

# NAIS

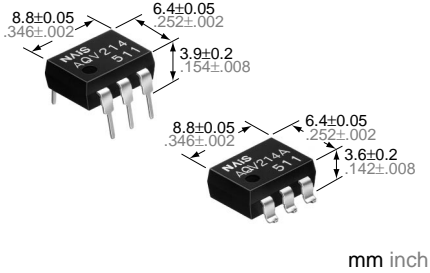
## GU (General Use) Type [1-Channel (Form A) Type]

# 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  $\mu$ V)**



### TYPICAL APPLICATIONS

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

### TYPES

Type	I/O isolation	Output rating*		Part No.				Packing quantity	
				Through hole terminal	Surface-mount terminal				
					Tube packing style		Tape and reel packing style		
AC/DC	Standard 1,500 V AC	60 V	400 mA	AQV212	AQV212A	AQV212AX	AQV212AZ	1 tube contains 50 pcs. 1 batch contains 500 pcs.	1,000 pcs.
		100 V	320 mA	AQV215	AQV215A	AQV215AX	AQV215AZ		
		200 V	180 mA	AQV217	AQV217A	AQV217AX	AQV217AZ		
		350 V	130 mA	AQV210	AQV210A	AQV210AX	AQV210AZ		
		400 V	120 mA	AQV214	AQV214A	AQV214AX	AQV214AZ		
		600 V	50 mA	AQV216	AQV216A	AQV216AX	AQV216AZ		
	Reinforced 5,000 V	400 V	120 mA	AQV214H	AQV214HA	AQV214HAX	AQV214HAZ		

\*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°C 77°F)

Item		Sym- bol	Type of connec- tion	AQV212(A)	AQV215(A)	AQV217(A)	AQV210(A)	AQV214(A)	AQV216(A)	AQV214H(A)	Remarks
Input	LED forward current	$I_F$		50 mA							
	LED reverse voltage	$V_R$		3 V							
	Peak forward current	$I_{FP}$		1 A							f = 100 Hz, Duty factor = 0.1%
	Power dissipation	$P_{in}$		75 mW							
Output	Load voltage (peak AC)	$V_L$		60 V	100 V	200 V	350 V	400 V	600 V	400 V	
	Continuous load current	$I_L$	A	0.40 A	0.32 A	0.18 A	0.13 A	0.12 A	0.05 A	0.12 A	A connection: Peak AC, DC; B, C connection: DC
			B	0.60 A	0.42 A	0.22 A	0.15 A	0.13 A	0.06 A	0.13 A	
			C	0.80 A	0.60 A	0.30 A	0.17 A	0.15 A	0.08 A	0.15 A	
	Peak load current	$I_{peak}$		1.2 A	0.96 A	0.54 A	0.4 A	0.3 A	0.15 A	0.3 A	A connection: 100 ms (1 shot), $V_L=DC$
Power dissipation	$P_{out}$		500 mW								
Total power dissipation		$P_T$		550 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 temp.
	Storage	$T_{stg}$		-40°C to +100°C -40°F to +212°F							

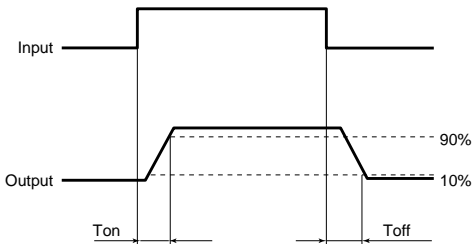
2. Electrical characteristics (Ambient temperature: 25°C 77°F)

