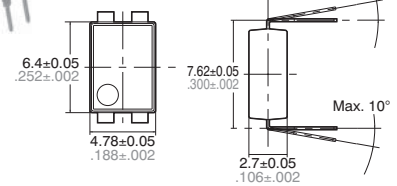
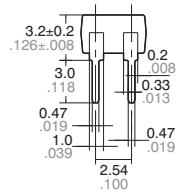
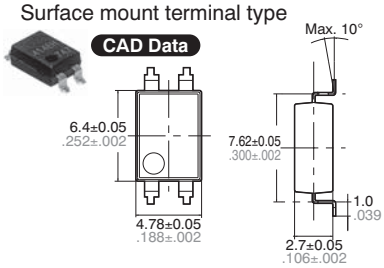
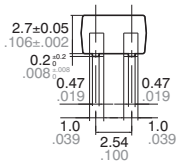
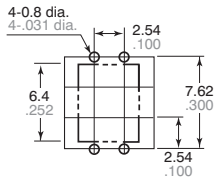
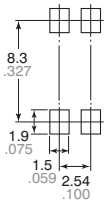
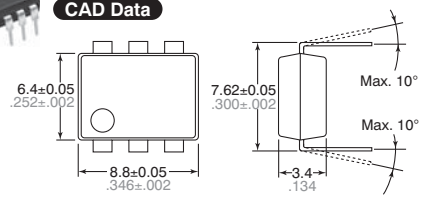
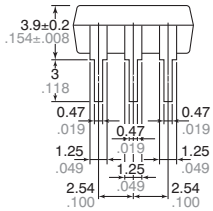
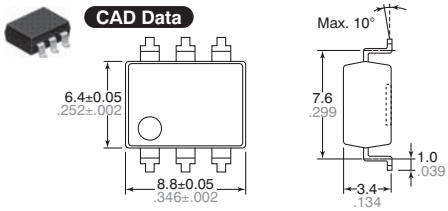
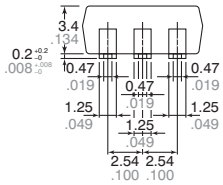
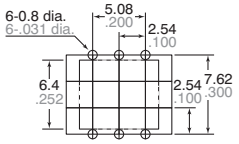
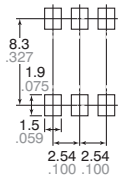
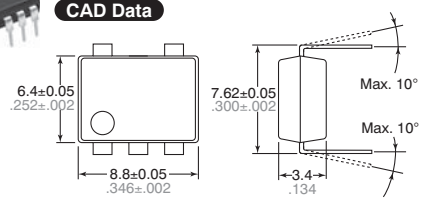
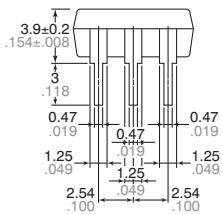
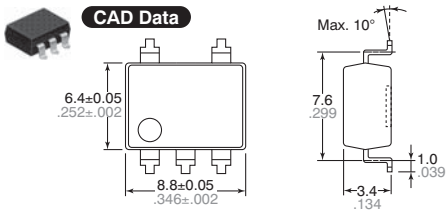
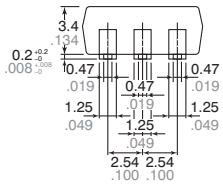
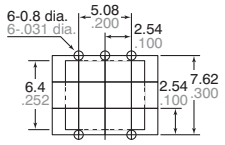
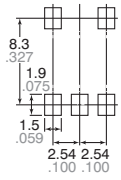
PhotoMOS® Dimensions

mm inch

Type	Dimensions
AQY21(DIP) AQY41(DIP) Series	Through hole terminal type  CAD Data   Terminal thickness = 0.2 .008 General tolerance: ±0.1 ±.004 Surface mount terminal type CAD Data   Terminal thickness = 0.2 .008 General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
AQV10(DIP) AQV11(DIP) AQV20(DIP) AQV21(DIP) AQV22(DIP) AQV23(DIP) AQV25(DIP) AQV41(DIP) AQV45(DIP) Series	Through hole terminal type  CAD Data   Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 Surface mount terminal type CAD Data   Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view) 
APV1122(DIP)	Through hole terminal type  CAD Data   Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 Surface mount terminal type CAD Data   Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view) 

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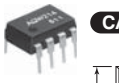
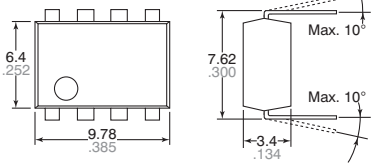
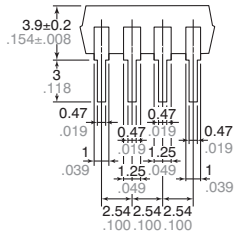
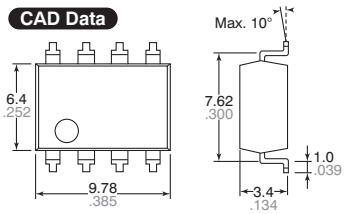
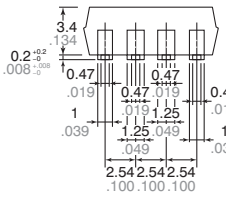
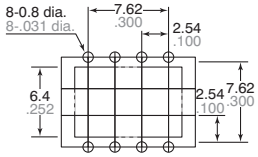
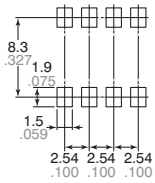
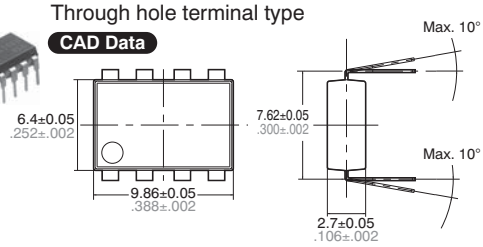
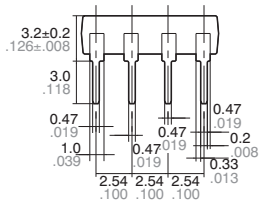
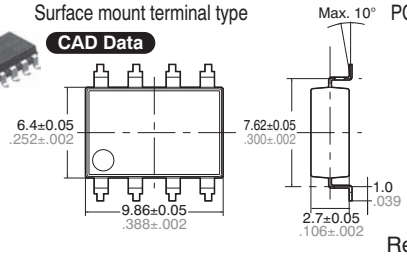
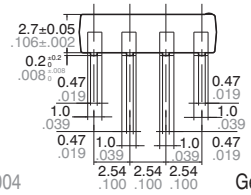
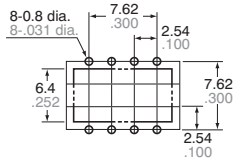
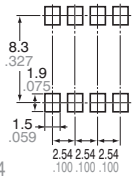
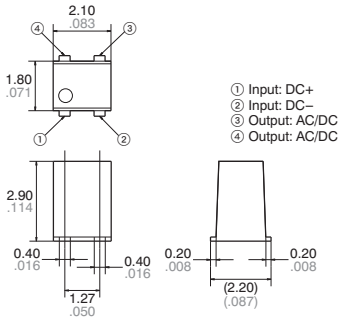
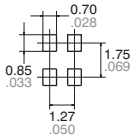
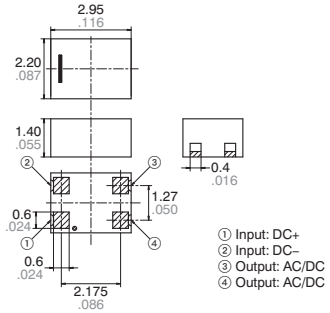
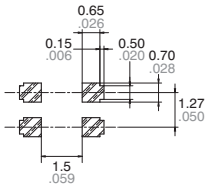
mm inch

Type	Dimensions
AQW21(DIP) AQW22(DIP) AQW25(DIP) AQW41(DIP) AQW45(DIP) AQW61(DIP) AQW65(DIP) Series	Through hole terminal type  CAD Data  Terminal thickness = 0.25 .010  General tolerance: ±0.1 ±.004 Surface mount terminal type  CAD Data  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❍EH (DIP) AQW21❍HL (DIP) AQW41❍EH (DIP) AQW61❍EH (DIP) Series	Through hole terminal type  CAD Data  Terminal thickness = 0.2 .008  General tolerance: ±0.1 ±.004 Surface mount terminal type  CAD Data  Terminal thickness = 0.2 .008  General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
AQY22(VSSOP) Series	 CAD Data  ① Input: DC+ ② Input: DC– ③ Output: AC/DC ④ Output: AC/DC General tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
AQY22(SON) Series	CAD Data   ① Input: DC+ ② Input: DC– ③ Output: AC/DC ④ Output: AC/DC General tolerance: ±0.2 ±.008 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004

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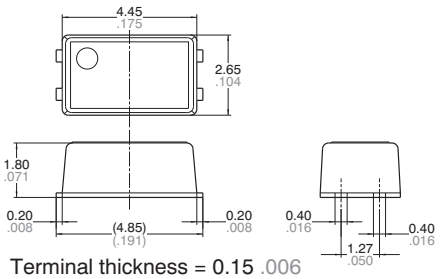
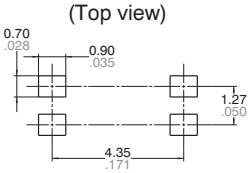
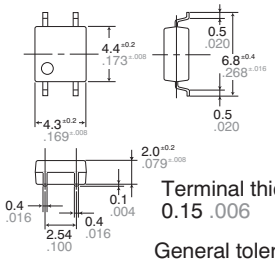
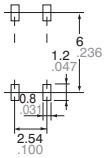
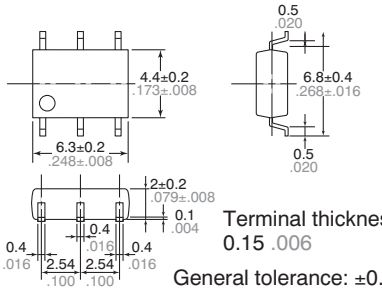
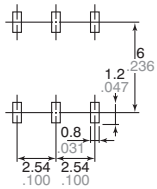
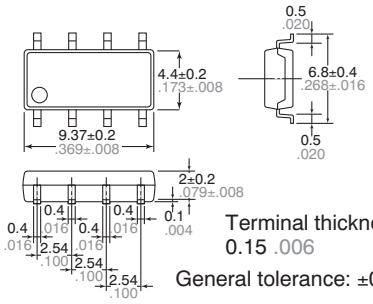
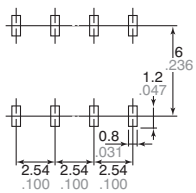
mm inch

