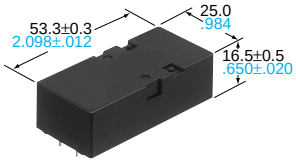
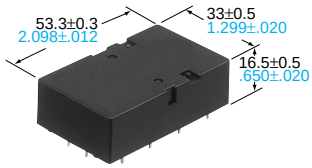
# POLARISED, MONOSTABLE SAFETY RELAY

# SF-RELAYS
## Double contact




2 Form A 2 Form B




4 Form A 4 Form B

mm inch

## FEATURES

**• High contact reliability**
High contact reliability is achieved through the use of a double contact.

**• Forced operation contacts (2 Form A 2 Form B)**
N.O. and N.C. side contacts are connected through a card so that one interacts with the other in movement. In case of a contact welding, the other keeps a min. 0.5mm .020inch contact gap.

**• Independent operation contacts (4 Form A 4 Form B)**
There are 4 points of forced operation contacts.
Each pair of contacts is free from the main armature and is independent from each other. So if a N.O. pair of contacts are welded, the other 3 N.O. contacts are not effected (operate properly) That enables to plan a circuit to detect welding or go back to the beginning condition.

**• Separated chamber structure (2 Form A 2 Form B, 4 Form A 4 Form B)**
N.O. and N.C. side contacts are put in each own space surrounded with a card and a body-separater. That prevents short circuit between contacts, which is caused by their springs welding or damaged.

**• High breakdown voltage 2,500 Vrms between contacts and coil**

**• High sensitivity**
Realizes thin shape and high sensitivity (500 mW nominal operating power) by utilizing high-efficiency polarized magnetic circuit with 4-gap balanced armature.

**• Complies with safety standards**
Standard products are UL, CSA, TÜV and SEV certified. Comform to European standards. TÜV certified (945/EL, 178/88). Complies with SUVA European standard.

## SPECIFICATIONS

### Contact

| | | | |
|---|---|---|---|
| Contact arrangement | | 2 Form A<br>2 Form B | 4 Form A<br>4 Form B |
| Initial contact resistance, max.<br>(By voltage drop 6 V DC 1 A) | | 30 mΩ | |
| Contact material | | Gold-flashed silver alloy | |
| Rating (resistive) | Nominal switching capacity | 6 A 250 V AC, 6 A 30 V DC | |
| | Max. switching power | 1,500 VA, 180 W | |
| | Max. switching voltage | 440 V AC, 30 V DC | |
| | Max. carrying current | 6 A | |
| Expected life (min. operations) | Mechanical (at 180 cpm) | $10^7$ | |
| | Electrical (at 20 cpm) | $10^5$ | |

### Coil

| | |
|---|---|
| Nominal operating power | 500 mW |

**Remarks**
* Specifications will vary with foreign standards certification ratings.
*1 Measurement at same location as “Initial breakdown voltage” section
*2 Detection current: 10mA
*3 Excluding contact bounce time
*4 Half-wave pulse of sine wave: 11ms; detection time: 10μs
*5 Half-wave pulse of sine wave: 6ms
*6 Detection time: 10μs
*7 Refer to 6. Usage, transport and storage mentioned in NOTES

### Characteristics

| | | | |
|---|---|---|---|
| Contact arrangement | | 2 Form A<br>2 Form B | 4 Form A<br>4 Form B |
| Max. operating speed | | 180 cpm (at nominal voltage) | |
| Initial insulation resistance*1 | | Min. 1,000 MΩ at 500 V DC | |
| Initial breakdown voltage*2 | Between open contacts | 1,300 Vrms | |
| | Between contact sets | 2,500 Vrms | |
| | Between contact and coil | 2,500 Vrms | |
| Operate time*3 (at nominal voltage) | | Approx. 17 ms | Approx. 18 ms |
| Release time (without diode)*3 (at nominal voltage) | | Approx. 7 ms | Approx. 6 ms |
| Temperature rise (at nominal voltage) (at 20°C) | | Max. 45°C with nominal coil voltage and at 6 A carry current | |
| Shock resistance | Functional*4 | Min. 294 m/s² {30 G} | |
| | Destructive*5 | Min. 980 m/s² {100 G} | |
| Vibration resistance | Functional*6 | 10 to 55 Hz at double amplitude of 2 mm | |
| | Destructive | 10 to 55 Hz at double amplitude of 2 mm | |
| Conditions for operation, transport and storage*7 (Not freezing and condensing at low temperature) | Ambient temp. | –40°C to +70°C<br>–40°F to +158°F | |
| | Humidity | 5 to 85% R.H. | |
| Unit weight | | Approx. 38 g 1.34 oz | Approx. 47 g 1.66 oz |

