

HCPL0600, HCPL0601, HCPL0611, HCPL0637, HCPL0638, HCPL0639 High Speed-10 MBit/s Logic Gate Optocouplers

Single Channel: HCPL0600, HCPL0601, HCPL0611
Dual Channel: HCPL0637, HCPL0638, HCPL0639

Features

- Compact SO8 package
- Very high speed-10 MBit/s
- Superior CMR
- Logic gate output
- Storable output (single channel devices)
- Wired OR-open collector
- U.L. recognized (File # E90700)
- VDE approval pending

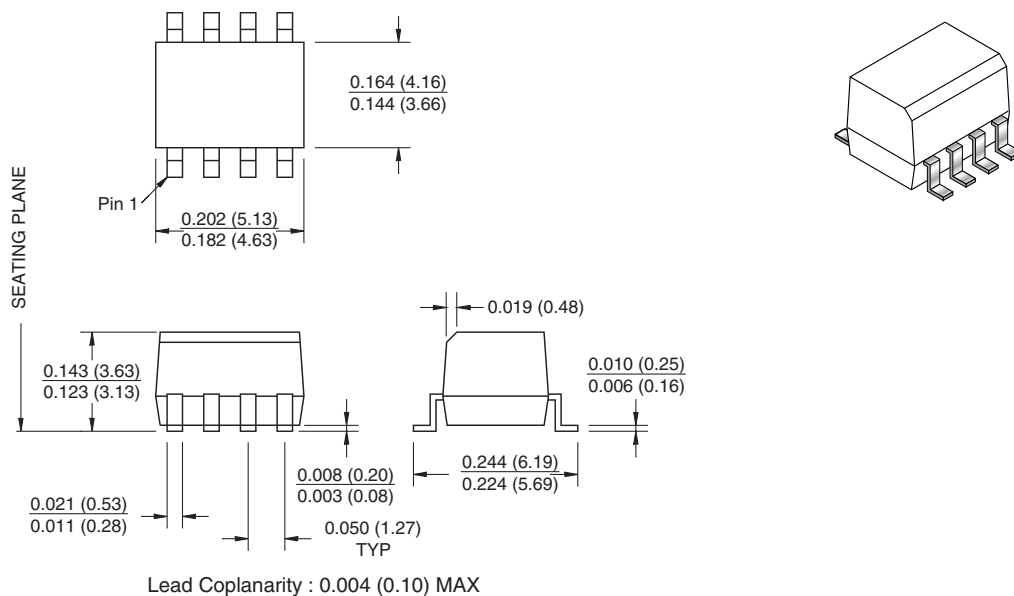
Applications

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

Description

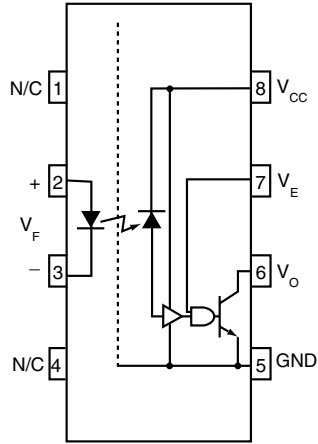
The HCPL06XX optocouplers consist of an AlGaAs LED, optically coupled to a very high speed integrated photo-detector logic gate with a storable output (single channel devices). The devices are housed in a compact small-outline package. This output features an open collector, thereby permitting wired OR outputs. The HCPL0600, HCPL0601 and HCPL0611 output consists of bipolar transistors on a bipolar process while the HCPL0637, HCPL0638, and HCPL0639 output consists of bipolar transistors on a CMOS process for reduced power consumption. The coupled parameters are guaranteed over the temperature range of -40°C to +85°C. An internal noise shield provides superior common mode rejection.

Package Dimensions

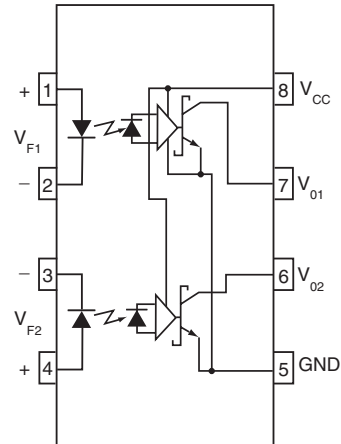


Note:

All dimensions are in inches (millimeters)



Single-channel circuit drawing
(HCPL0600, HCPL0601 and HCPL0611)



Dual-channel circuit drawing
(HCPL0637, HCPL0638 and HCPL0639)

