

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

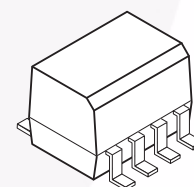
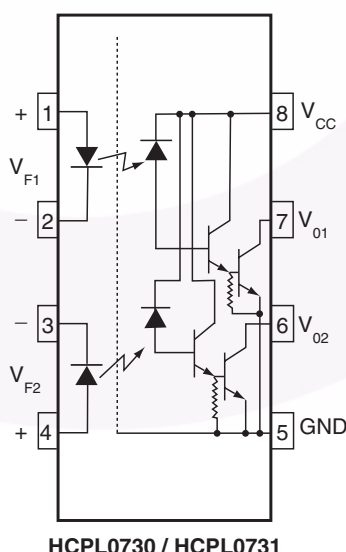
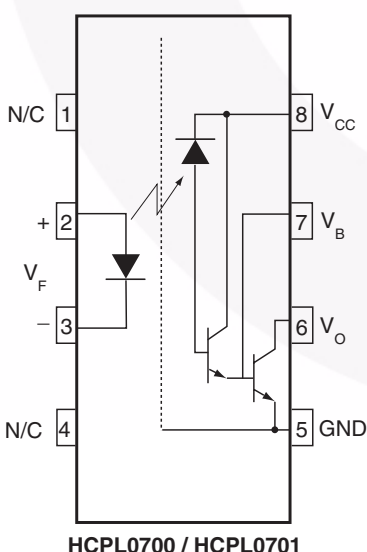
Description

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 _O
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	°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	$I_F = 1.6\text{mA}$	$T_A = 25^\circ\text{C}$	1.0	1.25	1.7	V
					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			
DETECTOR							
I_{OH}	Logic High Output Current	$I_F = 0\text{mA}$, $V_O = V_{CC} = 18\text{V}$	HCPL0701/31		0.01	100	μA
		$I_F = 0\text{mA}$, $V_O = V_{CC} = 7\text{V}$	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	μA
		$I_{F1} = I_{F2} = 0$, $V_{CC} = 7\text{V}$	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	COUPLED	$I_F = 0.5\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$	HCPL0701/31	400		5000	%
	Current Transfer Ratio (Note 1, 2)	$I_F = 1.6\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$	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 HCPL0731			0.4	V
		$I_F = 1.6\text{mA}$, $I_O = 8\text{mA}$, $V_{CC} = 4.5\text{V}$				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	μA
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}		Ω

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

Electrical Characteristics ($T_A = 0$ to 70°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	μs
			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	μs
			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:

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., $V_O > 2.0\text{V}$). 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., $V_O < 0.8\text{ V}$).
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)

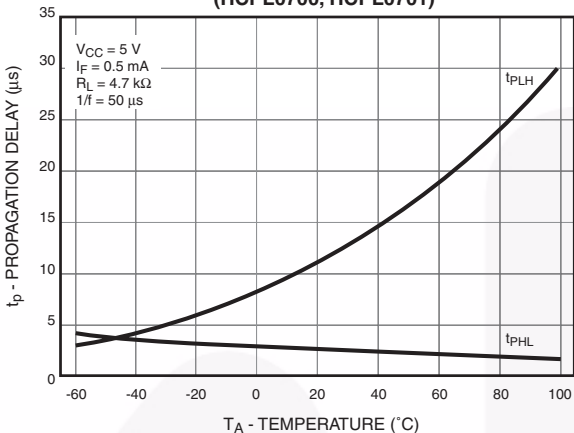


Fig. 2 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)

