# PhotoMOS RELAYS 

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


## FEATURES

1. High sensitivity and low onresistance
2. Controls various types of loads such as relays, motors, lamps and solenoids.
3. Optical coupling for extremely high isolation
$5,000 \mathrm{Vrms}$ I/O isolation available.
4. Low-level off state leakage current
5. Eliminates the need for a power supply to drive the power MOSFET A power supply used to drive the power MOSFET is unnecessary because of the built-in optoelectronic device. This results in easy circuit design and small PC board area.
6. Low thermal electromotive force (Approx. $1 \mu \mathrm{~V}$ )

## TYPICAL APPLICATIONS

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


## TYPES



* Indicate the peak AC and DC values.

Note: For space reasons, the package type indicator " $X$ " and " $Z$ " are omitted from the seal.

## RATING

1. Absolute maximum ratings (Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$ )

| Item |  |  | Symbol | $\begin{aligned} & \text { Type of } \\ & \text { cornec } \\ & \text { tion } \end{aligned}$ | AQV251(A) | AQV252(A) | AQV255(A) | AQV257(A) | $\begin{gathered} \text { AQV253(A) } \\ \text { AQV253H(A) } \\ \hline \end{gathered}$ | $\begin{array}{\|c} \text { AQV254(A) } \\ \text { AQV254H(A) } \\ \hline \end{array}$ | AQV259(A) | AQV258(A) | Remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Input | LED forward current |  | $\mathrm{I}_{\text {F }}$ |  | 50 mA |  |  |  |  |  |  |  |  |
|  | LED reverse voltage |  | $\mathrm{V}_{\mathrm{R}}$ |  | 3 V |  |  |  |  |  |  |  |  |
|  | Peak forward current |  | IfP |  | 1 A |  |  |  |  |  |  |  | $\begin{aligned} & \mathrm{f}=100 \mathrm{~Hz}, \\ & \text { Duty factor }+0.1 \% \\ & \hline \end{aligned}$ |
|  | Power dissipation |  | Pin |  | 75 mW |  |  |  |  |  |  |  |  |
| Output | Load voltage (peak AC) |  | $\mathrm{V}_{\mathrm{L}}$ |  | 40 V | 60 V | 100 V | 200 V | 250 V | 400 V | 1,000 V | 1,500 V |  |
|  | Continuous load current |  | IL | $\begin{aligned} & \hline \text { A } \\ & \text { B } \\ & \text { C } \end{aligned}$ | $\begin{aligned} & \hline 0.5 \mathrm{~A} \\ & 0.7 \mathrm{~A} \\ & 1.0 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & \hline 0.4 \mathrm{~A} \\ & 0.6 \mathrm{~A} \\ & 0.8 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0.35 \mathrm{~A} \\ & 0.45 \mathrm{~A} \\ & 0.70 \mathrm{~A} \\ & \hline \end{aligned}$ | $\begin{aligned} & 0.25 \mathrm{~A} \\ & 0.35 \mathrm{~A} \\ & 0.5 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0.2 \mathrm{~A} \\ & 0.3 \mathrm{~A} \\ & 0.4 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0.15 \mathrm{~A} \\ & 0.18 \mathrm{~A} \\ & 0.25 \mathrm{~A} \\ & \hline \end{aligned}$ | 0.03 A <br> 0.04 A <br> 0.05 A | $\begin{aligned} & 0.0 \mathrm{~A} \\ & 0.025 \mathrm{~A} \\ & 0.04 \mathrm{~A} \end{aligned}$ | A connection: Peak AC, DC <br> B, C connection: DC |
|  | Peak load current |  | $\mathrm{I}_{\text {peak }}$ | $\rangle$ | 1.8 A | 1.5 A | 1.0 A | 0.75 A | 0.6 A | 0.5 A | 0.09 A | 0.06 A | A connection: $\begin{array}{r} 100 \mathrm{~ms} \\ \left(1 \text { shot) } \mathrm{V}_{\mathrm{L}}=\mathrm{DC}\right. \end{array}$ |
|  | Power dissipation |  | Pout |  | 360 mW |  |  |  |  |  |  |  |  |
| Total power dissipation |  |  | $\mathrm{P}_{\mathrm{T}}$ |  | 410 mW |  |  |  |  |  |  |  |  |
| I/O isolation voltage |  |  | $\mathrm{V}_{\text {iso }}$ |  | $1,500 \mathrm{~V} \mathrm{AC}\langle 5,000 \mathrm{~V} \mathrm{AC}$ 〉 |  |  |  |  |  |  |  |  |
| Temperature limits |  | Operating | Topr |  | $-20^{\circ} \mathrm{C}$ to $+80^{\circ} \mathrm{C}-4^{\circ} \mathrm{F}$ to $+176{ }^{\circ} \mathrm{F}$ |  |  |  |  |  |  |  | Non-condensing at low temperatures |
|  |  | Storage | $\mathrm{T}_{\text {stg }}$ |  | $-40^{\circ} \mathrm{C}$ to $+100^{\circ} \mathrm{C}-40^{\circ} \mathrm{F}$ to $+212^{\circ} \mathrm{F}$ |  |  |  |  |  |  |  |  |

