

**FAIRCHILD**  
SEMICONDUCTOR®

# SINGLE CHANNEL HIGH SPEED TRANSISTOR OPTOCOUPPLERS

**HCPL-0452**

**HCPL-0500**

**HCPL-0501**

## DESCRIPTION

The HCPL-0500, HCPL-0501 and HCPL-0452 optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor housed in a compact 8-pin smalloutline package.

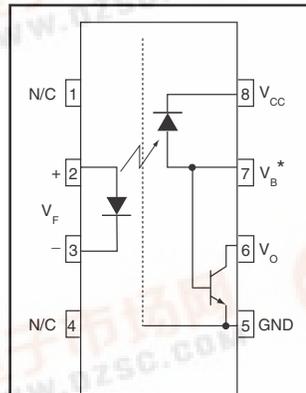
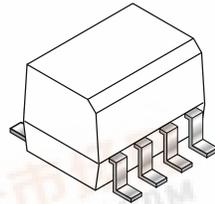
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

## FEATURES

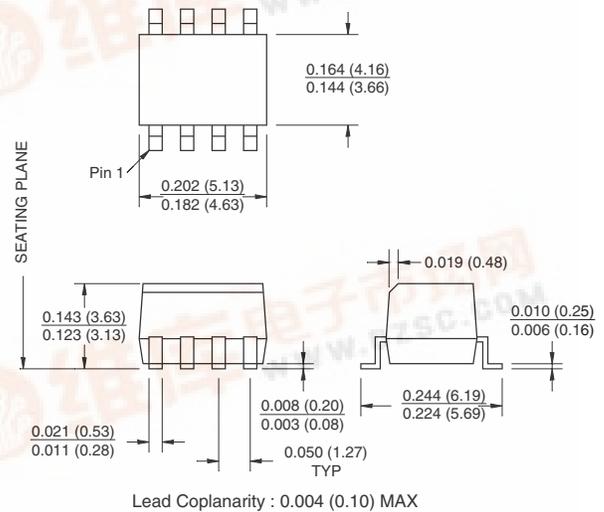
- High speed-1 MBit/s
- Superior CMR-1 kV/μs
- CTR guaranteed 0-70°C
- U.L. recognized (File # E90700)

## APPLICATIONS

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



## PACKAGE DIMENSIONS



## NOTE

All dimensions are in inches (millimeters)

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**ABSOLUTE MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Value	Units
Storage Temperature	$T_{STG}$	-55 to +125	$^\circ\text{C}$
Operating Temperature	$T_{OPR}$	-55 to +100	$^\circ\text{C}$
Reflow Temperature Profile (Refer to fig. 11)			
<b>EMITTER</b>			
DC/Average Forward Input Current	$I_F$ (avg)	25	mA
Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	$I_F$ (pk)	50	mA
Peak Transient Input Current - ( $\leq 1 \mu\text{s}$ P.W., 300 pps)	$I_F$ (trans)	1.0	A
Reverse Input Voltage	$V_R$	5	V
Input Power Dissipation	$P_D$	45	mW
<b>DETECTOR</b>			
Average Output Current (Pin 6)	$I_O$ (avg)	8	mA
Peak Output Current	$I_O$ (pk)	16	mA
Emitter-Base Reverse Voltage (Except HCPL-0452)	$V_{EBR}$	5	V
Supply Voltage	$V_{CC}$	-0.5 to 30	V
Output Voltage	$V_O$	-0.5 to 20	V
Base Current (Except HCPL-0452)	$I_B$	5	mA
Output power dissipation	$P_D$	100	mW