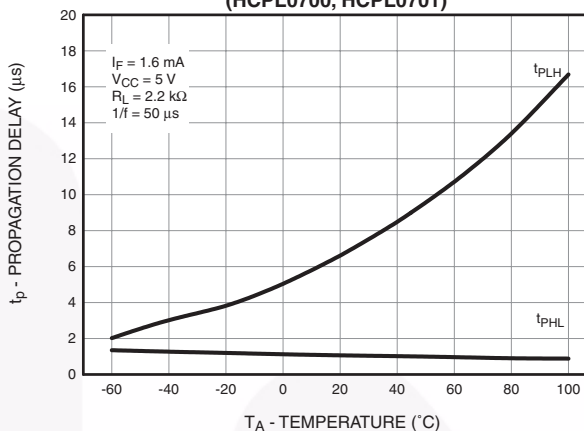


Fig. 3 Propagation Delay vs. Temperature (HCPL0700, HCPL0701)

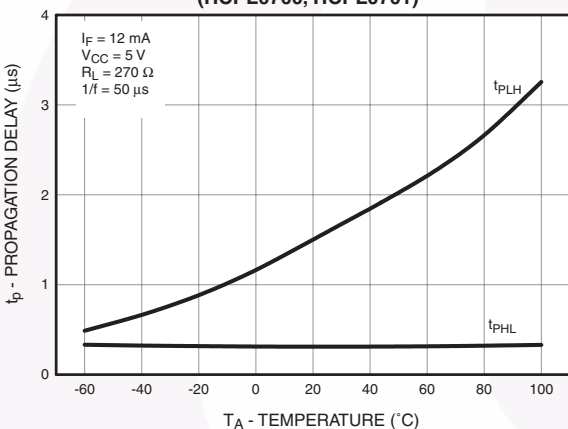


Fig. 4 Logic High Output Current vs. Temperature (HCPL0700, HCPL0701)

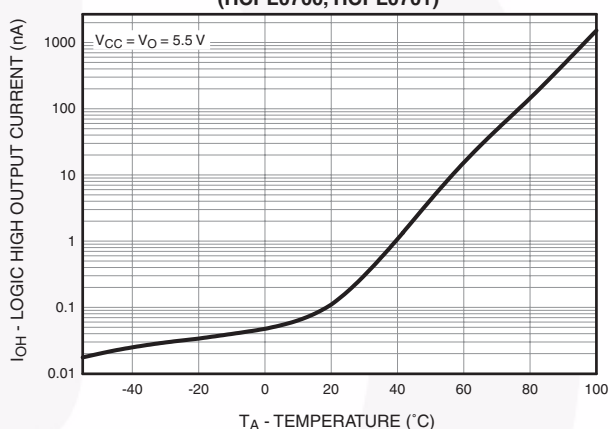


Fig. 5 Propagation Delay vs. Input Forward Current (HCPL0730, HCPL0731)

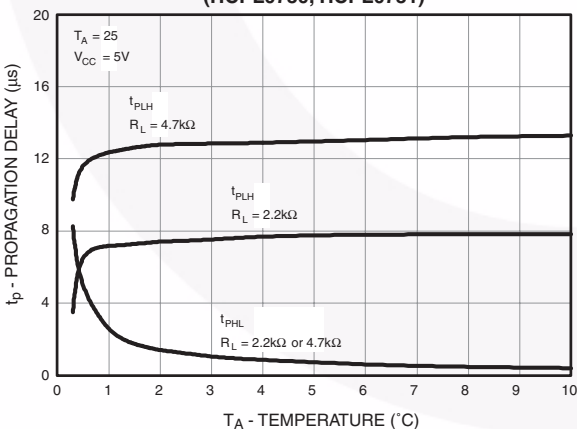
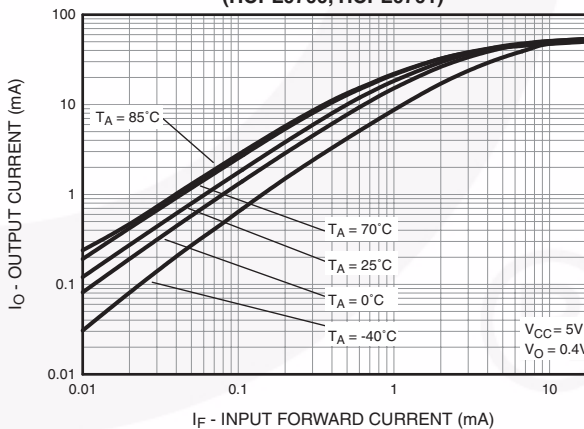


