

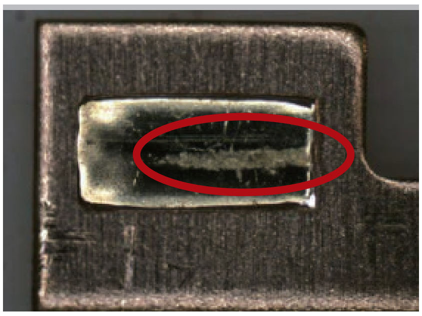
This phenomenon may occur under the conditions listed below in the situation in which the contacts of a relay are NC contacts and are gold clad.

- When ultrasonic cleaning is performed, the contacts vibrate at high speed, which causes sticking to occur.
- When the terminal leads are cut, ultrasonic vibrations are transmitted to the terminal, which causes the contact to vibrate, which may also lead to sticking.

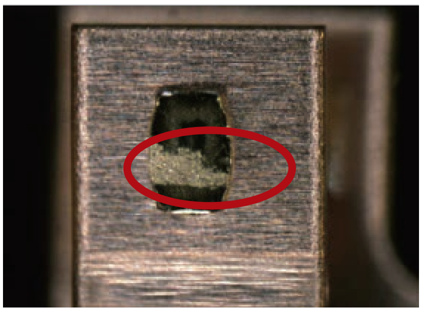
Reference

Properties of gold

Gold is extremely soft, deforms easily, and has high corrosion resistance. Therefore, even a small contact force causes a new surface to form due to deformation. When new and pure gold surfaces such as these come in contact with each other, they may adhere together—like the layering of lumps of clay—and not be able to separate.



Stationary contact



Moving contact

Solution

1. Solution using a relay

Among OMRON PCB relays, there are some products that are compatible with ultrasonic cleaning, so select these relays when performing ultrasonic cleaning.

2. Solution during PCB mounting

- **Do not perform ultrasonic cleaning with products that are not compatible with ultrasonic cleaning.**

  Even with products that are compatible with ultrasonic cleaning, perform cleaning according to the recommended conditions listed below.

Ultrasonic wave output	Frequency	Frequency mode	Cleaning time
460 mW/cm² or less	24 kHz 28 kHz 45 kHz	Single	Within 1 minute
	28 kHz to 90 kHz	Multi	

- **Do not cut the relay terminal leads.**

  Note that even if contact sticking occurs, you can return the relay to normal operation by subjecting it to a light impact, by applying voltage to the coil, or by similar methods. In situations such as these, microscopic depressions and projections (roughness) remain on the gold surface, but, generally speaking, the relay can be used as normal in the majority of cases.

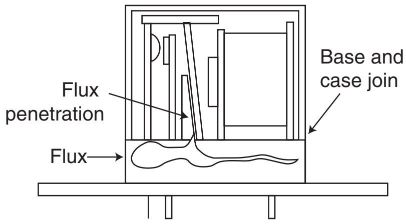
CASE 07

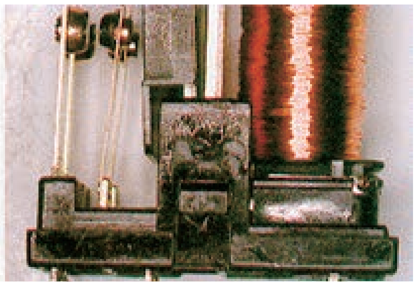
Operation Failure due to Flux Penetration

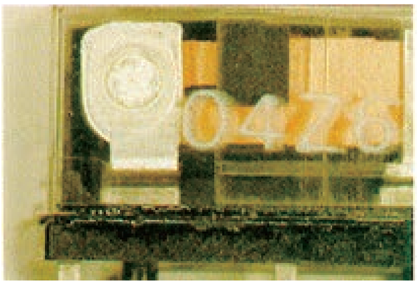
When mounting relays on PCBs, flux penetrates into the relays, which leads to operation failures and contact failures.

Likely Cause: High Flux Liquid Level

When flux is applied to a PCB, if the flux liquid level is high and adheres to the part where the relay base and case fit together, flux penetrates into the relay. If the flux adheres to the sliding parts, the result is operation failures. If the flux adheres to the contact, the result is contact failures.




Flux oozing


Flux oozing

Solution

1. **Closely manage the flux liquid level.**
2. **If it is difficult to manage the liquid level, we recommend that you use plastic sealed relays.**
3. **If there is evidence of the flux adhering to the part where the relay base and case fit together and of the flux penetrating into the relay, replace the relay.**

CASE 08

Locking due to Contact Transfer

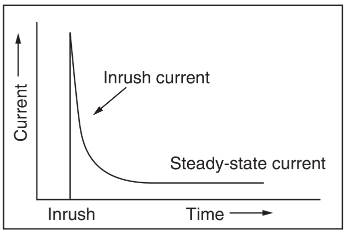
Due to contact load conditions, contact transfer can occur and develop as the count of contact switching operations increases. This causes opposing contacts to become mechanically caught, making it impossible to open them, which is locking (release failures and operation failures).

Likely Cause: Arc Heating during Load Switching

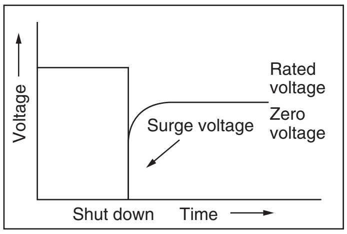
During load switching (turning the load ON or OFF), the contact (made of silver, which has a boiling point of approximately 2000°C) is vaporized locally due to arc heating (approximately 6000°C). This vapor adheres to and accumulates on one of the poles (either from the positive pole to the negative pole or from the negative pole to the positive pole), which causes transfer to occur or develop.

Under the following conditions, this phenomenon occurs even at a load current that is less than or equal to the rated current, so it is necessary to check for this phenomenon using actual devices (that is, with factors such as the actual environment and the actual switching frequency to be used).

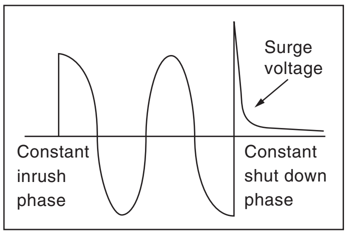
1. This phenomenon occurs with loads that have an inrush current that is larger than the breaking (steady-state) current. Examples of such loads include DC lamp loads and capacitor loads.

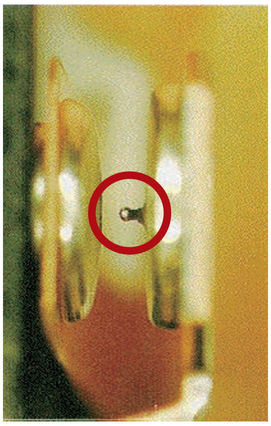


2. This phenomenon occurs with loads that generate a large counter-electromotive voltage (surge voltage) when they are turned off. Examples of such loads include DC solenoid loads, valve loads, and contactor loads.
Even if there is no inrush current, transfer is caused by the arc heating of the counter-electromotive voltage.
Also, even during just the turning ON operation when the turning OFF operation is no-load switching, transfer occurs due to the bounce when the contact turns ON.

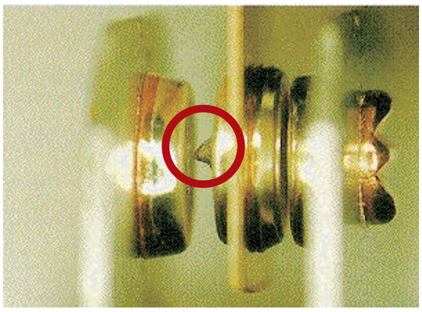


3. Generally speaking, this phenomenon occurs with DC loads. However, even with an AC load, if the inrush or shut down phase is always the same, the state becomes just like the switching of DC loads, and transfer occurs.
Even if you do not intend for synchronization to occur, it may be caused by some signal.