TRUTH TABLE (Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H
H*	NC*	L*
L*	NC*	H*

*Dual channel devices or single channel devices with pin 7 not connected.
A 0.1μF bypass capacitor must be connected between pins 8 and 5. (See note 1)

Absolute Maximum Ratings (No derating required up to 85°C)

Symbol	Parameter		Value	Units
T _{STG}	Storage Temperature		-40 to +125	°C
T _{OPR}	Operating Temperature		-40 to +85	°C
EMITTER				
I _F	DC/Average Forward Input Current (each channel)	Single Channel	50	mA
		Dual Channel		
V _E	Enable Input Voltage Not to exceed V _{CC} by more than 500mV	Single Channel	5.5	V
V _R	Reverse Input Voltage (each channel)		5.0	V
P _I	Power Dissipation	Single Channel	45	mW
		Dual Channel		
DETECTOR				
V _{CC} (1 minute max)	Supply Voltage		7.0	V
I _O	Output Current (each channel)	Single Channel	50	mA
		Dual Channel	15	
V _O	Output Voltage (each channel)		7.0	V
P _O	Collector Output Power Dissipation	Single Channel	85	mW
		Dual Channel	85	

Recommended Operating Conditions

Symbol	Parameter		Min.	Max.	Units
I _{FL}	Input Current, Low Level		0	250	μA
I _{FH}	Input Current, High Level		*6.3	15	mA
V _{CC}	Supply Voltage, Output		4.5	5.5	V
V _{EL}	Enable Voltage, Low Level	Single Channel only	0	0.8	V
V _{EH}	Enable Voltage, High Level	Single Channel only	2.0	V _{CC}	V
T _A	Operating Temperature		-40	+85	°C
N	Fan Out (TTL load)	Single Channel		8	TTL Loads
		Dual Channel		5	
R _L	Output Pull-up		330	4K	Ω

*6.3mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0mA or less

Electrical Characteristics ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ Unless otherwise specified.)

Individual Component Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.**	Max.	Unit
EMITTER						
V_F	Input Forward Voltage	$I_F = 10\text{mA}$ $T_A = 25^\circ\text{C}$			1.8	V
					1.75	
B_{VR}	Input Reverse Breakdown Voltage	$I_R = 10\mu\text{A}$	5.0			V
$\Delta V_F/\Delta T_A$	Input Diode Temperature Coefficient	$I_F = 10\text{mA}$		-1.5		mV/ $^\circ\text{C}$
DETECTOR						
I_{CCH}	High Level Supply Current	$I_F = 0\text{mA}$, $V_{CC} = 5.5\text{V}$	$V_E = 0.5\text{V}$ Single Channel		10	mA
			Dual Channel		15	
I_{CCL}	Low Level Supply Current	$I_F = 10\text{mA}$, $V_{CC} = 5.5\text{V}$	$V_E = 0.5\text{V}$ Single Channel		13	mA
			Dual Channel		21	
I_{EL}	Low Level Enable Current	$V_{CC} = 5.5\text{V}$, $V_E = 0.5\text{V}$			-1.6	mA
I_{EH}	High Level Enable Current	$V_{CC} = 5.5\text{V}$, $V_E = 2.0\text{V}$			-1.6	mA
V_{EH}	High Level Enable Voltage	$V_{CC} = 5.5\text{V}$, $I_F = 10\text{mA}$	2.0			V
V_{EL}	Low Level Enable Voltage	$V_{CC} = 5.5\text{V}$, $I_F = 10\text{mA}^{(2)}$			0.8	V

Switching Characteristics ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $V_{CC} = 5\text{V}$, $I_F = 7.5\text{mA}$ Unless otherwise specified.)

