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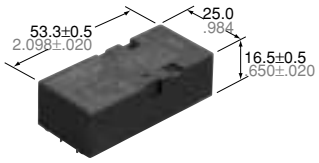
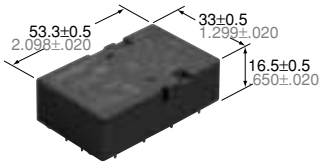
POLARIZED, MONOSTABLE SAFETY RELAY

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 2 Form B	4 Form A 4 Form B
Initial contact resistance, max. (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. Conditions for operation, transport and storage mentioned in AMBIENT ENVIRONMENT.

Characteristics (at 20°C 68°F)

Contact arrangement		2 Form A 2 Form B	4 Form A 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)		Max. 30 ms	
Release time (without diode)*3 (at nominal voltage)		Max. 15 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 –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

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ORDERING INFORMATION

Ex. SF [2] [D] — [DC 5 V]

Contact arrangement	Coil voltage
2: 2 Form A 2 Form B 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**

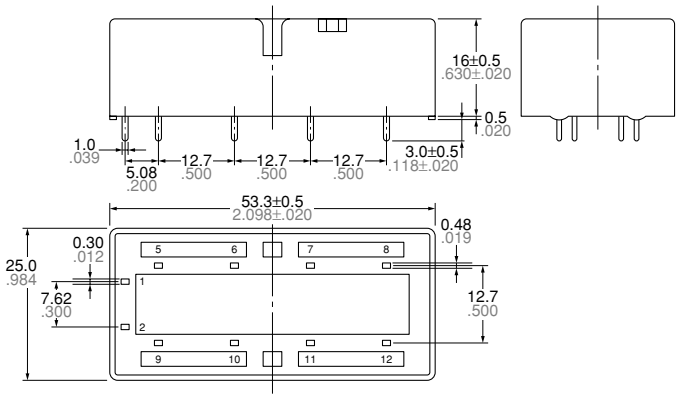
TYPES AND COIL DATA (at 20°C 68°F)

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

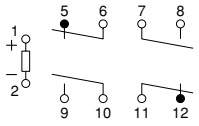
mm inch

1. 2 Form A 2 Form B

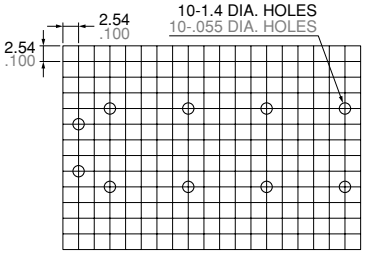


General tolerance: ±0.3 ±.012

Schematic (Bottom view)

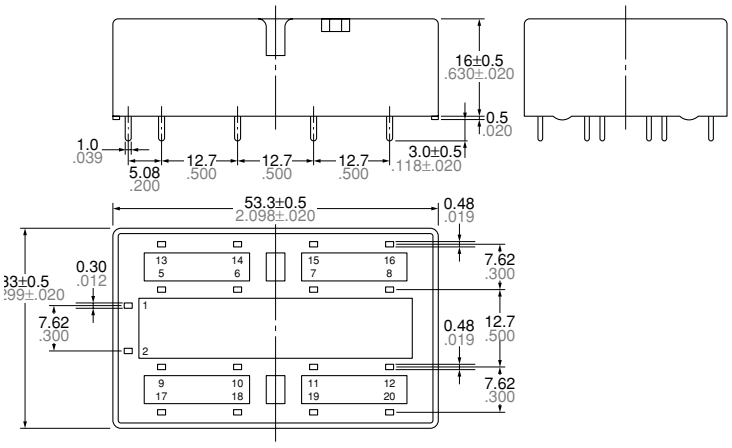


PC board pattern (Bottom view)



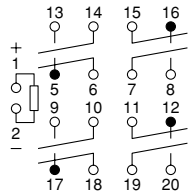
Tolerance: ±0.1 ±.004

2. 4 Form A 4 Form B

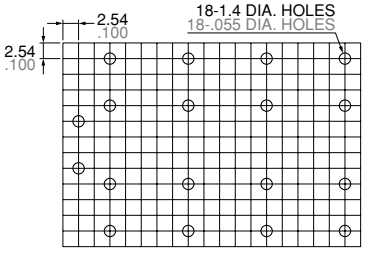


General tolerance: ±0.3 ±.012

Schematic (Bottom view)



