



# 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/ $\mu$ s 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

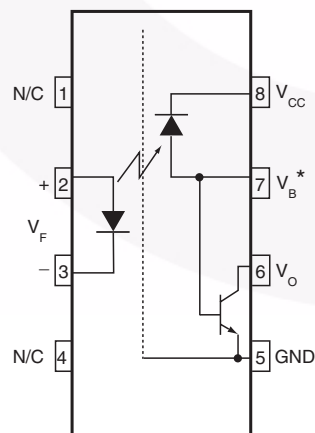
The HCPL05XX, and HCPL04XX optocouplers consist of an AlGaAs LED optically coupled to a high speed photodiode transistor housed in a compact 8-pin small out-line package.

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.

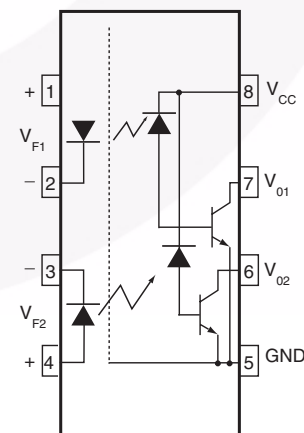
## Truth Table (positive Logic)

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
$T_{STG}$	Storage Temperature	-40 to +125	$^\circ\text{C}$
$T_{OPR}$	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
$V_{EBR}$	Emitter-Base Reverse Voltage (HCPL0500/HCPL0501 only)	5	V
$V_{CC}$	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	$\mu\text{A}$
			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**  $T_{V_{CC}} = 5\text{V}$ 

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
$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}$ (Note 3) (Fig. 9)	HCPL0452/3				1.0		
	HCPL0501/0531/4						
$T_{PLH}$	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
$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}$ (Note 3) (Fig. 9)	HCPL0452/3				1.0		
	HCPL0501/0531/4						
$ICM_{HI}$	Common Mode Transient Immunity at Logic HIGH	$I_F = 0\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}$ (Note 4) (Fig. 10)	HCPL0500	1,000	10,000		$\text{V}/\mu\text{s}$
			HCPL0530				
		$I_F = 0\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 1.9\text{k}\Omega$ , $T_A = 25^\circ\text{C}$ , (Note 4) (Fig. 10)	HCPL0452	1,000	10,000		
			HCPL0501/31				
HCPL0534	15,000	40,000					
$I_F = 16\text{mA}$ , $V_{CM} = 1500\text{V}_{P-P}$ , $R_L = 1.9\Omega$ , $T_A = 25^\circ\text{C}$ (Note 4) (Fig. 10)	HCPL0453	15,000	40,000				
$ICM_{LI}$	Common Mode Transient Immunity at Logic LOW	$I_F = 16\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}$ (Note 4) (Fig. 10)	HCPL0500	1,000	10,000		$\text{V}/\mu\text{s}$
			HCPL0530				
		$I_F = 16\text{mA}$ , $V_{CM} = 10\text{V}_{P-P}$ , $R_L = 1.9\text{k}\Omega$ (Note 4) (Fig. 10)	HCPL0452	1,000	10,000		
			HCPL0501/31				
HCPL0534	15,000	40,000					
$I_F = 16\text{mA}$ , $T_A = 25^\circ\text{C}$ , $V_{CM} = 1500\text{V}_{P-P}$ , $C_L = 15\text{pF}$ (Note 4) (Fig. 10)	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			$V_{ac_{RMS}}$
$R_{ISO}$	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		$\text{pF}$

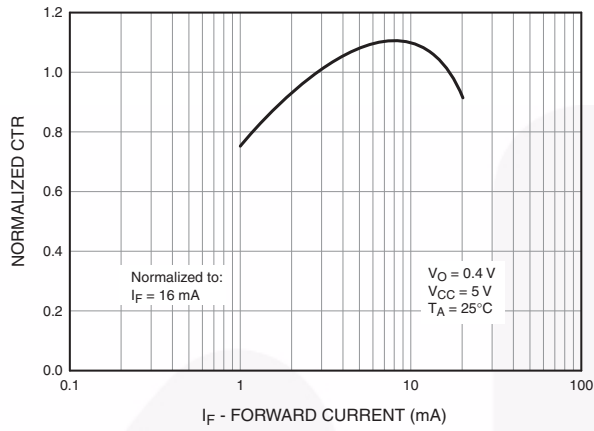
 \*All typicals at  $T_A = 25^\circ\text{C}$

