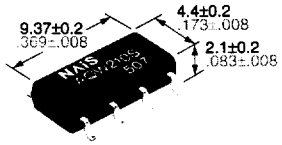
NAiS

GU (General Use) Type
SOP Series
2-Channel (Form A) Type

PhotoMOS RELAYS

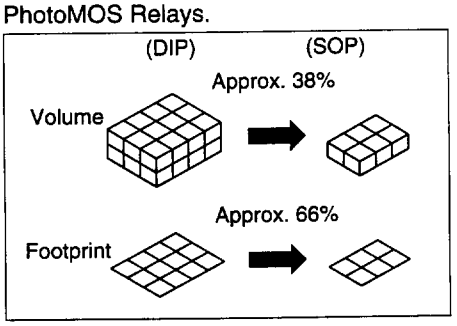
UL File No.: E43149
CSA File No.: LR26550



mm inch

FEATURES

1. 2 channels in super miniature design
The device comes in a super-miniature SO package measuring (W) 4.4×(L) 9.37×(H) 2.1 mm (W) .173×(L) .369×(H) .083 inch—approx. 38% of the volume and 66% of the footprint size of DIP type PhotoMOS Relays.



2. Tape and reel
The device comes standard in a tape and reel (1,000 pcs./reel) to facilitate automatic insertion machines.

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

4. Low-level off state leakage current
In contrast to the SSR with an off state leakage current of several milliamps, the PhotoMOS relay features a very small off state leakage current of only 100 pA even with the rated load voltage of 400 V (AQW214S).

TYPICAL APPLICATIONS

- Telephones
- Measuring instruments
- Computer
- Industrial robots
- High-speed inspection machines

TYPES

	Output rating*		Part No.		Packing quantity in tape and reel
	Load voltage	Load current	Picked from the 1/2/3/4-pin side	Picked from the 5/6/7/8-pin side	
AC/DC type	350 V	100 mA	AQW210SX	AQW210SZ	1,000 pcs.
	400 V	80 mA	AQW214SX	AQW214SZ	

* Indicate the peak AC and DC values.

Notes: (1) Tape package is the standard packing style. Also available in tube. (Part No. suffix "X" or "Z" is not needed when ordering; Tube: 50 pcs.; Case: 1,000 pcs.)
(2) For space reasons, the package type indicator "X" and "Z" are omitted from the seal.

RATING

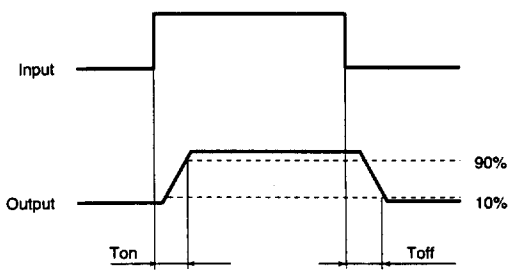
1. Absolute maximum ratings (Ambient temperature: 25°C 77°F)

Item		Symbol	AQW210S	AQW214S	Remarks
Input	LED forward current	I_F	50 mA		
	LED reverse voltage	V_R	3 V		
	Peak forward current	I_{FP}	1 A		f = 100 Hz, Duty factor = 0.1%
	Power dissipation	P_{in}	75 mW		
Output	Load voltage (peak AC)	V_L	350 V	400 V	
	Continuous load current	I_L	0.1 A (0.13 A)	0.08 A (0.1 A)	( ): in case of using only 1 channel
	Peak load current	I_{peak}	0.3 A	0.24 A	A connection: 100ms (1 shot), V_L = DC
	Power dissipation	P_{out}	600 mW		
Total power dissipation		P_T	650 mW		
I/O isolation voltage		V_{iso}	1,500 V AC		
Temperature limits	Operating	T_{opr}	−20°C to +80°C −4°F to +176°F		Non-condensing at low temperatures
	Storage	T_{stg}	−40°C to +100°C −40°F to +212°F		