Contact transfer due to inrush current



Contact transfer due to inrush current

Contact transfer due to surge voltage

Solution

1. Solution using circuit design

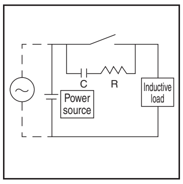
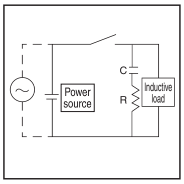
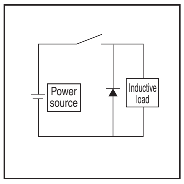
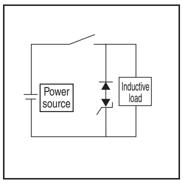
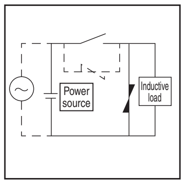
(1) For loads with a large inrush current such as DC lamps, capacitors loads, and motor loads

- **Make the inrush current as small as possible.**
  One method is to install a current-limiting resistance in series with the load to reduce the inrush current.

(2) For loads that generate large counter-electromotive voltage when they are turned OFF such as DC solenoids, valves, and contactors

- **Make the counter-electromotive voltage (surge) as small as possible. Refer to the following table of typical surge killer examples when considering which product to use.**

Surge killer typical examples

Classification / Item		CR method		Diode method	Diode + Zener diode method	Varistor method
Circuit example						
Applicable	AC	OK*	Good	Poor	Poor	Good
	DC	Good	Good	Good	Good	Good
Characteristics		* When using this method with an AC load, ensure that the load's impedance is sufficiently smaller than the CR impedance.	When the load is a relay, solenoid, or a similar device, the release time becomes longer.	The energy stored in the coil flows in the coil as current due to the diode that is connected in parallel. This energy is consumed as joule heating by the resistance of the inductive load. This method's release time is even longer than the CR method.	This method is effective when the release time is too long with the diode method.	This method uses the constant voltage property of varistors in order to ensure that the voltage that is applied between contacts is not too high. This method also slightly increases the release time. When the power supply voltage is 24 to 48 V, it is effective to establish a connection between the loads. When the power supply voltage is 100 to 200 V, it is effective to establish a connection between the contacts.
How to select elements		C and R guidelines C: 0.5 to 1 (µF) per 1 A of the contact current R: 0.5 to 1 (Ω) per 1 V of the contact voltage These values may not match the actual situation depending on factors such as load materials and variations in relay properties. Use an experiment to check that C is affected by the electrical discharge control when the contact opens and that R serves the role of limiting the current the next time power is supplied. Generally use a product with a C withstand voltage of 200 to 300 V.		Use a diode with a reversed withstand voltage that is 10 times or more the circuit voltage and with a forward current that is greater than or equal to the load current. If the circuit voltage of the electric circuit is not that high, you can use a diode that has a reversed withstand voltage that is approximately 2 to 3 times the power supply voltage.	Use a Zener diode that has a Zener voltage that is approximately equal to the power supply voltage.	Select a varistor so that the cutoff voltage Vc is within the conditions listed below. For AC, it is necessary to make the cutoff voltage $\sqrt{2}$ times the power supply voltage. Contact withstand voltage > Vc > power supply voltage

2. Solution using a relay

- **You can slightly reduce the contact transfer by changing the contact material, but it is not possible to completely prevent this phenomenon from occurring. As such, it is necessary to perform a check with actual devices, that is, in the actual environment and with the actual switching frequency.**

Ag ——— AgNi ——— AgSnIn
Occurs easily ⟵⟶ Does not occur easily

Contact material	Typical model
AgNi	MK□P, etc.
AgSnIn	G7T (for output), etc.

- **By changing to a relay with a large rated current, it may be possible to perform switching in which a slight amount of transfer can be ignored.**
  This also needs to be checked with actual devices, that is, in the actual environment and with the actual switching frequency.

CASE 09

Contact Failure due to Carbonization

During switching, carbonization occurs (carbon is generated) on the contacting surfaces. This increases the contact resistance and leads to contact failure.

Likely Cause: Carbonization

The instant that a circuit is opened, the arc heating of the counter-electromotive voltage causes the organic gas surrounding the contact to decompose or carbonizes dust and similar materials, leading to the formation of carbide on the contacting point. This occurs easily with inductive loads such as solenoids, valves, contactors, and relays.
Also, if the contacting surface is carbonized, the minimum arc current becomes small, as shown in the table on the right. This may accelerate the carbonization.

Reference
Arc heating also occurs when power is turned ON, but this has less of an effect than the phenomenon when power is turned OFF.

Reference
Minimum arc voltage and current

Material	Minimum arc voltage (V)	Minimum arc current (A)
Au	9.5 to 15	0.38 to 0.42
Ag	8 to 13	0.4 to 0.9
C (carbide)	15 to 20	0.01 to 0.03

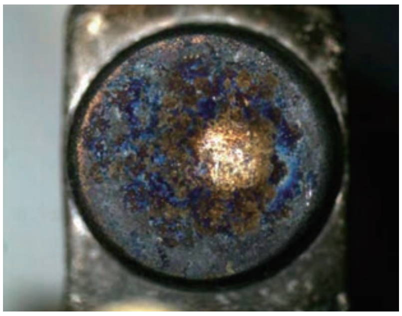
1. Guidelines for conditions under which it is easy for contact failure due to carbonization to occur

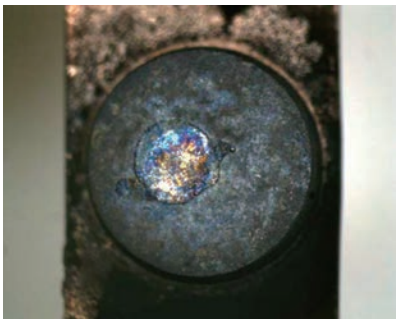
×: Occurs easily △: Occurs somewhat easily
○: Does not occur easily ◎: Does not occur

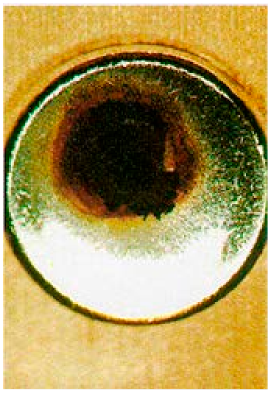
Load type and current (Load voltage)		12 VDC	24 VDC	48 VDC min.	100 VAC	200 VAC
Inductive loads (solenoid, valve, contactor, relay, etc.)	10 mA max.	○	○	○	○	◎
	10 to 100 mA	×	×	○	○	◎
	100 to 300 mA	△	△	○	○	◎
	300 mA min.	△	○	◎	◎	◎
Resistive loads and loads with large inrush current and that generate a shut-down surge (motor)	10 mA max.	○	○	◎	◎	◎
	10 to 100 mA	△	△	○	○	◎
	100 to 300 mA	○	○	◎	◎	◎
	300 mA min.	○	◎	◎	◎	◎
Loads with large inrush current (lamp, capacitor, etc.)	10 mA max.	○	◎	◎	◎	◎
	10 to 100 mA	○	◎	◎	◎	◎
	100 to 300 mA	◎	◎	◎	◎	◎
	300 mA min.	◎	◎	◎	◎	◎

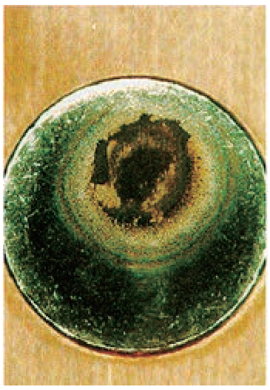
* There are major variations depending on factors such as the concentration of the organic matter and the relay model, so use this information as a guideline.