**Notes**

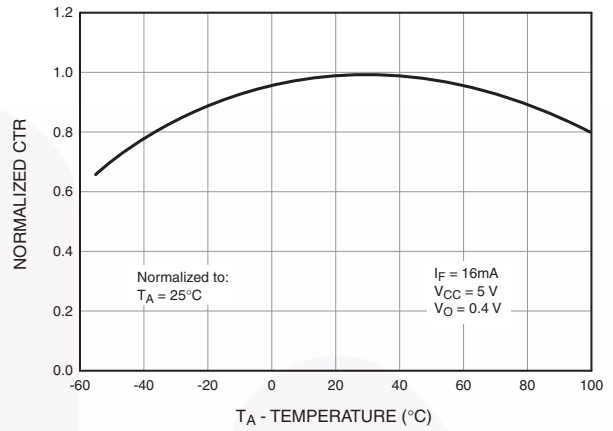
1. Current Transfer Ratio is designed as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$  times 100%.
2. The 4.1 k $\Omega$  load represents 1 LSTTL unit load of 0.36 mA and 6.1k $\Omega$  pull-up resistor.
3. The 1.9 k $\Omega$  load represents 1 TTL unit load 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

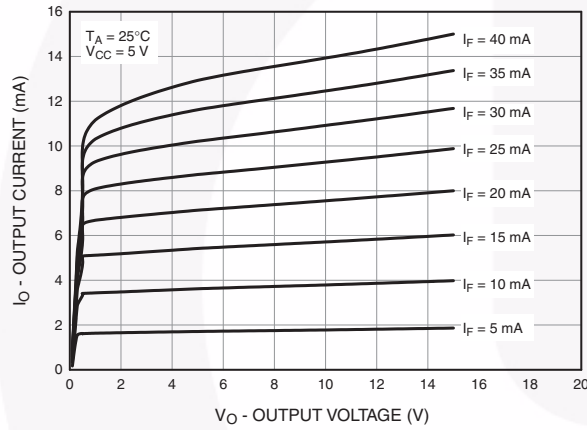
**Fig. 1 Normalized CTR vs. Forward Current**



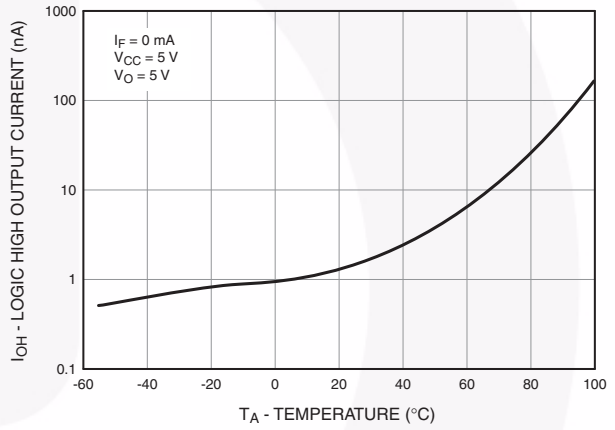
**Fig. 2 Normalized CTR vs. Temperature**



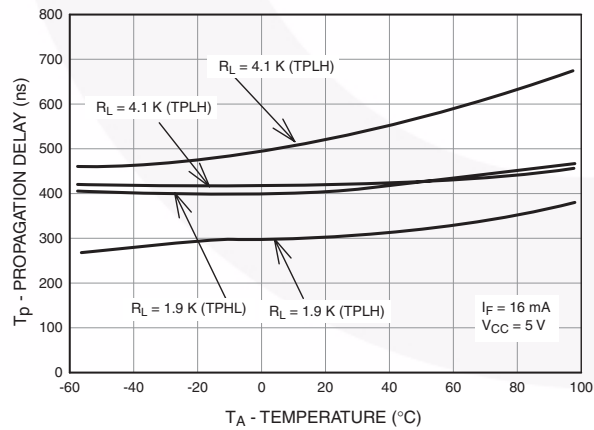
**Fig. 3 Output Current vs. Output Voltage**



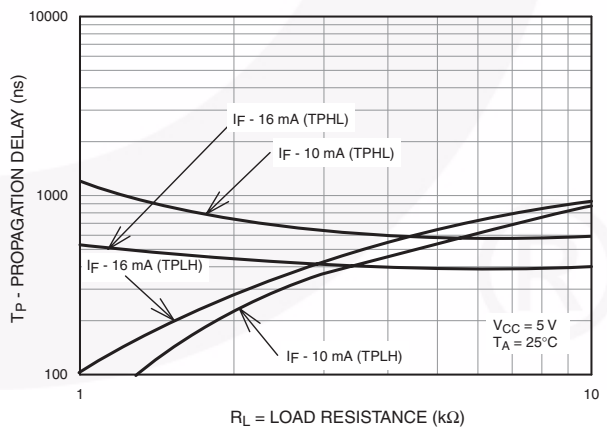
**Fig. 4 Logic High Output Current vs. Temperature**

