

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

Dual Channel, High Speed Optocouplers



Data Sheet



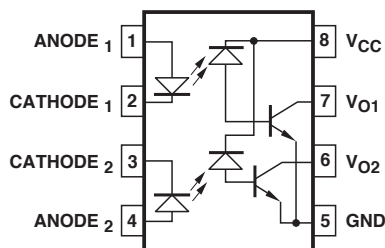
Description

These dual channel optocouplers contain a pair of light emitting diodes and integrated photo-detectors 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.

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.

| 8 Pin DIP | SO-8 Package |
|-----------|--------------|
| HCPL-2530 | HCPL-0530 |
| HCPL-2531 | HCPL-0531 |
| HCPL-4534 | HCPL-0534 |

Functional Diagram



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

TRUTH TABLE
(POSITIVE LOGIC)

| LED | V_O |
|-----|-------|
| ON | LOW |
| OFF | HIGH |

Features

- 15 kV/ μ s minimum common mode transient immunity at $V_{CM} = 1500$ V (HCPL-4534/0534)
- 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
- **Safety approval**
UL Recognized – 3750 V rms for 1 minute (5000 V rms for 1 minute for Option 020) per UL1577
CSA Approved
IEC/EN/DIN EN 60747-5-5
– $V_{IORM} = 630$ Vpeak for HCPL-2530/2531/4534 Option 060
– $V_{IORM} = 567$ Vpeak for HCPL-0530/0531/0534 Option 060
- Single channel version available (4502/3, 0452/3)
- MIL-PRF-38534 hermetic version available (55XX/65XX/4N55)

Applications

- Line receivers – high common mode transient immunity (>1000 V/ μ s) 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

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.

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 $I_F = 16 \text{ mA}$.

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 Ω pull-up resistor. CTR of the HCPL-2531/0531 is 19% minimum at $I_F = 16 \text{ mA}$.

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

Selection Guide

| Minimum CMR | | | 8-pin DIP (300 Mil) | | Small-Outline SO-8 | | Widebody (400 Mil) | Hermetic |
|---------------------------|--------------|----------------------------|----------------------|-------------------------|----------------------|-------------------------|-------------------------|-----------------------------------|
| dV/dt (V/ μs) | V_{CM} (V) | Current Transfer Ratio (%) | 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 HCPL-4502 | HCPL-0531 | HCPL-0501 HCPL-0452 | HCNW136 HCNW4502 | |
| 15,000 | 1500 | 19 | HCPL-4534 | HCPL-4503 | HCPL-0534 | HCPL-0453 | HCNW4503 | |
| 1,000 | 10 | 9 | | | | | | HCPL-55XX HCPL-65XX 4N55 |

* Technical data for these products are on separate Avago publications.

Ordering Information

HCPL-2530, HCPL-2531, HCPL-4534, HCPL-0530, HCPL-0531 and HCPL-0534 are UL Recognized with 3750 Vrms for 1 minute per UL1577 and are approved under CSA Component Acceptance Notice #5, File CA 88324.

| Part number | Option | | Package | Surface Mount | Gull Wing | Tape & Reel | UL 5000 Vrms/ 1 Minute rating | IEC/EN/DIN EN 60747-5-5 | Quantity |
|-------------------------------------|----------------|--------------------|-----------------|---------------|-----------|-------------|----------------------------------|-------------------------|---------------|
| | RoHS Compliant | Non RoHS Compliant | | | | | | | |
| HCPL-2530 HCPL-2531 HCPL-4534 | -000E | No option | 300mil 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 |
| | -360E | #360 | | X | X | | | X | 50 per tube |
| | -560E | #560 | | X | X | X | | X | 1000 per reel |
| HCPL-0530 HCPL-0531 HCPL-0534 | -000E | No option | SO-8 | | | | | | 100 per tube |
| | -500E | #500 | | 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.

Example 1:

HCPL-2530-560E 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.

