Force Guided Relays

# RF Series

## Enables flexible construction of safety circuits

Compact and EN compliant RF1V force guided relays.

(force guided relays)

(socket)

• See website for details on approvals and standards.

| | No. of Poles | Page |
|---|---|---|
|  | 6-pole | E-186 |
|  | 4-pole | E-186 |
|  | 2-pole | E-192 |

## Force guided contact mechanism

EN50205 Type A TÜV approved

## Fast Response Time

Response time of 8 ms.
Ensures safety by turning the load off quickly.

## High Shock Resistance

High shock resistant suitable for use in machine tools and in environments subjected to vibration and shocks. (200 m/s$^2$ minimum)

## Clear Visiblilty

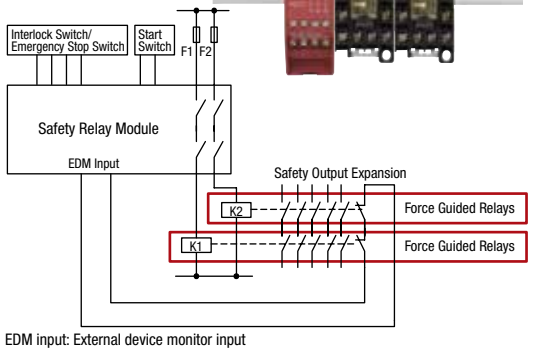
Available with a built-in LED.

## Output expansion for safety relay modules and safety controllers

### HR1S Safety Relay Module

Cost effective and easy method to expand mechanical contact outputs.

• Circuit Example

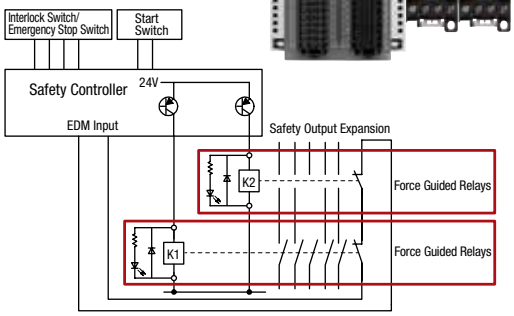



EDM input: External device monitor input

### FS1A Safety Controller

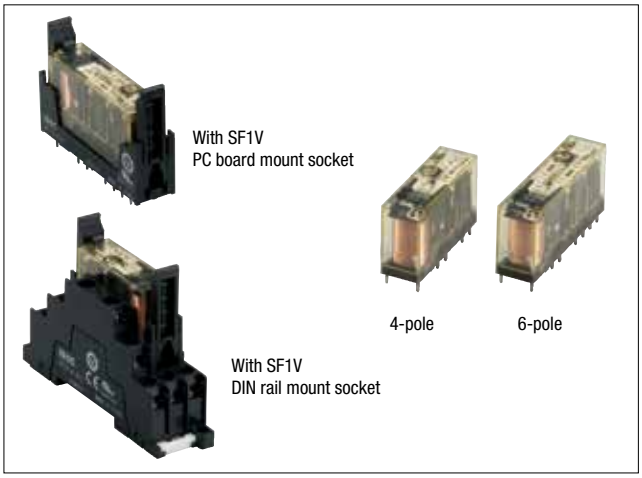
Solid state safety outputs of safety controllers can be converted to mechanical contact outputs.

• Circuit Example



# RF1V Force-guided Relays / SF1V Relay Sockets

## Compact and EN compliant RF1V force guided relays.




Package quantity: 10

| Contact | | Rated Coil Voltage | Without LED Indicator | With LED Indicator | With Counter-electromotive Force Diode With LED Indicator |
|---|---|---|---|---|---|
| | | | Part No. | Part No. | Part No. |
| 4-pole | 2NO-2NC | 12V DC | RF1V-2A2B-D12 | RF1V-2A2BL-D12 | RF1V-2A2BLD1-D12 |
| | | 24V DC | RF1V-2A2B-D24 | RF1V-2A2BL-D24 | RF1V-2A2BLD1-D24 |
| | | 48V DC | RF1V-2A2B-D48 | RF1V-2A2BL-D48 | RF1V-2A2BLD1-D48 |
| | 3NO-1NC | 12V DC | RF1V-3A1B-D12 | RF1V-3A1BL-D12 | RF1V-3A1BLD1-D12 |
| | | 24V DC | RF1V-3A1B-D24 | RF1V-3A1BL-D24 | RF1V-3A1BLD1-D24 |
| | | 48V DC | RF1V-3A1B-D48 | RF1V-3A1BL-D48 | RF1V-3A1BLD1-D48 |
| 6-pole | 4NO-2NC | 12V DC | RF1V-4A2B-D12 | RF1V-4A2BL-D12 | RF1V-4A2BLD1-D12 |
| | | 24V DC | RF1V-4A2B-D24 | RF1V-4A2BL-D24 | RF1V-4A2BLD1-D24 |
| | | 48V DC | RF1V-4A2B-D48 | RF1V-4A2BL-D48 | RF1V-4A2BLD1-D48 |
| | 5NO-1NC | 12V DC | RF1V-5A1B-D12 | RF1V-5A1BL-D12 | RF1V-5A1BLD1-D12 |
| | | 24V DC | RF1V-5A1B-D24 | RF1V-5A1BL-D24 | RF1V-5A1BLD1-D24 |
| | | 48V DC | RF1V-5A1B-D48 | RF1V-5A1BL-D48 | RF1V-5A1BLD1-D48 |
| | 3NO-3NC | 12V DC | RF1V-3A3B-D12 | RF1V-3A3BL-D12 | RF1V-3A3BLD1-D12 |
| | | 24V DC | RF1V-3A3B-D24 | RF1V-3A3BL-D24 | RF1V-3A3BLD1-D24 |
| | | 48V DC | RF1V-3A3B-D48 | RF1V-3A3BL-D48 | RF1V-3A3BLD1-D48 |

## Sockets

Package quantity: 10

| Types | No. of Poles | Part No. |
|---|---|---|
| DIN Rail Mount Sockets | 4 | SF1V-4-07L |
| | 6 | SF1V-6-07L |
| PC Board Mount Sockets | 4 | SF1V-4-61 |
| | 6 | SF1V-6-61 |

## Coil Ratings

| Contact | | Rated Coil Voltage (V) | Rated Current (mA) ±10% (at 20°C) (Note 1) | Coil Resistance (Ω) ±10% (at 20°C) | Operating Characteristics (at 20°C) | | | Power Consumption |
|---|---|---|---|---|---|---|---|---|
| | | | | | Pickup Voltage (initial value) | Dropout Voltage (initial value) | Maximum allowable Voltage (Note 2) | |
| 4-pole | 2NO-2NC | 12V DC | 30.0 | 400 | 75% maximum | 10% minimum | 110% | Approx. 0.36W |
| | | 24V DC | 15.0 | 1,600 | | | | |
| | | 48V DC | 7.5 | 6,400 | | | | |
| | 3NO-1NC | 12V DC | 30.0 | 400 | | | | |
| | | 24V DC | 15.0 | 1,600 | | | | |
| | | 48V DC | 7.5 | 6,400 | | | | |
| 6-pole | 4NO-2NC | 12V DC | 41.7 | 288 | | | | Approx. 0.50W |
| | | 24V DC | 20.8 | 1,152 | | | | |
| | | 48V DC | 10.4 | 4,608 | | | | |
| | 5NO-1NC | 12V DC | 41.7 | 288 | | | | |
| | | 24V DC | 20.8 | 1,152 | | | | |
| | | 48V DC | 10.4 | 4,608 | | | | |
| | 3NO-3NC | 12V DC | 41.7 | 288 | | | | |
| | | 24V DC | 20.8 | 1,152 | | | | |
| | | 48V DC | 10.4 | 4,608 | | | | |

Note 1: For relays with LED indicator, the rated current increases by approx. 2 mA.
Note 2: Maximum allowable voltage is the maximum voltage that can be applied to relay coils.