Symbol	AC Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Unit
T_{PLH}	Propagation Delay Time to Output High Level	$R_L = 350\Omega$, $C_L = 15\text{pF}^{(3)}$ (Fig. 20) $T_A = 25^\circ\text{C}$	All	20		75 100	ns
T_{PHL}	Propagation Delay Time to Output Low Level	$R_L = 350\Omega$, $C_L = 15\text{pF}^{(4)}$ (Fig. 20) $T_A = 25^\circ\text{C}$	All	25		75 100	ns
$ T_{PHL} - T_{PLH} $	Pulse Width Distortion	$R_L = 350\Omega$, $C_L = 15\text{pF}$ (Fig. 20)	All			35	ns
t_r	Output Rise Time (10-90%)	$R_L = 350\Omega$, $C_L = 15\text{pF}^{(5)}$ (Fig. 20)	Single Ch		50		ns
			Dual Ch		17		
t_f	Output Fall Time (90-10%)	$R_L = 350\Omega$, $C_L = 15\text{pF}^{(6)}$ (Fig. 20)	Single Ch		12		ns
			Dual Ch		5		
t_{ELH}	Enable Propagation Delay Time to Output High Level	$I_F = 7.5\text{mA}$, $V_{EH} = 3.5\text{V}$, $R_L = 350\Omega$, $C_L = 15\text{pF}^{(7)}$ (Fig. 21)	HCPL0600 HCPL0601 HCPL0611		20		ns
t_{EHL}	Enable Propagation Delay Time to Output Low Level	$I_F = 7.5\text{mA}$, $V_{EH} = 3.5\text{V}$, $R_L = 350\Omega$, $C_L = 15\text{pF}^{(8)}$ (Fig. 21)	HCPL0600 HCPL0601 HCPL0611		20		ns
ICM_{Hl}	Common Mode Transient Immunity (at Output High Level)	$R_L = 350\Omega$, $T_A = 25^\circ\text{C}$, $I_F = 0\text{mA}$, V_{OH} (Min.) = $2.0\text{V}^{(9)}$ (Fig. 22, 23)	$ V_{CM} = 10\text{V}$	HCPL0600 HCPL0637			V/ μs
			$ V_{CM} = 50\text{V}$	HCPL0601 HCPL0638	5000		
			$ V_{CM} = 1,000\text{V}$	HCPL0611	10,000		
				HCPL0639	25,000		
ICM_{Hl}	Common Mode Transient Immunity (at Output Low Level)	$R_L = 350\Omega$, $T_A = 25^\circ\text{C}$, $I_F = 7.5\text{mA}$, V_{OL} (Max.) = $0.8\text{V}^{(10)}$ (Fig. 22, 23)	$ V_{CM} = 10\text{V}$	HCPL0600 HCPL0637			V/ μs
			$ V_{CM} = 50\text{V}$	HCPL0601 HCPL0638	5000		
			$ V_{CM} = 1,000\text{V}$	HCPL0611	10,000		
				HCPL0639	25,000		

Transfer Characteristics ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ Unless otherwise specified.)

Symbol	DC Characteristics	Test Conditions	Min.	Typ.**	Max.	Unit
I_{OH}	High Level Output Current	$V_{CC} = 5.5\text{V}$, $V_O = 5.5\text{V}$, $I_F = 250\mu\text{A}$, $V_E = 2.0\text{V}^{(2)}$			100	μA
V_{OL}	Low Level Output Voltage	$V_{CC} = 5.5\text{V}$, $I_F = 5\text{mA}$, $V_E = 2.0\text{V}$, $I_{OL} = 13\text{mA}^{(2)}$			0.6	V
I_{FT}	Input Threshold Current	$V_{CC} = 5.5\text{V}$, $V_O = 0.6\text{V}$, $V_E = 2.0\text{V}$, $I_{OL} = 13\text{mA}$			5	mA

Isolation Characteristics ($T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ Unless otherwise specified.)

Symbol	Characteristics	Test Conditions	Min.	Typ.**	Max.	Unit
I_{I-O}	Input-Output Insulation Leakage Current	Relative humidity = 45%, $T_A = 25^\circ\text{C}$, $t = 5\text{s}$, $V_{I-O} = 3000\text{VDC}^{(11)}$			1.0*	μA
V_{ISO}	Withstand Insulation Test Voltage	$R_H < 50\%$, $T_A = 25^\circ\text{C}$, $I_{I-O} \leq 2\mu\text{A}$, $t = 1\text{min.}^{(11)}$	3750			V_{RMS}
R_{I-O}	Resistance (Input to Output)	$V_{I-O} = 500\text{V}^{(11)}$		10^{12}		Ω
C_{I-O}	Capacitance (Input to Output)	$f = 1\text{MHz}^{(11)}$		0.6		pF

** All typical values are at $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$

Notes:

1. The V_{CC} supply to each optoisolator must be bypassed by a $0.1\mu\text{F}$ capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.
2. Enable Input – No pull up resistor required as the device has an internal pull up resistor.
3. t_{PLH} – Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
4. t_{PHL} – Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
5. t_r – Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
6. t_f – Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
7. t_{ELH} – Enable input propagation delay is measured from the 1.5V level on the HIGH to LOW transition of the input voltage pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
8. t_{EHL} – Enable input propagation delay is measured from the 1.5V level on the LOW to HIGH transition of the input voltage pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
9. CM_H – The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., $V_{OUT} > 2.0\text{V}$). Measured in volts per microsecond ($\text{V}/\mu\text{s}$).
10. CM_L – The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_{OUT} < 0.8\text{V}$). Measured in volts per microsecond ($\text{V}/\mu\text{s}$).
11. Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

