каталог, описание, технические, характеристики, datasheet, параметры, маркировка,габариты, фото

QR код

Panasonic

Short form

RELAYS

Panasonic Relay Technology – Innovations in 3,000 versions

Hardly any sector of the economy can exist without modern relay technology today. Panasonic Electric Works meets the sometimes highly specialized needs with a vast range of innovative and economical relays series. After more than 30 years experience at the forefront of relay innovation and development, Panasonic today offers a portfolio of 3,000 relay versions in the field of miniaturized relays, from ultra-miniature SMD semiconductor types to robust, compact industrial devices. Load switching capability ranges from low-level signals to double-digit ampere values. Various connection types such as circuit boards, plug-in or screw terminals offer a large variety of options that are tailored to the application. Signal relays of the T- and G-series, for example, contribute significantly to secure data transmission and perfect measurement applications. If a low profile is required, like measurement and medical applications, especially Panasonic's PhotoMOS relays can score points. They enable a fast, low noise and bounce-free switching in the smallest design and with an extremely long life. Panasonic power relays - especially the J-, L- and C-series - are used as network relays in a variety of durable household and consumer goods as well as in the automotive industry and in diverse OEM manufacturing industries.

In the field of safety of man and machine, the SF series relays with forcibly guided contacts, have set new standards. A wide range of electromechanical, semiconductor and PhotoMOS relays are also perfectly suited for SMD processing in automated manufacturing processes. Top quality and reliablity are guaranteed at Panasonic by strict production rules, advanced measuring and testing procedures as well as extensive testing before delivery, to comply with international standards. Of course, we sell RoHS compliant products and have ISO9001 certification. If you need more detailed information about Panasonic relays, please ask us to send you the complete relay catalog.

Relays: Characteristics at a Glance

	Coil insulation	Relays
UL coil insulation	UL-B	LE, LZ, JS, JQ, JW
	UL-F	LE, LZ, JT-V

	TV rated	Steady	Inrush (A)	Relays
TV rated	TV-2			HL (1C; NC), HL (2c, NC)
	TV-3	4.5	71	ST, HC, (1c, 2c), HL (1c, NC)
	TV-4	6.0	91	LA, HL (2c, NO)
	TV-5	7.5	111	LK-P, LK-Q, JQ, JS, JW, HL (1c, NO)
	TV-8	12.0	163	LK-T, LK-Q
	TV-10	15.0	191	HE (2a)
	TV-15	18.8	215	HE (1a)

	Surge voltage	Relays
Surge voltage between contact and coil	5000V	DS-P
	6000V	ST, PF, JT-V
	8000V	JQ, JK, PQ
	10000V	LF, LE, LZ, LA, LJ, LK-S, LK-P, LK-T, LK-Q, JW, JM, HE, JC, DJ, DK, DQ, DY

	Relays	Arrangement	Isolation	Insertion loss
High frequency characteristics	RD coaxial switch	SPDT, Transfer, SP6T	Min. 60dB (18GHz)	Max. 0.5dB (18GHz)
	RD coaxial switch	SPDT	Min. 60dB (18GHz)	Max. 0.7dB (18GHz)
	RJ	2 Form C	Min. 35dB (5GHz)	Max. 0.5dB (18GHz)
	RE	1 Form C	Min. 30dB (2.6GHz)	Max. 0.5dB (2.6GHz)
	RA	2 Form C	Min. 30dB (1GHz)	Max. 0.3dB (1GHz)
	RS	2 Form C	Min. 30dB (3GHz)	Max. 0.3dB (3GHz)

	Relays
Terminal socket	HN, HC, HJ, HL, SP, NC, HE, SFS
Socket	HC, HL, S, ST, SP, NC, PA, DK, DS-P, JW, JC, Power PhotoMOS Relays, SFS, PF
LED operation indication type	HN, HC, HJ, HL, SFS, AQ-K

Please download CAD Data from our Website: **www.panasonic-electric-works.com**

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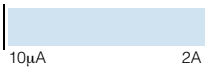
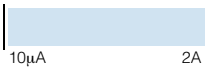
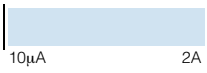
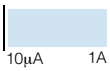
Service has Priority

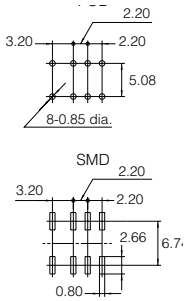
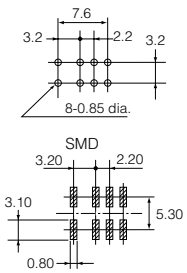
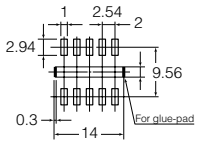
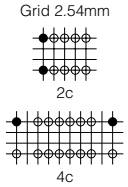
We respond quickly to customer needs. Just give us a call. Whether you have specific application requests or you simply want technical information, we are always ready to advise and assist you. Our current delivery program is assembled for you in this relay overview. Of course, data sheets are available on our homepage:

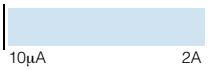
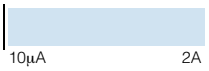
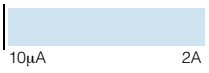
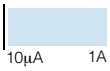
www.panasonic-electric-works.com

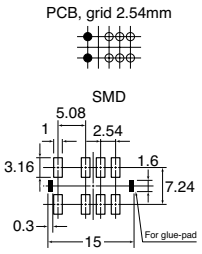
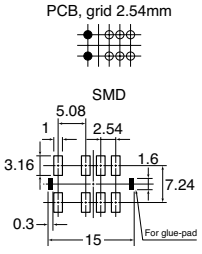
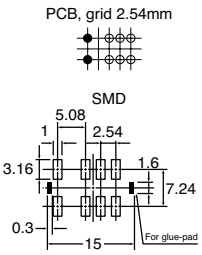
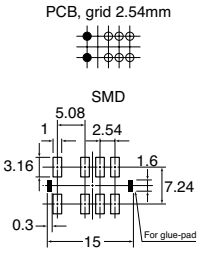
About the Selector Chart

This selector chart is designed to help you quickly select a relay best suited for your needs. Please note: the values given for switching current and switching voltage do not necessarily indicate standard operating conditions. For the nominal switching capacity and other critical values, please refer to the respective data sheet or contact your Panasonic representative.

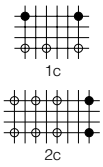
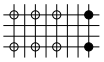
Type (Picture scale: DIN A4)	Features	Switching current	Max. switching voltage	Contact arrangement	Coil voltage
GQ (SMD) 1:1  10.6 x 7.2 x 5.2/5.4mm	» Compact flat body saves space » Outstanding surge resistance » The use of twin crossbar contacts ensures high contact reliability » High sensitivity 100mW type available » RTIII (IP67)	**Max.:** 2A **Min.:** 10µA  	» 110V DC » 125V AC	2c	(DC) 1.5, 3, 4.5, 6, 9, 12, 24V
GN (SMD) 1:1  10.6 x 5.7 x 9.0mm	» Compact slim body saves space » Outstanding surge resistance » The use of twin crossbar contacts ensures high contact reliability » High sensitivity 100mW type available » RTIII (IP67)	**Max.:** 2A **Min.:** 10µA10µA  	» 110V DC » 125V AC	2c	(DC) 1.5, 3, 4.5, 6, 9, 12, 24V
TQ (SMD) 1:1  14 x 9 x 5.6mm	» Ultra low profile 5.8mm » Surge withstand 2,500V » 3 types of surface-mount terminals available » RTIII (IP67)	**Max.:** 2A **Min.:** 10µA  	» 220V DC » 125V AC	2c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24, 48V
TQ (THT) 1:1  14 x 9 x 5mm	» 1,500V FCC » RTIII (IP67)	**Max.:** 1A **Min.:** 10µA  	» 110V DC » 125V AC	2c	(DC) 3, 4.5, 5, 6, 9, 12, 24, 48V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
Single side stable: 140mW (1.5 - 12V DC) 230mW (24V DC) **Sensitive type:** 100mW (1.5V - 12V DC) 120mW (24V DC) **1 coil latching:** 100mW (1.5V - 12V DC) 120mW (24V DC)	750Vrms	1000Vrms	1500Vrms	1,500V FCC Between open contacts 2,500V Telcordia Between contacts and coil	PCB, SMT 	BSI, CSA, UL
Single side stable: 140mW (1.5 - 12V DC) 230mW (24V DC) **Sensitive type:** 100mW (1.5V - 12V DC) 120mW (24V DC) **1 coil latching:** 100mW (1.5V - 12V DC) 120mW (24V DC)	750Vrms	1000Vrms	1500Vrms	1,500V FCC Between open contacts 2,500V Telcordia Between contacts and coil	PCB, SMT 	BSI, CSA, UL
Single side stable: 140mW (up to 12V DC) 200mW (24V DC) 300mW (48V DC) **1 coil latching:** 70mW (up to 12V DC) 100mW (24V DC) **2 coil latching:** 140mW (up to 12V DC) 200mW (24V DC)	1000Vrms	1500Vrms	1500Vrms	1,500V FCC Between open contacts 2,500V Telcordia Between contacts and coil	SMT 	CSA, UL
Single side stable: 140mW (3 - 12V DC) 200mW (24V DC) 300mW (48V DC) **1 coil latching:** 100mW (3 - 12V DC) 150mW (24V DC) **2 coil latching:** 200mW (3 - 12V DC) 300mW (24V DC)	750Vrms	1000Vrms	1000Vrms	1,500V FCC Between open contacts	PCB 	CSA, UL

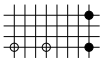
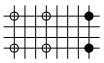
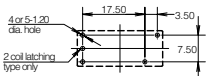
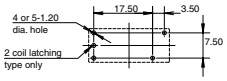
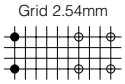
Type (Picture scale: DIN A4)	Features	Switching current	Max. switching voltage	Contact arrangement	Coil voltage
TX (SMD) 1:1  15 x 7.4 x 8.2mm	» Surge withstand 2,500V » Breakdown voltage between contacts and coil 2,000V » 3 types of surface-mount terminals available » Added new pin layout (LT type) in 2 coil latching type » RTIII (IP67)	**Max.:** 2A **Min.:** 10μA  	» 220V DC » 220V AC	2c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24, 48V
TX-TH (SMD) 1:1  15 x 7.4 x 8.2mm	» Controlled 7.5A inrush current » 2 types of pin layouts » 3 types of surface mount terminals available » RTIII (IP67)	**Max.:** 7.5A **Min.:** 10μA  	» 220V DC » 250V AC	2c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24, 48V
TX-D (SMD) 1:1  15 x 7.4 x 8.2/8.4mm	» High-insulation relay that conforms to the insulation level provided for in the EN41003 » 3 types of surface-mount terminals available » High-insulation relay that conforms to the insulation level provided for in the EN60950 » Surge breakdown voltage 6kV (contacts to coil) available » RTIII (IP67)	**Max.:** 2A **Min.:** 10μA  	Break Before Make: » 220V DC » 250V AC Make Before Break: » 125V DC » 125V AC	2c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24V
TX-S (SMD) 1:1  15 x 7.4 x 8.2/8.4mm	» Higher sensitivity » Nominal operating power, 50mW » 1,500V FCC » 3 types of surface-mount terminals available » Added new pin layout (LT type) in 2 coil latching type » RTIII (IP67)	**Max.:** 1A **Min.:** 10μA  	» 110V DC » 125V AC	2c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
Single side stable: 140mW (up to 24V DC) 270mW (48V DC) **1 coil latching:** 100mW **2 coil latching:** 200mW	1000Vrms	1000Vrms	2000Vrms	1,500V FCC Between open contacts 2,500V Telcordia Between contacts and coil	PCB, SMT 	BSI, CSA, UL
Single side stable: 140mW (up to 24V DC) 270mW (48V DC) **1 coil latching:** 100mW (up to 24V DC) **2 coil latching:** 140mW (up to 24V DC)	1000Vrms	1000Vrms	2000Vrms	1,500V FCC Between open contacts 2,500V Telcordia Between contacts and coil	PCB, SMT 	BSI, CSA, UL
Single side stable: 200mW (1.5 - 12V DC) 230mW (24V DC) **1 coil latching:** 150mW (1.5 - 12V DC) 170mW (24V DC)	1000Vrms	1000Vrms	3000Vrms	1,500V FCC Between open contacts 6,000V Between contacts and coil	PCB, SMT 	BSI, CSA, UL
Single side stable: 50mW (1.5 - 12V DC) 70mW (24V DC) **1 coil latching:** 35mW (1.5 - 12V DC) 50mW (24V DC) **2 coil latching:** 70mW (1.5 - 12V DC) 150mW (24V DC)	750Vrms	1000Vrms	1800Vrms	1,500V FCC Between open contacts 2,500V Telcordia Between contacts and coil	PCB, SMT 	BSI, CSA, UL

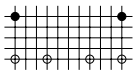
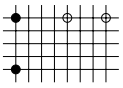
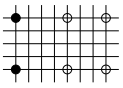
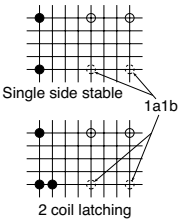
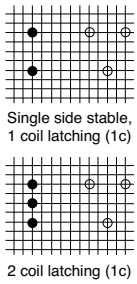
Type (Picture scale: DIN A4)	Features	Switching current	Max. switching voltage	Contact arrangement	Coil voltage
DS 1:1  15/20 x 9.9 x 9.9mm	» 1,500V FCC » High switching power » RTIII (IP67)	**Max.:** 2A **Min.:** 10µA 10µA 2A	» 220V DC » 250V AC	1c, 2c	(DC) 1.5, 3, 5, 6, 9, 12, 24, 48V
DS2Y 1:1  20 x 9.9 x 9.3mm	» High sensitivity » 2 Form C contact » 1,500V FCC » Sealed construction » RTIII (IP67)	**Max.:** 2A **Min.:** 10µA 10µA 2A	» 220V DC » 250V AC	2c	(DC) 1.5, 3, 5, 6, 9, 12, 24, 48V
HY 1:1  12 x 7.4 x 10.1mm	» High sensitivity 150mW / 200mW » RTIII (IP67)	**Max.:** 1A **Min.:** 10µA 10µA 1A	» 60V DC	1c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
Single side stable: 200mW **1 coil latching:** 90mW **2 coil latching:** 180mW	1000Vrms (DS1E-S: 500Vrms)	1000Vrms	1500Vrms (DS1E-S: 1000Vrms)	1,500V FCC Between open contacts	PCB Grid 2.54mm  1c 2c	CSA, UL
Single side stable: 200mW (up to 24V DC) 300mW (48V DC)	750Vrms	750Vrms	1000Vrms	1,500V FCC Between open contacts	PCB Grid 2.54mm 	CSA, UL
Standard: 200mW **High sensitivity:** 150mW	500Vrms	—	1000Vrms	—	PCB Grid 2.54mm 	CSA, UL

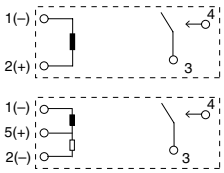
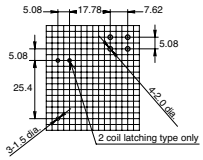
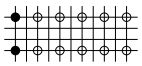
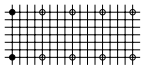
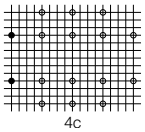
Type (Picture scale: DIN A4)	Features	Switching current (Min.: see data sheet)	Max. switching voltage	Contact arrangement	Coil voltage
DSP 1:2  20.2 x 11 x 10.5mm	» High switching capacity » High sensitivity » High breakdown voltage » Miniature high-power relay » Creepage and clearance distance min. 3.5mm » RTIII (IP67)	**Max.:** 8A (1a) 8A 5A (1a1b, 2a) 5A	» 220V DC » 400V AC	1a, 1a1b, 2	(DC) 3, 5, 6, 9, 12, 24V
DW 1:2  24 x 10 x 18.8mm	» Pin-in-Paste version available » Surge withstand voltage between coil and contact: 12,000V » Breakdown voltage between coil and contact: 5,000V rms » Conforms to EN 60335 » Creepage and clearance distance min. 6mm » RTII (IP54)	**Max.:** 8A/16A (1a) 8A 16A	» 8A 250V AC » 16A 277V AC	1a	(DC) 3, 5, 6, 9, 12, 24V
DW-HL 1:2  24 x 10 x 15.8mm	» Low profile type available (h = 15.8 mm) » Inrush type available (TV-8 UL/C-UL approved) » IEC60335-1* compliant type available (PTI 325V VDE approved) » Reflow possible (pin-in-paste) » Certified by UL/C-UL, VDE	**Max.:** 16A (1a) 16A	» 277V AC	1a	(DC) 3, 5, 6, 9, 12, 24V
DZ  Horizontal terminal type  Vertical terminal type	» IEC62055-31 UC3 compliant (short current 3,000 A) » High switching capacity » 120 A 250 VAC (Resistive load) » Twin contacts for low temperature rise » Low operating power	**Max.:120A (1a)** 120A	» 276 V AC	1a	(DC) 5, 12, 24V
DE 1:2  25 x 12.5 x 12.5mm	» Conforms to VDE0631 » Low coil power » Compact body saves space » High switching capacity: 16A = 25,000 10A = 100,000 switching cycles » Creepage and clearance distance min. 8mm » RTIII (IP67)	**Max.:** 10/16A (1a) 10A 16A 8A (1a1b, 2a) 8A	» 230V DC » 440V AC	1a, 1a1b, 2a	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24, 48V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
Single side stable: 300mW **1 coil latching:** 150mW **2 coil latching:** 300mW	1000Vrms	2000Vrms	3000Vrms	5,000V	PCB Grid 2.54mm  1a  1a1b, 2a	CSA, SEV, TÜV, UL
1 coil latching: 200mW **2 coil latching:** 400mW	1000Vrms	—	5000Vrms	12,000V	PCB, PiP 	C-UL, VDE, UL
1 coil latching: 200mW **2 coil latching:** 400mW	1000Vrms	—	5000Vrms	12,000V	PCB 	C-UL, VDE, UL
1 coil latching: 1400mW **2 coil latching:** 2800mW	2000Vrms	—	4000Vrms	12,000V	Terminal mounting	VDE
Single side stable: 200mW **1 coil latching:** 100mW **2 coil latching:** 200mW	1000Vrms	4000Vrms (1a1b, 2a)	5000Vrms	12,000V	PCB Grid 2.54mm 	CSA, TÜV, UL, VDE

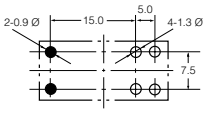
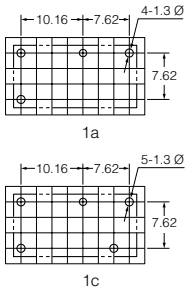
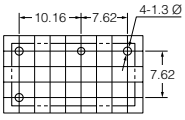
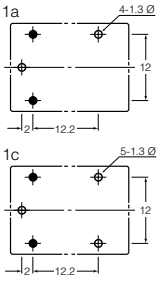
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
ST 1:2  31 x 14 x 11.3mm	» High capacity in small size » High inrush capability » Latching type available » Frictionless pivoted rotating armature » High breakdown voltage » Socket available » Not for new applications » Creepage and clearance distance more than 3mm, approx. 4mm » RTIII (IP67)	**Max.:** 8A **Min.:** 1mA 1mA 8A	» 250V DC » 400V AC	1a1b, 2a	(DC) 3, 5, 6, 9, 12, 24, 48V
DK 1:2  20 x 12.5 x 9.7mm	» Dimensions for 1a = 12.5mm, for 2a, 1a1b = 15mm » Low coil power » Creepage and clearance distance min. 8mm: DK2A-L1/L2 min. 6.8mm DK1A1B-L1/L2 min. 6.8mm » RTIII (IP67)	**Max.:** 10A (1a) 10A 8A (1a1b, 2a) 8A	» 125V DC » 400V AC	1a, 1a1b, 2a	(DC) 3, 5, 6, 9, 12, 24V
DY 1:2  20 x 15 x 9.7mm	» Low cost, polarized power relay » 1a1b-contact arrangement is pin-compatible to DK1a1b » Latching type available » Creepage and clearance distance min. 6mm » RTIII (IP67)	**Max.:** 10A (1a) 10A 8A (1a1b) 8A	» 125V DC » 380V AC	1a, 1a1b	(DC) 3, 5, 6, 12, 24V
DJ 1:2  29 x 13 x 16/16.5mm	» Latching type available » Compact with high capacity » Low coil power » Optional available with manual test button » Creepage and clearance distance min. 8mm » RTII (IP54), RTIII (IP67)	**Max.:** 20A 20A	» 125V DC » 400V AC	1a, 1b, 1c, 1a1b, 2a, 2b, 2c	(DC) 5, 6, 12, 24, 48V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
Single side stable: 240mW **1 coil latching:** 130mW **2 coil latching:** 240mW	1200Vrms	2000Vrms	3750Vrms	6,000V	PCB Grid 2.54mm  (Single side stable)	CSA, TV rating, UL, VDE
Single side stable: 200mW **2 coil latching:** 200mW	1000Vrms	4000Vrms	4000Vrms	10,000V	PCB Grid 2.54mm  1a  1a1b, 2a	CSA, SEV, TÜV, UL, VDE
Single side stable: 200mW **2 coil latching:** 200mW	1000Vrms	4000Vrms	4000Vrms	10,000V	PCB Grid 2.54mm  Single side stable 1a1b 2 coil latching	CSA, TÜV, UL
Single side stable: 250mW **1 coil latching:** 150mW **2 coil latching:** 250mW	1000Vrms	—	4000Vrms	10,000V	PCB Grid 2.54mm  Single side stable, 1 coil latching (1c) 2 coil latching (1c)	CSA, SEV, TÜV, UL, VDE

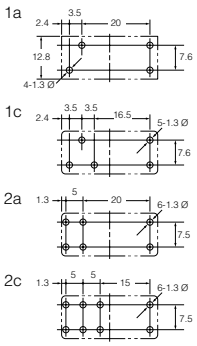
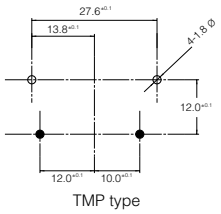
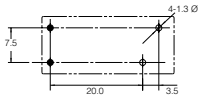
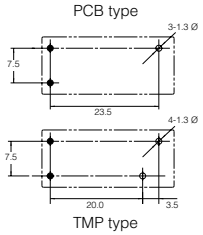
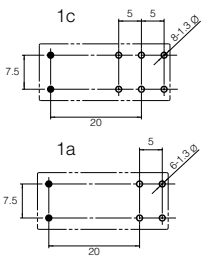
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
DJ-H 1:2  39 x 15 x 33mm	» Manual Lever Type » Compact with high capacity » High insulation » Creepage and clearance distance min. 8mm » RTII » High inrush current capacity ~ 500A » EN 60669 compliant	**Max.:** 50A 50A	» 480V AC	1a	(DC) 5, 6, 9, 12, 24V
DQM 1:2  44 x 40.4 x 17.3mm	» Miniature 60A polarized power relay » Latching type available » High insulation » Creepage and clearance distance min. 8mm » RTIII (IP67)	**Max.:** 60A 60A	» 250V AC	1a	(DC) 4.5, 6, 9, 12, 24V
S 1:2  28 x 12 x 10.4mm	» High switching capacity range due to 5-layer contact » High sensitivity » High vibration and shock resistance » Low thermal electromotive force (approx. 3µV) » Latching type available Sockets available » RTIII (IP67)	**Max.:** 4A **Min.:** 100µA 4A 100mA	» 200V DC » 250V AC	2a2b, 3a1b, 4a	(DC) 3, 5, 6, 12, 24, 48V
SP 1:2  2c: 50 x 25.6 x 22mm 4c: 50 x 36.8 x 22mm	» Polarized power relay with rotating armature » High sensitivity » High vibration and shock resistance » Wide switching range » Latching type available » Socket available » RTI	**Max.:** 15A 15A	» 110V DC » 250V AC	2c, 4c	(DC) 3, 5, 6, 12, 24, 48V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
1 coil latching: 1000mW **2 coil latching:** 2000mW	1500Vrms	—	4000Vrms	12,000V	PCB 	CSA, UL
1 coil latching: 500mW **2 coil latching:** 1000mW	1500Vrms	—	4000Vrms	10,000V	PCB 	—
Single side stable: ~200mW (3V - 24V DC) 271mW (48V DC) **1 coil latching:** ~100mW (3V - 24V DC) 144mW (48V DC) **2 coil latching:** ~200mW (3V - 24V DC) 355mW (48V DC)	750Vrms	1000Vrms	1500Vrms	—	PCB Grid 2.54mm 	CSA, UL
Single side stable: 300mW **2 coil latching:** 300mW	1500Vrms	3000Vrms	3000Vrms	—	PCB, Plug-in Grid 2.54mm  2c  4c	CSA, TÜV, UL

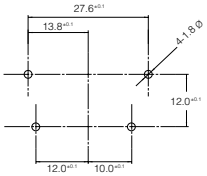
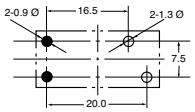
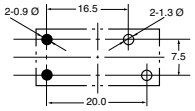
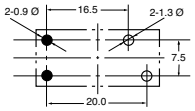
Type (Picture scale: DIN A4)	Features	Switching current (Min.: see data sheet)	Max. switching voltage	Contact arrangement	Coil voltage
Non polarized power relays					
LA 1:2  24 x 12 x 25mm	» Low cost slim power relay: 2 Form A » High insulation resistance between contact and coil » 3A-version with gold clad contacts available (ideal speaker switch) » Surge withstand voltage: 10kV » Creepage and clearance distance min. 6mm » RTIII (IP67)	**Standard:** **Max.:** 3 A (3A rated) 3A **Power type:** **Max.:** 5A (5A, TV-4 rated) 5A	» 30V DC » 277V AC	2a	(DC) 12, 24V
LQ 1:2  20 x 10 x 16mm	» High switching capacity in small size » High surge withstand voltage: 8,000V » Low power consumption » F-coil type for high ambient temperature (105°C) available » Extremely low cost » Creepage and clearance distance: 1a: min. 4.55mm 1c: min. 3.53mm » RTIII (IP67)	**Max.:** 10A (1a, 1c) 10A	» 277V AC	1a, 1c	(DC) 5, 6, 9, 12, 18, 24V
PQ 1:2  20 x 10 x 15.6mm	» High electrical noise immunity » High sensitivity: 200mW » High surge voltage: 8,000V » Pin-compatible to JQ1a » Gold-clad twin (bifurcated) contacts	**Max.:** 5A 5A	» 110V DC » 250V AC	1a	(DC) 3, 5, 6, 9, 12, 18, 24V
JS 1:2  22 x 16 x 16mm	» Ultra-miniature power relay with universal terminal footprint » F-coil type for high ambient temperature (105°C) available » Extremely low cost » High switching capacity: 10A » RTIII (IP67)	**Max.:** 10A 10A	» 100V DC » 277V AC	1a, 1c	(DC) 5, 6, 9, 12, 18, 24, 48V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
530mW	1000Vrms	1000Vrms	4000Vrms	10,000V	PCB 	CSA, SEV, SEMKO, TÜV, UL
200mW (1a) 400mW (1c)	1000Vrms (1a) 750Vrms (1c)	—	4000Vrms	8,000V	PCB 	C-UL, UL, VDE
200mW	1000Vrms	—	4000Vrms	8,000V	PCB 	CSA, SEMKO, TÜV, UL, VDE
360mW	750Vrms	—	1500Vrms	—	PCB 	CSA, TÜV, complies with TV-5, UL, VDE

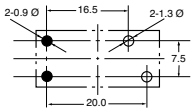
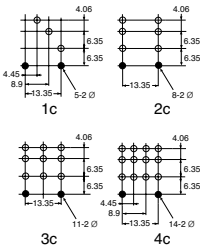
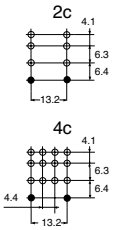
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
JW 1:2  28.6 x 12.8 x 20mm	» Compact power relay » High surge withstand voltage: 10,000V » Class B coil insulation types available » Creepage and clearance distance min. 8mm between contacts and coil (for 2 changeover contacts min. 7.5mm) » RTIII (IP67)	**Standard:** **Max.:** 5A (2a, 2c) 5A **High capacity:** **Max.:** 10A (1a, 1c) 10A	» 100V DC 440V AC	1a, 1c, 2a, 2c	(DC) 5, 6, 9, 12, 18, 24, 48V
LF 1:2  30.1 x 15.7 x 23.3mm	» Ideal for compressor and inverter loads » High insulation resistance » Inrush current: 102A/200V AC 224A/100V AC » High surge withstand voltage » Creepage and clearance distance min. 8mm » RTII	**Max.:** 25A 25A	» 250V AC	1a	(DC) 5, 6, 9, 12, 18, 24V
LE 1:2  28.6 x 12.4 x 24.9mm	» Ideal for magnetron and heater loads » Excellent heat resistance » 4.8mm faston terminals » High sensitivity: 200mW » Creepage and clearance distance min. 8mm » RTI	**Max.:** 16A 16A	» 277/400V AC	1a	(DC) 5, 6, 9, 12, 18, 24, 48V
LZ 1:2  28.8 x 12.5 x 15.7mm	» Low profile relay (15.7mm) » Low operating power of 400mW » Ambient temperature up to 105°C » Creepage and clearance distance min. 10mm » RTIII (IP67)	**Max.:** 16A 16A	» 250V DC » 440V AC	1a, 1c	(DC) 5, 9, 12, 18, 24, 48V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
530mW	1000Vrms	3000Vrms (2a, 2c)	5000Vrms	10,000V	PCB 	CSA, SEMKO, SEV, TÜV, UL, VDE
900mW	1000Vrms	—	5000Vrms	10,000V	PCB Top mounting  TMP type	CSA, SEMKO, TÜV, UL, VDE
Standard: 400mW **High sensitivity:** 200mW	1000Vrms	—	4000Vrms	10,000V	PCB Top mounting  PCB type  TMP type	CSA, TÜV, UL, VDE
400mW	1000Vrms	—	5000Vrms	10,000V	PCB 	CSA, UL, VDE

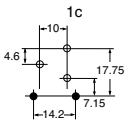
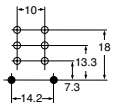
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
LF-G1/LF-G2 1:2  30.1 x 15.7 x 23.3mm	» Ideal for solar inverters » High insulation resistance » Inrush current: 102A/200V AC 224A/100V AC » High switching capacity 33A/277V AC » High surge withstand voltage, Creepage distance between contact and coil terminal: Min. 9.5 mm Clearance distance between contact and coil terminal: Min. 6.5 mm » RTI	**Standard:** **Max.:** 22A 22A **High capacity type,** 1.5mm contact gap: **Max.:** 31A 31A **High capacity type,** 1.8mm contact gap: **Max.:** 33A 33A	» 250V AC	1a	(DC) 9, 12, 18, 24V
LK-G 1:2  24 x 11 x 25mm	» Contact gap: 1mm » 3 different types available » High insulation resistance » Slim profile » High noise immunity » Creepage and clearance distance between contact and coil min. 6mm (IEC65 compliant) » RTI	**Max.:** 10A 10A **Max.**: 16A 16A	» 277V AC	1a	(DC) 5, 9, 12, 24V
LK-P 1:2  24 x 11 x 25mm	» High switching capacity 10A 277V AC » High inrush current capability: 111A » UL/CSA TV-5 rated type available » High insulation: Creepage and clearance distance between contact and coil min. 6mm » RTI	**Max.:** 10A 10A	» 30V DC » 277V AC	1a	(DC) 12, 24V
LK-Q 1:2  24 x 11 x 25mm	» Reduced noise » High sensitivity: nominal coil power 250mW » TV-5/TV-8 rated type available » Slim shape » Creepage and clearance distance min. 6mm » RTI	**Max.:** TV5: 5A (AC) 5A TV8: 8A (AC) 8A	» 30V DC » 277V AC	1a	(DC) 5, 9, 12, 24V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
1400mW	2500Vrms	—	4000Vrms	6,000V	PCB 	C-UL, UL, VDE
530mW	1000Vrms	—	4000Vrms	10,000V	PCB 	CSA, TÜV, UL
530mW	1000Vrms	—	4000Vrms	10,000V	PCB 	CSA, SEMKO, SEV, TÜV, TV-5 rating, UL, VDE
250mW	1000Vrms	—	4000Vrms	10,000V	PCB 	CSA, SEMKO, SEV, TÜV, complies with TV-5, TV-8, UL, VDE

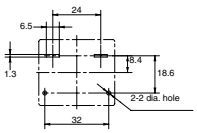
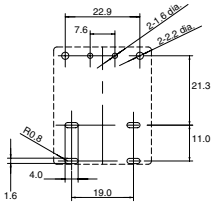
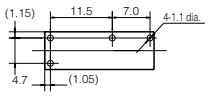
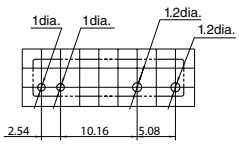
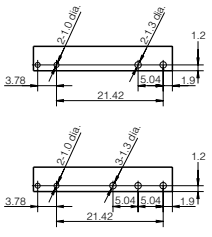
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
LK-T 1:2  24 x 11 x 25mm	» High inrush current capability: 118A » UL/CSA TV-8 rated type available » High noise immunity realized by the card separation structure between contact and coil » High insulation resistance: 1) Creepage and clearance distance between contact and coil min. 6mm 2) Surge withstand voltage between contact and coil > 10kV » RTI	**Max.:** 8A 	» 277V AC	1a	(DC) 5, 9, 12, 24V
HC 1:2  27.2 x 20.8 x 35.2mm	» Wide applications » Versatile range » Footprint compatible with competitive types » Compact power relay » AC and DC coil available » Socket available » Pin-compatible with the HJ relays » RTI, RTIII (IP67)	**Max.:** 10A **Min.:** 1mA 	» 30V DC » 250V AC	1c, 2c, 3c, 4c	(DC) 6, 12, 24, 48, 110V (AC) 6, 12, 24, 48, 120, 240V
HJ 1:2  28 x 21.5 x 35/38mm	» 2 contact arrangements, same footprint as our popular HC relay » Coil breakdown detection function (AC type with LED only) » Convenient screw terminal sockets with finger protection also available » Test button type available » Compact power relay for AC and DC voltage » Socket available » RTI	**Max.:** 7A 	» 30V DC » 250V AC	2c, 4c	(DC) 12, 24, 48, 110V (AC) 12, 24, 48, 100, 120, 200, 220/240V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
250mW	1000Vrms	—	4000Vrms	10,000V	PCB 	CSA, SEMKO, SEV, TÜV, TV rating UL, VDE
(DC) 900mW (AC) 1.2VA	700Vrms	700Vrms	2000Vrms	—	PCB, Plug-in, Top mounting 	CSA, SEV, TV rating, UL, VDE
(DC) 900 mW (AC) 1.2 - 1.5VA	1000Vrms	2000Vrms	2000Vrms	—	Plug-in 	CSA, SEV, TV rating, UL, VDE

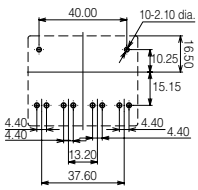
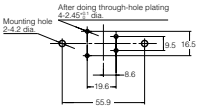
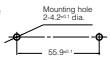
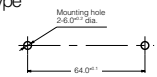
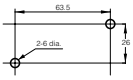
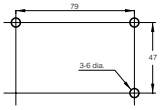
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
HN 1:2  29 x 13 x 28mm	» Slim (13mm) and compact size relay: The size has been reduced 20% compared with the existing HC/HJ relays. » Plug-in solder type available » Slim screw terminal socket (17.5mm) » Also available with LED indication » High reliability » AC and DC coil available » RTII	**Max.:** 5A 5A **Max.:** 10A 10A **Max.:** 16A 16A	» 30V DC » 250V AC	1c, 2c	(DC) 5, 6, 12, 24, 48V (AC) 100, 120, 240V
HL 1:2  27.2 x 20.8 x 35.4mm	» Large capacity » Compact size » Designed for long lifetime » Footprint compatible with competitive types » High load switching range » Socket available » RTI	**Max.:** 15A **Min.:** 1mA 1mA 15A	» 30V DC » 250V AC	1c, 2c	(DC) 6, 12, 24, 48, 110V (AC) 6, 12, 24, 48, 120, 240V

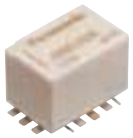
Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
(DC) 530mW (AC) 0.9VA	1000Vrms	3000Vrms	5000Vrms	—	Plug-in, Screw terminal —	UL, C-UL, (VDE)
(DC) 900 - 1000mW (AC) 1.2 - 1.3VA	1000Vrms	1500Vrms	2000Vrms	—	PCB, Plug-in, Top mounting 1c  2c  	CSA, complies with TV-5, UL

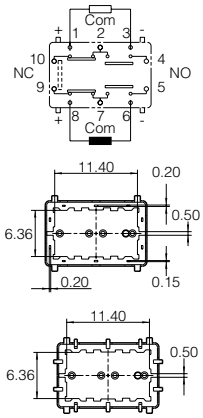
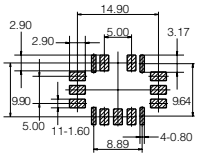
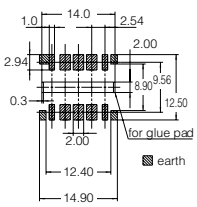
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
HE/ HE PV 1:3  33 x 38 x 38,8mm	» High surge withstand voltage: 10,000V » High inrush resistance: TV-15: 1 form A TV-10: 2 form A » Compact power relays for AC and DC voltage » Contact gap: 3mm » Socket available » Creepage and clearance distance min. 8mm	**Max.:** 90A 	» 100V DC » 277V AC	1a, 2a	(DC) 6, 12, 24, 48, 110V (AC) 12, 24, 48, 120, 240V
HE-S 1:3  36 x 30 x 40mm	» High-capacity and long life 35A 277V AC 5×104 (long life type) » Reduced coil holding power 170mW contributes to saving energy of equipment » Contact gap: 3.2 mm » Safety: Mirror contact mechanisms according to IEC 60947-4-1	**Max.:** 35A 	» 220V DC » 480V AC	2a, 1b	(DC) 6, 9, 12, 24, 48
Slim Power Relays					
LD-P 1:2  20.3 x 7 x 15mm	» Slim type: width 7mm » Coil power: 200mW » High switching capacity 5A/277V AC » Creepage and clearance distance min. 6mm » RTIII (IP67)	**Max.:** 5A 	» 30V DC » 277V AC	1a	(DC) 5, 6, 9, 12,18, 24V
PA-N 1:2  20 x 5 x 12.5mm	» High density mounting » Low operating power » Complies with IEC61010 reinforced insulation standards » Insulation distance: › 5.29mm clearance › 5.35mm creepage » Complies with Standard for Hazardous Location (ANSI/ ISA 12.12.01)	**Max.:** 5A 	» 110V DC » 250V AC	1a	(DC) 3, 4.5, 5, 6, 9, 2,18, 24V
PF 1:2  28 x 5 x 15mm	» Slim size permits high density mounting » Wide switching capacity » Slim relay for grid applications » Insulation construction conforms to VDE0700 » Contacts with gold flash plating or gold-clad contacts available » Clearance distance min. 6.0mm » Creepage distance min. 8mm » RTIII (IP67) » Bent pin type available	**Max.:** 6A 	» 300V DC » 400V AC	1a, 1c	(DC) 4.5, 5, 6,12, 18, 24, 48, 60V

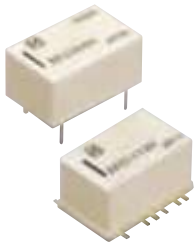
Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
(DC) 1920mW (AC) 1.7 - 2.7VA	2000Vrms	4000Vrms	5000Vrms	10,000V	Top mounting 	CSA, TÜV, TV rating, UL, VDE
(DC) 1880mW	2000Vrms	5000Vrms	10000Vrms	10,000V	Recommended PC board pattern (Bottom view) 	UL/C-UL, CUL, VDE
200mW	750Vrms	—	4000Vrms	10,000V	PCB 	C-UL, UL, VDE
110mW (5 - 18V) 180mW (24V)	1000Vrms	—	3000Vrms	6,000V	PCB 	UL/C-UL, TÜV,
170mW (5 - 24V) 217mW (48V) 175mW (60V)	1000Vrms	—	4000Vrms	6,000V	PCB 	C-UL, UL, VDE

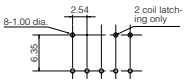
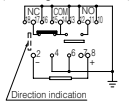
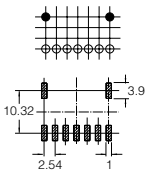
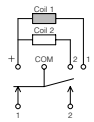
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
HE-V 1:3  50 x 41 x 39.4mm	» Max. 1,000V DC, 20A cut-off possible in compact size relay » Coil holding power 210mW » High surge withstand voltage: 10,000V » Protective construction: Flux-resistant type » Contact gap: min. 3.0mm » Clearance distance min. 8mm » Creepage distance min. 9.6mm	**Max.:** 20A 20A	» 1000V DC	2a	(DC) 6, 9, 12, 15, 24
EP 1:8  62.4 x 37.9 x 31.3mm  66.8 x 37.9 x 45mm  78 x 40 x 48.1mm  75.5 x 40 x 79mm  111 x 63 x 74.7mm	» High capacity to cut off DC voltage in a compact relay: max. cut-off current 2,500A/300V DC » Nominal switching capacity 300A 400V DC » Low operating noise » High contact reliability » DC type with sealed capsule » RTIII (IP67)	**Max.:** 10A 10A 20A 20A 80A 80A 300A 300A	» 1000V DC	1a	(DC) 12, 24, 48, 100V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
(DC) 1920mW	2000Vrms	4000Vrms	5000Vrms	10,000V	PCB 	UL, VDE
Max.: 1.4W (10A) 3.9W (20A) 4.5W (80A) 4 - 40W (300A)	2500Vrms	—	2500Vrms	—	PCB 10A PC board type  10A TM type  20A type  80A type  300A type 	—

Type (Picture scale: DIN A4)	**Features**	**Switching current**	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
RJ 1:1  14 x 9 x 8.2mm	» Shielded HF relay » Up to 8GHz » Impedance 50Ω » Latching types available » SMD and PCB version available » RTIII (IP67) HF characteristics at 5GHz: » Isolation min. 35dB » Isolation min. 30dB between contact sets » Insertion loss max. 0.5dB » V.S.W.R. max.1.25	**DC:** 0.3A **HF:** 1W (5GHz)	» 30V DC	2c	(DC) 3, 4.5, 12, 24V
RN 1:1  14.6 x 9.6 x 10.0mm	» High hot switching capability up to 80W at 2GHz, contact rating up to 150W at 2GHz » High frequency capability up to 6GHz » 1 changeover contact, impedance 50Ω » Reversed contact type available » Single side stable or 2 coil latching types available » SMT version available » Very good HF characteristics » RTIII (IP67) HF characteristics at 2GHz: » Isolation min. 55dB » Insertion loss max. 0.12dB » V.S.W.R. max. 1.15	**DC:** 0.5A **HF:** 80W	» 30V DC	1c SPDT	(DC) 4.5, 12, 24V
RA 1:1  14.7 x 9.7 x 5.9mm	» HF relay in SMT version » Up to 1GHz » Impedance 50Ω Latching types available » RTIII (IP67) HF characteristics at 1GHz: » Isolation min. 20dB » Isolation min. 30dB between contact sets » Insertion loss max. 0.3dB » V.S.W.R. max. 1.2	**DC:** 1A **HF:** 3W (1GHz, carrying point to carrying current)	» 30V DC	2c	(DC) 1.5, 3, 4.5, 5, 6, 9, 12, 24, 48V

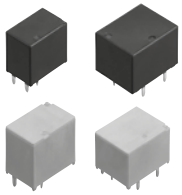
Coil power	Breakdown voltage				Life (min. operations)		Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil	Between live parts and ground	Electrical	Mechanical		
Single side stable: 200mW **2 coil latching:** 150mW	500Vrms	500Vrms	500Vrms	500Vrms	10^6	10^7	PCB, SMT 	—
Single side stable: 320mW **2 coil latching:** 400mW	500Vrms	—	500Vrms		10^5	10^6	SMT 	—
Single side stable: 140mW (1.5 - 12V) 200mW (24V) 300mW (48V) **1 coil latching:** 70mW (1.5 - 12V) 100mW (24V) **2 coil latching:** 140mW (1.5 - 12V) 200mW (24V)	750Vrms	1000Vrms	1000Vrms	1000Vrms	10^7	10^8	SMT 	—

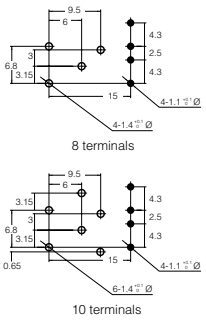
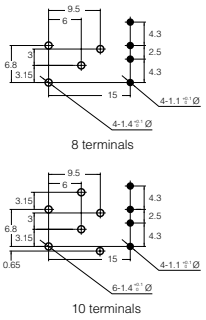
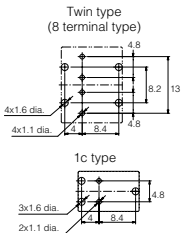
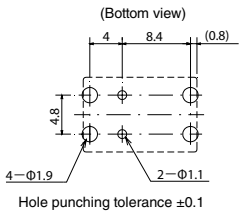
Type (Picture scale: DIN A4)	Features	Switching current	Max. switching voltage	Contact arrangement	Coil voltage
High-Frequency Relays					
RS 1:1  14 x 8.6 x 7/8mm	» HF relay » Up to 3GHz » Impedance 50/75Ω » Silent type available » Latching types available » SMT and PCB version available » 10W at 3GHz contact carrying power » RTIII (IP67) HF characteristics at 3GHz (50ΩPCB type): » Isolation min. 35dB » Insertion loss max. 0.35dB » V.S.W.R. max. 1.4	**DC:** 0.5A **HF:** 1W (3GHz)	» 30V DC	1c	(DC) 3, 4.5, 9, 12, 24V
RE 1:1  20.2 x 11.2 x 8.9/9.6mm	» HF relay » Up to 2.6GHz » Impedance 50/75Ω » SMT and PCB version available » RTIII (IP67) HF characteristics at 2.6GHz (75ΩPCB type): » Isolation min. 30dB » Insertion loss max. 0.5dB » V.S.W.R. max. 1.5	**DC:** 0.5A **HF:** 1W (2.6GHz)	» 30V DC	1c	(DC) 3, 4.5, 6, 9, 12, 24V
Coaxial Switches					
RV SPDT 1:1  15.9 x 15.9 x 11.2mm	» Ultra small coaxial switch » Up to 26.5 GHz » Impedance 50Ω » PIN and SMA terminals available » Latching types available » 2-coil latching type helps reduce power consumption » Failsafe type available » Reverse type available » Surge withstand voltage: 500Vrms HF characteristics at 18GHz/ SMA type: » Isolation min. 40dB » Insertion loss max. 0.7dB » V.S.W.R. max. 1.7	**HF:** 50W (3GHz)	—	SPDT	(DC) 4.5, 12, 24V

