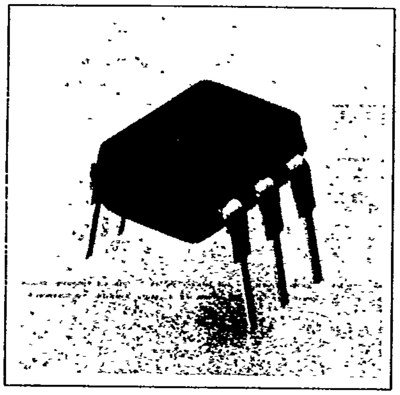
SIEMENS

T-41-87

IL410

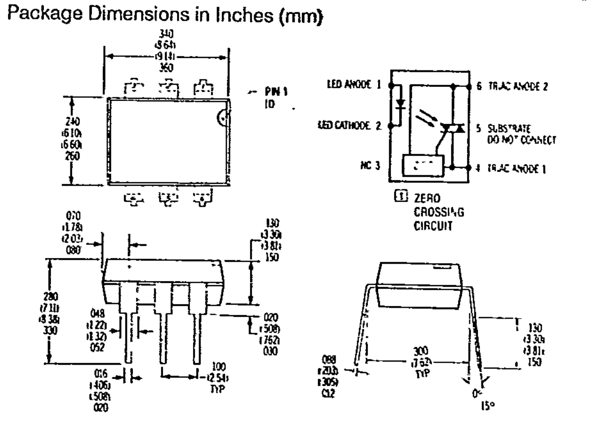
ZERO VOLTAGE CROSSING 600 V TRIAC DRIVER OPTOCOUPLER



FEATURES

- High Input Sensitivity
  I_{FT} = 2 mA, PF = 1.0
  I_{FT} = 5 mA, Typical PF ≤ 1.0
- Zero Voltage Crossing
- 600 V Blocking Voltage
- 300 mA On-State Current
- High Static dv/dt 10,000 V/μs
- Inverse Parallel SCRs Provide Commutating dv/dt >10K V/μs
- Very Low Leakage <10K μA
- Withstand Test Voltage from Double Molded Package 7500 VAC_{PEAK}
- Small 6-Pin DIP Package
- UL Approval #E52744

Package Dimensions in Inches (mm)



DESCRIPTION

The IL410 consists of a GaAs 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 in-line 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 2 mA(DC).

The IL410 uses two discrete SCRs resulting in a commutating dV/dt greater than 10KV/μs. The use of a proprietary dv/dt clamp results in a static dV/dt of greater than 10KV/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 600V blocking voltage permits control of off-line voltages up to 240VAC, with a safety factor of more than two, and is sufficient for as much as 380VAC.

The IL410 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.

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Maximum Ratings

Emitter

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

Detector

- Peak Off-State Voltage .... 600 V
- Peak Reverse Voltage .... 600 V
- RMS On-State Current .... 300 mA
- Single Cycle Surge .... 3 A
- Total Power Dissipation .... 500 mW
- Derate 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.
- Withstand Test Voltage .... 7500 VAC_{PEAK}/5300 VAC_{RMS}

Characteristics

	Symbol	Min.	Typ.	Max	Unit
Emitter					
Forward Voltage (I_F=60 mA)	V_F		1.3	1.5	V
Breakdown Voltage (I_R=10 µA)	V_{BR}	6	30		V
Reverse Current (V_R=6 V)	I_R		0.1	10	µA
Capacitance (V_F=0 V, f=1 MHz)	C_0		40		pF
Thermal Resistance Junction to Lead	R_{THJL}		750		°C/W
Output Detector					
Repetitive Peak Off-State Voltage (I_{DRM}=100 µA)	V_{DRM}	600	650		V
Off-State Voltage ($I_{D(RMS)}$=70 µA)	$V_{D(RMS)}$	424	460		V
Off-State Current (V_D=600 V, T_{amb}=100°C, I_F=0 mA)	$I_{D(RMS)1}$		10	100	µA
Off-State Current (V_D=120 V, I_F=Rated I_{FT})	$I_{D(RMS)2}$			20	µA
On-State Voltage (I_T=300 mA)	V_{TM}		1.7	3	V
On-State Current (PF=1.0, $V_{T(RMS)}$=1.7 V)	I_{TM}			300	mA
Surge (Non-Repetitive) On-State Current (f=50 Hz)	I_{TSM}			3	A

Characteristics (Cont.)

