

# HCPL0452, HCPL0453, HCPL0500, HCPL0501, HCPL0530, HCPL0531, HCPL0534 High Speed Transistor Optocouplers

Single Channel: HCPL0452 HCPL0453 HCPL0500 HCPL0501  
Dual Channel: HCPL0530 HCPL0531 HCPL0534

## Features

- High speed – 1 MBit/s
- 15kV/μs minimum common mode transient immunity at  $V_{CM} = 1500V$  (HCPL0453/0534)
- Open collector output
- Guaranteed performance over temperature: 0°C to 70°C
- U.L. recognized (File # E90700)
- VDE0884 recognized (file#136616)
  - approval pending for HCPL0530/0531/0453
  - ordering option V, e.g., HCPL0500V
- BSI recognized (file# 8661, 8662)
  - HCPL0452/0500/0501 only

## Applications

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

## Description

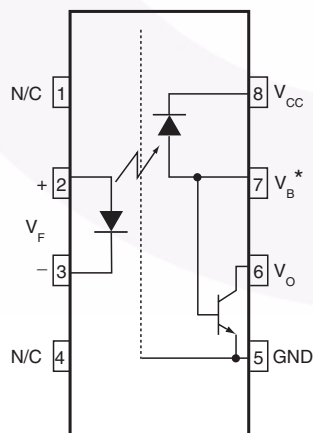
The HCPL05XX, and HCPL04XX optocouplers consist of an AlGaAs LED optically coupled to a high speed photo-detector transistor housed in a compact 8-pin small out-line package.

A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor. The HCPL04XX devices do not have the base bonded out to a lead for additional noise margin. The HCPL053X devices have two channels per package for optimum mounting density.

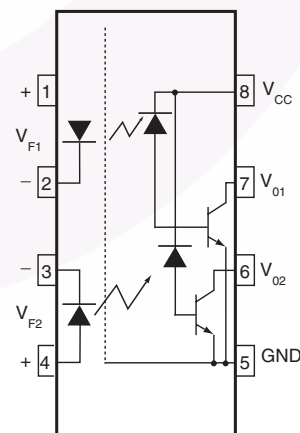
## Truth Table (positive Logic)

| LED | V <sub>O</sub> |
|-----|----------------|
| ON  | LOW            |
| OFF | HIGH           |

## Schematics



HCPL0500, HCPL0501  
\*BASE NOT CONNECTED  
FOR HCPL0452, HCPL0453



HCPL0530/HCPL0531/HCPL0534

# **Absolute Maximum Ratings** ( $T_A = 25^{\circ}\text{C}$ unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol           | Parameter                                                           | Value       | Units              |
|------------------|---------------------------------------------------------------------|-------------|--------------------|
| $T_{\text{STG}}$ | Storage Temperature                                                 | -40 to +125 | $^{\circ}\text{C}$ |
| $T_{\text{OPR}}$ | Operating Temperature                                               | -40 to +85  | $^{\circ}\text{C}$ |
|                  | Reflow Temperature Profile (Refer to page 11)                       |             |                    |
| <b>EMITTER</b>   |                                                                     |             |                    |
| $I_F$ (avg)      | DC/Average Forward Input Current                                    | 25          | mA                 |
| $I_F$ (pk)       | Peak Forward Input Current (50% duty cycle, 1ms P.W.)               | 50          | mA                 |
| $I_F$ (trans)    | Peak Transient Input Current - ( $\leq 1\mu\text{s}$ P.W., 300 pps) | 1.0         | A                  |
| $V_R$            | Reverse Input Voltage                                               | 5           | V                  |
| $P_D$            | Input Power Dissipation                                             | 45          | mW                 |
| <b>DETECTOR</b>  |                                                                     |             |                    |
| $I_O$ (avg)      | Average Output Current (Pin 6)                                      | 8           | mA                 |
| $I_O$ (pk)       | Peak Output Current                                                 | 16          | mA                 |
| $V_{\text{EBR}}$ | Emitter-Base Reverse Voltage (HCPL0500/HCPL0501 only)               | 5           | V                  |
| $V_{\text{CC}}$  | Supply Voltage                                                      | -0.5 to 30  | V                  |
| $V_O$            | Output Voltage                                                      | -0.5 to 20  | V                  |
| $I_B$            | Base Current (HCPL0500/HCPL0501 only)                               | 5           | mA                 |
| $P_D$            | Output power dissipation                                            | 100         | mW                 |

