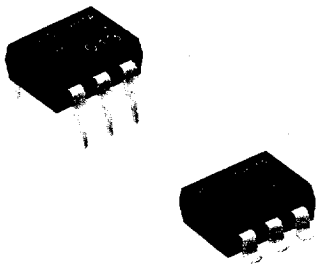
NAiS/SDS
Matsushita Automation Controls

SEMICONDUCTOR RELAY 1 From A (AQV25) Type

AQV 254

849



FEATURES

1. Controls low-level input signals
PhotoMOS relays feature extremely low closed-circuit offset voltage to enable control of low-level analog signals without distortion.

2. Highly sensitive and low on-resistance

3. Controls various types of loads such as relays, motors, lamps and solenoids.

4. Optical coupling for extremely high isolation
Unlike mechanical relays, the PhotoMOS relay combines LED and optoelectronic device to transfer signals using light for extremely high isolation.

5. Low-level off state leakage current

6. Eliminates the need for a power supply to drive the power MOSFET
A power supply used to drive the power MOSFET is unnecessary because of the built-in optoelectronic device. This results in easy circuit design and small PC board area.

7. Low thermal electromotive force (Approx. 1 μV)

8. UL FILE: E43149
CSA FILE: LR26550

TYPICAL APPLICATIONS

- High-speed inspection machines
- Telephone equipment
- Data communication equipment

TYPES

	Output rating		Part No.		Standard packing	
	Load voltage	Load current	Through hole terminal	Surface-mount terminal	Tube	Case
AC/DC type	40 V	500 mA	AQV251	AQV251A	50 pcs.	500 pcs.
	60 V	400 mA	AQV252	AQV252A		
	250 V	200 mA	AQV253	AQV253A		
	400 V	150 mA	AQV254	AQV254A		
	1,000 V	30 mA	AQV259	AQV259A		

RATING

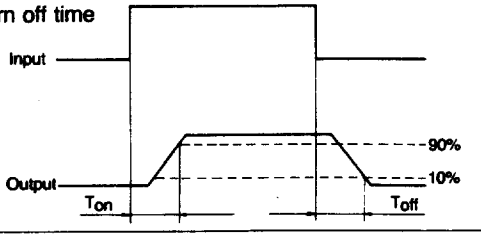
1. Absolute maximum ratings (Ambient temperature: 25°C 77°F)

Item		Symbol	Type of connection	AQV251(A)	AQV252(A)	AQV253(A)	AQV254(A)	AQV259(A)	Remarks
Input	LED forward current	I_F		50 mA	50 mA	50 mA	50 mA	50 mA	
	LED reverse voltage	V_R		3 V	3 V	3 V	3 V	3 V	
	Peak forward current	I_{FP}		1 A	1 A	1 A	1 A	1 A	f = 100 Hz, Duty factor = 0.1%
	Power dissipation	P_{in}		75 mW	75 mW	75 mW	75 mW	75 mW	
Output	Load voltage (peak AC)	V_L		40 V	60 V	250 V	400 V	1,000 V	
	Continuous load current	I_L	A B C	0.5 A 0.7 A 1.0 A	0.4 A 0.6 A 0.8 A	0.2 A 0.3 A 0.4 A	0.15 A 0.18 A 0.25 A	0.03 A 0.04 A 0.05 A	A connection: Peak AC, DC B, C connection: DC
	Peak load current	Ipeak		1.8 A	1.5 A	0.6 A	0.5 A	0.09 A	A connection: 100 msec. (1 shot) V_L = DC
	Power dissipation	Pout		360 mW	360 mW	360 mW	360 mW	360 mW	
Total power dissipation		P_T		410 mW					
I/O isolation voltage		Viso		1,500 V AC					
Temperature limits	Operating	Topr		−20°C to 80°C −4°F to 176°F					Non-condensing at low temperatures
	Storage	Tstg		−40°C to 100°C −40°F to 212°F					

2. Electrical characteristics (Ambient temperature: 25°C 77°F)

Item				Symbol	Type of connection	AQV251(A)	AQV252(A)	AQV253(A)	AQV254(A)	AQV259(A)	Condition
Input	LED operate current		Minimum Typical Maximum	I_{Fon}	—	 0.9 mA 3 mA	 0.9 mA 3 mA	 0.9 mA 3 mA	 0.9 mA 3 mA	 0.9 mA 3 mA	I_L = Max.
	LED turn off current		Minimum Typical Maximum	I_{Foff}	—	 0.4 mA 0.8 mA	 0.4 mA 0.8 mA	 0.4 mA 0.8 mA	 0.4 mA 0.8 mA	 0.4 mA 0.8 mA	I_L = Max.
	LED dropout voltage		Minimum Typical Maximum	V_F	—	 1.14 V 1.5 V	 1.14 V 1.5 V	 1.14 V 1.5 V	 1.14 V 1.5 V	 1.14 V 1.5 V	I_F = 5 mA
Output	On resistance		Minimum Typical Maximum	Ron	A	 0.6 Ω 1 Ω	 0.74 Ω 1.4 Ω	 5.5 Ω 8 Ω	 12.4 Ω 16 Ω	 85 Ω 200 Ω	I_F = 5 mA I_L = Max. Within 1 sec. on time
			Minimum Typical Maximum	Ron	B	 0.3 Ω 0.5 Ω	 0.37 Ω 0.7 Ω	 2.7 Ω 4 Ω	 6.2 Ω 8 Ω	 60 Ω 100 Ω	I_F = 5 mA I_L = Max. Within 1 sec. on time
			Minimum Typical Maximum	Ron	C	 0.15 Ω 0.25 Ω	 0.18 Ω 0.35 Ω	 1.4 Ω 2 Ω	 3.1 Ω 4 Ω	 30 Ω 50 Ω	I_F = 5 mA I_L = Max. Within 1 sec. on time
	Off state leakage current		Minimum Typical Maximum	—	—	 1 μA	 1 μA	 1 μA	 1 μA	 10 μA	I_F = 0 V_L = Max.
Transfer characteristics	Switching speed	Turn on time*	Minimum Typical Maximum	Ton	—	 1.7 msec. 3 msec.	 1.4 msec. 3 msec.	 0.8 msec. 2 msec.	 0.8 msec. 2 msec.	 0.6 msec. 1 msec.	I_F = 5 mA I_L = Max.
		Turn off time*	Minimum Typical Maximum	Toff	—	 0.07 msec. 0.2 msec.	 0.07 msec. 0.2 msec.	 0.06 msec. 0.2 msec.	 0.05 msec. 0.2 msec.	 0.04 msec. 0.2 msec.	I_F = 5 mA I_L = Max.
	I/O capacitance		Minimum Typical Maximum	Ciso	—	 1.3 pF 3 pF	 1.3 pF 3 pF	 1.3 pF 3 pF	 1.3 pF 3 pF	 1.3 pF 3 pF	f = 1 MHz V_B = 0
	Initial I/O isoltion resistance		Minimum Typical Maximum	Riso	—	 1,000 MΩ	 1,000 MΩ	 1,000 MΩ	 1,000 MΩ	 1,000 MΩ	500 V DC