	Symbol	Min.	Typ.	Max	Unit
Output Detector (Cont.)					
Holding Current (V_T=3 V)	I_H		65	200	µA
Latching Current (V_T=2.2 V)	I_L		5		mA
LED Trigger Current (V_{AK}=5 V)	I_{FT}		1	2	mA
Zero Cross Inhibit Voltage (I_F=Rated I_{FT})	V_{IH}		15	25	
Turn-On Time (V_{RM}=V_{DM}=424 VAC)	t_{ON}		35		µs
Turn-Off Time (PF=1.0, I_T=300 mA)	t_{OFF}		50		µs
Critical Rate of Rise of Off-State Voltage (V_{RM}=V_{DM}=424 VAC)	$dv_{(MT)}/dt$	10000			V/µs
(T_{amb}=80°C)			2000		V/µs
Critical Rate of Rise of Commutating Voltage (V_{RM}=V_{DM}=424 VAC)	$dv_{(COM)}/dt$	10000			V/µs
(T_{amb}=80°C)			2000		V/µs
Critical Rate of Rise of Commutating Current (I_T=300 mA)	di/dt		100		A/ms
Thermal Resistance Junction to Lead	R_{THJL}		150		°C/W
Insulation and Isolation					
Critical Rate of Rise of Coupled Input/Output Voltage (I_T=0 A, V_{RM}=V_{DM}=424 VAC)	$dv_{(IO)}/dt$		10000		V/µs
Common Mode Coupling Capacitor	C_{CM}		0.01		pF
Package Capacitance (f=1 MHz, V_{IO}=0 V)	C_{IO}		0.8		pF
Insulation Resistance	R_S				Ω
Withstand Test Voltage Input-Output (Relative Humidity ≤50%)	WTV	4420			VAC_{RMS}
(I_{IO}≤10 µA, 1 min.)	WTV	6250			VAC_{PEAK}
Relative Humidity ≤50%)	WTV	5300			VAC_{RMS}
(I_{IO}≤10 µA, 1 sec.)	WTV	7500			VAC_{PEAK}

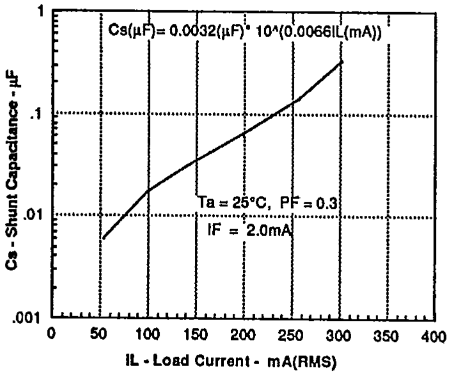
Optocouplers (Optoisolators)

POWER FACTOR CONSIDERATIONS

A snubber isn't needed to eliminate false operation of the TRIAC driver because of the IL410'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 1. Note that the value of the capacitor increases as a function of the load current.