## Electrical Characteristics ( $T_A = 0$ to $70^\circ\text{C}$ unless otherwise specified)

### Individual Component Characteristics

| Symbol                    | Parameter                                  | Test Conditions                                                                             | Device            | Min. | Typ.* | Max. | Unit                 |
|---------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------|-------------------|------|-------|------|----------------------|
| <b>EMITTER</b>            |                                            |                                                                                             |                   |      |       |      |                      |
| $V_F$                     | Input Forward Voltage                      | $I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$                                              | All               |      | 1.45  | 1.7  | V                    |
|                           |                                            | $I_F = 16\text{mA}$                                                                         |                   |      |       | 1.8  |                      |
| $BV_R$                    | Input Reverse Breakdown Voltage            | $I_R = 10\mu\text{A}$                                                                       | All               | 5.0  |       |      | V                    |
| $\Delta V_F / \Delta T_A$ | Temperature Coefficient of Forward Voltage | $I_F = 16\text{mA}$                                                                         | All               |      | -1.6  |      | mV/ $^\circ\text{C}$ |
| <b>DETECTOR</b>           |                                            |                                                                                             |                   |      |       |      |                      |
| $I_{OH}$                  | Logic High Output Current                  | $I_F = 0\text{mA}$ , $V_O = V_{CC} = 5.5\text{V}$ , $T_A = 25^\circ\text{C}$                | All               |      | 0.001 | 0.5  | $\mu\text{A}$        |
|                           |                                            | $I_F = 0\text{mA}$ , $V_O = V_{CC} = 15\text{V}$ , $T_A = 25^\circ\text{C}$                 | All               |      | 0.005 | 1    |                      |
|                           |                                            | $I_F = 0\text{mA}$ , $V_O = V_{CC} = 15\text{V}$                                            | All               |      |       | 50   |                      |
| $I_{CCL}$                 | Logic Low Supply Current                   | $I_F = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$                           | HCPL0452/3/0500/1 |      | 120   | 200  | $\mu\text{A}$        |
|                           |                                            |                                                                                             | HCPL0530/1/4      |      |       | 400  |                      |
| $I_{CCH}$                 | Logic High Supply Current                  | $I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$ , $T_A = 25^\circ\text{C}$ | All               |      | 0.01  | 1    | $\mu\text{A}$        |
|                           |                                            | $I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{V}$                            | HCPL0452/3/0500/1 |      |       | 2    |                      |
|                           |                                            |                                                                                             | HCPL0530/1/4      |      |       | 4    |                      |

### Transfer Characteristics

| Symbol         | Parameter                       | Test Conditions                                                                                | Device          | Min. | Typ.* | Max. | Unit |
|----------------|---------------------------------|------------------------------------------------------------------------------------------------|-----------------|------|-------|------|------|
| <b>COUPLED</b> |                                 |                                                                                                |                 |      |       |      |      |
| CTR            | Current Transfer Ratio (Note 1) | $I_F = 16\text{mA}$ , $V_O = 0.4\text{V}$ , $V_{CC} = 4.5\text{V}$ , $T_A = 25^\circ\text{C}$  | HCPL0500/0530   | 7    | 2.7   | 50   | %    |
|                |                                 |                                                                                                | HCPL0452/3      | 19   | 27    | 50   |      |
|                |                                 |                                                                                                | HCPL0501/0531   |      |       |      |      |
|                |                                 | $I_F = 16\text{mA}$ , $V_O = 0.5\text{V}$ , $V_{CC} = 4.5\text{V}$                             | HCPL0500        | 5    | 30    |      |      |
|                |                                 |                                                                                                | HCPL0452/3      | 15   | 30    |      |      |
|                |                                 |                                                                                                | HCPL0501/0534   |      |       |      |      |
| $V_{OL}$       | Logic Low Output Voltage        | $I_F = 16\text{mA}$ , $I_O = 1.1\text{mA}$ , $V_{CC} = 4.5\text{V}$ , $T_A = 25^\circ\text{C}$ | HCPL0500        |      | 0.18  | 0.4  | V    |
|                |                                 |                                                                                                | HCPL0530        |      |       | 0.5  |      |
|                |                                 | $I_F = 16\text{mA}$ , $I_O = 3\text{mA}$ , $V_{CC} = 4.5\text{V}$ , $T_A = 25^\circ\text{C}$   | HCPL0452/3      |      | 0.25  | 0.4  |      |
|                |                                 |                                                                                                | HCPL0501/0531/4 |      |       |      |      |
|                |                                 | $I_F = 16\text{mA}$ , $I_O = 0.8\text{mA}$ , $V_{CC} = 4.5\text{V}$                            | HCPL0500        |      | 0.13  | 0.5  |      |
|                |                                 |                                                                                                | HCPL0530        |      |       |      |      |
|                |                                 | $I_F = 16\text{mA}$ , $I_O = 2.4\text{mA}$ , $V_{CC} = 4.5\text{V}$                            | HCPL0452/3      |      | 0.23  | 0.5  |      |
|                |                                 |                                                                                                | HCPL0501/0531/4 |      |       |      |      |

