

# Dual Channel, High Speed Optocouplers

## Technical Data

**HCPL-2530    HCPL-0530**  
**HCPL-2531    HCPL-0531**  
**HCPL-4534    HCPL-0534**

### Features

- **15 kV/μs Minimum Common Mode Transient Immunity at  $V_{CM} = 1500$  V (HCPL-4534/0534)**
- **High Speed: 1 Mb/s**
- **TTL Compatible**
- **Available in 8 Pin DIP, SO-8, and 8 Pin DIP – Gull Wing Surface Mount (Option 020) Packages**
- **High Density Packaging**
- **3 MHz Bandwidth**
- **Open Collector Outputs**
- **Guaranteed Performance from 0°C to 70°C**
- **Safety Approval**  
UL Recognized – 2500 V rms for 1 minute (5000 V rms for 1 minute for Option 020) per UL1577  
CSA Approved
- **Single Channel Version Available (4502/3, 0452/3)**
- **MIL-STD-1772 Version Available (55XX/65XX/4N55)**

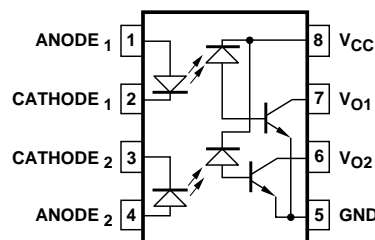
### Applications

- **Line Receivers** – High Common Mode Transient Immunity (>1000 V/μs) and Low Input-Output Capacitance (0.6 pF)
- **High Speed Logic Ground Isolation** – TTL/TTL, TTL/LTTL, TTL/CMOS, TTL/LSTTL
- **Replace Pulse Transformers** – Save Board Space and Weight
- **Analog Signal Ground Isolation** – Integrated Photon Detector Provides Improved Linearity over Phototransistor Type
- **Polarity Sensing**
- **Isolated Analog Amplifier** – Dual Channel Packaging Enhances Thermal Tracking

### Description

These dual channel optocouplers contain a pair of light emitting diodes and integrated photodetectors with electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collectors increase the speed up to a hundred times that of a conventional phototransistor coupler by reducing the base-collector capacitance.

### Functional Diagram



| TRUTH TABLE<br>(POSITIVE LOGIC) |       |
|---------------------------------|-------|
| LED                             | $V_O$ |
| ON                              | LOW   |
| OFF                             | HIGH  |

A 0.1 μF bypass capacitor between pins 5 and 8 is recommended.

*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.*

These dual channel optocouplers are available in an 8 Pin DIP and in an industry standard SO-8 package. The following is a cross reference table listing the 8 Pin DIP part number and the electrically equivalent SO-8 part number.

| <b>8 Pin DIP</b> | <b>SO-8 Package</b> |
|------------------|---------------------|
| HCPL-2530        | HCPL-0530           |
| HCPL-2531        | HCPL-0531           |
| HCPL-4534        | HCPL-0534           |

The SO-8 does not require “through holes” in a PCB. This package occupies approximately one-third the footprint area of the standard dual-in-line package. The lead profile is designed to be compatible with standard surface mount processes.

The HCPL-2530/0530 is for use in TTL/CMOS, TTL/LSTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the HCPL-2530/0530 is 7% minimum at  $I_F = 16$  mA.

The HCPL-2531/0531 is designed for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6 k $\Omega$  pull-up resistor. CTR of the HCPL-2531/0531 is 19% minimum at  $I_F = 16$  mA.

The HCPL-4534/0534 is an HCPL-2531/0531 with increased common mode transient immunity of 15,000 V/ $\mu$ s minimum at  $V_{CM} = 1500$  V guaranteed.

## Selection Guide

| Minimum CMR        |              | Current Transfer Ratio (%) | 8-pin DIP (300 Mil)  |                         | Small-Outline SO-8   |                         | Widebody (400 Mil)      | Hermetic                          |
|--------------------|--------------|----------------------------|----------------------|-------------------------|----------------------|-------------------------|-------------------------|-----------------------------------|
| dV/dt (V/ $\mu$ s) | $V_{CM}$ (V) |                            | Dual Channel Package | Single Channel Package* | Dual Channel Package | Single Channel Package* | Single Channel Package* | Single and Dual Channel Packages* |
| 1,000              | 10           | 7                          | HCPL-2530            | 6N135                   | HCPL-0530            | HCPL-0500               | HCNW135                 |                                   |
|                    |              | 19                         | HCPL-2531            | 6N136<br>HCPL-4502      | HCPL-0531            | HCPL-0501<br>HCPL-0452  | HCNW136<br>HCNW4502     |                                   |
| 15,000             | 1500         | 19                         | HCPL-4534            | HCPL-4503               | HCPL-0534            | HCPL-0453               | HCNW4503                |                                   |
| 1,000              | 10           | 9                          |                      |                         |                      |                         |                         | HCPL-55XX<br>HCPL-65XX<br>4N55    |

\*Technical data for these products are on separate Agilent publications.

