

Both low on-resistance and good cost-performance achieved.

PhotoMOS<sup>®</sup>  
HE 1 Form A  
(AQV25○)

## FEATURES

1. Wide variation of 40V, 60V, 100V, 200V, 250V, 400V, 600V, 1,000V and 1,500V load voltage
2. Low on-resistance of typ. 0.6Ω (AQV251)
3. Reinforced insulation type of 5,000V I/O isolation available

## TYPICAL APPLICATIONS

- Measuring instruments
- Data communication equipment
- Telephone equipment
- Automatic meter reading device



RoHS compliant

## TYPES

|                | I/O isolation     | Output rating* |        | Package  | Part No.              |                        |                                |                                | Packing quantity                                       |               |
|----------------|-------------------|----------------|--------|----------|-----------------------|------------------------|--------------------------------|--------------------------------|--|---------------|
|                |                   |                |        |          | Through hole terminal | Surface-mount terminal |                                |                                | Tube   | Tape and reel |
|                |                   |                |        |          |                       | Tube packing style     | Tape and reel packing style    |                                |  |               |
|                |                   |                |        |          |                       |                        | Picked from the 1/2/3-pin side | Picked from the 4/5/6-pin side |  |               |
| AC/DC dual use | 1,500V            | 40 V           | 500 mA | DIP6-pin | AQV251                | AQV251A                | AQV251AX                       | AQV251AZ                       | 1 tube contains: 50 pcs.<br>1 batch contains: 500 pcs. | 1,000 pcs.    |
|                |                   | 60 V           | 400 mA |          | AQV252                | AQV252A                | AQV252AX                       | AQV252AZ                       |  |               |
|                |                   | 100 V          | 350 mA |          | AQV255                | AQV255A                | AQV255AX                       | AQV255AZ                       |  |               |
|                |                   | 200 V          | 250 mA |          | AQV257                | AQV257A                | AQV257AX                       | AQV257AZ                       |  |               |
|                |                   | 250 V          | 200 mA |          | AQV253                | AQV253A                | AQV253AX                       | AQV253AZ                       |  |               |
|                |                   | 400 V          | 150 mA |          | AQV254                | AQV254A                | AQV254AX                       | AQV254AZ                       |  |               |
|                |                   | 1,000 V        | 30 mA  |          | AQV259                | AQV259A                | AQV259AX                       | AQV259AZ                       |  |               |
|                |                   | 1,500 V        | 20 mA  |          | AQV258                | AQV258A                | AQV258AX                       | AQV258AZ                       |  |               |
|                | Reinforced 5,000V | 250 V          | 200 mA |          | AQV253H               | AQV253HA               | AQV253HAX                      | AQV253HAZ                      |  |               |
|                |                   | 400 V          | 150 mA |          | AQV254H               | AQV254HA               | AQV254HAX                      | AQV254HAZ                      |  |               |
|                |                   | New 600 V      | 130 mA |          | AQV256H               | AQV256HA               | AQV256HAX                      | AQV256HAZ                      |  |               |
|                |                   |                |        |          |                       |                        |                                |                                |  |               |

\*Indicate the peak AC and DC values.

Note: The surface mount terminal indicator "A" and the packing style indicator "X" or "Z" are not marked on the device.

