ORDERING INFORMATION

Ex. A CT 1 12

Product name	Contact arrangement	Coil voltage (V DC)
CT	1: 1 Form C 2: 1 Form C × 2 (8 terminals type) 5: 1 Form C × 2 (10 terminals type)	12: 12

Standard packing; 1 Form C: Carton(tube package) 30pcs. Case 1,500pcs.
1 Form C × 2: Carton(tube package) 30pcs. Case 900pcs.

TYPES AND COIL DATA (at 20°C 68°F)

Contact arrangement	Part No.	Nominal voltage, V DC	Pick-up voltage, V DC (Initial)	Drop-out voltage, V DC (Initial)	Coil resistance, Ω	Nominal operating current, mA	Nominal operating power, mW	Usable voltage range, V DC
1c	ACT112	12	Max. 7.2	Min. 1.0	180±10%	66.7±10%	800	10 to 16
1c × 2 (8 terminals type)	ACT212	12	Max. 7.2	Min. 1.0	180±10%	66.7±10%	800	10 to 16
1c × 2 (10 terminals type)	ACT512	12	Max. 7.2	Min. 1.0	180±10%	66.7±10%	800	10 to 16

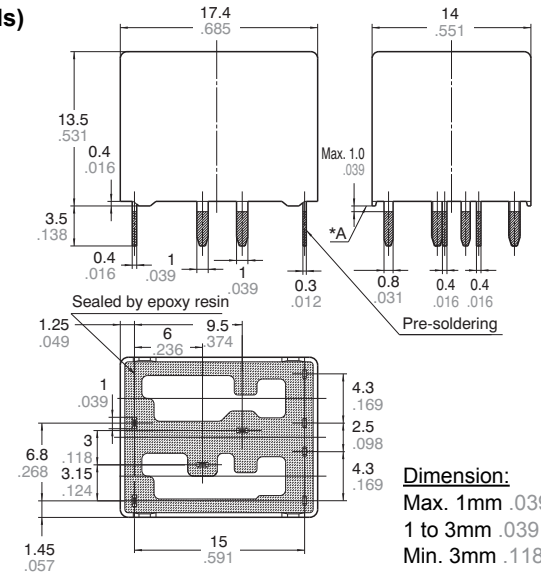
* Other pick-up voltage types are also available. Please contact us for details.

DIMENSIONS (mm inch)

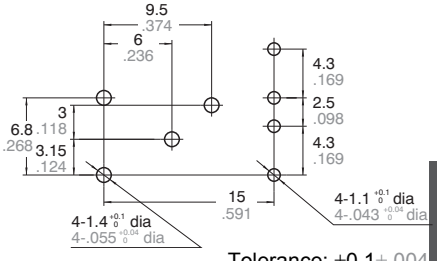
Download CAD Data from our Web site.

1. Twin type (8 terminals)

CAD Data

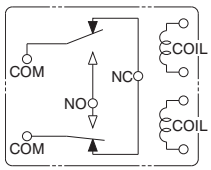


PC board pattern (Bottom view)



Tolerance: ±0.1±.004

Schematic (Bottom view)

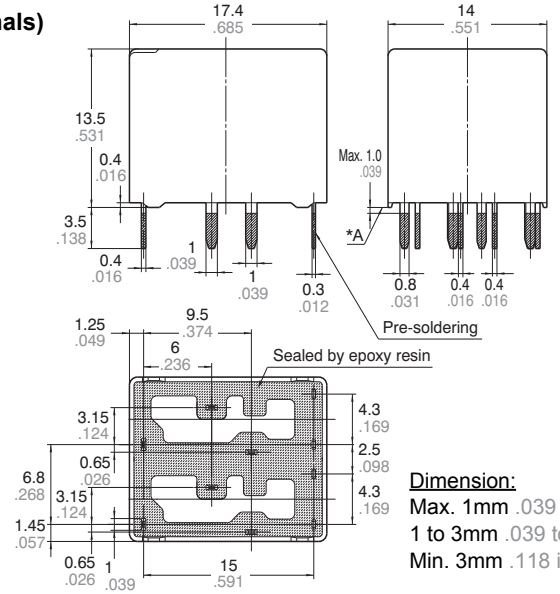


Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

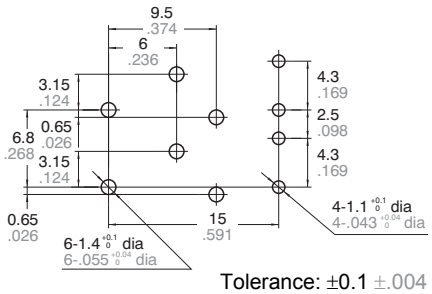
* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering. Intervals between terminals is measured at A surface level.

2. Twin type (10 terminals)

CAD Data

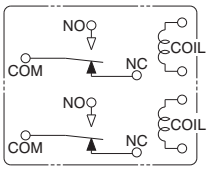


PC board pattern (Bottom view)



Tolerance: ±0.1 ±.004

Schematic (Bottom view)



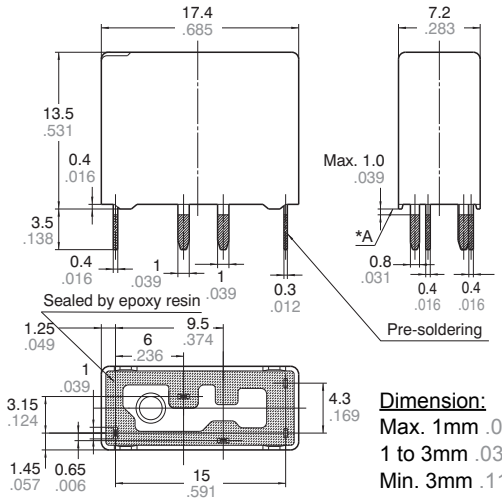
Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

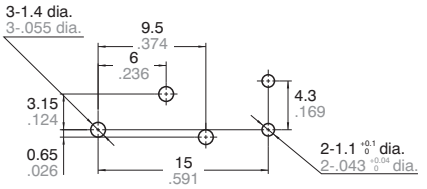
3. Slim 1c type

CAD Data

mm inch

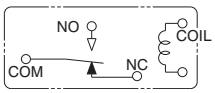


PC board pattern (Bottom view)



Tolerance: ±0.1±.004

Schematic (Bottom view)

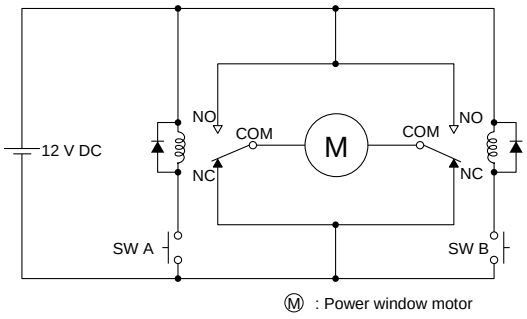


Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

EXAMPLE OF CIRCUIT

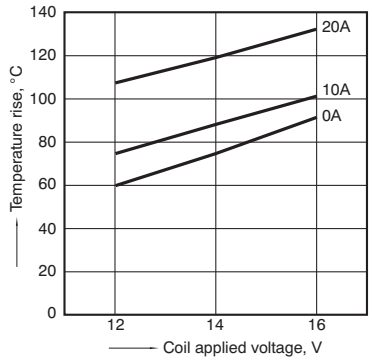
Forward/reverse control circuits of DC motor for power windows



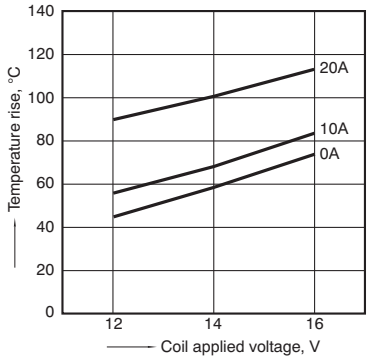
Ⓜ : Power window motor

REFERENCE DATA

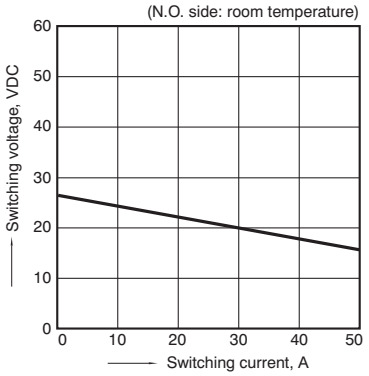
1-(1). Coil temperature rise (at room temperature)
Sample: ACT212, 3pcs.
Contact carrying current: 0A, 10A, 20A



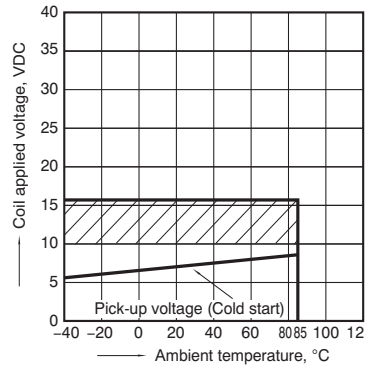
1-(2). Coil temperature rise (at 85°C 185°F)
Sample: ACT212, 3pcs.
Contact carrying current: 0A, 10A, 20A



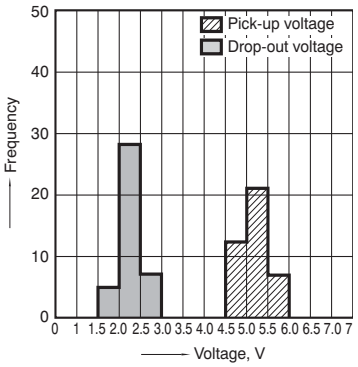
2. Max. switching capability (Resistive load, initial)



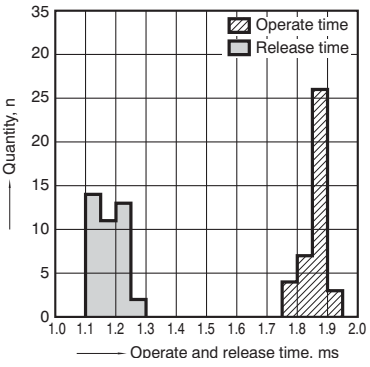
3. Ambient temperature and operating voltage range



4. Distribution of pick-up and drop-out voltage
Sample: ACT212, 40pcs.



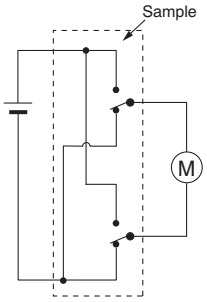
5. Distribution of operate and release time
Sample: ACT212, 40pcs.
* Without diode



6-(1). Electrical life test (Motor free)

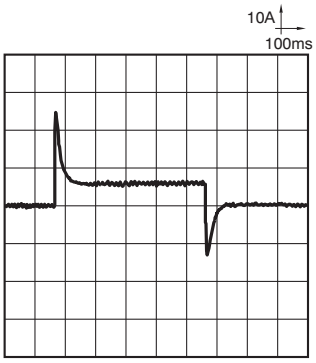
Sample: ACT212, 3pcs.
Load: 5A steady, Inrush 25A, 14V DC
Brake current: 13A 14V DC,
Power window motor actual load (free condition)
Operating frequency: (ON : OFF = 0.5s : 9.5s)
Ambient temperature: Room temperature

Circuit:

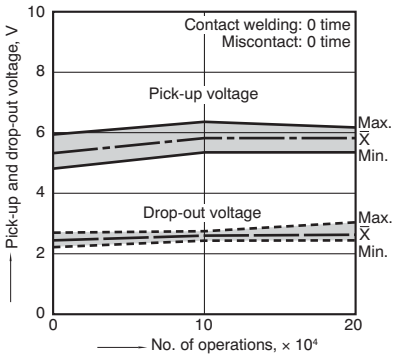


Load current waveform

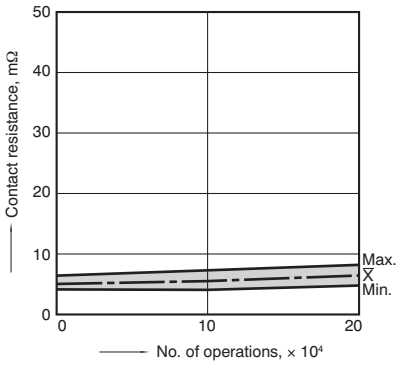
Inrush current: 25A, Steady current: 6A
Brake current: 13A



Change of pick-up and drop-out voltage



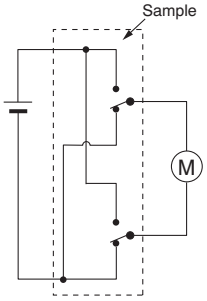
Change of contact resistance



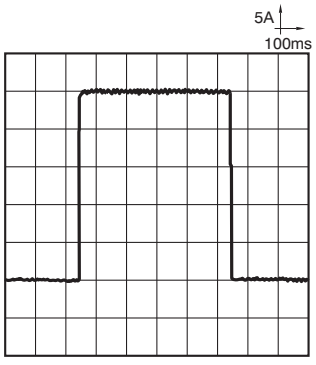
6-(2). Electrical life test (Motor lock)

Sample: ACT212, 3pcs.
Load: 25A 14V DC
Switching frequency: (ON : OFF = 0.5s : 9.5s)
Ambient temperature: Room temperature

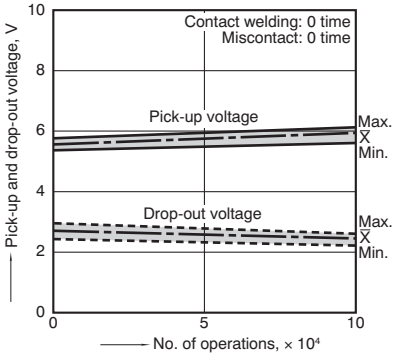
Circuit:



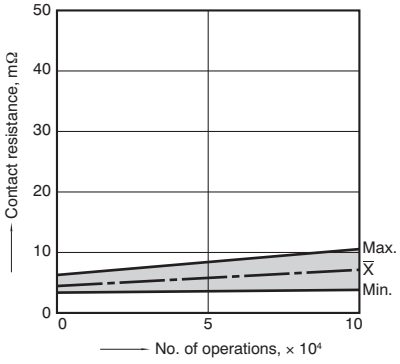
Load current waveform



Change of pick-up and drop-out voltage



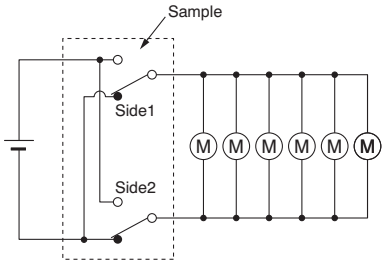
Change of contact resistance

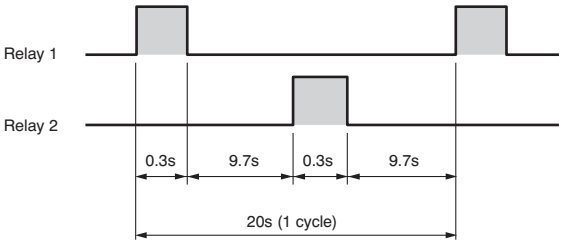


6-(3). Electrical life test (Motor lock)

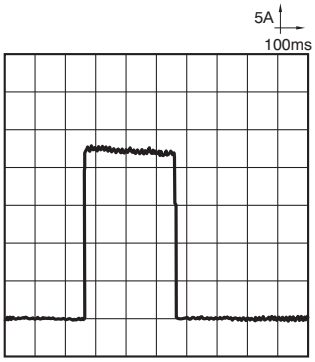
Sample: ACT212, 3pcs.
Load: 20A 14V DC,
door lock motor actual load (Lock condition)
Switching frequency: (ON : OFF = 0.3s : 19.7s)
Ambient temperature: Room temperature

Circuit:

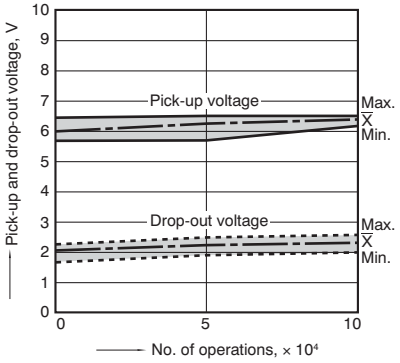




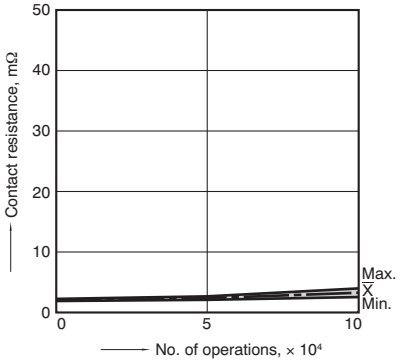
Load current waveform



Change of pick-up and drop-out voltage



Change of contact resistance

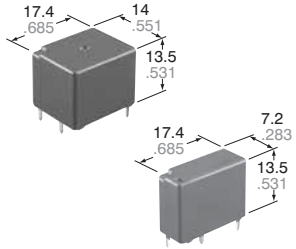


For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Power type small & slim automotive relay

CT RELAYS
<POWER TYPE>



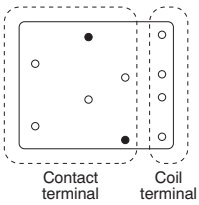
FEATURES

1. Compact type for automotives
We successfully developed a power type that is the same size as our CT relay.
2. 30 A maximum switching capacity
Switching of 30 A motor loads is possible due to change of COM spring material and other improvements.
3. Still top-of-its-class for silent operation
Maintains equally silent operation as our CT relay (ACT).
4. Sealed type
Sealed type makes automatic cleaning possible.

APPLICATIONS

Power windows, Powered seats, Auto door lock, Slide door closers, Power sunroof, etc.

10-terminal layout



*8-terminal type has no ● terminals.

SPECIFICATIONS

Contact

Arrangement			1 Form C×2, 1 Form C
Contact material			Ag alloy (Cadmium free)
Initial contact resistance (Initial) (By voltage drop 6 V DC 1 A)			Typ. 7 mΩ (N.O.) Typ. 10 mΩ (N.C.)
Rating	Nominal switching capacity		N.O.: 30 A 14 V DC N.C.: 10 A 14 V DC
	Max. carrying current (N.O.)		40 A for 2 minutes, 25 A for 1 hour (at 20°C 68°F) 35 A for 2 minutes, 20 A for 1 hour (at 85°C 185°F)
	Min. switching capacity#1		1 A 12 V DC
Expected life (min. operation)	Mechanical (at 120 cpm)		Min. 10^6
	Electrical	Resistive load	Min. 5×10^4*1
		Motor load	Min. 10^5*2 (free)
			Min. 5×10^4*3 (lock)

Coil

Nominal operating power	1,000 mW

#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.

Remarks
*1 At nominal switching capacity, operating frequency: 1s ON, 9s OFF
*2 N.O.: at 7 A (steady), 30 A (inrush)/N.C.: at 15 A (brake) 14 V DC, operating frequency: 0.5s ON, 9.5s OFF
*3 At 30A 14 V DC (Motor lock), operating frequency: 0.5s ON, 9.5s OFF
*4 Measurement at same location as "Initial breakdown voltage" section
*5 Detection current: 10mA
*6 Excluding contact bounce time
*7 Half-wave pulse of sine wave: 11ms; detection: 10μs
*8 Half-wave pulse of sine wave: 6ms
*9 Detection time: 10μs
*10 Time of vibration for each direction;

X, Y, direction: 2 hours
Z direction: 4 hours

*11 Refer to "Usage ambient condition" on page 139.
Please inquire if you will be using the relay in a high temperature atmosphere (110°C 230°F).
* If the relay is used continuously for long periods of time with coils on both sides in an energized condition, breakdown might occur due to abnormal heating depending on the carrying condition. Therefore, please inquire when using with a circuit that causes an energized condition on both sides simultaneously.

Characteristics

Max. operating speed (at nominal switching capacity)		6 cpm
Initial insulation resistance*4		Min. 100 MΩ (at 500 V DC)
Initial breakdown voltage*5	Between open contacts	500 Vrms for 1 min.
	Between contacts and coil	500 Vrms for 1 min.
Operate time*6 (at nominal voltage) (at 20°C 68°F)		Max. 10ms (Initial)
Release time*6 (at nominal voltage) (at 20°C 68°F)		Max. 10ms (Initial)
Shock resistance	Functional*7	Min. 100 m/s² {10G}
	Destructive*8	Min. 1,000 m/s² {100G}
Vibration resistance	Functional*9	10 Hz to 100 Hz, Min. 44.1m/s² {4.5G}
	Destructive*10	10 Hz to 500 Hz, Min. 44.1m/s² {4.5G}
Conditions for operation, transport and storage*11 (Not freezing and condensing at low temperature)	Ambient temp	–40°C to +85°C –40°F to +185°F
	Humidity	5% R.H. to 85% R.H.
Mass		Twin type: approx. 8.0g .28oz 1 Form C type: approx. 4.0g .14oz

TYPES AND COIL DATA (at 20°C 68°F)

Standard packing; 1 Form C: Carton(tube package) 30pcs. Case 1,500pcs.
1 Form C × 2: Carton(tube package) 30pcs. Case 900pcs.

Contact arrangement	Part No.	Nominal voltage, V DC	Pick-up voltage, V DC (Initial)	Drop-out voltage, V DC (Initial)	Coil resistance, Ω	Nominal operating current, mA	Nominal operating power, mW	Usable voltage range, V DC
1 Form C	ACTP112	12	Max. 7.2	Min. 1.0	144±10%	83.3±10%	1,000	10 to 16
1 Form C × 2 (8 terminals type)	ACTP212	12	Max. 7.2	Min. 1.0	144±10%	83.3±10%	1,000	10 to 16
1 Form C × 2 (10 terminals type)	ACTP512	12	Max. 7.2	Min. 1.0	144±10%	83.3±10%	1,000	10 to 16

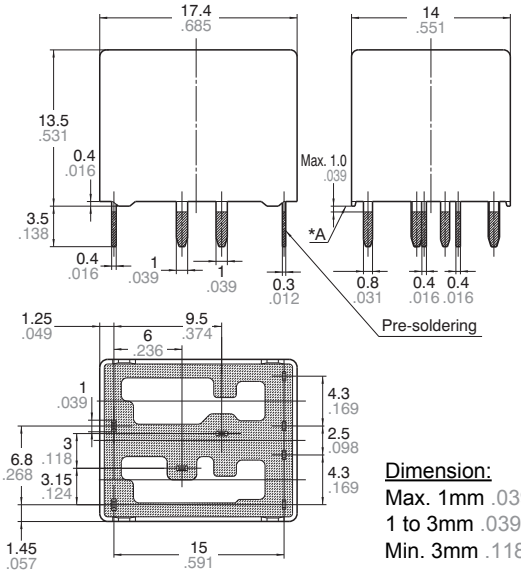
* Other pick-up voltage types are also available. Please contact us for details.

DIMENSIONS (mm inch)

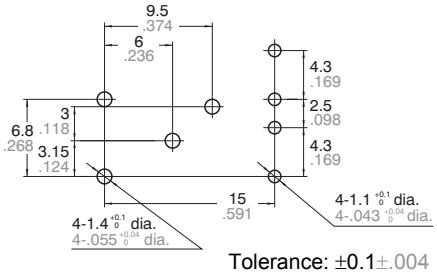
Download CAD Data from our Web site.

1. Twin type (8 terminals)

CAD Data

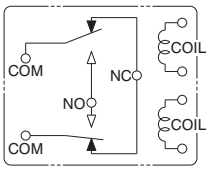


PC board pattern (Bottom view)



Tolerance: ±0.1 ±.004

Schematic (Bottom view)

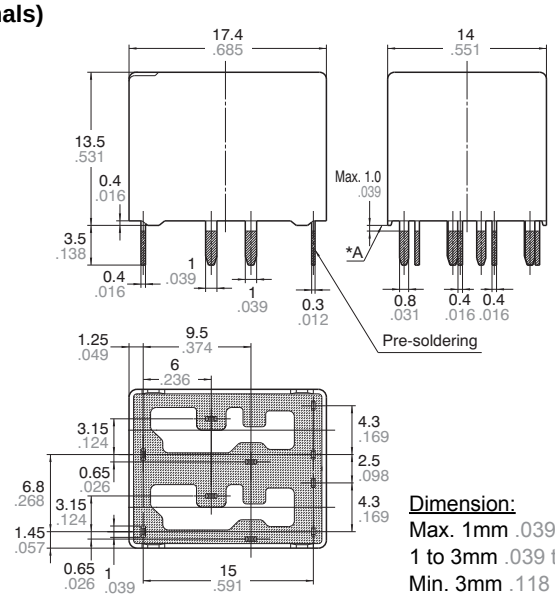


Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

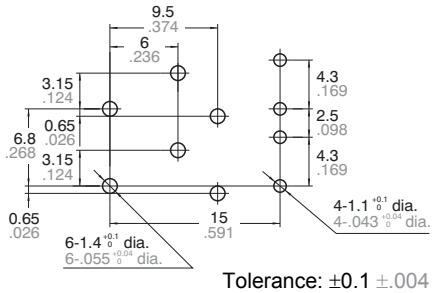
* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

2. Twin type (10 terminals)

CAD Data

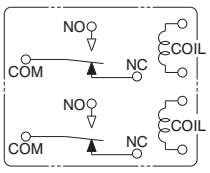


PC board pattern (Bottom view)



Tolerance: ±0.1 ±.004

Schematic (Bottom view)



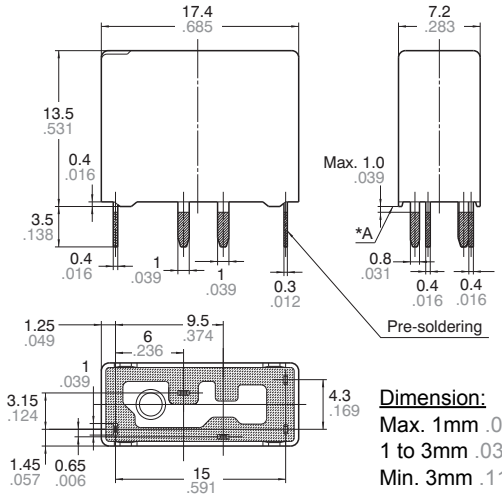
Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

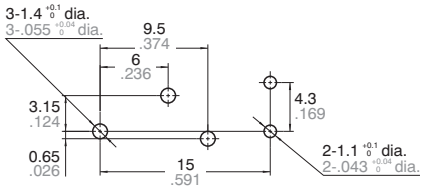
3. Single type (1 Form C)

CAD Data

mm inch

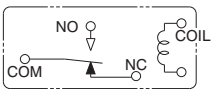


PC board pattern (Bottom view)



Tolerance: ±0.1±.004

Schematic (Bottom view)

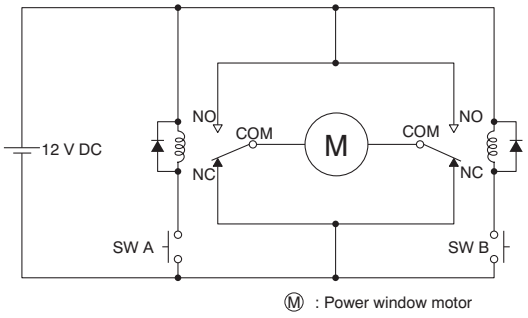


Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

EXAMPLE OF CIRCUIT

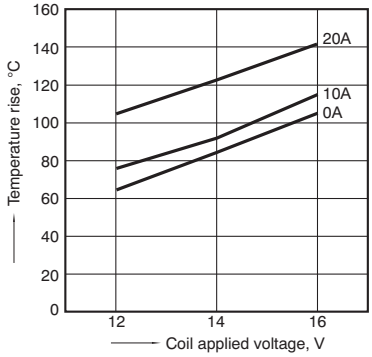
Forward/reverse control circuits of DC motor for power windows



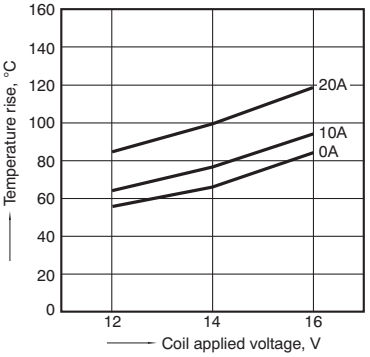
Ⓜ : Power window motor

REFERENCE DATA

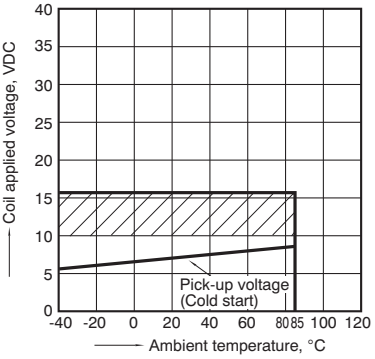
1-(1). Coil temperature rise (at room temperature)
Sample: ACTP212, 3pcs.
Contact carrying current: 0A, 10A, 20A



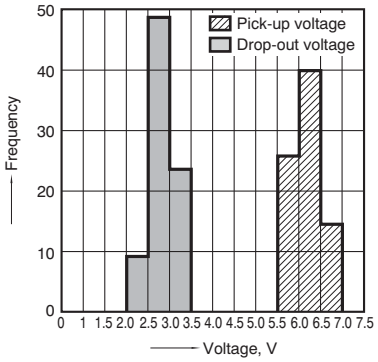
1-(2). Coil temperature rise (at 85°C 185°F)
Sample: ACTP212, 3pcs.
Contact carrying current: 0A, 10A, 20A



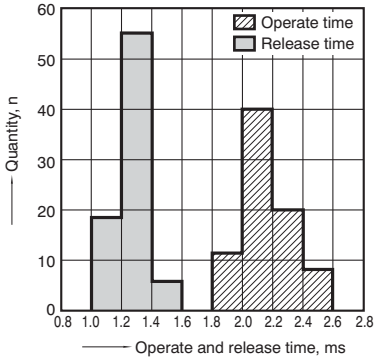
2. Ambient temperature and operating voltage range



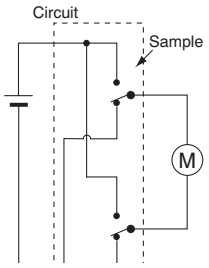
3. Distribution of pick-up and drop-out voltage
Sample: ACTP212, 40pcs.



