



# NAIS

## HF (High Function) Type [1-Channel (Form A) Type]

# PhotoMOS RELAYS

### FEATURES

- 1. Controls low-level analog signals**  
PhotoMOS relays feature extremely low closed-circuit offset voltage to enable control of low-level analog signals without distortion.
- 2. Control with low-level input signals**
- 3. Controls various types of loads such as relays, motors, lamps and solenoids.**
- 4. Optical coupling for extremely high isolation**  
Unlike mechanical relays, the PhotoMOS relay combines LED and optoelectronic device to transfer signals using light for extremely high isolation.
- 5. Eliminates the need for a counter electromotive force protection diode in the drive circuits on the input side**
- 6. Stable on resistance**

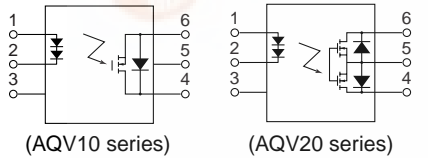
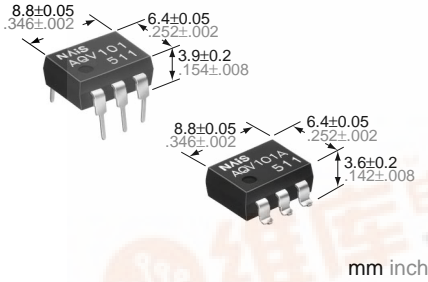
- 7. Low-level off state leakage current**
- 8. Eliminates the need for a power supply to drive the power MOSFET**  
A power supply used to drive the power MOSFET is unnecessary because of the built-in optoelectronic device. This results in easy circuit design and small PC board area.
- 9. Low thermal electromotive force (Approx. 1 μV)**

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

- 5. Eliminates the need for a counter electromotive force protection diode in the drive circuits on the input side**
- 6. Stable on resistance**

### TYPICAL APPLICATIONS

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



### TYPES

#### 1. DC type (AQV10 types)

Output rating*		Part No.				Packing quantity	
		Through hole terminal	Surface-mount terminal				
Load voltage	Load current	Tube packing style		Tape and reel packing style		Tube	Tape and reel
				Picked from the 1/2/3-pin side	Picked from the 4/5/6-pin side		
40 V	700 mA	AQV101	AQV101A	AQV101AX	AQV101AZ	1 tube contains 50 pcs. 1 batch contains 500 pcs.	1,000 pcs
60 V	600 mA	AQV102	AQV102A	AQV102AX	AQV102AZ		
250 V	300 mA	AQV103	AQV103A	AQV103AX	AQV103AZ		
400 V	180 mA	AQV104	AQV104A	AQV104AX	AQV104AZ		

\*Indicate the peak AC and DC values.

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

#### 2. AC/DC type (AQV20 types)

Output rating*		Part No.				Packing quantity	
		Through hole terminal	Surface-mount terminal				
Load voltage	Load current	Tube packing style		Tape and reel packing style		Tube	Tape and reel
				Picked from the 1/2/3-pin side	Picked from the 4/5/6-pin side		
40 V	500 mA	AQV201	AQV201A	AQV201AX	AQV201AZ	1 tube contains 50 pcs. 1 batch contains 500 pcs.	1,000 pcs
60 V	400 mA	AQV202	AQV202A	AQV202AX	AQV202AZ		
250 V	200 mA	AQV203	AQV203A	AQV203AX	AQV203AZ		
400 V	150 mA	AQV204	AQV204A	AQV204AX	AQV204AZ		

\*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. DC type (AQV10 types)