## ORDERING INFORMATION

Ex. SF [2] — [D] — [DC 5 V]

| Contact arrangement | Coil voltage |
|---|---|
| 2: 2 Form A 2 Form B<br>4: 4 Form A 4 Form B | DC 5, 12, 24, 48, 60 V |

UL/CSA, TÜV, SEV approved type is standard

## TYPICAL APPLICATIONS

- **Industrial equipment such as presses and machine tools**

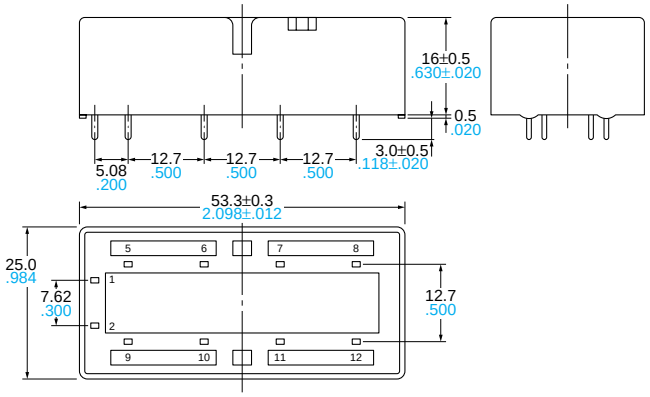
## TYPES AND COIL DATA (at 20°C 68°F)

| Contact arrangement | Part No. | Nominal voltage, V DC | Pick-up voltage, VDC (max.) | Drop-out voltage, V DC (min.) | Coil resistance Ω (±10%) | Nominal operating current, mA (±10%) | Nominal operating power, mW | Max. allowable voltage, V DC |
|---|---|---|---|---|---|---|---|---|
| 2 Form A 2 Form B | SF2D-DC5V | 5 | 3.75 | 0.5 | 50 | 100 | 500 | 6 |
| | SF2D-DC12V | 12 | 9 | 1.2 | 288 | 41.7 | 500 | 14.4 |
| | SF2D-DC24V | 24 | 18 | 2.4 | 1.152 | 20.8 | 500 | 28.8 |
| | SF2D-DC48V | 48 | 36 | 4.8 | 4.608 | 10.4 | 500 | 57.6 |
| | SF2D-DC60V | 60 | 45 | 6.0 | 7.200 | 8.3 | 500 | 72 |
| 4 Form A 4 Form B | SF4D-DC5V | 5 | 3.75 | 0.75 | 50 | 100 | 500 | 6 |
| | SF4D-DC12V | 12 | 9 | 1.8 | 288 | 41.7 | 500 | 14.4 |
| | SF4D-DC24V | 24 | 18 | 3.6 | 1.152 | 20.8 | 500 | 28.8 |
| | SF4D-DC48V | 48 | 36 | 7.2 | 4.608 | 10.4 | 500 | 57.6 |
| | SF4D-DC60V | 60 | 45 | 9.0 | 7.200 | 8.3 | 500 | 72 |

## DIMENSIONS

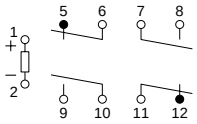
mm inch

### 1. 2 Form A 2 Form B

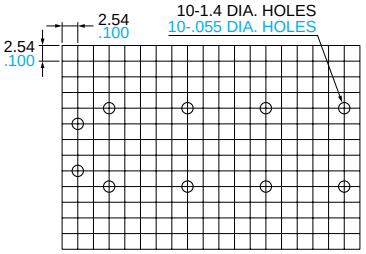



General tolerance: ±0.3 ±.012

Schematic (Bottom view)