FIGURE 1. SHUNT CAPACITANCE VS. 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 2 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 2. NORMALIZED LED TRIGGER CURRENT VS. POWER FACTOR

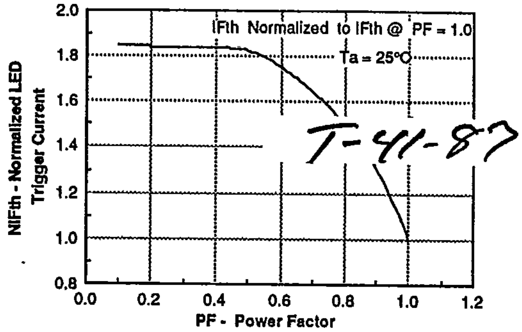
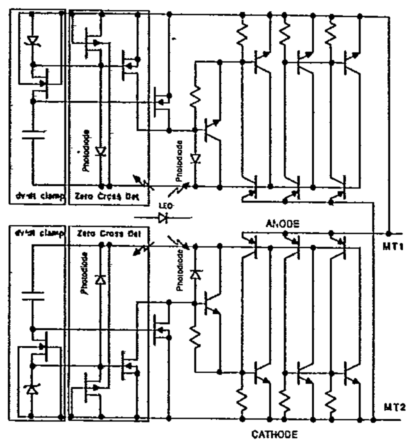


FIGURE 3. SCHEMATIC



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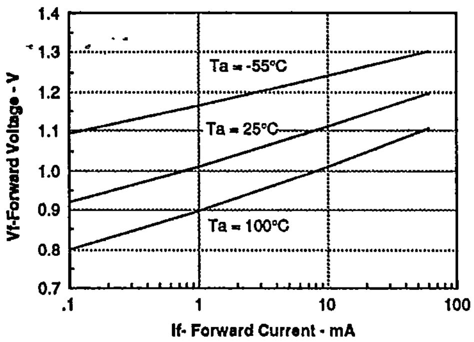
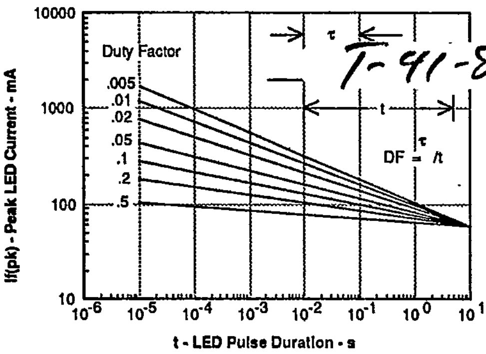
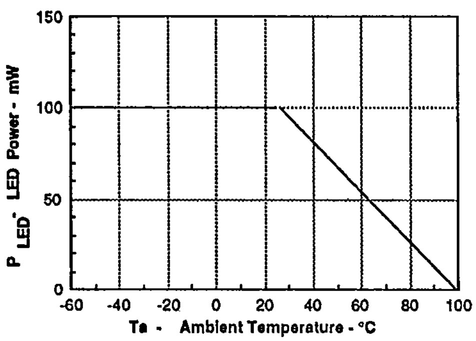
Forward voltage versus forward current



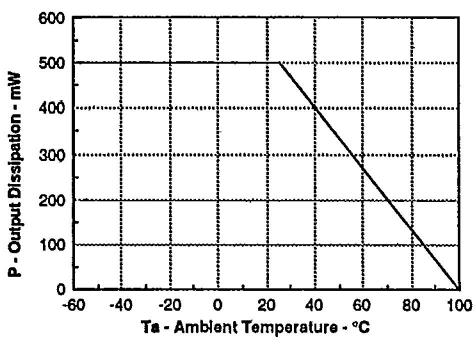
Peak LED current versus duty factor, Tau



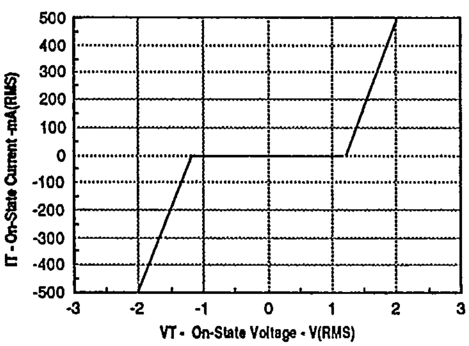
Maximum LED power dissipation



Maximum output power dissipation



On-state terminal voltage versus terminal current



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