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

Item			Sym-bol	AQW210S	AQW214S	Condition
Input	LED operate current	Minimum Typical Maximum	I_{Fon}	0.9 mA 3 mA		I_L = Max.
	LED turn off current	Minimum Typical Maximum	I_{Foff}	0.4 mA 0.8 mA		I_L = Max.
	LED dropout voltage	Minimum Typical Maximum	V_F	1.14 V (1.25 V at I_F = 50 mA) 1.5 V		I_F = 5 mA
Output	On resistance	Minimum Typical Maximum	R_{on}	16 Ω 35 Ω	30 Ω 50 Ω	I_F = 5 mA I_L = Max. Within 1 s on time
	Off state leakage current	Minimum Typical Maximum	I_{Leak}	1 μA		I_F = 0 mA I_L = Max.
Transfer characteristics	Turn on time*	Minimum Typical Maximum	T_{on}	0.23 ms 0.5 ms	0.21 ms 0.5 ms	I_F = 5 mA I_L = Max.
	Turn off time*	Minimum Typical Maximum	T_{off}	0.04 ms 0.2 ms		I_F = 5 mA I_L = Max.
	I/O capacitance	Minimum Typical Maximum	C_{iso}	0.8 pF 1.5 pF		f = 1 MHz V_B = 0
	Initial I/O isolation resistance	Minimum Typical Maximum	R_{iso}	1,000 MΩ		500 V DC

*Turn on/Turn off time

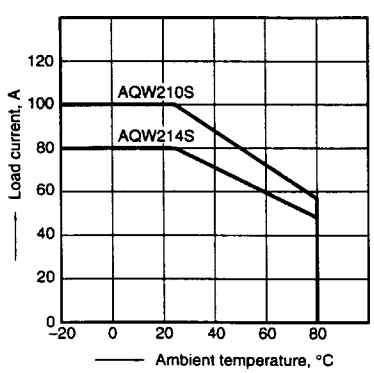


■ **For Dimensions, see Page 20.**
■ **For Schematic and Wiring Diagrams, see Page 23.**
■ **For Cautions for Use, see Page 27.**

REFERENCE DATA

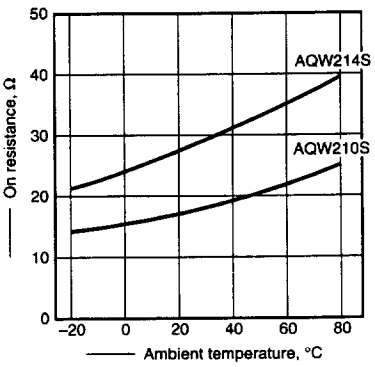
1. Load current vs. ambient temperature characteristics

Allowable ambient temperature: −20°C to +80°C
−4°F to +176°F



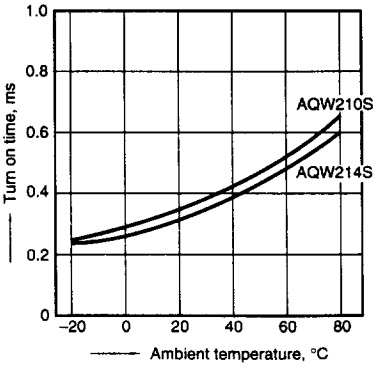
2. On resistance vs. ambient temperature characteristics

Measured portion: between terminals 5 and 6, 7 and 8;
LED current: 5 mA; Load voltage: Max. (DC);
Continuous load current: Max. (DC)

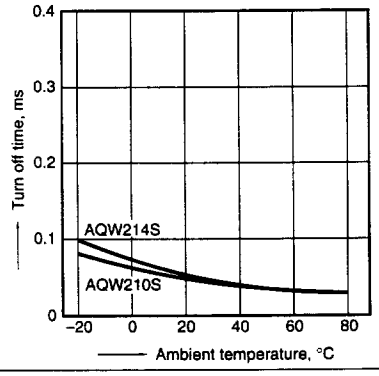


3. Turn on time vs. ambient temperature characteristics

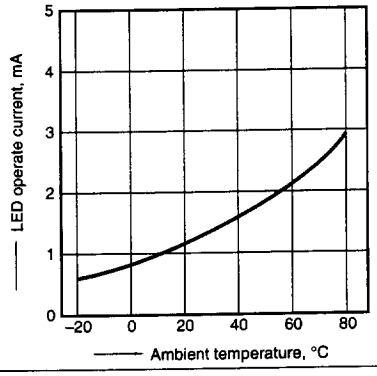
LED current: 5 mA; Load voltage: Max. (DC);
Continuous load current: Max. (DC)