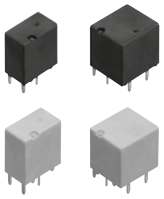
Coil power	Breakdown voltage				Life (min. operations)		Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil	Between live parts and ground	Electrical	Mechanical		
Single side stable: 200mW **1 coil latching:** 200mW **2 coil latching:** 400mW	500Vrms	—	1000Vrms	500Vrms	3×10^5	5×10^6	PCB, SMT  50Ω PCB type Single side stable type (Deenergized condition)  50Ω SMT type	—
Single side stable: 200mW	500Vrms	—	1000Vrms	500Vrms	3×10^5	10^6	PCB, SMT Grid 2.54mm  	—
700mW	500Vrms	500Vrms	500Vrms	500Vrms	3×10^5	10^6	PIN, SMA  	—

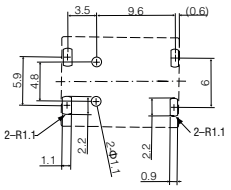
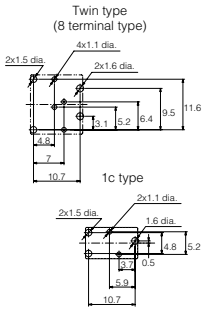
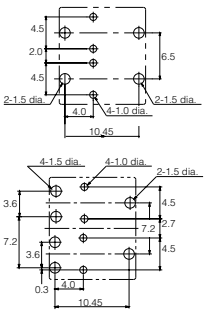
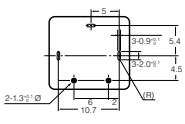
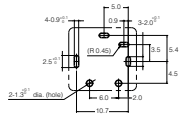
Type (Picture scale: DIN A4)	**Features**	**Switching current**	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
RD SPDT 1:2  34 x 13.2 x 40mm	» Coaxial relay » Up to 26.5GHz (18GHz) » Impedance 50Ω » Latching types available » TTL Version available » RTI HF characteristics at 18GHz: » Isolation min. 60dB » Insertion loss max. 0.5dB » V.S.W.R. max. 1.5	**DC:** 100mA (indicator) **HF:** 120W (3GHz)	» 30V DC (indicator)	SPDT	(DC) 4.5, 5, 12, 24V
RD TRANSFER 1:2  32 x 32 x 40mm	» Coaxial relay » Up to 26.5GHz (18GHz) » Impedance 50Ω » Latching types available » TTL Version available » RTI HF characteristics at 18GHz: » Isolation min. 60dB » Insertion loss max. 0.5dB » V.S.W.R. max. 1.5	**DC:** 100mA (indicator) **HF:** 120W (3GHz)	» 30V DC (indicator)	DPDT	(DC) 4.5, 5, 12, 24V
RD SP6T 1:4  80 x 80 x 40.5mm	» Coaxial relay » Up to 13GHz (18GHz) » Terminated type available » Impedance 50Ω » Latching types available » RTI HF characteristics at 13GHz: » Isolation min. 65dB » Insertion loss max. 0.4dB » V.S.W.R. max. 1.5	**DC:** 100mA (indicator) **HF:** 120W (3GHz)	» 30V DC (indicator)	SP6T	(DC) 4.5, 5, 12, 24V

Coil power	Breakdown voltage				Life (min. operations)		Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil	Between live parts and ground	Electrical	Mechanical		
Single side stable: 840-930mW (4.5, 12, 24V) **2 coil latching:** 600-620mW (4.5, 12, 24V) **Latching with TTL driver (self cut-off function):** 5, 12, 24V	500Vrms	500Vrms	500Vrms	500Vrms	5×10^6	5×10^6	Coax	—
Single side stable: 1540-1630mW (4.5, 12, 24V) **2 coil latching:** 700-1120mW (4.5, 12, 24V) **Latching with TTL driver (self cut-off function):** 5, 12, 24V	500Vrms	500Vrms	500Vrms	500Vrms	5×10^6	5×10^6	Coax	—
Single side stable: 840mW (4.5, 12V) 930mW (24V) **Latching:** 600mW (SET 4.5V) 600mW (SET 12V) 620mW (SET 24V)	500Vrms	500Vrms	500Vrms	500Vrms	5×10^6	5×10^6	Coax	—

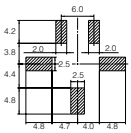
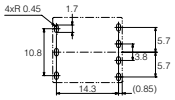
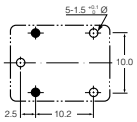
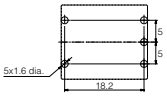
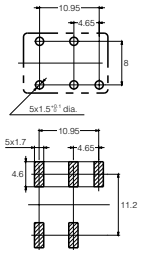
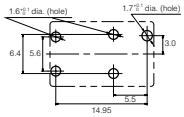
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
PCB relays					
CT 1:2  Single: 17.4 x 7.2 x 13.5mm Twin: 17.4 x 14 x 13.5mm	» Super miniature size » Twin (1 Form C x 2) » ACT512 layout = layout of 2 x ACT112 » H-bridge type available (twin relay) » Quiet operation » Pin in Paste (with vent hole) available	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c, 1c x 2	(DC) 12V
CT POWER 1:2  Single: 17.4 x 7.2 x 13.5mm Twin: 17.4 x 14 x 13.5mm	» Super miniature size » Twin (1 Form C x 2) » Footprint same as CT standard type » 30A switching capacity (motor load) » H-bridge type available (twin relay) » Pin in Paste (with vent hole) available	**Max.:** 30A (N.O.) 30A 10A (N.C.) 10A	» 16V DC	1c, 1c x 2	(DC) 12V
TB 1:2  Single Print: 14 x 9.2 x 13.5mm PiP: 14 x 9.2 x 14.0mm Twin Print: 17.4 x 14 x 13.5mm PiP: 17.4 x 14 x 14.0mm	» Super miniature size » Single (1 Form A, 1 Form C) Twin (1 Form C x 2) » H-bridge type available (twin relay) » Pin in Paste (with vent hole) available » Lamp load type available	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1a, 1c 1c x 2 (8 terminals) 1c x 2 (10 terminals)	(DC) 12V
TB1P 1:2  Size 14.0 x 9.2 x 14mm	» 1 form A contact arrangement » Low power consumption (typ. 480mW) » Small board space » Light weight	**Max.:** 30A (N.O.) 30A 10A (N.C.) 10A	» 16V DC	1a	(DC) 12V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
800mW	500Vrms	—	500Vrms	—	PCB, PiP 	—
1000mW	500Vrms	—	500Vrms	—	PCB, PiP 	—
1,440mW (for pick-up voltage max. 5.5V DC) 900mW (for pick-up voltage max. 6.5V DC) 640mW (for pick-up voltage max. 7.7V DC)	500Vrms	—	500Vrms	—	PCB, PiP 	—
480mW	500Vrms	—	500Vrms	—		

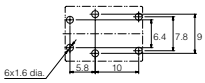
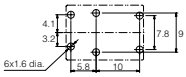
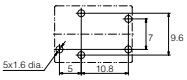
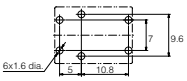
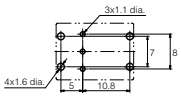
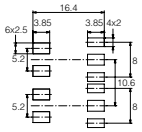
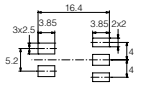
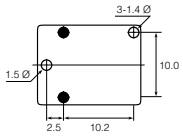
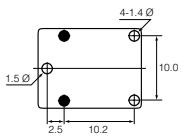
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
TL 1:2  14.4 x 11.0 x 16.0mm	» 1 form U contact arrangement (Double make) » Small board space » Light weight	**Max.:** 40A (N.O.) 40A	» 16V DC	1u (double make contact)	(DC) 12V
TE 1:2  Single Print: 12 x 7.2 x 13.5mm PiP: 12 x 7.2 x 14.0mm Twin Print: 13.6 x 12 x 13.5mm PiP: 13.6 x 12 x 14.0mm	» Ultra small size » Smallest in its class » High capacity in a compact body » Single (1 Form C) » Twin (1 Form C x 2) » H-bridge type available (twin relay) » RTIII (IP67) » Pin in Paste (with vent hole) available	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c, 1c x 2 (8 terminals)	(DC) 12V
CJ 1:2  5 Pin Print: 7.2 x 12.2 x 13.5mm PiP: 7.2 x 12.2 x 13.8mm 8 Pin Print: 13.7 x 12.2 x 13.5mm PiP: 13.7 x 12.2 x 13.8mm 10 Pin Print: 14.4 x 12.2 x 13.5mm PiP: 14.4 x 12.2 x 13.8mm	» Ultra small size » Single (1 Form C) » Twin (1 Form C x 2) » High capacity in a compact body » H-bridge type available (twin relay) » Pin in Paste (with vent hole) available	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c, 1c x 2	(DC) 12V
CP 1:2  14 x 13 x 9.5mm	» Very low profile » High capacity » 24V DC type available on request	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1a, 1c	(DC) 12V, 24V
CP POWER 1:2  14 x 13 x 9.5mm	» Very low profile » High capacity type: 45A maximum carrying current » Improved heat conduction thanks to additional pin » Layout is downward compatible to CP » Pin in Paste (with vent hole) available	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1a, 1c	(DC) 12V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
640mW (for pick-up voltage max. 6.5V DC)	500Vrms	—	500Vrms	—		—
1,309mW (for pick-up voltage max. 5.5V DC) 900mW (for pick-up voltage max. 6.5V DC) 655mW (for pick-up voltage max. 7.7V DC)	500Vrms	—	500Vrms	—	PCB, PiP 	—
Standard: 800mW High sensitivity: 640mW	500Vrms	—	500Vrms	—	PCB, PiP 	—
640mW	500Vrms	—	500Vrms	—	PCB 	—
450mW 640mW	500Vrms	—	500Vrms	—	PCB 	—

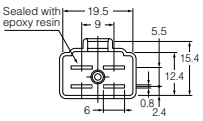
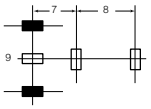
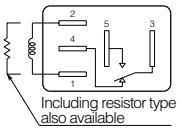
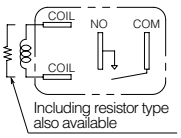
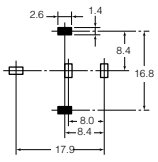
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
CP (SMD) 1:2  14 x 13 x 10.5mm	» Very low profile » High capacity	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c	(DC) 12V
TJ 1:2  15 x 16 x 11.2mm	» Compact flat type (height: 11.2mm) » High capacity switching » Thermal resistant type	**Max.:** 30A (N.O.) 30A 15A (N.C.) 15A	» 16V DC	1c	(DC) 12V
CQ 1:2  17 x 13 x 16.6mm	» Very quiet operation » Terminal layout identical to JJM	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c	(DC) 12V
TA 1:2  19.8 x 17 x 14mm	» Very quiet operation » Flat type	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c	(DC) 12V
CN-M 1:2  15,5 x 11 x 14.4mm	» Space-saving design » High switching capacity (up to 30A) » SMD type available » Pin in Paste (with vent hole) available	**Max.:** 30A (N.O.) 30A 25A (N.C.) 25A	» 16V DC	1a, 1c	(DC) 12V
CN-H 1:2  17 x 10.6 x 18.3mm	» Best space savings in its class » Substitute for Micro-ISO relay » Low operating power type » High current-carrying capacity	**Max.:** 30A	» 16V DC	1a	(DC) 12V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
640mW	500Vrms	—	500Vrms	—	SMT 	—
450mW	500Vrms	—	500Vrms	—	PCB 	—
640mW	500Vrms	—	500Vrms	—	PCB 	—
640mW (for pick-up voltage max. 7.7V DC) 900mW (for pick-up voltage max. 6.5V DC)	500Vrms	—	500Vrms	—	PCB 	—
640mW	500Vrms	—	500Vrms	—	PCB, SMT 	—
450mW (for pick-up voltage max. 6.5V DC) 640mW (for pick-up voltage max. 5.5V DC)	500Vrms	—	500Vrms	—	PCB 	—

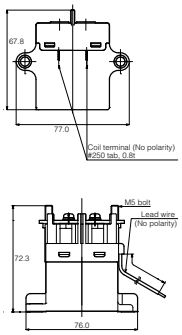
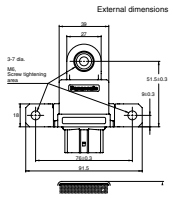
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
TG 1:2 17.8 x 12.6 x 18mm	» Large capacity switching despite small size » Substitute for micro ISO relays » Low operating power type	**Max.:** 30A (N.O.) 30A 15A (N.C.) 15A	» 16V DC	1a, 1c	(DC) 12V
TC 1:2 Print: 17.8 x 13 x 16.0mm PiP: 17.8 x 13 x 16.4mm	» Large capacity switching despite small size » Substitute for micro ISO relays » Latching type available » High heat resistant type available » Pin in Paste (with vent hole) available	**Max.:** 30A (N.O.) 30A 15A (N.C.) 15A	» 16V DC	1a, 1c, 2a (2 coil latching	(DC) 12V
TH 1:2 Single: 11 x 12 x 8.8mm Twin: 21.6 x 12 x 8.8mm	» Ultra compact flat type » SMD mounting type: 8.8mm » High switching capacity (up to 25A) » Single (1 Form C) » Twin (1 Form C x 2)	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1c 1c x 2 (10 terminals)	(DC) 12V
JJM 1:2 15.5 x 12 x 13.9mm	» Compact size » Bestselling, familiar blinker sound	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1a, 1c	(DC) 12V
JJM-DM 1:2 15.5 x 12 x 13.9mm	» Small size » Double make contact arrangement » Terminal layout compatible to JJM	**Max.:** 2 x 6A 6A 6A	» 16V DC	1u (double make contact)	(DC) 12V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
640mW (for pick-up voltage max. 6.5V DC) 450mW (for pick-up voltage max. 7.0V DC)	500Vrms	—	500Vrms	—	PCB 1a type  1c type 	—
1,309mW (for pick-up voltage max. 6.5V DC) 900mW (for pick-up voltage max. 7.0V DC) 640mW (for pick-up voltage max. 7.5V DC) 1,920mW (2 coil latching type)	500Vrms	—	500Vrms	—	PCB, PiP 1a standard type  1c/2a standard type  2a latching type 	—
900mW (for pick-up voltage max. 6.5V DC) 655mW (for pick-up voltage max. 7.7V DC)	500Vrms	—	500Vrms	—	SMT Twin type (10 terminal type)  1c type 	—
640mW	500Vrms	—	500Vrms	—	PCB 	—
1000mW	500Vrms	—	500Vrms	—	PCB 	—

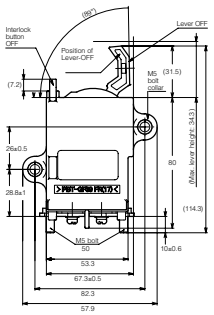
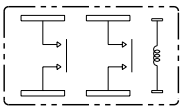
Type (Picture scale: DIN A4)	**Features**	**Switching current** (Min.: see data sheet)	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
Plug-in relays					
CA 1:2  21.5 x 14.4 x 37mm	» Small size » Direct plug-in	**Max.:** 20A (1a, 1.4W type) 20A 30A (1a, 1.8W type) 30A 20A (1b, 1c) 20A	» 15V DC (1c - 12V DC type) » 16V DC (1a, 1b - 12V DC type) » 30V DC (1c - 24V DC type)	1a, 1b, 1c	(DC) 12, 24V
CM 1:2  20 x 15 x 22mm	» Small substitute for Mini-ISO relay » Micro-ISO terminal type	**Max.:** 35A (N.O.) 35A 20A (N.C.) 20A	» 16V DC (12V DC type) » 32V DC (24V DC type)	1a, 1c	(DC) 12, 24V
CV 1:2  22.5 x 15 x 15.7mm	» Low profile » 20A Micro-ISO terminal type	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 16V DC	1a, 1c	(DC) 12V
CV-N 1:2  22.5 x 15 x 15.7mm	» Low profile » Low temperature rise » Low sound pressure level » RTIII (IP67) available	**Max.:** 20A (N.O.) 20A 10A (N.C.) 10A	» 14V DC	1a, 1c	(DC) 12V
CB 1:2  26 x 22 x 25mm	» 40A switching current at 85°C » Mini-ISO type terminals » High shock resistance » High thermal resistance » 1 Form A available with 70A switching current » Broad lineup	**Max.:** 70A (N.O. H type) 70A 40A (1a, 1c N.O.) 40A 30A (1c N.C.) 30A	» 16V DC (12V DC type) » 32V DC (24V DC type)	1a, 1c	(DC) 12, 24V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
1800mW 1400mW (type S)	500Vrms	—	500Vrms	—	Plug-in  1a, 1b	—
1500mW (12V DC type) 1800mW (24V DC type)	500Vrms	—	500Vrms	—	PCB (24V), Plug-in  	—
800mW	500Vrms	—	500Vrms	—	Plug-in  	—
800mW	500Vrms	—	500Vrms	—	Plug-in  	—
1400mW (12V DC type) 1800mW (24V DC type) 1800mW (12V DC, H type)	500Vrms	—	500Vrms	—	PCB, Plug-in  (PCB standard type)	—

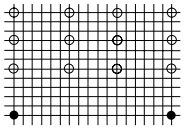
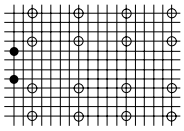
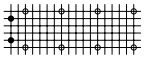
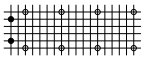
Type (Picture scale: DIN A4)	Features	Switching current (Min.: see data sheet)	Max. switching voltage	Contact arrangement	Coil voltage
High current/ High voltage relays					
EV 1:8  66.8 x 49.7 x 37.9mm  78 x 40 x 48.1mm  82.8 x 40 x 79mm  75.5 x 40 x 80mm  95 x 45 x 86.4mm  111 x 63 x 75mm	» 6 versions available: 10, 20, 80, 120, 200A, 300A » DC type with sealed capsule for electric and hybrid vehicles » Compact size » Small arcing space required thanks to blow-out magnets » Safety construction » High contact reliability	**Max.:** 10A (1a) 10A 20A (1a) 20A 60A (1a) 60A 80A (1a) 80A 120A (1a) 120A 200A (1a) 200A 300A (1a) 300A	» 400V DC	1a	(DC) 12, 24V
EV QUIET 1:4  76 x 36 x 72.3mm  77 x 67.8 x 37.7mm	» DC type with sealed capsule, mainly for hybrid vehicles » Very quiet operation » Small size and light weight » Small arcing space required thanks to blow-out magnets » Safety construction » High contact reliability » Standard type for horizontal mounting available	**Max.:** 60A (1a) 60A	» 400V DC	1a	(DC) 12V
CN-L 1:4  85.3 x 91.5 x 38.5mm	» Continuous carrying current of 150A@85°C » Continuous carrying current of 80A@125°C » Max. ambient temperature 125°C » Can be installed to engine compartment (IP54) » Version without fasten lug available » Overcurrent (> 2000A) trip function » No additional fuse needed	**Max.:** 150A (1a) 150A	» 14V DC	1a	(DC) 12V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
Stable: » 1240mW (10A, 12/24V) » 3900mW (20A, 12V) » 4200mW (80A/120A, 12/24V) » 6000mW (200A, 12/24V) » 3600mW (300A, 12V) » 3800mW (300A, 24V) Inrush: » 37.9W (300A, 12V) » 44.4W (300A, 24V)	2500Vrms	—	2500Vrms	—	Faston terminal (10A, 20A) Screw terminal (60A, 80A, 120A, 200A, 300A)	—
4500mW	Vertical: 2500Vrms Horizontal: 2000Vrms	—	Vertical: 2500Vrms Horizontal: 2000Vrms	—	Screw terminal 	—
30W	500Vrms	—	500Vrms	—	Screw terminal 	—

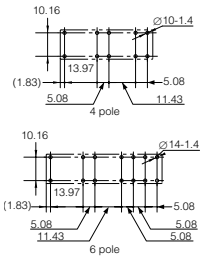
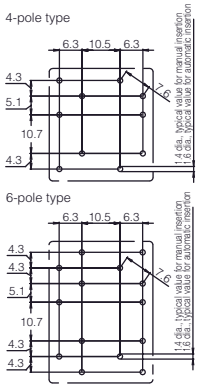
EV SWITCH 1:4  59.9 x 34.6 x 114.3mm	» High performance with capsule contact technology » High carrying current performance » Safety function	**Max.:** 80A (1a) 80A	» 400V DC	1a	—
CW 1:2  32 x 18 x 26mm	» Ideal relay for high output, 3-phase motors (Electric Power Steering) » High cut-off current capability and high carrying current	**Max.:** 120A	» 14V DC	2a	(DC) 12V

—	2500Vrms	—	2500Vrms	—	Screw terminal 	—
1400mW	500Vrms	—	500Vrms	—	Welding 	—

Type (Picture scale: DIN A4)	**Features**	**Switching current**	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
SFN4D 1:3  53.3 x 33 x 14.5mm	» Polarised relay with forcibly guided contacts according to EN 50205, Type B » Safety double contact » Coil power: 390mW » Relay height: 14.5mm » Reinforced insulation, creepage and clearance distance 5.5mm » RTIII (IP67)	**Max.:** 8A **Min.:** 10mA 	» 500V DC » 500V AC	4a2b	(DC) 5, 9, 12, 16, 18, 21, 24, 36, 48, 60V
SF4D 1:3  53.3 x 33 x 16.5mm	» Polarised relay with forcibly guided contacts according to EN 50205, Type B » Safety double contact » RTIII (IP67)	**Max.:** 8A **Min.:** 10mA 	» 400V DC » 400V AC	4a4b	(DC) 5, 9, 12, 18, 21, 24, 36, 48, 60V
SF2D 1:3  53.3 x 25 x 16.5mm	» Polarised relay with forcibly guided contacts according to EN 50205, Type A » Safety double contact » For applications according to EN 50155 » IEC/EN 60335-1 (GWT) compliant » RTIII (IP67)	**Max.:** 8A **Min.:** 10mA 	» 400V DC » 400V AC	2a2b	(DC) 5, 9, 12, 18, 21, 24, 36, 48, 60V
SF3 1:3  53.3 x 25 x 16.5mm	» Polarised relay with forcibly guided contacts according to EN 50205, Type A » For applications according to EN 50155 » IEC/EN 60335-1 (GWT) compliant » RTIII (IP67)	**Max.:** 8A **Min.:** 10mA 	» 400V DC » 400V AC	3a1b	(DC) 5, 9, 12, 18, 21, 24, 36, 48, 60V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
390mW (5 - 24V) 420mW (36 - 60V)	2500Vrms	4000Vrms	5000Vrms	—	PCB Grid 2.5mm  4a2b	CSA, TÜV, UL
500mW	2500Vrms	2500Vrms	2500Vrms	—	PCB Grid 2.54mm  4a4b	CSA, TÜV, UL
500mW	2500Vrms	2500Vrms	2500Vrms	—	PCB Grid 2.54mm  2a2b	CSA, TÜV, UL
500mW	2500Vrms	2500Vrms	2500Vrms	—	PCB Grid 2.54mm  3a1b	CSA, TÜV, UL

Type (Picture scale: DIN A4)	**Features**	**Switching current**	**Max. switching voltage**	**Contact arrangement**	**Coil voltage**
SFS 1:3  40 x 13 x 24mm  50 x 13 x 24mm	» Polarised relay with forcibly guided contacts according to EN 50205, Type A » 4-pole and 6-pole type with various contact arrangements » Slim profile reduces mounting area » PC board sockets and DIN-rail terminal socket available » RTII (IP54)	**Max.:** 6A **Min.:** 1mA 1mA 6A	» 30V DC » 250V AC	2a2b, 3a1b, 4a2b, 5a1b, 3a3b	(DC) 12, 16, 18, 21, 24, 48V
SF-Y 1:3  39 x 14.5 x 28.6mm  31 x 14.5 x 28.6mm	» Polarised relay with forcibly guided contacts according to EN 50205, Type A » 4-pole and 6-pole type with various contact arrangements » Gold clad contacts on request » Reinforced insulation according to EN 50178, creepage and clearance distance ≥5.5mm (V=230V overvoltage category III, 6 kV) » RTIII (IP67)	**Max.:** 8A **Min.:** 1mA 1mA 8A	» 400V DC » 250V AC	2a2b, 3a1b, 4a2b, 5a1b	(DC) 5, 12, 18, 21, 24V

Coil power	Breakdown voltage			Surge withstand voltage	Mounting method (bottom view)	Approvals
	Between open contacts	Between contact sets	Contacts to coil			
360mW (4 poles) 500mW (6 poles)	1500Vrms	2500Vrms/ 4000Vrms	4000Vrms	—	PCB 	CSA, TÜV, UL
670mW (4 poles, 6 poles)	1500Vrms	2500Vrms/ 4000Vrms	4000Vrms	—	PCB 	CSA, TÜV, UL

PHOTOMOS RELAYS

Panasonic

Lineup

Main Features

- Very compact housing (SON)
- Very low On resistance (HE-Type: Ron = typ. 8mΩ)
- Fast turn-on time (RF-Type: ton = 0,2ms)
- Very low leakage current (RF-Type: Leak = 10pA)
- High shock and vibration withstand capability (1000G)
- No arcing
- No abrasion → Endless lifetime

Highlights

- No threshold voltage
- Switching of lowest analog signals is possible
- Linear output characteristic
- Low control voltage / non inductive Input
- High I/O-Isolation (up to 5kV)
- High shock and vibration withstand capability (1000G)

Applications

- Automotive electronics
- Energy management
- Measurement equipment
- Telecommunication equipment
- Industrial automation
- Medical equipment
- Home and building security equipment

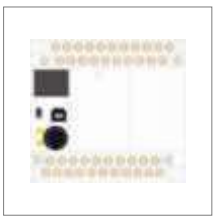
Applications

Automotive electronics

Energy management

Measurement equipment

Telecommunication equipment



Industrial Automation

Medical equipment

Home and building security equipment

What is PhotoMOS?

Panasonic Electric Works offers a wide range of PhotoMOS relays for use in telecommunication, measurement, security devices and industrial control. Obviously, the PhotoMOS relay differs from the conventional electromechanical relay, but it also distinguishes itself from other switching solutions that utilize optocouplers or semiconductors.

The construction of the PhotoMOS relay is illustrated below:

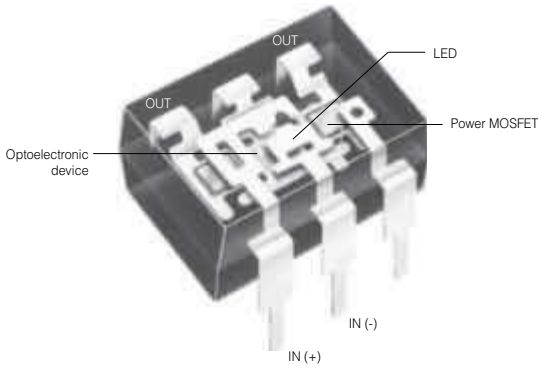


Figure 1 PhotoMOS internal construction

The input pins are connected to a light emitting diode. This LED is located on the upper part of the relay and as soon as a current flows through it, it starts emitting infrared light. Below the LED, there is an array of solar cells intergrated into an optoelectronic device, thus switching the output transistors.

The light emitter and detector are moulded in translucent resin that allows light to pass through but provides a dielectric barrier between the input and output side. By integrating an internal circuit in the optoelectronic device, it serves as a control circuit for switching the power MOSFETs and therefore the load circuit in an ON or OFF state.

A single power MOSFET is only capable of switching a DC voltage since its internal source-drain diode will become forward biased if the load polarity is reversed. Using a PhotoMOS relay for switching AC voltages therefore requires two source-coupled power MOSFETs in one PhotoMOS relay.

By connecting the two output transistors of an AC relay in parallel, the allowable DC current can also be increased (A, B or C connection) as illustrated below:

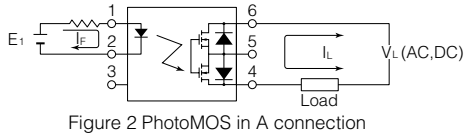


Figure 2 PhotoMOS in A connection

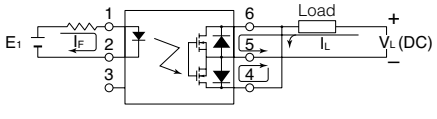


Figure 3 PhotoMOS in C connection

Basically, the power MOSFET's output acts as a pure ohmic resistance thus distinguishing the PhotoMOS from an optocoupler or triac solution, since no saturation voltage or offset voltage is required. However the aforementioned source-drain diode of the MOSFET may influence the linearity of the output, and the output capacitance may limit the usability for higher frequencies. This strongly depends on the type of PhotoMOS relay used and on the application's requirements.

Due to Panasonic's broad product range, we are able to offer PhotoMOS relays for numerous applications, enabling you to utilize

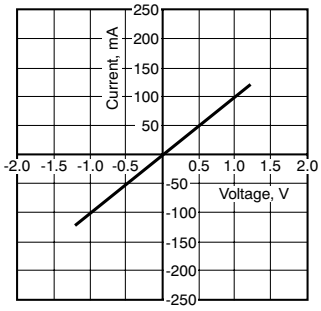
PhotoMOS advantages:

- Low control current
- Control of small analog signals
- Low leakage current
- Fast switching speed
- Stable ON-resistance over lifetime
- Extremely long product life
- Small size
- Flexible mounting position
- High vibration and shock resistance
- No contact bouncing
- No switching noise

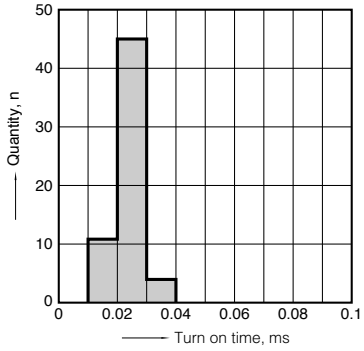
Due to the enormous variety of PhotoMOS relays, they are suitable for numerous applications (see figure 4). They can be used in telecommunications and for measurement equipment, for switching and controlling small motors or other power loads, and for controlling various signals out of microcontrollers.

Examples of PhotoMOS Advantages

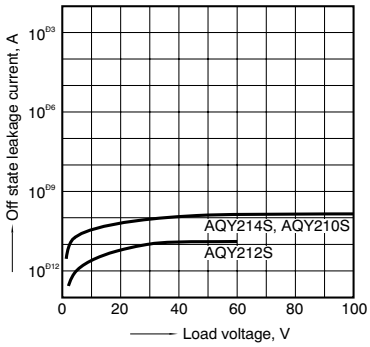
1. High output linearity without any saturation or offset voltage making PhotoMOS perfectly suitable for switching signals or loads (AQY225R2V).



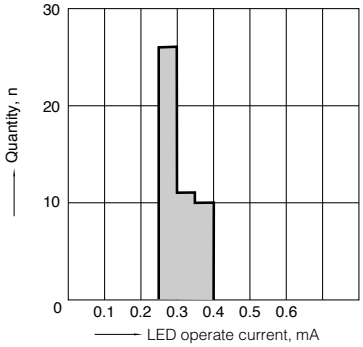
2. Fast switching times with stable behavior over lifetime and no contact bouncing due to semiconductor technology (AQY221N3V).

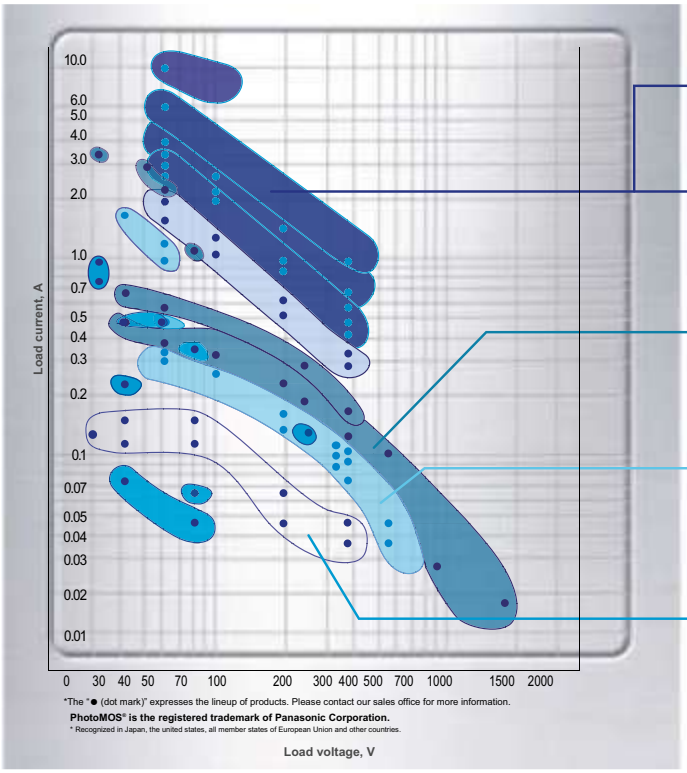


3. Perfectly suited for switching low level signals due to low off-state leakage current in the range of pA to nA (AQY21*S).



4. PhotoMOS relays require very low input control currents. Sensitive types are also available (AQV234). Take temperature and safety considerations into account.

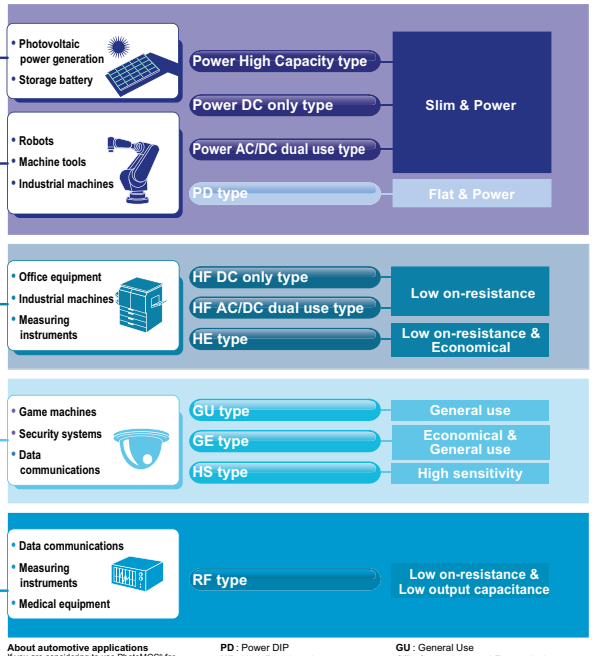




*The "● (dot mark)" expresses the lineup of products. Please contact our sales office for more information.

PhotoMOS® is the registered trademark of Panasonic Corporation.

* Recognized in Japan, the united states, all member states of European Union and other countries.



About automotive applications
If you are considering to use PhotoMOS® for automotive applications, please contact your local Panasonic Corporation technical representive.

PD : Power DIP
HF : High Functioned
HE : High functioned and Economical
RF : Radio Frequency

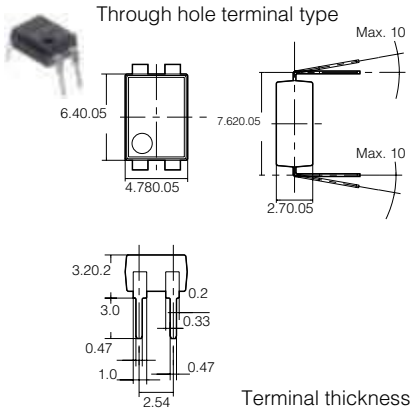
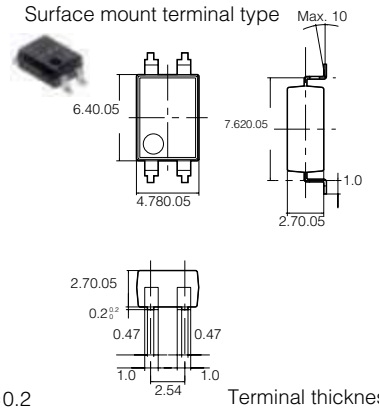
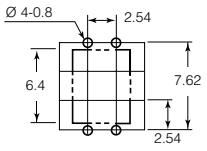
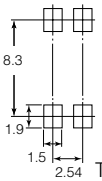
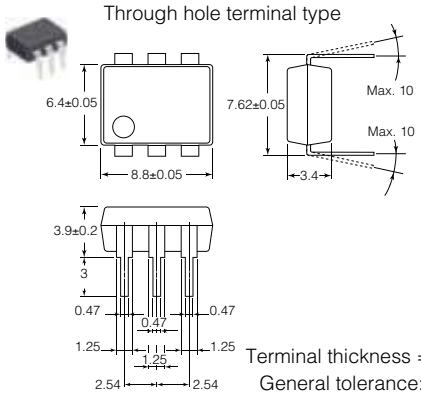
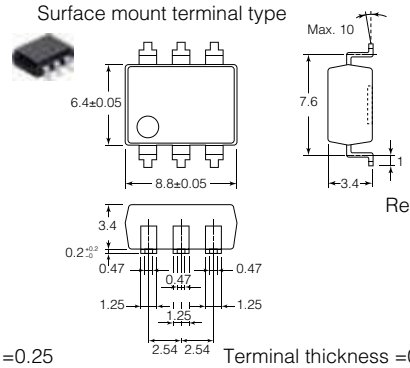
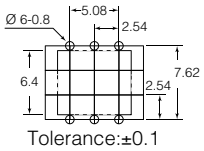
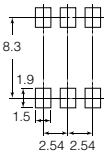
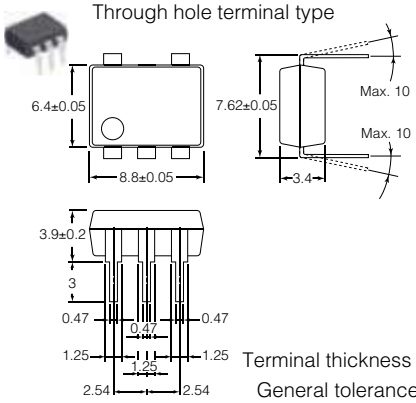
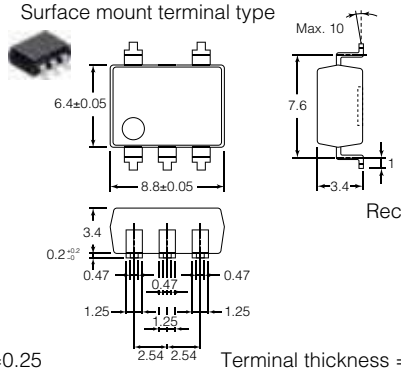
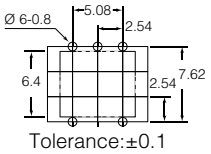
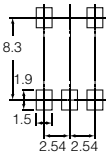
GU : General Use
GE : General use and Economical
HS : High Sensitivity

PhotoMOS Relays: Popular Type Selection Table

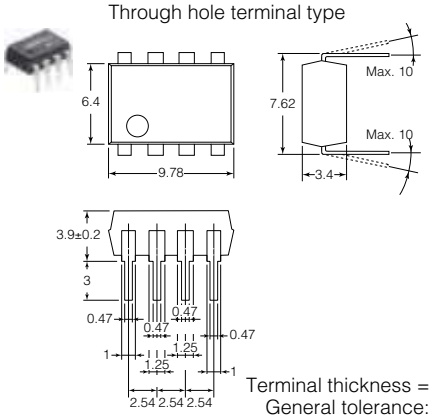
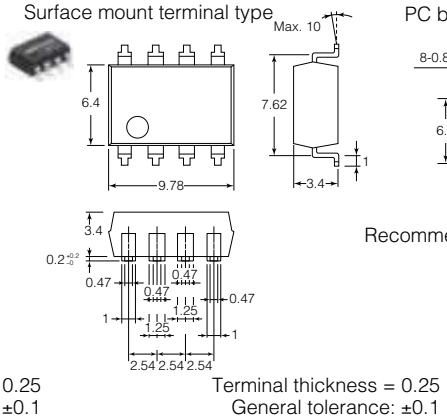
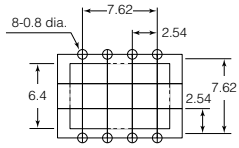
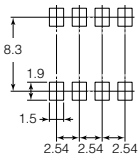
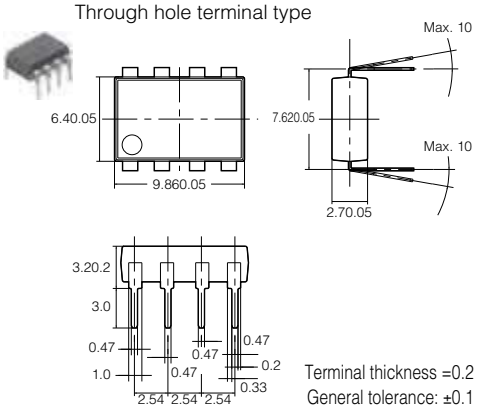
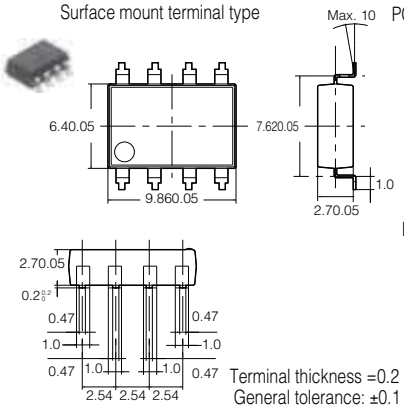
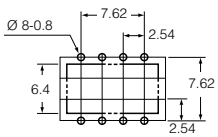
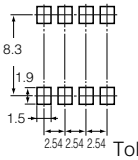
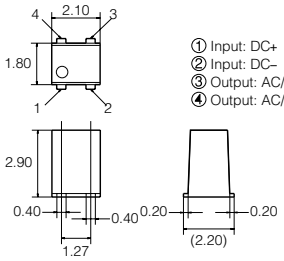
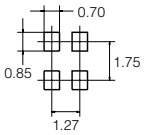
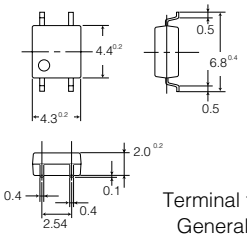
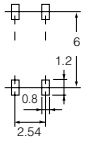
	Type[1]	Package	Contact	Voltage (V)[2]	Current (A)[2]	R_{on}[3] (Ω)	C_{out}[3] (pF)	Info.
	AQY211EH(A)	DIP4	1a	30	10	025	240	General use
	AQY212EH(A)			60	055	085	80	
	AQY212GH(A)			60	11	034	220	
	AQY210EH(A)			350	013	180	45	
	AQY214EH(A)			400	012	260	45	
	AQY216EH(A)			600	005	52	35	
	AQY212S	SOP4		60	05	083	80	
	AQY212GS			60	10	034	220	
	AQY212G2S			60	125	02	180	
	AQY210S			350	012	170	45	
	AQY214S			400	01	250	45	
	AQY412S		1b	60	05	10	450	
	AQY410S			350	012	180	110	
	AQY414S			400	01	260	100	
	AQY232S	SOP4	1a	60	05	085	80	Low operate current
	AQY230S			350	012	190	45	
	AQY234S			400	01	270	45	
	AQV112KL(A)	DIP6	1a	60	05	055	300	Short circuit protected
	AQY210KS	SOP4		350	012	23	42	
	AQV251G	DIP6	1a	30	35	0035	350	High power
	AQV252G2S	SOP6		50	30	004	360	
	AQV252G	DIP6		60	25	008	240	
	AQV255GS	SOP6		80	125	009	300	
	AQV259H(A)	DIP6		1,000	003	850	80	
	AQV258H(A)			1,500	002	3.450	80	
	AQY2C1R6P	TSON	1a	30	0.75	0.22	40	Low CxR for high frequencies
	AQY2C1R2P			40	0.3	0.9	14.5	
	AQY2C2R2P			60	0.3	1.0	27	
	AQY221N3T	VSSOP		25	015	55	11	
	AQY221N2T			40	012	95	11	
	AQY221R2T			60	04	08	27	
	AQY225R3T			100	012	88	58	
	AQY221N3M	SON		25	015	55	11	
	AQY221N2M			40	012	95	11	
	AQY221R2M			40	025	08	14	
	AQY221N2V	SSOP		40	012	95	1	
	AQY221R2V			40	025	075	125	
	AQY221R4V			40	05	055	24	
	AQY225R2V			80	012	105	45	
	AQY225R3V			100	012	88	58	
	AQY221N2S	SOP4		40	012	95	1	
	AQY221R2S			40	025	08	13	
	AQY225R2S			80	015	105	45	
	AQZ202		1a	60	30	011	1.400	AC and DC
	AQZ205			100	20	023	1.400	
	AQZ204			400	05	20	600	
	AQZ404		1b	400	05	28	2.000	

[1] A = SMD type, [2] Maximum value (DC or peak AC), [3] Typical value

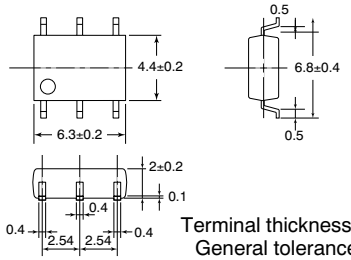
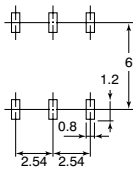
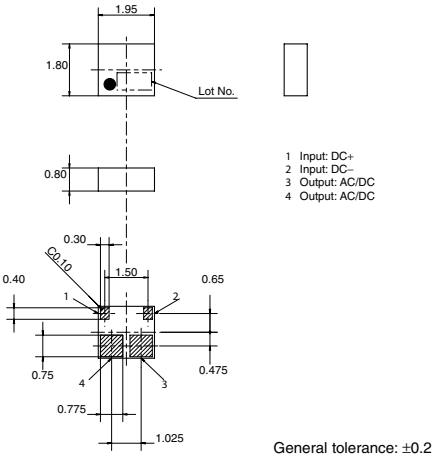
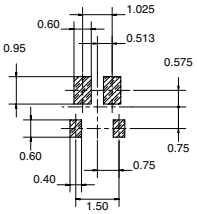
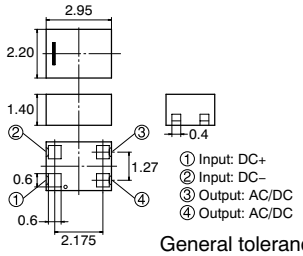
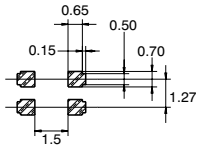
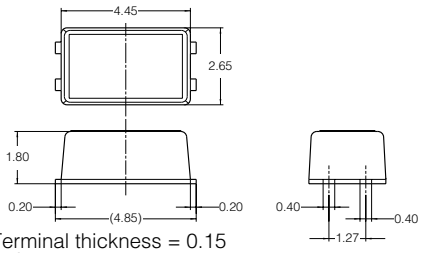
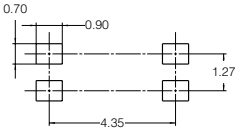
PhotoMOS Relay Dimensions