## RATING

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

| Item               | Symbol                  | Type of connection | AQV251(A)                       | AQV252(A)           | AQV255(A)      | AQV257(A) | AQV253(A) | AQV254(A) | AQV259(A)  | AQV258(A) | AQV253H(A) | AQV254H(A) | AQV256H(A) | Remarks   |                           |
|--------------------|-------------------------|--------------------|---------------------------------|---------------------|----------------|-----------|-----------|-----------|------------|-----------|------------|------------|------------|---|---------------------------|
|                    |                         |                    | Input                           | LED forward current | I <sub>F</sub> | 50 mA     |           |           |            |           |            |            |            |   |                           |
|                    | LED reverse voltage     | V <sub>R</sub>     | 5 V                             |                     |                |           |           |           |            |           |            |            |            |   |                           |
|                    | Peak forward current    | I <sub>FP</sub>    | 1 A                             |                     |                |           |           |           |            |           |            |            |            | f = 100 Hz,<br>Duty factor +0.1%                  |                           |
|                    | Power dissipation       | P <sub>in</sub>    | 75 mW                           |                     |                |           |           |           |            |           |            |            |            |   |                           |
| Output             | Load voltage (peak AC)  | V <sub>L</sub>     | 40V                             | 60V                 | 100V           | 200V      | 250V      | 400V      | 1,000V     | 1,500V    | 250V       | 400V       | 600V       |   |                           |
|                    | Continuous load current | I <sub>L</sub>     | A                               | 0.5A                | 0.4A           | 0.35A     | 0.25A     | 0.2A      | 0.15A      | 0.03A     | 0.02A      | 0.2A       | 0.15A      | 0.13A   | A connection: Peak AC, DC |
|                    |                         |                    | B                               | 0.7A                | 0.6A           | 0.45A     | 0.35A     | 0.3A      | 0.18A      | 0.04A     | 0.025A     | 0.3A       | 0.18A      | 0.14A   | B, C connection: DC       |
|                    |                         |                    | C                               | 1.0A                | 0.8A           | 0.70A     | 0.5A      | 0.4A      | 0.25A      | 0.05A     | 0.04A      | 0.4A       | 0.25A      | 0.16A   |                           |
|                    | Peak load current       | I <sub>peak</sub>  | 1.8A                            | 1.5A                | 1.0A           | 0.75A     | 0.6A      | 0.5A      | 0.09A      | 0.06A     | 0.6A       | 0.5A       | 0.4A       | A connection: 100 ms (1 shot) V <sub>L</sub> = DC |                           |
|                    | Power dissipation       | P <sub>out</sub>   | 360 mW                          |                     |                |           |           |           |            |           |            |            |            |   |                           |
|                    | Total power dissipation | P <sub>T</sub>     | 410 mW                          |                     |                |           |           |           |            |           |            |            |            |   |                           |
|                    | I/O isolation voltage   | V <sub>iso</sub>   | 1,500 V AC                      |                     |                |           |           |           | 5,000 V AC |           |            |            |            |   |                           |
| Temperature limits | Operating               | T <sub>opr</sub>   | -40°C to +85°C -40°F to +185°F  |                     |                |           |           |           |            |           |            |            |            | Non-condensing at low temperatures                |                           |
|                    | Storage                 | T <sub>stg</sub>   | -40°C to +100°C -40°F to +212°F |                     |                |           |           |           |            |           |            |            |            |   |                           |