*Turn on/Turn off time

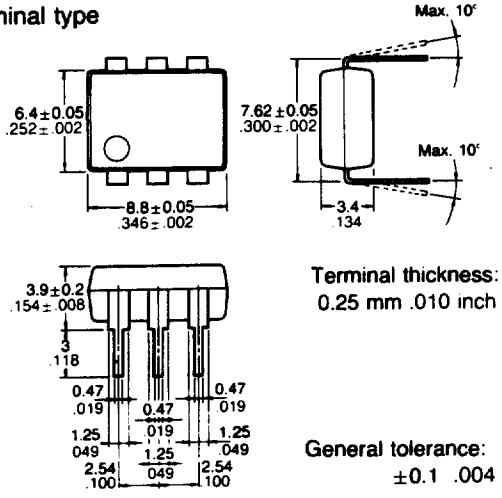


For type of connection, see p. 3.

DIMENSIONS

mm inch

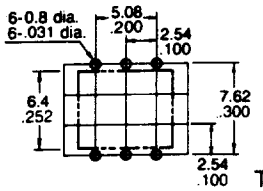
Through-hole terminal type



Terminal thickness:
0.25 mm .010 inch

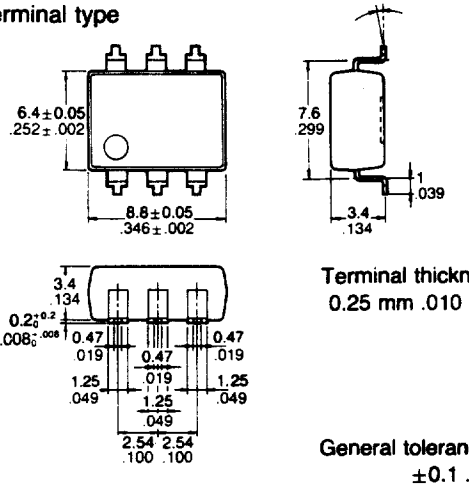
General tolerance:
±0.1 .004

PC board pattern (Bottom view)



Tolerance: ±0.1 .004

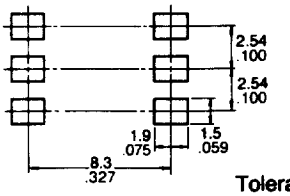
Surface mount terminal type



Terminal thickness:
0.25 mm .010 inch

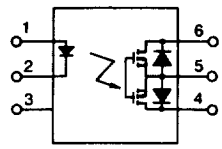
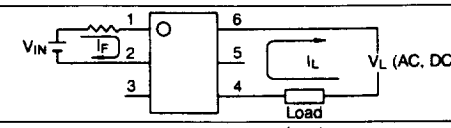
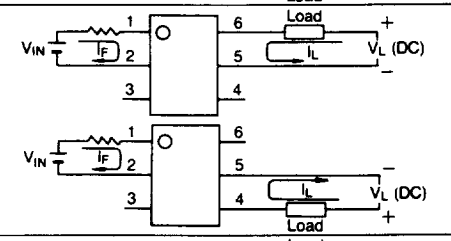
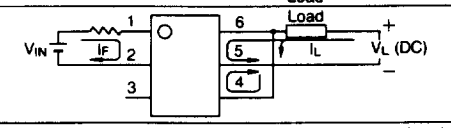
General tolerance:
±0.1 .004

Mounting pad (Top view)



Tolerance ±0.1 .004

SCHEMATIC AND WIRING DIAGRAMS

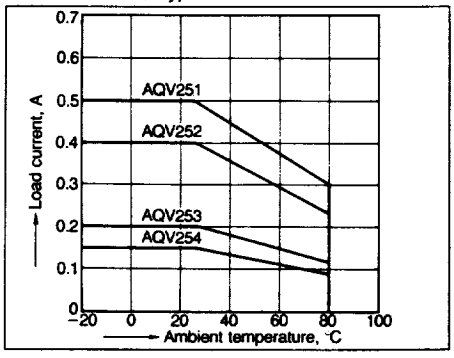
AQV25 types	 Note: Terminal 3 cannot be used, since it is in the internal circuit of the relay.	AC/DC	A	
		DC	B**	
		DC	C	

**Can be also connected as 2 Form A type. (However, the sum of the continuous load current should not exceed the absolute maximum rating.)