Type	Dimensions
APV21(SSOP) AQY22(SSOP) Series	 CAD Data  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.020 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
APV11(SOP) APV21(SOP) AQY21(SOP) AQY22(SOP) AQY23(SOP) AQY41(SOP) Series	 CAD Data  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
AQV21(SOP) AQV22(SOP) AQV25(SOP) AQV41(SOP) Series	 CAD Data  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
AQW21(SOP) AQW22(SOP) AQW41(SOP) AQW61(SOP) Series	 CAD Data  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004

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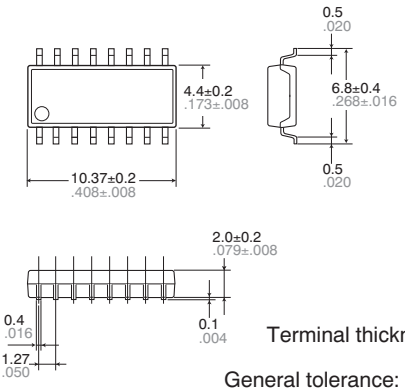
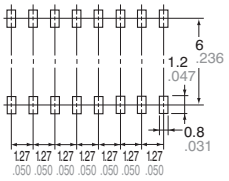
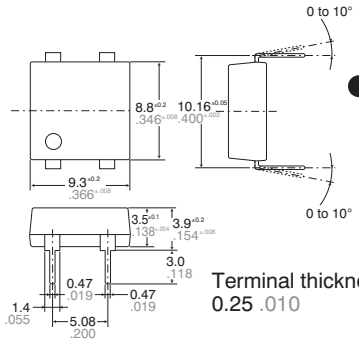
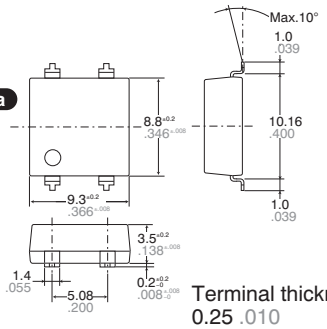
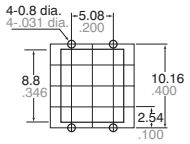
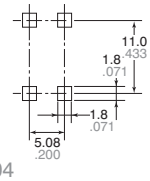
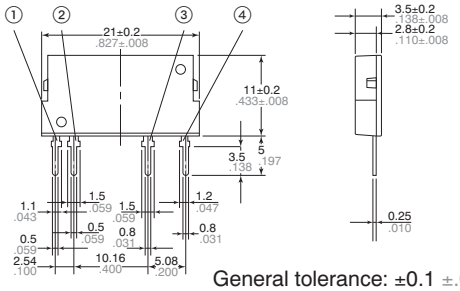
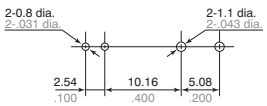
mm inch

Type	Dimensions
AQS22(SOP) Series	 CAD Data  Recommended mounting pad (Top view)  Terminal thickness = 0.15 .006 General tolerance: ±0.1 ±.004 Tolerance: ±0.1 ±.004
AQY27 (Power-DIP) Series	Through hole terminal type  CAD Data  Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 Surface mount terminal type  CAD Data  Terminal thickness = 0.25 .010 General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 Recommended mounting pad (Top view)  Tolerance: ±0.1 ±.004
AQZ10(SIL) AQZ20(SIL) AQZ40(SIL) Series	 CAD Data  General tolerance: ±0.1 ±.004 PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 AC/DC type ① Input: DC– ② Input: DC+ ③ Output: DC or AC ④ Output: DC or AC DC type ① Input: DC– ② Input: DC+ ③ Output: DC– ④ Output: DC+

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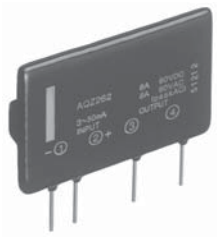
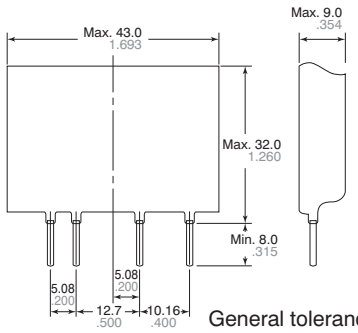
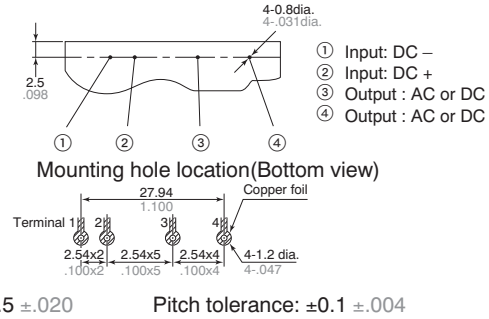
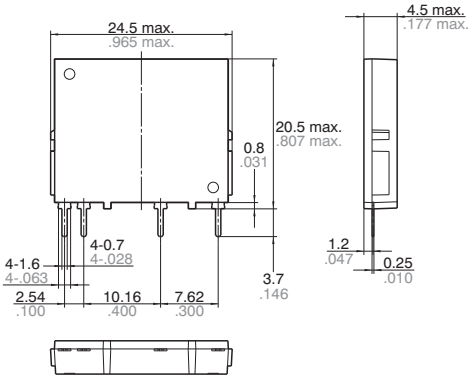
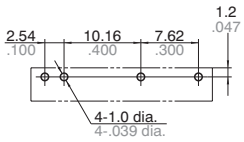
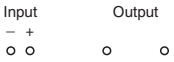
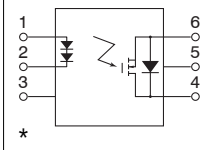
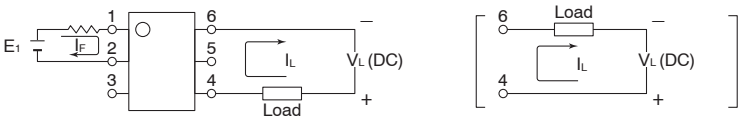
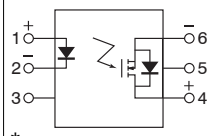
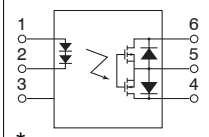
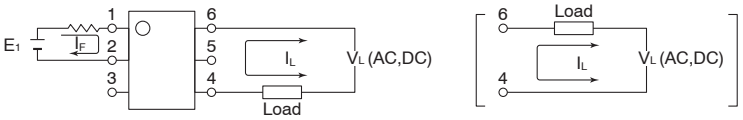
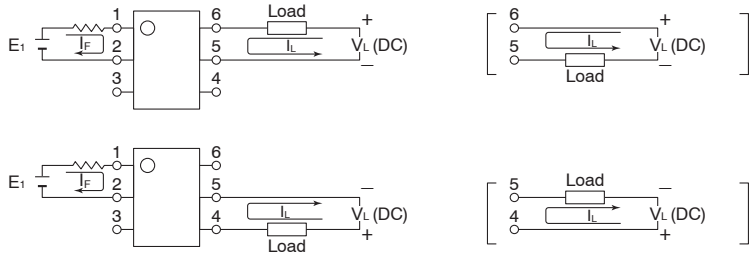
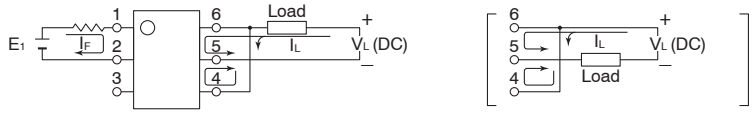
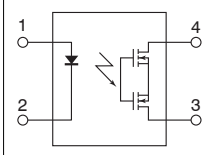
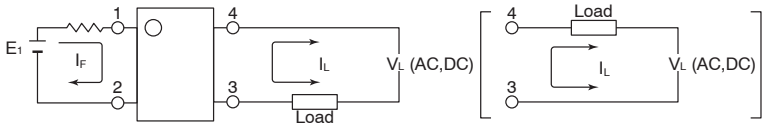
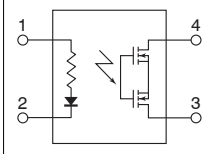
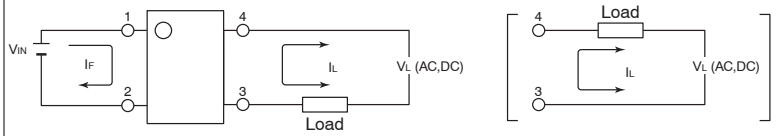
mm inch

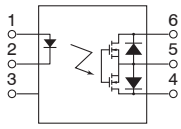
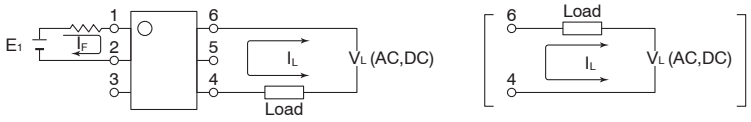
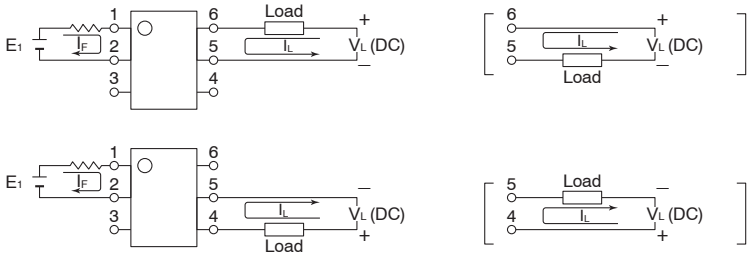
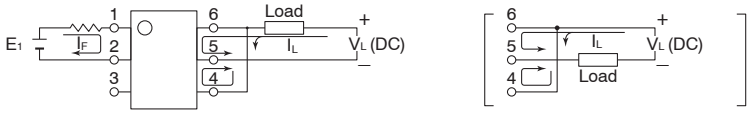
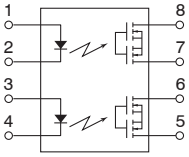
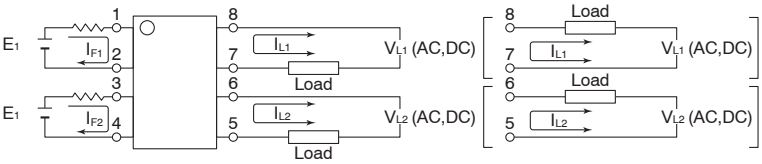
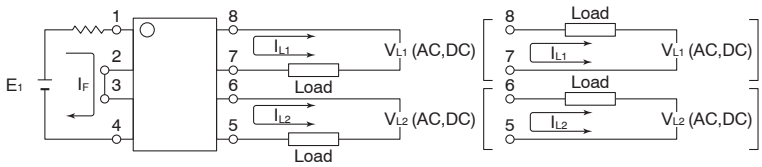
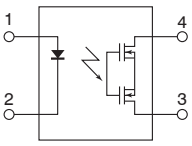
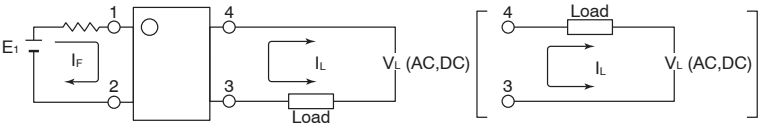
Type	Dimensions
AQZ26(SIL) Series	 CAD Data   General tolerance: ±0.5 ±.020 Pitch tolerance: ±0.1 ±.004
AQZ19(SIL) Series	 CAD Data  PC board pattern (Bottom view)  Tolerance: ±0.1 ±.004 Schematic  General tolerance: ±0.2 ±.008

Download CAD Data from our Web site.

