

**SINGLE-CHANNEL**  
**6N137**  
**HCPL-2601**  
**HCPL-2611**

**DUAL-CHANNEL**  
**HCPL-2630**  
**HCPL-2631**

## DESCRIPTION

The 6N137, HCPL-2601/2611 single-channel and HCPL-2630/2631 dual-channel optocouplers consist of a 850 nm AlGaAs LED, optically coupled to a very high speed integrated photodetector logic gate with a strobable output. This output features an open collector, thereby permitting wired OR outputs. The coupled parameters are guaranteed over the temperature range of -40°C to +85°C. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan out of 8).

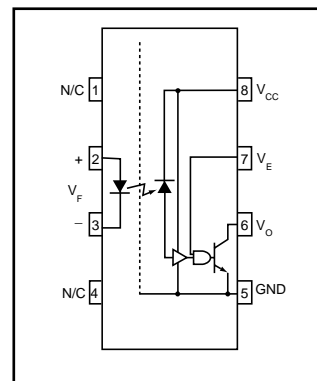
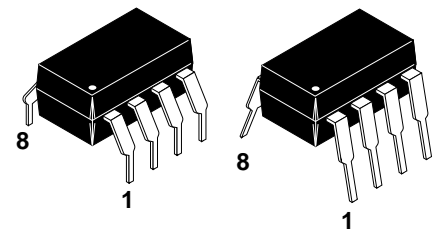
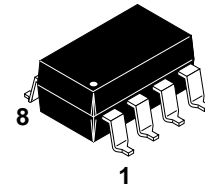
An internal noise shield provides superior common mode rejection of typically 10 kV/μs. The HCPL-2601 and HCPL-2631 has a minimum CMR of 5 kV/μs. The HCPL-2611 has a minimum CMR of 10 kV/μs.

## FEATURES

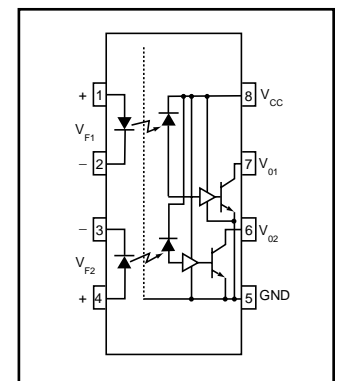
- Very high speed-10 MBit/s
- Superior CMR-10 kV/μs
- Double working voltage-480V
- Fan-out of 8 over -40°C to +85°C
- Logic gate output
- Storable output
- Wired OR-open collector
- U.L. recognized (File # E90700)

## APPLICATIONS

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface



Single-channel  
circuit drawing



Dual-channel  
circuit drawing

TRUTH TABLE  
(Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H
H	NC	L
L	NC	H

A 0.1 μF bypass capacitor must be connected between pins 8 and 5.  
(See note 1)



# HIGH SPEED-10 MBit/s LOGIC GATE OPTOCOUPLEDERS

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## ABSOLUTE MAXIMUM RATINGS (No derating required up to 85°C)

Parameter	Symbol	Value	Units
Storage Temperature	$T_{STG}$	-55 to +125	°C
Operating Temperature	$T_{OPR}$	-40 to +85	°C
Lead Solder Temperature	$T_{SOL}$	260 for 10 sec	°C
<b>EMITTER</b>			
DC/Average Forward Current	$I_F$	50	mA
Input Current		30	
Enable Input Voltage	$V_E$	5.5	V
Not to exceed $V_{CC}$ by more than 500 mV			
Reverse Input Voltage	$V_R$	5.0	V
Power Dissipation	$P_I$	100	mW
		45	
<b>DETECTOR</b>			
Supply Voltage	$V_{CC}$ (1 minute max)	7.0	V
Output Current	$I_O$	50	mA
		50	
Output Voltage	$V_O$	7.0	V
Collector Output Power Dissipation	$P_O$	85	mW
		60	

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Units
Input Current, Low Level	$I_{FL}$	0	250	μA
Input Current, High Level	$I_{FH}$	*6.3	15	mA
Supply Voltage, Output	$V_{CC}$	4.5	5.5	V
Enable Voltage, Low Level	$V_{EL}$	0	0.8	V
Enable Voltage, High Level	$V_{EH}$	2.0	$V_{CC}$	V
Low Level Supply Current	$T_A$	-40	+85	°C
Fan Out (TTL load)	N		8	

\* 6.3 mA is a guard banded value which allows for at least 20 % CTR degradation. Initial input current threshold value is 5.0 mA or less

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## ELECTRICAL CHARACTERISTICS ( $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ Unless otherwise specified.)