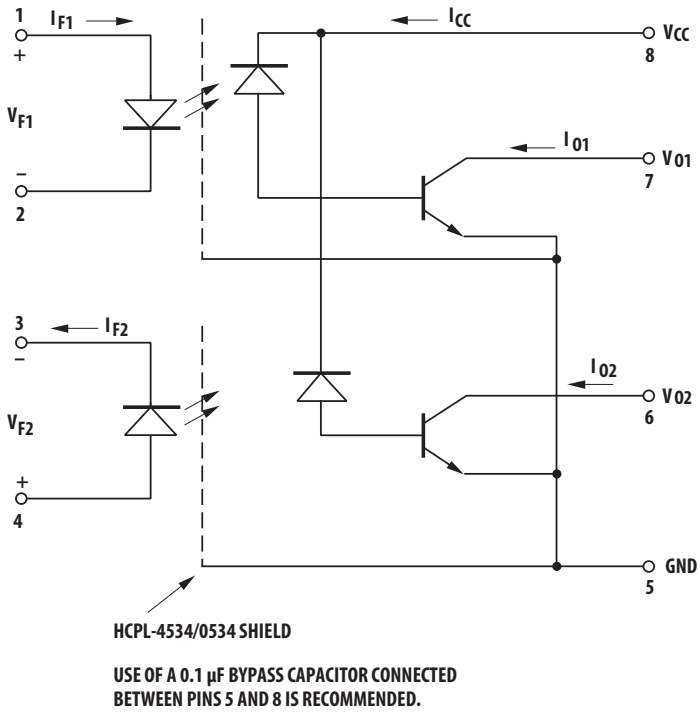
Example 2:

HCPL-2530 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.

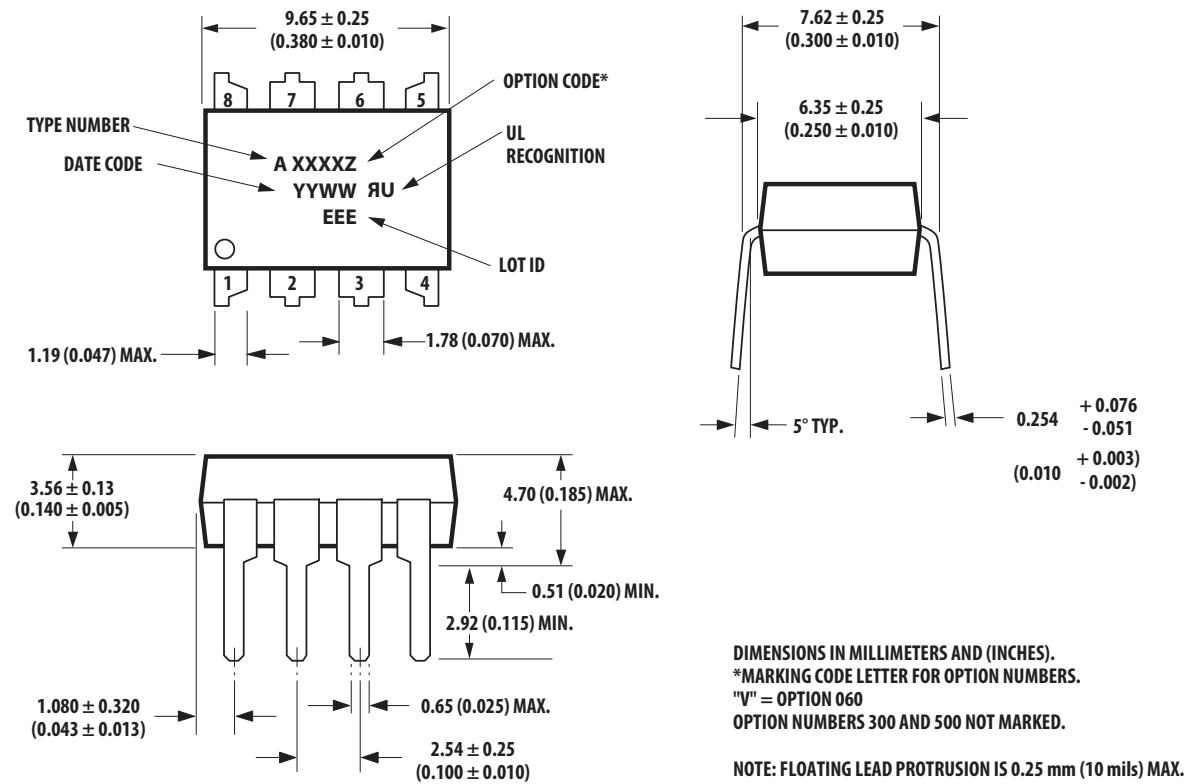
Remarks: The notation '#XXX' is used for existing products, while (new) products launched since 15th July 2001 and RoHS compliant option will use '-XXxE'.