## Relay Specifications

| | | | | | | |
|---|---|---|---|---|---|---|
| Number of Poles | | 4-pole | | 6-pole | | |
| Contact Configuration | | 2NO-2NC | 3NO-1NC | 4NO-2NC | 5NO-1NC | 3NO-3NC |
| Contact Resistance (initial value) (Note 1) | | 100 mΩ maximum | | | | |
| Contact Material | | $AgSnO_2$ (Au flashed) | | | | |
| Rated Load (resistive load) | | 6A 250V AC, 6A 30V DC | | | | |
| Allowable Switching Power (resistive load) | | 1500 VA, 180W DC (30V DC max.), 85W DC (30V to 120V DC max.) | | | | |
| Allowable Switching Voltage | | 250V AC, 125V DC | | | | |
| Allowable Switching Current | | 6A | | | | |
| Minimum Applicable Load (Note 2) | | 5V DC, 1 mA (reference value) | | | | |
| Power Consumption (approx.) | | 0.36W | | 0.50W | | |
| Insulation Resistance | | 1000 MΩ minimum (500V DC megger, same measurement positions as the dielectric strength) | | | | |
| Dielectric Strength | Between contact and coil | 4000V AC, 1 minute | | | | |
| | Between contacts of different poles | 2500V AC, 1 minute<br>Between contacts 7-8 and 9-10 | | 2500V AC, 1 minute<br>Between contacts 7-8 and 11-12<br>Between contacts 9-10 and 13-14<br>Between contacts 11-12 and 13-14 | | |
| | | 4000V AC, 1 minute<br>Between contacts 3-4 and 5-6<br>Between contacts 3-4 and 7-8<br>Between contacts 5-6 and 9-10 | | 4000V AC, 1 minute<br>Between contacts 3-4 and 5-6<br>Between contacts 3-4 and 7-8<br>Between contacts 5-6 and 9-10<br>Between contacts 7-8 and 9-10 | | |
| | Between contacts of the same pole | 1500V AC, 1 minute | | | | |
| Operate Time (at 20°C) | | 20 ms maximum (at the rated coil voltage, excluding contact bounce time) | | | | |
| Response Time (at 20°C) (Note 3) | | 8 ms maximum (at the rated coil voltage, excluding contact bounce time, without diode) (Note 4) | | | | |
| Release Time (at 20°C) | | 20 ms maximum (at the rated coil voltage, excluding contact bounce time, without diode) | | | | |
| Vibration Resistance | Operating Extremes | 10 to 55 Hz, amplitude 0.75 mm | | | | |
| | Damage Limits | 10 to 55 Hz, amplitude 0.75 mm | | | | |
| Shock Resistance | Operating Extremes (half sine-wave pulse: 11 ms) | 200 $m/s^2$, when mounted on DIN rail mount socket: 150 $m/s^2$ | | | | |
| | Damage Limits (half sine-wave pulse: 6 ms) | 1000 $m/s^2$ | | | | |
| Electrical Life | | 250V AC 6A resistive load: 100,000 operations minimum (operating frequency 1200 per hour)<br>30V DC 6A resistive load: 100,000 operations minimum (operating frequency 1200 per hour)<br>250V AC 1A resistive load: 500,000 operations minimum (operating frequency 1800 per hour)<br>30V DC 1A resistive load: 500,000 operations minimum (operating frequency 1800 per hour)<br>[AC 15] 240V AC 2A inductive load: 100,000 operations minimum<br>(operating frequency 1200 per hour, cos ø = 0.3)<br>[DC 13] 24V DC 1A inductive load: 100,000 operations minimum<br>(operating frequency 1200 per hour, L/R = 48 ms) | | | | |
| Mechanical Life | | 10 million operations minimum (operating frequency 10,800 operations per hour) | | | | |
| Operating Temperature (Note 5) | | –40 to +85°C (no freezing) | | | | |
| Operating Humidity | | 5 to 85%RH (no condensation) | | | | |
| Storage Temperature | | –40 to +85°C (no freezing) | | | | |
| Storage Humidity | | 5 to 85%RH (no condensation) | | | | |
| Operating Frequency (rated load) | | 1200 operations per hour | | | | |
| Weight (approx.) | | 20g | | 23g | | |

Note 1: Measured using 6V DC,1A voltage drop method.
Note 2: Failure rate level P (reference value)
Note 3: Response time is the time until NO contact opens, after the coil voltage is turned off.
Note 4: With diode: 12ms maximum (at the rated coil voltage, excluding contact bounce time)
Note 5: See the table below for the current and operating temperature

## Socket Specifications

| Model | SF1V-4-07L | SF1V-6-07L | SF1V-4-61 | SF1V-6-61 |
|---|---|---|---|---|
| Rated Current | 6A | | | |
| Rated Voltage | 250V AC/DC | | | |
| Insulation Resistance | 1000 MΩ minimum (500V DC megger, between terminals) | | | |
| Applicable Wire | 0.7 to 1.65 $mm^2$<br>(18 AWG to 14 AWG) | | — | |
| Recommended Screw Tightening Torque | 0.5 to 0.8 N·m | | — | |
| Screw Terminal Style | M3 slotted Phillips self-tapping screw | | — | |
| Terminal Strength | Wire tensile strength: 50N min. | | — | |
| Dielectric Strength | 2500V AC, 1 minute<br>(Between live and dead metal parts, between live parts of different poles) | | | |
| Vibration Resistance | Damage limits: 10 to 55 Hz, amplitude 0.75 mm<br>Resonance: 10 to 55 Hz, amplitude 0.75 mm | | | |
| Shock Resistance | 1000 $m/s^2$ | | | |
| Operating Temperature (Note) | –40 to +85°C (no freezing) | | | |
| Operating Humidity | 5 to 85% RH (no condensation) | | | |
| Storage Temperature | –40 to +85°C (no freezing) | | | |
| Storage Humidity | 5 to 85% RH (no condensation) | | | |
| Degree of Protection | IP20<br>(finger-safe screw terminals) | | — | |
| Weight (approx.) | 40g | 55g | 9g | 10g |

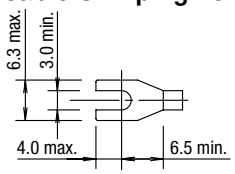
Note: See the table at right for the current and operating temperature.

## Operating Temperature (relay, socket)

| | Single mounting | Collective mounting | |
|---|---|---|---|
| Operating Temperature | –40˚C to +85˚C | 4-pole | –40˚C to +70˚C |
| | | 6-pole | –40˚C to +65˚C |
| Contact Current | 6A | 6A | |
| Remarks | When the ambient temperature is over 70°C, lower the contact current at 0.1A/°C.<br>5NO1NC:<br>Up to 70°C: Keep the total current of NO side to 24A maximum.<br>Over 70°C: Lower the contact current at 0.1A/°C. | 4-pole | When the ambient temperature is over 60°C, lower the contact current at 0.1A/°C. |
| | | 6-pole | When the ambient temperature is over 50°C, lower the contact current at 0.1A/°C.<br>5NO1NC:<br>Up to 50°C: Keep the total current of NO side to 24A maximum.<br>Over 50°C: Lower the contact current at 0.1A/°C. |

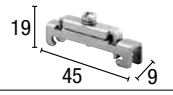
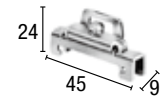
## Applicable Crimping Terminal

All dimensions in mm.



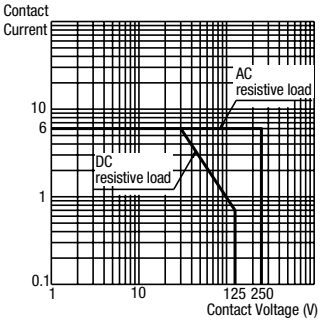

Note: Ring tongue terminals cannot be used.

## Accessories

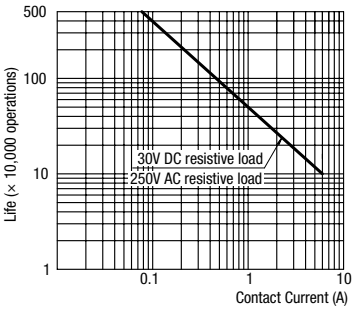
| Item | Shape | Specifications | Part No. | Ordering Part No. | Package Quantity | Remarks |
|---|---|---|---|---|---|---|
| DIN Rail |  | Aluminum<br>Weight: Approx. 200g | BAA1000 | BAA1000PN10 | 10 | Length: 1m<br>Width: 35 mm |
| | | Steel<br>Weight: Approx. 320g | BAP1000 | BAP1000PN10 | 10 | |
| End Clip |  | Metal (zinc plated steel)<br>Weight: Approx. 15g | BNL5 | BNL5PN10 | 10 | — |
| |  | | BNL6 | BNL6PN10 | 10 | |

## Characteristics

### Maximum Switching Capacity

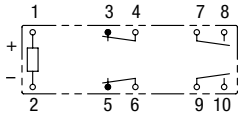



### Electrical Life Curve




## Notes on Contact Gaps except Welded Contacts

Example: RF1V-2A2B-D24



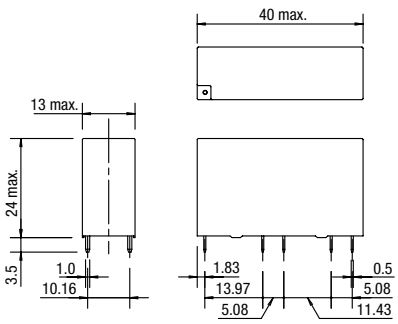

- If the NO contact (7-8 or 9-10) welds, the NC contact (3-4 or 5-6) remains open even when the relay coil is de-energized, maintaining a gap of 0.5 mm minimum. The remaining unwelded NO contact (9-10 or 7-8) is either open or closed.
- If the NC contact (3-4 or 5-6) welds, the NO contact (7-8 or 9-10) remains open even when the relay coil is energized, maintaining a gap of 0.5 mm minimum. The remaining unwelded NC contact (5-6 or 3-4) is either open or closed.