### INDIVIDUAL COMPONENT CHARACTERISTICS

Parameter	Test Conditions	Symbol	Min	Typ**	Max	Unit
<b>EMITTER</b>						
Input Forward Voltage	( $I_F = 10\text{ mA}$ ) $T_A = 25^\circ\text{C}$	$V_F$		1.4	1.8	V
Input Reverse Breakdown Voltage	( $I_R = 10\ \mu\text{A}$ )	$B_{VR}$	5.0			V
Input Capacitance	( $V_F = 0$ , $f = 1\text{ MHz}$ )	$C_{IN}$		60		pF
Input Diode Temperature Coefficient	( $I_F = 10\text{ mA}$ )	$\Delta V_F/\Delta T_A$		-1.4		mV/ $^\circ\text{C}$
<b>DETECTOR</b>						
High Level Supply Current	Single Channel Dual Channel ( $V_{CC} = 5.5\text{ V}$ , $I_F = 0\text{ mA}$ ) ( $V_E = 0.5\text{ V}$ )	$I_{CCH}$		7	10	mA
Low Level Supply Current	Single Channel Dual Channel ( $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ ) ( $V_E = 0.5\text{ V}$ )	$I_{CCL}$		9	13	mA
Low Level Enable Current	( $V_{CC} = 5.5\text{ V}$ , $V_E = 0.5\text{ V}$ )	$I_{EL}$		-0.8	-1.6	mA
High Level Enable Current	( $V_{CC} = 5.5\text{ V}$ , $V_E = 2.0\text{ V}$ )	$I_{EH}$		-0.6	-1.6	mA
High Level Enable Voltage	( $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ )	$V_{EH}$	2.0			V
Low Level Enable Voltage	( $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ ) (Note 3)	$V_{EL}$			0.8	V

## SWITCHING CHARACTERISTICS ( $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ , $V_{CC} = 5\text{ V}$ , $I_F = 7.5\text{ mA}$ Unless otherwise specified.)

AC Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Propagation Delay Time to Output High Level	(Note 4) ( $T_A = 25^\circ\text{C}$ ) ( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Fig. 12)	$T_{PLH}$	20	45	75	ns
Propagation Delay Time to Output Low Level	(Note 5) ( $T_A = 25^\circ\text{C}$ ) ( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Fig. 12)	$T_{PHL}$	25	45	75	ns
Pulse Width Distortion	( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Fig. 12)	$ T_{PHL} - T_{PLH} $		3	35	ns
Output Rise Time (10-90%)	( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Note 6) (Fig. 12)	$t_r$		50		ns
Output Fall Time (90-10%)	( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Note 7) (Fig. 12)	$t_f$		12		ns
Enable Propagation Delay Time to Output High Level	( $I_F = 7.5\text{ mA}$ , $V_{EH} = 3.5\text{ V}$ ) ( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Note 8) (Fig. 13)	$t_{ELH}$		20		ns
Enable Propagation Delay Time to Output Low Level	( $I_F = 7.5\text{ mA}$ , $V_{EH} = 3.5\text{ V}$ ) ( $R_L = 350\ \Omega$ , $C_L = 15\text{ pF}$ ) (Note 9) (Fig. 13)	$t_{EHL}$		20		ns
Common Mode Transient Immunity (at Output High Level)	( $T_A = 25^\circ\text{C}$ ) $ V_{CM}  = 50\text{ V}$ , (Peak) ( $I_F = 0\text{ mA}$ , $V_{OH}$ (Min.) = 2.0 V) 6N137, HCPL-2630 ( $R_L = 350\ \Omega$ ) (Note 10) HCPL-2601, HCPL-2631 (Fig. 14) HCPL-2611 $ V_{CM}  = 400\text{ V}$	$ CM_H $		10,000		V/ $\mu\text{s}$
Common Mode Transient Immunity (at Output Low Level)	( $R_L = 350\ \Omega$ ) ( $I_F = 7.5\text{ mA}$ , $V_{OL}$ (Max.) = 0.8 V) 6N137, HCPL-2630 $ V_{CM}  = 50\text{ V}$ (Peak) HCPL-2601, HCPL-2631 ( $T_A = 25^\circ\text{C}$ ) (Note 11) (Fig. 14) HCPL-2611 ( $T_A = 25^\circ\text{C}$ ) $ V_{CM}  = 400\text{ V}$	$ CM_L $		10,000		V/ $\mu\text{s}$
			5000	10,000		
			10,000	15,000		

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## TRANSFER CHARACTERISTICS (T<sub>A</sub> = -40°C to +85°C Unless otherwise specified.)

