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# HCPL0700, HCPL0701, HCPL0730, HCPL0731

## Low Input Current High Gain Split Darlington Optocouplers

Single Channel: HCPL0700, HCPL0701, Dual Channel: HCPL0730, HCPL0731

### Features

- Low input current: 0.5mA
- Superior CTR: 2000%
- Superior CMR – 10 kV/μs
- CTR guaranteed 0°C to 70°C
- U.L. Recognized (file# E90700)
- VDE 0884 recognized (file# 136616)  
– approval pending for HCPL0730/0731
- BSI recognized (file# 8661, 8662)  
– HCPL0700/0701 only

### Applications

- Digital logic ground isolation
- Telephone ring detector
- EIA-RS-232C line receiver
- High common mode noise line receiver
- μP bus isolation
- Current loop receiver

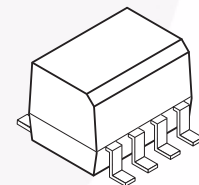
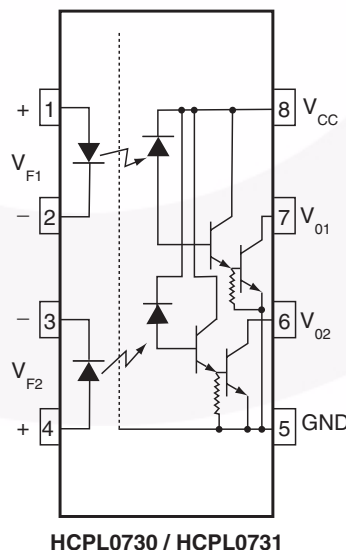
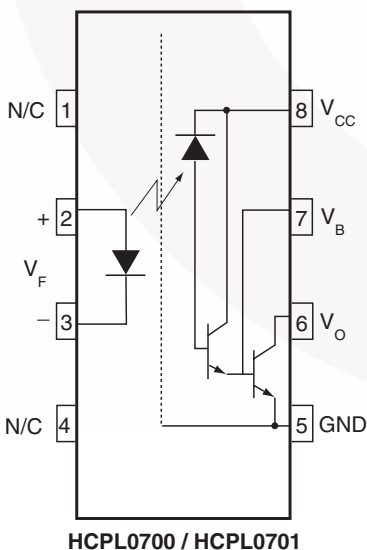
### Description

The HCPL0700, HCPL0701, HCPL0730 and HCPL0731 optocouplers consist of an AlGaAs LED optically coupled to a high gain split darlington photodetector housed in a compact 8-pin small outline package. The HCPL0730 and HCPL0731 devices have two channels per package for optimum mounting density.

The split darlington configuration separating the input photodiode and the first stage gain from the output transistor permits lower output saturation voltage and higher speed operation than possible with conventional darlington phototransistor optocoupler.

The combination of a very low input current of 0.5mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out TTL requirements.

### Schematics



### Truth Table

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

### 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 12)			
<b>EMITTER</b>				
$I_F$ (avg)	DC/Average Forward Input Current	20	mA	
$I_F$ (pk)	Peak Forward Input Current (50% duty cycle, 1 ms P.W.)	40	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	35	mW	
<b>DETECTOR</b>				
$I_O$ (avg)	Average Output Current (Pin 6)	60	mA	
$V_{EBR}$	Emitter-Base Reverse Voltage	HCPL0700/HCPL0701	0.5	V
$V_{CC}, V_O$	Supply Voltage, Output Voltage	HCPL0700/HCPL0730	-0.5 to 7	V
		HCPL0701/HCPL0731	-0.5 to 18	
$P_D$	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	$I_F = 1.6\text{mA}$	$T_A = 25^\circ\text{C}$	HCPL0700/01	1.0	1.25	1.7	V
				HCPL0730/31		1.35		
		All			1.75			
$BV_R$	Input Reverse Breakdown Voltage	$T_A = 25^\circ\text{C}$ , $I_R = 10\mu\text{A}$	All	5.0				
<b>DETECTOR</b>								
$I_{OH}$	Logic High Output Current	$I_F = 0\text{mA}$ , $V_O = V_{CC} = 18\text{V}$	HCPL0701/31		0.01	100	$\mu\text{A}$	
		$I_F = 0\text{mA}$ , $V_O = V_{CC} = 7\text{V}$	HCPL0700/30		0.01	250		
$I_{CCL}$	Logic Low Supply Current	$I_F = 1.6\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 18\text{V}$	HCPL0700/01		0.4	1.5	mA	
		$I_{F1} = I_{F2} = 1.6\text{mA}$ , $V_{CC} = 7\text{V}$	HCPL0730		0.8	3		
		$V_{O1} = V_{O2} = \text{Open}$ , $V_{CC} = 18\text{V}$	HCPL0731		1			
$I_{CCH}$	Logic High Supply Current	$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 18\text{V}$	HCPL0700/01			10	$\mu\text{A}$	
		$I_{F1} = I_{F2} = 0$ , $V_{CC} = 7\text{V}$	HCPL0730		0.001	20		
		$V_{O1} = V_{O2} = \text{Open}$ , $V_{CC} = 18\text{V}$	HCPL0731		0.01			

