

### Data Sheet



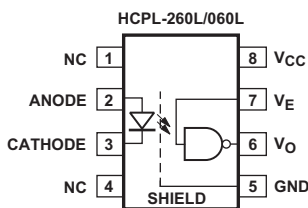
#### Description

The HCPL-260L/060L/263L/063L are optically coupled gates that combine a GaAsP light emitting diode and an integrated high gain photo detector. An enable input allows the detector to be strobed. The output of the detector IC is an open collector Schottky-clamped transistor. The internal shield provides a guaranteed common mode transient immunity specification of 15 kV/μs at 3.3V.

This unique design provides maximum AC and DC circuit isolation while achieving LVTTTL/LVCMOS compatibility. The optocoupler AC and DC operational parameters are guaranteed from -40°C to +85°C allowing trouble-free system performance.

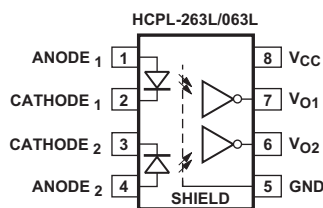
These optocouplers are suitable for high speed logic interfacing, input/output buffering, as line receivers in environments that conventional line receivers cannot tolerate and are recommended for use in extremely high ground or induced noise environments.

#### Functional Diagram



TRUTH TABLE  
(POSITIVE LOGIC)

| LED | ENABLE | OUTPUT |
|-----|--------|--------|
| ON  | H      | L      |
| OFF | H      | H      |
| ON  | L      | H      |
| OFF | L      | H      |
| ON  | NC     | L      |
| OFF | NC     | H      |



TRUTH TABLE  
(POSITIVE LOGIC)

| LED | OUTPUT |
|-----|--------|
| ON  | L      |
| OFF | H      |

A 0.1 μF bypass capacitor must be connected between pins 5 and 8.

#### Features

- 3.3V/5V Dual Supply Voltages
- Low power consumption
- 15 kV/μs minimum Common Mode Rejection (CMR) at V<sub>CM</sub> = 1000 V
- High speed: 15 MBd typical
- LVTTTL/LVCMOS compatible
- Low input current capability: 5 mA
- Guaranteed AC and DC performance over temperature: -40°C to +85°C
- Available in 8-pin DIP, SOIC-8
- Storable output (single channel products only)
- Safety approvals: UL, CSA, IEC/EN/DIN EN 60747-5-5

#### Applications

- Isolated line receiver
- Computer-peripheral interfaces
- Microprocessor system interfaces
- Digital isolation for A/D, D/A conversion
- Switching power supply
- Instrument input/output isolation
- Ground loop elimination
- Pulse transformer replacement
- Field buses

**CAUTION:** It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

## Ordering Information

HCPL-xxxx is UL Recognized with 3750 Vrms for 1 minute per UL1577

| Part number | Option         |                    | Package         | Surface Mount | Gull Wing | Tape & Reel | UL 5000<br>Vrms/ 1 Min-<br>ute rating | IEC/EN/DIN<br>EN 60747-5-5 | Quantity      |
|-------------|----------------|--------------------|-----------------|---------------|-----------|-------------|---------------------------------------|----------------------------|---------------|
|             | RoHS Compliant | Non RoHS Compliant |                 |               |           |             |                                       |                            |               |
| HCPL-260L   | -000E          | No option          | 300mil<br>DIP-8 |               |           |             |                                       |                            | 50 per tube   |
|             | -300E          | -300               |                 | X             | X         |             |                                       |                            | 50 per tube   |
|             | -500E          | #500               |                 | X             | X         | X           |                                       |                            | 1000 per reel |
|             | -020E          | -020               |                 |               |           |             | X                                     |                            | 50 per tube   |
|             | -320E          | -320               |                 | X             | X         |             | X                                     |                            | 50 per tube   |
|             | -520E          | -520               |                 | X             | X         | X           | X                                     |                            | 1000 per reel |
|             | -060E          | #060               |                 |               |           |             |                                       | X                          | 50 per tube   |
|             | -560E          | #560               |                 | X             | X         | X           |                                       | X                          | 1000 per reel |
| HCPL-263L   | -000E          | No option          | 300mil<br>DIP-8 |               |           |             |                                       |                            | 50 per tube   |
|             | -300E          | #300               |                 | X             | X         |             |                                       |                            | 50 per tube   |
|             | -500E          | #500               |                 | X             | X         | X           |                                       |                            | 1000 per reel |
|             | -020E          | #020               |                 |               |           |             | X                                     |                            | 50 per tube   |
|             | -320E          | -320               |                 | X             | X         |             | X                                     |                            | 50 per tube   |
|             | -520E          | #520               |                 | X             | X         | X           | X                                     |                            | 1000 per reel |
|             | -060E          | -060               |                 |               |           |             |                                       | X                          | 50 per tube   |
|             | -560E          | -560               |                 | X             | X         | X           |                                       | X                          | 1000 per reel |
| HCPL-060L   | -000E          | No option          | SO-8            | X             |           |             |                                       |                            | 100 per tube  |
|             | -500E          | #500               |                 | X             |           | X           |                                       |                            | 1500 per reel |
|             | -060E          | #060               |                 | X             |           |             |                                       | X                          | 100 per tube  |
|             | -560E          | -560               |                 | X             |           | X           |                                       | X                          | 1500 per reel |
| HCPL-063L   | -000E          | No option          | SO-8            | X             |           |             |                                       |                            | 100 per tube  |
|             | -500E          | #500               |                 | X             |           | X           |                                       |                            | 1500 per reel |
|             | -060E          | -060               |                 | X             |           |             |                                       | X                          | 100 per tube  |
|             | -560E          | -560               |                 | X             |           | X           |                                       | X                          | 1500 per reel |

To order, choose a part number from the part number column and combine with the desired option from the option column to form an order entry. Combination of Option 020 and Option 060 is not available.

Example 1:

HCPL-260L-560E to order product of 300mil DIP Gull Wing Surface Mount package in Tape and Reel packaging with IEC/EN/DIN EN 60747-5-5 Safety Approval in RoHS compliant.

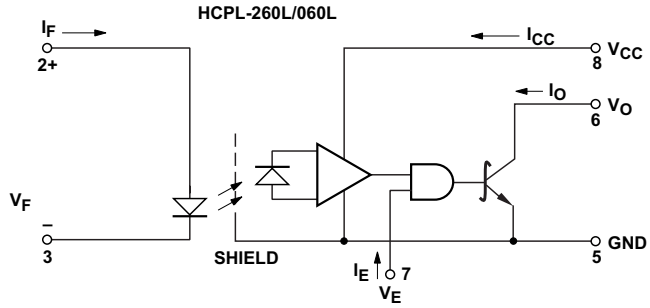
Example 2:

HCPL-263L to order product of 300mil DIP package in tube packaging and non RoHS compliant.

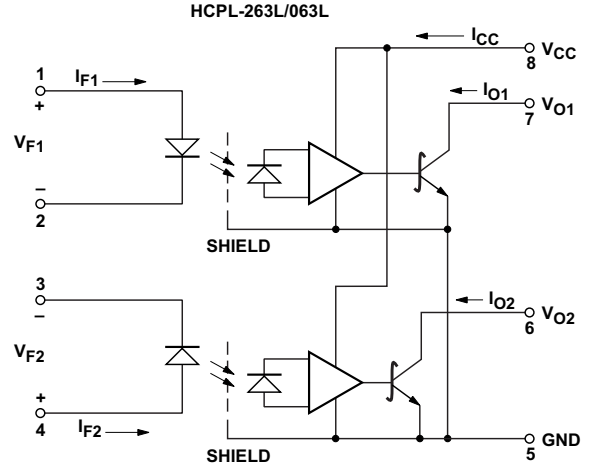
Option datasheets are available. Contact your Avago sales representative or authorized distributor for information.

Remarks: The notation '#XXX' is used for existing products, while (new) products launched since 15th July 2001 and RoHS compliant option will use '-XXXE'.