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

# **Electrical Characteristics** (Continued) ( $T_A = 0$ to $70^\circ\text{C}$ unless otherwise specified)

## **Switching Characteristics** $V_{CC} = 5\text{V}$

| Symbol     | Parameter                                    | Test Conditions                                                                                                       | Device          | Min.   | Typ.*  | Max. | Unit                   |
|------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------|--------|--------|------|------------------------|
| $T_{PHL}$  | Propagation Delay Time to Logic LOW          | $T_A = 25^\circ\text{C}$ , $R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}$ (Note 2) (Fig. 9)                          | HCPL0500/0530   |        | 0.45   | 1.5  | $\mu\text{s}$          |
|            |                                              | $R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$ (Note 3) (Fig. 9)                          | HCPL0452/3      |        | 0.45   | 0.8  |                        |
|            |                                              |                                                                                                                       | HCPL0501/0531/4 |        |        |      |                        |
|            |                                              | $R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}$ (Note 2) (Fig. 9)                                                     | HCPL0500/0530   |        |        | 2.0  |                        |
| $T_{PLH}$  | Propagation Delay Time to Logic HIGH         | $T_A = 25^\circ\text{C}$ , $R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}$ (Note 2) (Fig. 9)                          | HCPL0500/0530   |        | 0.5    | 1.5  | $\mu\text{s}$          |
|            |                                              | $R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$ (Note 3) (Fig. 9)                          | HCPL0452/3      |        | 0.3    | 0.8  |                        |
|            |                                              |                                                                                                                       | HCPL0501/0531/4 |        |        |      |                        |
|            |                                              | $R_L = 4.1\text{k}\Omega$ , $I_F = 16\text{mA}$ (Note 2) (Fig. 9)                                                     | HCPL0500/0530   |        |        | 2.0  |                        |
| $ICM_{HI}$ | Common Mode Transient Immunity at Logic HIGH | $I_F = 0\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}$ (Note 4) (Fig. 10)   | HCPL0500        | 1,000  | 10,000 |      | $\text{V}/\mu\text{s}$ |
|            |                                              |                                                                                                                       | HCPL0530        |        |        |      |                        |
|            |                                              | $I_F = 0\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 1.9\text{k}\Omega$ , $T_A = 25^\circ\text{C}$ , (Note 4) (Fig. 10) | HCPL0452        | 1,000  | 10,000 |      |                        |
|            |                                              |                                                                                                                       | HCPL0501/31     |        |        |      |                        |
| $ICM_{LI}$ | Common Mode Transient Immunity at Logic LOW  | $I_F = 16\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}$ (Note 4) (Fig. 10)  | HCPL0500        | 1,000  | 10,000 |      | $\text{V}/\mu\text{s}$ |
|            |                                              |                                                                                                                       | HCPL0530        |        |        |      |                        |
|            |                                              | $I_F = 16\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 1.9\text{k}\Omega$ (Note 4) (Fig. 10)                             | HCPL0452        | 1,000  | 10,000 |      |                        |
|            |                                              |                                                                                                                       | HCPL0501/31     |        |        |      |                        |
| $ICM_{LI}$ | Common Mode Transient Immunity at Logic LOW  | $I_F = 16\text{mA}$ , $V_{CM} = 10V_{P-P}$ , $R_L = 1.9\text{k}\Omega$ (Note 4) (Fig. 10)                             | HCPL0534        | 15,000 | 40,000 |      | $\text{V}/\mu\text{s}$ |
|            |                                              |                                                                                                                       | HCPL0453        | 15,000 | 40,000 |      |                        |
|            |                                              | $I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$ , $V_{CM} = 1500V_{P-P}$ , $C_L = 15\text{pF}$ (Note 4) (Fig. 10)      | HCPL0453        | 15,000 | 40,000 |      |                        |
|            |                                              |                                                                                                                       | HCPL0453        | 15,000 | 40,000 |      |                        |

## **Isolation Characteristics**

| Symbol    | Characteristics                | Test Conditions                                                                      | Min.      | Typ.* | Max . | Unit        |
|-----------|--------------------------------|--------------------------------------------------------------------------------------|-----------|-------|-------|-------------|
| $V_{ISO}$ | Input-Output Isolation Voltage | $f = 60\text{ Hz}$ , $t = 1.0\text{ min.}$ , $I_{I-O} \leq 2\mu\text{A}$ (Note 5, 6) | 2500      |       |       | $V_{acRMS}$ |
| $R_{ISO}$ | Isolation Resistance           | $V_{I-O} = 500\text{V}$ (Note 5)                                                     | $10^{11}$ |       |       |             |
| $C_{ISO}$ | Isolation Capacitance          | $V_{I-O} = 0$ , $f = 1.0\text{MHz}$ (Note 5)                                         |           | 0.2   |       | $\text{pF}$ |