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

Item		Symbol	AQV101(A)	AQV102(A)	AQV103(A)	AQV104(A)	Remarks
Input	LED forward current	$I_F$	50 mA				
	LED reverse voltage	$V_R$	6 V				
	Peak forward current	$I_{FP}$	1 A				f = 100 Hz, Duty factor = 0.1%
	Power dissipation	$P_{in}$	150 mW				
Output	Load voltage (DC)	$V_L$	40 V	60 V	250 V	400 V	
	Continuous load current (DC)	$I_L$	0.7 A	0.6 A	0.3 A	0.18 A	
	Peak load current	$I_{peak}$	1.8 A	1.5 A	0.6 A	0.5 A	100 ms (1 shot)
	Power dissipation	$P_{out}$	360 mW				
Total power dissipation		$P_T$	410 mW				
I/O isolation voltage		$V_{iso}$	1,500 V (AC)				
Temperature limits	Operating	$T_{opr}$	-40°C to +85°C -40°F to +185°F				Non-condensing at low temperatures
	Storage	$T_{stg}$	-40°C to +100°C -40°F to +212°F				

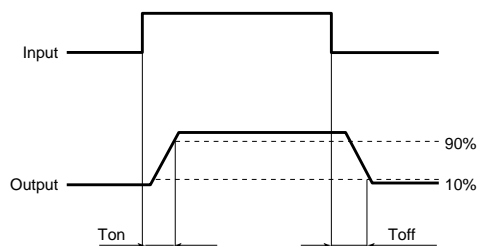
2) Electrical characteristics (Ambient temperature: 25°C 77°F)

Item			Symbol	AQV101(A)	AQV102(A)	AQV103(A)	AQV104(A)	Condition	
Input	LED operate current	Typical	$I_{Fon}$	2.3 mA				$I_L = \text{Max.}$	
		Maximum		5 mA					
	LED turn off current	Minimum	$I_{Foff}$	0.8 mA				$I_L = \text{Max.}$	
		Typical		2.2 mA					
LED dropout voltage	Typical	$V_F$	2.3 V				$I_F = 10 \text{ mA}$		
	Maximum		3 V						
Output	On resistance	Typical	$R_{on}$	0.3 $\Omega$	0.37 $\Omega$	2.7 $\Omega$	6.3 $\Omega$	$I_F = 10 \text{ mA}$ $I_L = \text{Max.}$ Within 1 s on time	
		Maximum		0.5 $\Omega$	0.7 $\Omega$	4 $\Omega$	8 $\Omega$		
	Off state leakage current	Maximum	—	1 $\mu\text{A}$				$I_F = 0, V_L = \text{Max.}$	
Transfer characteristics	Switching speed	Turn on time*	$T_{on}$	0.23 ms	0.22 ms	0.13 ms	0.09 ms	$I_F = 10 \text{ mA}$ $I_L = \text{Max.}$	
				1 ms					
	Turn off time*	$T_{off}$	0.07 ms	0.07 ms	0.07 ms	0.08 ms	$I_F = 10 \text{ mA}$ $I_L = \text{Max.}$		
			1 ms						
	I/O capacitance			$C_{iso}$	1.3 pF				f = 1 MHz
					3 pF				
Initial I/O isolation resistance	Minimum	$R_{iso}$	1,000 M $\Omega$				500 V DC		

Note: Recommendable LED forward current  $I_F = 10 \text{ mA}$ .

For type of connection, see page 31.

\*Turn on/Turn off time



# AQV100, 200

## 2. AC/DC type (AQV20 types)

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

Item		Symbol	Type of connection	AQV201(A)	AQV202(A)	AQV203(A)	AQV204(A)	Remarks
Input	LED forward current	$I_F$		50 mA				f = 100 Hz, Duty factor = 0.1%
	LED reverse voltage	$V_R$		6 V				
	Peak forward current	$I_{FP}$		1 A				
	Power dissipation	$P_{in}$		150 mW				
Output	Load voltage (peak AC)	$V_L$		40 V	60 V	250 V	400 V	A connection: Peak AC, DC B, C connection: DC
	Continuous load current	$I_L$	A	0.5 A	0.4 A	0.2 A	0.15 A	
			B	0.7 A	0.6 A	0.3 A	0.18 A	
			C	1.0 A	0.8 A	0.4 A	0.25 A	
	Peak load current	$I_{peak}$		1.8 A	1.5 A	0.6 A	0.5 A	A connection 100 ms (1 shot) $V_L = DC$
Power dissipation	$P_{out}$		360 mW					
Total power dissipation		$P_T$		410 mW				
I/O isolation voltage		$V_{iso}$		1,500 V AC				
Temperature limits	Operating	$T_{opr}$		-40°C to +85°C -40°F to +185°F				Non-condensing at low temperature
	Storage	$T_{stg}$		-40°C to +100°C -40°F to +212°F				