DATA

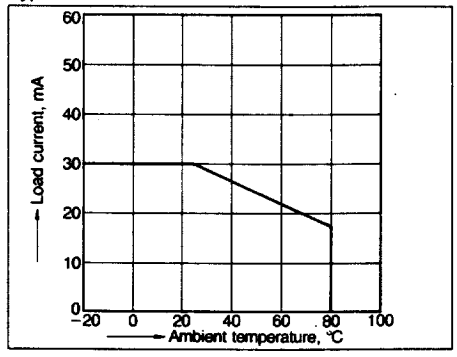
1.-(1) Load current vs. ambient temperature characteristics

Allowable ambient temperature: −20°C to +80°C −4°F to +176°F; Type of connection: A



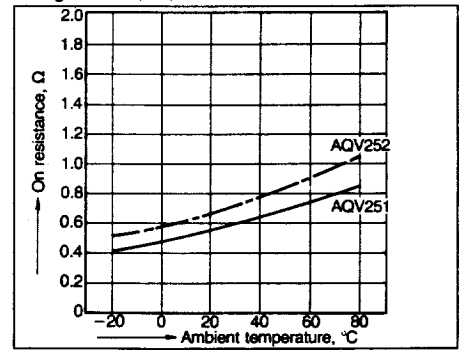
1.-(2) Load current vs. ambient temperature characteristics

Sample: AQV259; Allowable ambient temperature: −20°C to +80°C −4°F to +176°F; Type of connection: A



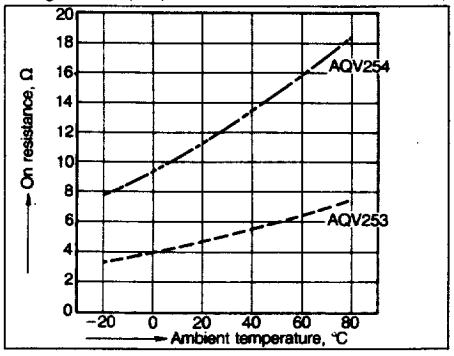
2.-(1) On resistance vs. ambient temperature characteristics

Sample: AQV251, AQV252; Measured portion: between terminals 4 and 6; LED current: 5 mA: Load voltage: Max. (DC); Continuous load current: Max. (DC)



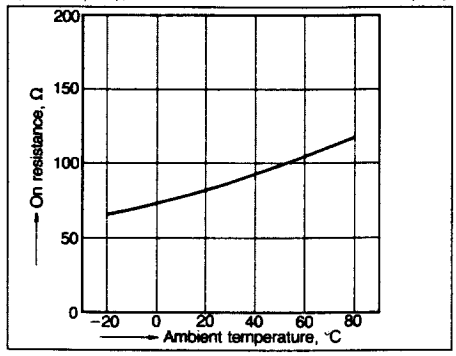
2.-(2) On resistance vs. ambient temperature characteristics

Sample: AQV253, AQV254; Measured portion: between terminals 4 and 6; LED current: 5 mA; Load voltage: Max. (DC): Continuous load current: Max. (DC)



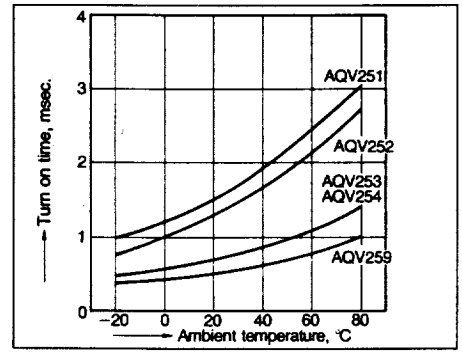
2.-(3) On resistance vs. ambient temperature characteristics

Sample: AQV259; Measured portion: between terminals 4 and 6; LED current: 5 mA: Load voltage: 1,000 V (DC); Continuous load current: 30 mA (DC)



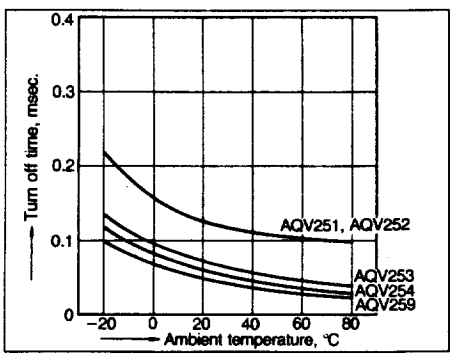
3. Turn on time vs. ambient temperature characteristics

LED current: 5 mA: Load voltage: Max. (DC); Continuous load current: Max. (DC)



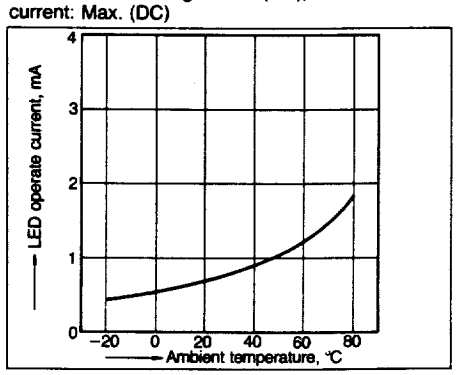
4. Turn off time vs. ambient temperature characteristics

LED current: 5 mA; Load voltage: Max. (DC); Continuous load current: Max. (DC)



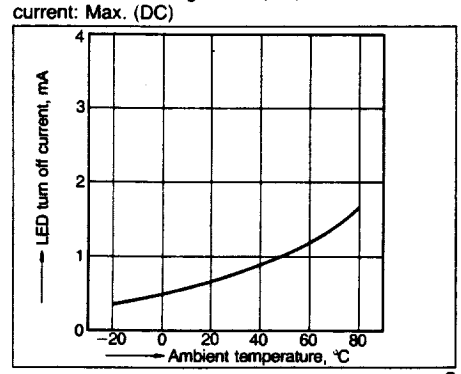
5. LED operate current vs. ambient temperature characteristics