## Dimensions

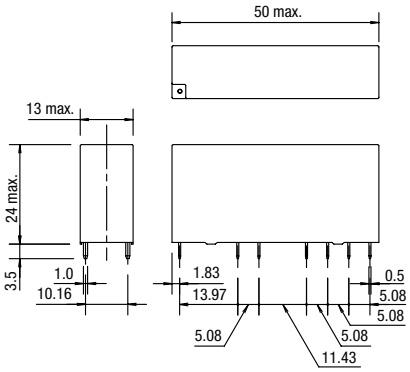
(All dimensions in mm.)

### RF1V Relays

#### RF1V (4-pole)

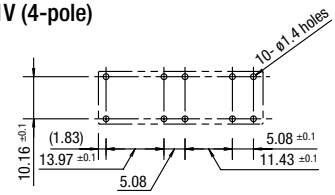



#### RF1V (6-pole)

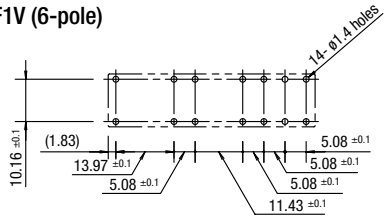



### PC Board Terminal Model Mounting Hole Layout (Bottom View)

#### RF1V (4-pole)



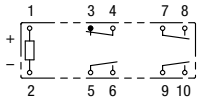

#### RF1V (6-pole)



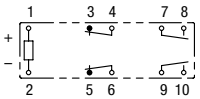

## Internal Connection (Bottom View)

### RF1V (4-pole)

#### Without LED Indicator

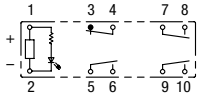



3NO-1NC Contact

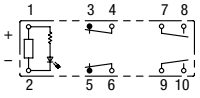



2NO-2NC Contact

#### With LED Indicator

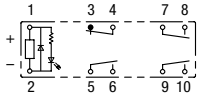



3NO-1NC Contact

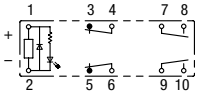



2NO-2NC Contact

#### With Counter-electromotive Force Diode



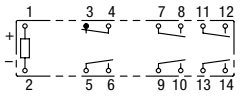

3NO-1NC Contact



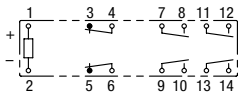

2NO-2NC Contact

### RF1V (6-pole)

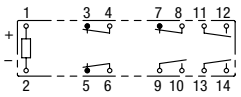
#### Without LED Indicator




5NO-1NC Contact

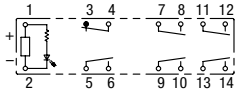



4NO-2NC Contact

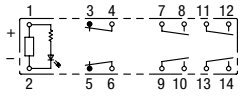



3NO-3NC Contact

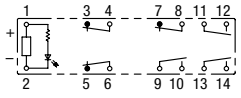
#### With LED Indicator




5NO-1NC Contact

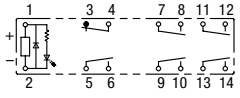



4NO-2NC Contact

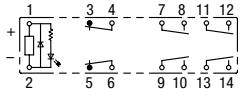



3NO-3NC Contact

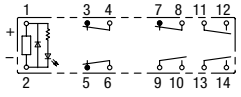
#### With Counter-electromotive Force Diode




5NO-1NC Contact




4NO-2NC Contact



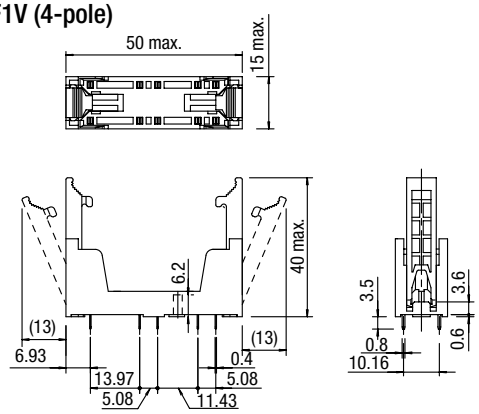

3NO-3NC Contact

## Dimensions

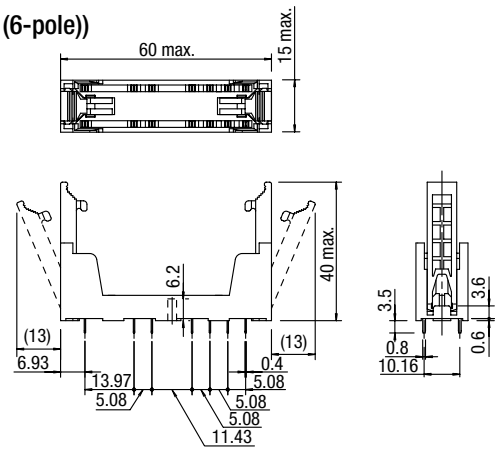
(All dimensions in mm.)

## SF1V PC Board Mount Sockets

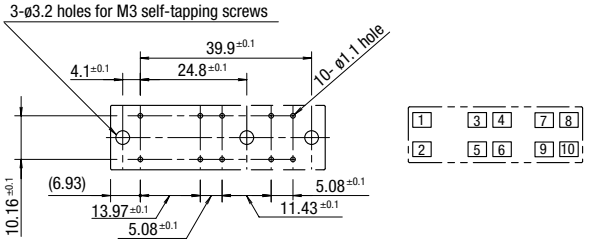
### SF1V (4-pole)



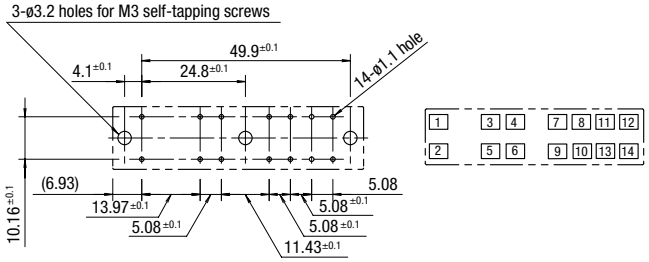

### SF1V (6-pole))




PC Board Mounting Hole Layout / Terminal Arrangement (Bottom View)



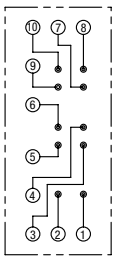

PC Board Mounting Hole Layout / Terminal Arrangement (Bottom View)



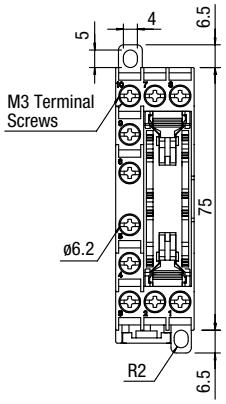

## SF1V DIN Rail Mount Socket Dimensions

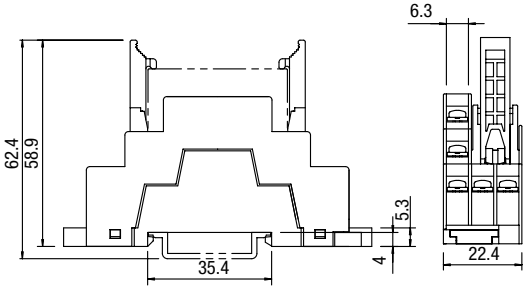
### SF1V (4-pole)

(Internal Connection)

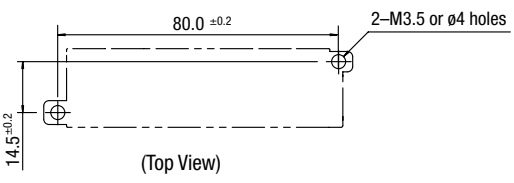



(Top View)