**ELECTRICAL CHARACTERISTICS** ( $T_A = 0$  to  $70^\circ\text{C}$  Unless otherwise specified)

**INDIVIDUAL COMPONENT CHARACTERISTICS**

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
<b>EMITTER</b>							
Input Forward Voltage	( $I_F = 16 \text{ mA}$ , $T_A = 25^\circ\text{C}$ )	$V_F$	All		1.45	1.7	V
	( $I_F = 16 \text{ mA}$ )					1.8	
Input Reverse Breakdown Voltage	( $I_R = 10 \mu\text{A}$ )	$BV_R$	All	5.0			V
Temperature coefficient of forward voltage	( $I_F = 16 \text{ mA}$ )	( $\Delta V_F / \Delta T_A$ )	All		-1.6		mV/ $^\circ\text{C}$
<b>DETECTOR</b>							
Logic high output current	( $I_F = 0 \text{ mA}$ , $V_O = V_{CC} = 5.5 \text{ V}$ , $T_A = 25^\circ\text{C}$ )	$I_{OH}$	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				
Logic low supply current	( $I_F = 16 \text{ mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15 \text{ V}$ )	$I_{CCL}$	All		120	200	$\mu\text{A}$
Logic high supply current	( $I_F = 0 \text{ mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15 \text{ V}$ , $T_A = 25^\circ\text{C}$ )	$I_{CCH}$	All		0.01	1	$\mu\text{A}$
	( $I_F = 0 \text{ mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15 \text{ V}$ )		All				

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<b>TRANSFER CHARACTERISTICS</b> ( $T_A = 0$ to $70^\circ\text{C}$ Unless otherwise specified)							
Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
<b>COUPLED</b>  Current transfer ratio (Note 5)	$(I_F = 16 \text{ mA}, V_O = 0.4 \text{ V})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	CTR	HCPL-0500	7	27	50	%
			HCPL-0452	19	27	50	
			HCPL-0501				
	$(I_F = 16 \text{ mA}, V_O = 0.5 \text{ V})$ $(V_{CC} = 4.5 \text{ V})$		HCPL-0500	5	30		
			HCPL-0452	15	30		
			HCPL-0501				
Logic low output voltage output voltage	$(I_F = 16 \text{ mA}, I_O = 1.1 \text{ mA})$ $(V_{CC} = 4.5 \text{ V}, T_A = 25^\circ\text{C})$	V <sub>OL</sub>	HCPL-0500		0.18	0.4	V
			HCPL-0452		0.25	0.4	
	HCPL-0501						
	$(I_F = 16 \text{ mA}, I_O = 0.8 \text{ mA})$ $(V_{CC} = 4.5 \text{ V})$		HCPL-0500		0.13	0.5	
			HCPL-0452		0.23	0.5	
	HCPL-0501						

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

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**SWITCHING CHARACTERISTICS** ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified.,  $V_{CC} = 5\text{ V}$ )

Parameter	Test Conditions	Symbol	Device	Min	Typ**	Max	Unit
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 6) (Fig. 9)	$T_{PHL}$	HCPL-0500		0.45	1.5	$\mu\text{s}$
			HCPL-0452		0.45	0.8	
	HCPL-0501						
	HCPL-0500				2.0		
	HCPL-0452				1.0		
	HCPL-0501						
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 6) (Fig. 9)	$T_{PLH}$	HCPL-0500		0.5	1.5	$\mu\text{s}$
			HCPL-0452		0.3	0.8	
	HCPL-0501						
	HCPL-0500				2.0		
	HCPL-0452				1.0		
	HCPL-0501						
Common mode transient immunity at logic high	$(I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $R_L = 4.1\text{ k}\Omega$ ) (Note 8) (Fig. 10) $T_A = 25^\circ\text{C}$	$ICM_{HI}$	HCPL-0500		1,000		$\text{V}/\mu\text{s}$
			HCPL-0452		1,000		
			HCPL-0501				
Common mode transient immunity at logic low	$(I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $R_L = 4.1\text{ k}\Omega$ ) (Note 8) (Fig. 10) $T_A = 25^\circ\text{C}$	$ICM_{LI}$	HCPL-0500		1,000		$\text{V}/\mu\text{s}$
			HCPL-0452		1,000		
			HCPL-0501				

**ISOLATION CHARACTERISTICS** ( $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$  Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-Output Isolation Voltage	$(f = 60\text{ Hz}$ , $t = 1.0\text{ min}$ ) <sup>(9,10)</sup>	$V_{ISO}$	2500	—	—	$V_{AC_{RMS}}$
Isolation Resistance	$(V_{I-O} = 500\text{ V})$ <sup>(9)</sup>	$R_{ISO}$	$10^{11}$	—	—	$\Omega$
Isolation Capacitance	$(V_{I-O} = 0$ , $f = 1.0\text{ MHz})$ <sup>(9)</sup>	$C_{ISO}$	—	0.2	—	$\text{pF}$