2. Some examples of organic matter that cause carbonization include aromatic, unsaturated, cyclic compounds (such as benzene and toluene); exhaust fumes; and tobacco smoke.


Fixed contact


Moving contact


Fixed contact


Moving contact

Solution

1. Solution through usage

(1) With inductive loads, the counter-electromotive voltage is large, which results in large arcs. Compared to resistive loads, this makes it several times easier for carbonization to occur with inductive loads.

Installing a surge killer greatly reduces the counter-electromotive voltage to the point where it approaches that of resistive loads. This improves the contact reliability.

(2) Avoid environments with organic gases as much as possible.

2. Solution through relay selection

(1) Select a type of relay that is resistant to the effect of the surrounding environment.

Flux proof models ——— Plastic sealed models ——— Hermetically sealed models

Low resistance ←——————→ High resistance

(2) If there are no problems regarding the service life of the contact, select the type of contact according to the information shown below.

Silver alloy contacts — Silver contacts — Gold-plated contacts —
Bifurcated (gold-clad) contacts — Crossbar bifurcated (gold-clad) contacts

Low resistance ←——————→ High resistance

Contact Failure due to Silicone

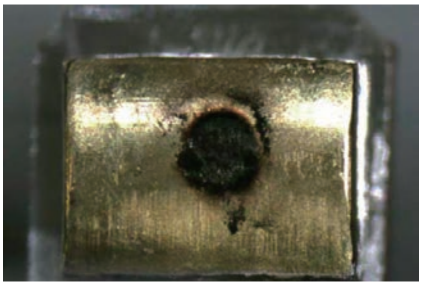
When a relay is used in an environment in which silicone gas is present, the gas penetrates into the relay (even with plastic sealed models, the silicone penetrates through the case) and is converted to silicone oxide by the arc heating during load switching. This silicone oxide adheres to and accumulates on the contacting surface, which leads to contact failures.

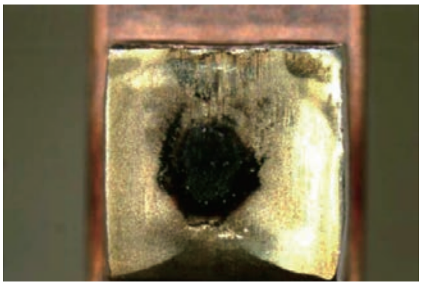
Likely Cause: Silicone Gas

1. Sources of silicone gas

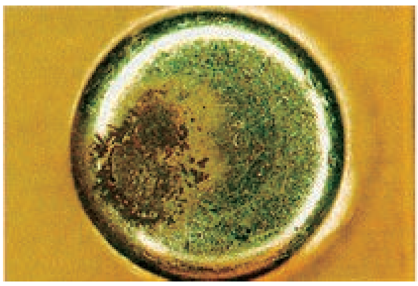
Some sources of silicone gas are listed in the following table. Prior to use, check that no organic silicone gas is generated. Things to pay special attention to include the direct application of silicone coating agent to a relay and the use of a relay and a silicone gas source at the same time within a well-sealed housing because these will increase the concentration of silicone, which is dangerous.

Example sources of silicone gas
1. Silicone coating agent
2. Silicone adhesive
3. Silicone rubber
4. Silicone oil
5. Silicone grease
6. Transformers that use silicone
7. Silicone lead wires


Fixed contact


Moving contact


Fixed contact


Moving contact

2. Penetration process of silicone gas

(1) The relay is used in an environment in which silicone gas is present.

⇩

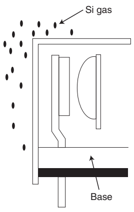
(2) The silicone gas penetrates into the relay through its case or through the gaps between the parts that are fit together.

⇩

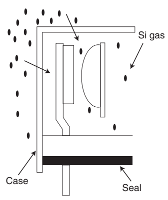
(3) The arc energy during contact load switching converts the organic silicon (Si) into silicone oxide (SiO_2), which adheres to the contacting point.

⇩

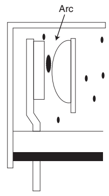
(4) The silicone oxide accumulates as the count of switching operations increases, which increases the contact resistance. This results in contact failure.



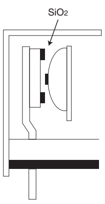
Use of a relay in an environment in which silicone gas is present.



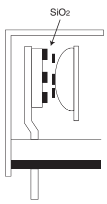
After approximately 1 to 3 months, the silicone gas penetrates into the relay case due to its absorption.



The arc energy (approximately 6000°C) during load switching converts the Si gas into SiO_2, which is burned to the contacting point.



As the Si gas is supplied and the number of switching operations increases, the adhered SiO_2 accumulates.



This results in contact failure.

Reference

Case material and thickness

There are products with a case made of a thin layer of PBT approximately 0.3 mm thick. The atmosphere gradually penetrates into the case due to the respiration of the resin.

Reference

Atmosphere penetration period

With plastic sealed models, it takes 1 to 3 months for the atmosphere to penetrate into the case. With flux proof models, it takes 1 day for the atmosphere to penetrate into the case.

Reference

Contact load conditions

Even if silicone gas exists in the operating environment, contact failures may not occur.
This depends on the contact load conditions and on the silicone gas concentration.

Example test in a silicone gas environment

○: SiO_2 adhesion present ×: No SiO_2 adhesion present

No.	Load			Contacting point SiO_2 adhesion	Contact resistance	Considerations
1	DC	1 V	1 mA	×	No increase detected	No arcs are generated, so the Si gas is not chemically changed to SiO_2 and burned onto the contact.
2	DC	1 V	36 mA	×		
3	DC	3.5 V	1 mA	×		
4	DC	5.6 V	1 mA	×		
5	DC	12 V	1 mA	○	Increase of a few ohms	SiO_2 is generated in the area where it is easiest to increase the resistance and the purification operation is weak.
6	DC	24 V	1 mA	○	10 Ω or more total for 3000 times	
7	DC	24 V	35 mA	○	10 Ω or more total for 45000 times	
8	DC	24 V	100 mA	○	No increase detected	The arcs generate SiO_2, but the purification operation of the arcs (the removal of SiO_2 by the arcs) has a greater effect.
9	DC	24 V	200 mA	○		
10	DC	24 V	1 A	○		
11	DC	24 V	4 A	○		
12	AC	100 V	30 mA	○		
13	AC	100 V	100 mA	○		
14	AC	100 V	1 A	○		

Solution

1. Solution using a relay

If you cannot avoid environments in which silicone gas is present, consider using a hermetically sealed relay that has a metal case (example: MY4H).

2. Solution using PCB design

During the design stage, consider how to ensure there is no silicone gas in the environment around the relay.

Another possible solution is installing a surge killer to greatly suppress the arcs.

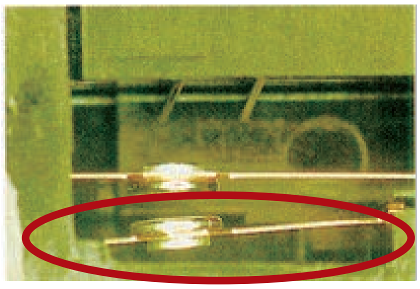
CASE 11

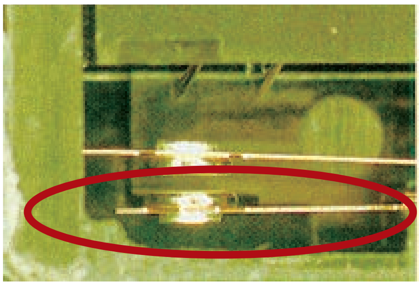
No Contact Follow

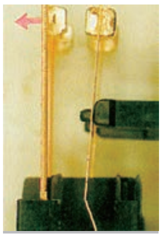
When a relay receives a strong impact (such as by the relay being dropped), the contact arm is deformed or the stationary terminal is tilted. In this state, even if the rated voltage is applied to the coil, the contacts do not touch, so there is no contact continuity. This situation is known as "no contact follow."

