

mm inch

### FEATURES

#### 1. Current Limit Function

To control an over current from flowing, the current limit function has been realized. It keeps an output current at a constant value when the current reaches a specified current limit value.

#### 2. Enhancing the capability of surge resistance between output terminals

The current limit function controls the ON time surge current to enhance the capability of surge resistance between output terminals.

#### 3. Reinforced insulation 5,000 V type

More than 0.4 mm internal insulation distance between inputs and outputs. Conforms to EN41003, EN60950 (reinforced insulation).

#### 4. Compact 6-pin DIP size

The device comes in a compact (W)6.4 × (L)8.8 × (H) 3.9mm (W).252 × (L).346 × (H).154inch, 6-pin DIP size

#### 5. Controls low-level analog signals

PhotoMOS relays feature extremely low closed-circuit offset voltage to enable control of low-level analog signals without distortion.

#### 6. High sensitivity, low ON resistance

#### 7. Low-level off state leakage current

### TYPICAL APPLICATIONS

- Telephone equipment
- Modem

### TYPES

Type	I/O isolation voltage	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
AC/DC type	Reinforced 5,000 V	350 V	130 mA	AQV210HL	AQV210HLA	Picked from the 1/2/3-pin side	Picked from the 4/5/6-pin side	1 tube contains 50 pcs. 1 batch contains 500 pcs.	

\*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		Symbol	AQV210HL(A)	Remarks
Input	LED forward current	I <sub>F</sub>	50 mA	
	LED reverse voltage	V <sub>R</sub>	3 V	
	Peak forward current	I <sub>FP</sub>	1 A	f = 100 Hz, Duty factor = 0.1%
	Power dissipation	P <sub>in</sub>	75 mW	
Output	Load voltage (peak AC)	V <sub>L</sub>	350 V	
	Continuous load current	I <sub>L</sub>	0.13 A	
	Power dissipation	P <sub>out</sub>	500 mW	
Total power dissipation		P <sub>T</sub>	550 mW	
I/O isolation voltage		V <sub>iso</sub>	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	

# AQV210HL

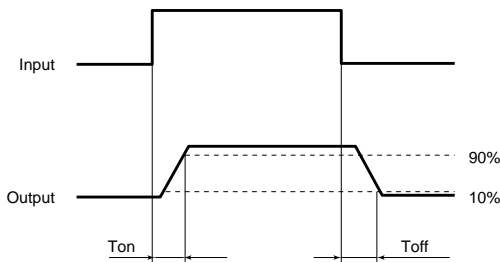
## 2. Electrical characteristics (Ambient temperature: 25°C 77°F)

Item		Symbol	AQV210HL(A)	Condition	
Input	LED operate current	Typical	1.6 mA	$I_L = \text{Max.}$	
		Maximum	3.0 mA		
	LED turn off current	Minimum	0.4 mA	$I_L = \text{Max.}$	
		Typical	1.5 mA		
LED dropout voltage	Minimum	1.14 (1.25 V at $I_F = 50\text{mA}$ )	$I_F = 5 \text{ mA}$		
	Typical	1.5 V			
Output	On resistance	Typical	20Ω	$I_F = 5 \text{ mA}$ $I_L = \text{Max.}$ Within 1 s on time	
		Maximum	25Ω		
	Off state leakage current	Maximum	1μA	$I_F = 0$ $V_L = \text{Max.}$	
Current limit	Typical	—	180 mA	$I_F = 5 \text{ mA}$	
Transfer characteristics	Turn on time*	Typical	0.8 ms	$I_F = 5 \text{ mA}$ $I_L = \text{Max.}$	
		Maximum	2.0 ms		
	Turn off time*	Typical	0.05 ms	$I_F = 5 \text{ mA}$ $I_L = \text{Max.}$	
		Maximum	1.0 ms		
	I/O capacitance	Typical	—	0.8 pF	$f = 1 \text{ MHz}$ $V_B = 0$
		Maximum	—	1.5 pF	
Initial I/O isolation resistance	Minimum	$R_{iso}$	1,000 MΩ	500 V DC	

Note: Recommendable LED forward current  $I_F = 5$  to 10 mA.

For type of connection, see Page 4.