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

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**NOTES**

1. Derate linearly above 70°C free-air temperature at a rate of 0.8 mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6 mA/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.9 mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 2.0 mW/°C.
5. Current Transfer Ratio is defined as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$  times 100%.
6. The 4.1 kΩ load represents 1 LSTTL unit load of 0.36 mA and 6.1kΩ pull-up resistor.
7. The 1.9 kΩ load represents 1 TTL unit load of 1.6 mA and 5.6 kΩ pull-up resistor.
8. 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).
9. 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.
10. 2500 VAC RMS for 1 minute duration is equivalent to 3000 VAC RMS for 1 second duration.

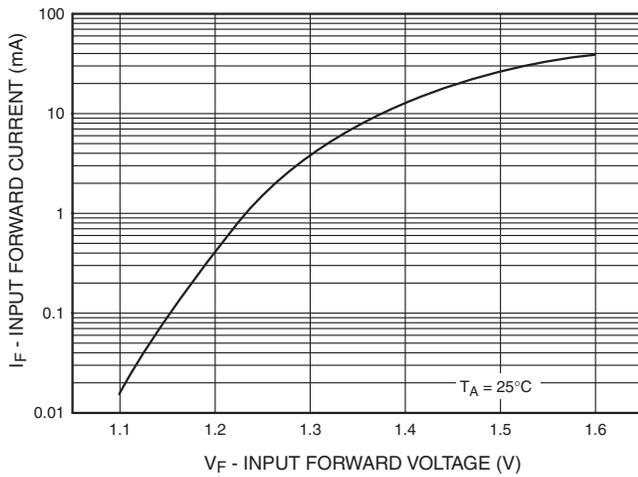
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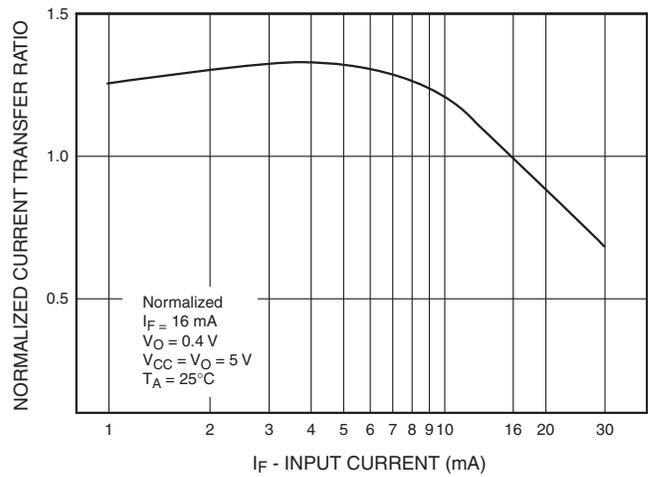
**HCPL-0501**

**TYPICAL PERFORMANCE CURVES**

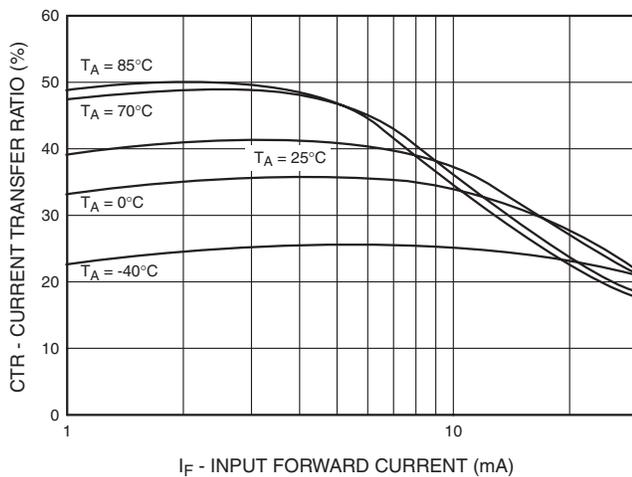
**Fig. 1 Input Forward Current vs. Input Forward Voltage**