Sample: AQV251, AQV252, AQV253, AQV254, AQV259; Load voltage: Max. (DC); Continuous load current: Max. (DC)

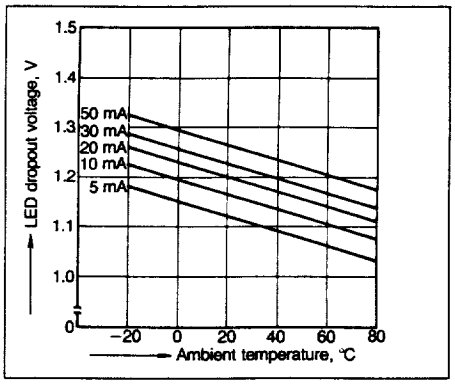


6. LED turn off current vs. ambient temperature characteristics

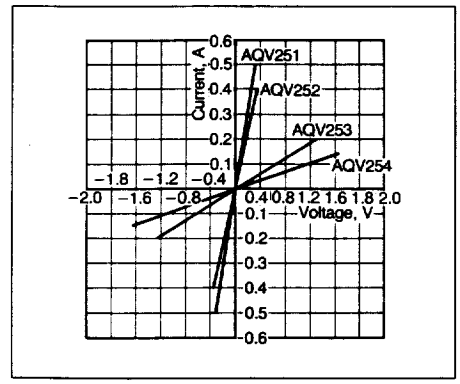
Sample: AQV251, AQV252, AQV253, AQV254, AQV259; Load voltage Max. (DC); Continuous load current: Max. (DC)



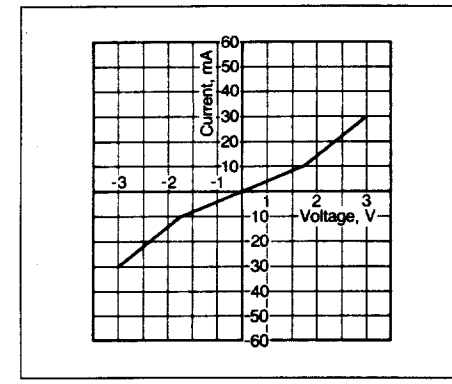
7. LED dropout voltage vs. ambient temperature characteristics
LED current: 5 to 50 mA



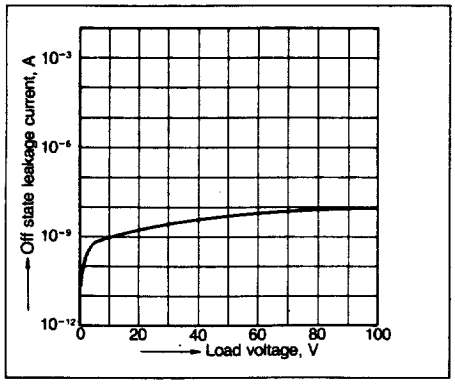
8.-(1) Voltage vs. current characteristics of output at MOS portion
Measured portion: between terminals 4 and 6;
Ambient temperature: 25°C 77°F



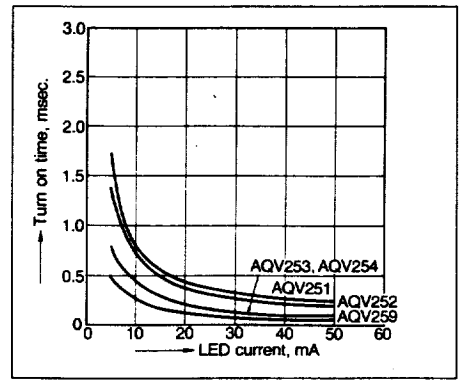
8.-(2) Voltage vs. current characteristics of output at MOS portion
Sample: AQV259
Measured portion: between terminals 4 and 6;
Ambient temperature: 25°C 77°F



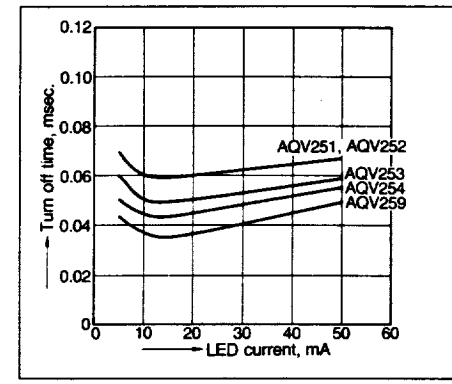
9. Off state leakage current
Sample: AQV259; Measured portion: between terminals 4 and 6; Ambient temperature: 25°C 77°F



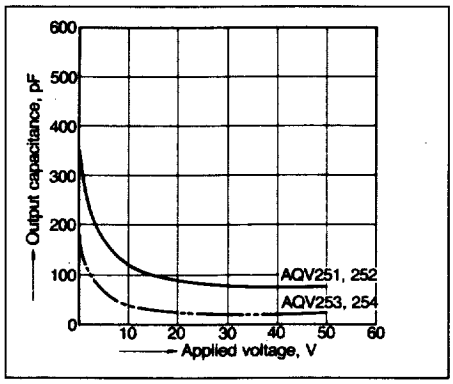
10. LED forward current vs. turn on time characteristics
Measured portion: between terminals 4 and 6; Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



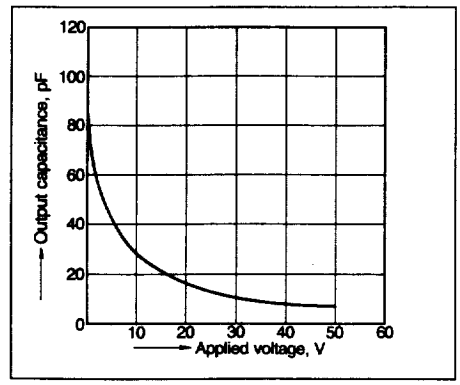
11. LED forward current vs. turn off time characteristics
Measured portion: between terminals 4 and 6; Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