## Schematic

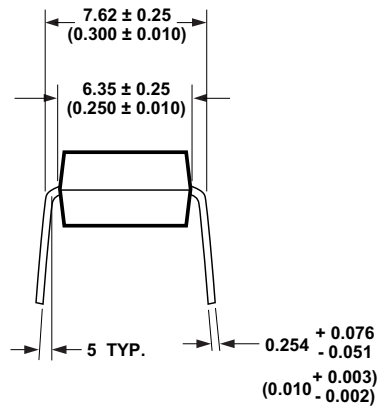
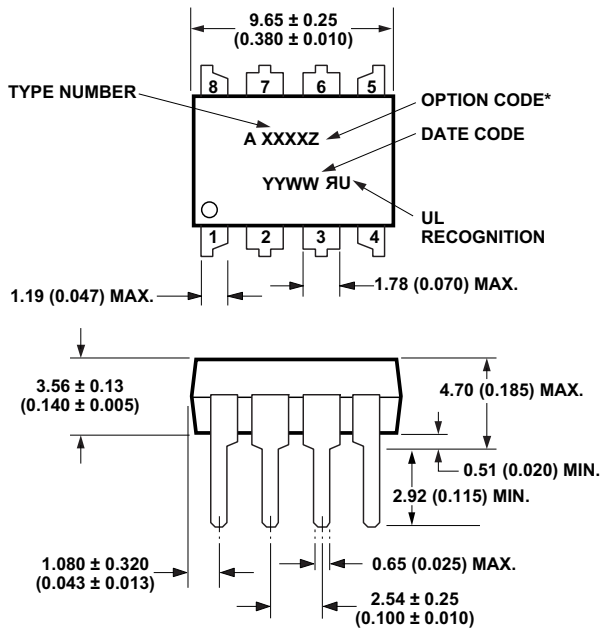


USE OF A 0.1  $\mu$ F BYPASS CAPACITOR CONNECTED BETWEEN PINS 5 AND 8 IS RECOMMENDED (SEE NOTE 5).



## Package Outline Drawings

### 8-Pin DIP Package

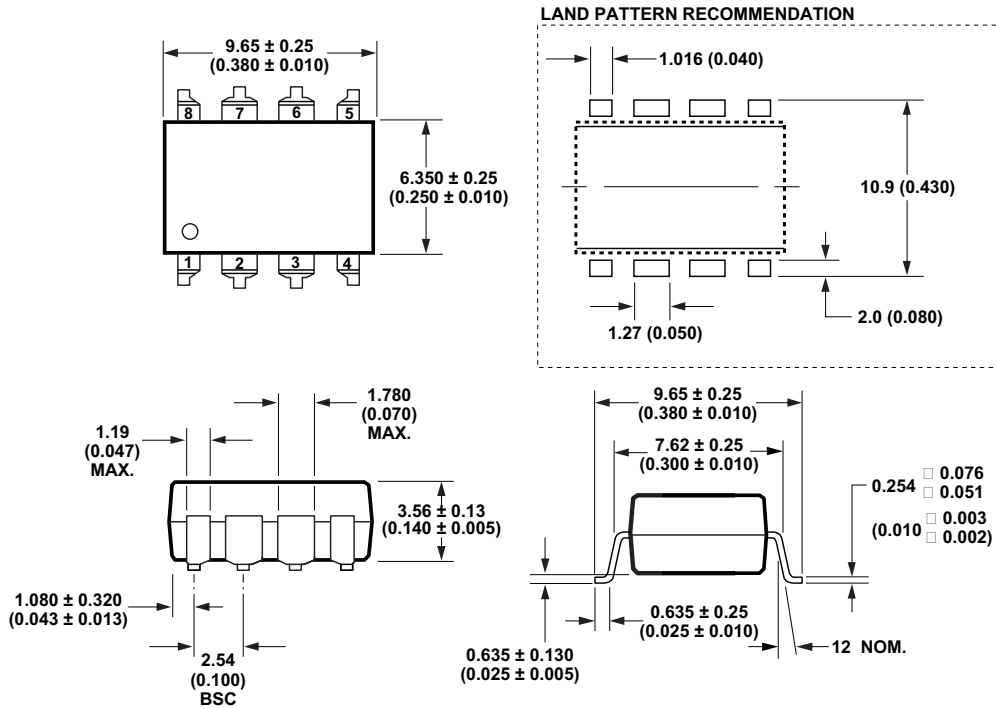


DIMENSIONS IN MILLIMETERS AND (INCHES).  
 \* MARKING CODE LETTER FOR OPTION NUMBERS  
 "V" = OPTION 060  
 OPTION NUMBER 500 NOT MARKED.

NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

## 8-Pin DIP Package with Gull Wing Surface Mount in Option 500

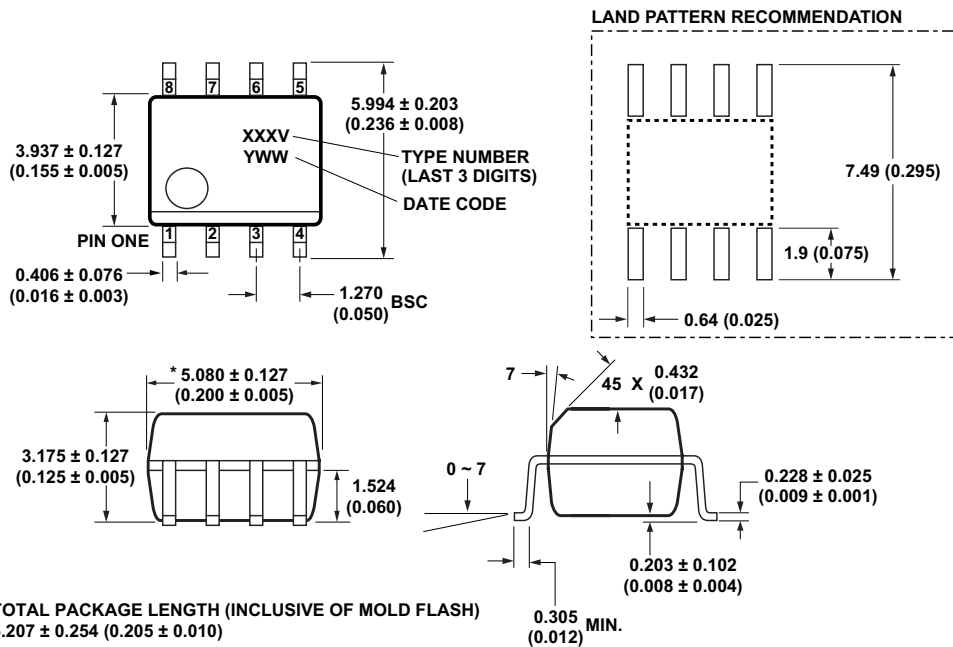
(HCPL-260L, HCPL-263L)



DIMENSIONS IN MILLIMETERS (INCHES).  
LEAD COPLANARITY = 0.10 mm (0.004 INCHES).

NOTE: FLOATING LEAD PROTRUSION IS 0.25 mm (10 mils) MAX.

## Small Outline SO-8 Package



\* TOTAL PACKAGE LENGTH (INCLUSIVE OF MOLD FLASH)  
5.207 ± 0.254 (0.205 ± 0.010)

DIMENSIONS IN MILLIMETERS (INCHES).  
LEAD COPLANARITY = 0.10 mm (0.004 INCHES) MAX.

OPTION NUMBER 500 NOT MARKED.

NOTE: FLOATING LEAD PROTRUSION IS 0.15 mm (6 mils) MAX.

## Reflow Soldering Profile

Recommended reflow condition as per JEDEC Standard, J-STD-020 (latest revision). Non-Halide Flux should be used.

## Regulatory Information

The HCPL-260L/060L/263L/063L have been approved by the following organizations:

### UL

Approval under UL 1577, Component Recognition Program, File E55361.

### CSA

Approval under CSA Component Acceptance Notice #5, File CA 88324.

### IEC/EN/DIN EN 60747-5-5

## Insulation and Safety Related Specifications

| Parameter   | Symbol  | 8-Pin DIP<br>(300 Mil)<br>Value | S0-8<br>Value | Units | Conditions   |
|---|---------|---------------------------------|---------------|-------|--|
| Minimum External Air Gap (External Clearance)     | L (101) | 7.1                             | 4.9           | mm    | Measured from input terminals to output terminals, shortest distance through air.  |
| Minimum External Tracking (External Creepage)     | L (102) | 7.4                             | 4.8           | mm    | Measured from input terminals to output terminals, shortest distance path along body.  |
| Minimum Internal Plastic Gap (Internal Clearance) |         | 0.08                            | 0.08          | mm    | Through insulation distance, conductor to conductor, usually the direct distance between the photoemitter and photodetector inside the optocoupler cavity. |
| Tracking Resistance (Comparative Tracking Index)  | CTI     | 200                             | 200           | Volts | DIN IEC 112/VDE 0303 Part 1  |
| Isolation Group                                   |         | IIIa                            | IIIa          |       | Material Group (DIN VDE 0110, 1/89, Table 1)   |