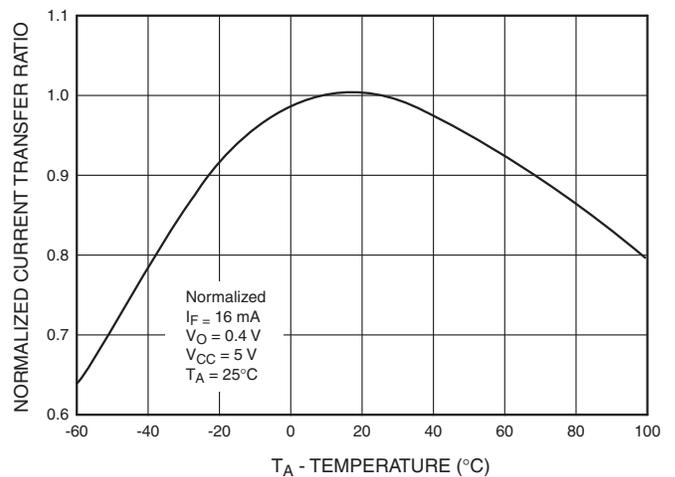
**Fig. 2 Current Transfer Ratio vs. Input Current**



**Fig. 3 Current Transfer Ratio vs. Input Forward Current**



**Fig. 4 Current Transfer Ratio vs. Temperature**



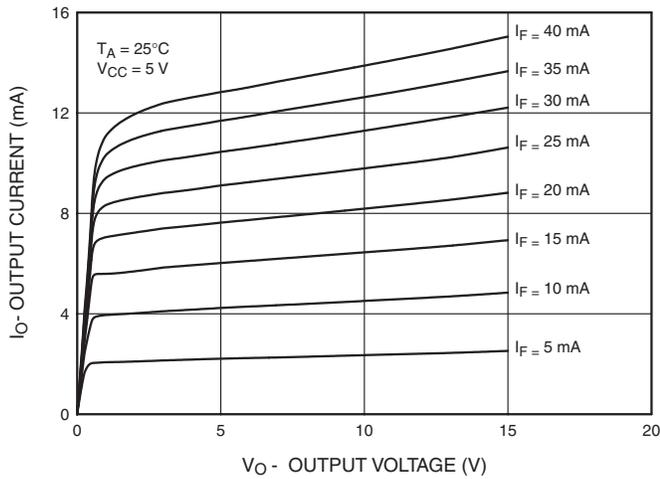
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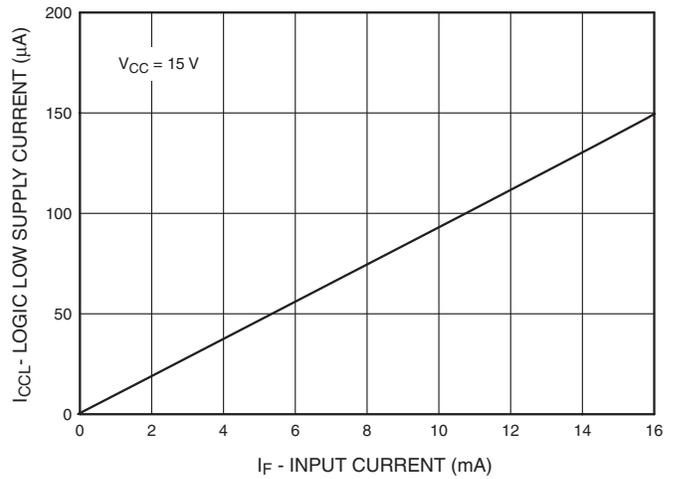
**HCPL-0501**

