

**SINGLE-CHANNEL**  
**6N135, 6N136**  
**HCPL-2503**  
**HCPL-4502**

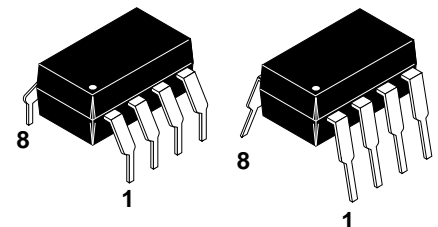
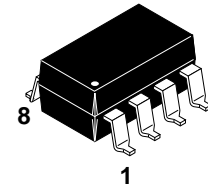
**DUAL-CHANNEL**  
**HCPL-2530**  
**HCPL-2531**

## DESCRIPTION

The HCPL-4502/HCPL-2503, 6N135/6 and HCPL-2530/HCPL-2531 optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor.

A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

An internal noise shield provides superior common mode rejection of 10kV/μs. An improved package allows superior insulation permitting a 480 V working voltage compared to industry standard Of 220 V.

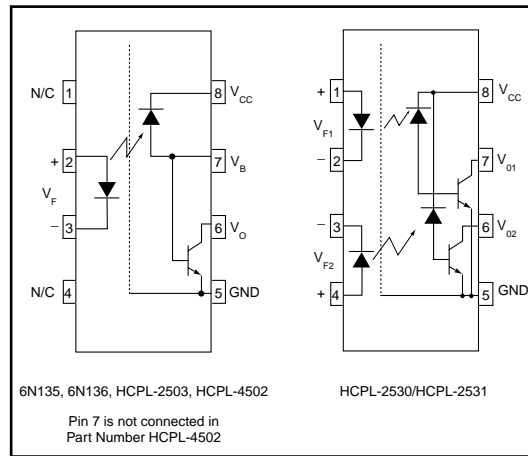


## FEATURES

- High speed-1 MBit/s
- Superior CMR-10 kV/μs
- Dual-Channel  
HCPL-2530/HCPL-2531
- Double working voltage-480V RMS
- CTR guaranteed 0-70°C
- U.L. recognized (File # E90700)

## APPLICATIONS

- Line receivers
- Pulse transformer replacement
- Output interface to CMOS-LSTTL-TTL
- Wide bandwidth analog coupling



## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise specified)

Parameter	Symbol	Value	Units
Storage Temperature	T <sub>STG</sub>	-55 to +125	°C
Operating Temperature	T <sub>OPR</sub>	-55 to +100	°C
Lead Solder Temperature	T <sub>SOL</sub>	260 for 10 sec	°C
<b>EMITTER</b>			
DC/Average Forward Input Current	I <sub>F</sub> (avg)	25	mA
Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	I <sub>F</sub> (pk)	50	mA
Peak Transient Input Current - (≤ 1 μs P.W., 300 pps)	I <sub>F</sub> (trans)	1.0	A
Reverse Input Voltage	V <sub>R</sub>	5	V
Input Power Dissipation	P <sub>D</sub>	100	mW
		45	
<b>DETECTOR</b>			
Average Output Current	I <sub>O</sub> (avg)	8	mA
Peak Output Current	I <sub>O</sub> (pk)	16	mA
Emitter-Base Reverse Voltage	V <sub>EBR</sub>	5	V
Supply Voltage	V <sub>CC</sub>	-0.5 to 30	V
Output Voltage	V <sub>O</sub>	-0.5 to 20	V
Base Current	I <sub>B</sub>	5	mA
Output power dissipation	P <sub>D</sub>	100	mW
		35	mW