**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
CTR	<b>COUPLED</b> Current Transfer Ratio (Note 1, 2)	$I_F = 0.5\text{mA}$ , $V_O = 0.4\text{V}$ , $V_{CC} = 4.5\text{V}$	HCPL0701/31	400		5000	%
		$I_F = 1.6\text{mA}$ , $V_O = 0.4\text{V}$ , $V_{CC} = 4.5\text{V}$	HCPL0700	300		2600	
			HCPL0701	500		2600	
			HCPL0730	300		5000	
			HCPL0731	500		5000	
$V_{OL}$	Logic Low Output Voltage	$I_F = 0.5\text{mA}$ , $I_O = 2\text{mA}$ , $V_{CC} = 4.5\text{V}$	HCPL0701			0.4	V
		$I_F = 1.6\text{mA}$ , $I_O = 8\text{mA}$ , $V_{CC} = 4.5\text{V}$	HCPL0731			0.4	
		$I_F = 5\text{mA}$ , $I_O = 15\text{mA}$ , $V_{CC} = 4.5\text{V}$				0.4	
		$I_F = 12\text{mA}$ , $I_O = 24\text{mA}$ , $V_{CC} = 4.5\text{V}$				0.4	
		$I_F = 1.6\text{mA}$ , $I_O = 4.8\text{mA}$ , $V_{CC} = 4.5\text{V}$	HCPL0700/0730			0.4	

**Isolation Characteristics**

Symbol	Characteristics	Test Conditions	Min.	Typ.*	Max.	Unit
$I_{I-O}$	Input-Output Insulation Leakage Current	Relative humidity = 45%, $T_A = 25^\circ\text{C}$ , $t = 5\text{ s}$ , $V_{I-O} = 3000\text{ VDC}$ (Note 4)			1.0	$\mu\text{A}$
$V_{ISO}$	Withstand Insulation Test Voltage	$R_H \leq 50\%$ , $T_A = 25^\circ\text{C}$ , $I_{I-O} \leq 2\mu\text{A}$ , $t = 1\text{ min.}$ (Note 4, 5)	2500			$V_{RMS}$
$R_{I-O}$	Resistance (Input to Output)	$V_{I-O} = 500\text{ VDC}$ (Note 4)		$10^{12}$		$\Omega$

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

## Electrical Characteristics ( $T_A = 0$ 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 (Note 2) (Fig. 14)	$R_L = 4.7\text{k}\Omega$ , $I_F = 0.5\text{mA}$ $T_A = 25^\circ\text{C}$	HCPL0701			30	$\mu\text{s}$		
			HCPL0731			120			
			HCPL0701			3		25	
			HCPL0731			5		100	
		$R_L = 270\ \Omega$ , $I_F = 12\text{mA}$ $T_A = 25^\circ\text{C}$	HCPL0701				2		
			HCPL0731				3		
			HCPL0701				0.3	1	
			HCPL0731				0.4	2	
		$R_L = 2.2\ \text{k}\Omega$ , $I_F = 1.6\text{mA}$ $T_A = 25^\circ\text{C}$	HCPL0700				15		
			HCPL0730/0731				25		
			HCPL0700				1	10	
			HCPL0730/0731				2	20	
$T_{PLH}$	Propagation Delay Time to Logic High (Note 2) (Fig. 14)	$R_L = 4.7\ \text{k}\Omega$ , $I_F = 0.5\text{mA}$ $T_A = 25^\circ\text{C}$	HCPL0701/31			90	$\mu\text{s}$		
			HCPL0701/31			12		60	
		$R_L = 270\ \Omega$ , $I_F = 12\text{mA}$ $T_A = 25^\circ\text{C}$	HCPL0701				10		
			HCPL0731				15		
			HCPL0701				1.6	7	
			HCPL0731				1.6	10	
		$R_L = 2.2\ \text{k}\Omega$ , $I_F = 1.6\text{mA}$ $T_A = 25^\circ\text{C}$	HCPL0700/30/31				50		
			HCPL0700/30/31				7	35	
		$ICM_H$	Common Mode Transient Immunity at Logic High	$I_F = 0\text{mA}$ , $ V_{CM}  = 10\ \text{V}_{P-P}$ , $T_A = 25^\circ\text{C}$ , $R_L = 2.2\text{k}\Omega$ (Note 3) (Fig. 15)	ALL	1,000	10,000		$\text{V}/\mu\text{s}$
		$ICM_L$	Common Mode Transient Immunity at Logic Low	$I_F = 1.6\text{mA}$ , $ V_{CM}  = 10\ \text{V}_{P-P}$ , $T_A = 25^\circ\text{C}$ , $R_L = 2.2\ \text{k}\Omega$ (Note 3) (Fig. 15)	ALL	1,000	10,000		$\text{V}/\mu\text{s}$

