RF1V  Force Guided Relays
SF1V  Relay Sockets
Enables flexible construction of safety circuits

**Complies with International Standards**
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.
(200 m/s² minimum)

**High Shock Resistance**
High shock resistant suitable for use in machine tools and in environments subjected to vibration and shocks.

**Clear Visibility**
Available with a built-in LED.

**Compact and Slim**
Compact size enables size reduction of PC board.
4-pole type: 13W × 40D × 24H mm
6-pole type: 13W × 50D × 24H mm

**Socket Variation**
PC board mount and DIN rail mount sockets are available.

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**What is a force guided relay?**
Relays used in safety circuits to detect failures such as contact welding and damage to the contact spring.

Contacts of a force guided relay are forced to open and close by a guide connected to the armature. Due to requirements of standard EN50205, a force guided relay has independent NO and NC contacts. If a NO contact welds, a NC contact will not close even when the relay coil is turned off (de-energized) and must maintain a gap of at least 0.5 mm. Furthermore, if a NC contact welds, a NO contact will not close when the relay is turned on (energized) and must maintain a gap of at least 0.5 mm. (General-purpose relays do not have the above characteristics.)

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**Applications**
Force guided relays are used in safety circuits in combination with interlock switches, light curtains, and emergency stop switches to control outputs. They can also be used to expand outputs for safety relay modules and safety controllers.

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**Output expansion for safety relay modules and safety controllers**

**HR1S Safety Relay Module**
Cost effective and easy method to expand mechanical contact outputs.

**FS1A Safety Controller**
Solid state safety outputs of safety controllers can be converted to mechanical contact outputs.
RF1V Force Guided Relays / SF1V Relay Sockets

Compact and EN compliant RF1V force guided relays.

- Force guided contact mechanism (EN50205 Type A TÜV approved)
- Contact configuration
  - 4-pole (2NO-2NC, 3NO-1NC)
  - 6-pole (4NO-2NC, 5NO-1NC, 3NO-3NC)
- Built-in LED indicator available.
- Fast response time (8 ms maximum).
- High shock resistance (200 m/s² minimum)
- Finger-safe DIN rail mount socket and PC board mount socket.

- Sockets
  - Types
    - DIN Rail Mount Sockets
      - 4-pole
        - 2NO-2NC: SF1V-4-07L
        - 3NO-1NC: SF1V-6-07L
      - 6-pole
        - 4NO-2NC: SF1V-4-61
        - 5NO-1NC: SF1V-6-61
        - 3NO-3NC: SF1V-6-61
    - PC Board Mount Sockets
      - 4-pole
        - 2NO-2NC: SF1V-4-61
        - 3NO-1NC: SF1V-4-61
      - 6-pole
        - 4NO-2NC: SF1V-6-61
        - 5NO-1NC: SF1V-6-61
        - 3NO-3NC: SF1V-6-61

- Certification for Sockets
  - UL508 CSA C22.2 No.14
  - EN147000 EN147100

- Types
  - Force Guided Relays
    - Contact
      - Rated Coil Voltage
      - Without LED Indicator
        - Ordering Type No.
      - With LED Indicator
        - Ordering Type No.
      - 4-pole
        - 2NO-2NC: 12V DC
          - RF1V-2A2B-D12
          - RF1V-2A2BL-D12
        - 3NO-1NC: 12V DC
          - RF1V-3A1B-D12
          - RF1V-3A1BL-D12
      - 6-pole
        - 4NO-2NC: 12V DC
          - RF1V-4A2B-D12
          - RF1V-4A2BL-D12
        - 5NO-1NC: 12V DC
          - RF1V-5A1B-D12
          - RF1V-5A1BL-D12
        - 3NO-3NC: 12V DC
          - RF1V-3A3B-D12
          - RF1V-3A3BL-D12

- Coil Ratings
  - Contact
    - Rated Coil Voltage (V)
    - Rated Current (mA) ±10% (at 20°C) (Note 1)
    - Contact Resistance (Ω) ±10% (at 20°C)
  - Operating Characteristics
    - Pickup Voltage
    - Dropout Voltage
    - Maximum Continuous Applied Voltage (Note 2)
  - Power Consumption
    - Approx. 0.36W
    - Approx. 0.5W

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

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
RF1V Force Guided Relays / SF1V Relay Sockets

### Relay Specifications

<table>
<thead>
<tr>
<th>Number of Poles</th>
<th>4-pole</th>
<th>6-pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Configuration</td>
<td>2NO-2NC</td>
<td>3NO-1NC</td>
</tr>
<tr>
<td>2NO-2NC</td>
<td>3NO-1NC</td>
<td>4NO-2NC</td>
</tr>
<tr>
<td>Contact Resistance (initial value) (Note 1)</td>
<td>100 mΩ maximum</td>
<td></td>
</tr>
<tr>
<td>Contact Material</td>
<td>AgSnO2 (Au flashed)</td>
<td></td>
</tr>
<tr>
<td>Rated Load (resistive load)</td>
<td>6A 250V AC, 6A 30V DC</td>
<td></td>
</tr>
<tr>
<td>Allowable Switching Power (resistive load)</td>
<td>1500 VA, 180W</td>
<td></td>
</tr>
<tr>
<td>Allowable Switching Voltage</td>
<td>250V AC, 30V DC</td>
<td></td>
</tr>
<tr>
<td>Allowable Switching Current</td>
<td>6A</td>
<td></td>
</tr>
<tr>
<td>Minimum Applicable Load (Note 2)</td>
<td>5V DC, 1 mA (reference value)</td>
<td></td>
</tr>
<tr>
<td>Power Consumption (approx.)</td>
<td>0.36W</td>
<td>0.5W</td>
</tr>
</tbody>
</table>

### Applicable Crimping Terminals

- Ring tongue terminals cannot be used.