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<b>ELECTRICAL CHARACTERISTICS</b> ( $T_A = 0$ to $70^\circ\text{C}$ Unless otherwise specified)							
<b>INDIVIDUAL COMPONENT CHARACTERISTICS</b>							
Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
<b>EMITTER</b>							
Input Forward Voltage	( $I_F = 16$ mA, $T_A = 25^\circ\text{C}$ )	$V_F$			1.45	1.7	V
	( $I_F = 16$ mA)				1.8		
	Input Reverse Breakdown Voltage	( $I_R = 10$ $\mu\text{A}$ )	$B_{VR}$		5.0		V
Temperature coefficient of forward voltage	( $I_F = 16$ mA)	$(\Delta V_F / \Delta T_A)$			-1.6		mV/ $^\circ\text{C}$
<b>DETECTOR</b>							
Logic high output current	( $I_F = 0$ mA, $V_O = V_{CC} = 5.5$ V) ( $T_A = 25^\circ\text{C}$ )	$I_{OH}$	All		0.001	0.5	$\mu\text{A}$
	( $I_F = 0$ mA, $V_O = V_{CC} = 15$ V) ( $T_A = 25^\circ\text{C}$ )		6N135 6N136 HCPL-4502 HCPL-2503		0.005	1	
	( $I_F = 0$ mA, $V_O = V_{CC} = 15$ V)		All			50	
Logic low supply current	( $I_F = 16$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)	$I_{CCL}$	6N135 6N136 HCPL-4502 HCPL-2503		120	200	$\mu\text{A}$
	( $I_{F1} = I_{F2} = 16$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)		HCPL-2530 HCPL-2531		200	400	
Logic high supply current	( $I_F = 0$ mA, $V_O = \text{Open}$ , $V_{CC} = 15$ V) ( $T_A = 25^\circ\text{C}$ )	$I_{CCH}$	6N135 6N136 HCPL-4502 HCPL-2503			1	$\mu\text{A}$
	( $I_F = 0$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)		6N135 6N136 HCPL-4502 HCPL-2503			2	
	( $I_F = 0$ mA, $V_O = \text{Open}$ ) ( $V_{CC} = 15$ V)		HCPL-2530 HCPL-2531		0.02	4	

\*\* All typicals at  $T_A = 25^\circ\text{C}$

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<b>TRANSFER CHARACTERISTICS</b> ( $T_A = 0$ to $70^\circ\text{C}$ Unless otherwise specified)									
Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit		
<b>COUPLED</b>  Current transfer ratio (Note 5)	$(I_F = 16 \text{ mA}, V_O = 0.4 \text{ V})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	CTR	6N135 HCPL-2530	7	18	50	%		
			6N136 HCPL-4502 HCPL-2531	19	27	50	%		
			HCPL-2503	12	27		%		
			6N135 HCPL-2530	5	21		%		
	$(I_F = 16 \text{ mA}, V_O = 0.5 \text{ V})$ $(V_{CC} = 4.5 \text{ V})$		6N136 HCPL-4502 HCPL-2531	15	30		%		
			HCPL-2503	9	30		%		
			Logic low output voltage output voltage	$(I_F = 16 \text{ mA}, I_O = 1.1 \text{ mA})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	6N135 HCPL-2530		0.18	0.4	V
					6N136 HCPL-4502 HCPL-2503		0.18	0.5	
$(I_F = 16 \text{ mA}, I_O = 3 \text{ mA})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	HCPL-2531			0.25	0.4				
$(I_F = 16 \text{ mA}, I_O = 0.8 \text{ mA})$ $(V_{CC} = 4.5 \text{ V})$	6N135 HCPL-2530				0.5				
$(I_F = 16 \text{ mA}, I_O = 2.4 \text{ mA})$ $(V_{CC} = 4.5 \text{ V})$	6N136 HCPL-4502 HCPL-2503 HCPL-2531				0.5				

\*\* All typicals at  $T_A = 25^\circ\text{C}$

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**SWITCHING CHARACTERISTICS** ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified.,  $V_{CC} = 5\text{ V}$ )

