

**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).

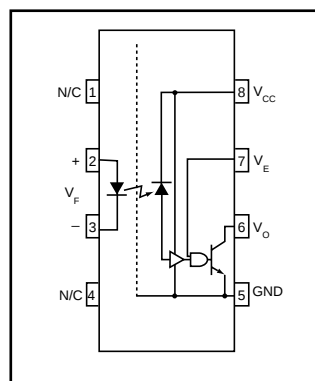
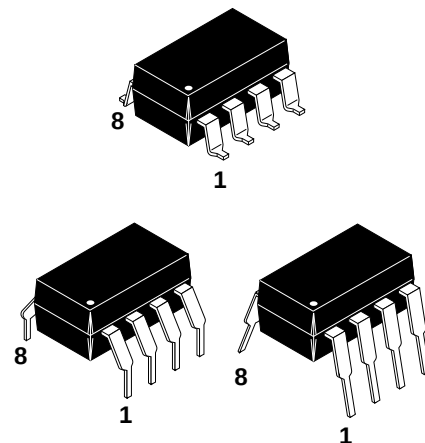
An internal noise shield provides superior common mode rejection of typically 10 kV/μs. The HCPL- 2601 and HCPL- 2631 has a minimum CMR of 5 kV/μs. The HCPL-2611 has a minimum CMR of 10 kV/μs.

## FEATURES

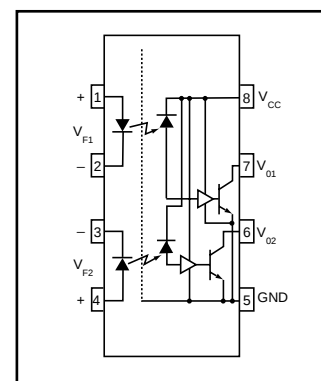
- Very high speed-10 MBit/s
- Superior CMR-10 kV/μs
- Double working voltage-480V
- Fan-out of 8 over -40°C to +85°C
- Logic gate output
- Storable output
- Wired OR-open collector
- U.L. recognized (File # E90700)

## 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)

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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 Input Current           | $I_F$                      | 50             | mA    |
| Single channel                             |                            |                |       |
| Dual channel (Each channel)                |                            | 30             |       |
| Enable Input Voltage                       | $V_E$                      | 5.5            | V     |
| Single channel                             |                            |                |       |
| Not to exceed $V_{CC}$ by more than 500 mV |                            |                |       |
| Reverse Input Voltage                      | $V_R$                      | 5.0            | V     |
| Power Dissipation                          | $P_I$                      | 100            | mW    |
| Single channel                             |                            |                |       |
| Dual channel (Each channel)                |                            | 45             |       |
| <b>DETECTOR</b>                            |                            |                |       |
| Supply Voltage                             | $V_{CC}$<br>(1 minute max) | 7.0            | V     |
| Output Current                             | $I_O$                      | 50             | mA    |
| Single channel                             |                            |                |       |
| Dual channel (Each channel)                |                            | 50             |       |
| Output Voltage                             | $V_O$                      | 7.0            | V     |
| Collector Output                           | $P_O$                      | 85             | mW    |
| Single channel                             |                            |                |       |
| Power Dissipation                          |                            | 60             |       |
| Dual channel (Each channel)                |                            |                |       |

