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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD SEMICONDUCTOR®

April 2009

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

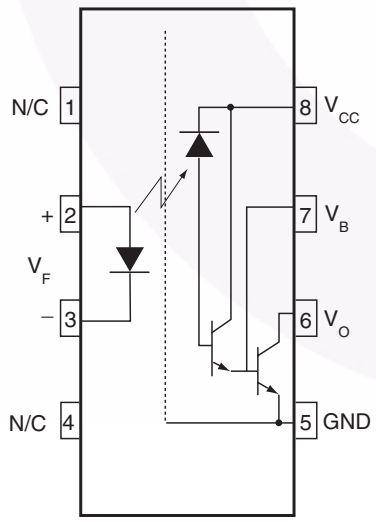
Description

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.

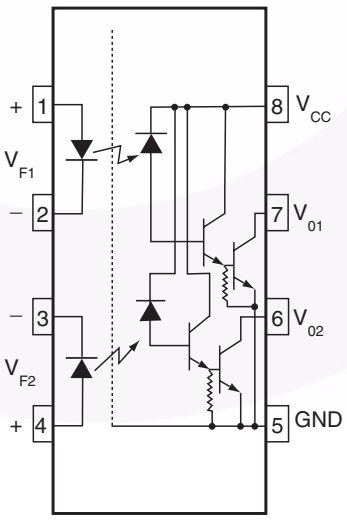
The split darlington configuration separating the input photodiode and the first stage gain from the output transistor permits lower output saturation voltage and higher speed operation than possible with conventional darlington phototransistor optocoupler.

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.

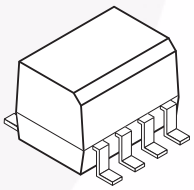
Schematics



HCPL0700 / HCPL0701



HCPL0730 / HCPL0731



Truth Table

LED	V_O
ON	LOW
OFF	HIGH

Absolute Maximum Ratings (T_A = 25°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	°C
T_{OPR}	Operating Temperature		-40 to +85	°C
	Reflow Temperature Profile (Refer to page 12)			
EMITTER				
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 - (≤1 µs P.W., 300 pps)		1.0	A
V_R	Reverse Input Voltage		5	V
P_D	Input Power Dissipation		35	mW
DETECTOR				
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°C unless otherwise specified)

Individual Component Characteristics

Symbol	Parameter	Test Conditions		Device	Min.	Typ.*	Max	Unit
EMITTER								
V_F	Input Forward Voltage	I_F = 1.6mA	T_A = 25°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°C, I_R = 10µA		All	5.0			
DETECTOR								
I_{OH}	Logic High Output Current	I_F = 0mA, V_O = V_{CC} = 18V		HCPL0701/31		0.01	100	µA
		I_F = 0mA, V_O = V_{CC} = 7V		HCPL0700/30		0.01	250	
I_{CCL}	Logic Low Supply Current	I_F = 1.6mA, V_O = Open, V_{CC} = 18V		HCPL0700/01		0.4	1.5	mA
		I_{F1} = I_{F2} = 1.6mA, V_{CC} = 7V		HCPL0730		0.8	3	
		V_{O1} = V_{O2} = Open, V_{CC} = 18V		HCPL0731		1		
I_{CCH}	Logic High Supply Current	I_F = 0mA, V_O = Open, V_{CC} = 18V		HCPL0700/01			10	µA
		I_{F1} = I_{F2} = 0, V_{CC} = 7V		HCPL0730		0.001	20	
		V_{O1} = V_{O2} = Open, V_{CC} = 18V		HCPL0731		0.01		

