

## TRIAC DRIVER OPTOCOUPLER

### FEATURES

- High Input Sensitivity  $I_{FT}=1.3$  mA
- 600/700/800 V Blocking Voltage
- 300 mA On-State Current
- High Static  $dv/dt$  10,000 V/ $\mu$ sec., typical
- Inverse Parallel SCRs Provide Commutating  $dv/dt >10$  KV/ $\mu$ sec
- Very Low Leakage  $<10$   $\mu$ A
- Isolation Test Voltage from Double Molded Package 5300 VAC<sub>RMS</sub>
- Package, 6-Pin DIP
- Underwriters Lab File #E52744

### DESCRIPTION

The IL421x consists of an AlGaAs IRLED optically coupled to a pair of photosensitive non-zero crossing SCR chips and are connected inversely parallel to form a TRIAC. These three semiconductors are assembled in a six pin 0.3 inch dual in-line package, using high insulation double molded, over/under lead-frame construction.

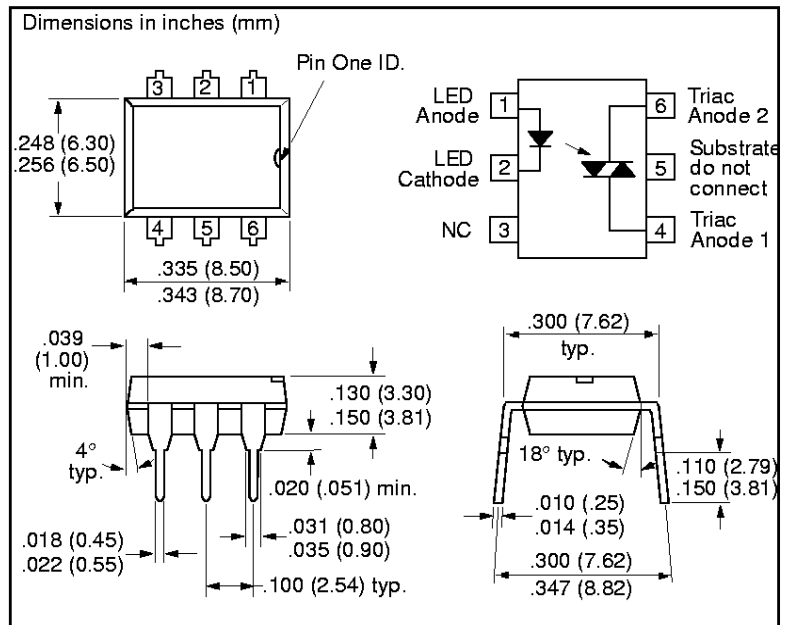
High input sensitivity is achieved by using an emitter follower phototransistor and a cascaded SCR pre-driver resulting in an LED trigger current of less than 1.3 mA (DC).

The IL421x uses two discrete SCRs resulting in a commutating  $dv/dt$  of greater than 10KV/ $\mu$ s. The use of a proprietary  $dv/dt$  clamp results in a static  $dv/dt$  of greater than 10KV/ $\mu$ s. This clamp circuit has a MOS-FET that is enhanced when high  $dv/dt$  spikes occur between MT1 and MT2 of the TRIAC. The FET clamps the base of the phototransistor when conducting, disabling the internal SCR predriver.

The blocking voltage of up to 800 V permits control of off-line voltages up to 240 VAC, with a safety factor of more than two, and is sufficient for as much as 380 VAC. Current handling capability is up to 300 mA RMS, continuous at 25°C.

The IL421x isolates low-voltage logic from 120, 240, and 380 VAC lines to control resistive inductive, or capacitive loads including motors solenoids, high current thyristors or TRIAC and relays.

Applications include solid-state relays, industrial controls, office equipment, and consumer appliances.