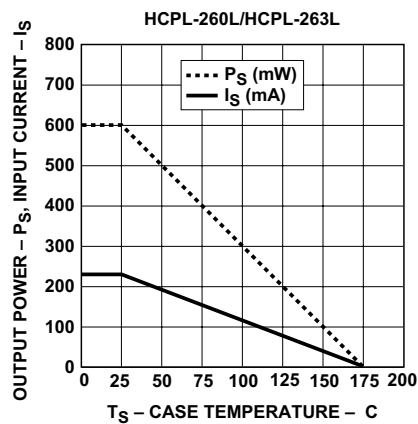
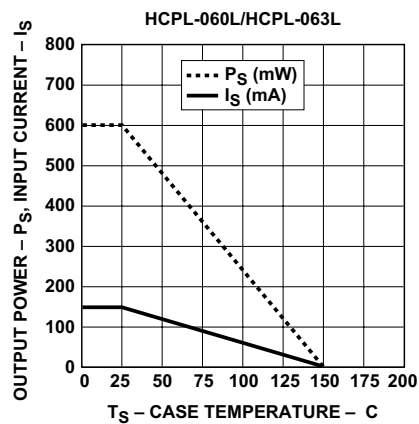
## IEC/EN/DIN EN 60747-5-5 Insulation Characteristics\*

| Description  | Symbol          | PDIP Option 060             | S0-8 Option 060             | Unit               |
|--|-----------------|-----------------------------|-----------------------------|--------------------|
| Installation classification per DIN VDE 0110, Table 1<br>for rated mains voltage $\leq 150$ Vrms<br>for rated mains voltage $\leq 300$ Vrms<br>for rated mains voltage $\leq 600$ Vrms |                 | I – IV<br>I – IV<br>I – III | I – IV<br>I – IV<br>I – III |                    |
| Climatic Classification  |                 | 40/85/21                    | 40/85/21                    |                    |
| Pollution Degree (DIN VDE 0110/39)   |                 | 2                           | 2                           |                    |
| Maximum Working Insulation Voltage   | $V_{IORM}$      | 630                         | 567                         | Vpeak              |
| Input to Output Test Voltage, Method b*<br>$V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m=1$ sec,<br>Partial discharge $< 5$ pC                                     | $V_{PR}$        | 1181                        | 1063                        | Vpeak              |
| Input to Output Test Voltage, Method a*<br>$V_{IORM} \times 1.6 = V_{PR}$ , Type and Sample Test, $t_m=10$ sec, Partial<br>discharge $< 5$ pC  | $V_{PR}$        | 1008                        | 907                         | Vpeak              |
| Highest Allowable Overvoltage<br>(Transient Overvoltage $t_{ini} = 60$ sec)  | $V_{IOTM}$      | 6000                        | 6000                        | Vpeak              |
| Safety-limiting values<br>– maximum values allowed in the event of a failure.  |                 |                             |                             |                    |
| Case Temperature   | $T_S$           | 175                         | 150                         | $^{\circ}\text{C}$ |
| Input Current  | $I_{S, INPUT}$  | 230                         | 150                         | mA                 |
| Output Power   | $P_{S, OUTPUT}$ | 600                         | 600                         | mW                 |
| Insulation Resistance at $T_S$ , $V_{IO} = 500$ V  | $R_S$           | $\geq 10^9$                 | $\geq 10^9$                 | $\Omega$           |

\*Refer to the front of the optocoupler section of the current catalog, under Product Safety Regulations section IEC/EN/DIN EN 60747-5-5, for a detailed description.

**Note:** Isolation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in application.

## Thermal Derating Curve Figures



**Absolute Maximum Ratings (No Derating Required up to 85°C)**

| Parameter   | Symbol   | Package**                       | Min. | Max.           | Units | Note |
|---|----------|---------------------------------|------|----------------|-------|------|
| Storage Temperature   | $T_S$    |                                 | -55  | 125            | °C    |      |
| Operating Temperature†  | $T_A$    |                                 | -40  | 85             | °C    |      |
| Average Forward Input Current                                     | $I_F$    | Single 8-Pin DIP                |      | 20             | mA    | 2    |
|   |          | Single SO-8                     |      |                |       |      |
|   |          | Dual 8-Pin DIP<br>Dual SO-8     |      | 15             |       | 1, 3 |
| Reverse Input Voltage   | $V_R$    | 8-Pin DIP, SO-8                 |      | 5              | V     | 1    |
| Input Power Dissipation   | $P_I$    |                                 |      | 40             | mW    |      |
| Supply Voltage (1 Minute Maximum)                                 | $V_{CC}$ |                                 |      | 7              | V     |      |
| Enable Input Voltage (Not to Exceed $V_{CC}$ by more than 500 mV) | $V_E$    | Single 8-Pin DIP<br>Single SO-8 |      | $V_{CC} + 0.5$ | V     |      |
| Enable Input Current  | $I_E$    |                                 |      | 5              | mA    |      |
| Output Collector Current  | $I_O$    |                                 |      | 50             | mA    | 1    |
| Output Collector Voltage  | $V_O$    |                                 |      | 7              | V     | 1    |
| Output Collector Power Dissipation                                | $P_O$    | Single 8-Pin DIP<br>Single SO-8 |      | 85             | mW    |      |
|   |          | Dual 8-Pin DIP                  |      | 60             |       | 1, 4 |
|   |          | Dual SO-8                       |      |                |       |      |

\*\*Ratings apply to all devices except otherwise noted in the Package column.

**Recommended Operating Conditions**

| Parameter   | Symbol        | Min. | Max.     | Units     |
|---|---------------|------|----------|-----------|
| Input Current, Low Level                              | $I_{FL}^*$    | 0    | 250      | μA        |
| Input Current, High Level <sup>[1]</sup>              | $I_{FH}^{**}$ | 5    | 15       | mA        |
| Power Supply Voltage                                  | $V_{CC}$      | 2.7  | 3.6      | V         |
|   |               | 4.5  | 5.5      |           |
| Low Level Enable Voltage                              | $V_{EL}$      | 0    | 0.8      | V         |
| High Level Enable Voltage                             | $V_{EH}$      | 2.0  | $V_{CC}$ | V         |
| Operating Temperature                                 | $T_A$         | -40  | 85       | °C        |
| Fan Out (at $R_L = 1\text{ k}\Omega$ ) <sup>[1]</sup> | N             |      | 5        | TTL Loads |
| Output Pull-up Resistor                               | $R_L$         | 330  | 4 k      | Ω         |

\*The off condition can also be guaranteed by ensuring that  $V_{FL} \leq 0.8$  volts.

\*\*The initial switching threshold is 5 mA or less. It is recommended that 6.3 mA to 10 mA be used for best performance and to permit at least a 20% LED degradation guardband.

## Electrical Specifications

Over Recommended Operating Conditions ( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $2.7\text{V} \leq V_{CC} \leq 3.6\text{V}$ ) unless otherwise specified. All Typical at  $V_{CC} = 3.3\text{V}$ ,  $T_A = 25^{\circ}\text{C}$ . All enable test conditions apply to single channel products only. See Note 5.

| Parameter                           | Sym.                      | Device | Min. | Typ. | Max.  | Units                       | Test Conditions   | Fig. | Note  |
|-------------------------------------|---------------------------|--------|------|------|-------|-----------------------------|---|------|-------|
| High Level Output Current           | $I_{OH}^*$                |        |      | 4.5  | 50    | $\mu\text{A}$               | $V_{CC} = 3.3\text{V}$ , $V_E = 2.0\text{V}$ , $V_O = 3.3\text{V}$ , $I_F = 250\mu\text{A}$                 | 1    | 1, 15 |
| Input Threshold Current             | $I_{TH}$                  |        |      | 3.0  | 5.0   | $\text{mA}$                 | $V_{CC} = 3.3\text{V}$ , $V_E = 2.0\text{V}$ , $V_O = 0.6\text{V}$ , $I_{OL}(\text{Sinking}) = 13\text{mA}$ | 2    | 15    |
| Low Level Output Voltage            | $V_{OL}^*$                |        |      | 0.35 | 0.6   | $\text{V}$                  | $V_{CC} = 3.3\text{V}$ , $V_E = 2.0\text{V}$ , $I_F = 5\text{mA}$ , $I_{OL}(\text{Sinking}) = 13\text{mA}$  | 3    | 15    |
| High Level Supply Current           | $I_{CCH}$                 | Single |      | 4.7  | 7.0   | $\text{mA}$                 | $V_E = 0.5\text{V}$ $I_F = 0\text{mA}$  |      |       |
|                                     |                           | Dual   |      | 6.9  | 10.0  |                             | $V_{CC} = 3.3\text{V}$  |      |       |
| Low Level Supply Current            | $I_{CCL}$                 | Single |      | 7.0  | 10.0  | $\text{mA}$                 | $V_E = 0.5\text{V}$ $I_F = 10\text{mA}$   |      |       |
|                                     |                           | Dual   |      | 8.7  | 15.0  |                             | $V_{CC} = 3.3\text{V}$  |      |       |
| High Level Enable Current           | $I_{EH}$                  | Single |      | -0.5 | -1.2  | $\text{mA}$                 | $V_{CC} = 3.3\text{V}$ , $V_E = 2.0\text{V}$  |      |       |
| Low Level Enable Current            | $I_{EL}^*$                | Single |      | -0.5 | -1.2  | $\text{mA}$                 | $V_{CC} = 3.3\text{V}$ , $V_E = 0.5\text{V}$  |      |       |
| High Level Enable Voltage           | $V_{EH}$                  | Single | 2.0  |      |       | $\text{V}$                  |   |      | 15    |
| Low Level Enable Voltage            | $V_{EL}$                  | Single |      |      | 0.8   | $\text{V}$                  |   |      |       |
| Input Forward Voltage               | $V_F$                     |        | 1.4  | 1.5  | 1.75* | $\text{V}$                  | $T_A = 25^{\circ}\text{C}$ , $I_F = 10\text{mA}$  | 5    | 1     |
| Input Reverse Breakdown Voltage     | $BV_R^*$                  |        | 5    |      |       | $\text{V}$                  | $I_R = 10\mu\text{A}$   |      | 1     |
| Input Diode Temperature Coefficient | $\Delta V_F / \Delta T_A$ |        |      | -1.6 |       | $\text{mV}^{\circ}\text{C}$ | $I_F = 10\text{mA}$   |      | 1     |
| Input Capacitance                   | $C_{IN}$                  |        |      | 60   |       | $\text{pF}$                 | $f = 1\text{MHz}$ , $V_F = 0\text{V}$   |      | 1     |

\*The JEDEC Registration specifies  $0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ . Avago specifies  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .



