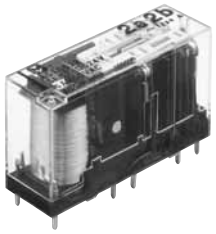
Slim type safety relays

SF RELAYS
Slim type



RoHS compliant

Protective construction: Flux-resistant type

FEATURES

1. Acquisition of Korean safety certification ("S" mark)
Excluding with diode type
2. Forcibly guided contact structure
3. Slim profile (mm inch)
40/50 (L) × 13 (W) × 24 (H)
1.575/1.969 (L) × .512 (W) × .945 (H)
4. Fast response time is achieved (8 ms or less).
5. With diode and LED indication type available
6. Sockets and terminal sockets (spade and ring tongue terminal compatible) are available.

TYPICAL APPLICATIONS

1. Machine tools
2. Robots
3. Safety PLCs
4. Circuits with stringent safety standard requirements such as those in motor vehicle production equipment.

ORDERING INFORMATION

SF S □ - □ - □ - □

S: Slim type

Contact arrangement
2: 2 Form A 2 Form B
3: 3 Form A 1 Form B
4: 4 Form A 2 Form B
5: 5 Form A 1 Form B
6: 3 Form A 3 Form B

Operation indication
Nil: Without LED indication
L: With LED indication

Nominal coil voltage
12, 24, 48V DC

Function
Nil: None
D: With diode

Notes: 1. Please consult us about other coil voltages.
2. LED indication color is green.

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TYPES

1. Standard type

Contact arrangement		Nominal coil voltage	Without LED indication	With LED indication
			Part No.	Part No.
4 poles	2 Form A 2 Form B	12 V DC	SFS2-DC12V	SFS2-L-DC12V
		24 V DC	SFS2-DC24V	SFS2-L-DC24V
		48 V DC	SFS2-DC48V	SFS2-L-DC48V
	3 Form A 1 Form B	12 V DC	SFS3-DC12V	SFS3-L-DC12V
		24 V DC	SFS3-DC24V	SFS3-L-DC24V
		48 V DC	SFS3-DC48V	SFS3-L-DC48V
6 poles	4 Form A 2 Form B	12 V DC	SFS4-DC12V	SFS4-L-DC12V
		24 V DC	SFS4-DC24V	SFS4-L-DC24V
		48 V DC	SFS4-DC48V	SFS4-L-DC48V
	5 Form A 1 Form B	12 V DC	SFS5-DC12V	SFS5-L-DC12V
		24 V DC	SFS5-DC24V	SFS5-L-DC24V
		48 V DC	SFS5-DC48V	SFS5-L-DC48V
	3 Form A 3 Form B	12 V DC	SFS6-DC12V	SFS6-L-DC12V
		24 V DC	SFS6-DC24V	SFS6-L-DC24V
		48 V DC	SFS6-DC48V	SFS6-L-DC48V

Standard packing: Carton: 50 pcs.; Case: 200 pcs.

* Sockets and terminal sockets available.

2. With diode and LED indication type

Contact arrangement		Nominal coil voltage	Part No.
4 poles	2 Form A 2 Form B	12 V DC	SFS2-L-DC12V-D
		24 V DC	SFS2-L-DC24V-D
		48 V DC	SFS2-L-DC48V-D
	3 Form A 1 Form B	12 V DC	SFS3-L-DC12V-D
		24 V DC	SFS3-L-DC24V-D
		48 V DC	SFS3-L-DC48V-D
6 poles	4 Form A 2 Form B	12 V DC	SFS4-L-DC12V-D
		24 V DC	SFS4-L-DC24V-D
		48 V DC	SFS4-L-DC48V-D
	5 Form A 1 Form B	12 V DC	SFS5-L-DC12V-D
		24 V DC	SFS5-L-DC24V-D
		48 V DC	SFS5-L-DC48V-D
	3 Form A 3 Form B	12 V DC	SFS6-L-DC12V-D
		24 V DC	SFS6-L-DC24V-D
		48 V DC	SFS6-L-DC48V-D

Standard packing: Carton: 50 pcs.; Case: 200 pcs.

* Sockets and terminal sockets available.