### Maximum Ratings

#### Emitter

Reverse Voltage .....	6 V
Forward Current .....	60 mA
Surge Current .....	2.5 A
Power Dissipation .....	100 mW
Derate Linearly from 25°C .....	1.33 mW/°C
Thermal Resistance .....	750 °C/W

#### Detector

Peak Off-State Voltage	
IL4216 .....	600 V
IL4217 .....	700 V
IL4218 .....	800 V
RMS On-State Current .....	300 mA
Single Cycle Surge .....	3 A
Total Power Dissipation .....	500 mW
Derate Linearly from 25°C .....	6.6 mW/°C
Thermal Resistance .....	150°C/W

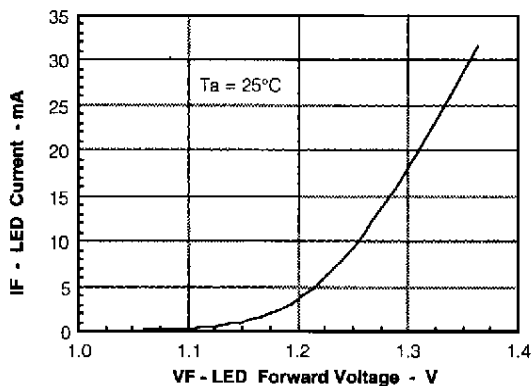
#### Package

Isolation Test Voltage .....	5300 VAC <sub>RMS</sub>
Storage Temperature .....	-55°C to +150°C
Operating Temperature .....	-55°C to +100°C
Lead Soldering Temperature .....	260°C/5 sec.
Isolation Resistance	
$V_{IO}=500$ V, $T_A=25$ °C .....	$\geq 10^{12}$ $\Omega$
$V_{IO}=500$ V, $T_A=100$ °C .....	$\geq 10^{11}$ $\Omega$

**Characteristics (T<sub>A</sub>=25°C)**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
<b>Emitter</b>						
Forward Voltage	V <sub>F</sub>		1.3	1.5	V	I <sub>F</sub> =20 mA
Breakdown Voltage	V <sub>BR</sub>	6	30		V	I <sub>R</sub> =10 mA
Reverse Current	I <sub>R</sub>		0.1	10	μA	V <sub>R</sub> =6 V
Capacitance	C <sub>O</sub>		40		pF	V <sub>F</sub> =0 V, f=1 MHz
Thermal Resistance, Junction to Lead	R <sub>THJL</sub>		750		°C/W	
<b>Output Detector</b>						
Repetitive Peak Off-State Voltage IL4216 IL4217 IL4218	V <sub>DRM</sub> V <sub>DRM</sub> V <sub>DRM</sub>	600 700 800	650 750 850		V	I <sub>DRM</sub> =100 μA I <sub>DRM</sub> =100 μA I <sub>DRM</sub> =100 μA
Off-State Voltage IL4216 IL4217 IL4218	V <sub>D(RMS)</sub> V <sub>D(RMS)</sub> V <sub>D(RMS)</sub>	424 484 565	460 536 613		V	I <sub>D(RMS)</sub> =70 μA I <sub>D(RMS)</sub> =70 μA I <sub>D(RMS)</sub> =70 μA
Off-State Current	I <sub>D(RMS)</sub>		10	100	μA	V <sub>D</sub> =600 V, T <sub>A</sub> =100°C
Reverse Current	I <sub>R(RMS)</sub>		10	100	μA	V <sub>R</sub> =600 V, T <sub>A</sub> =100°C
On-State Voltage	V <sub>TM</sub>		1.7	3	V	I <sub>T</sub> =300 mA
On-State Current	I <sub>TM</sub>			300	mA	PF=1.0, V <sub>T(RMS)</sub> =1.7 V
Surge (Non-Repetitive) On-State Current	I <sub>TSM</sub>			3	A	f=50 Hz
Holding Current	I <sub>H</sub>		65	200	μA	V <sub>T</sub> =3 V
Latching Current	I <sub>L</sub>		5		mA	V <sub>T</sub> =2.2 V
LED Trigger Current	I <sub>FT</sub>		0.7	1.3	mA	V <sub>AK</sub> =5 V
Turn-On Time	t <sub>ON</sub>		35		μs	V <sub>RM</sub> =V <sub>DM</sub> =424 VAC
Turn-Off Time	t <sub>OFF</sub>		50		μs	PF=1.0, I <sub>T</sub> =300 mA
Critical State of Rise: Off-State Voltage	dv <sub>(MT)</sub> /dt	10,000	2000		V/μs V/μs	V <sub>RM</sub> , V <sub>DM</sub> =400 VAC, T <sub>A</sub> =25°C V <sub>RM</sub> , V <sub>DM</sub> =400 VAC, T <sub>A</sub> =25°C
Commutating Voltage	dv <sub>(COM)</sub> /dt	10,000	2000		V/μs V/μs	V <sub>RM</sub> , V <sub>DM</sub> =400 VAC, T <sub>A</sub> =25°C V <sub>RM</sub> , V <sub>DM</sub> =400 VAC, T <sub>A</sub> =25°C
Off-State Current	di/dt		100		A/ms	I <sub>T</sub> =300 mA
Thermal Resistance, Junction to Lead	R <sub>THJL</sub>		150		°C/W	
<b>Package</b>						
Critical Rate of Rise of Coupled Input-Output Voltage	dv <sub>(IO)</sub> /dt	5000			V/μs	I <sub>T</sub> =0 A, V <sub>RM</sub> =V <sub>DM</sub> =300 VAC
Common Mode Coupling Capacitor	C <sub>CM</sub>		0.01		pF	
Package Capacitance	C <sub>IO</sub>		0.8		pF	f=1 MHz, V <sub>IO</sub> =0 V