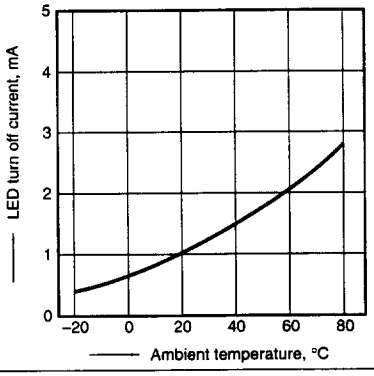
4. Turn off time vs. ambient temperature characteristics
LED current: 5 mA; Load voltage: Max. (DC); Continuous load current: Max. (DC)



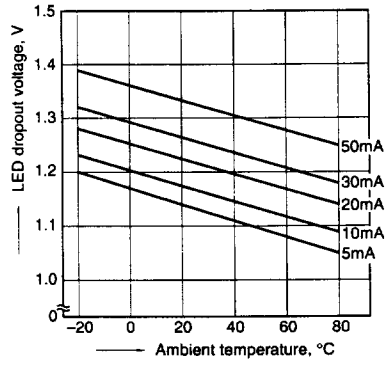
5. LED operate current vs. ambient temperature characteristics
Sample: All types; Load voltage: Max. (DC); Continuous load current: Max. (DC)



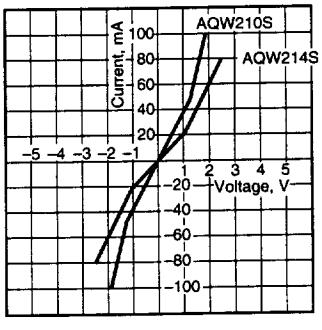
6. LED turn off current vs. ambient temperature characteristics
Sample: All types; Load voltage: Max. (DC); Continuous load current: Max. (DC)



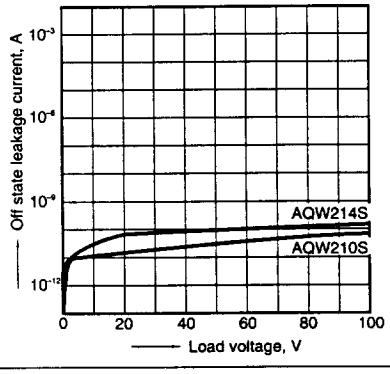
7. LED dropout voltage vs. ambient temperature characteristics
Sample: All types; LED current: 5 to 50 mA



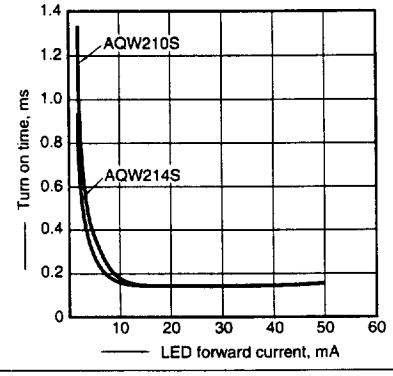
8. Voltage vs. current characteristics of output at MOS portion
Measured portion: between terminals 5 and 6, 7 and 8; Ambient temperature: 25°C 77°F



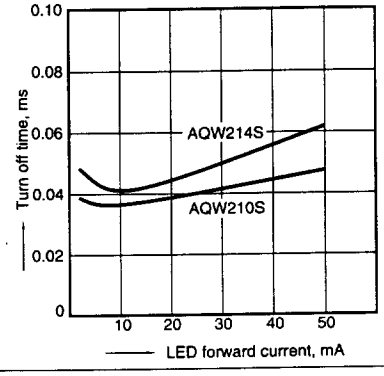
9. Off state leakage current
Measured portion: between terminals 5 and 6, 7 and 8: Ambient temperature: 25°C 77°F