RATING

1. Coil data

Contact arrangement		Nominal coil voltage	Pick-up voltage (at 20°C 68°F)	Drop-out voltage (at 20°C 68°F)	Nominal operating current [±10%] (at 20°C 68°F)	Coil resistance [±10%] (at 20°C 68°F)	Nominal operating power (at 20°C 68°F)	Max. applied voltage (at 20°C 68°F)
4 poles	2 Form A 2 Form B	12V DC	75%V or less of nominal voltage (Initial)	10%V or more of nominal voltage (Initial)	30 mA	400Ω	Approx. 360mW	110%V of nominal voltage
		24V DC			15 mA	1,600Ω		
		48V DC			7.5mA	6,400Ω		
	3 Form A 1 Form B	12V DC			30 mA	400Ω		
		24V DC			15 mA	1,600Ω		
		48V DC			7.5mA	6,400Ω		
6 poles	4 Form A 2 Form B	12V DC			41.7mA	288Ω	Approx. 500mW	
		24V DC			20.8mA	1,152Ω		
		48V DC			10.4mA	4,608Ω		
	5 Form A 1 Form B	12V DC			41.7mA	288Ω		
		24V DC			20.8mA	1,152Ω		
		48V DC			10.4mA	4,608Ω		
	3 Form A 3 Form B	12V DC			41.7mA	288Ω		
		24V DC			20.8mA	1,152Ω		
		48V DC			10.4mA	4,608Ω		

Note: The nominal operating current will increase by approximately 2mA due to the LED on the LED indication type.

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2. Specifications (relay)

Characteristics	Item		Specifications				
			4 poles		6 poles		
Contact	Contact arrangement		2 Form A 2 Form B	3 Form A 1 Form B	4 Form A 2 Form B	5 Form A 1 Form B	3 Form A 3 Form B
	Contact resistance (Initial)		Max. 100 mΩ (By voltage drop 6 V DC 1A)				
	Contact material		Au flashed $AgSnO_2$ type				
Rating	Nominal switching capacity (resistive load)		6A 250V AC, 6A 30V DC				
	Max. switching power (resistive load)		1,500VA, 180W				
	Max. switching voltage		250V AC, 125V DC				
	Max. switching current		6 A (Reduce by 0.1 A/°C for temperatures 70 to 85°C 158 to 185°F)				
	Min. switching capacity (Reference value)*1		1mA 5V DC				
	Nominal operating power		Approx. 360mW		Approx. 500mW		
Electrical characteristics	Insulation resistance (Initial)		Min. 1,000MΩ (at 500V DC) Measurement at same location as “Breakdown voltage” section.				
	Breakdown voltage (Initial)	Between open contacts	1,500 Vrms for 1 min. (Detection current: 10mA)				
		Between contact sets	2,500 Vrms for 1 min. (Detection current: 10mA); 7-8/9-10 between open contacts		2,500 Vrms for 1 min. (Detection current: 10mA); 7-8/11-12 between open contacts 9-10/13-14 between open contacts 11-12/13-14 between open contacts		
			4,000 Vrms for 1 min. (Detection current: 10mA); 3-4/5-6 between open contacts 3-4/7-8 between open contacts 5-6/9-10 between open contacts		4,000 Vrms for 1 min. (Detection current: 10mA); 3-4/5-6 between open contacts 3-4/7-8 between open contacts 5-6/9-10 between open contacts 7-8/9-10 between open contacts		
		Between contact and coil	4,000 Vrms for 1min (Detection current: 10mA)				
	Operate time (at 20°C 68°F)		Max. 20ms (Nominal coil voltage applied to the coil, excluding contact bounce time)				
	Response time (at 20°C 68°F)*2		Max. 8ms (Nominal coil voltage applied to the coil, excluding contact bounce time and without diode)*4				
	Release time (at 20°C 68°F)		Max. 20ms (Nominal coil voltage applied to the coil, excluding contact bounce time)				
Mechanical characteristics	Shock resistance	Functional	200 m/s² (Half-wave pulse of sine wave: 11 ms; detection time: 10μs)				
		Destructive	1,000 m/s² (Half-wave pulse of sine wave: 6 ms)				
	Vibration resistance	Functional	10 to 55 Hz at double amplitude of 1.5 mm (Detection time: 10μs)				
		Destructive	10 to 55 Hz at double amplitude of 1.5 mm				
Expected life	Mechanical		Min. 10^7 (at 180 times/min.)				
	Electrical		250 V AC 6 A resistive load: Min. 10^5 (at 20 times/min.)				
			30 V DC 6 A resistive load: Min. 10^5 (at 20 times/min.)				
			250 V AC 1 A resistive load: Min. 5×10^5 (at 30 times/min.)				
			30 V DC 1 A resistive load: Min. 5×10^5 (at 30 times/min.)				
			[AC 15] 240 V AC 2 A inductive load: Min. 10^5 (at 20 times/min., $\cos\varphi = 0.3$)				
			[DC 13] 24 V DC 1 A inductive load: Min. 10^5 (at 20 times/min., L/R = 48 ms)				
Conditions	Conditions for operation, transport and storage*3		Ambient temperature: –40°C to +85°C –40°F to +185°F Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)				
	Max. operating speed		20 times/min. (at max. rating)				
Unit weight			Approx. 20 g .71 oz		Approx. 23 g .81 oz		