Schematic



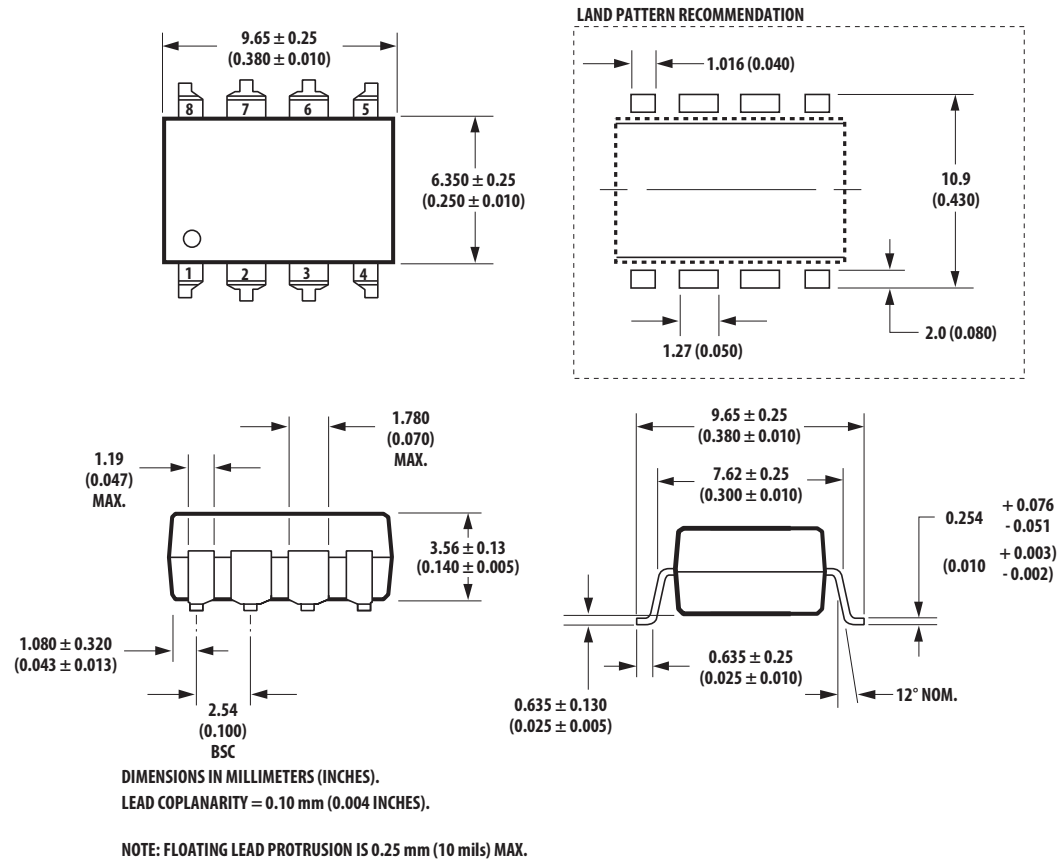
Package Outline Drawings

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

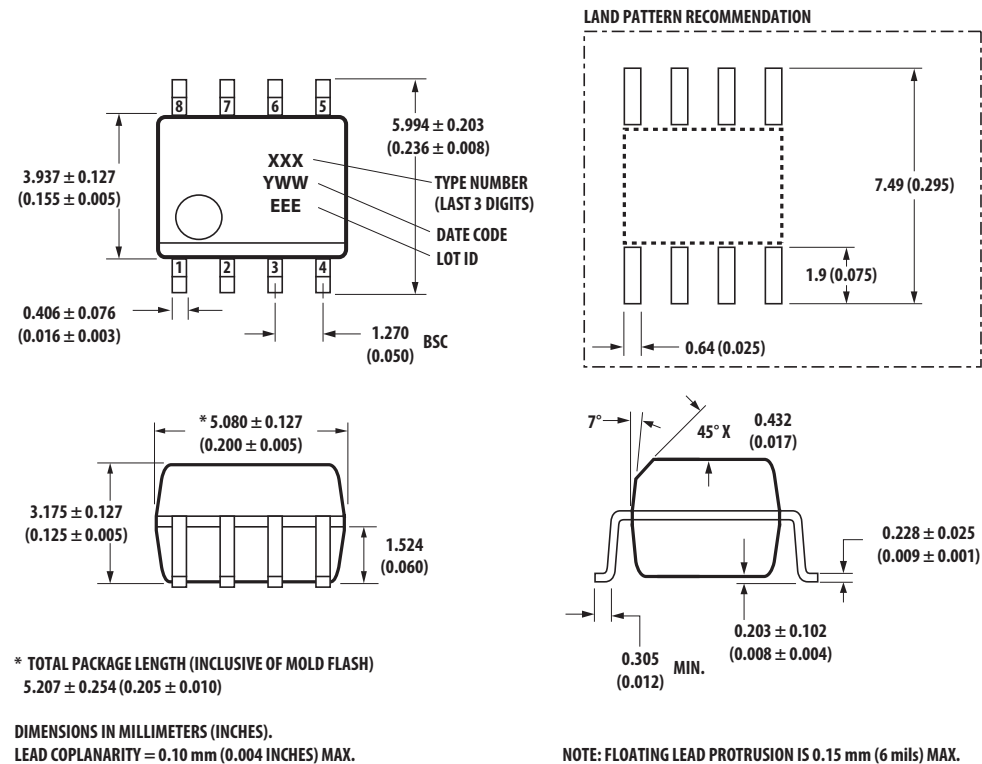


Package Outline Drawings, continued

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



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



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. |
| IEC/EN/DIN | IEC/EN/DIN EN 60747-5-5 Approved under: (Option 060 only) |

Insulation and Safety Related Specifications

| Parameter | Symbol | 8-Pin DIP (300 Mil) | SO-8 | Units | Conditions |
|---|--------|------------------------|-------|-------|--|
| | | Value | Value | | |
| 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. |
| 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.

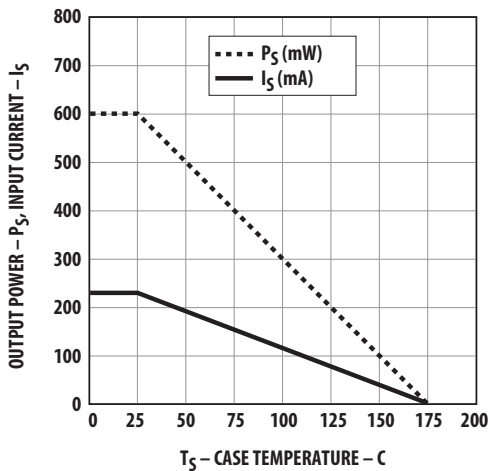
IEC/EN/DIN EN 60747-5-5 Insulation Characteristics (OPTION 060)