PC board pattern (Bottom view)



Tolerance: ±0.1 ±.004

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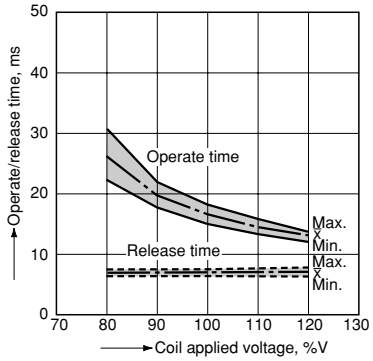
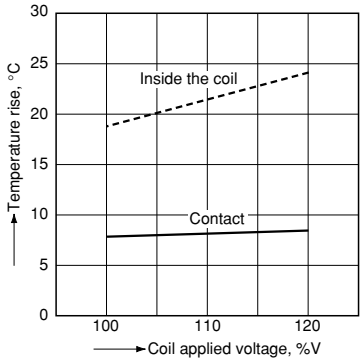
REFERENCE DATA

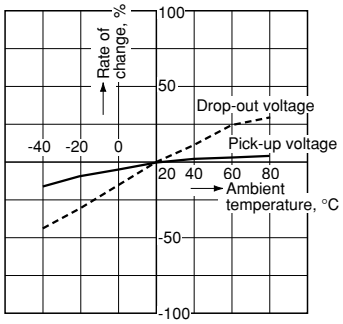
1. Operate/release time (without diode)
Tested sample: SF2D-DC24V
Quantity: n = 20



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

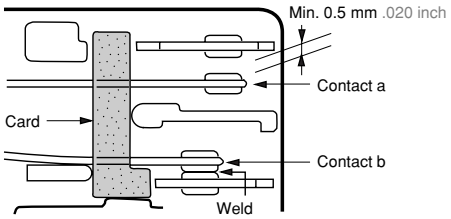
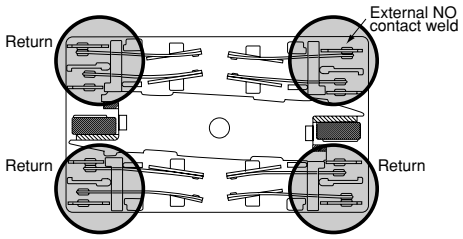
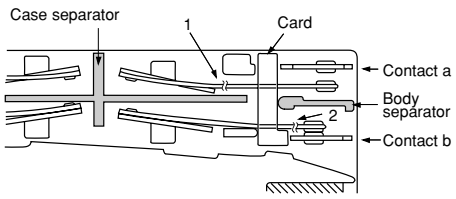


3. Ambient temperature characteristics
Tested sample: SF4D-DC12V
Quantity: n = 6



SAFETY STRUCTURE OF SF RELAYS

This SF relay design ensures that subsequent operations shut down and can automatically return to a safe state when the SF relay suffers overloading and other circuit abnormalities (unforeseen externally caused circuit or device breakdowns, end of life incidents, and noise, surge, and environmental influences) owing to contact welding, spring fusion or, in the worst-case scenario, relay breakdown (coil rupture, faulty operation, faulty return, and fatigue and breakage of the operating spring and return spring), and even in the event of end of life.

	Structure	Operation
1. Forced operation method (2a2b, 4a4b types)	 The two contacts “a” and “b” are coupled with the same card. The operation of each contact is regulated by the movement of the other contact.	Even when one contact is welded closed, the other maintains a gap of greater than 0.5 mm .020 inch. In the diagram on the left, the lower contact "b" have welded but the upper contact "a" maintain at a gap of greater than 0.5 mm .020 inch. Subsequent contact movement is suspended and the weld can be detected
2. Independent operation method (4a4b type)	 None of four contacts are held in position by the armature. Even though one of the external N.O. contacts has welded, the other three contacts have returned owing to the de-energizing of the coil.	Enables design of safety circuits that allow weld detection and return at an early stage. As shown at the top right of the diagram on the left, if the external N.O. contact welds, a 0.5 mm .020 inch gap is maintained. Each of the other contacts returns to N.O. because the coil is no longer energized.
3. Separate chamber method (2a2b, 4a4b types)	In independent chambers, the contacts "a" and "b" are kept apart by a body/card separator or by the card itself. 	Prevents shorting and fusing of springs and spring failure owing to short-circuit current. As shown on the diagram on the left, even if the operating springs numbered 1 and 2 there is no shorting between "a" and "b" contacts.
4. 2a2b contact 4a4b contact	Structure with independent COM contact of (2a2b), (3a1b), (4a4b) contacts.	Independent COM enables differing pole circuit configurations. This makes it possible to design various kinds of control circuits and safety circuits.