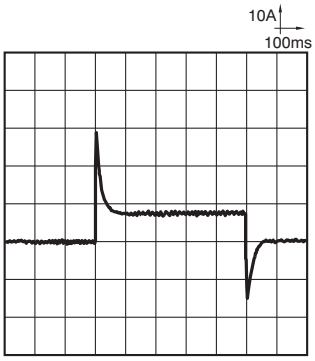
4. Distribution of operate and release time
Sample: ACTP212, 40pcs.
* Without diode



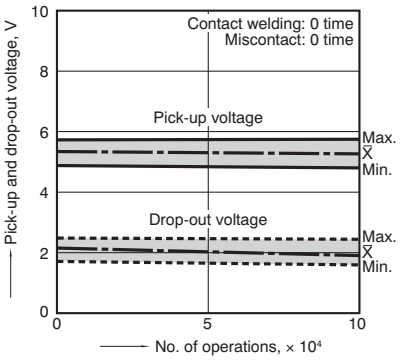
5. Electrical life test (Motor free)
Sample: ACTP212, 3pcs.
Load: 7A steady, Inrush 30A
Brake current: 15A 14V DC,
Power window motor actual load (free condition)
Operating frequency: (ON : OFF = 0.5s : 9.5s)
Ambient temperature: Room temperature
Circuit:



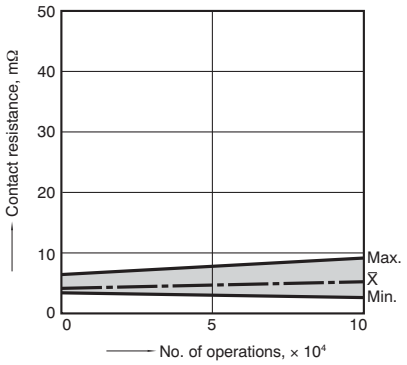
Load current waveform
Inrush current: 30A, Steady current: 7A
Brake current: 15A



Change of pick-up and drop-out voltage



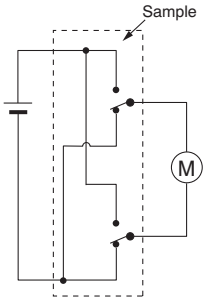
Change of contact resistance



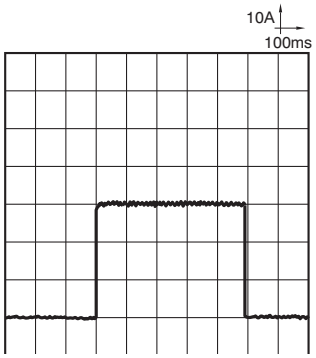
6. Electrical life test (Motor lock)

Sample: ACTP212, 3pcs.
Load: 30A 14V DC
Switching frequency: (ON : OFF = 0.5s : 9.5s)
Ambient temperature: Room temperature

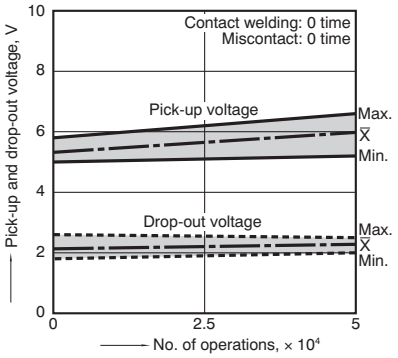
Circuit:



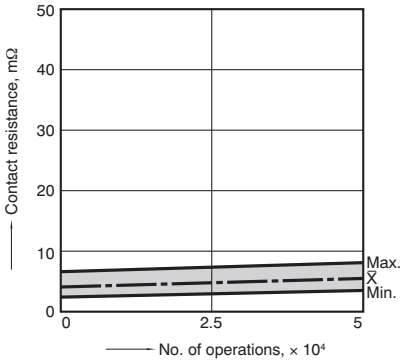
Load current waveform



Change of pick-up and drop-out voltage



Change of contact resistance



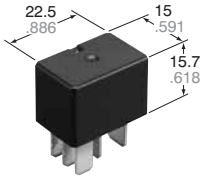
For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Automotive low profile micro-ISO relay

CV RELAYS (ACV)

mm inch



Micro ISO 1c type

Micro ISO 1a type

✂ Products to be discontinued.

FEATURES

• Low profile:
22.5 mm(L)×15 mm(W)×15.7 mm(H)
.886 inch(L)×.591 inch(W)×.618 inch(H)

• Low temperature rise
Terminal temperature has been reduced compared with using our conventional product

• Low sound pressure level
Noise level has been reduced approx.10dB compared with using our conventional product.

• Wide line-up
Micro ISO terminal types and resistor and ✂ diode inside type.

• Plastic sealed type
Plastically sealed for automatic cleaning.

• Compact and high-capacity 20A load switching
N.O.: 20A 14V DC, N.C.: 10A 14V DC
(Max. carrying current: at 85°C 185°F)

TYPICAL APPLICATIONS

- Headlights
- Magnetic clutches
- Radiator fans
- Blowers
- Fog lamps
- Tail lights
- Heaters
- Defoggers
- Horns
- Condenser fans, etc.

SPECIFICATIONS

Contact

Arrangement		1 Form A	1 Form C
Contact material		Ag alloy (Cadmium free)	
Initial contact resistance (Initial) (By voltage drop 6 V DC 1 A)		Typ. 3 mΩ	
Contact voltage drop		N.O.: Max. 0.2 V (at 20 A)	N.O.: Max. 0.2 V (at 20 A switching) N.C.: Max. 0.5 V (at 10 A switching)
Rating	Nominal switching capacity	N.O.: 20 A 14 V DC	N.O.: 20 A 14 V DC N.C.: 10 A 14 V DC
	Max. carrying current (Continuous, at 85°C 185°F)	N.O.: 20 A 12 V DC	N.O.: 20 A 12 V DC N.C.: 10 A 12 V DC
	Min. switching capacity#1	1 A 12 V DC	
Expected life (min. operation)	Mechanical (at 120 cpm)	Min. 10^6	
	Electrical (at rated load)	Min. 10^5*1	

Coil

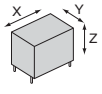
Nominal operating power	0.8 W, 1.0 W (with resistor inside type)

#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.

Characteristics

Max. operating speed (at nominal switching capacity)		15cpm
Initial insulation resistance*2		Min. 20MΩ (at 500 V DC)
Initial breakdown voltage*3	Between open contacts	500 Vrms for 1min.
	Between contacts and coil	500 Vrms for 1min.
Operate time*4 (at nominal voltage) (at 20°C 68°F)		Max. 10ms (initial)
Release time*4 (at nominal voltage) (at 20°C 68°F)		Max. 10ms (initial) Max. 15ms (initial) (with diode inside type)
Shock resistance	Functional*5	Min. 100 m/s²{10 G}
	Destructive*6	Min. 1,000 m/s²{100 G}
Vibration resistance	Functional*7	10 Hz to 100 Hz, Min.44.1 m/s² {4.5 G}
	Destructive*8	10 Hz to 500 Hz, Min.44.1 m/s² {4.5 G}
Conditions in case of operation, transport and storage*9 (Not freezing and condensing at low temperature)	Ambient temp	–40°C to +85°C –40°F to +185°F
	Humidity	5% R.H. to 85% R.H.
Mass		Approx. 15.0g .53 oz

Remarks
*1 At nominal switching capacity, operating frequency: 2s ON, 2s OFF
*2 Measurement at same location as "Initial breakdown voltage" section.
*3 Detection current: 10mA
*4 Excluding contact bounce time.
*5 Half-wave pulse of sine wave: 11 ms; detection time: 10 μs
*6 Half-wave pulse of sine wave: 6 ms
*7 Detection time: 10 μs
*8 Time of vibration for each direction;
X, Y, Z direction: 4 hours



*9 Refer to "Usage ambient condition" on page 139.
Please inquire if you will be using the relay in a high temperature atmosphere.

Automotive

ORDERING INFORMATION

Ex. A CV [ ] [ ] [ ] 12

Product name	Contact arrangement	Mounting classification	Type classification	Coil voltage, V DC
CV	1: 1 Form C 3: 1 Form A	1: Micro ISO plug-in type	0: Standard type 1: With diode inside 2: With resistor inside	12: 12

Note: Standard packing; Carton (Tube): 50 pcs.; Case: 200 pcs.
✂ D: with diode inside

TYPES

Coil voltage (DC)	Contact arrangement	Mounting classification	Type classification	Part No.
12 V	1 Form A	Sealed type	Micro ISO plug-in type	ACV31012
	1 Form C		Micro ISO plug-in type	ACV11012

COIL DATA (at 20°C 68°F)

Nominal voltage, V DC	Pick-up voltage, * V DC (Initial)	Drop-out voltage, V DC (Initial)	Coil resistance, W	Nominal operating current, mA	Nominal operating power, W	Usable voltage range, V DC (at 85°C 185°F)
12	Max. 7.0	Min. 0.6	180±10% 142.3±10% (with resistor)	67±10% 84±10% (with resistor)	0.8 1.0 (with resistor)	10 to 16

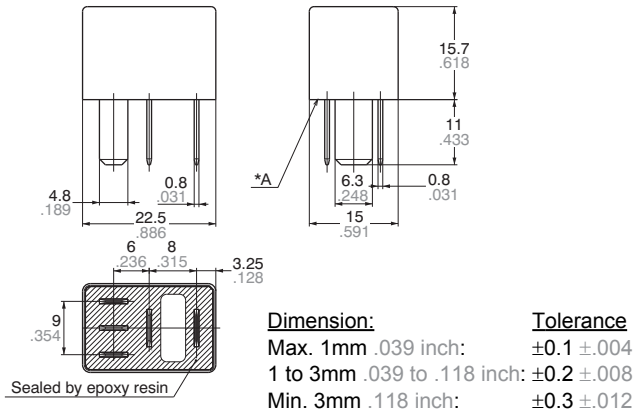
* Other pick-up voltage types are also available. Please contact us for details.

DIMENSIONS (mm inch)

Download CAD Data from our Web site.

Micro ISO terminal type

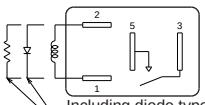
CAD Data



Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

Schematic (Bottom view)

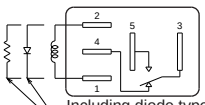
1 Form A



Including diode type, including resistor type also available

✂ diode type

1 Form C



Including diode type, including resistor type also available

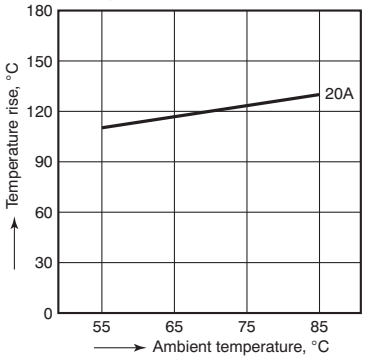
✂ diode type

* Intervals between terminals is measured at A surface level.

REFERENCE DATA

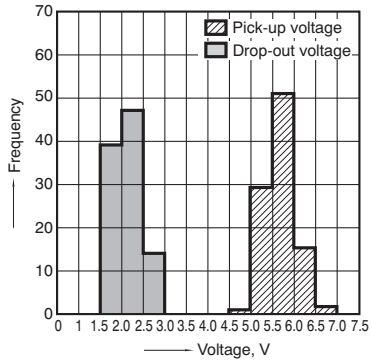
1. Coil temperature rise (20A)

Point measured: Inside the coil
Contact carrying current: 20A
Coli applied voltage: 13.5V



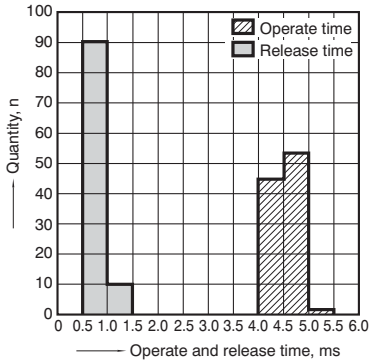
2. Distribution of pick-up and drop-out voltage

Sample: ACV11012, 100pcs



3. Distribution of operate and release time

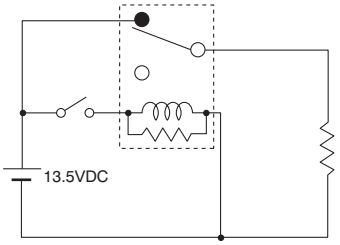
Sample: ACV11012, 100pcs.



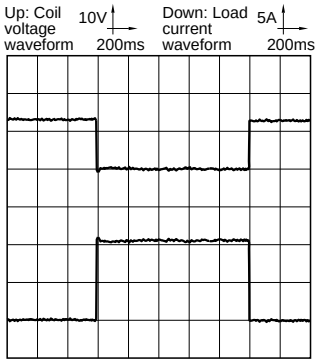
4-(1). Electrical life test (Resistive load)

Sample: ACV12212, 3pcs.
Load: Resistive load (NC switching) 11A
Switching frequency: (ON : OFF = 1s : 1s)
Ambient temperature: Room temperature

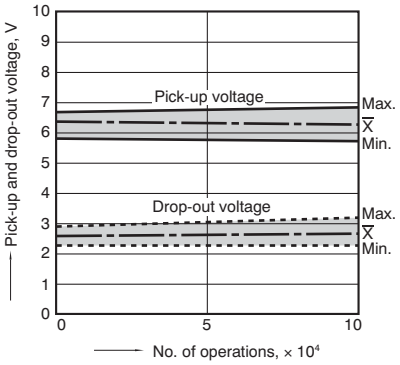
Circuit



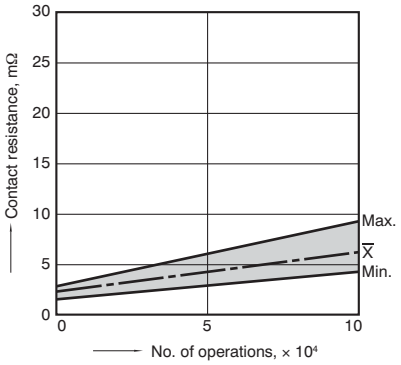
Load current waveform



Change of pick-up and drop-out voltage



Change of contact resistance

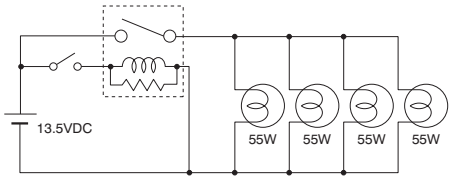


Automotive

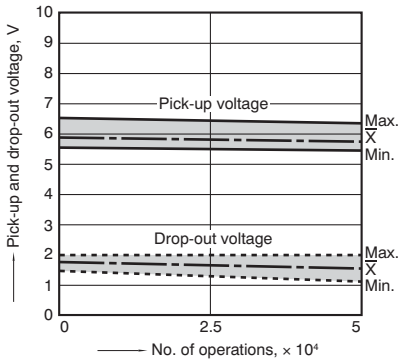
4-(2). Electrical life test (Lamp load)

Sample: ACV12212, 3pcs.
Load: 55Wx4, inrush: 90A/steady: 20A,
lamp actual load
Switching frequency: (ON : OFF = 1s : 14s)
Ambient temperature: Room temperature

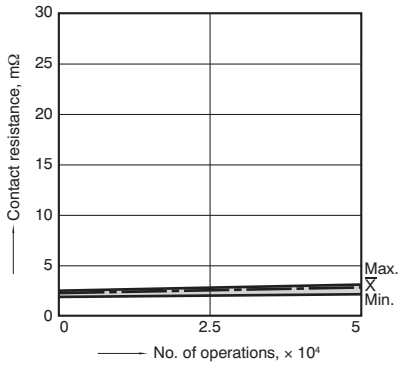
Circuit



Change of pick-up and drop-out voltage

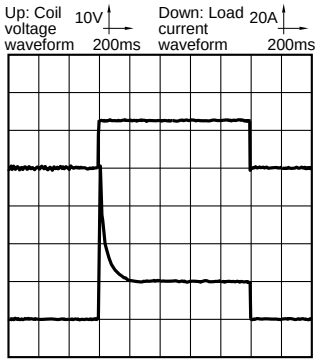


Change of contact resistance



Load current waveform

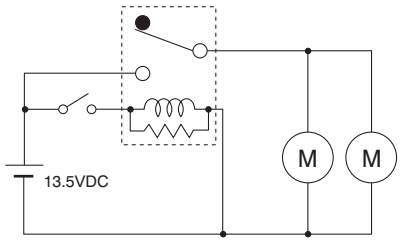
Inrush current: 90A, steady current: 20A



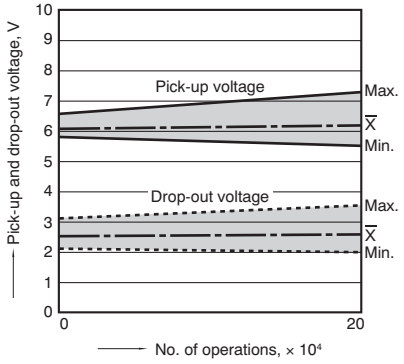
4-(3). Electrical life test (Motor load)

Sample: ACV12212, 3pcs.
Load: inrush: 80A/steady: 18A,
radiator fan actual load (motor free)
Switching frequency: (ON : OFF = 2s : 6s)
Ambient temperature: Room temperature

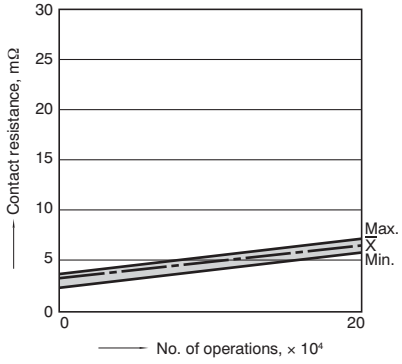
Circuit



Change of pick-up and drop-out voltage

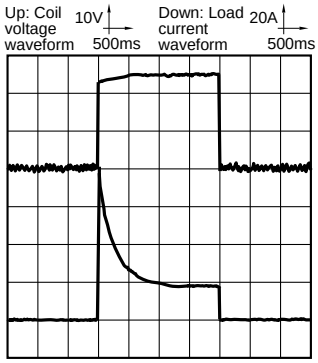


Change of contact resistance



Load current waveform

Inrush current: 80A, steady current: 18A



Cautions regarding the protection element

1. Part numbers without protection elements

• 12 V models

When connecting a coil surge protection circuit to these relays, we recommend a Zener diode with a Zener voltage of 24 V or higher, or a resistor (680Ω to 1,000Ω). When a diode is connected to the coil in parallel, the release time will slow down and working life may shorten. Before use, please check the circuit and verify that the diode is not connected in parallel to the coil drive circuit.

✂ **2. Part numbers with diodes**

These relays use a diode in the coil surge protection element. Therefore, the release time is slower and the working life might be shorter compared to part numbers without protection elements and part numbers with resistors.

Be sure to use only after evaluating under actual load conditions.

3. Part numbers with resistors

This part number employs a resistor in the coil surge protection circuit; therefore, an external surge protection element is not required. In particular, when a diode is connected in parallel with a coil, the revert time becomes slower which could adversely affect working life. Please check the circuit and make sure that a diode is not connected in parallel with the coil drive circuit.

For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Automotive relay for failsafe circuits in high output motors (EPS)

CW RELAYS (ACW)

FEATURES

• Ideal relay for high output 3-phase motors (EPS)
2-path cut-off (2 Form A) using single coil for 3-phase motors
• High cut-off current capability
High cut-off current performance (12V) using 2-point cut-off configuration
• High carrying current performance
High capacity achieved through use of high conductivity material
• Highly heat resistance properties
High heat resistance (at 125°C 257°F) through use of high heat resistance plastic

TYPICAL APPLICATIONS

• To 3-phase motor EPS unit (for failsafe circuit)

ORDERING INFORMATION

ACW 2 ☐

Contact arrangement
2: 2 Form A

Coil voltage (DC)
12: 12 V

TYPES

Contact arrangement	Coil voltage	Part No.
2 Form A	12 V DC	ACW212

Standard packing; Carton: 40 pcs.; Case: 160 pcs.

RATING

1. Coil data

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)	Usable voltage range
12V DC	Max. 6.2 V DC (Initial)	Min. 0.5 V DC (Initial)	117 mA	103Ω	1.4 W	10 to 16V DC

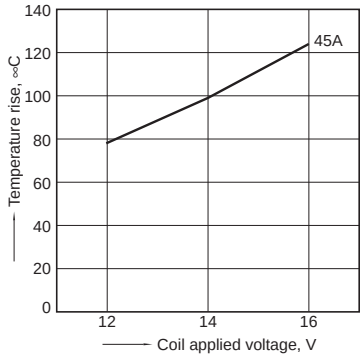
2. Specifications

Characteristics	Item		Specifications
Contact	Arrangement		2 Form A
	Contact resistance (Initial)		Max. 50 mΩ (By voltage drop 6V DC 1A)
	Contact material		Ag alloy (Cadmium free)
Rating	Max. carrying current (14V DC)		120 A for 5 seconds (at 20°C 68°F) 70 A for 1 minute (at 85°C 185°F) 45 A for continuous (at 85°C 185°F)
	Nominal operating power		1.4 W
	Min. switching capacity (resistive load)		1 A 14V DC (at 20°C 68°F)
Electrical characteristics	Insulation resistance (Initial)		Min. 100 MΩ (at 500V DC)
	Breakdown voltage (Initial)	Between open contacts	500 Vrms for 1 min. (Detection current: 10mA)
		Between contacts and coil	500 Vrms for 1 min. (Detection current: 10mA)
	Operate time (at nominal voltage)		Max. 20ms (at 20°C 68°F, excluding contact bounce time) (Initial)
	Release time (at nominal voltage)		Max. 20ms (at 20°C 68°F) (Initial) (without protective element)
Mechanical characteristics	Shock resistance	Functional	Min. 200 m/s² {approx. 20G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs) (12 V DC applied to the coil, at 20°C 68°F)
		Destructive	Min. 1,000 m/s² {approx. 100G} (Half-wave pulse of sine wave: 6ms)
	Vibration resistance	Functional	10 Hz to 500 Hz, Min. 44.1 m/s² {approx. 4.5G} (Detection time: 10μs) (12 V DC applied to the coil, at 20°C 68°F)
		Destructive	10 Hz to 500 Hz, Min. 44.1 m/s² {approx. 4.5G}, Time of vibration for each direction; X, Y, Z direction: 4 hours
Expected life	Mechanical		Min. 2×10^5 (at 60 cpm)
	Electrical (at cut off only)		200 A 14V DC (resistive load), Min. 3 times (without diode)
Conditions	Conditions for operation, transport and storage*		Ambient temperature: –40°C to +125°C –40°F to +257°F, Humidity: 5% R.H. to 85% R.H. (Not freezing and condensing at low temperature)
Mass			Approx. 26 g .92 oz

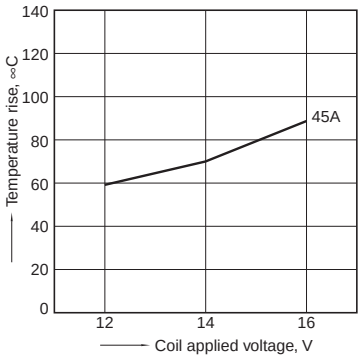
Note:
* The upper operation ambient temperature limit is the maximum temperature that can satisfy the coil temperature rise value. Refer to “Usage ambient condition“ on page 139.

REFERENCE DATA

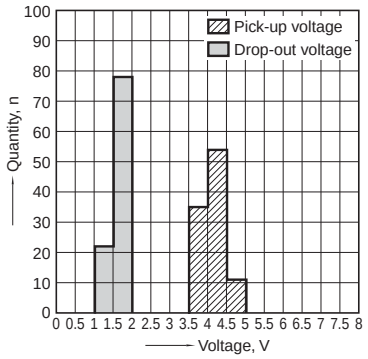
1.-(1) Coil temperature rise (25°C 77°F)
Sample: ACW212, 3pcs
Point measured: Inside the coil
Contact carrying current: 45A
Ambient temperature: 25°C 77°F



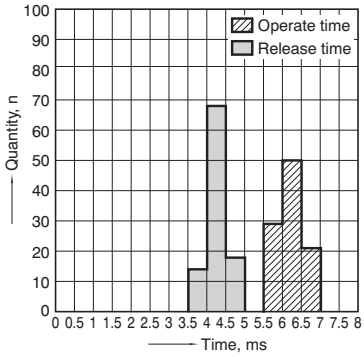
1.-(1) Coil temperature rise (85°C 185°F)
Sample: ACW212, 3pcs
Point measured: Inside the coil
Contact carrying current: 45A
Ambient temperature: 85°C 185°F



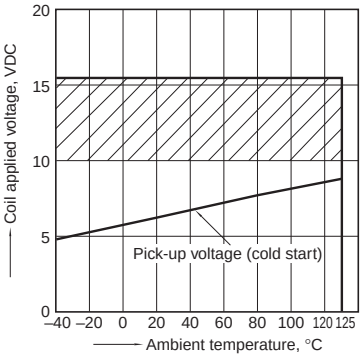
2. Distribution of pick-up and drop-out voltage
Sample: ACW212, 100pcs



3. Distribution of operate and release time
Sample: ACW212, 100pcs.



4. Ambient temperature and operating voltage range

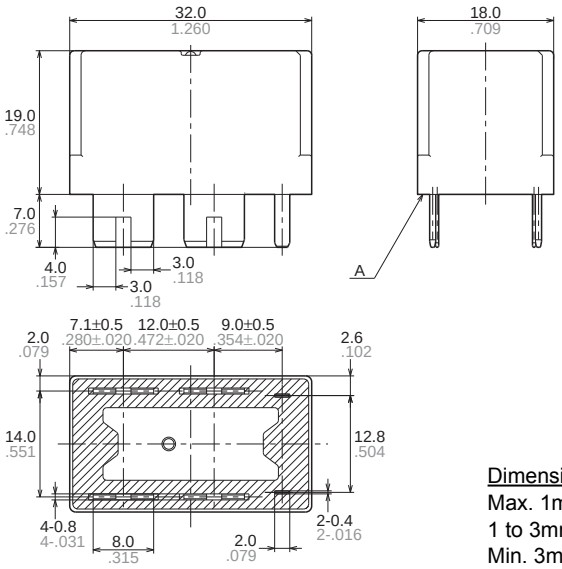


DIMENSIONS (mm inch)

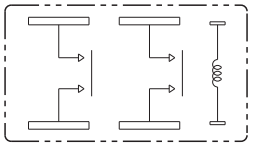
Download CAD Data from our Web site.

CAD Data

External dimensions



Schematic (Bottom view)



Dimension:	Tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

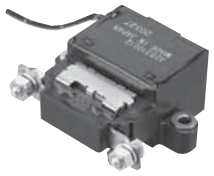
* Intervals between terminals is measured at A surface level.

For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Compact but cut off DC power current, power capsule contact relay

EB RELAYS (AEB)



(100A type)

FEATURES

• Compact and high capacity using double contacts in series and permanent magnet installed.
(1,000A/3 times) cut-off possible
(EB Relay 100A type)
• Compact and lightweight for space savings and improved gas mileage.

TYPICAL APPLICATIONS

Equipment requiring high capacity cutoff such as main power supplies for 42 V vehicles, motor assisters, quick recharging power supplies for AGVs (automatic guided vehicle), and motor controls for forklifts, etc.

ORDERING INFORMATION

AEB [3] [1] [0] [0] [ ]

Contact arrangement
3: 1 Form A

Contact rating / Relay shape
1: 100 A / Flat

Heat resistance grade / protective element
0: Standard / no protective element

Terminal shape
0: Screw terminal

Coil voltage (DC)
12: 12 V
24: 24 V
36: 36 V

Automotive

TYPES

Contact arrangement	Coil voltage	Protective costruction	Terminal shape	Part No.
1 Form A	12 V DC	Dust cover	Screw terminal	AEB310012
	24 V DC			AEB310024
	36 V DC			AEB310036

RATING

1. Coil data

Type	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)	Usable voltage range
100 A	12V DC	Max. 9.0 V DC	Min. 1.0 V DC	410 mA	29.0Ω	5.0 W	10 to 16V DC
	24V DC	Max. 18.0 V DC	Min. 2.0 V DC	208 mA	115Ω	5.0 W	20 to 32V DC
	36V DC	Max. 27.0 V DC	Min. 3.0 V DC	139 mA	260Ω	5.0 W	30 to 48V DC

2. Specifications

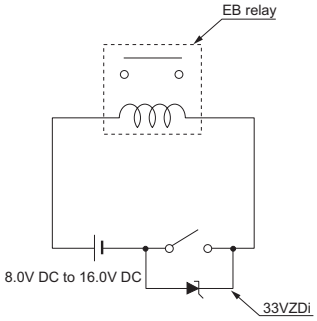
Characteristics	Item		Specifications
			100 A type
Contact rating	Arrangement		1 Form A
	Between terminal voltage drop (Initial)		Max. 0.15 V (at 100 A), Max. 0.05 V (at 10 A), Max. 0.01 V (at 1 A)
	Contact material		Ag alloy (Cadmium free)
	Nominal switching capacity (resistive load)		100 A 42V DC
	Max. carrying current		1,000A (0.1s)
	Min. switching capacity (resistive load)*1		1 A 12V DC
	Max. cut-off current		1,000A 42V DC/3 cycle*3
	Overload opening/closing rating		400A 55V DC/10 cycle
Electrical characteristics	Insulation resistance (Initial)		Min. 100 MΩ (at 500V DC)
	Breakdown voltage (Initial)	Between open contacts	1,500 Vrms for 1 min.
		Between contacts and coil	2,500 Vrms for 1 min.
	Operate time (at nominal voltage)		Max. 30ms (at nominal coil voltage, excluding contact bounce time, at 20°C 68°F)
	Release time (at nominal voltage)		Max. 15ms (at nominal coil voltage, at 20°C 68°F)
Mechanical characteristics	Shock resistance	Functional	Min. 196 m/s² {20.0G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs) (Nominal coil voltage applied to the coil)
		Destructive	Min. 980 m/s² {100G} (Half-wave pulse of sine wave: 6ms) (Nominal coil voltage applied to the coil or deenergized)
	Vibration resistance	Functional	10 Hz to 500 Hz, Min. 44.1 m/s² {4.5G} (Nominal coil voltage applied to the coil)
		Destructive	10 Hz to 200 Hz, Min. 44.1 m/s² {4.5G}, (Nominal coil voltage applied to the coil or deenergized)
Expected life	Mechanical		Min. 10^6
	Electrical		Min. 10^4 (at 100 A 42V DC) (resistive load, operating frequency: 1s ON, 9s OFF, room temperature)
Conditions	Conditions for operation, transport and storage*2		Ambient temperature: –40°C to +85°C –40°F to +185°F
Mass			Approx. 300 g 10.58 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. The upper operation ambient temperature limit is the maximum temperature that can satisfy the coil temperature rise value. Refer to “Usage ambient condition“ on page 139.
*3. Condition: Nominal switching 100cycles, each cut off 1,000A
* When using a surge absorbing element for the relay coil drive circuit, please use with a surge absorbing element with a clamp voltage of “Rating voltage x1.5: 18V/36V/54V” or more. When the coil is connected in parallel with a diode, resistor or capacitor, the revert time will delay which might lead to degradation in shutoff performance and electrical working life.
Contact terminals have polarity; therefore, please obey the wiring diagram when connecting contacts.
The electrical load performance value applies when a varistor is connected in parallel with the coil.