## 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               | ( $I_F = 10\text{ mA}$ )<br>$T_A = 25^\circ\text{C}$                                                       | $V_F$                     |     | 1.4   | 1.8  | V                    |
| Input Reverse Breakdown Voltage     | ( $I_R = 10\text{ }\mu\text{A}$ )                                                                          | $B_{VR}$                  | 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 ( $V_{CC} = 5.5\text{ V}$ , $I_F = 0\text{ mA}$ )<br>Dual Channel ( $V_E = 0.5\text{ V}$ )  | $I_{CCH}$                 |     | 7     | 10   | mA                   |
| Low Level Supply Current            | Single Channel ( $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ )<br>Dual Channel ( $V_E = 0.5\text{ V}$ ) | $I_{CCL}$                 |     | 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) ( $T_A = 25^\circ\text{C}$ )<br>( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ ) (Fig. 12)                                                                                                                                                                                            | $T_{PLH}$             | 20   | 45     | 75  | ns               |
| Propagation Delay Time to Output Low Level            | (Note 5) ( $T_A = 25^\circ\text{C}$ )<br>( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ ) (Fig. 12)                                                                                                                                                                                            | $T_{PHL}$             | 25   | 45     | 75  | ns               |
| Pulse Width Distortion                                | ( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ ) (Fig. 12)                                                                                                                                                                                                                                     | $ T_{PHL} - T_{PLH} $ |      | 3      | 35  | ns               |
| Output Rise Time (10-90%)                             | ( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ )<br>(Note 6) (Fig. 12)                                                                                                                                                                                                                         | $t_r$                 |      | 50     |     | ns               |
| Output Fall Time (90-10%)                             | ( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ )<br>(Note 7) (Fig. 12)                                                                                                                                                                                                                         | $t_f$                 |      | 12     |     | ns               |
| Enable Propagation Delay Time to Output High Level    | ( $I_F = 7.5\text{ mA}$ , $V_{EH} = 3.5\text{ V}$ )<br>( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ ) (Note 8) (Fig. 13)                                                                                                                                                                     | $t_{ELH}$             |      | 20     |     | ns               |
| Enable Propagation Delay Time to Output Low Level     | ( $I_F = 7.5\text{ mA}$ , $V_{EH} = 3.5\text{ V}$ )<br>( $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ ) (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)<br>( $I_F = 0\text{ mA}$ , $V_{OH}(\text{Min.}) = 2.0\text{ V}$ )<br>6N137, HCPL-2630 ( $R_L = 350\text{ }\Omega$ ) (Note 10)<br>HCPL-2601, HCPL-2631 (Fig. 14)<br>HCPL-2611 $ V_{CM}  = 400\text{ V}$                              | $ CM_H $              | 5000 | 10,000 |     | V/ $\mu\text{s}$ |
| Common Mode Transient Immunity (at Output Low Level)  | ( $R_L = 350\text{ }\Omega$ ) ( $I_F = 7.5\text{ mA}$ , $V_{OL}(\text{Max.}) = 0.8\text{ V}$ )<br>6N137, HCPL-2630 $ V_{CM}  = 50\text{ V}$ (Peak)<br>HCPL-2601, HCPL-2631 ( $T_A = 25^\circ\text{C}$ )<br>(Note 11) (Fig. 14)<br>HCPL-2611 ( $T_A = 25^\circ\text{C}$ ) $ V_{CM}  = 400\text{ V}$ | $ CM_L $              | 5000 | 10,000 |     | V/ $\mu\text{s}$ |

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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)<br>(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)<br>(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,<br>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<br>Insulation Leakage Current | (Relative humidity = 45%)<br>(T <sub>A</sub> = 25°C, t = 5 s)<br>(V <sub>I-O</sub> = 3000 VDC)<br>(Note 12) | I <sub>I-O</sub> |      |                  | 1.0* | μA               |
| Withstand Insulation Test Voltage          | (RH < 50%, T <sub>A</sub> = 25°C)<br>(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

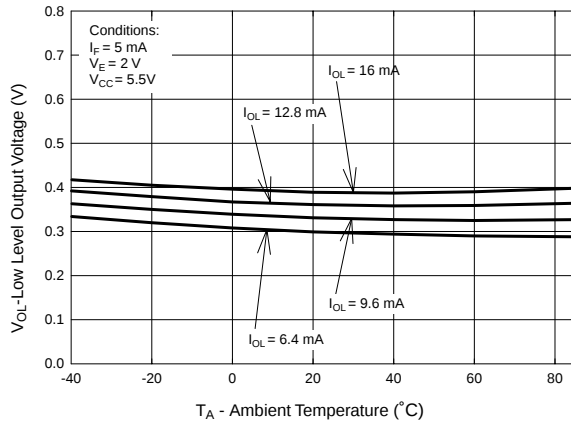
## NOTES

- 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.