Item		Symbol	Type of connection**	AQV212(A)	AQV215(A)	AQV217(A)	AQV210(A)	AQV214(A)	AQV216(A)	AQV214H(A)	Condition	
Input	LED operate current	Typical	—	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1.3 mA	I <sub>L</sub> = Max.	
		Maximum		3 mA	3 mA	3 mA	3 mA	3 mA	3 mA	3 mA		
	LED turn off current	Minimum	—	0.4 mA	0.4 mA	0.4 mA	0.4 mA	0.4 mA	0.4 mA	0.4 mA	I <sub>L</sub> = Max.	
Typical	0.79 mA	0.79 mA		0.79 mA	0.79 mA	0.79 mA	0.79 mA	1.2 mA				
LED dropout voltage	Typical	V <sub>F</sub>	—	1.14 V (1.25 V at I <sub>F</sub> = 50 mA)							I <sub>F</sub> = 5 mA	
	Maximum			1.5 V								
Output	On resistance	Typical	R <sub>on</sub>	A	0.83 Ω	2.3 Ω	11.0 Ω	23 Ω	30 Ω	70 Ω	30 Ω	I <sub>F</sub> = 5 mA I <sub>L</sub> = Max. Within 1 s on time
		Maximum			2.5 Ω	4.0 Ω	15.0 Ω	35 Ω	50 Ω	120 Ω	50 Ω	
	On resistance	Typical	R <sub>on</sub>	B	0.44 Ω	1.15 Ω	5.5 Ω	11.5 Ω	22.5 Ω	55 Ω	22.5 Ω	I <sub>F</sub> = 5 mA I <sub>L</sub> = Max. Within 1 s on time
		Maximum			1.25 Ω	2.0 Ω	7.5 Ω	17.5 Ω	25 Ω	100 Ω	25 Ω	
	On resistance	Typical	R <sub>on</sub>	C	0.25 Ω	0.6 Ω	2.8 Ω	6.0 Ω	11.3 Ω	28 Ω	11.3 Ω	I <sub>F</sub> = 5 mA I <sub>L</sub> = Max. Within 1 s on time
		Maximum			1.63 Ω	1.0 Ω	3.8 Ω	8.8 Ω	12.5 Ω	50 Ω	12.5 Ω	
Output capacitance	Typical	C <sub>out</sub>	A	150 pF	110 pF	70 pF	45 pF	45 pF	45 pF	45 pF	I <sub>F</sub> = 0 V <sub>B</sub> = 0 f = 1 MHz	
Off state leakage current	Maximum	—	—	1 μA							I <sub>F</sub> = 0 V <sub>L</sub> = Max.	
Switching speed	Turn on time*	Typical	T <sub>on</sub>	—	0.65 ms	0.6 ms	0.25 ms	0.25 ms	0.21 ms	0.28 ms	0.6 ms	I <sub>F</sub> = 5 mA** I <sub>L</sub> = Max.
		Maximum			2 ms	2 ms	1.0 ms	0.5 ms	0.5 ms	0.5 ms	0.8 ms	
	Turn off time*	Typical	T <sub>off</sub>	—	0.08 ms	0.06 ms	0.05 ms	0.05 ms	0.05 ms	0.04 ms	0.05 ms	I <sub>F</sub> = 5 mA I <sub>L</sub> = Max.
		Maximum			0.2 ms	0.2 ms	0.2 ms	0.2 ms	0.2 ms	0.2 ms	0.2 ms	
I/O capacitance	Typical	C <sub>iso</sub>	—	0.8 pF							f = 1 MHz V <sub>B</sub> = 0	
	Maximum			1.5 pF								
Initial I/O isolation resistance	Minimum	R <sub>iso</sub>	—	1,000 MΩ							500 V DC	

Note: Recommendable LED forward current  
 Standard type: 5 mA  
 Reinforced type: 5 to 10 mA

\*Turn on/Turn off time

< >: Value for high I/O isolation voltage type  
 \*\*Type of connection, see Page 444.



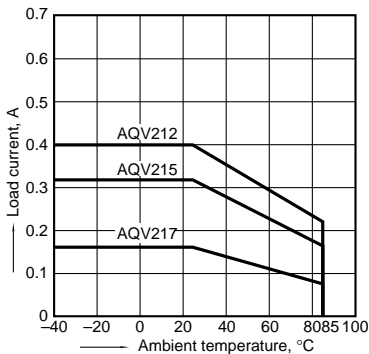
- For Dimensions, see Page 440.
- For Schematic and Wiring Diagrams, see Page 444.
- For Cautions for Use, see Page 449.