2. Electrical characteristics (Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$ )

| Item |  |  |  | Symbol | Type of connection | AQV251(A) | AQV252(A) | AQV255(A) | AQV257(A) | AQV253(A) <br> AQV253H(A) | AQV254(A) AQV254H(A) | AQV259(A) | AQV258(A) | Condition |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Input | LED operate current |  | Minimum <br> Typical Maximum | $\mathrm{I}_{\text {fon }}$ | - | $\begin{aligned} & 0.9 \mathrm{~mA} \\ & 3 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.9 \mathrm{~mA} \\ & 3 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.8 \mathrm{~mA} \\ & 3 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.9 \mathrm{~mA} \\ & 3 \mathrm{~mA} \end{aligned}$ | $\begin{array}{ll}  & (\mathrm{mA}) \\ 0.9 & \langle 1.4\rangle \\ 3 & \langle 3\rangle \end{array}$ | $\begin{array}{\|l\|l\|} \hline & (\mathrm{mA}) \\ 0.9 & \langle 1.4\rangle \\ 3 & \langle 3\rangle \end{array}$ | $\begin{aligned} & 0.9 \mathrm{~mA} \\ & 3 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.9 \mathrm{~mA} \\ & 3 \mathrm{~mA} \end{aligned}$ | $\mathrm{I}_{\mathrm{L}}=\mathrm{Max}$. |
|  | LED turn off current |  | Minimum Typical Maximum | $\mathrm{I}_{\text {Foff }}$ | - | $\begin{aligned} & 0.4 \mathrm{~mA} \\ & 0.8 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.4 \mathrm{~mA} \\ & 0.8 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.4 \mathrm{~mA} \\ & 0.7 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.4 \mathrm{~mA} \\ & 0.8 \mathrm{~mA} \end{aligned}$ | $(\mathrm{mA})$ $0.4\langle 0.4\rangle$ $0.8\langle 1.3\rangle$ | $\begin{gathered} (\mathrm{mA}) \\ 0.4\langle 0.4\rangle \\ 0.8\langle 1.3\rangle \end{gathered}$ | $\begin{aligned} & 0.4 \mathrm{~mA} \\ & 0.8 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0.4 \mathrm{~mA} \\ & 0.8 \mathrm{~mA} \end{aligned}$ | $\mathrm{I}_{\mathrm{L}}=\mathrm{Max}$. |
|  | LED dropout voltage |  | Minimum Typical <br> Maximum | $V_{F}$ | - | $\begin{aligned} & 1.14 \mathrm{~V}^{*} \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 1.14 \mathrm{~V}^{\star *} \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 1.14 \mathrm{~V}^{*} \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 1.14 \mathrm{~V}^{* *} \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\begin{gathered} 1.14 \mathrm{~V}^{\star *} \\ \langle 1.14\rangle \\ 1.5 \mathrm{~V} \end{gathered}$ | $\begin{aligned} & 1.14 \mathrm{~V}^{* *} \\ & \langle 1.14\rangle \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 1.14 \mathrm{~V}^{* *} \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 1.14 \mathrm{~V}^{\star *} \\ & 1.5 \mathrm{~V} \end{aligned}$ | $\mathrm{I}_{\mathrm{F}}=5 \mathrm{~mA}$ |
| Output | On resistance |  | Minimum Typical Maximum | $\mathrm{R}_{\text {on }}$ | A | $\begin{aligned} & 0.6 \Omega \\ & 1 \quad \Omega \end{aligned}$ | $\begin{aligned} & 0.74 \Omega \\ & 1.4 \Omega \end{aligned}$ | $\begin{aligned} & 1.8 \Omega \\ & 2.5 \Omega \end{aligned}$ | $\begin{aligned} & 2.6 \Omega \\ & 4 \quad \Omega \end{aligned}$ | $\begin{aligned} & 5.5 \Omega \\ & 8 \quad \Omega \end{aligned}$ | $\begin{aligned} & 12.4 \Omega \\ & 16 \quad \Omega \end{aligned}$ | $\begin{gathered} 85 \Omega \\ 200 \Omega \end{gathered}$ | $\begin{aligned} & 345 \Omega \\ & 500 \Omega \end{aligned}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{F}}=5 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{L}}=\text { Max. } \end{aligned}$ <br> Within 1 s on time |
|  |  |  | Minimum Typical Maximum | $\mathrm{R}_{\text {on }}$ | B | $\begin{aligned} & 0.3 \Omega \\ & 0.5 \Omega \end{aligned}$ | $\begin{aligned} & 0.37 \Omega \\ & 0.7 \Omega \end{aligned}$ | $\begin{aligned} & 0.9 \Omega \\ & 1.25 \Omega \end{aligned}$ | $\begin{aligned} & 1.4 \Omega \\ & 2 \quad \Omega \\ & \hline \end{aligned}$ | $\begin{aligned} & 2.7 \Omega \\ & 4 \quad \Omega \end{aligned}$ | $\begin{aligned} & 6.2 \Omega \\ & 8 \quad \Omega \end{aligned}$ | $\begin{gathered} 60 \Omega \\ 100 \Omega \end{gathered}$ | $\begin{aligned} & 345 \Omega \\ & 500 \Omega \end{aligned}$ | $\begin{aligned} & I_{F}=5 \mathrm{~mA} \\ & I_{L}=\text { Max. } . \end{aligned}$ <br> Within 1 s on time |
|  |  |  | Minimum Typical Maximum | $\mathrm{R}_{\text {on }}$ | C | $\begin{aligned} & 0.15 \Omega \\ & 0.25 \Omega \end{aligned}$ | $\begin{aligned} & 0.18 \Omega \\ & 0.35 \Omega \end{aligned}$ | $\begin{aligned} & 0.45 \Omega \\ & 0.63 \Omega \end{aligned}$ | $\begin{array}{ll} 0.7 & \Omega \\ 1 & \Omega \end{array}$ | $\begin{aligned} & 1.4 \Omega \\ & 2 \Omega \end{aligned}$ | $\begin{aligned} & 3.1 \Omega \\ & 4 \quad \Omega \end{aligned}$ | $\begin{aligned} & 30 \Omega \\ & 50 \Omega \end{aligned}$ | $\begin{aligned} & 160 \Omega \\ & 250 \Omega \end{aligned}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{F}}=5 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{L}}=\text { Max. } \end{aligned}$ <br> Within 1 s on time |
|  | Off state leakage current |  | Minimum <br> Typical Maximum | - | - | $1 \mu \mathrm{~A}$ | $1 \mu \mathrm{~A}$ | $1 \mu \mathrm{~A}$ | $1 \mu \mathrm{~A}$ | $1 \mu \mathrm{~A}$ | $1 \mu \mathrm{~A}$ | $10 \mu \mathrm{~A}$ | $10 \mu \mathrm{~A}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{F}}=0 \\ & \mathrm{~V}_{\mathrm{L}}=\mathrm{Max} . \end{aligned}$ |
| Transfer characteristics | Switch ing speed | Turn on time* | Minimum Typical Maximum | Ton | - | $\begin{aligned} & \text { (ms) } \\ & 1.7 \\ & 3 \end{aligned}$ | $\begin{gathered} (\mathrm{ms}) \\ 1.4 \\ 3 \end{gathered}$ | $\begin{aligned} & \text { (ms) } \\ & 0.9 \\ & 2 \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 1.5 \\ & 3 \end{aligned}$ | $\begin{gathered} \quad(\mathrm{ms}) \\ 0.8\langle 2.4\rangle \\ 2 \end{gathered}$ | $\begin{aligned} & \quad(\mathrm{ms}) \\ & 0.8\langle 1.8\rangle \\ & 2\langle 3\rangle \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.6 \\ & 1 \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.35 \\ & 1 \end{aligned}$ | $\begin{aligned} & I_{F}=5 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{L}}=\mathrm{Max} . \end{aligned}$ |
|  |  | Turn off time* | Minimum <br> Typical Maximum | $\mathrm{T}_{\text {off }}$ | - | $\begin{aligned} & \text { (ms) } \\ & 0.07 \\ & 0.2 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.07 \\ & 0.2 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.09 \\ & 0.2 \end{aligned}$ | $\begin{gathered} (\mathrm{ms}) \\ 0.1 \\ 0.2 \\ \hline \end{gathered}$ | $\begin{aligned} & \text { (ms) } \\ & 0.06 \\ & 0.2 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.05 \\ & 0.2 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.04 \\ & 0.2 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { (ms) } \\ & 0.04 \\ & 0.2 \end{aligned}$ | $\begin{aligned} & \mathrm{I}_{\mathrm{F}}=5 \mathrm{~mA} \\ & \mathrm{I}_{\mathrm{L}}=\text { Max. } \end{aligned}$ |
|  | I/O capacitance |  | Minimum Typical Maximum | $\mathrm{C}_{\text {iso }}$ | - | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \\ & \hline \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \\ & \hline \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \\ & \hline \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \\ & \hline \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \\ & \hline \end{aligned}$ | $\begin{aligned} & 1.3 \mathrm{pF} \\ & 3 \mathrm{pF} \\ & \hline \end{aligned}$ | $\begin{aligned} & \mathrm{f}=1 \mathrm{MHz} \\ & \mathrm{VB}=0 \end{aligned}$ |
|  | Initial I/O isolation resistance |  | Minimum Typical Maximum | $\mathrm{R}_{\text {iso }}$ | - | 1,000 M $\Omega$ | 1,000 M $\Omega$ | 1,000 M $\Omega$ | 1,000 M 2 | 1,000 M $\Omega$ | 1,000 M $\Omega$ | 1,000 M $\Omega$ | 1,000 M $\Omega$ | 500 V DC |

