SIEMENS

600 V IL4116
700 V IL4117
800 V IL4118
ZERO VOLTAGE CROSSING TRIAC DRIVER OPTOCOUPLER

FEATURES
- **High Input Sensltlvlty: I_{FT}=1.3 mA, PF=1.0; I_{FT}=3.5 mA, Typlcal PF < 1.0**
- **Zero Voltage Crosslng**
- **600/700/800 V Blocklng Voltage**
- **300 mA On-State Current**
- **High Statlc dv/dt 10,000 V/µsec., typical**
- **Inverse Parallel SCRs Provide Commutatlng dv/dt >10 KV/msec.**
- **Very Low Leakage <10 mA**
- **Isolation Test Voltage from Double Molded Package 5300 VACRMS**
- **Package, 6-Pln DIP**
- **Underwriters Lab File #E52744**

DESCRIPTION
The IL411x consists of an AlGaAs IRLED optically coupled to a photosensitive zero crossing TRIAC network. The TRIAC consists of two inverse parallel connected monolithic SCRs. These three semiconductors are assembled in a six pin 0.3 inch dual inline package, using high insulation double molded, over/under leadframe construction.

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

The IL411x uses two discrete SCRs resulting in a commutating dV/dt greater than 10 KV/ms The use of a proprietary dv/dt clamp results in a static dv/dt of greater than 10 KV/µs. This clamp circuit has a MOSFET that is enhanced when high dv/dt spikes occur between MT1 and MT2 of the TRIAC. When conducting, the FET clamps the base of the phototransistor, disabling the first stage SCR predriver.

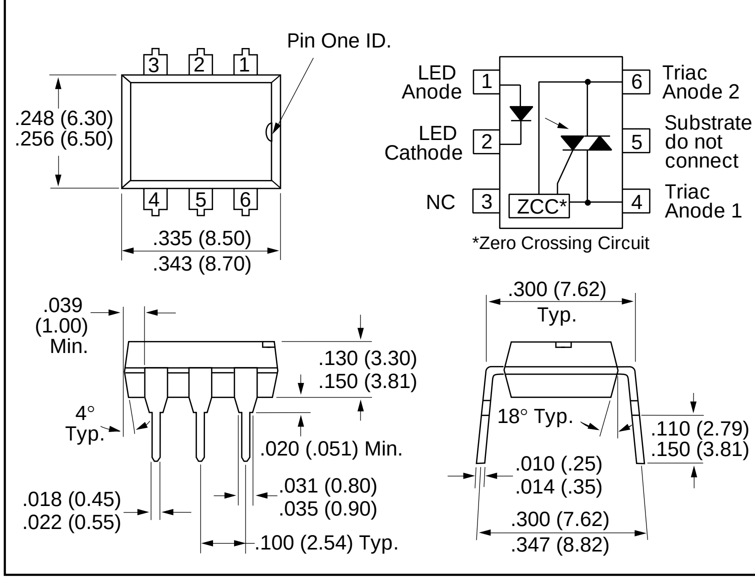
The zero cross line voltage detection circuit consists of two enhancement MOSFETS and a photodiode. The inhibit voltage of the network is determined by the enhancement voltage of the N-channel FET. The P-channel FET is enabled by a photocurrent source that permits the FET to conduct the main voltage to gate on the N-channel FET. Once the main voltage can enable the N-channel, it clamps the base of the phototransistor, disabling the first stage 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 IL411x 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.

Dimensions in inches (mm)



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	
IL4116	600 V
IL4117	700 V
IL4118	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