| Description | Symbol | Characteristic HCPL- | | Unit |
|---|-----------------|----------------------------|-----------------------------|------------|
| | | 2530/2531/4534 | 0530/0531/0534 | |
| Installation classification per DIN VDE 0110, Table 1 for rated mains voltage ≤ 150 Vrms for rated mains voltage ≤ 300 Vrms for rated mains voltage ≤ 600 Vrms | | I – IV I – IV I – IV | I – IV I – IV I – III | |
| Climatic Classification | | 0/70/21 | 0/70/21 | |
| Pollution Degree (DIN VDE 0110/39) | | 2 | 2 | |
| Maximum Working Insulation Voltage | V_{IORM} | 630 | 567 | V_{peak} |
| Input to Output Test Voltage, Method b* $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test $t_m=1$ sec, Partial discharge < 5 pC | V_{PR} | 1181 | 1063 | V_{peak} |
| Input to Output Test Voltage, Method a* $V_{IORM} \times 1.6 = V_{PR}$, Type and Sample Test, $t_m=10$ sec, Partial discharge < 5 pC | V_{PR} | 1008 | 907 | V_{peak} |
| Highest Allowable Overvoltage (Transient Overvoltage $t_{ini} = 60$ sec) | V_{IOTM} | 8000 | 6000 | V_{peak} |
| Safety-limiting values – max. values allowed in the event of a failure. | | | | |
| Case Temperature | T_S | 175 | 150 | °C |
| Input Current** | $I_{S, INPUT}$ | 230 | 230 | mA |
| Output Power** | $P_{S, OUTPUT}$ | 600 | 600 | mW |
| Insulation Resistance at $T_S, V_{IO} = 500$ V | R_S | $>10^9$ | $>10^9$ | Ω |

* Refer to the optocoupler section of the Isolation and Control Components Designer's Catalog, under Product Safety Regulations section, IEC/EN/DIN EN 60747-5-5, for a detailed description of Method a and Method b partial discharge test profiles.

** Refer to the following figure for dependence of P_S and I_S on ambient temperature.

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



Absolute Maximum Ratings

| Parameter | Symbol | Device | Min. | Max. | Units | Note |
|--|----------------|-----------|------|------|-------|------|
| Storage Temperature | T_S | | -55 | 125 | °C | |
| Operating Temperature | T_A | | -55 | 100 | °C | |
| Average Forward Input Current (each channel) | $I_{F(AVG)}$ | | | 25 | mA | |
| Peak Forward Input Current (each channel) (50% duty cycle, 1 ms pulse width) | $I_{F(PEAK)}$ | | | 50 | mA | |
| Peak Transient Input Current (each channel) ($\leq 1 \mu s$ pulse width, 300 pps) | $I_{F(TRANS)}$ | | | 1 | A | |
| Reverse LED Input Voltage (each channel) | V_R | | | 5 | V | |
| Input Power Dissipation (each channel) | P_{IN} | | | 45 | mW | |
| Average Output Current (each channel) | $I_{O(AVG)}$ | | | 8 | mA | |
| Peak Output Current | $I_{O(PEAK)}$ | | | 16 | mA | |
| Supply Voltage (Pin 8-5) | V_{CC} | | -0.5 | 30 | V | |
| Output Voltage (Pins 7-5, 6-5) | V_O | | -0.5 | 20 | V | |
| Output Power Dissipation (each channel) | P_O | | | 35 | mW | 13 |
| Lead Solder Temperature (Through-Hole Parts Only) 1.6 mm below seating plane, 10 seconds | T_{LS} | 8 Pin DIP | | 260 | °C | |

Electrical Specifications (DC)