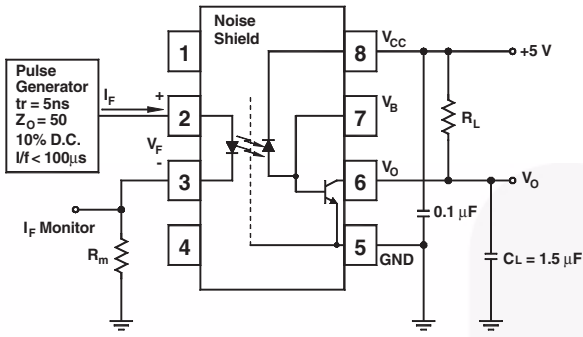


**Fig. 5 Propagation Delay vs. Temperature**

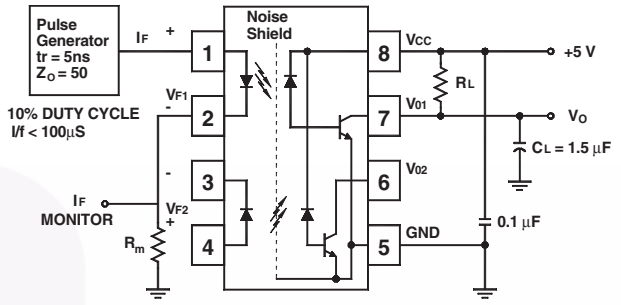


**Fig. 6 Propagation Delay vs. Load Resistance**





Test Circuit for HCPL0452, HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0530, HCPL0531 and HCPL0534

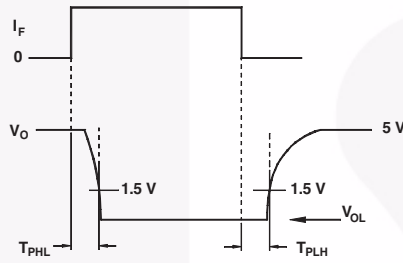
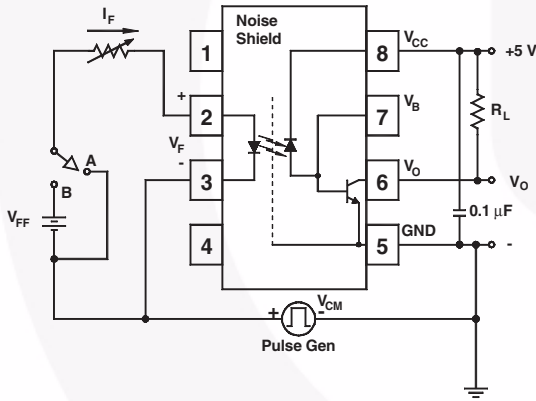
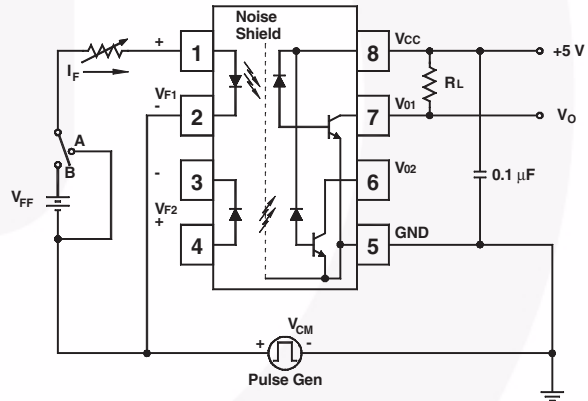