## Electrical Specifications (DC)

Over recommended operating conditions ( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $4.5\text{V} \leq V_{DD} \leq 5.5\text{V}$ ) unless otherwise specified.  
All typicals at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^{\circ}\text{C}$ .

| Parameter                           | Symbol                    | Channel | Min. | Typ.* | Max. | Units                        | Test Conditions   | Fig. | Note |
|-------------------------------------|---------------------------|---------|------|-------|------|------------------------------|---|------|------|
| High Level Output Current           | $I_{OH}$                  |         |      | 5.5   | 100  | $\mu\text{A}$                | $V_{CC} = 5.5\text{V}$ ,<br>$V_O = 5.5\text{V}$ ,<br>$I_{FL} = 250\ \mu\text{A}$        | 1    | 1,15 |
| Input Threshold Current             | $I_{TH}$                  | Single  |      | 2.0   | 5.0  | $\text{mA}$                  | $V_{CC} = 5.5\text{V}$ , $V_O = 0.6\text{V}$ ,<br>$I_{OL} > 13\text{mA}$                | 2    | 15   |
|                                     |                           | Dual    |      | 2.5   |      |                              |   |      |      |
| Low Level Output Voltage            | $V_{OL}$                  |         |      | 0.35  | 0.6  | $\text{V}$                   | $V_{CC} = 5.5\text{V}$ , $I_F = 5\text{mA}$ ,<br>$I_{OL}(\text{Sinking}) = 13\text{mA}$ | 3    | 15   |
| High Level Supply Current           | $I_{CCH}$                 | Single  |      | 7.0   | 10.0 | $\text{mA}$                  | $V_E = 0.5\text{V}$ , $V_{CC} = 5.5\text{V}$ ,<br>$I_F = 0\text{mA}$                    |      |      |
|                                     |                           |         |      | 6.5   |      | $\text{mA}$                  | $V_E = V_{CC}$ , $V_{CC} = 5.5\text{V}$ ,<br>$I_F = 0\text{mA}$                         |      |      |
|                                     |                           | Dual    |      | 10.0  | 15.0 |                              | $V_{CC} = 5.5\text{V}$ , $I_F = 0\text{mA}$   |      |      |
| Low Level Supply Current            | $I_{CCL}$                 | Single  |      | 9.0   | 13.0 | $\text{mA}$                  | $V_E = 0.5\text{V}$ , $V_{CC} = 5.5\text{V}$ ,<br>$I_F = 0\text{mA}$                    |      |      |
|                                     |                           |         |      | 8.5   |      | $\text{mA}$                  | $V_E = V_{CC}$ , $V_{CC} = 5.5\text{V}$ ,<br>$I_F = 0\text{mA}$                         |      |      |
|                                     |                           | Dual    |      | 13.0  | 21.0 | $\text{mA}$                  | $V_{CC} = 5.5\text{V}$ , $I_F = 0\text{mA}$   |      |      |
| High Level Enable Current           | $I_{EH}$                  | Single  |      | -0.7  | -1.6 | $\text{mA}$                  | $V_{CC} = 5.5\text{V}$ , $V_E = 2.0\text{V}$  |      |      |
| Low Level Enable Current            | $I_{EL}$                  | Single  |      | -0.9  | -1.6 | $\text{mA}$                  | $V_{CC} = 5.5\text{V}$ , $V_E = 0.5\text{V}$  |      |      |
| High Level Enable Voltage           | $V_{EH}$                  | Single  | 2.0  |       |      | $\text{V}$                   |   |      | 15   |
| Low Level Enable Voltage            | $V_{EL}$                  | Single  |      |       | 0.8  | $\text{V}$                   |   |      |      |
| Input Forward Voltage               | $V_F$                     |         | 1.4  | 1.5   | 1.75 | $\text{V}$                   | $T_A = 25^{\circ}\text{C}$ , $I_F = 10\text{mA}$  |      | 5    |
|                                     |                           |         | 1.3  |       | 1.8  | $\text{V}$                   |   |      |      |
| Input Reverse Breakdown Voltage     | $BV_R$                    |         | 5    |       |      | $\text{V}$                   | $I_R = 10\ \mu\text{A}$   |      | 1    |
| Input Diode Temperature Coefficient | $\Delta V_F / \Delta T_A$ |         |      | -1.6  |      | $\text{mV}/^{\circ}\text{C}$ | $I_F = 10\text{mA}$   |      | 1    |
| Input Capacitance                   | $C_{IN}$                  |         |      | 60    |      | $\text{pF}$                  | $f = 1\text{MHz}$ , $V_F = 0\text{V}$   |      | 1    |

## Switching Specifications

Over Recommended Operating Conditions ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $2.7\text{V} \leq V_{CC} \leq 3.6\text{V}$ ),  $I_F = 7.5\text{ mA}$  unless otherwise specified. All Typical at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{ V}$ .

| Parameter  | Symbol                | Min. | Typ. | Max. | Units | Test Conditions   | Fig. | Note     |
|--|-----------------------|------|------|------|-------|---|------|----------|
| Propagation Delay Time to High Output Level                | $t_{PLH}$             |      |      | 90   | ns    | $R_L = 350\ \Omega$<br>$C_L = 15\ \text{pF}$  | 6, 7 | 1, 6, 15 |
| Propagation Delay Time to Low Output Level                 | $t_{PHL}$             |      |      | 75   | ns    | $R_L = 350\ \Omega$<br>$C_L = 15\ \text{pF}$  |      | 1, 7, 15 |
| Pulse Width Distortion                                     | $ t_{PHL} - t_{PLH} $ |      |      | 25   | ns    | $R_L = 350\ \Omega$<br>$C_L = 15\ \text{pF}$  | 8    | 9, 15    |
| Propagation Delay Skew                                     | $t_{PSK}$             |      |      | 40   | ns    | $R_L = 350\ \Omega$<br>$C_L = 15\ \text{pF}$  |      | 8, 9, 15 |
| Output Rise Time (10-90%)                                  | $t_r$                 |      | 45   |      | ns    | $R_L = 350\ \Omega$<br>$C_L = 15\ \text{pF}$  |      | 1, 15    |
| Output Fall Time (90-10%)                                  | $t_f$                 |      | 20   |      | ns    | $R_L = 350\ \Omega$<br>$C_L = 15\ \text{pF}$  |      | 1, 15    |
| Propagation Delay Time of Enable from $V_{EH}$ to $V_{EL}$ | $t_{ELH}$             |      | 45   |      | ns    | $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$ ,<br>$V_{EL} = 0\text{ V}$ , $V_{EH} = 3\text{ V}$ | 9    | 10       |
| Propagation Delay Time of Enable from $V_{EL}$ to $V_{EH}$ | $t_{EHL}$             |      | 30   |      | ns    | $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$ ,<br>$V_{EL} = 0\text{ V}$ , $V_{EH} = 3\text{ V}$ | 9    | 11       |