Type	Dimensions
AQY21 AQY41 Series	Through hole terminal type  Terminal thickness =0.2 General tolerance: ±0.1 Surface mount terminal type  Terminal thickness = 0.2 General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance: ±0.1 Mounting pad (Top view)  Tolerance: ,
AQV10 AQV11 AQV20 AQV21 AQV22 AQV23 AQV25 AQV41 AQV45 Series	Through hole terminal type  Terminal thickness =0.25 General tolerance: ±0.1 Surface mount terminal type  Terminal thickness =0.25 General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance:±0.1 Recommended mounting pad (Top view) 
APV1122 Series	Through hole terminal type  Terminal thickness =0.25 General tolerance: ±0.1 Surface mount terminal type  Terminal thickness =0.25 General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance:±0.1 Recommended mounting pad (Top view) 

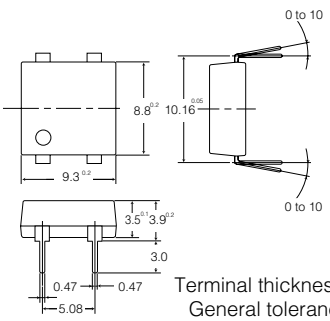
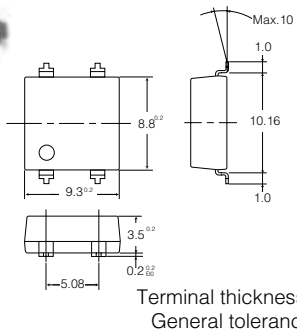
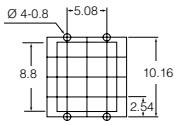
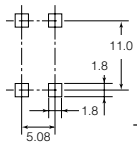
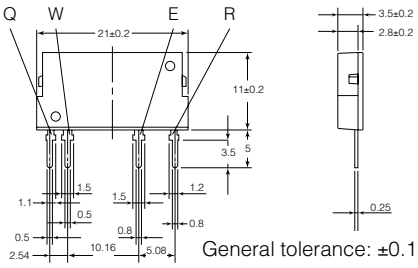
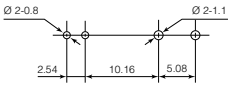
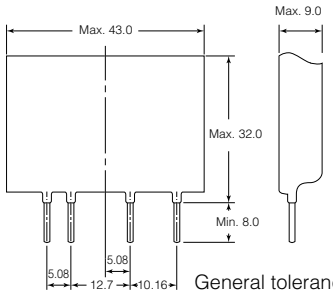
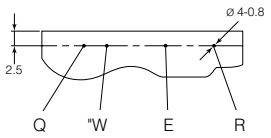
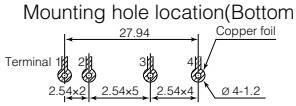
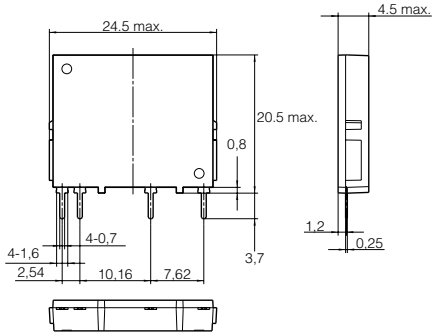
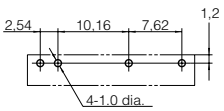
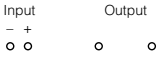
Please download CAD Data from our Web site: www.panasonic-electric-works.com

Type	Dimensions
AQW21 AQW22 AQW25 AQW41 AQW45 AQW61 AQW65 Series	Through hole terminal type  Terminal thickness = 0.25 General tolerance: ±0.1 Surface mount terminal type  Terminal thickness = 0.25 General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance:±0.1 Recommended mounting pad (Top view) 
AQW21ΩEH AQW21ΩHL AQW41ΩEH AQW61ΩEH Series	Through hole terminal type  Terminal thickness =0.2 General tolerance: ±0.1 Surface mount terminal type  Terminal thickness =0.2 General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance:±0.1 Mounting pad (Top view)  Tolerance:±0.1
AQY22 (VSSOP) Series AQW21ΩHL	  ① Input: DC+ ② Input: DC– ③ Output: AC/DC ④ Output: AC/DC General tolerance: ±0.2 Recommended mounting pad (Top view)  Tolerance : ±0.1
APV11(SOP) APV21(SOP) AQY21(SOP) AQY22(SOP) AQY23(SOP) AQY41(SOP) Series	  Terminal thickness =0.15 General tolerance: ±0.1 Recommended mounting pad (Top view)  Tolerance: ±0.1

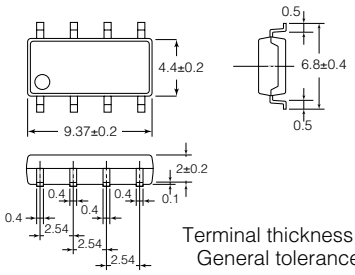
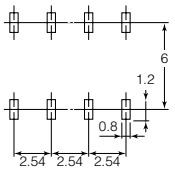
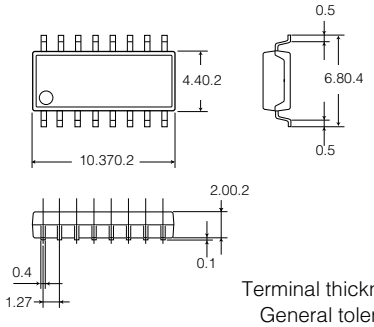
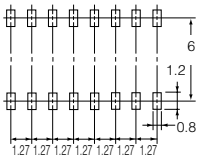
PhotoMOS Relay Dimensions

Type	Dimensions
AQV21(SOP) AQV22(SOP) AQV25(SOP) AQV41(SOP) Series	  Terminal thickness =0.15 General tolerance: ±0.1 Recommended mounting pad (Top view)  Tolerance: ±0.1
AQY2 (TSON) Series	 External dimensions  1 Input: DC+ 2 Input: DC– 3 Output: AC/DC 4 Output: AC/DC General tolerance: ±0.2 Recommended mounting pad (Top view)  Tolerance: ±0.1
AQY22 (SON) Series	  ① Input: DC+ ② Input: DC– ③ Output: AC/DC ④ Output: AC/DC General tolerance: ±0.2 Recommended mounting pad (Top view)  Tolerance : ±0.1
APV21 (SSOP) AQY22 (SSOP) Series	  Terminal thickness = 0.15 General tolerance: ±0.5 Recommended mounting pad (Top view)  Tolerance: ±0.1

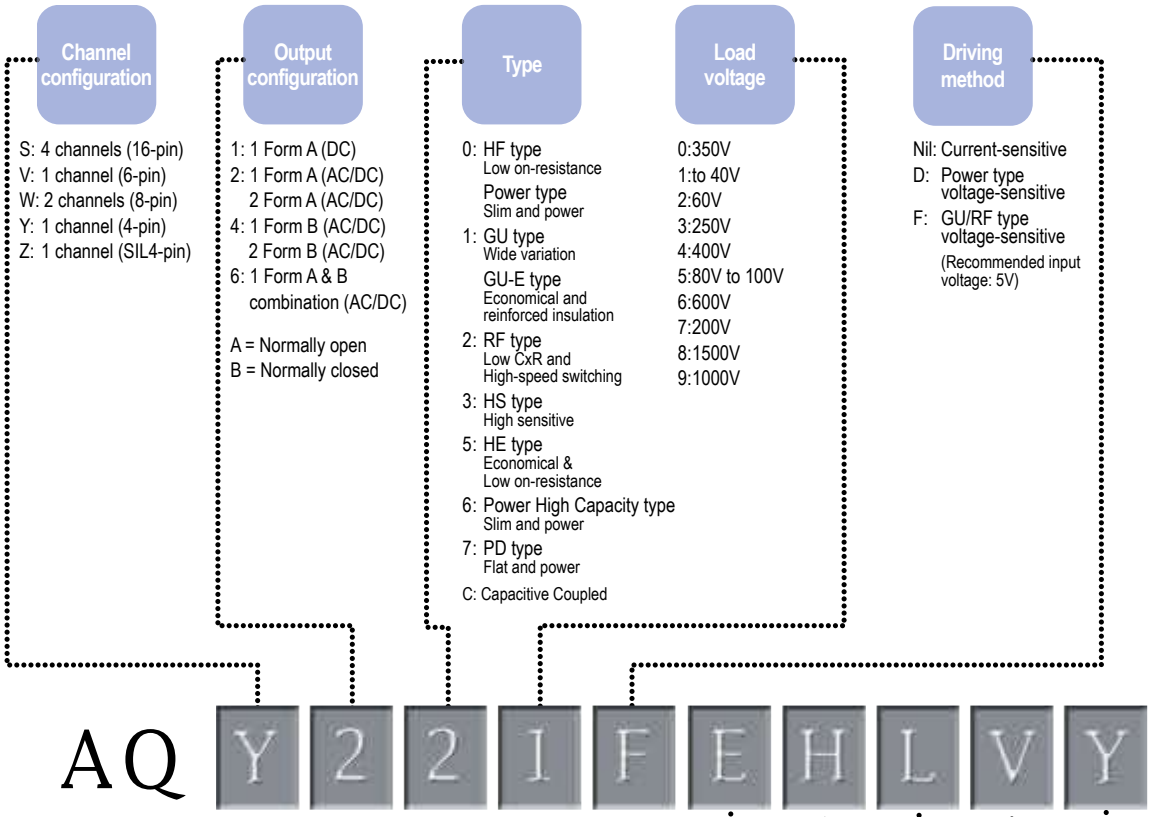
Please download CAD Data from our Web site: www.panasonic-electric-works.com

Type	Dimensions
AQY27 Series	Through hole terminal type   Terminal thickness =0.25 General tolerance: ±0.1 Surface mount terminal type   Terminal thickness =0.25 General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance: ±0.1 Recommended mounting pad (Top view)  Tolerance: ±0.1
AQZ10 AQZ20 AQZ40 Series	  General tolerance: ±0.1 PC board pattern (Bottom view)  Tolerance: ±0.1 AC/DC type Q Input: DC - W Input: DC+ E Output: DC or AC R Output: DC or AC DC type Q Input: DC - W Input: DC+ E Output: DC - R Output: DC+
AQZ26 Series	  General tolerance 0.5  Q Input: DC - "W Input: DC + E Output : AC or DC R Output : AC or DC Mounting hole location(Bottom view)  Pitch tolerance: 0.1
AQZ19 Series	  General tolerance: ±0,2 PC board pattern (Bottom view)  Tolerance: ±0,1 Schematic 

PhotoMOS Relay Dimensions

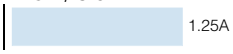
Type	Dimensions
AQW21(SOP) AQW22(SOP) AQW41(SOP) AQW61(SOP) Series	  Terminal thickness =0.15 General tolerance: ±0.1 Recommended mounting pad (Top view)  Tolerance: ±0.1
AQS22(SOP) Series	  Terminal thickness = 0.15 General tolerance: ±0.1 Recommended mounting pad (Top view)  Tolerance:±0.1

Product Key

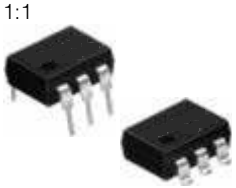


Note: Valid only for combinations of products listed in the catalog.
(Please inquire regarding combinations with products not listed in the catalog.)

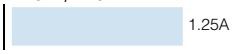
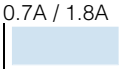
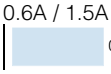
Product key may be followed by letter “J” or “T” for country of origin.

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQY211G2S	1:1  4.3 x 4.4 x 2.1mm	High capacity type	40V	» 1.6A / 4.0A 
AQY212G2S		High capacity type	60V	» 1.25A / 3.0A 
AQY212GS		High capacity type	60V	» 1.0A / 3.0A
AQY212S			60V	» 0.5A / 1.0A 
AQY210LS		Current limiting	350V	» 0.12A / - 0.18A (Output limit current [typ.])
AQY210S		PSpice	350V	» 0.12A / 0.3A
AQY210KS		Short circuit protected	350V	» 0.12A / - 0.2A (Cut off current [typ.])
AQY214S		PSpice	400V	» 0.1A / 0.24A
AQY232S	1:1  4.3 x 4.4 x 2.1mm	Sensitive type	60V	» 0.5A / 1.5A
AQY230S		Sensitive type	350V	» 0.12A / 0.3A
AQY234S		Sensitive type	400V	» 0.1A / 0.24A

Output		**Input**		**Switching speed** (I LED = 5mA)		**I/O isolation voltage**	**Approvals**
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.1/0.15Ω	180pF	3.0mA	0.2mA	3.0ms	0.5ms	1,500V AC	C-UL, UL, VDE
0.2/0.5Ω	180pF	3.0mA	0.3mA	5.0ms	0.5ms	1,500V AC	C-UL, UL, VDE
0.34/0.7Ω	220pF	3.0mA	0.3mA	5.0ms	0.5ms	1,500V AC	C-UL, UL, VDE
0.83/2.5Ω	80pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	BSI, C-UL, UL
20/25Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
17/25Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	BSI, C-UL, UL
23.5/35Ω	42pF	3.0mA	0.3mA	2.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
25/35Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	BSI, C-UL, UL
0.85/2.5Ω	0.8pF	0.5mA	0.1mA	5.0ms	2.0ms	1,500V AC	C-UL, UL, VDE
19/25Ω	0.8pF	0.5mA	0.1mA	5.0ms	2.0ms	1,500V AC	C-UL, UL, VDE
27/35Ω	0.8pF	0.5mA	0.1mA	5.0ms	2.0ms	1,500V AC	C-UL, UL, VDE

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQY211EH	1:1  DIP : 4.78 x 6.4 x 3.2mm SMD: 4.78 x 6.4 x 2.9mm		30V	» 1.0A / 3.0A 1A
AQY212EH			60V	» 0.55A / 1.5A 0.55A
AQY212GH		High capacity type	60V	» 1.1A / 3.0A 1.1A
AQY214EH			400V	» 0.12A / 0.3A 0.12A
AQY210EH			350V	» 0.13A / 0.4A 0.13A
AQY210HL		Current limiting	350V	» 0.12A / - 0.18A (Output limit current [typ.]) 0.12A
AQY216EH			600V	» 0.05A / 0.15A 0.05A
AQV212S	1:1  6.3 x 4.4 x 2.1mm	PSpice	60V	» 0.5A / 1.0A 0.5A
AQV215S		PSpice	100V	» 0.3A / 0.9A 0.3A
AQV217S		PSpice	200V	» 0.16A / 0.48A 0.16A
AQV210S		PSpice	350V	» 0.12A / 0.3A 0.12A
AQV214S		PSpice	400V	» 0.1A / 0.3A 0.1A
AQV216S		PSpice	600V	» 0.04A / 0.12A 0.04A
AQV212	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm	PSpice	60V	» 0.55A / 1.2A 0.55A
AQV252G		High capacity type	60V	» 2.5A / 6.0A 2.5A
AQV251G		High capacity type	30V	» 3.5A / 6.0A 3.5A

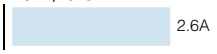
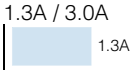
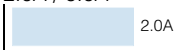
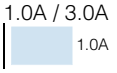
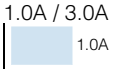
Output		**Input**		**Switching speed** (I LED = 5mA)		**I/O isolation voltage**	**Approvals**
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.25/0.5Ω	240pF	3.0mA	0.4mA	5.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
0.85/2.5Ω	80pF	3.0mA	0.4mA	4.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
0.34/0.7Ω	220pF	3.0mA	0.3mA	5.0ms	0.5ms	5,000V AC	C-UL, UL, VDE
26/35Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
18/25Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
20/25Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
52/120Ω	35pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
0.83/2.5Ω	150pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
2.3/4.0Ω	110pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
11/15Ω	70pF	3.0mA	0.4mA	1.0ms	0.2ms	1,500V AC	C-UL, UL
23/35Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
30/50Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
70/120Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
0.83/2.5Ω	150pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
0.08/0.12Ω	240pF	3.0mA	0.2mA	5.0ms	0.5ms	1,500V AC	C-UL, UL, VDE
0.035/0.08Ω	350pF	3.0mA	0.2mA	5.0ms	0.5ms	1,500V AC	C-UL, UL, VDE

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQV252G2S	1:1  6.3 x 4.4 x 2.0mm	High capacity type	50V	» 3.0A / 6.0A 
AQV255GS		High capacity type	80V	» 1.25A / 2.5A 
AQV215	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm	PSpice	100V	» 0.32A / 0.96A
AQV217		PSpice	200V	» 0.18A / 0.54A
AQV210		PSpice	350V	» 0.13A / 0.4A
AQV210E	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm		350V	» 0.13A / 0.4A 
AQV210EH			350V	» 0.13A / 0.4A 
AQV214		PSpice	400V	» 0.12A / 0.3A 
AQV214E			400V	» 0.12A / 0.3A 
AQV214EH			400V	» 0.12A / 0.3A 
AQV214H			400V	» 0.12A / 0.3A 
AQV216		PSpice	600V	» 0.05A / 0.15A 
AQV101			40V DC	» 0.7A / 1.8A 
AQV201			40V	» 0.5A / 1.8A 
AQV251			40V	» 0.5A / 1.8A 
AQV102			60V DC	» 0.6A / 1.5A 
AQV202			60V	» 0.4A / 1.5A 

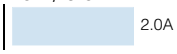
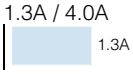
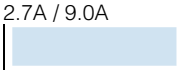
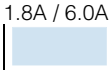
Output		**Input**		**Switching speed** (I LED = 5mA)		**I/O isolation voltage**	**Approvals**
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.04/0.07Ω	360pF	3.0mA	0.2mA	5.0ms	0.5ms	1,500V AC	C-UL, UL, VDE
0.09/0.15Ω	300pF	3.0mA	0.2mA	5.0ms	0.5ms	1,500V AC	C-UL, UL, VDE
2.3/4.0Ω	110pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
11/15Ω	70pF	3.0mA	0.4mA	1.0ms	0.2ms	1,500V AC	C-UL, UL
23/35Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
23/35Ω	45pF	3.0mA	1.0mA	2.0ms	1.0ms	1,500V AC	C-UL, UL
23/35Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
30/50Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
30/50Ω	45pF	3.0mA	0.3mA	2.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
30/50Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
30/50Ω	45pF	3.0mA	0.4mA	0.8ms	0.2ms	5,000V AC	BSI. C-UL, UL
70/120Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
0.3/0.5Ω	600pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
0.6/1Ω	350pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
0.6/1.0Ω	350pF	3.0mA	0.4mA	3.0ms	0.2ms	1,500V AC	C-UL, UL
0.37/0.7Ω	600pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, TÜV, UL
0.74/1.4Ω	350pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, TÜV, UL

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQV252	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm		60V	» 0.4A / 1.5A 0.4A
AQV112KL		Short circuit protected	60V DC	» 0.5A / - 0.5A
AQV255			100V	» 0.35A / 1.0A 0.35A
AQV257			200V	» 0.25A / 0.75A 0.25A
AQV103			250V DC	» 0.3A / 0.6A 0.3A
AQV203			250V	» 0.2A / 0.6A 0.2A
AQV253			250V	» 0.2A / 0.6A 0.2A
AQV253H	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm		250V	» 0.2A / 0.6A 0.2A
AQV104			400V DC	» 0.18A / 0.5A 0.18A
AQV204			400V	» 0.15A / 0.5A 0.15A
AQV234		Sensitive type	400V	» 0.12A / 0.3A 0.12A
AQV254			400V	» 0.15A / 0.5A 0.15A
AQV254H			400V	» 0.15A / 0.5A 0.15A
AQV256H			600V	» 0.13A / 0.4A 0.13A
AQV259			1,000V	» 0.03A / 0.09A 0.03A
AQV258			1,500V	» 0.02A / 0.06A 0.03A

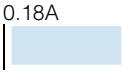
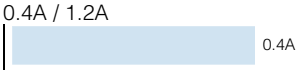
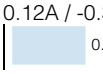
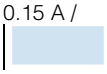
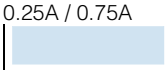
Output		**Input**		**Switching speed** (I LED = 5mA)		**I/O isolation voltage**	**Approvals**
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.74/1.4Ω	350pF	3.0mA	0.4mA	1.4ms	0.2ms	1,500V AC	C-UL, UL
0.55/2Ω	300pF	10mA	0.3mA	2.0ms	1.0ms	1,500V AC	C-UL, UL, VDE
1.8/2.5Ω	350pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
2.6/4.0Ω	170pF	3.0mA	0.4mA	3.0ms	0.2ms	1,500V AC	C-UL, UL
2.7/4Ω	300pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
5.5/8Ω	170pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
5.5/8.0Ω	170pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
5.5/8Ω	170pF	3.0mA	0.4mA	4.0ms	0.2ms	5,000V AC	BSI, C-UL, UL
6.3/8Ω	300pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, TÜV, UL
12.4/16Ω	170pF	5.0mA	0.8mA	1.0ms	1.0ms	1,500V AC	C-UL, TÜV, UL
30/50Ω	45pF	0.31mA	0.1mA	2.0ms	1.0ms	1,500V AC	CSA, C-UL, TÜV, UL
12.4/16Ω	170pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
12.4/16Ω	170pF	3.0mA	0.4mA	3.0ms	0.2ms	5,000V AC	BSI, C-UL, UL
20/30Ω	70pF	3.0mA	0.4mA	3.0ms	0.2ms	5,000V AC	C-UL, UL, VDE
80/200Ω	80pF	3.0mA	0.4mA	1.0ms	0.2ms	1,500V AC	C-UL, UL
345/500Ω	80pF	3.0mA	0.4mA	1.0ms	0.2ms	1,500V AC	C-UL, UL, VDE

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQZ102	1:1  21 x 3.5 x 12.5mm		60V DC	» 4.0A / 9.0A 
AQZ105			100V DC	» 2.6A / 6.0A 
AQZ107			200V DC	» 1.3A / 3.0A 
AQZ104			400V DC	» 0.7A / 1.5A 
AQZ262	1:1  43 x 9 x 32mm		60V	» 6.0A / 10.0A 
AQZ192	1:1  24.5 x 4.5 x 20.5mm	DC high capacity	60V	» 10.0A / 30.0A 
AQZ197		DC high capacity	200V	» 5.0A / 15.0A 
AQZ202	1:1  21 x 3.5 x 12.5mm		60V	» 3.0A / 9.0A 
AQZ205			100V	» 2.0A / 6.0A 
AQZ207			200V	» 1.0A / 3.0A 
AQZ204			400V	» 0.5A / 1.5A 
AQZ264	1:1  43 x 9 x 32mm		400V	» 1.0A / 3.0A 

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.05/0.09Ω	1700pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.081/0.17Ω	1700pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.34/0.55Ω	900pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
1.06/1.6Ω	900pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.036/0.05Ω	1400pF	3.0mA	0.4mA	10.0ms	3.0ms	1,500V AC	C-UL, UL, VDE
0.008/0.015Ω	1800pF	3.0mA	0.2mA	3.0ms	1.0ms	3,000V AC	C-UL, UL, VDE
0.031/0.05Ω	2600pF	3.0mA	0.2mA	3.0ms	1.0ms	3,000V AC	C-UL, UL, VDE
0.11/0.18Ω	1400pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.23/0.34Ω	1400pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.7/1.1Ω	600pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
2.1/3.2Ω	600pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
1.0/1.4Ω	600pF	3.0mA	0.4mA	10.0ms	3.0ms	1,500V AC	C-UL, UL, VDE

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
PhotoMOS 1 Form A Power Relays				
AQY272	1:1  DIP : 9.3 x 8.8 x 3.9mm SMD: 9.3 x 8.8 x 3.7mm		60V	» 2.0A / 6.0A  2.0A
AQY275			100V	» 1.3A / 4.0A  1.3A
AQY277			200V	» 0.65A / 2.0A 0.65A
AQY274			400V	» 0.35A / 1.0A  0.35A
PhotoMOS 1 Form A Voltage Sensitive Power Relays				
AQZ102D	1:1  21 x 3.5 x 12.5mm	Input voltage sensitive	60V DC	» 3.6A / 9.0A 3.6A
AQZ105D		Input voltage sensitive	100V DC	» 2.3A / 6.0A 2.3A
AQZ107D		Input voltage sensitive	200V DC	» 1.1A / 3.0A 1.1A
AQZ104D		Input voltage sensitive	400V DC	» 0.6A / 1.5A  0.6A
AQZ202D		Input voltage sensitive	60V	» 2.7A / 9.0A  2.7A
AQZ205D		Input voltage sensitive	100V	» 1.8A / 6.0A  1.8A
AQZ207D		Input voltage sensitive	200V	» 0.9A / 3.0A  0.9A
AQZ204D		Input voltage sensitive	400V	» 0.45A / 1.5A  0.45A

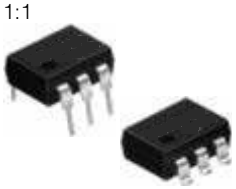
Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.11/0.18Ω	1400pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.23/0.34Ω	1400pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.7/1.1Ω	600pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
2.1/3.2Ω	600pF	3.0mA	0.4mA	5.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.033/0.09Ω	1700pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.090/0.17Ω	1700pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.33/0.55Ω	900pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
1.23/1.6Ω	900pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.066/0.18Ω	1400pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.18/0.34Ω	1400pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
0.64/1.1Ω	600pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE
2.4/3.2Ω	600pF	4V	0.8V	10.0ms	3.0ms	2,500V AC	C-UL, UL, VDE

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQY2C1R6P	1:1  1.8 x 1.95 x 2.9mm	Low CxR Capacitive Coupled	30V	» 0.75A 
AQY2C1R2P		Low CxR Capacitive Coupled	40V	» 0.3A 
AQY221R6T	1:1  1.8 x 2.1 x 2.9mm	Low CxR	30V	» 0.8A 
AQY221R2T		Low CxR	40V	» 0.25A
AQY221N2T		Low CxR	40V	» 0.12A
AQY221N3T		Low CxR	25V	» 0.15A
AQY221N5T		Low CxR	20V	» 0.18A 
AQY222R2T		Low CxR	60V	» 0.4A / 1.2A 
AQY225R3T		Low CxR	100V	» 0.12A / -0.3A 
AQY221N3M	1:1  2.2 x 2.95 x 1.4mm	Low CxR	25V	» 0.15 A / 
AQY221R2M		Low CxR	40V	» 0.25A / 0.75A 
AQY221N2M		Low CxR	40V	» 0.12A / - 

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
0.2/0.4Ω	40pF	0.2mA	0.1mA	0.5ms	0.5ms	200V AC	—
0.8/1.5Ω	14.5pF	0.2mA	0.1mA	0.5ms	0.5ms	200V AC	—
0.18/1.35Ω	37.5pF	3.0mA	0.1mA	0.5ms	0.2ms	200V AC	
0.8/1.25Ω	14pF	3.0mA	0.1mA	0.5ms	0.2ms	200V AC	—
9.5/12.5Ω	1.1pF	3.0mA	0.2mA	0.2ms	0.2ms	200V AC	—
5.5/7.5Ω	1.1pF	3.0mA	0.2mA	0.2ms	0.2ms	200V AC	—
2.8/4.5Ω	1.5pF	3.0mA	0.6mA	0.2ms	0.2ms	200V AC	—
0.8/1.25Ω	27pF	3.0mA	0.1mA	0.5ms	0.2ms	200V AC	—
8.8/14Ω	5.8pF	3.0mA	0.1mA	0.5ms	0.2ms	200V AC	—
5.5/7.5Ω	1.1pF	3.0mA	0.2mA	0.2ms	0.2ms	200V AC	—
0.8/1.25Ω	14pF	3.0mA	0.2mA	0.5ms	0.2ms	200V AC	—
9.5/12.5Ω	1.1pF	3.0mA	0.2mA	0.2ms	0.2ms	200V AC	—

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQY221N3V	1:1  2.65 x 4.45 x 1.8mm	Low CxR	25V	» 0.15A / 0.4A 0.15A
AQY221N5V		Low CxR	20V	» 1.0A / 1.5A 1A
AQY221R6V		Low CxR	30V	» 1.0A / 1.5A 1A
AQY221R4V		Low CxR	40V	» 0.5A / 1.0A 0.5A
AQY221N2V		Low CxR PSpice	40V	» 0.12A / 0.3A 0.12A
AQY221R2V		Low CxR PSpice	40V	» 0.25A / 0.75A 0.25A
AQY222R2V		Low CxR	60V	» 0.4A / 1.2A 0.4A
AQY225R2V		Low CxR	80V	» 0.12A / 0.3A 0.12A
AQY221N2S	1:1  4.3 x 4.4 x 2.1mm	Low CxR	40V	» 0.12A / 0.3A 0.12A
AQY221R2S		Low CxR	40V	» 0.25A / 0.75A 0.25A
AQY222R1S		Low CxR	60V	» 0.5A / 1.0A 0.5A
AQY225R1S		Low CxR	80V	» 0.35A / 0.7A 0.35A
AQY225R2S		Low CxR	80V	» 0.15A / 0.45A 0.15A
AQY225R3V		Low CxR	100V	» 0.12A / 0.3A 0.12A
AQY225R3T		Low CxR	100V	» 0.12A / 0.3A 0.12A
AQV227NS	1:1  6.3 x 4.4 x 2.1mm	Low CxR	200V	» 0.05A / 0.15A 0.05A
AQV224NS		Low CxR	400V	» 0.04A / 0.12A 0.04A

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
5.5/7.5Ω	1.0pF	3.0mA	0.2mA	0.2ms	0.2ms	1,500V AC	—
2.8/4.5Ω	1.5pF	3.0mA	0.7mA	0.2ms	0.2ms	500V AC	
0.18/0.35Ω	37.5pF	3.0mA	0.1mA	0.75ms	0.2ms	1,500V AC	—
0.55/1.0Ω	24pF	3.0mA	0.1mA	0.75ms	0.2ms	1,500V AC	—
9.5/12.5Ω	1.0pF	3.0mA	0.2mA	0.5ms	0.2ms	1,500V AC	—
0.75/1.25Ω	12.5pF	3.0mA	0.1mA	0.5ms	0.2ms	1,500V AC	—
0.8/1.25Ω	27pF	3.0mA	0.1mA	0.5ms	0.2ms	1,500V AC	—
10.5/15Ω	4.5pF	3.0mA	0.1mA	0.5ms	0.2ms	1,500V AC	—
9.5/12.5Ω	1.0pF	3.0mA	0.2mA	0.5ms	0.2ms	1,500V AC	—
0.8/1.25Ω	13pF	3.0mA	0.1mA	0.5ms	0.2ms	500V AC	—
0.8/1.2Ω	27.5pF	3.0mA	0.1mA	0.5ms	0.2ms	1,500V AC	—
0.8/1.2Ω	37.5pF	3.0mA	0.1mA	0.75ms	0.2ms	1,500V AC	C-UL, UL
10.5/15Ω	4.5pF	3.0mA	0.1mA	0.5ms	0.2ms	1,500V AC	—
8.8/14Ω	5.8pF	3.0mA	0.1mA	0.5ms	0.05ms	1,500V AC	
8.8/14Ω	5.8pF	3.0mA	0.1mA	0.5ms	0.2ms	200V AC	
30/50Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
70/100Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
PhotoMOS 1 Form A Low CxR				
AQV221	1:1  DIP : 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm		40V	» 0.08A / 0.18A 0.8A
AQV225			80V	» 0.05A / 0.15A 0.05A
AQV227N			200V	» 0.07A / 0.21A 0.07A
AQV224N			400V	» 0.05A / 0.15A 0.05A
1 Form B Signal Relays				
AQY412S	1:1  4.3 x 4.4 x 2.1mm		60V	» 0.5A / 1.5A 0.5A
AQY410S			350V	» 0.12A / 0.3A 0.12A
AQY414S			400V	» 0.1A / 0.24A 0.1A
AQY412EH	1:1  DIP : 4.78 x 6.4 x 3.2mm SMD: 4.78 x 6.4 x 2.9mm		60V	» 0.55A / 1.5A 0.55A
AQY410EH			350V	» 0.13A / 0.4A 0.13A
AQY414EH			400V	» 0.12A / 0.3A 0.12A
AQV414S	1:1  6.3 x 4.4 x 2.1mm		400V	» 0.1A / 0.3A 0.1A

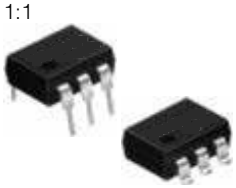
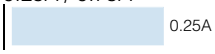
Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
22/35Ω	5.6pF	3.0mA	0.4mA	0.3ms	0.1ms	1,500V AC	C-UL, UL
36/50Ω	4.8pF	3.0mA	0.4mA	0.3ms	0.1ms	1,500V AC	C-UL, UL
30/50Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
70/100Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
1/2.5Ω	450pF	3.0mA	0.4mA	3.0ms	1.0ms	1,500V AC	C-UL, UL, VDE
18/25Ω	110pF	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
26/35Ω	100pF	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
1/2.5Ω	480pF	3.0mA	0.4mA	10.0ms	1.0ms	5,000V AC	C-UL, UL, VDE
18/25Ω	110pF	3.0mA	0.4mA	3.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
26/35Ω	100pF	3.0mA	0.4mA	3.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
26/50Ω	100pF	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	C-UL, UL

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQV410EH	1:1  DIP : 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm		350V	» 0.13A / 0.4A 0.13A
AQV412EH			60V	» 0.55A / 1.5A 0.55A
AQV414E			400V	» 0.12A / 0.3A 0.12A
AQV414EH			400V	» 0.12A / 0.3A 0.12A
AQV453			250V	» 0.2A / 0.6A 0.2A
AQV414			400V	» 0.12A / 0.3A 0.12A
AQV454			400V	» 0.15A / 0.5A 0.15A
AQV454H			400V	» 0.15A / 0.5A 0.15A
1 Form B Power Relays				
AQZ404	1:1  21 x 3.5 x 12.5mm		400V	» 0.5A / 1.5A 0.5A

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
18/35Ω	110pF	3.0mA	0.4mA	3.0ms	1.5ms	5,000V AC	BSI, C-UL, UL
1/2.5Ω	480pF	3.0mA	0.4mA	10.0ms	1.5ms	5,000V AC	C-UL, UL, VDE
26/50Ω	100pF	3.0mA	0.3mA	2.0ms	1.0ms	1,500V AC	C-UL, UL
26/50Ω	100pF	3.0mA	0.4mA	3.0ms	1.5ms	5,000V AC	BSI, C-UL, UL
5.5/8.0Ω	350pF	3.0mA	0.4mA	3.0ms	1.0ms	1,500V AC	C-UL, UL
26/50Ω	100pF	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
10.5/16Ω	170pF	3.0mA	0.4mA	2.0ms	1.0ms	1,500V AC	C-UL, UL
10.5/16Ω	170pF	3.0mA	0.4mA	3.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
2.8/4.0Ω	2000pF	3.0mA	0.4mA	7.5ms	3.0ms	2,500V AC	C-UL, UL, VDE

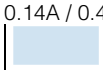
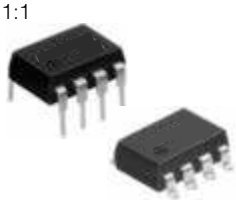
Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQW210S	1:1  9.37 x 4.4 x 2.1mm		350V	» 0.1A / 0.3A 0.1A
AQW212S			60V	» 0.4A / 1.5A 0.4A
AQW214S			400V	» 0.08A / 0.24A 0.08A
AQW212EH	1:1  DIP : 9.86 x 6.4 x 3.2mm SMD: 9.86 x 6.4 x 2.9mm		60V	» 0.5A / 1.5A 0.5A
AQW210EH			350V	» 0.12A / 0.36A 0.12A
AQW210HL		Current limiting	350V	» 0.1A / - 0.18A (Output limit current [typ.]) 0.1A
AQW214EH			400V	» 0.1A / 0.3A 0.1A
AQW216EH			600V	» 0.04A / 0.12A 0.04A
AQW212	1:1  DIP : 9.78 x 6.4 x 3.9mm SMD: 9.78 x 6.4 x 3.6mm		60V	» 0.6A / 1.0A 0.6A »
AQW215			100V	» 0.3A / 0.9A 0.3A
AQW217			200V	» 0.16A / 0.48A 0.16A
AQW210			350V	» 0.12A / 0.36A 0.12A
AQW214			400V	» 0.1A / 0.3A 0.1A
AQW254			400V	» 0.12A / 0.36A 0.12A
AQW216			600V	» 0.04A / 0.12A 0.04A

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
16/35Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	BSI, C-UL, UL
0.83/2.5Ω	-	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	BSI, C-UL, UL
30/50Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	BSI, C-UL, UL
0.83/2.5Ω	80pF	3.0mA	0.4mA	4.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
18/25Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
20/25Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
26/35Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
52/120Ω	45pF	3.0mA	0.4mA	2.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
0.83/2.5Ω	150pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
2.3/4.0Ω	110pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
11/15Ω	70pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
23/35Ω	45pF	3.0mA	0.4mA	0.5ms	0.05ms	1,500V AC	C-UL, UL
30/50Ω	45pF	3.0mA	0.4mA	0.5ms	0.05ms	1,500V AC	C-UL, UL
12.4/16Ω	170pF	3.0mA	0.4mA	2.0ms	0.2ms	1,500V AC	C-UL, UL
70/120Ω	45pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL

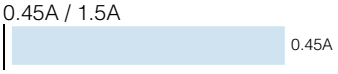
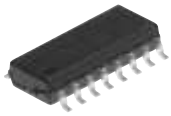
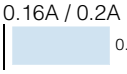
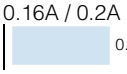
Type	Photo with dimensions (Picture scale: DIN A4)	Application	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
AQV258HAXC**	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm	Isolation monitoring	1500V	» 0.02A / 0.06A 
AQV219HAXC**		Isolation monitoring	900V	» 0.015A / 0.045A 
AQW212HAXC**	1:1  DIP : 9.86 x 6.4 x 3.2mm SMD: 9.86 x 6.4 x 2.9mm	Cell Balancing	60V	» 0.6A / 1.5A 
AQW216HAXC**		Battery monitoring	600V	» 0.05A / 0.12A 
AQV216HAXC**	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm	Battery monitoring	600V	» 0.04A / 0.12A 
AQY215HAXC**	1:1  DIP : 4.78 x 6.4 x 3.2mm SMD: 4.78 x 6.4 x 2.9mm	Wake up switch	100V	» 0.25A / 0.75A 

**Project based number

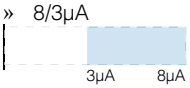
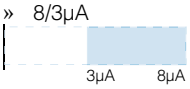
Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
305/500Ω	on request	3.0mA	0.4mA	1ms	0.5ms	5,000V AC	–
310/500Ω	on request	3.0mA	0.8mA	0.5ms	0.2ms	3,000V AC	–
0,85/2,50Ω	on request	3.0mA	0.8mA	2ms	0.5ms	1,500V AC	–
70/150Ω	on request	3.0mA	0.8mA	0.5ms	0.4ms	5,000V AC	–
70/120Ω	on request	3.0mA	0.8mA	0.5ms	0.2ms	2,500V AC	–
2,3/4Ω	on request	3.0mA	0.4mA	2ms	0.7ms	2,500V AC	–

Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
2 Form A Low CxR				
AQW227NS	1:1  9.37 x 4.4 x 2.1mm		200V	» 0.04A / 0.15A 0.04A
AQW223R2S		Low CxR	250V	» 0.14A / 0.42A  0.14A
AQW227N	1:1  DIP : 9.78 x 6.4 x 3.9mm SMD: 9.78 x 6.4 x 3.6mm		200V	» 0.05A / 0.15A 0.05A
AQW224N			400V	» 0.04A / 0.12A 0.04A
2 Form B				
AQW414S	1:1  9.37 x 4.4 x 2.1mm		400V	» 0.08A / 0.24A 0.24A
AQW414EH	1:1  DIP : 9.86 x 6.4 x 3.2mm SMD: 9.86 x 6.4 x 2.9mm		400V	» 0.1A / 0.3A  0.1A
AQW414	1:1  DIP : 9.78 x 6.4 x 3.9mm SMD: 9.78 x 6.4 x 3.6mm		400V	» 0.1A / 0.3A 0.1A
AQW454			400V	» 0.12A / 0.36A 0.12A

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
30/50Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
10/15Ω	33pF	3.0mA	0.1mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
30/50Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
70/100Ω	10pF	3.0mA	0.4mA	0.5ms	0.2ms	1,500V AC	C-UL, UL
26/50Ω	100pF	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
26/35Ω	100pF	3.0mA	0.4mA	3.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
26/50Ω	100pF	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
11/16Ω	170pF	3.0mA	0.4mA	2.0ms	1.0ms	1,500V AC	C-UL, UL

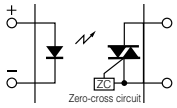
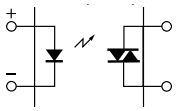
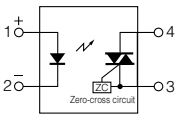
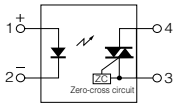
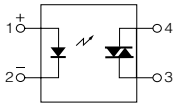
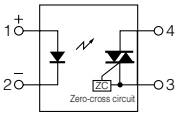
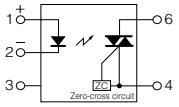
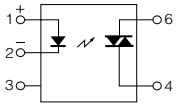
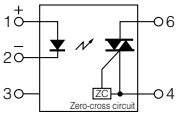
Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Peak load V DC/AC	Continuous load current/ Peak load current (100ms)
1 Form A / 1 Form B				
AQW612S	1:1  9.37 x 4.4 x 2.1mm		60V	» 0.45A / 1.5A 
AQW610S			350V	» 0.1A / 0.3A 
AQW612EH	1:1  DIP : 9.86 x 6.4 x 3.2mm SMD: 9.86 x 6.4 x 2.9mm		60V	» 0.5A / 1.5A 
AQW610EH			350V	» 0.12A / 0.36A
AQW614EH			400V	» 0.1A / 0.3A 
AQW614	1:1  DIP : 9.78 x 6.4 x 3.9mm SMD: 9.78 x 6.4 x 3.6mm		400V	» 0.1A / 0.3A
AQW654			400V	» 0.12A / 0.36A
Multichannel				
AQS221R2S	1:1  10.37 x 4.4 x 2.1mm	Low CxR	40V	» 0.16A / 0.2A 
AQS221N2S		Low CxR	40V	» 0.06A / 0.12A 
AQS225R2S		Low CxR	80V	» 0.07A / 0.2A 
AQS221FR2S		Built-in resistor	40V	» 0.16A / 0.2A 
AQS221FN2S		Built-in resistor	40V	» 0.06A / 0.12A 

Output		Input		Switching speed		I/O isolation voltage	Approvals
ON resistance (typical/max.)	Output capacitance (typical)	LED operate current (max.)	LED turn-off current (min.)	Turn-on time (max.)	Turn-off time (max.)		
1/2.5Ω	80pF (N.O.) 450pF (N.C.)	3.0mA	0.4mA	3.0ms	1.0m	1,500V AC	C-UL, UL, VDE
18/25Ω	45pF (N.O) 100pF (N.C.)	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	BSI, C-UL, UL
1/2.5Ω	80pF (N.O.) 480pF (N.C.)	3.0mA	0.4mA	4.0ms (N.O.) 10.0ms (N.C.)	1.0ms	5,000V AC	C-UL, UL, VDE
18/25Ω	45pF (N.O.) 100pF (N.C.)	3.0mA	0.4mA	3.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
26/35Ω	45pF (N.O.) 100pF (N.C.)	3.0mA	0.4mA	3.0ms	1.0ms	5,000V AC	BSI, C-UL, UL
27/50Ω	45pF (N.O.) 100pF (N.C.)	3.0mA	0.4mA	1.0ms	1.0ms	1,500V AC	C-UL, UL
N.O.: 10/16Ω N.C.: 11/16Ω	170pF	3.0mA	0.4mA	3.0ms	1.0ms	1,500V AC	C-UL, UL
0.8/1.25Ω	13pF	3.0mA	0.1mA	0.5ms	0.2ms	500V AC	—
9.5/12.5Ω	1pF	3.0mA	0.1mA	0.2ms	0.2ms	500V AC	—
10.5/15.0Ω	4.5pF	3.0mA	0.3mA	0.3ms	0.2ms	1,500V AC	—
0.5/1.5Ω	12.5pF	Operate voltage V_{Fon} (max.) 4.0V	Turn off voltage V_{Foff} (min.) 0.8V	0.5ms	0.2ms	500V AC	—
9.5/12.5Ω	1pF	Operate voltage V_{Fon} (max.) 4.0V	Turn off voltage V_{Foff} (min.) 0.8V	0.5ms	0.2ms	500V AC	—

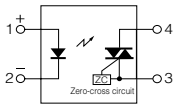
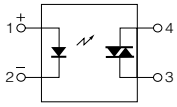
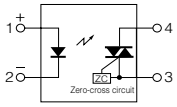
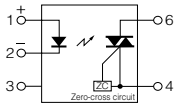
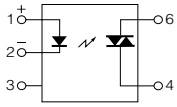
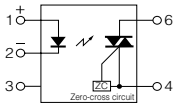
Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output	
			Drop-out voltage (typical/min.)	Short circuit current (typical/min.)
APV2111V	1:1  2.65 x 4.45 x 1.8mm	Ultra small SSOP housing	8.2/5.0V	» 8/3µA 
APV1121S	1:1  4.3 x 4.4 x 2mm	Ultra small SMD (SOP) housing	8.7/6.0V	» 14/5µA 
APV2121S		Ultra small SMD (SOP) housing	8.2/5.0V	» 8/3µA 
APV1122	1:1  DIP : 8.8 x 6.4 x 3.6mm SMD: 8.8 x 6.4 x 3.9mm	5000V breakdown voltage	8.7/6.0V	» 14/5µA 