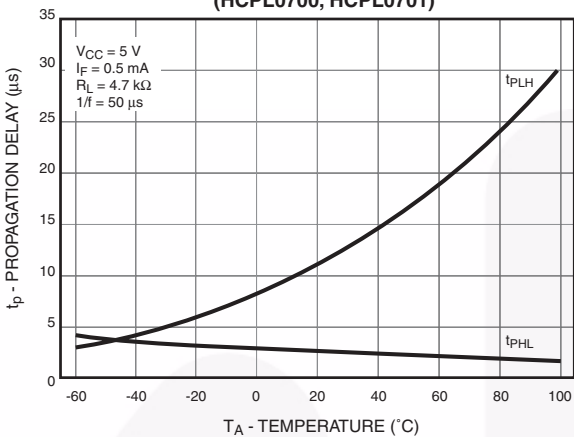
\*All typicals at  $T_A = 25^\circ\text{C}$

#### Notes:

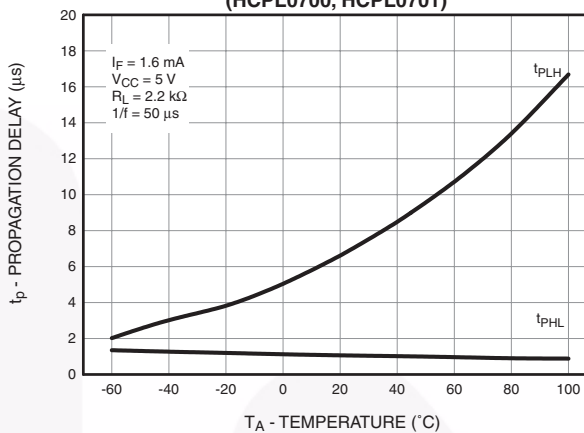
- Current Transfer Ratio is defined as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.
- Pin 7 open. Use of a resistor between pins 5 and 7 will decrease gain and delay time.
- Common mode transient immunity in logic high level is the maximum tolerable (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.,  $V_O > 2.0\text{V}$ ). 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.,  $V_O < 0.8\ \text{V}$ ).
- 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.
- 2500 VAC RMS for 1 minute duration is equivalent to 3000 VAC RMS for 1 second duration.

## Typical Performance Curves

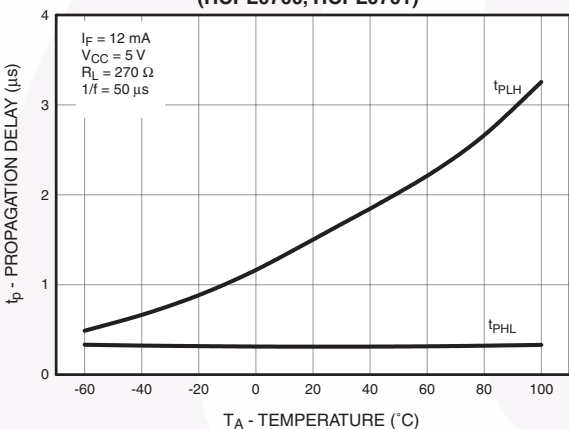
**Fig. 1 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)**



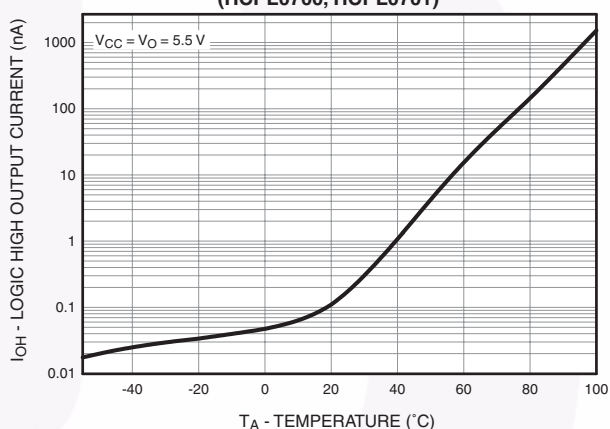
**Fig. 2 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)**