## Ordering Information

Specify Part Number followed by Option Number (if desired).

Example:

HCPL-2531#XXX

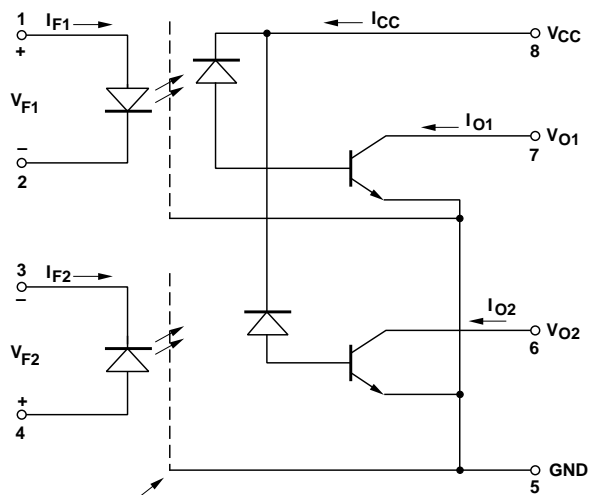
- 020 = UL 5000 V rms/1 Minute Option\*
- 300 = Gull Wing Surface Mount Option†
- 500 = Tape and Reel Packaging Option

Option data sheets available. Contact your Agilent sales representative or authorized distributor for information.

\*For HCPL-2530/1 and HCPL-4534 only.

†Gull wing surface mount option applies to through hole parts only.