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
Propagation delay time to logic low	$T_A = 25^\circ\text{C}$ , ( $R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)	$T_{PHL}$	6N135 HCPL-2530		0.45	1.5	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7) $T_A = 25^\circ\text{C}$		6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.45	0.8	$\mu\text{s}$
	$(R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)		6N135 HCPL-2530			2.0	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7)		6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	$\mu\text{s}$
Propagation delay time to logic high	$T_A = 25^\circ\text{C}$ , ( $R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)	$T_{PLH}$	6N135 HCPL-2530		0.5	1.5	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7) $T_A = 25^\circ\text{C}$		6N136 HCPL-4502 HCPL-2503 HCPL-2531		0.3	0.8	$\mu\text{s}$
	$(R_L = 4.1\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 6) (Fig. 7)		6N135 HCPL-2530			2.0	$\mu\text{s}$
	$(R_L = 1.9\text{ k}\Omega$ , $I_F = 16\text{ mA}$ ) (Note 7) (Fig. 7)		6N136 HCPL-4502 HCPL-2503 HCPL-2531			1.0	$\mu\text{s}$
Common mode transient immunity at logic high	$(I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $R_L = 4.1\text{ k}\Omega$ ) (Note 8) (Fig. 8) $T_A = 25^\circ\text{C}$	$ CM_H $	6N135 HCPL-2530		10,000		$\text{V}/\mu\text{s}$
	$(I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ ) $T_A = 25^\circ\text{C}$ , ( $R_L = 1.9\text{ k}\Omega$ ) (Note 8) (Fig. 8)		6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		$\text{V}/\mu\text{s}$
Common mode transient immunity at logic low	$(I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $R_L = 4.1\text{ k}\Omega$ ) (Note 8) (Fig. 8) $T_A = 25^\circ\text{C}$	$ CM_L $	6N135 HCPL-2530		10,000		$\text{V}/\mu\text{s}$
	$(I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ ) $(R_L = 1.9\text{ k}\Omega)$ (Note 8) (Fig. 8)		6N136 HCPL-4502 HCPL-2503 HCPL-2531		10,000		$\text{V}/\mu\text{s}$

\*\* All typicals at  $T_A = 25^\circ\text{C}$

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<b>ISOLATION CHARACTERISTICS</b> ( $T_A = 0$ to $70^\circ\text{C}$ Unless otherwise specified)						
Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-output insulation leakage current	(Relative humidity = 45%) ( $T_A = 25^\circ\text{C}$ , $t = 5$ s) ( $V_{I-O} = 3000$ VDC) (Note 9)	$I_{I-O}$			1.0	$\mu\text{A}$
Withstand insulation test voltage	( $RH \leq 50\%$ , $T_A = 25^\circ\text{C}$ ) (Note 9) ( $t = 1$ min.)	$V_{ISO}$	2500			$V_{RMS}$
Resistance (input to output)	(Note 9) ( $V_{I-O} = 500$ VDC)	$R_{I-O}$		$10^{12}$		$\Omega$
Capacitance (input to output)	(Note 9) ( $f = 1$ MHz)	$C_{I-O}$		0.6		pF
DC Current gain	( $I_O = 3$ mA, $V_O = 5$ V)	HFE		150		
Input-Input Insulation leakage current	( $RH \leq 45\%$ , $V_{I-I} = 500$ VDC) (Note 10) $t = 5$ s, (HCPL-2530/2531 only)	$I_{I-I}$		0.005		$\mu\text{A}$
Input-Input Resistance	( $V_{I-I} = 500$ VDC) (Note 10) (HCPL-2530/2531 only)	$R_{I-I}$		$10^{11}$		$\Omega$
Input-Input Capacitance	( $f = 1$ MHz) (Note 10) (HCPL-2530/2531 only)	$C_{I-I}$		0.03		pF