Fig. 6 Output Current vs. Input Forward Current (HCPL0700, HCPL0701)



Typical Performance Curves (Continued)

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

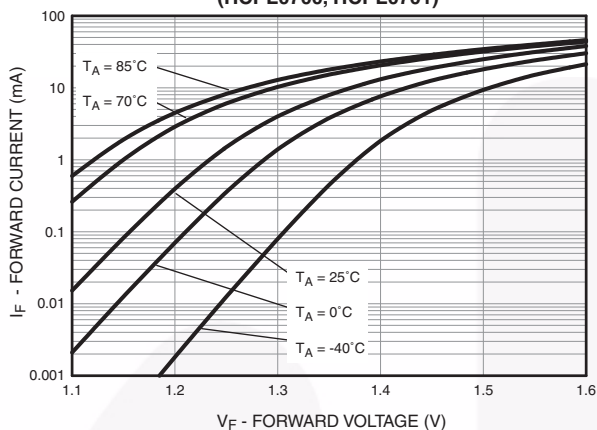


Fig. 8 Input Forward Current vs. Forward Voltage
(HCPL0730, HCPL0731)

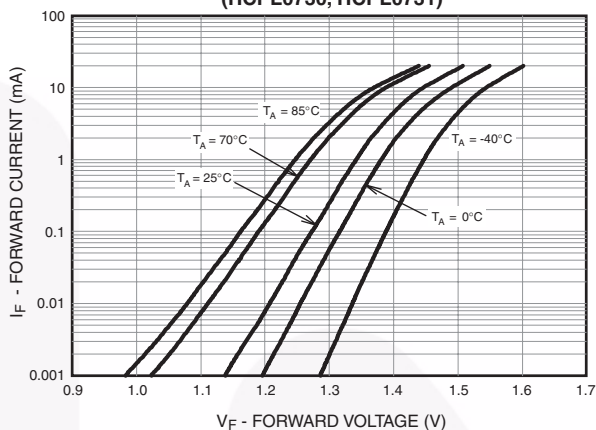


Fig. 9 Logic Low Supply Current vs. Input Forward Current
(HCPL0700, HCPL0701)

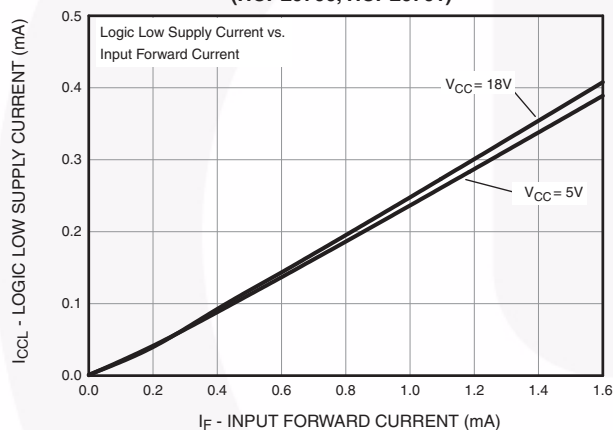


Fig. 10 Supply Current vs. Input Forward Current
(HCPL0730, HCPL0731)

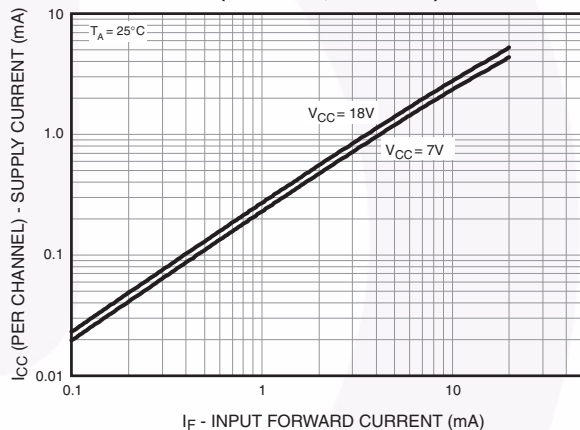


Fig. 11 DC Transfer Characteristics
(HCPL0700, HCPL0701)