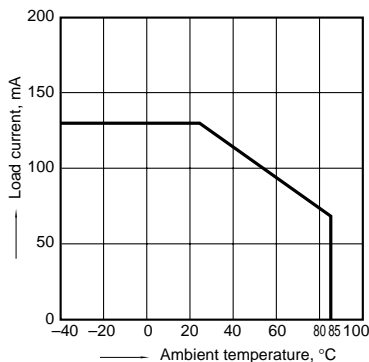
\*Turn on/Turn off time



## REFERENCE DATA

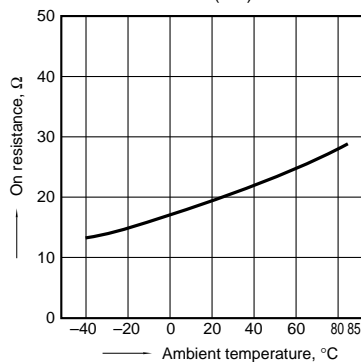
1. Load current vs. ambient temperature characteristics

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



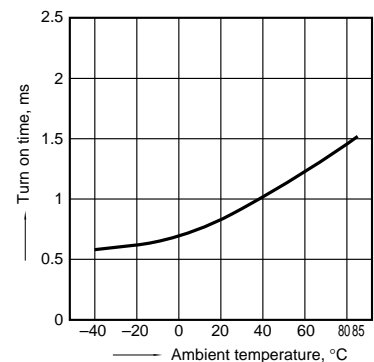
2. On resistance vs. ambient temperature characteristics

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



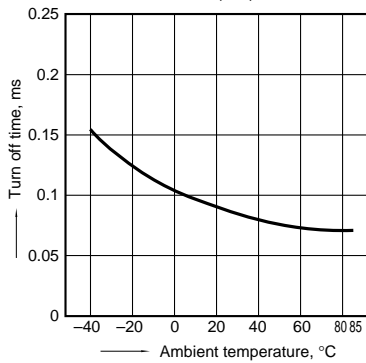
3. Turn on time vs. ambient temperature characteristics

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



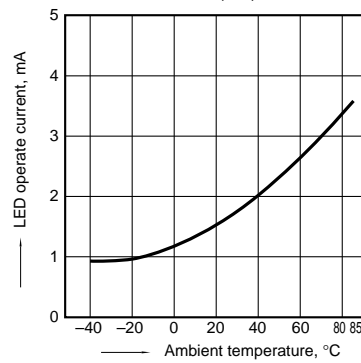
4. Turn off time vs. ambient temperature characteristics

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



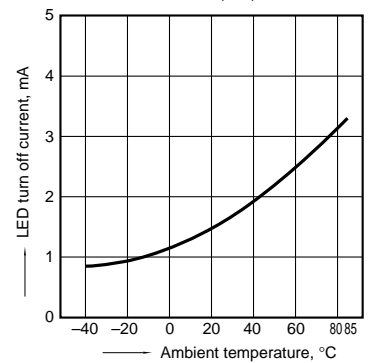
5. LED operate current vs. ambient temperature characteristics

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



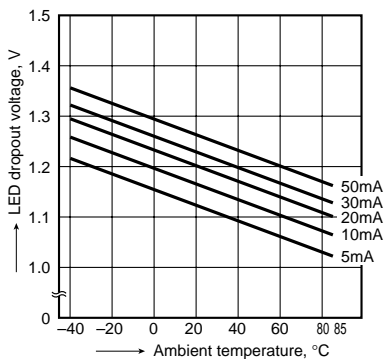
6. LED turn off current vs. ambient temperature characteristics

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



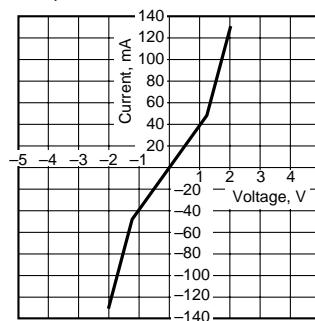
7. LED dropout voltage vs. ambient temperature characteristics

LED current: 5 to 50 mA



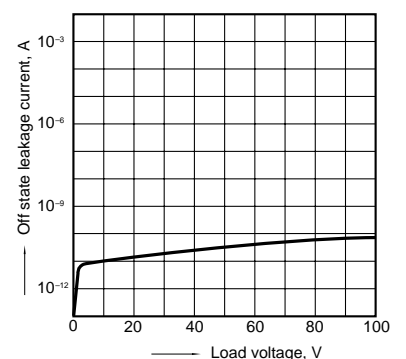
8. Voltage vs. current characteristics of output at MOS portion