Notes: *1. This value can change due to the switching frequency, environmental conditions, and desired reliability level, therefore it is recommended to check this with the actual load.
*2. Response time is the time after the coil voltage turns off until the time when “a” contact turns off.
*3. The upper limit of the ambient temperature is the maximum temperature that can satisfy the coil temperature rise value. Refer to Usage, transport and storage conditions in NOTES.
*4. Response time of built-in diode type is 12 ms or less (excluding contact bounce time when nominal coil voltage is applied to the coil).

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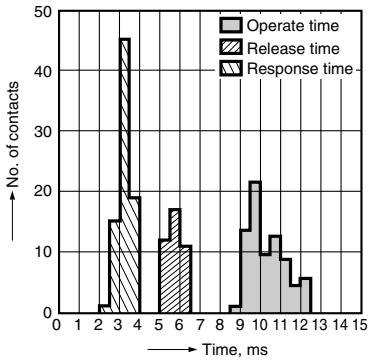
REFERENCE DATA

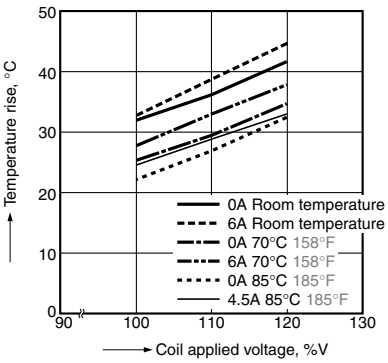
1. Operate/response/release time

Tested sample: SFS4-DC24V (4 Form A 2 Form B), 20pcs. (a contacts: 80, b contacts: 40)



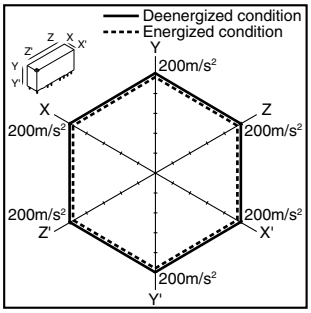
2. Coil temperature rise

Tested sample: SFS4-DC24V (4 Form A 2 Form B), 3pcs.
Measured portion: Inside the coil
Ambient temperature: Room temperature (27°C 80.6°F), 70°C 158°F, 85°C 185°F

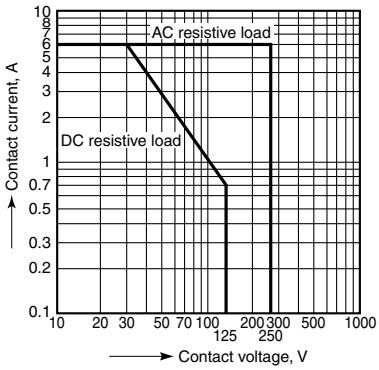


3. Malfunctional shock

Tested sample: SFS4-DC24V (4 Form A 2 Form B), 3pcs.



4. Max, switching capacity



Other contact gaps when contacts are welded

Sample: SFS4-DC24V (4 Form A 2 Form B)

The table below shows the state of the other contacts.
In case of form “NO” contact weld the coil applied voltage is 0 V.
In case of form “NC” contact weld the coil applied voltage is nominal.