Typical Performance Curves (HCPL0600, HCPL0601 and HCPL0611 only)

Fig. 1 Forward Current vs. Input Forward Voltage

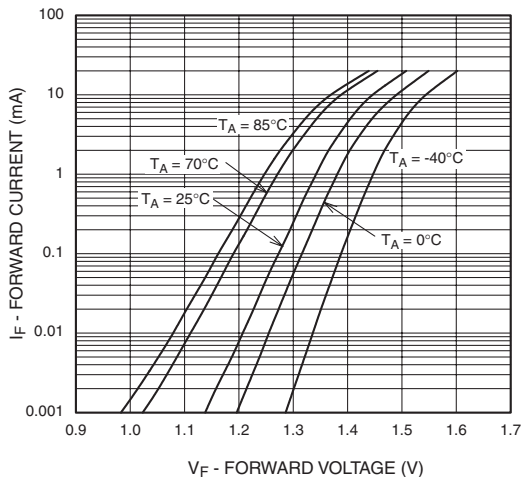


Fig. 2 Output Voltage vs. Forward Current

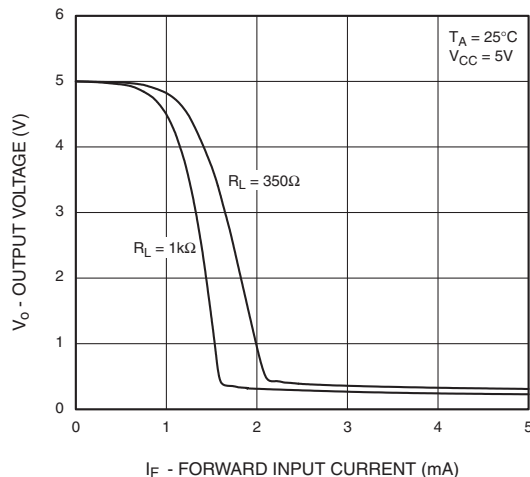


Fig. 3 Input Threshold Current vs. Temperature

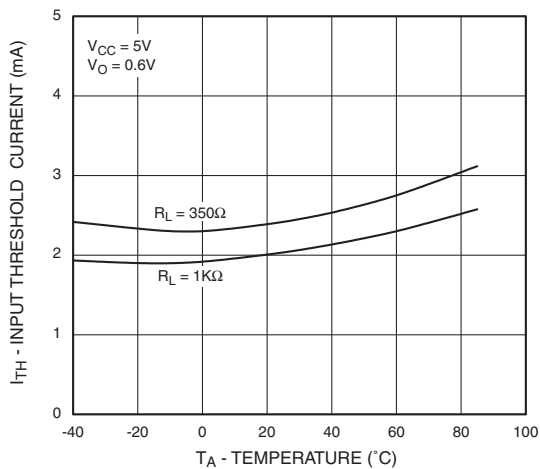
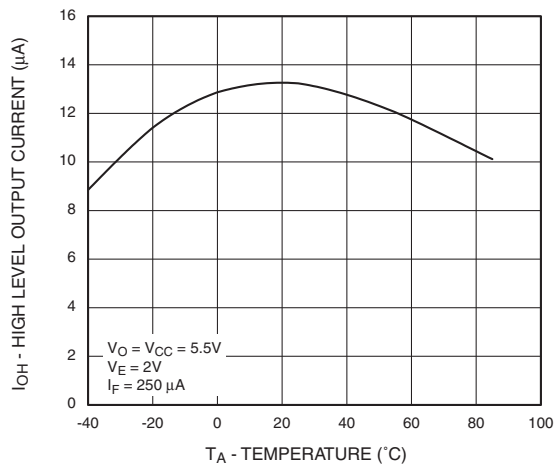


Fig. 4 High Level Output Current vs. Temperature



Typical Performance Curves (HCPL0600, and HCPL0601 and HCPL0611 only)