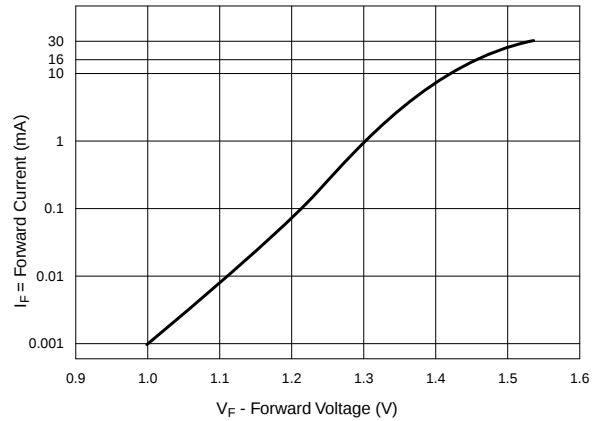
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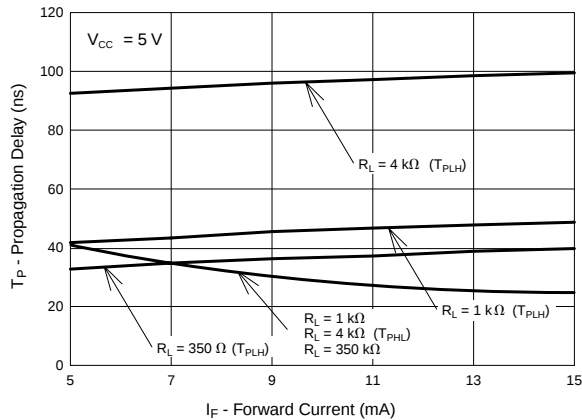
**Fig.1 Low Level Output Voltage vs. Ambient Temperature**



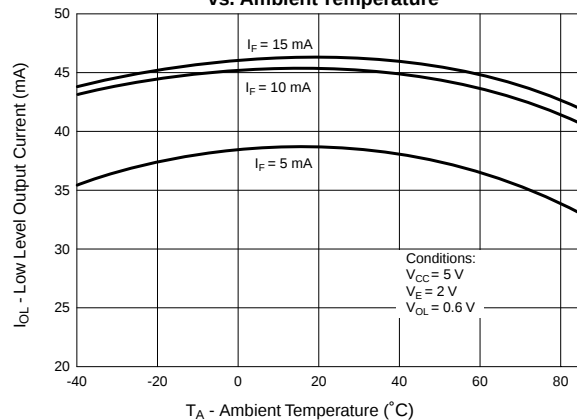
**Fig. 2 Input Diode Forward Voltage vs. Forward Current**



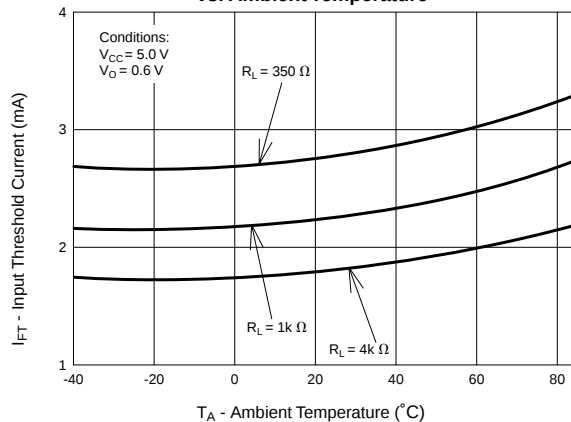
**Fig.3 Switching Time vs. Forward Current**



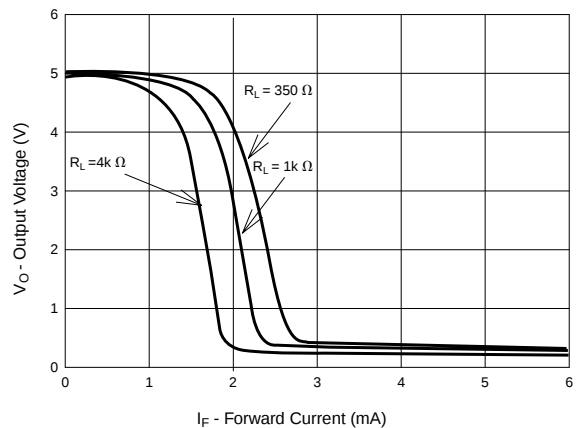
**Fig. 4 Low Level Output Current vs. Ambient Temperature**