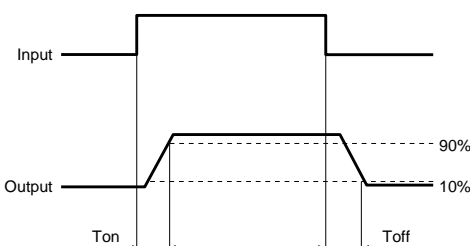
2) Electrical characteristics (Ambient temperature: 25°C 77°F)

Item		Symbol	Type of connection	AQV201(A)	AQV202(A)	AQV203(A)	AQV204(A)	Remarks	
Input	LED operate current	Typical	$I_{Fon}$	2.4 mA				$I_L = Max.$	
		Maximum		5 mA					
	LED turn off current	Minimum	$I_{Foff}$	0.8 mA				$I_L = Max.$	
		Typical		2.2 mA					
LED dropout voltage	Typical	$V_F$	2.3 V				$I_F = 10 mA$		
	Maximum		3 V						
Output	On resistance	Typical	$R_{on}$	A	0.6 Ω	0.74 Ω	5.5 Ω	12.4 Ω	$I_F = 10 mA$ $I_L = Max.$ Within 1 s on time
		Maximum		1 Ω	1.4 Ω	8 Ω	16 Ω		
		Typical	$R_{on}$	B	0.3 Ω	0.37 Ω	2.7 Ω	6.2 Ω	$I_F = 10 mA$ $I_L = Max.$ Within 1 s on time
		Maximum		0.5 Ω	0.7 Ω	4 Ω	8 Ω		
	Typical	$R_{on}$	C	0.15 Ω	0.18 Ω	1.4 Ω	3.1 Ω	$I_F = 10 mA$ $I_L = Max.$ Within 1 s on time	
	Maximum		0.25 Ω	0.35 Ω	2 Ω	4 Ω			
Off state leakage current	Maximum	—	—	1 μA				$I_F = 0, V_L = Max.$	
Transfer characteristics	Switching speed	Turn on time*	$T_{on}$	Typical	0.38 ms	0.41 ms	0.21 ms	0.18 ms	$I_F = 10 mA$ $I_L = Max.$
		Maximum		1 ms					
	Turn off time*	Typical	$T_{off}$	—	0.08 ms	0.08 ms	0.07 ms	0.07 ms	$I_F = 10 mA$ $I_L = Max.$
		Maximum		1 ms					
	I/O capacitance	Typical	$C_{iso}$	—	1.3 pF				f = 1 MHz
Maximum	3 pF								
Initial I/O isolation resistance	Minimum	$R_{iso}$	—	1,000 MΩ				500 V DC	

Note: Recommendable LED forward current  $I_F = 10 mA$ .

For type of connection, see page 31.

\*Turn on/Turn off time



■ For Dimensions, see Page 27.

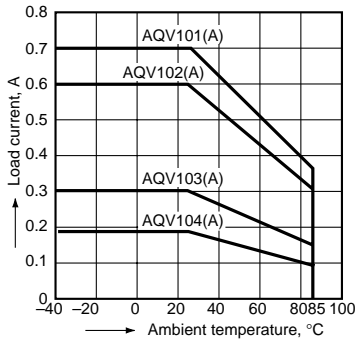
■ For Schematic and Wiring Diagrams, see Page 31.

■ For Cautions for Use, see Page 36.