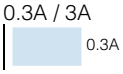
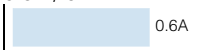
Input		Switching speed		I/O isolation voltage	Approvals
LED operate current (max.)	LED turn-off current (min.)	Turn-on time (typical)	Turn-off time (typical)		
3.0mA	0.2mA	0.8ms	0.1ms	1,500V AC	C-UL, UL
3.0mA	0.2mA	0.4ms	0.1ms	2,500V AC	C-UL, UL
3.0mA	0.2mA	0.8ms	0.1ms	2,500V AC	C-UL, UL
3.0mA	0.2mA	0.4ms	0.1ms	5,000V AC	C-UL, UL

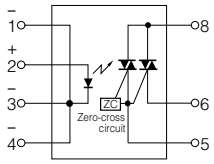
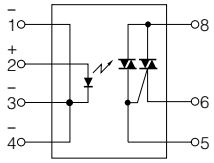
Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output			
			Repetitive peak OFF-state voltage	Max. load current/ Non-repetitive surge current (1 cycle, 60Hz)	Peak ON-state voltage (max.)	Peak OFF-state current (max.)
APT1211S	1:1  4.3 x 4.4 x 2.1mm	» Zero-cross » SOP 4 pin	600V	» 0.05A / 0.6A 0.05A	2.5V	1µA
APT1221S		» Random » SOP 4 pin				
APT1231S		» Low zero-cross » SOP 4 pin			2.0V	
APT1211	1:1  DIP : 4.78 x 6.4 x 3.2mm SMD: 4.78 x 6.4 x 2.9mm	» Zero-cross » DIP 4 pin	600V	» 0.1A / 1.2A 0.1A	2.5V	1µA
APT1221		» Random » DIP 4 pin				
APT1231		» Low zero-cross » DIP 4 pin			2.0V	
APT1212	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm	» Zero-cross » DIP 6 pin	600V	» 0.1A / 1.2A 0.1A	2.5V	1µA
APT1222		» Random » DIP 6 pin				
APT1232		» Low zero-cross » DIP 6 pin			2.0V	

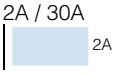
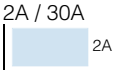
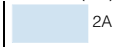
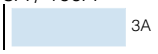
Input			Zero-cross voltage (max.)	I/O isolation voltage	Connection type Switching diagram	Approvals
LED trigger current (max.)	LED drop-out voltage (max.)	Turn-on time (max.)				
10mA	1.3V	0.1ms	50V	3,750V AC	SMT (SOP) 	C-UL, UL, VDE
			—		SMT (SOP) 	
			15V		SMT (SOP) 	
10mA	1.3V	0.1ms	50V	5,000V AC	PCB, SMT 	C-UL, UL, VDE
			—		PCB, SMT 	
			15V		PCB, SMT 	
10mA	1.3V	0.1ms	50V	5,000V AC	PCB, SMT 	C-UL, UL, VDE
			—		PCB, SMT 	
			15V		PCB, SMT 	

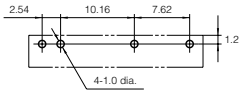
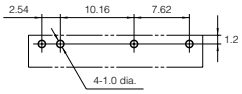
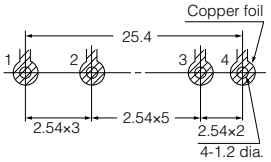
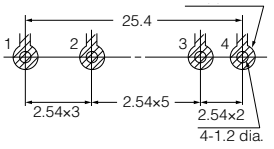
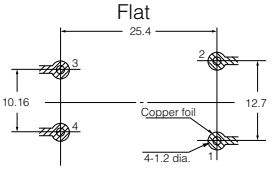
Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output			
			Repetitive peak OFF-state voltage	Max. load current/ Non-repetitive surge current (1 cycle, 60Hz)	Peak ON-state voltage (max.)	Peak OFF-state current (max.)
APT1211W	1:1  DIP : 4.78 x 6.4 x 3.0mm SMD: 4.78 x 6.4 x 2.7mm	» Zero-cross » DIP 4 pin wide terminal	600V	» 0.1A / 1.2A 0.1A	2.5V	1µA
APT1221W		» Random » DIP 4 pin wide terminal				
APT1231W		» Low zero-cross » DIP 4 pin wide terminal			2.0V	
APT1212W	1:1  DIP: 8.8 x 6.4 x 3.9mm SMD: 8.8 x 6.4 x 3.6mm	» Zero-cross » DIP 6 pin wide terminal	600V	» 0.1A / 1.2A 0.1A	2.5V	1µA
APT1222W		» Random » DIP 6 pin wide terminal				
APT1232W		» Low zero-cross » DIP 6 pin wide terminal			2.0V	

Input			Zero-cross voltage (max.)	I/O isolation voltage	Connection type Switching diagram	Approvals
LED trigger current (max.)	LED drop-out voltage (max.)	Turn-on time (max.)				
10mA	1.3V	0.1ms	50V	5,000V AC	PCB, SMT 	C-UL, UL, VDE
			—		PCB, SMT 	
			15V		PCB, SMT 	
10mA	1.3V	0.1ms	50V	5,000V AC	PCB, SMT 	C-UL, UL, VDE
			—		PCB, SMT 	
			15V		PCB, SMT 	

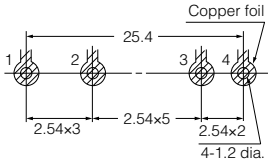
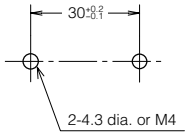
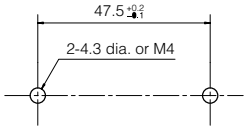
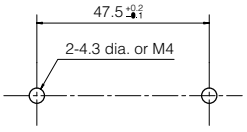
Type	Photo with dimensions (Picture scale: DIN A4)	Features	Output			
			Repetitive peak OFF-state voltage	Max. load current/ Non-repetitive surge current (1 cycle, 60Hz)	Peak ON-state voltage (max.)	Peak OFF-state current (max.)
AQH0213	1:1  DIP : 9.78 x 6.4 x 3.9mm SMD: 9.78 x 6.4 x 3.6mm	» Photo-Triac » Zero-cross	600V	» 0.3A / 3A 	2.5V	100µA
AQH0223		» Photo-Triac » Random				
AQH1213		» Photo-Triac » Zero-cross	600V	» 0.6A / 6A 	2.5V	100µA
AQH1223		» Photo-Triac » Random				
AQH2213		» Photo-Triac » Zero-cross	600V	» 0.9A / 9A 	2.5V	100µA
AQH2223		» Photo-Triac » Random				
AQH3213		» Photo-Triac » Zero-cross	600V	» 1.2A / 12A 	2.5V	100µA
AQH3223		» Photo-Triac » Random				

Input			Zero-cross voltage (max.)	I/O isolation voltage	Connection type Switching diagram	Approvals
LED trigger current (max.)	LED drop-out voltage (max.)	Turn-on time (max.)				
10mA	1.3V	0.1ms	50V	5,000V	PCB, SMT With zero-cross switch:  Without zero-cross switch:  	C-UL, UL, VDE
			—			
10mA	1.3V	0.1ms	50V	5,000V		
			—			
10mA	1.3V	0.1ms	50V	5,000V		
			—			
10mA	1.3V	0.1ms	50V	5,000V		
			—			

Type	Features	Output		
		Load voltage	Max. load current/ Non-repetitive surge current (1 cycle, 60Hz)	OFF-state leakage current (max.)
AQG 1A 1:2  24.5 x 4.5 x 13.5mm	» Photo-Triac » Zero-cross » Integrated snubber circuit	» 75 - 264V AC	» 1A / 8A 	1.5mA
	» Photo-Triac » Random » Integrated snubber circuit	» 75 - 264V AC	» 1A / 8A 	1.5mA
AQG 2A 1:2  24.5 x 4.5 x 20.5mm	» Photo-Triac » Zero-cross » Integrated snubber circuit	» 75 - 264V AC	» 2A / 30A 	1.5mA
	» Photo-Triac » Random » Integrated snubber circuit	» 75 - 264V AC	» 2A / 30A 	1.5mA
AQ1 1A (DC output) 1:2  33 x 10 x 25.1mm	» Photo-Transistor	» 10 - 200V DC	» 1A / 5A (1s) 	1mA
AQ1 2A (DC output) 1:2  33 x 10 x 25.1mm	» Photo-Transistor	» 3 - 60V DC	» 2A / 5A (1s) 	1mA
AQ1 3A (AC output) 1:2  33 x 10 x 25.1mm  33 x 25 x 12mm	» Photo-Triac » Zero-cross and random type available	» 75 - 250V AC	» 3A / 100A 	5mA

Input					Breakdown voltage	Connection type Terminal layout	Approvals
Input voltage	Input impedance	Drop-out voltage (min.)	Operate time	Release time			
4 - 6V DC	0.3kΩ	1V	½ cycle of voltage sine wave + 1ms	½ cycle of voltage sine wave + 1ms	3,000V AC	PCB 	C-UL, UL, VDE
9.6 - 14.4V DC	0.8kΩ						
19.2 - 28.8V DC	1.6kΩ						
4 - 6V DC	0.3kΩ	1V	1ms	½ cycle of voltage sine wave + 1ms	3,000V AC		
9.6 - 14.4V DC	0.8kΩ						
19.2 - 28.8V DC	1.6kΩ						
4 - 6V DC	0.3kΩ	1V	½ cycle of voltage sine wave + 1ms	½ cycle of voltage sine wave + 1ms	3,000V AC	PCB 	
9.6 - 14.4V DC	0.8kΩ						
19.2 - 28.8V DC	1.6kΩ						
4 - 6V DC	0.3kΩ	1V	1ms	½ cycle of voltage sine wave + 1ms	3,000V AC		
9.6 - 14.4V DC	0.8kΩ						
19.2 - 28.8V DC	1.6kΩ						
3 - 28V DC	1.6kΩ	0.8V	0.5ms	2ms	3,000V AC	PCB Slim 	CSA, TÜV, UL
3 - 28V DC	1.6kΩ	0.8V	0.5ms	2ms	3,000V AC		
4 - 32V DC	— (Input current, max. 20mA)	1.0V	½ cycle of voltage sine wave + 1ms	½ cycle of voltage sine wave + 1ms	» 4,000V AC (between input and output) » 2,500V AC (between input, output and case)	PCB Slim  Flat 	C-UL, UL, VDE

Type	Features	Output		
		Load voltage	Max. load current/ Non-repetitive surge current (1 cycle, 60Hz)	OFF-state leakage current (max.)
AQ1 10A (AC output) 1:2  54 x 26mm	» Photo-Triac » Zero-cross and random type available	» 75 - 250V AC	» 10A (5A without heat sink) / 100A 10A	5mA
Solid State Hockey Puck Types				
AQ-J 1:2  38 x 28 x 17mm	» Photo-Triac » Zero-cross and random type available » Ultra-compact size » Built-in varistor » Wide range input	» 75 - 264V AC	» 10A / 100A 10A » 15A / 150A 15A » 25A / 250A 25A	5mA
AQ-A 1:2  58 x 40 x 25.5mm	» Photo-Triac » Zero-cross and random type available » Built-in varistor and LED indication » Wide range input	» 75 - 250V AC	» 15A / 150A 15A » 25A / 250A 25A » 40A / 400A 40A	10mA
AQ-AD 1:2  58 x 40 x 25.5mm	» DC high power LED indication » Internal diode » Terminal cover » Wide range input	» 100 / 600V DC	» 10A 10A » 30A 30A	100µA

Input					Breakdown voltage	Connection type Terminal layout	Approvals
Input voltage	Input impedance	Drop-out voltage (min.)	Operate time	Release time			
4 - 32V DC	— (Input current, max. 20mA)	1,0V	½ cycle of voltage sine wave + 1ms	½ cycle of voltage sine wave + 1ms	» 4,000V AC (between input and output) » 2,500V AC (between input, output and case)	PCB 	C-UL, UL, TÜV
4 - 32V DC	— (Input current, max. 20mA)	1V	½ cycle of voltage sine wave + 1ms	½ cycle of voltage sine wave + 1ms	» 3,000V AC (between input and output) » 2,500V AC (between input, output and case)	— 	C-UL, UL, TÜV
4 - 32V DC	— (Input current, max. 20mA)	1V	½ cycle of voltage sine wave + 1ms	½ cycle of voltage sine wave + 1ms	» 4,000V AC (between input and output) » 2,500V AC (between input, output and case)	— 	C-UL, UL, VDE
4 - 32V DC	— (Input current, max. 20mA)	1V	5ms	1ms	» 4,000V AC (between input and output) » 2,500V AC (between input, output and case)	— 	C-UL, UL, VDE
			10ms	3ms			

Mechanical Relays

Semiconductor Relays

1 EMC Directive

The EMC Directive concerns primarily the finished products. In applying the Directive to components, the Guidelines[1] should be consulted to determine whether the component in question has a "direct function". Electric motors, power supply units or temperature controls represent examples of such components with "direct function". These types of components must be provided with a CE marking.

Components which are integrated into a device, such as relays, do not have an independent function of their own. A given relay may perform differing functions in different devices. Consequently, all-or-nothing relays must be considered components without "direct function" which are not subject to the EMC Directive.

All-or-nothing - be they electro-mechanical relays or solid state relays - shall not be labeled with a CE marking nor shall a declaration of conformity be issued within the scope of the EMC Directive.

2 Low Voltage Directive

Relays with terminals for printed boards/plug-and-socket connections do not come within the purview of the Low Voltage Directive.

The Low Voltage Directive concerns electrical equipment intended for incorporation into a device as well as equipment intended for direct use. In the case of electrical equipment which is considered a basic component intended for incorporation into other electrical equipment, the properties and safety of the final product will be largely dependent on how it is integrated: as such, these components do not fall within the Low Voltage Directive and shall not be CE marked. The Guidelines[2] specifically cite electro-mechanical basic components such as connectors, relays with terminals for printed circuit boards and micro switches. They are therefore not subject to the scope of the Low Voltage Directive.

Except for larger relays which may, for example, find application in switching cabinets, the same considerations apply to common-place relays with plug-in connections available also with printed board terminals. Here again, safety is a function of the individual application. In evaluating these relays' performance from the perspective of the Low Voltage Directive, the same conclusion is reached as with the printed board relay. As such, CE marking is not mandatory for this type of relay.

3 Machinery Directive

The Machinery Directive differentiates between machines, machine parts and safety components. Relays are not part of any of these categories. The listing of safety components in Appendix IV is conclusive and does not include relays.

Consequently, a CE marking shall not be affixed nor shall a declaration of conformity or manufacturer's declaration be issued under the Machinery Directive.

As of this moment, none of the aforementioned directives require CE marking for all-or-nothing relays[3].

4 RoHS Directive

The substances prohibited by the RoHS Directive (Pb, Hg, Cd, Cr+6, PBB, PBDE) concern 10 categories of devices that are mostly, but not entirely, intended for private use. Components such as relays are not listed in these categories. Therefore they do not directly fall within the scope of this directive. However, if the user employs relays in devices that fall within the scope of this directive, the user must also acknowledge the substances prevented. In order to adapt to this situation in good time, all Panasonic relays are generally RoHS compliant.

1 Guidelines (version dated March 22, 2007) for the Application of the Council Directive 2004/108/EC.
2 Guidelines (version dated August 2007) for the Application of the Council Directive 2006/95/EC.
3 This writing deals exclusively with "non-specified-time all-or-nothing relays". The abbreviated term "all-or nothing relay" has been introduced merely for purposes of convenience. The term includes solid state all-or nothing relays.

Panasonic Electric Works offers a wide product range from one source, from individual components to complete systems. Technology support for advice, design-in, installation and commissioning by our qualified application engineers round off the Panasonic service profile.

Connectors

Today's electronic components are expected to meet stringent demands: They have to be as compact as possible and provide maximum reliability. To fulfill these requirements, Panasonic engineers have developed narrow-pitch connectors that utilize TOUGH CONTACT technology. In addition to their excellent shock and vibration resistance, these connectors feature an ultra-slim profile, which makes them ideally suited to applications where space is at a premium. Our versatile board-to-board and board-to-FPC connector product range offers the appropriate solution for practically any scenario.

Switches

The immense portfolio includes switches in all common sizes and with various IP degrees of protection, and are guaranteed to cover all standard requirements. Our switches are characterized by a large switching capacity range, long lifetime and exceptional reliability. A wide selection of supplemental actuators coupled with various terminal styles, e.g. solder, quick connect, PC board terminal and cable connections, maximize flexibility and ease application design.

PaPIRs motion sensors

Intelligent automation solutions help increase energy efficiency, cost effectiveness and comfort significantly. With a power consumption as low as 1µA and a height of just 6mm, PaPIRS open up a diverse range of possibilities to the lighting and building technology as well as battery-driven applications.

NaPiOn motion Sensors

NaPiOn motion sensors are ideal for efficient lighting and energy management.

» Small size: Ø10x13.5mm (thimble size)
» Integrated amplifier
» 2 lens colors: white and black

Pressure sensors

Panasonic's pressure sensors contain built-in amplification and temperature compensation circuits. Users need not be concerned with circuit design or customization.
State-of-the-art technology allows us to achieve high-level precision and reliability, yet without compromising compactness.

» Footprint 7.0mm (W) x 7.2mm (D)
» 10.4mm (W) x 10.4mm (D) (low pressure type)

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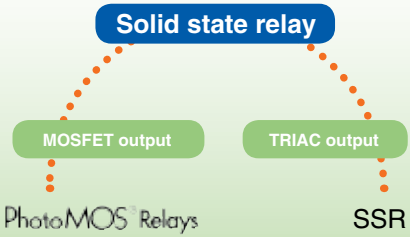
Panasonic

SOLID STATE RELAYS

AN OVERVIEW



The number of electronic devices used by consumers on a daily basis continues to be on the rise, and the demand for reliable, long-lasting component parts has increased accordingly. Whether it be as central switching elements for household devices or as components for industrial application areas Panasonic's solid state relays (SSRs) are designed to meet the most rigorous customer requirements.

Panasonic has played an instrumental role in the development of modern relays. Thanks to our research and production centers in Japan and Germany, we now offer a versatile product line that provides solutions for practically any application. As an ISO 9001-certified supplier, we not only deliver the quality you've come to expect from Panasonic, we also offer the support that only global players can provide.

For more and more applications, modern solid state relays are now a viable alternative to the classic electromechanical relays. Compared to conventional relays, semiconductor-based switching elements offer two essential advantages: superb reliability and a nearly unlimited lifespan. The various solid-state relay types all work according to the same principle: In the input circuit, an LED energizes an optoelectronic device via optical beam (-> insulation method), which in turn activates a power semiconductor on the output. At Panasonic, we differentiate between two solid state relay categories: the PhotoMOS type, with a MOSFET on the output, and the SSR type, with a TRIAC as a power semiconductor.

Ready to run – it's up to you to say when!

With most SSRs, you can choose between two types of switching behaviors:

Zero-cross

The zero-cross output does not become conductive until the load voltage crosses zero. As a result, the voltage on the component and on the load stays low during the switching cycle. The inrush current – and thus the impact on the component and on the load – as well as the electromagnetic noise are thereby reduced to a minimum.

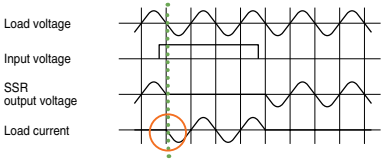


Fig. 1: Zero-cross switching behavior

Random

The random output becomes conductive immediately upon application of the LED input current. Thus, in addition to serving as a simple switch, it also lets you drive the load via phase control.

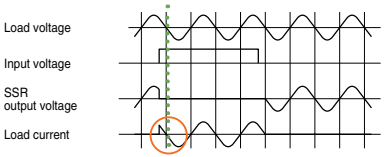


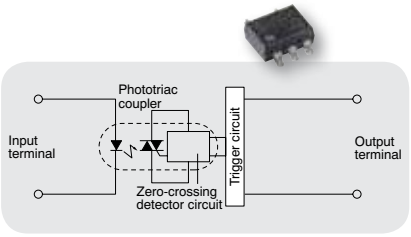
Fig. 2: Random switching behavior

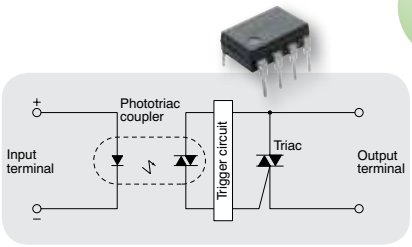
APT1- Phototriac coupler

Ideal for TRIAC driver

FEATURES

- Reduced zero-cross voltage (max. 15 V)
- Several housing types available (including wide terminal type with 10.16 mm pitch between I/O)
- High I/O isolation voltage (between input and output; for SOP type: 3750 V; for DIP type: 5000 V)
- Handles both 100 and 200 V AC loads
- Zero-cross type and random type available





AQ-H

Compact DIP type: 0.3 A to 1.2 A

FEATURES

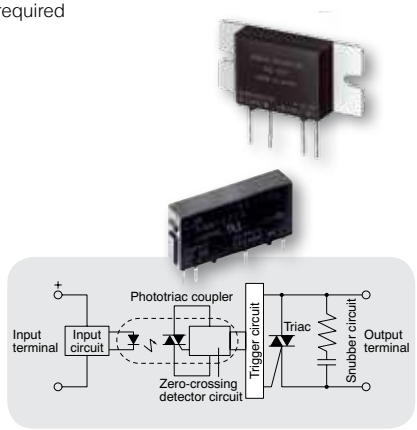
- Compact SSR, ideal for AC load control
- Supports 0.3 A, 0.6 A, 0.9 A, and 1.2 A RMS on-state current
- Handles both 100 and 200 V AC loads
- High I/O isolation voltage: 5000 V AC (between input and output)
- Zero-cross type and random type available
- No derating up to +40°C
- No heat sink required

AQ-G / AQ-10

Compact SIL type: 1A to 10A

FEATURES

- Slim vertical types
- 1A to 10A load types available
- High I/O isolation voltage: 3000 V AC
- VDE (EN60950-1)-compliant types (with reinforced insulation) available
- Integrated snubber circuit
- Zero-cross type and random type available

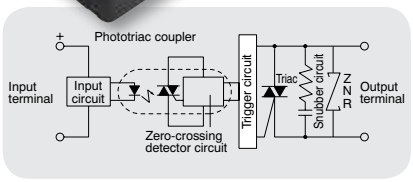


AQ-J

Compact high-capacity plug-in SSR: 10 A to 25 A

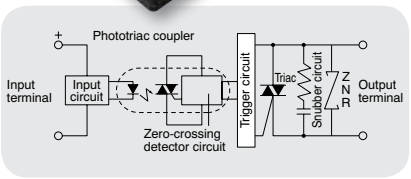
FEATURES

- Compact dimensions: W28 x L38 x H30 mm
- Simple installation:
  - Screw mount or DIN rail mount
  - Easy I/O connection with tab terminals
- Built-in varistor
- Integrated snubber circuit
- Heat sink combined type easy to mount on DIN rail
- Output arrangement 1a and 2x 1a available in the heat sink combined type
- Zero-cross type and random type available
- High I/O isolation voltage: 3000 V AC



AQ-A / AQ-AD

Compact high-capacity screw terminal type: 15A to 40A



FEATURES

- AC or DC switching
- Compact dimensions: W40 x L58 x H25.5 mm
- Terminal cover on output side
- Wide input range (4 to 32 V DC)
- Mounting pitch: 47.5 mm (1.870 in)
- Operation status LED
- Reinforced insulation (breakdown voltage: 4000 V_{RMS} between input and output)
- Built-in varistor (AC), Built-in Diode (DC)
- Integrated snubber circuit (AC)
- Zero-cross type and random type available (AC)

Solid State Relays: Selected Models

	Model [1]	Housing	Load voltage (AC) [2]	Continuous load current	Function
	APT1211S	SOP4	250V	0.05A	Zero-cross
	APT1221S	SOP4	250V	0.05A	Random
	APT1211(A)	DIP4	250V	0.1A	Zero-cross
	APT1221(A)	DIP4	250V	0.1A	Random
	APT1212(A)	DIP6	250V	0.1A	Zero-cross
	APT1222(A)	DIP6	250V	0.1A	Random
	AQH0213(A)	DIP8	250V	0.3A	Zero-cross
	AQH0223(A)	DIP8	250V	0.3A	Random
	AQH3213(A)	DIP8	250V	1.2A	Zero-cross
	AQH3223(A)	DIP8	250V	1.2A	Random
	AQG12112	SIL4	250V	1A	Zero-cross
	AQG22112	SIL4	250V	2A	Zero-cross
	AQG12212	SIL4	250V	1A	Random
	AQG22212	SIL4	250V	2A	Zero-cross
	AQ3A2ZT432	SIL4	250V	3A	Zero-cross
	AQ10A2ZT432	SIL4	250V	10A*	Zero-cross
	AQJ416V	Hockey Puck	250V	25A*	Zero-cross
	AQJ116V	Hockey Puck	250V	15A*	Zero-cross
	AQA211VL	Hockey Puck	250V	15A*	Zero-cross
	AQA411V	Hockey Puck	250V	25A*	Zero-cross
	AQA611V	Hockey Puck	250V	40A*	Zero-cross
	AQAD551DL	Hockey Puck	100V DC	30A*	–
	AQAD171DL	Hockey Puck	600V DC	10A*	–

1) A = SMD model
2) Effective value
* with heat sink fins

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ideas for life

1a/1c 5A/10A small power relays

JQ RELAYS

RoHS compliant

FEATURES

- **High electrical noise immunity**
- **High switching capacity in a compact package**
- **High sensitivity: 200 mW (1a), 400 mW (1c)**
- **High surge voltage: 8,000 V between contacts and coil**
- **UL, CSA, VDE, SEMKO approved and TÜV available**
- **Class B coil insulation type also available.**

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- **Heaters**

ORDERING INFORMATION

JQ ☐ ☐ - ☐ - ☐ - **F**

Contact arrangement
1a: 1 Form A
1 : 1 Form C

Contact capacity
Nil: Standard (5A)
P: High capacity (10A)

Coil insulation class
Nil: Class E coil insulation
B: Class B coil insulation (UL)

Nominal coil voltage (DC)
5V, 6V, 9V, 12V, 18V, 24V, 48V*

Contact material
F: $AgSnO_2$ type

Certified by UL, CSA, VDE and SEMKO
Note: *Available only for 1 Form C type

TYPES

1) Standard type

Nominal coil voltage	Standard type		High capacity type	
	1 Form A	1 Form C	1 Form A	1 Form C
	Part No.	Part No.	Part No.	Part No.
5V DC	JQ1a-5V-F	JQ1-5V-F	JQ1aP-5V-F	JQ1P-5V-F
6V DC	JQ1a-6V-F	JQ1-6V-F	JQ1aP-6V-F	JQ1P-6V-F
9V DC	JQ1a-9V-F	JQ1-9V-F	JQ1aP-9V-F	JQ1P-9V-F
12V DC	JQ1a-12V-F	JQ1-12V-F	JQ1aP-12V-F	JQ1P-12V-F
18V DC	JQ1a-18V-F	JQ1-18V-F	JQ1aP-18V-F	JQ1P-18V-F
24V DC	JQ1a-24V-F	JQ1-24V-F	JQ1aP-24V-F	JQ1P-24V-F
48V DC	–	JQ1-48V-F	–	JQ1P-48V-F

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

RATING

1. Coil data

Contact arrangement	Nominal coil voltage	Pick-up voltage (at 20°C 68°F)	Drop-out voltage (at 20°C 68°F)	Nominal operating current [±10%] (at 20°C 68°F)	Coil resistance [±10%] (at 20°C 68°F)	Nominal operating power (at 20°C 68°F)	Max. applied voltage
1 Form A	5V DC	Standard type: 75%V or less of nominal voltage (Initial) High capacity type: 80%V or less of nominal voltage (Initial)	5%V or more of nominal voltage (Initial)	40.0mA	125 Ω	200mW	180% of nominal voltage (at 20°C 68°F) 130% of nominal voltage (at 70°C 158°F) [When using relays at 85°C 185°F, see Notes*4]
	6V DC			33.3mA	180 Ω		
	9V DC			22.2mA	405 Ω		
	12V DC			16.7mA	720 Ω		
	18V DC			11.1mA	1,620 Ω		
	24V DC			8.3mA	2,880 Ω		
1 Form C	5V DC	Standard type: 75%V or less of nominal voltage (Initial) High capacity type: 80%V or less of nominal voltage (Initial)	5%V or more of nominal voltage (Initial)	80 mA	62.5Ω	400mW	150% of nominal voltage (at 20°C 68°F) 110% of nominal voltage (at 70°C 158°F) [When using relays at 85°C 185°F, see Notes*4]
	6V DC			66.7mA	90 Ω		
	9V DC			44.4mA	202.5Ω		
	12V DC			33.3mA	360 Ω		
	18V DC			22.2mA	810 Ω		
	24V DC			16.7mA	1,440 Ω		
	48V DC			8.3mA	5,760 Ω		

2. Specifications

Characteristics	Item		Specifications			
			Standard type		High capacity type	
Contact	Arrangement		1 Form A	1 Form C	1 Form A	1 Form C
	Contact resistance (Initial)		Max. 100mΩ (By voltage drop 6 V DC 1 A)			
	Contact material		$AgSnO_2$ type			
Rating	Nominal switching capacity (resistive load)		5 A 125 V AC, 2 A 250 V AC, 5 A 30 V DC	N.O. side: 5 A 125 V AC, 2 A 250 V AC, 3 A 30 V AC N.C. side: 2 A 125 V AC, 1 A 250 V AC, 1 A 30 V DC	10 A 125 V AC, 5 A 250 V AC, 5 A 30 V DC	N.O. side: 10 A 125 V AC, 5 A 250 V AC, 5 A 30 V AC N.C. side: 3 A 125 V AC, 2 A 250 V AC, 1 A 30 V DC
	Max. switching power (resistive load)		625 VA, 150 W	N.O. side: 625 VA, 90 W N.C. side: 250 VA, 30 W	1,250 V AC, 150 W	N.O. side: 1,250 VA, 150 W N.C. side: 500 V AC, 30 W
	Max. switching voltage		250 V AC, 110 V DC (0.3A)			
	Max. switching current		N.O.: 5 A, N.C.: 2 A		N.O.: 10 A, N.C.: 3 A	
	Nominal operating power		200 mW	400 mW	200 mW	400 mW
	Min. switching capacity (reference value)*1		100 mA, 5 V DC			
Electrical characteristics	Insulation resistance (Initial)		Min. 1,000 MΩ (at 500 V DC) Measurement at same location as “Breakdown voltage” section.			
	Breakdown voltage (Initial)	Between open contacts	1,000 Vrms for 1 min.	750 Vrms for 1 min.	1,000 Vrms for 1 min.	750 Vrms for 1 min.
		Between contact and coil	4,000 Vrms for 1 min. (Detection current: 10 mA)			
	Temperature rise (coil)		Max. 45°C 113°F (By resistive method, nominal coil voltage applied to the coil; contact carrying current: 5A, at 70°C 158°F)		Max. 45°C 113°F (By resistive method, nominal coil voltage applied to the coil; contact carrying current: 10A, at 70°C 158°F)	
	Surge breakdown voltage*2 (Between contact and coil) (Initial)		8,000 V			
	Operate time (at nominal voltage) (at 20°C 68°F) (Initial)		Max. 20 ms (excluding contact bounce time.)			
	Release time (at nominal voltage) (at 20°C 68°F) (Initial)		Max. 10 ms (excluding contact bounce time) (Without diode)			
Mechanical characteristics	Shock resistance	Functional	294 m/s^2 (Half-wave pulse of sine wave: 11 ms; detection time: 10μs.)			
		Destructive	980 m/s^2 (Half-wave pulse of sine wave: 6 ms.)			
	Vibration resistance	Functional	10 to 55 Hz at double amplitude of 1.6 mm (Detection time: 10μs.)			
		Destructive	10 to 55 Hz at double amplitude of 2.0 mm			
Expected life	Mechanical (at 180 times/min.)		Min. 10^7			
Conditions	Conditions for operation, transport and storage*3		Ambient temperature: –40°C to +70°C –40°F to +158°F (class E insulation), –40°C to +85°C –40°F to +185°F*4 (class B insulation) Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)			
	Max. operating speed		20 times/min. (at nominal switching capacity)			
Unit weight			Approx. 7 g .25 oz			

* Specifications will vary with foreign standards certification ratings.

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. Wave is standard shock voltage of ±1.2×50μs according to JEC-212-1981

*3. The upper limit of the ambient temperature is the maximum temperature that can satisfy the coil temperature rise value. Refer to Usage, transport and storage conditions in NOTES.

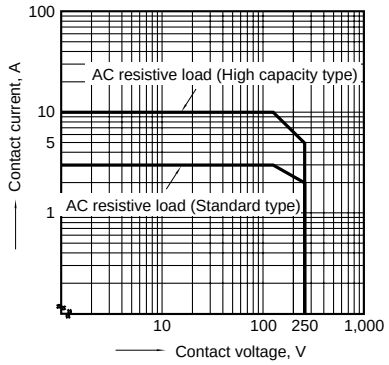
*4. When using relays in a high ambient temperature, consider the pick-up voltage rise due to the high temperature (a rise of approx. 0.4% V for each 1°C 33.8°F with 20°C 68°F as a reference) and use a coil impressed voltage that is within the maximum applied voltage range.

3. Expected electrical life

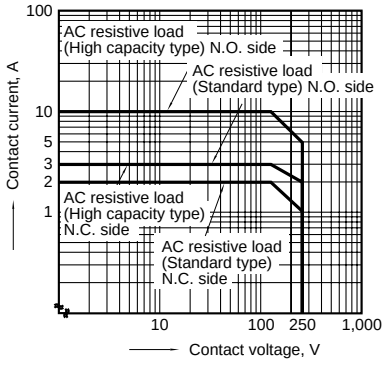
Type			Switching capacity	No. of operations
Standard type	1 Form A		5 A 125 V AC 3 A 125 V AC 2 A 250 V AC 5 A 30 V DC	5×10^4 2×10^5 2×10^5 10^5
	1 Form C	N.O.	5 A 125 V AC 3 A 125 V AC 2 A 250 V AC 3 A 30 V DC	5×10^4 2×10^5 2×10^5 10^5
		N.C.	2 A 125 V AC 1 A 250 V AC 1 A 30 V DC	2×10^5 2×10^5 10^5
High capacity type	1 Form A		10 A 125 V AC 5 A 250 V AC 5 A 30 V DC	5×10^4 5×10^4 10^5
	1 Form C	N.O.	10 A 125 V AC 5 A 250 V AC 5 A 30 V DC	5×10^4 5×10^4 10^5
		N.C.	3 A 125 V AC 2 A 250 V AC 1 A 30 V DC	2×10^5 2×10^5 10^5

REFERENCE DATA

1.-(1) Max. switching capacity (1 Form A type)



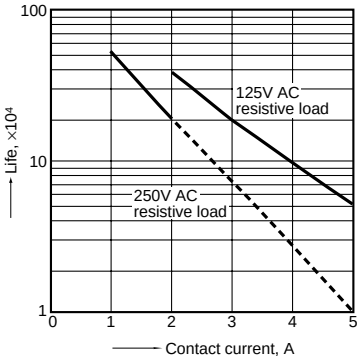
1.-(2) Max. switching capacity (1 Form C type)



Standard type

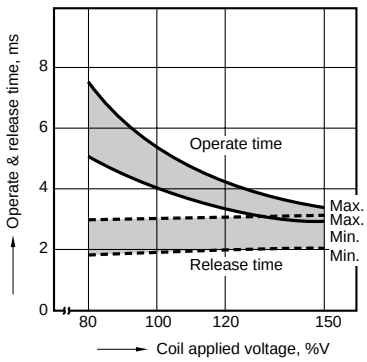
2. Life curve

Ambient temperature: room temperature



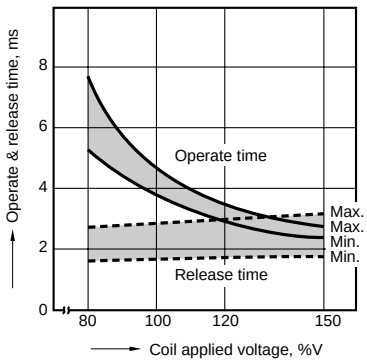
3.-(1) Operate & release time (1 Form A type)

Tested sample: JQ1a-12V-F, 25 pcs.

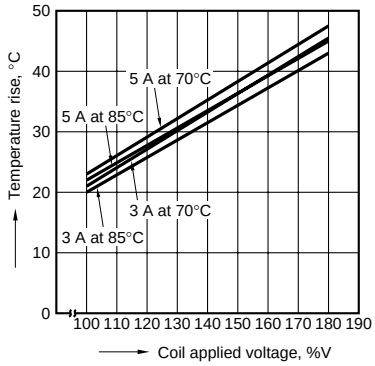


3.-(2) Operate & release time (1 Form C type)

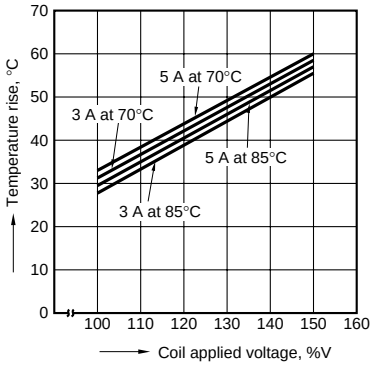
Tested sample: JQ1-24V-F, 25 pcs.



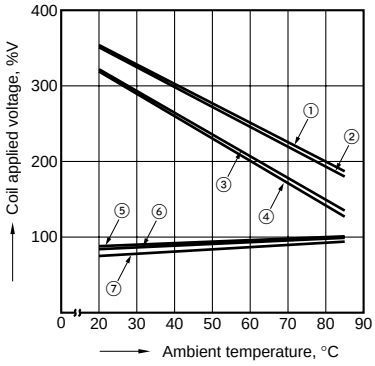
4.-(1) Coil temperature rise (1 Form A type)
Contact carrying current: 3 A, 5 A
Measured portion: Inside the coil



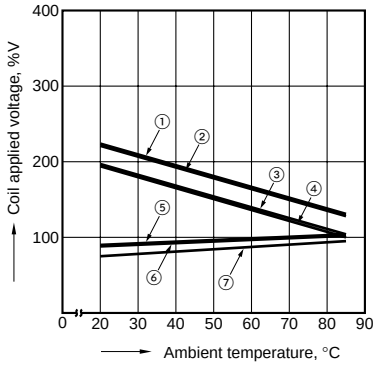
4.-(2) Coil temperature rise (1 Form C type)
Contact carrying current: 3 A, 5 A
Measured portion: Inside the coil



5.-(1) Ambient temperature characteristics (1 Form A type)
Tested sample: JQ1a-24V-F
Contact carrying current: 3 A, 5 A



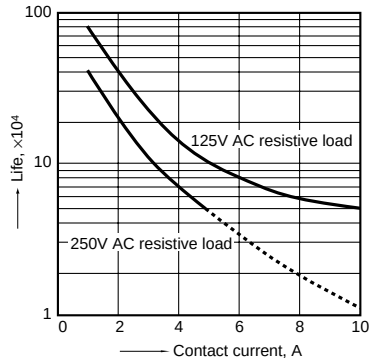
5.-(2) Ambient temperature characteristics (1 Form C type)
Tested sample: JQ1-24V-F
Contact carrying current: 3 A, 5 A



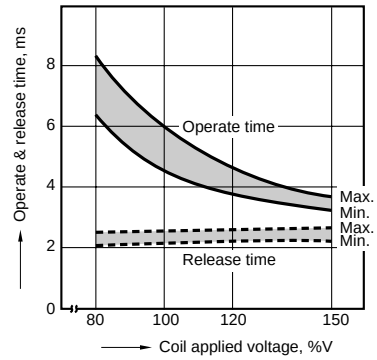
① Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 130°C 266°F) (Carrying current: 3 A)
② Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 130°C 266°F) (Carrying current: 5 A)
③ Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 115°C 239°F) (Carrying current: 3 A)
④ Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 115°C 239°F) (Carrying current: 5 A)
⑤ Pick-up voltage with a hot-start condition of 100%V on the coil (Carrying current: 5 A)
⑥ Pick-up voltage with a hot-start condition of 100%V on the coil (Carrying current: 3 A)
⑦ Pick-up voltage

High capacity type

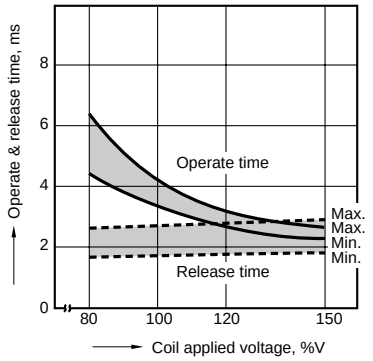
1. Life curve
Ambient temperature: room temperature



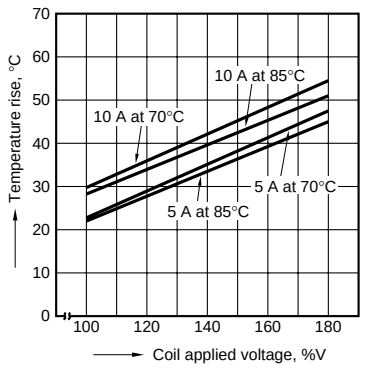
2.-(1) Operate & release time (1 Form A type)
Tested sample: JQ1aP-12V-F, 25 pcs.



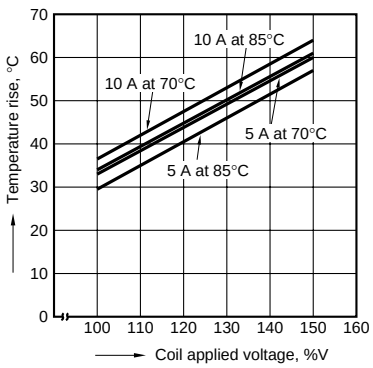
2.-(2) Operate & release time (1 Form C type)
Tested sample: JQ1P-12V-F, 25 pcs.



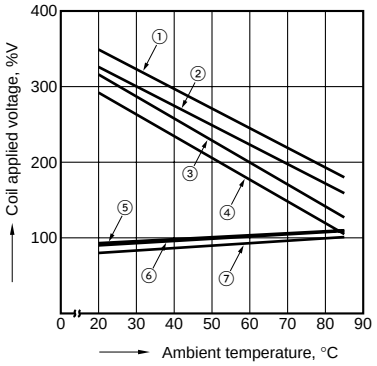
3.-(1) Coil temperature rise (1 Form A type)
Contact carrying current: 5 A, 10 A
Measured portion: Inside the coil



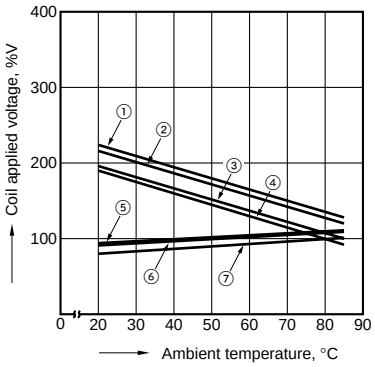
3.-(2) Coil temperature rise (1 Form C type)
Contact carrying current: 5 A, 10 A
Measured portion: Inside the coil



4.-(1) Ambient temperature characteristics
(1 Form A type)
Tested sample: JQ1aP-24V-F
Contact carrying current: 5 A, 10 A



4.-(2) Ambient temperature characteristics
(1 Form C type)
Tested sample: JQ1P-24V-F
Contact carrying current: 5 A, 10 A



① Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 130°C 266°F) (Carrying current: 5 A)
② Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 130°C 266°F) (Carrying current: 10 A)
③ Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 115°C 239°F) (Carrying current: 5 A)
④ Allowable ambient temperature against % coil voltage (max. inside the coil temperature set as 115°C 239°F) (Carrying current: 10 A)
⑤ Pick-up voltage with a hot-start condition of 100%V on the coil (Carrying current: 10 A)
⑥ Pick-up voltage with a hot-start condition of 100%V on the coil (Carrying current: 5 A)
⑦ Pick-up voltage

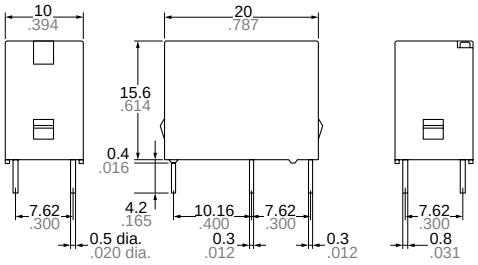
DIMENSIONS (mm inch)

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

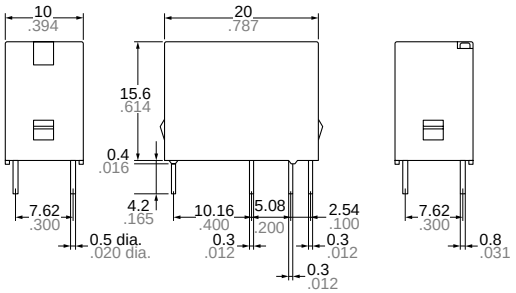
CAD Data

External dimensions

1 Form A

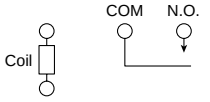


1 Form C

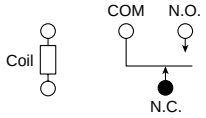


Schematic (Bottom view)

1 Form A

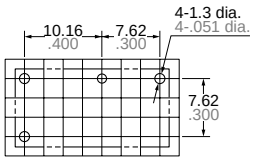


1 Form C

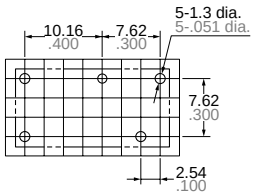


PC board pattern (Bottom view)

1 Form A



1FormC



Tolerance: ±0.1 ±.004

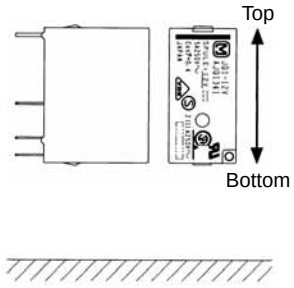
Dimension:	General tolerance
Less than 1mm .039inch:	±0.2 ±.008
Min. 1mm .039inch less than 5mm .197 inch:	±0.3 ±.012
Min. 5mm .197 inch:	±0.4 ±.016

SAFETY STANDARDS

Item	UL/C-UL (Recognized)		CSA (Certified)		VDE (Certified)		TÜV (Certified)		SEMKO (Certified)	
	File No.	Contact rating	File No.	Contact rating	File No.	Contact rating	File No.	Rating	File No.	Contact rating
Standard type (5A) 1 Form A	E43028	5A 125V AC 5A 277V AC 5A 30V DC 0.3A 110V DC 1/10HP 125V AC 1/6HP 277V AC	LR26550	5A 125V AC 5A 277V AC 5A 30V DC 0.3A 110V DC 1/10HP 125V AC 1/6HP 277V AC	40011435	5A 250V AC (cosϕ=0.4)	B 11 04 13461 296	5A 250V AC (cosϕ=0.4) 5A 30V DC (0ms)	817138	3(2)A 125V AC 2(1)A 250V AC 5A 30V DC
Standard type (5A) 1 Form C	E43028	5A 125V AC 5A 277V AC 5A 30V DC 0.3A 110V DC 1/10HP 125V AC 1/6HP 277V AC	LR26550	5A 125V AC 5A 277V AC 5A 30V DC 0.3A 110V DC 1/10HP 125V AC 1/6HP 277V AC	40011435	5A 250V AC (cosϕ=0.4) (N.O.) 3A 250V AC (cosϕ=0.4) (N.C.)	B 11 04 13461 296	5A 250V AC (cosϕ=0.4) 5A 30V DC (0ms)	817138	3(2)A 125V AC 2(1)A 250V AC 5A 30V DC
High capacity type (10A) 1 Form A	E43028	10A 125V AC 8A 277V AC 5A 30V DC 0.3A 110V DC 1/6HP 125V AC 1/6HP 277V AC	LR26550	10A 125V AC 8A 277V AC 5A 30V DC 0.3A 110V DC 1/6HP 125V AC 1/6HP 277V AC	40011435	10A 250V AC (cosϕ=0.4)	B 11 04 13461 296	10A 250V AC (cosϕ=0.4) 5A 30V DC (0ms)	817138	5(3)A 250V AC 5A 30V DC
High capacity type (10A) 1 Form C	E43028	10A 125V AC 8A 277V AC 5A 30V DC 0.3A 110V DC 1/6HP 125V AC 1/6HP 277V AC	LR26550	10A 125V AC 8A 277V AC 5A 30V DC 0.3A 110V DC 1/6HP 125V AC 1/6HP 277V AC	40011435	(N.O.) 10A 250V AC (cosϕ=0.4) (N.C.) 3A 250V AC (cosϕ=0.4)	B 11 04 13461 296	10A 250V AC (cosϕ=0.4) 5A 30V DC (0ms)	817138	5(3)A 250V AC 5A 30V DC

NOTES

Note about relay installation orientation



When installing with the relay terminals parallel to the ground, the contact terminals at the bottom and the coil terminals at the top, component friction will occur after numerous switching actions or due to vibration in the non-excitation state.
Since this may cause the relay to stop functioning when the pick-up voltage increases even if the nominal voltage is applied, please do not install using this orientation.

