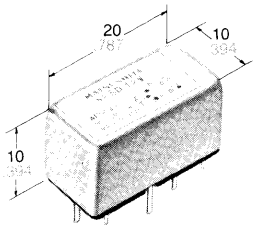
NAiS HALF SIZE Amber RELAY

R-RELAYS



mm inch

UL File No.: E43149 CSA File No.: LR26550

- **Amber sealed construction for automatic wave soldering and cleaning**
- **Latching types available**
- **High sensitivity—TTL direct drive possible**
- **High speed—Up to 500 cycle/sec. operations**
- **Wide switching range and high welding resistance**
  Gold cobalt (AuCo) contact permits
  - **Wider switching range from low level up to high current: 10 μA to 1 A**
  - **Higher sticking resistance to inrush current**
  - **Stable contact resistance from initial stage throughout life**

SPECIFICATIONS

Contact

Arrangement	1 Form C
Initial contact resistance, max. (By voltage drop 6 V DC 1 A)	60 mΩ
Initial contact pressure	Approx. 5 g .18 oz
Electrostatic capacitance	
Contact-Contact	4 pF
N.O. contact-coil	5 pF
N.C. contact-coil	6 pF
Rating (resistive)	
Max. switching power	33 VA, 20 W
Max. switching voltage	110 V AC, 30 V DC
Max. switching current	AC 0.3 A, DC 1 A
Min. switching power	Approx. 100 mV 10 μA
UL/CSA rating	0.3 A 125 V AC, 1 A 30 V DC
Contact material	Gold cobalt
Expected life (min. operations)	
Mechanical (at 500 cps.)	10^9
Electrical (resistive)	
1 A 20 V DC/0.3 A 110 V AC	10^6 (at 1 cps.)
0.5 A 30 V DC/0.1 A 110 V AC	3×10^6 (at 2 cps.)
0.25 A 30 V DC/0.25 A 30 V AC	5×10^6 (at 5 cps.)
0.2 A 24 V DC/0.2 A 24 V AC	10^7 (at 25 cps.)
0.1 A 12 V DC/0.1 A 12 V AC	5×10^7 (at 50 cps.)
0.1 A 9 V DC/0.1 A 9 V AC	10^8 (at 100 cps.)
Contact bounce	Approx. 0.3 msec.

Coil (polarized) (at 25°C 77°F)

Minimum operating power	
Single side stable	72 to 133 mW
1 coil latching	41 to 45 mW
2 coil latching	72 to 107 mW
Nominal operating power	
Single side stable	147 to 300 mW
1 coil latching	74 to 153 mW
2 coil latching	147 to 331 mW

Characteristics

Max. operating speed	500 cps. (mechanical)
Operate time	Approx. 1 msec.
Release time	Approx. 0.5 msec.
Initial breakdown voltage	
Between live parts and ground	1,000 Vrms*1
Between open contacts	350 Vrms (500 V DC)
Between contact and coil	1,000Vrms
Initial insulation resistance (min.)	1,000 MΩ at 500 V DC
Temperature rise	Max. 35°C at 0.5 W operating power Max. 65°C at 1 W operating power
Ambient temperature*2	−55°C to +65°C −67°F to 149°F
Shock resistance	100 G
Vibration resistance*3	10 G, 10 to 55 Hz at double amplitude of 1.6 mm
Unit weight	RS: 6.5 g .23 oz RH: 4.5 g .16 oz

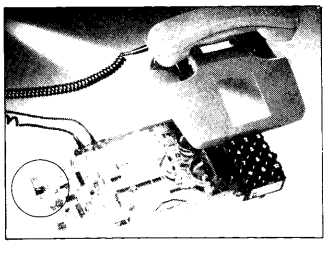
(Notes) *1 Except for between coils of 2 coil latching type

*2 Total temperature (ambinet temperature plus temperature rise in coil) should not exceed 90°C 194°F for single side stable, and 105°C 221°F for bistable relays. See DATA for determination of coil voltage versus temperature.

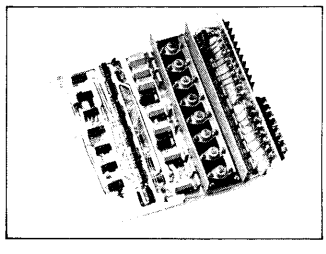
*3 Although R relays are rated at 10G/55cps. vibration resistance, they will withstand up to 60G/2,000 cps., provided they receive additional support such as anchoring to the PC board with epoxy resin.

TYPICAL APPLICATIONS

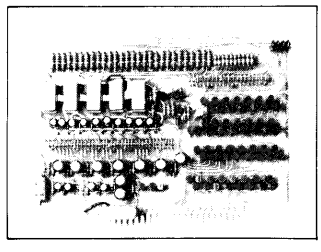
Telecommunications equipment, alarm devices, machine tools, NC machines, automatic warehouse control, conveyors, air-conditioners, pressing machines, textile machinery, elevators, control panels, pin-board programmers, parking meters, industrial robots, detectors, annunciators, optical instruments, business machines, time recorders, cash registers, copiers, vending machines, medical equipment.



Pushbutton telephone



Industrial robot



Sequence processor

ORDERING INFORMATION

EX. R [H] [L2] —— [12V]

Types of case	Operating function	Coil voltage (DC)
H: Sealed S: Magnetically shielded	Nil: Single side stable L: 1 coil latching L2: 2 coil latching	5, 6, 12, 24, 42 V other coil voltages on request

(Notes) 1. Power types and 1 Form A types are available on request.
2. For UL/CSA recognized types, add suffix UL/CSA, when ordering. Ex. RS -12V UL/CSA
3. Standard packing Carton: 50 pcs., Case: 500 pcs.