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

| Item                             |                      | Sym-<br>bol       | Type of<br>con-<br>nection | AQV251(A)                                | AQV252(A) | AQV255(A) | AQV257(A) | AQV253(A) | AQV254(A) | AQV259(A) | AQV258(A) | AQV253H(A) | AQV254H(A) | AQV256H(A)                                     | Condition                                      |   |                        |
|----------------------------------|----------------------|-------------------|----------------------------|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|--|--|---|------------------------|
| Input                            | LED operate current  | Typical           | I <sub>Fon</sub>           | 0.9 mA                                   |           |           |           |           |           |           |           | 1.4 mA     |            |  | I <sub>L</sub> = Max.                          |   |                        |
|                                  |                      | Maximum           |                            | 3 mA                                     |           |           |           |           |           |           |           |            |            |  |  |   |                        |
|                                  | LED turn off current | Minimum           | I <sub>Foff</sub>          | 0.4 mA                                   |           |           |           |           |           |           |           |            |            |  |  |   | I <sub>L</sub> = Max.  |
|                                  |                      | Typical           |                            | 0.8 mA                                   |           |           |           |           |           |           |           | 1.3 mA     |            |  |  |   |                        |
| LED dropout voltage              | Typical              | V <sub>F</sub>    | —                          | 1.25 V (1.14 V at I <sub>F</sub> = 5 mA) |           |           |           |           |           |           |           |            |            |  |  |   | I <sub>F</sub> = 50 mA |
|                                  | Maximum              |                   |                            | 1.5 V                                    |           |           |           |           |           |           |           |            |            |  |  |   |                        |
| Output                           | On resistance        | Typical           | R <sub>on</sub>            | A  | 0.6 Ω     | 0.74 Ω    | 1.8 Ω     | 2.6 Ω     | 5.5 Ω     | 12.4 Ω    | 85 Ω      | 345 Ω      | 5.5 Ω      | 12.4 Ω   | 20 Ω   | I <sub>F</sub> = 5 mA<br>I <sub>L</sub> = Max.<br>Within 1 s<br>on time |                        |
|                                  |                      | Maximum           |                            |  | 1 Ω       | 1.4 Ω     | 2.5 Ω     | 4 Ω       | 8 Ω       | 16 Ω      | 200 Ω     | 500 Ω      | 8 Ω        | 16 Ω   | 30 Ω   |   |                        |
|                                  |                      | Typical           | R <sub>on</sub>            | B  | 0.35 Ω    | 0.37 Ω    | 0.9 Ω     | 1.4 Ω     | 2.7 Ω     | 6.2 Ω     | 60 Ω      | 345 Ω      | 2.7 Ω      | 6.2 Ω  | 15 Ω   | I <sub>F</sub> = 5 mA<br>I <sub>L</sub> = Max.<br>Within 1 s<br>on time |                        |
|                                  |                      | Maximum           |                            |  | 0.5 Ω     | 0.7 Ω     | 1.25 Ω    | 2 Ω       | 4 Ω       | 8 Ω       | 100 Ω     | 500 Ω      | 4 Ω        | 8 Ω  | 20 Ω   |   |                        |
|                                  |                      | Typical           | R <sub>on</sub>            | C  | 0.15 Ω    | 0.18 Ω    | 0.45 Ω    | 0.7 Ω     | 1.4 Ω     | 3.1 Ω     | 30 Ω      | 160 Ω      | 1.4 Ω      | 3.1 Ω  | 7.5 Ω  | I <sub>F</sub> = 5 mA<br>I <sub>L</sub> = Max.<br>Within 1 s<br>on time |                        |
|                                  |                      | Maximum           |                            |  | 0.25 Ω    | 0.35 Ω    | 0.63 Ω    | 1 Ω       | 2 Ω       | 4 Ω       | 50 Ω      | 250 Ω      | 2 Ω        | 4 Ω  | 10 Ω   |   |                        |
| Off state leakage current        | Maximum              | I <sub>Leak</sub> | —                          | 1 μA                                     |           |           |           |           |           | 10 μA     |           | 1 μA       |            |  | I <sub>F</sub> = 0 mA<br>V <sub>L</sub> = Max. |   |                        |
| Transfer characteristics         | Turn on time*        | Typical           | T <sub>on</sub>            | 1.7 ms                                   | 1.4 ms    | 0.9 ms    | 1.5 ms    | 0.8 ms    | 0.6 ms    | 0.35 ms   | 2.4 ms    | 1.8 ms     | 1.2 ms     | I <sub>F</sub> = 5 mA<br>I <sub>L</sub> = Max. |  |   |                        |
|                                  |                      | Maximum           |                            | 3 ms                                     |           | 2 ms      | 3 ms      | 2 ms      | 1 ms      |           | 4 ms      | 3ms        |            |  |  |   |                        |
|                                  | Turn off time*       | Typical           | T <sub>off</sub>           | —  | 0.07 ms   | 0.09 ms   | 0.1 ms    | 0.06 ms   | 0.05 ms   | 0.04 ms   |           | 0.06 ms    | 0.05 ms    | 0.06 ms  | I <sub>F</sub> = 5 mA<br>I <sub>L</sub> = Max. |   |                        |
|                                  |                      | Maximum           |                            | 0.2 ms                                   |           |           |           |           |           |           |           |            |            |  |  |   |                        |
|                                  | I/O capacitance      | Typical           | C <sub>iso</sub>           | —  | 1.3 pF    |           |           |           |           |           |           |            |            |  |  | f = 1 MHz<br>V <sub>B</sub> = 0 V                                       |                        |
| Maximum                          |                      | 3 pF              |                            |  |           |           |           |           |           |           |           |            |            |  |  |   |                        |
| Initial I/O isolation resistance | Minimum              | R <sub>iso</sub>  | —                          | 1,000 MΩ                                 |           |           |           |           |           |           |           |            |            |  | 500 V DC                                       |   |                        |

\*Turn on/Turn off time



## RECOMMENDED OPERATING CONDITIONS

Please obey the following conditions to ensure proper device operation and resetting.

| Item              | Symbol         | Recommended value                                       | Unit |
|-------------------|----------------|---|------|
| Input LED current | I <sub>F</sub> | Standard type: 5<br>Reinforced insulation type: 5 to 10 | mA   |

- For Dimensions.
- For Schematic and Wiring Diagrams.
- For Cautions for Use.

■ These products are not designed for automotive use.

If you are considering to use these products for automotive applications, please contact your local Panasonic Corporation technical representative.  
For more information.

■ Continual DC bias (for AQV258\*\*, AQV259\*\*)

In cases in which a continual DC bias is applied between the input and output, the output-side MOS-FET may deteriorate due to the voltage. Therefore, please verify operation of the actual design before using. An example of a circuit that might undergo MOS-FET deterioration due to voltage is given below.