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



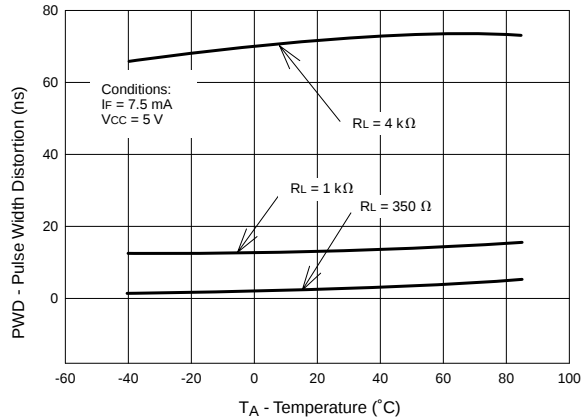
**Fig. 6 Output Voltage vs. Input Forward Current**



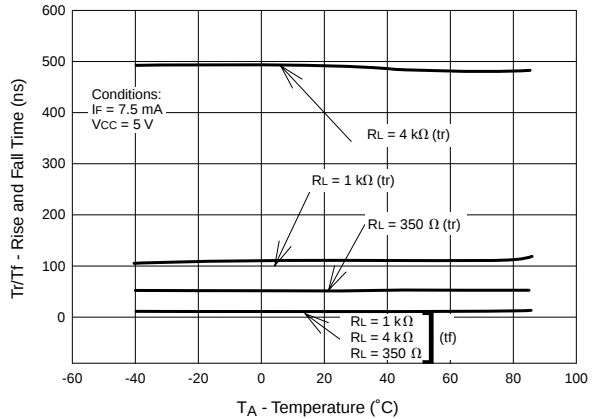
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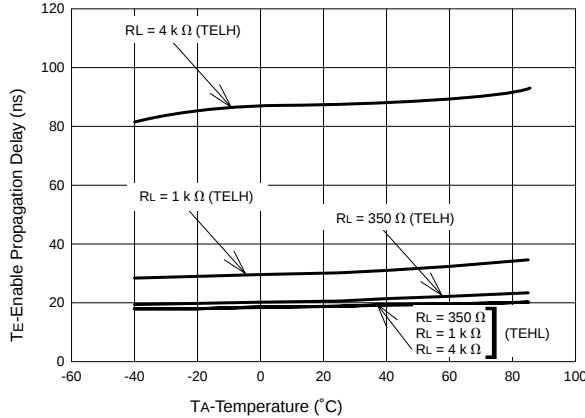
**Fig. 7 Pulse Width Distortion vs. Temperature**



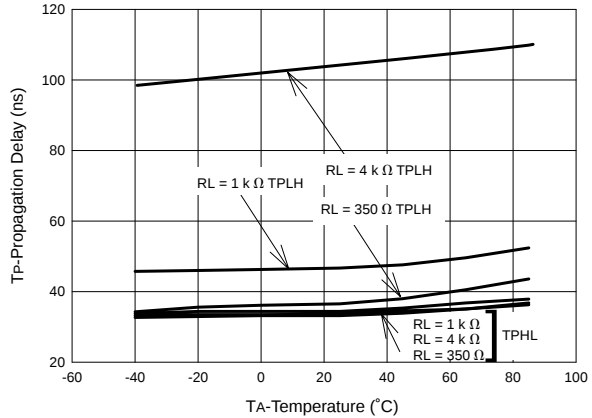
**Fig. 8 Rise and Fall Time vs. Temperature**



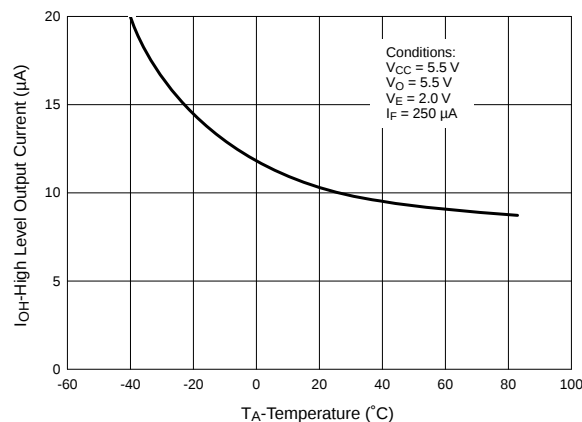
**Fig. 9 Enable Propagation Delay vs. Temperature**