## Switching Specifications (AC)

Over recommended operating conditions  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $4.5 \leq V_{CC} \leq 5.5\text{V}$ ,  $I_F = 7.5\text{ mA}$  unless otherwise specified. All typicals at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

| Parameter  | Symbol                | Min. | Typ. | Max.             | Units | Test Conditions  | Fig. | Note    |
|--|-----------------------|------|------|------------------|-------|--|------|---------|
| Propagation Delay Time to High Output Level                | $t_{PLH}$             | 20   | 48   | $\frac{75}{100}$ | ns    | $T_A = 25^\circ\text{C}$ , $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$                    | 6,7  | 1,6,15  |
| Propagation Delay Time to Low Output Level                 | $t_{PHL}$             | 25   | 50   | $\frac{75}{100}$ | ns    | $T_A = 25^\circ\text{C}$ , $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$                    | 6, 7 | 1,7, 15 |
| Pulse Width Distortion                                     | $ t_{PHL} - t_{PLH} $ |      | 3.5  | 35               | ns    | $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$   | 8    | 9, 15   |
| Propagation Delay Skew                                     | $T_{PSK}$             |      |      | 40               | ns    | $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$   |      | 8,9, 15 |
| Output Rise Time (10%-90%)                                 | $t_r$                 |      | 24   |                  | ns    | $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$   |      | 1,15    |
| Output Fall Time (10%-90%)                                 | $t_f$                 |      | 10   |                  | ns    | $R_L = 350\ \Omega$ ,<br>$C_L = 15\ \text{pF}$   |      | 1, 15   |
| Propagation Delay Time of Enable from $V_{EH}$ to $V_{EL}$ | $t_{ELH}$             |      | 30   |                  | ns    | $R_L = 350\ \Omega$ , $C_L = 15\ \text{pF}$ ,<br>$V_{EL} = 0\text{V}$ , $V_{EH} = 3\text{V}$ | 9    | 10      |
| Propagation Delay Time of Enable from $V_{EL}$ to $V_{EH}$ | $t_{EHL}$             |      | 20   |                  | ns    | $R_L = 350\ \Omega$ , $C_L = 15\ \text{pF}$ ,<br>$V_{EL} = 0\text{V}$ , $V_{EH} = 3\text{V}$ | 9    | 11      |

| Parameter  | Sym.            | Device   | Min. | Typ. | Units | Test Conditions   | Fig. | Note             |
|--|-----------------|--|------|------|-------|---|------|------------------|
| Output High Level<br>Common Mode<br>Transient Immunity | CM <sub>H</sub> | HCPL-263L<br>HCPL-063L<br>HCPL-260L<br>HCPL-060L | 15   | 25   | kV/μs | V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 0 mA,<br>V <sub>O(MIN)</sub> = 2 V, R <sub>L</sub> = 350 Ω,<br>T <sub>A</sub> = 25°C, V <sub>CM</sub> = 1000 V<br>and V <sub>CM</sub> = 10V     | 10   | 12,<br>14,<br>15 |
| Output Low Level<br>Common Mode<br>Transient Immunity  | CM <sub>L</sub> | HCPL-263L<br>HCPL-063L<br>HCPL-260L<br>HCPL-060L | 15   | 25   | kV/μs | V <sub>CC</sub> = 3.3 V, I <sub>F</sub> = 7.5 mA,<br>V <sub>O(MAX)</sub> = 0.8 V, R <sub>L</sub> = 350 Ω,<br>T <sub>A</sub> = 25°C, V <sub>CM</sub> = 1000 V<br>and V <sub>CM</sub> = 10V | 10   | 13,<br>14,<br>15 |
| Output High Level<br>Common Mode<br>Transient Immunity | CM <sub>H</sub> | HCPL-263L<br>HCPL-063L<br>HCPL-260L<br>HCPL-060L | 10   | 15   | kV/μs | V <sub>CC</sub> = 5 V, I <sub>F</sub> = 0 mA,<br>V <sub>O(MIN)</sub> = 2 V, R <sub>L</sub> = 350 Ω,<br>T <sub>A</sub> = 25°C, V <sub>CM</sub> = 1000 V                                    | 10   | 12,<br>14,<br>15 |
| Output Low Level<br>Common Mode<br>Transient Immunity  | CM <sub>L</sub> | HCPL-263L<br>HCPL-063L<br>HCPL-260L<br>HCPL-060L | 10   | 15   | kV/μs | V <sub>CC</sub> = 5 V, I <sub>F</sub> = 7.5 mA,<br>V <sub>O(MAX)</sub> = 0.8 V, R <sub>L</sub> = 350 Ω,<br>T <sub>A</sub> = 25°C, V <sub>CM</sub> = 1000 V                                | 10   | 13,<br>14,<br>15 |

## Package Characteristics

All Typicals at  $T_A = 25^\circ\text{C}$ .

| Parameter                                  | Sym.        | Package                         | Min. | Typ.         | Max | Units         | Test Conditions   | Fig. | Note      |
|--|-------------|---------------------------------|------|--------------|-----|---------------|---|------|-----------|
| Input-Output Insulation                    | $I_{I-O}^*$ | Single 8-Pin DIP<br>Single SO-8 |      |              | 1   | $\mu\text{A}$ | 45% RH, $t = 5\text{ s}$ ,<br>$V_{I-O} = 3\text{ kV DC}$ , $T_A = 25^\circ\text{C}$ |      | 16, 17    |
| Input-Output Momentary Withstand Voltage** | $V_{ISO}$   | 8-Pin DIP, SO-8                 | 3750 |              |     | V rms         | RH $\leq 50\%$ , $t = 1\text{ min}$ ,<br>$T_A = 25^\circ\text{C}$                   |      | 16, 17    |
| Input-Output Resistance                    | $R_{I-O}$   | 8-Pin, SO-8                     |      | $10^{12}$    |     | $\Omega$      | $V_{I-O} = 500\text{ V dc}$   |      | 1, 16, 19 |
| Input-Output Capacitance                   | $C_{I-O}$   | 8-Pin DIP, SO-8                 |      | 0.6          |     | pF            | $f = 1\text{ MHz}$ , $T_A = 25^\circ\text{C}$                                       |      | 1, 16, 19 |
| Input-Input Leakage Current                | $I_{I-I}$   | Dual Channel                    |      | 0.005        |     | $\mu\text{A}$ | RH $\leq 45\%$ , $t = 5\text{ s}$ ,<br>$V_{I-I} = 500\text{ V}$                     |      | 20        |
| Resistance (Input-Input)                   | $R_{I-I}$   | Dual Channel                    |      | $10^{11}$    |     | $\Omega$      |   |      | 20        |
| Capacitance (Input-Input)                  | $C_{I-I}$   | Dual 8-Pin Dip<br>Dual SO-8     |      | 0.03<br>0.25 |     | pG            | $f = 1\text{ MHz}$  |      | 20        |

\*The JEDEC Registration specifies  $0^\circ\text{C}$  to  $+70^\circ\text{C}$ . Avago specifies  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

\*\*The Input-Output Momentary Withstand Voltage is a dielectric voltage rating that should not be interpreted as an input-output continuous voltage rating. For the continuous voltage rating refer to the IEC/EN/DIN EN 60747-5-5 Insulation Characteristics Table (if applicable), your equipment level safety specification or Avago Application Note 1074 entitled "Optocoupler Input-Output Endurance Voltage."

### Notes:

- Each channel.
- Peaking circuits may produce transient input currents up to 50 mA, 50 ns maximum pulse width, provided average current does not exceed 20 mA.
- Peaking circuits may produce transient input currents up to 50 mA, 50 ns maximum pulse width, provided average current does not exceed 15 mA.
- Derate linearly above  $+80^\circ\text{C}$  free-air temperature at a rate of  $2.7\text{ mW}/^\circ\text{C}$  for the SOIC-8 package.
- Bypassing of the power supply line is required, with a  $0.1\text{ }\mu\text{F}$  ceramic disc capacitor adjacent to each optocoupler as illustrated in Figure 11. Total lead length between both ends of the capacitor and the isolator pins should not exceed 20 mm.
- The  $t_{PLH}$  propagation delay is measured from the 3.75 mA point on the falling edge of the input pulse to the 1.5 V point on the rising edge of the output pulse.
- The  $t_{PHL}$  propagation delay is measured from the 3.75 mA point on the rising edge of the input pulse to the 1.5 V point on the falling edge of the output pulse.
- $t_{PSK}$  is equal to the worst case difference in  $t_{PHL}$  and/or  $t_{PLH}$  that will be seen between units at any given temperature and specified test conditions.
- See test circuit for measurement details.
- The  $t_{ELH}$  enable propagation delay is measured from the 1.5 V point on the falling edge of the enable input pulse to the 1.5 V point on the rising edge of the output pulse.
- The  $t_{EHL}$  enable propagation delay is measured from the 1.5 V point on the rising edge of the enable input pulse to the 1.5 V point on the falling edge of the output pulse.
- $CM_H$  is the maximum tolerable rate of rise on the common mode voltage to assure that the output will remain in a high logic state (i.e.,  $V_O > 2.0\text{ V}$ ).
- $CM_L$  is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (i.e.,  $V_O < 0.8\text{ V}$ ).
- For sinusoidal voltages,  $(|dV_{CM}| / dt)_{\max} = \pi f_{CM} V_{CM} (p-p)$ .
- No external pull up is required for a high logic state on the enable input. If the  $V_E$  pin is not used, tying  $V_E$  to  $V_{CC}$  will result in improved CMR performance. For single channel products only. See application information provided.
- Device considered a two-terminal device: pins 1, 2, 3, and 4 shorted together, and pins 5, 6, 7, and 8 shorted together.
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 4500\text{ V rms}$  for one second (leakage detection current limit,  $I_{I-O} \leq 5\text{ }\mu\text{A}$ ). This test is performed before the 100% production test for partial discharge (Method b) shown in the IEC/EN/DIN EN 60747-5-5 Insulation Characteristics Table, if applicable.
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 6000\text{ V rms}$  for one second (leakage detection current limit,  $I_{I-O} \leq 5\text{ }\mu\text{A}$ ). This test is performed before the 100% production test for partial discharge (Method b) shown in the IEC/EN/DIN EN 60747-5-5 Insulation Characteristics Table, if applicable.
- Measured between the LED anode and cathode shorted together and pins 5 through 8 shorted together. For dual channel products only.
- Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together. For dual channel products only.