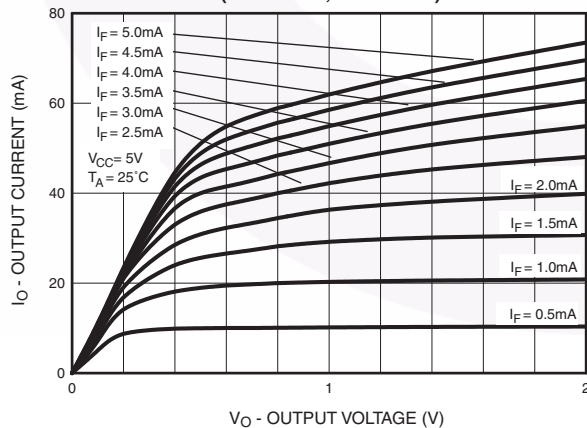
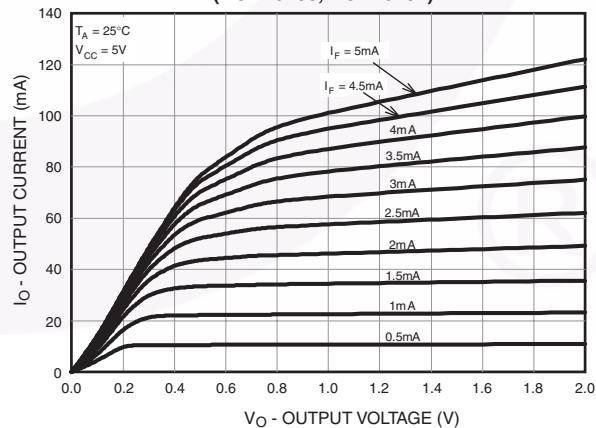
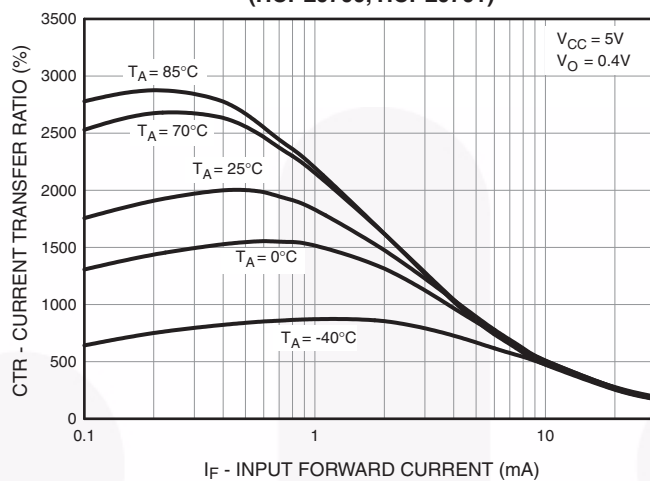


Fig. 12 DC Transfer Characteristics
(HCPL0730, HCPL0731)

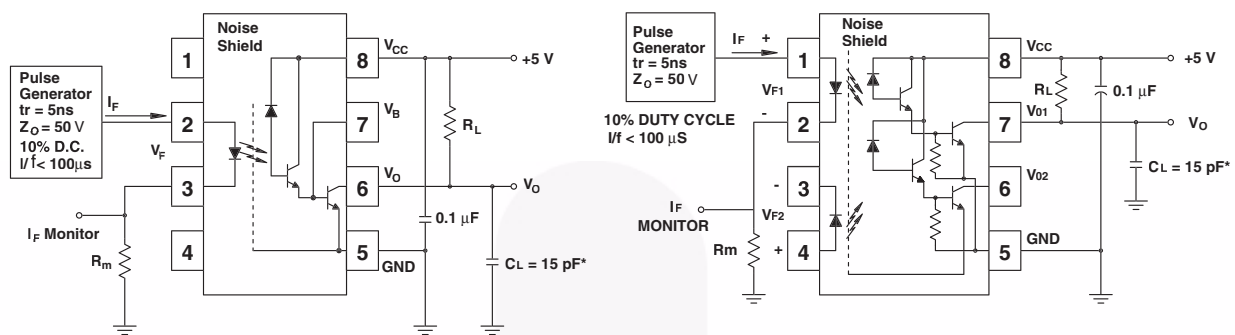


Typical Performance Curves (Continued)