DC Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
High Level Output Current	(V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V) (I <sub>F</sub> = 250 μA, V <sub>E</sub> = 2.0 V) (Note 2)	I <sub>OH</sub>			100	μA
Low Level Output Current	(V <sub>CC</sub> = 5.5 V, I <sub>F</sub> = 5 mA) (V <sub>E</sub> = 2.0 V, I <sub>CL</sub> = 13 mA) (Note 2)	V <sub>OL</sub>		.35	.06	V
Input Threshold Current	(V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.6 V, V <sub>E</sub> = 2.0 V, I <sub>OL</sub> = 13 mA)	I <sub>FT</sub>		3	5	mA

## ISOLATION CHARACTERISTICS (T<sub>A</sub> = -40°C to +85°C Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-Output Insulation Leakage Current	(Relative humidity = 45%) (T <sub>A</sub> = 25°C, t = 5 s) (V <sub>I-O</sub> = 3000 VDC) (Note 12)	I <sub>I-O</sub>			1.0*	μA
Withstand Insulation Test Voltage	(RH < 50%, T <sub>A</sub> = 25°C) (Note 12) ( t = 1 min.)	V <sub>ISO</sub>	2500			V <sub>RMS</sub>
Resistance (Input to Output)	(V <sub>I-O</sub> = 500 V) (Note 12)	R <sub>I-O</sub>		10 <sup>12</sup>		Ω
Capacitance (Input to Output)	(f = 1 MHz) (Note 12)	C <sub>I-O</sub>		0.6		pF

\*\* All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

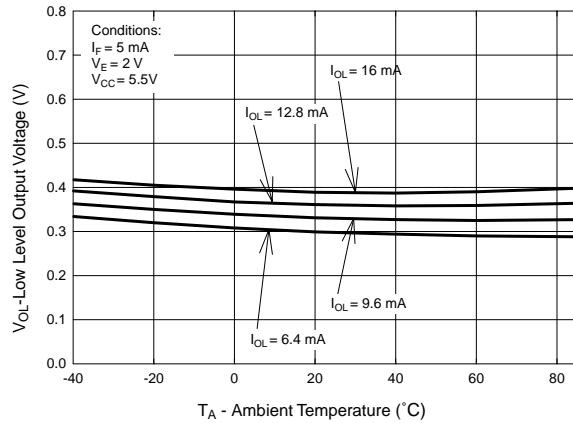
## NOTES

- The V<sub>CC</sub> supply to each optoisolator must be bypassed by a 0.1μF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V<sub>CC</sub> and GND pins of each device.
- Each channel.
- Enable Input - No pull up resistor required as the device has an internal pull up resistor.
- t<sub>PLH</sub> - Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- t<sub>PHL</sub> - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- t<sub>r</sub> - Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
- t<sub>f</sub> - Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
- t<sub>ELH</sub> - Enable input propagation delay is measured from the 1.5 V level on the HIGH to LOW transition of the input voltage pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- t<sub>EHL</sub> - Enable input propagation delay is measured from the 1.5 V level on the LOW to HIGH transition of the input voltage pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- CM<sub>H</sub> - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V<sub>OUT</sub> > 2.0 V). Measured in volts per microsecond (V/μs).
- CM<sub>L</sub> - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the low output state (i.e., V<sub>OUT</sub> < 0.8 V). Measured in volts per microsecond (V/μs).
- Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

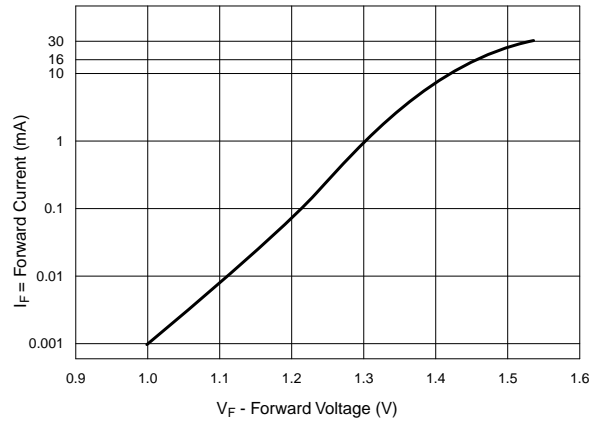
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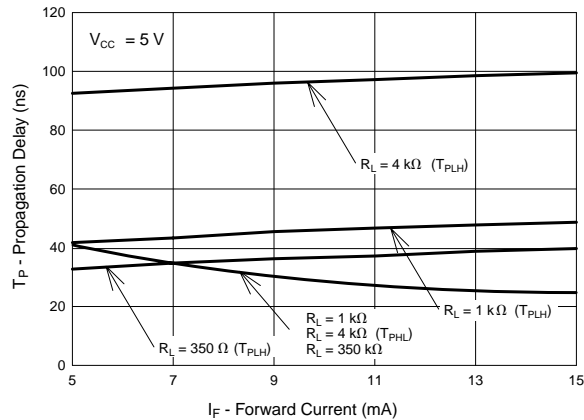
**Fig.1 Low Level Output Voltage vs. Ambient Temperature**