Fig. 5 Low Level Output Voltage vs. Temperature

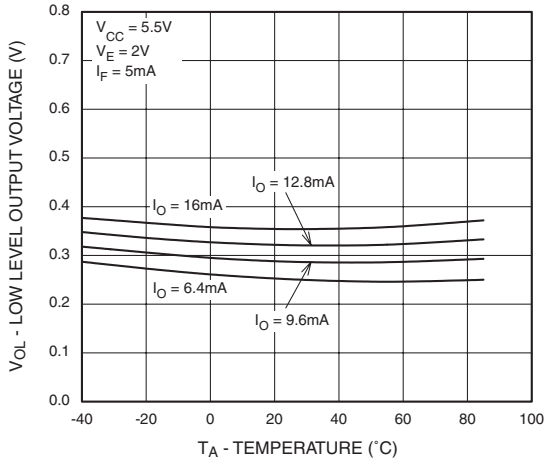


Fig. 6 Low Level Output Current vs. Temperature

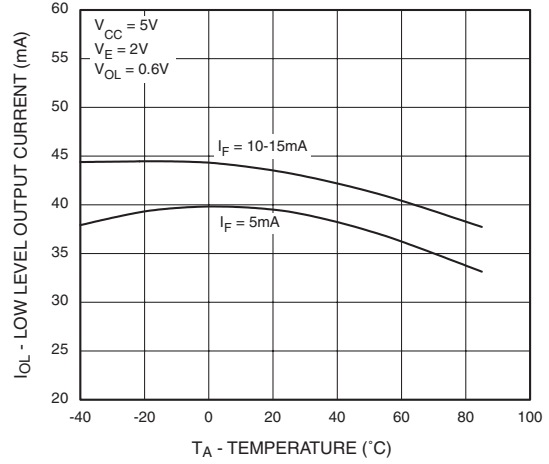


Fig. 7 Propagation Delay vs. Temperature

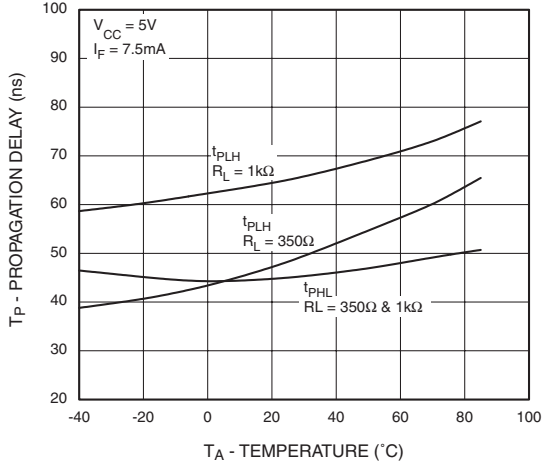
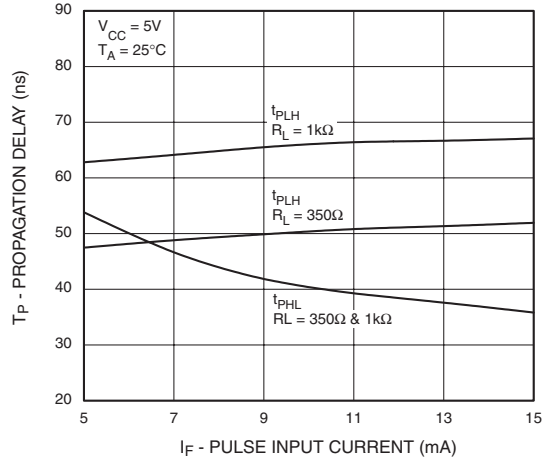


Fig. 8 Propagation Delay vs. Pulse Input Current



Typical Performance Curves (HCPL0600, HCPL0601 and HCPL0611 only)