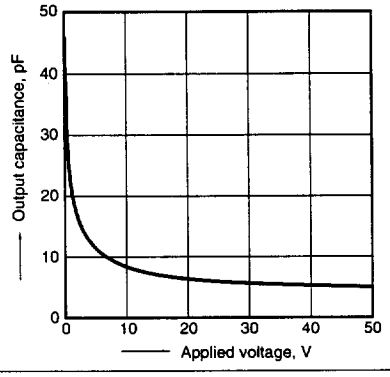
10. LED forward current vs. turn on time characteristics
Measured portion: between terminals 5 and 6, 7 and 8; Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



11. LED forward current vs. turn off time characteristics
Measured portion: between terminals 5 and 6, 7 and 8; Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F

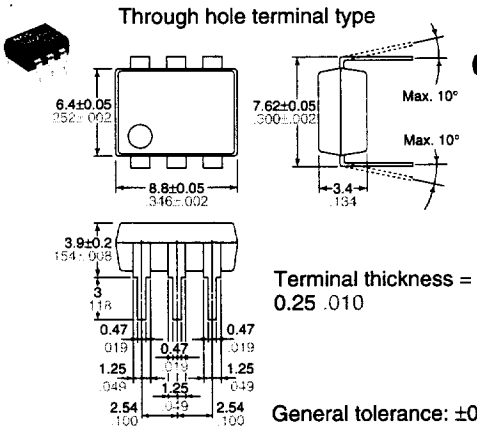
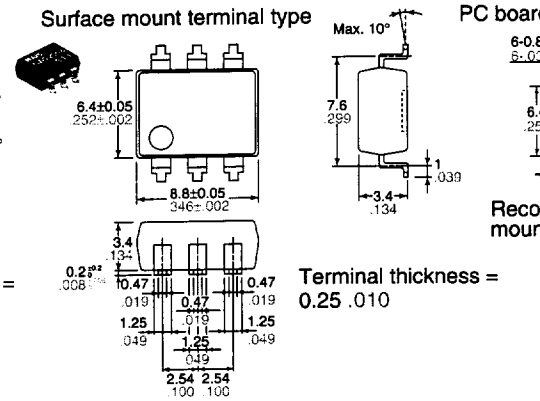
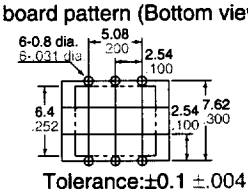
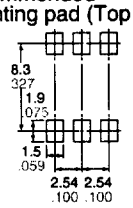
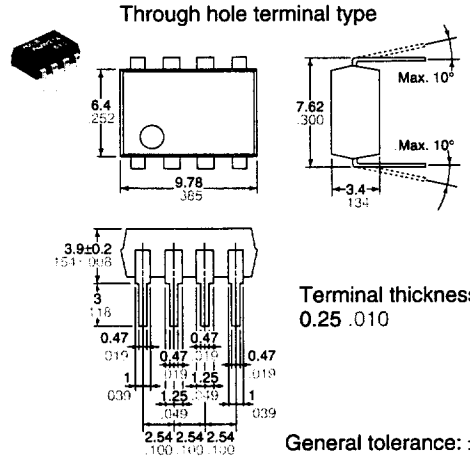
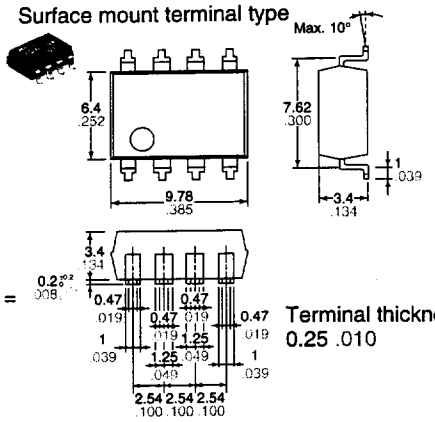
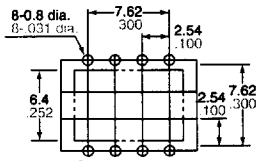
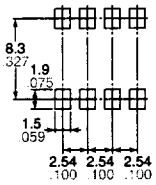
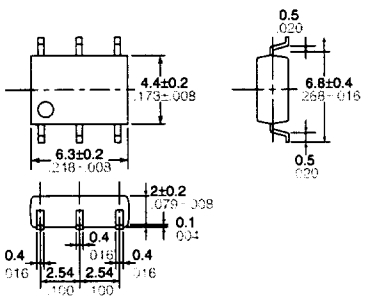
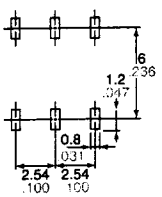
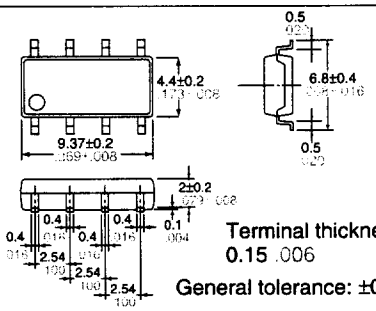
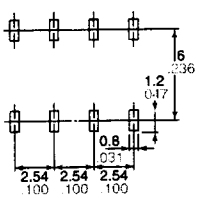
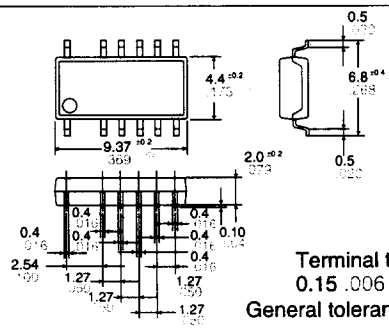
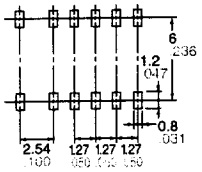