**Figure 1. LED forward current vs. forward voltage**



**Figure 2. Forward voltage versus forward current**

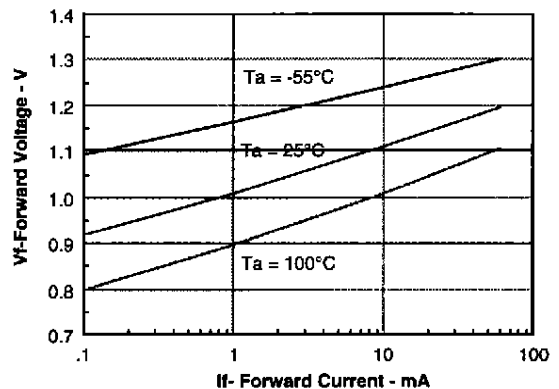


Figure 3. Peak LED current vs. duty factor, Tau

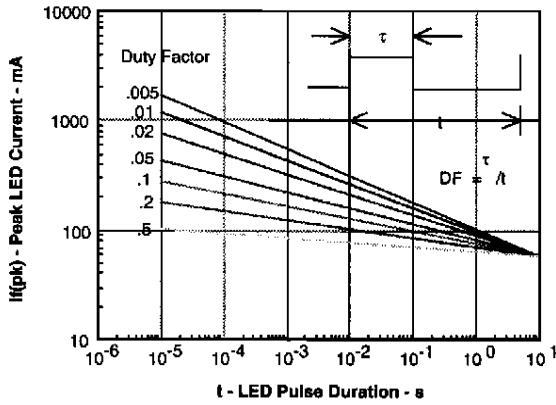


Figure 4. Maximum LED power dissipation

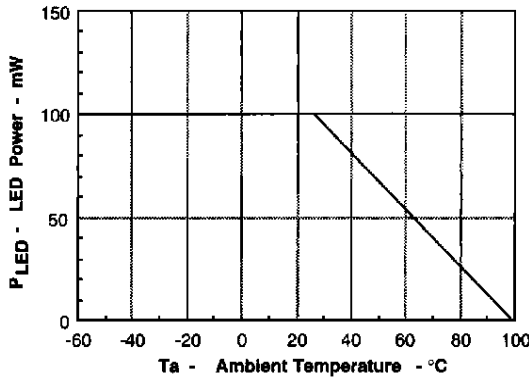


Figure 5. On-state terminal voltage vs. terminal current

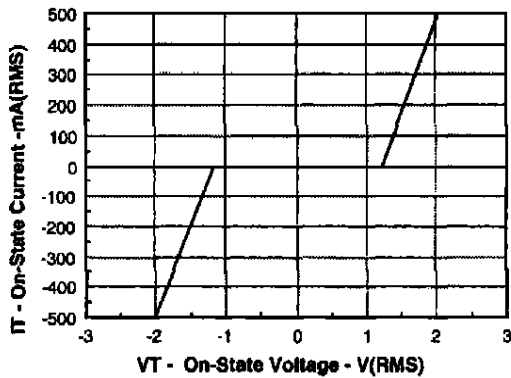
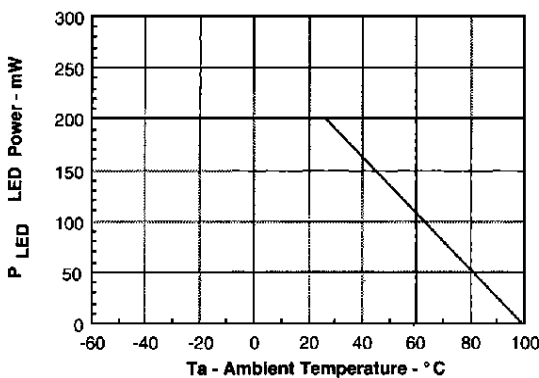


Figure 6. Maximum output power dissipation



**Power Factor Considerations**

A snubber isn't needed to eliminate false operation of the TRIAC driver because of the IL411's high static and commutating dv/dt with loads between 1 and 0.8 power factors. When inductive loads with power factors less than 0.8 are being driven, include a RC snubber or a single capacitor directly across the device to damp the peak commutating dv/dt spike. Normally a commutating dv/dt causes a turning-off device to stay on due to the stored energy remaining in the turning-off device.