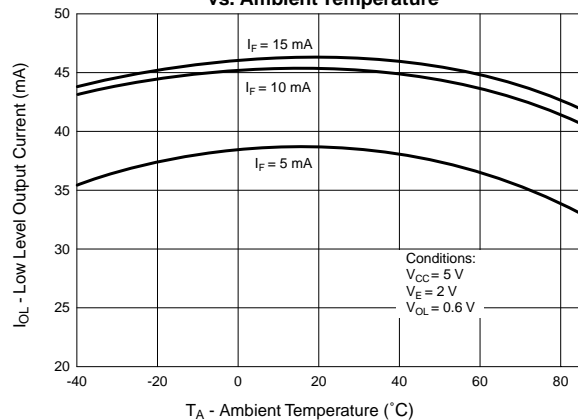
**Fig. 2 Input Diode Forward Voltage vs. Forward Current**



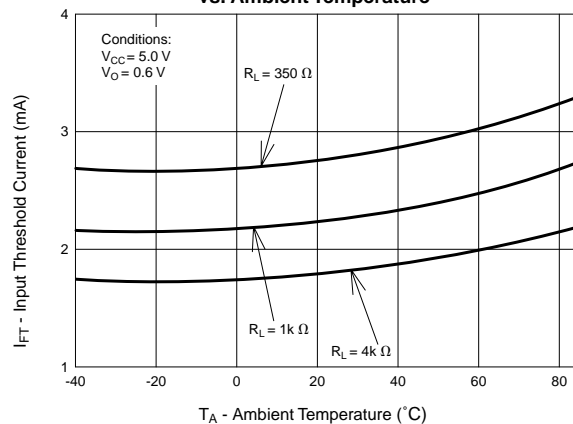
**Fig.3 Switching Time vs. Forward Current**



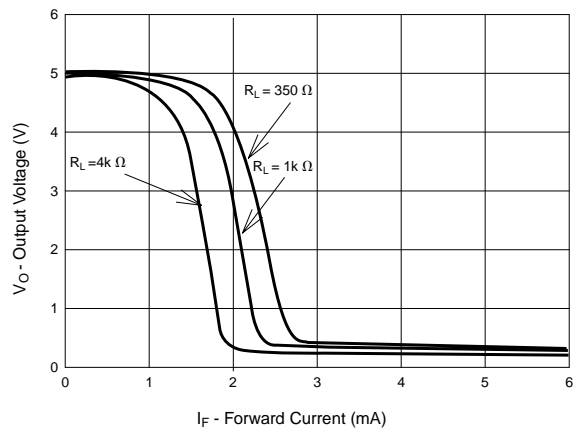
**Fig. 4 Low Level Output Current vs. Ambient Temperature**



**Fig. 5 Input Threshold Current vs. Ambient Temperature**



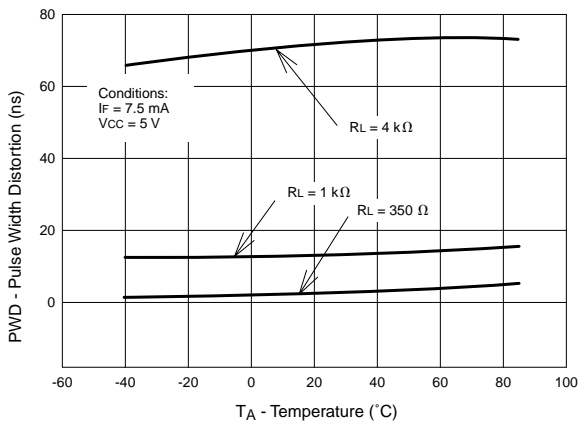
**Fig. 6 Output Voltage vs. Input Forward Current**