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



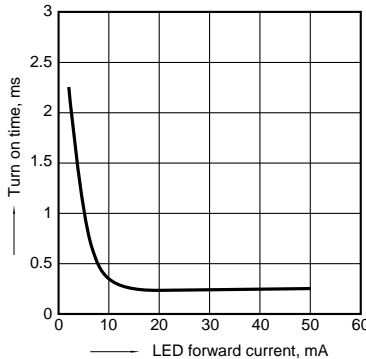
9. Off state leakage current

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



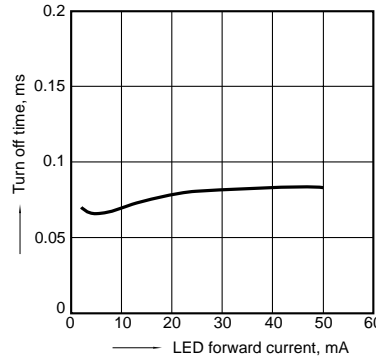
10. LED forward current vs. turn on time characteristics

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



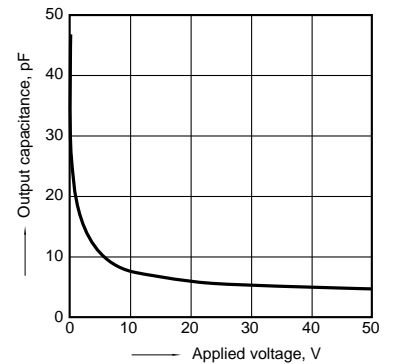
11. LED forward current vs. turn off time characteristics

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



What is current limit

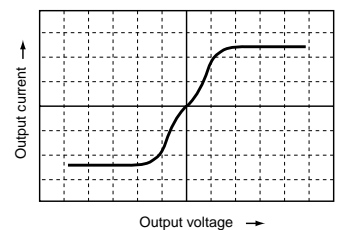
When a load current reaches the specified output control current, a current limit function works against the load current to keep the current a constant value. The current limit circuit built into the PhotoMOS relay thus controls the instantaneous load current to effectively ensure circuit safety. This safety feature protects circuits down-

stream of the PhotoMOS relay against over-current.

But, if the current-limiting feature is used longer than the specified time, the PhotoMOS relay can be destroyed. Therefore, set the output loss to the max. rate or less.

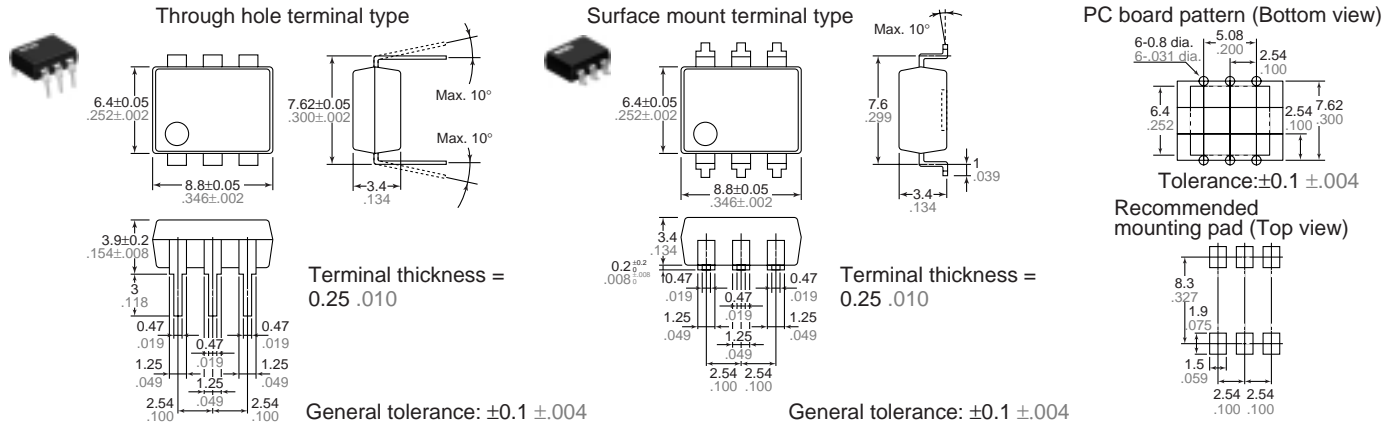
- Comparison of output voltage and output current characteristics

V-I Characteristics



# AQV210HL

## DIMENSIONS



## SCHEMATIC AND WIRING DIAGRAMS

Notes: E<sub>1</sub>: Power source at input side; V<sub>IN</sub>: Input voltage; I<sub>F</sub>: LED forward current; I<sub>IN</sub>: Input current; V<sub>L</sub>: Load voltage; I<sub>L</sub>: Load current; R: Current limit resistor.