*Turn on/Turn off time For type of connection, see Page 366.
$\langle\quad\rangle$ : Value for reinforced $5,000 \mathrm{~V}$ type ** 1.25 V at $\mathrm{I}_{\mathrm{F}}=50 \mathrm{~mA}$


## REFERENCE DATA

1.-(1) Load current vs. ambient temperature characteristics
Allowable ambient temperature: $-20^{\circ} \mathrm{C}$ to $+80^{\circ} \mathrm{C}$ $-4^{\circ} \mathrm{F}$ to $+176^{\circ} \mathrm{F}$; Type of connection: A

1.-(2) Load current vs. ambient temperature characteristics
Allowable ambient temperature: $-20^{\circ} \mathrm{C}$ to $+80^{\circ} \mathrm{C}$ $-4^{\circ} \mathrm{F}$ to $+176^{\circ} \mathrm{F}$; Type of connection: A

2.-(1) On resistance vs. ambient temperature characteristics
Measured portion: between terminals 4 and 6; LED current: 5 mA ; Continuous load current: Max. (DC)

2.-(2) On resistance vs. ambient temperature characteristics
Measured portion: between terminals 4 and 6; LED current: 5 mA ; 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)

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

9.-(1) Off state leakage current

Sample: AQV259;
Measured portion: between terminals 4 and 6;
Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$
2.-(3) On resistance vs. ambient temperature characteristics
Measured portion: between terminals 4 and 6; LED current: 5 mA ; Continuous load current: 30 mA (DC)

5. LED operate current vs. ambient temperature characteristics
Sample: AQV251, AQV252, AQV253, AQV254, AQV259; Load voltage: Max. (DC); Continuous load current: Max. (DC)

8.-(1) Voltage vs. current characteristics of output at MOS portion
Measured portion: between terminals 4 and 6; Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

9.-(2) Off state leakage current Sample: AQV254H;
Measured portion: terminals 4 and 6; Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$
3. Turn on time vs. ambient temperature characteristics
LED current: 5 mA ; Load voltage: Max. (DC); Continuous load current: Max. (DC)

6. LED turn off current vs. ambient temperature characteristics
Sample: AQV251, AQV252, AQV253, AQV254, AQV259; Load voltage Max. (DC); Continuous load current: Max. (DC)

8.-(2) Voltage vs. current characteristics of output at MOS portion
Measured portion: between terminals 4 and 6; Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

10.-(1) LED forward current vs. turn on time characteristics
Measured portion: between terminals 4 and 6;
Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

10.-(2) LED forward current vs. turn on time characteristics
Measured portion: between terminals 4 and 6; Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

12.-(1) Applied voltage vs. output capacitance characteristics
Measured portion: between terminals 4 and 6;
Frequency: 1 MHz ; Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

11.-(1) LED forward current vs. turn off time characteristics
Measured portion: between terminals 4 and 6; Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

11.-(2) LED forward current vs. turn off time characteristics
Measured portion: between terminals 4 and 6;
Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: $25^{\circ} \mathrm{C} 77^{\circ} \mathrm{F}$

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


## PhotoMOS Relay Technical Information

## How PhotoMOS Relays Operate:

Optoelectronic device directly drives a power MOSFET.
Semiconductor relay incorporating the advantages of both electromagnetic relays and semiconductors.