Fig. 7 Switching Time Test Circuit



Test Circuit for HCPL0452, HCPL0453, HCPL0500 and HCPL0501



Test Circuit for HCPL0530, HCPL0531 and HCPL0534

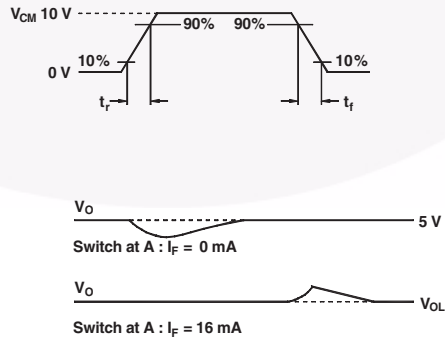
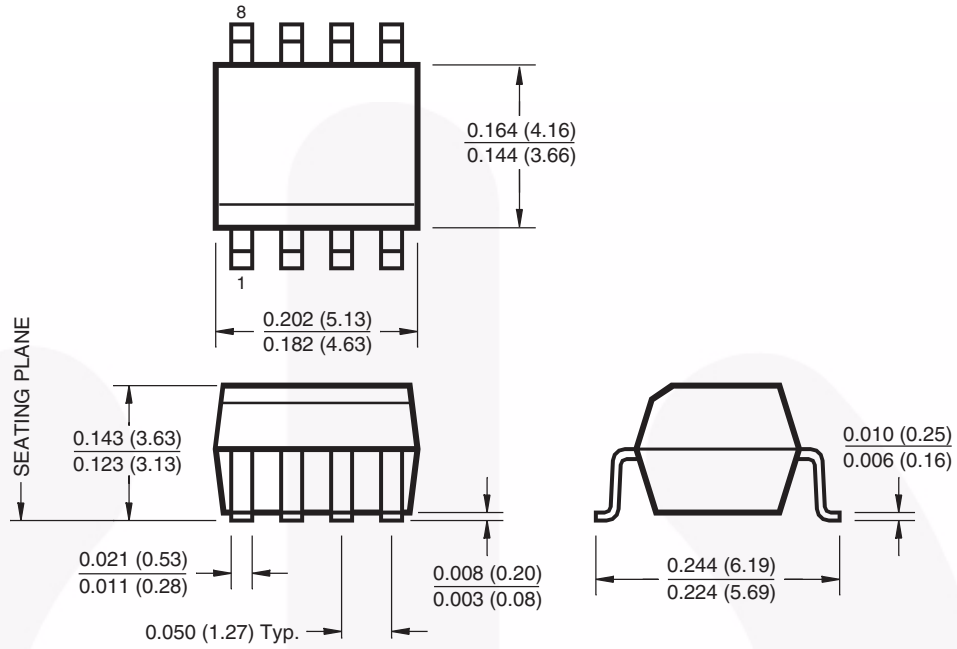


Fig. 8 Common Mode Immunity Test Circuit

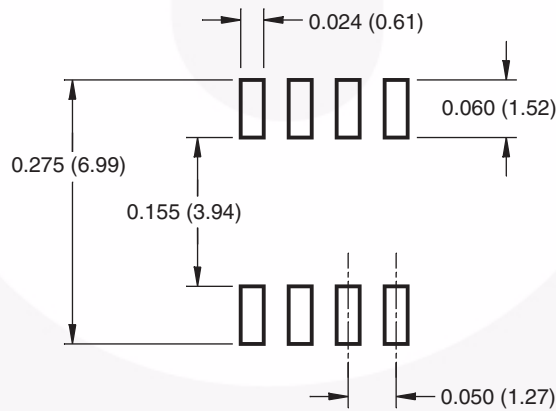
## Package Dimensions

### 8-pin SOIC Surface Mount



Lead Coplanarity: 0.004 (0.10) MAX

### 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:

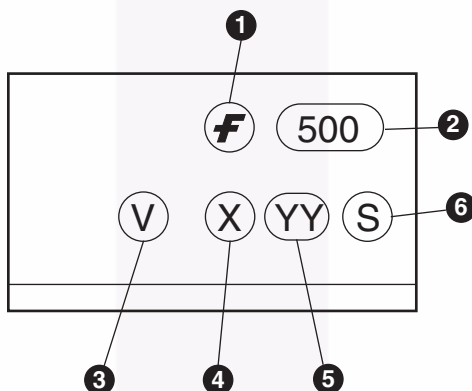
<http://www.fairchildsemi.com/packaging/>