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

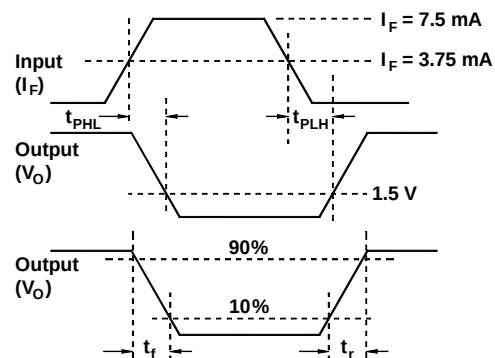
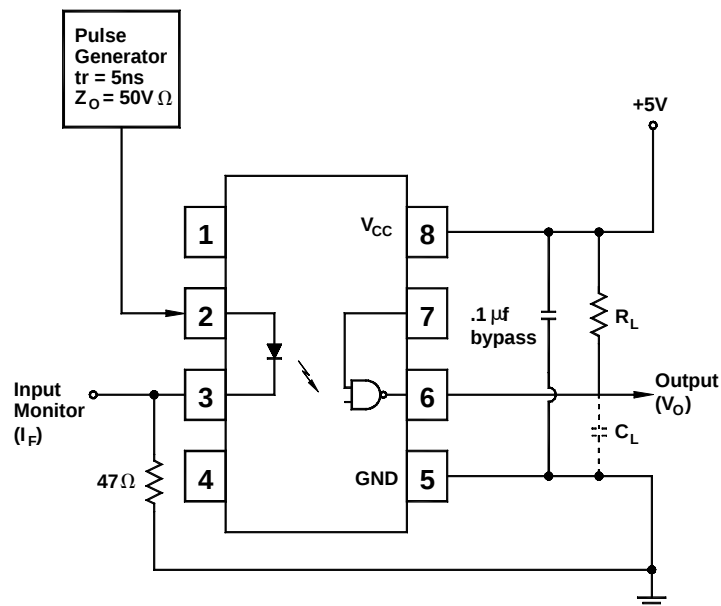


**Fig. 11 High Level Output Current vs. Temperature**

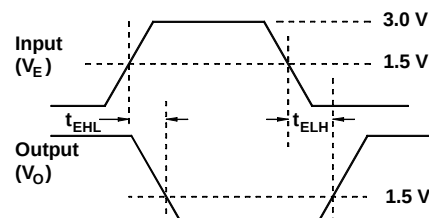
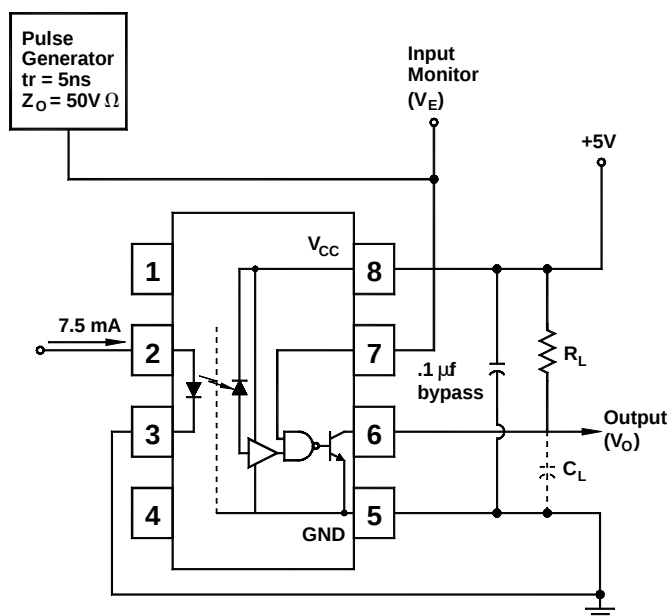