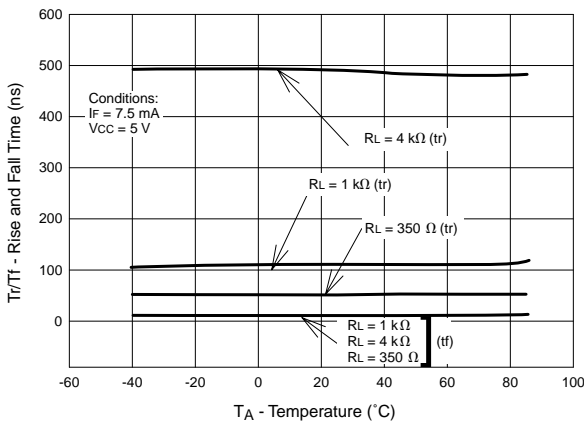
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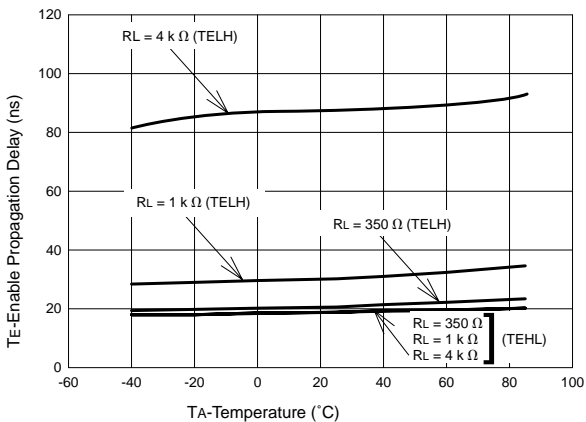
**Fig. 7 Pulse Width Distortion vs. Temperature**



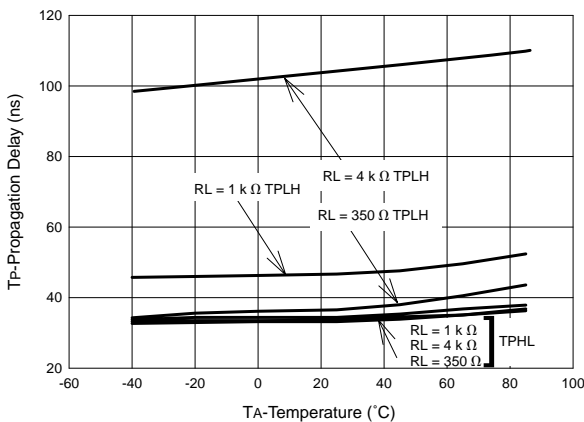
**Fig. 8 Rise and Fall Time vs. Temperature**



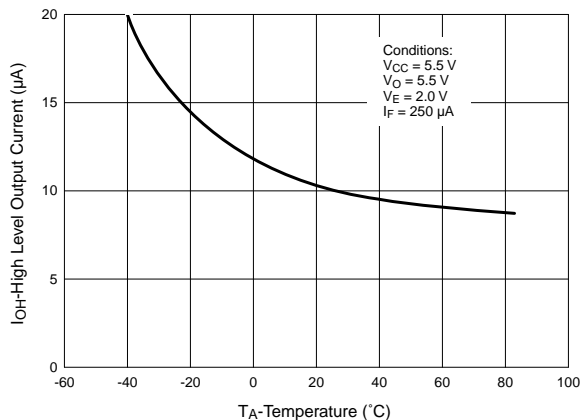
**Fig. 9 Enable Propagation Delay vs. Temperature**