### Ordering Information

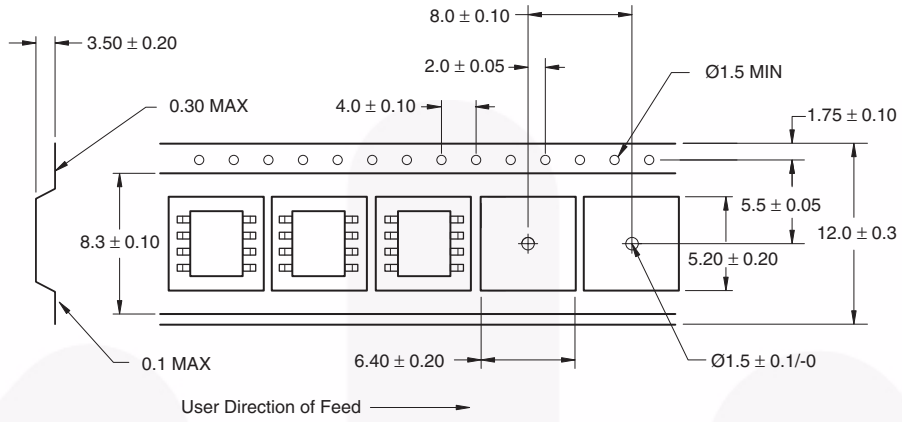
Option	Order Entry Identifier	Description
V	V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534)
R2	R2	Tape and reel (2500 units per reel)
R2V	R2V	VDE 0884 (approval pending for HCPL0530, HCPL0531 & HCPL0534), Tape and reel (2500 units per reel)

### Marking Information

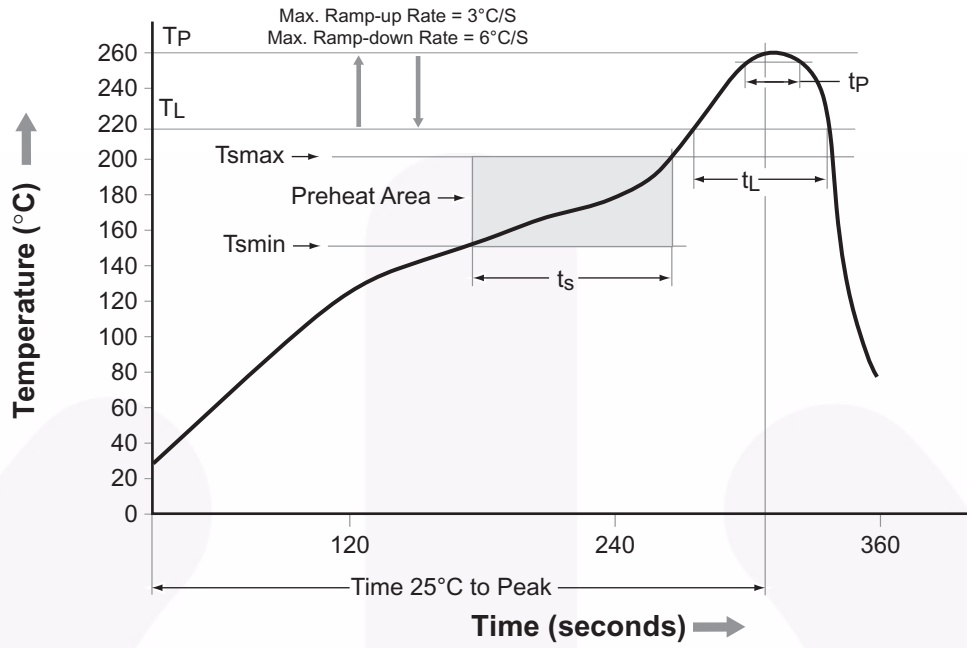


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

### Carrier Tape Specifications



### Reflow Profile







Profile Feature	Pb-Free Assembly Profile
Temperature Min. ( $T_{smin}$ )	150°C
Temperature Max. ( $T_{smax}$ )	200°C
Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )	60–120 seconds
Ramp-up Rate ( $t_L$ to $t_p$ )	3°C/second max.
Liquidous Temperature ( $T_L$ )	217°C
Time ( $t_L$ ) Maintained Above ( $T_L$ )	60–150 seconds
Peak Body Package Temperature	260°C +0°C / -5°C
Time ( $t_p$ ) within 5°C of 260°C	30 seconds
Ramp-down Rate ( $T_P$ to $T_L$ )	6°C/second max.
Time 25°C to Peak Temperature	8 minutes max.



**TRADEMARKS**

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- |  |   |  |   |
|--|---|--|---|
| 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™   |  ™  | 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™   |  ™ |
| 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™   |  | SyncFET™   | XS™   |
| FETBench™  | PDP SPM™  | Sync-Lock™   |   |
| FlashWriter®*  | Power-SPM™  |  ™* |   |
| FPS™   |   |  |   |

\* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

**DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**ANTI-COUNTERFEITING POLICY**

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

**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.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. 140