Transfer Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
CTR	**COUPLED**	I_F = 0.5mA, V_O = 0.4 V, V_{CC} = 4.5V	HCPL0701/31	400		5000	%
	Current Transfer Ratio (Note 1, 2)	I_F = 1.6mA, V_O = 0.4 V, V_{CC} = 4.5V	HCPL0700	300		2600	
			HCPL0701	500		2600	
			HCPL0730	300		5000	
			HCPL0731	500		5000	
V_{OL}	Logic Low Output Voltage	I_F = 0.5mA, I_O = 2mA, V_{CC} = 4.5V	HCPL0701 HCPL0731			0.4	V
		I_F = 1.6mA, I_O = 8mA, V_{CC} = 4.5V				0.4	
		I_F = 5mA, I_O = 15mA, V_{CC} = 4.5V				0.4	
		I_F = 12mA, I_O = 24mA, V_{CC} = 4.5V				0.4	
		I_F = 1.6mA, I_O = 4.8mA, V_{CC} = 4.5V	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°C, t = 5 s, V_{I-O} = 3000 VDC (Note 4)			1.0	µA
V_{ISO}	Withstand Insulation Test Voltage	$R_H \leq 50\%$, T_A = 25°C, $I_{I-O} \leq 2\mu A$, t = 1 min. (Note 4, 5)	2500			V_{RMS}
R_{I-O}	Resistance (Input to Output)	V_{I-O} = 500 VDC (Note 4)		10^{12}		Ω

*All typicals at T_A = 25°C

Electrical Characteristics (T_A = 0 to 70°C unless otherwise specified)

Switching Characteristics (V_{CC} = 5V)

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic Low (Note 2) (Fig. 14)	R_L = 4.7kΩ, I_F = 0.5mA	HCPL0701			30	µs
			HCPL0731			120	
		T_A = 25°C	HCPL0701		3	25	
			HCPL0731		5	100	
		R_L = 270 Ω, I_F = 12mA	HCPL0701			2	
			HCPL0731			3	
		T_A = 25°C	HCPL0701		0.3	1	
			HCPL0731		0.4	2	
		R_L = 2.2 kΩ, I_F = 1.6mA	HCPL0700			15	
			HCPL0730/0731			25	
		T_A = 25°C	HCPL0700		1	10	
			HCPL0730/0731		2	20	
T_{PLH}	Propagation Delay Time to Logic High (Note 2) (Fig. 14)	R_L = 4.7 kΩ, I_F = 0.5mA	HCPL0701/31			90	µs
		T_A = 25°C	HCPL0701/31		12	60	
		R_L = 270 Ω, I_F = 12mA	HCPL0701			10	
			HCPL0731			15	
		T_A = 25°C	HCPL0701		1.6	7	
			HCPL0731		1.6	10	
		R_L = 2.2 kΩ, I_F = 1.6mA	HCPL0700/30/31			50	
		T_A = 25°C	HCPL0700/30/31		7	35	
$\|CM_H\|$	Common Mode Transient Immunity at Logic High	I_F = 0mA, $\|V_{CM}\|$ = 10 V_{P-P}, T_A = 25°C, R_L = 2.2kΩ (Note 3) (Fig. 15)	ALL	1,000	10,000		V/µs
$\|CM_L\|$	Common Mode Transient Immunity at Logic Low	I_F = 1.6mA, $\|V_{CM}\|$ = 10 V_{P-P}, T_A = 25°C, R_L = 2.2 kΩ (Note 3) (Fig. 15)	ALL	1,000	10,000		V/µs

*All typicals at T_A = 25°C

Notes:

1. Current Transfer Ratio is defined as a ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
2. Pin 7 open. Use of a resistor between pins 5 and 7 will decrease gain and delay time.
3. 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 > 2.0V). 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).
4. 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.
5. 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)

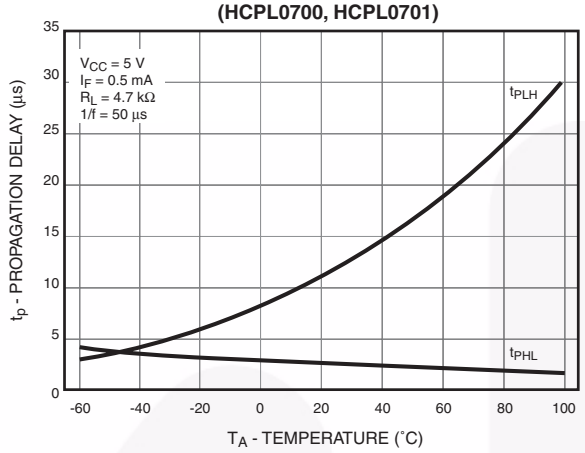


Fig. 2 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)