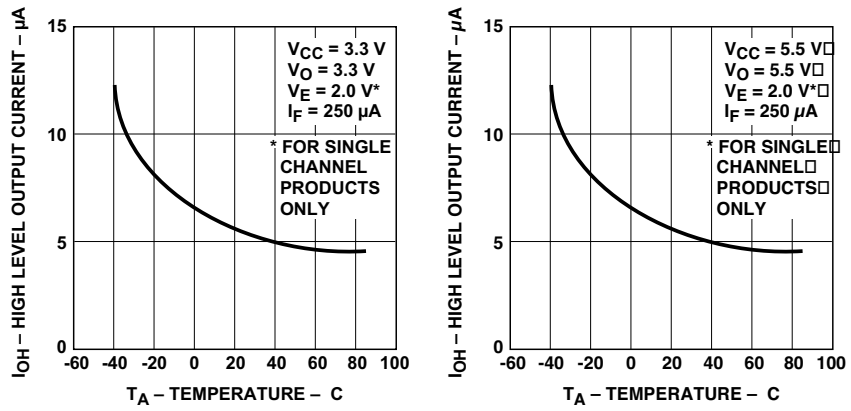


Figure 1. Typical high level output current vs. temperature.

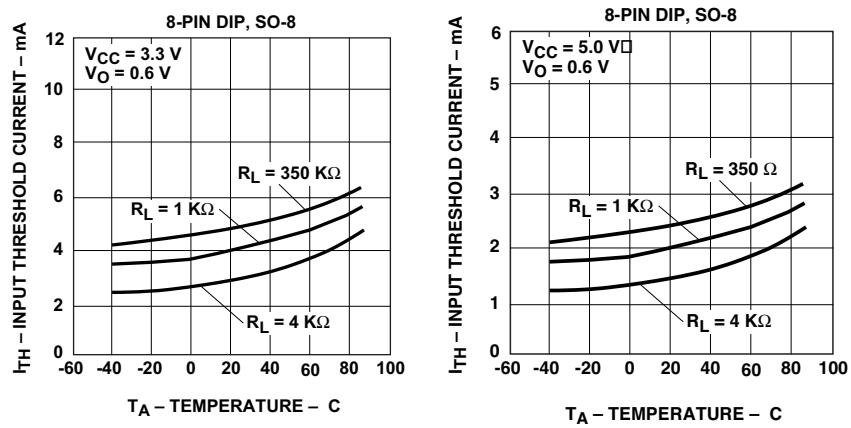


Figure 2. Typical output voltage vs. forward input current.

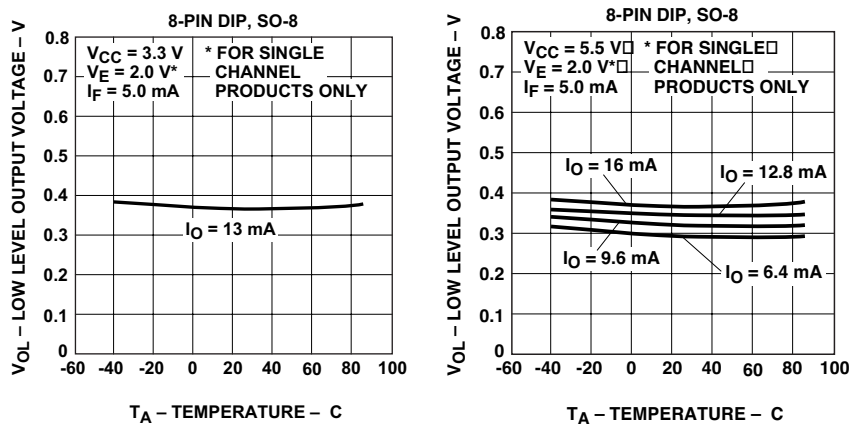


Figure 3. Typical low level output voltage vs. temperature.

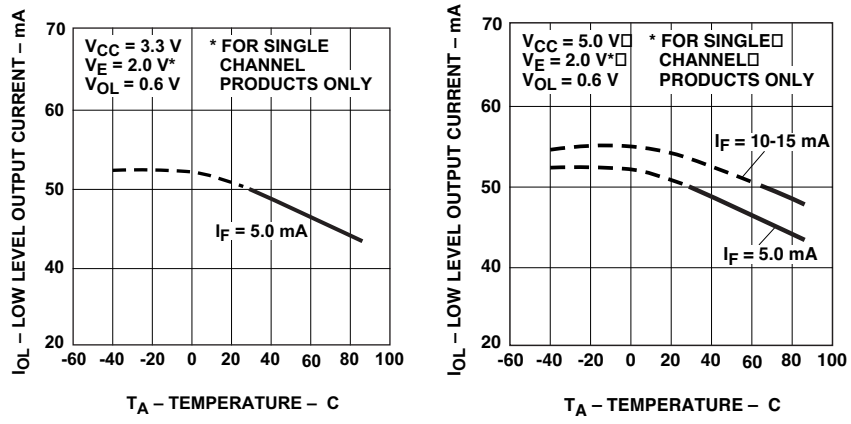


Figure 4. Typical low level output current vs. temperature.

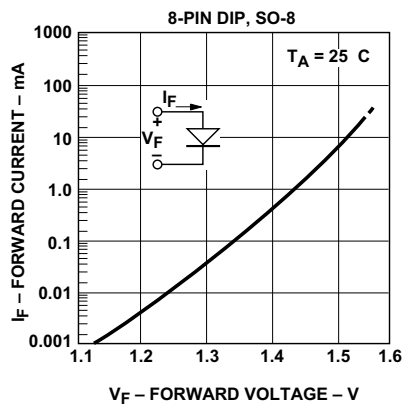


Figure 5. Typical input diode forward characteristic.

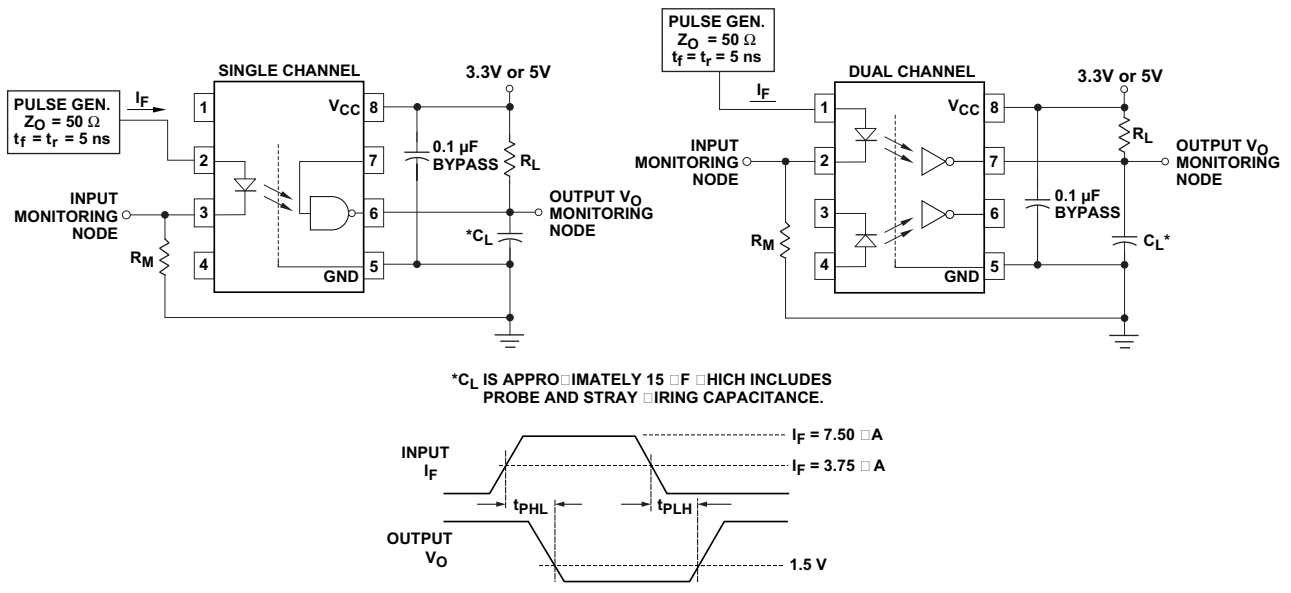


Figure 6. Test circuit for  $t_{pHL}$  and  $t_{pLH}$ .