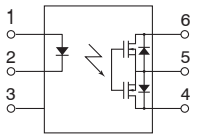
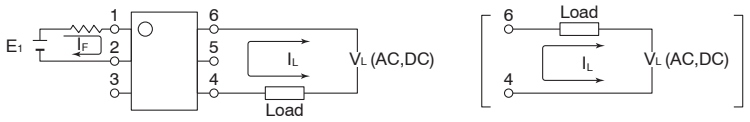
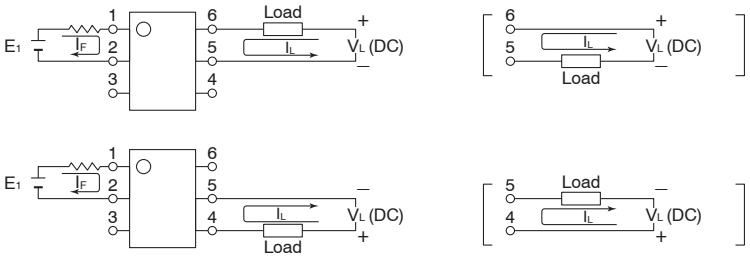
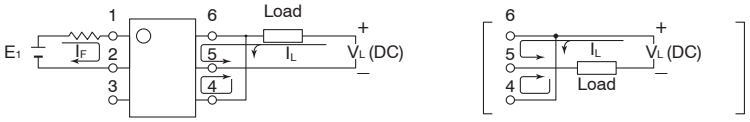
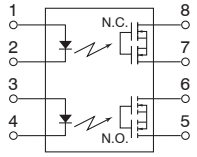
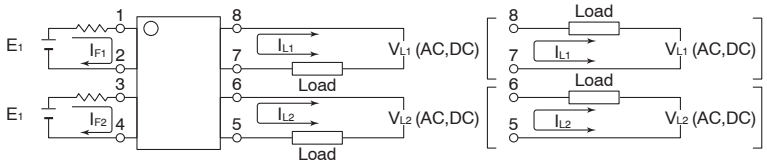
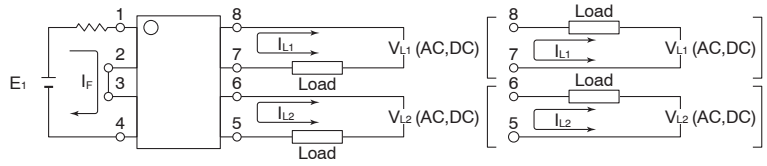
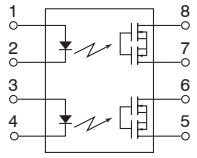
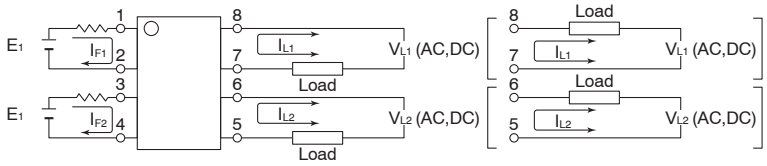
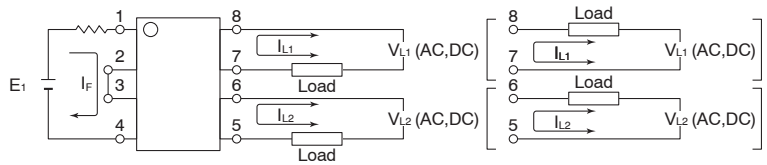
PhotoMOS® Schematic and Wiring Diagrams

	Schematic	Output configuration	Load type	Connection	Wiring diagram
AQV10(DIP) Series	 *	1a	DC	A	
AQV11(DIP) Series	 *				
AQV20(DIP) Series	 *	1a	AC/DC	A	
			DC	B	 Can be also connected as 2 Form A type. (However, the sum of the continuous load current should not exceed the absolute maximum rating.)
			DC	C	
AQY21 (DIP, SOP) AQY22 (SOP, SSOP, SON, VSSOP) AQY23(SOP) AQY27 (Power-DIP) Series		1a	AC/DC	—	
AQY22❍F (SOP, SSOP) AQY21❍F (SOP, SSOP) Series		1a	AC/DC	—	

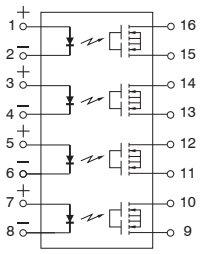
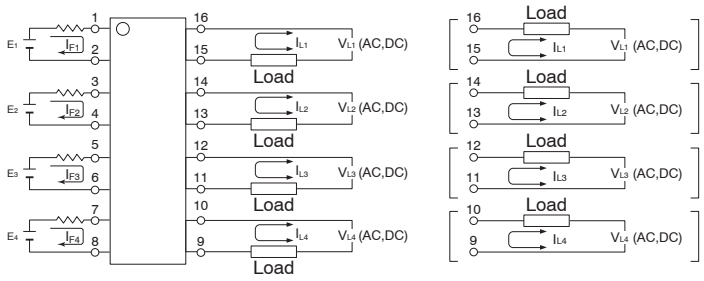
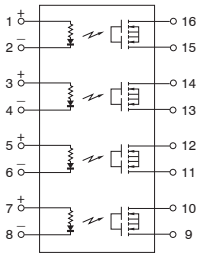
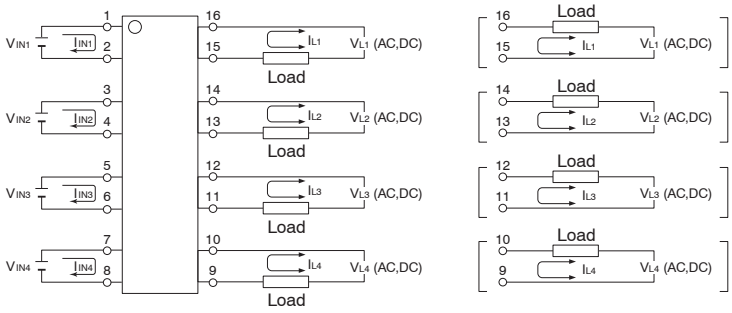
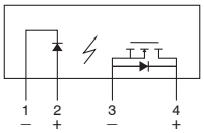
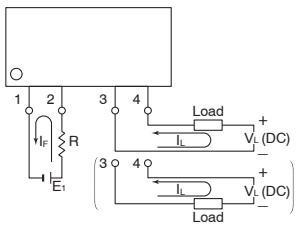
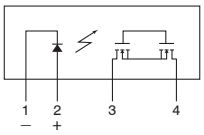
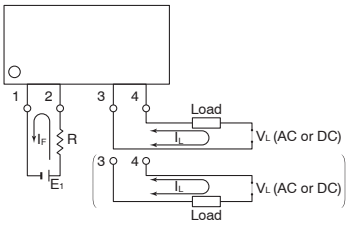
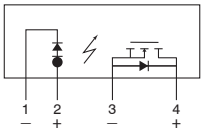
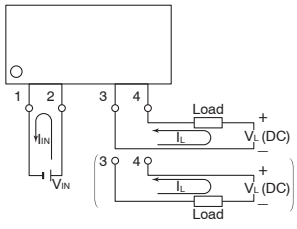
Notes: 1. E_1: Power source at input side; V_{IN}: Input voltage; I_F: LED forward current; I_{IN}: Input current; V_L: Load voltage; I_L: Load current; R: Current limit resistor.
2. Method of connecting the load at the output is divided into 3 types.
*Terminal 3 cannot be used, since it is in the internal circuit of the device.

	Schematic	Output configuration	Load type	Connection	Wiring diagram
AQV21 (DIP, SOP) AQV22 (DIP, SOP) AQV23(DIP)* AQV25 (DIP, SOP) Series	 Terminal 3 cannot be used, since it is in the internal circuit of the device.	1a	AC/DC	A	
			DC	B	 Can be also connected as 2 Form A type. (However, the sum of the continuous load current should not exceed the absolute maximum rating.)
			DC	C	
AQW21 (DIP, SOP) AQW22 (DIP, SOP) AQW25(DIP) Series		2a	AC/DC	—	(1) Two independent 1 Form A use  (2) 2 Form A use 
AQY41 (DIP, SOP) Series		1b	AC/DC	—	

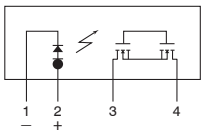
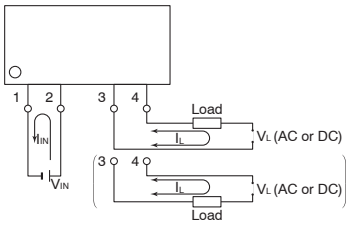
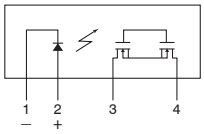
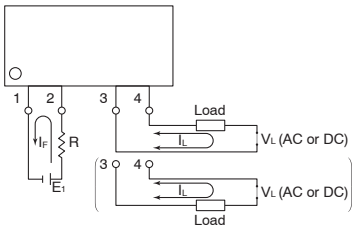
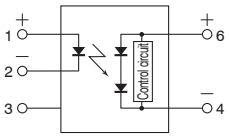
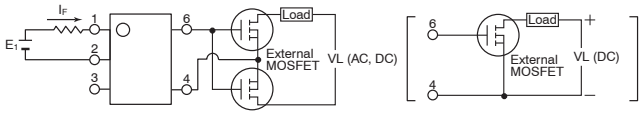
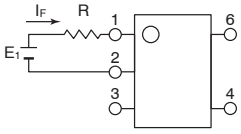
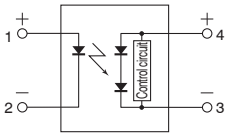
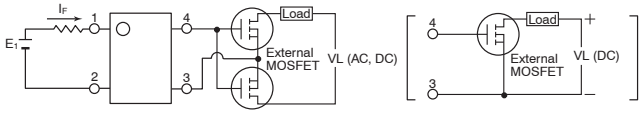
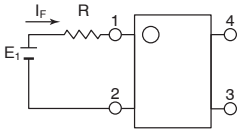
Notes: 1. E_1: Power source at input side; V_{IN}: Input voltage; I_F: LED forward current; I_{IN}: Input current; V_L: Load voltage; I_L: Load current; R: Current limit resistor.
2. Method of connecting the load at the output is divided into 3 types.
* AQV23 series in SOP is also possible. Please inquire.