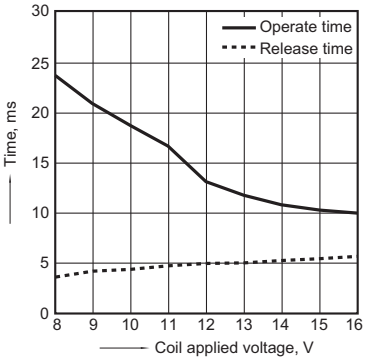
REFERENCE DATA

1. Operate and release time characteristics

Sample: AEB310012
*nominal coil voltage 12V type, 1pcs
Load: Coil applied voltage; 8.0 to 16.0V DC, coil surge protection elements; with zener diode (33V)
Ambient temperature: 25°C 77°F
Circuit:



Coil applied voltage vs operate and release time

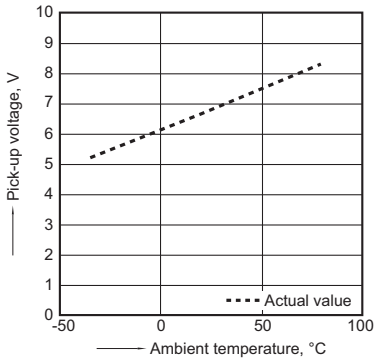


2. Ambient temperature characteristics (Cold start)

Sample: AEB310012
*nominal coil voltage 12V type
5pcs

Ambient temperature (°C)	–35	20	80
Standard value (V)	—	9.0	—
Actual value (V)	5.4	6.7	8.3

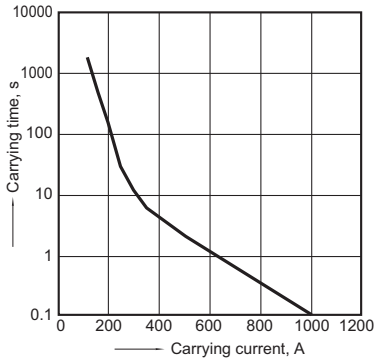
Ambient temperature vs pick-up voltage (Cold start)



3. Carrying current limit (error assumed)

Sample: AEB310012
*nominal coil voltage 12V type
1pcs
Connection electric wire: 40mm²
Ambient temperature: 85°C 185°F
Standard for judgment: Relay contacts off when carrying finished.

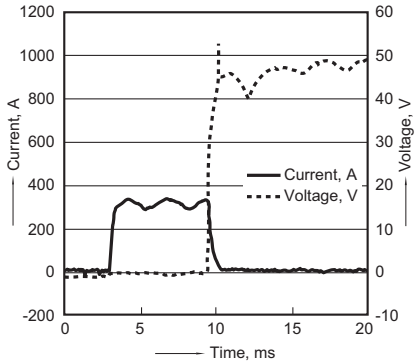
Carrying current and carrying time



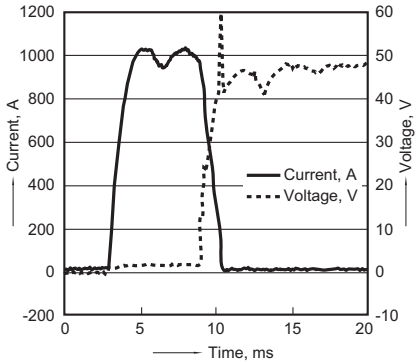
4. Cut-off characteristics

Sample: AEB310012
*nominal coil voltage 12V type
2pcs
Load: Coil applied voltage; 14V DC
Ambient temperature: Room temperature
Max. cut-off current:
(1) 300A (42V DC: resistive load)
(2) 1,000A (42V DC: resistive load)
Operating cycle:
(1) 300A/10 cycles
(2) 1.000A/3 cycles

(1) Cut off current/voltage: 300A/42V DC (resistive load)



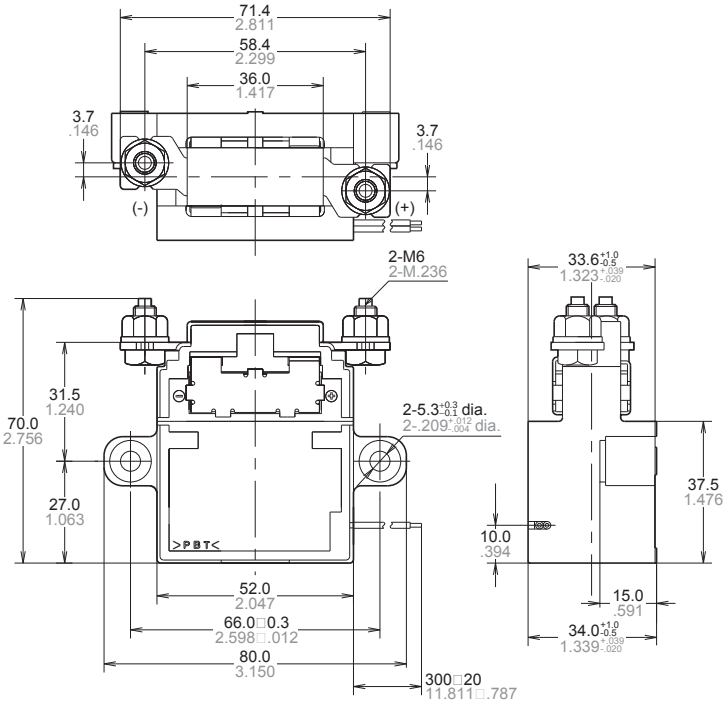
(2) Cut-off current/voltage: 1,000A/42V DC (resistive load)



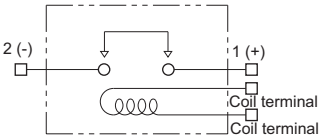
DIMENSIONS (mm inch)

Download CAD Data from our Web site.

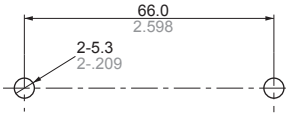
CAD Data External dimensions



Schematic (TOP VIEW)



Mounting hole pattern (TOP VIEW)



Tolerance: ±0.1 ±.004

General tolerance:

less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

Notes: 1. Please be warned that contact terminals have polarity. There is no polarity in the coil input line.
2. We will make separate consideration if a coil lead wire connector is desired.
3. M6 tighten torque: 6.0 N·m to 8.0 N·m

NOTES

1. For general cautions for use, please refer to the "CAUTIONS FOR USE OF AUTOMOTIVE RELAYS".

2. To ensure proper operation, the voltage applied to the coil should be the rated operating voltage of the coil. Also, be aware that the pick-up and drop-out voltages will fluctuate depending on the ambient temperature and operating conditions.

3. 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.

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

5. When using this relay for AC load switching, caution is required. Please contact us.

6. Make sure that the relay is wired correctly. Incorrect wiring may cause unexpected events or the generation of heat or flames.

7. We recommend you use a surge absorbing element with a clamp voltage of "Rating voltate x1.5: 18V/ 36V/54V" or more for the relay coil drive circuit as a means for relay coil surge absorption. Please avoid the use of diodes, capacitors and resistors because they lead to degradation in cut-off performance.

8. Avoid mounting the relay in strong magnetic fields (near a transformer or magnet) or close to an object that radiates heat.

9. Electrical life
This relay is a high-voltage direct-current switch. In its final breakdown mode, it may lose the ability to provide the proper cut-off. Therefore, do not exceed the indicated switching capacity and life. (Please treat the relay as a product with limited life and replace it when necessary.)
In the event that the relay loses cut-off ability, there is a possibility that burning may spread to surrounding parts, so configure the layout so that the power is turned off within one second.

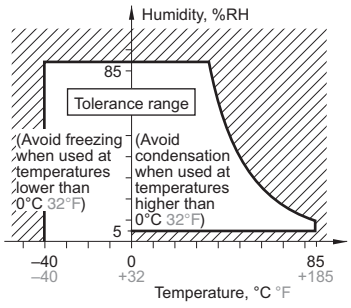
10. If the power is turned off and then immediately on after applying the rated voltage (current) continuously to the relay's coil and contact, the resistance of the coil will increase due to a rise in the coil temperature. This causes the pick-up voltage to rise, and possibly exceed the rated pick-up voltage. In these circumstances, take measures such as reducing the load current, limiting the duration of current flow, and applying a coil voltage higher than the rated operating voltage (quick start).

11. If you are using an inductive load (L load) such that L/R > 1 ms, add surge protection in parallel with the inductive load. If this is not done, the electrical life will decrease and cut-off failure may occur.

12. Be careful that foreign matter and oils and fats kind doesn't stick to the main terminal part because it is likely to cause a terminal part to give off unusual heat.

13. Avoid excessive load applied to the terminal in case of installing such as a bus bar etc., because it might give bad influence to the opening and closing performance.
Tighten each of the screws within the rated ranges given below.
Main terminal (M6 screw):
6.0N·m to 8.0N·m
Main unit mounting (M5 screw):
2.5N·m to 3.6N·m

14. Usage, transport and storage conditions
Ambient temperature, humidity, and atmospheric pressure during usage, transport, and storage of the relay:
1) Temperature: –40 to +85°C –40 to +185°F
2) Humidity: 5 to 85% RH
(Avoid freezing and condensation.)
3) Atmospheric pressure: 85 to 106 kPa
Temperature and humidity range for usage, transport, and storage:



4) 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.
5) 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.
6) 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.

For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Capsule contact mechanism and high-capacity cut-off compact relay

EV RELAYS (AEV)


10A


20A


80A


120A


300A

FEATURES

1. Compact and lightweight
Charged with hydrogen gas for high arc cooling capacity, short gap cutoff has been achieved at high DC voltages.

2. Safety
High safety achieved with construction that prevents explosions by keeping the arc from leaking.

3. High contact reliability
Since the contact portion is sealed in hydrogen gas, there is no contact oxidation. The relay is also dustproof.

TYPICAL APPLICATIONS

High DC voltage applications such as
- **Electric vehicle**
- **Hybrid vehicle**
- **Fuel-cell vehicle**
- **Battery charge and discharge systems**
- **Construction equipment**

ORDERING INFORMATION

AEV □ □ **0** □ □

EV relays

Contact arrangement
1: 1 Form A (Screw terminal or TM with terminal protection cover)
5: 1 Form A (TM type)

Contact rating
1: 10 A
2: 20 A
8: 80 A
9: 300 A
4: 120 A

Coil voltage
12: 12V DC
24: 24V DC

Coil terminal structure
Nil: Plug-in (Faston) (for 20 A type), Connector (for 80 A, 120 A and 300 A)
2: Plug-in (Faston) (for 10 A type with terminal protection cover)

TYPES

Type	Nominal coil voltage	Contact arrangement	Part number
10 A	12 V DC	1 Form A	AEV110122
20 A			AEV52012
80 A			AEV18012
120 A			AEV14012
300 A			AEV19012
10 A	24 V DC	1 Form A	AEV110242
80 A			AEV18024
120 A			AEV14024
300 A			AEV19024

Packing quantity:
Inner 25pcs. Outer 100pcs (for 10 A type)
Inner 25pcs. Outer 50pcs (for 20 A type)
Inner 1pc. Outer 20pcs (for 80 A type)
Inner 1pc. Outer 20pcs (for 120 A type)
Inner 1pc. Outer 5pcs (for 300 A type)

RATING

1. Coil data

Type	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)	Nominal operating power (at 20°C 68°F)	Max. allowable voltage
10 A	12 V DC	Max. 9 V DC	Min. 1 V DC	0.103 A	1.24 W	16 V DC
20 A		Max. 9 V DC	Min. 0.5 V DC	0.327 A	3.9 W	
80 A		Max. 9 V DC	Min. 1 V DC	0.353 A	4.2 W	
120 A		Max. 9 V DC	Min. 1 V DC	0.353 A	4.2 W	
300 A		Max. 9 V DC	Min. 2 V DC	3.2 A (Inrush)	37.9 W (Inrush, approx. 0.1 sec.) 3.6 W (Stable)	
10 A	24 V DC	Max. 18 V DC	Min. 2 V DC	0.052 A	1.24 W	32 V DC
80 A		Max. 18 V DC	Min. 2 V DC	0.176 A	4.2 W	
120 A		Max. 18 V DC	Min. 2 V DC	0.176 A	4.2 W	
300 A		Max. 18 V DC	Min. 4 V DC	1.85 A (Inrush)	44.4 W (Inrush, approx. 0.1 sec.) 3.8 W (Stable)	

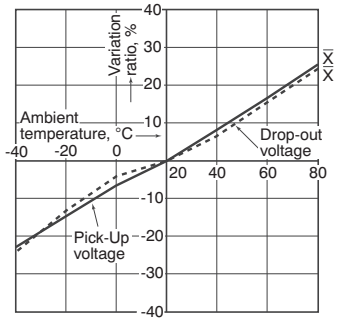
2. Specifications

Characteristics	Item		Specifications				
			10A type	20A type	80A type	120 A type	300 A type
Contact rating	Contact arrangement		1 Form A				
	Nominal switching capacity (resistive load)		10A 400V DC	20A 400V DC	80A 400V DC	120A 400V DC (Carry current)	300A 400V DC
	Short term current		15A 2min, 30A 30sec (2mm²)	40A 10min, 60A 1min (3mm²)	120A 15min, 180A 2min (15mm²)	225A 3min, 400A 30sec. (38mm²)	400A 10 min, 600A 1 min. (100mm²)
	Min. switching capacity (resistive load)*1		1A 12V DC	1A 12V DC	1A 12V DC	1A 12V DC	1A 24V DC
	Max. cut-off current*5		—	—	800A 300V DC (Min. 1 cycles)*2	1,200A 300V DC (Min. 1 cycle)*2	2,500A 300V DC (Min. 3 cycles)*3
	Overload opening/closing rating*5		30A 400V DC (Min. 50 cycles)*2	60A 400V DC (Min. 50 cycles)*2	120A 400V DC (Min. 50 cycles)*2	800A 300V DC (Min. 5 cycles)*2 120A 400V DC (Min. 50 cycles)*2	600A 400V DC (Min. 300 cycles)
	Reverse direction cut-off*5		—	—	–120A 200V DC (Min. 50 cycle)*2	–120A 200V DC (Min. 50 cycle)*2	–300A 200V DC (Min. 100 cycles)
	Contact voltage drop (Initial)		Max. 0.5V (By voltage drop 6 V DC 10A)	Max. 0.2V (By voltage drop 6 V DC 20A)	Max. 0.067 V (By voltage drop 6 V DC 20A)	Max. 0.03V (By voltage drop 6 V DC 20A)	Max. 0.06V (300 A Carry current)
Electrical characteristics	Insulation resistance (Initial)		Min. 100MΩ (at 500 V DC, Measurement at same location as “Initial breakdown voltage” section.)				
	Breakdown voltage (Initial)	Between open contacts	2,500Vrms/min. (Detection current: 10mA)				
		Between contact and coil	2,500Vrms/min. (Detection current: 10mA)				
	Operate time (at 20°C 68°F)		Max. 50ms (Nominal coil voltage applied to the coil, excluding contact bounce time.)				Max. 30ms (Nominal coil voltage applied to the coil, excluding contact bounce time.)
	Release time (at 20°C 68°F)		Max. 30ms (Nominal coil voltage applied to the coil, without diode.)				Max. 10ms (Nominal coil voltage applied to the coil, without diode.)
Mechanical characteristics	Shock resistance	Functional	Min. 196m/s² {20 G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs)	For ON: Min. 196m/s² {20 G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs) For OFF: Min. 98m/s² {10 G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs)			
		Destructive	Min. 490 m/s² {50 G} (Half-wave pulse of sine wave: 6ms)				
	Vibration resistance	Functional	10 to 200 Hz, Min.43 m/s² {4.4 G} (Detection time: 10μs)				10 to 200 Hz, Min.44 m/s² {4.5 G} (Detection time: 10μs)
		Destructive	10 to 200 Hz, Min.43 m/s² {4.4 G} (Time of vibration for each direction; X, Y, Z direction: 4 hours)				10 to 200 Hz, Min.44 m/s² {4.5 G} (Time of vibration for each direction; X, Y, Z direction: 4 hours)
Expected life	Mechanical		Min. 10^5	Min. 2×10^5			
	Electrical (resistive load)		10A 400V DC Min. 75,000*2	20A 400V DC Min. 3,000*2	80A 400V DC Min. 1,000*2	30A 400V DC Min. 3,000*2	300A 400V DC Min. 1,000
Conditions*6	Conditions for operation, transport and storage		Ambient temperature: –40 to +80°C –40 to +176°F (Storage: Max. 85°C 185°F), Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)				Ambient temperature: –40 to +85°C –40 to +185°F (Storage: Max.85°C 185°F), Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)
Unit weight (Approx.)			90 g 3.17 oz	180 g 6.35 oz	400 g 14.11 oz	400 g 14.11 oz	750 g 26.46 oz

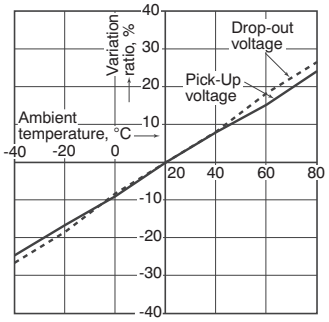
Notes:
*1. This value can change due to the switching frequency, environmental conditions, and desired reliability level, therefore it is recommended to check this with the actual load.
*2. The electrical load performance value for the 10A, 20A, 80A and 120 A types applies when a varistor is connected in parallel to the coil. Please be warned that working life will be reduced when a diode is used.
*3. Condition: Nominal switching 10 cycles, each cut-off 2,500 A
*4. The coil voltage 12 V DC type and 24 V DC type have the same specifications.
*5. at L/R ≤ 1ms
*6. Refer to “Usage ambient condition“ on page 139.

REFERENCE DATA

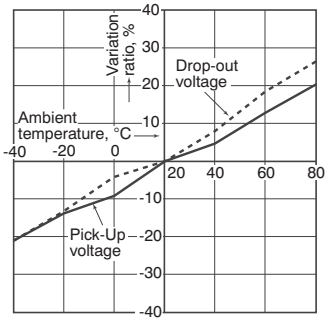
1.-(1) Ambient temperature characteristics (10 A type)
Sample: EV relay 10 A, 3 pcs.



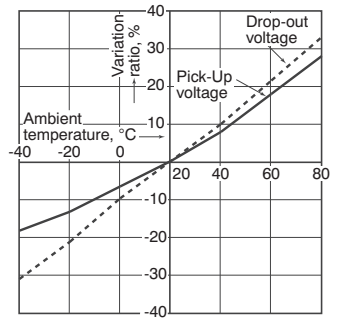
1.-(2) Ambient temperature characteristics (20 A type)
Sample: EV relay 20 A, 3 pcs.



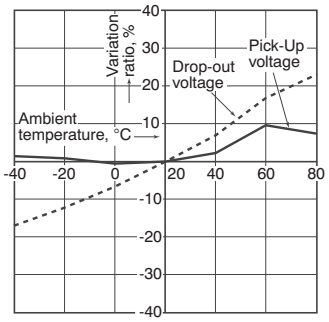
1.-(3) Ambient temperature characteristics (80 A type)
Sample: EV relay 80 A, 3 pcs.



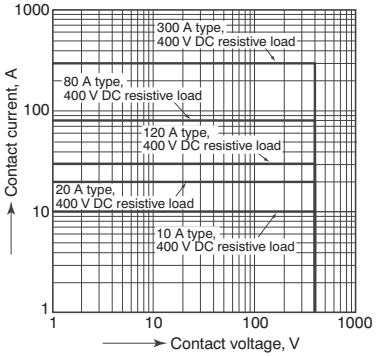
1.-(4) Ambient temperature characteristics (120 A type)
Sample: EV relay 120 A, 3 pcs.



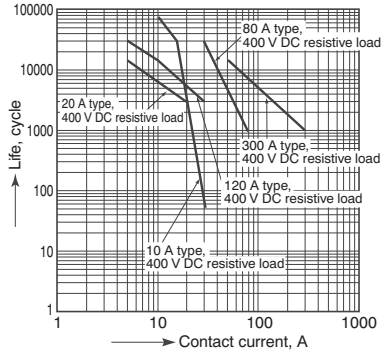
1.-(5) Ambient temperature characteristics (300 A type)
Sample: EV relay 300 A, 3 pcs.



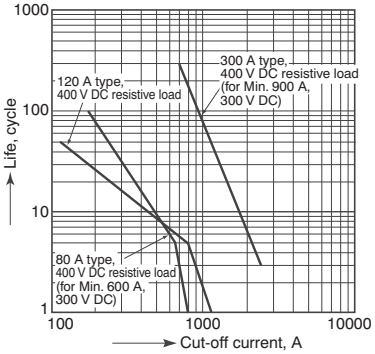
2. Max. value for switching capacity



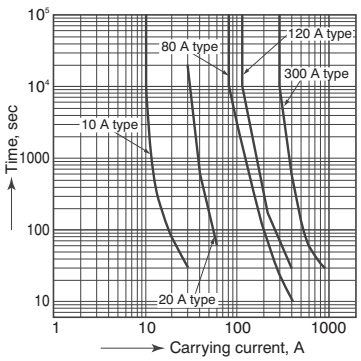
3. Switching life curve



4. Cut-off life curve



5. Carrying performance curve (80°C 176°F)
*For 300 A, at 85°C 185°F

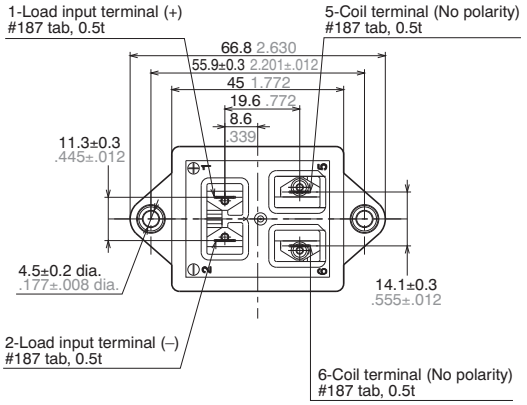


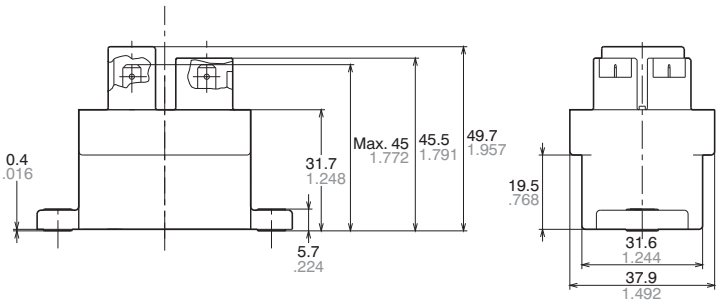
DIMENSIONS (mm inch)

Download CAD Data from our Web site.

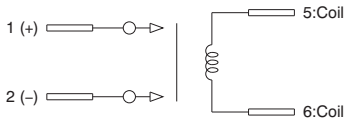
1. 10 A type

CAD Data



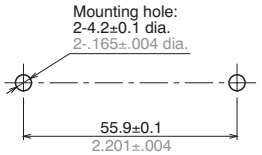


Schematic (TOP VIEW)



Load side has polarities (+) and (–)

Mounting dimensions

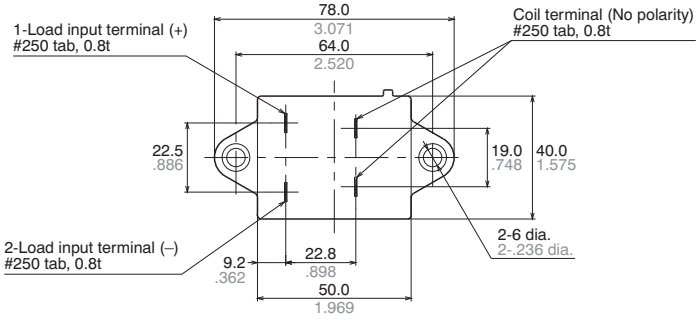


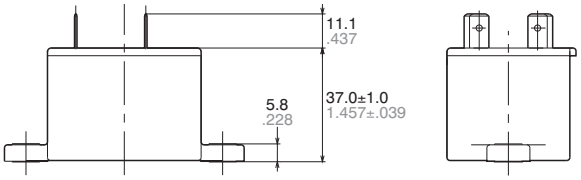
General tolerance:

less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

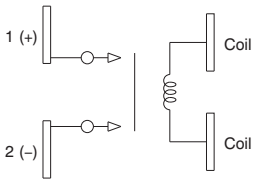
2. 20 A type

CAD Data



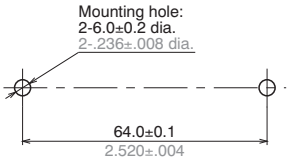


Schematic (TOP VIEW)



Load side has polarities (+) and (–)

Mounting dimensions

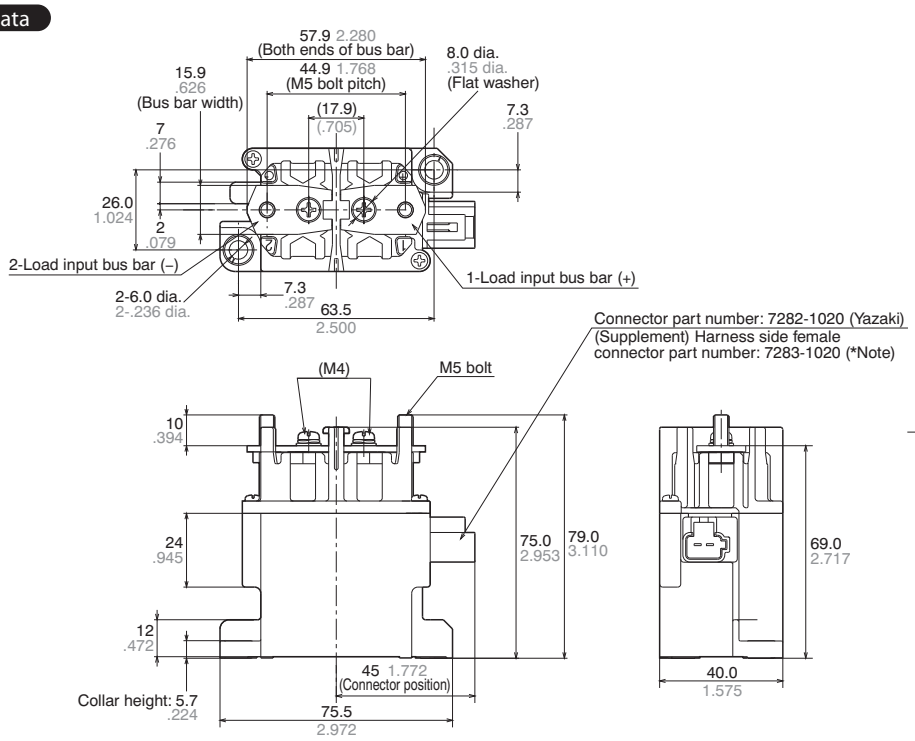


General tolerance:

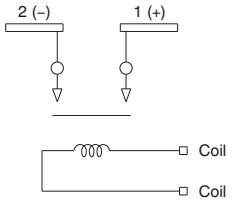
less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

3. 80 A type

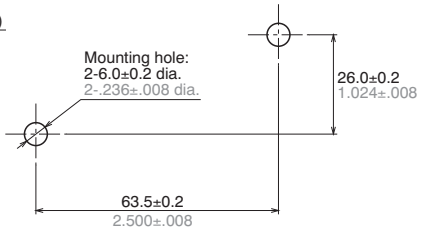
CAD Data



Schematic (TOP VIEW)



Mounting dimensions



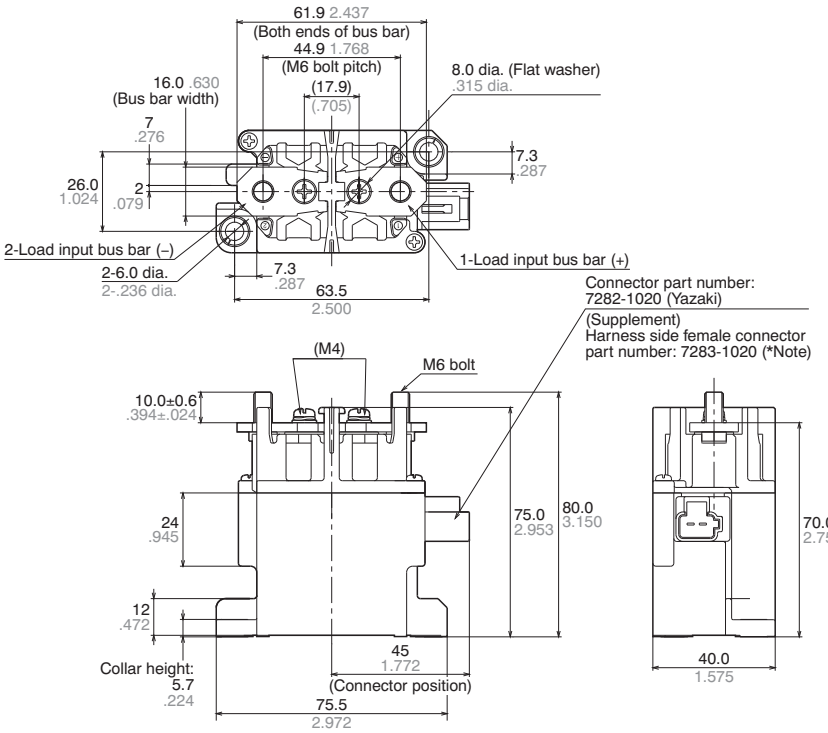
General tolerance:

less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

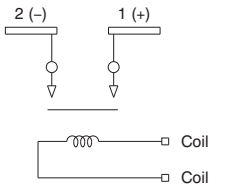
*Note: Separate connection of the terminal and lead wire is required.