For Cautions for Use.

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.

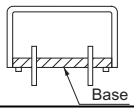
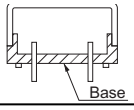
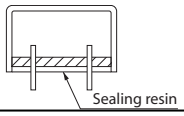
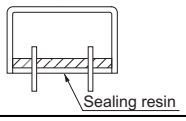
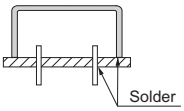
3. Sealed Type

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

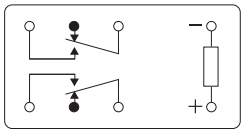
Type	Construction	Characteristics	Automatic Soldering	Automatic Cleaning	Dust Resistance	Harmful Gas Resistance
Dust Cover Type		Most basic construction where the case and base (or body) are fitted together.	Take care	No	Take care	No
Flux-Resistant Type		Terminals are sealed or molded simultaneously. 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

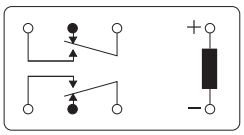
Relay which turns on when the coil is energized and turns off when de-energized.



(Schematic example: DS relay)

2. 1 Coil Latching Type

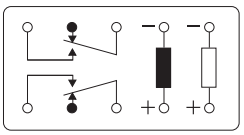
Relay with latching construction that can maintain the on or off state with a pulse input. With one coil, the relay is set or reset by applying signals of opposite polarities.



(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.



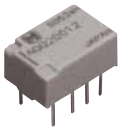
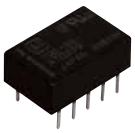
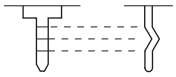
Schematic example: DS relay

4. Operation Indication

Indicates the set and reset states either electrically or mechanically for easy maintenance. An LED type (HC relay with LED) is available.

LED type, HC relay

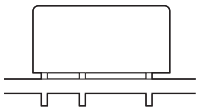
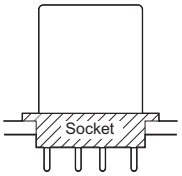
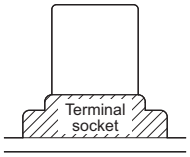
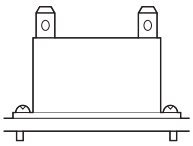
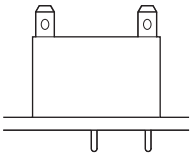
TERMINAL CONFIGURATION

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 relay	LE, LF relay

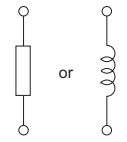
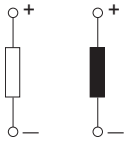
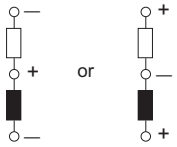
Notes:

- 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.

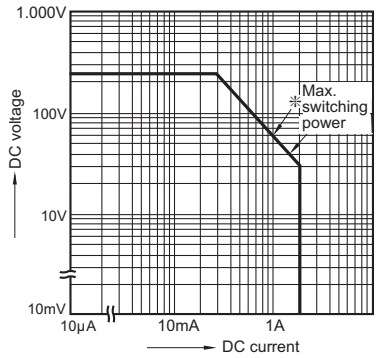
7. Maximum Switching Power

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.)

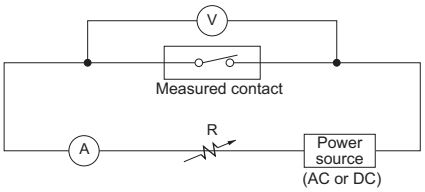
9. Minimum switching capability

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

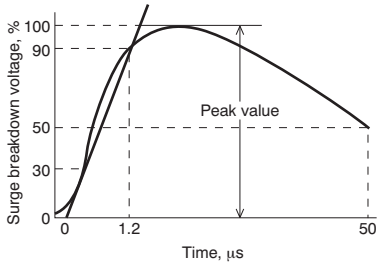
2. Breakdown Voltage

(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.

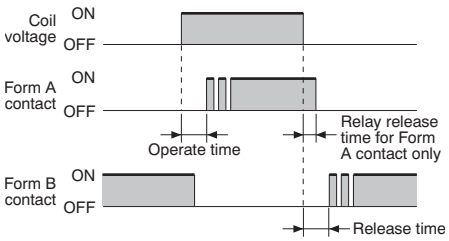
3. Surge Breakdown Voltage

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

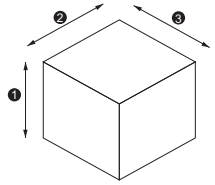
1. Shock Resistance

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.



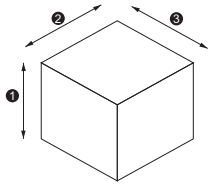
2. Vibration Resistance

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

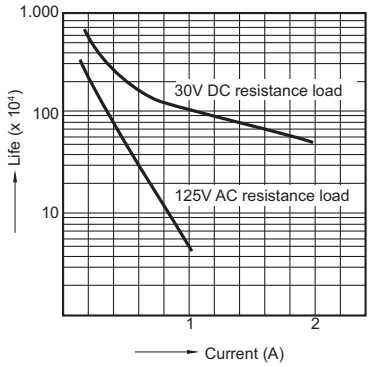
This is listed in the data column for each type of relay. The life (number of operations) can be estimated from the switching voltage and switching current. For example, for a DS relay operating at:

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.

GENERAL APPLICATION GUIDELINES

A relay may encounter a variety of ambient conditions during actual use resulting in unexpected failure. Therefore, testing over a practical range under actual operating conditions is necessary. Application considerations should be reviewed and determined for proper use of the relay.

SAFETY PRECAUTIONS

- 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.
- 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.
- 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.
- If the possibility exists that faulty adhesion or contact could endanger assets or human life, take double safety precautions and make sure that operation is foolproof.

[1] METHOD OF DETERMINING SPECIFICATIONS

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 conditions, contact conditions, and the ambient conditions for the relay that is actually used must be sufficiently known in advance. In the table below, a summary has been made of the points of consideration for relay selection. It may be used as a reference for investigation of items and points of caution.

Specification item		Consideration points regarding selection
Coil	a) Rating b) Pick-up voltage/current c) Drop-out voltage/current d) Maximum continuous voltage/ current e) Coil resistance f) Impedance g) Temperature rise	1) Select relay with consideration for power source ripple. 2) Give sufficient consideration to ambient temperature, for the coil temperature rise and hot start. 3) When used in conjunction with semiconductors, additional attention to the application should be taken. Be careful of voltage drops when starting up.
Contacts	a) Contact arrangement b) Contact rating c) Contact material d) Life e) Contact resistance	1) It is desirable to use a standard product with more than the required number of contacts. 2) It is beneficial to have the relay life balanced with the life of the device it is used in. 3) Is the contact material matched to the type of load? It is necessary to take care particularly with low level load. 4) The rated life may become reduced when used at high temperatures. Life should be verified in the actual atmosphere used. 5) Depending on the circuit, the relay drive may synchronize with the AC load. As this will cause a drastic shortening of life should be verified with the actual machine.
Operate time	a) Operate time b) Release time c) Bounce time d) Switching frequency	1) It is beneficial to make the bounce time short for sound circuits and similar applications.
Mechanical characteristics	a) Vibration resistance b) Shock resistance c) Ambient temperature d) Life	1) Give consideration to performance under vibration and shock in the use location. 2) In particular, when used in high temperature applications, relay with class B or class F coil insulation may be required.
Other items	a) Breakdown voltage b) Mounting method c) Size d) Protective construction	1) Selection can be made for connection method with plug-in type, PC board type, soldering, tab terminals, and screw fastening type. 2) For use in an adverse atmosphere, sealed construction type should be selected. 3) When used in adverse environments, use the sealed type. 4) Are there any special conditions?

BASICS ON RELAY HANDLING

- To maintain initial performance, care should be taken to avoid dropping or hitting the relay.
- Under normal use, the relay is designed so that the case will not detach. To maintain initial performance, the case should not be removed. Relay characteristics cannot be guaranteed if the case is removed.
- Use of the relay in an atmosphere at standard temperature and humidity with minimal amounts of dust, SO_2, H_2S, or organic gases is recommended.
  For installation in adverse environments, one of the sealed types should be considered.
  Please avoid the use of silicone-based resins near the relay, because doing so may result in contact failure. (This applies to plastic sealed type relays, too.)
- Care should be taken to observe correct coil polarity (+, –) for polarized relays.
- Proper usage requires that the rated voltage be impressed on the coil. Use rectangular waves for DC coils and sine waves for AC coils.
- Be sure the coil impressed voltage does not continuously exceed the maximum allowable voltage.
- The rated switching power and life are given only as guides. The physical phenomena at the contacts and contact life greatly vary depending on the type of load and the operating conditions. Therefore, be sure to carefully check the type of load and operating conditions before use.
- Do not exceed the usable ambient temperature values listed in the catalog.
- Use the flux-resistant type or sealed type if automatic soldering is to be used.
- Use alcohol based cleaning solvents when cleaning is to be performed using a sealed type relay. Avoid ultrasonic cleaning of all types of relays.
- As a guide, use a Faston mounting pressure of 40 to 70N {4 to 7kgf} for relays with tab terminals.
- Avoid bending terminals, because it may cause malfunction.
- For proper use, read the main text for details.

[2] PRECAUTIONS REGARDING COIL INPUT

Application of the rated voltage is the most basic requirement for accurate relay operation. Although the relay will work if the voltage applied exceeds the pick-up voltage, it is required that only the rated voltage be applied to the coil out of consideration for changes in coil resistance, etc., due to differences in power supply type, voltage fluctuations, and rises in temperature. Also, caution is required, because problems such as layer shorts and burnout in the coil may occur if the voltage applied exceeds the maximum that can be applied continuously. The following section contains precautions regarding coil input. Please refer to it in order to avoid problems.

1. Basic Precautions Regarding Coil

• AC operation type

For the operation of AC relays, the power source is almost always a commercial frequency (50 or 60Hz) with standard voltages of 6, 12, 24, 48, 115, 120, 230 and 240V AC. Because of this, when the voltage is other than the standard voltage, the product is a special order item, and the factors of price, delivery, and stability of characteristics may create inconveniences. To the extent that it is possible, the standard voltages should be selected.

Also, in the AC type, shading coil resistance loss, magnetic circuit eddy current loss, and hysteresis loss exit, and because of lower coil efficiency, it is normal for the temperature rise to be greater than that for the DC type.

Furthermore, because humming occurs when below the pick-up voltage and when above the rated voltage, care is required with regard to power source voltage fluctuations.

For example, in the case of motor starting, if the power source voltage drops, and during the humming of the relay, if it reverts to the restored condition, the contacts suffer a burn damage and welding, with the occurrence of a false operation self-maintaining condition.

For the AC type, there is an inrush current during the operation time (for the separated condition of the armature, the impedance is low and a current greater than rated current flows; for the adhered condition of the armature, the impedance is high and the rated value of current flows), and because of this, for the case of several relays being used in parallel connection, it is necessary to give consideration to power consumption.

• DC operation type

For the operation of DC relays, standards exist for power source voltage and current, with DC voltage standards set at 5, 6, 12, 24, 48, and 100V, but with regard to current, the values as expressed in catalogs in milliamperes of pick-up current.

However, because this value of pick-up current is nothing more than a guarantee of just barely moving the armature, the variation in energizing voltage and resistance values, and the increase in coil resistance due to temperature rise, must be given consideration for the worst possible condition of relay operation, making it necessary to consider the current value as 1.5 to 2 times the pick-up current. Also, because of the extensive use of relays as limit devices in place of meters for both voltage and current, and because of the gradual increase or decrease of current impressed on the coil causing possible delay in movement of the contacts, there is the possibility that the designated control capacity may not be satisfied. Thus it is necessary to exercise care. The DC type relay coil resistance varies due to ambient temperature as well as to its own heat generation to the extent of about 0.4%/°C, and accordingly, if the temperature increases, because of the increase in pick-up and drop-out voltages, care is required.

(However, for some polarized relays, this rate of change is considerably smaller.)

2. Power Source for Coil Input

- **Energizing voltage of AC coil**

In order to have stable operation of the relay, the energizing voltage should be basically within the range of +10%/-15% of the rated voltage. However, it is necessary that the waveform of the voltage impressed on the coil be a sine wave. There is no problem if the power source is commercially provided power, but when a stabilized AC power source is used, there is a waveform distortion due to that equipment, and there is the possibility of abnormal overheating. By means of a shading coil for the AC coil, humming is stopped, but with a distorted waveform, that function is not displayed.

Figure 1 shows an example of waveform distortion.

If the power source for the relay operating circuit is connected to the same line as motors, solenoids, transformers, and other loads, when these loads operate, the line voltage drops, and because of this the relay contacts suffer the effect of vibration and subsequent burn damage. In particular, if a small type transformer is used and its capacity has no margin of safety, when there is long wiring, or in the case of household used or small sales shop use where the wiring is slender, it is necessary to take precautions because of the normal voltage fluctuations combined with these other factors. When trouble develops, a survey of the voltage situation should be made using a synchroscope or similar means, and the necessary counter-measures should be taken, and together with this determine whether a special relay with suitable excitation characteristics should be used, or make a change in the DC circuit as shown in Figure 2 in which a capacitor is inserted to absorb the voltage fluctuations.

In particular, when a magnetic switch is being used, because the load becomes like that of a motor, depending upon the application, separation of the operating circuit and power circuit should be tried and investigated.

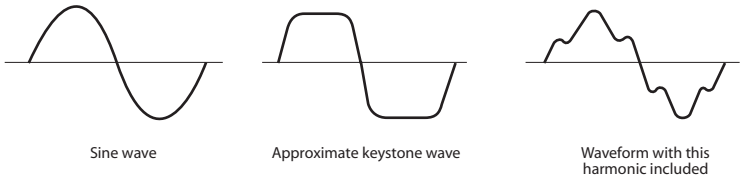


Figure 1 Distortion in an AC stabilized power source

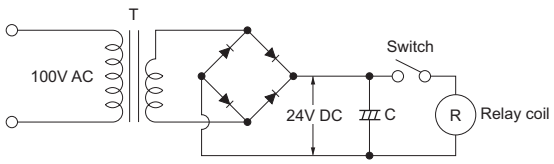


Figure 2 Voltage fluctuation absorbing circuit using a condenser

- **Power source for DC input**

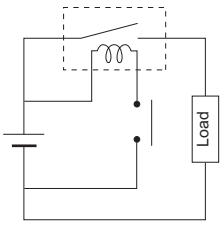
We recommend that the voltage applied to both ends of the coil in DC type relays be within ±5% of the rated coil voltage.

As a power source for the DC type relay, a battery or either a half wave or full wave rectifier circuit with a smoothing capacitor is used. The characteristics with regard to the pick-up voltage of the relay will change depending upon the type of power source, and because of this, in order to display stable characteristics, the most desirable method is perfect DC.

In the case of ripple included in the DC power source, particularly in the case of half wave rectifier circuit with a smoothing capacitor, if the capacity of the capacitor is too small, due to the influence of the ripple, humming develops and an unsatisfactory condition is produced. With the actual circuit to be used, it is absolutely necessary to confirm the characteristics.

It is necessary to give consideration to the use of a DC power source with less than a 5% ripple. Also ordinarily the following must be given thought.

- It is desirable to have less than a 5% ripple for the reed type relay.
- For the hinge type relay, a half wave rectifier cannot be used, alone unless you use a smoothing capacitor. The ripple and the characteristics must be evaluated for proper usage.
- For the hinge type relay, there are certain applications that may or may not use the full wave rectifier on it's own. Please check specifications with the original manufacture.
- Coil applied voltage and the drop in voltage
  Shown following is a circuit driven by the same power supply (battery, etc.) for both the coil and contact.
  Electrical life will be affected by the drop in voltage in the coil when load is turned on.
  Please verify that the actual voltage is applied to the coil at the actual load.



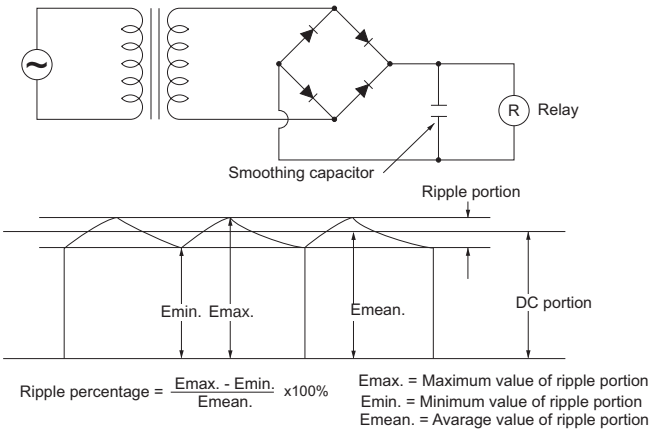


Figure 3

3. Maximum Continuous Voltage and Temperature Rise

Proper usage requires that the rated voltage be impressed on the coil. Note, however, that if a voltage greater than or equal to the maximum continuous voltage is impressed on the coil, the coil may burn or its layers short due to the temperature rise. Furthermore, do not exceed the usable ambient temperature range listed in the catalog.

- **Maximum continuous voltage**

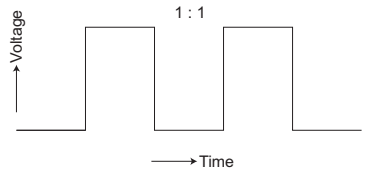
In addition to being a requirement for relay operation stability, the maximum continuous voltage is an important constraint for the prevention of such problems as thermal deterioration or deformity of the insulation material, or the occurrence of fire hazards.

In actual use with E-type insulation, when the ambient temperature is 40°C 104°F, a temperature rise limit of 80°C 176°F is thought to be reasonable according to the resistance method. However, when complying with the Electrical Appliance and Material Safety Law, this becomes 75°C 167°F.

- **Temperature rise due to pulse voltage**

When a pulse voltage with ON time of less than 2 minutes is used, the coil temperature rise bares no relationship to the ON time. This varies with the ratio of ON time to OFF time, and compared with continuous current passage, it is rather small. The various relays are essentially the same in this respect.

Current passage time	%
For continuous passage	Temperature rise value is 100%
ON : OFF = 3 : 1	About 80%
ON : OFF = 1 : 1	About 50%
ON : OFF = 1 : 3	About 35%



- **Pick-up voltage change due to coil temperature rise (hot start)**

In DC relays, after continuous passage of current in the coil, if the current is turned OFF, then immediately turned ON again, due to the temperature rise in the coil, the pick-up voltage will become somewhat higher. Also, it will be the same as using it in a higher temperature atmosphere. The resistance/temperature relationship for copper wire is about 0.4% for 1°C, and with this ratio the coil resistance increases. That is, in order to operate of the relay, it is necessary that the voltage be higher than the pick-up voltage and the pick-up voltage rises in accordance with the increase in the resistance value. However, for some polarized relays, this rate of change is considerably smaller.

4. Coil Applied Voltage and Operate Time

In the case of AC operation, there is extensive variation in operate time depending upon the point in the phase at which the switch is turned ON for coil excitation, and it is expressed as a certain range, but for miniature types it is for the most part 1/2 cycle. However, for the somewhat large type relay where bounce is large, the operate time is 7 to 16ms, with release time in the order of 9 to 18ms. Also, in the case of DC operation, to the extent of large coil input, the operating time is rapid, but if it is too rapid, the “Form A” contact bounce time is extended.

Please be warned that load conditions (in particular when inrush current is large or load is close to the load rating) may cause the working life to shorten and slight welding.

5. Stray Circuits (Bypass Circuits)

In the case of sequence circuit construction, because of bypass flow or alternate routing, it is necessary to take care not to have erroneous operation or abnormal operation. To understand this condition while preparing sequence circuits, as shown in Figure 4, with 2 lines written as the power source lines, the upper line is always ⊕ and the lower line ⊖ (when the circuit is AC, the same thinking applies). Accordingly the ⊕ side is necessarily the side for making contact connections (contacts for relays, timers and limit switches, etc.), and the ⊖ side is the load circuit side (relay coil, timer coil, magnet coil, solenoid coil, motor, lamp, etc.).

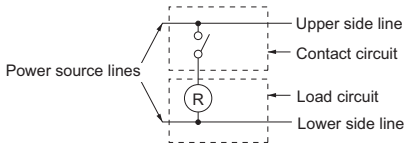


Figure 4 Example of a vertically written sequence circuit

Figure 5 shows an example of stray circuits. In Figure 5 (a), with contacts A, B, and C closed, after relays R_1, R_2, and R_3 operate, if contacts B and C open, there is a series circuit through A, R_1, R_2, and R_3, and the relays will hum and sometimes not be restored to the drop out condition.

The connections shown in Figure 5 (b) are correctly made. In addition, with regard to the DC circuit, because it is simple by means of a diode to prevent stray circuits, proper application should be made.

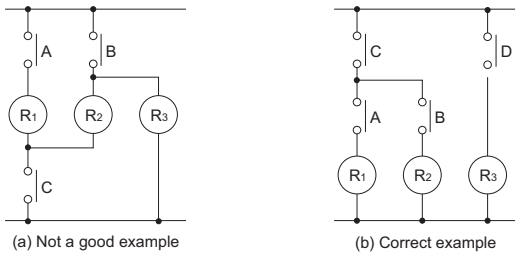


Figure 5 Stray circuits

6. Gradual Increase of Coil Impressed Voltage and Suicide Circuit

When the voltage impressed on the coil is increased slowly, the relay transferring operation is unstable, the contact pressure drops, contact bounce increases, and an unstable condition of contact occurs. This method of applying voltage to the coil should not be used, and consideration should be given to the method of impressing voltage on the coil (use of switching circuit). Also, in the case of latching relays, using self “Form B” contacts, the method of self coil circuit for complete interruption is used, but because of the possibility of trouble developing, care should be taken.

The circuit shown in Figure 6 causes a timing and sequential operation using a reed type relay, but this is not a good example with mixture of gradual increase of impressed voltage for the coil and a suicide circuit. In the timing portion for relay R_1, when the timing times out, chattering occurs causing trouble. In the initial test (trial production), it shows favorable operation, but as the number of operations increases, contact blackening (carbonization) plus the chattering of the relay creates instability in performance.

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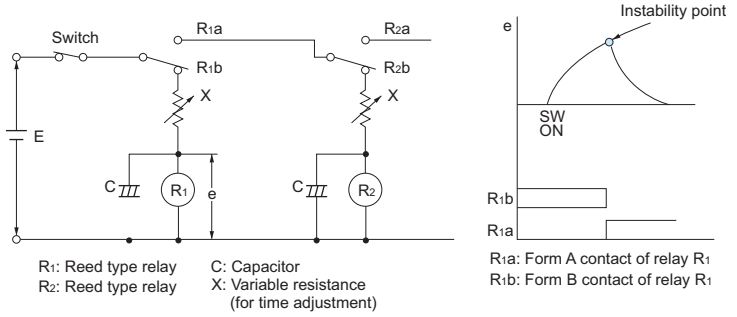


Figure 6 “Not a good example”: A timing and sequential operation using a reed type relay

7. Phase Synchronization in AC Load Switching

If switching of the relay contacts is synchronized with the phase of the AC power, reduced electrical life, welded contacts, or a locking phenomenon (incomplete release) due to contact material transfer may occur. Therefore, check the relay while it is operating in the actual system. When driving relays with timers, micro computers and thyristors, etc., there may be synchronization with the power supply phase.

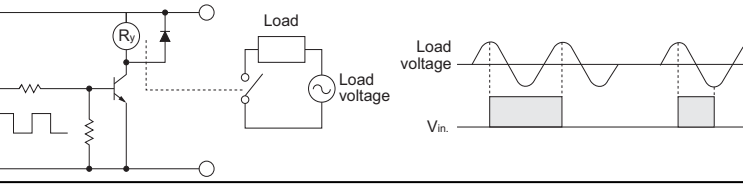


Figure 7

8. Erroneous Operation due to Inductive Interference

For long wire runs, when the line for the control circuit and the line for electric power use a single conduit, induction voltage, caused by induction from the power line, will be applied to the operation coil regardless of whether or not the control signal is off. In this case the relay and timer may not revert. Therefore, when wiring spans a long distance please remember that along with inductive interference, connection failure may be caused by a problem with distribution capacity or the device might break down due to the influence of externally caused surges, such as that caused by lightning.

9. Long Term Current Carrying

A circuit designed for non-excitation when left running is desirable for circuits (circuits for emergency lamps, alarm devices and error inspection that, for example, revert only during malfunction and output warnings with form B contacts) that will be carrying a current continuously for long periods without relay switching operation.

Continuous, long-term current to the coil will facilitate deterioration of coil insulation and characteristics due to heating of the coil itself.

For circuits such as these, please use a magnetic-hold type latching relay. If you must use a single stable relay, use a sealed type relay that is not easily affected by ambient conditions and provide a failsafe circuit design that considers the possibility of contact failure or disconnection.

10.Usage with Infrequent Switching

Please carry out periodic contact conductivity inspections when the frequency of switching is once or fewer times per month. When no switching of the contacts occurs for long periods, organic membrane may form on the contact surfaces and lead to contact instability.

11.Regarding Electrolytic Corrosion of Coils

In the case of comparatively high voltage coil circuits, when such relays are used in high temperature and high humidity atmospheres or with continuous passage of current, the corrosion can be said to be the result of the occurrence of electrolytic corrosion. Because of the possibility of open circuits occurring, attention should be given to the following points.

- The ⊕ side of the power source should be connected to the chassis. (Refer to Figure 8) (Common to all relays)

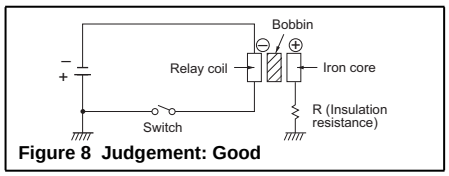


Figure 8 Judgement: Good

- In the case where unavoidably the ⊕ side is grounded, or in the case where grounding is not possible.
  - Insert the contacts (or switch) in the ⊕ side of the power source. (Refer to Figure 9) (Common to all relays)

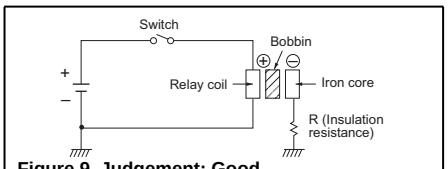


Figure 9 Judgement: Good

  - When a grounding is not required, connect the ground terminal to the ⊕ side of the coil. (Refer to Figure 10) (NF and NR with ground terminal)

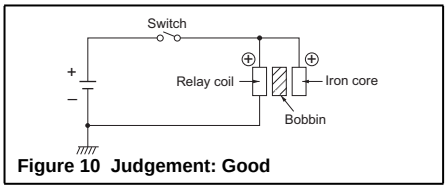


Figure 10 Judgement: Good

- When the ⊕ side of the power source is grounded, always avoid interting the contacts (and switches) in the ⊕ side. (Refer to Figure 11) (Common to all relays)

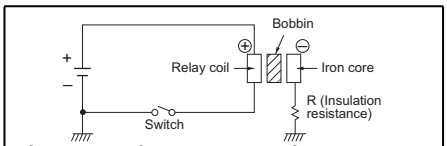


Figure 11 Judgement: No good

- In the case of relays provided with a ground terminal, when the ground terminal is not considered effective, not making a connection to ground plays an important role as a method for preventing electrolytic corrosion.

Note: The designation on the drawing indicates the insertion of insulation between the iron core and the chassis. In relays where a ground terminal is provided, the iron core can be grounded directly to the chassis, but in consideration of electrolytic corrosion, it is more expedient not to make the connection.

[3] PRECAUTIONS REGARDING CONTACT

- **Contact**

The contacts are the most important elements of relay construction. Contact performance conspicuously influenced by contact material, and 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, form of contact, contact switching speed, and of bounce.

Because of contact transfer, welding, abnormal wear, increase in contact resistance, and the various other damages which bring about unsuitable operation, the following items require full investigation.

*We recommend that you verify with one of our sales offices

1. Basic Precautions Regarding Contact

- **Voltage, AC and DC**

When there is inductance included in the circuit, a rather high counter emf is generated as a contact circuit voltage, and since, to the extent of the value of that voltage, the energy applied to the contacts causes damage with consequent wear of the contacts, and transfer of the contacts, it is necessary to exercise care with regard to control capacity. In the case of DC, there is no zero current point such as there is with AC, and accordingly, once a cathode arc has been generated, because it is difficult to quench that arc, the extended time of the arc is a major cause. In addition, due to the direction of the current being fixed, the phenomenon of contact shift, as noted separately below, occurs in relation to the contact wear. Ordinarily, the approximate control capacity is mentioned in catalogs or similar data sheets, but this alone is not sufficient. With special contact circuits, for the individual case, the maker either estimates from the past experience or makes test on each occasion. Also, in catalogs and similar data sheets, the control capacity that is mentioned is

limited to resistive load, but there is a broad meaning indicated for that class of relay, and ordinarily it is proper to think of current capacity as that for 125V AC circuits.

Minimum applicable loads are given in the catalog; however, these are only provided as a guide to the lower limit that the relay is able to switch and are not guaranteed values. The level of reliability of these values depends on switching frequency, ambient conditions, change in the desired contact resistance, and the absolute value. Please use relays with AgPd contacts when minute analog load control or contact resistance no higher than 100 mΩ is desired (for measurement and wireless applications, etc.).

- **Current**

The current at both the closing and opening time of the contact circuit exerts important influence. For example, when the load is either a motor or a lamp, to the extent of the inrush current at the time of closing the circuit, wear of the contacts, and the amount of contact transfer increase, and contact welding and contact transfer make contact separation impossible.

2. Characteristics of Common Contact Materials

Characteristics of contact materials are given below. Refer to them when selecting a relay.

Contact Material	Ag (silver)	Electrical conductivity and thermal conductivity are the highest of all metals. Exhibits low contact resistance, is inexpensive and widely used. A disadvantage is it easily develops a sulfide film in a sulfide atmosphere. Care is required at low voltage and low current levels.
	$AgSnO_2$ (silver-tin)	Exhibits superior welding resistance characteristics equal or better than AgCdO. Like silver, it easily develops a sulfide film in a sulfide atmosphere.
	AgW (silver-tungsten)	Hardness and melting point are high, arc resistance is excellent, and it is highly resistant to material transfer. However, high contact pressure is required. Furthermore, contact resistance is relatively high and resistance to corrosion is poor. Also, there are constraints on processing and mounting to contact springs.
	AgNi (silver-nickel)	Equals the electrical conductivity of silver. Excellent arc resistance.
	AgPd (silver-palladium)	At standard temperature, good corrosion resistance and good sulfidation resistance. However, in dry circuits, organic gases adhere and it easily develops a polymer. Gold clad is used to prevent polymer buildup. Expensive.
Surface Finish	Rh plating (rhodium)	Combines perfect corrosion resistance and hardness. As plated contacts, used for relatively light loads. In an organic gas atmosphere, care is required as polymers may develop. Therefore, it is used in hermetic sealed relays (reed relays, etc.). Expensive.
	Au clad (gold clad)	Au with its excellent corrosion resistance is pressure welded onto a base metal. Special characteristics are uniform thickness and the nonexistence of pinholes. Greatly effective especially for low level loads under relatively adverse atmospheres. Often difficult to implement clad contacts in existing relays due to design and installation.
	Au plating (gold plating)	Similar effect to Au clad. Depending on the plating process used, supervision is important as there is the possibility of pinholes and cracks. Relatively easy to implement gold plating in existing relays.
	Au flash plating (gold thin-film plating) 0.1 to 0.5μm	Purpose is to protect the contact base metal during storage of the switch or device with built-in switch. However, a certain degree of contact stability can be obtained even when switching loads.

3. Contact Protection

- **Counter EMF**

When switching inductive loads with a DC relay such as relay sequence circuits, DC motors, DC clutches, and DC solenoids, it is always important to absorb surges (e.g. with a diode) to protect the contacts.

When these inductive loads are switched off, a counter emf of several hundred to several thousand volts develops which can severely damage contacts and greatly shorten life. If the current in these loads is relatively small at around 1A or less, the counter emf will cause the ignition of a glow or arc discharge. The 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.

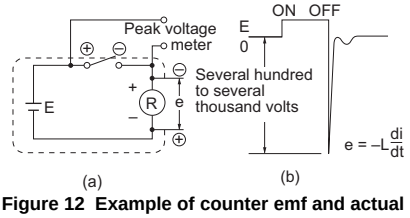


Figure 12 Example of counter emf and actual measurement

In Figure 12 (a), a counter emf (e = –L di/dt) with a steep waveform is generated across the coil with the polarity shown in Figure 12 (b) at the instant the inductive load is switched off. The counter emf passes through the power supply line and reaches both contacts.

Generally, the critical dielectric breakdown voltage at standard temperature and pressure in air is about 200 to 300 volts. Therefore, if the counter emf exceeds this, discharge occurs at the contacts to dissipate the energy ($^1/_2Li^2$) stored in the coil. For this reason, it is desirable to absorb the counter emf so that it is 200V or less.

- **Material transfer phenomenon**

Material transfer of contacts occurs when one contact melts or boils and the contact material transfers to the other contact. As the number of switching operations increases, uneven contact surfaces develop such as those shown in Figure 13. After a while, the uneven contacts lock as if they were welded together. This often occurs in circuits where sparks are produced at the moment the contacts "make" such as when the DC current is large for DC inductive or capacitive loads or when the inrush current is large (several amperes or several tens of amperes).

Contact protection circuits and contact materials resistant to material transfer such as $AgSnO_2$, AgW or AgCu are used as countermeasures. Generally, a concave formation appears on the cathode and a convex formation appears on the anode. For DC capacitive loads (several amperes to several tens of

amperes), it is always necessary to conduct actual confirmation tests.

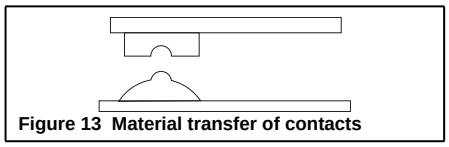
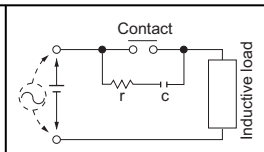
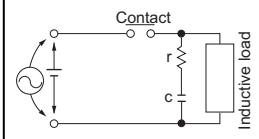
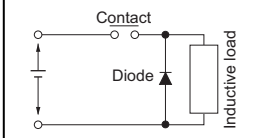
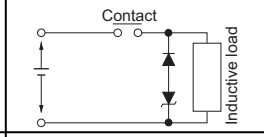
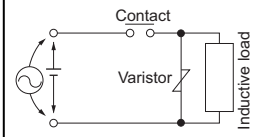


Figure 13 Material transfer of contacts

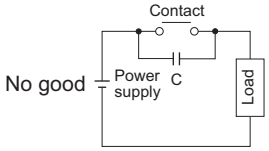
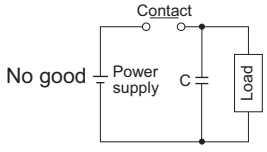
- **Contact protection circuit**

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.

(G: Good, NG: No Good, C: Conditional)

Circuit		Application AC	Application DC	Features/Others	Devices Selection
CR circuit		C*	G	If the load is a timer, leakage current flows through the CR circuit causing faulty operation. * If used with AC voltage, be sure the impedance of the load is sufficiently smaller than that of the CR circuit	As a guide in selecting c and r, c: 0.5 to 1μF per 1A contact current r: 0.5 to 1Ω per 1V contact voltage Values vary depending on the properties of the load and variations in relay characteristics. Capacitor “c” acts to suppress the discharge the moment the contacts open. Resistor “r” acts to limit the current when the power is turned on the next time. Test to confirm. Use a capacitor “c” with a breakdown voltage of 200 to 300V. Use AC type capacitors (non-polarized) for AC circuits.
		G	G	If the load is a relay or solenoid, the release time lengthens. Effective when connected to both contacts if the power supply voltage is 24 or 48V and the voltage across the load is 100 to 200V.	
Diode circuit		NG	G	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 further delays the release time compared to the CR circuit. (2 to 5 times the release time listed in the catalog)	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. 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		NG	G	Effective when the release time in the diode circuit is too long.	Use a zener diode with a zener voltage about the same as the power supply voltage.
Varistor circuit		G	G	Using the stable voltage characteristics of the varistor, this circuit prevents excessively high voltages from being applied across the contacts. This circuit also slightly delays the release time. Effective when connected to both contacts if the power supply voltage is 24 to 48V and the voltage across the load is 100 to 200V.	–

- Avoid using the protection circuits shown in the figures on the right.
  Although DC inductive loads are usually more difficult to switch than resistive loads, use of the proper protection circuit will raise the characteristics to that for resistive loads.

	
Although 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 short-circuit current flows from “C” when the contacts close.	Although 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.

- **Mounting the protective device**

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

- **Abnormal corrosion during high frequency switching of DC loads (spark generation)**

If, for example, a DC valve or clutch is switched at a high frequency, a blue-green corrosion may develop. This occurs from the reaction with nitrogen and oxygen in the air when sparks (arc discharge) are generated during switching. Therefore, care is required in circuits where sparks are generated at a high frequency.

4. Cautions on Use Related to Contacts

• Connection of load and contacts

Connect the load to one side of the power supply as shown in Figure 14 (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 Figure 14 (b), there is a risk of shorting the power supply when relatively close contacts short.

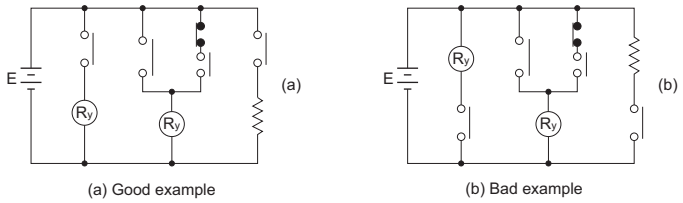


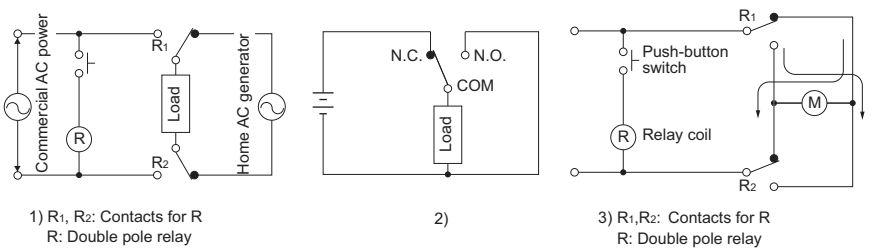
Figure 14

• Dummy Resistor

Since voltage levels at the contacts used in low current circuits (dry circuits) are low, poor conduction is often the result. One method to increase reliability is to add a dummy resistor in parallel with the load to intentionally raise the load current reaching the contacts.

• Avoid circuits where shorts occur between Form A and B contacts

1) The clearance between form A and B contacts in compact control components is small. The occurrence of shorts due to arcing must be assumed. 2) Even if the three N.C., N.O., and COM contacts are connected so that they short, a circuit must never be designed to allow the possibility of burning or generating an overcurrent. 3) A forward and reverse motor rotation circuit using switching of form A and B contacts must never be designed.



1) R_1, R_2: Contacts for R
R: Double pole relay

2)

3) R_1,R_2: Contacts for R
R: Double pole relay

Figure 15 Bad example of Form A and B use

• Shorts between different electrodes

Although there is a tendency to select miniature control components because of the trend toward miniaturizing electrical control units, care must be taken when selecting the type of relay in circuits where different voltages are applied between electrodes in a multi-pole relay, especially when switching two different power supply circuits. This is not a problem that can be determined from sequence circuit diagrams. The construction of the control component itself must be examined and sufficient margin of safety must be provided especially in creepage between electrodes, space distance, presence of barrier, etc.

- **Type of load and inrush current**

The type of load and its inrush current characteristics, together with the switching frequency, are important factors which cause contact welding.

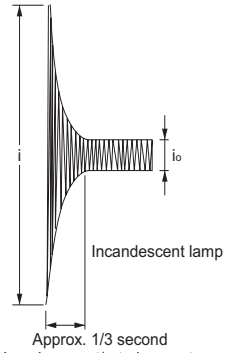
Particularly for loads with inrush currents, measure the steady state and inrush current. Then select a relay which provides an ample margin of safety. The table on the right shows the relationship between typical loads and their inrush currents.

Also, verify the actual polarity used since, depending on the relay, electrical life is affected by the polarity of COM and NO.

Type of load	Inrush current
Resistive load	Steady state current
Solenoid load	10 to 20 times the steady state current
Motor load	5 to 10 times the steady state current
Incandescent lamp load	10 to 15 times the steady state current
Mercury lamp load	Approx. 3 times the steady state current
Sodium vapor lamp load	1 to 3 times the steady state current
Capacitive load	20 to 40 times the steady state current
Transformer load	5 to 15 times the steady state current

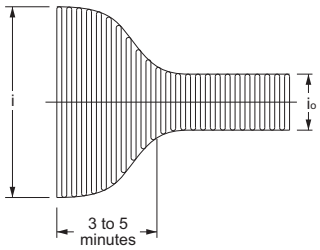
Load Inrush Current Wave and Time

(1) Incandescent Lamp Load

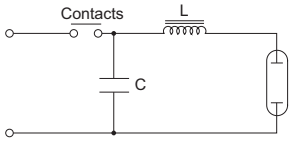


Inrush current/rated current:
i/io] 10 to 15 times

(2) Mercury Lamp Load
i/io approx. 3 times

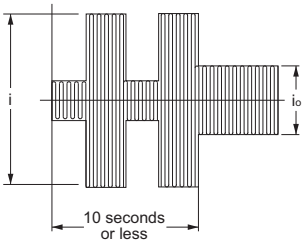


The discharge tube, transformer, choke coil, capacitor, etc., are combined in common discharge lamp circuits. Note that the inrush current may be 20 to 40 times, especially if the power supply impedance is low in the high power factor type.

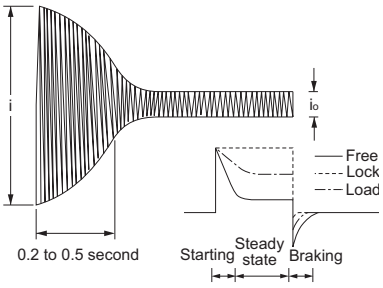


(for high power factor type)

(3) Fluorescent Lamp Load
i/io approx. 5 to 10 times

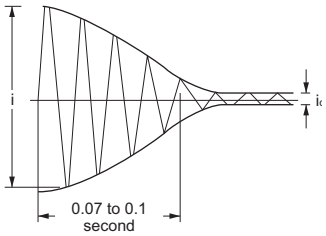


(4) Motor Load i/io approx. 5 to 10 times



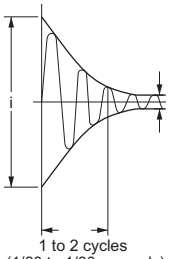
- Conditions become more harsh if plugging or inching i performed since state transitions are repeated.
- When using a relay to control a DC motor and brake, the on time inrush current, steady state current and of time brake current differ depending on whether the load to the motor is free or locked. In particular, with non-polarized relays, when using from B contact of from contact for the DC motor brake, mechanical life might be affected by the brake current. Therefore, please verify current at the actual load.

