Precautions for use

Precautions for use of 24VDC N/O contact relay input modules

(1) Relay switching frequency

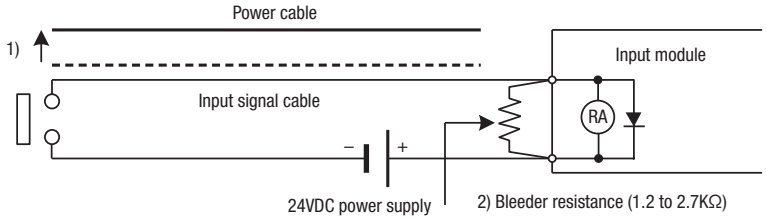
Use the module with a maximum input signal switching frequency of one-second or longer on, and one-second or longer off.

(2) Surge/inductive voltage to the input side power cable

Do not install the 24VDC input signal cable together with the main circuit lines or power cables.
Keep a distance of 100mm or more between them.
If they are installed together, an input signal may turn/remain on/off improperly due to the inductive voltage from the main circuit lines or power cables.
Or, a diode, inserted in parallel with a relay in the module, may be damaged due to a high surge voltage generated when the main circuit lines or power cables turns on/off.

Countermeasures

1) Keep an input signal cable away from the main circuit lines or power cables. (Use different cables for an input signal, the main circuit, power supply, and others, without bundling them.)
2) Insert a bleeder resistance in parallel with input signals to reduce input impedance of input signals.
3) Select a module whose off voltage is high for input signals.
(Photocoupler input modules: FA-TH16X24D31, FA-TH16X24D31L, FA1-TH*X2SC20S1E+FA1-TM1X24D-*)
4) Select a 48/100VDC input module.
(Photocoupler input modules: FA-TH16X48D31L, FA-TH16X100D31L, FA1-TH*X2SC20S1E+FA1-TM1X48D-*/FA1-TM1X100D-*)



• Try bleeder resistances with larger resistance value then smaller one, and select the one hardly causing malfunctions.

Precautions for use of relay output modules

<FA1-TH16Y2RA20S1E, FA1-TH1E16Y2RA20S1E, FA1-TH1E16Y2RA20S, FA-TH16YRA11/11S/20/20S/21/21S/20SL, FA-TH16YRAB20SL, FA-TH16YRAC20S>

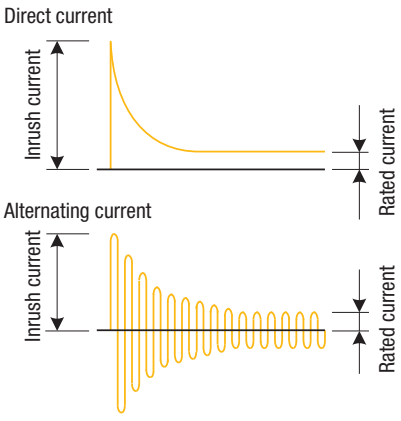
(1) Relay switching frequency

Use the module with a maximum output signal switching frequency of one-second or longer on, and one-second or longer off.

(2) Relay contact locking

When the relay turns on while using any of the loads shown in the following table such as a timer or counter using a switching control AC/DC or DC/DC power supply and incandescent lamp, an inrush current may flow and cause contact welding, or a locking phenomenon may occur in the contact due to transition (where the contact remains on and do not return to off).

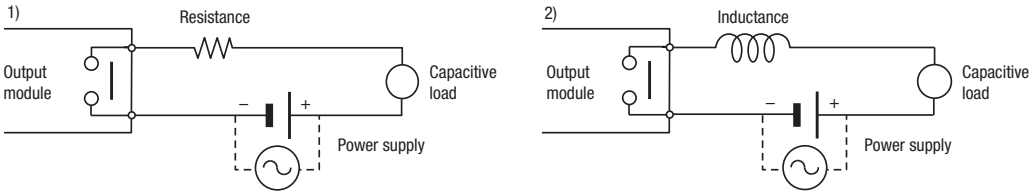
Load type	Inrush current/Rated current	Inrush current waveform
Resistance	1 times	
Incandescent lamp	Approx. 10× to 15×	
Capacitor (Note 1)	Approx. 20× to 50×	
Solenoid	Approx. 10× to 20×	
Electromagnetic contactor	Approx. 3× to 10×	
Fluorescent lamp	Approx. 5× to 15× (Note 2)	
Motor	Approx. 5× to 15×	
Transformer	Approx. 5× to 15×	
Mercury lamp	Approx. 3× (Note 2)	