		State of other contacts					
		3-4 (NC)	5-6 (NC)	7-8 (NO)	9-10 (NO)	11-12 (NO)	13-14 (NO)
Welded contact No.	3-4 (NC)			>0.5	>0.5	>0.5	>0.5
	5-6 (NC)			>0.5	>0.5	>0.5	>0.5
	7-8 (NO)	>0.5	>0.5				
	9-10 (NO)	>0.5	>0.5				
	11-12 (NO)	>0.5	>0.5				
	13-14 (NO)	>0.5	>0.5				

>0.5: contact gap is kept at min. 0.5 mm .020inch
Empty cells: either ON or OFF
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.

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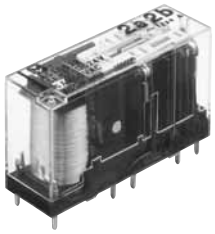
DIMENSIONS (mm inch)

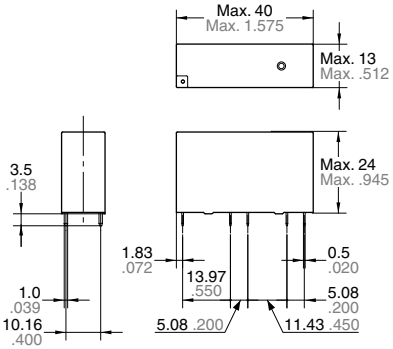
The CAD data of the products with a **CAD Data** mark can be downloaded from: http://industrial.panasonic.com/ac/e/

1. 4 poles (2 Form A 2 Form B, 3 Form A 1 Form B)

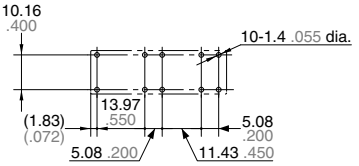
CAD Data



External dimensions



PC board pattern (Bottom view)

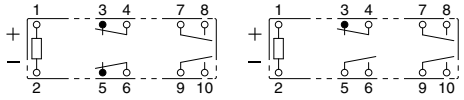


Tolerance: ±0.1 ±.004

General tolerance: ±0.3 ±.012

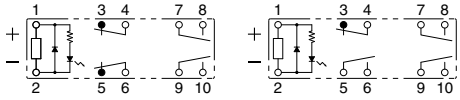
Schematic (Bottom view)

Standard



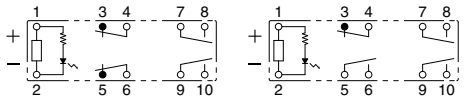
(2 Form A 2 Form B) (3 Form A 1 Form B)

With diode and LED indication type



(2 Form A 2 Form B) (3 Form A 1 Form B)

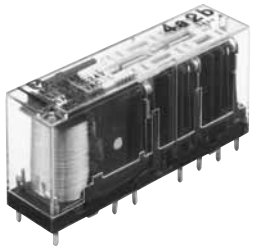
With LED indication



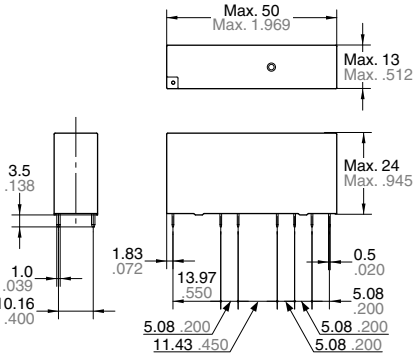
(2 Form A 2 Form B) (3 Form A 1 Form B)

2. 6 poles (4 Form A 2 Form B, 5 Form A 1 Form B, 3 Form A 3 Form B)

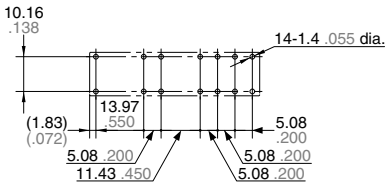
CAD Data



External dimensions



PC board pattern (Bottom view)

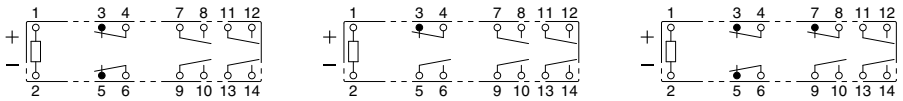


Tolerance: ±0.1 ±.004

General tolerance: ±0.3 ±.012

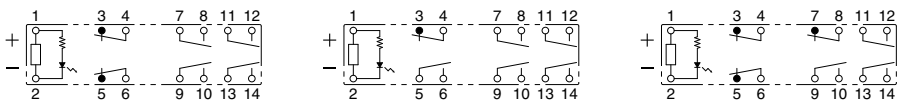
Schematic (Bottom view)