REFERENCE DATA

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

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

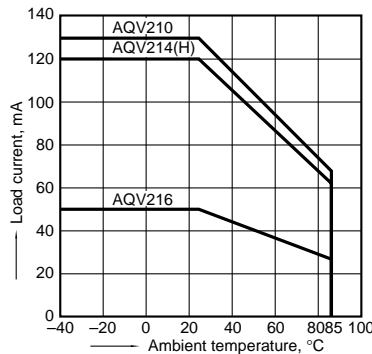
Type of connection: A



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

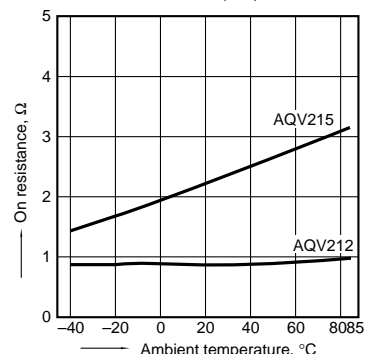
Allowable ambient temperature: -40°C to +85°C  
 -40°F to +185°F

Type of connection: A



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

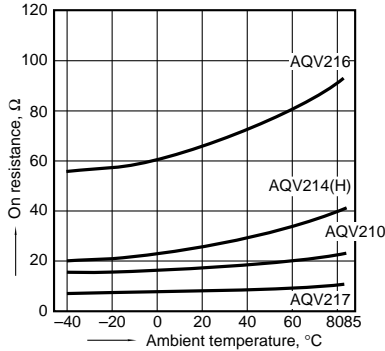
Measured portion: between terminals 4 and 6;  
 LED current: 5 mA; Load voltage: Max. (DC)  
 Continuous load current: Max. (DC)



# AQV210

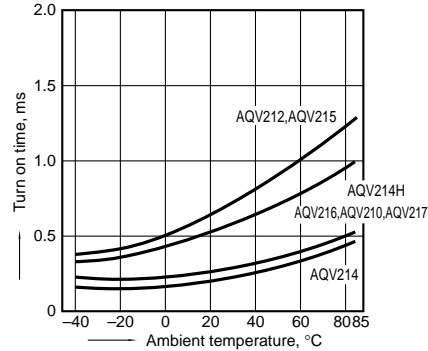
## 2-(2). On resistance vs. ambient temperature characteristics

Measured portion: between terminals 4 and 6;  
LED current: 5 mA; Load voltage: Max. (DC)  
Continuous load current: Max. (DC)



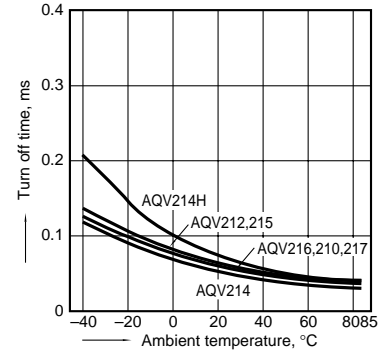
## 3. Turn on time vs. ambient temperature characteristics

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



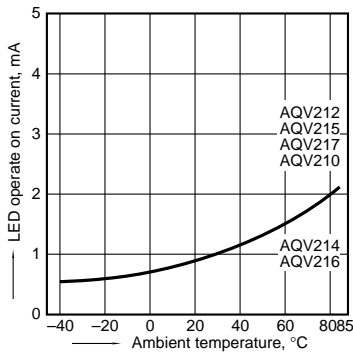
## 4. Turn off time vs. ambient temperature characteristics

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



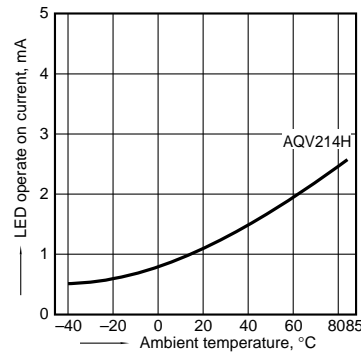
## 5-(1). LED operate current vs. ambient temperature characteristics

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



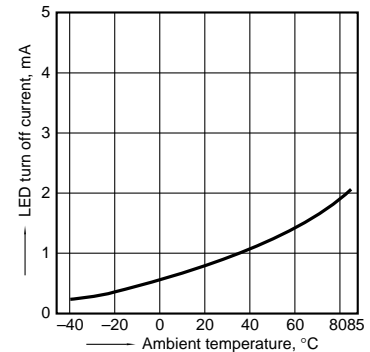
## 5-(2). LED operate current vs. ambient temperature characteristics