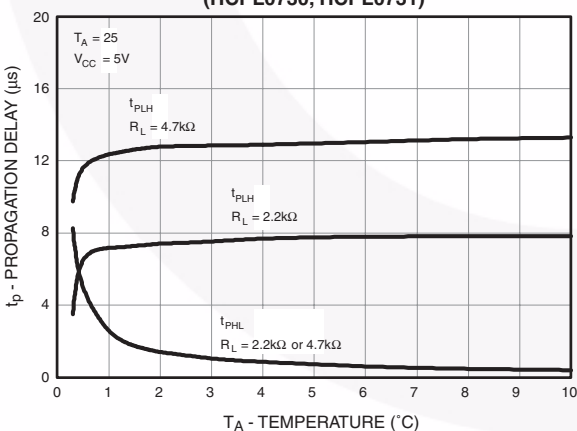
**Fig. 3 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)**



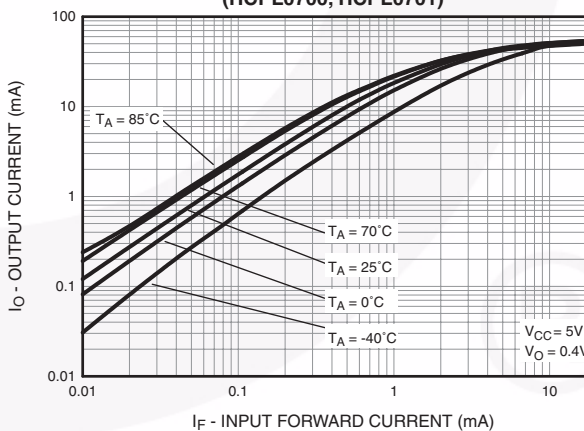
**Fig. 4 Logic High Output Current vs. Temperature (HCPL0700, HCPL0701)**