## Schematic

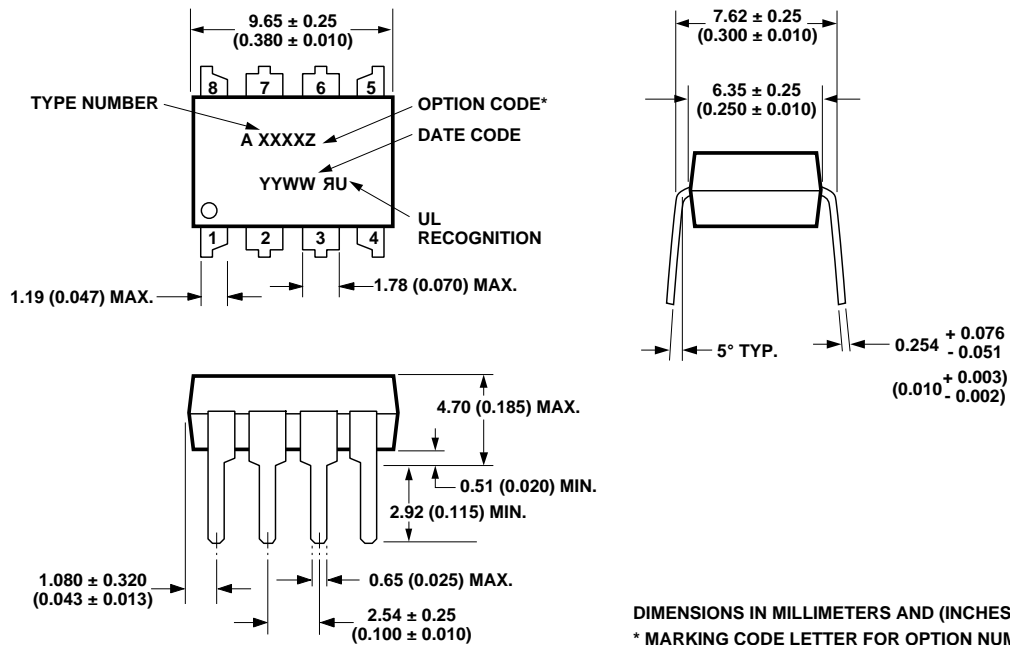


HCPL-4534/0534 SHIELD

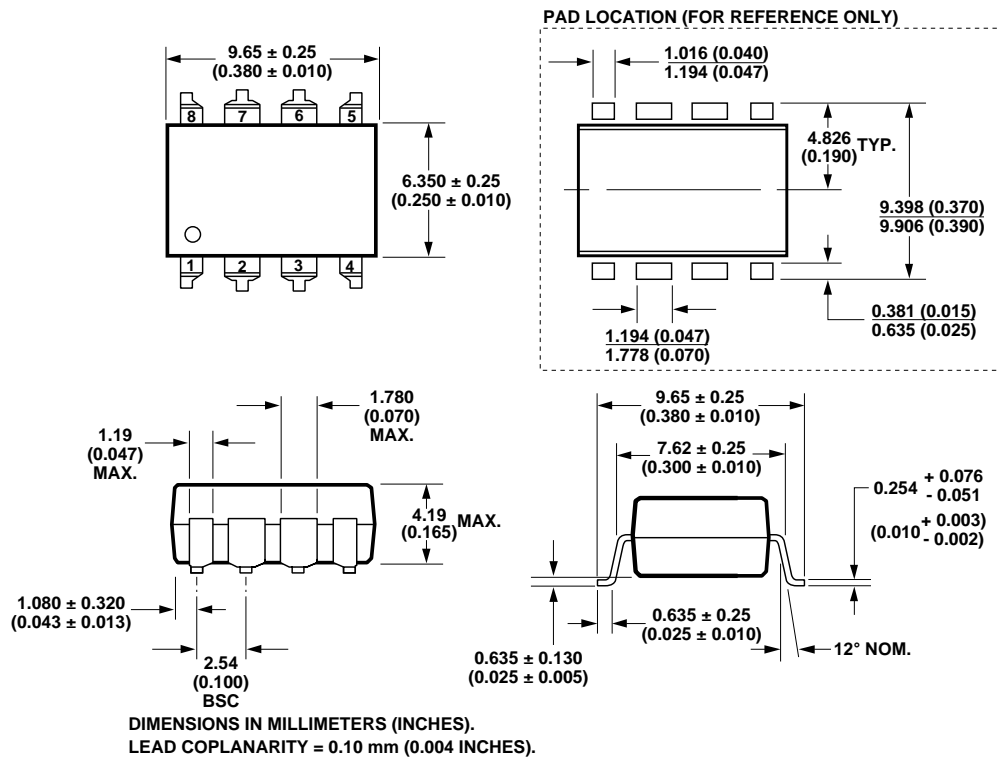
USE OF A 0.1  $\mu$ F BYPASS CAPACITOR CONNECTED BETWEEN PINS 5 AND 8 IS RECOMMENDED.

## Package Outline Drawings

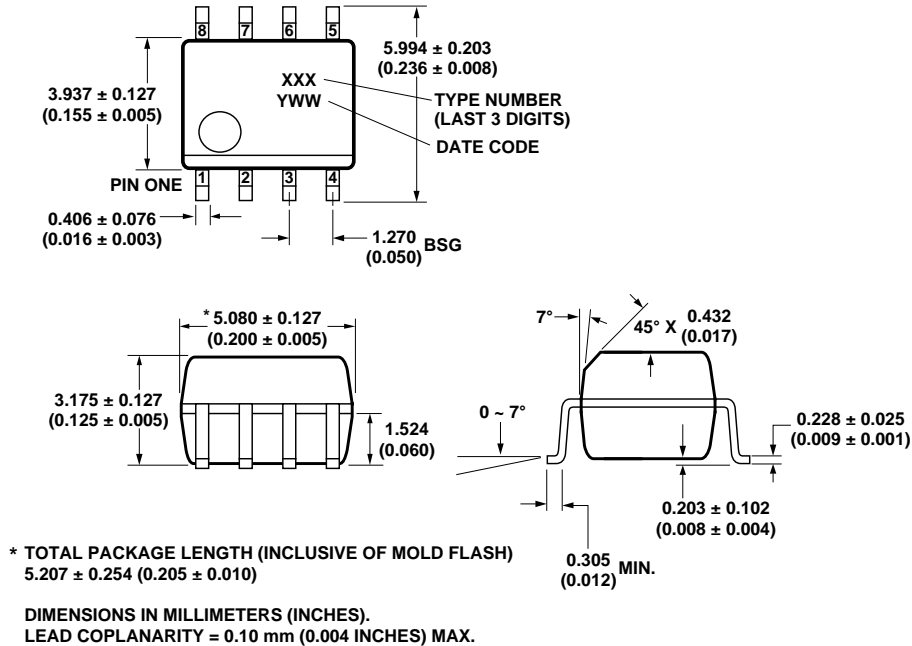
### 8-Pin DIP Package (HCPL-2530/2531/4534)