TYPES AND COIL DATA at 25°C 77°F

Besides standard types 3, 9, 16, 28, 35 and 60 V types for RH- and RS-relays and 1.5, 3, 16 and 35 V types for RHL-, RHL2- and RSL-, RSL2 relays available on request

Single side stable (RS , RH)

Nominal coil voltage, V DC	Pick-up voltage, V DC (max.)	Drop-out voltage, V DC (min.)	Maximum allowable voltage, V DC (40°C)	Coil resistance, Ω (±10%)	Nominal operating power, mW	Inductance, Henrys
5	3.5	0.5	13	170	147	0.050
6	4.7	0.6	14	220	164	0.075
12	9.3	1.2	28	890	162	0.3
24	16	2.4	42	2,000	288	0.66
42	28	4.2	85	8,000	221	2.7

1 coil latching (RSL , RHL)

Nominal coil voltage, V DC	Pick-up voltage, V DC (max.)	Maximam allowable voltage, V DC (40°C)	Coil resistance, Ω (±10%)	Nominal operating power, mW	Inductance, Henrys
5	3.5	18	340	74	0.12
6	4.3	20	450	80	0.16
12	8.0	30	1,500	96	0.66
24	17	75	6,000	96	2.4
42	23	110	12,000	147	3.9

2 coil latching (RSL2 , RHL2)

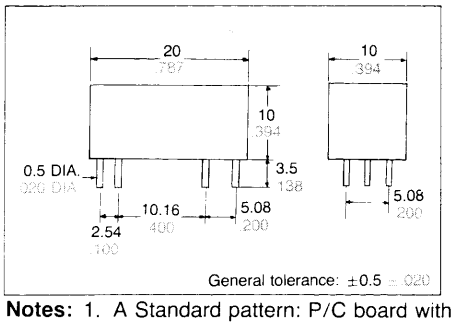
Nominal coil voltage, V DC	Pick-up voltage, V DC (max.)	Maximum allowable voltage, V DC (40°C)	Coil resiatnce, Ω (±10%)		Nominal operating power, mW	Inductance, Henrys
			Coil 1	Coil 2		
5	3.5	13.0	170	170	147	0.024
6	4.3	14.0	225	225	160	0.04
12	8.0	26.0	650	650	230	0.14
24	17.0	50.0	2,700	2,700	213	0.35
42	23.0	75.0	5,500	5,500	321	0.8

(Notes) 1. Maximum allowable operating power: 1000 mW at 25°C 77°F.
2. Change rate of pick-up voltage vs. temperature is described in Data on page 105.

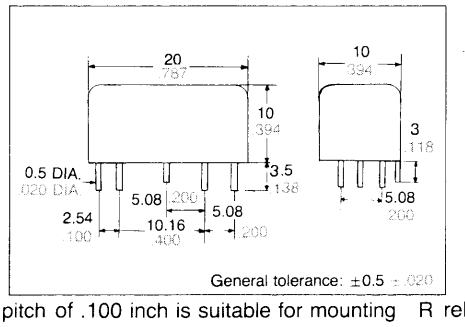
DIMENSIONS

mm inch

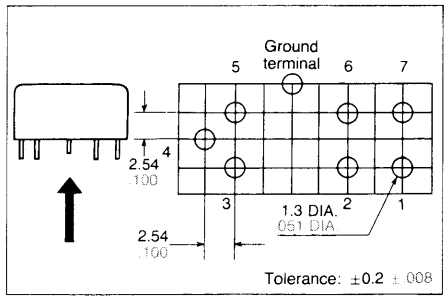
Sealed type (RH series)



Magnetically shieled type (RS series)



PC board pattern (Copper-side view)



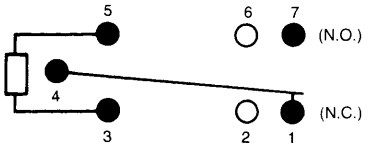
Notes: 1. A Standard pattern: P/C board with a pitch of .100 inch is suitable for mounting R relays.
2. Ground terminal for the megnetically shielded type (RS series) only.

SCHEMATIC

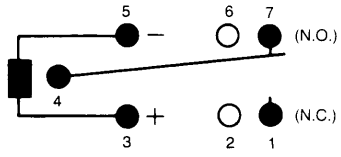
1. Single side stable (2, 6: free terminals)

Same operation as the conventional magnetic relays.

(a) During deenergization, terminals **No. 4 (COM)** and **No. 1 (N.C.)** are on "make".



(b) During energization with the indicated polarity, terminals **No. 4** and **No. 7 (N.O.)** are on "make".



Note:
Energization with an opposite polarity does not switch the contact. Apply proper polarity to switch the contact.

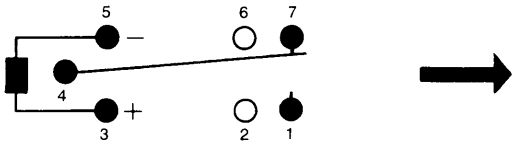
2. Latching type

Once energized, the **COM** contact is kept under the same condition without further energizing continuously.

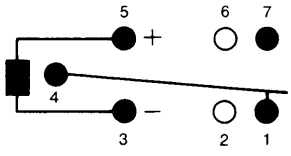
To switch over the contact, energy with an opposite polarity should be applied to the coil.

1 coil latching (2, 6: free terminals) (HL , SL)

(a) When terminals **No. 5 (–)** and **No. 3 (+)** are energized, terminals **No. 4** and **No. 7** are switched to "make". (or stay on "make"). When the coil current is switched off, terminals **No. 4** and **No. 7** are held on "make".

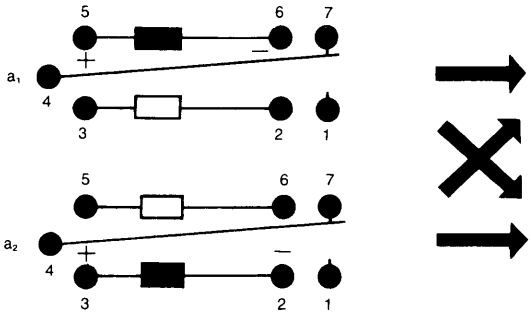


(b) When energized with reverse polarity terminals **No. 4** and **No. 1** are switched to "make" and held on "make" until energized again with an opposite polarity.