(5) Solenoid Load
i/io approx.10 to 20 times

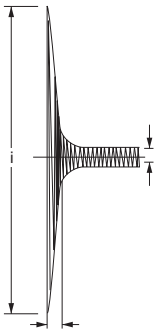


Note that since inductance is great, the arc lasts longer when power is cut. The contact may beome easily worn.

(6) Electromagnetic Contact Load
i/io approx. 3 to 10 times



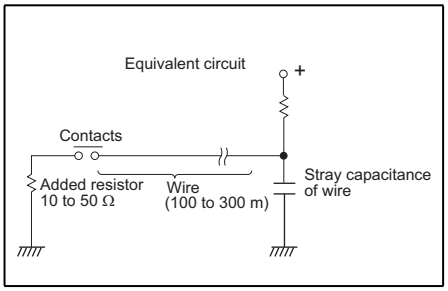
(7) Capacitive Load
i/io approx. 20 to 40 times



1/2 to 2 cycles (1/120 to 1/30 second

- **When using long wires**

If long wires (100 to 300m) are to be used in a relay contact circuit, inrush current may become a problem due to the stray capacitance existing between wires. Add a resistor (approx. 10 to 50Ω) in series with the contacts.

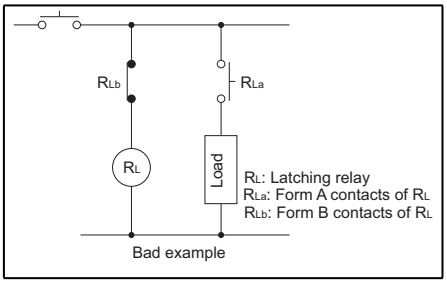


- **Electrical life at high temperatures**

Verify at the actual load since electrical life may be affected by use at high temperatures.

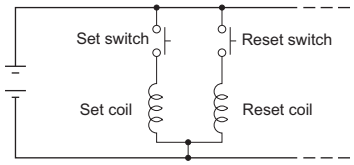
[4] PRECAUTIONS REGARDING LATCHING RELAYS

- Latching relays are shipped from the factory in the reset state. A shock to the relay during shipping or installation may cause it to change to the set state. Therefore, it is recommended that the relay be used in a circuit which initializes the relay to the required state (set or reset) whenever the power is turned on.
- Avoid impressing voltages to the set coil and reset coil at the same time.
- Connect a diode as shown since latching may be compromised when the relay is used in the following circuits.
  - If set coils or reset coils are to be connected together in parallel, connect a diode in series to each coil. Figure 16 (a), (b)
  - Also, if the set coil of a relay and the reset coil of another relay are connected in parallel, connect a diode to the coils in series. Figure 16 (c)
  - If the set coil or reset coil is to be connected in parallel with an inductive load (e.g. another electromagnetic relay coil, motor, transformer, etc.), connect a diode to the set coil or reset coil in series. Figure 16 (d)
- Use a diode having an ample margin of safety for repeated DC reverse voltage and peak reverse voltage applications and having an average rectified current greater than or equal to the coil current.
- Avoid applications in which conditions include frequent surges to the power supply.
- Avoid using the following circuit since self-excitation at the contacts will inhibit the normal keep state



- Four-terminal latching relay

In the 2-coil latching type circuit as shown below, one terminal at one end of the set coil and one terminal at one end of the reset coil are connected in common and voltages of the same polarity are applied to the other side for the set and reset operations. In this type of circuit, short 2 terminals of the relay as noted in the table. This helps to keep the insulation high between the two winding.



- Minimum pulse width

As a guide, make the minimum pulse width in order to set or reset a latching relay at least 5 times the set time or reset time of each product and apply a rectangular-wave rated voltage. Also, please verify operation. Please inquire if you cannot obtain a pulse width of at least 5 times the set (reset) time. Also, please inquire regarding capacitor drive.

Relay Type		Terminal Nos.
DS	1c	—
	2c	15 & 16
	4c	*
NC	Flat	5 & 6
	Slim	3 & 4
ST		*
SP		2 & 4

Notes:
1. DS4c and ST relays are constructed so that the set coil and reset coil are separated for high insulation resistance.
2. DSP, TQ, S relays are not applicable due to polarity.

- Two Coil Latch Induction Voltage

Each coil in a 2-coil latch relay is wound with a set coil and a reset coil on the same iron cores. Accordingly, induction voltage is generated on the reverse side coil when voltage is applied and shut off to each coil. Although the amount of induction voltage is about the same as the rated relay voltage, you must be careful of the reverse bias voltage when driving transistors.

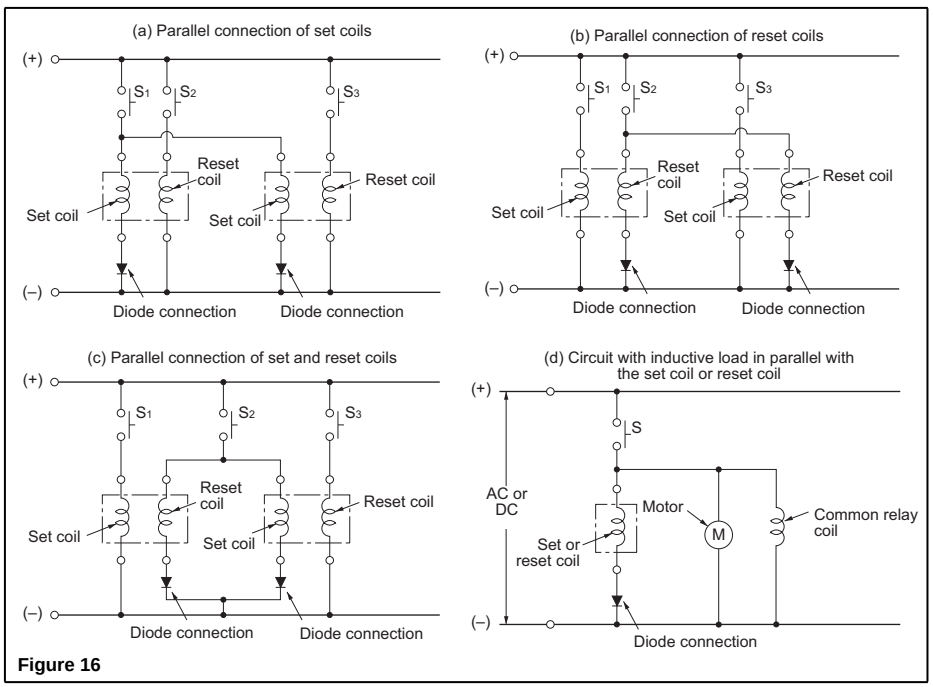
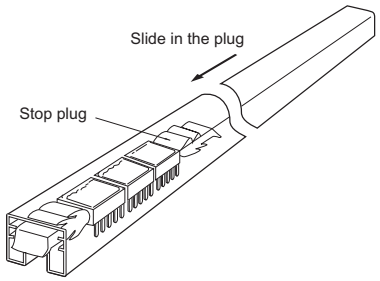


Figure 16

[5] HANDLING CAUTIONS FOR TUBE PACKAGING

Some types of relays are supplied in tube packaging. If you remove any relays from the tube packaging, be sure to slide the stop plug at one end to hold the remaining relays firmly together so they would not move in the tube. Failing to do this may lead to the appearance and/or performance being damaged.



[6] AMBIENT ENVIRONMENT

1. Ambient Temperature and Atmosphere

Be sure the ambient temperature at the installation does not exceed the value listed in the catalog. Furthermore, environmentally sealed types (plastic sealed type) should be considered for applications in an atmosphere with dust, sulfur gases (SO_2, H_2S), or organic gases.

2. Silicone Atmosphere

Silicone-based substances (silicone rubber, silicone oil, silicone-based coating material, silicone caulking compound, etc.) emit volatile silicone gas. Note that when silicone is used near relay, switching the contacts in the presence of its gas causes silicone to adhere to the contacts and may result in contact failure (in plastic sealed types, too).

In this case, use a substitute that is not silicone-based.

3. NOx Generation

When a relay is used in an atmosphere high in humidity to switch a load which easily produces an arc, the NOx created 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 use at an ambient humidity of 85%RH or higher (at 20°C 68°F). If use at high humidity is unavoidable, consult us.

4. Vibration and Shock

If a relay and magnetic switch are mounted next to each other on a single plate, the relay contacts may separate momentarily from the shock produced when the magnetic switch is operated and result in faulty operation. Countermeasures include mounting them on separate plates, using a rubber sheet to absorb the shock, and changing the direction of the shock to a perpendicular angle.

Also, if the relay will be subject to continual vibration (trains, etc.), do not use it with a socket. We recommend that you solder directly to the relay terminals.

5. Influence of External Magnetic Fields

Permanent magnets are used in reed relays and polarized relays, and their movable parts are constructed of ferrous materials. For this reason, when a magnet or permanent magnet in any other large relay, transformer, or speaker is located nearby, the relay characteristics may change and faulty operations may result. The influence depends on the strength of the magnetic field and it should be checked at the installation.

6. Usage, Storage, and Transport Conditions

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.

- **Temperature**

The allowable temperature range differs for each relay, so refer to the relay's individual specifications.

In addition, when transporting or storing relays while they are tube packaged, there are cases when the temperature may differ from the allowable range.

In this situation, be sure to consult the individual specifications.

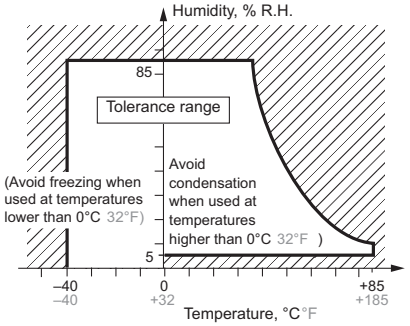
- **Humidity**

5 to 85 % R.H.

- **Pressure**

86 to 106 kPa

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



(The allowable temperature depends on the switch.)

- Condensation will occur inside the switch if there is a sudden change in ambient temperature when used in an atmosphere of high temperature and high humidity. This is particularly likely to happen when being transported by ship, so please be careful of the atmosphere when shipping. Condensation is the phenomenon whereby steam condenses to cause water droplets that adhere to the switch when an atmosphere of high temperature and humidity rapidly changes from a high to low temperature or when the switch is quickly moved from a low humidity location to one of high temperature and humidity. Please be careful because condensation can cause adverse conditions such as deterioration of insulation, coil cutoff, and rust.
- Condensation or other moisture may freeze on the switch when the temperatures is lower than 0°C 32°F. This causes problems such as sticking of movable parts or operational time lags.
- The plastic becomes brittle if the switch is exposed to a low temperature, low humidity environment for long periods of time.

- Storage for extended periods of time (including transportation periods) at high temperatures or high humidity levels or in atmospheres with organic gases or sulfide gases may cause a sulfide film or oxide film to form on the surfaces of the contacts and/or it may interfere with the functions. Check out the atmosphere in which the units are to be stored and transported.
- In terms of the packing format used, make every effort to keep the effects of moisture, organic gases and sulfide gases to the absolute minimum.
- Since the SMD type is sensitive to humidity it is packaged with tightly sealed anti-humidity packaging. However, when storing, please be careful of the following:

- Please use promptly once the anti-humidity pack is opened (Signal relay: with in 3 days, Max. 30°C 86°F/60%RH). If left with the pack open, the relay will absorb moisture which will cause thermal stress when reflow mounting and thus cause the case to expand. As a result, the seal may break.
- When storing for a long period after opening the anti-humidity pack, you must take measures to prevent humidity, for example, by storing in the open location of a promptly re-sealed anti-humidity pack after it is used or in a humidity-controlled desicator. You may also store it in an anti-humidity bag to which silica gel has been added.
- To avoid incorrect handling of our moisture-sensitive products, Panasonic affixes a cautionary label to the vacuum-sealed bag in which the products are delivered.

- **Note:**
  Please note that the products must be mounted within the time limit specified on the bag. The time limit given on the bag varies for the different kinds of surface-mount terminal type products.

7. Vibration, Impact and Pressure when Shipping

When shipping, if strong vibration, impact or heavy weight is applied to a device in which a relay is installed, functional damage may occur. Therefore, please package in a way, using shock absorbing material, etc., so that the allowable range for vibration and impact is not exceeded.

[7] ENVIRONMENTALLY SEALED TYPE RELAYS

Sealed type (plastic sealed type, etc.) relays are available. They are effective when problems arise during PC board mounting (e.g. automatic soldering and cleaning). They also, of course, feature excellent corrosion resistance. Note the cautions below regarding the features and use of environmentally sealed type relays to avoid problems when using them in applications.

1. Operating Environment

Plastic sealed type relays are not suited for use in environments that especially require air tightness. Although there is no problem if they are used at sea level, avoid atmospheric pressures beyond 96±10kPa. Also avoid using them in an atmosphere containing flammable or explosive gases.

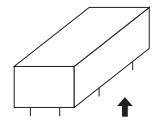
2. Cleaning

When cleaning a printed circuit board after soldering, we recommend using alcohol based cleaning fluids. Please avoid ultrasonic cleaning. The ultrasonic energy from this type of cleaning may cause coil line breakage and light sticking of contacts.

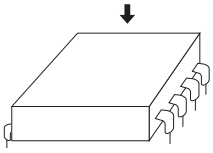
[8] MOUNTING CONSIDERATIONS

1. Top View and Bottom View

Relays used for PC boards, especially the flat type relays, have their top or bottom surface indicated in the terminal wiring diagrams.



Relay with terminals viewed from the bottom (terminals cannot be seen from the top)



Relay with terminals viewed from the top (all terminals can be seen from the top)
Note during PC board pattern design (NL, NC)

2. Mounting Direction

Mounting direction is important for optimum relay characteristics.

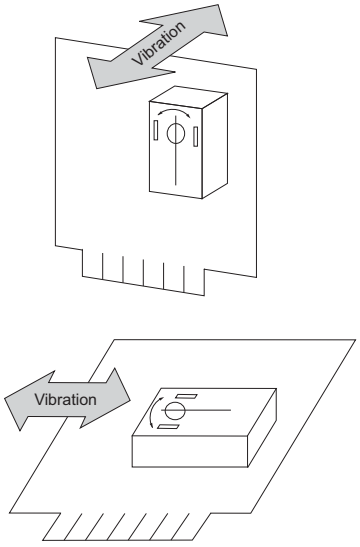
- **Shock resistance**

It is ideal to mount the relay so 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 Form B contacts while the coil is not excited is greatly affected by the mounting direction of the relay.

- **Contact reliability**

Mounting the relay so the surfaces of its contacts (fixed contacts or movable contacts) are vertical prevents dirt and dust as well as scattered contact material (produced due to large loads from which arcs are generated) and powdered metal from adhering to them.

Furthermore, it is not desirable to switch both a large load and a low level load with a single relay. The scattered contact material produced when switching the large load adheres to the contacts when switching the low level load and may cause contact failure. Therefore, avoid mounting the relay with its low level load contacts located below the large load contacts.



3. Adjacent Mounting

When many relays are mounted close together, abnormally high temperatures may result from the combined heat generated. Mount relays with sufficient spacing between them to prevent heat buildup.

This also applies when a large number of boards mounted with relays are installed as in a card rack. Be sure the ambient temperature of the relay does not exceed the value listed in the catalog.

- **Influence of adjacent mounting of polarized relays**

When polarized relays are mounted close together, their characteristics change. Since the affect of adjacent mounting differs according to the type of relay, refer to the data for the particular type.

4. Panel Mounting

- Do not remove the cover. It has a special function. (It will not come off under normal handling.)

[9] METHOD OF MOUNTING AND LEAD WIRES CONNECTION

1. Mounting Method

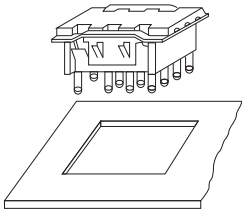
The direction of mounting is not specifically designated, but to the extent possible, the direction of contact movement should be such that vibration and shock will not be applied.

When a terminal socket is used

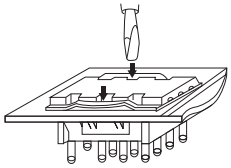
After drilling the mounting holes, the terminal socket should be mounted making certain the mounting screws are not loose. DIN standard sockets are available for one-touch mounting on DIN rail of 35mm 1.378 inch width.

When reversible terminal sockets are used

- The reversible terminal sockets (HC, HL socket) are for one-touch mounting. (A panel thickness of 1 to 2mm .039 to .079 inch should be used.)



- The socket should be pushed through the opening in the mounting panel until the projections on the side of the mounting bracket extend out over the back surface.



- When all four of the projections are visible from the back side of the mounting panel, the mounting is completed and the socket is fastened.
- To remove the socket, the projections on the side of the mounting bracket should be pushed inward and at the same time the body of the socket should be pushed lightly from the back side. The socket can then be removed from the panel.

2. Connection of Lead Wires

- When making the connections, depending upon the size of load, the wire cross-section should be at least as large as the values shown in the table below.

Permissible current (A)	Cross-section (mm^2)
2	0.2
3	0.3
5	0.5
7.5	0.75
12.5	1.25
15	2
20	2
30	3.5

- When the terminal socket uses screw fastening connections, either pressure terminals or other means should be used to make secure fastening of the wire.
- To prevent damage and deformity, please use a torque within the following range when tightening the push screw block of the terminal socket.

Screw	Torque
M4.5	1.47 to 1.666 N·m (15 to 17 kgf·cm)
M4	1.176 to 1.37 N·m (12 to 14 kgf·cm)
M3.5	0.784 to 0.98 N·m (8 to 10 kgf·cm)
M3	0.49 to 0.69 N·m(5 to 7 kgf·cm)

[10]CAUTIONS FOR USE–CHECK LIST

Item	To check
Coil Drive Input	1) Is the correct rated voltage applied? 2) Is the applied coil voltage within the allowable continuous voltage limit? 3) Is the ripple in the coil voltage within the allowable level? 4) For voltage applied to a polarized coil, is polarity observed? 5) When hot start is required, is the increase in coil resistance resulting from coil temperature rise taken into account in setting coil voltage? 6) Is the coil voltage free from momentary drop caused by load current? (Pay special attention for self-holding relays.) 7) Is supply voltage fluctuation taken into account when setting the rated coil voltage? 8) The relay status may become unstable if the coil voltage (current) is gradually increased or decreased. Was the relay tested in a real circuit or with a real load? 9) When driving with transistors, did you consider voltage drops?
Load (Relay contacts)	1) Is the load rated within the contact ratings? 2) Does the load exceed the contacts' minimum switching capacity? 3) Special attention is required for contact welding when the load is a lamp, motor, solenoid, or electromagnetic contractor. Was the relay tested with a real load? 4) A DC load may cause contact lock-up due to large contact transfer. Was the relay tested with a real load? 5) For an inductive load, is a surge absorber used across the contacts? 6) When an inductive load causes heavy arc discharge across the relay contacts, the contacts may be corroded by chemical reaction with nitrogen in the atmosphere. Was the relay tested with a real load? 7) Platinum contacts may generate brown powder due to a catalyzer effect or vibration energy. Was the relay tested with a real load? 8) Is the contact switching frequency below the specification? 9) When there are more than two sets of contacts (2T) in a relay, metallic powder shed from one set of contacts may cause a contact failure on the other set (particularly for light loads). Was the relay tested in a real load? 10)A delay capacitor used across relay contacts may cause contact welding. Was the relay tested with a real load? 11)For an AC relay, a large contact bounce may cause contact welding. Was the relay tested in a real circuit or with a real load? 12)A high voltage may be induced at transformer load. Was the relay tested with a real load?
Circuit Design	1) Does circuit design take into account electrolytic corrosion of the coil? 2) Are transistors and other circuit components protected rom counter electromotive force that develops across the relay coil? 3) Is the circuit designed so the relay coil is left deenergized while the relay is inactive for long period of time? 4) Is the relay operated within the ratings approved by the relevant international standard (if compliance is required)? 5) Is the circuit protected from malfunction when the relay's activation and/or deactivation time varies considerably? 6) Is the circuit protected from malfunctions that might result from relay contact bounce? 7) Is the circuit protected from malfunction when a high-sensitivity latching type relay is to be used? 8) When there are two or more sets of contacts (2T) in a relay, arc discharges from load switching may cause short circuits across the two or more sets of contacts. Is the circuit designed to suppress such arc discharges? 9) Item 8 above also requires special attention when loads are supplied from separate power sources. 10)Does the post-installation insulation distance comply with the requirement of the relevant international standard or the Electrical Appliance and Material Control Law? 11)Is the circuit protected from malfunction when the relay is to be driven by transistors? 12)When the SCR is used for on/off control, the relay activation tends to synchronize with the line frequency, resulting in an extremely shortened life. Was the relay tested in a real circuit or with a real load? 13)Does the PC board design take into account use of on-board relay? 14)RF signals may leak across relay's open contacts. Check for adequate contact isolation and use RF relays as needed

Item	To check
Operating Environment	1) Is the ambient temperature in the allowable operating temperature range?
	2) Is the humidity in the allowable humidity range?
	3) Is the operating atmosphere free from organic and sulfide gases?
	4) Is the operating atmosphere free from silicone gas? Depending on the load type, silicone gas may cause a black substance to from on the contacts, leading to contact failure.
	5) Is the operating atmosphere free from excessive airborne dust?
	6) Is the relay protected from oil and water splashes?
	7) Is the relay protected from vibration and impact which may cause poor contact with the socket?
	8) Is ambient vibration and impact below the level allowable for the relay?
	9) Is the relay free from mechanical resonance after it is installed in position?
	10)Is insulation coating applied to the relay along with the PC board? Depending on the load type, a black substance may form to cause contact failure.
Installation and Connection	1) Is the relay protected from solder chips and flux when it is manually soldered?
	2) Are preparations for flux application and automatic soldering complete?
	3) Is the PC board cleaning process designed to minimize adverse affects to the relays?
	4) Are adequate separations provided between polarized or reed relays to prevent magnetic coupling?
	5) Are the relay terminals free from stress in the socket?
	6) Polarized relay's characteristics may be affected by strong external magnetic field. Are the relays installed away from such fields?
	7) If very long leads (100 to 300 meters) are used to connect the load, the stray capacity existing across the leads may cause the inrush current. Was the relay tested with a real load?
	8) Unless otherwise specified, all relay terminals should be soldered at 250°C 482°F within 5 sec. or at 350°C 662°F within 3 sec.
	9) A badly warped PC board can cause stress to the relay terminals which may lead to degraded relay characteristics.
	10)Glass shot should not be used to clean the PC board of solder flux. This may cause relay malfunction due to glass powder becoming lodged in the relay's internal structure.
	11)Relays should always be used with their plastic shields installed, or degraded relay performance may result.
	12)Do not cut away any relay terminal as the stress may cause degraded relay performance.
Storage and Transport	1) Is the relay subject to freezing or condensation (especially when shipping)?
	2) Is the temperature in the allowable temperature range?
	3) Is the humidity in the allowable humidity range?
	4) Is the storing atmosphere free from organic and sulfide gases?
	5) Is the storing atmosphere free from excessive airborne dust?
	6) Is the relay protected from oil and water splashes?
	7) Is the relay subject to the application of heavy weight?
	8) When shipping does vibration and impact exceed the allowable range?

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.

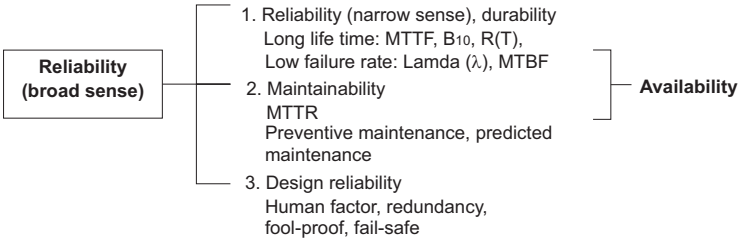
2. Reliability in a Broad Sense of the Term

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.

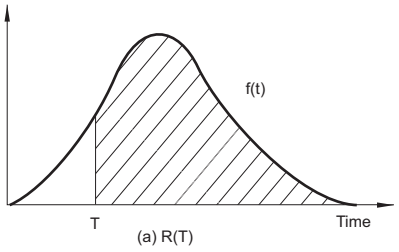
Product reliability at the user’s site is called “reliability of use”, which consists mainly of reliability in the broad sense. In the relay industry, reliability of use has a significance in aspects of servicing.



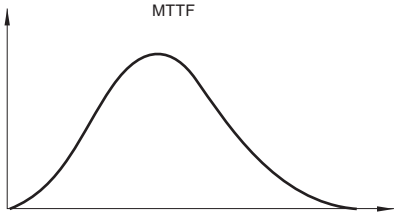
[2] RELIABILITY MEASURES

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

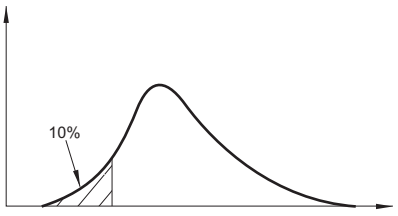
Reliability measure	Sample representation
Degree of reliability R(T)	99.9%
MTBF	100 hours
MTTF	100 hours
Failure rate λ	20 fit, 1%/hour
Safe life B_{10}	50 hours



(a) R(T)



(b) MTTF



(c) Safe life

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

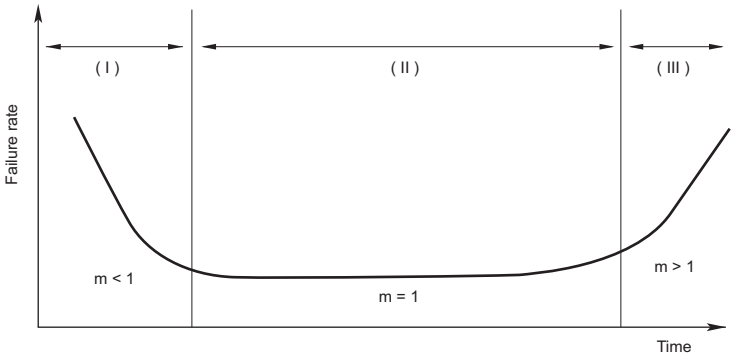
The high failure rate in the initial failure period is derived from latent design errors, process errors, and many other causes. Initial failures are screened at manufacturer’s site through burn-in process. This process is called debugging, performing aging or screening.

(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:

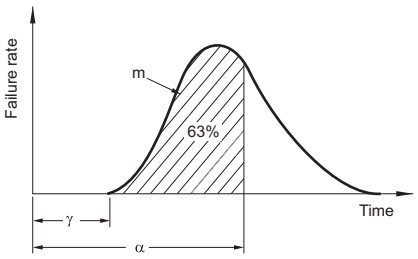
$$f(x) = \frac{m}{\alpha}(\chi-\gamma)^{m-1} e^{-\frac{(\chi-\gamma)^m}{\alpha}}$$

m : Figure parameter

α : Measurement parameter

γ : Position parameter

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:

- The Weibull distribution has the closest proximity to the actual lifetime distribution.
- The Weibull probability chart is easy to use.
- Different types of failures can be identified on the chart.

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

- When $m < 1$: Initial failures
- When $m = 1$: Accidental failures
- When $m > 1$: Wear-out failures

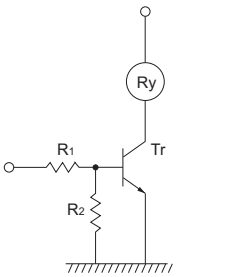
APPLICATIONS OF RELAYS IN ELECTRONIC CIRCUITS

[1] RELAY DRIVE BY MEANS OF A TRANSISTOR

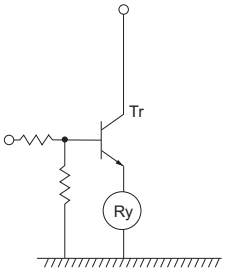
1. Connection Method

If the relay is transistor driven, we recommend using it with a collector connection.

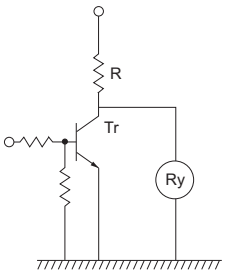
The voltage impressed on the relay is always full rated voltage, and in the OFF time, the voltage is completely zero for avoidance of trouble in use.



(Good) Collector connection
With this most common connection, operation is stable.



(Care) Emitter connection
When the circumstances make the use of this connection unavoidable, if the voltage is not completely impressed on the relay, the transistor does not conduct completely and operation is uncertain.



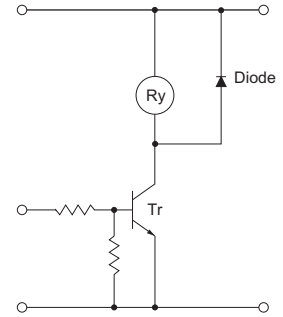
(Care) Parallel connection
When the power consumed by the complete circuit becomes large, consideration of the relay voltage is necessary.

2. Countermeasures for Surge Breakdown 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.

As suitable ratings for this diode, the current should be equivalent to the average rectified current to the coil, 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 a Zener diode that will make the Zener voltage somewhat higher than the supply voltage.

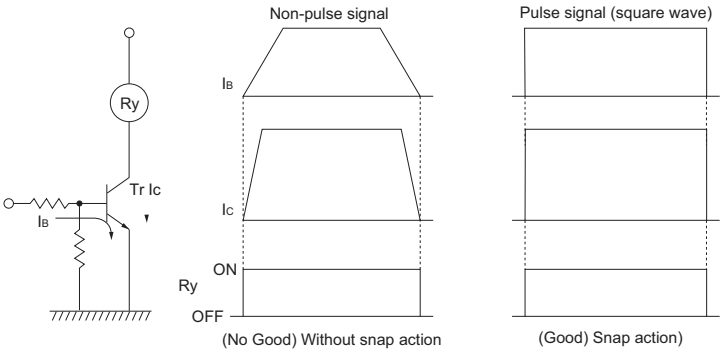


Take care of the "Area of Safe Operation (ASO)"

3. Snap Action

(Characteristic of relay with voltage rise and fall of voltage)

Unlike the characteristic when voltage is impressed slowly on the relay coil, this is the case where it is necessary to impress the rated voltage in a short time and also to drop the voltage in a short time.



(No Good) Without snap action

(Good) Snap action)

4. Schmidt Circuit (Snap Action Circuit)

(Wave rectifying circuit)

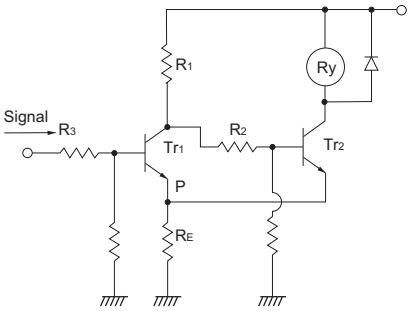
When the input signal does not produce a snap action, ordinarily a Schmidt circuit is used to produce safe snap action.

Characteristic points

- The common emitter resistor R_E must have a value sufficiently small

compared with the resistance of the relay coil.

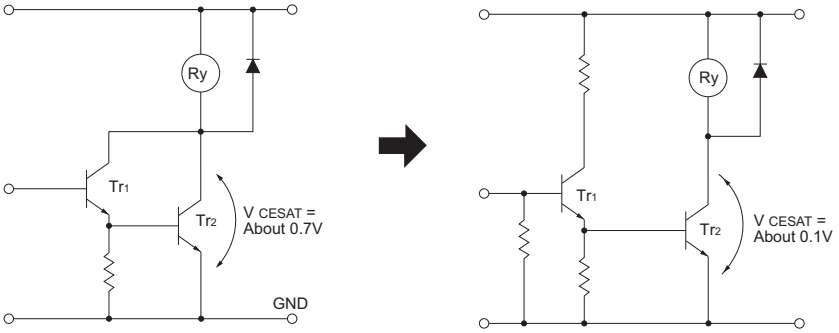
- Due to the relay coil current, the difference in the voltage at point P when Tr_2 is conducting and at point P when Tr_1 is conducting creates hysteresis in the detection capability of Schmidt circuit, and care must be taken in setting the values.
- When there is chattering in the input signal because of waveform oscillation, an CR time constant circuit should be inserted in the stage before the Schmidt trigger circuit. (However, the response speed drops.)



5. Avoid Darlington Connections.

(High amplification)

This circuit is a trap into which it is easy to fall when dealing with high circuit technology. This does not mean that it is immediately connected to the defect, but it is linked to troubles that occur after long periods of use and with many units in operation.



(No good) Darlington connection

(Due to excessive consumption of power, heat is generated.)

(A strong Tr_1 is necessary)

(Good) Emitter connection

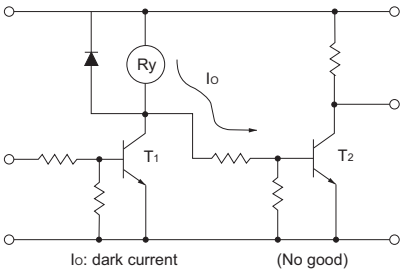
(Tr_2 conducts completely.)

(Tr_1 is sufficient for signal use.)

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. By using DC coils, there may be a reduction in; the danger of incomplete restoration, the contact pressure, and the vibration resistance. This is because the drop-out voltage is 10% or more of the rated voltage, a low value compared to that for AC coil, and also 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 on the right, a minute dark current flows to the relay even if the transistor is off. This may cause the problems described above.

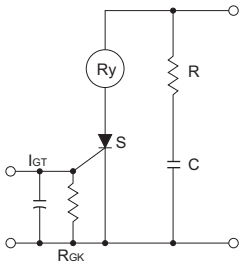
Connection to the next stage through collector



[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.



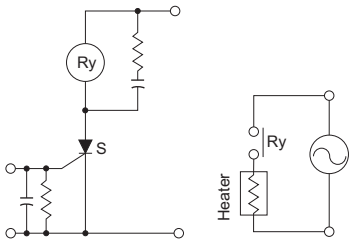
I_{GT} : There is no problem even with more then 3 times the related current.
R_{GK} : 1K Ω must be connected.
R,C : This is for prevention of ignition error due to a sudden rise in the power source or to noise. (dv/dt countermeasure)

2. Caution points regarding ON/OFF control circuits

(When used for temperature or similar control circuits)

When the relay contacts close simultaneously with an AC single phase power source, because the electrical life of the contacts suffers extreme shortening, care is necessary.

- 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.
- 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.
- When the load for the temperature control is a high current load such as a heater, the switching can occur only at peak values and it can occur only at zero phase values as a phenomenon of this type of control. (Depending upon the sensitivity and response speed of the relay)
- Accordingly, either an extremely long life or an extremely short life results with wide variation, and it is necessary to take care with the initial device quality check.

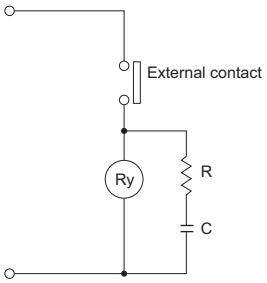


[3] RELAY DRIVE FROM EXTERNAL CONTACTS

Relays for PC board use have high sensitivity and high speed response characteristics, and because they respond sufficiently to chattering and bouncing, it is necessary to take care in their drive.

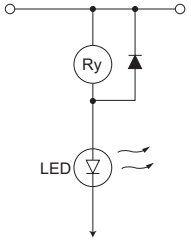
When the frequency of use is low, with the delay in response time caused by a condenser, it is possible to absorb the chattering and bouncing.

(However, it is not possible to use only a condenser. A resistor should also be used with the capacitor.)



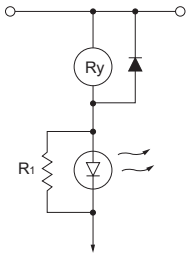
[4] LED SERIES AND PARALLEL CONNECTIONS

1) In series with relay



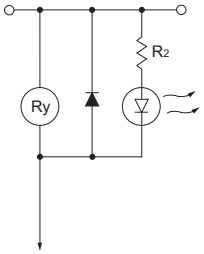
Power consuption:
In common with relay (Good)
Defective LED:
Relay does not operate (No Good)
Low voltage circuit:
With LED, 1.5V down (No good)
No. of parts: (Good)

2) R in parallel with LED



Power consuption:
In common with relay (Good)
Defective LED:
Relay operate (Good)
Low voltage cicuit:
With LED, 1.5V down (No good)
No. of parts: R_1 (Care)

3) In parallel connection with relay

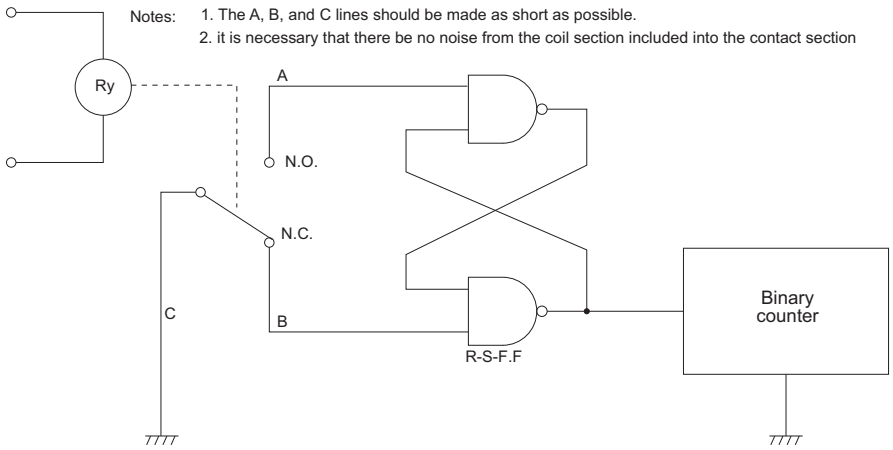


Power consumption:
Current limiting resistor R_2 (Care)
Defective LED:
Relay operate stable (Good)
Low voltage circuit: (Good)
No. of parts: R_2 (Care)

[5] ELECTRONIC CIRCUIT DRIVE BY MEANS OF A RELAY

1. Chatterless Electronic Circuit

Even though a chatterless characteristic is a feature of relays, this is to the fullest extent a chatterless electrical circuit, much the same as a mercury relay. To meet the requirement for such circuits as the input to a binary counter, there is an electronic chatterless method in which chattering is absolutely not permissible. Even if chattering develops on one side, either the N.O. side contacts or the N.C. side contacts, the flip flop does not reverse, and the counter circuit can be fed pulsed without a miss. (However, bouncing from the N.O. side to N.C. side must be absolutely avoided.)

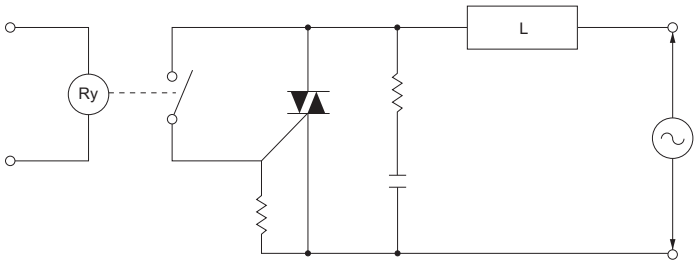


2. Triac Drive

When an electronic circuit using a direct drive from a triac, the electronic circuit will not be isolated from the power circuit, and because of this, troubles due to erroneous operation and damage can develop easily. The introduction of a relay drive is the most economical and most effective solution. (Photo coupler and pulse transformer circuits are complicated.)

Also, compared to switching a direct load with a relay, long life and reduced arc noise can be achieved.

When a zero cross switching characteristic is necessary, a solid state relay (SSR) should be used.



[6] POWER SOURCE CIRCUIT

1. Constant Voltage Circuit

In general, electronic circuits are extremely vulnerable to such phenomena as power supply ripples and voltage fluctuations. Although relay power supplies are not as vulnerable as electronic circuits, please keep both ripples and the regulation within the specification.

If power supply voltage fluctuations are large, please connect a stabilized circuit or constant-voltage circuit as shown in Figure 17.

If the relay power consumption is great, satisfactory results can be achieved by implementing a circuit configuration as shown in Figure 18.

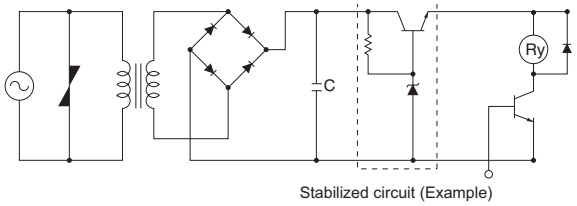


Figure 17

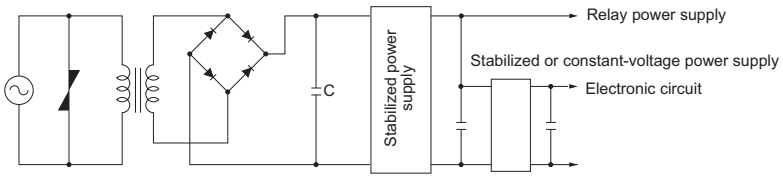


Figure 18

2. Prevention of Voltage Drop Due to Rush Current

In the circuit shown in Figure 19, rush current flows from the lamp or capacitor. The instant the contacts close, the voltage drops and the relay releases or chatters.

In this case it is necessary to raise the transformer's capacity or add a smoothing circuit.

Figure 20 shows an example of the modified circuit.

Figure 21 shows a battery-powered version.

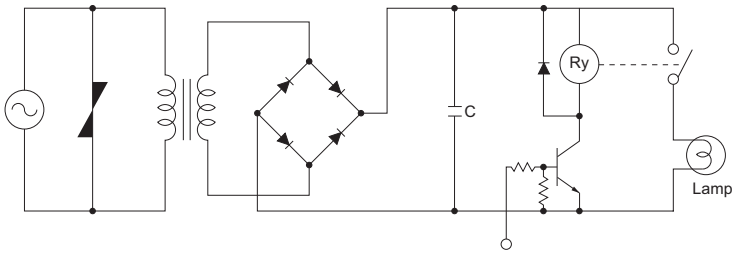


Figure 19

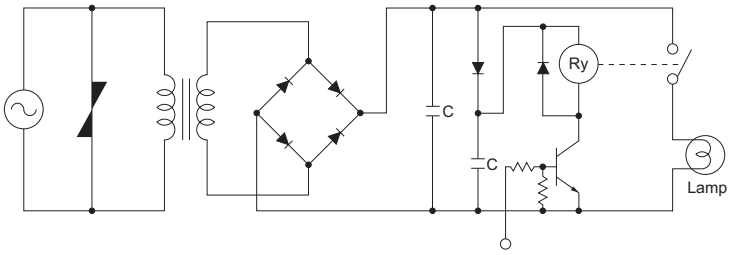


Figure 20

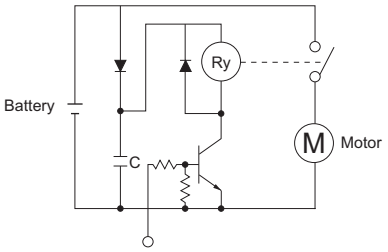


Figure 21

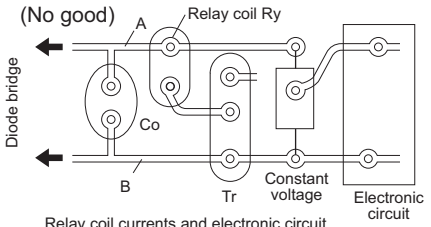
[7] PC BOARD DESIGN CONSIDERATIONS

1. Pattern Layout for Relays

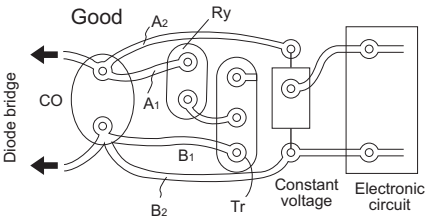
Since relays affect electronic circuits by generating noise, the following points should be noted.

Keep relays away from semiconductor devices. Design the pattern traces for shortest lengths. 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 broken seal. Even for the same circuit, pattern design considerations which minimize the influence of the on/off operations of the relay coil and lamp on other electronic circuits are necessary.



Relay coil currents and electronic circuit flow together trough A and B.



Relay coil currents consist only of A1 and B1.

Electronic circuit currents consist only of A2 and B2. A simple design consideration can change the safety of the operation.

2. Hole and land diameter

The hole diameter and land 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.

Standard dimensions for hole and land diameter mm inch

Standard hole diameter	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		

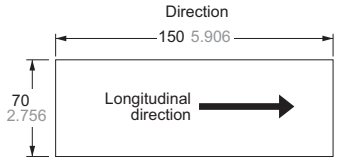
Remarks

1. 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, because of the fear of solder passing through to the component side, it is more suitable to make the hole diameter equal to the lead diameter +0.2mm.
2. The land diameter should be 2 to 3 times the hole diameter.
3. Do not put more than 1 lead in one hole.

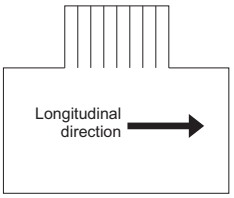
3. Expansion and shrinkage of copperclad laminates

Because copperclad laminates have a longitudinal and lateral direction, the manner of punching fabrication and layout must be observed with care. The expansion and shrinkage in the longitudinal direction due to heat is 1/15 to 1/2 that in the lateral, and accordingly, after the punching fabrication, the distortion in the longitudinal direction will be 1/15 to 1/2 that of 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.

Example: As shown is the drawing below, the 150mm 5.906 inch direction is taken as the longitudinal direction

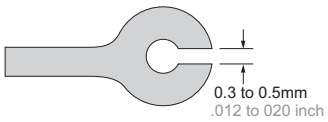


Also, as shown in the drawing below, when the pattern has a connector section, the direction is taken as shown by the arrow in the longitudinal direction



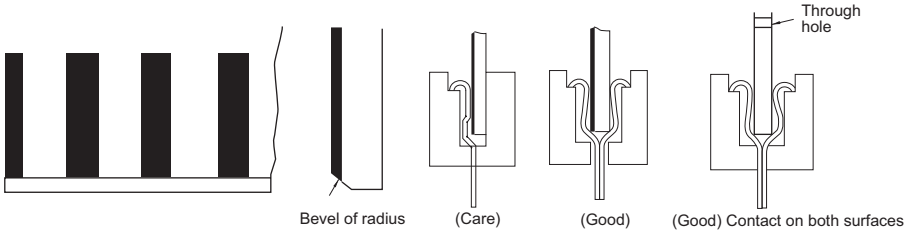
4. When it is necessary to use hand soldering for one part of a component after dip soldering has been done

By providing a narrow slot in the circular part of the foil pattern, the slot will prevent the hole from being plugged with solder.