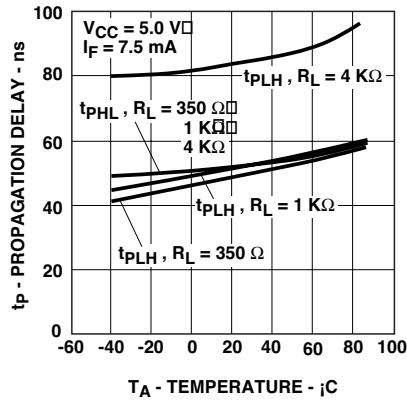
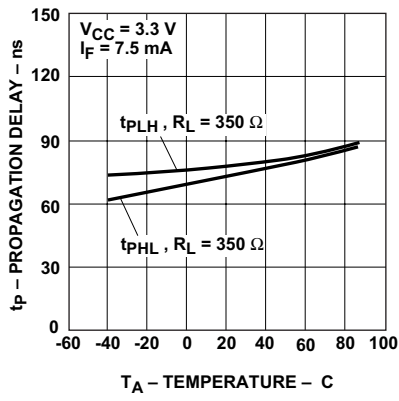


Figure 7. Typical propagation delay vs. temperature.

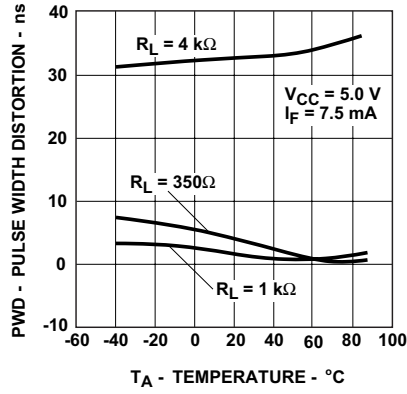
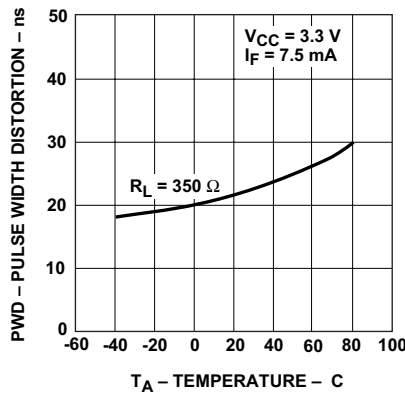


Figure 8. Typical pulse width distortion vs. temperature.

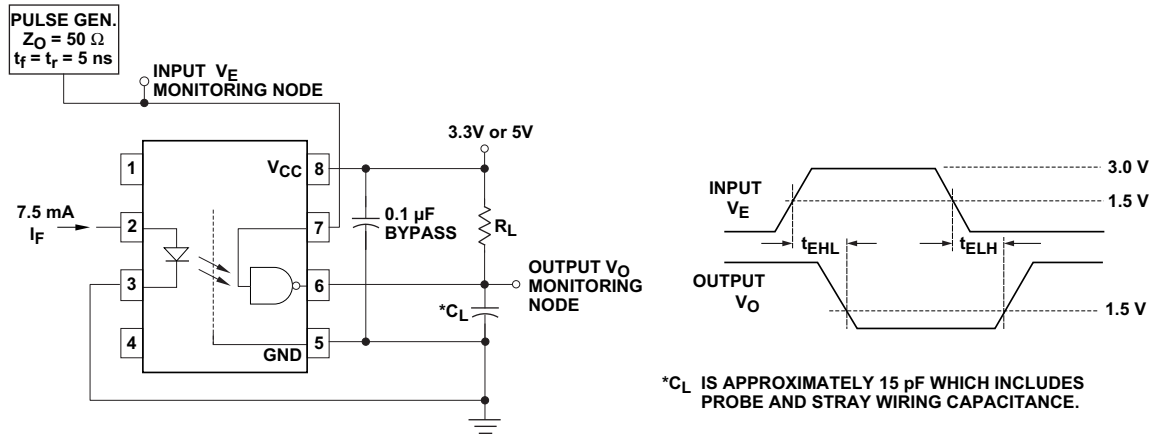


Figure 9. Test circuit for  $t_{EHL}$  and  $t_{ELH}$ .

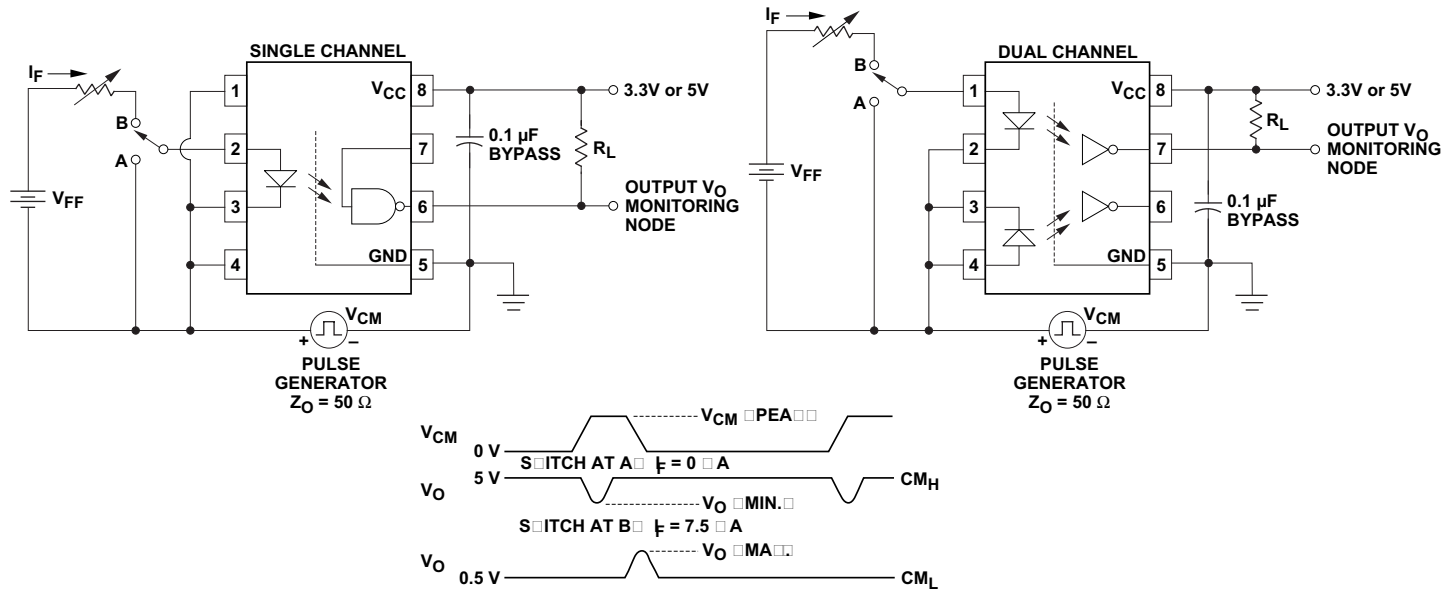


Figure 10. Test circuit for common mode transient immunity and typical waveforms.

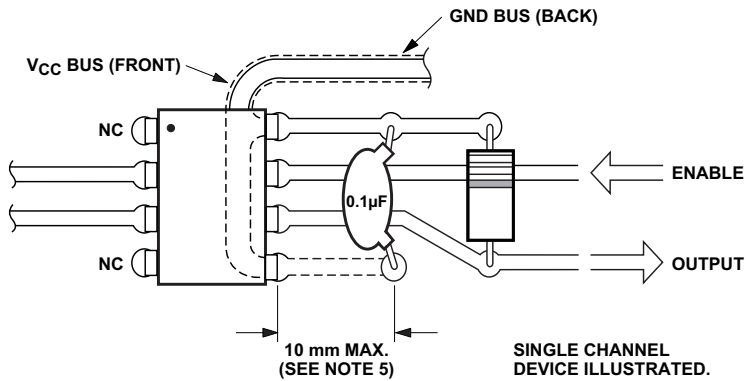
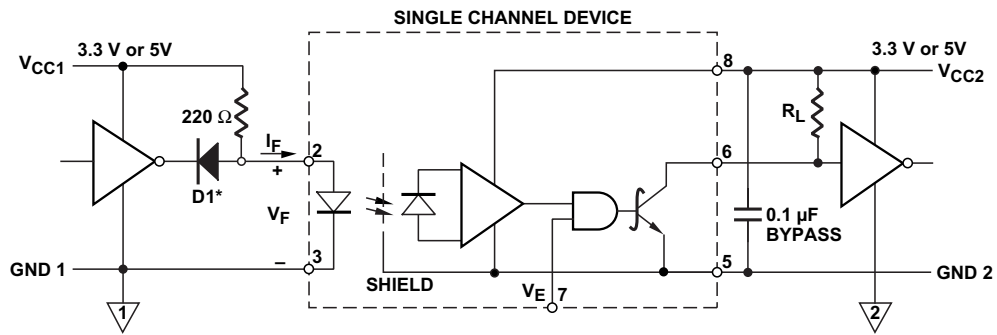


Figure 11. Recommended printed circuit board layout.