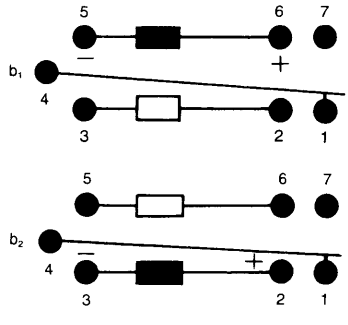


2 coil latching (HL2 , SL2)

(a) When terminals **No. 5 (+)** and **No. 6 (–)** or terminals **No. 3 (+)** and **No. 2 (–)** are energized terminals **No. 4** and **No. 7** are switched to "make". (or remain on "make"). When the coil current is switched off, these terminals are held on "make".

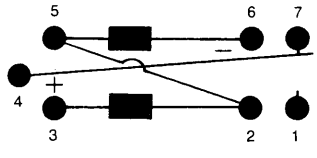


(b) When terminals **No. 5 (–)** and **No. 6 (+)** or terminals **No. 3 (–)** and **No. 2 (+)** are energized in the reverse of condition (a), terminals **No. 4** and **No. 1** are switched to "make" and held on "make" until energized in an opposite polarity once again.



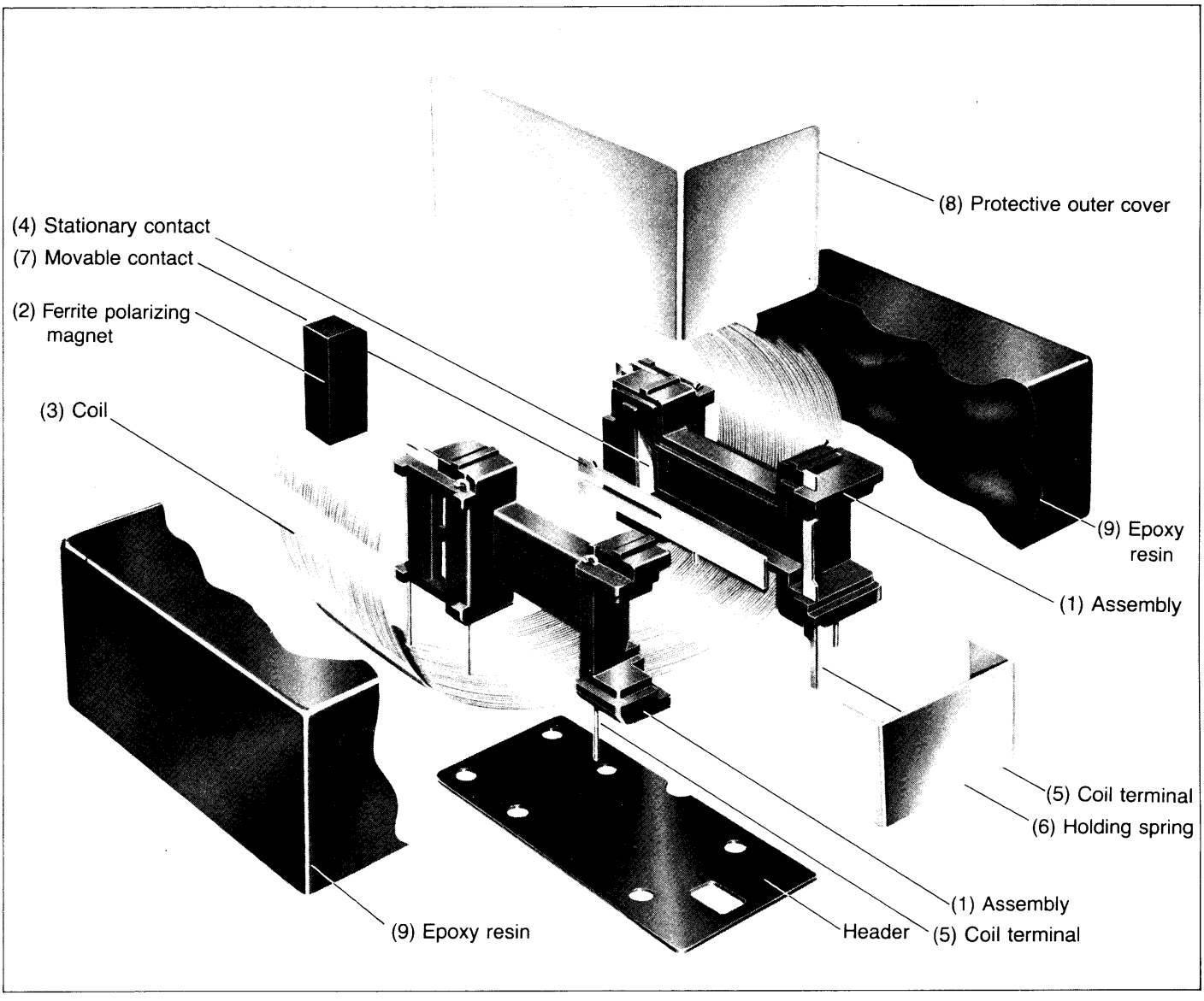
Special use of 2 coil latching

2 coil latching can be used in the same manner as 1 coil latching by shorting **No. 5** and **No. 2** or **No. 3** and **No. 6**.



1. The latching type of R relay can be used as the memory element to be operated by a pulse supplied from one or two different sources.
2. With the 2 coil latching type, when simultaneously applying one polarity to one coil and the opposite polarity to the other, the previously energized coil will take priority of operation and will maintain the contact condition.
3. In practical use, switching either from $\mathbf{a}_1$ to $\mathbf{b}_2$ or from $\mathbf{a}_2$ to $\mathbf{b}_1$ is recommendable.

CONSTRUCTION

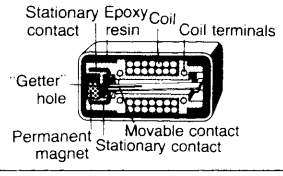
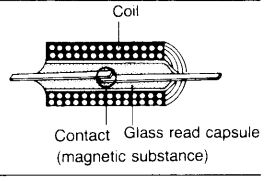


The R relay is a unique relay which not only replaces reed relays but provides the design engineer with a far more versatile device capable of much broader usage. An explanation of its operation will show why.