When operated

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 turned off


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



Terminology

| Term |  | Symbol | Description |
| :---: | :---: | :---: | :---: |
| Input | LED forward current | $\mathrm{I}_{\mathrm{F}}$ | Current that flows between the input terminals when the input diode is forward biased. |
|  | LED reverse voltage | $\mathrm{V}_{\mathrm{R}}$ | Reverse breakdown voltage between the input terminals. |
|  | Peak forward current | $\mathrm{I}_{\text {FP }}$ | Maximum instantaneous value of the forward current. |
|  | LED operate current | $\mathrm{I}_{\text {FON }}$ | 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 | $l_{\text {Foff }}$ | 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 | Pin | Allowable power dissipation between the input terminals. |
| Output | Load voltage | $\mathrm{V}_{\mathrm{L}}$ | Supply voltage range at the output used to normally operate the PhotoMOS relay. Represents the peak value for AC voltages. |
|  | Continuous load current | IL | 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 | Ron | Obtained using the equation below from dropout voltage $\mathrm{V}_{\mathrm{DS}}$ (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.) Ron $=\mathrm{V}_{\mathrm{DS}}$ (on)/IL |
|  | Off state leakage current | Ileak | Current flowing to the output when a designated supply voltage is applied between the output terminals with no LED current flow. |
|  | Power dissipation | Pout | Allowable power dissipation between the output terminals. |
| Electrical characteristics | Turn on time | Ton | Delay time until the output switches on after a designated LED current is made to flow through the input terminals. |
|  | Turn off time | Toff | Delay time until the output switches off after the designated LED current flowing through the input terminals is cut off. |
|  | I/O capacitance | Ciso | Capacitance between the input and output terminals. |
|  | Output capacitance | Cout | Capacitance between output terminals when LED current does not flow. |
|  | I/O isolation resistance | Riso | Resistance between terminals (input and output) when a specified voltage is applied between the input and output terminals. |
|  | Total power dissipation | $\mathrm{P}_{\mathrm{T}}$ | Allowable power dissipation in the entire circuit between the input and output terminals. |
|  | I/O isolation voltage | Viso | 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 | Topr | Ambient temperature range in which the PhotoMOS relay can operate normally with a designated load current conditions. |
|  | Storage temperature | Tstg | 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 | Tstg (Max.) | Determines resistance to long term storage at high temperature. |
|  | Low temperature storage test | $\mathrm{T}_{\text {stg }}$ (Min.) | Determines resistance to long term storage at low temperature. |
|  | High temperature and high humidity storage test | $85^{\circ} \mathrm{C} 185^{\circ} \mathrm{F}$, R.H. $85 \%$ | Determines resistance to long term storage at high temperature and high humidity. |
|  | Continuous operation life test | VL = Max., IL = Max., IF = LED operate current (Max.) | Determines resistance to electrical stress (voltage and current). |
| Thermal environment tests | Temperature cycling test | Low storage temperature ( $\mathrm{T}_{\text {stg }}$ Min.) High storage temperature (Tstg Max.) | Determines resistance to exposure to both low temperatures and high temperatures. |
|  | Thermal shock test | Low temperature $\left(0^{\circ} \mathrm{C}\right)\left(32^{\circ} \mathrm{F}\right)$, High temperature $\left(100^{\circ} \mathrm{C}\right)\left(212^{\circ} \mathrm{F}\right)$ | Determines resistance to exposure to sudden changes in temperature. |
|  | Solder burning resistance | $260 \pm 5^{\circ} \mathrm{C} 500 \pm 41^{\circ} \mathrm{F}, 10 \mathrm{~s}$ | Determines resistance to thermal stress occurring while soldering. |
| Mechanical environment tests | Vibration test | $196 \mathrm{~m} / \mathrm{s}^{2}\{20 \mathrm{G}\}, 20$ to $2,000 \mathrm{~Hz}^{* 1}$ | Determines the resistance to vibration sustained during shipment or operation. |
|  | Shock test | $\begin{aligned} & 9,800 \mathrm{~m} / \mathrm{s}^{2}\{1,000 \mathrm{G}\} 0.5 \mathrm{~ms}^{* 2} ; \\ & 4,900 \mathrm{~m} / \mathrm{s}^{2}\{500 \mathrm{G}\} 1 \mathrm{~ms} \end{aligned}$ | 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 | $230^{\circ} \mathrm{C} 446^{\circ} \mathrm{F} 5 \mathrm{~s}$ (with soldering flux) | Evaluates the solderability of the terminals. |
| ${ }^{* 1} 10$ to 55 Hz at double amplitude of 3 mm for Power PhotoMOS relays. <br> ${ }^{* 2} 4,900 \mathrm{~m} / \mathrm{s}^{2}, 1 \mathrm{~ms}$ for Power PhotoMOS relays. |  |  |  |

## PhotoMOS Relay Schematic and Wiring Diagrams

| Type | Schematic | Output configuration | Load | Connection | Wiring diagram |
| :---: | :---: | :---: | :---: | :---: | :---: |
| AQV21 <br> AQV21 (SOP) AQV22 AQV22 (SOP) AQV23 AQV25 Series | (AQV254R only) | 1a | AC/DC | A |  |
|  |  |  | DC | B* |  |
|  |  |  | DC | C |  |
| AQW21 <br> AQW21 (SOP) AQW22 AQW25 Series |  | 2a | AC/DC | - | (1) Two independent 1 Form A use <br> (2) 2 Form A use |
| AQW21OTS Series |  <br> Relay portion (1,2,7,8 pins) Detector portion (3,4,5,6 pins) | Relay portion 1a <br> Detecter portion 1a | Relay portion AC/DC Detecter portion DC | - |  |
| AQW21OT2S Series | Relay portion (1,2,11,12 pins) Detector portion (3,4,9,10 pins) (5,6,7,8 pins) | Relay portion 1a <br> Detecter portion 2a | Relay portion AC/DC Detecter portion DC | - |  |

[^0]| Type | Schematic | Output configuration | Load | Connection | Wiring diagram |
| :---: | :---: | :---: | :---: | :---: | :---: |
| AQV41 <br> AQV41 (SOP) <br> AQV45 <br> Series |  | 1b | AC/DC | A | $\mathrm{E}_{1} \underset{\sim}{\text { comen }}$ |
|  |  |  | DC | B** |  |
|  |  |  | DC | C |  |
| AQW61 <br> AQW65 <br> Series |  | 1a1b | AC/DC | - | (1) Two independent 1 Form $A$ \& 1 Form $B$ use <br> (2) 1 Form A 1 Form B use $\mathrm{E}_{1} \begin{aligned} & \mathrm{T} \\ & \mathrm{I}_{\mathrm{F}} \\ & \hline \end{aligned}$ |
| AQW41 AQW45 Series |  | 2 b | AC/DC | - | (1) Two independent 1 Form B use <br> (2) 2 Form B use |
| AQV10 Series | Terminal 3 cannot be used, since it is in the internal circuit of the relay. | 1a | DC | A |  |

*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. $\mathrm{E}_{1}$ : Power source at input side; $\mathrm{V}_{\mathrm{IN}}$ : Input voltage; $\mathrm{IF}_{\mathrm{F}}$ : LED forward current; $\mathrm{V}_{\mathrm{L}}$ : Load voltage; $\mathrm{I}_{\mathrm{L}}$ : Load current; R: Current limit resistor.
2. Method of connecting the load at the output is devided into 3 types.