Standard



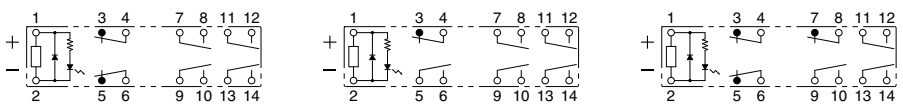
(4 Form A 2 Form B) (5 Form A 1 Form B) (3 Form A 3 Form B)

With LED indication



(4 Form A 2 Form B) (5 Form A 1 Form B) (3 Form A 3 Form B)

With diode and LED indication type



(4 Form A 2 Form B) (5 Form A 1 Form B) (3 Form A 3 Form B)

SAFETY STANDARDS

Certification authority	File No.	
UL/C-UL	E43149*	6A 277V AC, 6A 30V DC
TÜV	B 15 05 13461 346	6A 250V AC (cosϕ=1.0), 6A 30V DC (0ms), AC15: 2A 240V AC (cosϕ=0.3), DC13: 1A 24V DC (L/R 48ms)

* CSA standard: Certified by C-UL

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NOTES

1. For cautions for use, please read "GENERAL APPLICATION GUIDELINES".

2. Coil operating power

Pure DC current should be applied to the coil. 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.

The wave form should be rectangular.

3. Coil connection

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

4. Cleaning

This relay is not sealed, therefore, immersion may cause failure. Be careful that flux does not overflow onto the PC board or penetrate inside the relay.

5. Soldering

When using automatic soldering, the following conditions are recommended

1) Preheating: 120°C 248°F, within 120 Sec (PC board solder surface)

2) Soldering: 260°C±5°C 500°F±41°F, within 6 Sec

6. Other

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

2) The switching lifetime is defined under the standard test condition specified in the JIS* C 5442-1996 standard (temperature 15 to 35°C 59 to 95°F, humidity 25 to 75%). Check this with the actual product as it is affected by the coil driving circuit, load type, activation frequency, activation phase, ambient conditions and other factors.

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

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

(2) During high frequency on/off operation with certain loads, arcing may occur at the contacts. This can cause fusion to Oxygen and Nitrogen gas in the air creating Nitric Acid (HNO_3) which can cause corrosion to the contacts.

Please see the following countermeasure examples:

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

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

4) Heat, smoke, and/or fire may occur if the relay is used outside 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 false operation or generate 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 damage. Avoid exposing the relays to heavy loads, or strong shock and vibration.

7. Usage, transport and storage conditions

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

(1) Temperature: –40 to +85°C –40 to +185°F

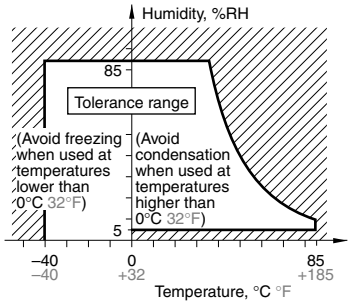
(When the temperature is 70 to 85°C 158 to 185°F, reduce the 6 A max. switching current by 0.1 A/°C.)

(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 and low humidity

At low temperature, low humidity environments, the plastic becomes brittle.

Please note corrections.

8. Please connect DC coil types with LED and built-in diode correctly by verifying the coil polarity ("+" and "–"). Connecting with reverse polarity will cause the LED not to light and damage the built-in diode due to its specification.

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ACCESSORIES

SF RELAYS
Slim type
(Sockets and DIN rail terminal sockets)

TYPES

1. Sockets

Type	No. of poles	Part No.
PC board sockets	4 poles	SFS4-PS
	6 poles	SFS6-PS

Standard packing: Carton: 10 pcs.; Case: 100 pcs.

2. DIN rail terminal socket

Type	No. of poles	Part No.
New Terminal sockets for spade and ring tongue terminals	4 poles	SFS4-SFD-R
	6 poles	SFS6-SFD-R

Standard packing: Carton: 10 pcs.; Case: 100 pcs.
Note: For previous products (spade tongue terminal dedicated terminal sockets), please order SFS4-SFD for 4 poles and SFS6-SFD for 6 poles.