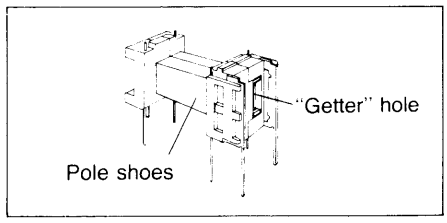
The assembly (1) is constructed of a high temperature, organic free, degassed plastic. Mounted internally is a single pole double throw bifurcated contact assembly. The ferrite polarizing magnet (2) is mounted as shown in the diagram and the coil (3) is wound around a molded frame. Stationary contacts (4) and coil terminals (5) are molded into the frame. This assembly is fitted with a holding spring (6). Each relay is individually calibrated by adjusting the movable contact (7).

The protective outer cover (8) is then fitted over the assembly. A special metallic cover is used to prevent interaction between relays mounted in close proximity to each other and also to protect the relay from other external magnetic fields (transformers, solenoids, etc.). A highly stable epoxy resin (9) is finally used to assure complete protection.

DIFFERENCES BETWEEN R RELAYS AND REED RELAYS

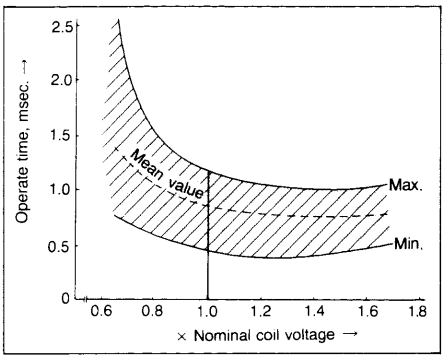
	R relays	Reed relays
Structure		
Contact arrangement	1 Form C	1 Form A or 1 Form B
Contact capacity	20 W (high contact pressure)	5 to 15 W
Operating function	Single side stable Latching	Single side stable
"Getter" hole	Yes	No

"Getter" holes are formed on both pole shoes to obtain uniform contact resistance throughout life. Film-forming phenomena on contacts is thus fully prevented.

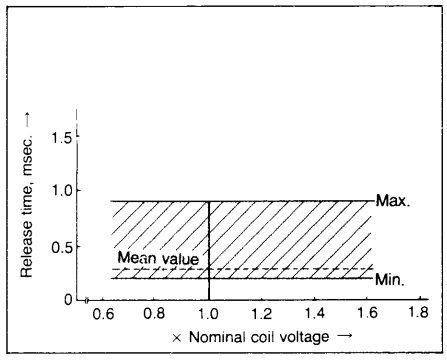


DATA

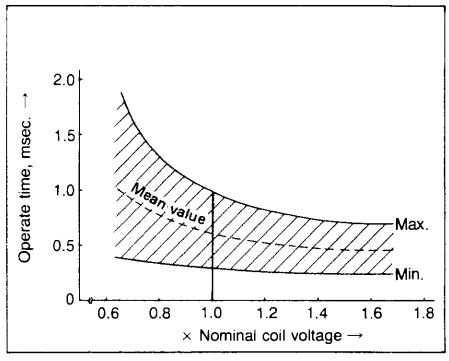
Operate time including bounce time (Single side stable)



Release time including bounce time (Single side stable)

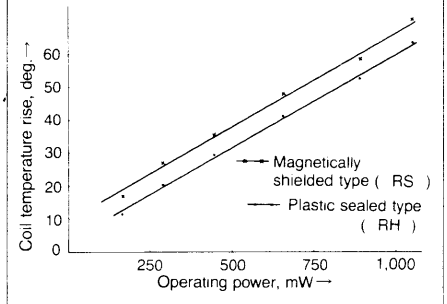


Operate time including bounce time (2 coil latching)

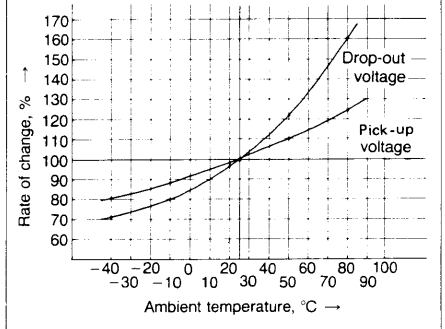


Coil temperature rise (under saturated condition)

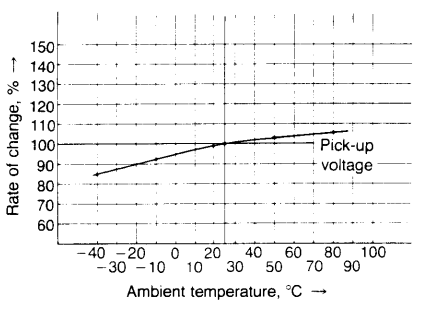
Tested sample: RS -12V
10 pcs. each



Rate of change in pick-up and drop-out voltage (Single side stable)

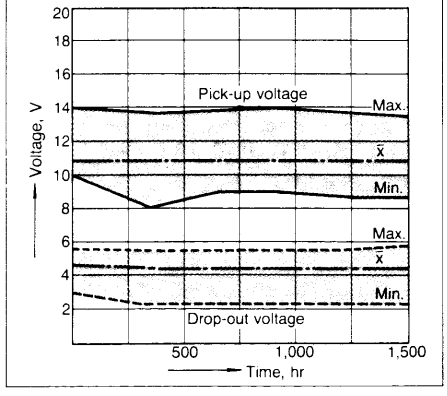


Rate of change in pick-up voltage (2 coil latching)



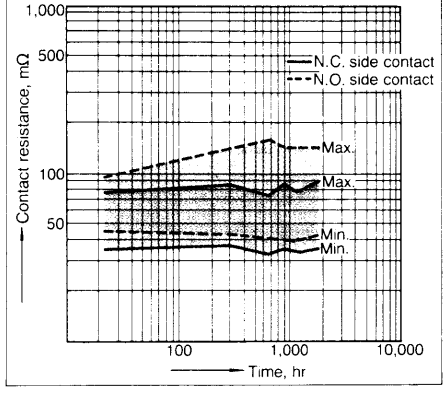
Leaving at high temperature (Change of pick-up and drop-out voltages)