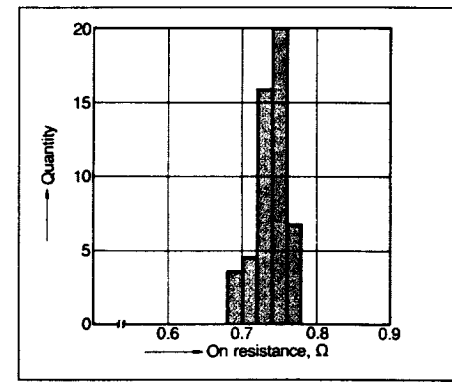
12.-(1) Applied voltage vs. output capacitance characteristics
Measured portion: between terminals 4 and 6; Frequency: 1 MHz; Ambient temperature: 25°C 77°F



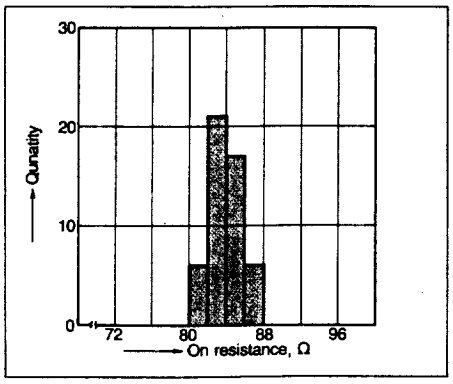
12.-(2) Applied voltage vs. output capacitance characteristics
Sample: AQV259; Measured portion: between terminals 4 and 6; Frequency: 1 MHz; Ambient temperature: 25°C 77°F



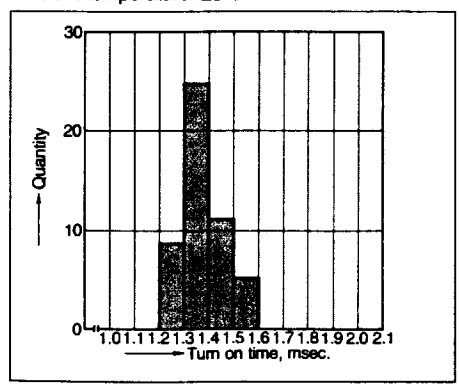
13.-(1) On resistance distribution
Sample: AQV252; Measured portion: between terminals 4 and 6; Continuous load current: 0.4 A (DC); Quantity, n = 50; Ambient temperature: 25°C 77°F



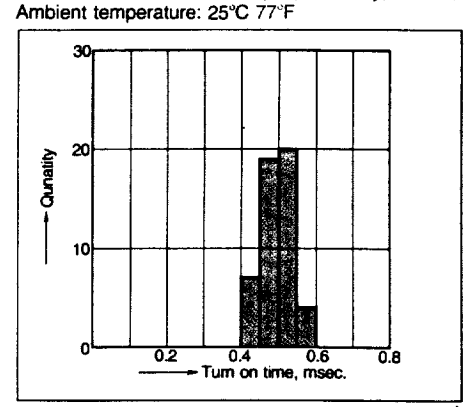
13.-(2) On resistance distribution
Sample: AQV259; Measured portion: between terminals 4 and 6; Continuous load current: 30 mA (DC); Quantity, n = 50; Ambient temperature: 25°C 77°F



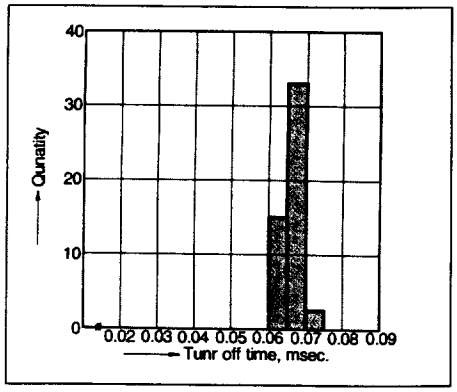
14.-(1) Turn on time distribution
Sample: AQV252; Load voltage: 60 V (DC); Continuous load current: 0.4 A (DC): Quantity, n = 50;
Ambient temperature: 25°C 77°F



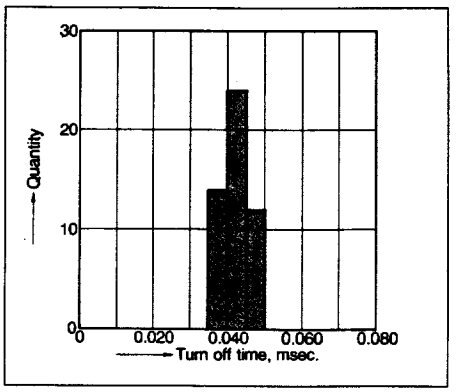
14.-(2) Turn on time distribution
Sample: AQV259; Load voltage: 1,000 V (DC); Continuous load current: 30 mA (DC): Quantity, n = 50;
Ambient temperature: 25°C 77°F



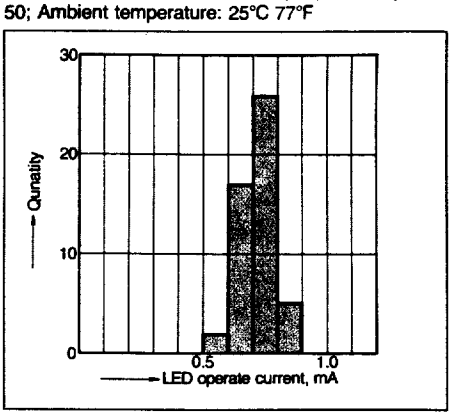
15.-(1) Turn off time distribution
Sample: AQV252; Load voltage: 60 V (DC); Continuous load current: 0.4 A (DC); Quantity, n = 50; Ambient temperature: 25°C 77°F