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

**Notes**

1. Current Transfer Ratio is designed as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$  times 100%.
2. The 4.1 k $\Omega$  load represents 1 LSTTL unit load of 0.36 mA and 6.1k $\Omega$  pull-up resistor.
3. The 1.9 k $\Omega$  load represents 1 TTL unit load of 1.6 mA and 5.6 k $\Omega$  pull-up resistor.
4. Common mode transient immunity in logic high level is the maximum tolerable (positive)  $dV_{cm}/dt$  on the leading edge of the common mode pulse signal  $V_{CM}$ , to assure that the output will remain in a logic high state (i.e.,  $V_O > 2.0$  V). Common mode transient immunity in logic low level is the maximum tolerable (negative)  $dV_{cm}/dt$  on the trailing edge of the common mode pulse signal,  $V_{CM}$ , to assure that the output will remain in a logic low state (i.e.,  $V_O < 0.8$  V).
5. Device is considered a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
6. 2500 VAC RMS for 1 minute duration is equivalent to 3000 VAC RMS for 1 second duration.

## Typical Performance Curves

Fig. 1 Normalized CTR vs. Forward Current

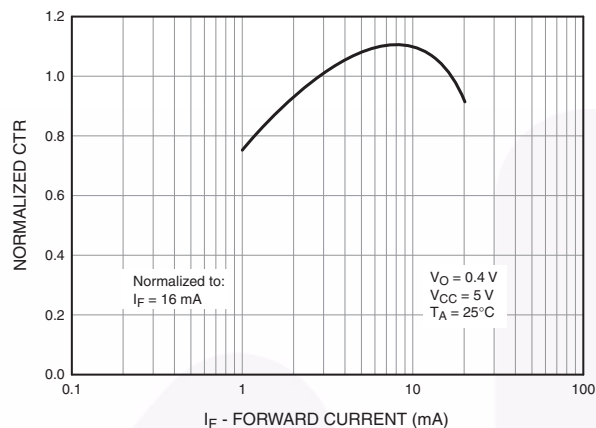


Fig. 2 Normalized CTR vs. Temperature

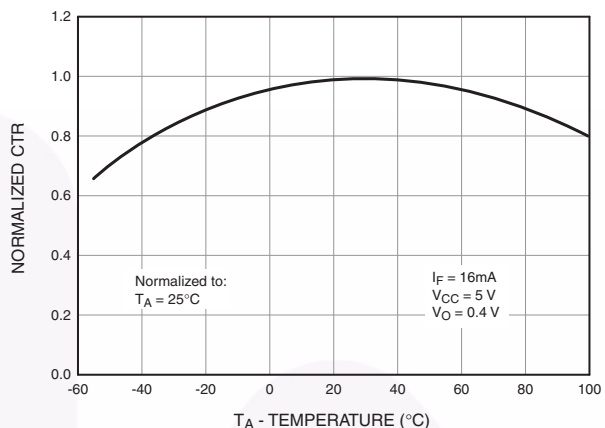


Fig. 3 Output Current vs. Output Voltage

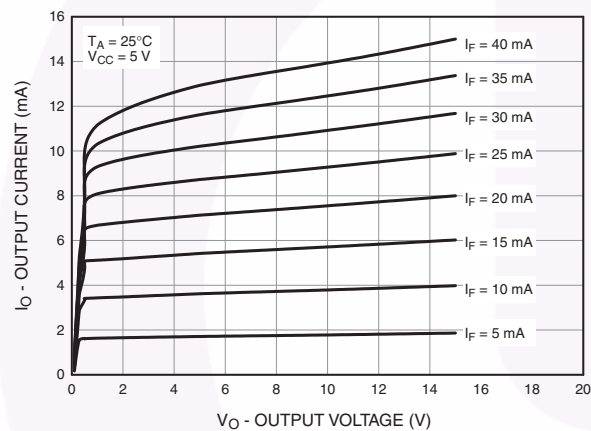


Fig. 4 Logic High Output Current vs. Temperature

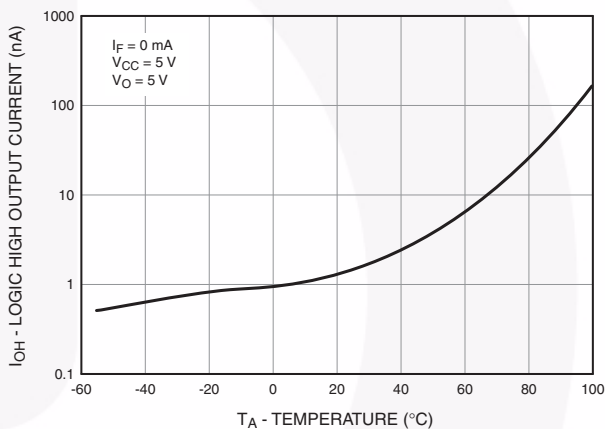


Fig. 5 Propagation Delay vs. Temperature

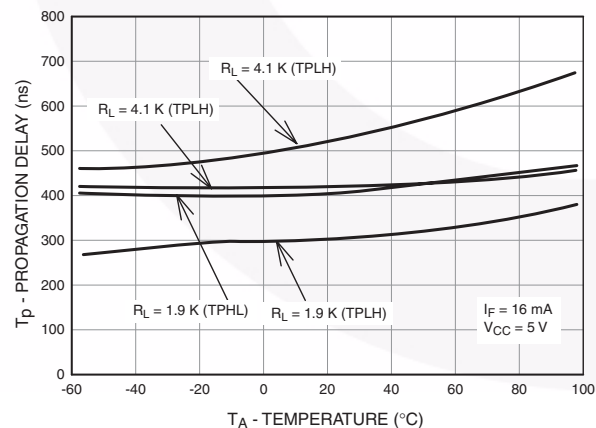
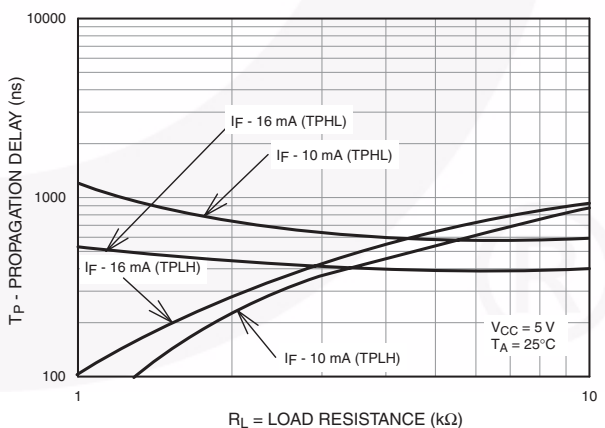
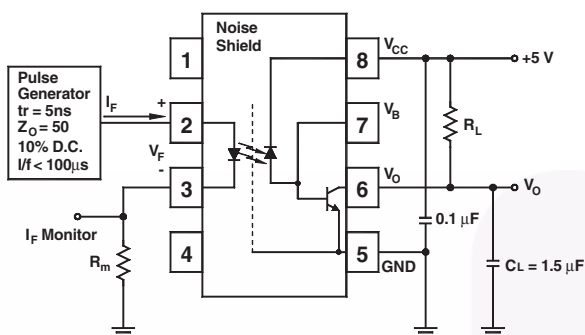
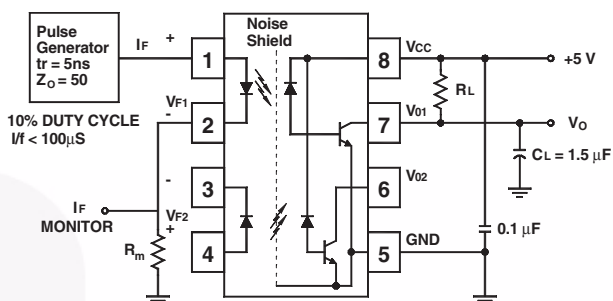


Fig. 6 Propagation Delay vs. Load Resistance





Test Circuit for HCPL0452, HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0530, HCPL0531 and HCPL0534