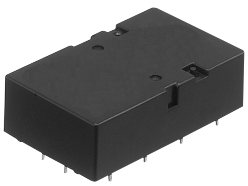


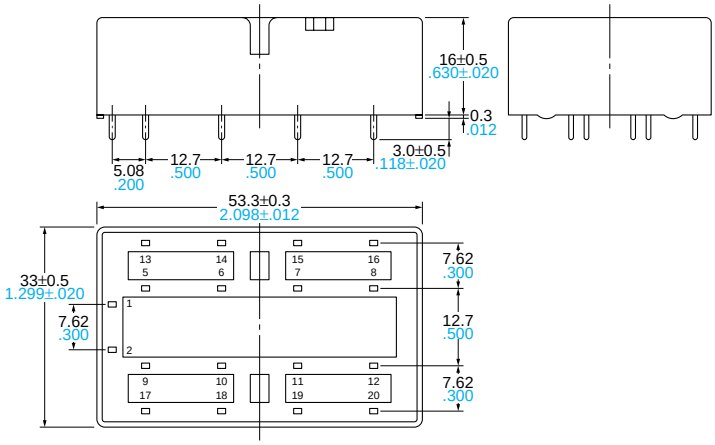

PC board pattern (Bottom view)




Tolerance: ±0.1 ±.004

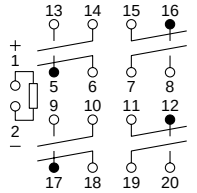
### 2. 4 Form A 4 Form B



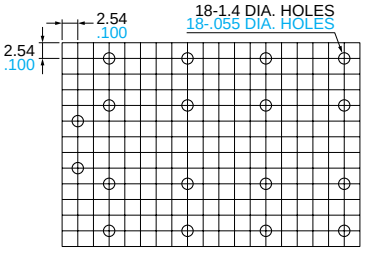



General tolerance: ±0.3 ±.012

Schematic (Bottom view)




PC board pattern (Bottom view)

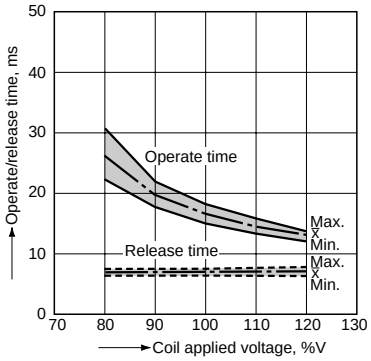



Tolerance: ±0.1 ±.004

# REFERENCE DATA

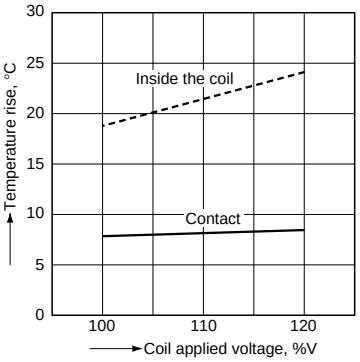
1. Operate/release time (without diode)

Tested sample: SF2D-DC24V
Quantity: n = 20



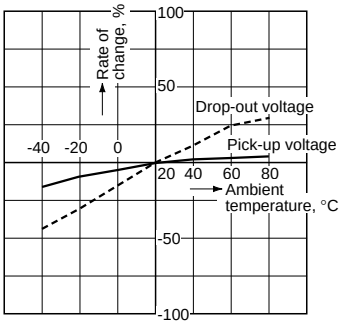

2. Temperature rise

Tested sample: SF4D-DC24V
Quantity: n = 6
Coil applied voltage: 100%V, 120%V
Contact carry current: 6A




3. Ambient temperature characteristics

Tested sample: SF4D-DC12V
Quantity: n = 6

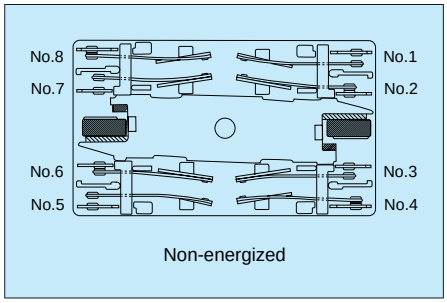


# THE OPERATION OF SF RELAYS (when contacts are welded)

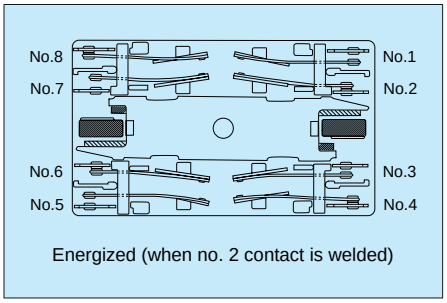
**SF relays work to maintain a normal operating state even when the contact welding occur by overloading or short-circuit currents. It is easy to make weld detection circuits and safety circuits in the design to ensure safety even if contacts weld.**

## Internal Contacts Weld

If the internal contacts (No. 2, 3, 6, and 7) weld of 4a4b type, the armature becomes non-operational and the contact gaps of each of the four form “a” contacts are maintained at greater than 0.5 mm .020 inch. Reliable isolation is thus ensured. The 2a2b type operates in the same way.