\*\* All typicals at  $T_A = 25^\circ\text{C}$

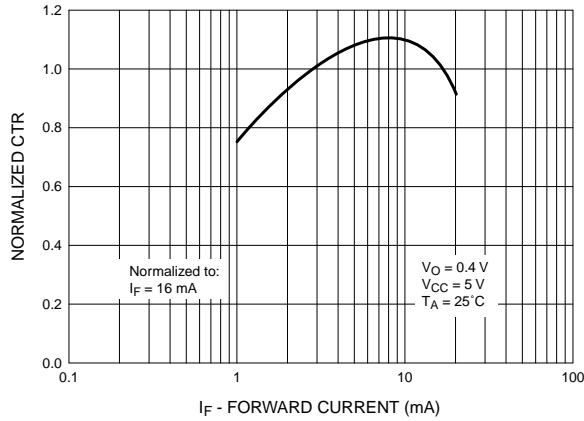
## NOTES

- Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $0.8$  mA/ $^\circ\text{C}$ .
- Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $1.6$  mA/ $^\circ\text{C}$ .
- Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $0.9$  mW/ $^\circ\text{C}$ .
- Derate linearly above  $70^\circ\text{C}$  free-air temperature at a rate of  $2.0$  mW/ $^\circ\text{C}$ .
- Current Transfer Ratio is defined as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.
- The  $4.1$  k $\Omega$  load represents 1 LSTTL unit load of  $0.36$  mA and  $6.1$  k $\Omega$  pull-up resistor.
- The  $1.9$  k $\Omega$  load represents 1 TTL unit load of  $1.6$  mA and  $5.6$  k $\Omega$  pull-up resistor.
- Common mode transient immunity in logic high level is the maximum tolerable (positive)  $dV_{cm}/dt$  on the leading edge of the common mode pulse signal  $V_{CM}$ , to assure that the output will remain in a logic high state (i.e.,  $V_O > 2.0$  V). Common mode transient immunity in logic low level is the maximum tolerable (negative)  $dV_{cm}/dt$  on the trailing edge of the common mode pulse signal,  $V_{CM}$ , to assure that the output will remain in a logic low state (i.e.,  $V_O < 0.8$  V).
- Device is considered a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
- Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.

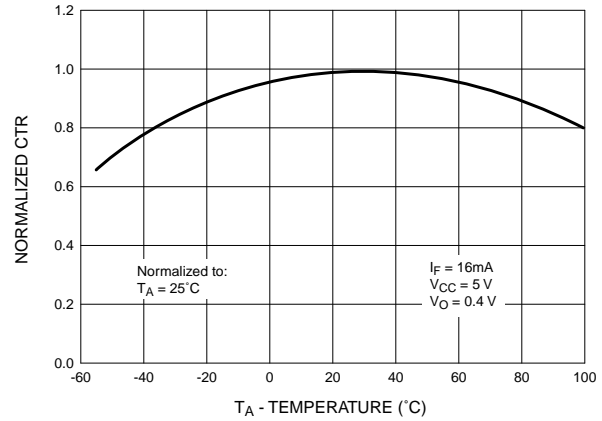
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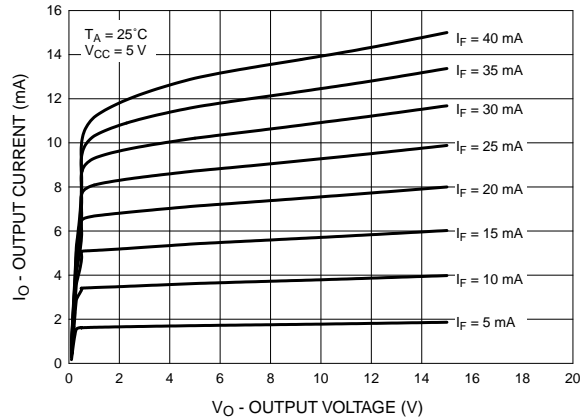
**Fig. 1 Normalized CTR vs. Forward Current**



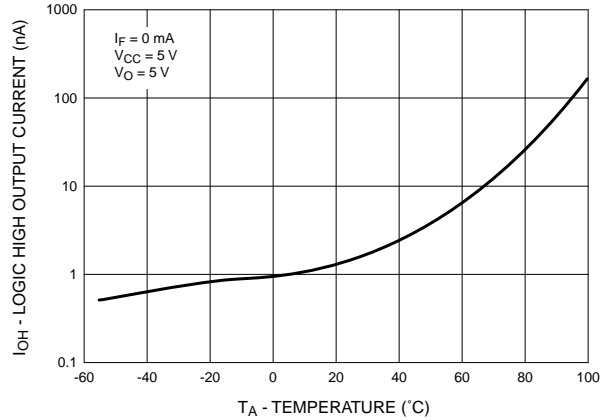
**Fig. 2 Normalized CTR vs. Temperature**