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

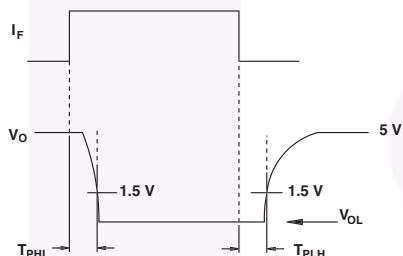
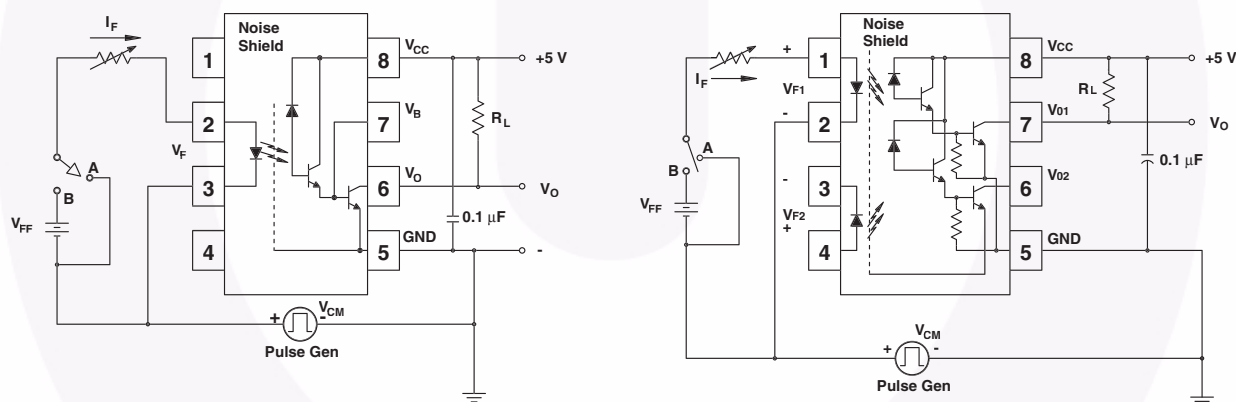