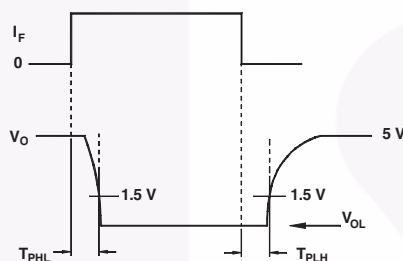
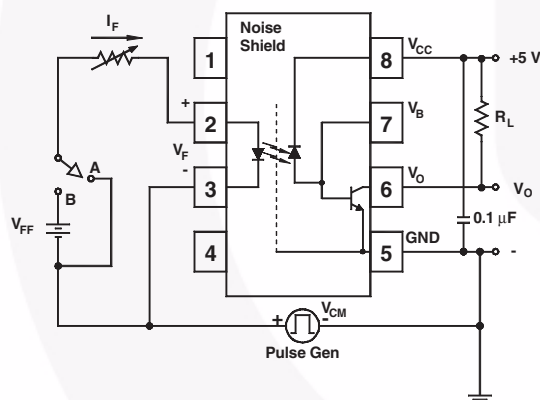
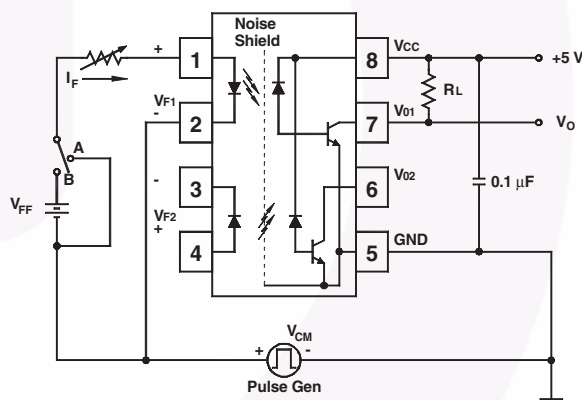


Fig. 7 Switching Time Test Circuit



Test Circuit for HCPL0452, HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0530, HCPL0531 and HCPL0534

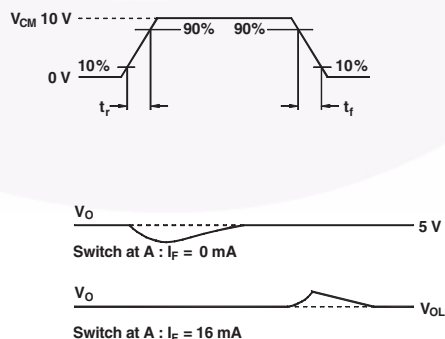
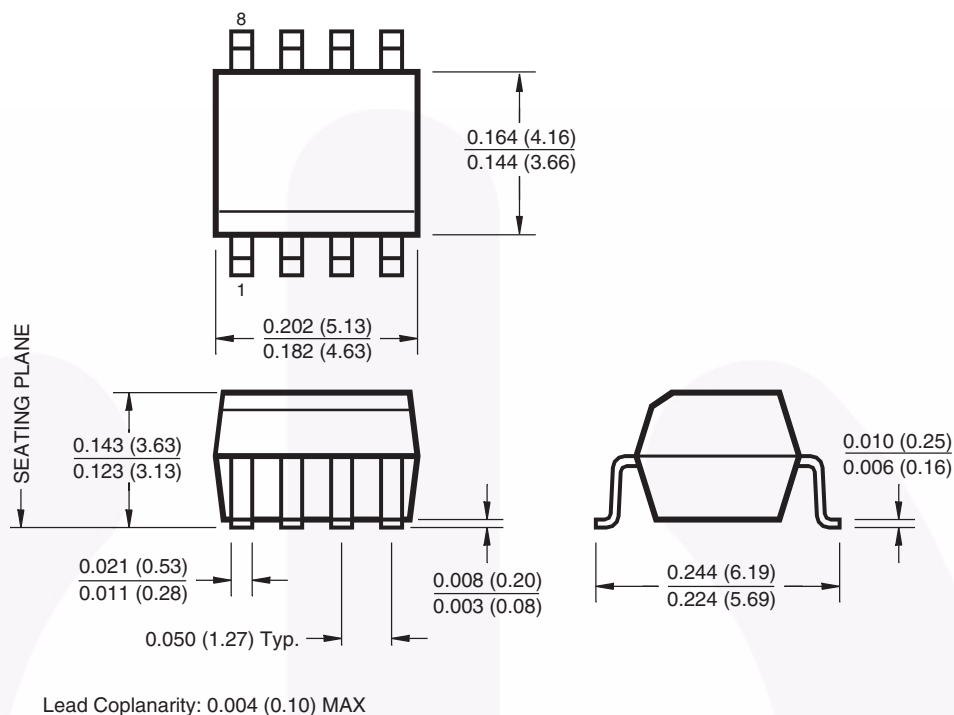


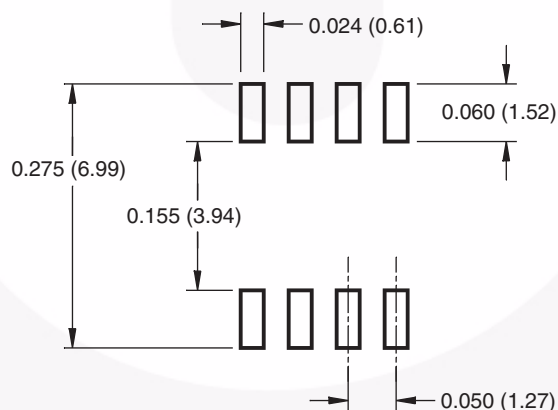
Fig. 8 Common Mode Immunity Test Circuit

## Package Dimensions

### 8-pin SOIC Surface Mount



### Recommended Pad Layout



Dimensions in inches (mm).