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



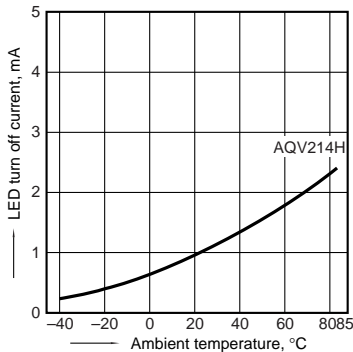
## 6-(1). LED turn off current vs. ambient temperature characteristics

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



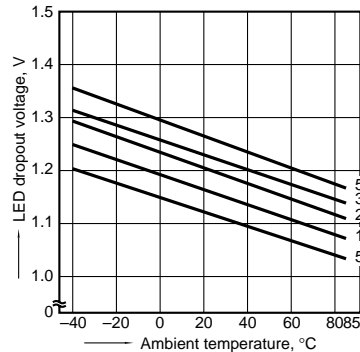
## 6-(2). LED turn off current vs. ambient temperature characteristics

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



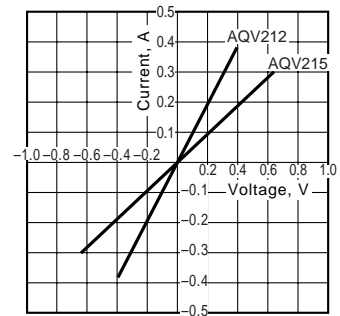
## 7. LED dropout voltage vs. ambient temperature characteristics

Sample: All types  
LED current: 5 to 50 mA



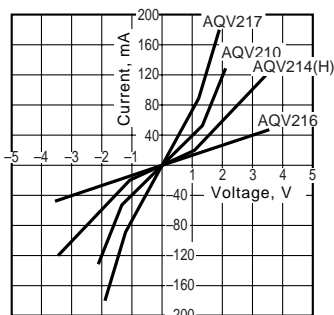
## 8-(1). Voltage vs. current characteristics of output at MOS portion

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



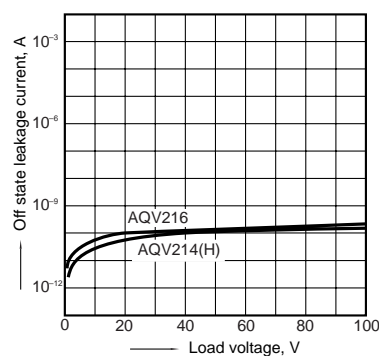
## 8-(2). Voltage vs. current characteristics of output at MOS portion

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



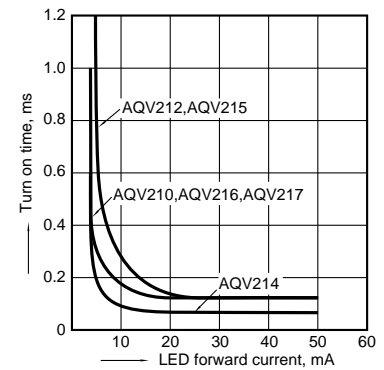
## 9. Off state leakage current

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



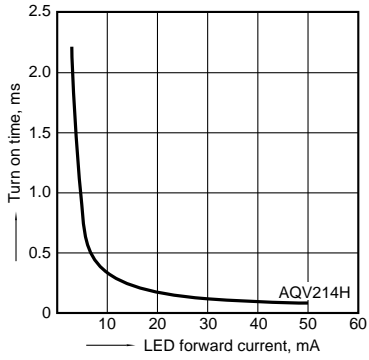
## 10-(1). LED forward current vs. turn on time characteristics

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



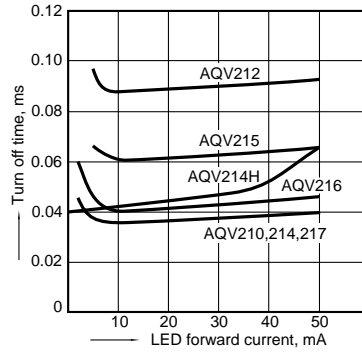
10-(2). LED forward current vs. turn on time characteristics

Measured portion: between terminals 4 and 6;  
 Load voltage: 400 V (DC); Continuous load current:  
 120 mA (DC); Ambient temperature: 25°C 77°F



11. 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°C 77°F



12. Applied voltage vs. output capacitance characteristics

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