Tested sample: RS -24V 30 pcs.
Condition: Deenergized leaving at 90°C
194 F (constant temperature)



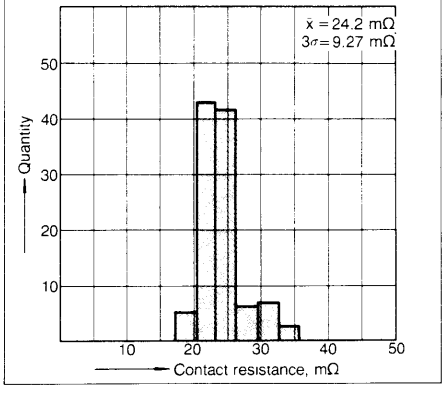
Leaving at high temperature (Change of contact resistance)

Tested sample: RS -24V 30 pcs.
Condition: Deenergized leaving at 90°C
194 F (constant temperature)



Distribution of contact resistance

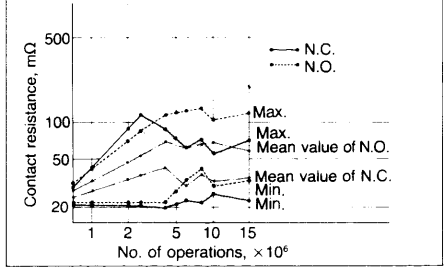
Tested sample: RS -24V (WG type)
105 pcs.



Resistive load test

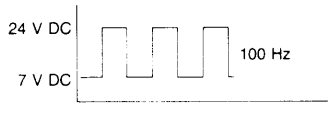
TEST CONDITION
1. Sample: RS -24V 10 pcs.
2. Load: 1 A 20 V DC Resistive
3. Cycle rate: 1.4 cps.

Contact resistance in life test

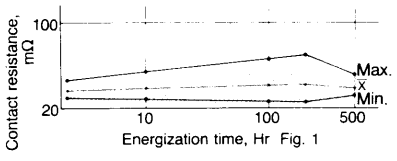


Contact sticking resistance

TEST CONDITION
The purpose of this test was to confirm contact sticking reistance and contact stability against coil ripples.
1. Sample: RS -24V 10 pcs.
2. Test method: Following coil ripples were applied.
3. Test period: 500 hours



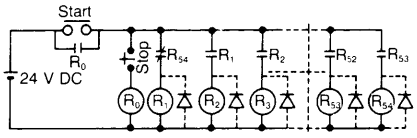
TEST RESULT
1. No occurance of sticking was observed.
2. Contact resistance: Fig. 1
RS -24V: 29 mΩ to 30.4 mΩ



In actual application, above coil ripples should be avoided and use of a capacitor in the circuit is recommended to keep the ripple factor below 5%.

Contact reliability

Tested sample: RS -24V
54 pcs.
Circuits: (A) Following figure with diode
(B) Following figure without diode

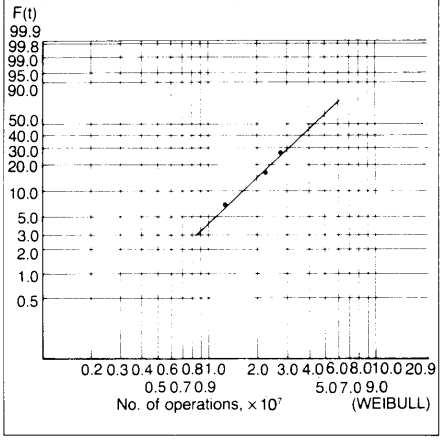


Item to be checked: Detect with the circuit stopped
Circuits:
(A) Diode provided: The circuit does not stop throughout 100 million times.
(B) Diode not provided: $\lambda_{60} = 2.5 \times 10^{-6}$ times

Contact reliability

TEST CONDITION
1. Sample: RS -24V 10 pcs.
2. Contact voltage: 100 mV
3. Contact current: 10 μA
4. Cycle rate: 50 cps.
5. Rejection level: 100 Ω
6. Testing operation: 3×10^7

m = 1.9 σ = 2.5×10^7
μ = 4.7×10^7 95% reliability limit: 1.15×10^7
(Mean time between failure)



High temperature test

TEST CONDITION
1. Sample: RS -24V 30 pcs.
2. Ambient temperature: 80°C
3. Humidity: less than 50% R.H.
4. Exposure time: 2,000 hours with relays deenergized.

TEST RESULT
Contact resistance: Fig. 1
All samples were measured less than 100 mΩ in contact resistance throughout this test.

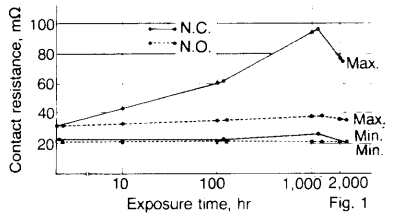
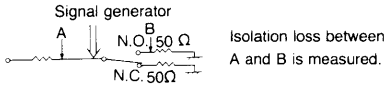
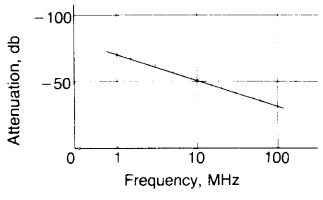


Fig. 1

High frequency characteristics

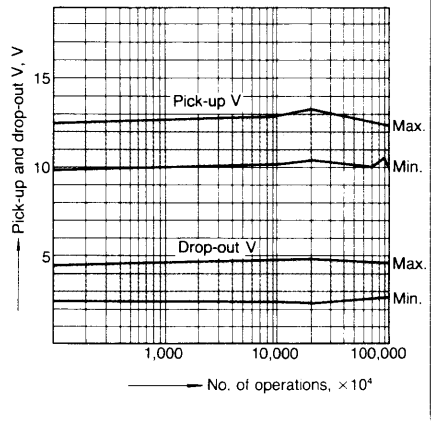


Isolation loss between A and B is measured.