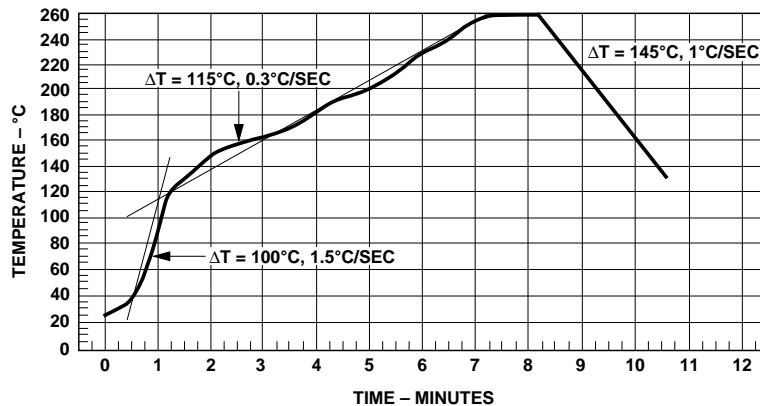
### 8-Pin DIP Package with Gull Wing Surface Mount Option 300 (HCPL-2530/2531/4534)



### Small Outline SO-8 Package (HCPL-0530/0531/0534)



### Solder Reflow Temperature Profile (HCPL-0530/0531/0534 and Gull Wing Surface Mount Option Parts)



Note: Use of nonchlorine activated fluxes is highly recommended.

#### Regulatory Information

The devices contained in this data sheet have been approved by the following organizations:

#### UL

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

#### CSA

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

### Insulation and Safety Related Specifications

| Parameter   | Symbol | 8-Pin DIP<br>(300 Mil)<br>Value | SO-8<br>Value | Units | Conditions   |
|---|--------|---------------------------------|---------------|-------|--|
| Minimum External Air Gap (External Clearance)     | L(101) | 7.1                             | 4.9           | mm    | Measured from input terminals to output 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. |
| Minimum Internal Tracking (Internal Creepage)     |        | NA                              | NA            | mm    | Measured from input terminals to output terminals, along internal 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)   |

Option 300 - surface mount classification is Class A in accordance with CECC 00802.

### Absolute Maximum Ratings

| Parameter  | Symbol                | Device                 | Min.  | Max. | Units | Note |
|--|-----------------------|------------------------|---|------|-------|------|
| Storage Temperature  | T <sub>S</sub>        |                        | -55   | 125  | °C    |      |
| Operating Temperature  | T <sub>A</sub>        |                        | -55   | 100  | °C    |      |
| Average Forward Input Current (each channel)   | I <sub>F(AVG)</sub>   |                        |   | 25   | mA    |      |
| Peak Forward Input Current (each channel)<br>(50% duty cycle, 1 ms pulse width)                | I <sub>F(PEAK)</sub>  |                        |   | 50   | mA    |      |
| Peak Transient Input Current (each channel)<br>(≤ 1 μs pulse width, 300 pps)                   | I <sub>F(TRANS)</sub> |                        |   | 1    | A     |      |
| Reverse LED Input Voltage (each channel)   | V <sub>R</sub>        |                        |   | 5    | V     |      |
| Input Power Dissipation (each channel)   | P <sub>IN</sub>       |                        |   | 45   | mW    |      |
| Average Output Current (each channel)  | I <sub>O(AVG)</sub>   |                        |   | 8    | mA    |      |
| Peak Output Current  | I <sub>O(PEAK)</sub>  |                        |   | 16   | mA    |      |
| Supply Voltage (Pin 8-5)   | V <sub>CC</sub>       |                        | -0.5  | 30   | V     |      |
| Output Voltage (Pins 7-5, 6-5)   | V <sub>O</sub>        |                        | -0.5  | 20   | V     |      |
| Output Power Dissipation (each channel)  | P <sub>O</sub>        |                        |   | 35   | mW    | 13   |
| Lead Solder Temperature<br>(Through-Hole Parts Only)<br>1.6 mm below seating plane, 10 seconds | T <sub>LS</sub>       | 8 Pin DIP              |   | 260  | °C    |      |
| Reflow Temperature Profile   | T <sub>RP</sub>       | SO-8 and<br>Option 300 | See <b>Package Outline Drawings</b> section |      |       |      |

## Electrical Specifications (DC)

Over recommended temperature ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ) unless otherwise specified. See note 9.