*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 . $\mathrm{E}_{1}$ : Power source at input side; $\mathrm{V}_{\mathrm{IN}}$ : Input voltage; $\mathrm{I}_{\mathrm{F}}$ : LED forward current; $\mathrm{V}_{\mathrm{L}}$ : Load voltage; L : Load current; R: Current limit resistor. 2. Method of connecting the load at the output is devided into 3 types.


Notes: 1 . $\mathrm{E}_{1}$ : Power source at input side; $\mathrm{V}_{\mathrm{IN}}$ : Input voltage; $\mathrm{I}_{\mathrm{F}}$ : LED forward current; $\mathrm{V}_{\mathrm{L}}$ : Load voltage; $\mathrm{I}_{\mathrm{L}}$ : Load current; R: Current limit resistor. 2. Method of connecting the load at the output is devided into 3 types.

## PhotoMOS Relay 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 relay (including connecting parts such as the terminal board and socket).
- Check the connection diagrams in the catalog and be sure to connect the terminals correctly. Erroneous connections could lead to unexpected operating errors, overheating, or fire.


## NOTES

## $\square$ PhotoMOS Relays excluding Power PhotoMOS Relays

## 1. Unused terminals

The No. 3 terminal is used with the circuit inside the relay. Therefore, do not connect it to the external circuitry with either connection method $A, B$ or $C$.

## 2. Short across terminals

Do not short circuit between terminals when relay is energized, since there is the possibility of breaking the internal IC.
3. 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 be- low the reverse breakdown voltage.


## 4. Recommended LED forward current ( $\mathrm{IF}_{\text {) }}$

It is recommended that the LED forward current (IF) of each PhotoMOS Relay should be set according to the following table.

| Type |  | Product name | Recommended LED forward current ( $\mathrm{I}_{\mathrm{F}}$ ) |
| :---: | :---: | :---: | :---: |
| DIP <br> SMD <br> type | Standard 1/O isolation type (1,500 V AC) | AQV10,20 Series | 10 mA |
|  |  | AQY27 Series* | 5 to 10 mA |
|  |  | AQV21 Series (including SOP) <br> AQV22 Series including SOP) <br> AQV25 Series AQV45 Series AQW21 Series (including SOP) <br> AQW21OTS,T2S <br> Series <br> AQW41 Series <br> AQW61 Series <br> AQW22 Series <br> AQW25 Series <br> AQW45 Series <br> AQW65 Series <br> AQY21,41 Series | 5 mA |
|  |  | AQV23 Series | 2 mA |
|  | Reinforced I/O isolation (5,000 V AC) | AQV21,41 Series AQV25,45 Series | 5 to 10 mA |
| SIL <br> type | AQX21 Series |  | 5 mA |
|  | AQZ10,20,26 Series |  | 5 to 10 mA |

5. Ripple in the input power supply If ripple is present in the input power supply, observe the following:
1) For LED operate current at $E_{\text {min }}$, maintain the value mentioned in the table of "Note 4. Recommended LED forward current (IF)."
2) Keep the LED operate current at 50 VmA ( 25 mA for PhotoMOS HE Relay with LED display type) or less at $\mathrm{E}_{\text {max }}$.

6. 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 are shown below.

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.

## 7. Cleaning solvents compatibility

Dip cleaning with an organic solvent is recommended for removal of solder flux, dust, etc. Select a cleaning solvent from the following table. If ultrasonic cleaning must be used, the severity of factors such as frequency, output power and cleaning solvent selected may cause loose wires and other defects. Make sure these conditions are correct before use. For details, please consult us.

| Cleaning solvent |  | Compatibility <br> $\left(\begin{array}{l}\text { O: Yes } \\ \text { x: No }\end{array}\right.$ |
| :--- | :--- | :---: |
| Chlorine- <br> base | - I.I.I. Trichloroethlene <br> (Chloroethlene) <br> - Trichloroethlene <br> (Trichlene) <br> - Perchloroethlene <br> - Methlene chloride | $O$ |
| Adueous | - Indusco 624, 1000 <br> - Hollis 310 <br> - Lonco Terg | $\bigcirc$ |
| Alcohol- <br> base | - IPA <br> - Ethanol | $\bigcirc$ |
| Others | - Thinner <br> - Gasoline | $\times$ |

## 8. INPUT WIRING PATTERN

With AQY or AQW types, avoid installing the input (LED side) wiring pattern to the bottom side of the package if you require the specified I/O isolation voltage (Viso) 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.


## 9. Soldering

1) When soldering PC board terminals, keep soldering time to within 10 s at $260^{\circ} \mathrm{C} 500^{\circ} \mathrm{F}$.
2) When soldering surface-mount terminals, the following conditions are recommended.
(1) IR (Infrared reflow) soldering method

(4) Soldering iron method

Tip temperature: 280 to $300^{\circ} \mathrm{C} 536$ to $572^{\circ} \mathrm{F}$
Wattage: 30 to 60 W
Soldering time: within 5 s
(2) Vapor phase soldering method

(5) Others

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

- The temperature profile indicates the temperature of the soldered terminal on the surface of the PC board. The
(3) Double wave soldering method

ambient temperature may increase excessively. Check the temperature under mounting conditions.
- The conditions for the infrared reflow soldering apply when preheating using the VPS method.

10. The following shows the packaging format


| Type | Tape dimensions | Dimensions of paper tape reel |
| :---: | :---: | :---: | :---: | :---: | :---: |


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

(DIP, SMD type)

(2) Storage

PhotoMOS relays implemented in SO packages 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 at the most).
- 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).

## 11. Transportation and storage

1) Extreme vibration during transport will warp the lead or damage the relay. Handle the outer and inner boxes with care.
2) Storage under extreme conditions will cause soldering degradation, external appearance defects, and deterioration of the characteristics. The following storage conditions are recommended:

- Temperature: 5 to $30^{\circ} \mathrm{C} 41$ to $86^{\circ} \mathrm{F}$
- Humidity: Less than 60\% R.H.
- Atomosphere: No harmful gasses such as sulfurous acid gas, minimal dust.