	Schematic	Output configuration	Load type	Connection	Wiring diagram
AQV41 (DIP, SOP) AQV45(DIP) Series	 Terminal 3 cannot be used, since it is in the internal circuit of the device.	1b	AC/DC	A	
			DC	B	 Can be also connected as 2 Form B type. (However, the sum of the continuous load current should not exceed the absolute maximum rating.)
			DC	C	
AQW61 (DIP, SOP) AQW65(DIP) Series		1a1b	AC/DC	—	(1) Two independent 1 Form A & 1 Form B use  (2) 1 Form A 1 Form B use 
AQW41(DIP) AQW41(SOP) AQW45(DIP) Series		2b	AC/DC	—	(1) Two independent 1 Form B use  (2) 2 Form B use 

Notes: 1. E_1: Power source at input side; V_{IN}: Input voltage; I_F: LED forward current; I_{IN}: Input current; V_L: Load voltage; I_L: Load current; R: Current limit resistor.
2. Method of connecting the load at the output is divided into 3 types.

	Schematic	Output configu-ration	Load type	Connec-tion	Wiring diagram
AQS22(SOP) Series		4a	AC/DC	—	
AQS22❍F (SOP) Series		4a	AC/DC	—	
AQZ10(SIL) AQZ19(SIL) Series		1a	DC	—	
AQZ20(SIL) AQZ26(SIL) Series		1a	AC/DC	—	
AQZ10❍D (SIL) Series		1a	DC	—	

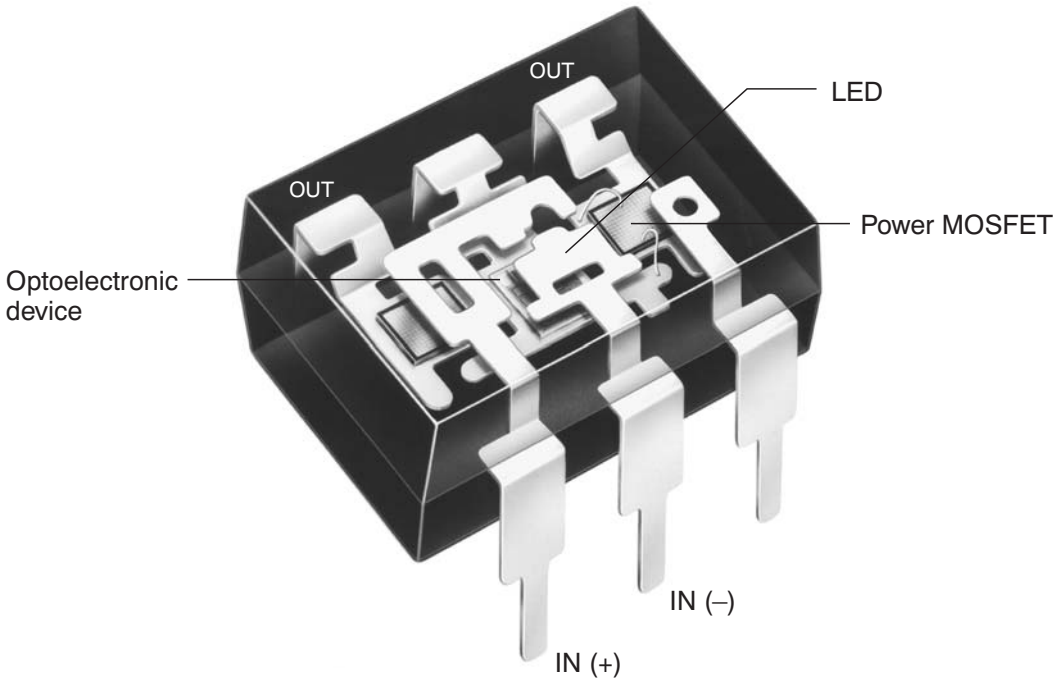
Notes: 1. E_1: Power source at input side; V_{IN}: Input voltage; I_F: LED forward current; I_{IN}: Input current; V_L: Load voltage; I_L: Load current; R: Current limit resistor.
2. Method of connecting the load at the output is divided into 3 types.

	Schematic	Output configu-ration	Load type	Connec-tion	Wiring diagram
AQZ20❍D (SIL) Series		1a	AC/DC	—	
AQZ40(SIL) Series		1b	AC/DC	—	
APV1122 (DIP)		1a	—	—	Power MOSFET drive wiring diagram  Example of each input power supply and current limit resistors (I_F = 10mA) 
APV1121S APV2121S APV2111V (SOP, SSOP)		1a	—	—	Power MOSFET drive wiring diagram  Example of each input power supply and current limit resistors (I_F = 10mA) 

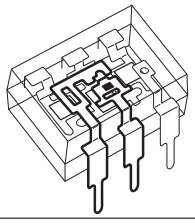
E_1	R
5V	Approx. 380Ω
15V	Approx. 1.4kΩ
24V	Approx. 2.3kΩ

Notes: 1. E_1: Power source at input side; V_{IN}: Input voltage; I_F: LED forward current; I_{IN}: Input current; V_L: Load voltage; I_L: Load current; R: Current limit resistor.
2. Method of connecting the load at the output is divided into 3 types.

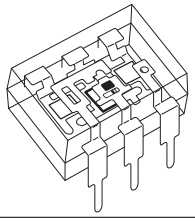
How PhotoMOS® Operate



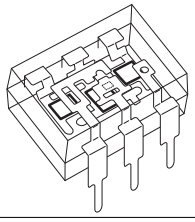
When operated



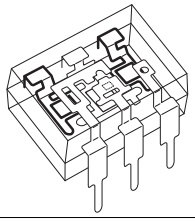
When a signal current flows to the input terminals the LED on the input side emits light.



The emitted light passes through transparent silicon and reaches the photoelectric element (solar cell) which is mounted opposite the LED.

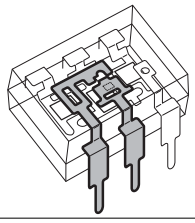


The photoelectric element converts the received light to a voltage corresponding to the quantity of light. This voltage passes through a control circuit and charges the MOSFET gate on the output side.

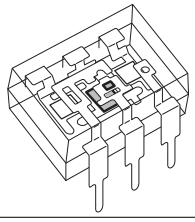


When the MOSFET gate voltage supplied from the photoelectric element reaches a preset voltage value, the MOSFET begins to conduct and turns on the load.

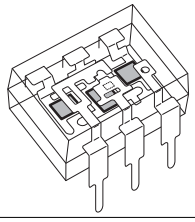
When turned off



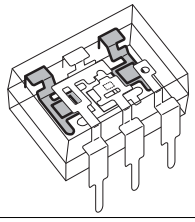
When the signal current at the input terminal is cut off, the LED stops emitting light.



When the emitted light from the LED stops, the voltage of the photoelectric element decreases.



When the voltage supplied from photoelectric element decrease, the control circuit rapidly discharges the gate charge of MOSFET.



This control circuit makes MOSFET stop conducting and immediately turns off the load.

Note: The explanation above applies to the current driving method. Products using the voltage driving method employ a different internal structure and operating principle.

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 device 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®. 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® under designated ambient temperature conditions. Represents the peak value for AC current.
	On resistance	R_{on}	Obtained using the equation below from dropout voltage VDS (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.
	Open-circuit output voltage	V_{oc}	Voltage required for driving a MOSFET
	Short-circuit current	I_{sc}	Current that is output from the driver when the input is turned on
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® can operate normally with a designated load current conditions.
	Storage temperature	T_{stg}	Ambient temperature range in which the PhotoMOS® can be stored without applying voltage.
	Maximum switching frequency	—	Maximum switching frequency at which a PhotoMOS® can operate normally when applying the specified pulse input to the input terminal

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 = Recommended LED forward current	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® 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®.
*2 4,900 m/s², 1 ms for Power PhotoMOS®.

PhotoMOS® Cautions for Use

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 device (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.

1. Applying stress that exceeds the absolute maximum rating

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

Therefore, the circuit should be designed in such a way that the load never exceed the absolute maximum ratings, even momentarily.

2. Derating design

Derating is essential in any reliable design and is a significant factor for product life.

Even if the conditions of use (temperature, current, voltage, etc.) of the product fall within the absolute maximum ratings, reliability can be reduced remarkably when continually used under high load (high temperature, high humidity, high current, high voltage, etc.). Therefore, please derate sufficiently below the absolute maximum rating and verify operation of the actual design before use.

Also, if there is the possibility that the inferior quality of this product could possibility cause great adverse affect on human life or physical property we recommend that, from the perspective of a manufacturer's liability, sufficient amount of derating to be added to the maximum rating value and implement safety measures such as fail-safe circuit.

3. Unused terminals

The No. 3 terminal is used with the circuit inside the device. Therefore, do not connect it to the external circuitry with either connection method A, B or C.
(1 Form A 6-pin type)

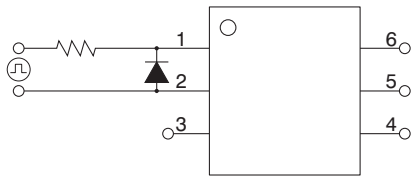
4. Short across terminals

Do not short circuit between terminals when device is energized, since there is possibility of breaking of the internal IC.

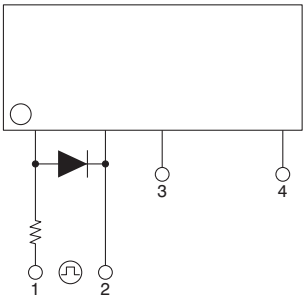
5. Surge voltages at the input

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

Typical circuits are below shown.
1) 6-pin



2) Power type



6. Recommended LED forward current (I_F) or recommended input voltage (V_{IN})

It is recommended that the LED forward current (I_F) or the input voltage (V_{IN}) of each PhotoMOS® should be set according to the following table.