| Parameter                                  | Sym.                            | Device                           | Min. | Typ.* | Max. | Units                   | Test Conditions   | Fig.  | Note      |      |
|--|---------------------------------|----------------------------------|------|-------|------|-------------------------|---|---|-----------|------|
| Current Transfer Ratio                     | CTR                             | HCPL-2530/0530                   | 7    | 18    | 50   | %                       | $T_A = 25^\circ\text{C}$  | $I_F = 16\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$<br>$V_O = 0.5\text{ V}$ | 1, 2<br>4 | 1, 2 |
|  |                                 |                                  | 5    |       |      |                         |   |   |           |      |
|  |                                 | HCPL-2531/0531<br>HCPL-4534/0534 | 19   | 24    | 50   | %                       | $T_A = 25^\circ\text{C}$  |   |           |      |
|  |                                 |                                  | 15   |       |      |                         |   |   |           |      |
| Logic Low Output Voltage                   | $V_{OL}$                        | HCPL-2530/0530                   |      | 0.1   | 0.5  | V                       | $T_A = 25^\circ\text{C}$ $I_O = 1.1\text{ mA}$                          | $I_F = 16\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$                         | 1         | 1    |
|  |                                 |                                  |      |       | 0.5  |                         | $I_O = 0.8\text{ mA}$   |   |           |      |
|  |                                 | HCPL-2531/0531<br>HCPL-4534/0534 |      | 0.1   | 0.5  | V                       | $T_A = 25^\circ\text{C}$ $I_O = 3.0\text{ mA}$                          |   |           |      |
|  |                                 |                                  |      |       | 0.5  |                         | $I_O = 2.4\text{ mA}$   |   |           |      |
| Logic High Output Current                  | $I_{OH}$                        |                                  |      | 0.003 | 0.5  | $\mu\text{A}$           | $T_A = 25^\circ\text{C}$ $V_O = \text{Open}$<br>$V_{CC} = 5.5\text{ V}$ | $I_F = 0\text{ mA}$   | 6         | 1    |
|  |                                 |                                  |      |       | 50   |                         | $V_O = \text{Open}$<br>$V_{CC} = 15.0\text{ V}$                         |   |           |      |
| Logic Low Supply Current                   | $I_{CCL}$                       |                                  |      | 100   | 400  | $\mu\text{A}$           | $I_F = 16\text{ mA}$ , $V_O = \text{Open}$ ,<br>$V_{CC} = 15\text{ V}$  |   |           |      |
| Logic High Supply Current                  | $I_{CCH}$                       |                                  |      | 0.05  | 4    | $\mu\text{A}$           | $I_F = 0\text{ mA}$ , $V_O = \text{Open}$ ,<br>$V_{CC} = 15\text{ V}$   |   |           |      |
| Input Forward Voltage                      | $V_F$                           |                                  |      | 1.5   | 1.7  | V                       | $T_A = 25^\circ\text{C}$  | $I_F = 16\text{ mA}$  | 3         | 1    |
|  |                                 |                                  |      |       | 1.8  |                         |   |   |           |      |
| Input Reverse Breakdown Voltage            | $BV_R$                          |                                  | 5    |       |      | V                       | $I_R = 10\text{ }\mu\text{A}$   |   |           | 1    |
| Temperature Coefficient of Forward Voltage | $\frac{\Delta V_F}{\Delta T_A}$ |                                  |      | -1.6  |      | mV/<br>$^\circ\text{C}$ | $I_F = 16\text{ mA}$  |   |           |      |
| Input Capacitance                          | $C_{IN}$                        |                                  |      | 60    |      | pF                      | $f = 1\text{ MHz}$ , $V_F = 0\text{ V}$                                 | 1   |           |      |

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

## Switching Specifications (AC)

Over recommended temperature ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ),  $V_{CC} = 5\text{ V}$ ,  $I_F = 16\text{ mA}$  unless otherwise specified.

| Parameter   | Sym.      | Device HCPL-        | Min. | Typ.* | Max.                       | Units                   | Test Conditions            |   | Fig.     | Note    |
|---|-----------|---------------------|------|-------|----------------------------|-------------------------|----------------------------|---|----------|---------|
| Propagation Delay Time to Logic Low at Output             | $t_{PHL}$ | 2530/0530           |      | 0.2   | 1.5                        | $\mu\text{s}$           | $T_A = 25^\circ\text{C}$   | $R_L = 4.1\text{ k}\Omega$  | 5, 9, 11 | 6, 7    |
|   |           |                     |      |       | 2.0                        |                         | $T_A = 25^\circ\text{C}$   |   |          |         |
|   |           | 2531/0531/4534/0534 |      | 0.2   | 0.8                        |                         |                            | $R_L = 1.9\text{ k}\Omega$  |          |         |
|   |           |                     |      |       | 1.0                        |                         |                            |   |          |         |
| Propagation Delay Time High to Logic at Output            | $t_{PLH}$ | 2530/0530           |      | 1.3   | 1.5                        | $\mu\text{s}$           | $T_A = 25^\circ\text{C}$   | $R_L = 4.1\text{ k}\Omega$  | 5, 9, 11 | 6, 7    |
|   |           |                     |      |       | 2.0                        |                         | $T_A = 25^\circ\text{C}$   |   |          |         |
|   |           | 2531/0531/4534/0534 |      | 0.6   | 0.8                        |                         |                            | $R_L = 1.9\text{ k}\Omega$  |          |         |
|   |           |                     |      |       | 1.0                        |                         |                            |   |          |         |
| Common Mode Transient Immunity at Logic High Level Output | $ CM_H $  | 2530/0530           | 1    | 10    |                            | $\text{kV}/\mu\text{s}$ | $R_L = 4.1\text{ k}\Omega$ | $I_F = 0\text{ mA}$ ,<br>$T_A = 25^\circ\text{C}$ ,<br>$V_{CM} = 10\text{ V}_{p-p}$ | 10       | 5, 6, 7 |
|   |           | 2531/0531           | 1    | 10    | $R_L = 1.9\text{ k}\Omega$ |                         |                            |   |          |         |
|   |           | 4534/0534           | 15   | 30    | $R_L = 1.9\text{ k}\Omega$ |                         |                            |   |          |         |
| Common Mode Transient Immunity at Logic Low Level Output  | $ CM_L $  | 2530/0530           | 1    | 10    |                            | $\text{kV}/\mu\text{s}$ | $R_L = 4.1\text{ k}\Omega$ | $I_F = 0\text{ mA}$ ,<br>$T_A = 25^\circ\text{C}$ ,<br>$V_{CM} = 10\text{ V}_{p-p}$ | 10       | 5, 6, 7 |
|   |           | 2531/0531           | 1    | 10    | $R_L = 1.9\text{ k}\Omega$ |                         |                            |   |          |         |
|   |           | 4534/0534           | 15   | 30    | $R_L = 1.9\text{ k}\Omega$ |                         |                            |   |          |         |
| Bandwidth   | BW        |                     |      | 3     |                            | MHz                     | $R_L = 100\text{ k}\Omega$ |   | 7, 8     |         |