Non-energized

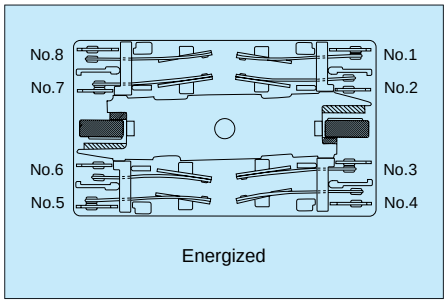



Energized (when no. 2 contact is welded)

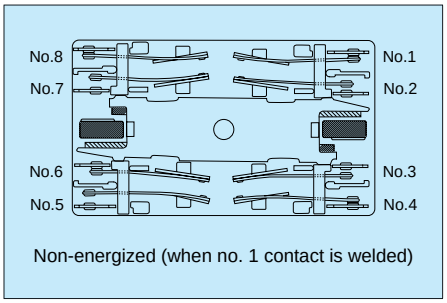
If the No. 2 contact welds.
Each of the four form “a” contacts (No. 1, 3, 5, and 7) maintains a gap of greater than 0.5 mm .020 inch.

## External Contacts Weld

If the external contacts (No. 1, 4, 5, and 8) weld of 4a4b type, gaps of greater than 0.5 mm .020 inch are maintained between adjacent contacts and the other contacts return by an non-energized.



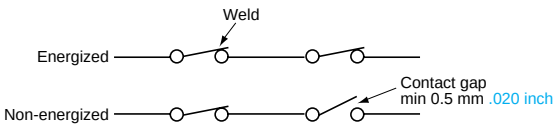

Energized




Non-energized (when no. 1 contact is welded)

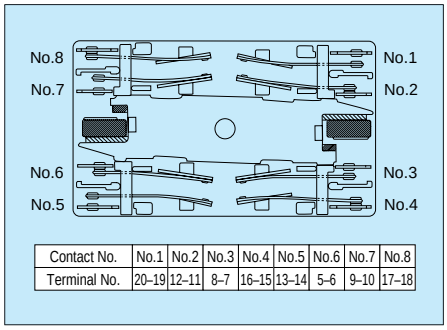
If the No. 1 contact welds.
The adjacent No. 2 contact maintains a gap of greater than 0.5 mm .020 inch. The other contacts, because the coil is not energized, return to their normal return state; each of form “a” contacts (No. 3, 5, and 7) maintains a contact gap of greater than 0.5 mm .020 inch; each of the form “b” contacts (No. 4, 6, and 8) return to a closed state.

If external connections are made in series.
Even if one of the contacts welds, the other contacts operate independently and the contact gaps are maintained at greater than 0.5 mm .020 inch.




## Contact Operation Table

The table below shows the state of the other contacts. In case of form “a” contact weld the coil applied voltage is 0 V.
In case of form “b” contact weld the coil applied voltage is nominal.




| Contact No. | No.1 | No.2 | No.3 | No.4 | No.5 | No.6 | No.7 | No.8 |
|---|---|---|---|---|---|---|---|---|
| Terminal No. | 20–19 | 12–11 | 8–7 | 16–15 | 13–14 | 5–6 | 9–10 | 17–18 |

| Contact No. \ State of other contacts | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Welded contact No. | 1 | | >0.5 | >0.5 | ≠ | >0.5 | ≠ | >0.5 | ≠ |
| | 2 | >0.5 | | >0.5 | | >0.5 | | >0.5 | |
| | 3 | | >0.5 | | >0.5 | | >0.5 | | >0.5 |
| | 4 | ≠ | >0.5 | >0.5 | | ≠ | >0.5 | ≠ | >0.5 |
| | 5 | >0.5 | ≠ | >0.5 | ≠ | | >0.5 | >0.5 | ≠ |
| | 6 | >0.5 | | >0.5 | | >0.5 | | >0.5 | |
| | 7 | | >0.5 | | >0.5 | | >0.5 | | >0.5 |
| | 8 | ≠ | >0.5 | ≠ | >0.5 | ≠ | >0.5 | >0.5 | |

>0.5: contact gap is kept at min. 0.5 mm .020 inch
≠: contact closed
Empty cells: either closed or open

Note: Contact gaps are shown at the initial state.
If the contact transfer is caused by load switching, it is necessary to check the actual loading.