**Fig. 10 Switching Time vs. Temperature**

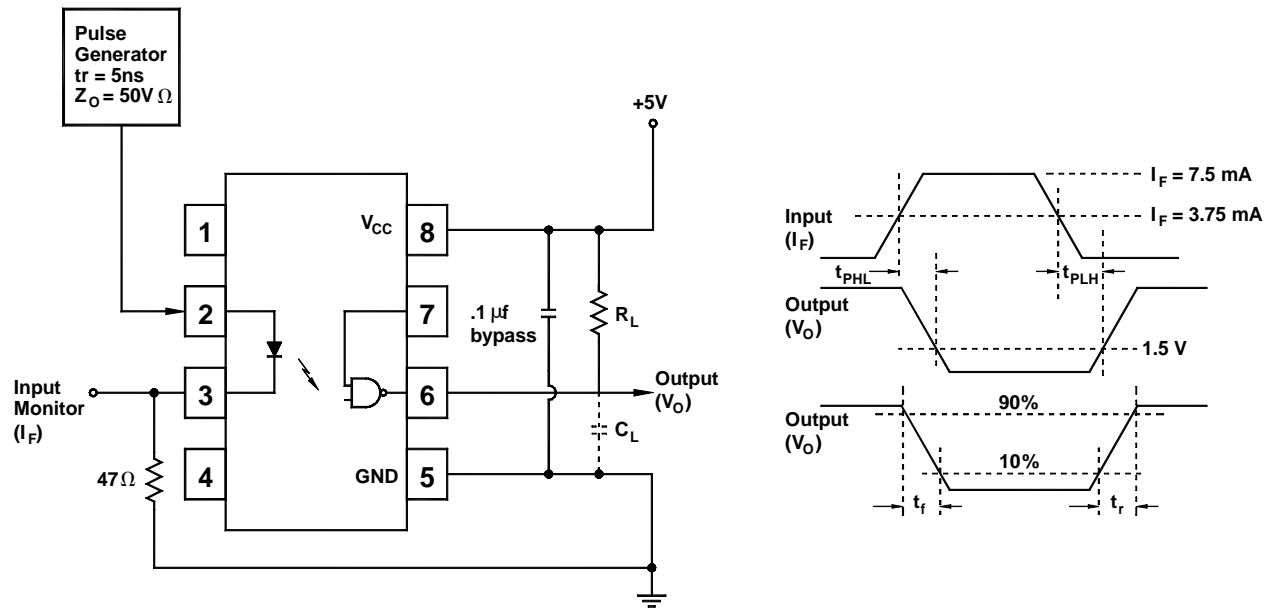


**Fig. 11 High Level Output Current vs. Temperature**

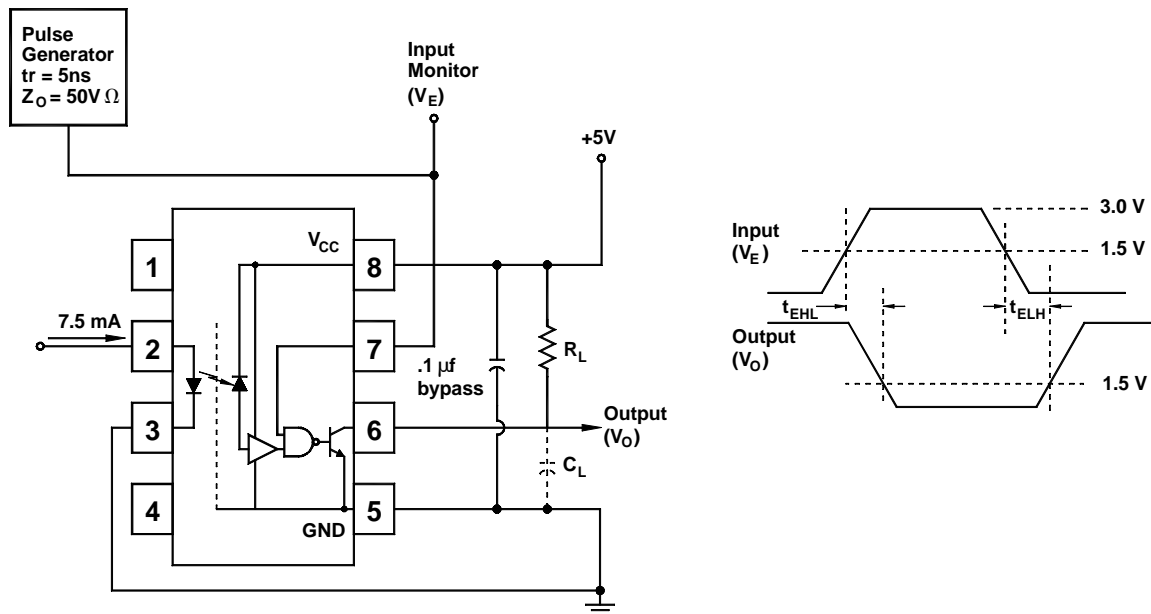


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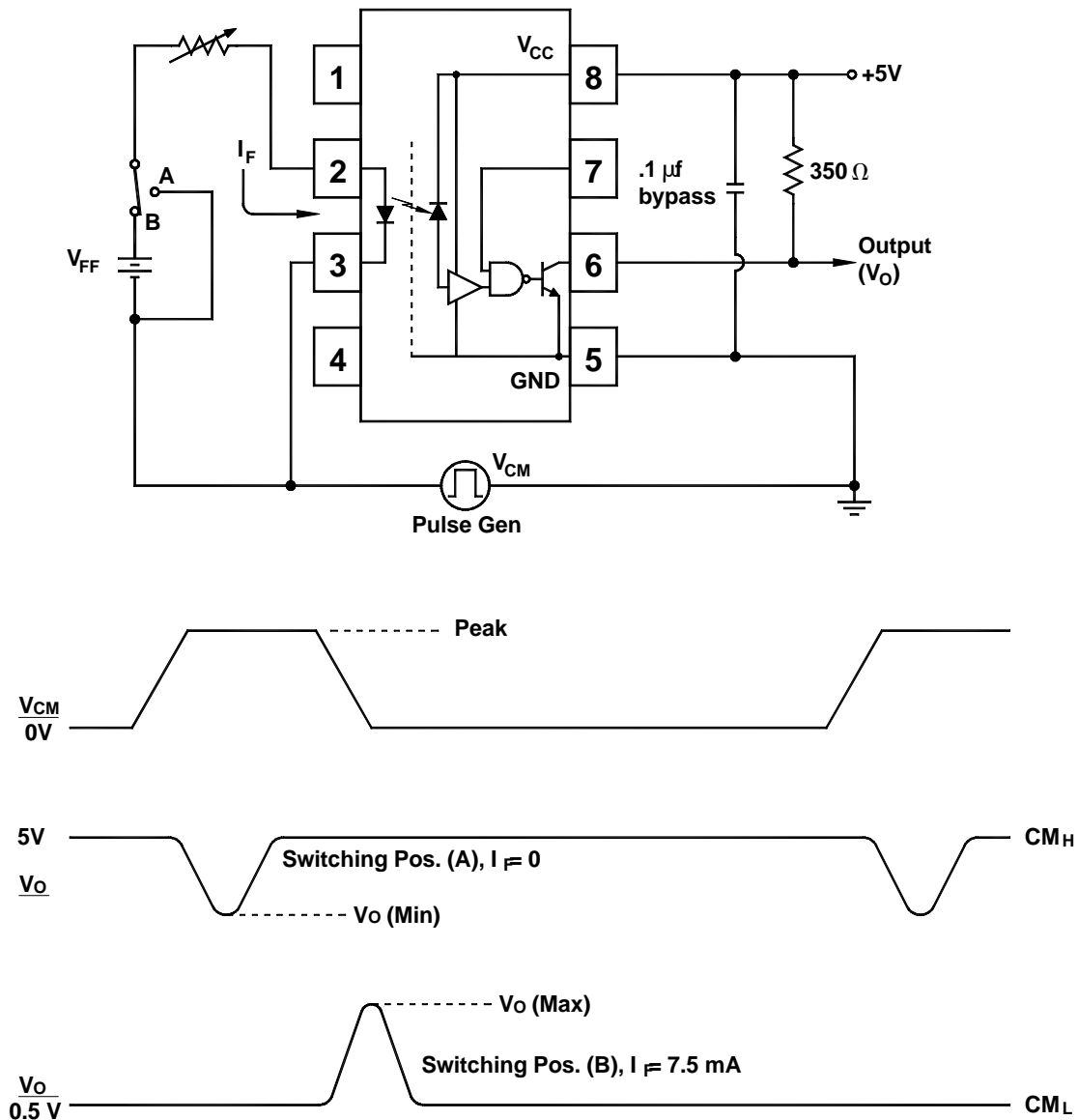