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

## Package Characteristics

| Parameter                                  | Sym.      | Device                         | Min. | Typ.*     | Max. | Units         | Test Conditions  | Fig. | Note  |
|--|-----------|--------------------------------|------|-----------|------|---------------|--|------|-------|
| Input-Output Momentary Withstand Voltage** | $V_{ISO}$ |                                | 2500 |           |      | V rms         | $RH < 50\%$ ,<br>$t = 1\text{ min.}$ ,                               |      | 3, 10 |
|  |           | HCPL-2530/2531/4534 Option 020 | 5000 |           |      |               |  |      | 3, 11 |
| Resistance (Input-Output)                  | $R_{I-O}$ |                                |      | $10^{12}$ |      | $\Omega$      | $RH \leq 45\%$<br>$V_{I-O} = 500\text{ Vdc}$ ,<br>$t = 5\text{ s}$   |      | 3     |
| Capacitance (Input-Output)                 | $C_{I-O}$ |                                |      | 0.6       |      | pF            | $f = 1\text{ MHz}$ ,<br>$T_A = 25^\circ\text{C}$                     |      | 12    |
| Input-Input Insulation Leakage Current     | $I_{I-I}$ |                                |      | 0.005     |      | $\mu\text{A}$ | $RH \leq 45\%$ ,<br>$t = 5\text{ s}$ ,<br>$V_{I-I} = 500\text{ Vdc}$ |      | 4     |
| Resistance (Input-Input)                   | $R_{I-I}$ |                                |      | $10^{11}$ |      | $\Omega$      |  |      | 4     |
| Capacitance (Input-Input)                  | $C_{I-I}$ | HCPL-2530/2531/4534            |      | 0.03      |      | pF            | $f = 1\text{ MHz}$   |      | 4     |
|  |           | HCPL-0530/0531/0534            |      | 0.25      |      |               |  |      |       |

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

\*\*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 VDE 0884 Insulation Characteristics Table (if applicable), your equipment level safety specification or Agilent Application Note 1074 entitled "Optocoupler Input-Output Endurance Voltage," publication number 5963-2203E.



**Notes:**

1. Each channel.
2. CURRENT TRANSFER RATIO is defined as the ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.
3. Device considered a two-terminal device: pins 1, 2, 3, and 4 shorted together and pins 5, 6, 7, and 8 shorted together.
4. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.
5. Common mode transient immunity in a Logic High level is the maximum tolerable (positive)  $dV_{CM}/dt$  on the rising edge of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in a Logic High state (i.e.,

- $V_O > 2.0$  V). Common mode transient immunity in a Logic Low level is the maximum tolerable (negative)  $dV_{CM}/dt$  on the falling 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).
6. The 1.9 k $\Omega$  load represents 1 TTL unit load of 1.6 mA and the 5.6 k $\Omega$  pull-up resistor.
  7. The 4.1 k $\Omega$  load represents 1 LSTTL unit load of 0.36 mA and the 6.1 k $\Omega$  pull-up resistor.
  8. The frequency at which the ac output voltage is 3 dB below the low frequency asymptote.
  9. Use of a 0.1  $\mu$ F bypass capacitor connected between pins 5 and 8 is recommended.