\*DIODE D1 (1N916 OR EQUIVALENT) IS NOT REQUIRED FOR UNITS WITH OPEN COLLECTOR OUTPUT.

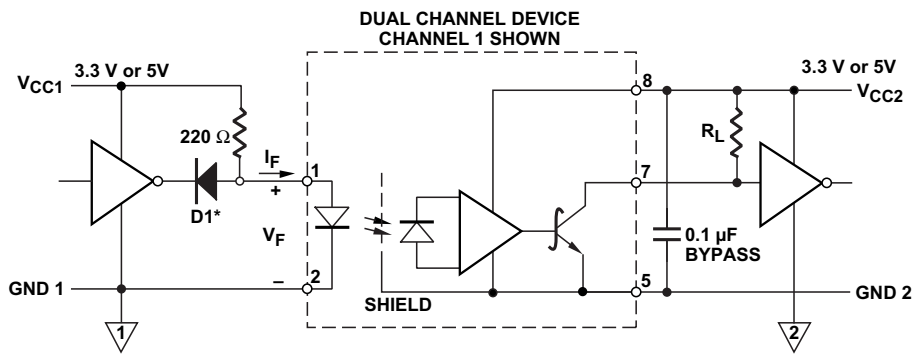


Figure 12. Recommended LVTTL interface circuit.

## Application Information

### Common-Mode Rejection for HCPL-260L Families:

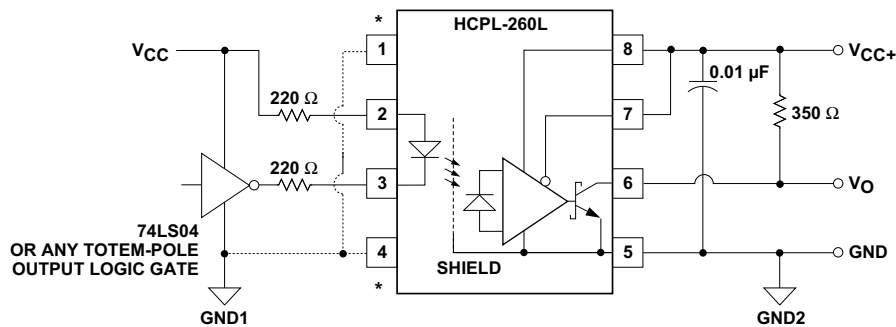
Figure 13 shows the recommended drive circuit for optimal common-mode rejection performance. Two main points to note are:

1. The enable pin is tied to  $V_{CC}$  rather than floating (this applies to single-channel parts only).
2. Two LED-current setting resistors are used instead of one. This is to balance  $I_{LED}$  variation during common-mode transients.

If the enable pin is left floating, it is possible for common-mode transients to couple to the enable pin, resulting in common-mode failure. This failure mechanism only occurs when the LED is on and the output is in the Low State. It is identified as occurring when the transient output voltage rises above 0.8 V. Therefore, the enable pin should be connected to either  $V_{CC}$  or logic-level high for best common-mode performance with the output low ( $CMR_L$ ). This failure mechanism is only present in single-channel parts which have the enable function.

Also, common-mode transients can capacitively couple from the LED anode (or cathode) to the output-side ground causing current to be shunted away from the LED (which can be bad if the LED is on) or conversely cause current to be injected into the LED (bad if the LED is meant to be off). Figure 14 shows the parasitic capacitances which exist between LED anode/cathode and output ground ( $C_{LA}$  and  $C_{LC}$ ). Also shown in Figure 14 on the input side is an AC-equivalent circuit.

For transients occurring when the LED is on, common-mode rejection ( $CMR_L$ , since the output is in the “low” state) depends upon the amount of LED current drive ( $I_F$ ). For conditions where  $I_F$  is close to the switching threshold ( $I_{TH}$ ),  $CMR_L$  also depends on the extent which  $I_{LP}$  and  $I_{LN}$  balance each other. In other words, any condition where common-mode transients cause a momentary decrease in  $I_F$  will cause common-mode failure for transients which are fast enough.



\* HIGHER CMR MAY BE OBTAINABLE BY CONNECTING PINS 1, 4 TO INPUT GROUND (GND1).

Figure 13. Recommended drive circuit for High-CMR.

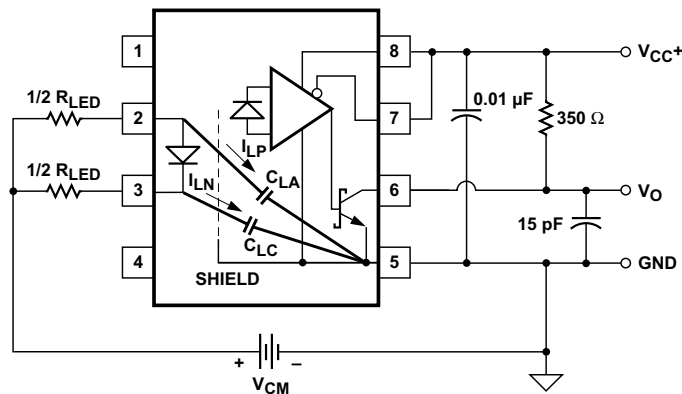


Figure 14. AC equivalent circuit.

Likewise for common-mode transients which occur when the LED is off (i.e.  $CMR_H$ , since the output is “high”), if an imbalance between  $I_{LP}$  and  $I_{LN}$  results in a transient  $I_F$  equal to or greater than the switching threshold of the optocoupler, the transient “signal” may cause the output to spike below 2 V (which constitutes a  $CMR_H$  failure).

By using the recommended circuit in Figure 13, good CMR can be achieved. The balanced  $I_{LED}$ -setting resistors help equalize  $I_{LP}$  and  $I_{LN}$  to reduce the amount by which  $I_{LED}$  is modulated from transient coupling through  $C_{LA}$  and  $C_{LC}$ .

### CMR with Other Drive Circuits

CMR performance with drive circuits other than that shown in Figure 13 may be enhanced by following these guidelines:

1. Use of drive circuits where current is shunted from the LED in the LED “off” state (as shown in Figures 15 and 16). This is beneficial for good  $CMR_H$ .
2. Use of  $I_{FH} > 3.5$  mA. This is good for high  $CMR_L$ .

Figure 15 shows a circuit which can be used with any totem-pole-output TTL/LSTTL/HCMOS logic gate. The buffer PNP transistor allows the circuit to be used with logic devices which have low current-sinking capability. It also helps maintain the driving-gate power-supply current at a constant level to minimize ground shifting for other devices connected to the input-supply ground.

When using an open-collector TTL or open-drain CMOS logic gate, the circuit in Figure 16 may be used. When using a CMOS gate to drive the optocoupler, the circuit shown in Figure 17 may be used. The diode in parallel with the  $R_{LED}$  speeds the turn-off of the optocoupler LED.

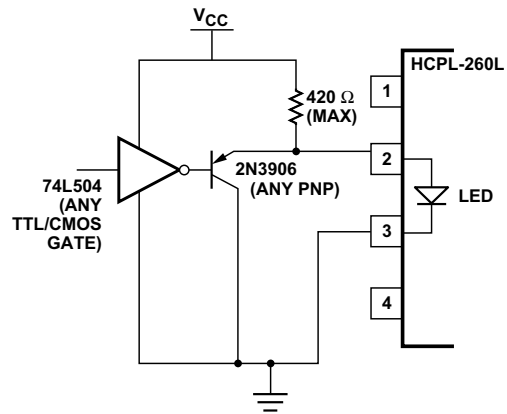


Figure 15. TTL interface circuit.

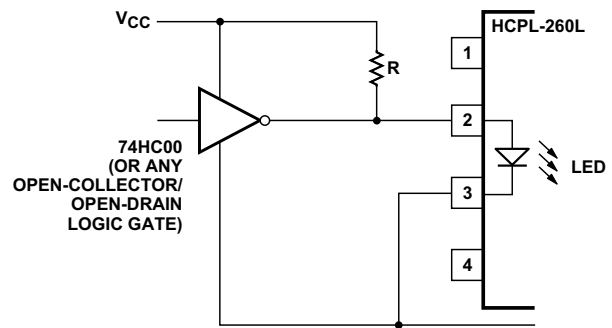


Figure 16. TTL open-collector/open drain gate drive circuit.

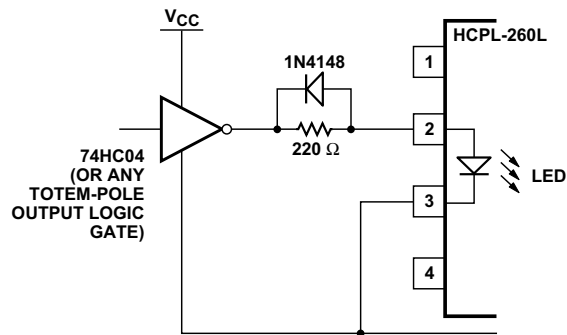


Figure 17. CMOS gate drive circuit.

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