4. 120 A type

CAD Data

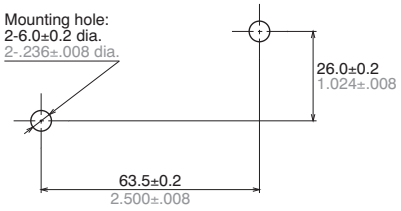


Schematic (TOP VIEW)



Load side has polarities (+) and (–)

Mounting dimensions



General tolerance:

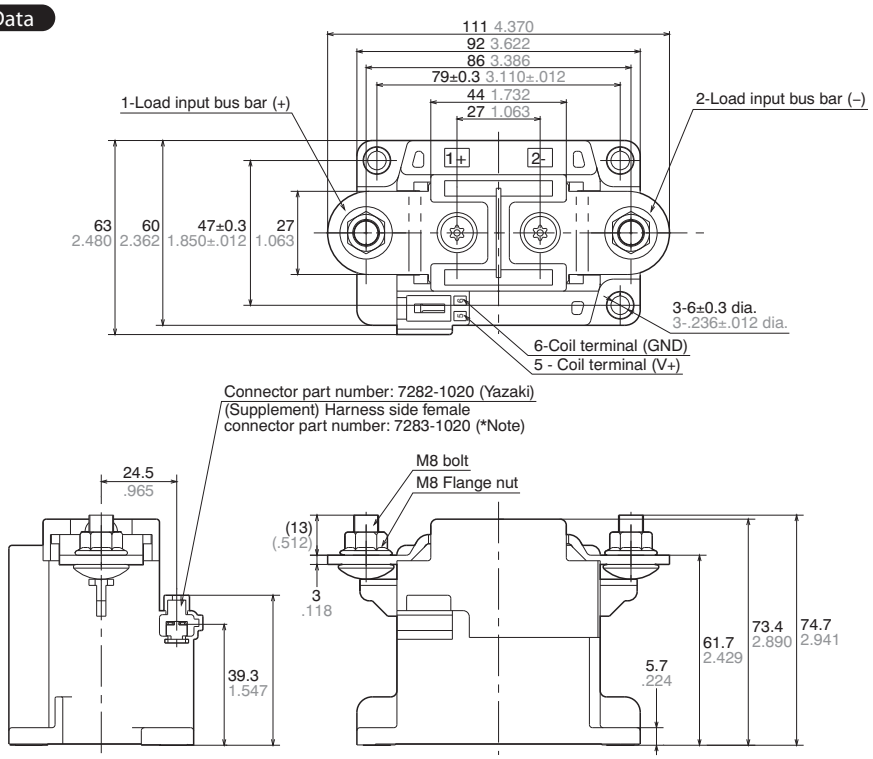
less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

*Note: Separate connection of the terminal and lead wire is required.

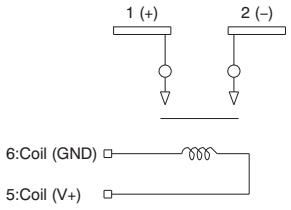
Automotive

5. 300 A type

CAD Data

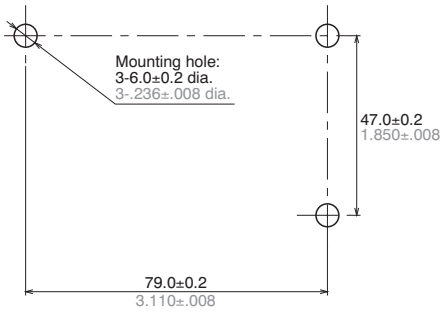


Schematic (TOP VIEW)



Load side has polarities (+) and (–)

Mounting dimensions



General tolerance:

less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039
more than 100 3.937:	±1.6 ±.063

*Note: Separate connection of the terminal and lead wire is required.

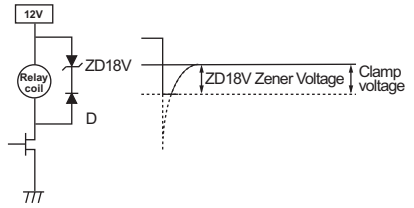
NOTES

1. When installing the relay, always use washers to prevent the screws from loosening.

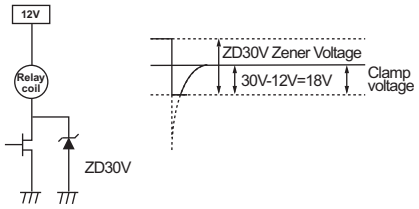
Tighten each screw within the rated range given below. Exceeding the maximum torque may result in breakage. Mounting is possible in either direction.
<Relay installing section>
• M4 screw (for 10A type): 1.8 to 2.7 N·m
• M5 screw (for 20A, 80A, 120A and 300A types): 3 to 4 N·m
<Main terminal installing section>
• M5 nut (for 80A type): 3 to 4 N·m
• M6 nut (for 120A type): 6 to 8 N·m
• M8 nut (for 300A type): 10 to 12 N·m

2. The coils (300 A type) and contacts (all type) of the relay are polarized, so follow the connection schematic when connecting the coils and contacts.

Type 300 A contains a reverse surge voltage absorption circuit; therefore a surge protector is not needed.
We recommend installing a surge protector varistor (ZNR) for the 10A, 20A, 80A and 120A types.
Example 1: Using a varistor
<Recommend varistor>
Amount of proof energy: Min. 1 J
Varistor voltage: min. 150% of nominal voltage
Example 2: Using a Zener diode



ZD18V Zener Voltage



ZD30V Zener Voltage

Note:

Using a diode may result in decreased cut-off capability.

3. As a general rule, do not use a relay if it has been dropped.

4. Avoid mounting the relay in strong magnetic fields (near a transformer or magnet) or close to an object that radiates heat.

5. Electrical life

This relay is a high-voltage direct-current switch. In its final breakdown mode, it may lose the ability to provide the proper cut-off. Therefore, do not exceed the indicated switching capacity and life. (Please treat the relay as a product with limited life and replace it when necessary.)
In the event that the relay loses cut-off ability, there is a possibility that burning may spread to surrounding parts, so configure the layout so that the power is turned off within one second.

6. Permeation life of internal gas

This relay uses a hermetically encased contact (capsule contact) with gas inside. The gas has a permeation life that is affected by the temperature inside the capsule contact (ambient temperature + temperature rise due to flow of electrical current). For this reason, make sure the ambient operating temperature is between –40 and 80°C –40 and +176°F (300A type is Max. 85°C 185°F), and the ambient storage temperature is between –40 and 85°C –40 and +185°F.

7. If the power is turned off and then immediately on after applying the rated voltage (current) continuously to the relay's coil and contact, the resistance of the coil will increase due to a rise in the coil temperature. This causes the pick-up voltage to rise, and possibly exceed the rated pick-up voltage. In these circumstances, take measures such as reducing the load current, limiting the duration of current flow, and applying a coil voltage higher than the rated operating voltage.

8. Main contact ratings in the ratings apply to when there is a resistive load.
If you are using an inductive load (L load) such that L/R > 1 ms, add surge protection in parallel with the inductive load.
If this is not done, the electrical life will decrease and cut-off failure may occur.

9. For the 300 A type, drive the coil with a quick startup.
(Built-in one-shot pulse generator circuit)

10. Be careful that foreign matter and oils and fats kind don't stick to the main terminal parts because it is likely to cause terminal parts to give off unusual heat.
Also, please use the following materials for connected harnesses and bus bars.

10A type:
Min. 2 mm² nominal cross-sectional area
20A type:
Min. 3 mm² nominal cross-sectional area
80A type:
Min. 15 mm² nominal cross-sectional area
120A type:
Min. 38 mm² nominal cross-sectional area
300A type:
Min. 100 mm² nominal cross-sectional area

11. As a guide, the insertion strength of the plug-in terminal into the relay tab terminal should be 40 to 70N (10A type), 40 to 80N (20A type). Please select a plug-in terminal (flat connection terminal) which comply with JIS C2809-1992.

10A type: for plate thickness 0.5mm and #187 tab terminal
20A type: for plate thickness 0.8mm and #250 tab terminal

12. Avoid excessive load applied to the terminal in case of installing such as a bus bar etc., Because it might adversely affect the opening and closing performance.

13. Use the specified connector for the connector terminal connection (80A, 120A and 300A)
Yazaki Corporation 7283 – 1020 or equivalent

14. After the ON signal enters the 300A type, automatic coil current switching occurs after approximately 0.1 seconds. Do not repeatedly turn it OFF within that 0.1 seconds interval, as doing so may damage the relay.

For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Unique silencing technology and low operation noise

EV RELAYS (AEVS)
Quiet Type

Vertical type
(coil: lead wire)

Horizontal type
(coil: faston terminal)

FEATURES

- **Low operation noise**
  Compared to our previous product, ON noise has been reduced approx. 13 dB and OFF noise has been reduced approx. 5 dB.
- **Vertical and horizontal types available**
  Offers freedom of relay layout where space is restricted.
- **Compact and lightweight**
  Charged with hydrogen gas for high arc cooling capacity, short gap cutoff has been achieved at high DC voltages.
- **Capsule contact construction for safety and high contact reliability**
  High safety achieved with construction that prevents explosions by keeping the arc from leaking.
  Since the contact portion is sealed in hydrogen gas, there is no contact oxidation.

TYPICAL APPLICATIONS

- **Hybrid vehicle**
- **Small sized electric vehicle**
- **High DC voltage applications such as battery charge and discharge systems**
- **High-voltage accessories**

ORDERING INFORMATION

AEVS □ □ **0** □ □

Contact arrangement / Installation type
1: 1 Form A (Screw terminal, Vertical type)
9: 1 Form A (Screw terminal, Horizontal type)

Contact rating
6: 60 A

Coil voltage
12: 12V DC

Coil terminal structure
Nil: Lead wire
2: Faston terminal

TYPES

Contact rating	Nominal coil voltage	Contact arrangement	Installation type	Part No.
60 A	12 V DC	1 Form A	Vertical type	AEVS16012
			Horizontal type	AEVS960122

Standard packing; Carton: 1pc. Case: 20pcs

RATING

1. Coil data

Type	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)	Nominal operating power (at 20°C 68°F)	Max. allowable voltage*1
60 A	12 V DC	Max. 9 V DC	Min. 1 V DC	0.375A	4.5 W	16 V DC

Note: *1. When continually powered, the maximum allowable voltage is 14 V DC (at 65°C 149°F).

2. Specifications

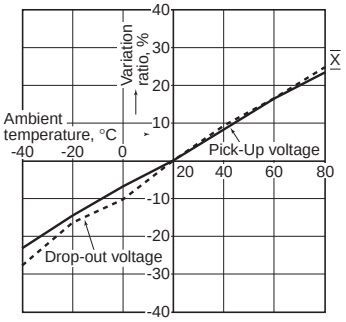
Characteristics	Item		Specifications	
			Vertical type	Horizontal type
Contact rating	Contact arrangement		1 Form A	
	Nominal switching capacity (resistive load)		60A 400V DC	
	Short term carrying current		100A 10 min., 180A 1 min. (15mm² Wire)	
	Min. switching capacity (resistive load)		1A 12V DC*1	
	Max. shutoff current		600A 300V DC (Min. 5 cycles)*2, *3	
	Overload opening/closing rating		120A 400V DC (Min. 50 cycles)*2, *3	
	Reverse direction shutoff		–120A 200V DC (Min. 50 cycles)*2, *3	
	Contact voltage drop (Initial)		Max. 0.067 V (By voltage drop 6 V DC 20A)	
Electrical characteristics	Insulation resistance (Initial)		Min. 100MΩ (at 500 V DC, Measurement at same location as “Initial breakdown voltage” section.)	
	Breakdown voltage (Initial)	Between open contacts	2,500Vrms/min. (Detection current: 10mA)	2,000Vrms/min. (Detection current: 10mA)
		Between contact and coil	2,500Vrms/min. (Detection current: 10mA)	2,000Vrms/min. (Detection current: 10mA)
	Operate time (at 20°C 68°F)		Max. 50ms (Nominal coil voltage applied to the coil, excluding contact bounce time)	
	Release time (at 20°C 68°F)		Max. 50ms (Nominal coil voltage applied to the coil, without diode)	
Mechanical characteristics	Shock resistance	Functional	For ON: Min. 196m/s² {20 G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs) For OFF: Min. 98m/s² {10 G} (Half-wave pulse of sine wave: 11ms; detection time: 10μs)	
		Destructive	Min. 490 m/s² {50 G} (Half-wave pulse of sine wave: 6ms)	
	Vibration resistance	Functional	10 to 100 Hz, acceleration: 43 m/s² {4.4 G} 100 to 200 Hz, acceleration: 19.6 m/s² {2 G} (Detection time: 10μs)	
		Destructive	10 to 100 Hz, acceleration: 43 m/s² {4.4 G} 100 to 200 Hz, acceleration: 19.6 m/s² {2 G} (Time of vibration for each direction; X, Y, Z direction: 4 hours)	
Expected life	Mechanical		Min. 2×10⁵ (at 60 cpm)	
	Electrical (resistive load)		60A 400V DC Min. 800 cycles	
Conditions	Conditions for operation		Ambient temperature: –40 to +80°C –40 to +176°F (–40 to +65°C –40 to +149°F when continually powered at 14 V DC.) Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)	
	Conditions for transport and storage		Ambient temperature: –40 to +80°C –40 to +176°F Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)	
Mass (Approx.)			250 g 8.82 oz	240 g 8.47 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.The electrical performance value applies when a varistor is connected in parallel to the coil. Please be warned that working life will be reduced when a diode is used.
*3.At L/R ≤ 1ms
*4. Refer to “Usage ambient condition“ on page 139.

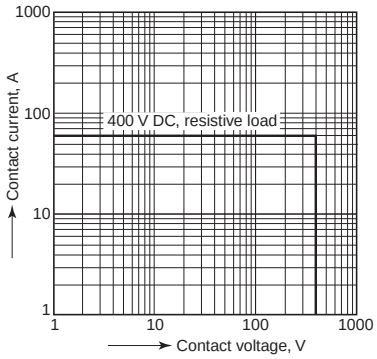
REFERENCE DATA

1. Ambient temperature characteristics

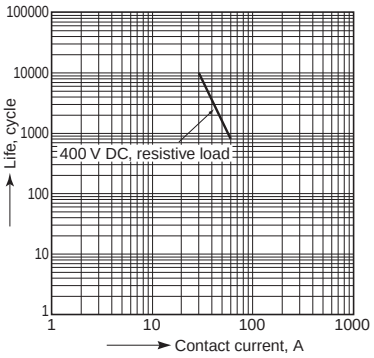
3 pcs.



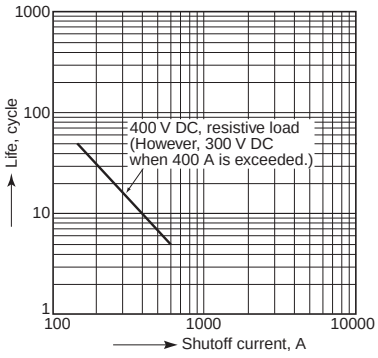
2. Max. value for switching capacity



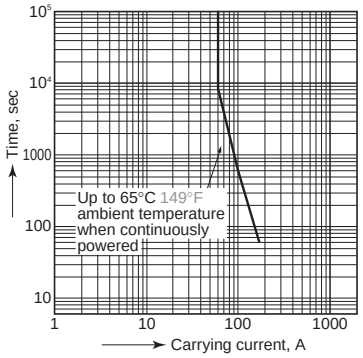
3. Switching life curve



4. Shutoff life curve (forward direction)

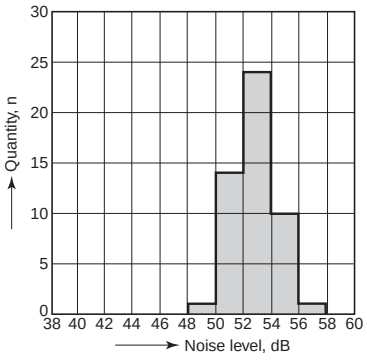


5. Carrying performance curve (80°C 176°F)



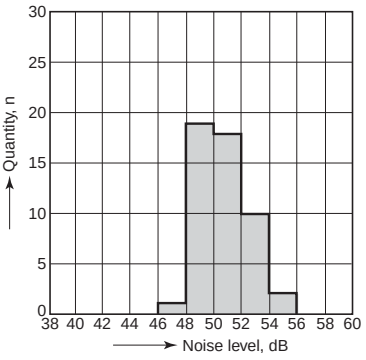
6.-(1)-1 Operation noise distribution (vertical type)

When operate



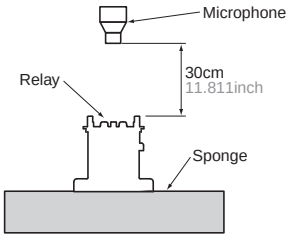
6.-(1)-2 Operation noise distribution (vertical type)

When release



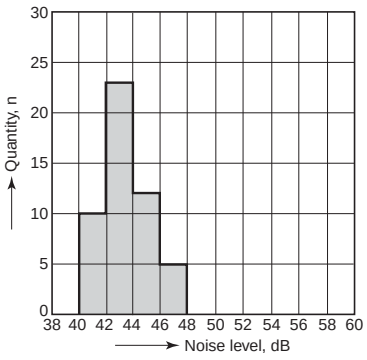
Vertical type

Measuring conditions
Sample: AEVS16012, 50pcs
Equipment setting: “A” weighted, Fast, Max. hold
Coil voltage: 12 V DC
Coil connection device: 18 V zener diode
Background noise: approx. 20dB



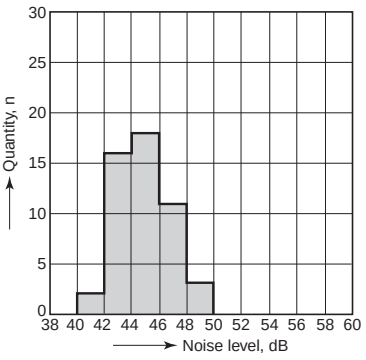
6.-(2)-1 Operation noise distribution (horizontal type)

When operate



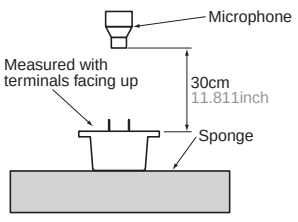
6.-(2)-2 Operation noise distribution (horizontal type)

When release



Horizontal type

Measuring conditions
Sample: AEVS960122, 50pcs
Equipment setting: “A” weighted, Fast, Max. hold
Coil voltage: 12 V DC
Coil connection device: 18 V zener diode
Background noise: approx. 20dB



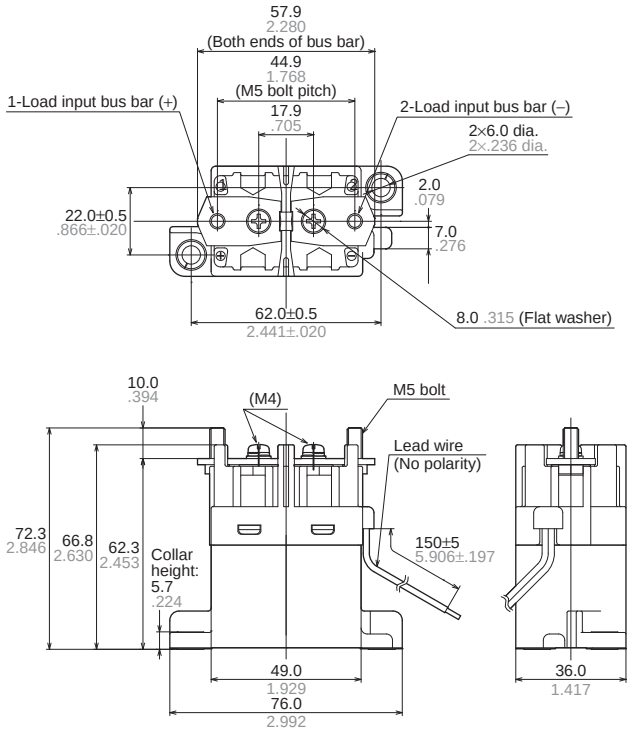
DIMENSIONS (mm inch)

Download CAD Data from our Web site.

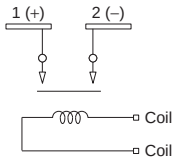
1. 60 A Vertical type

CAD Data

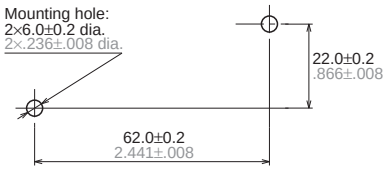
External dimensions



Schematic (TOP VIEW)



Mounting dimensions



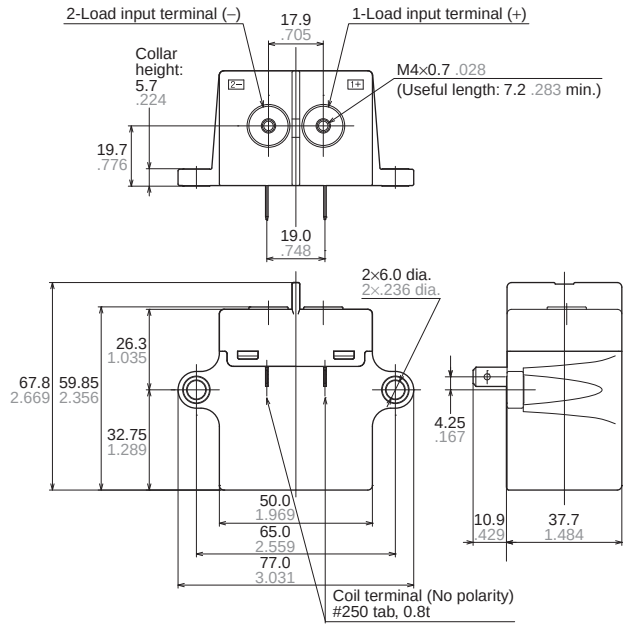
General tolerance:

less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

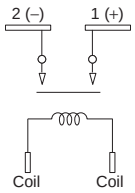
2. 60 A Horizontal type

CAD Data

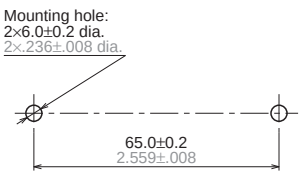
External dimensions



Schematic (TOP VIEW)



Mounting dimensions



General tolerance:

less than 10 .394:	±0.3 ±.012
10 to 50 .394 to 1.969:	±0.6 ±.024
more than 50 1.969:	±1.0 ±.039

Automotive

NOTES

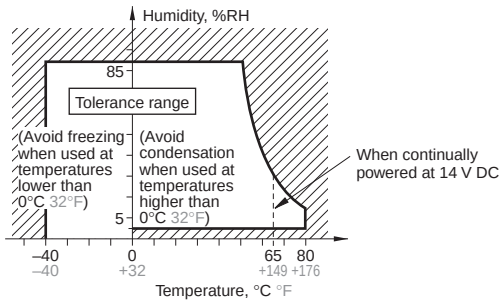
1. Usage, transport and storage conditions

1) Temperature: –40 to +80°C –40 to +176°F (–40 to +65°C –40 to +149°F when continually powered at 14 V DC)

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



4) 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.

5) 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.

2. Condition of tightening screw

1) Tightening torque for fixing relay-body;
Vertical and Horizontal type (M5 Screw): 3.0 to 4.0 N·m

2) Tightening torque for contact terminal;
Vertical type (M5 screw): 3.0 to 4.0 N·m,
Horizontal type (M4 screw): 2.2 to 2.8 N·m

3. Allowable pulling force for the coil input lead wire: Max.10N (for vertical type)

4. Insertion strength into the tab terminal: Max. 49N (for horizontal type)

Reference: Please select a faston terminal (flat connection terminal) which comply with JIS C2809-1999.
For plate thickness 0.8mm .031inch and #250 tab terminal

5. Cautions for Use

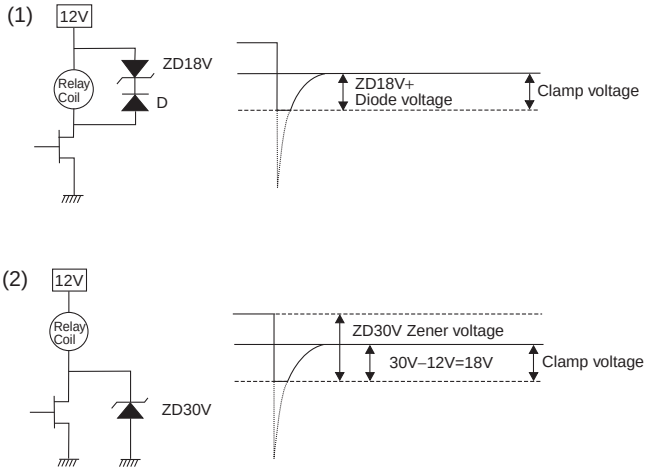
1) Regarding cautions for use and explanation of technical terms, please refer to our general catalog.

2) Additionally the ambient temperature and condition for your application should be considered because pick-up and drop-out voltage will be changed.

3) If it includes ripple, the ripple factor should be less than 5%.
For coil surge absorption, please use a zener diode or varistor, etc., so that the clamp voltage reaches 1.5 times or more (at least 18 V for rated 12 V type) the rated operation voltage.
If only a diode is connected in parallel with the relay coil, the contact opening velocity will become slow and sufficient cutoff performance cannot be guaranteed. Please avoid such usage.

Ex. 1: When using a varistor
Recommended Varistor; Maximum Energy: more than 1J
(However, please make settings using values that take into consideration the worst case scenario.)
Varistor voltage: For 12 V DC input, Min. 18 V

Ex. 2: When using a zener diode (circuit)



4) Lifetime is specified under the standard test conditions in JIS C 5442. (temperature 15 to 35°C 59 to 95°F, humidity 25%RH to 85%RH)
Lifetime is dependent on the coil driving circuit, load type, operation frequency and ambient conditions. Check lifetime under the actual condition.
Especially, Contact terminals have polarity. So if the contact terminals were connected with opposite pole, the electric life would be shorter.

5) When applying current which includes precipitous changes or ripple, the relay may generate buzzing sound. Therefore, please confirm with the actual load.

6) If the relay is used while exceeding the coil rating, contact rating or cycle lifetime, this may result in the risk of overheating.

7) As a general rule, do not use a relay if it has been dropped.

8) Take care to avoid cross connections as they may cause malfunctions or overheating.

9) When the screws for fixing relay-body and for additional terminal are tightened, it should be used within the range of decided torque.

10) Avoid mounting the relay in strong magnetic fields (near a transformer or magnet) or close to an object that radiates heat.

11) If the several relays are mounted closely or a heat-generation object is close to the relay, take care to check the abnormal temperature-rise and the insulation distance between the terminals outside of the relay.

12) The relay contacts are encapsulated in an inert gas atmosphere. Care must be exercised when the relay is to be used or stored at high ambient temperature.

13) If the power is turned off and then immediately on after applying the rated voltage (current) continuously to the relay's coil and contact, the resistance of the coil will increase due to a rise in the coil temperature.
This causes the pick-up voltage to rise, and possibly exceed the rated pick-up voltage. In these circumstances, take measures such as reducing the load current, limiting the duration of current flow, and applying a coil voltage higher than the rated operating voltage (quick start).

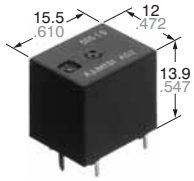
14) In case using a capacitive load (C-load), please take a countermeasure as pre-charging to the capacitive load so that the inrush current will not surpass 60A.
The relay might have a contact welding without such countermeasure.
15) If you are using an inductive load (L load) such that L/R > 1ms, add surge protection in parallel with the inductive load. If this is not done, the electrical life will decrease and cut-off failure may occur.
16) Use the suitable wire for wire at the load side according to the current. If the wire diameter is small, the maximum rated contact current cannot be guaranteed.
(Ex.) Carrying current; 60A: diameter of 15mm^2 or more
17) Take care to disconnect to the power supply when wiring.
18) Do not switch the contacts without any load as the contact resistance may become increased rapidly.
19) The relay satisfies the protection level of JIS D 0203 R2 (of waterproof). Please take any countermeasures additionally if it should be installed in the place where higher protection level is required.
20) Do not use this product in such atmosphere where any kind of organic solvent (as benzene, thinner and alcohol) and the strong alkali (as ammonia and caustic soda) might be adhered to this product.
21) Be careful that foreign matter and oils and fats kind don't stick to the main terminal parts because it is likely to cause terminal parts to give off unusual heat.
22) Do not make additional manufacturing upon the relay housing.
23) For AC shutoff these is no contact polarity, but confirm the electric life using the actual load.

For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Compact size automotive relay

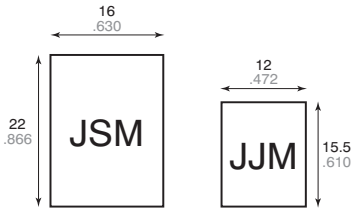
JJ-M RELAYS



mm inch

FEATURES

• Compact (half-size).
The base area is approximately half the size of conventional (JS-M) relays. The controller unit can be made more compact.
Base area has been reduced by one half



• Perfect for automobile electrical systems.
Over 2 × 10^5 openings possible with a 14 V DC motor load, an inrush current of 25 A, and steady state current of 5 A. (N.O. side)

• Standard terminal pitch employed
The terminal array used is identical to that used in small automotive relays.

• Plastic sealed type.
Plastically sealed for automatic cleaning.

• Line-up of 1 Form A and 1 Form C.

TYPICAL APPLICATIONS

- Power windows
- Auto door lock
- Electrically powered sun roof
- Electrically powered mirror
- Cornerring lamp, etc.

SPECIFICATIONS

Contact

Arrangement			1 Form A	1 Form C
Contact material			Ag alloy (Cadmium free)	
Initial contact resistance (Initial) (By voltage drop 6V DC 1A)			Typ. 5 mΩ	
Rating (resistive load)	Nominal switching capacity		20 A 14 V DC	20 A 14 V DC (N.O.) 10 A 14 V DC (N.C.)
	Min. switching capacity#1		1 A 12 V DC	
	Max. carrying current		N.O.: 35 A (12V, at 20°C 68°F for 2 minutes) 25 A (12V, at 20°C 68°F for 1 hour) 30 A (12V, at 85°C 185°F for 2 minutes) 20 A (12V, at 85°C 185°F for 1 hour)	
Expected life (min. operations)	Mechanical (at 120cpm)		10^7	
	Electrical (at rated load)	Resistive	10^5 *1	10^5 (N.O.)*2 10^5 (N.C.)*3
		Motor load	2×10^5 *4 5×10^4 *5	2×10^5 (N.O.)*6 5×10^4 (N.O.)*7 2×10^5 (N.C.)*8

Coil

Nominal operating power	640 mW

#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.