**TYPICAL PERFORMANCE CURVES**

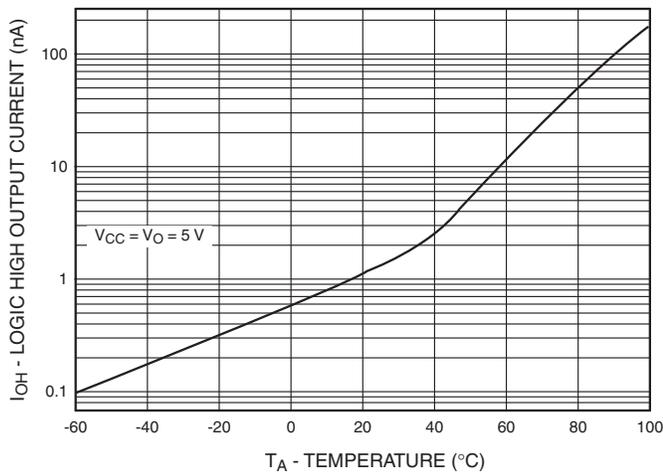
**Fig. 5 DC Transfer Characteristics**



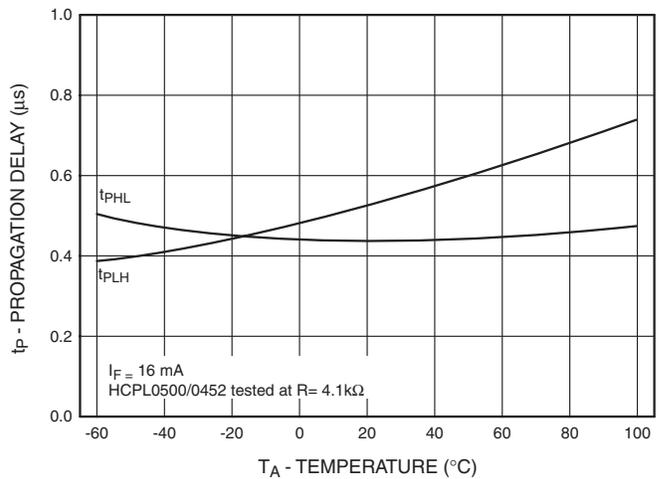
**Fig. 6 Logic Low Supply Current vs. Input Current**



**Fig. 7 Logic High Output Current vs. Temperature**



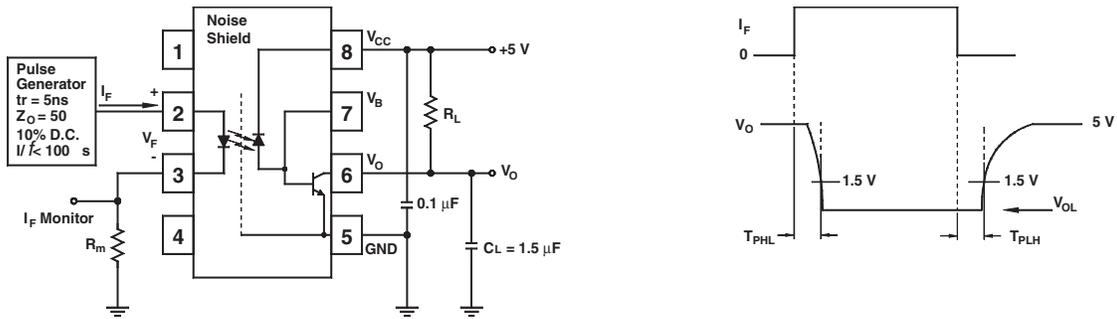
**Fig. 8 Propagation Delay vs. Temperature**



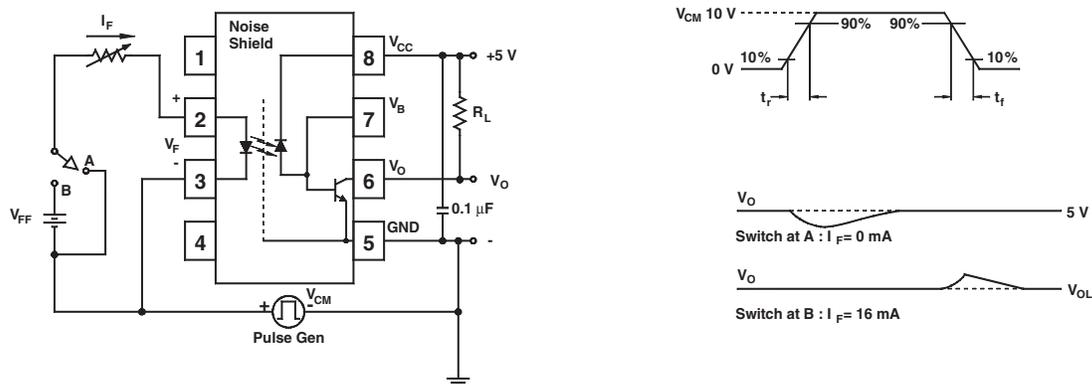
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**Fig. 9 Switching Time Test Circuit**