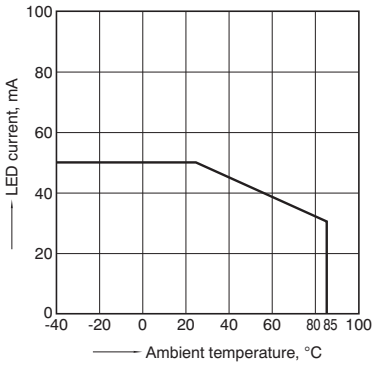
	Product name	Recommended LED forward current (I_F)
DIP SOP SSOP SON VSSOP	AQV10, 11, 20 Series APV11, 21 Series (MOSFET drivers)	10 mA
	AQY21, 41 Series AQY22 Series AQV21, 41 Series AQV22 Series AQV25, 45 Series AQW21 Series AQW41, 61 Series AQW22 Series AQW25, 45, 65 Series AQS22 Series	5mA
	AQY212GS, AQY212G2S, AQY211G2S AQY21✳H, 41✳H Series AQY210KS AQY210HL AQY27 Series AQV21✳H Series AQV25✳H, 45✳H Series AQV25✳G Series AQV255GS, AQV252G2S AQW21✳H, 41✳H, 61✳H Series AQW210HL	5 to 10mA
	AQV23 Series, AQY23 Series	2 mA
SIL	AQZ10, 20, 40 Series AQZ26 Series	5 to 10 mA
	AQZ19 Series	10 mA

	Product name	Recommended input voltage (V_{IN})
SOP • SSOP	AQY2○○F Series, AQS221F Series	5 V
SIL	AQZ10○D, AQZ20○D	

Notes: "✳" indicates two or more characters of number or alphabet.
"○" indicates a single-digit figure.

7. LED current vs. ambient temperature characteristics

Please keep the LED current to within the range given below.

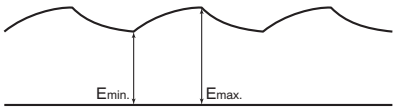


8. Ripple in the input power supply

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

1) For LED current at E_{min}, please maintain the value mentioned in the table of "6. Recommended LED forward current (I_F)."

2) Please make sure for $E_{max.}$ is no higher the LED current at than 50 mA.



3) Please maintain the input voltage at least 4V for $E_{min.}$ (GU, RF and Power voltage-sensitive type).

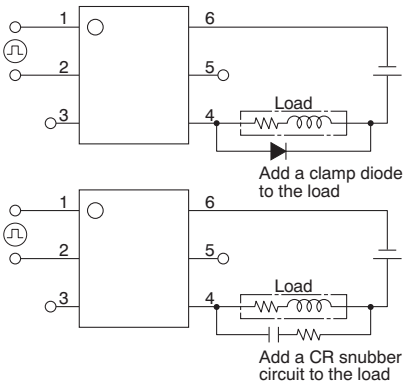
4) Please make sure the input voltage for $E_{max.}$ is no higher than 6V (GU and RF voltage-sensitive type).

5) Please make sure the input voltage for $E_{max.}$ is no higher than 30V (Power voltage-sensitive type).

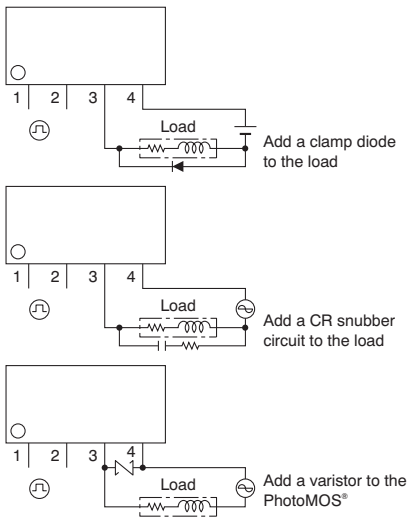
9. Output spike voltages

1) If an inductive load generates spike voltages which exceed the absolute maximum rating, the spike voltage must be limited. Typical circuits of AC/DC dual use type are shown below. It is the same with DC only type.

1) 6-pin



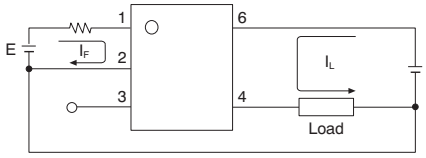
2) Power type



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

10. Continuous DC bias (AQV259 and AQV258)

If a continuous DC bias will be applied between the input and output, the breakdown voltage of the switching element MOSFET on the output side may degrade. Therefore, be sure to test the product under actual conditions. Example of circuits that will cause degradation of breakdown voltage of MOSFET is given below.



11. Cleaning solvents compatibility

We recommend cleaning with an organic solvent. If you cannot avoid using ultrasonic cleansing, please ensure that the following conditions are met, and check beforehand for defects.

- Frequency: 27 to 29 kHz
- Ultrasonic output:
  No greater than 0.25W/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.

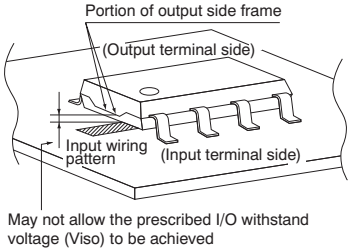
12. Notes for mounting

1) If many different packages are combined on a single substrate, then lead temperature rise is highly dependent on package size. For this reason, please make sure that the temperature of the terminal solder area of the PhotoMOS® falls within the temperature conditions of item 9 before mounting.

2) If the mounting conditions exceed the recommended solder conditions in item 12, resin strength will fall and the nonconformity of the heat expansion coefficient of each constituent material will increase markedly, possibly causing cracks in the package, severed bonding wires, and the like. For this reason, please inquire with us about whether this use is possible.

13. Input wiring pattern

With AQY* or AQW*, AQS series avoid installing the input (LED side) wiring pattern to the bottom side of the package if you require the specified I/O isolation voltage (V_{iso}) after mounting the PC board. Since part of the frame on the output side is exposed, it may cause fluctuations in the I/O isolation voltage.

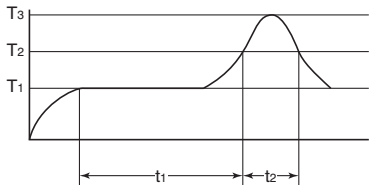


*except for GE (Reinforced 5,000V) type

14. 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, SOP, SSOP, SON and VSSOP 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

*245°C 473°F or less for SON, VSSOP package

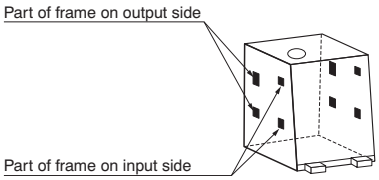
(2) Soldering iron method
Tip temperature: 350 to 400°C 662 to 752°F
Wattage: 30 to 60 W
Soldering time: within 3 s

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

• When using lead-free solder, we recommend a type with an alloy composition of Sn 3.0 Ag 0.5 Cu. Please inquire about soldering conditions and other details.
• 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.

15. About the exposed terminals on the sides of the package

As shown in the following figure, part of the input and output frames are exposed on the sides of the package. Due to this, please be keep in mind the cautions listed below.
1) Shorting the exposed terminals may cause deterioration of the insulation between the inputs and outputs, and may damage the internal IC.
2) Since the exposed terminals are connected electrically to the internal element, please refer to the section “4. Deterioration and destruction caused by discharge of static electricity”, and implement sufficient measures to control static electricity.
3) When installing the devices in the vicinity, please keep in mind that if the exposed frames of adjacent devices get too close, a short between devices may occur.



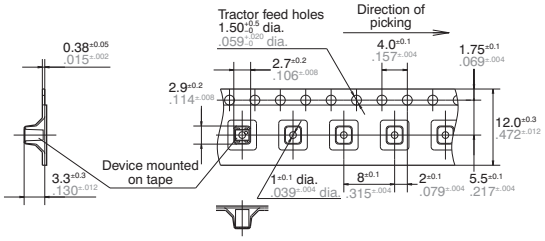
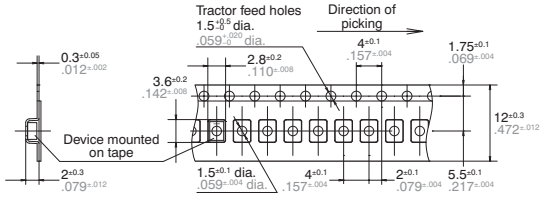
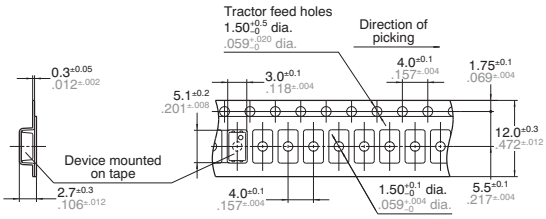
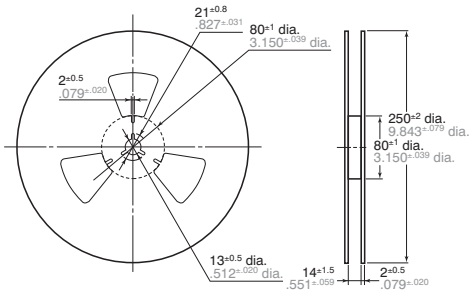
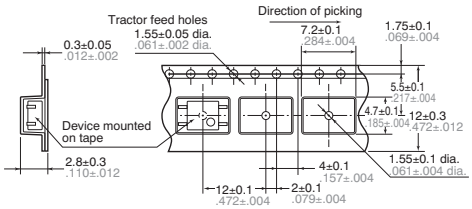
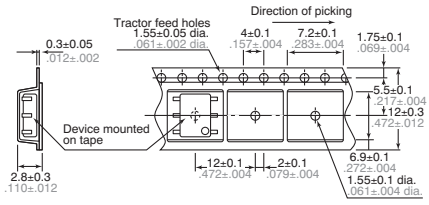
16. Regarding close installations

When this product is installed close to other parts, the ambient temperature may rise due to heating of the internal element when power is applied. Be sure to use with a reduced load current after testing under actual conditions, because the degree of temperature rise depends on the placement of the devices and conditions of use.