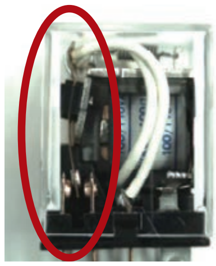
Likely Cause: Strong Impact (Such as Dropping the Relay)

The conditions vary depending on the size, weight, structure, contact arm and stationary terminal width, and board thickness differences between relays as well as the manner in which the relay was dropped (such as whether the relay itself was dropped or if it was dropped while packaged). However, applying a strong impact to a relay that exceeds the rated value of the relay (such as by dropping the relay), causes the elastic deformation area of the contact arm and stationary terminal to be exceeded due to the inertial force of the impact, which deforms the contact arm and stationary terminal, leading to their deformation and tilting.


Fault


Good product


Stationary terminal tilted to the outside


Deformation of the contact arm

Solution

1. **Exercise sufficient caution during handling to prevent the relay from being subjected to impacts such as by dropping the relay.**
2. **Do not use a relay that has been dropped or may possibly have been dropped by accident.**
3. **If the packaging (the external cardboard box or the individual packaging box) shows damage such as dents or signs of the load falling over during transport, there is a possibility that the relay has been dropped or has otherwise been subjected to impacts while packaged, so do not use the relay. Instead, contact the transporting company or OMRON.**

memo

CASE 12

Contact Failure due to Sulphurization or Chlorination

Under microload conditions, using a relay in an environment in which sulphide gas is present or in an environment in which it is subject to salt-air damage leads to the sulphurization or chlorination of the contacting surface, which increases the contact resistance, leading to contact failures.

Likely Causes

1. Sulphurization

Sulphide gas reacts with the silver contact material to generate silver sulphide (Ag_2S). (The more the color changes from light purple to black, the thicker the layer of silver sulphide.) Silver sulphide is an insulator, so using the relay with microloads and low-frequency switching may lead to contact failure.

2. Chlorination

In environments where chloride gas is present or in coastal areas where salt-air damage occurs (due to NaCl), silver chloride (AgCl, which has a white color) is generated in the same manner as explained above. As stated for sulphurization, chlorination can also lead to contact failure.

◆Conditions that make it easy for this phenomenon to occur

Gas concentration, microloads, low-frequency switching, and the use of silver contacts. The more of these conditions that apply, the easier it is for contact failure to occur.

Caution

Gold plating

The main purpose of the gold plating of the contacts of power relays (for example, the MY2Z) is to stabilize the initial contact resistance prior to the first use of the product.

The gold plating of the contact point is peeled off by the friction and pressure during contact switching or by the arc energy during load switching, which exposes the silver base material.

Sulphurization and chlorination can occur on this exposed part.

Even if a contact is gold plated, the combination of conditions such as the operating environment, microloads, and low-frequency switching may cause sulphurization to occur through pinholes in the gold plating, which may lead to contact failure.

Caution

Gold cladding

With gold-clad contacts (for example, the gold-clad contacts of the MY4), the cladded surface is thick, which generally eliminates the occurrence of pinholes (compared to gold-plated contacts). This provides a high level of resistance against both sulphurization and chlorination. However, in the same manner as gold-plated contacts, friction, pressure, and the arc energy during load switching can peel off the gold cladding of the contact point, exposing the silver base material. Sulphurization and chlorination may occur on the parts of the contact end face that are not clad in gold (locations where the silver is exposed).

Caution

Types for which the rate of occurrence of this phenomenon is high

- Enclosed (cased) relays
- Flux proof relays

Caution

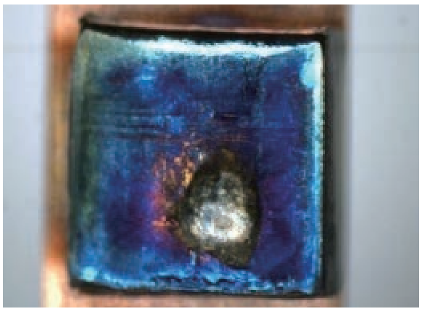
The effect of humidity

If the humidity exceeds 60%, sulphurization and chlorination accelerate.

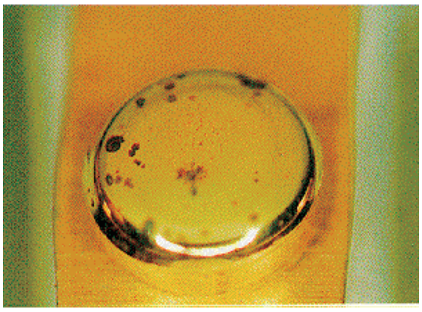
Caution

Contact load guidelines

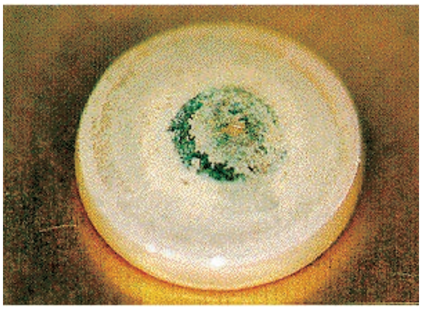
For contact load guidelines, at loads less than 48 V or less than 100 mA, cleaning effectiveness decreases, so it is necessary to consider sulphurization and chlorination.



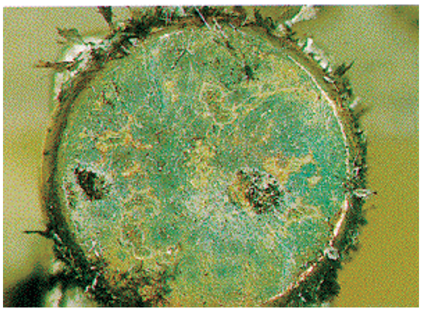
Sulphurization of a gold-clad contact



Sulphurization of a gold-plated contact



Chlorination of a silver contact



Sulphurization of a silver contact; silver sulphide whiskers

Solution

When it is not possible to avoid environments in which sulphide gas or chloride gas is present or in which salt-air damage occurs, select the relay after considering the information shown below.

1. Select a relay that is sealed as well as possible

Well-sealed relays

Sealing	Structure	Typical relays
High ↑ Low	Hermetically sealed	MYH
	Plastic sealed	MYQ
	Enclosed (in a case)	MY2Z MY4 MY4Z-CBG, G7T, etc.

2. When using an enclosed relay (in a case), select a relay that uses contact material with the highest corrosion resistance possible.

Corrosion resistance	Contact material	Contact structure	Typical relays
High ↑ Low	Au cladding + AgPd	Crossbar bifurcated contacts	MY4Z-CBG
	Au cladding + Ag alloy	Single contacts Bifurcated contacts	MY4, MY4Z, etc.
	Au plating + Ag alloy	Bifurcated contacts	MY2Z, etc.
	Ag alloy	Single contacts Bifurcated contacts, etc.	MY2, G2R, MK, MM, G7Z, etc.

* Ag alloy is effective for large-current switching. When the load current is small, it is easy to be affected by the outer atmosphere, so consider a relay with high corrosion resistance.

3. Relays have weak resistance against sulphurization and chlorination with microloads and low-frequency switching.
Increase the voltage and current that are applied to the contact in order to destroy the sulphide or chloride layer. In terms of sulphurization and chlorination, relays with low-frequency switching are at a disadvantage. Select an advantageous relay according to the information listed above.

CASE 13

Corrosion

The inside of a relay's transparent case may turn yellow/yellowish-green or green/bluish-green corrosion products may form on contacts and metal parts. Corrosion products forming on contacts and metal parts may lead to contact failure and operation failure.