Note 1: The capacitor load includes the stray capacitance from capacitors and wiring, and the capacitive load of timers, counters, etc. (in which a switching control AC/DC or DC/DC power supply is used).
Note 2: With a discharge lamp such as a mercury lamp and fluorescent lamp, especially when it is of a high power factor type and its power supply impedance is low, a current 20 to 40 times greater may flow.

Countermeasures

1) Insert a resistor in series with the load.
2) Insert inductance in series with the load.
3) For DC load, use the transistor output module FA-TH16Y2TR20 with the maximum inrush current of 8A or less. (As a reference, module's element: maximum inrush current of 20A, for DC load, in the surrounding temperature of 25°C.)
4) For AC load, use the triac output module FA1-TH16Y1SR20S1E, FA1-TH1E16Y1SR20S1E, FA-TH16YSR11S/21S/20S with the maximum inrush current of 25A or less. (As a reference, module's element: maximum inrush current of 50A, for 60Hz sine wave 1 full cycle, peak value, non-repetitive, in the surrounding temperature of 25°C.)

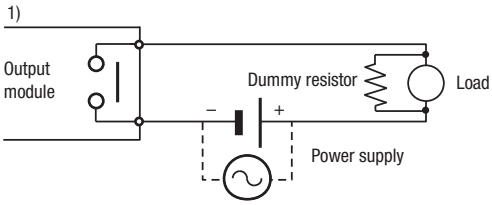


(3) Switching of slight current load

When a slight current load (5VDC or less or 1mA or less) is switched by an output relay, the load may not turn on even if the relay turns on due to poor contact of the relay contact.

Countermeasures

1) Insert a dummy resistor in parallel with the load.



• Increase the load current at relay on to prevent poor contact.

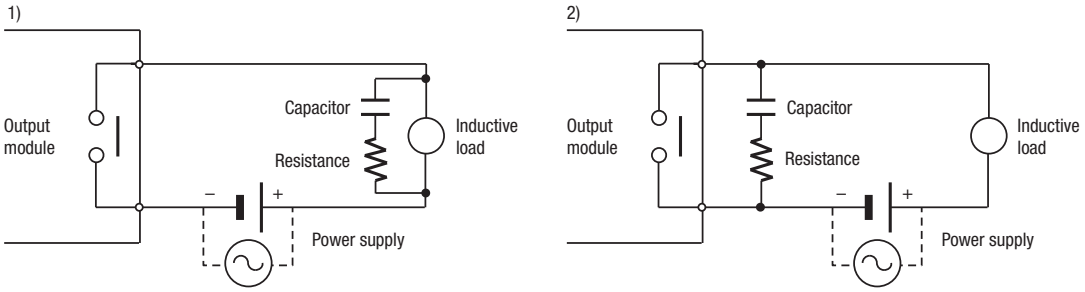
(4) Service life of relay contact

When an output relay module is used in applications with high switching frequency, the lifespan of the relay becomes a matter of concern. Use a transistor output module or triac output module.
The relay life curve shows the actual service life, not a guaranteed life. Consider the relay life with an adequate safety margin for the relay life curve.
When an inductive load such as an electromagnetic contactor and solenoid is disconnected, a high counter-electromotive force occurs between contacts, generating an arc discharge. If the switching current is high, the power factor is low, or a load whose time constant is high is connected, the life becomes short. Consideration is required in such a case.
For inductive loads, we recommend using a protection circuit based on the surge absorbing circuit in the figure below.

Countermeasures

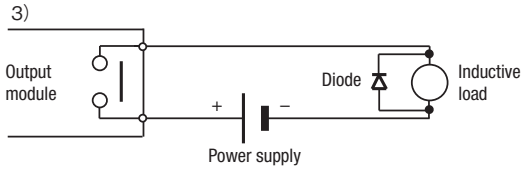
1) Insert a capacitor + resistor in parallel with the load (applicable to AC and DC loads).
2) Insert a capacitor + resistor in parallel with the contact (applicable to AC (Note1) and DC loads).