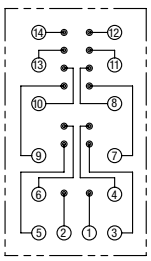

(Panel Mounting Hole Layout)



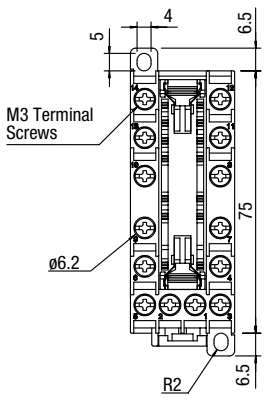

(Top View)

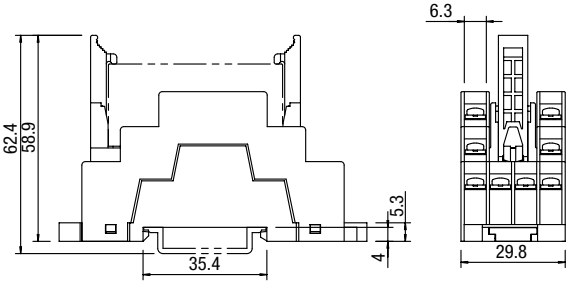
### SF1V (6-pole)

(Internal Connection)

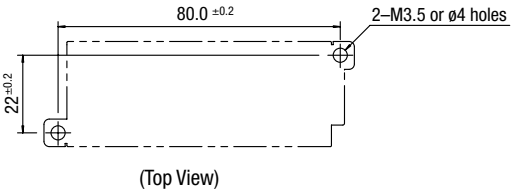



(Top View)




(Panel Mounting Hole Layout)

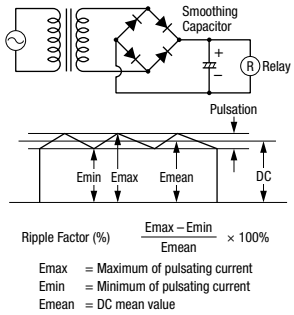



(Top View)

## Operating Instructions

### 1. Driving Circuit for Relays

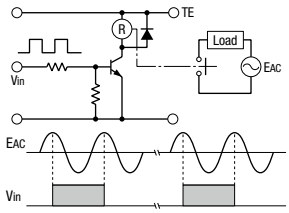
1. To make sure of correct relay operation, apply rated voltage to the relay coil. Pickup and dropout voltages may differ according to operating temperature and conditions.
2. Input voltage for DC coil:
   A complete DC voltage is best for the coil power to make sure of stable operation. When using a power supply containing a ripple voltage, suppress the ripple factor within 5%. When power is supplied through a rectifications circuit, relay operating characteristics, such as pickup voltage and dropout voltage, depend on the ripple factor. Connect a smoothing capacitor for better operating characteristics as shown below.




$$\text{Ripple Factor (\%)} \quad \frac{\text{Emax} - \text{Emin}}{\text{Emean}} \times 100\%$$

Emax = Maximum of pulsating current
Emin = Minimum of pulsating current
Emean = DC mean value

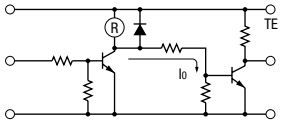
3. Operating the relay in sync with an AC load:



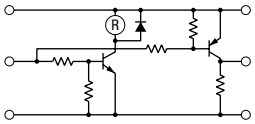

If the relay operates in sync with AC power voltage of the load, the relay life may be reduced. If this is the case, select a relay in consideration of the required reliability for the load. Or, make the relay turn on and off irrespective of the AC power phase or near the point where the AC phase crosses zero voltage.

4. Leakage current while relay is off:

Incorrect

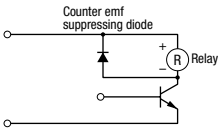



Correct




When driving an element at the same time as the relay operation, special consideration is needed for the circuit design. As shown in the incorrect circuit below, leakage current (Io) flows through the relay coil while the relay is off. Leakage current causes coil release failure or adversely affects the vibration resistance and shock resistance. Design a circuit as shown in the correct example.

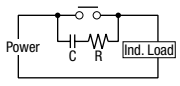
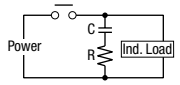
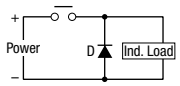
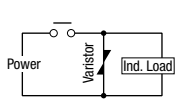
5. Surge suppression for transistor driving circuits: When the relay coil is turned off, a high-voltage pulse is generated. Be sure to connect a diode to suppress the counter electromotive force, or use RF1V with counter-electromotive force diode. Then, the coil release time becomes slightly longer. To shorten the coil release time, connect a Zener diode between the collector and emitter of the controlling transistor. Select a Zener diode with a Zener voltage slightly higher than the power voltage.




6. The coil terminal of the relay has polarity. Connect terminals according to the internal connection diagram. Incorrect wiring may cause malfunction.

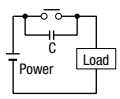
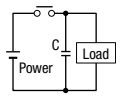
### 2. Protection for Relay Contacts

1. The contact ratings show maximum values. Make sure that these values are not exceeded even momentarily. When an inrush current flows through the load, the contact may become welded. If this is the case, connect a contact protection circuit, such as a current limiting resistor.
2. Contact protection circuit:
   When switching an inductive load, arcing causes carbides to form on the contacts, resulting in an increased contact resistance. In consideration of contact reliability, contact life, and noise suppression, use of a surge absorbing circuit is recommended. Note that the release time of the load becomes slightly longer. Check the operation using an actual load. Incorrect use of a contact protection circuit will adversely affect switching characteristics. Four typical examples of contact protection circuits are shown in the following table:

| | | |
|---|---|---|
| RC |  | This protection circuit can be used when the load impedance is smaller than the RC impedance in an AC load power circuit.<br>R: Resistor of approximately the same resistance value as the load<br>C: 0.1 to 1 µF |
| |  | This protection circuit can be used for both AC and DC load power circuits.<br>R: Resistor of approximately the same resistance value as the load<br>C: 0.1 to 1 µF |
| Diode |  | This protection circuit can be used for DC load power circuits. Use a diode with the following ratings.<br>Reverse withstand voltage:<br>Power voltage of the load circuit × 10<br>Forward current:<br>More than the load current |
| Varistor |  | This protection circuit can be used for both AC and DC load power circuits.<br>For a best result, when using on a power voltage of 24 to 48V AC/DC, connect a varistor across the load. When using on a power voltage of 100 to 240V AC/DC, connect a varistor across the contacts. |

## Operating Instructions

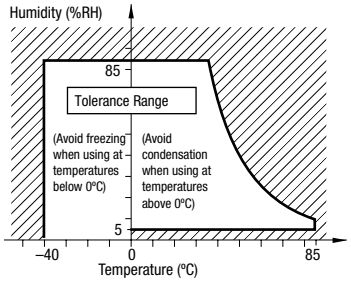
3. Do not use a contact protection circuit as shown below:

| | |
|---|---|
|  | This protection circuit is very effective in arc suppression when opening the contacts. But, the capacitor is charged while the contacts are opened. When the contacts are closed, the capacitor is discharged through the contacts, increasing the possibility of contact welding. |
|  | This protection circuit is very effective in arc suppression when opening the contacts. But, when the contacts are closed, a current flows to charge the capacitor, causing contact welding. |

Generally, switching a DC inductive load is more difficult than switching a DC resistive load. Using an appropriate arc suppressor will improve the switching characteristics of a DC inductive load.

### 3. Usage, transport, and storage conditions

1. Temperature, humidity, atmospheric pressure during usage, transport, and storage.
   ① Temperature: –40°C to +85°C (no freezing)
   See E-187 for the current and operating temperature.
   ② Humidity: 5 to 85%RH (no condensation)
   The humidity range varies with temperature. Use within the range indicated in the chart below.
   ③ Atmospheric pressure: 86 to 106 kPa
   Operating temperature and humidity range




2. Condensation
   Condensation occurs when there is a sudden change in temperature under high temperature and high humidity conditions. The relay insulation may deteriorate due to condensation.
3. Freezing
   Condensation or other moisture may freeze on the relay when the temperatures is lower than 0ºC. This causes problems such as sticking of movable parts or delay in operation.
4. Low temperature, low humidity environments
   Plastic parts may become brittle when used in low temperature and low humidity environments.

### 4. Panel Mounting

When mounting DIN rail mount sockets on a panel, take the following into consideration.

- Use M3.5 screws, spring washers, and hex nuts.
- For mounting hole layout, see dimensions on E-189.
- Keep the tightening torque within 0.49 to 0.68 N·m. Excessive tightening may cause damage to the socket.