**Fig. 10 Common Mode Immunity Test Circuit**

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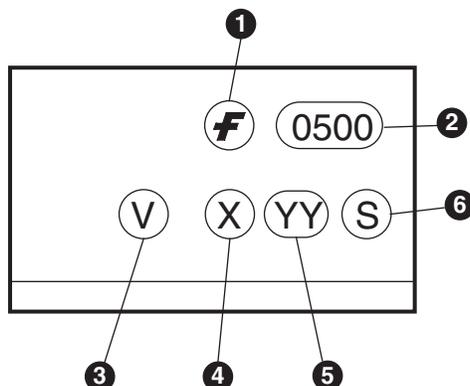
**HCPL-0500**

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**ORDERING INFORMATION**

Option	Order Entry Identifier	Description
V	V	VDE 0884
R1	R1	Tape and reel (500 units per reel)
R1V	R1V	VDE 0884, Tape and reel (500 units per reel)
R2	R2	Tape and reel (2500 units per reel)
R2V	R2V	VDE 0884, Tape and reel (2500 units per reel)

**MARKING INFORMATION**



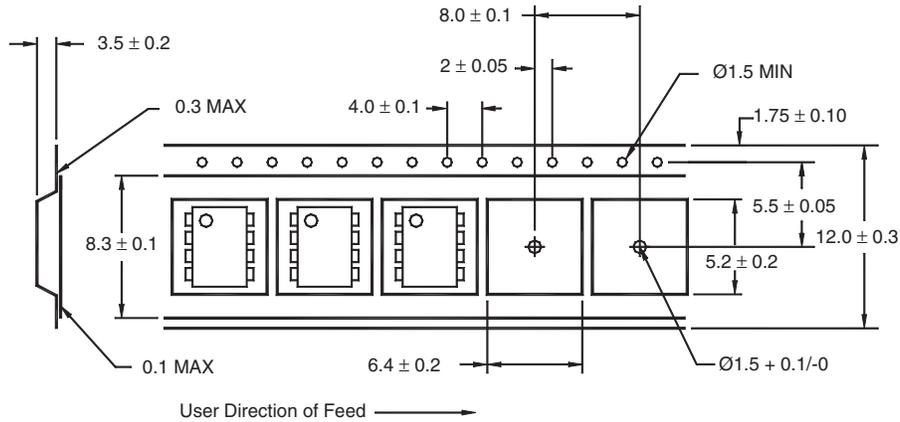
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

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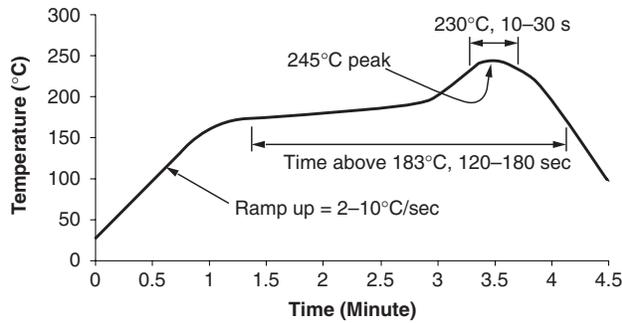
**HCPL-0500**

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**Carrier Tape Specifications**



**Reflow Profile**



- Peak reflow temperature: 245°C (package surface temperature)
- Time of temperature higher than 183°C for 120-180 seconds
- One time soldering reflow is recommended



# SINGLE CHANNEL HIGH SPEED TRANSISTOR OPTOCOUPLEDERS

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## **DISCLAIMER**

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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.