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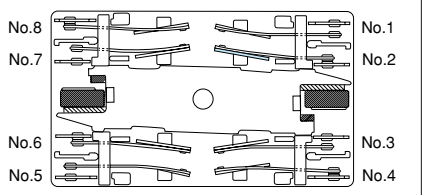
THE OPERATION OF SF RELAYS (when contacts are welded)

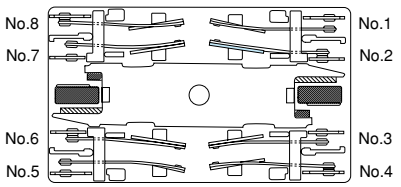
SF relays work to maintain a normal operating state even when the contact welding occur by overloading or short-circuit currents. It is easy to make weld detection circuits and safety circuits in the design to ensure safety even if contacts weld.

Internal Contacts Weld

a) When internal contacts (No. 2 or No. 6) are welded, the armature becomes non-operational and the four contact gaps (No. 1, No. 3, No. 5 and No. 7) are maintained at 0.5 mm .020inch or greater. Reliable cut-off is thus ensured.
b) When internal contacts (No. 3 or No. 7) are welded, the armature becomes non-operational and the four b type contact gaps (No. 2, No. 4, No. 6 and No. 8) are maintained at 0.5 mm .020inch or greater. Reliable cut-off is thus ensured.



Non-energized

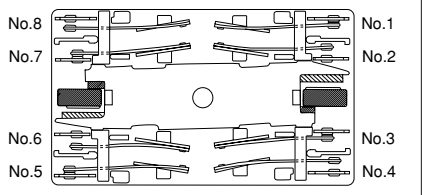


Energized (when no. 2 contact is welded)

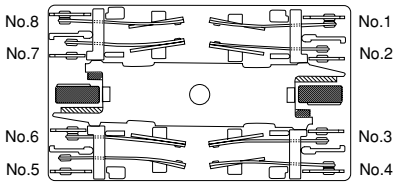
If the No. 2 contact welds.
Each of the four form “a” contacts (No. 1, 3, 5, and 7) maintains a gap of greater than 0.5 mm .020 inch.

External Contacts Weld

a) When external contacts (No. 4 or No. 8) are welded, gaps of 0.5 mm .020inch and greater are maintained between adjacent contacts and other contacts operate normally by the coil being energized.
b) When external contacts (No. 1 or No. 5) are welded, gaps of 0.5 mm .020inch and greater are maintained between adjacent contacts and other contacts are released by the coil being de-energized.



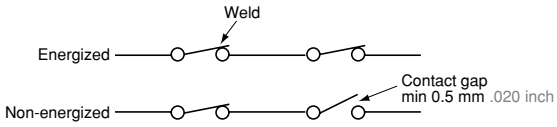
Energized



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

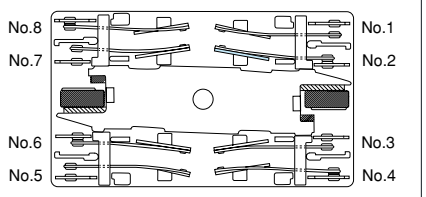
If the No. 1 contact welds.
The adjacent No. 2 contact maintains a gap of greater than 0.5 mm .020 inch. The other contacts, because the coil is not energized, return to their normal return state; each of form “a” contacts (No. 3, 5, and 7) maintains a contact gap of greater than 0.5 mm .020 inch; each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

For Cautions for Use, see Relay Technical Information.

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