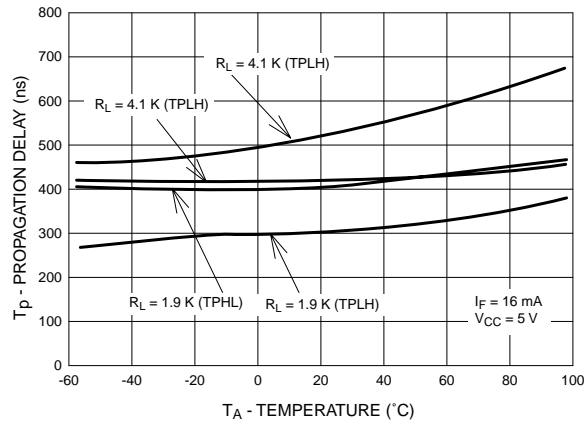
**Fig. 3 Output Current vs. Output Voltage**



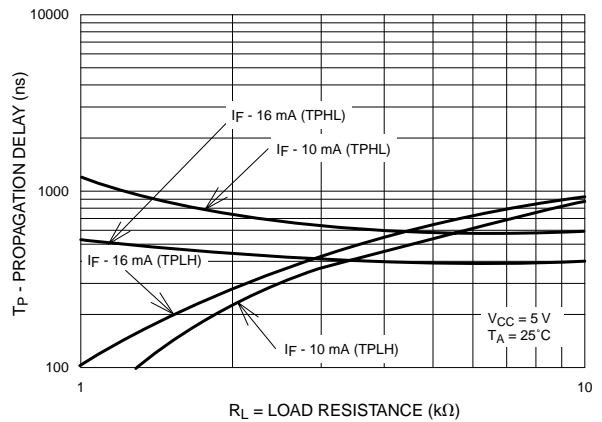
**Fig. 4 Logic High Output Current vs. Temperature**



**Fig. 5 Propagation Delay vs. Temperature**

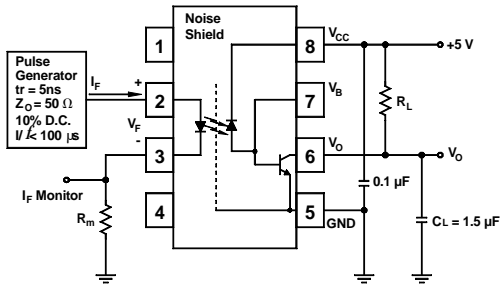


**Fig. 6 Propagation Delay vs. Load Resistance**

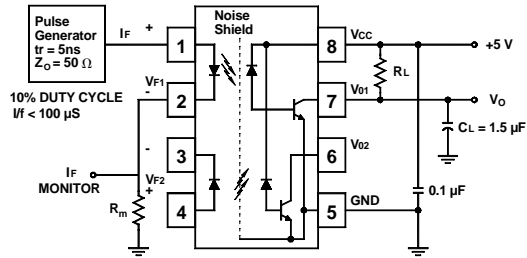


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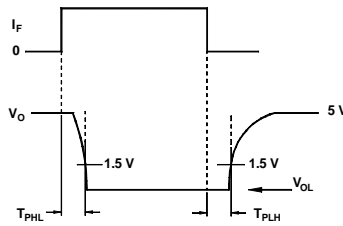
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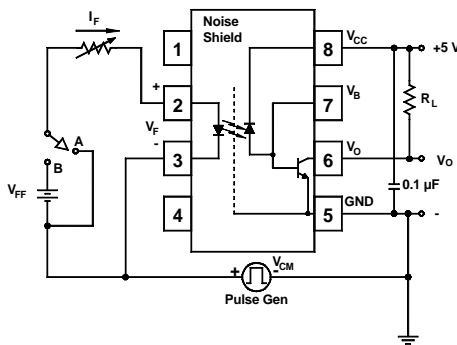
Test Circuit for 6N135, 6N136, HCPL-2503 and HCPL-4502



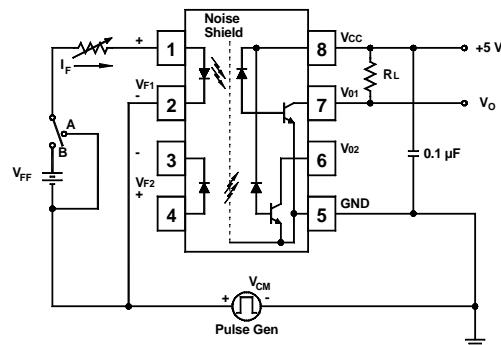
Test Circuit for HCPL-2530 and HCPL-2531