### 5. Others

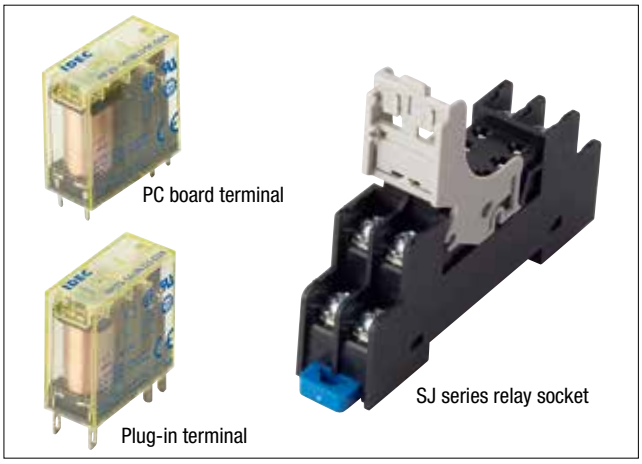
1. General notice
   ① To maintain the initial characteristics, do not drop or shock the relay.
   ② The relay cover cannot be removed from the base during normal operation. To maintain the initial characteristics, do not remove the relay cover.
   ③ Use the relay in environments free from condensation, dust, sulfur dioxide ($SO_2$), and hydrogen sulfide ($H_2S$).
   ④ The RF1V relay cannot be washed as it is not a sealed type. Also make sure that flux does not leak to the PC board and enter the relay.
2. Connecting outputs to electronic circuits:
   When the output is connected to a load which responds very quickly, such as an electronic circuit, contact bouncing causes incorrect operation of the load. Take the following measures into consideration.
   ① Connect an integration circuit.
   ② Suppress the pulse voltage due to bouncing within the noise margin of the load.
3. Do not use relays in the vicinity of strong magnetic field, as this may affect relay operation.
4. UL and CSA ratings may differ from product rated values determined by IDEC.

### 6. Notes on PC Board Mounting

- When mounting 2 or more relays on a PC board, keep a minimum spacing of 10 mm in each direction. If used without spacing of 10 mm, rated current and operating temperature differs. Consult IDEC.
- Manual soldering: Solder the terminals at 400°C within 3 sec.
- Auto-soldering: Preliminary heating at 120°C within 120 sec. Solder at 260°C±5°C within 6 sec.
- Because the terminal part is filled with epoxy resin, do not excessively solder or bend the terminal. Otherwise, air tightness will degrade.
- Avoid the soldering iron from touching the relay cover or the epoxy filled terminal part.
- Use a non-corrosive resin flux.

# RF2 2-pole Force Guided Relay / SJ Series Socket

## For simple and easy safety measure. Reduce cost and installation space.




## Force Guided Relays

| Contact Configuration | | Terminal Style | LED Indicator | w/diode of reverse polarity coil | Degree of Protection | | Rated Coil Voltage | Part No. |
|---|---|---|---|---|---|---|---|---|
| | | | | | Flux-tight (RTII) | Sealed (RTIII) | | |
| 2-pole | SPST-NO + SPST-NC | Plug-in | With | √ | √ | — | 12V DC | RF2S-1A1BLD1-D12 |
| | | | Without | — | √ | — | 24V DC | RF2S-1A1B-D24 |
| | | | | √ | √ | — | | RF2S-1A1BD1-D24 |
| | | | With | √ | √ | — | | RF2S-1A1BLD1-D24 |
| | | | | √ | — | √ | | RF2S-1A1BLD1K-D24 |
| | | | Without | — | √ | — | 48V DC | RF2S-1A1B-D48 |
| | | | With | √ | √ | — | | RF2S-1A1BLD1-D48 |
| | | | | √ | — | √ | | RF2S-1A1BLD1K-D48 |
| | DPDT (*1) | | Without | — | √ | — | 24V DC | RF2S-2C-D24 |
| | | | Without | √ | √ | — | | RF2S-2CD1-D24 |
| | | | With | √ | √ | — | | RF2S-2CLD1-D24 |
| | | | With | √ | — | √ | | RF2S-2CLD1K-D24 |
| | SPST-NO + SPST-NC | PC Board | Without | — | √ | — | 12V DC | RF2V-1A1B-D12 |
| | | | | — | √ | — | 24V DC | RF2V-1A1B-D24 |
| | | | | — | — | √ | | RF2V-1A1BK-D24 |
| | | | | √ | √ | — | | RF2V-1A1BD1-D24 |
| | | | | √ | — | √ | | RF2V-1A1BD1K-D24 |
| | | | With | √ | — | √ | | RF2V-1A1BLD1K-D24 |
| | | | Without | — | √ | — | 48V DC | RF2V-1A1B-D48 |
| | DPDT (*1) | | Without | — | √ | — | 24V DC | RF2V-2C-D24 |

*1) When using DPDT model as a force guided relay, use in SPST-NO+SPST-NC wiring (EN50205).

• Other part numbers are available. See below (contact IDEC for details).

## Part No. Development

| RF | 2 | | S | | – | 1A1B | | LD1 | | K | | – | D24 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series | No. of Poles | | Terminal Style | | | Contact Configuration | | Option | | Degree of Protection | | | Rated Coil Voltage | |
| | 2 | 2-pole | S | Plug-in | | 1A1B | SPST-NO + SPST-NC | Blank | Standard | Blank | RTII | | D12 | 12V DC |
| | | | V | PC Board | | 2C | DPDT | L | With LED indicator | K | RTIII | | D24 | 24V DC |
| | | | | | | | | D | With diode (Note 1) | | | | D48 | 48V DC |
| | | | | | | | | D1 | With diode of reverse polarity coil (Note 2) | | | | | |
| | | | | | | | | LD | With LED indicator & diode (Note 1) | | | | | |
| | | | | | | | | LD1 | With LED indicator & diode of reverse polarity coil (Note 2) | | | | | |

Note 1: With diode: terminal 1 –, terminal 8 +

Note 2: With diode of reverse polarity coil: terminal 1 +, terminal 8 –

Note 3: Use this chart for interpreting part numbers. Not all possible variations can be realized.

## Standard Ratings

| Voltage | UL Rating Resistive | | CSA Rating Resistive | |
|---|---|---|---|---|
| | NO | NC | NO | NC |
| 277V AC | 6A | 3A | 6A | 3A |
| 30V DC | 6A | 3A | 6A | 3A |

| Voltage | TÜV Rating Resistive | |
|---|---|---|
| | NO | NC |
| 240VAC | 6A | 3A |
| 24V DC | 6A | 3A |

## Ratings

### Coil ratings

| Rated Voltage (V) | Rated Current (mA) ±15% (at 20°C) | | Coil Resistance ±10% (at 20°C) | Operating Characteristics (against rated values at 20°C) | | | Power Consumption |
|---|---|---|---|---|---|---|---|
| | Without LED | With LED | | Minimum Pickup Voltage | Dropout Voltage | Maximum Allowable Voltage (Note) | |
| 12V DC | 58 | 63 | 205 | 75% maximum | 10% minimum | 110% | Approx. 0.7W |
| 24V DC | 29 | 33 | 820 | | | | |
| 48V DC | 14.6 | 18 | 3300 | | | | |

Note: Maximum allowable voltage is the maximum voltage that can be applied to relay coils.