**Fig. 12 Test Circuit and Waveforms for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ .**



**Fig. 13 Test Circuit  $t_{EHL}$  and  $t_{ELH}$ .**

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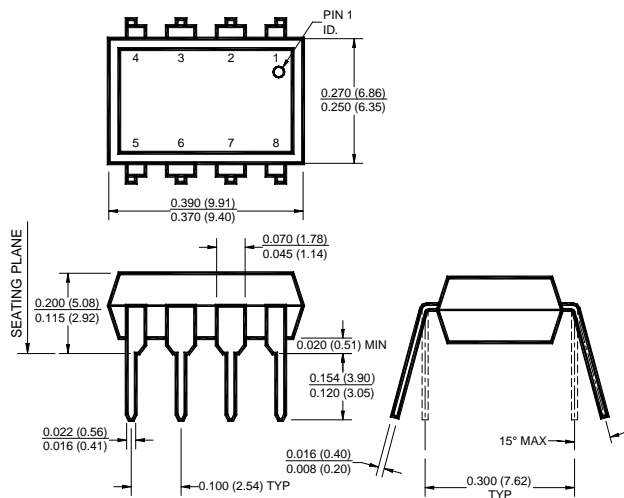
**Fig. 14 Test Circuit Common Mode Transient Immunity**