Fig. 9 Typical Enable Propagation Delay vs. Temperature

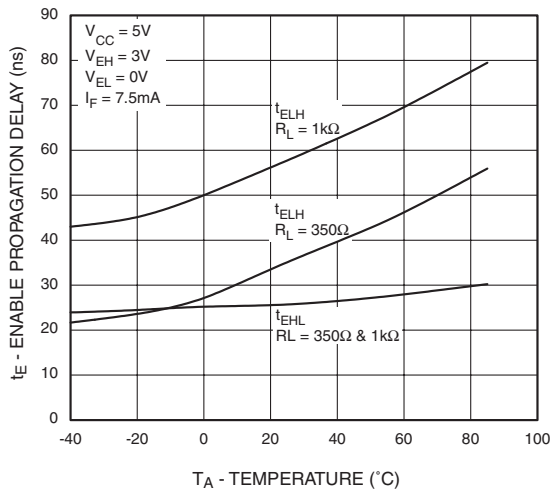


Fig. 10 Typical Rise and Fall Time vs. Temperature

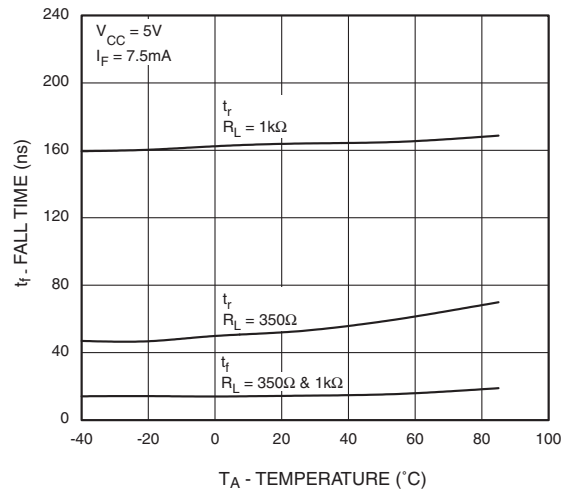
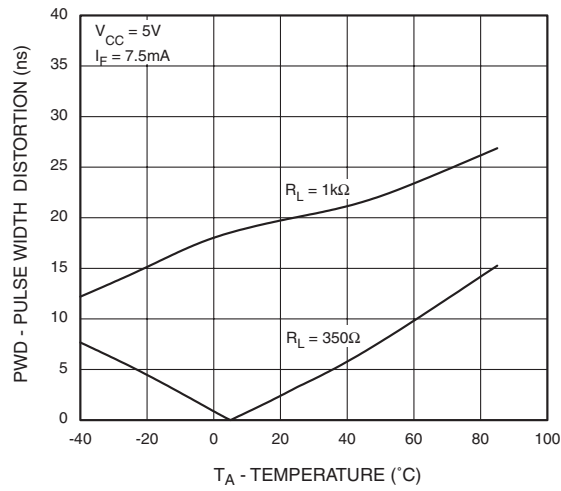


Fig. 11 Typical Pulse Width Distortion vs. Temperature



Typical Performance Curves (HCPL0637, HCPL0638 and HCPL0639 only)