12. Applied voltage vs. output capacitance characteristics
Measured portion: between terminals 5 and 6, 7 and 8: Frequency: 1 MHz; Ambient temperature: 25°C 77°F



PhotoMOS Relay Dimensions

mm inch

Type	Dimensions
AQV10 AQV20 AQV21 AQV22 AQV23 AQV25 AQV41 AQV45 Series	Through hole terminal type  Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 Surface mount terminal type  Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance:±0.1 ±.004 Recommended mounting pad (Top view) 
AQW21 AQW22 AQW25 AQW41 AQW45 AQW61 AQW65 Series	Through hole terminal type  Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 Surface mount terminal type  Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance:±0.1 ±.004 Recommended mounting pad (Top view) 
AQV21 (SOP) AQV22 (SOP) AQV41 (SOP) Series	  Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view) 
AQW21(SOP) AQW21OTS (SOP) Series	  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.004 Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view) 
AQW21OT2S (SOP) Series	  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.004 Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view) 

Terminology

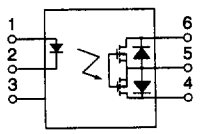
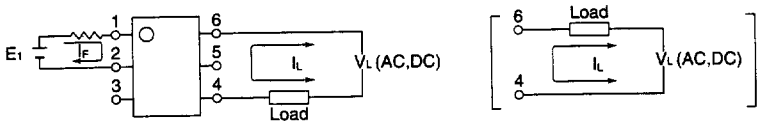
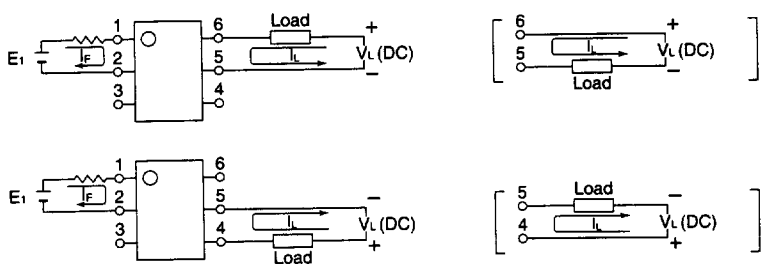
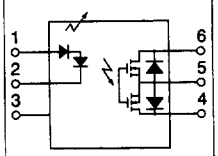
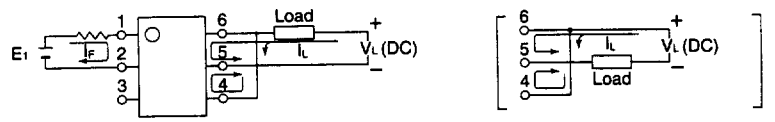
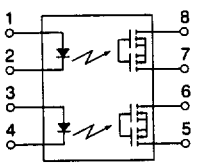
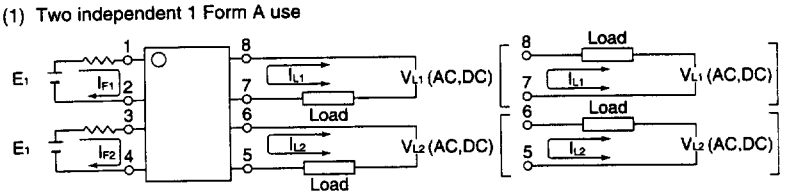
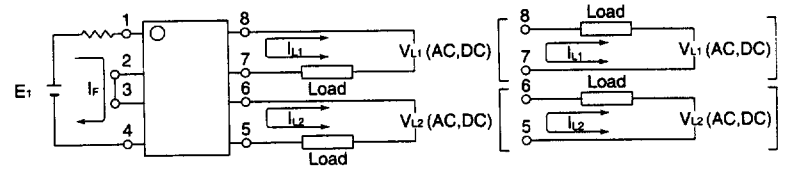
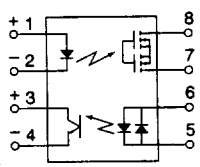
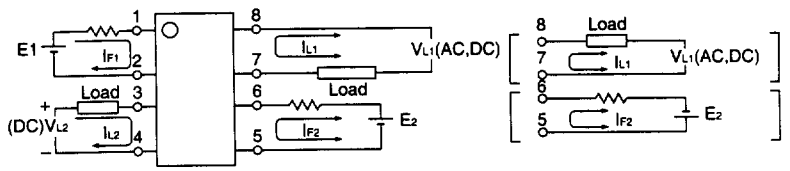
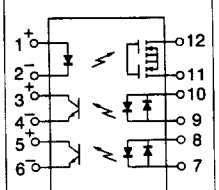
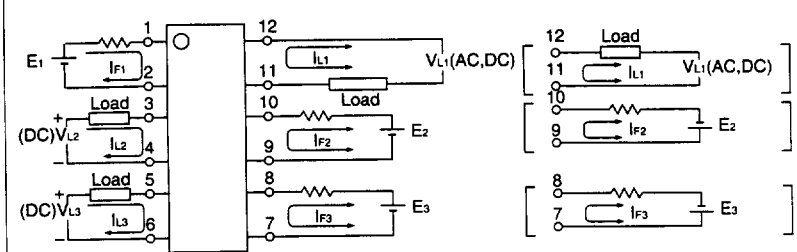
Term		Symbol	Description
Input	LED forward current	I_F	Current that flows between the input terminals when the input diode is forward biased.
	LED reverse voltage	V_R	Reverse breakdown voltage between the input terminals.
	Peak forward current	I_{FP}	Maximum instantaneous value of the forward current.
	LED operate current	I_{FON}	Current when the output switches on (by increasing the LED current) with a designated supply voltage and load connected between the output terminals.
	LED turn off current	I_{Foff}	Current when the output switches off (by decreasing the LED current) after operating the relay with a designated supply voltage and load connected between the output terminals.