Schematic	Output configuration	Load	Connection	Wiring diagram
	1a	AC/DC	A	
		DC	B	
DC	C			

# 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 elec-

trical 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

### 1. Unused terminals

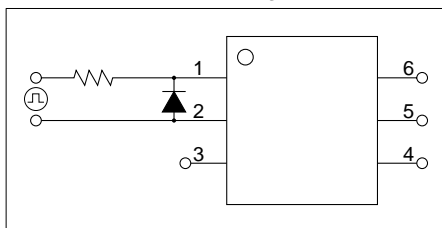
The No. 3 terminal is used with the circuit inside the relay. Therefore, do not connect it to the external circuitry with either connection method A, B or C.

### 2. Short across terminals

Do not short circuit between terminals when relay is energized, since there is 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 below the reverse breakdown voltage.



### 4. Recommended LED forward current (I<sub>F</sub>)

It is recommended that the LED forward current (I<sub>F</sub>) should be kept at 5 to 10 mA.

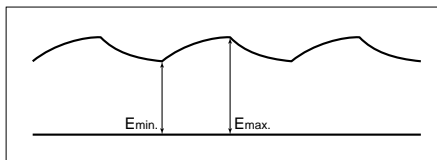
### 5. Ripple in the input power supply

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

- 1) For LED operate current at E<sub>min</sub>, main-

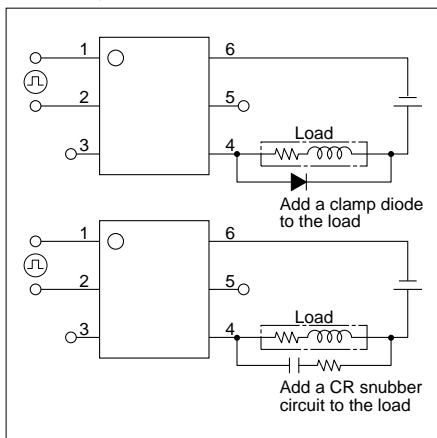
tain the value mentioned in the table of "Note 3. Recommended LED forward current (I<sub>F</sub>)."

- 2) Keep the LED operate current at 50 VmA or less at E<sub>max</sub>.



### 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.

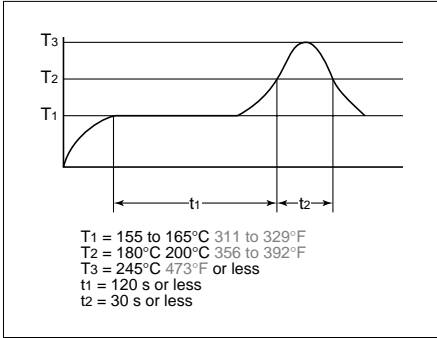
Cleaning solvent		Compatibility ○: Yes X: No
Chlorine-base	<ul style="list-style-type: none"> <li>• I.I.I. Trichloroethylene (Chloroethylene)</li> <li>• Trichloroethylene (Trichlene)</li> <li>• Perchloroethylene</li> <li>• Methylene chloride</li> </ul>	○
Aqueous	<ul style="list-style-type: none"> <li>• Indusco 624, 1000</li> <li>• Hollis 310</li> <li>• Lonco Terg</li> </ul>	○
Alcohol-base	<ul style="list-style-type: none"> <li>• IPA</li> <li>• Ethanol</li> </ul>	○
Others	<ul style="list-style-type: none"> <li>• Thinner</li> <li>• Gasoline</li> </ul>	X

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## 8. Soldering

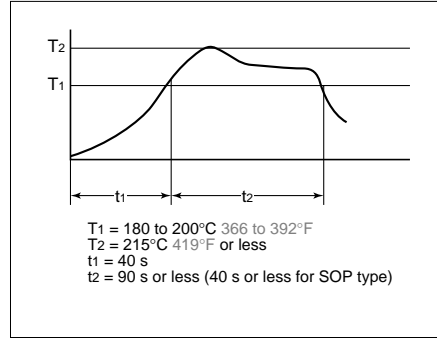
1) When soldering PC board terminals, keep soldering time to within 10 s at 260°C 500°F.