## Specifications

| Model | | **RF2S** (Plug-in Terminal) | **RF2V** (PC board terminal) |
|---|---|---|---|
| No. of Poles | | 2-pole | |
| Contact Configuration | | SPST-NO + SPST-NC, DPDT | |
| Disconnecting Means | | Micro disconnection | |
| Contact Resistance (Note 1) | | 100mΩ maximum | |
| Contact Material | | AgNi+Au-Clad | |
| Degree of Protection | | RTII (flux-tight), RTIII (sealed) | |
| Rated Load (resistive load) | | NO contact: 240V AC, 6A/24V DC, 6A<br>NC contact: 240V AC, 3A/24V DC, 3A | |
| Contact | Maximum Allowable Power (resistive load) | NO contact: 1440VA/144W, NC contact: 720VA/72W | |
| | Maximum Allowable Voltage | 250V AC, 125V DC | |
| | Maximum Allowable Current | 6A | |
| Minimum Applicable Load (Note 2) | | 1V DC, 1mA | |
| Power Consumption | | Approx. 0.7W | |
| Rated Insulation Voltage | | 250V | |
| Insulation Resistance | | 1000MΩ minimum (500V megger) | |
| Impulse Withstand Voltage | | 6000V | |
| Pollution Degree | | 2 | |
| Dielectric Strength | Between contact and coil | 5000V AC, 1 minute | |
| | Between contacts of the same pole | 4000V AC, 1 minute | |
| | Between contacts of the different poles | 1500V AC, 1 minute | |
| Operating Time | | 15ms max. (at the rated coil voltage, excluding contact bounce time) | |
| Response Time (Note 3) | | 5ms max. (at the rated coil voltage, without diode)<br>20ms max. (at the rated coil voltage, with diode) | |
| Release Time | | 10ms max. (at the rated coil voltage, excluding contact bounce time, without diode)<br>25ms max. (at the rated coil voltage, excluding contact bounce time, with diode) | |
| Vibration Resistance | Operating Extremes | NO contact: 10 to 55Hz, amplitude 0.75mm<br>NC contact:10 to 55Hz, amplitude 0.2mm | |
| | Damage Limits | 10 to 55Hz, amplitude 0.75mm | |
| Shock Resistance | Operating Extremes | NO contact: 100m/s$^2$, NC contact: 50m/s$^2$ | |
| | Damage Limits | 1000m/s$^2$ | |
| Electrical Life | | NO contact:<br>100,000 operations minimum (operating frequency 1,800 per hour) at 240V 6A resistive load or 2A inductive load (power factor 0.4)<br>100,000 operations minimum (operating frequency 1,800 per hour) at 24V 6A resistive load or 1A inductive load (time constant 48ms)<br>NC contact:<br>100,000 operations minimum (operating frequency 1,800 per hour) at 240V AC, 3A resistive load or 2A inductive load (power factor 0.4)<br>100,000 operations minimum (operating frequency 1,800 per hour) at 24V DC, 3A resistive load or 1A inductive load (time constant 48ms) | |
| Mechanical Life | | 10 million operations minimum (operating frequency 18,000 operations per hour) | |
| Operating Temperature | | Single mounting: –40 to +70°C (no freezing)<br>Collective mounting: –40 to +55°C (no freezing) | –40 to +70°C (no freezing) |
| Operating Humidity | | 5 to 85%RH (no condensation) | |
| Storage Temperature | | –40 to +85°C (no freezing) | |
| Weight (approx.) | | 18g (without LED/diode), 20g (with LED/with diode/with LED & diode) | |

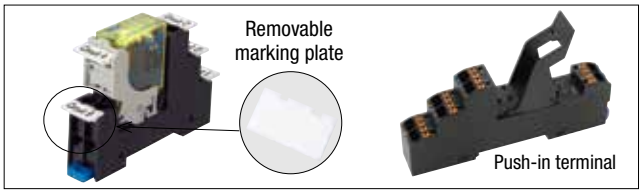
• Above values are initial values.
Note 1: Measured using 5V DC, 1A voltage drop method.
Note 2: Failure rate level P, reference value
Note 3: Response time is the time until NO contact opens, after the coil voltage is turned off.

## SJ Series Relay Socket

(Standard screw terminal and Fingersafe screw terminal)

(Push-in terminal)

• See website for details on approvals and standards.
Note: Sockets can be used on RF2S (Plug-in terminal) only.



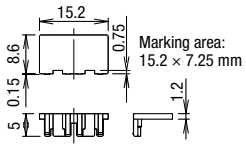
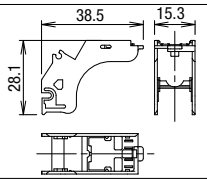
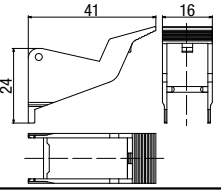

### Sockets

Package Quantity: 1

| Terminal Style | | Part No. | Ordering No. | Package Quantity |
|---|---|---|---|---|
| DIN-rail Socket (*1) | Standard Screw Terminal (*2) | SJ2S-05B | SJ2S-05B | 1 |
| | Fingersafe Screw Terminal (*2) | SJ2S-07L | SJ2S-07L | 1 |
| | Push-in Terminal | SJ2S-21L | SJ2S-21L | 1 |
| PC Board Socket | | SJ2S-61 | SJ2S-61PN10 | 10 |
| | | SJ2S-61 | SJ2S-05PN50 | 50 |

*1) Release lever is supplied with the socket.
*2) Terminal number marking in white also available.
Add "W" to the Part No.
Example: SJ2S-07LW
• See website for details on PC board socket.

### Accessories and Replacement Parts (for DIN-rail Socket)

| Description/Shape | | Applicable Socket Part No. | Material | Part No. | Ordering No. | Package Quantity | Remarks |
|---|---|---|---|---|---|---|---|
| Removable Marking Plate | | SJ2S-05B SJ2S-07L | Plastic (white) | SJ9Z-PW | SJ9Z-PWPN10 | 10 |  |
| | | SJ2S-21L | | SJ9Z-P2100W | SJ9Z-P2100W | | (*4) |
| Jumper (*3) | For 2 sockets | SJ2S-05B SJ2S-07L | Nickel-coated brass with polypropylene coating | SJ9Z-JF2 | SJ9Z-JF2PN10 | | Terminal centers: 15.5mm Rated current: 12A |
| | For 5 sockets | | | SJ9Z-JF5 | SJ9Z-JF5PN10 | | |
| | For 8 sockets | | | SJ9Z-JF8 | SJ9Z-JF8PN10 | | |
| | For 10 sockets | | | SJ9Z-JF10 | SJ9Z-JF10PN10 | | |
| | For 2 sockets | SJ2S-21L | Zinc-plated steel with polybutylene terephthalate coating | SJ9Z-J2102A | SJ9Z-J2102A | | A2 terminal of the coil is connected. The rated current is 2A. |
| Release Lever (with integrated marking plate)  | | SJ2S-05B SJ2S-07L | Plastic (gray) | SJ9Z-CM | SJ9Z-CMPN05 | 5 |  When not using marking plate |
| Release Lever  | | SJ2S-21L | Plastic | SJ9Z-C21R | SJ9Z-C21R | 10 |  |

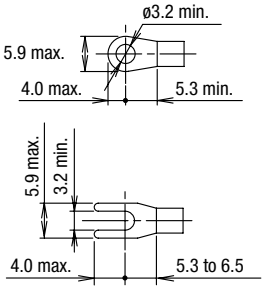
*3) Ensure that the total current to the jumper does not exceed the maximum current. *4) Used for Push-in terminals.

### Socket Specifications

| Model | | SJ2S-05B/-07L (DIN Rail Socket) | SJ2S-61 (PC Board Socket) | SJ2S-21L (Push-in Terminal Socket) |
|---|---|---|---|---|
| Rated Current | | 8A | | |
| Rated Insulation Voltage | | 250V AC/DC | | 300V AC/DC (*6) |
| Applicable Wire | | 2mm² | – | Solid wire / stranded wire: 0.14 to 1.5mm², AWG26 to 16<br>Stranded wire with ferrule (without insulated cover): 0.5 to 1.5mm², AWG20 to 16<br>Stranded wire with ferrule (with insulated cover): 0.14 to 1.0mm², AWG26 to 18 |
| Applicable Cripming Terminal | | See the dimensions shown at right | – | – |
| Recommended Tightening Torque | | 0.6 to 1.0 N·m | – | – |
| Screw Terminal Style | | M3 slotted Phillips screw (self-lifting) | – | – |
| Terminal Strength | | Wire tensile strength: 50N minimum | – | – |
| Dielectric Strength (*5) | Between contact and coil | 4000V AC, 1 min. | 5000V AC, 1 min. | 2500V AC, 1 min. (between live and dead metal parts, between live metal parts of the different poles) |
| | Between contacts of the same pole | 1000V AC, 1 min. | | |
| | Between contacts of the different pole | 3000V AC, 1 min. | | |
| Vibration Resistance | Damage limits | 90m/s² | | 10 to 55 Hz, amplitude 1.5 mm |
| | Resonance | Frequency 10 to 55Hz, amplitude 0.75mm | | |
| Shock Resistance (damage limits) | | 1000m/s² | | 50G (when using release lever) |
| Operating Temperature | | –40 to +70°C (no freezing) | | |
| Operating Humidity | | 5 to 85% RH (no condensation) | | |
| Storate Temperature | | –55 to +85°C (no freezing) | | –40 to +70°C (no freezing) |
| Degree of Protection (Screw Terminal) | | SJ2S-07L: IP20 (IEC 60529) | – | – |
| Weight | | 34g | 4.5g | 43g |

*5) The above are same when used with a RF2 force guided relay. *6) When using the socket with RF2S Force Guided Relay, the rated insulation voltage is 150V AC/DC.