	LED dropout voltage	V_F	Dropout voltage between the input terminals due to forward current.
	Power dissipation	P_{in}	Allowable power dissipation between the input terminals.
Output	Load voltage	V_L	Supply voltage range at the output used to normally operate the PhotoMOS relay. Represents the peak value for AC voltages.
	Continuous load current	I_L	Maximum current value that flows continuously between the output terminals of the PhotoMOS relay under designated ambient temperature conditions. Represents the peak value for AC current.
	On resistance	R_{on}	Obtained using the equation below from dropout voltage V_{DS} (on) between the output terminals (when a designated LED current is made to flow through the input terminals and the designated load current through the output terminals.) $R_{on} = V_{DS}$ (on)/I_L
	Off state leakage current	I_{leak}	Current flowing to the output when a designated supply voltage is applied between the output terminals with no LED current flow.
	Power dissipation	P_{out}	Allowable power dissipation between the output terminals.
Electrical characteristics	Turn on time	T_{on}	Delay time until the output switches on after a designated LED current is made to flow through the input terminals.
	Turn off time	T_{off}	Delay time until the output switches off after the designated LED current flowing through the input terminals is cut off.
	I/O capacitance	C_{iso}	Capacitance between the input and output terminals.
	Output capacitance	C_{out}	Capacitance between output terminals when LED current does not flow.
	I/O isolation resistance	R_{iso}	Resistance between terminals (input and output) when a specified voltage is applied between the input and output terminals.
	Total power dissipation	P_T	Allowable power dissipation in the entire circuit between the input and output terminals.
	I/O isolation voltage	V_{iso}	Critical value before dielectric breakdown occurs, when a high voltage is applied for 1 minute between the same terminals where the I/O isolation resistance is measured.
	Operating temperature	T_{opr}	Ambient temperature range in which the PhotoMOS relay can operate normally with a designated load current conditions.
	Storage temperature	T_{stg}	Ambient temperature range in which the PhotoMOS relay can be stored without applying voltage.