(1) IR (Infrared reflow) soldering method

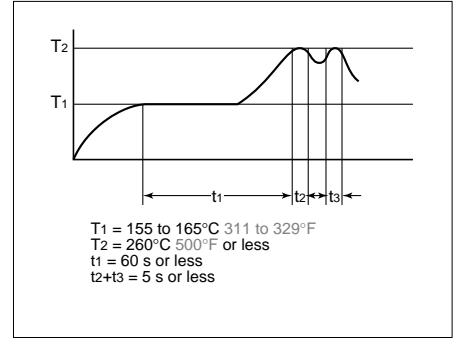


2) When soldering surface-mount terminals, the following conditions are recommended.

(2) Vapor phase soldering method



(3) Double wave soldering method



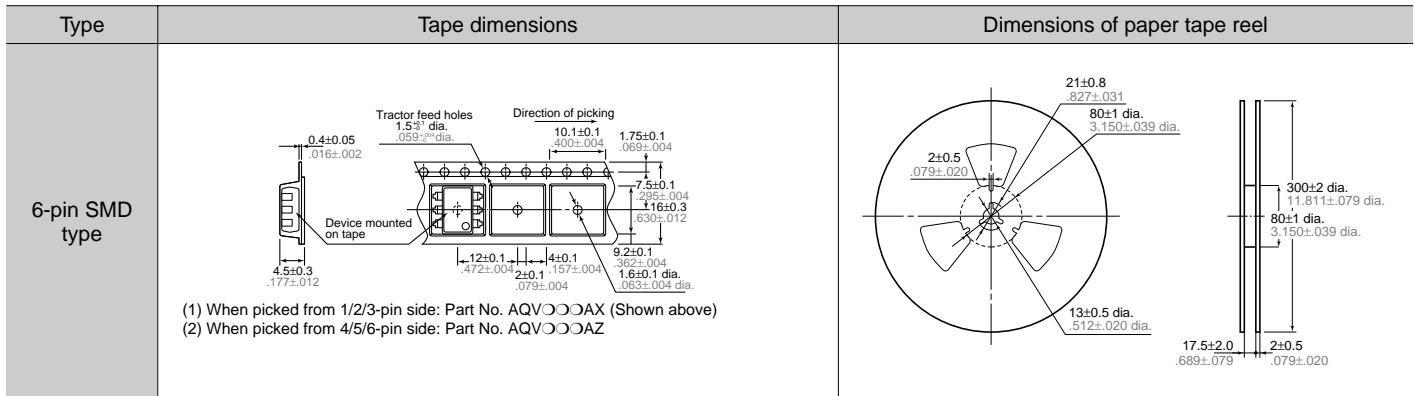
(4) Soldering iron method  
 Tip temperature: 280 to 300°C 536 to 572°F  
 Wattage: 30 to 60 W  
 Soldering time: within 5 s

(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.

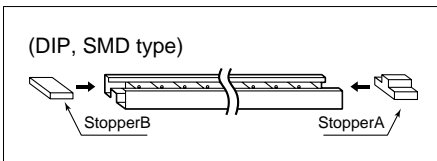
The ambient temperature may increase excessively. Check the temperature under mounting conditions.  
 • The conditions for the infrared reflow soldering apply when preheating using the VPS method.

## 9. The following shows the packaging format

1) Tape and reel



2) Tube  
 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.



## 10. Transportation and storage

1) Extreme vibration during transport will warp the lead or damage the relay. Handle the outer and inner boxes with care.

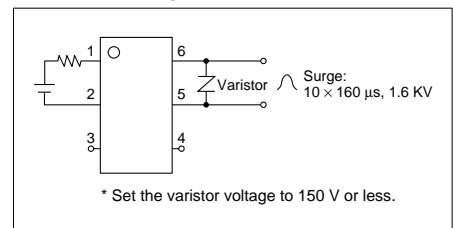
2) Storage under extreme conditions will cause soldering degradation, external appearance defects, and deterioration of the characteristics. The following storage conditions are recommended:

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

## 11. Current limit function (output current control)

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

shown in the figure below.



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