17. The following shows the packing format

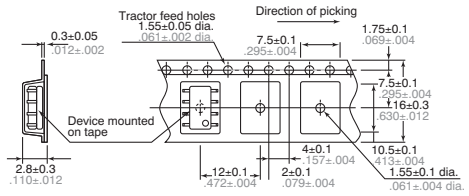
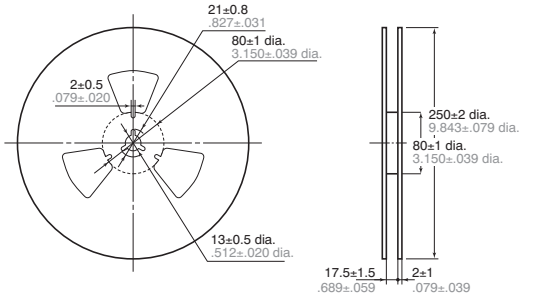
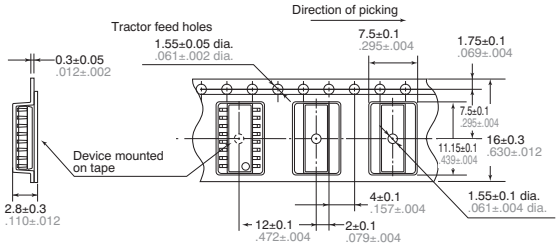
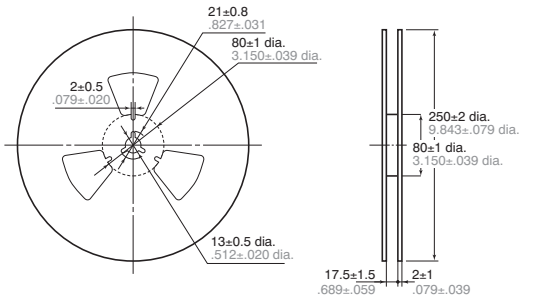
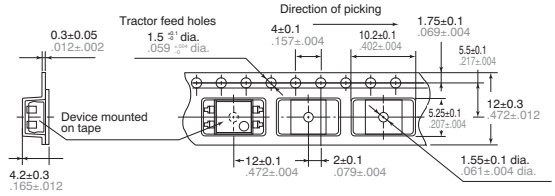
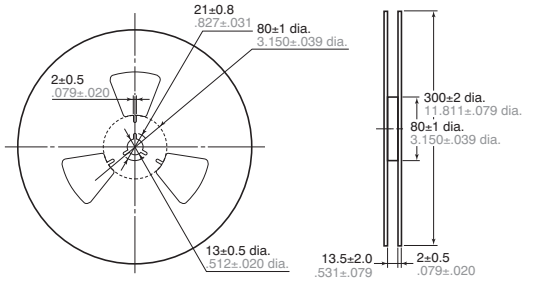
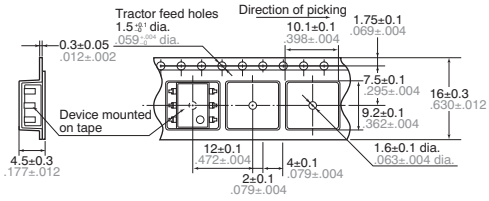
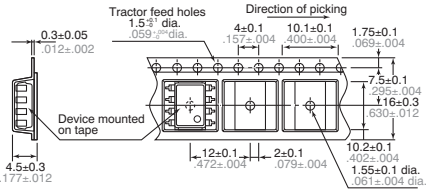
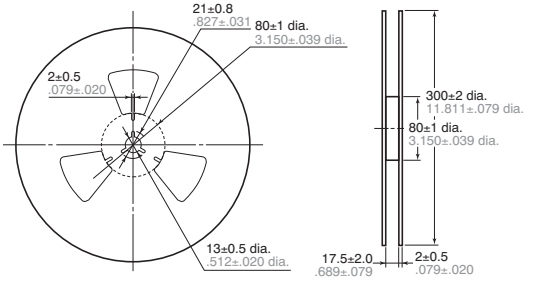
1) Tape and reel

mm inch

	Tape dimensions	Dimensions of paper tape reel
VSSOP 4-pin	 (1) When picked from 1 and 4-pin side: Part No. AQY❍❍❍TY (Shown above) (2) When picked from 2 and 3-pin side: Part No. AQY❍❍❍TW	
SON 4-pin	 (1) When picked from 1 and 4-pin side: Part No. AQY✳MY (Shown above) (2) When picked from 2 and 3-pin side: Part No. AQY✳MW	
SSOP 4-pin	 (1) When picked from 1 and 4-pin side: Part No. AQY✳VY, APV2111VY (Shown above) (2) When picked from 2 and 3-pin side: Part No. AQY✳VW, APV2111VW	
SOP 4-pin	 (1) When picked from 1/2-pin side: Part No. AQY✳SX, APV❍❍21SX (Shown above) (2) When picked from 3/4-pin side: Part No. AQY✳SZ, APV❍❍21SZ	
SOP 6-pin	 (1) When picked from 1/2/3-pin side: Part No. AQV✳SX (Shown above) (2) When picked from 4/5/6-pin side: Part No. AQV✳SZ	

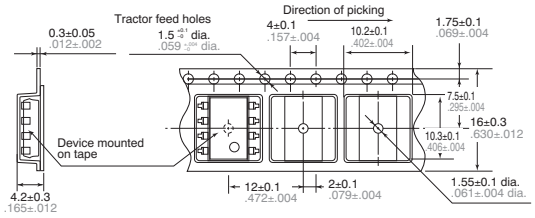
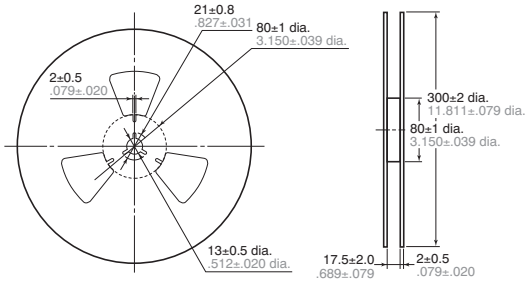
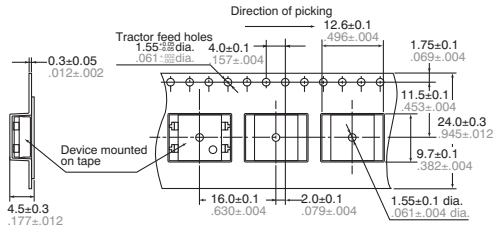
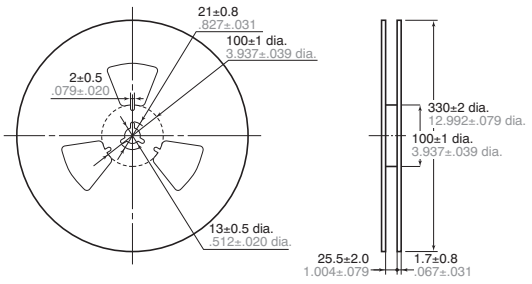
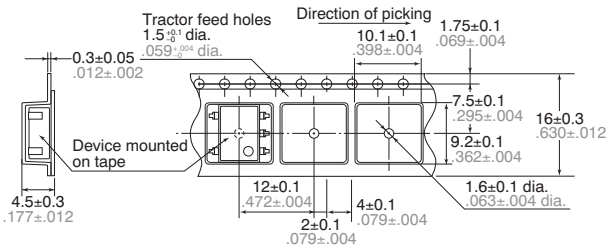
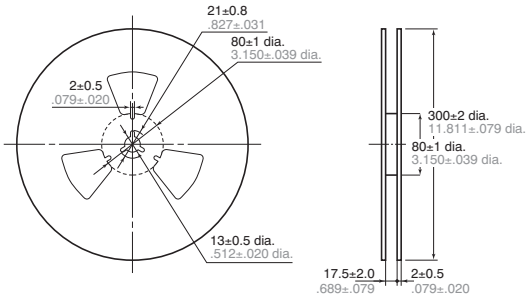
Notes: "✳" indicates two or more characters of number or alphabet.
"❍" indicates a single-digit figure.

mm inch

	Tape dimensions	Dimensions of paper tape reel
SOP 8-pin	 (1) When picked from 1/2/3/4-pin side: Part No. AQW✳SX (Shown above) (2) When picked from 5/6/7/8-pin side: Part No. AQW✳SZ	
SOP 16-pin	 (1) When picked from 1/2/3/4/5/6/7/8-pin side: Part No. AQS✳SX (Shown above) (2) When picked from 9/10/11/12/13/14/15/16-pin side: Part No. AQS✳SZ	
DIP 4-pin Surface mount terminal	 (1) When picked from 1/2-pin side: Part No. AQY✳HAX, AQY210HLAX (Shown above) (2) When picked from 3/4-pin side: Part No. AQY✳HAZ, AQY210HLAZ	
DIP 6-pin Surface mount terminal	 (1) When picked from 1/2/3-pin side: Part No. AQV✳AX (Shown above) (2) When picked from 4/5/6-pin side: Part No. AQV✳AZ	
DIP 8-pin Surface mount terminal (Basic insulation type)	 (1) When picked from 1/2/3/4-pin side: Part No. AQW✳AX (Shown above) (2) When picked from 5/6/7/8-pin side: Part No. AQW✳AZ	

Notes: "✳" indicates two or more characters of number or alphabet.
"❍" indicates a single-digit figure.

mm inch

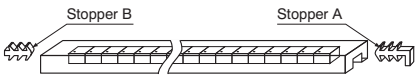
	Tape dimensions	Dimensions of paper tape reel
DIP 8-pin Surface mount terminal (Reinforced insulation type)	 (1) When picked from 1/2/3/4-pin side: Part No. AQW○○○EHAX, AQW210HLAX (Shown above) (2) When picked from 5/6/7/8-pin side: Part No. AQW○○○EHAZ, AQW210HLAZ	
Power-DIP 4-pin SMD	 (1) When picked from 1/2-pin side: Part No. AQY○7○AX (Shown above) (2) When picked from 3/4-pin side: Part No. AQY○7○AZ	
DIP 6-pin Surface mount terminal (Photovoltaic MOSFET driver)	 (1) When picked from 1/2/3-pin side: Part No. APV1122AX (Shown above) (2) When picked from 4/6-pin side: Part No. APV1122AZ	

Note: "✳" indicates two or more characters of number or alphabet.

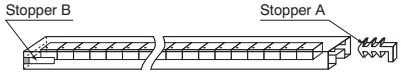
2) Tube

Devices are packaged in a tube so that pin No. 1 is on the stopper B side. Observe correct orientation when mounting them on PC boards.