Remarks
*1 at 20 A 14 V DC, at 20 cpm, operating frequency: 1s ON, 9s OFF
*2 at 20 A 14 V DC, operating frequency: 1s ON, 9s OFF
*3 at 10 A 14 V DC, at 20 cpm, operating frequency: 1s ON, 9s OFF
*4 at 5 A (steady), 25 A (inrush) 14 V DC
*5 at 20 A 14 V DC (Motor lock), operating frequency: 0.5 s ON, 9.5 s OFF
*6 at 5A (steady), 25 A (inrush) 14 V DC

Characteristics

Max. operating speed (at rated load)		6 cpm
Initial insulation resistance*9		Min. 100 MΩ (at 500 V DC)
Initial breakdown voltage*10	Between open contacts	500 Vrms for 1min.
	Between contact and coil	500 Vrms for 1min.
Operate time*11 (at nominal voltage)		Max. 10 ms (at 20°C 68°F)
Release time (without diode)*11 (at nominal voltage) (Initial)		Max. 10 ms (at 20°C 68°F)
Shock resistance	Functional*12	Min. 100 m/s² {10 G}
	Destructive*13	Min. 1,000 m/s² {100 G}
Vibration resistance	Functional*14	10 Hz to 100 Hz, Min. 44.1 m/s² {4.5 G}
	Destructive	10 Hz to 500 Hz, Min. 44.1 m/s² {4.5 G}
Conditions in case of operation, transport and storage*15 (Not freezing and condensing at low temperature)	Ambient temp.	–40°C to +85°C –40°F to +185°F
	Humidity	5% R.H. to 85% R.H.
Mass		Approx. 5 g .176 oz

*7 at 20 A 14 V DC (Motor lock)
*8 at peak 20 A 14 V DC (Braking current) operating frequency: 0.5 s ON, 9.5 s OFF
*9 Measurement at same location as “Initial break down voltage” section.
*10 Detection current: 10mA
*11 Excluding contact bounce time.
*12 Half-wave pulse of sine wave: 11 ms; detection time: 10 μs
*13 Half-wave pulse of sine wave: 6 ms
*14 Detection time: 10 μs
*15 Refer to “Usage ambient condition“ on page 139.
Please inquire if you will be using the relay in a high temperature atmosphere (110°C 230°F).

ORDERING INFORMATION

Ex. JJM □ — □

Contact arrangement	Coil voltage(DC)
1a: 1 Form A 1: 1 Form C	12 V

(Note) Standard packing: Carton: 50 pcs.; Case: 1,000 pcs.

TYPES AND COIL DATA (at 20°C 68°F)

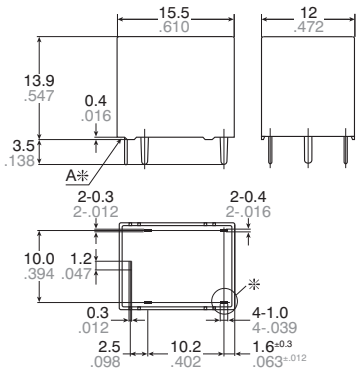
Contact arrangement	Part No.	Nominal voltage, V DC	Pick-up voltage, V DC (Initial)	Drop-out voltage, V DC (Initial)	Coil resistance Ω	Nominal operating current mA	Nominal operating power mW	Usable voltage range, V DC
1 Form A	JJM1a-12 V	12	Max. 7.2	Min. 1.0	225±10%	53.3±10%	640	10 to 16
1 Form C	JJM1-12 V	12	Max. 7.2	Min. 1.0	225±10%	53.3±10%	640	10 to 16

* Other pick-up voltage types are also available. Please contact us for details.

DIMENSIONS (mm inch)

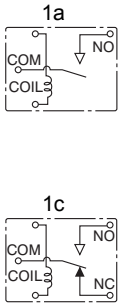
Download CAD Data from our Web site.

CAD Data

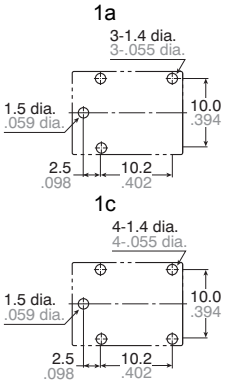


Note: ※Marked terminal is only for 1Form C type

Schematic (Bottom view)



PC board pattern (Bottom view)



Tolerance: ±0.1 ±.004

* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

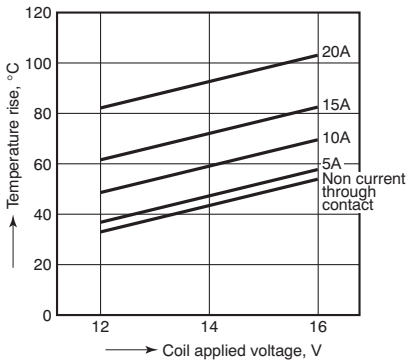
Dimension:	General tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

Automotive

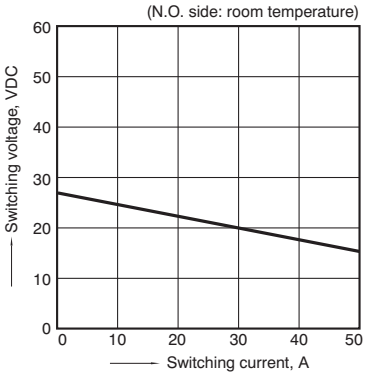
REFERENCE DATA

1. Coil temperature rise

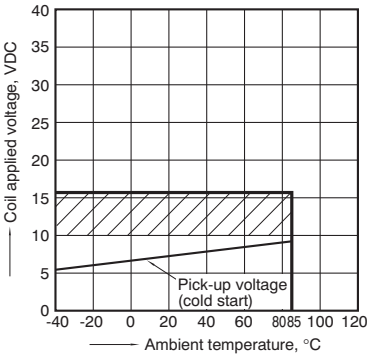
Sample: JJM1-12V, 6pcs
Point measured: Inside the coil
Contact current: Now current through contact, 5A, 10A, 15A, 20A
Resistance method, ambient temperature 85°C 185°F



2. Max. switching capability (Resistive load)

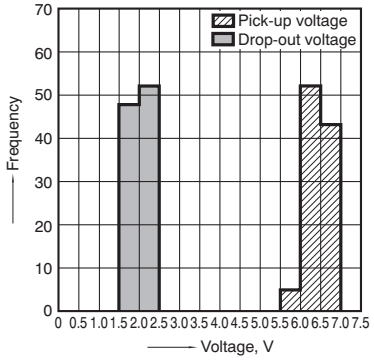


3. Ambient temperature and operating voltage range



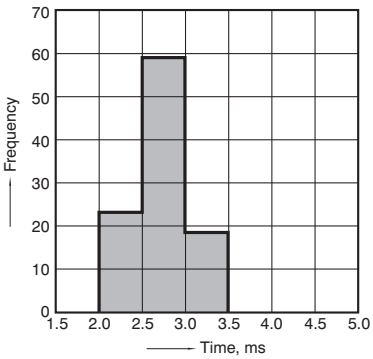
4. Distribution of pick-up and drop-out voltage

Sample: JJM1-12V, 100pcs



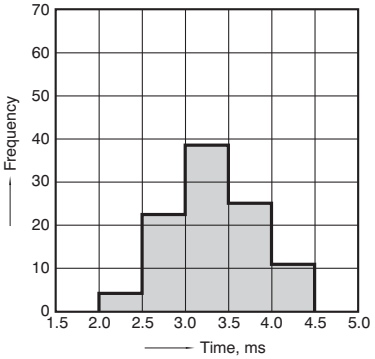
5. Distribution of operate time

Sample: JJM1-12V, 100pcs



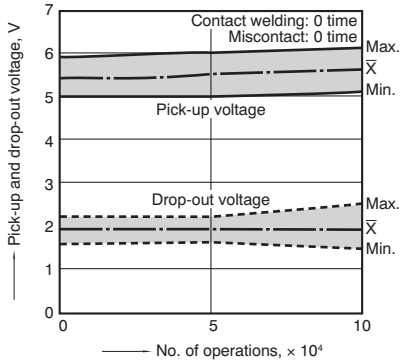
6. Distribution of release time

Sample: JJM1-12V, 100pcs
* With diode



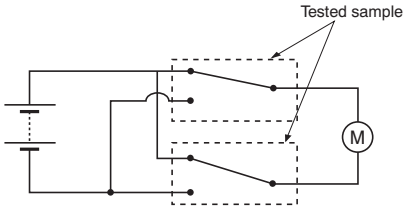
7-(1). Electrical life test (at rated load)

Sample: JJM1-12V
Quantity: n = 6 (NC = 3, NO = 3)
Load: Resisitive load (NC side: 10A 14 V DC, NO side: 20 A 14 V DC); Operating frequency: ON 1s, OFF 9s
Ambient temperature: Room temperature

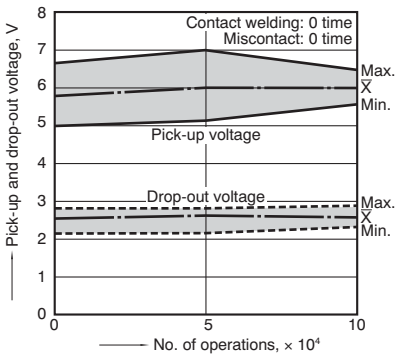


7-(2). Electrical life test (Motor free)
Sample: JJM1-12V, 6pcs.
Load: 5A, Inrush 25A, Brake current 18A 14V DC,
Power window motor load (Free condition).
Operating frequency: (ON : OFF = 0.5s : 9.5s)
Ambient temperature: Room temperature

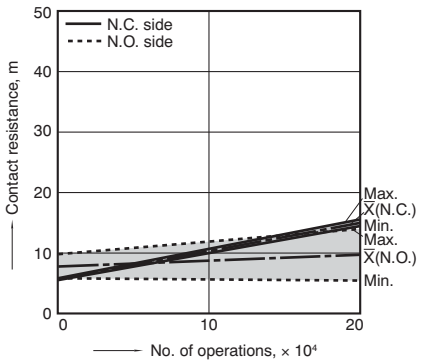
Circuit :



Change of pick-up and drop-out voltage

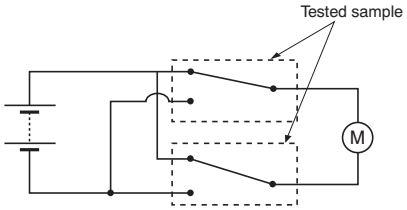


Change of contact resistance

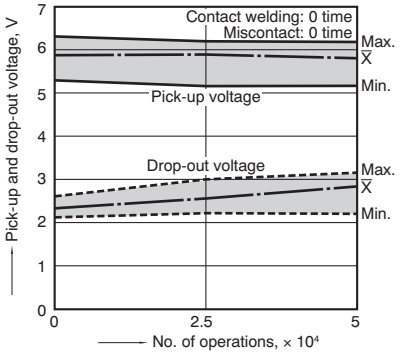


7-(3). Electrical life test (Motor lock)
Sample: JJM1-12V, 6pcs.
Load: 20A, 14VDC,
Power window motor actual load (lock condition).
Operating frequency: (ON : OFF = 1s : 5s)
Ambient temperature: Room temperature

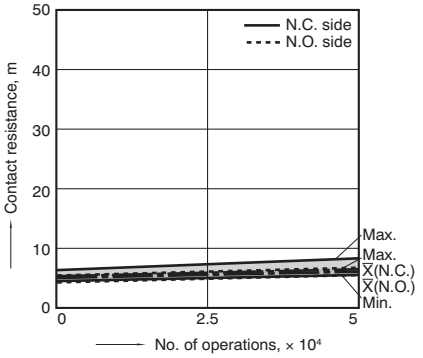
Circuit :



Change of pick-up and drop-out voltage

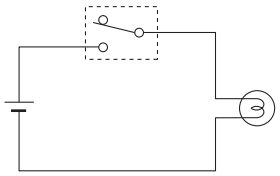


Change of contact resistance

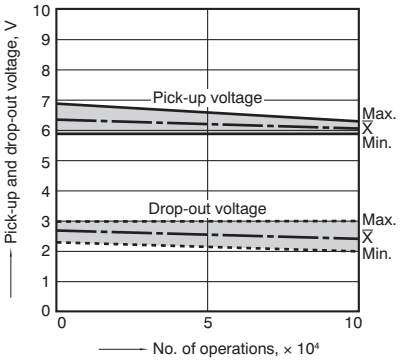


7-(4). Electrical life test (Lamp load)
Sample: JJM1-12V, 6pcs.
Load: 27W+21W, min. 4A (steady), Lamp actual load
Operating frequency: ON 2s, OFF 13s
Ambient temperature: Room temperature

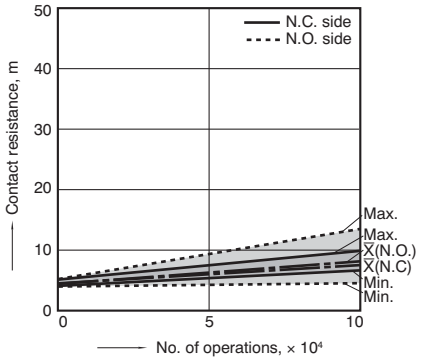
Circuit :



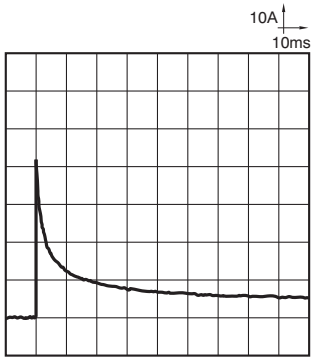
Change of pick-up and drop-out voltage



Change of contact resistance



Inrush current: 42A, Steady current: 4.4A

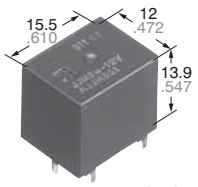


For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Double make contact automotive relay

JJ-M RELAYS
(Double make type)



mm inch

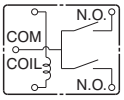
FEATURES

• Small size
The smallest double make type relay 12.0(W)×15.5(L)×13.9(H) mm .472(W)×.610(L)×.547(H) inch

• Pattern design simplification
Simplified pattern design is possible because, while double make construction is employed, the external COM terminal is single.

• Standard terminal pitch employed
The terminal array used is identical to that used in JJM relays(1c type).

• Plastic sealed type
Plastically sealed for automotive cleaning.



<Schematic>

SPECIFICATIONS

Contact

Arrangement		Double make contact
Contact material		Ag alloy (Cadmium free)
Initial contact resistance (Initial) (By voltage drop 6V DC 1A)		Typ. 10 mΩ
Contact voltage drop		Max. 0.25V (at 2 × 6A)
Rating	Nominal switching capacity	12A 14V DC (at 2 × 6A, lamp load)
	Max. carrying current	2 × 6A (12V, at 20°C 68°F), 2 × 4A (12V, at 85°C 185°F)
	Min. switching capacity#1	1A 12V DC
Expected life (min. operations)	Mechanical (at 120cpm)	Min. 10^7
	Electrical (lamp load)	Min. 10^5*1

Coil

Nominal operating power	1,000 mW

#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.

Remarks
*1 At 12A 14V DC (lamp), operating frequency: 1s ON, 14s OFF
*2 Measurement at same location as "initial breakdown voltage" section.
*3 Detection current: 10mA
*4 Excluding contact bounce time.
*5 Half-wave pulse of sine wave: 11 ms; detection time: 10 μs
*6 Half-wave pulse of sine wave: 6 ms
*7 Detection time: 10 μs
*8 Time of vibration for each direction; X, Y direction: 2 hours Z direction: 4 hours

*9 Refer to "Usage ambient condition" on page 139.
Please inquire if you will be using the relay in a high temperature atmosphere (110°C 230°F).

Characteristics

Max. operating speed (at nominal switching capacity)		4 cpm
Initial insulation resistance*2		Min. 100 MΩ (at 500 V DC)
Initial breakdown voltage*3	Between open contacts	500 Vrms for 1min.
	Between contact and coil	500 Vrms for 1min.
Operate time*4 (at nominal voltage)(at 20°C 68°F)		Max. 10 ms (Initial)
Release time (without diode)*4 (at nominal voltage)(at 20°C 68°F)		Max. 10 ms (Initial)
Shock resistance	Functional*5	Min. 100 m/s² {10 G}
	Destructive*6	Min. 1,000 m/s² {100 G}
Vibration resistance	Functional*7	10 Hz to 100 Hz, Min. 44.1 m/s² {4.5 G}
	Destructive*8	10 Hz to 500 Hz, Min. 44.1 m/s² {4.5 G}
Conditions in case of operation, transport and storage*9 (Not freezing and condensing at low temperature)	Ambient temp.	–40°C to +85°C –40°F to +185°F
	Humidity	5% R.H. to 85% R.H.
Mass		Approx. 5 g .176 oz

TYPICAL APPLICATIONS

Car alarm system flashing lamp etc.

ORDERING INFORMATION

Ex. JJM [2w] [12V]

Contact arrangement	Coil voltage (DC)
Double make contact	12V

Standard packing: Carton(tube package) 50pcs. Case: 1,000pcs.

TYPES AND COIL DATA (at 20°C 68°F)

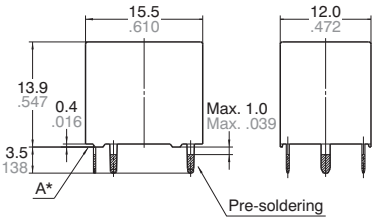
• Single side stable type

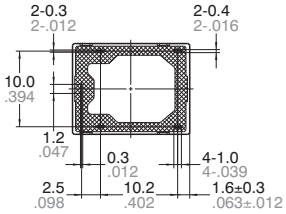
Part No.	Nominal voltage, V DC	Pick-up voltage, V DC (Initial)	Drop-out voltage, V DC (Initial)	Coil resistance Ω	Nominal operating current, mA	Nominal operating power, mW	Usable voltage range, V DC
JJM2w-12V	12	Max. 6.9	Min. 1.0	144±10%	83.3±10%	1,000	10 to 16

DIMENSIONS (mm inch)

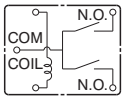
Download CAD Data from our Web site.

CAD Data

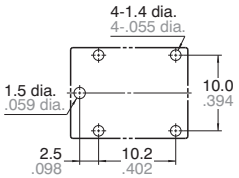




Schematic (Bottom view)



PC board pattern (Bottom view)



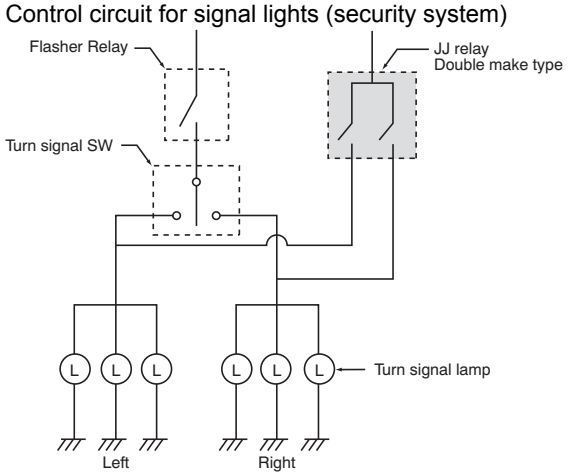
Tolerance: ±0.1 ±.004

Dimension:	General tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

* Dimensions (thickness and width) of terminal in this catalog is measured before pre-soldering.
Intervals between terminals is measured at A surface level.

EXAMPLE OF CIRCUIT

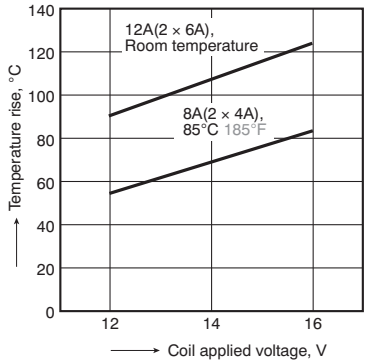
Control circuit for signal lights (security system)



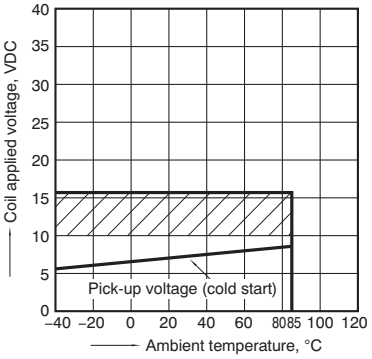
REFERENCE DATA

1. Coil temperature rise

Sample: JJM2w-12V, 6pcs.
Point measured: Inside the coil
Contact carrying current: 2 × 6A, 2 × 4A
Ambient temperature: Room temperature, 85°C 185°F

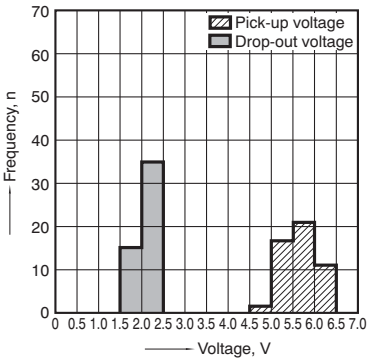


2. Ambient temperature and operating voltage range



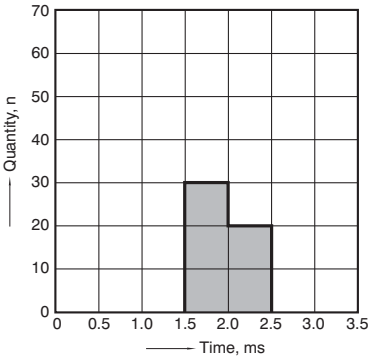
3. Distribution of pick-up and drop-out voltage

Sample: JJM2W-12V, 50pcs.



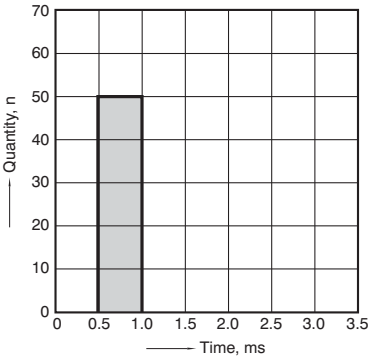
4. Distribution of operate time

Sample: JJM2W-12V, 50pcs.



5. Distribution of release time

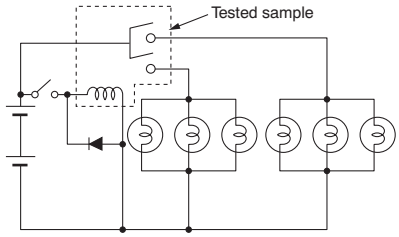
Sample: JJM2W-12V, 50pcs.
* Without diode



6. Electrical life test (Lamp load)

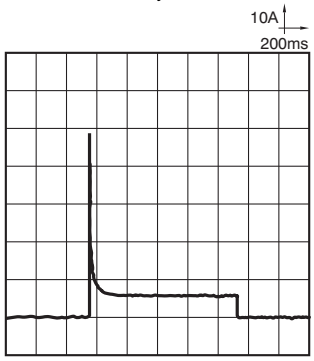
Sample: JJM2w-12V, 6pcs.
Load: 5.5A, inrush 48A, 6 × 21W
Operating frequency: (ON : OFF = 1s : 14s)
Ambient temperature: Room temperature

Circuit:

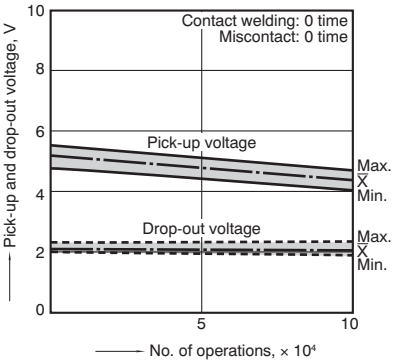


Load current waveform

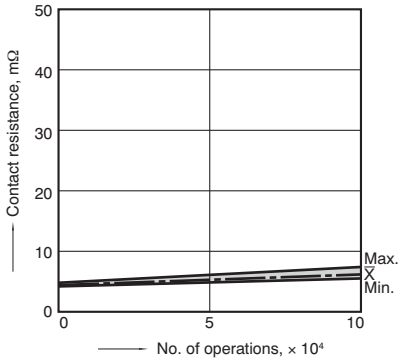
Current value per contact on one side
Inrush current: 48A, Steady current: 5.5A



Change of pick-up and drop-out voltage



Change of contact resistance

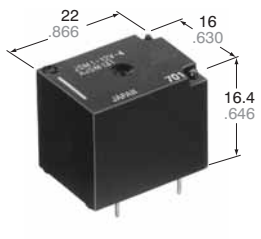


For Cautions for Use, see Relay Technical Information (page 126).

Panasonic
ideas for life

Global standard terminal pitch automotive power relay

JS-M RELAYS



mm inch

FEATURES

- **Low pick-up voltage for high ambient use**
- **Sealed construction**
- **Global standard terminal pitch**
- **Usable at high temperature: 85°C 185°F**

TYPICAL APPLICATIONS

- Power-window
- Car antenna
- Door lock
- Intermittent wiper
- Interior lighting
- Power seat
- Power sunroof
- Car stereo
- Horn
- Lift gate, etc.

SPECIFICATIONS

Contact

			Standard type	High capacity type
Arrangement			1 Form A, 1 Form C	
Contact material			Ag alloy (Cadmium free)	
Initial contact resistance (By voltage drop 6 V DC 1 A)			*Max. 100 mΩ	*Max. 100 mΩ
Contact voltage drop			Max. 0.2 V DC (at 10 A 12 V DC)	
Rating	Nominal switching capacity		10 A 16 V DC (resistive)	15 A 16 V DC (resistive)
	Max. carrying current		25 A (at 20°C 68°F for 2 minutes) 15 A (at 20°C 68°F for 1 hour) 20 A (at 85°C 185°F for 2 minutes) 10 A (at 85°C 185°F for 1 hour)	
	Max. switching power		160 W	
	Max. switching voltage		16 V DC	
	Max. switching current		10 A	15 A (10 A max. at 85°C)
	Min. switching capacity#1		1 A 12 V DC	
Expected life (min. ope.)	Mechanical life (at 180 cpm)		10^7	
	Electrical (at 15 cpm)	Resistive	10^5	N.O.: 10^5 N.C.: 5×10^4

* Measured after operating 5 times at the rated load

Coil

Nominal operating power	640 mW

Contact rating

Load	Standard type			High capacity type		
	Form A	Form C		Form A	Form C	
		N.O.	N.C.		N.O.	N.C.
Max. carry current	15 A	15 A	15 A	15 A	15 A	15 A
Max. make current	25 A	25 A	10 A	50 A	50 A	15 A
Max. break current	10 A	10 A	10 A	15 A	15 A	15 A

Characteristics

Max. operating speed (at rated load)		15 cps.
Initial insulation resistance*1		Min. 100 MΩ (at 500 V DC)
Initial breakdown voltage*2	Between open contacts	750 Vrms for 1 min.
	Between contacts and coil	1,500 Vrms for 1 min.
Operate time*3 (at nominal voltage)		Max. 10 ms
Release time (without diode)*3 (at nominal voltage)		Max. 10 ms
Shock resistance	Functional*4	Min. 98 m/s² {10 G}
	Destructive*5	Min. 980 m/s² {100 G}
Vibration resistance	Functional*6	10 Hz to 55 Hz at double amplitude of 1.6 mm
	Destructive	10 Hz 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 +85°C –40°F to +185°F
	Humidity	5% R.H. to 85% R.H.
Mass		Approx. 12 g .423 oz

#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.

Remarks

*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 "Usage ambient condition" on page 139.

ORDERING INFORMATION

Ex. JSM □ □ — 12V — □

Contact arrangement	Protective construction	Coil voltage (DC)	Contact material
1a: 1 Form A 1: 1 Form C	Nil: Sealed construction F: Flux-resistant type	12 V	4: Standard type (10 A) 5: High capacity type (15 A)

Note: Standard packing: Carton: 100 pcs. Case: 500 pcs.

TYPES AND COIL DATA (at 20°C 68°F)

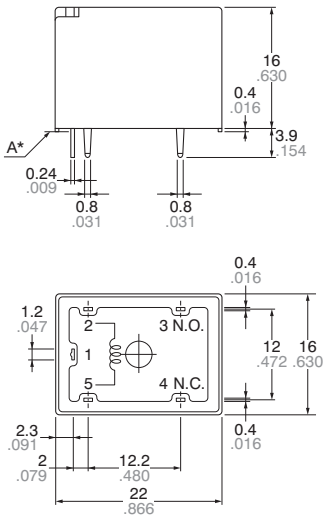
Contact arrange-ment	Coil voltage, V DC	Standard type (10 A)		High capacity type (15 A)		Nominal voltage, V DC	Pick-up voltage, V DC	Drop-out voltage, V DC	Coil resistance Ω	Nominal operating current, mA	Nominal operating power, mW	Max. allowable voltage, V DC (at 80°C 176°F)
		Sealed type	Flux-resistant type	Sealed type	Flux-resistant type							
1 Form A	12	JSM1a-12V-4	JSM1aF-12V-4	JSM1a-12V-5	JSM1aF-12V-5	12	Max. 6.3	Min. 0.9	225±10%	53.3±10%	640	10 to 16
1 Form C	12	JSM1-12V-4	JSM1F-12V-4	JSM1-12V-5	JSM1F-12V-5	12	Max. 6.3	Min. 0.9	225±10%	53.3±10%	640	10 to 16

* Other pick-up voltage types are also available. Please contact us for details.

DIMENSIONS (mm inch)

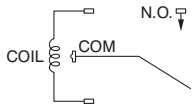
Download CAD Data from our Web site.

CAD Data

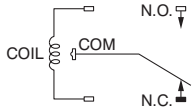


Schematic (Bottom view)

1a

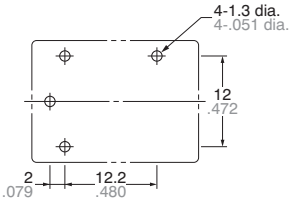


1c

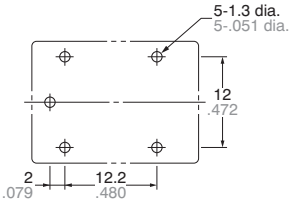


PC board pattern (Bottom view)

1a



1c



Dimension:	General tolerance
Max. 1mm .039 inch:	±0.1 ±.004
1 to 3mm .039 to .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

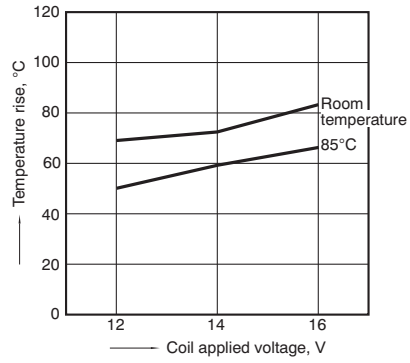
Tolerance: ±0.1 ±.004

* Dimensions (thickness and width) of terminal specified in this catalog is measured before pre-soldering. Intervals between terminals is measured at A surface level.