Over recommended temperature ($T_A = 0^\circ\text{C}$ to 70°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 | % | $T_A = 25^\circ\text{C}$ | $I_F = 16\text{ mA}$, $V_{CC} = 4.5\text{ V}$ $V_O = 0.5\text{ V}$ | 1, 2 4 |
| | | HCPL-2531/ 0531 | 19 | 24 | 50 | % | $T_A = 25^\circ\text{C}$ | | |
| | | HCPL-4534/ 0534 | 15 | | | | | | |
| Logic Low Output Voltage | V_{OL} | HCPL-2530/ 0530 | | 0.1 | 0.5 | V | $T_A = 25^\circ\text{C}$ $I_O = 1.1\text{ mA}$ | $I_F = 16\text{ mA}$, $V_{CC} = 4.5\text{ V}$ | 1 |
| | | | | | 0.5 | | $I_O = 0.8\text{ mA}$ | | |
| | | HCPL-2531/ 0531 | | 0.1 | 0.5 | V | $T_A = 25^\circ\text{C}$ $I_O = 3.0\text{ mA}$ | | |
| | | HCPL-4534/ 0534 | | | | | $I_O = 2.4\text{ mA}$ | | |
| Logic High Output Current | I_{OH} | | | 0.003 | 0.5 | μA | $T_A = 25^\circ\text{C}$ $V_{CC} = V_O = 5.5\text{ V}$, $I_F = 0\text{ mA}$ | 6 | 1 |
| | | | | | 50 | | $T_A = 25^\circ\text{C}$ $V_{CC} = V_O = 15\text{ V}$, $I_F = 0\text{ mA}$ | | |
| Logic Low Supply Current | I_{CCL} | | | 100 | 400 | μA | $I_F = 16\text{ mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{ V}$ | | |
| Logic High Supply Current | I_{CCH} | | | 0.05 | 4 | μA | $I_F = 0\text{ mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{ V}$ | | |
| Input Forward Voltage | V_F | | | 1.5 | 1.7 | V | $T_A = 25^\circ\text{C}$ | 3 | 1 |
| | | | | | 1.8 | | $I_F = 16\text{ mA}$ | | |
| 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/ $^\circ\text{C}$ | $I_F = 16\text{ mA}$ | | |
| 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°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 | μs | $T_A = 25^\circ\text{C}$ | $R_L = 4.1\text{ k}\Omega$ | 5, 9, 11 | 6, 7 |
| | | 2531/0531/ 4534/0534 | | 0.2 | 0.8 | | $T_A = 25^\circ\text{C}$ | $R_L = 1.9\text{ k}\Omega$ | | |
| Propagation Delay Time High to Logic at Output | t_{PLH} | 2530/0530 | | 1.3 | 1.5 | μs | $T_A = 25^\circ\text{C}$ | $R_L = 4.1\text{ k}\Omega$ | 5, 9, 11 | 6, 7 |
| | | 2531/0531/ 4534/0534 | | 0.6 | 0.8 | | $T_A = 25^\circ\text{C}$ | $R_L = 1.9\text{ k}\Omega$ | | |
| Common Mode Transient Immunity at Logic High Level Output | $ CM_H $ | 2530/0530 | 1 | 10 | | $\text{kV}/\mu\text{s}$ | $R_L = 4.1\text{ k}\Omega$ | $I_F = 0\text{ mA}$, $T_A = 25^\circ\text{C}$, $V_{CM} = 10\text{ V}_{p-p}$ | 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 | | $\text{kV}/\mu\text{s}$ | $R_L = 4.1\text{ k}\Omega$ | $I_F = 0\text{ mA}$, $T_A = 25^\circ\text{C}$, $V_{CM} = 10\text{ V}_{p-p}$ | 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} | | 3750 | | | V_{rms} | $RH < 50\%$, $t = 1\text{ min.}$, | | 3, 10 |
| | | HCPL-2530/2531/ /4534 Option 020 | 5000 | | | | | | 3, 11 |
| Resistance (Input-Output) | R_{I-O} | | | 10^{12} | | Ω | $RH \leq 45\%$ $V_{I-O} = 500\text{ Vdc}$, $t = 5\text{ s}$ | | 3 |
| Capacitance (Input-Output) | C_{I-O} | | | 0.6 | | pF | $f = 1\text{ MHz}$, $T_A = 25^\circ\text{C}$ | | 12 |
| Input-Input Insulation Leakage Current | I_{I-I} | | | 0.005 | | μA | $RH \leq 45\%$, $t = 5\text{ s}$, $V_{I-I} = 500\text{ Vdc}$ | | 4 |
| Resistance (Input-Input) | R_{I-I} | | | 10^{11} | | Ω | | | 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 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," 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 Ω load represents 1 TTL unit load of 1.6 mA and the 5.6 k Ω pull-up resistor.
7. The 4.1 k Ω load represents 1 LSTTL unit load of 0.36 mA and the 6.1 k Ω 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 μF 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 $\geq 4500 V$ 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.