Note 1: For use with AC voltage, check that the load impedance is adequately smaller than the C and R impedance.
(When the contact is off, a leakage current flows through C and R. The load may turn on or the load once turned on may not turn off.)



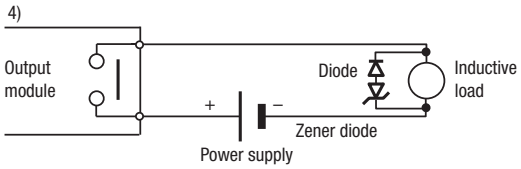
• A capacitor can suppress an electrical discharge at contact off, and a resistor can limit a current at contact on.
• The guidelines for element selection are as described below. Note, however, that the values differ according to variations in load properties and characteristics. Check the values via experiments.
Capacitor: 0.5 to 1 (μF) for a contact current of 1A, Resistor: 0.5 to 1 (Ω) for a contact voltage of 1V
• Use a capacitor whose withstand voltage is 200 to 300V in general. For an AC circuit, use an AC capacitor without polarity.
• If the load is a relay or solenoid, the recovery time is delayed. Caution is required.

Countermeasures 3) Insert a diode in parallel with the load (applicable to DC loads).



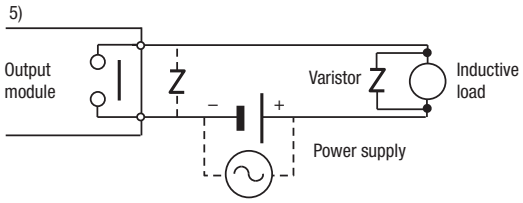
- When the contact turns off, the parallel diode causes the energy stored in the inductive load to flow to the load in the form of current, so that the energy is consumed by the resistance of the load as Joule heat.
- Use a diode whose reverse breakdown voltage is 10 times or more greater than the power supply voltage and whose forward current is equal to or greater than the load current.
- In this method, the recovery time delays more compared to the capacitor + resistor method.

Countermeasures 4) Insert a diode + Zener diode in parallel with the load (applicable to DC loads).



- This method is effective if used in cases in which the parallel diode in 3) results in excessive delay in the recovery time.
- Use a Zener diode whose Zener voltage is equal to or greater than the power supply voltage.

Countermeasures 5) Insert a varistor in parallel with the load or in parallel with the contact (applicable to AC or DC loads).



- Use the constant voltage characteristics of a varistor to ensure that a high voltage is not applied to the contact.
- Insert a varistor between the loads when the power supply voltage is 24 to 48V, or between the contacts when the power supply voltage is 100 to 200V.
- Select a varistor cut voltage Vc within the following conditions. (Setting Vc too high weakens the effect)
  For DC power supply: Vc > Power supply voltage × 1.5; For AC power supply: Vc > Power supply voltage × $\sqrt{2}$ × 1.5
- If the load is a relay or solenoid, the recovery time is delayed slightly.

Countermeasures 6) To drive an inductive load with high DC time constant, use a transistor output module with a built-in zener diode as a protection circuit.

- When the temperature in panel is 55°C and 8 points (every other point) are turned on at the same time, the following models can be used for a specified inductive load, and their life need not be considered, unlike a relay contact:
  FA-TH16YTL11S/TH11S and FA-THE16YTH11S for a load current of 0.65A or less; FA1-TH16Y1TR20S1E, FA1-TH1E16Y1TR20S1E, FA-TH16YTL21S/TR20S, and FA-THE16YTR20S for a load current of 0.7A or less; FA-TH16Y2TR20S for a load current of 2A or less

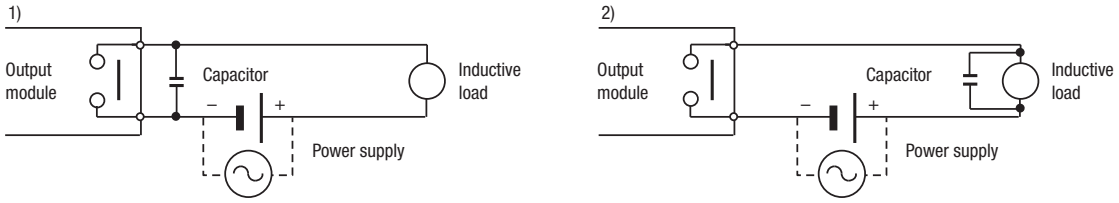
7) To drive an inductive load with small power factor, use a triac output module with a built-in varistor in parallel with a capacitor + resistor as a protection circuit.