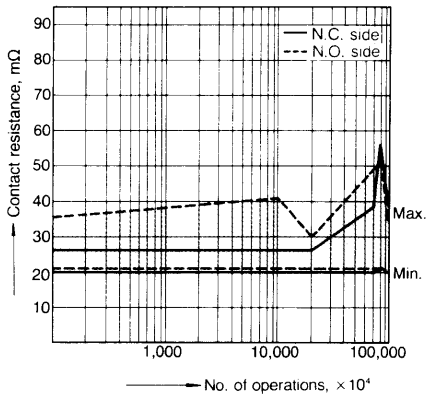


Mechanical life

Change of pick-up and drop-out V
Sample: 10 pcs. RS -24V
Operation frequency: 500 cps



Change of contact resistance
Sample: 10 pcs. RS -24V
Operation frequency: 500 cps

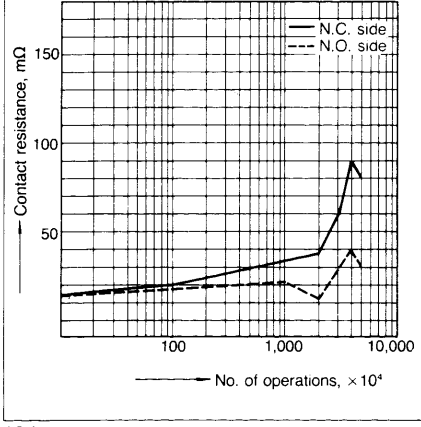


Influence of adjacent mounting

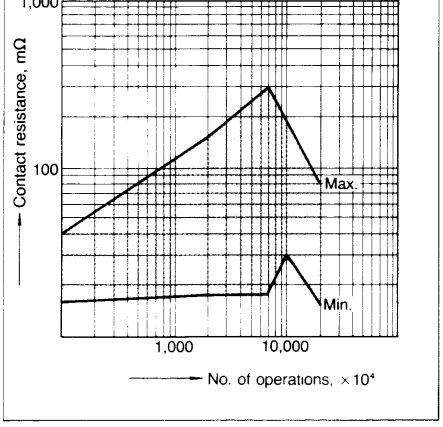
Type \ Distance (mm) (inch)	0 (0)	5 (.197)	10 (.394)	15 (.591)
Magnetically shielded type	±5%	±1%	0	0
Sealed type	—	±10%	±6%	±2%

Electrical life

Sample: 10 pcs. RS -24V
Load: 60 mA 24 V DC resistive load
Frequency: 50 cps

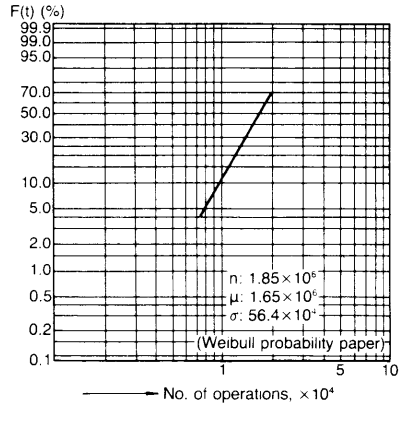


Sample: 10 pcs. RS -12V
Load: 54 mA 12 V DC inductive load with diode protection
(4 relay coils in parallel of RS -12V)
Frequency: 50 cps



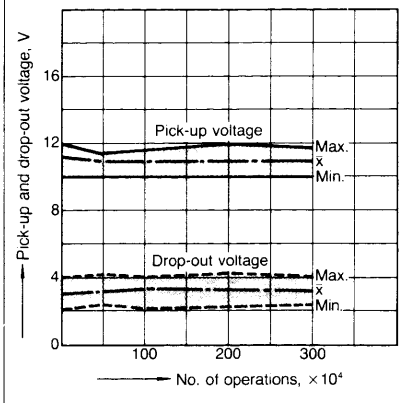
Electrical life (1 A 20 V DC resistive load)

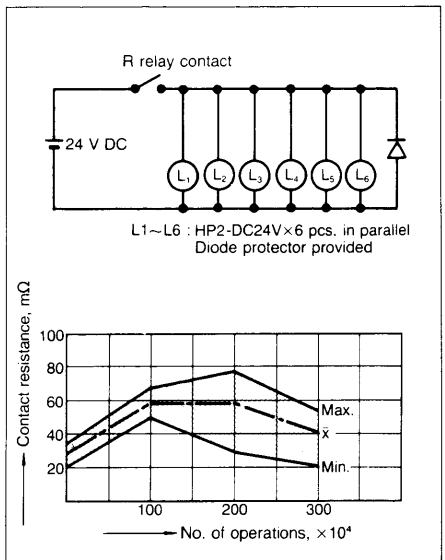
Tested sample: RS -24V
10 pcs.



Electrical life (327 mA 24 V DC relay coil load)

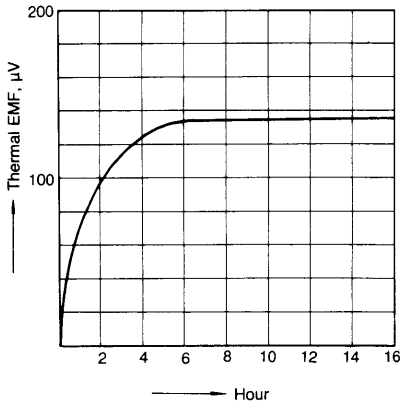
Tested sample: RS -24V
5 pcs.
Condition: HP2-DC24V×6 pcs. in parallel,
diode protector provided





Thermal electro motive force

Sample: 5 pcs. RS -12V
Coil applied V: 12 V DC
Ambient atmosphere: 25°C, 60% RH

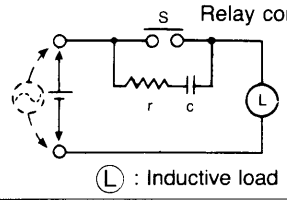
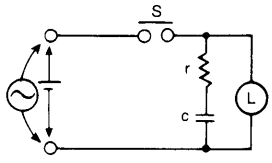
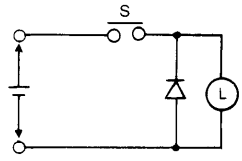


APPLICATION HINTS

Contact protection circuit

When using NR relays in inductive load circuits, a contact protection circuit is recommended.