RATING

Specifications

Item	Specifications
Breakdown voltage (Initial)	Between each terminal: 2,500 Vrms for 1 min. (Detection current: 10mA)
Insulation resistance (Initial)	Min. 1,000MΩ (at 500V DC) Measurement at same location as “Breakdown voltage” section.
Max. carrying current	6 A (Reduce by 0.1 A/°C for temperatures 70 to 85°C 158 to 185°F)

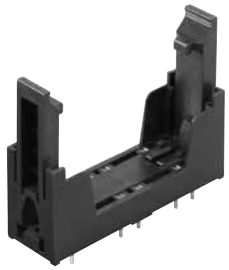
DIMENSIONS (mm inch)

The CAD data of the products with a CAD Data mark can be downloaded from: http://industrial.panasonic.com/ac/e/

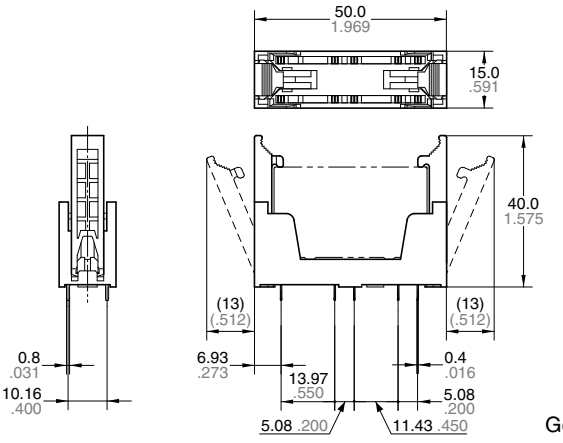
1. PC board sockets (4 poles)

(SFS4-PS)

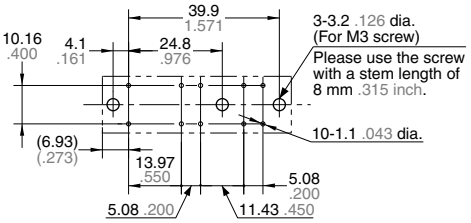
CAD Data



External dimensions



PC board pattern (Bottom view)

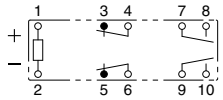


Tolerance: ±0.1 ±.004

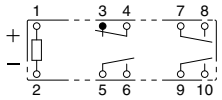
General tolerance: ±0.3 ±.012

Schematic (Bottom view)

Standard

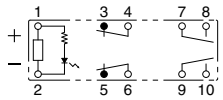


(When 2 Form A 2 Form B mounted)

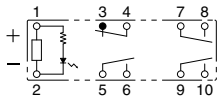


(When 3 Form A 1 Form B mounted)

With LED indication

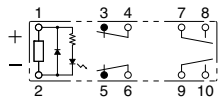


(When 2 Form A 2 Form B mounted)

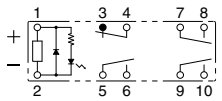


(When 3 Form A 1 Form B mounted)

With diode and LED indication type



(When 2 Form A 2 Form B mounted)



(When 3 Form A 1 Form B mounted)

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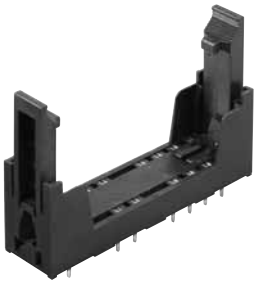
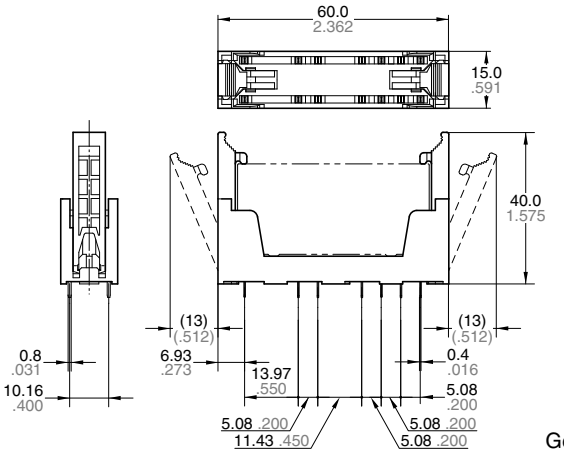
2. PC board sockets (6 poles)