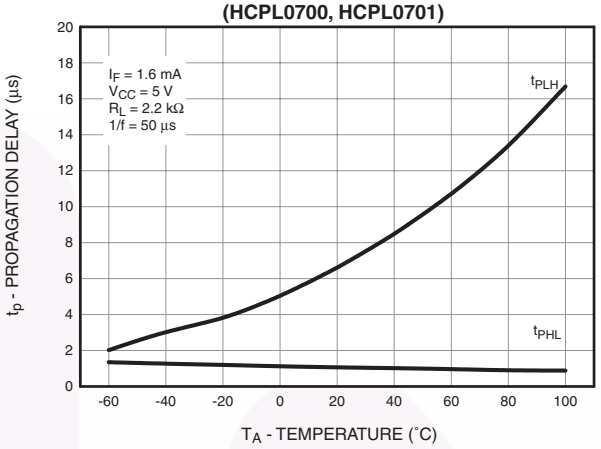


Fig. 3 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)

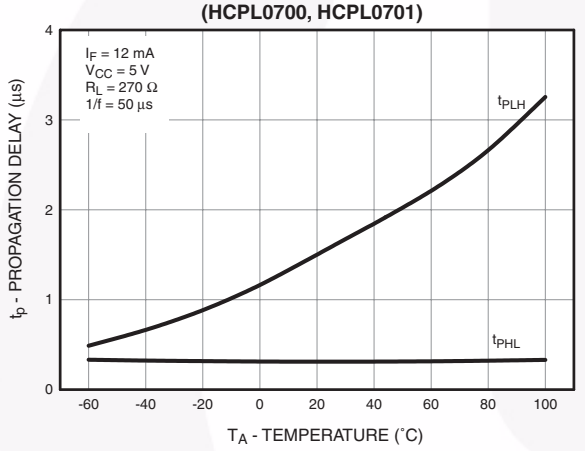


Fig. 4 Logic High Output Current vs. Temperature (HCPL0700, HCPL0701)

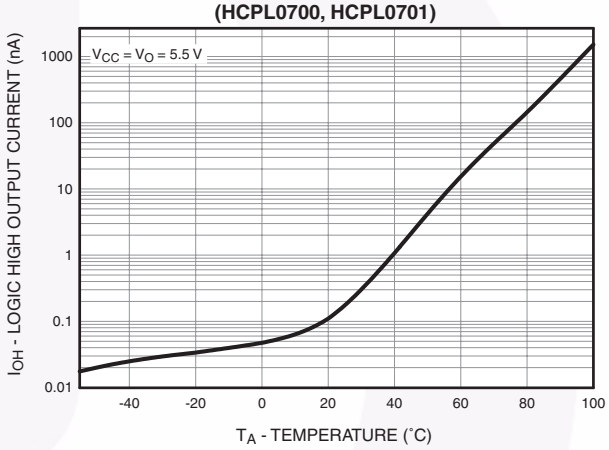


Fig. 5 Propagation Delay vs. Input Forward Currrent (HCPL0730, HCPL0731)

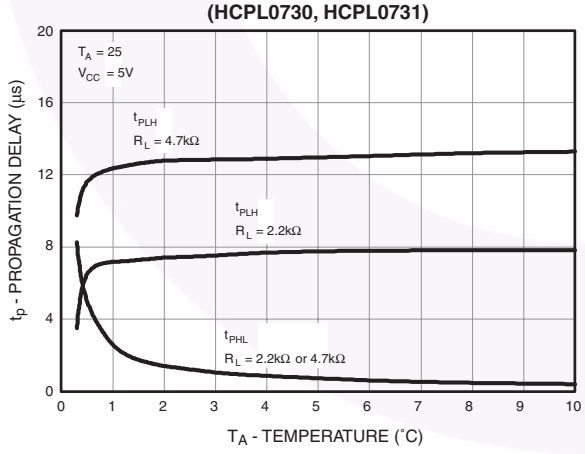
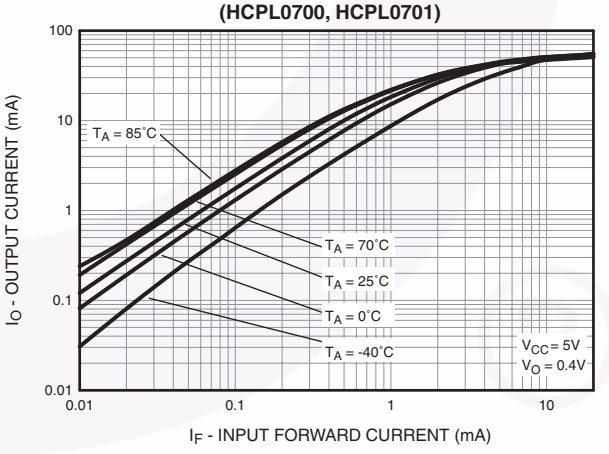