## 2. Short across terminals

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

## 3. 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 be low the reverse breakdown voltage.

## 4. Recommended load voltage

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

1) Power photoMOS relays

| Type |  | Absolute maximum rating |  | Recommended load voltage |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Load voltage | Load current |  |
| $\begin{aligned} & 0 \\ & \stackrel{0}{\mathrm{O}} \\ & \mathrm{O} \\ & \mathrm{O} \\ & \mathrm{O} \end{aligned}$ | AQZ202 | $\begin{gathered} \hline \text { Peak AC } \\ 60 \mathrm{~V} \end{gathered}$ | $\begin{gathered} \hline \text { Peak AC } \\ 3.0 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 12 \mathrm{~V} \mathrm{AC} ; 5, \\ & 12,24 \mathrm{~V} \text { DC } \end{aligned}$ |
|  | AQZ205 | $\begin{gathered} \text { Peak AC } \\ 100 \mathrm{~V} \end{gathered}$ | $\begin{gathered} \hline \text { Peak AC } \\ 2.0 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 24 \mathrm{~V} \mathrm{AC} \\ & 48 \mathrm{~V} \text { DC } \end{aligned}$ |
|  | AQZ207 | $\begin{gathered} \hline \text { Peak AC } \\ 200 \mathrm{~V} \\ \hline \end{gathered}$ | $\begin{gathered} \hline \text { Peak AC } \\ 1.0 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 48 \mathrm{~V} \mathrm{AC} \\ & 100 \mathrm{~V} \mathrm{DC} \end{aligned}$ |
|  | AQZ204 | $\begin{gathered} \text { Peak AC } \\ 400 \mathrm{~V} \end{gathered}$ | $\begin{gathered} \hline \text { Peak AC } \\ 0.5 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 100 \mathrm{~V} \mathrm{AC} \\ & 200 \mathrm{~V} \mathrm{DC} \end{aligned}$ |
| $\begin{aligned} & 0 \\ & \stackrel{\circ}{\mathrm{D}} \\ & \mathrm{O} \\ & \hline \end{aligned}$ | AQZ102 | 60 V DC | 4.0 A DC | $\begin{aligned} & 5,12,24 \mathrm{~V} \\ & \mathrm{DC} \end{aligned}$ |
|  | 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 |

2) Power PhotoMOS relay high capacity type

| Type |  | Absolute maximum rating |  | Recommended load voltage |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Load voltage | Load current |  |
| $$ | AQZ262 | Peak AC, DC 60V | $\begin{gathered} \text { Peak AC, } \\ \text { DC 6A } \\ \hline \end{gathered}$ | $\begin{array}{\|l\|} \hline 12 \mathrm{~V} \mathrm{AC} \\ 5,12,24 \mathrm{~V} \mathrm{DC} \\ \hline \end{array}$ |
|  | AQZ264 | Peak AC, DC 400V | Peak AC, DC 1A | $\begin{aligned} & \text { AC100V } \\ & \text { DC200V } \end{aligned}$ |

3) Power photoMOS relays (Voltage sensitive type)

| Type |  | Absolute maximum rating |  | Recommended load voltage |
| :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \text { Load } \\ \text { voltage } \end{gathered}$ | $\begin{aligned} & \text { Load } \\ & \text { current } \end{aligned}$ |  |
| $$ | AQZ202D | $\begin{aligned} & \text { Peak AC } \\ & 60 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & \text { Peak AC } \\ & 2.7 \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 12 \mathrm{VAC} ; 5, \\ & 12,24 \mathrm{~V} \text { DC } \end{aligned}$ |
|  | AQZ205D | $\begin{gathered} \text { Peak AC } \\ 100 \mathrm{~V} \\ \hline \end{gathered}$ | $\begin{gathered} \text { Peak AC } \\ 1.8 \mathrm{~A} \\ \hline \end{gathered}$ | $\begin{aligned} & 24 \mathrm{~V} \mathrm{AC} \\ & 48 \mathrm{~V} \mathrm{DC} \\ & \hline \end{aligned}$ |
|  | AQZ207D | $\begin{gathered} \text { Peak AC } \\ 200 \mathrm{~V} \end{gathered}$ | $\begin{gathered} \text { Peak AC } \\ 0.9 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 48 \mathrm{~V} \mathrm{AC} \\ & 100 \mathrm{~V} \mathrm{DC} \end{aligned}$ |
|  | AQZ204D | $\begin{gathered} \text { Peak AC } \\ 400 \mathrm{~V} \\ \hline \end{gathered}$ | $\begin{gathered} \text { Peak AC } \\ 0.45 \mathrm{~A} \\ \hline \end{gathered}$ | $\begin{aligned} & 100 \mathrm{~V} \mathrm{AC} \\ & 200 \mathrm{~V} \mathrm{DC} \\ & \hline \end{aligned}$ |
| $\begin{aligned} & 00 \\ & \\ & 0 \\ & 0 \end{aligned}$ | AQZ102D | 60 V DC | 3.6 A DC | $\begin{aligned} & 5,12,24 \mathrm{~V} \\ & \mathrm{DC} \end{aligned}$ |
|  | 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 |

4) Power photoMOS relays with internal varistor type

| Type |  | Absolute maximum rating |  | Recommended load voltage |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Load voltage | Load current |  |
|  | AQZ202V | $\begin{aligned} & \hline 17 \mathrm{~V} \mathrm{AC} \\ & 22 \mathrm{~V} \mathrm{DC} \end{aligned}$ | $\begin{gathered} \text { Peak AC } \\ 3.0 \mathrm{~A} \\ \hline \end{gathered}$ | $\begin{aligned} & \hline 12 \mathrm{~V} \mathrm{AC} ; \\ & 5,12 \mathrm{~V} \mathrm{DC} \\ & \hline \end{aligned}$ |
|  | AQZ205V | $\begin{aligned} & \hline 30 \mathrm{~V} \mathrm{AC} \\ & 38 \mathrm{~V} \mathrm{DC} \end{aligned}$ | $\begin{gathered} \hline \text { Peak AC } \\ 2.0 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 24 \mathrm{~V} \mathrm{AC} \\ & 48 \mathrm{~V} \mathrm{DC} \end{aligned}$ |
|  | AQZ207V | $\begin{aligned} & 60 \mathrm{~V} \mathrm{AC} \\ & 85 \mathrm{~V} D C \end{aligned}$ | $\begin{array}{c\|} \hline \text { Peak AC } \\ 1.0 \mathrm{~A} \end{array}$ | $\begin{aligned} & 48 \mathrm{~V} \mathrm{AC} \\ & 100 \mathrm{~V} \mathrm{DC} \end{aligned}$ |
|  | AQZ204V | $\begin{aligned} & 140 \mathrm{~V} \mathrm{AC} \\ & 180 \mathrm{~V} \text { DC } \end{aligned}$ | $\begin{gathered} \text { Peak AC } \\ 0.5 \mathrm{~A} \end{gathered}$ | $\begin{aligned} & 100 \mathrm{~V} \mathrm{AC} \\ & 200 \mathrm{~V} \text { DC } \end{aligned}$ |

5.-1) Ripple in the input power supply (Standard type and high capacity type and internal varistor type)
If ripple is present in the input power supply, observe the following:

1) For LED operate current at $E_{\text {min }}$, maintain min. 5 mA
2) Keep the LED operate current at 50 $m A$ or less at $E_{\text {max }}$.