Likely Cause: Nitric Acid (HNO_3)

These discolorations and corrosion products are caused by nitric acid (HNO_3).

The occurrence of arcs at the contact and the amount of moisture in the environment greatly affect the occurrence of corrosion due to nitric acid generation.
The generation of corrosion products is accelerated by loads that generate a large amount of arcs (such as DC loads and inductive loads) and by environments there the humidity is high.
(Generally, DC inductive loads make it easy for arcs to occur.)

Reference

Nitric acid generation principle

The arcs generated by load switching cause the nitrogen (N) in the atmosphere to react with moisture, which generates nitric acid. Nitric acid not only discolors cases but also bonds with the silver (Ag) or copper (Cu) contact material and with the iron (Fe) or nickel (Ni) of the armature and similar parts. This leads to corrosion products such as silver nitrate, copper nitrate, iron nitrate, and nickel nitrate forming on the surfaces of the metal parts.

Caution

Generally, this phenomenon occurs easily with relays used for power load switching.

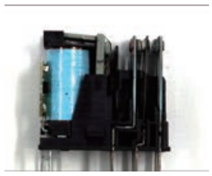
Overall (side)

Yoke armature

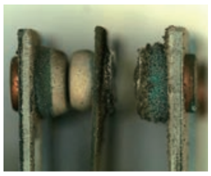
Moving contact

Stationary contact

Overall (side)



Open case



Corrosion due to nitric acid

Solution

1. **Do not use relays in environments that exceed their maximum ambient operating temperature or maximum ambient operating humidity.**
2. **Even in environments that are within the maximum ambient operating temperature and the maximum ambient operating humidity, corrosion products can be generated if arcs occur frequently, so eliminate arcs by adding a spark killer.**

memo

CASE 14

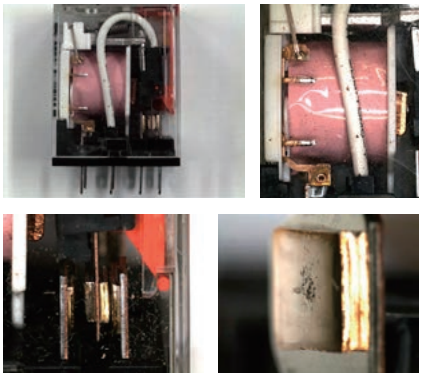
Contact Failure due to the Penetration and Adherence of Foreign Substances (Such as Dust and Insects)

With relays such as flux proof relays that are not airtight such as by being enclosed (cased), completely sealed, or heat sealed, if fine dust or insects exist in the operating environment, these foreign substances can penetrate into the inside of the relay through parts where the relay case and base fit together and through locations that are not sealed. These foreign substances can lead to contact failure by adhering to and mediating between contacts.

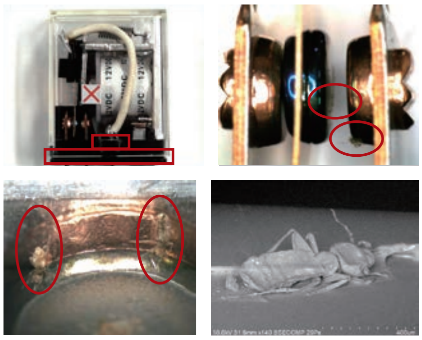
Likely Cause: Penetration of Foreign Substances into the Relay

With enclosed (cased) relays and flux proof relays, which are mainly used in power load switching, there are gaps where the case and base fit together and at the bottom of the base and there are ventilation holes on the top of the case.

In dust-producing environments such as where molding machines and grinders are present and in application environments in which small insects (such as ants) are present (which do not have to be outdoors, insects are also present in indoor environments), these foreign substances can penetrate into the relay through where parts of the relay fit together, through gaps between parts of the relay, and through the relay's ventilation holes. Once inside the relay, dust and insects often remain inside. If they adhere to the contacts, the result can be problems such as contact failure and unstable contacts.



Penetration of dust



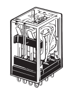
Penetration of insects

Solution

1. Check the relay's application environment to ensure that it is free of foreign substances such as fine dust and small insects.

2. It is desirable to cover the whole relay with a protective cover or a similar device, but if this is not possible, consider using a plastic sealed relay (examples: MYQ4 and LYQ2) or a hermetically sealed relay (example: MY4H) provided that doing so does not impede the load switching capacity.

3. Among our enclosed relays, special products with a transparent simple seal is wrapped around the part where the case and base fit together in order to prevent foreign substances from penetrating into the relay are also available, so contact your OMRON sales representative when considering such relays.

Installation structure	Protective structure	Features	Typical model	Operating environment (penetration of debris and dust)
PCB-mounted relay	Flux-proof model	A structure that makes it difficult for flux to penetrate into the relay during soldering	 G2R	OK (Prevents the penetration of large debris and dust)
	Plastic sealed model	A structure that prevents the penetration of flux during soldering and the penetration of cleaning solution during cleaning	  G6A G6S	Good
Plug-in relay	Enclosed (cased) model	A structure in which the relay is inserted in a case to protect against the adherence of foreign substances	 MY	OK (Prevents the penetration of large debris and dust)
	Plastic sealed model	A structure in which the relay is sealed with parts such as a resin case and cover to make it difficult for the relay to be affected by corrosive environments	 MYQ4	Good
	Hermetically sealed model	A sealed structure injected with an inert gas (N_2) and sealed with parts such as a metal or glass case and base (the outer surfaces of which are also resistant to harmful corrosion) in order to prevent corrosive gases from penetrating into the relay	 MYH	Good

CASE 15

Burn Damage

Burn damage is caused by problems such as overcurrent, overvoltage, and vibration. (Flame-retardant materials are used to construct relays, so the burn damage described in this section does not refer to damage caused by the relay catching fire and burning continuously.)

Likely Cause: Abnormal Heat Generation and Deterioration of Insulation

Abnormal heat generation from the area surrounding the contact and the deterioration of the insulation may lead to the area surrounding the contact melting, smoke being generated, and—in the worst case—burn damage.

◆Conditions that make it easy for burn damage to occur

Generally, burn damage is commonly caused by abnormal heat generation from the area surrounding the contact. It is easy for burn damage to occur under the following conditions.

(1) The melting of the contact and the resin surrounding the contact due to continuous arcs caused by contact vibration (extremely high-frequency switching).
Some possible causes of vibrations include the dropping of the applied coil voltage and malfunctions of the sensor, switch, microcomputer, or other device that controls turning the relay coil ON/OFF.

(2) Insulation failure between contacts with the same polarity or short-circuiting between contacts with different polarity due to factors such as usage in which the maximum value (the rating) of the contact voltage is exceeded and load surge voltage.

(3) Supplying to the contact circuit power that exceeds the maximum value (prescribed value) of the contact carry current or that has a short-circuit current.

(4) Deterioration of the insulation between contacts having the same polarity and between the coil and the contacts due to the accumulation of contact consumption powder or carbon within the relay arising from the use of the relay in a manner that exceeds its electrical durability.

Reference

Applying an overvoltage/ overcurrent to the coil

When an overvoltage/ overcurrent is applied to the coil, a coil break down occurs due to a layer short, which means that burn damage generally does not occur. (The extent of the burn damage is just the trace of abnormal heating on the coil.)

Caution

When the G7J is installed horizontally, load switching carbon accumulates between different polarities, which may cause problems ranging from insulation deterioration to burn damage.

Burn damage due to overcurrent/ overvoltage

Short-circuiting between contacts of different polarity

Burn damage due to insulation failure

Burn damage due to insulation failure

Solution

Follow the usage conditions clearly listed in the Datasheet and specifications when using the relay.