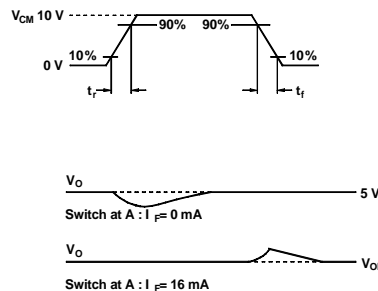
**Fig. 7 Switching Time Test Circuit**



Test Circuit for 6N135, 6N136, HCPL-2503 and HCPL-4502



Test Circuit for HCPL-2530 and HCPL-2531

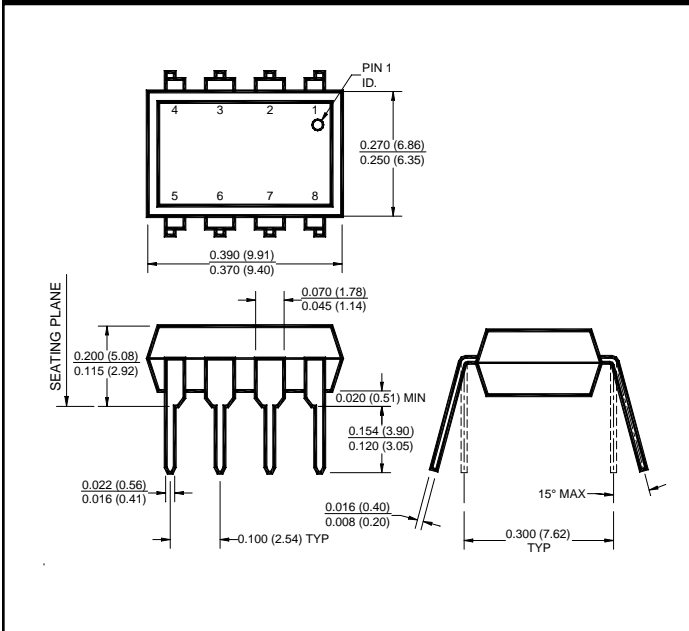


**Fig. 8 Common Mode Immunity Test Circuit**

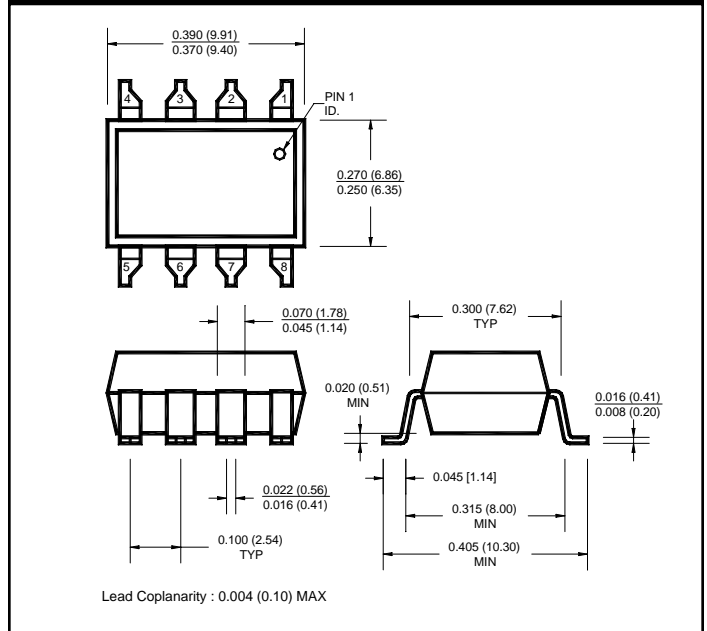
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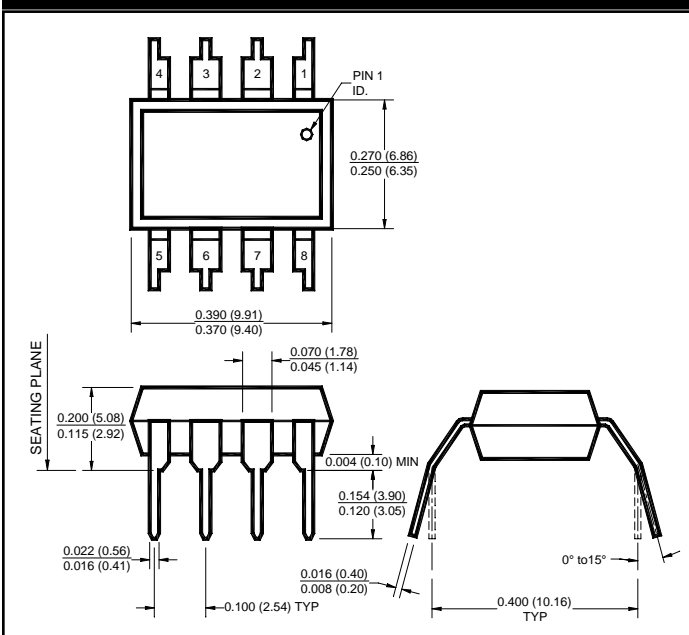
## Package Dimensions (Through Hole)