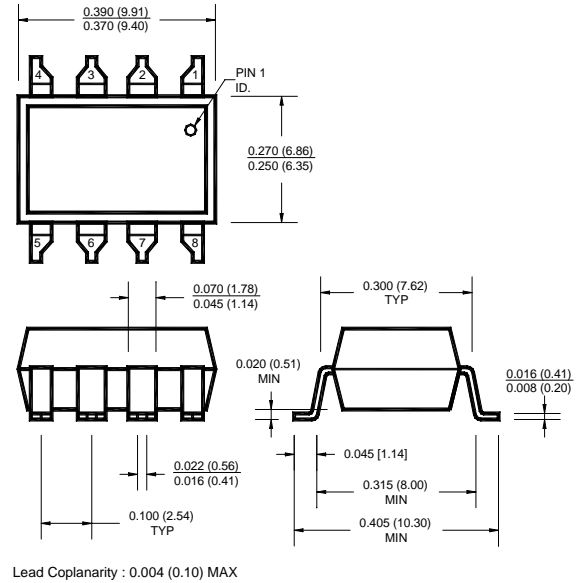
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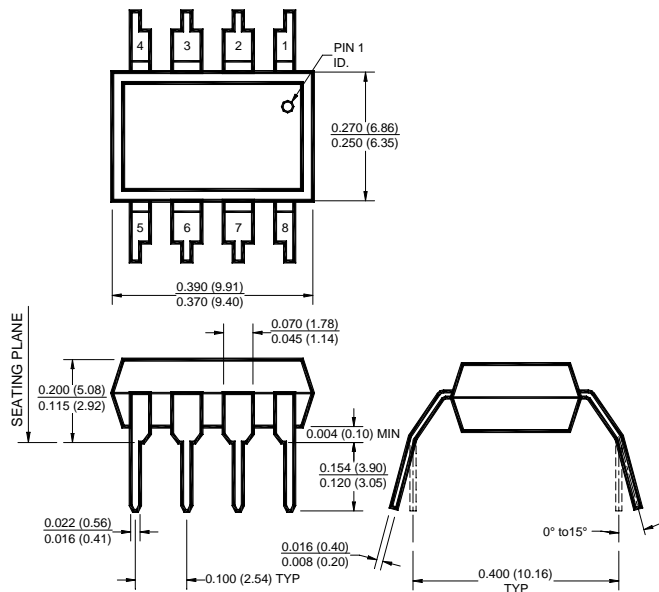
## Package Dimensions (Through Hole)



## Package Dimensions (Surface Mount)



## Package Dimensions (0.4" Lead Spacing)



### NOTE

All dimensions are in inches (millimeters)

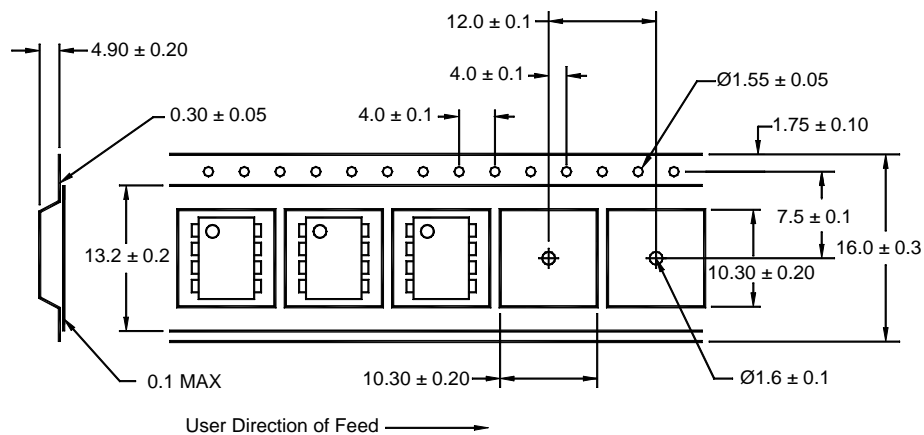
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## ORDERING INFORMATION

Option	Order Entry Identifier	Description
R2	.R2	Opto Plus Reliability Conditioning
S	.S	Surface Mount Lead Bend
SD	.SD	Surface Mount; Tape and reel
W	.W	0.4" Lead Spacing

## QT Carrier Tape Specifications ("D" Taping Orientation)



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**Call QT Optoelectronics for more information or the phone number of your nearest distributor.**

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