Fig. 6 Output Current vs. Input Forward Current (HCPL0700, HCPL0701)



Typical Performance Curves (Continued)

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

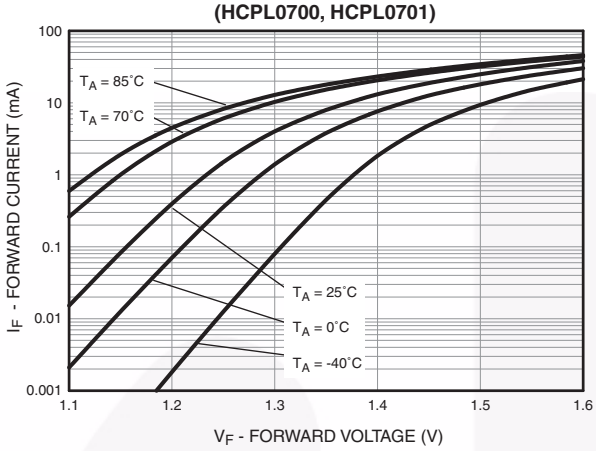


Fig. 8 Input Forward Current vs. Forward Voltage (HCPL0730, HCPL0731)

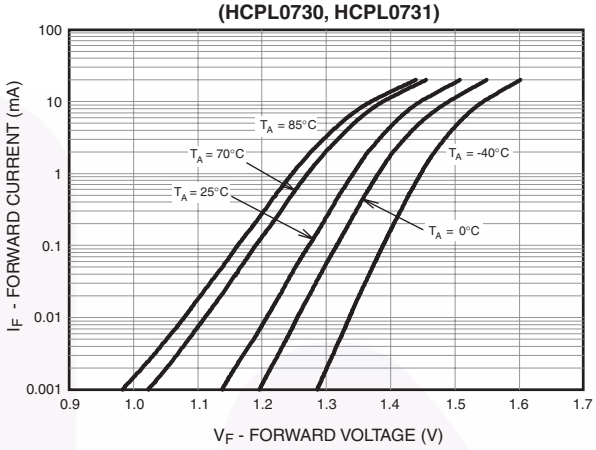


Fig. 9 Logic Low Supply Current vs. Input Forward Current (HCPL0700, HCPL0701)

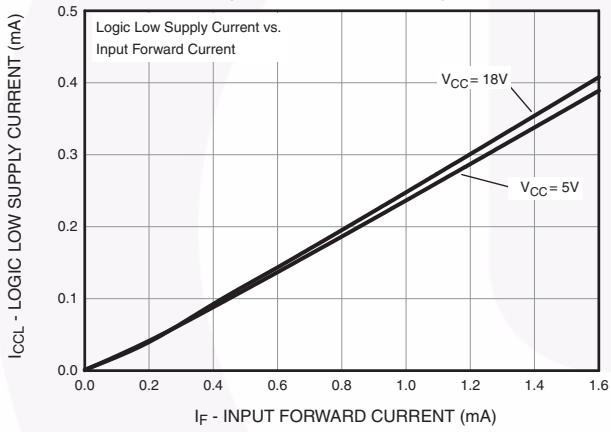


Fig. 10 Supply Current vs. Input Forward Current (HCPL0730, HCPL0731)