Fig. 14 Switching Time Test Circuit



Test Circuit for HCPL-0700 and HCPL-0701

Test Circuit for HCPL-0730 and HCPL-0731

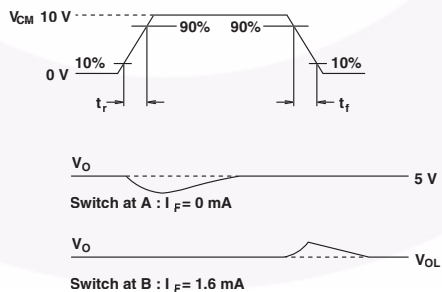
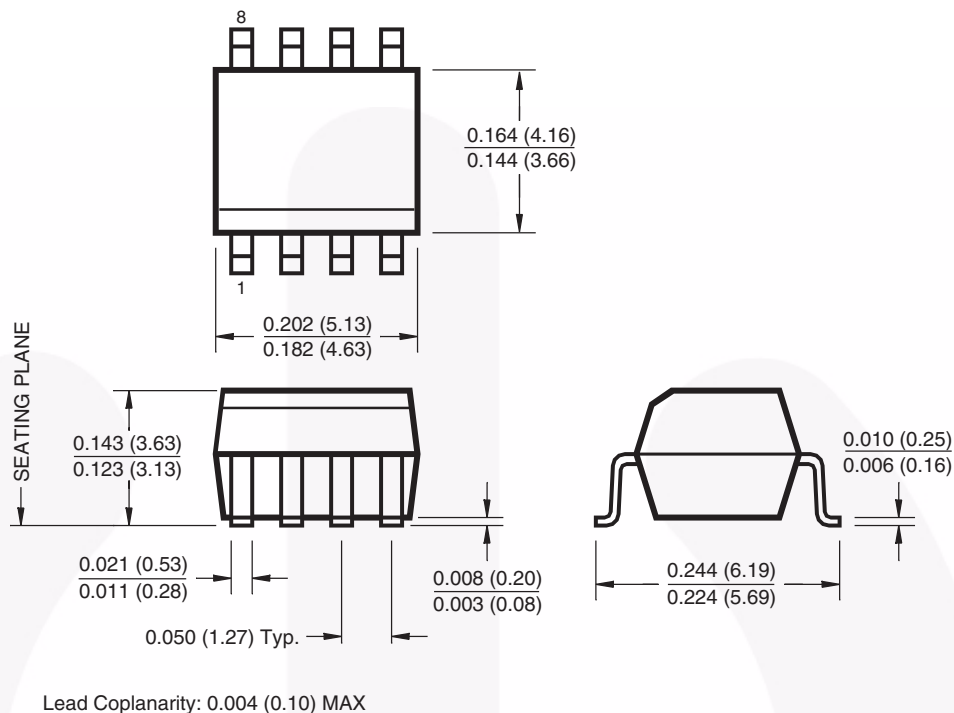


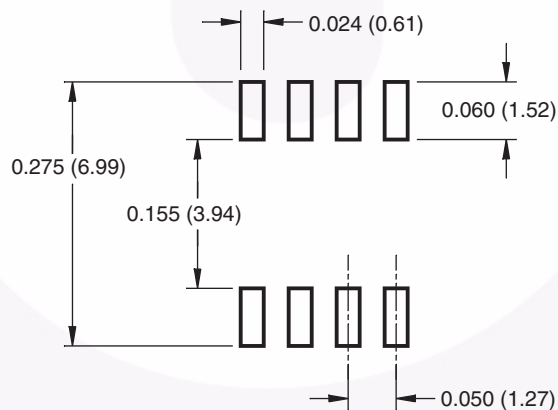
Fig. 15 Common Mode Immunity Test Circuit

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.

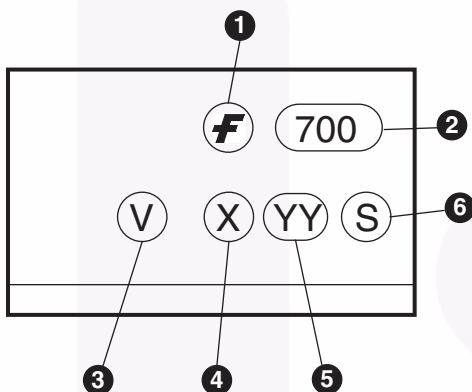
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