Storage Temperature	–55°C to +150°C
Operating Temperature	–55°C to +100°C
Lead Soldering Temperature	260°C/5 sec.
Isolation Test Voltage	5300 VAC_{RMS}
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_A=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Emitter						
Forward Voltage	V_F		1.3	1.5	V	I_F-20 mA
Breakdown Voltage	V_{BR}	6	30		V	I_R=10 µA
Reverse Current	I_R		0.1	10	µA	V_R=6 V
Capacitance	C_O		40		pF	V_F=0 V, f=1 MHz
Thermal Resistance, Junction to Lead	R_{THJL}		750		°C/W	
Output Detector						
Repetitive Peak Off-State Voltage IL4116 IL4117 IL4118	 V_{DRM} V_{DRM} V_{DRM}	 600 700 800	 650 750 850		 V V V	 I_{DRM}=100 mA I_{DRM}=100 mA I_{DRM}=100 mA
Off-State Voltage IL4116 IL4117 IL4118	 $V_{D(RMS)}$ $V_{D(RMS)}$ $V_{D(RMS)}$	 424 494 565	 460 536 613		 V V V	 $I_{D(RMS)}$=70 µA $I_{D(RMS)}$=70 µA $I_{D(RMS)}$=70 µA
Off-State Current	$I_{D(RMS)}$		10	100	µA	V_D=600 V, T_A=100°C
On-State Voltage	V_{TM}		1.7	3	V	I_T=300 mA
On-State Current	I_{TM}			300	mA	PF=1.0, $V_{T(RMS)}$=1.7 V
Surge (Non-Repetitive, On-State Current)	I_{TSM}			3	A	f=50 Hz
Holding Current	I_H		65	200	µA	V_T=3 V
Latchiing Current	I_L		5		mA	V_T=2.2 V
LED Trigger Current	I_{FT}		0.7	1.3	mA	V_{AK}=5 V
Zero Cross Inhibit Voltage	V_{IH}		15	25	V	I_F=Rated I_{FT}
Turn-On Time	t_{ON}		35		µs	V_{RM}=V_{DM}=424 VAC
Turn-Off Time	t_{OFF}		50		µs	PF=1.0, I_T=300 mA
Critical State of Rise: Off-State Voltage	$dv_{(MT)}/dt$	10,000	 2000		V/µs V/µs	V_{RM}, V_{DM}=400 VAC, T_A=25°C V_{RM}, V_{DM}=400 VAC, T_A=80°C
Commutating Voltage	$dv_{(COM)}/dt$	10,000	 2000		V/µs V/µs	V_{RM}, V_{DM}=400 VAC, T_A=25°C V_{RM}, V_{DM}=400 VAC, T_A=80°C
Commutating Current	di/dt		100		A/ms	I_T=300 mA
Thermal Resistance, Junction to Lead	R_{THJL}		150		°C/W	
Package						
Critical State of Rise of Couplrd Input-Output Voltage	$dv_{(IO)}/dt$	10,000			V/µs	I_T=0 A, V_{RM}=V_{DM}=424 VAC
Common Mode Coupling Capacitor	C_{CM}		0.01		pF	
Package Capacitance	C_{IO}		0.8		pF	f=1 MHz, V_{IO}=0 V