5. When the PC board itself is used as a connector

- The edge should be beveled. (This prevents peeling of the foil when the board is inserted into its socket.)
- When only a single side is used as the connector blade, if there is distortion in the PC board, contact will be defective.
- Care should be taken.



6. PC Board Reference Data

This data has been derived from samples of this company's products. Use this data as a reference when designing PC boards.

- **Conductor width**

The allowable current for the conductor was determined from the safety aspect and the effect on the performance of the conductor due to the rise in saturation temperature when current is flowing. (The narrower the conductor width and the thinner the copper foil, the larger the temperature rise.) For example, too high a rise in temperature causes degradation of the characteristic and color changes of the laminate. In general, the allowable current of the conductor is determined so that the rise is temperature is less than 10°C. It is necessary to design the conductor width from this allowable conductor current.
Figure 22, Figure 23, Figure 24 show the relationship between the current and the conductor width for each rise in temperature for different copper foils. It is also necessary to give consideration to preventing abnormal currents from exceeding the destruction current of the conductor.
Figure 25 shows the relationship between the conductor width and the destruction current.

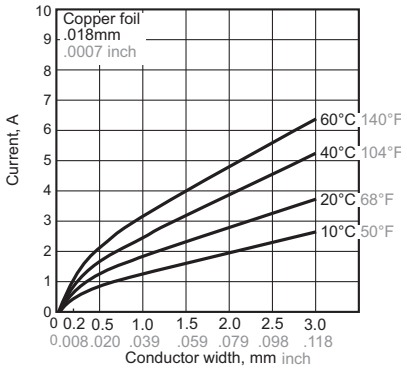


Figure 22

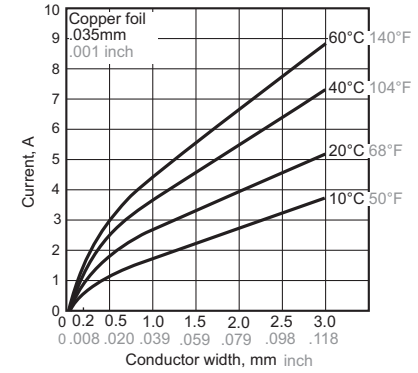


Figure 23

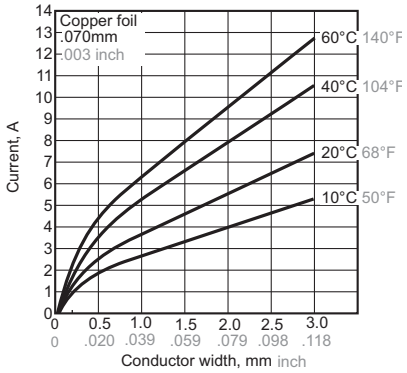


Figure 24

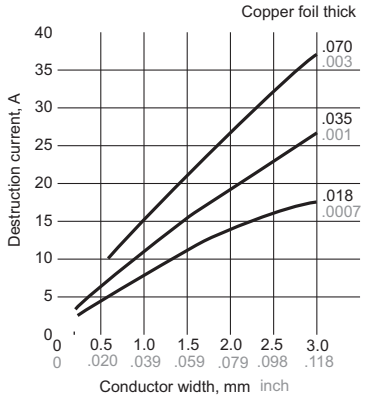


Figure 25

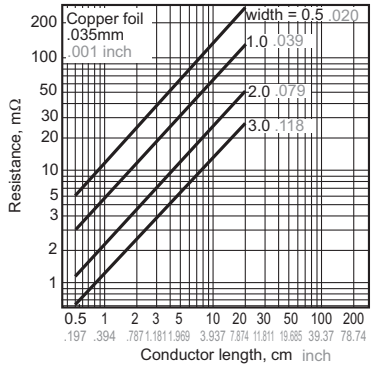


Figure 26

- **Space between conductors**

Figure 27 shows the relationship between the spacing between conductors and the destruction voltage. This destruction voltage is not the destruction voltage of the PC board; it is the flash over voltage (insulation breakdown voltage of the space between circuits.) Coating the surface of the conductor with an insulating resin such as a solder resist increases the flash over voltage, but because of the pin holes of the solder resist, it is necessary to consider the conductor destruction voltage without the solder resist. In fact, it is necessary to add an ample safety factor when determining the spacing between conductors. Table shows an example of a design for the spacing between conductors. (Taken from the JIS C5010 standards.) However, when the product is covered by the electrical products control law, UL standards or other safety standards, it is necessary to conform to the regulations.

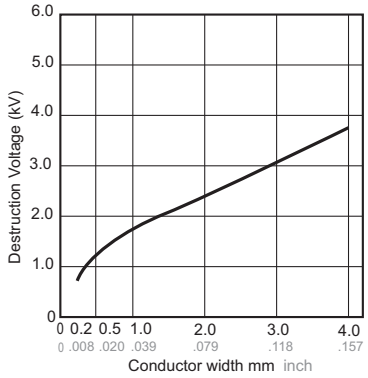


Figure 27

Example of conductor spacing design

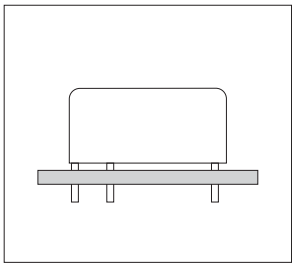
Maximum DC and AC Voltage Between Conductors (V)	Minimum Conductor Spacing (mm inch)
0 to 50	0.381 .015
51 to 150	0.635 .025
151 to 300	1.27 .050
301 to 500	2.54 .100
500 or more	Calculated at 0.00508 mm/V

RELAY SOLDERING AND CLEANING GUIDELINES

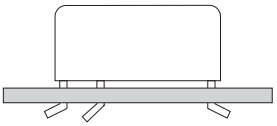
In keeping with making devices compact, it is becoming more common to weld the relay to a PC board along with the semiconductors instead of using the previous plug-in type in which relays were plugged into sockets. With this style, loss of function may occur because of seepage into the relay of flux, 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. Please review the parts on construction and characteristics. See “Configuration and Construction” on page 1.

1. Mounting of relay

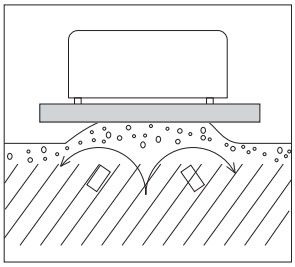


- Avoid bending the terminals to make the relay self-clinching. Relay performance cannot be guaranteed if the terminals are bent. Self-clinching terminal types are available depending on the type of relay.
- Correctly drill the PC board according to the given PC board pattern illustration.
- Stick packaging is also available for automatic mounting, 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.

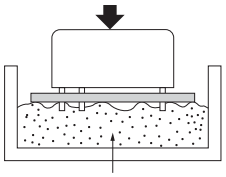


Bad example

2. Flux application

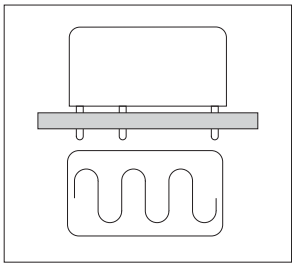


- Adjust the position of the PC board so that flux does not overflow onto the top of it. This must be observed especially for dust-cover type relays.
- Use rosin-based non-corrosive flux.
- If the PC board is pressed down into a flux-soaked sponge as shown on the right, the flux can easily penetrate 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.



Bad example

3. Preheating

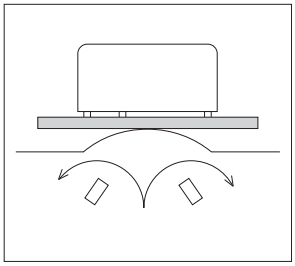


- Be sure to preheat before using automatic soldering. For dust-cover type relays and flux-resistant type relays, preheating acts to prevent the penetration of flux into the relay when soldering. Solderability also improves.
- Preheat according to the following conditions.

Temperature	120°C 248°F or less
Time	Within approx. 2 minutes

- 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	260°C±5°C 500°F±41°F
Soldering time	Within approx. 6 seconds

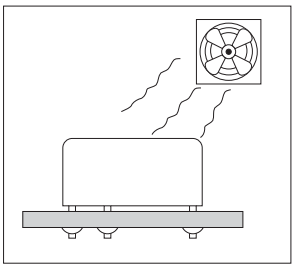
- Please take caution with multi-layer boards. Relay performance may degrade due to the high thermal capacity of these boards.
- **Hand soldering**

Keep the tip of the soldering iron clean.

Soldering Iron	30W to 60W
Iron Tip Temperature	350°C 662°F
Soldering Time	Within approx. 3 seconds

Relay Soldering and Cleaning Guidelines

5. Cooling

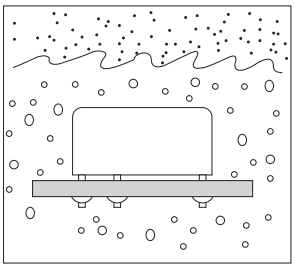


- **Automatic soldering**
- Immediate air cooling is recommend to prevent deterioration of the relay and surrounding parts due of soldering heat.
- Although the environmentally sealed type relay (plastic sealed type, etc.) can be cleaned, avoid immersing the relay into cold liquid (such as cleaning solvent)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

- **Hand soldering**

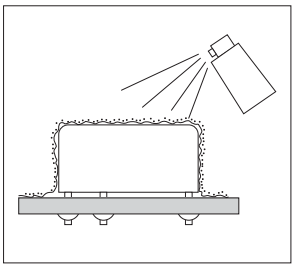
—

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 a Freon- or 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.
- 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.
- Depending on the type, some coating materials may have an adverse affect on relays. Furthermore, 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.

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.
Silicone-base	No Good	• Silicone gas becomes the cause of contact failure. Do not use the silicone-base type.

SMT SOLDERING GUIDELINES

CAUTIONS FOR SURFACE MOUNT RELAY INSTALLATION

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.

[1] What is a Surface Mount Relay?

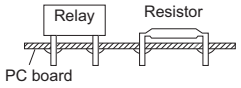
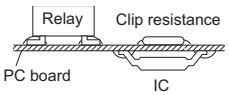
1. From IMT to SMT

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 (IMT) vs. Surface Mount Technology (SMT)

Insertion Mounting Technology (IMT)	Components' leads are inserted into lead holes drilled into the PC board and are soldered to copper pads on the other side of the board using flow-soldering techniques.	
Surface Mount Technology (SMT)	Components are placed on copper pads precoated 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 manufactured with the following advanced technologies:

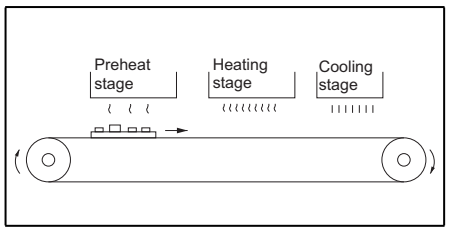
- Heat-resistance encapsulation technique
- Gas analysis
- Reliability assessment
- Precision molding technique for heat-resistant materials

3. Examples of SMT Applications

The following describes some examples of typical SMT applications:

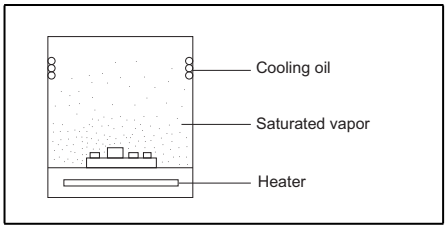
- Infrared Reflow Soldering (IRS)

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.



- 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.



- Belt conveyer reflow furnace

As PCB assemblies are transferred on a thin, heat-resistant belt conveyer, they are soldered by the heat from hotplates placed begeath the conveyer belt.

- Double Wave Soldering (DWS)

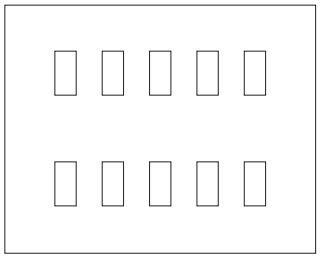
Components are glued to the PC board surface. The board assembly is transferred through a molten solder fountain (with the component side facing down), and the components are soldered to the board.

- Other Technologies

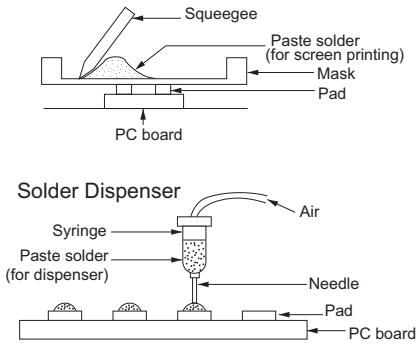
Other reflow soldering technologies include those utilizing lasers, hot air, and pulse heaters.

[2] Cautions for installation

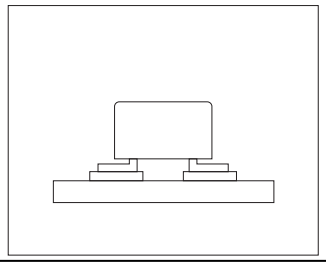
1. Paste Soldering



- 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.



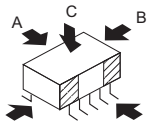
2. Relay Installation



- 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 sustain excessive mechanical stress from the placement machine's pickup head, their performance cannot be guaranteed.

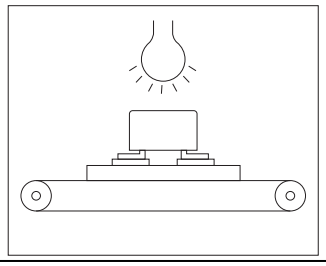
- Our SMT relays are supplied in stick packaging compatible with automatic placement processes. We also offer tape packaging at customer request.

Holding Pressure
Direction A: Less than 9.8 N (less than 1,000 gf)
Direction B: Less than 9.8 N (less than 1,000 gf)
Direction C: Less than 9.8 N (less than 1,000 gf)



(ex. TQ-SMD Relay)

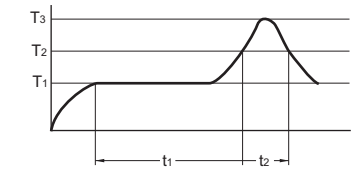
3. Reflow



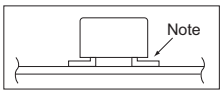
Reflow soldering under inadequate soldering conditions may result in unreliable relay performance or even physical damage to the relay (even if the relay is of surface mount type with high heat resistance).

Example of Recommended Soldering Condition for Surface Mount Relays.

- IRS technique



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



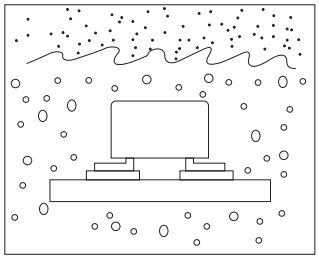
- It is recommended that the soldered pad be immediately cooled to prevent thermal damage to the relay and its associated components.
- While surface mount relays are solvent washable, do not immerse the relay in cold cleaning solvent immediately after soldering.

- Manual soldering
  - Soldering iron tip temperature: 350°C 662°F
  - Soldering iron wattage: 30 to 60 watts
  - Soldering time: Less than 3 sec.
- Others
  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.

Notes:

- The soldering temperature profile indicates the pad temperature. In some cases, the ambient temperature may be greatly increased. Check for the specific mounting condition.
- Please use promptly once the anti-humidity pack is opened (Signal relay: with in 3 days, Max. 30°C 86°F/ 60%RH). If left with the pack open, the relay will absorb moisture which will cause thermal stress when reflow mounting and thus cause the case to expand. As a result, the seal may break.

4. Cleaning

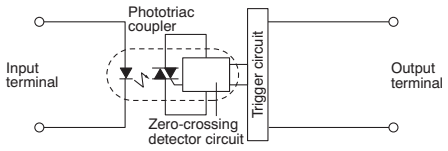
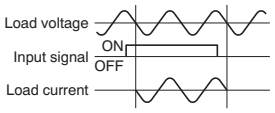
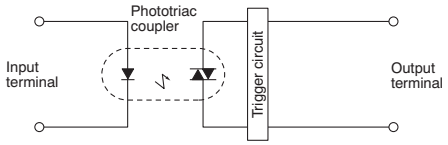
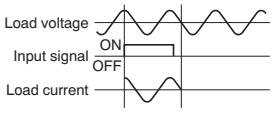


- The surface mount relays are solvent washable. Use alcohol or an equivalent solvent for cleaning.
- Boiled cleaning is approved for surface mount relays. Ultrasonic cleaning may cause coil damage or light contact sticking.

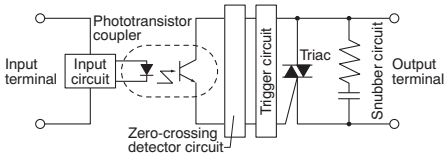
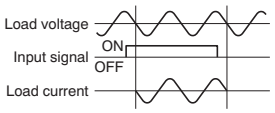
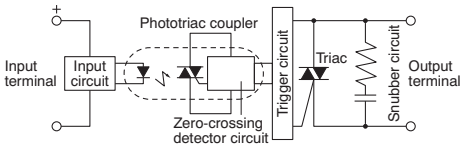
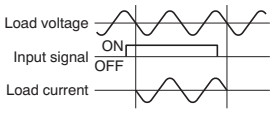
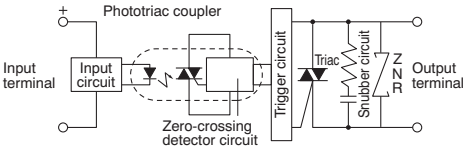
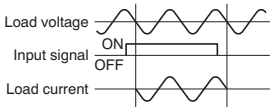
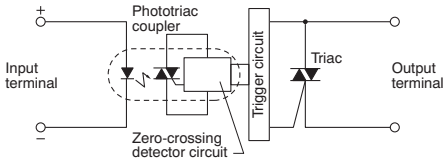
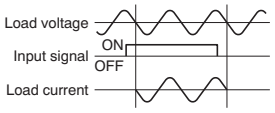
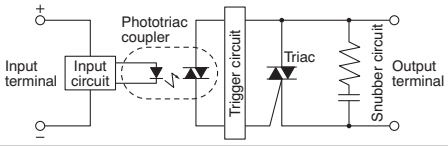
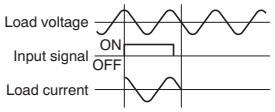
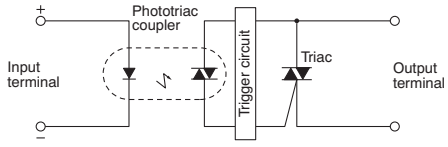
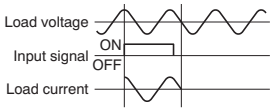
SSRs Technical Information

SSR Description and Circuit Configurations

Phototriac coupler

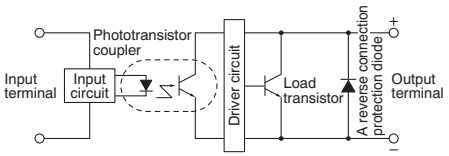
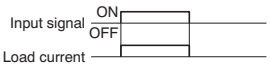
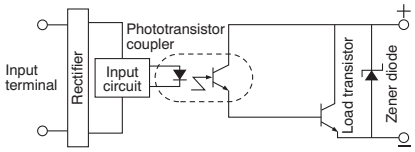
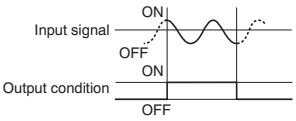
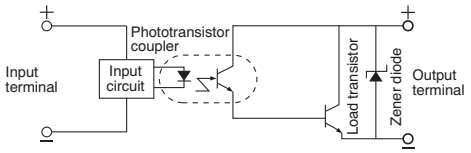
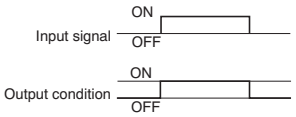
Load	Isolation type	Zero-crossing function	Model	Circuit configuration	I/O wave form (for resistive load)
AC	Phototriac	Yes	APT		
		No	APT		

SSR

Load	Isolation type	Zero-crossing function	Model	Circuit configuration	I/O wave form (for resistive load)
AC	Phototransistor	Yes	AQ1 (2A)		
	Phototriac	Yes	AQ-G AQ1 (3A, 10A)		
			AQ-J AQ-A		
			AQ-H		
		No	AQ-G (AQ1)* (AQ-J)* AQ-A		
			AQ-H		

* AQ1, AQ-J and AQ-A random types are available by special order.

SSR (continued)

Load	Isolation type	Zero-crossing function	Model	Circuit configuration	I/O wave form (for resistive load)
DC	Phototransistor	—	AQ1		
DC logic output	Phototransistor	—	—		
		—	—		

Principle of Operation

SSR Switching Characteristics

1.SSR for AC Loads

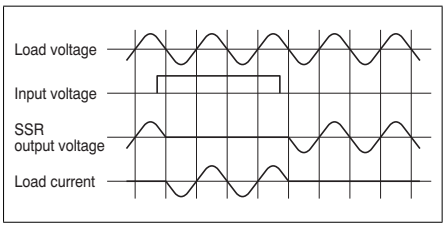
(1) Zero-crossing SSR

The zero-crossing SSR uses a phototransistor or phototriac coupler to isolate the input from the output (see the circuit configuration on the previous page). When the input signal is activated, the internal zero-crossing detector circuit triggers the triac to turn on as the AC load voltage crosses zero.

The load current is maintained by the triac's latching effect after the input signal is deactivated, until the triac is turned off when the load voltage crosses zero. The following describes voltage and current wave forms for different types of loads:

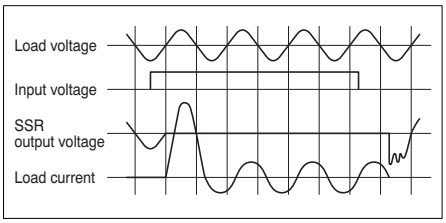
• Resistive loads

Since resistive loads cause no phase shift between the voltage and current, the triac turns on when the AC load voltage crosses zero after the input signal is activated. The SSR turns off when the AC load voltage crosses zero and the load current is turned off after the input signal is subsequently deactivated.



• Inductive loads

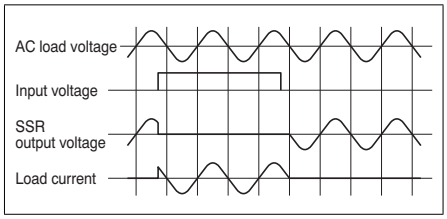
The SSR turns on when the load voltage crosses zero after the input signal is activated. It turns off when the load current subsequently crosses zero after the input signal is deactivated. A phase difference between the voltage and current may supply a transient spike to the SSR when it is turned off. While the snubber circuit absorbs this spike, an excessively large spike may result in a dv/dt error in the SSR's internal triac.



(2) Random type SSR

Random type SSR uses a phototriac coupler to isolate the input from the output. When the input signal is activated, the output immediately turns on, since there is no zero-crossing detector circuit. The load current is maintained by the triac's latching effect after the input signal is deactivated, until the AC load voltage crosses zero.

• Resistive loads



2. SSR for DC Loads

The SSR for DC loads uses a phototransistor coupler to isolate the input from the output. The output immediately responds to the input, since the phototransistor coupler directly turns the output transistor ON or OFF.

Terminology of Phototriac Coupler/AQ-H

Term		Symbol	Description
Input side	LED forward current	I_F	Current that flows between the input terminals when the input diode is forward biased.
	LED reverse voltage	V_R	Reverse breakdown voltage between the input terminals.
	Peak forward current	I_{FP}	Maximum instantaneous value of the forward current.
	LED dropout voltage	V_F	Dropout voltage between the input terminals due to forward current.
Output side	Repetitive peak OFF-state voltage	V_{DRM}	Maximum voltage with repeatability that can be applied continuously between the output terminals.
	ON-state RMS current	$I_{T(RSM)}$	Effective current value, based on designated conditions, that can flow continuously between output terminals.
	Non-repetitive surge current	I_{TSM}	Maximum current, without repeatability, that is based on designated conditions. Normally this is expressed as the wave height value of one power frequency current sinusoidal cycle.
	Peak ON-state voltage	V_{TM}	Effective value of the voltage drop when a regulated load current flows between the output terminals when device is on.
	Peak OFF-state current	I_{DRM}	Current that flows to output when a regulated load voltage is applied between the output terminals when device is off.
Electrical Characteristics	Trigger LED current	I_{FT}	Current flow when LED current is augmented and output is on, when regulated power supply voltage and load has been connected between the output terminals.
	Holding current	I_H	Load current to maintain on state after output terminals have been turned on based on designated conditions.
	Critical rate of rise of OFF-state voltage	dv/dt	Output terminals do not go to the on state from the off state based on designated conditions.
	Zero-cross voltage	V_{ZC}	In the zero-cross method, when input is turned on, the maximum voltage value when the output terminals turn on.
	Turn on time	Ton	Delay time until the output switches on after a designated LED current is made to flow through the input terminals.
	I/O capacitance	Ciso	Capacitance between the input and output terminals.
	I/O isolation resistance	Riso	Resistance between terminals (input and output) when a specified voltage is applied between the input and output terminals.

Terminology of SSR

Term		Description
Input side	Control voltage	Input voltage necessary for normal SSR operation under the specified temperature conditions.
	Activation voltage	Threshold at which the output turns on as the control voltage is gradually increased with the specified voltage applied to the loaded output.
	Recovery voltage	Threshold at which the output turns off as the control voltage is gradually decreased with the specified voltage applied to the loaded output.
	Input impedance	Resistance of the current limiting resistor used in the SSR input side.
	Input line voltage	Input voltage at which an input module SSR operates normally.
	Input current	Input current at which an input module SSR operates normally.
Load side	Max. load current	Maximum continuous current allowable across the SSR output terminals under the specified heat dissipation and ambient temperature conditions. AC current is specified in RMS units.
	Load voltage	Output supply voltage range in which the SSR operates normally. AC voltage is specified in RMS units.
	Logic supply voltage/current	Supply voltage/current range in which an input module SSR operates normally.
	Non-repetitive surge current	Maximum non-repetitive load current allowable under the specified heat dissipation and ambient temperature conditions. In general, it is given by the peak value of a single cycle of sinusoidal commercial AC current.
	“OFF-state” leakage current	Current that flows in the SSR output circuit when the specified supply voltage is applied to the output with no control voltage applied to the input.
	“ON-state” voltage drop	Output voltage drop caused by a specified load current supplied to the SSR output which is turned on by a specified input control voltage. AC voltage is specified in RMS units.
	Min. load current	Minimum load current at and above which the SSR operates normally under the specified temperature conditions. AC load current is specified in RMS units.
	Output stage breakdown voltage	Maximum voltage that can be applied across the output and ground of an input module SSR.
	Max. load current	Maximum current allowable for the output circuit of an input module SSR.
	Repetitive peak voltage, max.	Maximum repetitive voltage which can be continuously applied across the SSR output terminals. In general, a voltage of more than 400 V AC is used for 100 V AC applications, and more than 600 V AC for 200-250 V AC applications, to absorb supply voltage variations or on/off surges.
	Critical turn-off voltage rise ratio	SSRs may turn on if a turn-off voltage with a steep rising edge is applied. This phenomenon is called “dv/dt turn on.” Critical turn-off voltage rise ratio refers to the maximum turn-off voltage rise ratio at and below which the SSR remains turned off.
Electrical Characteristics	Operate time, max.	Time until the SSR output turns on after the specified control voltage is applied to the input.
	Release time, max.	Time until the SSR output turns off after the specified control voltage is removed from the input.
	Insulation resistance	Resistance measured with a specified voltage applied across the input and output, or across the input or output and frame ground.
	Breakdown voltage	Maximum voltage below which no dielectric breakdown occurs when applied for 1 minute across the same test points as those used for insulation resistance testing.
	Vibration resistance	Functional: The device sustains no damage and meets the specifications if it is exposed to vibration with its magnitude not exceeding this threshold during transit or installation. Destructive: Closed contacts of a relay remain closed for the specified time period if it is exposed to vibration with its magnitude not exceeding this threshold during operation.
	Shock resistance	Functional: The device sustains no damage and meets the specifications if it is exposed to physical impact with its magnitude not exceeding this threshold during transit or installation. Destructive: Closed contacts of a relay remain closed for the specified time period if it is exposed to physical impact with its magnitude not exceeding this threshold during operation.
	Ambient temperature	Ambient temperature range over which the SSR operates normally under the specified heat dissipation and load current conditions.
	Storage temperature	Ambient temperature range over which an SSR can be safely stored for extended periods without sustaining damage or performance degradation.

Cautions For Use of Phototriac Coupler/AQ-H

SAFETY WARNINGS

• Do not use the product under conditions that exceed the range of its specifications. It may cause overheating, smoke, or fire.

• Do not touch the recharging unit while the power is on. There is a danger of electrical shock. Be sure to turn off the power when performing mounting, maintenance, or repair operations on the relay (including connecting parts such as the terminal board and socket).

• Check the connection diagrams in the catalog and be sure to connect the terminals correctly. Erroneous connections could lead to unexpected operating errors, overheating, or fire.

Cautions for Use

1. Applying stress that exceeds the absolute maximum rating

If the voltage and current value for any of the terminals exceeds the absolute maximum rating, internal elements will deteriorate because of the excessive voltage and current. In extreme cases, wiring may melt, or silicon P/N junctions may be destroyed.

As a result, the design should ensure that the absolute maximum ratings will never be exceeded, even momentarily.

2. Derating

Derating is absolutely imperative for reliable design and is an essential factor in determining product life. Therefore, be sure to amply derate the maximum rated values when designing a system. Since it is important to derate in accordance with the type of relay, conditions for use, and environment, please be sure to conduct tests using actual equipment. Also, if there is a possibility that, due to a quality problem, this product might have a great effect on human life or property, do take product liability into consideration by being sure to take even extra leeway against the maximum rated value and implement safety measures such as the construction of redundant circuits.

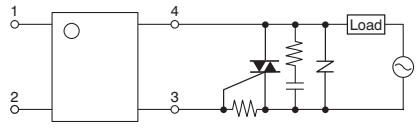
3. The phototriac coupler is designed solely to drive a triac. As a condition, the triac must be powered beforehand.

4. The internal IC could be damaged if a short forms between the I/O terminals while the phototriac coupler and AQ-H SSR are powered.

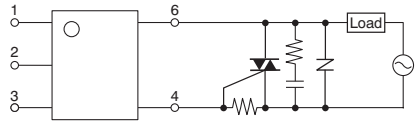
5. Output spike voltages

1) The figure below shows an ordinary triac drive circuit. Please add a snubber circuit or varistor, as noise/surge on the load side could damage the unit or cause malfunctions.

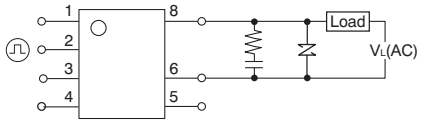
<Phototriac coupler SOP4, DIP4>



<Phototriac coupler DIP6>



<AQ-H>



Note: Connection of an external resister, etc., to terminal No. 5 (gate) is not necessary.

2) Clamp diode can limit spike voltages at the load side. However, long wires may cause spike voltages due to inductance. It is recommended to keep wires as short as possible to minimize inductance.

3) Output terminals may become conductive when a sudden voltage rise is applied, although the input power is not applied. This may occur even if voltage rise between terminals is less than the repetitive peak OFF-state voltage. Therefore, please perform sufficient tests with actual conditions.

4) When controlling loads using zero-cross voltage types in which the voltage and current phases differ, since the triac sometimes does not turn on regardless of the input state, please conduct sufficient tests using actual equipment.

6. Recommended input current value

I_F = 20 mA

7. Important Notes for Mounting

1) Temperature rise in the lead portion is highly dependent on package size. If multiple different packages are mounted on the same board, please check your board beforehand in an actual product, ensuring that the temperature conditions of the phototriac coupler fall within the parameters listed.

2) If the mounting conditions exceed the conditions recommended above, strength of the resin used will decrease and inconsistencies of the thermal expansion coefficients in the component materials will increase greatly. This can cause package cracking and breakage of the bonding wires. Please contact us for consultation.

8. Cleaning

The phototriac coupler and AQ-H SSR are forms an optical path by coupling a light-emitting diode (LED) and photodiode via transparent silicon resin. For this reason, unlike other directory element molded resin products (e.g., MOS transistors and bipolar transistors), avoid ultrasonic cleaning if at all possible. We recommend cleaning with an organic solvent. If you cannot avoid using ultrasonic cleaning, please ensure that the following conditions are met, and check beforehand for defects.

• Frequency: 27 to 29 kHz
• Ultrasonic output:
  No greater than 0.25 W/cm^2
• Cleaning time:
  No longer than 30 s
• Cleanser used: Asahiklin AK-225
• Other: Submerge in solvent in order to prevent the PCB and elements from being contacted directly by the ultrasonic vibrations.

Note: Applies to unit area ultrasonic output for ultrasonic baths.

9. Transportation and storage

1) Extreme vibration during transport will warp the lead or damage the relay. Handle the outer and inner boxes with care.

2) Storage under extreme conditions will cause soldering degradation, external appearance defects, and deterioration of the performance. The following storage conditions are recommended:

• Temperature: 0 to 45°C 32 to 113°F
• Humidity: Less than 70% R.H.
• Atmosphere: No harmful gases such as sulfurous acid gas, minimal dust.

3) Storage of SOP type

Phototriac couplers implemented in SO packages (SOP 4-pin type) are sensitive to moisture and come in sealed moisture-proof packages. Observe the following cautions on storage.

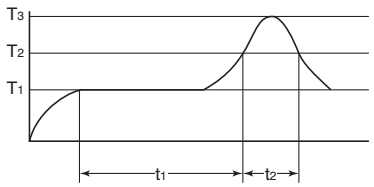
• After the moisture-proof package is unsealed, use the devices as soon as possible (use within 1 month ≦ 45°C 113°F/70% R.H.).
• If the devices are to be left in storage after the moisture-proof package has been unsealed, keep them in another moisture-proof bag containing silica gel and use within 3 months.

10. Soldering

1) When soldering PC board terminals, keep soldering time to within 10 s at 260°C 500°F.

2) When soldering surface-mount terminals or SO package, the following conditions are recommended.

(1) IR (Infrared reflow) soldering method



T1 = 150 to 180°C 302 to 356°F
T2 = 230°C 446°F
T3 = 250°C 482°F or less
t1 = 60 to 120 s or less
t2 = 30 s or less

(2) Soldering iron method

Tip temperature: 350 to 400°C 662 to 752°F

Wattage: 30 to 60 W

Soldering time: within 3 s

(3) Others

Check mounting conditions before using other soldering methods (DWS, VPS, hot-air, hot plate, laser, pulse heater, etc.)

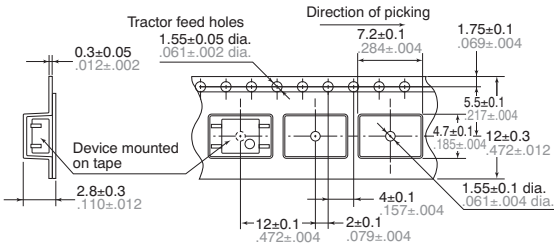
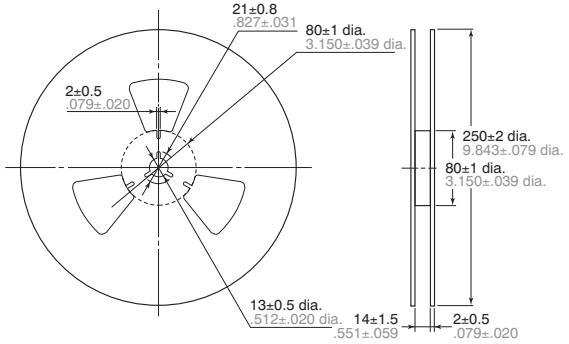
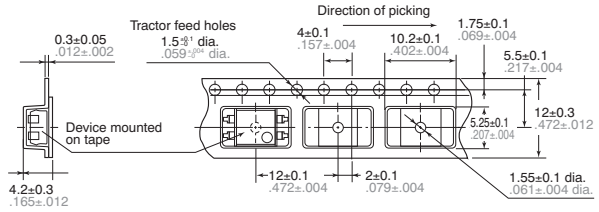
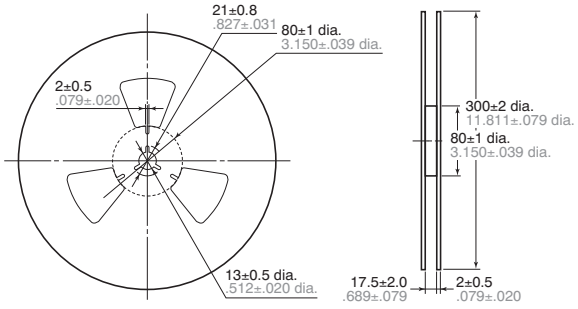
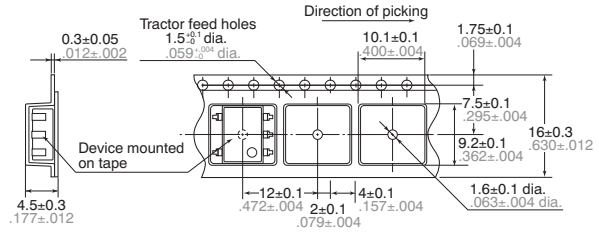
• The temperature profile indicates the temperature of the soldered terminal on the surface of the PC board. The ambient temperature may increase excessively. Check the temperature under mounting conditions.

• When using lead-free solder we recommend one with an alloy composition of Sn3.0Ag0.5Cu. Please consult us regarding details such as soldering conditions.

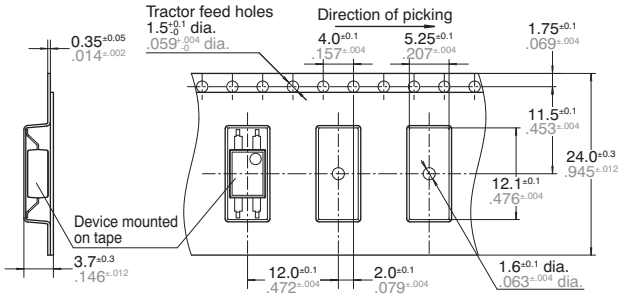
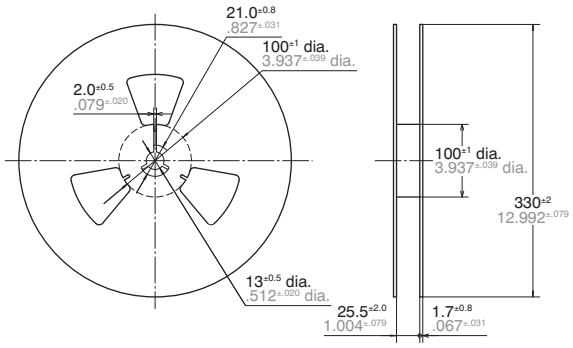
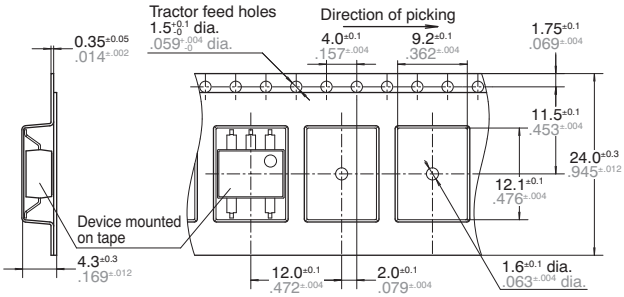
11. The following shows the packaging format

1) Tape and reel (Phototriac coupler)

mm inch

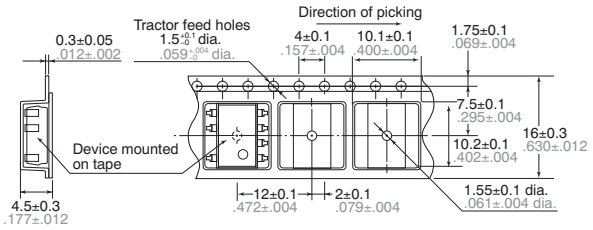
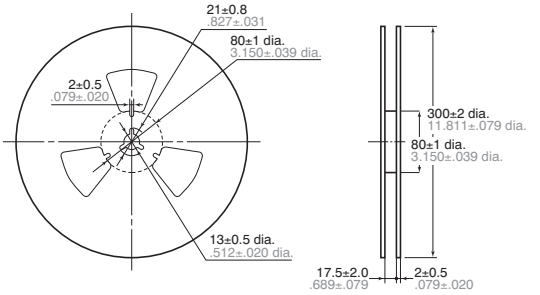
Type	Tape dimensions	Dimensions of paper tape reel
SO package 4-pin type		
	(1) When picked from 1/2-pin side: Part No. APT○○○○SX (Shown above) (2) When picked from 3/4-pin side: Part No. APT○○○○SZ	
DIP 4-pin type		
	(1) When picked from 1/2-pin side: Part No. APT○○○○AX (2) When picked from 3/4-pin side: Part No. APT○○○○AZ	
DIP 6-pin type		
	(1) When picked from 1/2/3-pin side: Part No. APT○○○○AX (2) When picked from 4/5/6-pin side: Part No. APT○○○○AZ	

mm inch

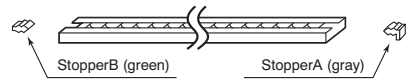
Type	Tape dimensions	Dimensions of paper tape reel
DIP 4-pin wide terminal type	 (1) When picked from 1/4-pin side: Part No. APT❍❍❍❍WAY (2) When picked from 2/3-pin side: Part No. APT❍❍❍❍WAW	
DIP 6-pin wide terminal type	 (1) When picked from 1/6-pin side: Part No. APT❍❍❍❍WAY (2) When picked from 3/4-pin side: Part No. APT❍❍❍❍WAW	

2) Tape and reel (AQ-H)

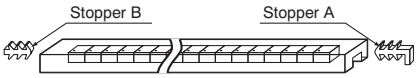
mm inch

Type	Tape dimensions	Dimensions of paper tape reel
8-pin SMD type	 (1) When picked from 1/2/3/4-pin side: Part No. AQH❍❍❍❍AX (Shown above) (2) When picked from 5/6/8-pin side: Part No. AQH❍❍❍❍AZ	

3) Tube
(1) Devices are packaged in a tube as pin No. 1 is on the stopper B side. Observe correct orientation when mounting them on PC boards.
(SOP type)



(DIP type)



13. Applying stress that exceeds the absolute maximum rating
If the voltage and current value for any of the terminals exceeds the absolute maximum rating, internal elements will deteriorate because of the excessive voltage and current. In extreme cases, wiring may melt, or silicon P/N junctions may be destroyed.
As a result, the design should ensure that the absolute maximum ratings will never be exceeded, even momentarily.

Cautions for Use of SSR

SAFETY WARNINGS

• Do not use the product under conditions that exceed the range of its specifications. It may cause overheating, smoke, or fire.

• Do not touch the recharging unit while the power is on. There is a danger of electrical shock. Be sure to turn off the power when performing mounting, maintenance, or repair operations on the relay (including connecting parts such as the terminal board and socket).

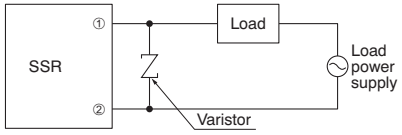
• Check the connection diagrams in the catalog and be sure to connect the terminals correctly. Erroneous connections could lead to unexpected operating errors, overheating, or fire.

Cautions for Use

1. Regarding output noise surge protection

(1) AC Output Type

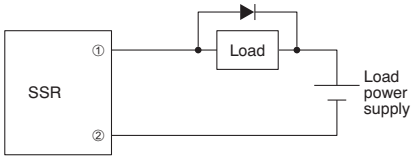
A high noise surge voltage applied to the SSR load circuit can cause malfunction or permanent damage to the device. If such a high surge is anticipated, use a varistor across the SSR output.



Note: AQ-F solid-state relay output terminals are numbered (8) and (12).

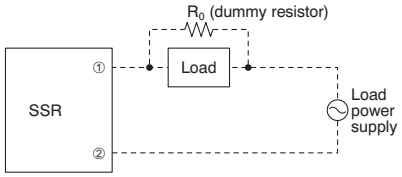
(2) DC Output Type

When the SSR is loaded with an inductive load, such as a solenoid contactor, motor, or solenoid valve, use a counter-EMF suppression diode across the load.



2. When used for the load less than rated

An SSR may malfunction if it is used below the specified load. In such an event, use a dummy resistor in parallel with the load.

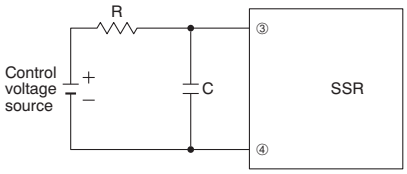


Load Specifications

Type		Load current
AQ-G	All models	20 mA
AQ-1	AC output type DC output type	50 mA 5 mA
AQ-J	All models	50 mA
AQ-A	All models	100 mA

3. Noise and surge protection at the input side

A high noise surge voltage applied to the SSR input circuit can cause malfunction or permanent damage to the device. If such a high surge is anticipated, use C or R noise absorber in the input circuit.

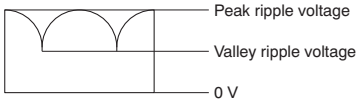


4. When the input terminals are connected with reverse polarity

Type	If the polarity of the input control voltage is reversed
AQ1, AQ-J, AQ-A, AQ-J	Reversing the polarity will not cause damage to the device, due to the presence of a protection diode, but the device will not operate.
AQ-H, AQ-G	Reversing the polarity may cause permanent damage to the device. Take special care to avoid polarity reversal or use a protection diode in the input circuit.

5. In the case of operating voltage containing ripple

If the SSR control voltage contains ripple, the peak of the ripple should not exceed the maximum rated control voltage, and the bottom of the ripple should exceed the minimum rated control voltage.



6. Cleaning solvents compatibility

Dip cleaning with an organic solvent is recommended for removal of solder flux, dust, etc. If ultrasonic cleaning must be used, the severity of factors such as frequency, out power and cleaning solvent selected may cause loose wires and other troubles.

Please make sure these conditions before use.

7. Transportation and storage

1) Extreme vibration during transport will warp the lead or damage the relay. Handle the outer and inner boxes with care.

2) Storage under extreme conditions will cause soldering degradation, external appearance defects, and deterioration of the characteristics. The following storage conditions are recommended:

• Temperature: 0 to 45°C 32 to 113°F

• Humidity: Less than 70% R.H.

• Atmosphere: No harmful gasses such as sulfurous acid gas, minimal dust.

8. Others

(1) If an SSR is used in close proximity to another SSR or heat-generating device, its ambient temperature may exceed the allowable level. Carefully plan SSR layout and ventilation.