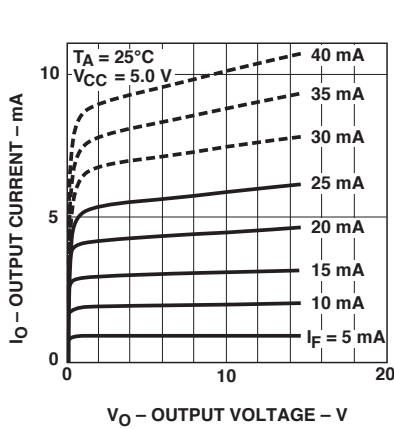


Figure 1. DC and pulsed transfer characteristics.

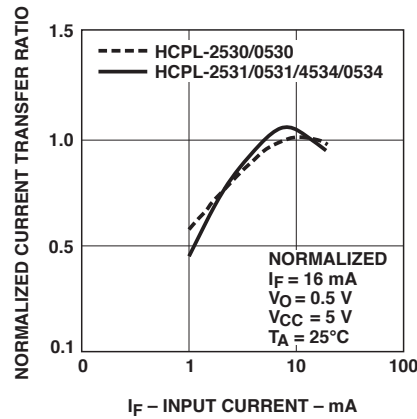


Figure 2. Current transfer ratio vs. input current.

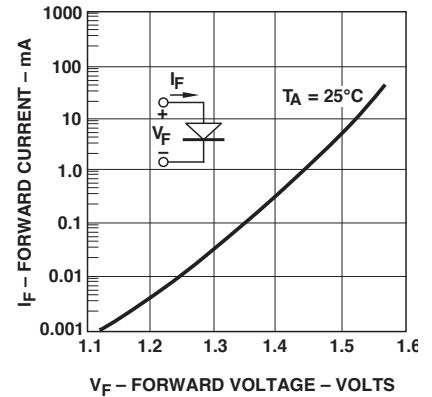


Figure 3. Input current vs. forward voltage.

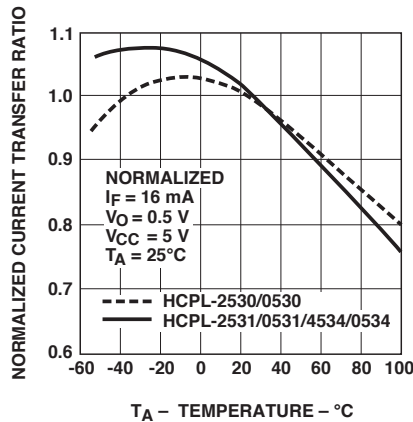


Figure 4. Current transfer ratio vs. temperature.

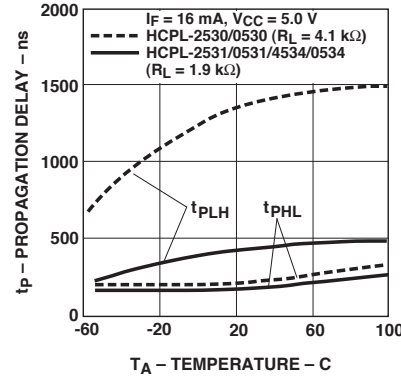


Figure 5. Propagation delay vs. temperature.