# NOTES

**1. Coil operating power**

Pure DC current should be applied to the coil. The wave form should be rectangular. If it includes ripple, the ripple factor should be less than 5%. However, check it with the actual circuit since the characteristics may be slightly different.

**2. Coil connection**

When connecting coils, refer to the wiring diagram to prevent mis-operation or malfunction.

**3. Cleaning**

For automatic cleaning, the boiling method is recommended. Avoid ultrasonic cleaning which subjects the relays to high frequency vibrations, which may cause the contacts to stick.

It is recommended that a fluorinated hydrocarbon or other alcoholic solvents be used.

**4. Soldering**

We recommend the following soldering conditions

1) Automatic soldering

1) Preheating: 100°C 212°F, max. 60 s

2) Soldering: 250°C 482°F, max. 5 s

**5. Others**

1) If the relay has been dropped, the appearance and characteristics should always be checked before use.

2) The cycle lifetime is defined under the standard test condition specified in the JIS* C 5442-1986 standard (temperature 15 to 35°C 59 to 95°F, humidity 25 to 85%). Check this with the real device as it is affected by coil driving circuit, load type, activation frequency, activation phase,ambient conditions and other factors.

Also, be especially careful of loads such as those listed below.

(1) When used for AC load-operating and the operating phase is synchronous. Rocking and fusing can easily occur due to contact shifting.

(2) High-frequency load-operating

When high-frequency opening and closing of the relay is performed with a load that causes arcs at the contacts, nitrogen and oxygen in the air is fused by the arc energy and $HNO_3$ is formed. This can corrode metal materials.

Three countermeasures for these are listed here.

1. Incorporate an arc-extinguishing circuit.
2. Lower the operating frequency
3. Lower the ambient humidity

3) For secure operations, the voltage applied to the coil should be nominal voltage. In addition, please note that pick-up and drop-out voltage will vary according to the ambient temperature and operation conditions.

4) Heat, smoke, and even a fire may occur if the relay is used in conditions outside of the allowable ranges for the coil ratings, contact ratings, operating cycle lifetime, and other specifications. Therefore, do not use the relay if these ratings are exceeded. Also, make sure that the relay is wired correctly.

5) Incorrect wiring may cause unexpected events or the generation of heat or flames.

6) Check the ambient conditions when storing or transporting the relays and devices containing the relays. Freezing or condensation may occur in the relay, causing functional damage. Avoid subjecting the relays to heavy loads, or strong vibration and shocks.

**6. Usage, transport and storage conditions**

1) Ambient temperature, humidity, and atmospheric pressure during usage, transport, and storage of the relay:

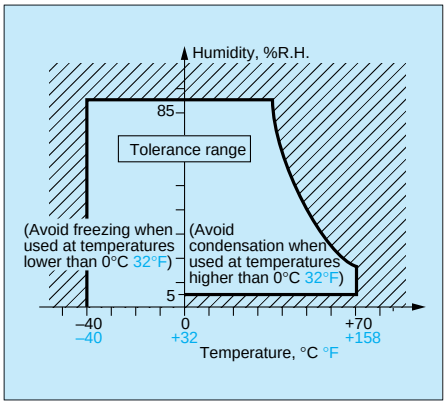
(1) Temperature:

–40 to +70°C –40 to +158°F

(2) Humidity: 5 to 85% RH

(Avoid freezing and condensation.)

The humidity range varies with the temperature. Use within the range indicated in the graph below.




(3) Atmospheric pressure: 86 to 106 kPa

Temperature and humidity range for usage, transport, and storage:

2) Condensation

Condensation forms when there is a sudden change in temperature under high temperature and high humidity conditions. Condensation will cause deterioration of the relay insulation.

3) Freezing

Condensation or other moisture may freeze on the relay when the temperatures is lower than 0°C 32°F. This causes problems such as sticking of movable parts or operational time lags.

4) Low temperature, low humidity environments

The plastic becomes brittle if the relay is exposed to a low temperature, low humidity environment for long periods of time.