### Applicable Crimping Terminals

![Applicable Crimping Terminals Diagram](image)

Note: Ring tongue terminals cannot be used.

### Socket Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>SF1V-4-07L</th>
<th>SF1V-6-07L</th>
<th>SF1V-4-61</th>
<th>SF1V-6-61</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Current</td>
<td>6A</td>
<td>6A</td>
<td>6A</td>
<td>6A</td>
</tr>
<tr>
<td>Rated Voltage</td>
<td>250V AC/DC</td>
<td>250V AC/DC</td>
<td>250V AC/DC</td>
<td>250V AC/DC</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>1000 MΩ minimum (500V DC megger, between terminals)</td>
<td>1000 MΩ minimum (500V DC megger, between terminals)</td>
<td>1000 MΩ minimum (500V DC megger, between terminals)</td>
<td>1000 MΩ minimum (500V DC megger, between terminals)</td>
</tr>
<tr>
<td>Dielectric Strength</td>
<td>30V DC 1A resistive load: 100,000 operations minimum (operating frequency 1200 per hour)</td>
<td>30V DC 1A resistive load: 100,000 operations minimum (operating frequency 1200 per hour)</td>
<td>30V DC 1A resistive load: 100,000 operations minimum (operating frequency 1800 per hour)</td>
<td>30V DC 1A resistive load: 100,000 operations minimum (operating frequency 1800 per hour)</td>
</tr>
<tr>
<td>Screw Terminal Style</td>
<td>M3 slotted Philips screw</td>
<td>M3 slotted Philips screw</td>
<td>M3 slotted Philips screw</td>
<td>M3 slotted Philips screw</td>
</tr>
<tr>
<td>Applicable Wire</td>
<td>0.7 to 1.65 mm² (18 AWG to 14 AWG)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Recommended Screw Tightening Torque</td>
<td>0.5 to 0.8 N·m</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Terminal Strength</td>
<td>Wire tensile strength: 50N min.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Vibration Resistance</td>
<td>Damage limits: 10 to 55 Hz, amplitude 0.75 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Shock Resistance</td>
<td>1000 m/s²</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Operating Temperature (Note)</td>
<td>—40 to +85°C (no freezing)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>5 to 85% RH (no condensation)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>—40 to +85°C</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Operating Frequency (rated load)</td>
<td>1200 operations per hour</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Weight (approx.)</td>
<td>20g</td>
<td>23g</td>
<td>9g</td>
<td>10g</td>
</tr>
</tbody>
</table>

Note: When using at 70 to 85°C, reduce the switching current by 0.1A/°C.
Accessories

<table>
<thead>
<tr>
<th>Item</th>
<th>Appearance</th>
<th>Specifications</th>
<th>Type No.</th>
<th>Ordering Type No.</th>
<th>Package Quantity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN Rail</td>
<td></td>
<td>Aluminum</td>
<td>BAA1000</td>
<td>BAA1000PN10</td>
<td>10</td>
<td>Length: 1m Width: 35 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weight: Approx. 200g</td>
<td></td>
<td></td>
<td></td>
<td>North American standard product</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steel</td>
<td>BAP1000</td>
<td>BAP1000PN10</td>
<td>10</td>
<td>Length: 1m Width: 35 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weight: Approx. 320g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aluminum</td>
<td>BNDN1000</td>
<td>BNDN1000</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weight: Approx. 250g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End Clip</td>
<td></td>
<td>Metal (zinc plated steel)</td>
<td>BNL5</td>
<td>BNL5PN10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weight: Approx. 15g</td>
<td>BNL6</td>
<td>BNL6PN10</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

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. 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. The remaining unwelded NC contact (5-6 or 3-4) is either open or closed.

RF1V Dimensions

- RF1V (4-pole)
- RF1V (6-pole)

PC Board Terminal Type Mounting Hole Layout (Bottom View)

- RF1V (4-pole)
- RF1V (6-pole)

Internal Connection (Bottom View)

- RF1V (4-pole)
- RF1V (6-pole)

With LED Indicator

Without LED Indicator

2NO-2NC Contact

2NO-1NC Contact

3NO1NC Contact

4NO-2NC Contact

5NO-1NC Contact

3NO-3NC Contact

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SF1V DIN Rail Mount Socket Dimensions

- SF1V-4-07L (4-pole)
  - (Panel Mounting Hole Layout)
  - (Top View)

- SF1V-6-07L (6-pole)
  - (Panel Mounting Hole Layout)
  - (Top View)

SF1V PC Board Mount Sockets

- SF1V-4-61 (4-pole)
  - (Top View)

- SF1V-6-61 (6-pole)
  - (Top View)

• PC Board Mounting Hole Layout / Terminal Arrangement (Bottom View)
  - 3-ø3.2 holes for M3 self-tapping screws

All dimensions in mm.
Instructions

1. Driving Circuit for Relays
   1. To make sure of correct relay operation, apply rated voltage to the relay coil. Pickup and drop-out voltages may differ according to operating temperature and humidity 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 drop-out voltage, depend on the ripple factor. Connect a smoothing capacitor for better operating characteristics as shown below.