Examples:

CR	CR	Diode
 Ⓛ : Inductive load		
1. r = more than 20 to 30 ohms 2. In an AC circuit impedance of L is to be somewhat smaller than impedance of r and c.	Can be used for both AC and DC circuits. Use 500 to 1000 ohms for r and 0.1 μF to 0.2 μF 200 V for c in a general 12 to 24 V load circuit.	For DC circuits only.

The following is life data under our HP2 relay load.

Contact voltage	Contact current	Contact protection circuit	Operating speed	Expected life, min. op.
6 V DC	232 mA	0.2 μF+1 kΩ or diode	2 op./sec.	3×10^7
12 V DC	106 mA	0.2 μF+1 kΩ or diode	2 op./sec.	3×10^7
24 V DC	54 mA	0.1 μF+1 kΩ or diode	2 op./sec.	3×10^7
100 V DC	15 mA	0.1 μF+1 kΩ or diode	2 op./sec.	2×10^7
24 V AC	80 mA	0.2 μF+1 kΩ	2 op./sec.	3×10^7
100 V AC	20 mA	0.1 μF+1 kΩ or varistor	2 op./sec.	2×10^7
200 V AC	10 mA	0.1 μF+1 kΩ	2 op./sec.	2×10^7

(Notes)

1. When inrush current occurs in the capacitor load circuit or incandescent lamp load circuit, reduce it to less than 5 A. Electrical life of "AuCo" contact types is 10,000 operations in a 5 A inrush current circuit.
2. When 5 A to 10 A inrush current occurs in the capacitor load circuit or incandescent lamp load circuit, the use of power types is recommended.

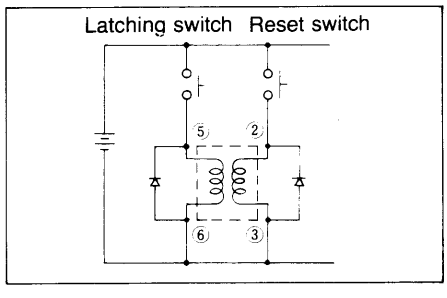
2 coil latching types

A) The circuit at right is recommended when using one coil for latching and the other coil for reset.

R relays are sensitive enough to be operated by the discharge of energy accumulated in the inner-coil capacitance. The use of a diode of over 200 V breakdown will prevent misoperation from this source.

In order to maintain the insulation between the two coils, connection of the terminal No. 3 and No. 6 or the terminal No. 2 and No. 5 is recommended, as shown in the right figure.

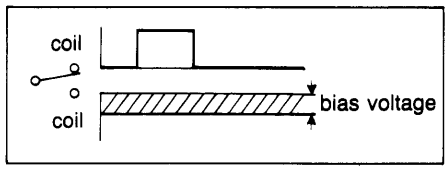
Rectifiers should be inserted in this circuit when the nominal coil voltage of the R relay is more than 24 V DC.



B) No damage will occur to the coil of either the one or two coil bistable types even if the operating voltage is as much as 2 or 3 times the nominal coil voltage.

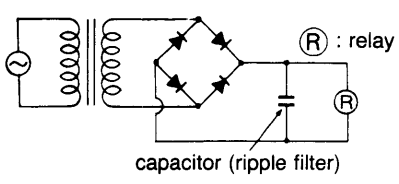
C) If separate pulses are applied to each coil of the 2 coil bistable types, the first pulse will operate when the pulses are of equal voltage. When voltages differ the higher voltage will cause operation provided the voltage difference is greater than the measured pick-up voltage. Voltage difference on the coils will reduce contact pressure proportionately.

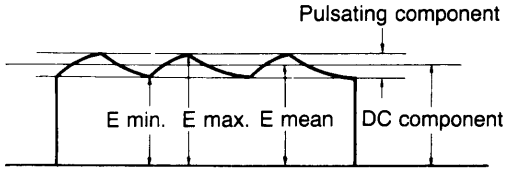
Continuous bias voltage after an operating pulse lowers contact pressure and vibration resistance.



Ripple factor

Coils should be operated on pure DC. Rectified AC may cause changes in the pick-up/drop-out characteristics because of the ripple factor. Use of a capacitor in the circuit is recommended to keep the ripple factor below 5%.





To calculate the ripple factor

$$\text{Ripple factor (\%)} = \frac{\text{E max.} - \text{E min.}}{\text{E mean}} \times 100\%$$

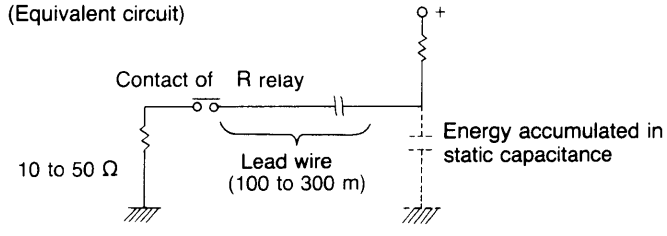
E max. = max. value of pulsating component
E min. = min. value of pulsating component
E mean = average value DC component

When designing R relay circuits

Care should be taken when designing relay circuits since the response of the relay is so fast that bouncing or chattering from conventional relays in the circuit may cause false operation.

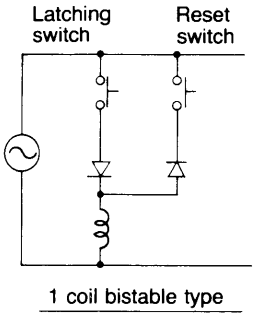
When using long lead wires

When long wires (as long as 100 m or more) are to be used, the use of resistance (10 to 50 Ω) in series with the contact is required in order to eliminate the effect of the possible inrush current due to the stray capacitance existing between the two wires or between the wire and ground.