- When the temperature in panel is 55°C and 8 points (every other point) are turned on at the same time, the following models can be used for a specified inductive load, and their life need not be considered, unlike a relay contact:
  FA1-TH16Y1SR20S1E, FA1-TH1E16Y1SR20S1E, and FA-TH16YSR11S for a load current of 0.5A or less; FA-TH16YSR21S/20S for a load current of 0.55A or less

(5) Precautions

1) Avoid protection circuits that connect a capacitor in parallel with a contact.
Connecting a capacitor in parallel with a contact is extremely effective in arc extinction at the time of disconnection. However, because electric charge is stored when the contact is off and a short-circuit current of the capacitor flows when the contact turns on, contact welding is likely to occur easily.

2) Avoid protection circuits that connect a capacitor in parallel with an inductive load.
Connecting a capacitor in parallel with an inductive load is extremely effective in arc extinction at the time of disconnection. However, because the charged current from the capacitor flows when the contact turns on, contact welding is likely to occur easily.



3) Install a protection circuit near the load or relay contact (module).
When a protection circuit is installed far away from the load or relay contact, the effect of the protection circuit cannot be adequately exhibited. As a rough distance, install the circuit within 50cm.

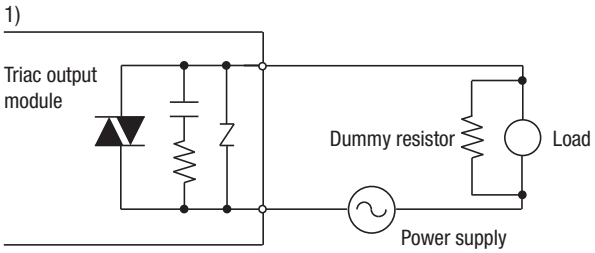
Precautions for use of triac output modules

<FA1-TH16Y1SR20S1E, FA1-TH1E16Y1SR20S1E, FA-TH16YSR11S/20S/21S>

(1) Leakage current at off for a triac output module

As a triac module has a built-in varistor in parallel with a capacitor + resistor as a protection circuit, a leakage current at off (1.5mA for 100VAC, 60Hz; 3mA for 200VAC, 60Hz) flows when the output is turned off. Due to this, the load may turn on when the output is off or may remain on when the output turns off.

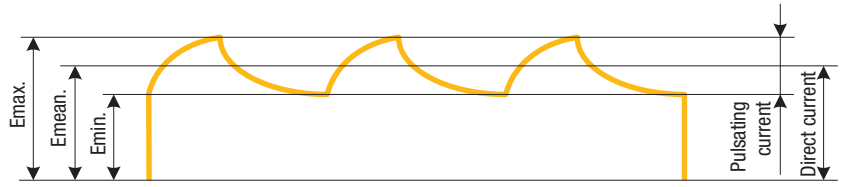
Countermeasures 1) Insert a dummy resistor in parallel with the load.



- The leakage current in the triac module flows into a dummy resistor so that the leakage current to a load is reduced, preventing the module from malfunction of the load.
- Reduce the resistance value of the dummy resistor in the descending order, and connect a resistor whose load operates properly.
- When selecting a load, check that the leakage current in the triac module does not cause a malfunction.

Precautions for a DC power supply for a digital signal converter

(1) The ripple ratio of the power supply must be 5% or less.



$$\text{Ripple ratio (\%)} = \frac{\text{Emax.} - \text{Emin.}}{\text{Emean.}} \times 100\%$$

Emax. = Maximum value of pulsating current
Emean. = Mean value of pulsating current
Emin. = Minimum value of pulsating current

Precautions for an AC power supply for a digital signal converter

(1) The waveform distortion rate of the power supply must be 5% or less.