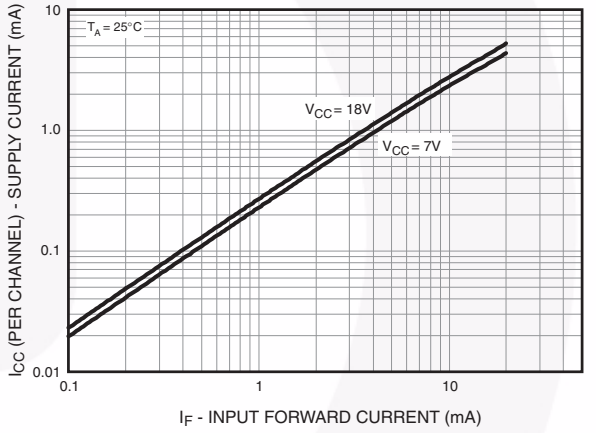


Fig. 11 DC Transfer Characteristics (HCPL0700, HCPL0701)

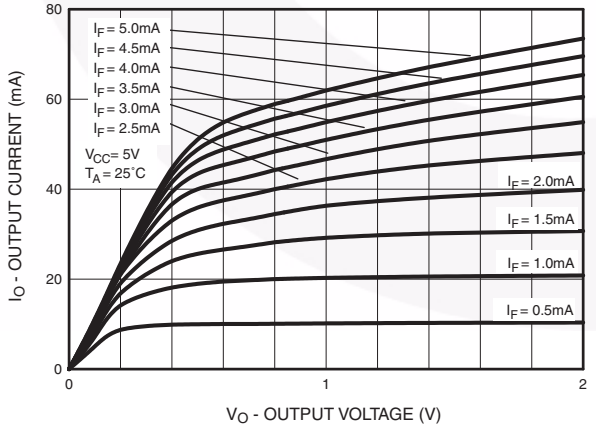
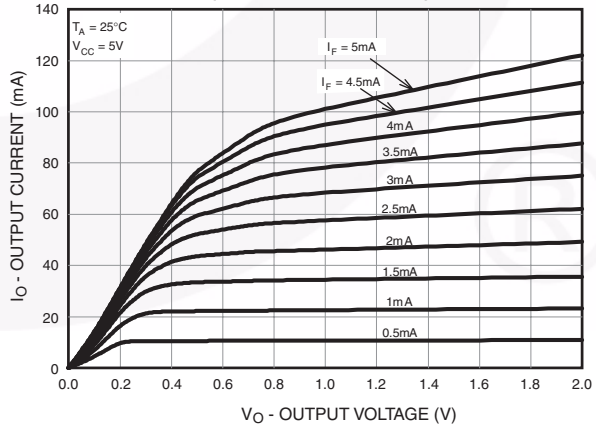
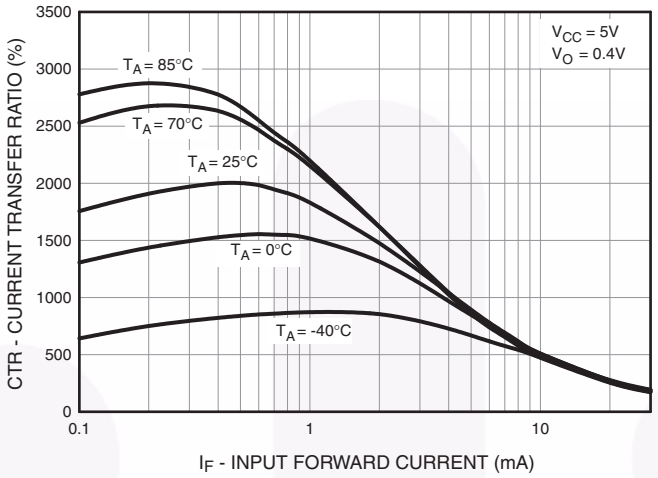


Fig. 12 DC Transfer Characteristics (HCPL0730, HCPL0731)