But in the case of a zero voltage crossing optotriac, the commutating dv/dt spikes can inhibit one half of the TRIAC from turning on. If the spike potential exceeds the inhibit voltage of the zero cross detection circuit, half of the TRIAC will be held-off and not turn-on. This hold-off condition can be eliminated by using a snubber or capacitor placed directly across the optotriac as shown in Figure 7. Note that the value of the capacitor increases as a function of the load current.

The hold-off condition also can be eliminated by providing a higher level of LED drive current. The higher LED drive provides a larger photocurrent which causes the phototransistor to turn-on before the commutating spike has activated the zero cross network. Figure 8 shows the relationship of the LED drive for power factors of less than 1.0. The curve shows that if a device requires 1.5 mA for a resistive load, then 1.8 times (2.7 mA) that amount would be required to control an inductive load whose power factor is less than 0.3.

Figure 7. Shunt capacitance versus load current versus power factor

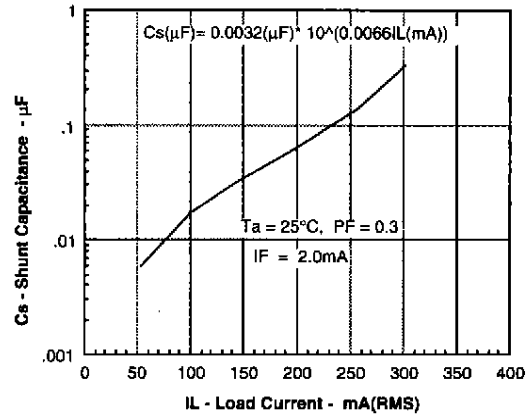


Figure 8. Normalized LED trigger current versus power factor