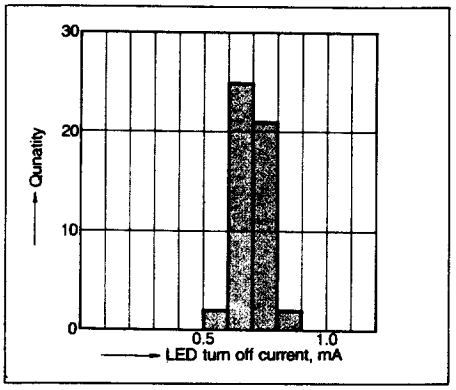
15.-(2) Turn off time distribution
Sample: AQV259; Load voltage: 1,000 V (DC); Continuous load current: 30 mA (DC); Quantity, n = 50; Ambient temperature: 25°C 77°F



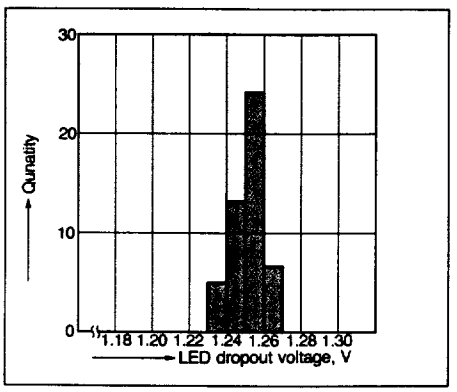
16. LED operate current distribution
Sample: AQV259; Load voltage: 1,000 V (DC); Continuous load current: 30 mA (DC): Quantity, n = 50; Ambient temperature: 25°C 77°F



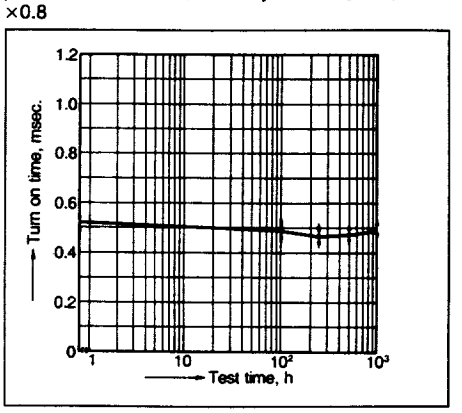
17. LED turn off current distribution
Sample: AQV259; Load voltage: 1,000 V (DC); Continuous load current: 30 mA (DC): Quantity, n = 50; Ambient temperature: 25°C 77°F



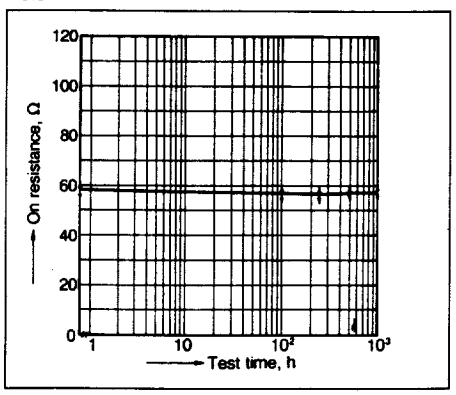
18. LED dropout voltage distribution
LED current: 50 mA; Quantity, n = 50; Ambient temperature: 25°C 77°F



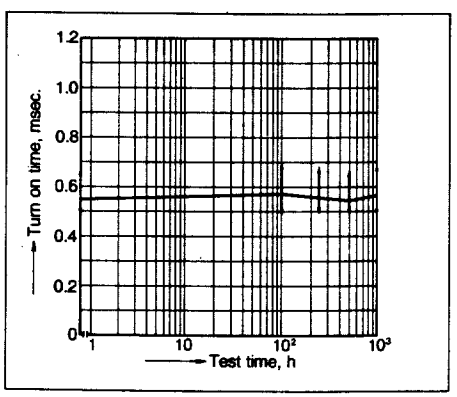
19.-(1) Bias test at high temperature and high humidity (change of turn on time)
Sample: AQV259; Quantity, n = 10; Ambient temperature: 85°C 185°F; Humidity: 85%; V_L = 1,000 V ×0.8



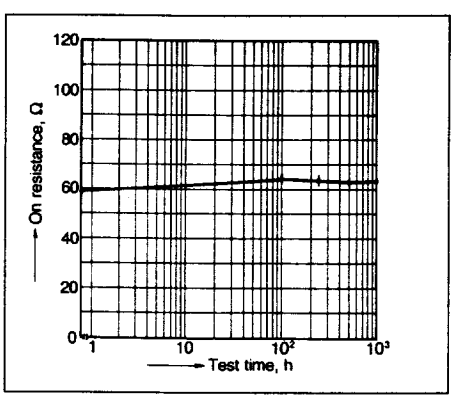
19.-(2) Bias test at high temperature and high humidity (change of on resistance)
Sample: AQV259; Quantity, n = 10; Ambient temperature: 85°C 185°F: Humidity: 85%; V_L = 1,000 V ×0.8



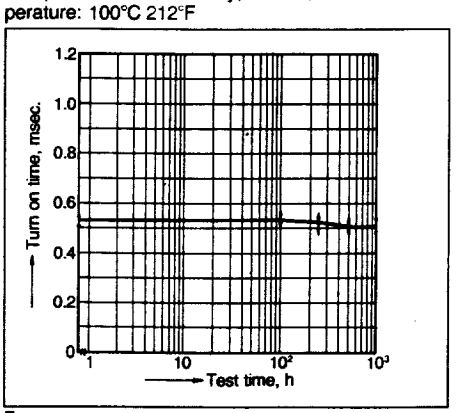
20.-(1) Low temperature storage test (change of turn on time)
Sample: AQV259; Quantity, n = 10; Ambient temperature: −40°C −40°F