(SFS6-PS)

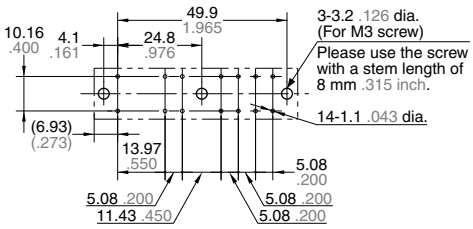
CAD Data



External dimensions



PC board pattern (Bottom view)

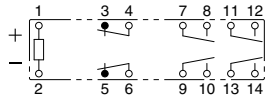


Tolerance: ±0.1 ±.004

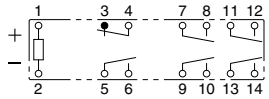
General tolerance: ±0.3 ±.012

Schematic (Bottom view)

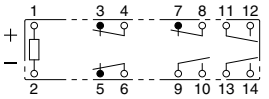
Standard



(When 4 Form A 2 Form B mounted)

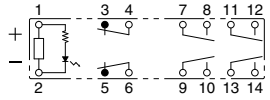


(When 5 Form A 1 Form B mounted)

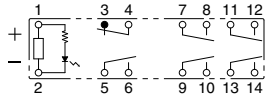


(When 3 Form A 3 Form B mounted)

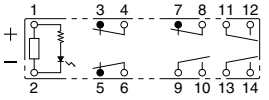
With LED indication



(When 4 Form A 2 Form B mounted)

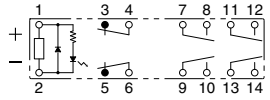


(When 5 Form A 1 Form B mounted)

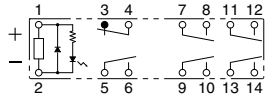


(When 3 Form A 3 Form B mounted)

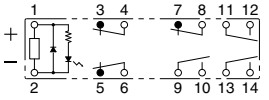
With diode and LED indication type



(When 4 Form A 2 Form B mounted)



(When 5 Form A 1 Form B mounted)

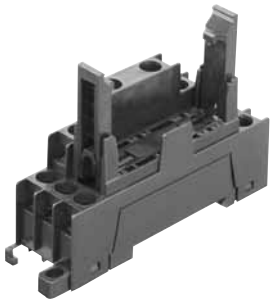


(When 3 Form A 3 Form B mounted)

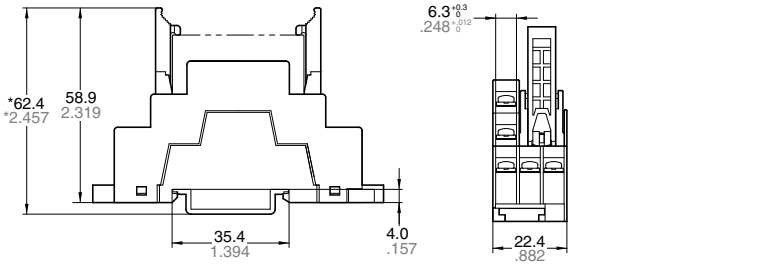
---

3. Terminal socket for spade and ring tongue terminals (For 4 poles finger protect type)

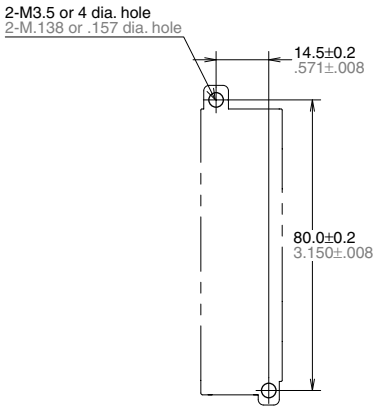
CAD Data



External dimensions

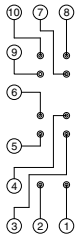


Mounting hole dimensions



Tolerance: ±0.1 ±.004

Schematic (Top view)



General tolerance: ±0.5 ±.020

* Reference value (when using DIN rail ATA48011)

Note: Ring tongue terminals cannot be used with conventional DIN rail terminal socket (SFS4-SFD).
In use of a ring tongue terminals, please use SFS4-SFD-R.