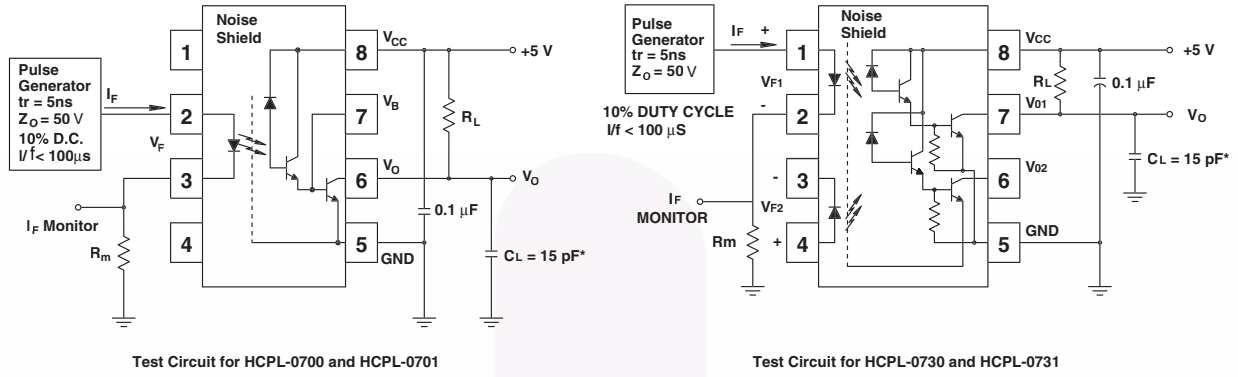


Typical Performance Curves (Continued)

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

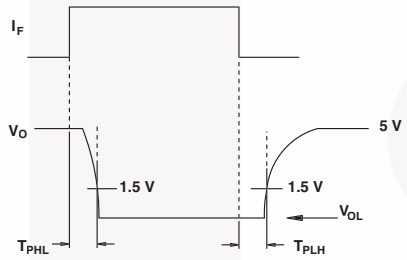
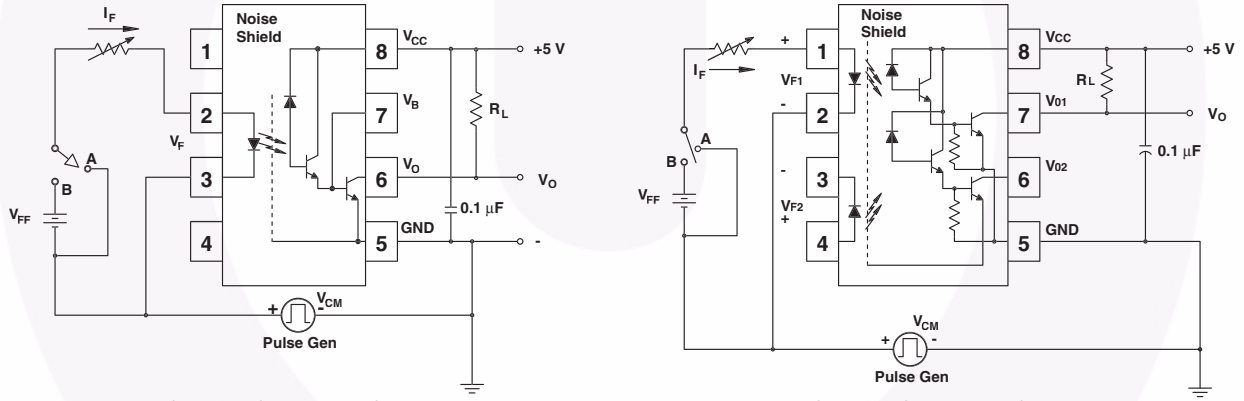


Fig. 14 Switching Time Test Circuit



Test Circuit for HCPL-0700 and HCPL-0701

Test Circuit for HCPL-0730 and HCPL-0731

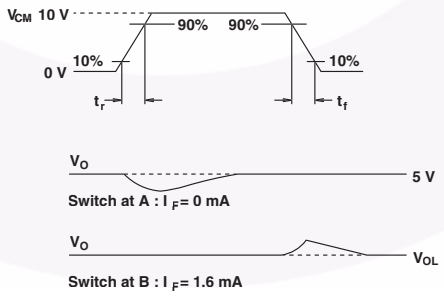
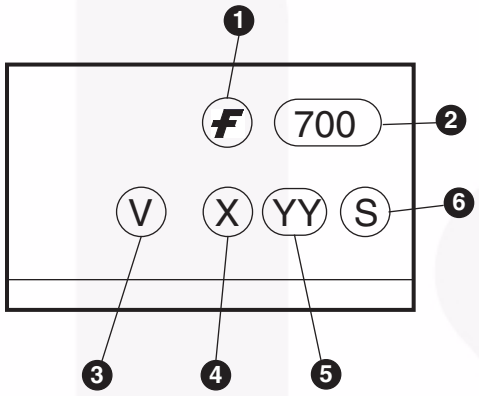