**Fig. 5 Propagation Delay vs. Input Forward Current (HCPL0730, HCPL0731)**

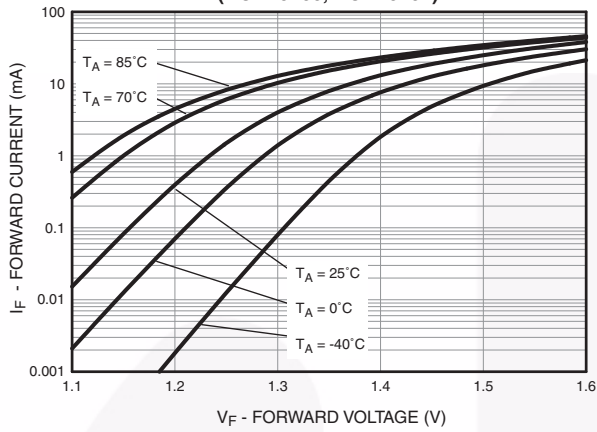


**Fig. 6 Output Current vs. Input Forward Current (HCPL0700, HCPL0701)**

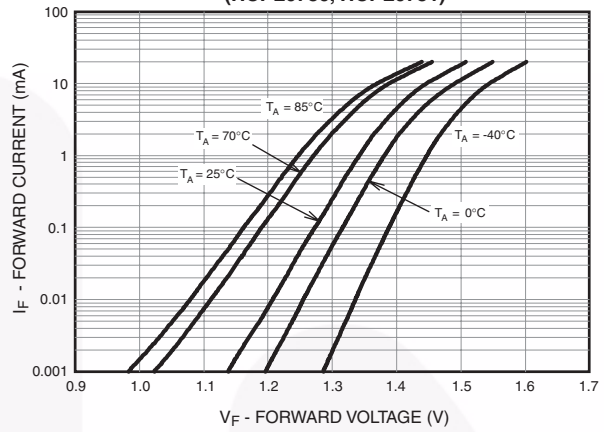


**Typical Performance Curves (Continued)**

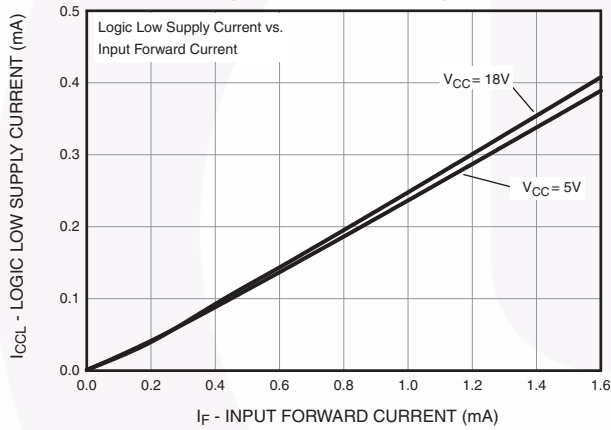
**Fig. 7 Input Forward Current vs. Forward Voltage (HCPL0700, HCPL0701)**



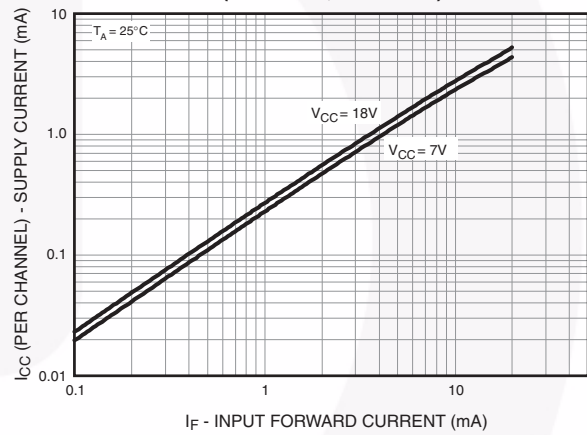
**Fig. 8 Input Forward Current vs. Forward Voltage (HCPL0730, HCPL0731)**



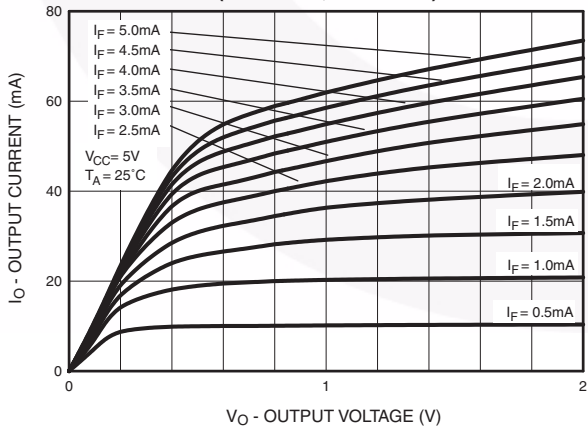
**Fig. 9 Logic Low Supply Current vs. Input Forward Current (HCPL0700, HCPL0701)**



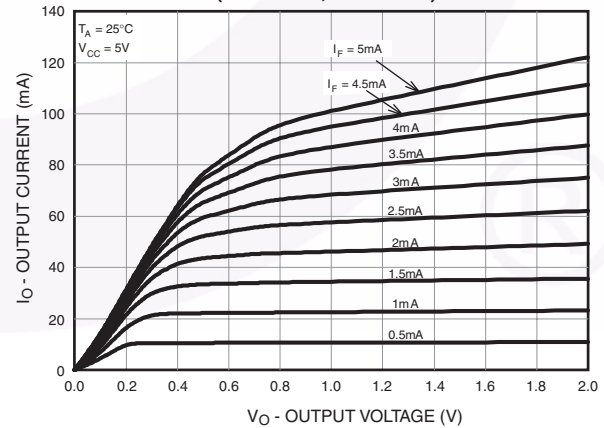
**Fig. 10 Supply Current vs. Input Forward Current (HCPL0730, HCPL0731)**