REFERENCE DATA

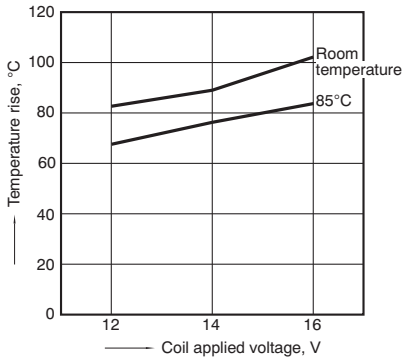
1-(1). Coil temperature rise (10A)

Measured portion: Inside the coil
Contact carrying current, 10A
Ambient temperature: Room temperature, 85°C 185°F

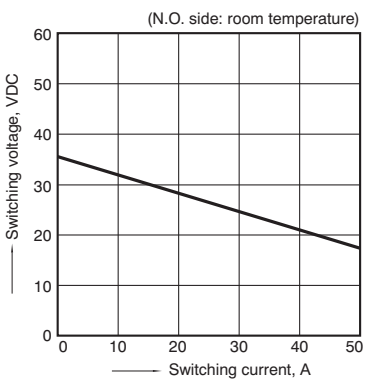


1-(2). Coil temperature rise (15A)

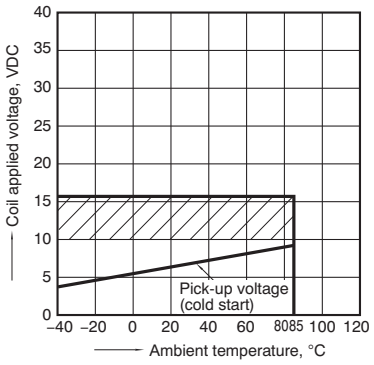
Measured portion: Inside the coil
Contact carrying current, 15A
Ambient temperature: Room temperature, 85°C 185°F



2. Max. switching capability (Resistive load, initial)

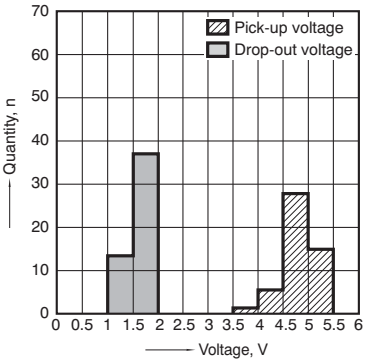


3. Ambient temperature and oprating voltage range



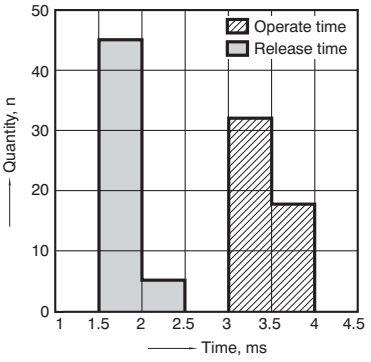
4. Distribution of pick-up and drop-out voltage

Sample: JSM1-12V-5, 50pcs.



5. Distribution of operate and release time

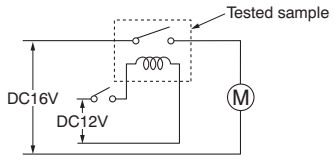
Sample: JSM1-12V-5, 50pcs.
Coil both side without diode

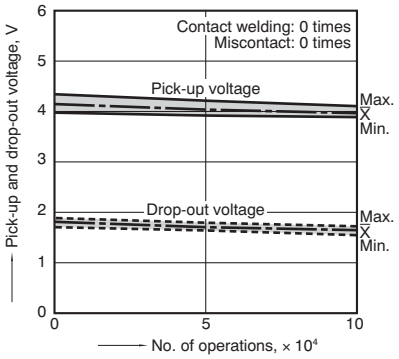


6-(1). Electrical life test (Motor load)

Sample: JSM1-12V-5, 3pcs.
Load: 50A (Inrush), 10A 16V DC (Steady)
Switching frequency: (ON : OFF = 1s : 9s)

Circuit :

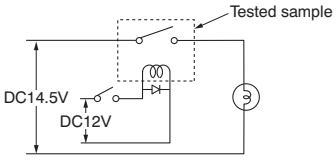


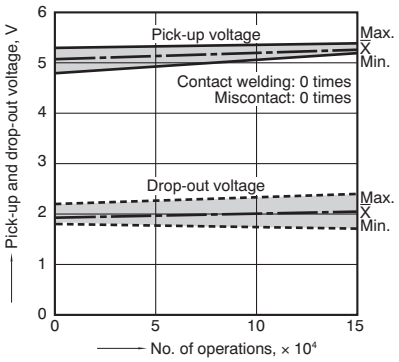


6-(2). Electrical life test (Lamp load)

Sample: JSM1-12V-5, 4pcs.
Load: 55.2A (Inrush), 9.6A 14.5V DC (Steady)
Switching frequency: (ON : OFF = 1s : 3s)

Circuit :





For Cautions for Use, see Relay Technical Information (page 126).

Relay Technical Information

CONFIGURATION AND CONSTRUCTION

PROTECTIVE CONSTRUCTION

1. Dust Cover Type

To protect from dust, these types are covered, for example, with a plastic case. We recommend hand soldering, because these relays are not constructed to prevent flux and cleaning fluid from entering during automatic soldering.

2. Flux-Resistant Type

The relay is constructed so that flux will not enter inside the relay during automatic soldering. However, cleaning is not possible.

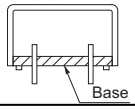
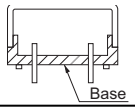
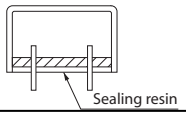
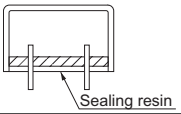
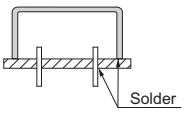
3. Sealed Type

Construction is designed to prevent seeping of flux when soldering and cleaning fluid when cleaning. Harmful substances on the contacts are removed by gas purging before sealing with.

4. Sealed capsule type

This type is hermetically sealed with ceramic and metal plating. No harmful gas or humidity will ever reach the contacts. This type cannot be washed.

CONSTRUCTION AND CHARACTERISTICS

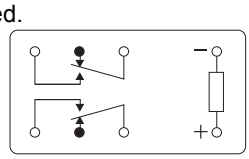
Type	Construction	Characteristics	Automatic Soldering	Automatic Cleaning	Dust Resistance	Harmful Gas Resistance
Dust Cover Type		Most basic construction where the case and base (or body) are fitted together.	Take care	No	Take care	No
Flux-Resistant Type		Terminals are sealed or molded simultaneously. The joint between the case and base is higher than the surface of the PC board.	Yes	No	Take care	No
		Terminals, case, and base are filled with sealing resin.	Yes	No	Take care	No
Sealed Type		Sealed construction with terminals, case and base sealed shut with sealing resin.	Yes	Yes	Yes	Yes*
Sealed capsule type (EP and EV relays only)		Hermetically sealed construction by sealing the metal case and plate, and the terminal and ceramic part, with solder.	No	No	Yes	Yes

*Since the plastic breathes, please do not use in an atmosphere that contains silicone.

OPERATIONAL FUNCTION

1. Single Side Stable Type

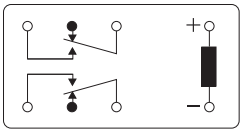
Relay which turns on when the coil is energized and turns off when de-energized.



(Schematic example: DS relay)

2. 1 Coil Latching Type

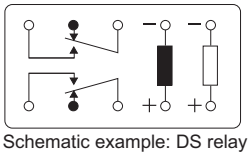
Relay with latching construction that can maintain the on or off state with a pulse input. With one coil, the relay is set or reset by applying signals of opposite polarities.



(Schematic example: DS relay)

3. 2 Coil Latching Type

Relay with latching construction composed of 2 coils: set coil and reset coil. The relay is set or reset by alternately applying pulse signals of the same polarity. The HC latching (keep) relay also has the same function.



Schematic example: DS relay

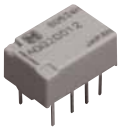
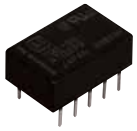
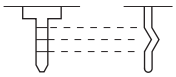
4. Operation Indication

Indicates the set and reset states either electrically or mechanically for easy maintenance. An LED type (HC relay with LED), lamp type (HP relay with lamp), and a mechanical display type (HC latching (keep) relay) in which the display

panel moves using the movement of the armature, are available.

LED type, HC relay

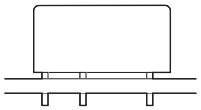
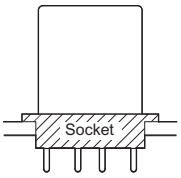
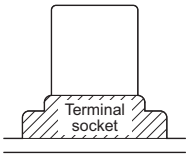
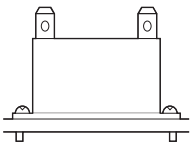
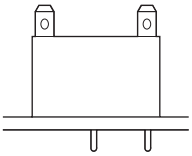
TERMINAL CONFIGURATION

Type	PC board through hole terminal	PC board self-clinching terminal	Plug-in terminal	Quick connect terminal	Screw terminal
Typical relay					
Terminal configuration					
Typical relay type	GQ(AGQ), TX, DS relay	TQ relay	HJ, HN relay	LE, LF, JM relay	HE, EP relay

Note:

A plug-in solder dual type (HG relay) is also available.

MOUNTING METHOD

Type	Insertion mount	Socket mount	Terminal socket mount	TM type	TMP type
Mounting configuration					
Typical relay type	TQ, DS, S relay	NC, HC relay	SP-, HC-, HJ-, HL-, JW-, SFS-Relays	HC, JC relay	LE, LF relay

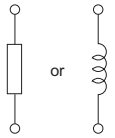
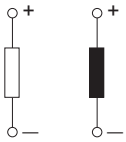
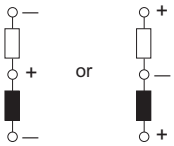
Notes:

- Sockets are available for certain PC board relays (S relay, ST relay).

DEFINITION OF RELAY TERMINOLOGY

COIL (also referred to as primary or input)

1. Coil Designation

Single side stable type		1 coil latching type	2 coil latching type	
Non-polarized	Polarized		4-terminal	3-terminal
				

A black coil represents the energized state. For latching relays, schematic diagrams generally show the coil in its reset state. Therefore, the coil symbol is also shown for the reset coil in its reset state.

2. Nominal Coil Voltage

(Rated Coil Voltage)

A single value (or narrow range) of source voltage intended by design to be applied to the coil or input.

3. Nominal Operating Current

The value of current flow in the coil when nominal voltage is impressed on the coil.

4. Nominal Operating Power

The value of power used by the coil at nominal voltage. For DC coils expressed in watts; AC expressed as volt amperes. Nominal Power (W or VA) = Nominal Voltage × Nominal Current.

5. Coil Resistance

This is the DC resistance of the coil in DC type relays for the temperature conditions listed in the catalog. (Note that for certain types of relays, the DC resistance may be for temperatures other than the standard 20°C 68°F.)

6. Pick-Up Voltage

(Pull-In Voltage or Must Operate Voltage)

As the voltage on an unoperated relay is increased, the value at or below which all contacts must function (transfer).

7. Drop-Out Voltage

(Release or Must Release Voltage)

As the voltage on an operated relay is decreased, the value at or above which all contacts must revert to their unoperated position.

8. Maximum Continuous Voltage

The maximum voltage that can be applied continuously to the coil without causing damage. Short duration spikes of a higher voltage may be tolerable, but this should not be assumed without first checking with the manufacturer.

CONTACTS (secondary or output)

1. Contact Forms

Denotes the contact mechanism and number of contacts in the contact circuit.

2. Contact Symbols

Form A contacts (normally open contacts)	
Form B contacts (normally closed contacts)	
Form C contacts (changeover contacts)	

Form A contacts are also called N.O. contacts or make contacts.

Form B contacts are also called N.C. contacts or break contacts.

Form C contacts are also called changeover contacts or transfer contacts.

3. MBB Contacts

Abbreviation for make-before-break contacts. Contact mechanism where Form A contacts (normally open contacts) close before Form B contacts open (normally closed contacts).

4. Rated Switching Power

The design value in watts (DC) or volt amperes (AC) which can safely be switched by the contacts. This value is the product of switching voltage x switching current, and will be lower than the maximum voltage and maximum current product.

5. Maximum Switching Voltage

The maximum open circuit voltage which can safely be switched by the contacts. AC and DC voltage maximums will differ in most cases.

6. Maximum Switching Current

The maximum current which can safely be switched by the contacts. AC and DC current maximums may differ.

7. Maximum Switching Power

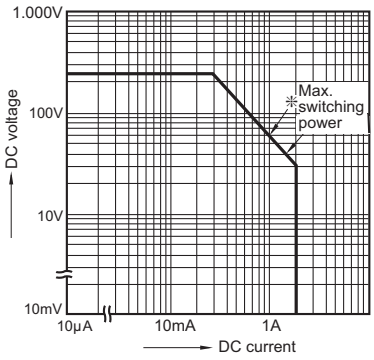
The upper limit of power which can be switched by the contacts. Care should be taken not to exceed this value.

8. Maximum Switching Capacity

This is listed in the data column for each type of relay as the maximum value of the contact capacity and is an interrelationship of the maximum switching power, maximum switching voltage, and maximum switching current. The switching current and switching voltage can be obtained from this graph.

For example, if the switching voltage is fixed in a certain application, the maximum switching current can be obtained from the intersection between the voltage on the axis and the maximum switching power.

Maximum switching capacity



Example: Using TX relay at a switching voltage of 60V DC, the maximum switching current is 1A.

(*Maximum switching capacity is given for a resistive load. Be sure to carefully check the actual load before use.)

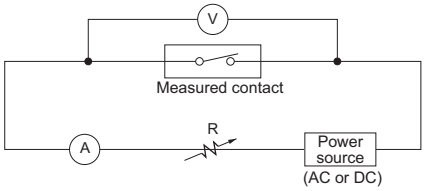
9. Minimum switching capability

This value is a guideline as to the lowest possible level at which it will be possible for a low level load to allow switching. The level of reliability of this value depends on switching frequency, ambient conditions, change in the desired contact resistance, and the absolute value. Please use a relay with AgPd contacts if your needs analog low level loads, control, or a contact resistance of 100 mΩ or less.

We recommend that you verify with one of our sales offices regarding usage.

10. Contact Resistance

This value is the combined resistance of the resistance when the contacts are touching each other, the resistance of the terminals and contact spring. The contact resistance is measured using the voltage-drop method as shown below. The measuring currents are designated.



Ⓐ:Ammeter Ⓥ: Voltmeter Ⓡ:Variable resistor

Test Currents

Rated Contact Current or Switching Current (A)	Test Current (mA)
Less than 0.01	1
0.01 or more and less than 0.1	10
0.1 or more and less than 1	100
1 or more	1,000

The resistance can be measured with reasonable accuracy on a YHP 4328A milliohmmeter.

In general, for relays with a contact rating of 1A or more, measure using the voltage-drop method at 1A 6V DC.

11. Maximum Carrying Current

The maximum current which after closing or prior to opening, the contacts can safely pass without being subject to temperature rise in excess of their design limit, or the design limit of other temperature sensitive components in the relay (coil, springs, insulation, etc.). This value is usually in excess of the maximum switching current.

12. Capacitance

This value is measured between the terminals at 1kHz and 20°C 68°F.

ELECTRICAL PERFORMANCE

1. Insulation Resistance

The resistance value between all mutually isolated conducting sections of the relay, i.e. between coil and contacts, across open contacts and between coil or contacts to any core or frame at ground potential. This value is usually expressed as “initial insulation resistance” and may decrease with time, due to material degradation and the accumulation of contaminants.

- Between coil and contacts
- Between open contacts
- Between contact sets
- Between set coil and reset coil

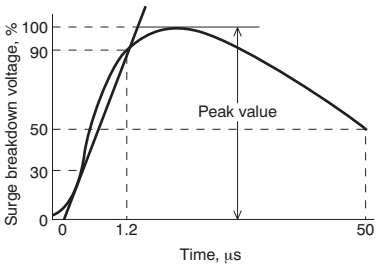
2. Breakdown Voltage

(Hi-Pot or Dielectric Strength)

The maximum voltage which can be tolerated by the relay without damage for a specified period of time, usually measured at the same points as insulation resistance. Usually the stated value is in VAC (RMS) for one minute duration.

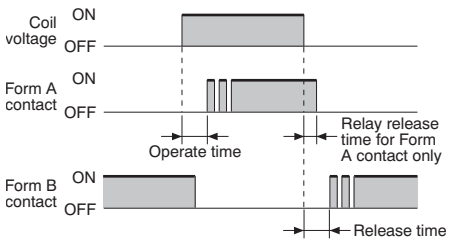
3. Surge Breakdown Voltage

The ability of the device to withstand an abnormal externally produced power surge, as in a lightning strike, or other phenomenon. An impulse test waveform is usually specified, indicating rise time, peak value and fall time.



4. Operate Time (Set Time)

The elapsed time from the initial application of power to the coil, until the closure of the Form A (normally open) contacts. (With multiple pole devices the time until the last contact closes.) This time does not include any bounce time.



5. Release Time (Reset Time)

The elapsed time from the initial removal of coil power until the reclosure of the Form B (normally closed) contacts (last contact with multi-pole). This time does not include any bounce time.

6. Contact Bounce (Time)

Generally expressed in time (ms), this refers to the intermittent switching phenomenon of the contacts which occurs due to the collision between the movable metal parts or contacts, when the relay is operated or released.

MECHANICAL PERFORMANCE AND LIFE

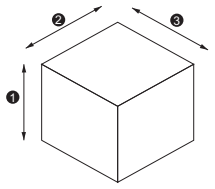
1. Shock Resistance

1) Functional

The acceleration which can be tolerated by the relay during service without causing the closed contacts to open for more than the specified time.
(usually 10 μs)

2) Destructive

The acceleration which can be withstood by the relay during shipping or installation without it suffering damage, and without causing a change in its operating characteristics. Usually expressed in "G"s. However, test was performed a total of 18 times, six times each in three-axis directions.



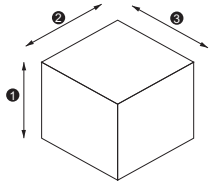
2. Vibration Resistance

1) Functional

The vibration which can be tolerated by the relay during service, without causing the closed contacts to open for more than the specified time.

2) Destructive

The vibration which can be withstood by the relay during shipping, installation or use without it suffering damage, and without causing a change in its operating characteristics. Expressed as an acceleration in G's or displacement, and frequency range. However, test was performed a total of six hours, two hours each in three-axis directions.



3. Mechanical Life

The minimum number of times the relay can be operated under nominal conditions (coil voltage, temperature, humidity, etc.) with no load on the contacts.

4. Electrical Life

The minimum number of times the relay can be operated under nominal conditions with a specific load being switched by the contacts.

5. Maximum Switching Frequency

This refers to the maximum switching frequency which satisfies the mechanical life or electrical life under repeated operations by applying a pulse train at the rated voltage to the operating coil.

6. Life Curve

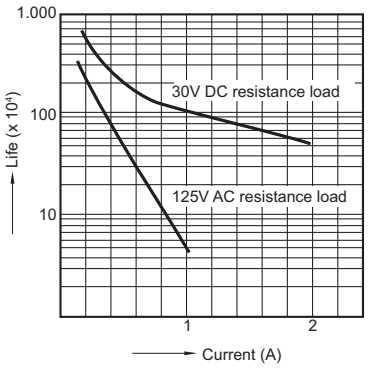
This is listed in the data column for each type of relay. The life (number of operations) can be estimated from the switching voltage and switching current. For example, for a DS relay operating at:

Switching voltage = 125V AC

Switching current = 0.6A

The life expectancy is 300,000 operations. However, this value is for a resistive load. Be sure to carefully check the actual load before use.

Life Curve



HIGH FREQUENCY CHARACTERISTICS

1. Isolation

High frequency signals leak through the stray capacitance across contacts even if the contacts are separated. This leak is called isolation. The symbol dB (decibel) is used to express the magnitude of the leak signal. This is expressed as the logarithm of the magnitude ratio of the signal generated by the leak with respect to the input signal. The larger the magnitude, the better the isolation.

2. Insertion Loss

At the high frequency region, signal disturbance occurs from self-induction, resistance, and dielectric loss as well as from reflection due to impedance mismatching in circuits. Loss due to any of these types of disturbances is called insertion loss. Therefore, this refers to the magnitude of loss of the input signal. The smaller the magnitude, the better the relay.

3. V.S.W.R.

(Voltage Standing Wave Ratio)

High frequency resonance is generated from the interference between the input signal and reflected (wave) signal.

V.S.W.R. refers to the ratio of the maximum value to minimum value of the waveform. The V.S.W.R. is 1 when there is no reflected wave. It usually becomes greater than 1.

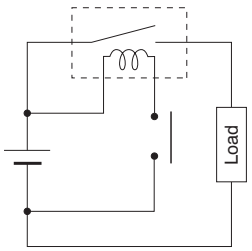
Notes:

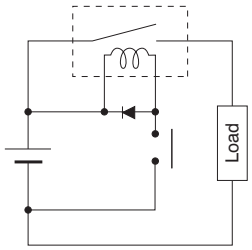
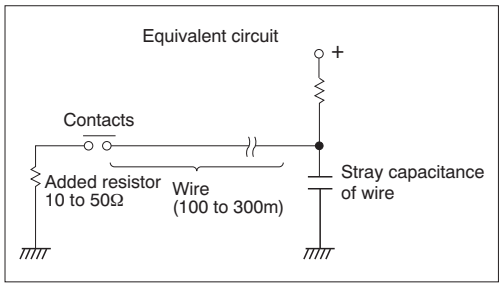
1. Except where otherwise specified, the tests above are conducted under standard temperature and humidity (15°C to 35°C 59°F to 95°F, 25 to 75%).
2. The coil impressed voltage in the switching tests is a rectangular wave at the rated voltage.
3. The phase of the AC load operation is random.

Cautions for Use of Automotive Relays

Please use the check sheet.

<table>
<tr><th>Category</th><th>Section</th><th>Contents</th></tr>
<tr><td>1. Confirmation under the actual use condition</td><td>1. Confirmation under the actual use</td><td>The rated switching power and life mentioned in the specification and catalog are given only as guides. A relay may encounter a variety of ambient conditions during actual use resulting in unexpected failure. Therefore, it is necessary for proper use of the relay to test and review with actual load and actual application under actual operating conditions.</td></tr>
<tr><td rowspan="4">2. Safety precautions</td><td>1. Specification range</td><td>Use that exceeds the specification ranges such as the coil rating, contact rating and switching life should be absolutely avoided. Doing so may lead to abnormal heating, smoke, and fire.</td></tr>
<tr><td>2. Installation, maintenance</td><td>Never touch live parts when power is applied to the relay. Doing so may cause electrical shock. When installing, maintaining, or troubleshooting a relay (including connecting parts such as terminals and sockets), be sure that the power is turned off.</td></tr>
<tr><td>3. Connection</td><td>When connecting terminals, please follow the internal connection diagrams in the catalog to ensure that connections are done correctly. Be warned that an incorrect connection may lead to unexpected operation error, abnormal heating, and fire.</td></tr>
<tr><td>4. Fail-safe</td><td>If there is a possibility that adhesion, contact failure, or breaking of wire could endanger assets or human life, please make sure that a fail-safe system is equipped in the vehicle.</td></tr>
<tr><td>3. Selection of relay type</td><td>1. Selection</td><td>In order to use the relays properly, the characteristics of the selected relay should be well known, and the conditions of use of the relay should be investigated to determine whether they are matched to the environmental conditions, and at the same time, the coil specification, contact specification, and the ambient conditions for the relay that is actually used must be fully understood in advance.
In the table below, please refer to a summary of the consideration points regarding selection of relay.
<table>
<tr><th colspan="2">Items</th><th>Consideration points regarding selection</th></tr>
<tr><td>Coil</td><td>a) Rating
b) Pull-in voltage (current)
c) Drop-out voltage (current)
d) Maximum continuous impressed voltage (current)
e) Coil resistance
f) Temperature rise</td><td>- Select relay with consideration for power source ripple.
- Give sufficient consideration to ambient temperature and for the coil temperature rise, and hot start.
- When used in conjunction with semiconductors, careful with the voltage drop.
- When starting up, careful with the voltage drop.</td></tr>
<tr><td>Contact</td><td>a) Contact arrangement
b) Contact rating
c) Contact material
d) Life
e) Contact resistance</td><td>- Note that the relay life is balanced with the life of the device the relay is used in.
- Is the contact material matched to the type of load? It is necessary to take care particularly with low level usage.
- The rated life may become reduced when used at high temperatures. Life should be verified in the actual use atmosphere.
- It is necessary to be tested and reviewed under actual use conditions with actual load and actual application.</td></tr>
<tr><td>Operate time</td><td>a) Operate time
b) Release time
c) Bounce time
d) Switching frequency</td><td>- Note that ambient temperature and applied voltage cause the change of operate time and bounce time.
- Note that operate time and release time do not include bounce time.
- Give consideration that switching life changes depending on switching frequency.</td></tr>
<tr><td>Mechanical characteristics</td><td>a) Vibration resistance
b) Shock resistance
c) Ambient use temperature
d) Life</td><td>- Give consideration to performance under vibration and shock in the use location.
- Confirm the allowable ambient temperature of the relay.</td></tr>
<tr><td>Other items</td><td>a) Breakdown voltage
b) Mounting, Connection
c) Size
d) Protection construction</td><td>- Selection can be made for connection method with plug-in type, printed circuit board type, soldering, and screw fastening type.
- Selection of protection construction can be made for PCB mounting method such as soldering and cleaning.
- For use in an adverse atmosphere, sealed construction type should be selected.
- Are there any special conditions?</td></tr>
</table>
</td></tr>
</table>

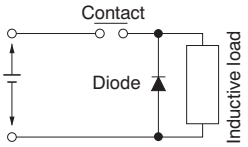
4. Load, Electrical life	1. General	Contact performance is significantly influenced by voltage and current values applied to the contacts (in particular, the voltage and current waveforms at the time of application and release), the type of load, frequency of switching, ambient atmosphere, contact switching speed, and of bounce, which lead the various other damages such as unsuitable operation contact transfer, welding, abnormal wear, increase in contact resistance. Therefore, please confirm that in actual use conditions such as actual circuit and actual load or contact our company.
	2. Inductive load	In the case of switching on and off with inductive loads such as coil, magnet crutch, and solenoid, the arc at switching can cause a severe damage on contacts and greatly shortening of life. In addition, in the case of switching at a high frequency, a blue-green corrosion may be developed. So, please contact our company to use it.
		If the current in the inductive load is relatively small, the arc discharge decomposes organic matter contained in the air and causes black deposits (oxides, carbides) to develop on the contacts. This may result in contact failure. So, please contact our company to use it.
	3. Lamp load	Large inrush current enhancing contact welding will be impressed. Its current value is greatly affected by wiring resistance, switching frequency and ambient temperature. The load current characteristics in actual circuit and actual use condition must be examined and sufficient margin of safety must be provided in selection of a relay.
		It is dangerous to use a lamp load whose nominal current is small even a large nominal current has been tested beforehand. Please contact us when switching at nominal current with a small lamp load (40W or less), because continuous ON failure may occur due to locking caused by contact-transfer phenomenon when switching arc is locally concentrated.
	4. Electric-discharge lamp load	Its load current tends to cause contact welding easily because its inrush current is larger than that of the regular lamp load. The load current characteristics in actual circuit and actual use condition must be examined and sufficient margin of safety must be provided in selection of a relay.
	5. LED lamp load	It is necessary to check the contact reliability because the load current of the LED load is very small. Please contact us before use.
	6. Other lamp load	Please contact us before use of new structured lamp except for halogen, Electric-discharge lamp, and LED.
	7. Motor load	When using of NC contact side of 1C contact for the motor brake, mechanical life might be affected by the brake current. Therefore, verify in actual use conditions with actual circuit.
		Note that larger inductivity of motor may cause contact damage and transfer even the motor load current is same.
	8. Capacitor load	Note that its load current tends to cause contact welding and contact transfer easily because its inrush current is generally large which has a small break current and a short time period to reach an inrush peak value. Also, inrush current value is influenced by wiring resistance. Therefore, the inrush current in actual circuit must be examined and sufficient margin of safety must be provided in selection of a relay.
	9. Resistance load	This load causes relatively-less contact damage since its inrush current is not large. Select a relay based on the rating control capacity, or contact us.
	10. Small electric current load	If the switching current is small (2A or less), contact reliability decreases since the contact surface is not cleaned by switching arc. So, please contact us for use.
	11. Load polarity	Electrical life may be affected by load polarity (+/-) connecting to relay contacts. So, please verify them in actual use polarity.
	12. Voltage drop of power supply	Under a circuit which inrush current is applied to such as lamps and capacitors, the moment the contact is closed, voltage drop to the coil, return of relay, or chattering may occur. Note that it may remarkably reduce the electrical life. 