   ![Smoothing Capacitor Circuit](image)

   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.

   ![Relay AC/DC Load](image)

   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 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.

   ![Incorrect Leakage Current](image)

   ![Correct Leakage Current](image)

   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 counterelectromotive 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.

   ![Zener Diode Circuit](image)

2. Protection for Relay Contacts
   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 limiter, to make sure of correct relay operation.
   2. Contact protection circuit:
      When switching an inductive load, arcing causes carbides to form on the contacts, resulting in an increased contact resistance. To improve 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:

   ![Contact Protection Circuit Table](image)

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

   ![Incorrect Contact Protection Circuit](image)

   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. Low temperature, low humidity environments
   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.
   2. Freezing: Condensation or other moisture may freeze on the relay when the temperatures is lower than 0°C. This causes problems such as sticking of movable parts or delay in operation.
   3. Low temperature, low humidity environments: Plastic parts may become brittle when used in low temperature and low humidity environments.

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 (SO₂), and hydrogen sulfide (H₂S).
      ④ The RF1V relay cannot be washed as it is not waterproof.

6. Notes on PC Board Mounting
   1. When mounting a relay 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.
   2. Manual soldering: Solder the terminals at 400°C within 3 sec.
   3. Auto-soldering: Preliminary heating at 120°C within 120 sec. Solder at 260°C/6 sec. Because the terminal part is filled with epoxy resin, do not excessively solder or bend the terminal. Otherwise, air tightness will degrade.
   4. Avoid the soldering iron from touching the relay cover or the epoxy filled terminal part. Use a non-corrosive resin flux.
Control circuits conforming with safety categories 2, 3, and 4 can be constructed.

- **Safety category 4 control circuits**
  The circuit example below consisting of interlock switches, force guided relays, and safety contactors are only a part of a safety-related system in a machine. In actual machines, risk assessment must be performed taking various aspects into consideration such as hazard types, safeguarding measures, and change of hazard level in operating mode, in order to reduce the risk of the entire machine to a tolerable level. The safety category of a machine needs to be evaluated for the entire safety-related system.

- **Safety function at occurrence of single faults**
  1. If a short-circuit failure occurs at either of the S1 channels, when the safety guard is open, K2 does not turn off but K1 turns off, so safety function (power interruption to the motor) is maintained. The system does not restart because the NC contact of K2 remains open and K3 is not energized even when S2 is turned on.
  2. If a short-circuit failure occurs between S1 channels, the potential difference of K1 and K2 coils become 0V, turning K1 and K2 off. (Fault detection function between safety input circuits)
  3. If NO contact of KM1 is welded, KM2 turns off when the safety guard is opened, so the safety function (power interruption to the motor) is maintained. The system does not restart because the NC contact remains open and K3 is not energized even when S2 is turned on.
  4. If the NO contact of K1 is welded, K2 turns off when the safety guard is opened, so the safety function (power interruption to the motor) is maintained. The system does not restart because the NC contact of K1 remains open and K3 is not energized even when S2 is turned on.
  5. If NC contact of K3 is welded, K1 and K2 turn off when the safety guard is opened, so the safety function (power interruption to the motor) is maintained. The system does not restart because the NO contact of K3 does not shut, therefore K1 and K2 cannot be energized.

**Switches, force guided relays, and safety contactors** are switches, force guided relays, and safety contactors respectively.

**Safety guard closed**

**Safety guard open**

**K3:** Safety contactor output

**K1, K2, K3:** RF1V force guided relays

**S1:** Start switch (HW series momentary type)

**S2:** Start switch (HW series momentary type)

**S1:** HS6B subminiature interlock switch

**F1:** Protection fuse for safety circuit

**F2:** Protection fuse for mechanical contact

**F3 to F5:** Protection fuse for mechanical contact output of force guided relay contact

**M:** Motor

**KM1, KM2:** Safety contactor

**K1, K2:** Force guided contacts

**K1, K2:** Force guided contacts

**Safety contactor output (KM1, KM2)**

**M:** Motor

**KM1, KM2:** Safety contactor

**K1, K2:** Force guided contacts

**K1, K2:** Force guided contacts

**F1:** Protection fuse for safety circuit

**F2:** Protection fuse for mechanical contact

**F3 to F5:** Protection fuse for mechanical contact output of safety contactors

**Time Chart**

**Safety guard closed**

**Safety guard open**

- **Specifications and other descriptions in this catalog are subject to change without notice.**

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