**Fig. 11 DC Transfer Characteristics (HCPL0700, HCPL0701)**

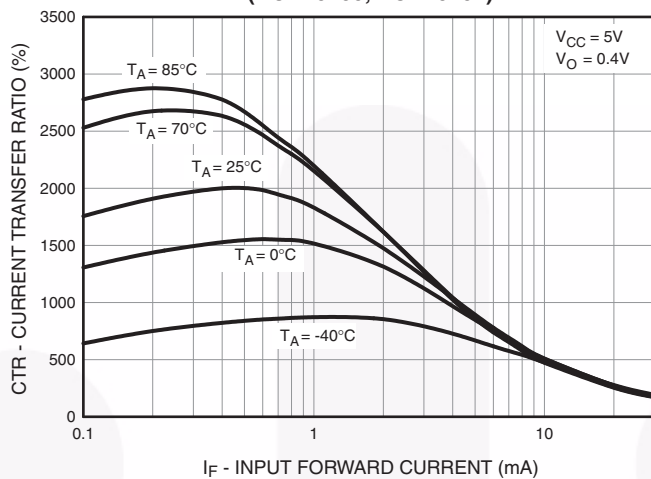


**Fig. 12 DC Transfer Characteristics (HCPL0730, HCPL0731)**



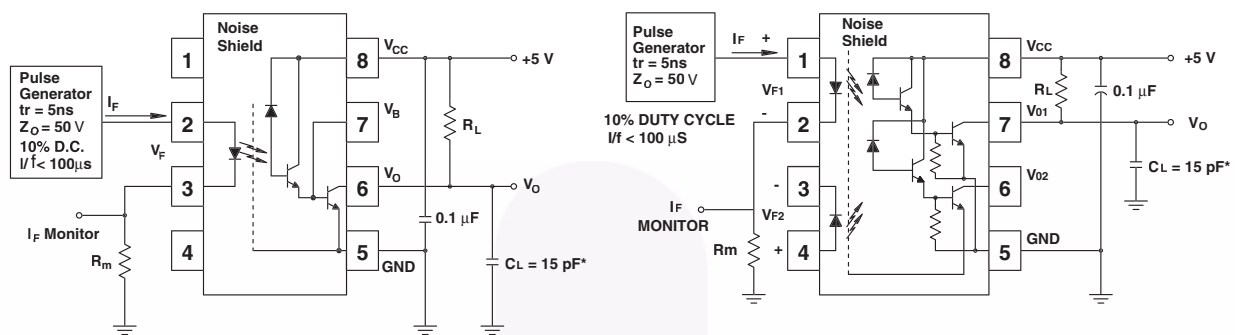
Typical Performance Curves (Continued)

Fig. 13 Current Transfer Ratio vs. Input Forward Current (HCPL0700, HCPL0701)





### Test Circuits



Test Circuit for HCPL-0700 and HCPL-0701

Test Circuit for HCPL-0730 and HCPL-0731

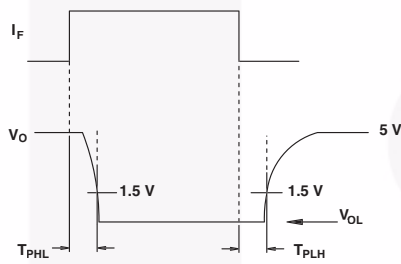
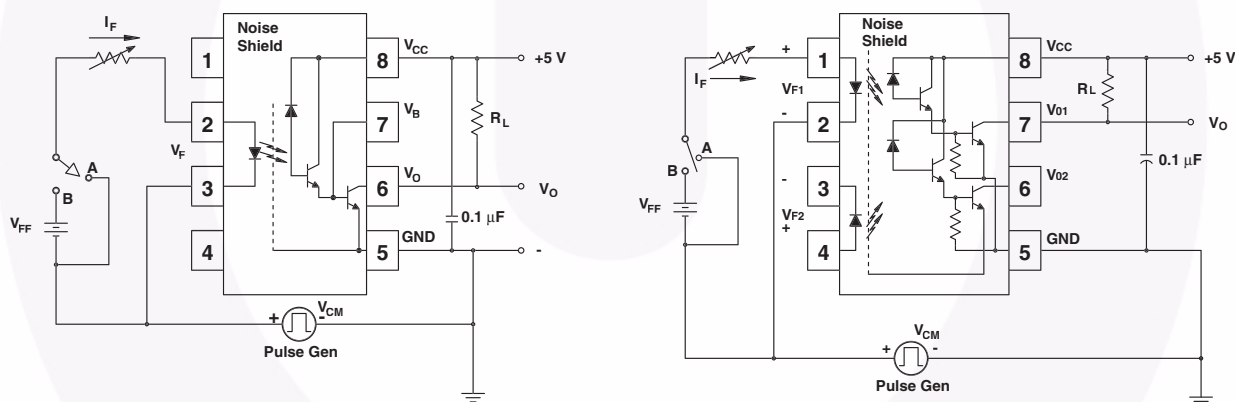