### Applicable Crimping Terminal



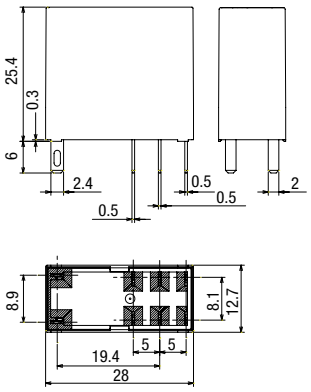

Note: Ring terminal cannot be used on SJ2S-0L. See Cat. No. EP1728 for applicable terminals on Push-in terminals.

## Dimensions

(All dimensions in mm.)

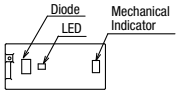
### Relay Dimensions

#### RF2S (plug-in terminal) Standard (without LED/diode)

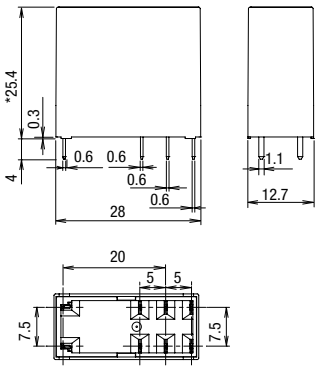



* With LED/diode: 28.4

With LED/diode

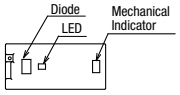



#### RF2V (PC board terminal) Standard (without LED/diode)



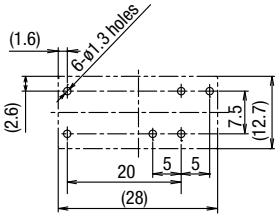

* With LED/diode: 28.4

With LED/diode

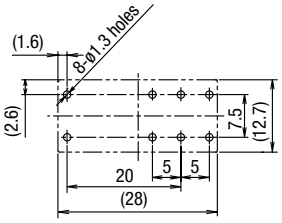



#### PC Board Terminal Mounting Hole Layout (Bottom View)

RF2V (SPST-NO + SPST-NC)

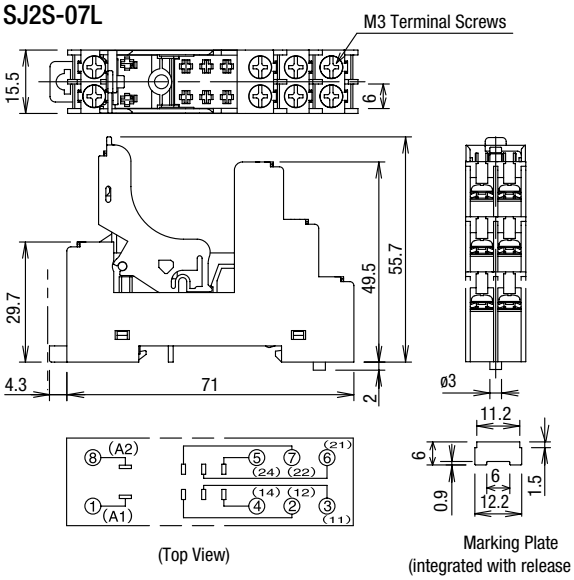



RF2V (DPDT)




### Socket Dimensions

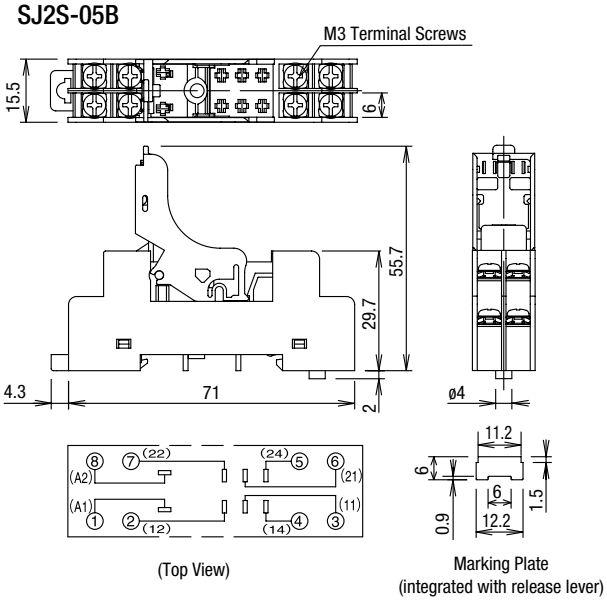
#### SJ2S-07L




(Top View)

Marking Plate
(integrated with release lever)

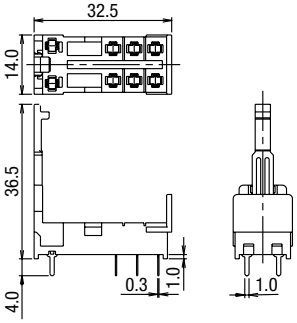
#### SJ2S-05B



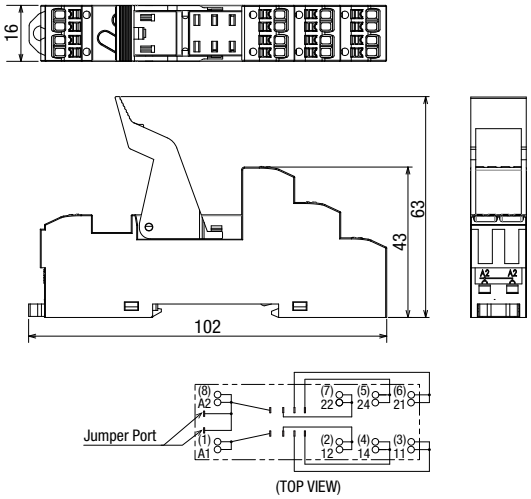

(Top View)

Marking Plate
(integrated with release lever)

#### SJ2S-61




#### SJ2S-21L



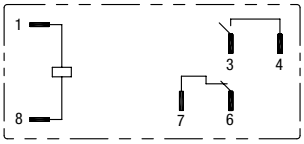

(TOP VIEW)

## Dimensions

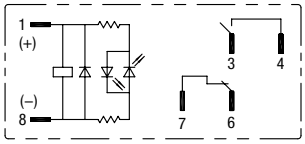
(All dimensions in mm.)

### Internal Connection (Bottom View)

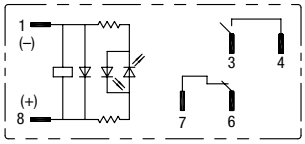
**RF2*-1A1B-☐**
Standard



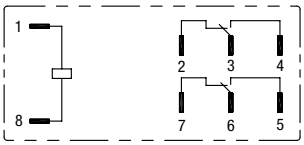

**RF2*-1A1BLD1-☐**
With LED indicator + diode of reverse polarity coil



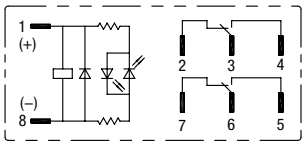

**RF2*-1A1BLD-☐**
With LED indicator + diode



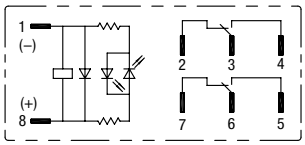

**RF2*-2C-☐**
Standard



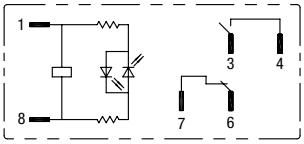

**RF2*-2CLD1-☐**
With LED indicator + diode of reverse polarity coil



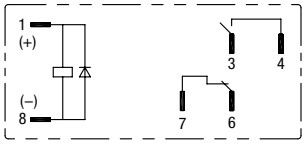

**RF2*-2CLD-☐**
With LED indicator + diode



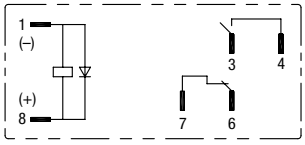

**RF2*-1A1BL-☐**
With LED indicator



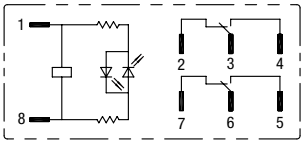

**RF2*-1A1BD1-☐**
With diode of reverse polarity coil



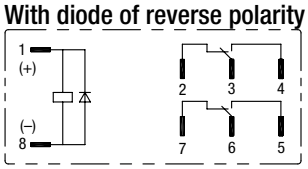

**RF2*-1A1BD-☐**
With diode



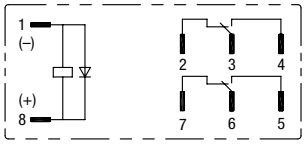

**RF2*-2CL-☐**
With LED indicator




**RF2*-2CD1-☐**
With diode of reverse polarity coil




**RF2*-2CD-☐**
With diode

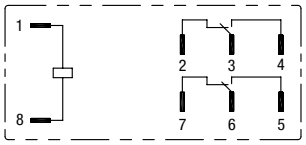



- Relays with diode have polarity. Take polarity into consideration when wiring.
- When using DPDT model as a force guided relay, use in SPST-NO + SPST-NC wiring (EN50205).