REFERENCE DATA

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

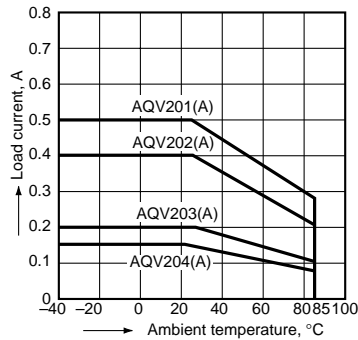
Allowable ambient temperature: -40°C to +85°C  
-40°F to +185°F



1.-(2) Load current vs. ambient temperature characteristics (AC/DC type)

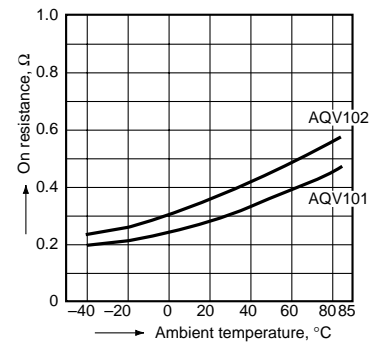
Allowable ambient temperature: -40°C to +85°C  
-40°F to +185°F

Type of connection: A



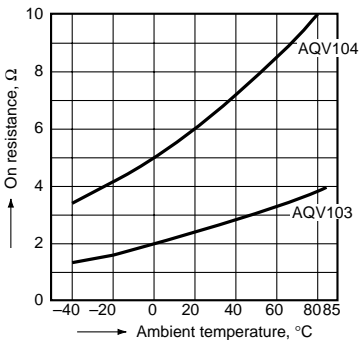
2.-(1) On resistance vs. ambient temperature characteristics (DC type: AQV101, AQV102)

LED current: 10 mA;  
Continuous load current: Max. (DC)



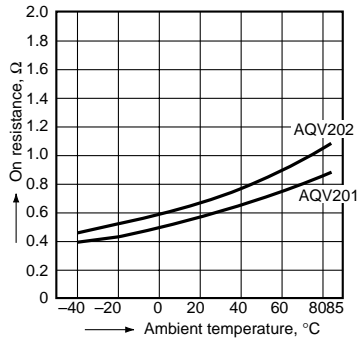
2.-(2) On resistance vs. ambient temperature characteristics (DC type: AQV103, AQV104)

LED current: 10 mA;  
Continuous load current: Max. (DC)



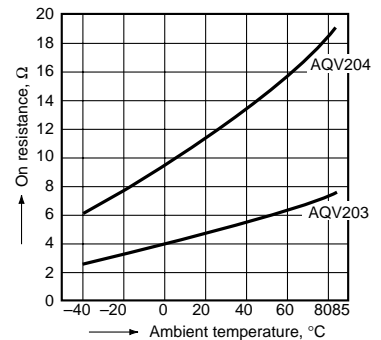
2.-(3) On resistance vs. ambient temperature characteristics (AC/DC type: AQV201, AQV202)

Measured portion: between terminals 4 and 6;  
LED current: 10 mA;  
Continuous load current: Max. (DC)



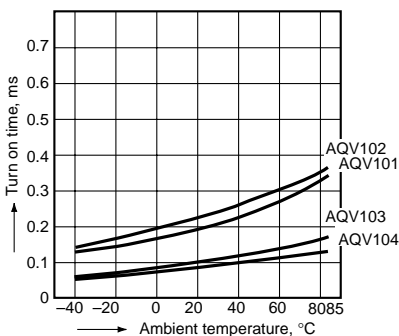
2.-(4) On resistance vs. ambient temperature characteristics (AC/DC type: AQV203, AQV204)

Measured portion: between terminals 4 and 6;  
LED current: 10 mA;  
Continuous load current: Max. (DC)



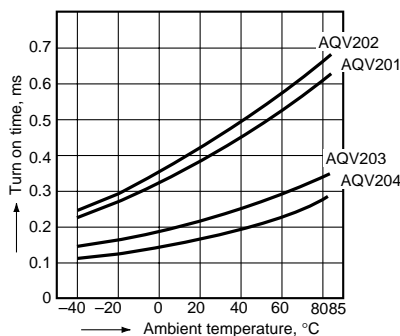
3.-(1) Turn on time vs. ambient temperature characteristics (DC type)