Fig. 14 Switching Time Test Circuit



Test Circuit for HCPL-0700 and HCPL-0701

Test Circuit for HCPL-0730 and HCPL-0731

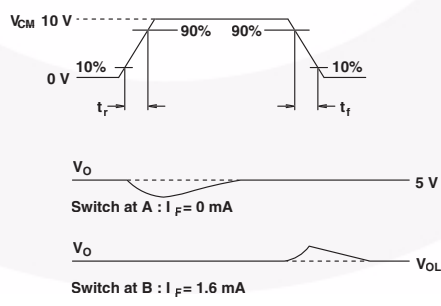
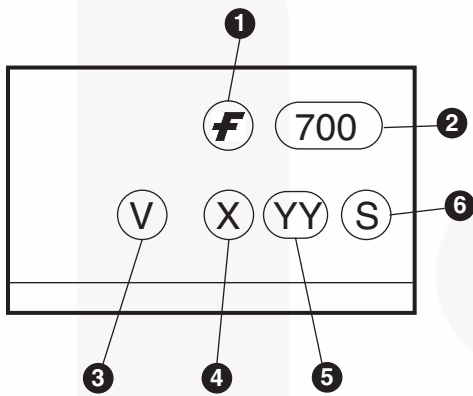


Fig. 15 Common Mode Immunity Test Circuit

### Ordering Information

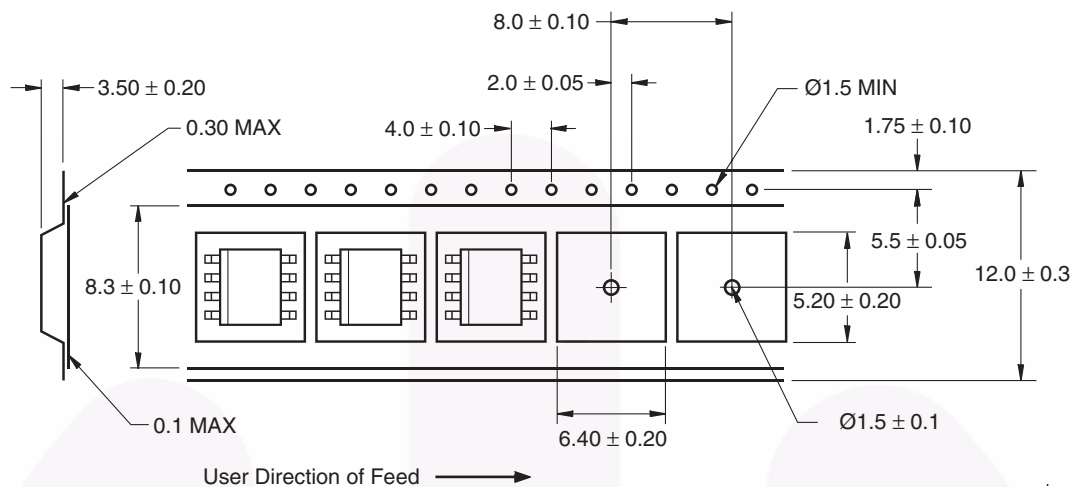
Option	Part Number Example	Description
V	HCPL0700V	VDE 0884
R2	HCPL0700R2	Tape and reel (2500 units per reel)
R2V	HCPL0700R2V	VDE 0884, Tape and reel (2500 units per reel)