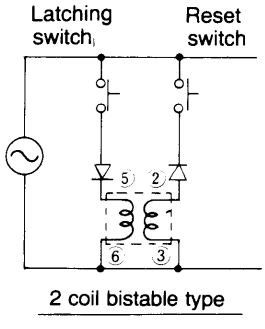


AC operation of latching relays

When using circuits such as those at the right, avoid continued or extended latching or resetting power input.



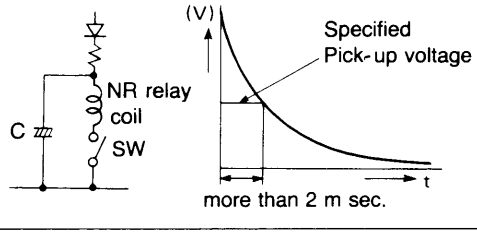
1 coil bistable type



2 coil bistable type

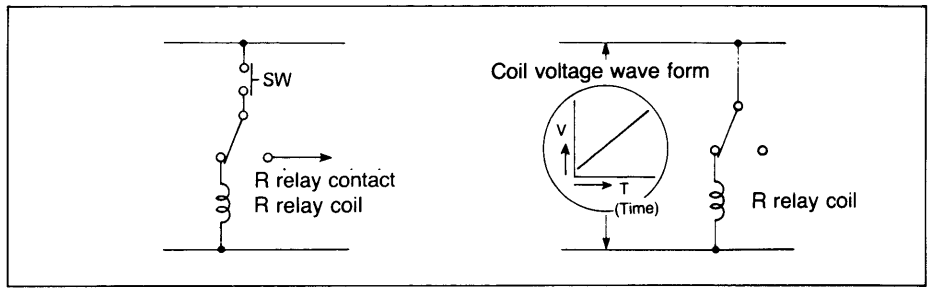
Capacitor discharge operation of latching types

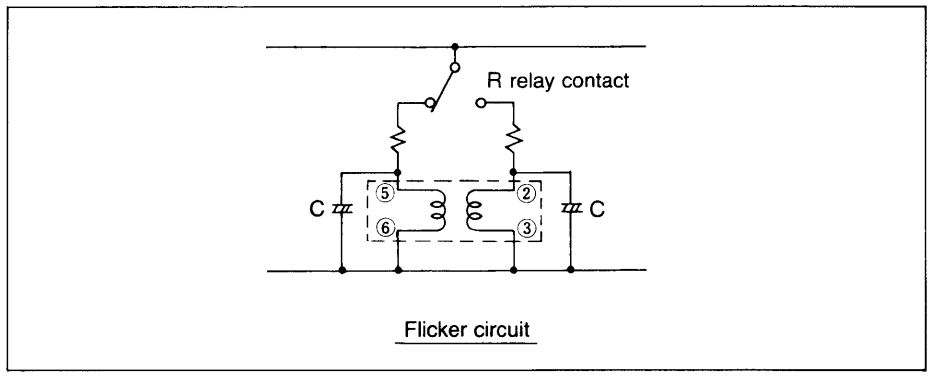
When operating bistable (latching) types by discharge of a capacitor, more reliable operation can be expected if the time to reach pick-up voltage is greater than 2 msec. at 5 to 10 μF: (24 V type).



Automatic coil circuit interruption

Misoperation may occur in self-operated cutoff circuits such as shown at right. This can be avoided by adding a resistor and capacitor and increasing the pick-up voltage to above that specified.
In a timer circuit, step-pulse voltage from PUT (Programable Unijunction Transistor) or SBS (Silicon Bilateral Switch) is recommended.





Flicker circuit

Residual voltage

When single side stable types or latching types are driven by transistor or UJT, residual voltage is sometimes applied to the coils and decreases contacf pressure at N.O. side even if the transistor or UJT are in OFF condition. As a result, characteristics of relays may be harmed. Design your circuits in principle to make such residual voltage zero.

Short circuit prevention between N.C. and N.O.

The separation of loads or insertion of a resistor for circuit protection are recommended for the circuits where large current flows due to arcing. (See Fig. 1).

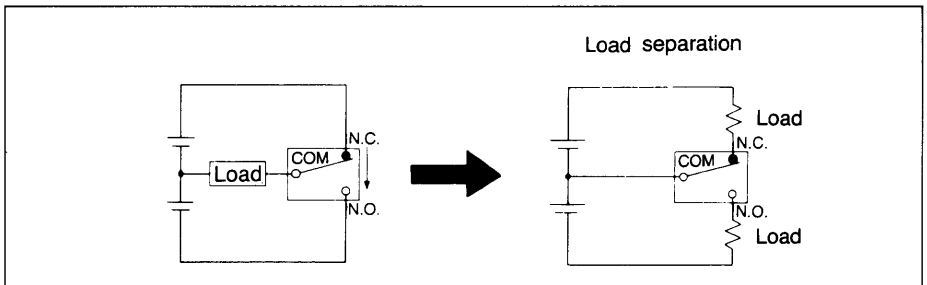
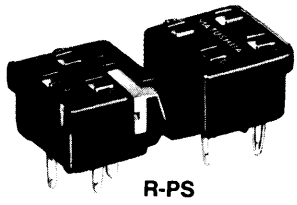


Fig. 1

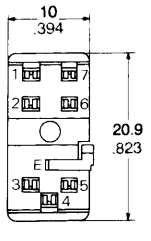
ACCESSORIES

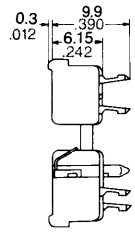
PC board terminal sockets (with hold-down clip)

mm inch



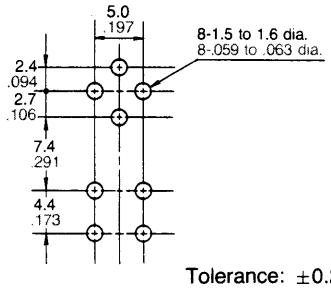
R-PS





General tolerance: ±0.5 ±.020

PC board pattern (Copper-side view)



Tolerance: ±0.2 ±.008