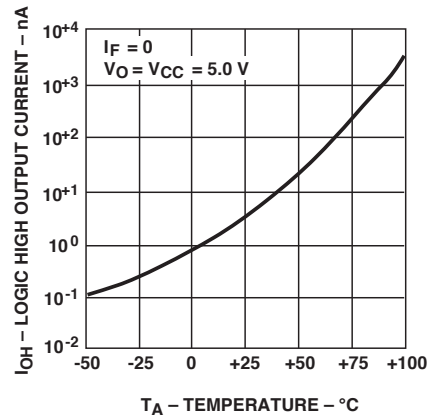


Figure 6. Logic high output current vs. temperature.

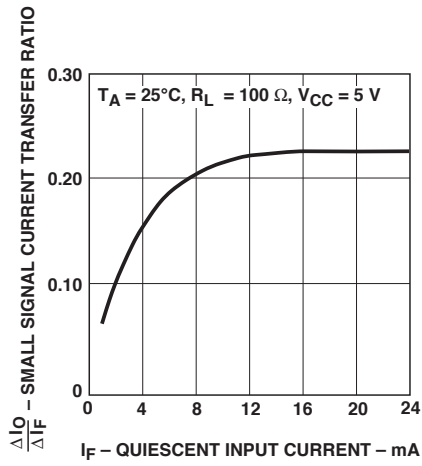


Figure 7. Small-signal current transfer ratio vs. quiescent input current.

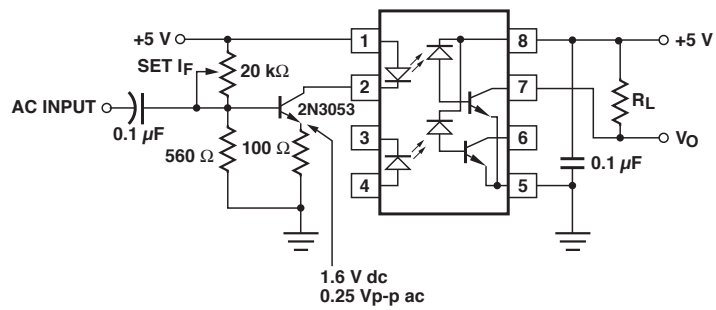
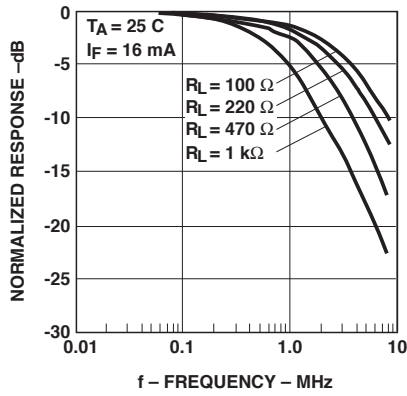


Figure 8. Frequency response.

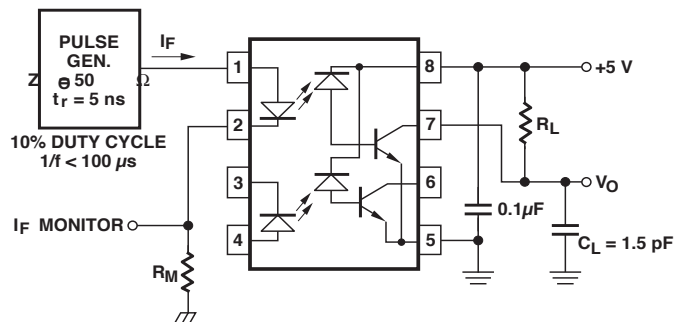
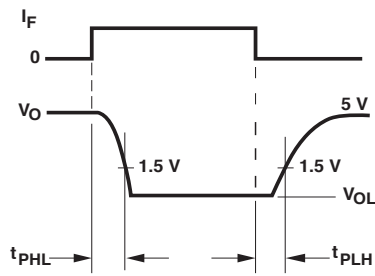


Figure 9. Switching test circuit.