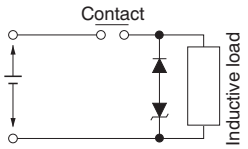
4. Load, Electrical life	13. Load voltage	If the load voltage is high, the arc energy which generated at contact switching increases, which may decrease the electrical life. Therefore, it is necessary to give consideration to the voltage which could occur in actual use condition.
	14. Coil voltage	If coil applied voltage gets higher, the relay operate time gets faster. However, contact bounce gets also larger so that the electrical life may decrease.
	15. Coil short-pulse input	When the short-pulse signal is input to the relay coil, the relay movable part may operate and touch lightly to the contact. Therefore, please avoid short pulse input (100ms or less) since it may cause contact welding due to less contact pressure. Please test adequately, for example when a relay is operated by external manual switch (such as key switch.)
	16. High-frequency of switching	When the switching frequency is high, the electrical life may decrease. Please confirm if there is a high-frequent switching caused by abnormal mode in actual use condition.
	17. Low-frequency of switching	Note that if the contact has not been switched for a long time period, organic film tends to be generated on the contact surface, which may cause contact instability.
	18. Ambient temperature	Verify in the actual use condition since electrical life may be affected by use at high temperatures.
	19. Connection of coil surge absorption circuit	If resistor, diode, zener diode are connected parallel to decrease the surge voltage when the relay coil being turned off, the relay release time will get longer and may decrease the electrical life or cause light-welding. 
	20. Sneak or remaining current	Please test a relay in actual vehicle condition since there is a risk of deterioration at relay function or switching performance such as slower release time which is caused by sneak current due to diode, zener diode, capacitor mounted on a vehicle or by remaining current soon after a motor is turned off.
	21. Wire length	If long wires (a few ten meters) are to be used in a relay contact circuit, inrush current may become a problem due to the stray capacitance existing between wires. In such case, add a resistor in series with the contacts. 

4. Load, electrical life

22. Contact protective circuit

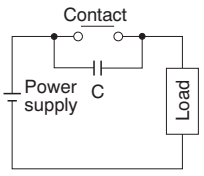
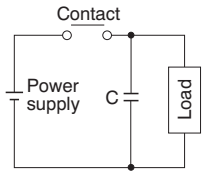
Use of contact protective devices or protection circuits can suppress the counter emf to a low level. However, note that incorrect use will result in an adverse effect. Typical contact protection circuits are given in the table below.
Also, note that release time will slow down due to sneak in the circuit and may cause the electrical life to shorten and slight-welding.

Diode circuit	
Circuit	
Features/Others	The diode connected in parallel causes the energy stored in the coil to flow to the coil in the form of current and dissipates it as joule heat at the resistance component of the inductive load. This circuit delays the release time. (2 to 5 times the release time listed in the catalog)
Devices Selection	Use a diode with a reverse breakdown voltage at least 10 times the circuit voltage and a forward current at least as large as the load current or larger. In electronic circuits where the circuit voltages are not so high, a diode can be used with a reverse breakdown voltage of about 2 to 3 times the power supply voltage.

Diode and zener diode circuit	
Circuit	
Features/Others	It is effective in the diode circuit when the release time is too long.
Devices Selection	Use a zener diode with a zener voltage about the same as the power supply voltage

In the actual circuit, it is necessary to mount the protective device (diode etc.) in the immediate vicinity of the load. If it is mounted too far away, the effectiveness of the protective device may diminish. As a guide, the distance should be within 50cm.

Avoid using the protection circuits shown in the figures below.
Although it is usually more difficult to switch with DC inductive loads compared to resistive loads, use of the proper protection circuit will raise the characteristics to that for resistive loads.

No good 	No good 
Although it is extremely effective in arc suppression as the contacts open, the contacts are susceptible to welding since energy is stored in C when the contacts open and discharge current flows from C when the contacts close.	Although it is extremely effective in arc suppression as the contacts open, the contacts are susceptible to welding since charging current flows to C when the contacts close.

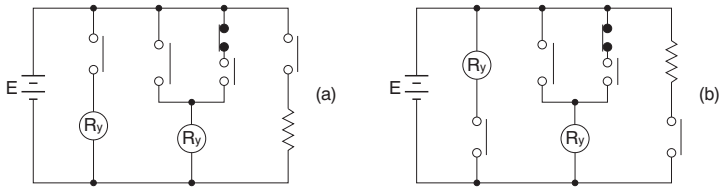
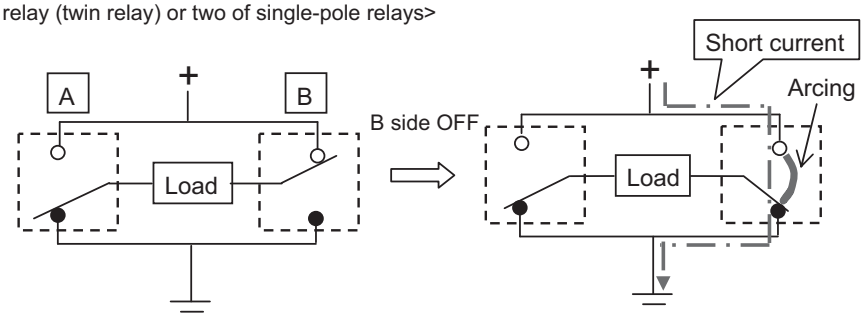
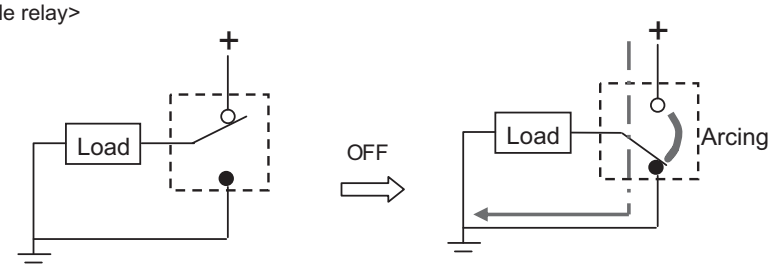
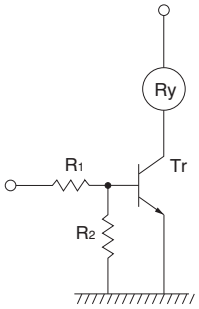
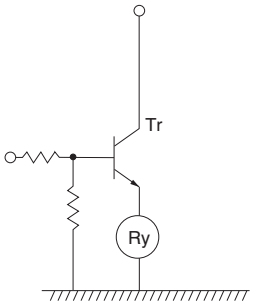
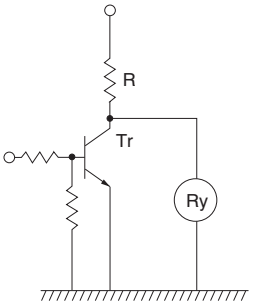
<table>
<tr><td rowspan="4">4. Load, electrical life</td><td>23. Connection of load</td><td>Connect the load to one side of the power supply as shown in Fig. (a). Connect the contacts to the other side. This prevents high voltages from developing between contacts. If contacts are connected to both side of the power supply as shown in Fig. (b), there is a risk of shorting of the power supply when relatively close contacts short.
 

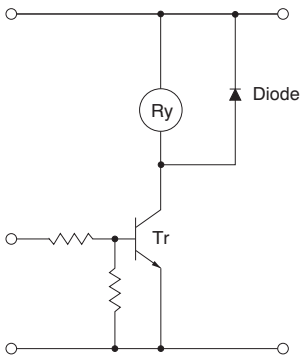
Fig. (a) Good example (b) Bad example</td></tr>
<tr><td></td><td>Regarding the following circuit constructions with 2-coil relays (twin relays) or single-pole relays, an arc between contacts may be generated when breaking of load current depending on the type of load current, voltage, and load. Please note that or contact us.
<2 coil relay (twin relay) or two of single-pole relays>
 

<Single-pole relay>
 
</td></tr>
<tr><td>24. Short between interelectrodes</td><td>When using of multipole relays such as 2-coil relays (twin relays), verify insulation and breakdown voltage between contacts in each pole in order to avoid an accident caused by short.</td></tr>
<tr><td rowspan="5">5. Coil impressed voltage</td><td rowspan="2">1. Hot start voltage</td><td>After continuous applying of current to coil and contacts, if the current is turned OFF then immediately turned ON again, coil resistance and the pick-up voltage will increase due to the temperature rise in the coil.</td></tr>
<tr><td>Temperature rise value of coil is greatly affected by circuit board, connected harness, connected connector, heat dissipation of system/modules, and heat source around relay. Please verify whether it is operating properly or inoperative under actual vehicle and actual use conditions.</td></tr>
<tr><td rowspan="2">2. Ambient temperature characteristic</td><td>Coil resistance and the pick-up voltage will increase when the relay is used in a higher temperature atmosphere. The resistance/temperature coefficient of copper wire is about 0.4% for 1°C, and the coil resistance increases with this ratio. On the other hand, coil resistance and the drop-out voltage will decrease at lower temperature. Coil resistance change decreases with the same ratio at higher temperature, about 0.4% for 1°C.
Therefore, please confirm the relay operation in every operating temperature range, with attention to such temperature characteristic.</td></tr>
<tr><td>The ambient usage temperature should be set as around the relay inside the box because a heat generated by a relay itself or other instruments causes increase of temperature inside the box.</td></tr>
<tr><td>3. Applied voltage</td><td>Note that a coil impression with a voltage greater than or equal to the maximum continuous impressed voltage may cause temperature rise which could cause coil burning or layer short. Furthermore, do not exceed the usable ambient temperature range listed in the catalog. Please contact us regarding PWM control.</td></tr>
</table>

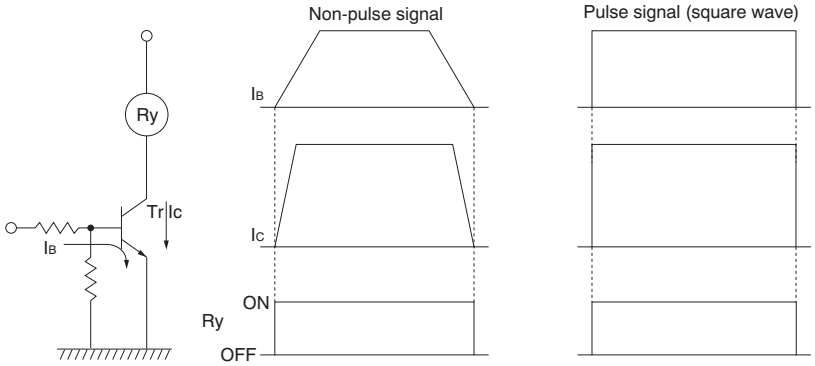
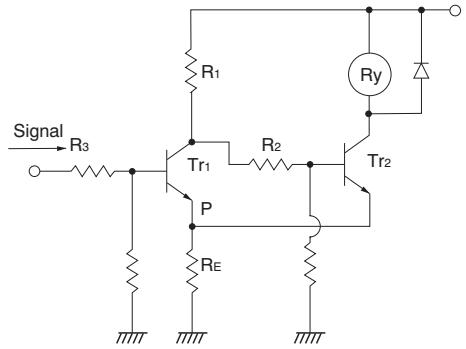
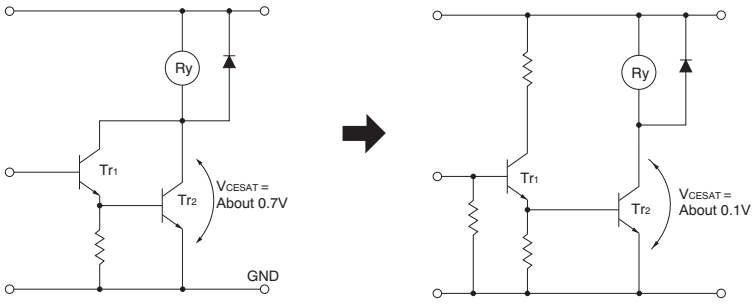
<table>
<tr><td rowspan="2">5. Coil impressed voltage</td><td>4.Twin-relay coil simultaneous operation</td><td>For relays which have multiple coils such as twin relay for forward-reverse operation of motor, if the coils are continuously turned on at the same time, the coil temperature may exceed the tolerance in a short time due to heat generation of each coil. Please contact us before use.</td></tr>
<tr><td>5. Continuous current</td><td>Coil heating due to continuous current applying to coil for extensive time periods will cause deterioration in insulation performance for coil.
For such circuit types, please consider the fail-safe circuit design in case of contact failure or breaking of coil.</td></tr>
<tr><td rowspan="2">6. Coil impressed circuit</td><td rowspan="2">1. Relay drive by means of a transistor</td><td>1. Connection method
<u>Collector connection method is the most recommendable when the relay is driven by means of a transistor.</u>
To avoid troubles in use, the rated voltage should always be impressed on the relay in the ON time and zero voltage be done in the OFF time.
 

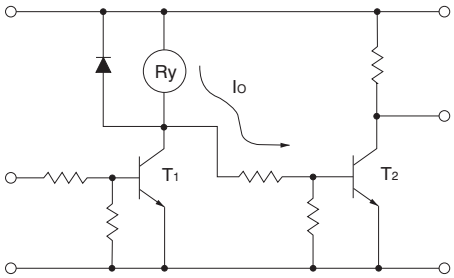
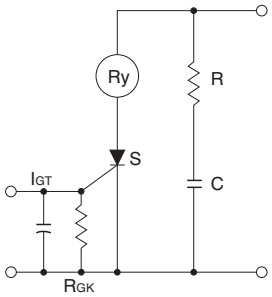
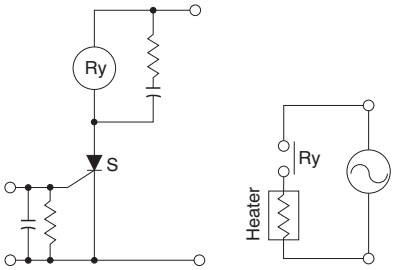
(Good) Collector connection
This is the most common connection, which operation is usually stable with.
 

(Care) Emitter connection
When the circumstances make the use of this connection unavoidable, the voltage may not be completely impressed on the relay and the transistor would not conduct completely.
 

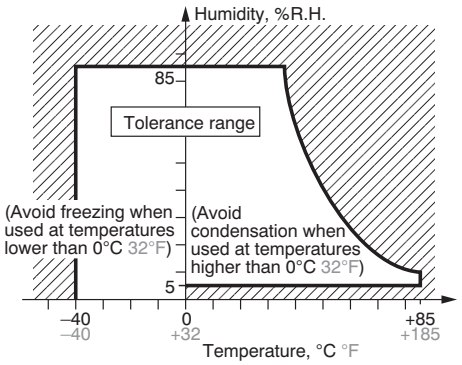
(Care) Parallel connection
As the power consumption of the entire circuit increases, the relay voltage should be considered.</td></tr>
<tr><td>2. Countermeasures for surge voltage of relay control transistor
If the coil current is suddenly interrupted, a sudden high voltage pulse is developed in the coil. If this voltage exceeds the breakdown voltage of the transistor, the transistor will be degraded, and this will lead to damage. It is absolutely necessary to connect a diode in the circuit as a means of preventing damage from the counter emf. In case of DC relay, connection of Diode is effective. As suitable ratings for this diode, the average rectified current should be equivalent to the coil current, and the reverse blocking voltage should be about 3 times the value of the power source voltage. Connection of a diode is an excellent way to prevent voltage surges, but there will be a considerable time delay when the relay is open. If you need to reduce this time delay you can connect between the transistor's Collector and Emitter with a Zener diode that will make the Zener voltage somewhat higher than the supply voltage.
 

Take care of Area of Safe Operation (ASO).</td></tr>
</table>

6. Coil impressed circuit	1. Relay drive by means of a transistor	**3. Snap action (Characteristic of relay with voltage rise and fall)** It is necessary for the relay coil not to impress voltage slowly but to impress the rated voltage in a short time and also to drop the voltage to zero in a short time.  **(No Good) Without snap action** **(Good) Snap action**
		4. Schmitt circuit (Snap action circuit) (Wave shaping circuit) When the input signal does not produce a snap action, ordinarily a Schmitt trigger circuit is used to produce safe snap action. 1. The common emitter resistor R_E must have a sufficiently small value compared with the resistance of the relay coil. 2. Due to the relay coil current, the difference in the voltage between at point P when $T_2$is conducting and at point P when $T_1$is conducting creates hysteresis in the detection capability of Schmitt circuit, and care must be taken in setting the values. 3. When there is chattering in the input signal because of waveform oscillation, an CR time constant circuit should be inserted in the stage before the Schmitt trigger circuit. (However, the response speed drops.) 
		5. Avoid Darlington circuit connections. (High amplification) Care must be taken in this circuit due to increase of V_{CESAT}. It does not cause a failure immediately, but it may lead to troubles by using for a long period or by operating with many units.  **(No good) Darlington connection** Due to excessive consumption of power, heat is generated. A strong Tr1 is necessary. **(Good) Emitter connection** Tr2 conducts completely. Tr1 is sufficient for signal use.

6. Coil impressed circuit	1. Relay drive by means of a transistor	**6. Residual Coil Voltage** In switching applications where a semiconductor (transistor, UJT, etc.) is connected to the coil, a residual voltage is retained at the relay coil which may cause incomplete restoration and faulty operation. Using of DC coils may cause incomplete restoration or reduction in contact pressure and vibration resistance, because its drop-out voltage is lower than that of AC coil (10% or more of the rated voltage) also because there is a tendency to increase the life by lowering the drop-out voltage. When the signal from the transistor's collector is taken and used to drive another circuit as shown in the figure as follows, a minute dark current flows to the relay even if the transistor is off. This may also cause the problems described above. **Connection to the next stage through collector**  Io: dark current **(No good)**
	2. Relay drive by means of SCR	**1. Ordinary drive method** For SCR drive, it is necessary to take particular care with regard to gate sensitivity and erroneous operation due to noise.  I_{GT} : There is no problem even with more than 3 times the rated current. R_{GK} : 1K ohms must be connected. RC : This is for prevention of switching error due to a sudden rise in the power source or to noise. **2. Cautions regarding ON/OFF control circuits** **(when used for temperature control circuits or similar one)** Care must be taken because the electrical life suffers extreme shortening when the relay contacts close simultaneously with an AC single phase power source. 1. When the relay is turned ON and OFF using a SCR, the SCR serves as a half wave power source as it is, and there are ample cases where the SCR is easily restored. 2. In this manner the relay operation and restoration timing are easily synchronized with the power source frequency, and the timing of the load switching also is easily synchronized. 3. In case of the load for temperature control whose load is a high current load such as a heater, some relays switch only peak values and some other relays switch only zero phase values as a phenomenon of this type of control. (Depending upon the sensitivity and response speed of the relay) 4. Accordingly, it causes either an extremely long life or an extremely short life resulting in wide variation. So, it is necessary to take care with the initial device quality check. 

7. Contact reliability	1. Load switch	When switching with a very small load after switching with a large load, ìcontact failure by small load switchingî may occur due to particles generated during switching of the contact with large load. Please note that or contact us.
	2. Installation condition	Note that if it is connected or installed with a high heat-capacity such as bas bar, connector, harness, and PCB, heat removal phenomenon at low temperature will make relay terminals and contacts cool and condensate a small amount of organic gas inside the relay, which may cause a contact failure. So, please contact us before use.
8. Contact resistance	1. Transient state	Contact resistance consists of dynamic and static contact resistance. ìContact resistanceî on the catalogue and the specifications refers to static contact resistance. Dynamic contact resistance usually shows a large value due to just after the contact operation. Please contact us if a stable contact resistance is necessary soon after a relay is turned on.
	2. Contact voltage, current	Note that if the contact-applied voltage is small (at 6V or less) and contact-applied current is small (at 1A or less), contact resistance may become a larger value due to a small amount of film on a contact surface.
9. Operate noise	1. Coil applied voltage	Mechanical relays produce an operational noise at operate and release time. Note that if the coil-applied voltage is higher at operate time, the noise becomes larger.
	2. Operate noise at installation	It is necessary to test relays in actual installation condition because operate noise may become larger in the installation condition than with a relay by itself due to resonance and sympathetic vibrations of installation PCB and system module.
10. Mechanical noise	1. Abnormal noise	Note that if a large current is applied to the contact, electromagnetic repulsion makes contact vibrate and produces an abnormal noise. Please contact us if quietness is required.
		Note that if an external vibration and shock are applied to a relay while the relay turns off, a movable part of the relay may vibrate and produce a noise. So, please test in the actual use condition if quietness is required.
11. Electrical noise	1. Serge voltage	When the relay turns off, serge voltage is generated from the coil. This serge voltage can be reduced if a resistor is connected in parallel to the coil. Likewise, it can be reduced more if a diode instead of resistor is connected in parallel. However, please contact us or note that if a resistor or a diode is connected in parallel electrical life may be affected due to slowing down of release time.

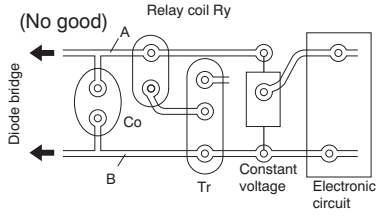
<table>
<tr><td rowspan="8">12. Usage ambient condition</td><td>1.Temperature, humidity, air pressure</td><td>During usage, storage, or transportation, avoid locations subject to direct sunlight and maintain normal temperature, humidity, and pressure conditions.
The allowable specifications for environments suitable for usage, storage, and transportation are given below.
1. Temperature: The allowable temperature range differs with each relay, so refer to the relay's individual specifications. In addition, in the case of transporting and storing relays in a tube package, the temperature may differ from the allowable range of the relay. So, please contact us for individual specifications.
2. Humidity: 5 to 85 % R.H.
3. Pressure: 86 to 106 kPa
Furthermore, the humidity range varies with the temperature. So, use relays within the range indicated in the graph below.
 

(The allowable temperature range differs for each relay.)
-Be sure the usage ambient temperature does not exceed the value listed in the catalog.
-When switching with a load which easily generates arc in high-humidity environment, the NO_x generated by the arc and the water absorbed from outside the relay combine to produce nitric acid. This corrodes the internal metal parts and adversely affects operation. Avoid using them at an ambient humidity of 85%RH or higher (at 20°C). If it is unavoidable to use them in such environment, please consult us.
-Plastic sealed type relays are especially not suited for use in environments which require airtight relays. Although there is no problem if they are used at sea level, avoid using them in atmospheric pressures beyond 96±10kPa. Also avoid using them in an atmosphere containing flammable or explosive gases.</td></tr>
<tr><td>2. Dust</td><td>It is recommendable to use relays in a normal temperature and humidity with less dust, sulfur gases (SO_2, H_2S), and organic gases.
Sealed types (plastic sealed type) should be considered for applications in an adverse environment.</td></tr>
<tr><td>3. Silicon</td><td>Silicon-based substances (silicon rubber, silicon oil, silicon-based coating material, silicon caulking compound, etc.) emit volatile silicon gas. Note that when silicon is used near relay, switching the contacts in the presence of its gas causes silicon to adhere to the contacts and may result in contact failure.
Therefore, please use a substitute that is not silicon-based. Plastic also has air permeability so please avoid using them in a silicone atmosphere.</td></tr>
<tr><td>4. Magnetism</td><td>If relays are proximately installed each other or installed near highly-magnetized parts such as motor and speaker, the relay may change its operational characteristics or cause malfunction. So, please verify in actual installation and operational condition.</td></tr>
<tr><td>5. Vibration</td><td>Vibration of the area where relay is installed may be enhanced more than expected depending on installation condition of PCB. So, please verify in actual use condition. NO contact is the recommended contact for the use at the vibration-frequent area because the vibration resistance performance of NC contact is generally inferior to that of NO contact.</td></tr>
<tr><td>6. Shock</td><td>It is ideal for mounting of relay that the movement of the contacts and movable parts is perpendicular to the direction of vibration or shock. Especially note that the vibration and shock resistance of NC contacts while the coil is not excited is greatly affected by the mounting direction of the relay.</td></tr>
<tr><td rowspan="2">7. Dew condensation</td><td>Condensation forms when vapors when there is a sudden change in temperature under high temperature, high humidity conditions. Note that condensation may cause deterioration of the insulation, breaking of coil, and rusting.</td></tr>
<tr><td>Note that if a relay is connected or installed with a high heat-capacity such as bas bar, connector, harness, and PCB, heat removal phenomenon will accelerate cooling of the relay inside and promote condensation. So, please verify in actual installation condition.</td></tr>
</table>

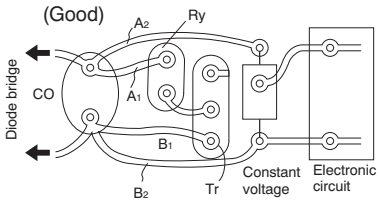
<table>
<tr><td rowspan="4">12. Usage ambient condition</td><td>8. Water resistance</td><td>Select the sealed-type for exposure to water. In the case of water exposure in severe conditions or immersion, please verify water resistance of the relay or contact us. Even for sealed-type relays, its terminals are not waterproof, so please avoid a failure such as terminal corrosion.</td></tr>
<tr><td rowspan="2">9. Freezing</td><td>Note that moisture adhered on relay in a due condensation or a high humidity condition freezes when the temperature is lower than 0∞C.This may cause problems such as sticking of movable parts or operational time lags, or poor contact conduction. Therefore, please test them in actual use environment.</td></tr>
<tr><td>Note that if a relay is connected or installed with a high heat-capacity such as bas bar, connector, harness, and PCB, heat removal phenomenon will accelerate cooling of the relay inside and promote freezing. So, please verify in actual installation condition.</td></tr>
<tr><td>10. Low temperature, low humidity</td><td>The plastic becomes brittle if the relay is exposed to a low temperature, low humidity environment for long periods of time.</td></tr>
<tr><td rowspan="3">13. Installation</td><td rowspan="3">1. Connector installation</td><td>Please consider the vibration at installation area to avoid loosely-contact.
Also, note that even a microscopic vibration may cause contact failure at the contact area of relay terminal and connector.</td></tr>
<tr><td>Decrease of fitting performance of connector may cause abnormal heat at connector contact area depending on use temperature and applying heat. Sufficient margin of safety must be provided in selection of a connector.</td></tr>
<tr><td>Please select the proper material of connector and surface treatment to avoid corrosion at the contact area of relay terminal and connector and increase of resistance at connecting area which may be caused depending on ambient environment.</td></tr>
<tr><td>14. PC board design</td><td>1. PC board design consideration</td><td>1. Cautions regarding Pattern Layout for Relays

Since relays affect electronic circuits by generating noise, the following points should be noted.

▪ Keep relays away from semiconductor devices.
▪ Design the pattern traces with the shortest length.
▪ Place the surge absorber (diode, etc.) near the relay coil.
▪ Avoid routing pattern traces susceptible to noise (such as for audio signals) underneath the relay coil section.
▪ Avoid through-holes in places which cannot be seen from the top (e.g. at the base of the relay). Solder flowing up through such a hole may cause damage such as a sealing failure.
▪ Even for the same circuit, it is necessary to consider the pattern design in order to minimize the influence of the on/off operations of the relay coil and lamp on other electronic circuits, as shown in the figure below.

-Relay currents and electronic circuit currents flow together through A and B.

-Relay coil currents consist only of A1 and B1.
-Electronic circuit currents consist only of A2 and B2. A simple design can change safety of the operation.</td></tr>
</table>

14. PC board design

2. Hole and Land diameter

The Hole and Land diameter are made with the hole slightly larger than the lead wire so that the component may be inserted easily. Also, when soldering, the solder will build up in an eyelet condition, increasing the mounting strength. The standard dimensions for the Hole diameter and Land are shown in the table below.

Standard dimensions for the Hole and Land diameter

Unit: mm/ inch

Standard Hole ϕd	Tolerance	Land diameter
0.8/ .031	±0.1/ ±.039	2.0 to 3.0/ .079 to .118
1.0/ .039		
1.2/ .047		3.5 to 4.5/ .138 to .177
1.6/ .063		

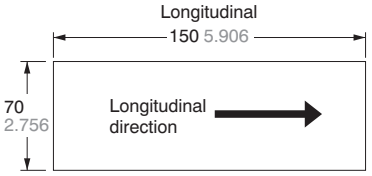
Remarks

- The Hole diameter is made 0.2 to 0.5mm/ .008 to .020inch larger than the lead diameter. However, if the jet method (wave type, jet type) of soldering is used, solder may pass through to the component side. Therefore, it is more suitable to make the Hole diameter equal to the lead diameter +0.2mm.
- The Land diameter should be 2 to 3 times the Hole diameter.
- Do not put more than 1 lead in one hole.

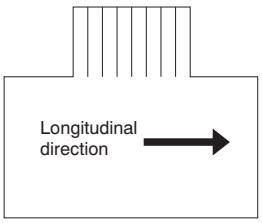
3. Expansion and shrinkage of copper-clad laminates

Because copper-clad laminates have a longitudinal and lateral direction, the manner of punching fabrication and layout must be observed with care. Expansion and shrinkage in the longitudinal direction due to heat is 1/15 to 1/2 of that in the lateral, and accordingly, after the punching fabrication, the distortion in the longitudinal direction will be 1/15 to 1/2 of that in the lateral direction. The mechanical strength in the longitudinal direction is 10 to 15% greater than that in the lateral direction. Because of this difference between the longitudinal and lateral directions, when products having long configurations are to be fabricated, the lengthwise direction of the configuration should be made in the longitudinal direction, and PC boards having a connector section should be made with the connector along the longitudinal side.(The figure below)

Example: As shown in the drawing below, the 150mm (5.906 inch) direction is taken in the longitudinal direction.



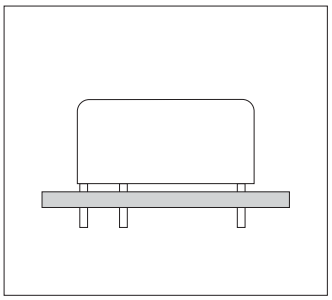
Also, as shown in the drawing below, when the pattern has a connector section, the direction is taken as shown by the arrow in the longitudinal direction.



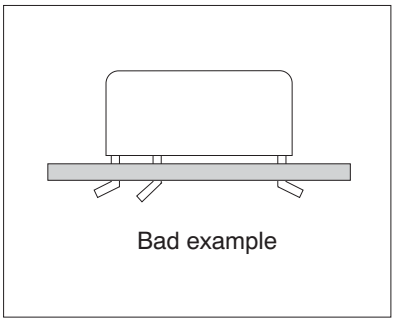
15. PCB mounting	1. Through-hole type

In keeping with making devices compact, it is becoming more common to solder the relay to a PC board along with the semiconductors instead of using the previous plug-in type in which relays were plugged into sockets.
With this style, loss of function may occur because of seepage into the relay of flux, which is applied to the PC board. Therefore, the following precautions are provided for soldering a relay onto a PC board. Please refer to them during installation in order to avoid problems.
The type of protective structure will determine suitability for automatic soldering or automatic cleaning. Therefore, please review the parts on construction and characteristics.