## 5.-2) Ripple in the input power supply

 (Voltage sensitive type)If ripple is present in the input power supply, observe the following:

1) For input voltage at Emin, maintain min. 4 V
2) Keep input voltage at 30 V or less at Emax.


## 6. 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 are shown below.


Does not include the internal varistor 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.

## 7. Adjacent mounting

1) When relays are mounted close together with the heat-generated devices, ambient temperature may rise abnormally. Mounting layout and ventilation should be considered.
2) When many relays are mounted close together, load current should be reduced. (Refer to the date of "Load current vs. ambient temperature characteristics in adjacent mounting.")

## 8. Cleaning solvents compatibility

Dip cleaning with an organic solvent is recommended for removal of solder flux, dust, etc. Select a cleaning solvent from the following table. If ultrasonic cleaning must be used, the severity of factors such as frequency, output power and cleaning solvent selected may cause loose wires and other defects. Make sure these conditions are correct before use. For details, please consult us.

| Cleaning solvent |  | Compatibility <br> $\binom{$ O: Yes }{$\times:$ No } |
| :--- | :--- | :---: |
| Chlorine- <br> base | I.I.I. Trichloroethlene <br> (Chloroethlene) <br> Trichloroethlene <br> (Trichlene) <br> • Perchloroethlene <br> - Methlene chloride | $\bigcirc$ |
| Adueous | - Indusco 624, 1000 <br> - Hollis 310 <br> - Lonco Terg | $\bigcirc$ |
| Alcohol- <br> base | - IPA <br> • Ethanol | $\bigcirc$ |
| Others | • Thinner <br> • Gasoline | $\times$ |

## 9. Soldering

When soldering PC board terminals, keep soldering time to within 10 s at $260^{\circ} \mathrm{C} 500^{\circ} \mathrm{F}$.

## 10. Packing style



The power photoMOS relays are stick packed so that the number 1 terminal is in the direction of stopper B.
One stick contains 25 power photoMOS relays.

## 11. Transport and storage

1) If the product is subject to extreme vibration during transport, the lead may warp or the main unit may become damaged. Handle the outer and inner boxes with care.
2) If the storage environment is extremely bad, it may give rise to deterioration of the soldering, external appearance defects, and degradation the characteristics of the product. The following conditions are recommended for the storage location:

- Temperature: 5 to $30^{\circ} \mathrm{C} 41$ to $86^{\circ} \mathrm{F}$
- Humidity: Less than 60\% RH
- Environment: No hazardous substances such as sulfurous acid gases, and little dust.


## PhotoMOS Relays 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 relays 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.


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 relays are capable of controlling small level (millivolts at microamperes) AC or DC signals.


## 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 relays are recommended for measurement scanning functions, automatic zero-point compensation to eliminate zero-point error, and measurement sequence interfaces (e.g. alarm interface.)



Medical equipment

Medical equipment which processes low level signals includes electrocardiographs, electroencephalographs, and X-ray CT scanners. PhotoMOS relays 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.


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 relays 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.


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 relays 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 relays decreases the mounting area requirements, resulting in more compact programmable controllers.


Security
Equipment

There are many types of security systems from home and office security to building security. PhotoMOS relays 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 .


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 relays 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.



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

If you would like to control small analog $\quad\left\{\quad\left\{\begin{array}{l}\text { PhotoMOS relays feature low offset voltages and on resistances of } 0.25 \Omega \text { or }\end{array}\right.\right.$ signals with a photocoupler and solid-state relays. less. (AQV251 Connection)

If you require a device with a small leakage current (as opposed to bipolar devices having large internal leakage currents).

- PhotoMOS relays 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 relays 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 relays 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 $A C$ control that is resistant to ambient temperature changes and input signal noise.

PhotoMOS relays 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 $80^{\circ} \mathrm{C} 176^{\circ} \mathrm{F}$.