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

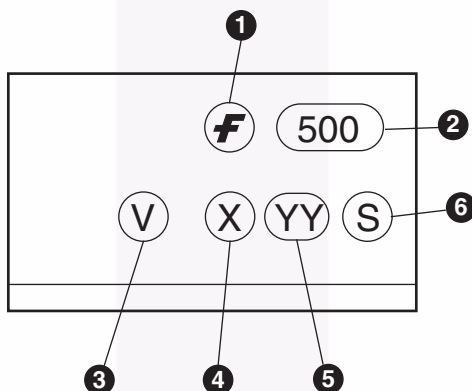
<http://www.fairchildsemi.com/packaging/>



## Ordering Information

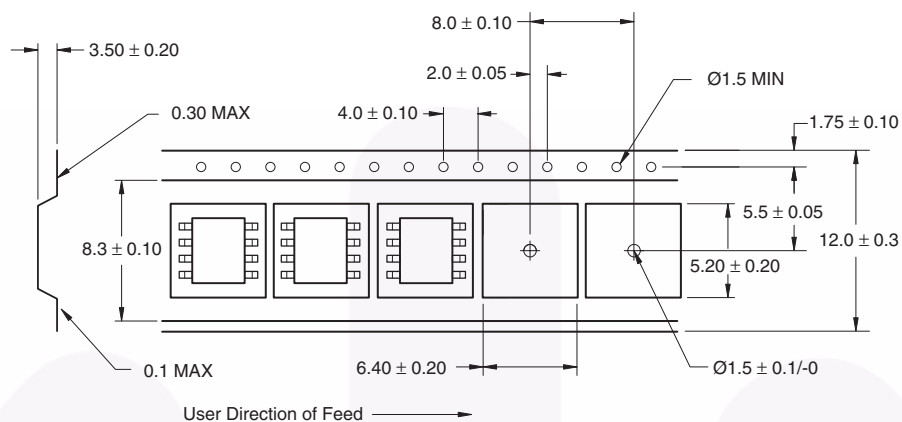
| Option | Order Entry Identifier | Description                                                                                           |
|--------|------------------------|-------------------------------------------------------------------------------------------------------|
| V      | V                      | VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534)                                         |
| R2     | R2                     | Tape and reel (2500 units per reel)                                                                   |
| R2V    | R2V                    | VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534),<br>Tape and reel (2500 units per reel) |

## Marking Information

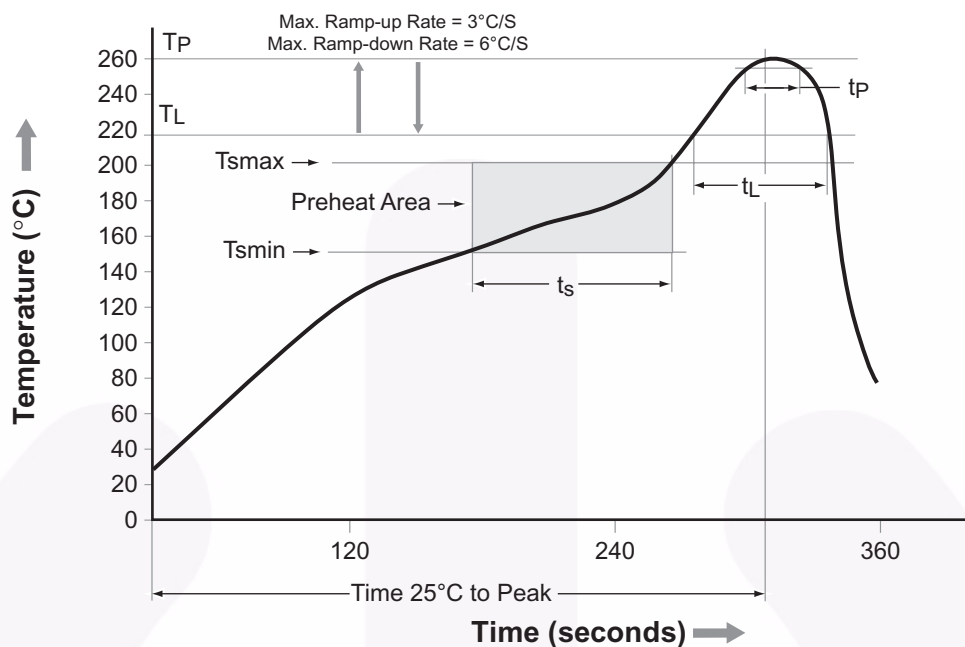


| Definitions |                                                                                        |
|-------------|----------------------------------------------------------------------------------------|
| 1           | Fairchild logo                                                                         |
| 2           | Device number                                                                          |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | One digit year code, e.g., '3'                                                         |
| 5           | Two digit work week ranging from '01' to '53'                                          |
| 6           | Assembly package code                                                                  |