10. In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 3000$  V rms for 1 second (leakage detection current limit,  $I_{L,O} \leq 5 \mu$ A).
11. In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 6000$  V rms for 1 second (leakage detection current limit,  $I_{L,O} \leq 5 \mu$ A).
12. Measured between the LED anode and cathode shorted together and pins 5 through 8 shorted together.
13. Derate linearly above 90°C free-air temperature at a rate of 3.0 mW/°C for the SOIC-8 package.

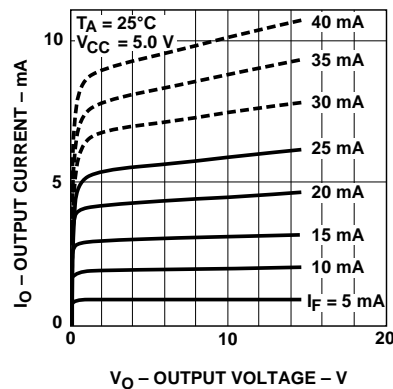


Figure 1. DC and Pulsed Transfer Characteristics.

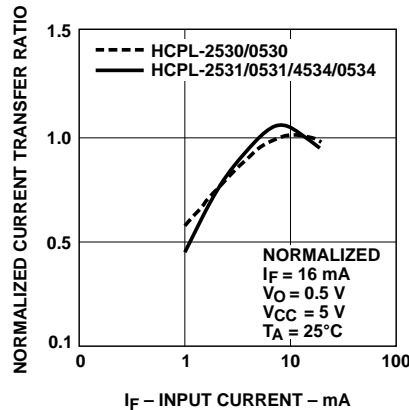


Figure 2. Current Transfer Ratio vs. Input Current.

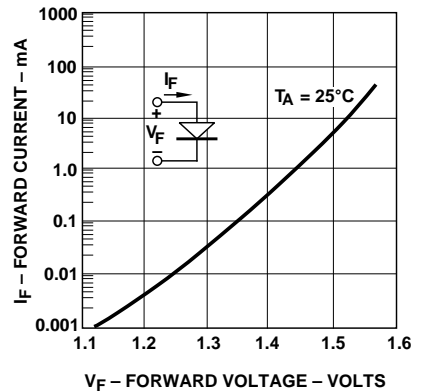


Figure 3. Input Current vs. Forward Voltage.

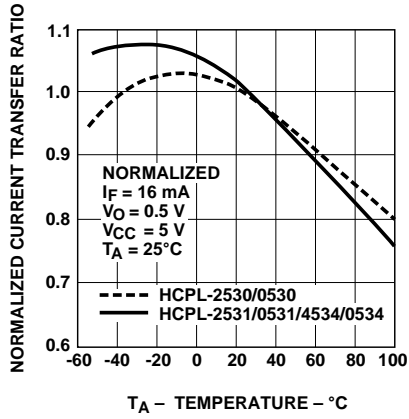


Figure 4. Current Transfer Ratio vs. Temperature.

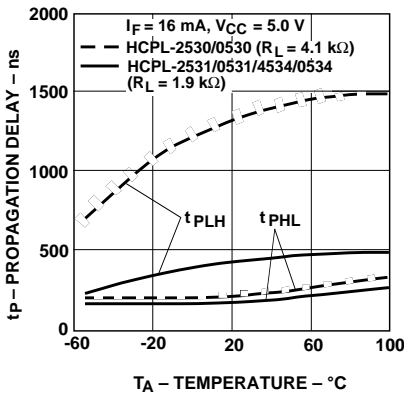


Figure 5. Propagation Delay vs. Temperature.

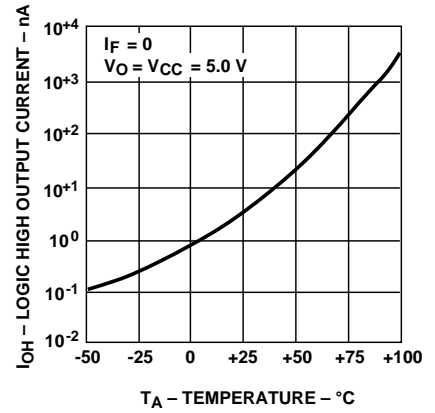


Figure 6. Logic High Output Current vs. Temperature.