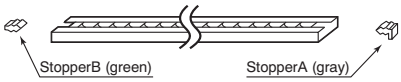
(PD type)



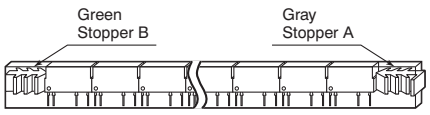
(DIP type)



(SOP type)



(Power type)



18. Transportation and storage

1) Extreme vibration during transport will warp the lead or damage the device. 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:

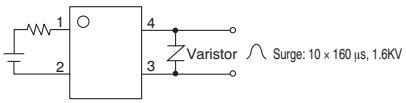
• Temperature: 0 to 45°C 32 to 113°F
• Humidity: Less than 70% R.H.
• Atmosphere: No harmful gasses such as sulfurous acid gas, minimal dust.

3) PhotoMOS® implemented in VSSOP, SON, SSOP, SOP are sensitive to moisture and come in sealed moisture-proof packages. Observe the following cautions on storage.

• After the moisture-proof package is unsealed, take the devices out of storage as soon as possible (within 1 month ≦ 45°C/70% R.H.).
• If the devices are to be left in storage for a considerable period after the moisture-proof package has been unsealed, it is recommended to keep them in another moisture-proof bag containing silica gel (within 3 months at the most).

19. Current limit function (output current control)

1) Current limit function aims to increase resistance to surges when the switch is turned on. Before using this function, connect the varistor to the output as shown in the figure below.



* Set the varistor voltage to 150 V or less.

2) The current limit function capability can be lost if used longer than the specified time. Be sure to set the output loss to the max. rate.

20. Deterioration and destruction caused by discharge of static electricity (RF C×R5, 10)

This phenomenon is generally called static electricity destruction, and occurs when static electricity generated by various factors is discharged while the device terminals are in contact, producing internal destruction of the element.

To prevent problems from static electricity, the following precautions and measures should be taken when using your device.

1) Employees handling devices should wear anti-static clothing and should be grounded through protective resistance of 500 kΩ to 1 MΩ.

2) A conductive metal sheet should be placed over the work table. Measuring instruments and jigs should be grounded.

3) When using soldering irons, either use irons with low leakage current, or ground the tip of the soldering iron. (Use of low-voltage soldering irons is also recommended.)

4) Devices and equipment used in assembly should also be grounded.

5) When packing printed circuit boards and equipment, avoid using high-polymer materials such as foam styrene, plastic, and other materials which carry an electrostatic charge.

6) When storing or transporting devices, the environment should not be conducive to generating static electricity (for instance, the humidity should be between 45 and 60%), and devices should be protected using conductive packing materials.

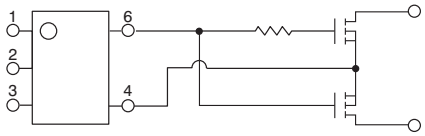
21. Short circuit protection circuit

The short circuit protection circuit is designed to protect circuits from excess current. Therefore, surge current may be detected as current overload in which case the output current will be cut and the off state maintained. For this reason, please include the inrush current in the load current and keep it below the maximum load current. Also, in order to maintain stability of internal IC operation, maintain an input current of at least 5 mA (Latch type), 10 mA (Non Latch type).

22. Photovoltaic MOSFET driver cautions for use

When two external MOSFETs are connected with a common source terminal, oscillation may occur when operation is restored. Therefore, please insert a 100 to 1,000 ohms resistor between the gate terminal of the first MOSFET and the gate terminal of the second MOSFET.

A typical example of this is given in the circuit below.



23. Power PhotoMOS® cautions for use

(1) Input LED current (Standard type)

For rising and dropping ratio of input LED current (di/dt), maintain min. 100 μA/s.

(2) Input voltage (Voltage sensitive type)

For rising and dropping ratio of input voltage (dv/dt), maintain min. 100 mV/s.

(3) Adjacent mounting

1) When devices are mounted close together with the heat-generated devices, ambient temperature may rise abnormally. Mounting layout and ventilation should be considered.

2) When many devices are mounted close together, load current should be reduced. (Refer to the date of “Load current vs. ambient temperature characteristics in adjacent mounting.”)

(4) Recommended load voltage

As a guide in selecting PhotoMOS®, please refer to the following table.

1) Power photoMOS® (1 Form A)

		Absolute maximum rating		Recommended load voltage
		Load voltage	Load current	
DC type	AQZ102	60 V DC	4.0 A DC	5, 12, 24 V DC
	AQZ105	100 V DC	2.6 A DC	48 V DC
	AQZ107	200 V DC	1.3 A DC	100 V DC
	AQZ104	400 V DC	0.7 A DC	200 V DC
AC/DC type	AQZ202	Peak AC 60 V	Peak AC 3.0 A	12 V AC; 5, 12, 24 V DC
	AQZ205	Peak AC 100 V	Peak AC 2.0 A	24 V AC 48 V DC
	AQZ207	Peak AC 200 V	Peak AC 1.0 A	48 V AC 100 V DC
	AQZ204	Peak AC 400 V	Peak AC 0.5 A	100 V AC 200 V DC

2) Power PhotoMOS® (1 Form B)

		Absolute maximum rating		Recommended load voltage
		Load voltage	Load current	
AC/DC type	AQZ404	Peak AC 400 V	Peak AC 0.5 A	100 V AC 200 V DC

3) Power PhotoMOS® Voltage-sensitive type (1 Form A)

		Absolute maximum rating		Recommended load voltage
		Load voltage	Load current	
DC type	AQZ102D	60 V DC	3.6 A DC	5, 12, 24 V DC
	AQZ105D	100 V DC	2.3 A DC	48 V DC
	AQZ107D	200 V DC	1.1 A DC	100 V DC
	AQZ104D	400 V DC	0.6 A DC	200 V DC
AC/DC type	AQZ202D	Peak AC 60 V	Peak AC 2.7 A	12 V AC; 5, 12, 24 V DC
	AQZ205D	Peak AC 100 V	Peak AC 1.8 A	24 V AC 48 V DC
	AQZ207D	Peak AC 200 V	Peak AC 0.9 A	48 V AC 100 V DC
	AQZ204D	Peak AC 400 V	Peak AC 0.45 A	100 V AC 200 V DC

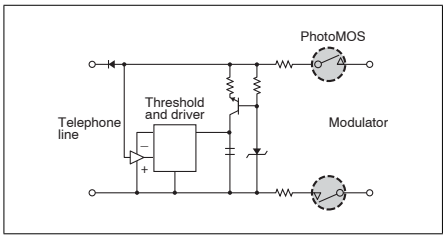
4) Power PhotoMOS® High Capacity type (1 Form A)

		Absolute maximum rating		Recommended load voltage
		Load voltage	Load current	
DC type	AQZ192	60 V DC	10 A DC	5, 12, 24 V DC
AC/DC type	AQZ262	Peak AC, DC 60V	Peak AC, DC 6A	12V AC 5, 12, 24 V DC
	AQZ264	Peak AC, DC 400V	Peak AC, DC 1A	100V AC 200V DC

PhotoMOS® for Various Applications

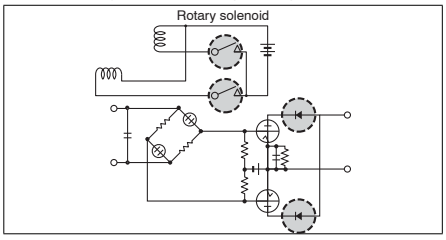
Automatic meter reading

The needs of centralized remote meter reading systems for water, gas and electricity in medium and high rise apartments and new subdivisions are now increasing. PhotoMOS® are capable of controlling from low level signals up to power signals and feature low leakage current and noise from the optoelectronic device and power MOSFET combination.



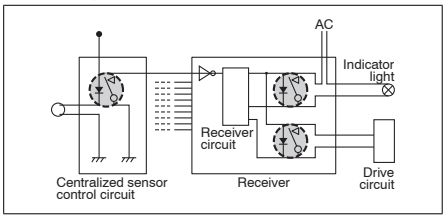
Medical equipment

Medical equipment which processes low level signals includes electrocardiographs, electroencephalographs, and X-ray CT scanners. PhotoMOS® accurately transfer low level signals (less than several hundred millivolts). Furthermore, they are also convenient in driving rotary solenoids such as those used to automatically switch voltage ranges.



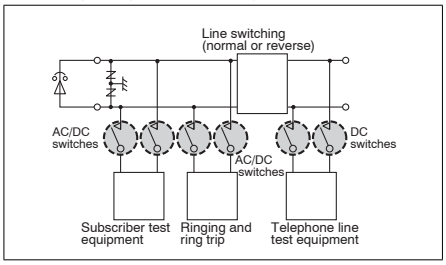
Security Equipment

There are many types of security systems from home and office security to building security. PhotoMOS® are ideal for use as input interfaces for system sensors and output interfaces for alarms.
Input interface: Low leakage current makes use possible for low level voltage and current input.
Output interface: Outputs either AC or DC up to a load voltage of 400 V.



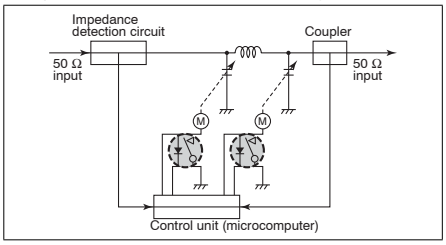
Telecommunications

A variety of signals, with levels from millivolts (at microamperes) to tens of volts (at several hundred milliamperes), AC or DC, and even high bit-rate signals, can be superimposed on telephone lines, the heart of telecommunication networks. The switches in telecommunication circuits, which normally carry DC signals, also carry AC signals on top of the DC level when an intermittent signal (e.g. ringer signal) is being sent. PhotoMOS® are capable of controlling small level (millivolts at microamperes) AC or DC signals.



Communications equipment

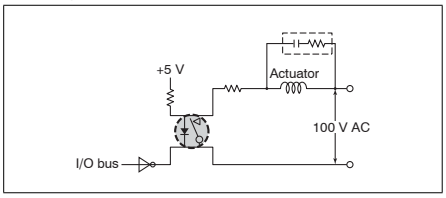
The future of communications is in satellite communications. Satellite-communications feature many advantages such as indifference to terrestrial disasters, wide service areas, simple circuit modification and simultaneous conversations. An important control operation in communications equipment is fast automatic tuning.
PhotoMOS® can easily be connected in parallel, difficult with conventional transistor type. As a result, a variety of circuit connection are possible and power circuits can also be designed.