# HE 1 Form A (AQV25○)

## REFERENCE DATA

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

Allowable ambient temperature:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$   
 $-40^{\circ}\text{F}$  to  $+185^{\circ}\text{F}$ ;

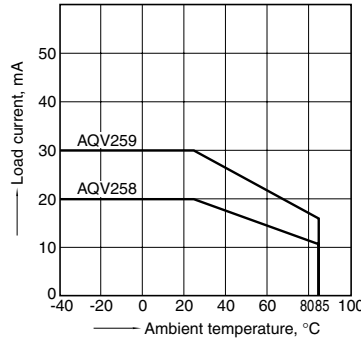
Type of connection: A



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

Allowable ambient temperature:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$   
 $-40^{\circ}\text{F}$  to  $+185^{\circ}\text{F}$ ;

Type of connection: A



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

Measured portion: between terminals 4 and 6;  
 LED current: 5 mA;

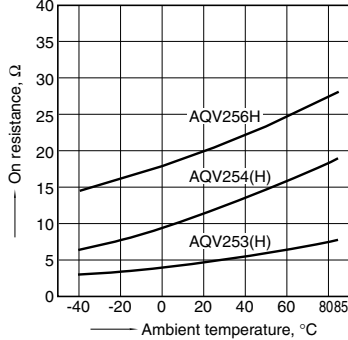
Continuous load current: Max. (DC)



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

Measured portion: between terminals 4 and 6;  
 LED current: 5 mA;

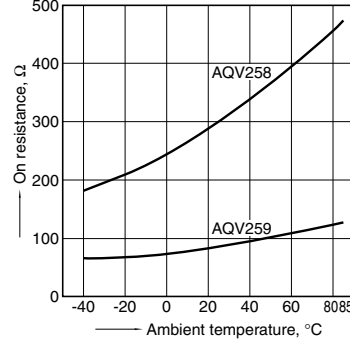
Continuous load current: Max. (DC)



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)

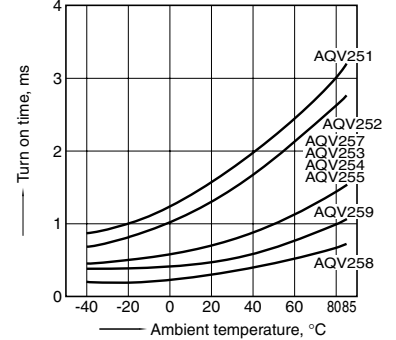


3.-(1) Turn on time vs. ambient temperature characteristics

LED current: 5 mA;

Load voltage: Max. (DC);

Continuous load current: Max. (DC)



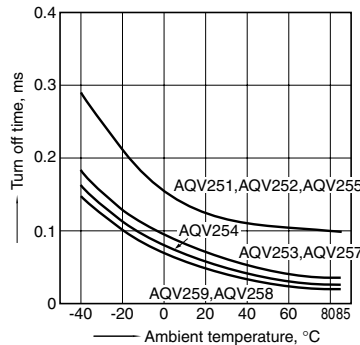
3.-(2) Turn on time vs. ambient temperature characteristics

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



4.-(1) Turn off time vs. ambient temperature characteristics

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



4.-(2) Turn off time vs. ambient temperature characteristics

Sample: AQV253H, AQV254H, AQV256H  
 LED current: 5 mA; Load voltage: Max. (DC);  
 Continuous load current: Max. (DC)



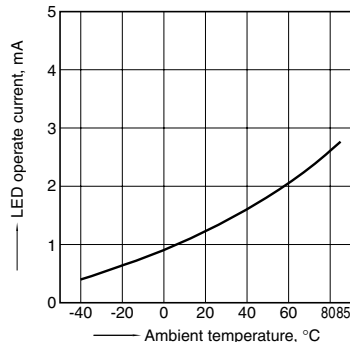
5.-(1) LED operate current vs. ambient temperature characteristics

Sample: AQV251, AQV252, AQV253, AQV254, AQV255, AQV258, AQV259; Load voltage: Max. (DC);  
 Continuous load current: Max. (DC)



5.-(2) LED operate current vs. ambient temperature characteristics

Sample: AQV253H, AQV254H, AQV256H; Load voltage: Max. (DC);  
 Continuous load current: Max. (DC)



6.-(1) LED turn off current vs. ambient temperature characteristics

Sample: AQV251, AQV252, AQV253, AQV254, AQV255, AQV258, AQV259; Load voltage: Max. (DC);  
 Continuous load current: Max. (DC)