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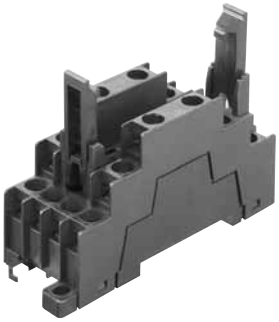
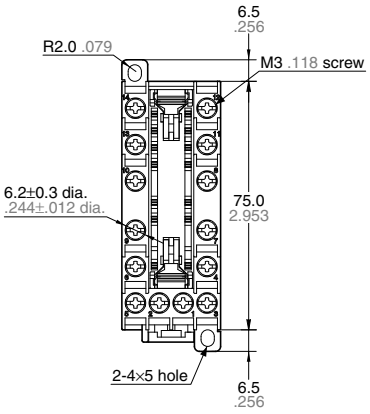
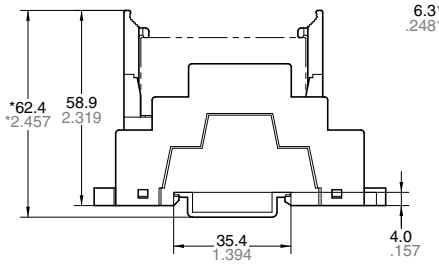
4. Terminal socket for spade and ring tongue terminals (For 6 poles finger protect type)

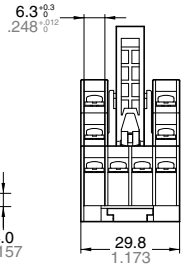
CAD Data



External dimensions

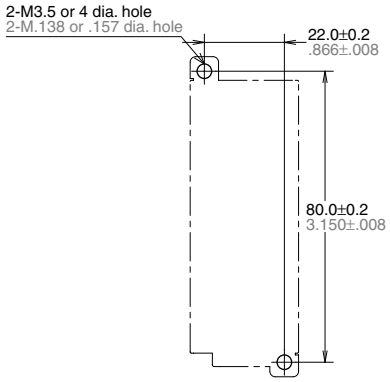






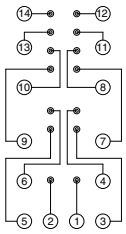
General tolerance: ±0.5 ±.020

Mounting hole dimensions



Tolerance: ±0.1 ±.004

Schematic (Top view)



* Reference value (when using DIN rail ATA48011)

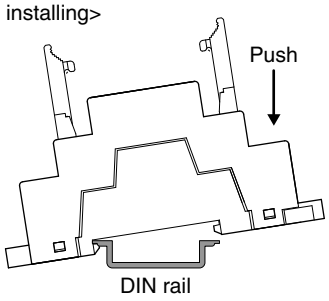
Note: Ring tongue terminals cannot be used with conventional DIN rail terminal socket (SFS6-SFD).
In use of a ring tongue terminals, please use SFS6-SFD-R.

NOTES

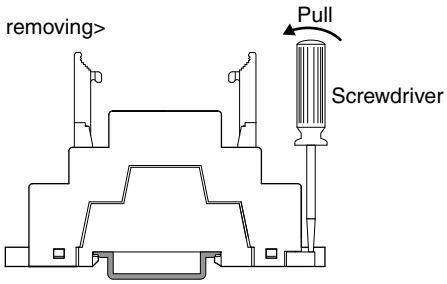
Installation

1) Attach directly to the chassis or use a DIN rail.
(1) When attaching directly to chassis
• Use a M3.5 screw, spring washer, and hex nut.
• For the mounting pitch, refer to the dimensions.
(2) When installing on a DIN rail
• Use a 35 mm 1.378 inch wide DIN rail (DIN46277).
• Install and remove as shown in the figures below.

<When installing>

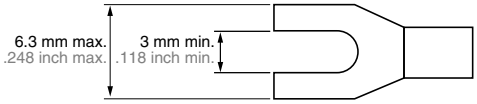


<When removing>

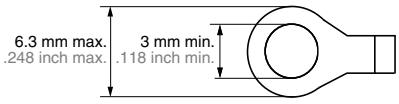


2) Refer to the figure below for applicable wire-pressed terminals.

Spade tongue terminal



Ring tongue terminal



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