CASE 16

CR Element Damage (Short/Open Fault) and Burning

Among OMRON relays (AC operation type [AC model] relays), there are models that have a built-in CR element in parallel with the coil to absorb the counter-electromotive voltage (surge) that occurs when the coil turns OFF.
With relays that have a built-in CR element, if an external surge that exceeds the capacity of the CR element is applied between the coil terminals, the CR element is damaged, leading to a short or open fault. However, in the majority of cases, the CR element is left in the open state, and it or its surrounding area is burned black.
In this situation, the relay operates but the CR element does not perform its function (absorbing the counter-electromotive voltage of the relay coil).

Likely Cause: Damage due to External Surge Voltage/Current

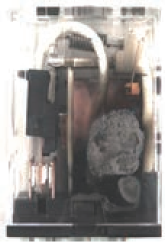
If a lightning surge, a surge generated by another device in the circuit in which the relay is used, or a withstand voltage test (the impulse withstand voltage test) performed on a control circuit in which the relay is installed exceeds the capacity of the CR element built into the relay, the CR element will be damaged.

Reference

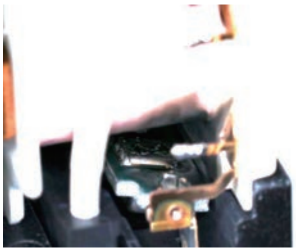
CR element (built into the relay)
The CR element protects the relay drive circuit (electronic components such as transistors) and other devices in the circuit by absorbing the counter-electromotive voltage (surge) generated from the relay's self-coiling when the relay turns OFF.
Example: Approximately 1000 V for the 200 VAC specification MY Series

Reference

CR element principle
C (the capacitor) stores the surge energy, which smooths out the rising edge of the applied surge voltage. R (the resistance) limits the surge current and converts the surge energy into heat to discharge it.



Burning in the area surrounding the CR element



Burning of the CR element (circuit board)

Solution

1. Solutions for external surges (including lightning surges)

Implement appropriate countermeasures (installing surge absorbers and varistors) for the surge sources (such as devices) in the circuit.

2. When it is not possible to reduce external surges

Possible methods include using the standard model (which does not have a built-in CR element), absorbing the counter-electromotive voltage generated from the relay coil, and separately installing a surge absorbing circuit that matches the level of the external surge that is generated in the circuit.

*** In AC circuits, the CR method and the varistor method are generally used for surge absorbing circuits.**

*** The surges (the discharged energy) generated from self-coiling are consumed by self-coiling and by the absorber, so installing surge absorbing elements lengthens the relay's release time. Therefore, use the actual devices to check for any effect on the devices due to the insertion of surge absorbing elements.**

Also, when changing from a CR built-in type to the standard type with an externally added absorbing circuit, the release time may change, so check for this change sufficiently with the actual devices.

CASE 17

Wear and Deterioration

The general failure modes due to a relay reaching the end of its service life are contact failure, contact welding, and insulation deterioration.
The failure mode varies depending on factors such as the relay model and the contact load.

Likely Causes

1. **Contact failure**
   Load switching causes contact wearing, which eliminates the contact force, thereby leading to contact failure.
2. **Contact welding**
   Load switching causes contact wearing, which eliminates contact wiping, thereby leading to contact welding.
3. **Insulation deterioration**
   Load switching causes contact wearing powder and carbon to accumulate, which leads to insulation failure.

Solution

1. A relay is a mechanical component and will eventually reach the end of its service life, so we recommend that you perform periodic replacements and maintenance according to the guidelines shown below.

2. The general criteria are shown below.
Replace the relay if it is exhibiting any of the symptoms shown below.

Maintenance reference

<table>
<tr><th colspan="2"></th><th>Maintenance timing</th><th>Determined by No. of operations</th><th>Determined by time</th><th>Remarks</th></tr>
<tr><td rowspan="2">Wear</td><td>Contact wear</td><td>The maintenance timing can be determined from the electrical durability curve drawn from load voltage, current, and load type. If there is no applicable electrical durability curve, the maintenance timing can be determined from test values from the device.</td><td rowspan="2">○</td><td>—</td><td rowspan="2">If the number of switching operations per unit time can be determined, the number of operations can be replaced by the time.</td></tr>
<tr><td>Wear in mechanical operation</td><td>The maintenance timing can be determined from the number of operations in the mechanical durability of the relay.
If the mechanical durability listed in the performance specifications is a value determined under standard test conditions and the actual operating conditions differ from these standard test conditions, the maintenance timing should be determined on the basis of test values from actual operating conditions.</td><td>—</td></tr>
<tr><td rowspan="4">Deterioration</td><td>Insulation deterioration of coils</td><td>The service life of a coil can be predicted if the temperature conditions under which the coil will be operated are known. A total of 40,000 hours at 120°C is used as a reference point for most polyurethane copper wire coils.</td><td>—</td><td>○</td><td>—</td></tr>
<tr><td>Contact stability</td><td rowspan="3">The inherent reliability is changed dramatically by the operating conditions and the environment. The maintenance timing can be determined by understanding the operating conditions and the environment and by performing sampling.</td><td rowspan="3">—</td><td rowspan="3">○</td><td rowspan="3">It is important to understand factors such as the on-site environment and the concentrations of toxic gases that adversely affect the contact materials.</td></tr>
<tr><td>Deterioration of the performance of metallic materials</td></tr>
<tr><td>Deterioration of the performance of resin materials</td></tr>
</table>

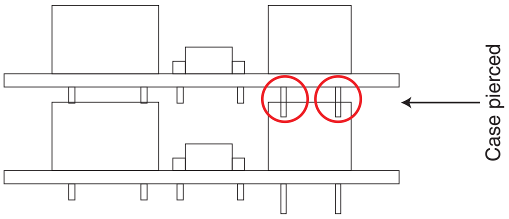
CASE 18

Case Holes

Case surface (top and side) materials that collapse into the inside of the relay obstruct the operation of the components that move inside the relay, which may lead to outer appearance defects, operation failures, and release failures.

Likely Cause: Terminals Piercing Cases

After relays are mounted on circuit boards, layering circuit boards on top of each other causes the terminals to pierce the relay cases, which leads to this problem.



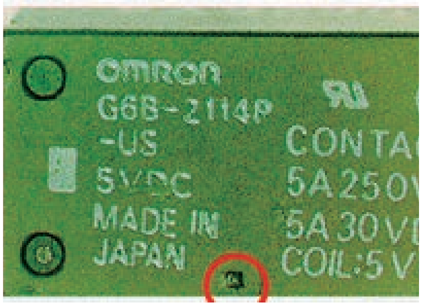
Reference

Case materials

The general material used in relay cases is PBT (polybutylene terephthalate) or PC (polycarbonate) and it usually has a thickness of approximately 0.3 to 0.5 mm. Therefore, if a pointed object comes in contact with a case, it may make a hole.

Caution

This problem may even occur with the PWB-mounted type G7J and G7SA.



Hole made in a case by a relay terminal

Hole made in a case by a relay terminal

Solution

1. **After relays are mounted on circuit boards, exercise caution to prevent the circuit boards from being layered on top of each other.**
2. **Also exercise caution when handling relays, as terminals may pierce the case in this stage as well, opening holes.**

CASE 19

Case Swelling

This phenomenon causes the top and sides of the case of a relay designed for use with printed circuit boards to swell.

Likely Cause: Temperature Stress

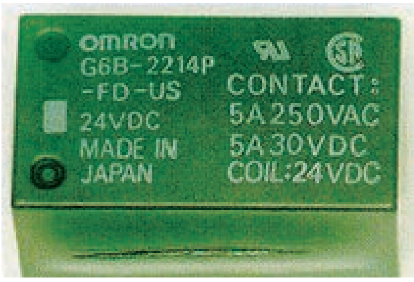
With plastic sealed relays, if the temperature around the relay increases or if a heat source is near the relay, the relay warms up. This causes the air inside the relay to expand, and the corresponding pressure causes the case to swell.