### 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

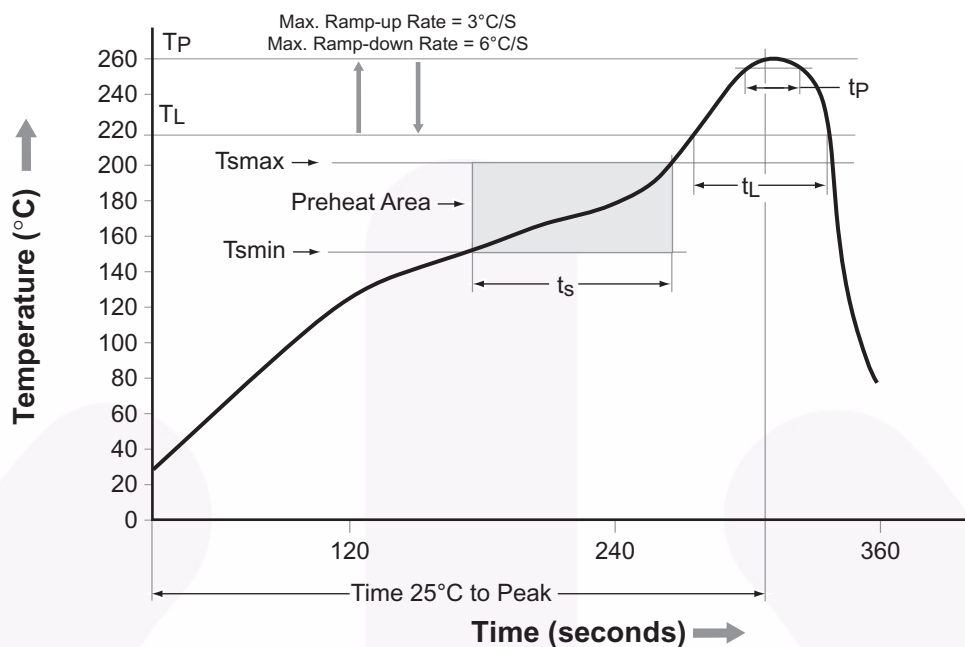
### Carrier Tape Specification



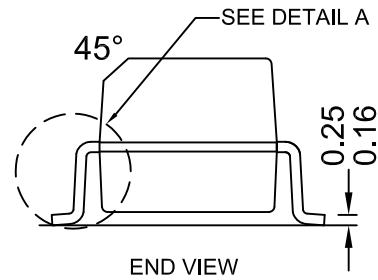
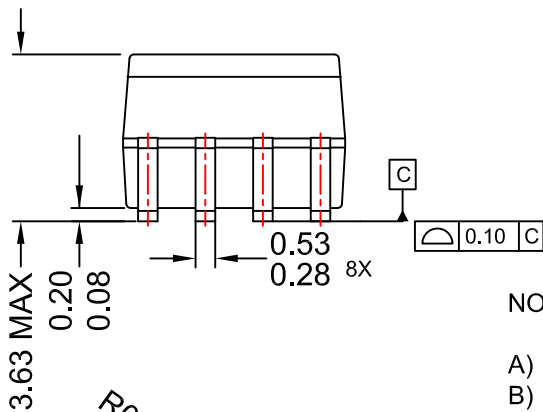
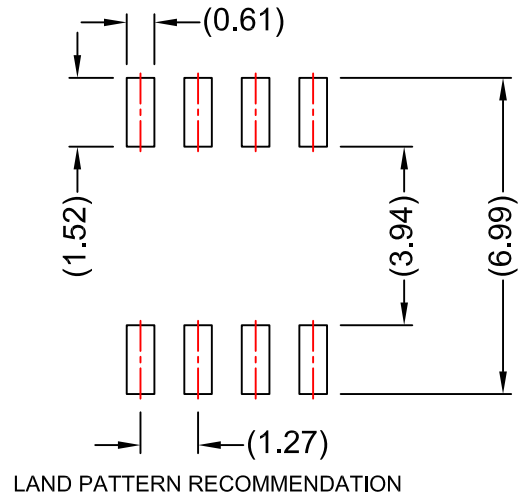
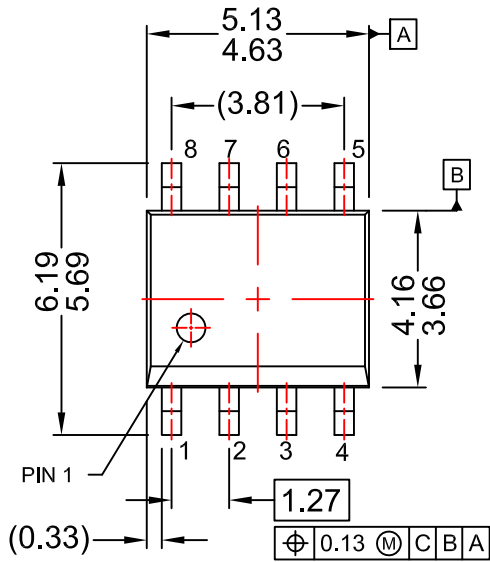
Dimensions in mm



## Reflow Profile

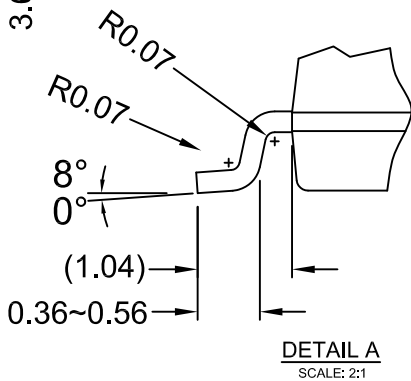


Profile Feature	Pb-Free Assembly Profile
Temperature Min. (T <sub>smín</sub> )	150°C
Temperature Max. (T <sub>smáx</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>smín</sub> to T <sub>smáx</sub> )	60–120 seconds
Ramp-up Rate (t <sub>L</sub> to t <sub>p</sub> )	3°C/second max.
Liquidous Temperature (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.



NOTES:

- A) NO STANDARD APPLIES TO THIS PACKAGE
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X175-8M.
- E) DRAWING FILENAME: MKT-M08Erev5



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