## PhotoMOS Relay Application Examples

High Response Speed


Capacitor Switch Circuit


Scanner


## Part No. vs. Load Voltage Quick Reference

PhotoMOS Relays

| Form A Type |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Group name | Part No. | Package style | Number of channels | Load voltage | 40 V | 60 V | $\begin{gathered} 100 \mathrm{~V} \\ (\mathrm{RF}: 80 \mathrm{~V}) \\ \hline \end{gathered}$ | 200 V | 250 V | 350 V | 400 V | 600 V | 1000 V | 1500 V |
|  |  |  |  | Third digit | 1 | 2 | 5 | 7 | 3 | 0 | 4 | 6 | 9 | 8 |
| HE | AQV25O | DIP | 1-channel | Standard Viso | AQV251 | AQV252 | AQV255 | AQV257 | AQV253 |  | AQV254 AQV254R |  | AQV259 | AQV258 |
|  |  |  |  | High Viso |  |  |  |  | AQV253H |  | AQV254H |  |  |  |
|  | AQW250 |  | 2-channels | Standard Viso |  |  |  |  |  |  | AQW254 |  |  |  |
| HE Soft ON/OFF type | AQV25OM | DIP | 1-channel | Standard Viso |  |  |  | AQV257M |  |  |  |  |  |  |
| GU | AQV21O | DIP | 1-channel | Standard Viso |  | AQV212 | AQV215 | AQV217 |  | AQV210 | AQV214 | AQV216 |  |  |
|  |  |  |  | High Viso |  |  |  |  |  |  | AQV214H |  |  |  |
|  | AQW21O |  | 2-channels | $\begin{gathered} \text { Standard } \\ \text { Viso } \end{gathered}$ |  | AQW212 | AQW215 | AQW217 |  | AQW210 | AQW214 | AQW216 |  |  |
|  | AQX2144O | SIL | 4-channels | Standard Viso |  |  |  |  |  |  | AQX21444 |  |  |  |
|  | AQY21OS | SOP | $\begin{gathered} \text { 1-channel } \\ \text { (4 pin) } \\ \hline \end{gathered}$ | $\begin{gathered} \text { Standard } \\ \text { Viso } \end{gathered}$ |  |  |  |  |  | AQY210S | AQY214S |  |  |  |
|  | AQV21OS |  | $\begin{gathered} \text { 1-channel } \\ (6 \mathrm{pin}) \\ \hline \end{gathered}$ | $\begin{gathered} \text { Standard } \\ \text { Viso } \end{gathered}$ |  | AQV212S | AQV215S | AQV217S |  | AQV210S | AQV214S | AQV216S |  |  |
|  | AQW21OS |  | 2-channels | $\begin{gathered} \text { Standard } \\ \text { Viso } \end{gathered}$ |  |  |  |  |  | AQW210S | AQW214S |  |  |  |
|  | AQW21OTS | SOP | 2-channels (MOSFET+ optocoupler) | Standard Viso |  |  |  |  |  | AQW210TS |  |  |  |  |
|  | $\begin{aligned} & \text { AQW21O } \\ & \text { T2S } \end{aligned}$ |  | 3-channels <br> (MOSFET+ <br> 2optocouplers) | Standard Viso |  |  |  |  |  | AQW210T2S |  |  |  |  |
| GU-E | AQV21OE | DIP | 1-channel | Standard Viso |  |  |  |  |  | AQV210E | AQV214E |  |  |  |
|  |  |  |  | High Viso |  |  |  |  |  | AQV210EH | AQV214EH |  |  |  |
| RF | AQV22O | DIP | 1-channel | Standard Viso | AQV221 |  | AQV225 |  |  |  |  |  |  |  |
| $\begin{gathered} \text { RF } \\ \text { Low-ON } \\ \text { type } \end{gathered}$ | AQV22ON | DIP | 1-channel | $\begin{gathered} \text { Standard } \\ \text { Viso } \\ \hline \end{gathered}$ |  |  | AQV225N | AQV227N |  |  | AQV224N |  |  |  |
|  | AQW22ON |  | 2-channels | $\begin{aligned} & \text { Standard } \\ & \text { Viso } \end{aligned}$ |  |  | AQW225N | AQW227N |  |  | AQW224N |  |  |  |
|  | AQV22ONS | SOP | 1-channel | $\begin{array}{\|c} \hline \text { Standard } \\ \text { Viso } \end{array}$ |  |  | AQV225NS | AQV227NS |  |  | AQV224NS |  |  |  |
| HS | AQV23O | DIP | 1-channel | Standard Viso |  |  |  |  |  |  | AQV234 |  |  |  |
| HF | AQV100 | DIP | 1-channel | Standard Viso | AQV101 | AQV102 |  |  | AQV103 |  | AQV104 |  |  |  |
|  | AQV200 |  | 1-channel | Standard Viso | AQV201 | AQV202 |  |  | AQV203 |  | AQV204 |  |  |  |
| PD | AQY27O | DIP | 1-channel | $\begin{gathered} \hline \text { Standard } \\ \text { Viso } \end{gathered}$ |  | AQY272 | AQY275 | AQY277 |  |  | AQY274 |  |  |  |

## Form B Type

| Group name | Part No. | Package style | Number of channels | Load voltage | 300 V | 400 V |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Third digit | 3 | 4 |
| HE | AQV45 | DIP | 1-channel | Standard Viso | AQV453 | AQV454 |
|  |  |  |  | High Viso |  | AQV454H |
|  | AQW45O |  | 2-channels | Standard Viso |  | AQW454 |
| GU | AQV41O | DIP | 1-channel | Standard Viso |  | AQV414 |
|  | AQW41O |  | 2-channels | Standard Viso |  | AQW414 |
|  | AQY41OS | SOP | $\begin{gathered} \text { 1-channel } \\ \text { (4-pin) } \\ \hline \end{gathered}$ | Standard Viso |  | AQY414S |
|  | AQV41OS |  | $\begin{array}{\|c\|} \hline \text { 1-channel } \\ \text { (6-pin) } \\ \hline \end{array}$ | Standard Viso |  | AQV414S |
| GU-E | AQV41OE | DIP | 1-channel | Standard Viso |  | AQV414E |
|  |  |  |  | High Viso |  | AQV414EH |

## Form A Form B Type

| Group name | Part No. | Package style | Number of channel | Load voltage | 400 V |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Third digit | 4 |
| HE | AQW65O | DIP | 2-channel | Standard Viso | AQW654 |
| GU | AQW61O | DIP | 2-channel | Standard Viso | AQW614 |

## Power PhotoMOS Relays

## Form A Type

| Group name | Part No. | Package style | Number of channels | Load voltage | 40 V | 60 V | 100 V | 200 V | 250 V | 350 V | 400 V |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Third digit | 1 | 2 | 5 | 7 | 3 | 0 | 4 |
| Standard type | AQZ100 | SIL | 1-channel | StandardViso |  | AQZ102 | AQZ105 | AQZ107 |  |  | AQZ104 |
|  | AQZ200 |  |  |  |  | AQZ202 | AQZ205 | AQZ207 |  |  | AQZ204 |
| Varistor incorporated type | AQZ200V |  |  |  |  | AQZ202V | AQZ205V | AQZ207V |  |  | AQZ204V |
| Voltage sensitive type | AQZ100D |  |  |  |  | AQZ102D | AQZ105D | AQZ107D |  |  | AQZ104D |
|  | AQZ200D |  |  |  |  | AQZ202D | AQZ205D | AQZ207D |  |  | AQZ204D |
| High capacity type | AQZ26O |  |  |  |  | AQZ262 |  |  |  |  | AQZ264 |

O stands for third digit.
Notes: 1. Standard Viso: 1,500 V between I/O. 2.High Viso: 5,000 V between I/O.


[^0]:    *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. $\mathrm{E}_{1}$ : Power source at input side; $\mathrm{V}_{\mathbf{I N}}$ : Input voltage; $\mathrm{IF}_{\mathrm{F}}$ : LED forward current; $\mathrm{V}_{\mathrm{L}}$ : Load voltage; L : Load current; R: Current limit resistor.
    2. Method of connecting the load at the output is devided into 3 types.