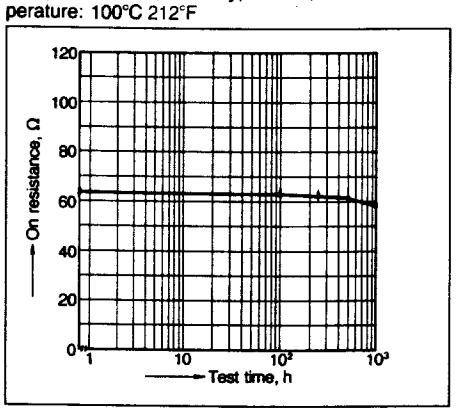
20.-(2) Low temperature storage test (change of on resistance)
Sample: AQV259; Qunatity, n = 10; Ambient temperature: −40°C −40°F



21.-(1) High temperature storage test (change of turn on time)
Sample: AQV259; Quantity, n = 10; Ambient temperature: 100°C 212°F



21.-(2) High temperature storage test (change of on resistance)
Sample: AQV259; Quantity, n = 10; Ambient temperature: 100°C 212°F



NOTES

1. Unused terminals

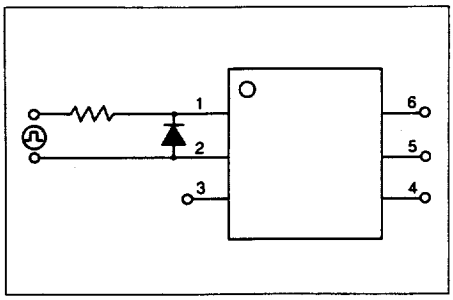
Terminal No. 3 should not be used, since it is used in the internal circuit of the relay.

2. Short across terminals

A short across the terminals while the relay is energized may result in damage to the internal IC.

3. Surge voltages at the input

If reverse surge voltages are present at the input terminals, connected a diode in reverse parallel across the input terminals and keep the reverse voltages below the reverse breakdown voltage.



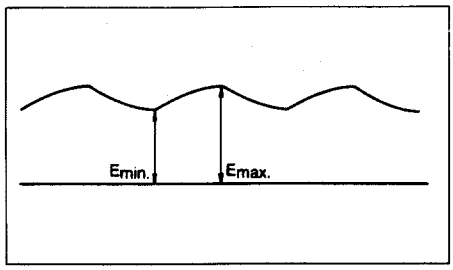
4. Ripple in the input power supply

If ripple is present in the input power supply, observe the followings:

1) For LED operate current at Emin, maintain as follows:

AQV25 types: Min. 5 mA

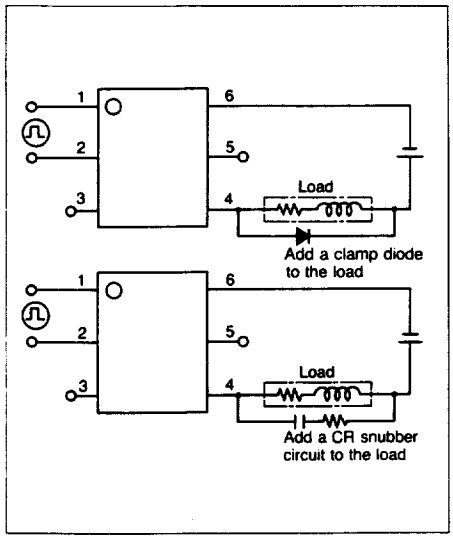
2) Keep the LED operate current at 50 mA or less at Emax.



5. Output spike voltages

1) If an inductive load generates spike voltages which exceed the absolute maximum rating, the spike voltages must be limited.

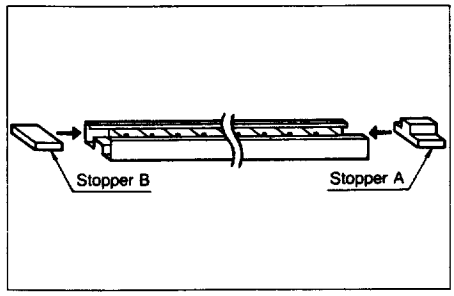
Typical circuits are shown below.



2) Even if spike voltages generated at the load are limited with a clamp diode by inductance if the circuit wires are long, spike voltages will occur. Keep wires as short as possible to minimize inductance.

6. Tube orientation

The relays are packaged in tubes with terminal 1 pointing toward stopper B as shown below. Observe correct orientation when mounting them on PC boards.

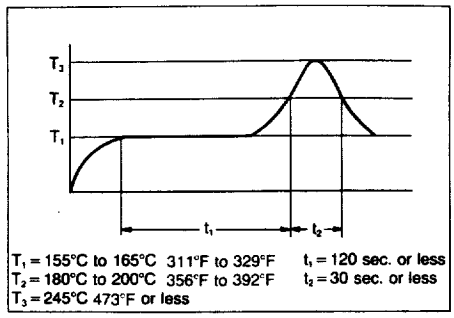


7. Soldering

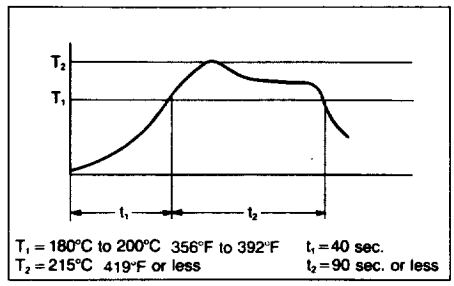
1) When soldering PC board terminals, keep soldering time to within 10 sec. at 260°C 500°F.