OA equipment

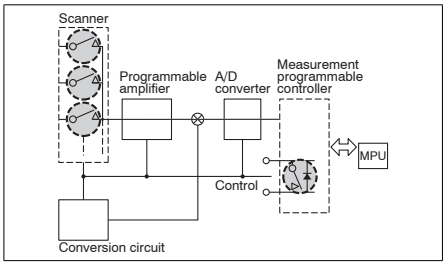
OA equipment usually contains a sensor control unit (for temperature, speed, torque, etc.), drive unit, power supply unit, and a processing unit which controls the overall system. It is organized similarly to compact factory automation machinery. PhotoMOS® have wide application in the interfaces for signals which connect the functions of these units.

- Operates on a 24 mW input to enable direct control of C-MOS devices.
- Signal transfer through optical coupling achieves high resistance to noise and transients, eliminating the need for adding a snubber circuit to the output to control the load voltage.
- Advantages in the total cost and reliability in the control system result from the absence of AC leakage current related to the snubber circuit.



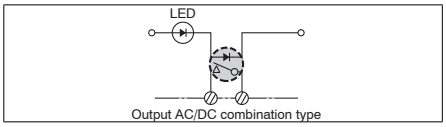
Instrumentation

With the spread of microcomputer chips, the latest instruments are required to measure a variety of signals at high speeds under various conditions. PhotoMOS® are recommended for measurement scanning functions, automatic zero-point compensation to eliminate zero-point error, and measurement sequence interfaces (e.g. alarm interface.)



Programmable controller

The output circuit of a programmable controller requires various interfaces to match the load type. Recently, as the computing speed and data processing speed increase, problems may arise from noise at the input interface as well as at the output interface.
PhotoMOS® are resistant to inrush current (due to phase shift) and eliminate the need for snubber circuits as long as they are operated within the ratings. Furthermore, use of PhotoMOS® decreases the mounting area requirements, resulting in more compact programmable controllers.

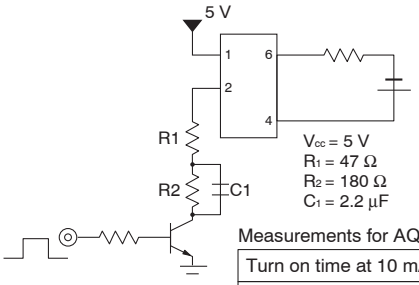


If you are a user experiencing difficulty with solid-state relays and triacs:

If you would like to control small analog signals with a photocoupler and solid-state relays.	➤	PhotoMOS® feature low offset voltages and on resistances of 0.25 Ω or less. (AQV251 Connection)
If you require a device with a small leakage current (as opposed to bipolar devices having large internal leakage currents).	➤	PhotoMOS® have leakage currents in the order of microamperes and can control up to 1500 V (peak). (AQV258)
If you would like to directly control analog signals and you would like a device integrating a photocoupler, driver and analog IC to simplify the circuit as much as possible.	➤	PhotoMOS® contain all of these functions in a single package. Furthermore, circuit design is simplified as a power supply is unnecessary since the internal optoelectronic device directly drives the power MOSFET.
If you require a snubber circuit with a triac or solid-state relay, but are concerned about the snubber circuit's AC leakage current.	➤	PhotoMOS® are resistant to transients and as long as they are operated within the maximum ratings, eliminate the need for adding a snubber circuit to the output to control the rise in load voltage. Leakage current ceases to be a problem, with cost and reliability being other advantages.
If you require a device for AC control that is resistant to ambient temperature changes and input signal noise.	➤	PhotoMOS® do not employ the self-trigger mechanism used in SCRs and triacs. Therefore, they do not switch on accidentally. Furthermore, the noise suppression characteristics of optoelectronic devices make them highly resistant to ambient noise for operation at temperatures up to 80°C 176°F.

PhotoMOS® Application Examples

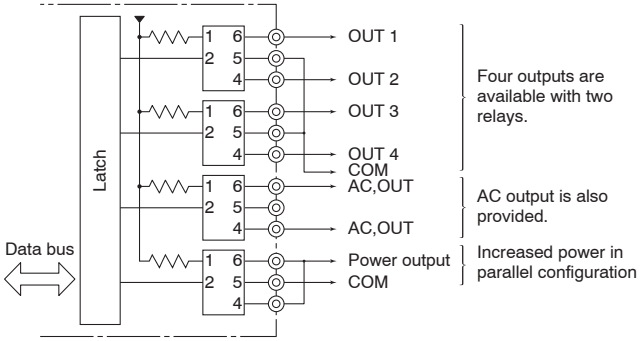
High Response Speed



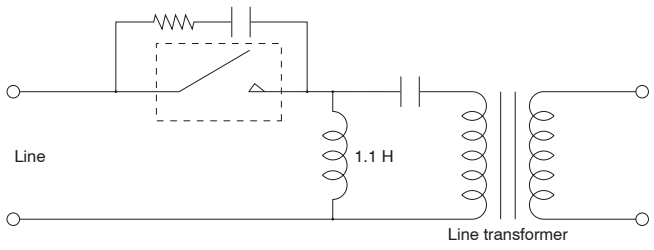
Measurements for AQV204(400V) AC/DC type

Turn on time at 10 mA LED current	0.18 ms
Turn on time with speed-increase capacitor (LED current 45 mA)	0.03 ms

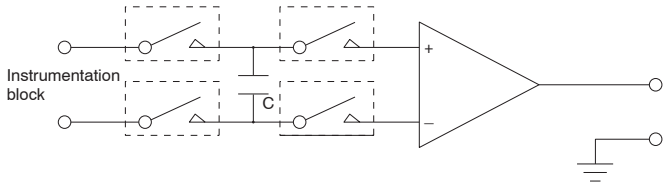
Microprocessor system I/O board



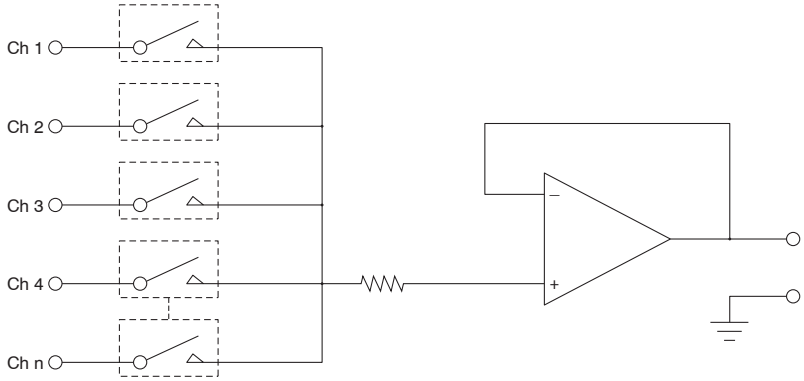
Dial Pulse Generator



Capacitor Switch Circuit



Scanner



PhotoMOS® for Automotive Applications

Before Selecting PhotoMOS® for Automotive Applications

Some changes in specification parameters are needed when PhotoMOS® are used in certain automotive applications. Automotive grade PhotoMOS® are generally used in automotive environment since stricter enhanced quality controls are needed.
The user is cautioned and asked to inquire with a Panasonic Corporation local sales representative before designing the products in such environments.

About Specification Reviews

Automotive applications require specification reviews. This is important and necessary in order to prevent performance, quality and reliability problems. The following parameters should be reviewed with a Panasonic Corporation local sales representative:

- Targeted application
- Targeted levels of quality and reliability
- Circuits description of load level, driving methods, etc.
- Service conditions
- Influence at failure and failsafe concepts, etc.

About Derating Design

Derating is essential in any reliable design and a significant factor in consideration of product life. Sufficient derating is needed against maximum rating when designing a system.
It is recommended using a derated voltage of 40% (or less) of absolute maximum load voltage rating, and 50% (or less) of absolute maximum load current ratings.
Devices should be examined using a measurement equipment.
Derated voltages must be considered according to operating and environmental conditions the device will be subjected to.
In case of automotive applications, more allowance should be given to maximum ratings and installation of safety measures (i.e. use of double circuits).
Misuse of the products listed in this document shall be made at the users' own risk.

Typical Products for Automotive Applications

Types and absolute maximum ratings (Ambient temperature: 25°C 77°F)

Part number	Type	Package	Contact configuration	Load voltage (V_L)*1	Continuous load current (I_L)*1	Temperature limits	
						Operating (T_{opr})	Storage (T_{stg})
AQW216HAX❍❍❍	GU	DIP8pin (SMD)	2 Form A	600V	40mA (50mA)*2	–40°C to +85°C –40°F to +185°F	–40°C to +100°C –40°F to +212°F
AQW212HAX❍❍❍	GU	DIP8pin (SMD)	2 Form A	60V	500mA (600mA)*2		
AQV258HAX❍❍❍	HE	DIP6pin (SMD)	1 Form A	1500V	20mA		

*1 Indicate the peak AC and DC values.
*2 In case of using only 1 channel

Recommended conditions of use (Ambient temperature: 25°C 77°F)

Part number	Load voltage (V_L)	Continuous load current (I_L)	LED forward current (I_F)
AQW216HAX❍❍❍	240V and less	20mA and less	10mA
AQW212HAX❍❍❍	24V and less	250mA and less	10mA
AQV258HAX❍❍❍	600V and less	10mA and less	10mA

Electric characteristics (Ambient temperature: 25°C 77°F)

Item			Symbol	Part number			Test conditions
				AQW216HAX❍❍❍	AQW212HAX❍❍❍	AQV258HAX❍❍❍	
Input	LED operate current	Typ.	I_{Fon}	1mA	1mA	0.8mA	I_L = Max.
		Max.		3mA	3mA	3mA	
	LED turn off voltage	Typ.	I_{Foff}	0.2mA	0.2mA	0.2mA	
		Max.		0.8mA	0.8mA	0.7mA	
	LED dropout voltage	Typ.	V_F	1.25V	1.25V	1.25V	I_F = 50mA
		Max.		1.5V	1.5V	1.5V	
Output	On resistance	Typ.	R_{on}	70Ω	0.83Ω	305Ω	I_F = 10mA I_L = Max.
		Max.		150Ω	2.5Ω	500Ω	
	Off state leakage current	Max.	I_{Leak}	1μA	1μA	10μA	I_F = 0mA, VL = Max.
Transfer characteristics	Turn on time	Typ.	T_{on}	0.2ms	0.5ms	0.14ms	I_F = 10mA I_L = Max.
		Max.		0.5ms	2ms	1ms	
	Turn off time	Typ.	T_{off}	0.04ms	0.08ms	0.1ms	
		Max.		0.5ms	0.5ms	0.5ms	

For further particulars on automotive grade PhotoMOS®, please inquire with a Panasonic Corporation sales representive.