LED current: 10 mA;  
Load voltage: Max. (DC);  
Continuous load current: Max. (DC)



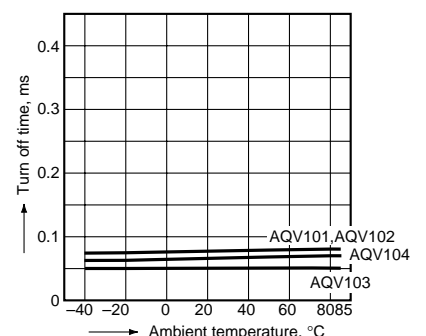
3.-(2) Turn on time vs. ambient temperature characteristics (AC/DC type)

LED current: 10 mA;  
Load voltage: Max. (DC);  
Continuous load current: Max. (DC)



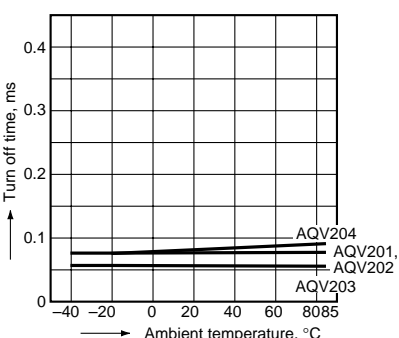
4.-(1) Turn off time vs. ambient temperature characteristics (DC type)

LED current: 10 mA;  
Load voltage: Max. (DC);  
Continuous load current: Max. (DC)



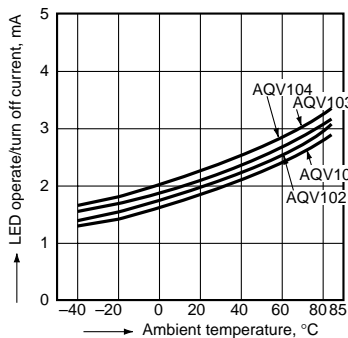
4.-(2) Turn off time vs. ambient temperature characteristics (AC/DC type)

LED current: 10 mA; Load voltage: Max. (DC);  
Continuous load current: Max. (DC)



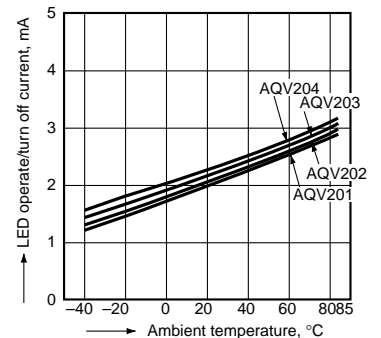
5.-(1) LED operate/turn off current vs. ambient temperature characteristics (DC type)

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



5.-(2) LED operate/turn off current vs. ambient temperature characteristics (AC/DC type)

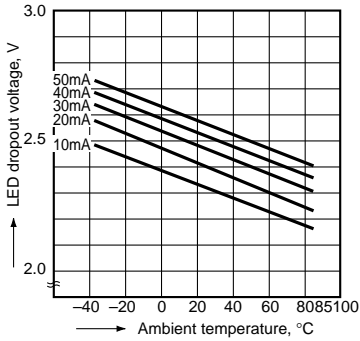
Load voltage: Max. (DC);  
Continuous load current: Max. (DC)



# AQV100, 200

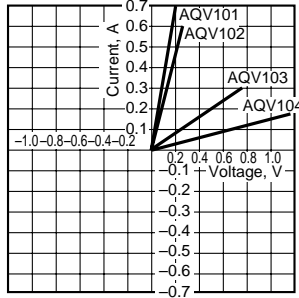
## 6. LED dropout voltage vs. ambient temperature characteristics