Fig. 12 Input Forward Current vs. Forward Voltage

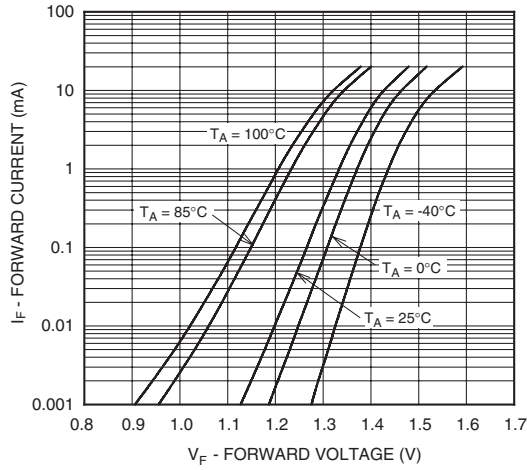


Fig. 13 Input Threshold Current vs. Ambient Temperature

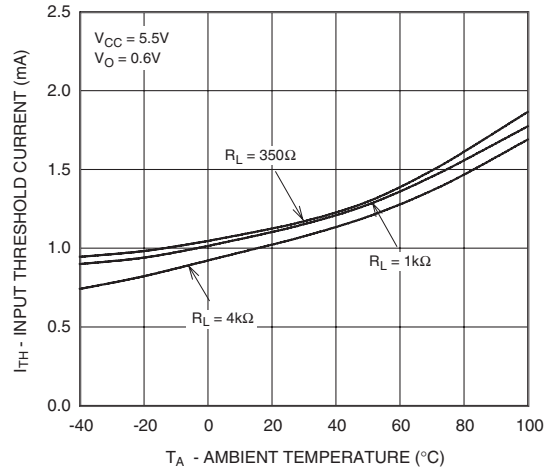


Fig. 14 High Level Output Current vs. Ambient Temperature

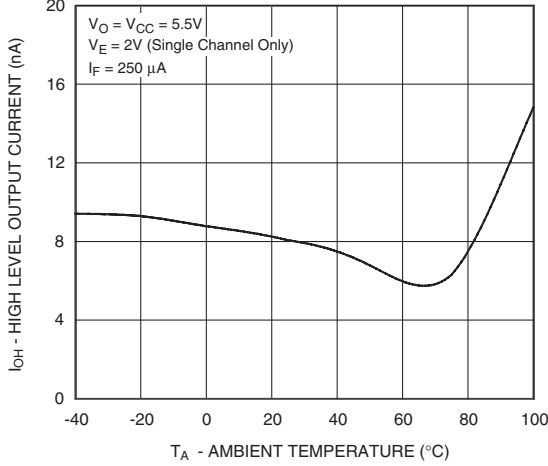


Fig. 15 Low Level Output Current vs. Ambient Temperature

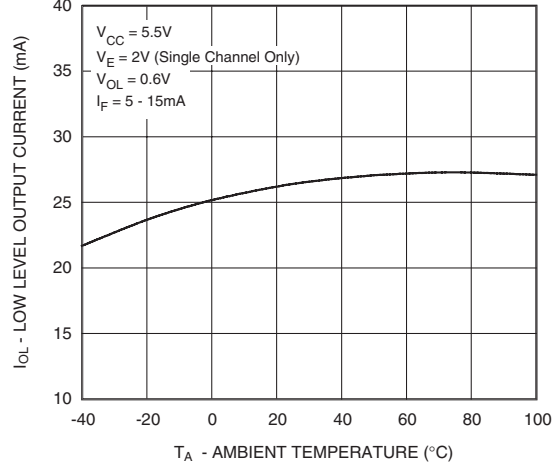


Fig. 16 Low Level Output Voltage vs. Ambient Temperature

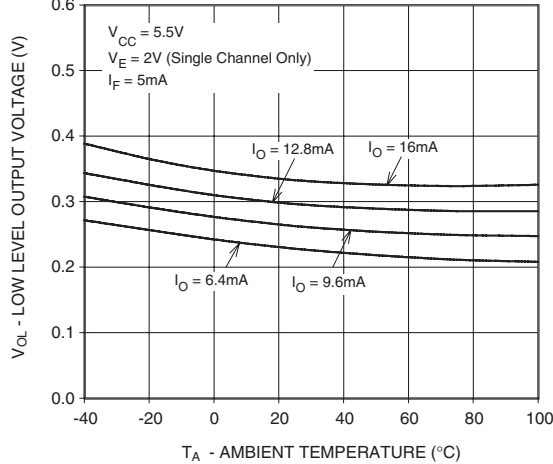
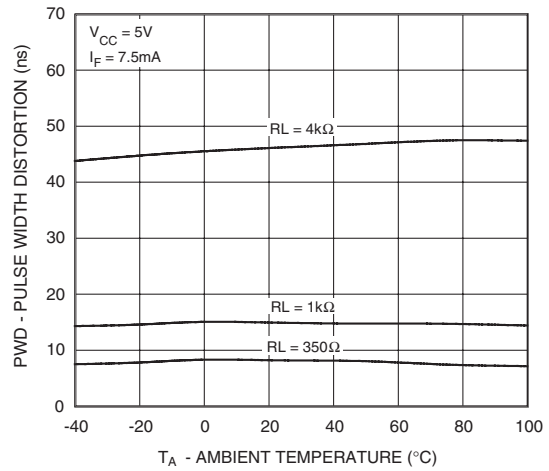


Fig. 17 Pulse Width Distortion vs. Ambient Temperature



Typical Performance Curves (HCPL0637, HCPL0638 and HCPL0639 only)

Fig. 18 Propagation Delay vs. Ambient Temperature

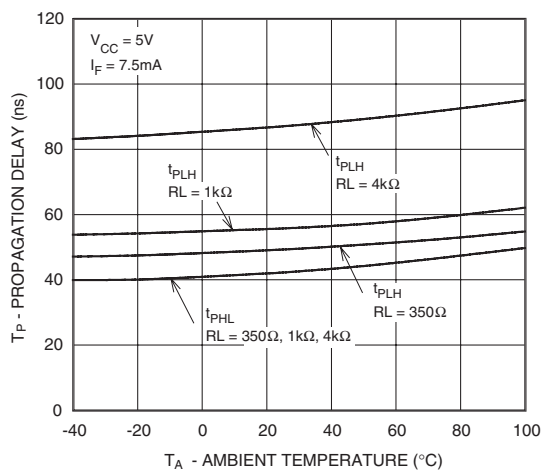
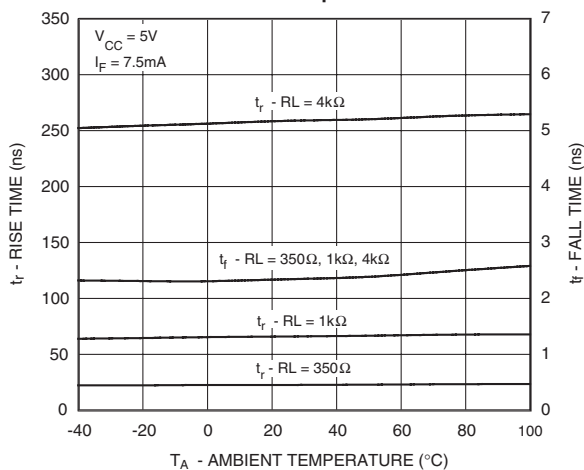