## Operating Instructions

### 1. When using DPDT model as a force guided relay

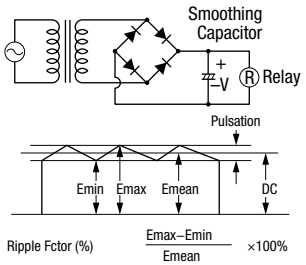
Use in SPST-NO + SPST-NC wiring according to EN50205 (2002)
RF2*-2C-☐
Standard




Example:
Use terminal 3-4 as NO contact and 6-7 as NC contact. Or terminal 2-3 as NC contact and terminal 5-6 as NO contact.

### 2. Driving Circuit for Relays

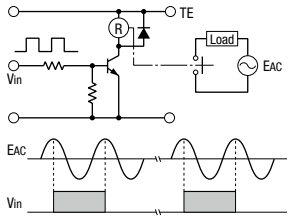
2-1. To make sure of correct relay operation, apply rated voltage to the relay coil. Pickup and dropout voltages may differ according to operating temperature and conditions.
2-2. Input voltage for DC coil:
A complete DC voltage is best for the coil power to make sure of stable operation. When using a power supply containing a ripple voltage, suppress the ripple factor within 5%. When power is supplied through a rectification circuit, the relay operating characteristics, such as pickup voltage and dropout voltage, depend on the ripple factor. Connect a smoothing capacitor for better operating characteristics as shown below.




Ripple Fctor (%) $\frac{Emax-Emin}{Emean} \times 100\%$

Emax = Maximum pulsating current
Emin = Minimum of pulsating current
Emean = DC mean value

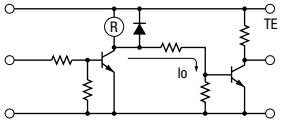
2-3. Operating the relay in sync with an AC load:



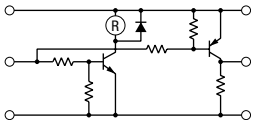

If the relay operates in sync with AC power voltage of the load, the relay life may be reduced. If this is the case, select a relay in consideration of the required reliability for the load. Or, make the relay turn on and off irrespective of the AC power phase or near the point where the AC phase crosses zero voltage.

2-4. Leakage current while relay is OFF
When driving an element at the same time as the relay operation, special consideration is needed for the circuit design. As shown in the incorrect circuit at right, leakage current (Io) flows through the relay coil while the relay is off.
Leakage current causes coil release failure or adversely affects the vibration resistance and shock resistance. Design a circuit as shown in the correct example.

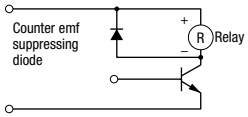
Correct




Incorrect




2-5. Surge suppression for transistor driving circuits:
When the relay coil is turned off, a high-voltage pulse is generated. Be sure to connect a diode to suppress the counter electromotive force. Then, the coil release time becomes slightly longer. To shorten the coil release time, connect a Zener diode between the collector and emitter of the controlling transistor. Select a Zener diode with a Zener voltage slightly higher than the power voltage.




2-6. The coil terminal of the relay has polarity.
Connect terminals according to the internal connection diagram. Incorrect wiring may cause malfunction.

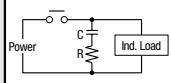
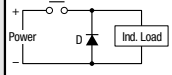
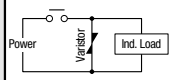
## Operating Instructions

### 3. Protection for Relay Contacts

3-1. The contact ratings show maximum values. Make sure that these values are not exceeded. When an inrush current flows through the load, the contact may become welded. If this is the case, connect a contact protection circuit, such as a current limiting resistor.

3-2. Contact protection circuit:

When switching an inductive load, arcing causes carbides to form on the contacts, resulting in an increased contact resistance. In consideration of contact reliability, contact life, and noise suppression, use of a surge absorbing circuit is recommended. Note that the release time of the load becomes slightly longer. Check the operation using an actual load. Incorrect use of a contact protection circuit will adversely affect switching characteristics. Four typical examples of contact protection circuits are shown in the following table:

| | | |
|---|---|---|
| RC |  | This protection circuit can be used for both AC and DC load power circuits.<br>R: Resistor of approximately the same resistance value as the load.<br>C: 0.1 to 1 µF |
| Diode |  | This protection circuit can be used for DC load power circuits. Use a diode with the following ratings.<br>Reverse withstand voltage:<br>Power voltage of the load circuit × 10<br>Forward current:<br>More than the load current |
| Varistor |  | This protection circuit can be used for both AC and DC load powercircuits. For the best result, when using on a power voltage of 24 to 48V AC/DC, connect a varistor across the load. When using on a power voltage of 100 to 240V AC/DC, connect a varistor across the contacts. |

3-3. Do not use a contact protection circuit as shown below:

| | |
|---|---|
|  | This protection circuit is very effective in arc suppression when opening the contacts. But, when the contacts are closed, a current flows to charge the capacitor, causing contact welding. |

Generally, switching a DC inductive load is more difficult than switching a DC resistive load. Using an appropriate arc suppressor will improve the switching characteristics of a DC inductive load.

### 4. Usage, transport, and storage conditions

4-1. Condensation

Condensation occurs when there is a sudden change in temperature under high temperature and high humidity conditions. The relay insulation may deteriorate due to condensation.

4-2. Freezing

Condensation or other moisture may freeze on the relay when the temperatures is lower than 0ºC. This causes problems such as sticking of movable parts or delay in operation.

4-3. Low temperature, low humidity environments

Plastic parts may become brittle when used in low temperature and low humidity environments.

### 5. Other Notices

5-1. General notice:

① To maintain the initial characteristics, do not drop or shock the relay.

② The relay cover cannot be removed from the base during normal operation. To maintain the initial characteristics, do not remove the relay cover.

③ Use the relay in environments free from condensation, dust, sulfur dioxide (SO2), and hydrogen sulfide (H2S).

④ RTII model cannot be washed as it is not a sealed type. Also make sure that flux does not leak to the PC board and enter the relay.

⑤ Make sure that the voltage applied to the coil cotinuously does not exceed the maximum allowable voltage.

5-2. Connecting outputs to electronic circuits:

When the output is connected to a load which responds very quickly, such as an electronic circuit, contact bouncing causes incorrect operation of the load. Take the following measures into consideration.

① Connect an integration circuit.

② Suppress the pulse voltage due to bouncing within the noise margin of the load.

5-3. Do not use relays in the vicinity of strong magnetic fields, as this may affect relay operation.

5-4. UL and CSA ratings may differ from product rated values determined by IDEC.

5-5. Others

• Shock Resistance

For the best shock resistance, it is ideal to install the RF2 relay so that the armature movent is perpendicular to the direction of vibration/ shock.

• Life

Large loads that causes arcs may result in the contact material scattered off, accumulating around the contact. This will degrade insulation resistance between the circuits. Make sure that the relay is mounted in the correct direction.

• Counter-electromotive force model (diode)

Counter-electromotive force diode model has polarity. The diode absorbs counter-electromotive force of relay coil. When excessive external surge voltage is anticipated, take additional counter-electromotive force measures. Otherwise the diode may be damaged. When using general purpose relays and force guided relays closely, use of a marking plate (optional) on the release lever or socket is recommended, so that force guided relay can be recognized easily.

### 6. Notes on PC Board Mounting

- When mounting two or more relays on a PC board, keep a minimum spacing of 5 mm in each direction. If used without spacing of 10 mm, rated current and operating temperature differs. Consult IDEC.
- Manual soldering: Solder the terminals at 350°C within 3 sec.
- Auto-soldering: Preliminary heating at 120°C within 60 sec. Solder at 250°C within 4 to 5 sec.
- Because the terminal part is filled with epoxy resin, do not excessively solder or bend the terminal. Otherwise, air tightness will degrade.
- Avoid the soldering iron from touching the relay cover or the epoxy filled terminal part. Use a non-corrosive resin flux.
- Do not install the relay on the PC board in the way the PC board is bent, otherwise copper foil may be cut or solder may be displaced after operating for a long time or due to vibration, degrading the relay's performance.
- When multiple PC boards with relays are mounted to a rack, the temperature may rise excessively. When mounting relays, leave enough space so that heat will not build up, and so that the relays' ambient temperature remains within the specified operating temperature range.