## Carrier Tape Specifications



## Reflow Profile



| Profile Feature                                                       | Pb-Free Assembly Profile |
|-----------------------------------------------------------------------|--------------------------|
| Temperature Min. (T <sub>smin</sub> )                                 | 150°C                    |
| Temperature Max. (T <sub>smax</sub> )                                 | 200°C                    |
| Time (t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> ) | 60–120 seconds           |
| Ramp-up Rate (t <sub>L</sub> to t <sub>p</sub> )                      | 3°C/second max.          |
| Liquidous Temperature (T <sub>L</sub> )                               | 217°C                    |
| Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )             | 60–150 seconds           |
| Peak Body Package Temperature                                         | 260°C +0°C / -5°C        |
| Time (t <sub>p</sub> ) within 5°C of 260°C                            | 30 seconds               |
| Ramp-down Rate (T <sub>p</sub> to T <sub>L</sub> )                    | 6°C/second max.          |
| Time 25°C to Peak Temperature                                         | 8 minutes max.           |



## TRADEMARKS

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|                                                                                      |                                                                                            |                                                                                                    |                                                                                             |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Auto-SPM™                                                                            | F-PFS™                                                                                     | PowerTrench®                                                                                       | The Power Franchise®                                                                        |
| Build it Now™                                                                        | FRFET®                                                                                     | PowerXS™                                                                                           | the power franchise                                                                         |
| CorePLUS™                                                                            | Global Power Resource™                                                                     | Programmable Active Droop™                                                                         | TinyBoost™                                                                                  |
| CorePOWER™                                                                           | Green FPS™                                                                                 | QFET®                                                                                              | TinyBuck™                                                                                   |
| CROSSVOLT™                                                                           | Green FPS™ e-Series™                                                                       | QS™                                                                                                | TinyLogic®                                                                                  |
| CTL™                                                                                 | Gmax™                                                                                      | Quiet Series™                                                                                      | TINYOPTO™                                                                                   |
| Current Transfer Logic™                                                              | GTO™                                                                                       | RapidConfigure™                                                                                    | TinyPower™                                                                                  |
| EcoSPARK®                                                                            | IntelliMAX™                                                                                |  TM               | TinyPWM™                                                                                    |
| EfficientMax™                                                                        | ISOPLANAR™                                                                                 | Saving our world, 1mW/W/kW at a time™                                                              | TinyWire™                                                                                   |
| EZSWITCH™*                                                                           | MegaBuck™                                                                                  | SmartMax™                                                                                          | TriFault Detect™                                                                            |
|  ™* | MICROCOUPLER™                                                                              | SMART START™                                                                                       | TRUECURRENT™*                                                                               |
|  ®  | MicroFET™                                                                                  | SPM®                                                                                               | µSerDes™                                                                                    |
| Fairchild®                                                                           | MicroPak™                                                                                  | STEALTH™                                                                                           |  SerDes® |
| Fairchild Semiconductor®                                                             | MillerDrive™                                                                               | SuperFET™                                                                                          | UHC®                                                                                        |
| FACT Quiet Series™                                                                   | MotionMax™                                                                                 | SuperSOT™-3                                                                                        | Ultra FRFET™                                                                                |
| FACT®                                                                                | Motion-SPM™                                                                                | SuperSOT™-6                                                                                        | UniFET™                                                                                     |
| FAST®                                                                                | OPTOLOGIC®                                                                                 | SuperSOT™-8                                                                                        | VCX™                                                                                        |
| FAST®                                                                                | OPTOPLANAR®                                                                                | SupreMOS™                                                                                          | VisualMax™                                                                                  |
| FastvCore™                                                                           |  PDP SPM™ | SyncFET™                                                                                           | XS™                                                                                         |
| FETBench™                                                                            | Power-SPM™                                                                                 | Sync-Lock™                                                                                         |                                                                                             |
| FlashWriter®*                                                                        |                                                                                            |  SYSTEM GENERAL®* |                                                                                             |
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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
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Rev. 140

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