Figure 1. LED forward current vs. forward voltage

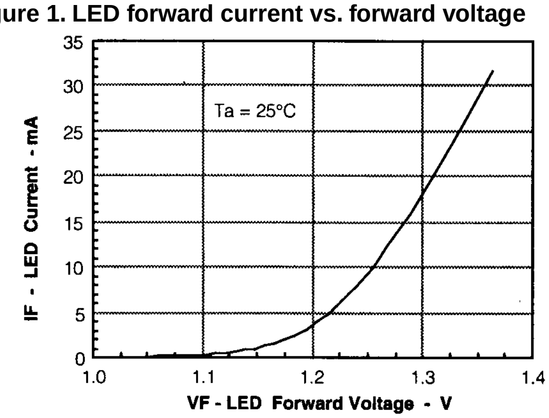


Figure 2. Forward voltage versus forward current

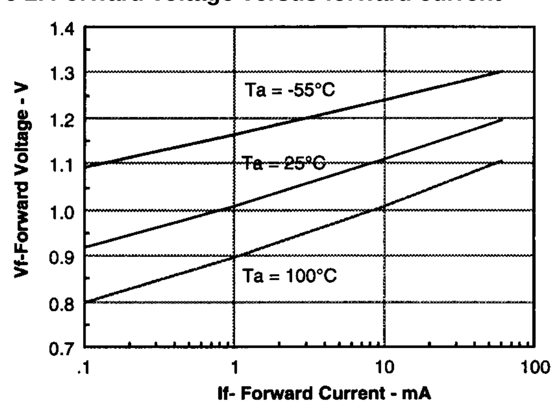


Figure 3. Peak LED current vs. duty factor, Tau

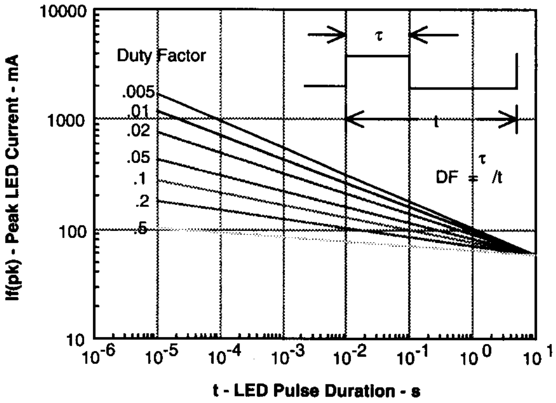


Figure 4. Maximum LED power dissipation

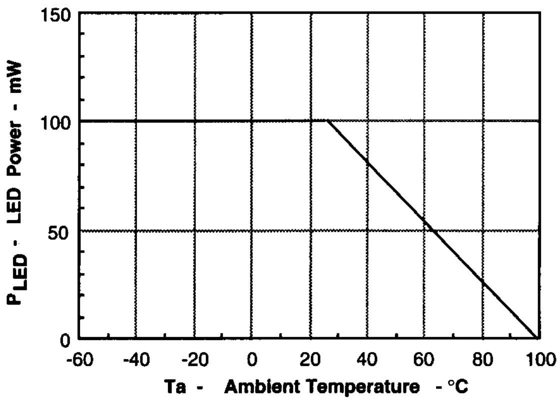


Figure 5. On-state terminal voltage vs. terminal current

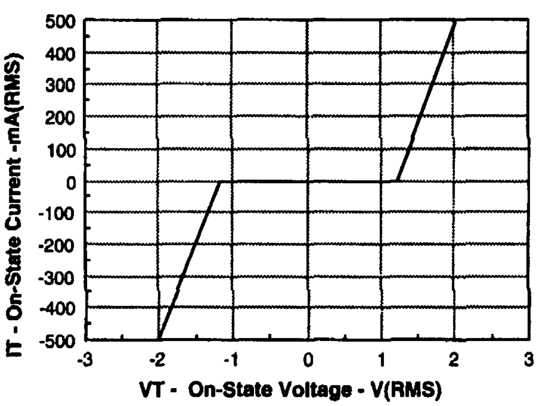
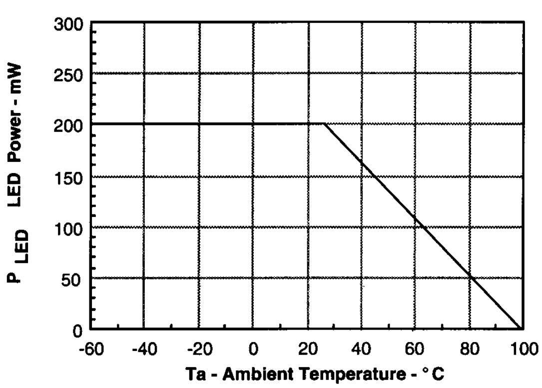


Figure 6. Maximum output power dissipation



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 causer. 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

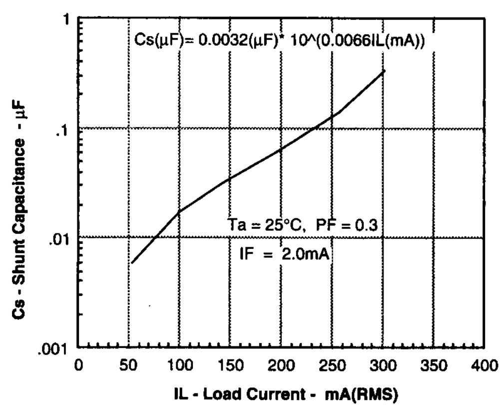


Figure 8. Normalized LED trigger current