(2) Soldering to SSR terminals should be completed within 5 seconds at 260°C.

(3) Terminal connections should be made by referring to the associated wiring diagram.

(4) For higher reliability, check device quality under actual operating conditions.

Snubber Circuit

1. Reduce dv/dt

An SSR used with an inductive load can accidentally fire due to a high load voltage rise rate (dv/dt), even though the load voltage is below the allowable level (inductive load firing).
Our SSRs contain a snubber circuit designed to reduce dv/dt (except AQ-H).

2. Selecting the snubber constants

1) C selection

The charging coefficient tau for C of the SSR circuit is shown in formula ①

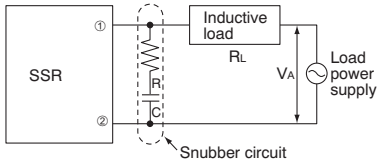
$\tau=(R_L+R) \times C$ ----------①

By setting formula ① so that it is below dv/dt value you have:

$C=0.632V_A/((dv/dt) \times (R_L+R))$ -----②

By setting C = 0.1 to 0.2 μF, dv/dt can be controlled to between nV/μs and n+V/μs or lower. For the condenser, use either an MP condenser metallized polyester film. For the 100 V line, use a voltage between 250 and 400 V, and for the 200 V line, use a voltage between 400 and 600 V.

2) R selection



If there is no resistance R (the resistance R controls the discharge current from condenser C), at turn-on of the SSR, there will be a sharp rise in dv/dt and the high peak value discharge current will begin to flow. This may cause damage to the internal elements of the SSR.

Therefore, it is always necessary to insert a resistance R. In normal applications, for the 100 V line, have R = 10 to 100 Ω and for the 200 V line, have R = 20 to 100 Ω. (The allowable discharge current at turn-on will differ depending on the internal elements of the SSR.) The power loss from R, written as P, caused by the discharge current and charging current from C, is shown in formula ③ below. For the 100 V line, use a power of 1/2 W, and for the 200 V line, use a power above 2 W.

$$P=\frac{C \times V_A^2 \times f}{2}$$ ---------- ③

f = Power supply frequency

Also, at turn-off of the SSR, a ringing circuit is formed with the capacitor C and the circuit inductance L, and a spike voltage is generated at both terminals of the SSR. The resistance R serves as a control resistance to prevent this ringing. Moreover, a good non-inductive resistance for R is required. Carbon film resistors or metal film resistors are often used. For general applications, the recommended values are C = 0.1 μF and R = 20 to 100 Ω. There are cases of resonance in the inductive load, so the appropriate care must be taken when making your selections.

Thermal Design

SSRs used in high-reliability equipment require careful thermal design. In particular, junction temperature control has a significant effect on device function and life time. The rated load current for board-mounting SSRs is defined as the maximum current allowable at an ambient temperature of 40°C (30°C) and under natural cooling. If the ambient temperature exceeds the SSRs derating temperature point (20°C to 40°C, depending on SSR), load current derating in accordance with the load current vs temperature diagram becomes nesessary. If adjacent devices act as heat sources, the SSR should be located more than 10 mm away from those devices. SSRs with a 5 A rating or more must be used with the dedicated heat sinks listed in Table 1 or equivalents. To ensure adequate thermal conduction, apply thermal conductive compound (Toshiba silicone YG6111, TSK5303 or alternate) to the SSR's mounting surface. For information on external heat sinks for our SSRs and their mounting method, refer to "Data and Cautions for Use for respective relay".

Table 1. Dedicated on-board heat sinks

Load current	Type	Heat sink
to 10 A	AQ10A2-ZT4/32V DC	AQ-HS-5A
10 A	AQ-J (10A)	AQP-HS-J10A AQP-HS-J10A (for AQ-J) AQP-HS-SJ10A (for AQ-J)* AQP-HS-SJ20A*
15 A	AQ-A (15A), AQ-J (15A)	AQP-HS-J10A AQP-HS-J10A (for AQ-J) AQP-HS-SJ10A (for AQ-J)* AQP-HS-SJ20A*
20 A	AQ-J (25A)	AQP-HS-J10A AQP-HS-SJ10A (for AQ-J)* AQP-HS-SJ20A*
25 to 40 A	AQ-A (25A)	AQP-HS-30/40A
25 A	AQ-J (25A)	AQP-HS-J25A
40 A	AQ-A (40A)	AQP-HS-J25A

*It is possible to mounting on the DIN rail.

Protection Circuit

High-reliability SSR circuits require an adequate protection circuit, as well as careful study of the characteristics and maximum ratings of the device.

1. Over-Voltage Protection

The SSR load power supply requires adequate protection against over-voltage errors from various causes. The methods of over-voltage protection include the following:

(1) Use devices with a guaranteed reverse surge withstand voltage (controlled avalanche devices, etc.)

(2) Suppress transient spikes
Use a switching device in the secondary circuit of a transformer or use a switch with a slow opening speed.

(3) Use a surge absorption circuit
Use a CR surge absorber or varistor across the load power supply or SSR. Special care must be taken so power on/off surges or external surges do not exceed the device's rated load voltage. If a surge voltage exceeding the device's rated voltage is anticipated, use a surge absorption device and circuit (e.g. a ZNR from Panasonic Electronic Devices Co., Ltd.).

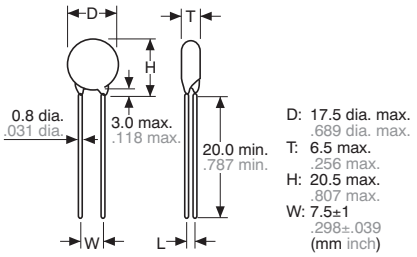
Cautions for Use of SSR

Choosing the Rated Voltage of the ZNR

(1) Peak supply voltage
(2) Supply voltage variation
(3) Degradation of ZNR characteristic (1 mA±10%)
(4) Tolerance of rated voltage (10%)

For application to 100 V AC lines, choose a ZNR with the following rated voltage:

(1) × (2) × (3) × (4) =
(100×2) ×1.1×1.1×1.1 = 188 (V)



Example of ZNR (Panasonic Electronic Components)

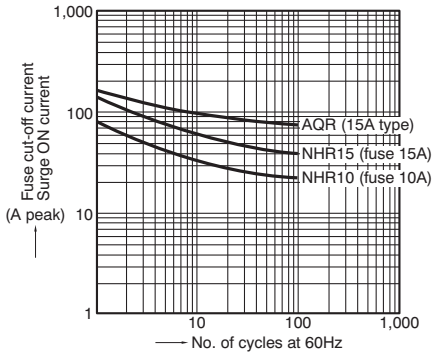
Types	Varistor voltage	Max. allowable circuit voltage		Max. control voltage	Max. average pulse electric power	Withstanding energy		Withstanding surge current		Electrostatic capacitance (Reference)
						(10/1000μs)	(2ms)	1time	(8/20μs) 2time	
	V1mA (V)	ACrms (V)	DC (V)	V50A (V)	(W)	(J)	(J)	(A)	(A)	@1KHz (pF)
ERZV14D201	200 (185 to 225)	130	170	340	0.6	70	50	6,000	5,000	770
ERZV14D221	220 (198 to 242)	140	180	360	0.6	78	55	6,000	5,000	740
ERZV14D241	240 (216 to 264)	150	200	395	0.6	84	60	6,000	5,000	700
ERZV14D271	270 (247 to 303)	175	225	455	0.6	99	70	6,000	5,000	640
ERZV14D361	360 (324 to 396)	230	300	595	0.6	130	90	6,000	4,500	540
ERZV14D391	390 (351 to 429)	250	320	650	0.6	140	100	6,000	4,500	500
ERZV14D431	430 (387 to 473)	275	350	710	0.6	155	110	6,000	4,500	450
ERZV14D471	470 (423 to 517)	300	385	775	0.6	175	125	6,000	4,500	400
ERZV14D621	620 (558 to 682)	385	505	1,025	0.6	190	136	6,000	4,500	330
ERZV14D681	680 (612 to 748)	420	560	1,120	0.6	190	136	5,000	4,500	320

2. Over-Current Protection

An SSR circuit operated without over-current protection may result in damage to the device. Design the circuit so the device's rated junction temperature is not exceeded for a continuous overload current.
(e.g. Surge current into a motor or light bulb)
The surge-on current rating applies to over-current errors which occur less than several tens of times during the service life of a semiconductor device. A protection coordination device is required for this rating.

Methods of over-current protection include the following:
(1) Suppressing over-currents
Use a current limiting reactor in series with the load power supply.
(2) Use a current shut-off device
Use a current limiting fuse or circuit breaker in series with the load power supply.

Example of executing fuse selection of over-current protection cooperation



Load Type Description

1. Heaters (Resistive Load)

The SSR is best suited to resistive loads. Noise levels can be drastically lowered with zero-crossing switching.

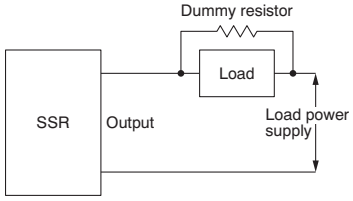
2. Lamps

Tungsten or halogen lamps draw a high inrush current when turned on (approximately 7 to 8 times the steady-state current for zero-crossing SSRs; approximately 9 to 12 times, in the worst case, for random type SSRs). Choose an SSR so the peak of the inrush current does not exceed 50% of the SSR surge-on current.

3. Solenoids

AC-driven solenoid contactors or solenoid valves also draw inrush current when they are activated. Choose an SSR such that the peak of the inrush current does not exceed 50% of the SSR surge-on current. For small solenoid valves and AC relays in particular, a leakage current may cause the load to malfunction after the SSR turns off. In such an event, use a dummy resistor in parallel with the load.

• Using an SSR below the Specified Load



4. Motors

When starting, an electric motor draws a symmetrical AC starting current some 5 to 10 times the steady-state load current, superimposed on a DC current. The starting time during which this high starting current is sustained depends on the capacities of the load and load power supply. Measure the starting current and time under the motor's actual operating conditions and choose an SSR so the peak of the starting current does not exceed 50% of the SSR surge-on current. When the motor load is deactivated, a voltage exceeding the load supply voltage is applied to the SSR due to counter-EMF. This voltage is approximately 1.3 times the load supply voltage for induction motors, and approximately 2 times that for synchronous motors.

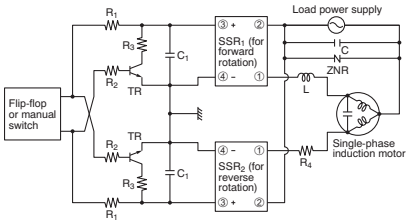
• Reversible Motor Control

When the direction of motor rotation is reversed, the transient current and time required for the reversal far exceed those required for simple starting. The reversing current and time should also be measured under actual operating conditions.

For a capacitor-starting, single-phase induction motor, a capacitive discharge current appears during the reversal process. Be sure to use a current limiting resistor or reactor in series with the SSR. Also, the SSR should have a high marginal voltage rating, since a voltage twice as high as the load supply voltage develops across the SSR in the reversal process. (For reversible control on a 100 V AC line, use SSRs with a 200 V rating; for use on a 200 V AC line, contact your nearest our representative for further information.)

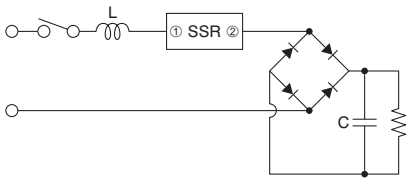
For reversible motor control, carefully design the driver circuit so the forward and reverse SSRs do not turn on at the same time.

Transistor-driven reversible motor control circuit



5. Capacitive Load

A capacitive load (switching regulator, etc.) draws an inrush current to charge the load capacitor when the SSR turns on. Choose an SSR so the peak of the inrush current does not exceed 50% of the SSR surge-on current. A timing error of up to one cycle can occur when a switch used in series with the SSR is opened or closed. If this is a problem, use an inductor (200 to 500 μH) in series to the SSR to suppress dv/dt error.

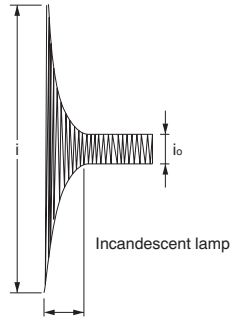


6. Other Electronic Equipment

In general, electronic equipment uses line filters in the primary supply circuit. The capacitors used in the line filters may cause the SSR to malfunction due to dv/dt turn on when the equipment is turned on or off. In such an event, use an inductor (200 to 500 μH) in series with the SSR to suppress dv/dt turn on.

Load Inrush Current Wave and Time

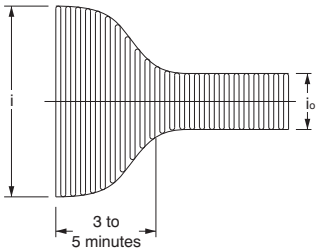
(1) Incandescent Lamp Load



Approx. 1/3 second

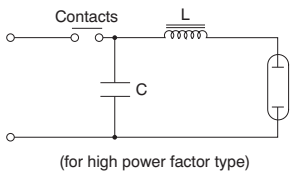
Inrush current/rated current: i/io]10 to 15 times

(2) Mercury Lamp Load i/io]3 times

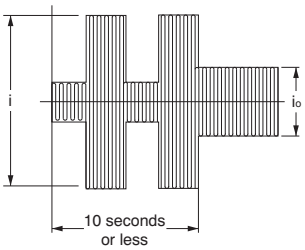


The discharge tube, transformer, choke coil, capacitor, etc., are combined in common discharge lamp circuits. Note that the inrush current may be 20 to 40 times, especially if the power supply impedance is low in the high power factor type.

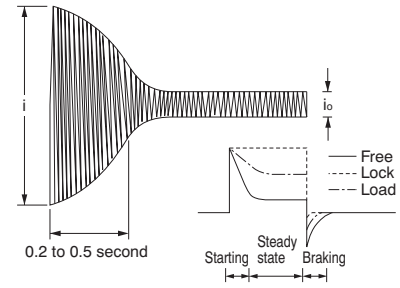
(3) Fluorescent Lamp Load i/io]5 to 10 times



(for high power factor type)

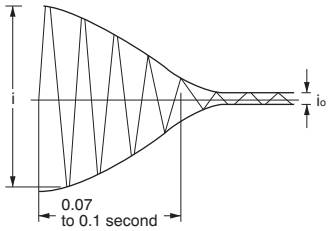


(4) Motor Load i/io]5 to 10 times



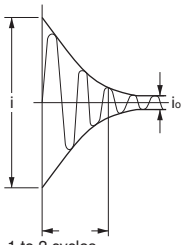
• Conditions become more harsh if plugging or inching is performed since state transitions are repeated.
• When using a relay to control a DC motor and brake, the on time inrush current, steady-state current and off time brake current differ depending on whether the load to the motor is free or locked. In particular, with non-polarized relays, when using from B contact of from contact for the DC motor brake, mechanical life might be affected by the brake current. Therefore, please verify current at the actual load.

(5) Solenoid Load i/io]10 to 20 times



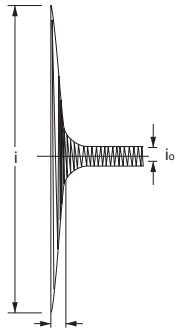
Note that since inductance is great, the arc lasts longer when power is cut. The contact may become easily worn.

(6) Electromagnetic Contact Load i/io]3 to 10 times



1 to 2 cycles (1/60 to 1/30 seconds)

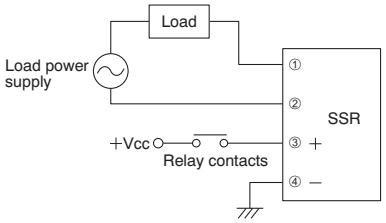
(7) Capacitive Load i/io]20 to 40 times



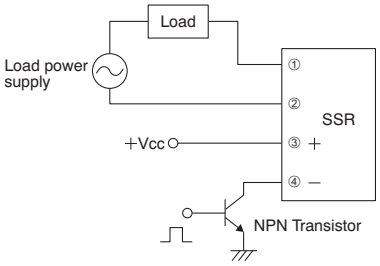
1/2 to 2 cycles (1/120 to 1/30 seconds)

SSR Driving Circuits

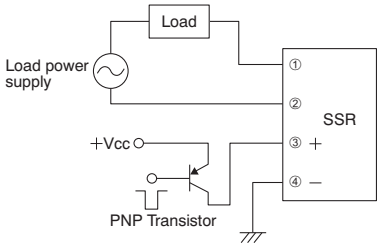
1. Relay Driver



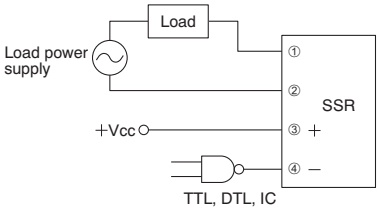
2. NPN Transistor Driver



3. PNP Transistor Driver

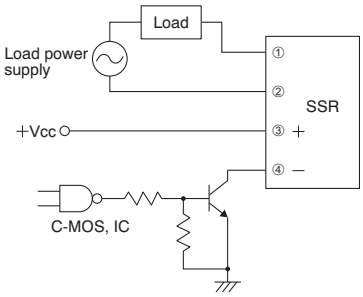


4. TTL/DTL/IC Driver

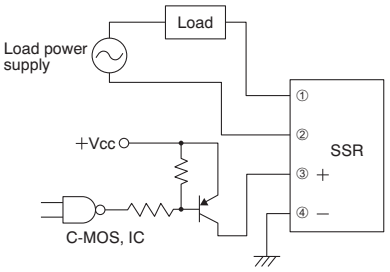


5. C-MOS/IC Driver

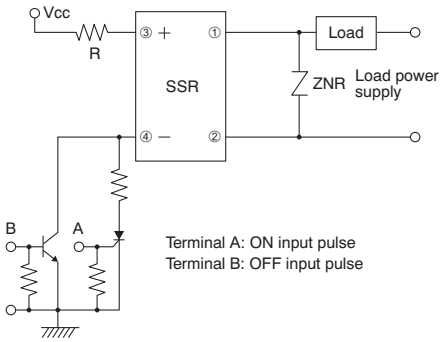
(1) SSR fires when IC output is HIGH:



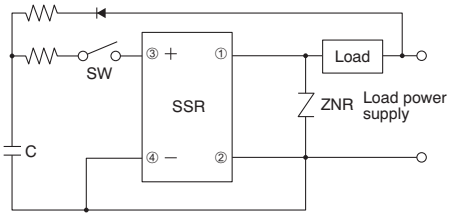
(2) SSR fires when IC output is LOW:



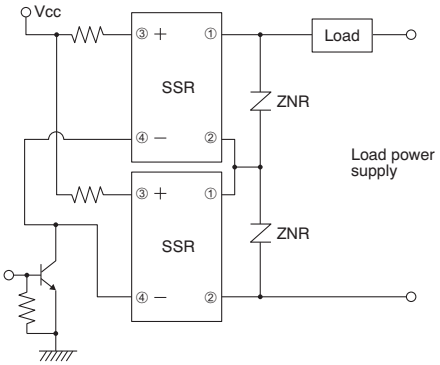
6. Self Sustaining Circuit Using SSR



7. Driving with a Shared Supply



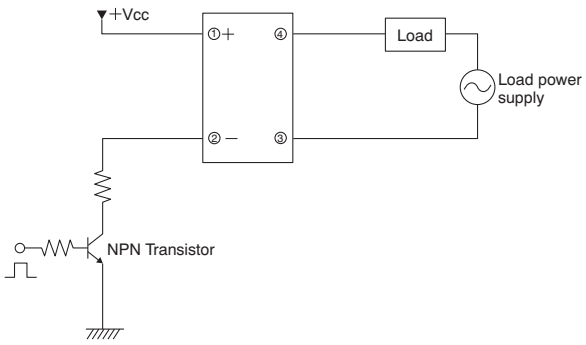
8. SSRs Used in Series



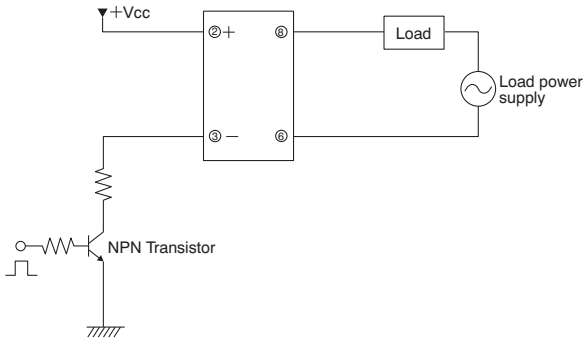
Phototriac Coupler, AQ-H Solid State Relay Driving Circuits

1. NPN Transistor Driver

1) Phototriac Coupler



2) AQ-H Solid State Relay

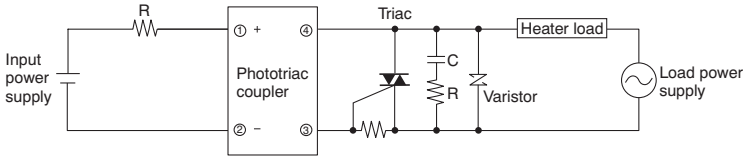


* Phototriac coupler and AQ-H is current driving type.

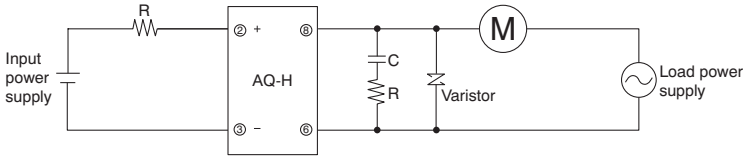
Phototriac Coupler/AQ-H Application Examples

Typical Applications

1. Temperature control for heater control



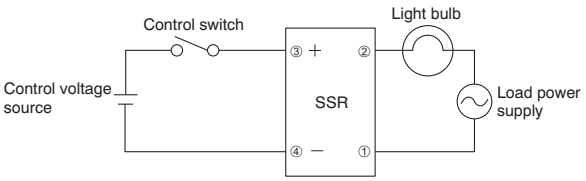
2. Airflow control for fan motors



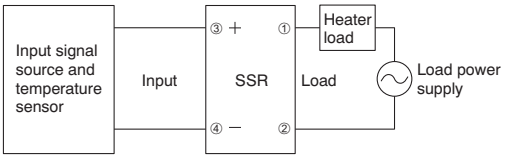
SSR Application Examples

Typical Applications

1. Light Bulb

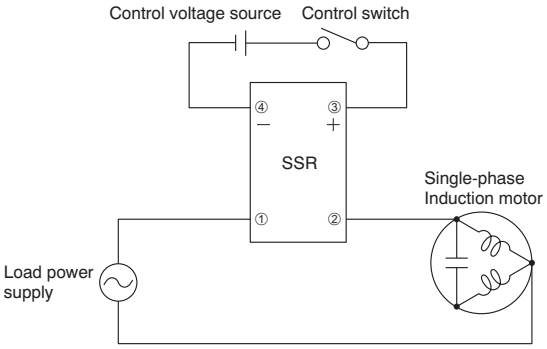


2. Electric Furnace Temperature Control

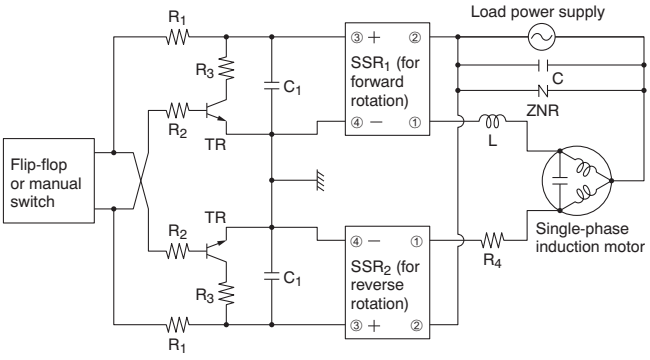


* KT Temperature Controller is available.

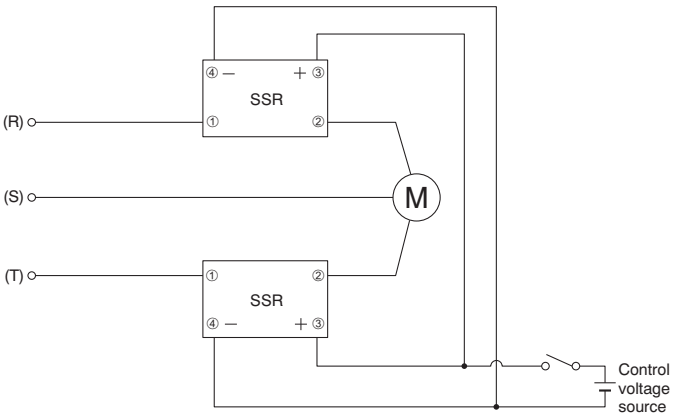
3. Single-Phase Induction Motor Control



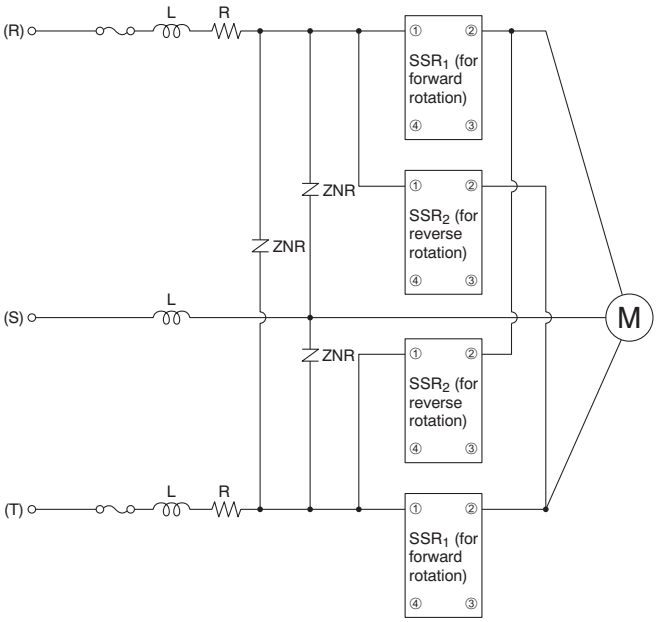
4. Reversible Control for a Single-Phase Induction Motor



5. Three-Phase Induction Motor Control

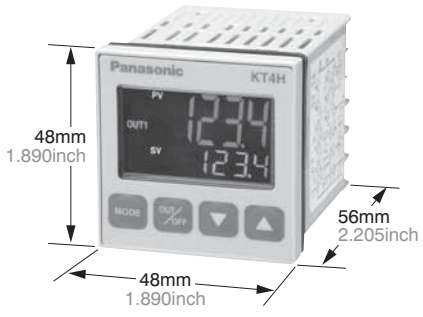


6. Reversible Control for a 3-Phase Induction Motor



Note: Take special care in the design to ensure that both the forward and reverse SSRs do not turn on at the same time.

Recommended Temperature Controllers



<KT4H Temperature Controller>

Our temperature controller is recommended for use with our Solid State Relays.

Features

- Data can be collected using the RS485 communications interface via a PLC.
- Improved visibility using a negative type LCD and backlight.
- Depth-wise length (chassis dimension) is 56 mm 2.205 inch.

Substitute part numbers

Power supply	Control output	Part No.
100 to 240 V AC	Relay contact	AKT4H112100

*For detailed product information about temperature controllers, please refer to our website: http://industrial.panasonic.com/ac/e/

SSR Load Recommendation Chart

Please use this chart when selecting the SSR load. The values presented are for ambient temperatures of 40°C 104°F (30°C 86°F) and lower. When selected, please measure the load current waveform and use within the range of each surge current characteristic.

Load voltage	Product	Max. load current	Type of load						Remarks
			Heater	Solenoid bulb	Single-phase motor	Triple-phase motor	Lamp	Trans-former	
110 V AC	AQG (1A type)	1A	0.8A	0.5A	7W	—	0.5A	50W	
	AQG (2A type)	2A	1.6A	1A	15W	—	1A	100W	
	AQ1 (3A type)	3A	2.4A	1.5A	60W	—	1.5A	150W	
	AQ1 (10A type) AQJ (10A type)	10A	8A	5A	200W	—	5A	500W	Heat sink AQP-HS-SJ10A (AQJ type) Heat sink AQP-HS-J10A, AQP-HS-SJ20A Heat sink AQ-HS-5A (AQ1 type)
	AQA (15A type) AQJ (15A type)	15A	12A	7.5A	300W	—	7.5A	750W	Heat sink AQP-HS-J10A, AQP-HS-SJ20A Heat sink AQP-HS-J10A (AQ-J type)
	AQA (25A type) AQJ (25A type)	25A	20A	12.5A	500W	—	12.5A	1.25kW	Heat sink AQP-HS-30/40A (AQ-A type) Heat sink AQP-HS-J25A (AQ-J type)
	AQA (40A type)	40A	32A	20A	750W	—	20A	2kW	Heat sink AQP-HS-J25A (AQ-A type)
220 V AC	AQG (1A type)	1A	0.8A	0.5A	15W	50W	0.5A	100W	
	AQG (2A type)	2A	1.6A	1A	35W	100W	1A	200W	
	AQ1 (3A type)	3A	2.4A	1.5A	100W	300W	1.5A	300W	
	AQ1 (10A type) AQJ (10A type)	10A	8A	5A	400W	1kW	5A	1kW	Heat sink AQP-HS-SJ10A (AQJ type) Heat sink AQP-HS-J10A, AQP-HS-SJ20A Heat sink AQ-HS-5A (AQ1 type)
	AQA (15A type) AQJ (15A type)	15A	12A	7.5A	600W	1.5kW	7.5A	1.5kW	Heat sink AQP-HS-J10A, AQP-HS-SJ20A Heat sink AQP-HS-J10A (AQ-J type)
	AQA (25A type) AQJ (25A type)	25A	20A	12.5A	1kW	2.5kW	12.5A	2.5kW	Heat sink AQP-HS-30/40A (AQ-A type) Heat sink AQP-HS-J25A (AQ-J type)
	AQA (40A type)	40A	32A	20A	1.5kW	3.7kW	20A	4kW	Heat sink AQP-HS-J25A (AQ-A type)
48 V DC	AQ1 (2A type)	2A	1.6A	1.0A	—	—	1.0A	—	
100 V DC	AQ1 (1A type)	1A	0.8A	0.5A	—	—	0.5A	—	

Panasonic
Ideas for life

1a/1c 10A cubic type power relay

JS RELAYS

FEATURES

- **Miniature size with universal terminal footprint**
- **High contact capacity: 10 A**
- **TV-5 type available (Standard type)**
  1 Form A type → TV-5
  1 Form C type → TV-5 (N.O. side only)
- **VDE, TÜV also approved**
- **Sealed construction for automatic cleaning (Standard type)**
- **Class B and F coil insulation type also available.**
- **EN60335-1 GWT compliant (Tested by VDE) type available**
- **Surge voltage 6 kV type also available**
- **Special type for high ambient temperature (105°C) available**

TYPICAL APPLICATIONS

1. Home appliances
Air conditioner, heater, etc.
2. Office machines
PPC, facsimile, etc.
3. Vending machines

ORDERING INFORMATION

JS □ □ - □ - □ - F □ - □ □

Contact arrangement
1: 1 Form C (Standard)
1a: 1 Form A (Standard)
1aP: 1 Form A (Long endurance type)

Protective construction
Nil: Sealed type
F: Flux-resistant type

Coil insulation class
Nil: Class E insulation
B: Class B insulation
F: Class F insulation

Nominal coil voltage (DC)
5V, 6V, 9V, 12V, 18V, 24V, 48V

Contact material
F: $AgSnO_2$ type

Flame resistance and tracking resistance
Nil: –
TT: EN60335-1 (Conform)

Surge voltage
6K: 6kV type

Standard: UL, CSA, VDE, TÜV (Standard type)
UL, CSA, VDE (Long endurance type and EN60335-1 GWT compliant type)
UL, CSA (Surge voltage 6kV type)
Notes: 1. When ordering TV rated (TV-5) types, add suffix -TV.
2. Contact arrangement 1aP type is Flux-resistant type only (Class B insulation only).

TYPES

Contact arrangement	Nominal coil voltage	Sealed type	Flux-resistant type
		Part No.	Part No.
1 Form A (Standard)	5V DC	JS1a-5V-F	JS1aF-5V-F
	6V DC	JS1a-6V-F	JS1aF-6V-F
	9V DC	JS1a-9V-F	JS1aF-9V-F
	12V DC	JS1a-12V-F	JS1aF-12V-F
	18V DC	JS1a-18V-F	JS1aF-18V-F
	24V DC	JS1a-24V-F	JS1aF-24V-F
	48V DC	JS1a-48V-F	JS1aF-48V-F
1 Form A Long endurance type	5V DC	–	JS1aPF-B-5V-F
	6V DC	–	JS1aPF-B-6V-F
	9V DC	–	JS1aPF-B-9V-F
	12V DC	–	JS1aPF-B-12V-F
	18V DC	–	JS1aPF-B-18V-F
	24V DC	–	JS1aPF-B-24V-F
	48V DC	–	JS1aPF-B-48V-F
1 Form C (Standard)	5V DC	JS1-5V-F	JS1F-5V-F
	6V DC	JS1-6V-F	JS1F-6V-F
	9V DC	JS1-9V-F	JS1F-9V-F
	12V DC	JS1-12V-F	JS1F-12V-F
	18V DC	JS1-18V-F	JS1F-18V-F
	24V DC	JS1-24V-F	JS1F-24V-F
	48V DC	JS1-48V-F	JS1F-48V-F

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

Notes: 1. Class B and F coil insulation types available.
Ex) JS1aF-B-12V-F, JS1aF-F-12V-F

2. EN60335-1 GWT compliant types available. When ordering, please add suffix “TT”.
Ex) JS1aF-B-12V-FTT

Contact arrangement	Nominal coil voltage	Sealed type	Flux-resistant type
		Part No.	Part No.
1 Form A (Standard)	5V DC	JS1a-5V-FTT	JS1aF-5V-FTT
	6V DC	JS1a-6V-FTT	JS1aF-6V-FTT
	9V DC	JS1a-9V-FTT	JS1aF-9V-FTT
	12V DC	JS1a-12V-FTT	JS1aF-12V-FTT
	18V DC	JS1a-18V-FTT	JS1aF-18V-FTT
	24V DC	JS1a-24V-FTT	JS1aF-24V-FTT
	48V DC	JS1a-48V-FTT	JS1aF-48V-FTT
1 Form A Long endurance type	5V DC	–	JS1aPF-B-5V-FTT
	6V DC	–	JS1aPF-B-6V-FTT
	9V DC	–	JS1aPF-B-9V-FTT
	12V DC	–	JS1aPF-B-12V-FTT
	18V DC	–	JS1aPF-B-18V-FTT
	24V DC	–	JS1aPF-B-24V-FTT
	48V DC	–	JS1aPF-B-48V-FTT
1 Form C (Standard)	5V DC	JS1-5V-FTT	JS1F-5V-FTT
	6V DC	JS1-6V-FTT	JS1F-6V-FTT
	9V DC	JS1-9V-FTT	JS1F-9V-FTT
	12V DC	JS1-12V-FTT	JS1F-12V-FTT
	18V DC	JS1-18V-FTT	JS1F-18V-FTT
	24V DC	JS1-24V-FTT	JS1F-24V-FTT
	48V DC	JS1-48V-FTT	JS1F-48V-FTT

3. Surge voltage 6kV types available. When ordering, please add suffix “6K” (except for Long endurance type and EN60335-1 GWT compliant type).
Ex) JS1aF-B-12V-F-6K

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)	Max. applied voltage (at 70°C 158°F)
5V DC	70%V or less of nominal voltage (Initial)	10%V or more of nominal voltage (Initial)	72 mA	69.4Ω	360mW	130%V of nominal voltage [When using relays at 85°C 185°F, see Note*]
6V DC			60 mA	100 Ω		
9V DC			40 mA	225 Ω		
12V DC			30 mA	400 Ω		
18V DC			20 mA	900 Ω		
24V DC			15 mA	1,600 Ω		
48V DC			7.5mA	6,400 Ω		

Note: * When using relays in a high ambient temperature, consider the pick-up voltage rise due to the high temperature (a rise of approx. 0.4% V for each 1°C 33.8°F with 20°C 68°F as a reference) and use a coil impressed voltage that is within the maximum applied voltage range.

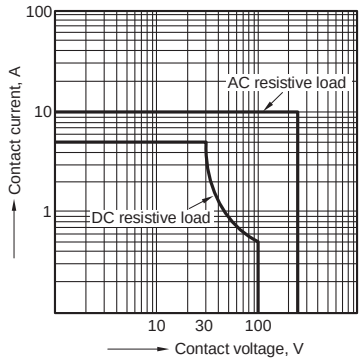
2. Specifications

Characteristics	Item		Specifications	
Contact	Contact material		$AgSnO_2$ type	
	Contact resistance (Initial)		Max. 100 mΩ (By voltage drop 6 V DC 1A)	
	Arrangement		1 Form A, 1 Form C	1 Form A Long endurance type
Rating	Nominal switching capacity (resistive load)		10 A 250 V AC (NO), 10 A 125 V AC, 6 A 277 V AC, 5 A 30 V DC	10 A 250 V AC, 10 A 277 V AC, 5 A 30 V DC
	Max. switching power (resistive load)		2,500VA 150W (NO), 1,662VA 150W (NC)	2,770VA 150W
	Max. switching voltage		250V AC, 100V DC (0.5A)	
	Max. switching current		10A (AC), 5A (DC)	
	Nominal operating power		360mW	
	Min. switching capacity*1		100mA, 5V DC	
Electrical characteristics	Insulation resistance (Initial)		Min. 100MΩ (at 500V DC) Measurement at same location as “Breakdown voltage” section.	
	Breakdown voltage (Initial)	Between open contacts	750 Vrms for 1 min. (Detection current: 10 mA)	
		Between contact and coil	1,500 Vrms for 1 min. (Detection current: 10 mA)	
	Temperature rise (coil)		Max. 35°C 95°F (By resistive method, nominal coil voltage applied to the coil; contact carrying current: 10A, at 70°C 158°F)	
	Operate time (at nominal voltage) (at 20°C 68°F)		Max. 10 ms (excluding contact bounce time.)	
	Release time (at nominal voltage) (at 20°C 68°F)		Max. 10 ms (excluding contact bounce time) (Without diode)	
Mechanical characteristics	Shock resistance	Functional	98 m/s^2 (Half-wave pulse of sine wave: 11 ms; detection time: 10μs.)	
		Destructive	980 m/s^2 (Half-wave pulse of sine wave: 6 ms.)	
	Vibration resistance	Functional	10 to 55 Hz at double amplitude of 1.6 mm (Detection time: 10μs.)	
		Destructive	10 to 55 Hz at double amplitude of 2 mm	
Expected life	Mechanical (at 180 times/min.)		Min. 10^7	
	Electrical (resistive load)		1×10^5 [10A 125V AC, 6A 277V AC, 5A 30V DC] 5×10^4 (NO contact only) [10A 250V AC]	2×10^5 [10A 277V AC] 1.5×10^5 [10A 250V AC (at 20 times/min., 105°C 221°F)] 1×10^5 [5A 30V DC]
Conditions	Conditions for operation, transport and storage*2		–40°C to +70°C –40°F to +158°F (Class E insulation) –40°C to +85°C –40°F to +185°F (Class B insulation)*3 –40°C to +105°C –40°F to +221°F (Class F insulation)*3 Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)	–40°C to +105°C –40°F to +221°F*3; Humidity: 5 to 85% R.H. (Not freezing and condensing at low temperature)
	Max. operating speed		20 times/min. (at nominal switching capacity)	
Unit weight			Approx. 12 g .423 oz	

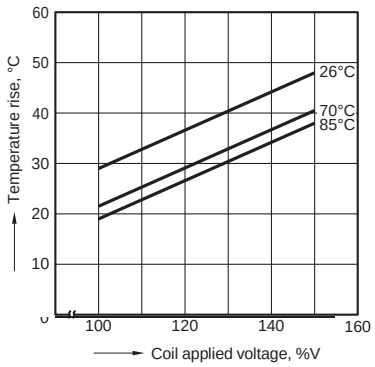
Notes:
*1. This value can change due to the switching frequency, environmental conditions, and desired reliability level, therefore it is recommended to check this with the actual load.
*2. The upper limit of the ambient temperature is the maximum temperature that can satisfy the coil temperature rise value. Refer to “6. Usage, Storage and Transport Conditions“ in AMBIENT ENVIRONMENT section in Relay Technical Information.
*3. When using relays in a high ambient temperature, consider the pick-up voltage rise due to the high temperature (a rise of approx. 0.4% V for each 1°C 33.8°F with 20°C 68°F as a reference) and use a coil impressed voltage that is within the maximum applied voltage range.

REFERENCE DATA

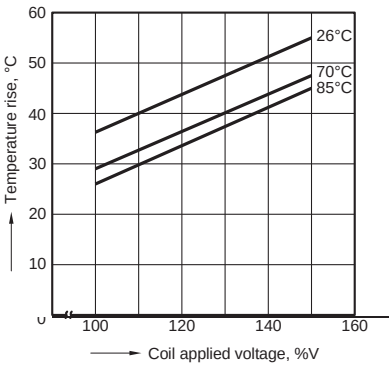
1. Maximum value for switching capacity



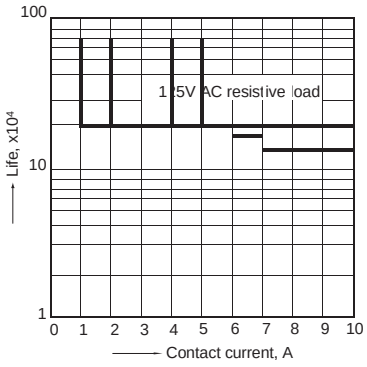
2.-(1) Coil temperature rise
Sample: 5 pcs., JS1a-24V-F
Measured portion: Inside the coil
Contact current: 5 A



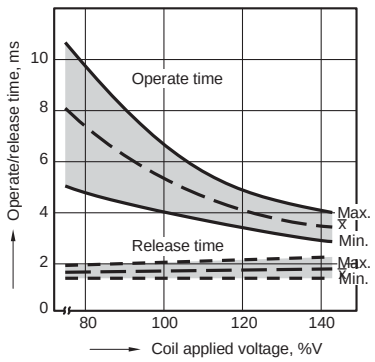
2.-(2) Coil temperature rise
Sample: 5 pcs., JS1a-24V-F
Measured portion: Inside the coil
Contact current: 10 A



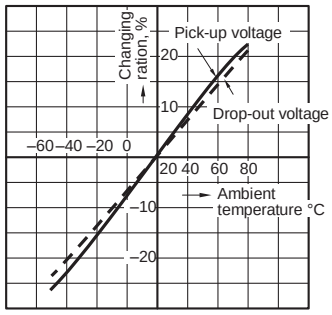
3. Life curve
Ambient temperature: Room temperature



4. Operate/release time
Sample: 25 pcs., JS1-12V-F



5. Ambient temperature characteristics
Sample: 6 pcs., JS1-12V-F

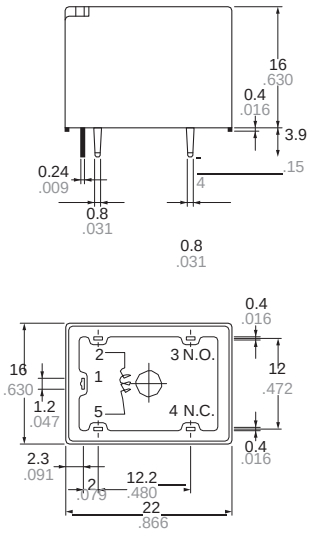


DIMENSIONS (mm inch)

Download CAD Data from our Web site.

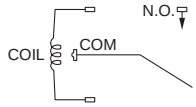
CAD Data

External dimensions

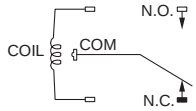


Schematic (Bottom view)

1 Form A

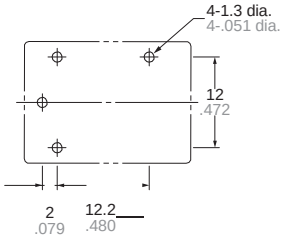


1 Form C

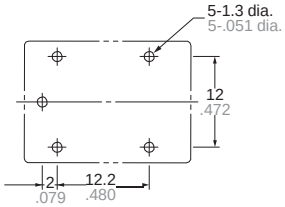


PC board pattern (Bottom view)

1 Form A
(Standard, High Power)



1 Form C
(Standard)



Note: Terminal No. 4 is only for Standard 1 Form C type

Dimension:	General tolerance
Less than 1mm .039inch:	±0.1 ±.004
Min. 1mm .039inch less than 3mm .118 inch:	±0.2 ±.008
Min. 3mm .118 inch:	±0.3 ±.012

Tolerance: ±0.1 ±.004

SAFETY STANDARDS

UL/C-UL (Recognized)		CSA (Certified)		VDE (Certified)		TV rating (UL/CSA)		TÜV (Certified)	
File No.	Contact rating	File No.	Contact rating	File No.	Contact rating	File No.	Rating	File No.	Rating
E43028	10A 125V AC, 6A 277V AC 5A 30V DC, 1/8HP 125V AC 1/8HP 277V AC 12A 125V AC (N.O., N.C.) 12A 277V AC (N.O., N.C.) 10A 125V AC (N.O., N.C.) 85°C 5A 125V AC (N.O., N.C.) 105°C, Class B insulation 4FLA/4LRA125V AC 105°C 2FLA/4LRA125V AC 105°C 1/3HP 125V AC 75°C N.O. 1/3HP 277V AC 75°C N.O. 6FLA/6LRA125V AC 85°C (N.O.)	LR26550	10A 125V AC 12A 125V AC 6A 277V AC 12A 277V AC 5A 30V DC 1/8HP 125V AC 1/8HP 277V AC	40011475	10A 125V AC ($\cos\varphi$=1.0) 5A 30V DC (0ms) 6A 250V AC ($\cos\varphi$=1.0)	UL E43028 CSA LR26550	1a→TV-5 1c→TV-5 (N.O.)	B 10 02 13461 271	10A 125V AC ($\cos\varphi$=1.0) 6A 250V AC ($\cos\varphi$=1.0) 5A 30V DC (0ms)

For Cautions for Use, see Relay Technical Information.

каталог, описание, технические, характеристики, datasheet, параметры, маркировка,габариты, фото

QR код