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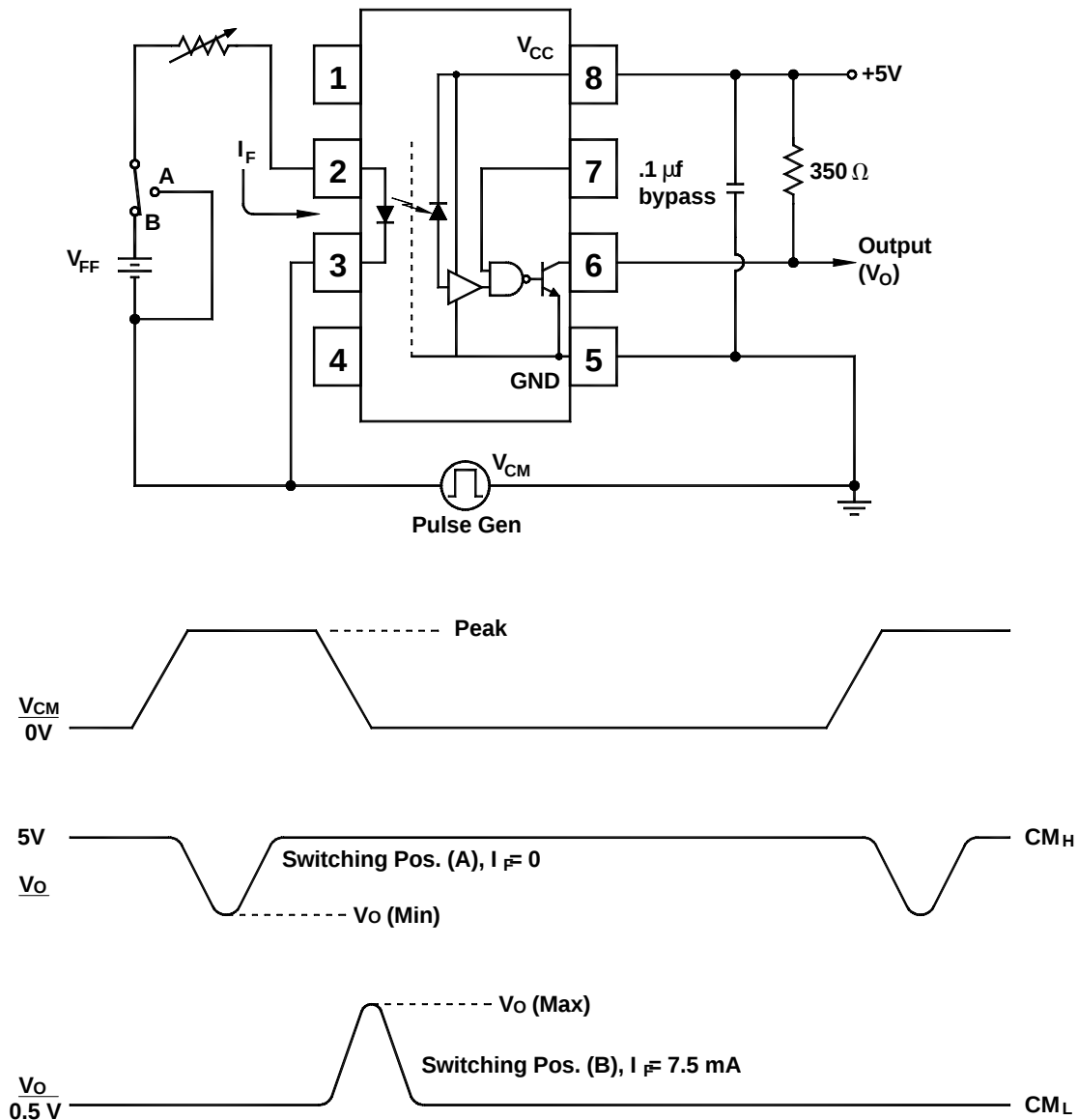
**Fig. 12 Test Circuit and Waveforms for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ .**



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

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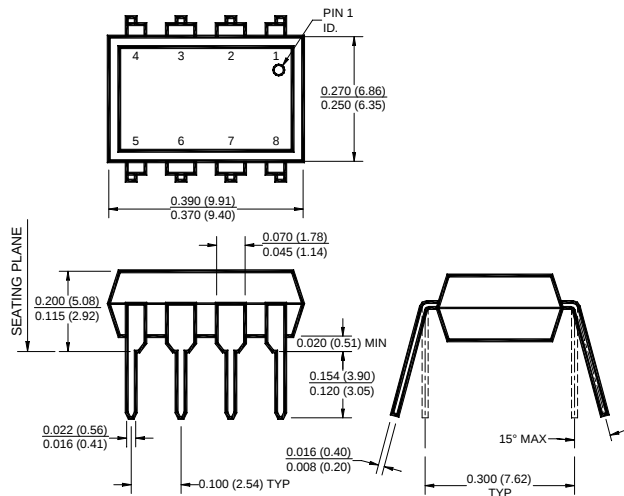