## 6.-(2) LED turn off current vs. ambient temperature characteristics

Sample: AQV253H, AQV254H, AQV256H;  
Load voltage: Max. (DC);  
Continuous load current: Max. (DC)



## 7. LED dropout voltage vs. ambient temperature characteristics

LED current: 5 to 50 mA



## 8.-(1) Current vs. voltage characteristics of output at MOS portion

Measured portion: between terminals 4 and 6;  
Ambient temperature: 25°C 77°F



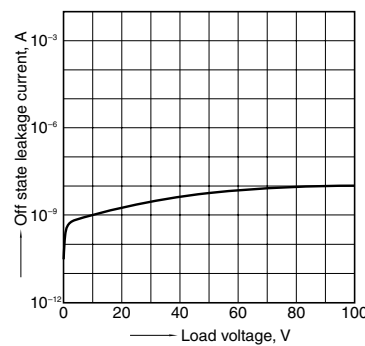
## 8.-(2) Current vs. voltage characteristics of output at MOS portion

Measured portion: between terminals 4 and 6;  
Ambient temperature: 25°C 77°F



## 9.-(1) Off state leakage current vs. load voltage characteristics

Sample: AQV259;  
Measured portion: between terminals 4 and 6;  
Ambient temperature: 25°C 77°F



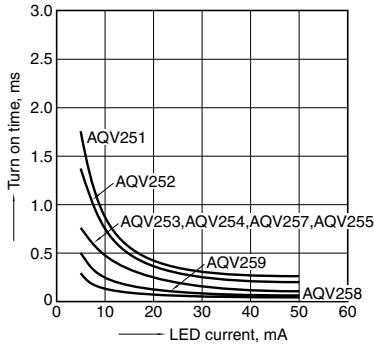
## 9.-(2) Off state leakage current vs. load voltage characteristics

Measured portion: between terminals 4 and 6;  
Ambient temperature: 25°C 77°F



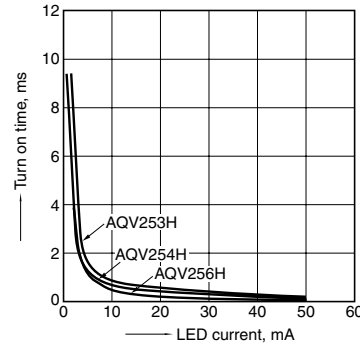
## 10.-(1) Turn on time vs. LED forward current characteristics

Measured portion: between terminals 4 and 6;  
Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



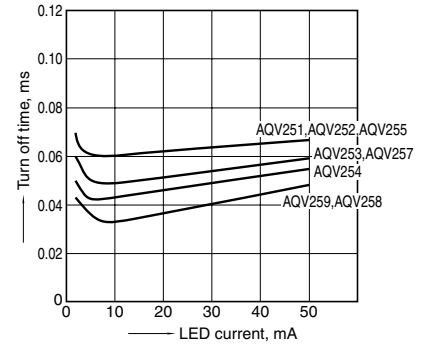
## 10.-(2) Turn on time vs. LED forward current characteristics

Measured portion: between terminals 4 and 6;  
Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



## 11.-(1) Turn off time vs. LED forward current characteristics

Measured portion: between terminals 4 and 6;  
Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



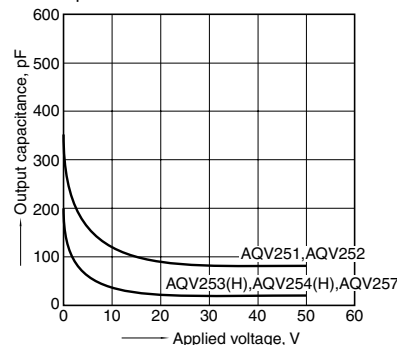
## 11.-(2) Turn off time vs. LED forward current characteristics

Measured portion: between terminals 4 and 6;  
Load voltage: Max. (DC); Continuous load current: Max. (DC); Ambient temperature: 25°C 77°F



## 12.-(1) Output capacitance vs. applied voltage characteristics

Measured portion: between terminals 4 and 6;  
Frequency: 1 MHz;  
Ambient temperature: 25°C 77°F



## 12.-(2) Output capacitance vs. applied voltage characteristics

Sample: AQV259;  
Measured portion: between terminals 4 and 6;  
Frequency: 1 MHz; Ambient temperature: 25°C 77°F



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