For example, consider a relay whose case material is PBT (polybutylene terephthalate) resin. This phenomenon occurs for such relays under the following conditions.

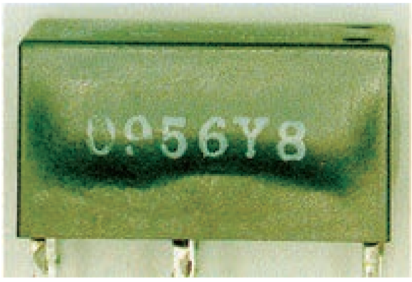
1. This phenomenon occurs if the relay receives excessive temperature stress (as shown below) when it is mounted on the circuit board.
   - When the preheating temperature is too high or when the preheating time is too long
   - When the soldering temperature is too high or when the soldering time is too long

2. If ambient humidity in which the relay is used is high, the relay's internal humidity increases and the relay absorbs moisture, which increases the saturation vapor pressure, so case swelling may occur more easily even under the same temperature and time conditions.

Case swelling



Case swelling


Case swelling

Solution

Mount the relay on a circuit board according to the temperature and time limits given under the guaranteed conditions for solder heat resistance listed in the product specifications of the relay.

Generally speaking, we recommend the following conditions.

Through hole type

Preheating conditions: 110°C or less, 40 seconds or less
Soldering conditions: 260°C or less, 5 seconds or less

Surface mount type

Preheating conditions: 150°C to 180°C, 120 seconds or less
Soldering conditions: 230°C to 250°C, 30 seconds or less

Operation Failure due to Seal Leakage

This phenomenon refers to the seal efficiency of plastic sealed relays being destroyed by the preheating when the relay is mounted on a circuit board or due to heating during soldering. Thereafter, the cleaning solution penetrates into the relay, causing insulation failure and operation failure.

Likely Cause: Temperature Stress

This phenomenon most commonly occurs when the seal efficiency around the terminals is destroyed by terminal heating during soldering. Thereafter, the cleaning solution penetrates into the relay through the terminal unit during circuit board cleaning. This phenomenon can lead to problems such as insulation failure, contact failure, and operation failure.

The proof stress varies depending on the relay model and structure, but this phenomenon occurs under the conditions listed below.

1. This phenomenon occurs if the relay receives excessive temperature stress (as shown below) when it is mounted on the circuit board.
   - When the preheating temperature is too high or when the preheating time is too long
   - When the soldering temperature is too high or when the soldering time is too long

2. This phenomenon occurs when cleaning solution is drawn into the inside of the relay, through locations where the seal is destroyed, due to atmospheric pressure changes inside the relay. Some examples of this situation include inserting the relay into cleaning solution while the relay is warm and cleaning the relay with warm cleaning solution, and then leaving the relay in a wet condition.

Solution

Mount the relay on a circuit board according to the temperature and time limits given under the guaranteed conditions listed in the catalog and in the product specifications.

Generally speaking, we recommend the following conditions.

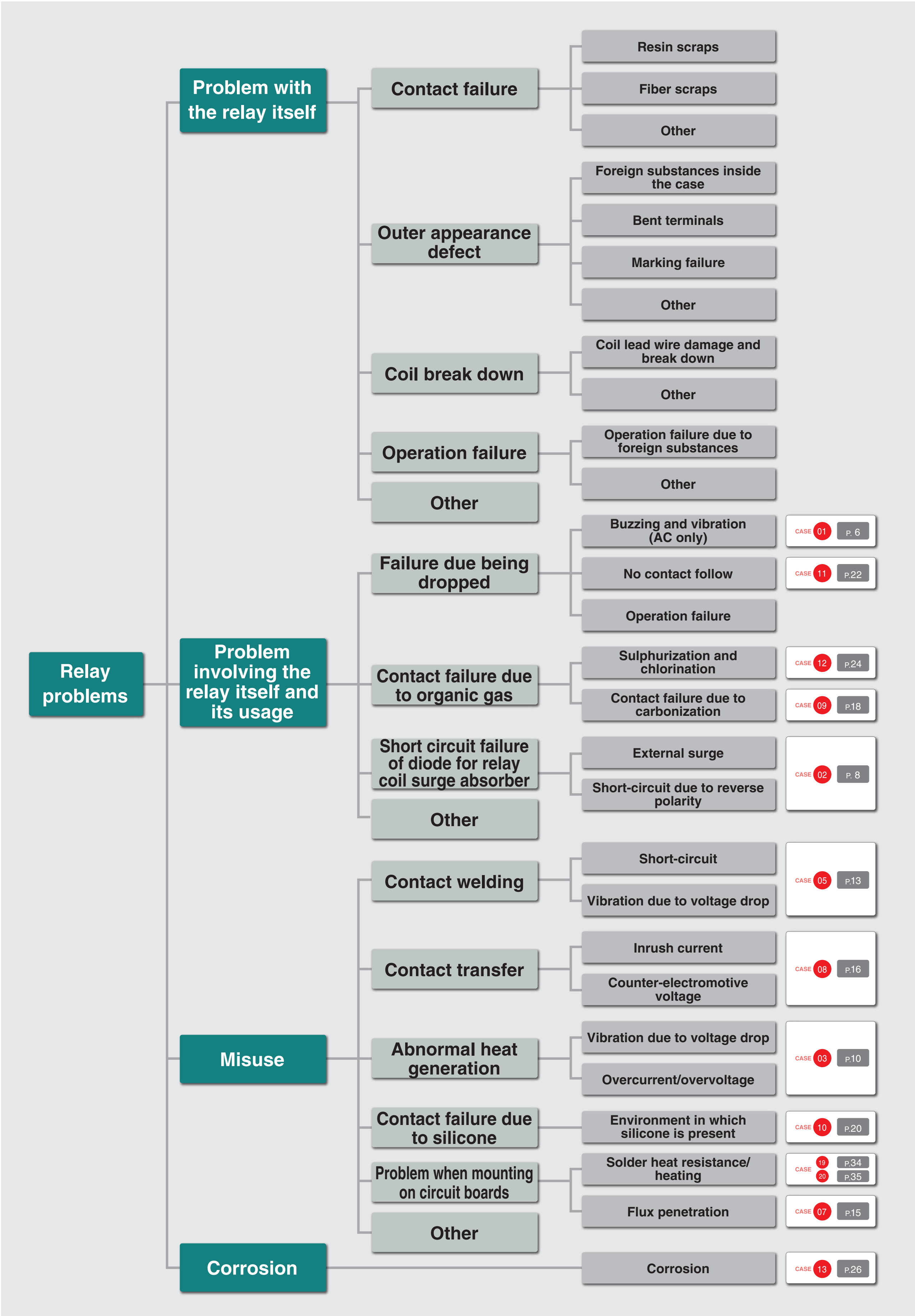
Through hole type

Preheating conditions: 110°C or less, 40 seconds or less
Soldering conditions: 260°C or less, 5 seconds or less

Surface mount type

Preheating conditions: 150°C to 180°C, 120 seconds or less
Soldering conditions: 230°C to 250°C, 30 seconds or less

Relay Problem Cause Overview



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OMRON provides a wide range of General-purpose Relays to meet customer needs.