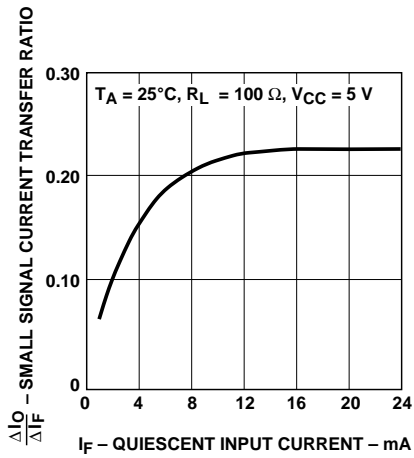


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

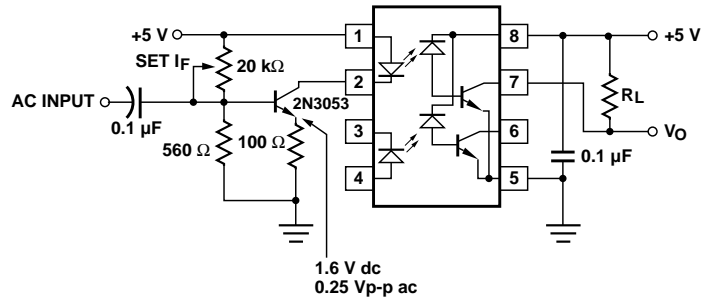
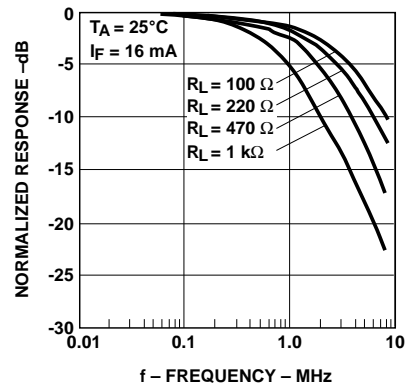


Figure 8. Frequency Response.

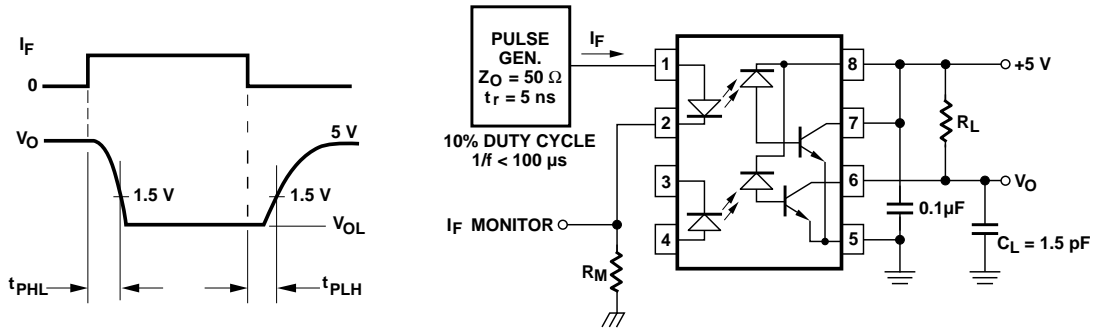


Figure 9. Switching Test Circuit.

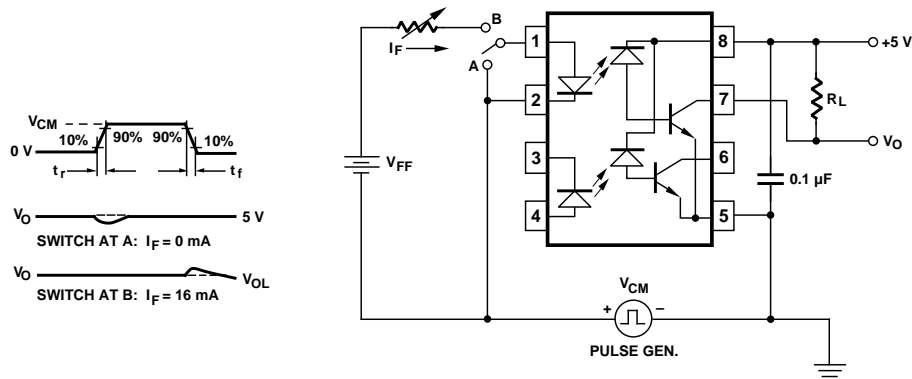


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

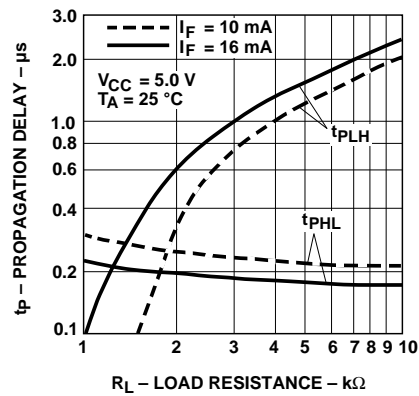
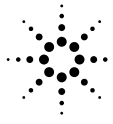


Figure 11. Propagation Delay Time vs. Load Resistance.



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Data subject to change.

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Obsoletes 5966-1272E

5968-1090E (11/99)