**Fig. 14 Test Circuit Common Mode Transient Immunity**

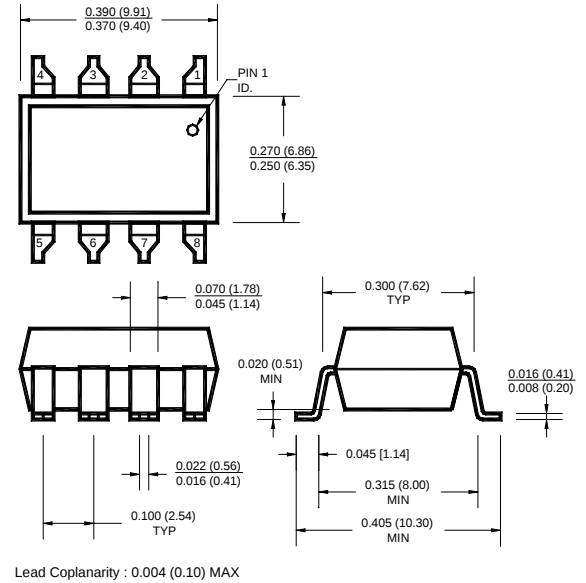
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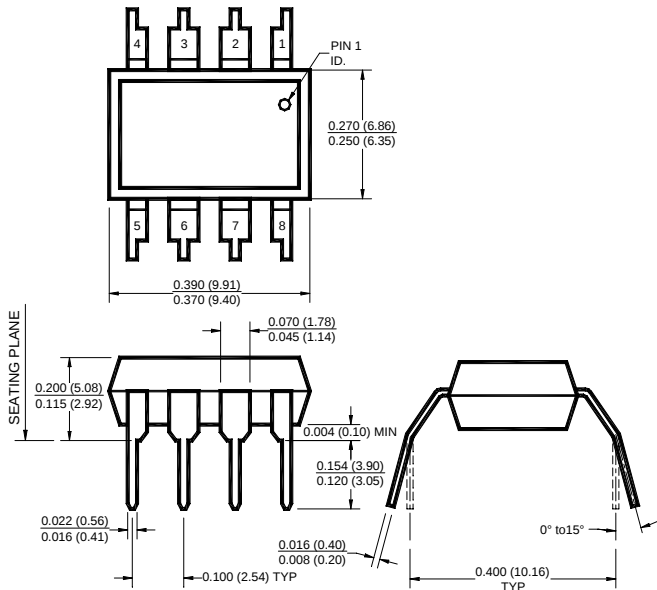
## Package Dimensions (Through Hole)



## Package Dimensions (Surface Mount)



## Package Dimensions (0.4" Lead Spacing)



### NOTE

All dimensions are in inches (millimeters)

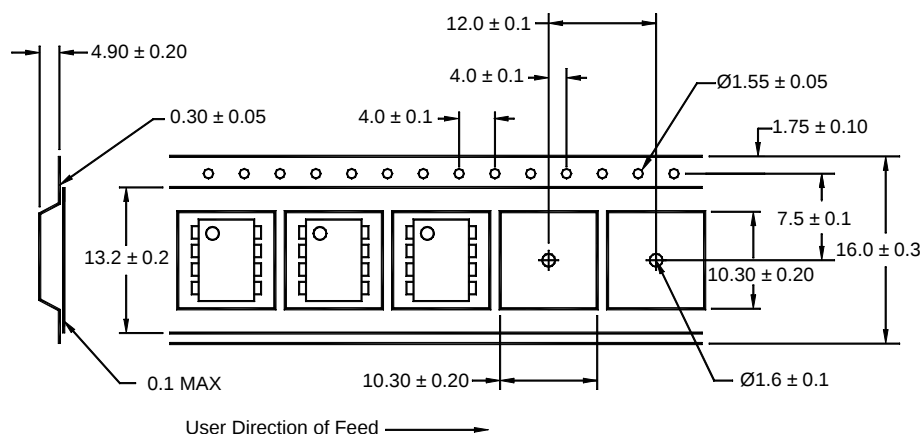
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## ORDERING INFORMATION

| 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)



### Corporate Headquarters

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Max-Huber-Strasse 8  
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49 [0] 89/96.54.74 Fax

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603/736-3382 Fax

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Aylesbury, Buckinghamshire  
HP19-3EY United Kingdom  
44 [0] 1296/30.44.99 Phone  
44 [0] 1296/39.24.32 Fax

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