Sample: AQV202  
LED current: 10 to 50 mA



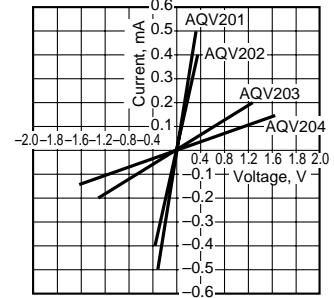
## 7.-(1) Voltage vs. current characteristics of output at MOS portion (DC type)

Ambient temperature: 25°C 77°F



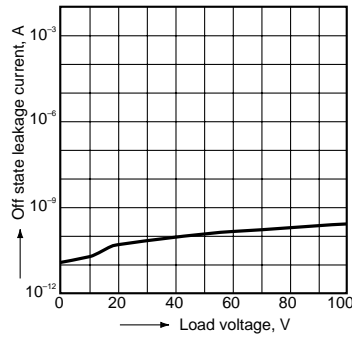
## 7.-(2) Voltage vs. current characteristics of output at MOS portion (AC/DC type)

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



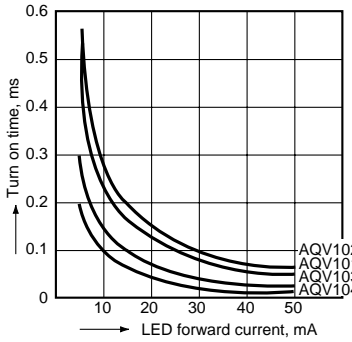
## 8. Off state leakage current

Sample: AQV204;  
Measured portion: between terminals 4 and 6;  
Ambient temperature: 25°C 77°F



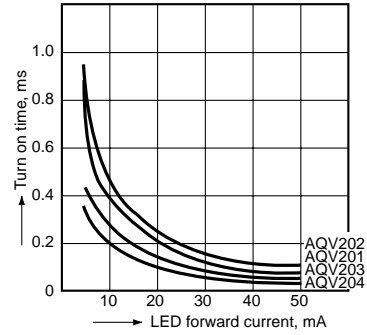
## 9.-(1) LED forward current vs. turn on time characteristics (DC type)

Load voltage: Max. (DC);  
Continuous load current: Max. (DC);  
Ambient temperature: 25°C 77°F



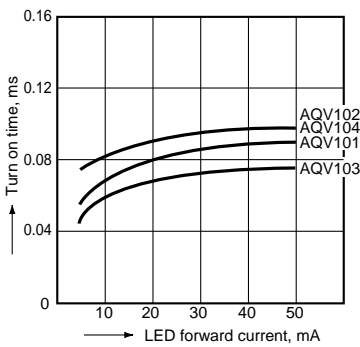
## 9.-(2) LED forward current vs. turn on time characteristics (AC/DC type)

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



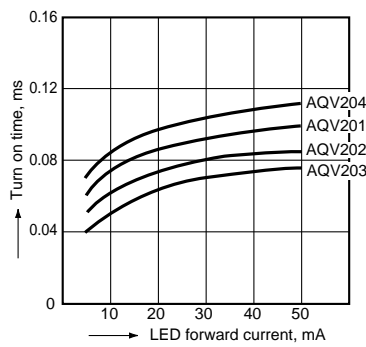
## 10.-(1) LED forward current vs. turn off time characteristics (DC type)

Load voltage: Max. (DC);  
Continuous load current: Max. (DC);  
Ambient temperature: 25°C 77°F



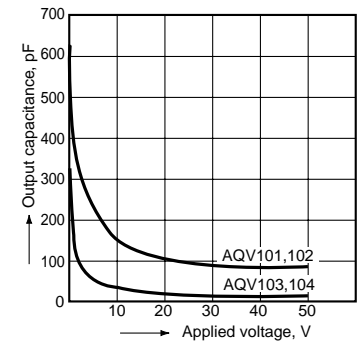
## 10.-(2) LED forward current vs. turn off time characteristics (AC/DC type)

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



## 11.-(1) Applied voltage vs. output capacitance characteristics (DC type)

Frequency: 1 MHz;  
Ambient temperature: 25°C 77°F



## 11.-(2) Applied voltage vs. output capacitance characteristics (AC/DC type)

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