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

Ordering Information

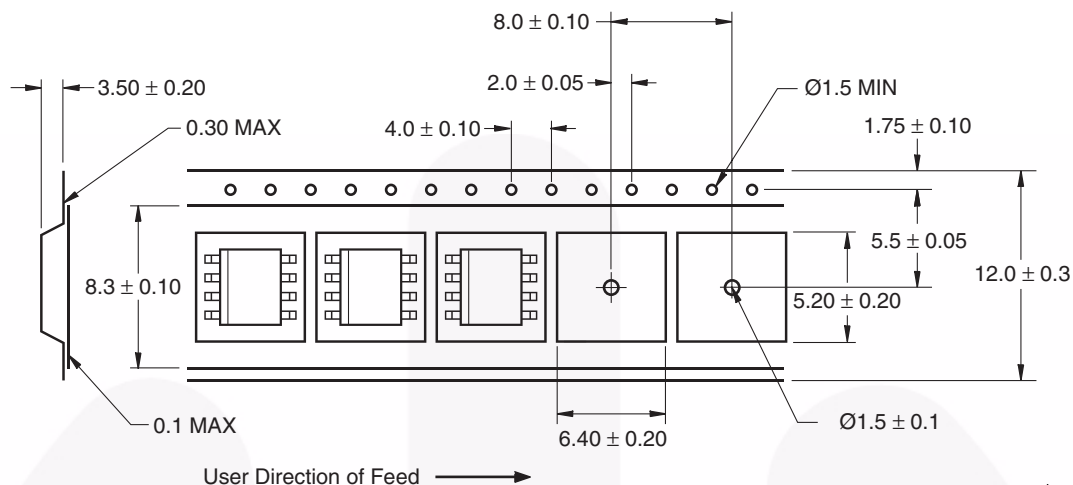
Option	Part Number Example	Description
V	HCPL0700V	VDE 0884
R2	HCPL0700R2	Tape and reel (2500 units per reel)
R2V	HCPL0700R2V	VDE 0884, Tape and reel (2500 units per reel)

Marking Information



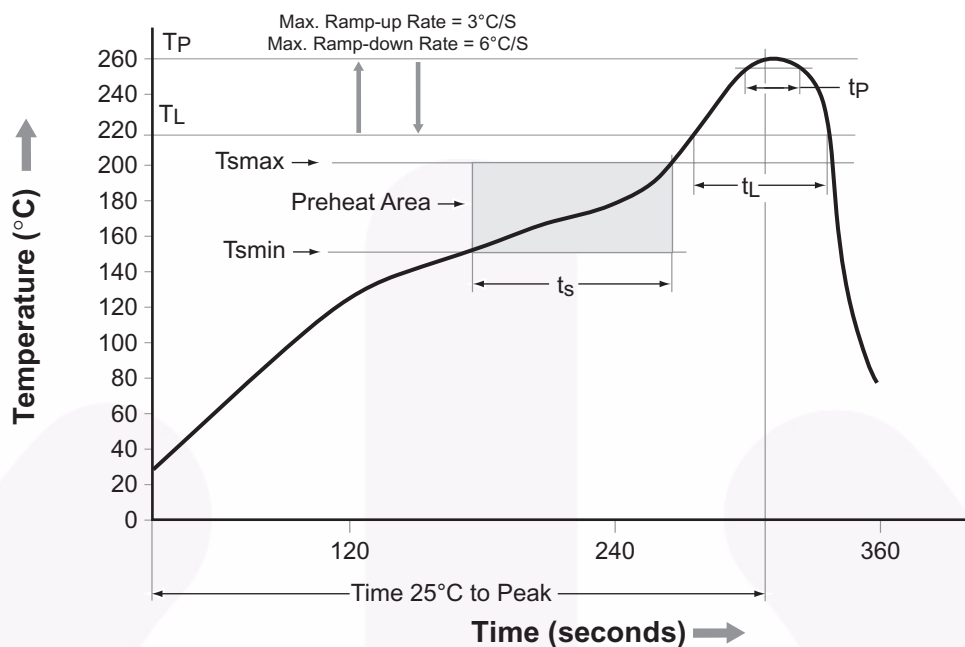
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specification



Dimensions in mm

Reflow Profile



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tssmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (ts) from (Tssmin to Tsmax)	60–120 seconds
Ramp-up Rate (tL to tp)	3°C/second max.
Liquidous Temperature (TL)	217°C
Time (tL) Maintained Above (TL)	60–150 seconds
Peak Body Package Temperature	260°C +0°C / –5°C
Time (tp) within 5°C of 260°C	30 seconds
Ramp-down Rate (TP to TL)	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™	 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™
FastvCore™	OPTOPLANAR®	SupreMOS™	VisualMax™
FETBench™	 TM	SyncFET™	XS™
FlashWriter®*	PDP SPM™	Sync-Lock™	
FPS™	Power-SPM™	 SYSTEM GENERAL®*	

* 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, 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