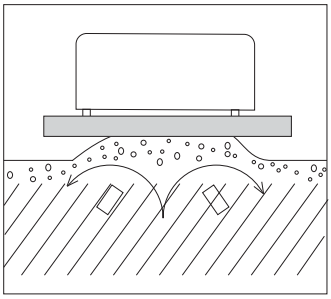
1. Mounting of Relay



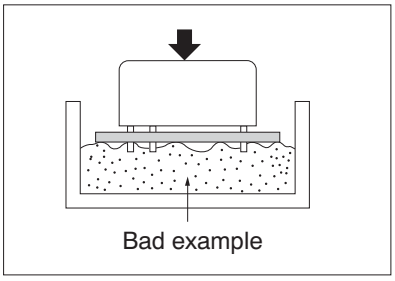
- Avoid bending the terminals to make the relay self-clinching. Relay performance cannot be guaranteed if the terminals are bent.
- Correctly make the PC board according to the given PC board pattern illustration.
- Tube packaging for automatic mounting is available depending on the type of relay. (Be sure that the relays don't rattle.) Interference may occur internally if the gripping force of the tab of the surface mounting machine is too great. This could impair relay performance.



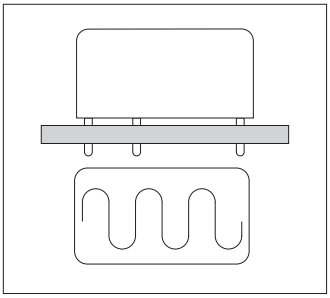
2. Flux Application



- Adjust the position of the PC board so that flux does not overflow onto the top of it. This must be observed especially for dust-cover type relays.
- Use rosin-based non-corrosive flux.
- If the PC board is pressed down into a flux-soaked sponge as shown on the right, the flux can easily penetrate a dust-cover type relay. Never use this method. Note that if the PC board is pressed down hard enough, flux may even penetrate a flux-resistant type relay.



3. Preheating

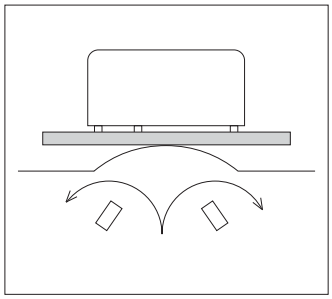


- Be sure to preheat before using automatic soldering. For dust-cover type relays and flux-resistant type relays, preheating acts to prevent the penetration of flux into the relay when soldering. Solderability also improves.
- Preheat according to the following conditions.

Temperature	120°C/ 248°F or less (PCB solder surface)
Time	Within approx. 2 minute

- Note that long exposure to high temperatures (e.g. due to a malfunctioning unit) may affect relay characteristics.

4. Soldering



Automatic Soldering

- Flow solder is the optimum method for soldering.
- Adjust the level of solder so that it does not overflow onto the top of the PC board.
- Unless otherwise specified, solder under the following conditions depending on the type of relay.

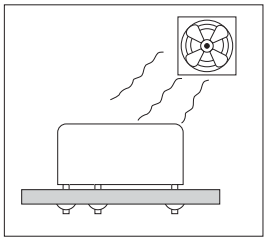
Solder Temperature	Approx.260°C±5°C/ 500°F±41°F
Soldering Time	Within approx. 6 seconds

Hand Soldering

- Please take caution with multi-layer boards. Relay performance may degrade due to the high thermal capacity of these boards
- Keep the tip of the soldering iron clean.

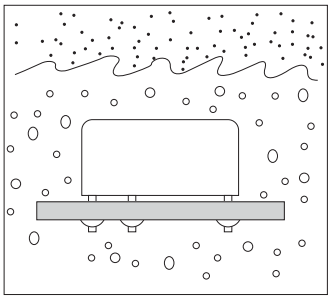
Soldering Iron	30W to 60W
Iron Tip Temperature	Approx. 350°C
Soldering Time	Within approx. 3 seconds

5. Cooling



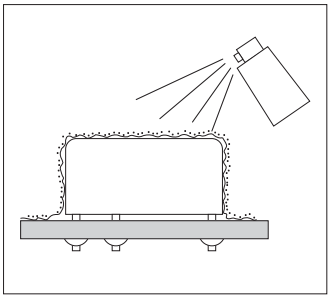
- Immediate air cooling is recommend to prevent deterioration of the relay and surrounding parts due of soldering heat.
- Although environmentally the sealed type relay (plastic sealed type, etc.) can be cleaned, avoid immersing the relay into cold liquid (such as cleaning solvent and coating material) immediately after soldering. Doing so may deteriorate the sealing performance.

6. Cleaning



- Do not clean dust-cover type relays and flux-resistant type relays by immersion. Even if only the bottom surface of the PC board is cleaned (e.g. with a brush), careless cleaning may cause cleaning solvent to penetrate the relay.
- Plastic sealed type relays can be cleaned by immersion. Use an alcohol-based cleaning solvent. Use of other cleaning solvents (e.g. Trichlene, chloroethene, thinner, benzyl alcohol, gasoline) may damage the relay case.
- Cleaning with the boiling method is recommended. Avoid ultrasonic cleaning on relays. Use of ultrasonic cleaning may cause breaks in the coil or slight sticking of the contacts due to the ultrasonic energy.
- Do not cut the terminals. When terminals are cut, breaking of coil wire and slight sticking of the contacts may occur due to vibration of the cutter.

7. Coating



- If the PC board is to be coated to prevent the insulation of the PC board from deteriorating due to corrosive gases and high temperatures, note the following.
- Do not coat dust-cover type relays and flux-resistant type relays, since the coating material may penetrate the relay and cause contact failure. Or, mount the relay after coating.
- Depending on the type, some coating materials may have an adverse affect on relays. Furthermore, some solvents (e.g. xylene, toluene, MEK, I.P.A.) may damage the case or chemically dissolve the epoxy and break the seal. Select coating materials carefully.
- If the relay and all components (e.g. ICs) are to be coated, be sure to carefully check the flexibility of the coating material. The solder may peel off from thermal stress.

Coating material type	Suitability for Relays	Features
Epoxy-base	Good	Good electrical insulation. Although slightly difficult to apply, does not affect relay contacts.
Urethane-base	Care	Good electrical insulation, easy to apply. Solvent may damage case. Check before use.
Silicon-base	No Good	Silicon gas becomes the cause of contact failure. Do not use the silicon-base type.

15. PCB mounting	2. SMD type

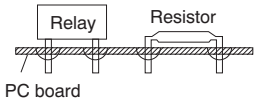
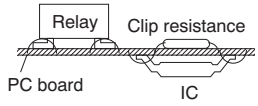
To meet the market demand for downsizing to smaller, lighter, and thinner products, PC boards also need to proceed from insertion mounting to surface mounting technology.
To meet this need, we offer a line of surface mount relays. The following describes some cautions required for surface mount relay installation to prevent malfunction and incorrect operation.
*Please contact us for or reflow soldering of through-hole terminal type.

[1] What is a Surface Mount Relay?

1. From IMT to SMT

Conventional insertion mount technology (IMT) with some 30 years of history is now being replaced with surface mount technology (SMT).
Solid-state components such as resistors, ICs, and diodes can withstand high heat stresses from reflow soldering because they use no mechanical parts. In contrast, the conventional electro-mechanical relays consisting of solenoid coils, springs, and armatures are very sensitive to thermal stress from reflow soldering.
We applied the experience gained from our advanced relay technologies to produce high-performance electromagnetic relays compatible with surface mount technologies such as IRS and VPS.

Insertion Mount Technology & Surface Mount Technology

Insertion Mounting Technology (IMT)	Components' terminals are inserted into terminal holes of PC board and are soldered to copper pads on the other side of the board. (flow-soldering)	
Surface Mounting Technology (SMT)	Components are placed on copper pads pre-coated with paste solder and the board assembly is heated to solder the components on the pads. (reflow soldering)	

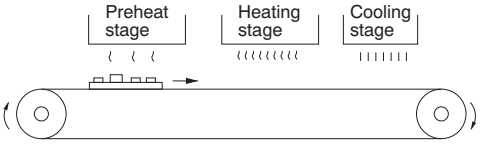
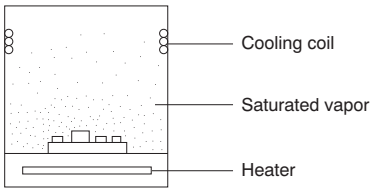
2. Features and Effects

Features	Effects
Allows high density mounting Components can be installed on both sides of a board Ceramic PC boards can be used	System downsizing
Compatible with automatic placement by robots Drilling for lead holes is not required Compact system designs are possible due to high density mounting	Overall cost reduction
High heat resistance Anti-gas measures	High reliability

The surface mount relay is realized with the following advanced technologies:

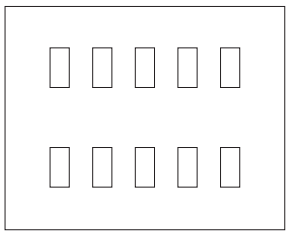
- Heat-resistance encapsulation technique
- Gas analysis
- Reliability assessment
- Precision molding technique for heat-resistant materials

3. Examples of SMT Applications

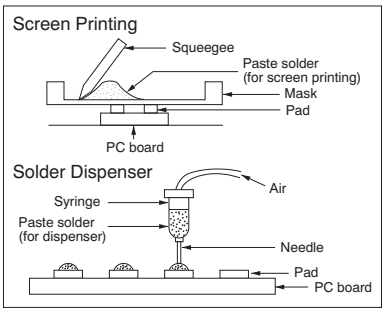
1. Infrared Reflow Soldering (IRS)	IRS is the most popular reflow soldering technology now available for surface mounting. It uses a sheath heater or infrared lamp as its heat source. PC board assemblies are continuously soldered as they are transferred through a tunnel furnace comprised of a preheating, heating, and cooling-stages. 
2. Vapor Phase Soldering (VPS)	With VPS technology, PCB assemblies are carried through a special inactive solvent, such as Fluorinert FC-70, that has been heated to a vapor state. As the saturated vapor condenses on the PC board surface, the resulting evaporation heat provides the energy for reflow soldering. 
3. Belt conveyer reflow oven	As PCB assemblies are transferred on a thin, heat-resistant belt conveyer, they are soldered by the heat from hotplates placed beneath the conveyer belt.
4. Double Wave Soldering (DWS)	After components are glued to the PC board surface, the board assembly is transferred through a molten solder fountain (with the component side facing down). Then, the components are soldered to the board.
5. Other Technologies	Other reflow soldering technologies include those of utilizing lasers, hot air, and pulse heaters.

[2] Cautions for installation

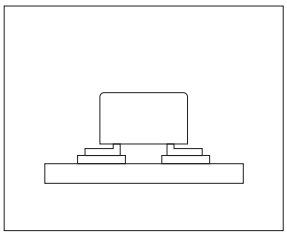
1. Paste Soldering



- Mounting pads on PC boards must be designed to absorb placement errors while taking account of solderability and insulation. Refer to the suggested mounting pad layout in the application data for the required relay product.
- Paste solder may be applied on the board with screen printing or dispenser techniques. For either method, the paste solder must be coated to appropriate thickness and shapes to achieve good solder wetting and adequate insulation.

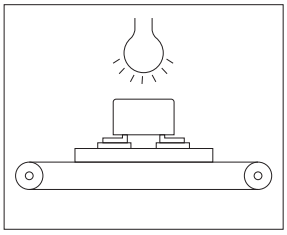


2. Relay mounting



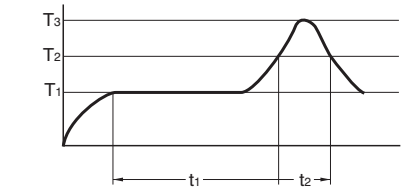
- For small, lightweight components such as chip components, a self-alignment effect can be expected if small placement errors exist. However, this effect is not as expected for electro-mechanical components such as relays, and they require precise positioning on their soldering pads.
- If SMT relays are subjected to excessive mechanical stress from the placement machine's pickup head and damaged inside, their performance cannot be guaranteed.
- Our SMT relays are supplied in tube packaging compatible with automatic placement processes. We also offer tape packaging at customer request..

3. Reflow

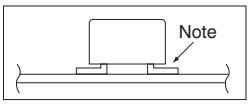


Reflow soldering under inadequate soldering conditions may result in unreliable relay performance or even physical damage to the relay (even if the relay is of surface mount type with high heat resistance).

1.IRS profile



T_1 = 150 to 180°C 302 to 356°F t_1 = 60 to 120 sec.
T_2 = 230°C 446°F or more t_2 = Less than 30 sec.
T_3 = Less than 250°C 482°F



Note: When a soldering technique other than above is to be used (hot air, hotplate, laser, or pulse heater technique), carefully investigate the suitability of the technique.
The soldering temperature profile indicates the pad temperature. In some cases, the ambient temperature may be greatly increased. Examine it under the specific mounting condition.

2.Manual soldering

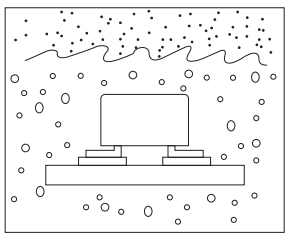
Soldering iron tip temperature: 350°C (662°F)
Soldering iron wattage: 30 to 60 W
Soldering time: Less than 3 sec.

3.Others

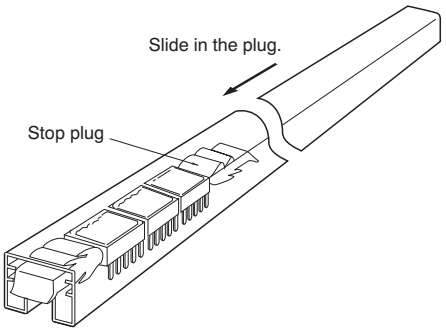
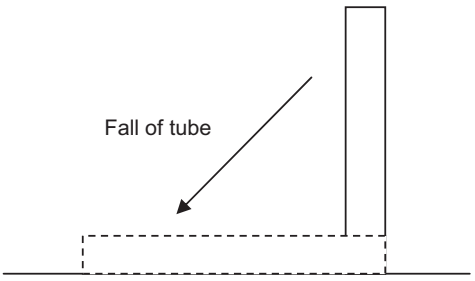
For other solder methods except for the above (such as hot air heating, hot plate heating, laser heating, pulse heating, etc.), please check for mounting and soldering condition before use.

- It is recommended that the soldered pad be immediately cooled to prevent thermal damage to the relay and its associated components.
- While surface mount relays are solvent washable, do not immerse the relay in cold cleaning solvent immediately after soldering.

4. Cooling / Cleaning



- While sealed-type (plastic-sealed) relays are solvent washable, do not immerse the relay in cold cleaning solvent immediately after soldering.
- Use alcohol or an equivalent solvent for cleaning.
- Boiled cleaning is approved for surface mount relays. Ultrasonic cleaning may cause coil damage or light contact sticking.

<table>
<tr><td rowspan="4">16. Soldering</td><td>1. Solder</td><td>Please use the flux-resistant type or sealed type in the case of automatic soldering.</td></tr>
<tr><td rowspan="2">2. Cleaning</td><td>Please use the sealed type for cleaning. Also, use the alcohol type for cleaning liquid and avoid ultrasonic cleaning.</td></tr>
<tr><td>When cleaning a printed circuit board after soldering, we recommend using alcohol-type cleaning liquid. Please avoid ultrasonic cleaning. The ultrasonic energy may cause breaking of coil and sticking of contacts.</td></tr>
<tr><td>3. Terminal clinch</td><td>Avoid bending terminals for the relay of print circuit board since it may cause malfunction.</td></tr>
<tr><td rowspan="2">17. Storage, transportation</td><td>1.Transportation</td><td>Relayís functional damage may occur if strong vibration, shock or heavy weight is applied to a relay during transportation of a device in which a relay is installed. Therefore, please pack them in a way, using shock-absorbing material, so that the allowable range for vibration and shock is not exceeded.</td></tr>
<tr><td>2. Storage</td><td>If the relay is stored for extended periods of time (including transportation period) at high temperatures or high humidity levels or in atmospheres with organic gas or sulfide gas, sulfide film or oxide film may be formed on surface of the contacts, which may cause contact instability, contact failure and functional failure. Please check the atmosphere in which the units are to be stored and transported.</td></tr>
<tr><td rowspan="2">18. Product handling</td><td rowspan="2">1. Tube packing</td><td>Some types of relays are supplied with tube packaging. If you remove some relays from the tube, be sure to slide a stop plug into one end of a tube to hold the remaining relays firmly and avoid rattling of relay inside the tube. Note that rattling may cause a damage on appearance and/or performance.
 
</td></tr>
<tr><td>Do not use the relays if they were dropped or fallen down in a tube packing condition because there is a risk of characteristic failure.
 
</td></tr>
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19. Reliability

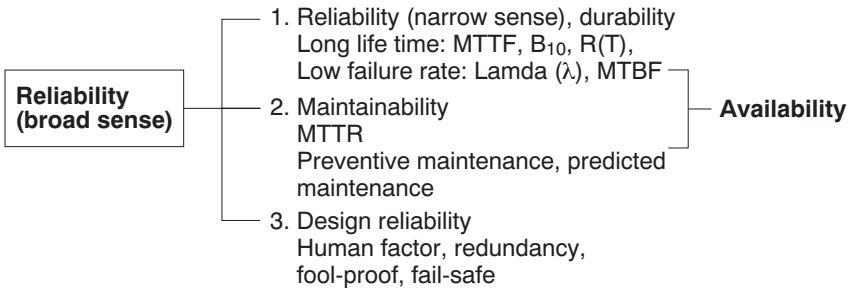
[1] What is Reliability?

1. Reliability in a Narrow Sense of the Term

In the industrial world, reliability is an index of how long a particular product serves without failure during use period.

2. Reliability in a Board Sense of the Term

Every product has a finite service lifetime. This means that no product can continue normal service infinitely. When a product has broken down, the user may throw it away or repair it. The reliability of repairable products is recognized as "reliability in a broad sense of the term." For repairable products, their serviceability or maintainability is another problem. In addition, reliability of product design is becoming a serious concern for the manufacturing industry. In short, reliability has three senses: i.e. reliability of the product itself, serviceability of the product, and reliability of product design.



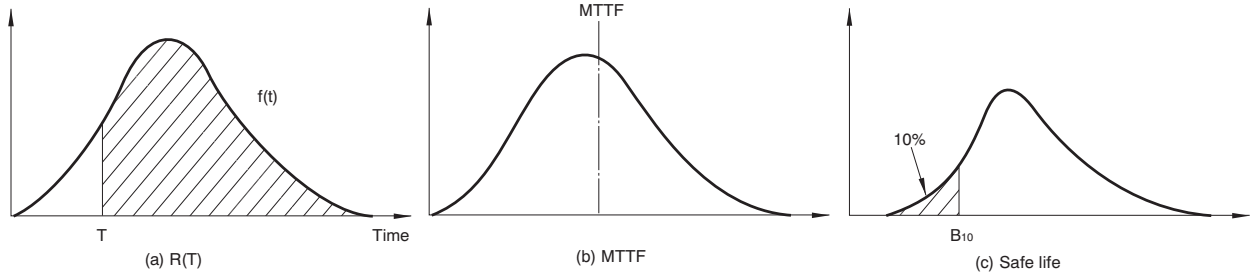
3. Intrinsic Reliability and Reliability of Use

Reliability is "built" into products. This is referred to as intrinsic reliability which consists mainly of reliability in the narrow sense. Product reliability at the user's site is called "reliability of use," which consists mainly of reliability in the broad sense. In the relay industry, reliability of use has a significance in aspects of servicing.

[2] Reliability Measures

The following list contains some of the most popular reliability measures:

Reliability measure	Sample representation
Degree of reliability R(T)	99.9%
MTBF	100 hours
MTTF	100 hours
Failure rate lambda	20 fit, 1%/hour
Safe life B_{10}	50 hours



Cautions for Use of Automotive Relays

1. Degree of Reliability

Degree of reliability represents percentage ratio of reliability. For example, if none of 10 light bulbs has failed for 100 hours, the degree of reliability defined in, 100 hours of time is 10/10 = 100%. If only three bulbs remained alive, the degree of reliability is 3/10 = 30%. The JIS Z8115 standard defines the degree of reliability as follows: The probability at which a system, equipment, or part provides the specified functions over the intended duration under the specified conditions.

2. MTBF

MTBF is an acronym of Mean Time Between Failures. It indicates the mean time period in which a system, equipment, or part operates normally between two incidences of repair. MTBF only applies to repairable products.
MTBF tells how long a product can be used without the need for repair.
Sometimes MTBF is used to represent the service lifetime before failure.

3. MTTF

MTTF is an acronym of Mean Time To Failure. It indicates the mean time period until a product becomes faulty MTTF normally applies to unrepairable products such as parts and materials.
The relay is one of such objective of MTTF.

4. Failure Rate

Failure rate includes mean failure rate and momentary failure rate. Mean failure rate is defined as follows:

Mean failure rate = Total failure count/total operating hours

In general, failure rate refers to momentary failure rate. This represents the probability at which a system, equipment, or part, which has continued normal operation to a certain point of time, becomes faulty in the subsequent specified time period.
Failure rate is often represented in the unit of percent/hours. For parts with low failure rates, "failure unit (Fit) = 10^{-9}/hour" is often used instead of failure rate. Percent/count is normally used for relays.

5. Safe Life

Safe life is an inverse of degree of reliability. It is given as value B which makes the following equation true:
1 - R(B) = t%
In general, "B[1 - R(B)] = 10%" is more often used. In some cases this represents a more practical value of reliability than MTTF.

[3] Failure

1. What is Failure?

Failure is defined as a state of system, equipment, or component in which part of all of its functions are impaired or lost.

2. Bathtub Curve

Product's failure rate throughout its lifetime is depicted as a bathtub curve, as shown below. Failure rate is high at the beginning and end of its service lifetime.

(I) Initial failure period

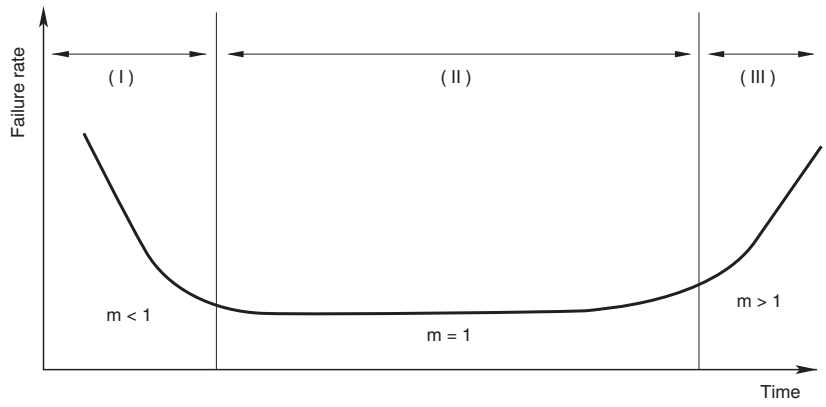
The high failure rate in the initial failure period is derived from latent design errors, process errors, and many other causes.. This process is called debugging, performing aging or screening in order to find out initial failures.

(II) Accidental failure period

The initial failure period is followed by a long period with low, stable failure rate. In this period, called accidental failure period, failures occurs at random along the time axis. While zero accidental failure rate is desirable, this is actually not practical in the real world.

(III) Wear-out failure period

In the final stage of the product's service lifetime comes the wear-out failure period, in which the life of the product expires due to wear of fatigue. Preventive maintenance is effective for this type of failure. The timing of a relay's wear-out failure can be predicted with a certain accuracy from the past record of uses. The use of a relay is intended only in the accidental failure period, and this period virtually represents the service lifetime of the relay.



3. Weibull Analysis

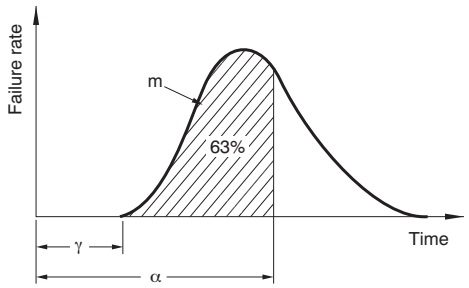
Weibull analysis is often used for classifying a product's failure patterns and to determine its lifetime.
Weibull distribution is expressed by the following equation:

$$f(x) = \frac{m}{\alpha}(\chi-\gamma)^{m-1} e^{-\frac{(\chi-\gamma)^m}{\alpha}}$$

where

m : Figure parameter
α : Measurement parameter
γ : Position prameter

Weibull distribution can be adopted to the actual failure rate distribution if the three variables above are estimated.



The Weibull probability chart is a simpler alternative of complex calculation formulas. The chart provides the following advantages:

(1) The Weibull distribution has the closest proximity to the actual failure rate distribution.

(2) The Weibull probability chart is easy to use.

(3) Different types of failures can be identified on the chart.

The following describes the correlation with the bathtub curve. The value of the parameter "m" represents the type of the failure.

(1) When m < 1: Initial failures

(2) When m = 1: Accidental failures

(3) When m > 1: Wear-out failures

CHECK SHEET

Category	Check box	Check item	Refer to the following page and item on Category - Section in this check sheet
Safety	☐	Does the vehicle system have a fail-safe in case of a relay failure?	1-1, 2-4
Load/ Electrical life	☐	Has it been confirmed by testing under actual load, actual circuit, and actual condition?	4-1
	☐	Have load type, load current characteristic, and current value been checked?	4-2 to 4-9
	☐	Isn't the applied contact current too small? (Small current is likely to decrease the contact reliability.)	4-10
	☐	Has connecting load polarity been checked?	4-11
	☐	Is the load likely to cause instant voltage drop?	4-12
	☐	Isn't the applied contact voltage too high? (High voltage decreases electrical life.)	4-13
	☐	Isn't applied coil voltage too high? (High voltage affects electrical life.)	4-14
	☐	Isn't short pulse applied to coil?	4-15
	☐	Isn't the switching frequency too high even including at abnormality?	4-16
	☐	Doesn't switching continue for a long time?	4-17
	☐	Does it switch under high temperature?	4-18
	☐	Have precautions been checked for using of coil surge absorption circuit?	4-19
	☐	Have you checked there is no sneak current or voltage to the relay coil?	4-20
	☐	Is there stray capacitance between lead wires?	4-21
	☐	Have precautions been checked for using of contact protective circuit?	4-22
	☐	Is there a risk of dead short in the power supply?	4-23
	☐	Is there a risk of short circuit in the power supply at load rejection?	4-23
	☐	Is there a risk of insulation and breakdown voltage between contacts in each pole when high voltage is applied to a twin relay?	4-24
Coil operation voltage	☐	Has hot start been considered?	5-1
	☐	Is the ambient temperature within the range of use? Also, is the ambient temperature characteristics considered?	5-2
	☐	Is the applied voltage below the maximum continuous applied voltage?	5-3
	☐	Is there a risk of using PWM control? (PWM control requires careful attention.)	5-3
	☐	Doesn't coil of twin relay operate at the same time?	5-4
	☐	Hasn't the current continuously applied to coil over a long period?	5-5
Coil operation circuit	☐	In case of relay operation by electric circuit, is the circuit designed in consideration of mal-function?	6-1, 6-2
	☐	Doesn't the surge voltage of relay cause mal-function or destruction of transistor circuit?	6-1, 6-2
	☐	When relay is applied to an electric circuit, has voltage drop caused by other electric components on the circuit been considered?	6-1, 6-2

Category	Check box	Check item	Refer to the following page and item on Category - Section in this check sheet
Contact reliability	☐	Have precautions been checked in the case of switching with both high and low loads by the same contact?	7-1
	☐	Doesn't heat dissipation occur under low temperature?	7-2
Contact resistance	☐	Has transient state of contact resistance been considered?	8-1
	☐	Are contact voltage and current 6V 1A or higher?	8-2
Operating sound	☐	Are there any problems regarding operating sound of relay?	9-1, 9-2
Mechanical noise	☐	Are there any problems regarding abnormal weak noise of relay?	10-1
Use environmental condition	☐	Is temperature, humidity, atomosphere pressure within the range of use?	12-1
	☐	Have precautions been checked in the case of switching under high humidity?	12-1
	☐	Is the ambient environment free from particles, dusts, sulfidizing gas, organic gas?	12-2
	☐	Is the ambient environment free from silicon?	12-3
	☐	Is the ambient environment free from high-field magnetic instruments such as speaker?	12-4
	☐	Are the ambient vibration and shock below the relay's vibration and impact characteristics? Also, is there no resonance after the relay is	12-5, 12-6
	☐	Isn't there a risk of freezing and dewing of relay?	7-2, 12-7, 12-9
	☐	Isn't there a risk of water or oil adhesion?	12-8
Mounting	☐	Doesn't vibration or shock cause poor connection between a relay and a connector?	13-1
PCB mounting	☐	Have precautions been checked for operating of flux applying and automatic soldering?	15-1, 15-2
	☐	Have precautions been checked for cleaning operation of print board?	15-1, 15-2
	☐	Isn't glass shot performed for flux cleaning? (Particle of the glass may get inside the relay and cause operation failure.)	15-1, 15-2
	☐	Does significant warping of print board occur, which applies a force on a relay teminal and changes the relay characteristics?	15-1, 15-2
	☐	Isn't the unused terminal cut? (Applied force on terminal can change the characteristics.)	15-1, 15-2
Soldering	☐	Any strong forces such as terminal clinch are not applied at attaching.	16-3
Storage, transportation	☐	Aren't load, shock, or vibration which is out of the allowable range applied during transportation?	17-1
	☐	Are temperature and humidity within the allowable range?	17-2
	☐	Is the ambient atomosphere free from organic gas and sulfidizing gas?	17-2
Product handling	☐	Aren't dropped or fallen tube packages used?	18-1

Cautions Regarding Protective Element

1. Part numbers without protective elements

1) 12 V models

When connecting a coil surge protection circuit to these relays, we recommend a Zener diode of at least 24 V or a resistor (680Ω to 1,000Ω).

When the diode is connected in parallel to the coil, the reset time will slow down, which may lead to shortening of expected life. Please check the circuit and make sure the diode is not connected in parallel with the coil drive circuit.

2) 24 V models

When connecting a coil surge protection circuit to these relays, we recommend a Zener diode of at least 48 V or a resistor (2,800Ω to 4,700Ω).

When the diode is connected in parallel to the coil, the reset time will slow down, which may lead to shortening of expected life. Please check the circuit and make sure the diode is not connected in parallel with the coil drive circuit.

2. Part numbers with diodes

Since these relays use a diode in the coil surge protective element, the reset time is slower and a reduction in expected life is possible compared to part numbers without protective elements and part numbers with resistors.

Please be sure not to use the product until you have evaluated it under actual load conditions.

3. Part numbers with resistors

Since these part numbers use a resistor in the coil surge protection circuit, an external surge protection element is not required. Please note that connecting a diode in parallel with the coil will decrease the reset time and possibly reduce the expected life of the product.

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