Fig. 15 Common Mode Immunity Test Circuit

Ordering Information

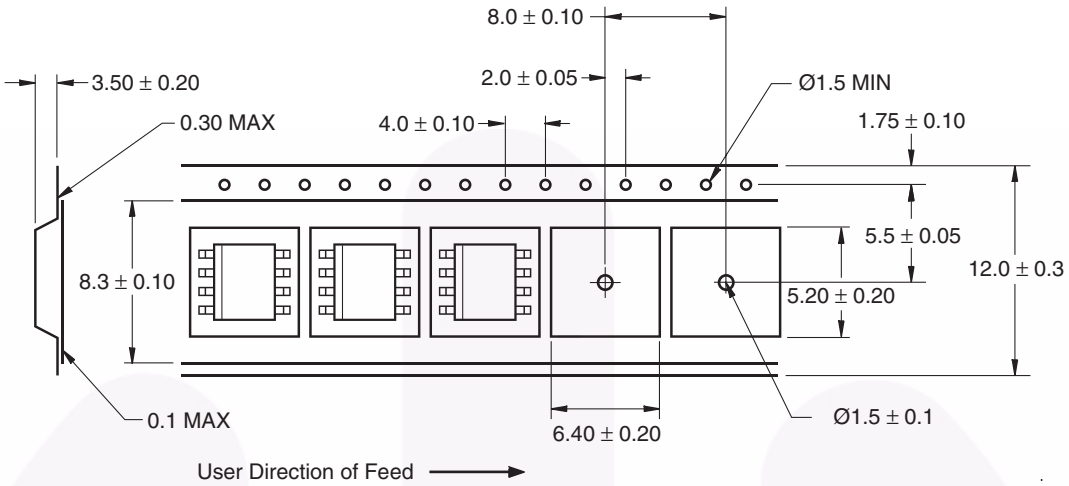
Option	Part Number Example	Description
V	HCPL0700V	VDE 0884
R2	HCPL0700R2	Tape and reel (2500 units per reel)
R2V	HCPL0700R2V	VDE 0884, Tape and reel (2500 units per reel)

Marking Information



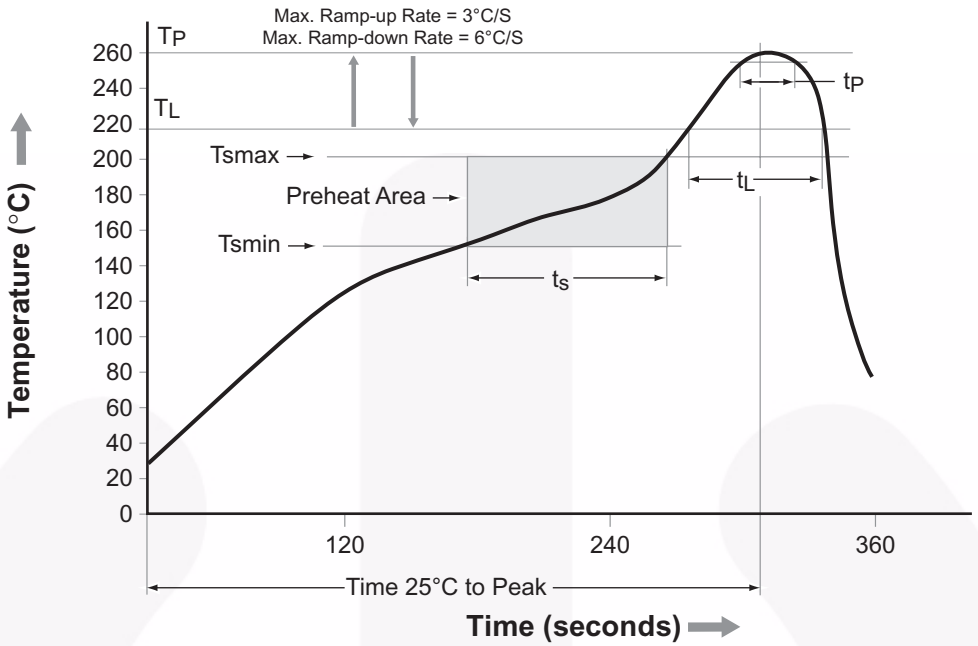
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., ‘3’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