Reliability tests

Classification	Item	Condition	Purpose
Life tests	High temperature storage test	T_{stg} (Max.)	Determines resistance to long term storage at high temperature.
	Low temperature storage test	T_{stg} (Min.)	Determines resistance to long term storage at low temperature.
	High temperature and high humidity storage test	85°C 185°F, R.H. 85%	Determines resistance to long term storage at high temperature and high humidity.
	Continuous operation life test	V_L = Max., I_L = Max., I_F = LED operate current (Max.)	Determines resistance to electrical stress (voltage and current).
Thermal environment tests	Temperature cycling test	Low storage temperature (T_{stg} Min.) High storage temperature (T_{stg} Max.)	Determines resistance to exposure to both low temperatures and high temperatures.
	Thermal shock test	Low temperature (0°C) (32°F), High temperature (100°C) (212°F)	Determines resistance to exposure to sudden changes in temperature.
	Solder burning resistance	260±5°C 500±41°F, 10 s	Determines resistance to thermal stress occurring while soldering.
Mechanical environment tests	Vibration test	196 m/s² {20 G}, 20 to 2,000 Hz*1	Determines the resistance to vibration sustained during shipment or operation.
	Shock test	9,800 m/s² {1,000 G} 0.5 ms*2; 4,900 m/s² {500 G} 1 ms	Determines the mechanical and structural resistance to shock.
	Drop test	Dropped at a height of 80 cm on oak board	Determines the mechanical resistance to drops sustained during shipment or operation.
	Terminal strength test	Determined from terminal shape and cross section	Determines the resistance to external force on the terminals of the PhotoMOS relay mounted on the PC board while wiring or operating.
	Solderability	230°C 446°F 5 s (with soldering flux)	Evaluates the solderability of the terminals.

*1 10 to 55 Hz at double amplitude of 3 mm for Power PhotoMOS relays.
*2 4,900 m/s², 1 ms for Power PhotoMOS relays.

PhotoMOS Relay Schematic and Wiring Diagrams

Type	Schematic	Output configuration	Load	Connection	Wiring diagram
AQV21 AQV21 (SOP) AQV22 AQV22 (SOP) AQV23 AQV25 Series		1a	AC/DC	A	
			DC	B*	
	 (AQV254R only)		DC	C	
AQW21 AQW21 (SOP) AQW22 AQW25 AQW27 Series		2a	AC/DC	—	(1) Two independent 1 Form A use  (2) 2 Form A use 
AQW21○TS Series	 Relay portion (1,2,7,8 pins) Detector portion (3,4,5,6 pins)	Relay portion 1a Detecter portion 1a	Relay portion AC/DC Detecter portion DC	—	
AQW21○T2S Series	 Relay portion (1,2,11,12 pins) Detector portion (3,4,9,10 pins) (5,6,7,8 pins)	Relay portion 1a Detecter portion 2a	Relay portion AC/DC Detecter portion DC	—	

*Can be also connected as 2 Form A type. (However, the sum of the continuous load current should not exceed the absolute maximum rating.)
**Can be also connected as 2 Form B type. (However, the sum of the continuous load current should not exceed the absolute maximum rating.)
Notes: 1. E_1: Power source at input side; V_{IN}: Input voltage; I_F: LED forward current; V_L: Load voltage; I_L: Load current; R: Current limit resistor.
2. Method of connecting the load at the output is devided into 3 types.