## Package Dimensions (Surface Mount)



## Package Dimensions (0.4" Lead Spacing)



**NOTE**

All dimensions are in inches (millimeters)



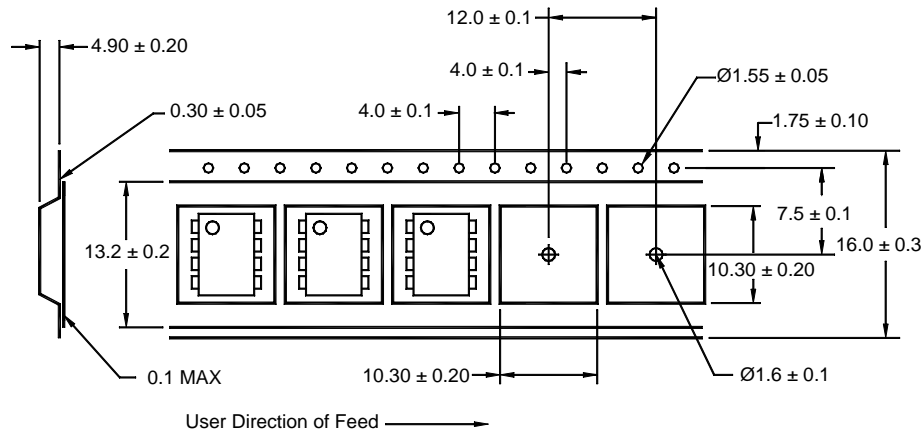
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## ORDERING INFORMATION

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

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



### Corporate Headquarters

QT Optoelectronics  
610 North Mary Avenue  
Sunnyvale, CA 94086  
(408) 720-1440 Phone  
(408) 720-0848 Fax

### North American Sales

QT Optoelectronics  
16775 Addison Rd., Suite 200  
Addison, TX 75001  
(972) 447-1300 Phone  
(972) 447-0784 Fax

### European Sales

Quality Technologies Deutschland GmbH  
Max-Huber-Strasse 8  
D-85737 Ismaning, Germany  
49 [0] 89/96.30.51 Phone  
49 [0] 89/96.54.74 Fax

### European Sales

QT Optoelectronics  
"Le Levant"  
2, rue du Nouveau Bercy  
F-94277-CHARENTON-LE PONT Cedex  
FRANCE  
33 [0] 1.45.18.78.78 Phone  
33 [0] 1.43.75.77.57 Fax

### Asia/Pacific Sales

QT Optoelectronics  
B613, 6th Floor  
East Wing, Wisma Tractors  
Jalan SS16/1, Subang Jaya  
47500 Petaling Jaya  
Selangor Darul Eshan, Malaysia  
603/735-2417 Phone  
603/736-3382 Fax

### European Sales

Quality Technologies (U.K) Ltd.  
10, Prebendal Court, Oxford Road  
Aylesbury, Buckinghamshire  
HP19-3EY United Kingdom  
44 [0] 1296/30.44.99 Phone  
44 [0] 1296/39.24.32 Fax

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.