Carrier Tape Specification

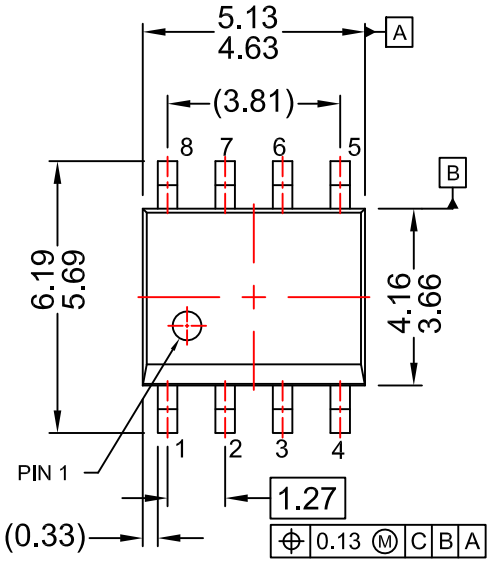


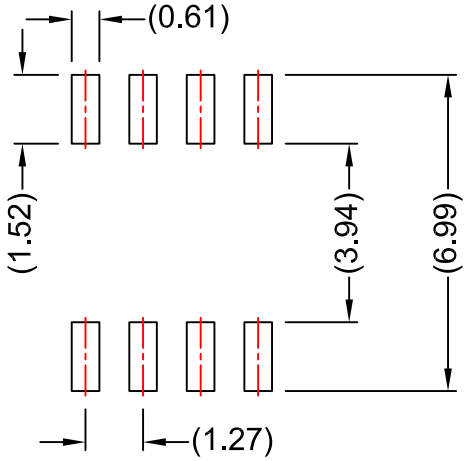
Dimensions in mm

Reflow Profile

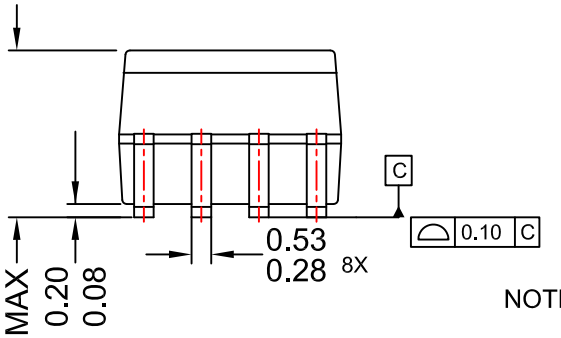


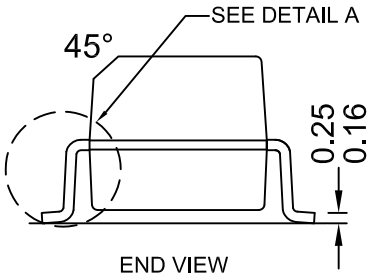
Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60–120 seconds
Ramp-up Rate (t_L to t_P)	3°C/second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60–150 seconds
Peak Body Package Temperature	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.



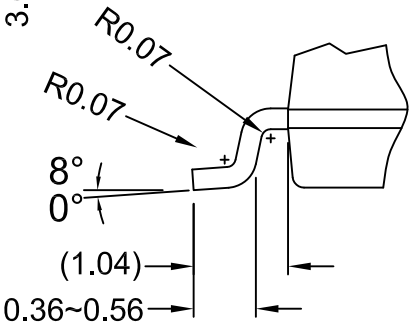


LAND PATTERN RECOMMENDATION





END VIEW



DETAIL A
SCALE: 2:1

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

FAIRCHILD

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
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Email: orderlit@onsemi.com

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Order Literature: http://www.onsemi.com/orderlit

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Authorized Distributor

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HCPL0701 HCPL0701R2V HCPL0701V HCPL0701R2