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

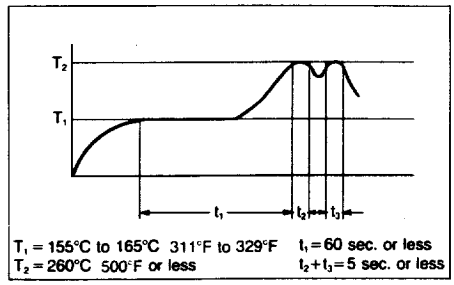
(1) IR (Infrared reflow) soldering method



(2) Vapor phase soldering method



(3) Double wave soldering method



(4) Soldering iron method

Tip temperature: 280°C to 300°C
536°F to 572°F

Wattage: 30 to 60 W

Soldering time: within 5 sec.

(5) Others

Check mounting conditions before using other soldering methods (hot-air, hot plate, 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.
- The conditions for the Infrared reflow soldering apply when preheating using the VPS method.

NAiS/SDS

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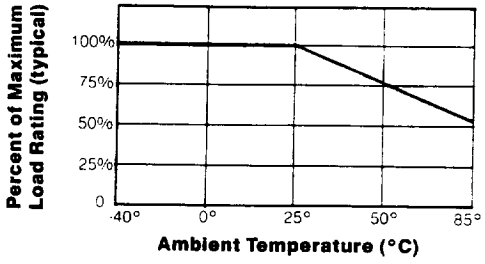
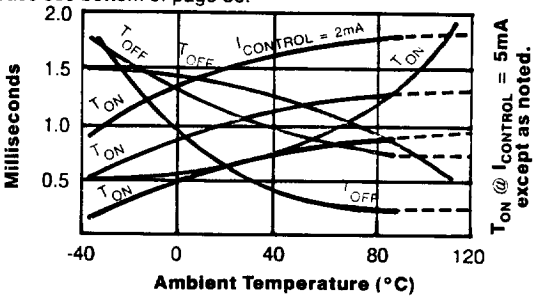
Performance

Load vs. Temperature

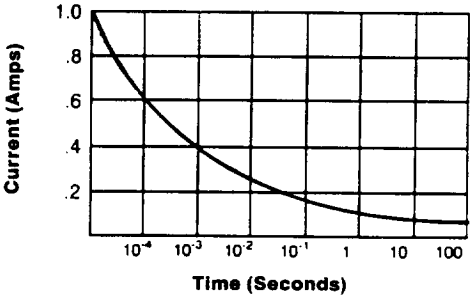


Typical Switching Time vs. Temperature ***

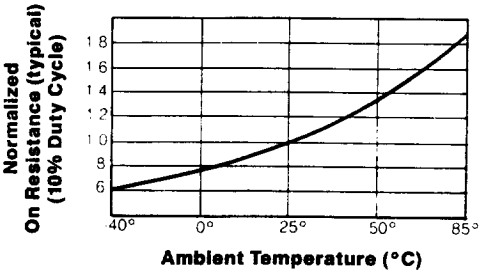
Please see bottom of page 36.



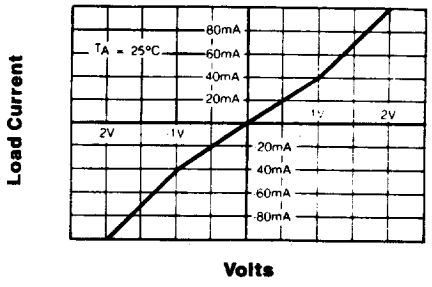
Energy Rating



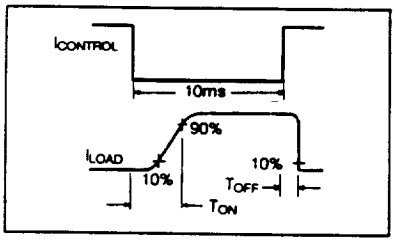
On Resistance vs. Temperature

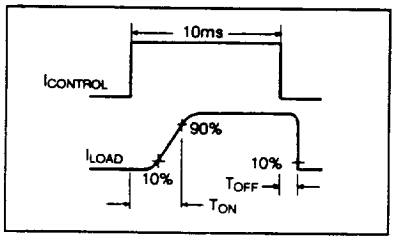


Typical I/V Characteristics

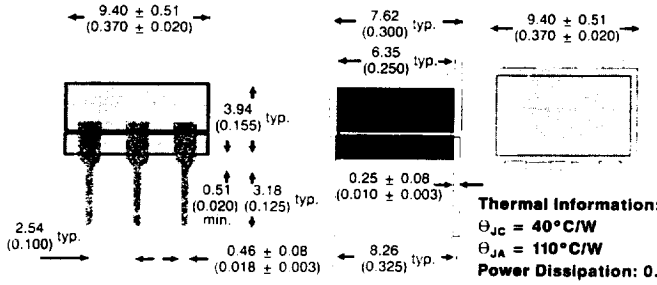


Switching Characteristics





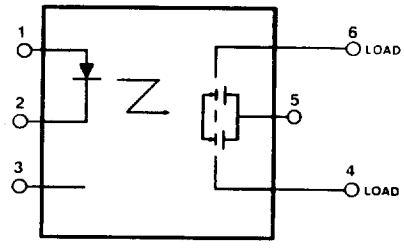
Package Mechanical Dimensions



Thermal Information:
θ_{JC} = 40°C/W
θ_{JA} = 110°C/W
Power Dissipation: 0.5 W

Configuration X

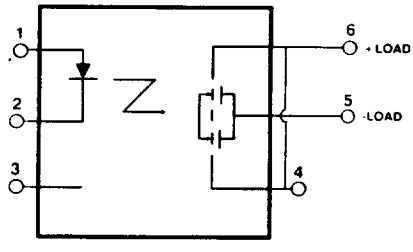
This is the preferred configuration for AC circuits.



Pin Connections
1 + Control
2 – Control
3 Do not use
4 Load
5 Do not use
6 Load

Configuration Y

This configuration is most useful for DC circuits where the direction of the current does not change.



Pin Connections
1 + Control
2 – Control
3 Do not use
4 + Load
5 – Load