Best-selling General-purpose Relays with high performance and many models

4PDT, 3 A
MY4

Push-In Plus

Models for minute loads

Bifurcated Contacts
MY4Z

Push-In Plus

Models for even smaller loads

Crossbar Bifurcated Contacts
MY4Z-CBG

Push-In Plus

Models with resistance to environments

Plastic sealed models
MYQ4

Push-In Plus

Models with greater resistance to environments

Hermetically sealed models
MY4H

Push-In Plus

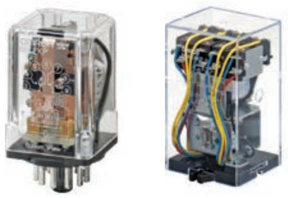
Holding contacts and low power consumption

Latching Relays
MY2K

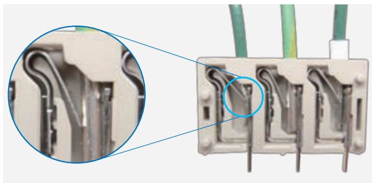
Push-In Plus

Models with higher capacity

Latching Relays, 5 A
MKK and MMK



Reduces Wiring Work! Push-In Plus Terminal Block Sockets Are Also Included in the Lineup



Requires just one hand!
Easily inserted just like an earphone jack.
Wiring is simple and can be performed with a single action.

Even crossover wiring is smooth!
Two terminals to be used in co-fastening are provided. One wire is connected to one terminal, which eliminates the need to perform troublesome co-fastening.

No extra tightening required!
Terminals and wires are fixed in place not with screws but with clamp spring pressure. This eliminates concerns regarding screws coming loose.

Space-saving models

SPDT contacts, 6 A Slim I/O Relays

G2RV-SR

Integrated with socket

Push-In Plus

DPDT contacts

DPDT, 5 A

G2R-2-S and G2R-2-S (S)

Push-In Plus

Models with higher capacity

SPDT, 10 A

G2R-1-S and G2R-1-S (S)

Push-In Plus

Higher power rating

Changeover contacts,
10 A at 110 V; LY1: 15 A

LY1, LY2, LY3, and LY4

200-V models

Changeover contacts, 10 A at 200 V

MK-S

Other Main Products

High-capacity models

G7Z
4 poles
440 VAC
40 A

G7J
4 poles
250 VAC
25 A

DC switching

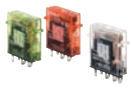
MK-S(X)
220 VDC 10 A

Popular in power industry

MM
DPDT to 4PDT
contacts, 7.5 A

Slim, minute-load models
ideal for PLC signals

G7T
Crossbar bifurcated
contacts



Circuit checks with latching levels

MY(S)

G2R-□-S(S)

G2RV -SR

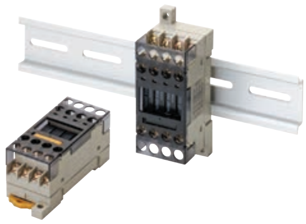
MK-S

memo

- OMRON's Terminal Relay Series contributes to saving space in control panels.
- They are ideal for output interfaces.

Our Most Popular Terminal Relays

Terminal Relays G6D-F4B

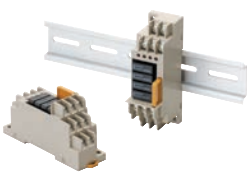


3 A, SPST-NO contacts × 4

Power Relays

Space-saving models	NC contact circuits	Higher power rating	Models for minute loads

Terminal Relays G6D-4B

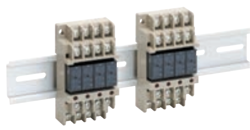


Slim width of 28 mm
3 A, SPST-NO × 4

Terminal Relays G6B-4CB

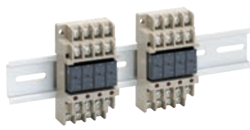
Changeover contacts
5 A, SPDT × 4

Terminal Relays G6B-4BND High Capacity / G6B-47BND Long Life



High capacity/long life
5 A, SPST-NO × 4

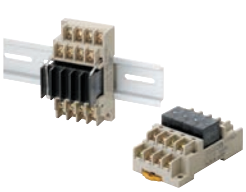
Terminal Relays G6B-48BND



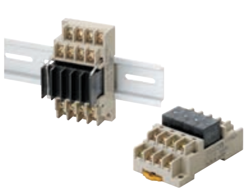
High reliability
2 A, SPST-NO × 4

Semiconductor output models

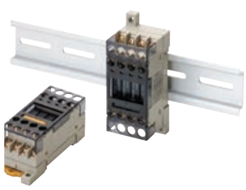
- AC output models
  - Terminal SSRs
    G3S4-A

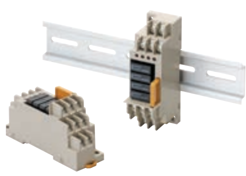
    SSR output
    1 A, SPST-NO × 4
- DC output models
  - Terminal SSRs
    G3S4-D

    SSR output
    1 A, SPST-NO × 4
- Standard models
  - Terminal Relays
    G3DZ-F4B

    MOSFET output
    0.3 A, SPST-NO × 4
    (Output AC/DC switching)
- Slim models
  - Terminal Relays
    G3DZ-4B

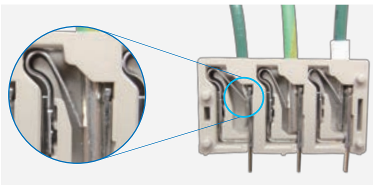
    MOSFET output
    0.3 A, SPST-NO × 4
    (Output AC/DC switching)

I/O Relay Terminals
Recommended Selections

I/O Relay Terminals simplify connecting Controllers and help reduce wiring in control panels. Achieve wiring with one Connecting Cable. Terminals are available for both inputs and outputs.

Relay outputs from PLCs

Push-In Plus Terminal Block Type Reduces Wiring Work



Requires just one hand!
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No extra tightening required!
Terminals and wires are fixed in place not with screws but with clamp spring pressure. This eliminates concerns regarding screws coming loose.

Reducing Wiring Even More

Flexibility and Downsizing

I/O Relay Terminals
G70V

Input Terminals and Output Terminals available.

Push-In Plus

Slim I/O Relays with PLC Interface Units
G2RV-SR+P2RVC

Push-In Plus

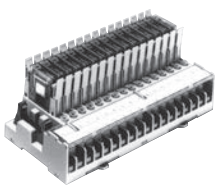
Standard models

- Using Inputs Too
- Saving Space

High-capacity, space-saving models

High-capacity sockets

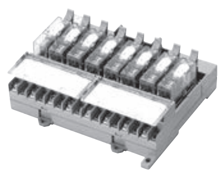
I/O Relay Terminals
G7TC



Input Terminals and Output Terminals available.

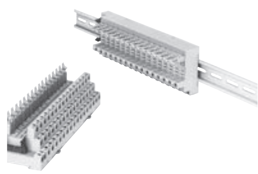
Relay Output Terminal Blocks
G70D

Relay Output Terminal Blocks
G70R



Contact current: 10 A

I/O Block Bases
G70A



G2R Relays, SSRs, Timers, and other components can be mounted.

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Terms and Conditions Agreement

Read and understand this catalog.

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranties.

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Product Catalogs for Control Panels

Sockets, Slim I/O Relays, I/O Relay Terminals Push-In Plus Terminal Block Series
PYF-PU, P2RF-PU, G2RV-SR/G3RV-SR, G70V/P7SA-PU

Cat. No. J213

Switch Mode Power Supplies
S8VK-S

Cat. No. T206

Measuring and Monitoring Relays
K8DT

Cat. No. N210

Solid-state Timers
H3DT

Cat. No. M091

Digital Temperature Controllers
E5_C series

Cat. No. H220

Solid State Relays for Heaters
G3PJ

Cat. No. J211

DIN Track Terminal Blocks
XW5T

Cat. No. G123

Power Monitors
KM-N2/KM-N3

Cat. No. N212

Push-In Plus Terminal Blocks Series Pushbutton Switches
A22N-P/A30N-P/M22N-P

Cat. No. A253

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