Fig. 19 Rise and Fall Times vs. Ambient Temperature



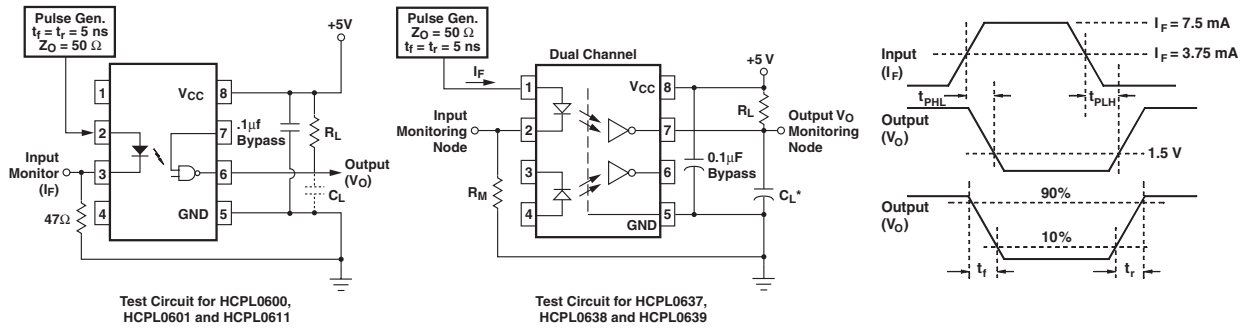


Fig. 20 Test Circuit and Waveforms for t_{PLH} , t_{PHL} , t_r and t_f .

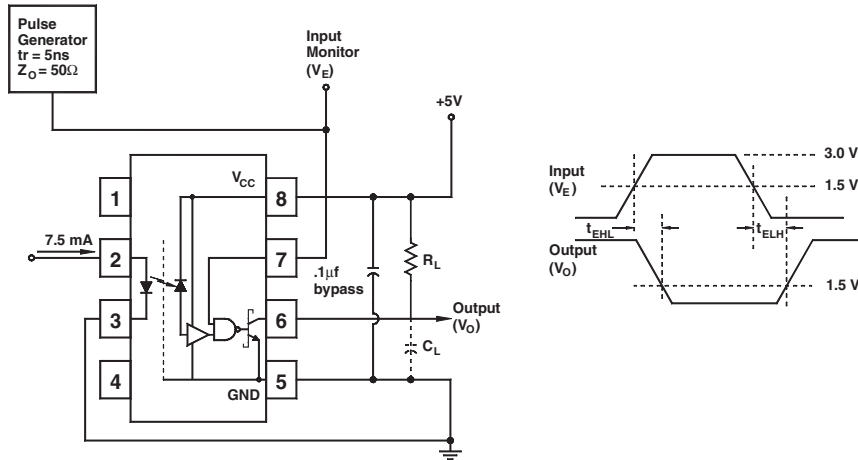
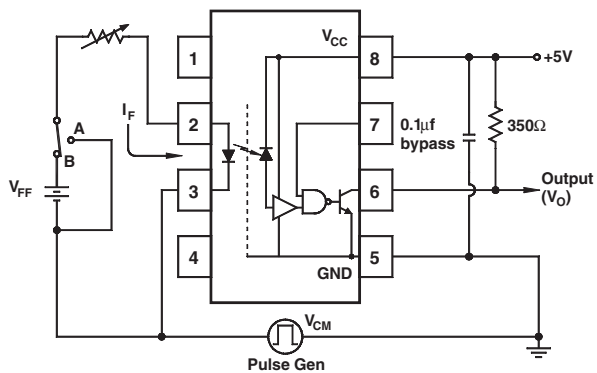


Fig. 21 Test Circuit t_{EHL} and t_{ELH} .



Test Circuit for HCPL0600, HCPL0601, and HCPL0611

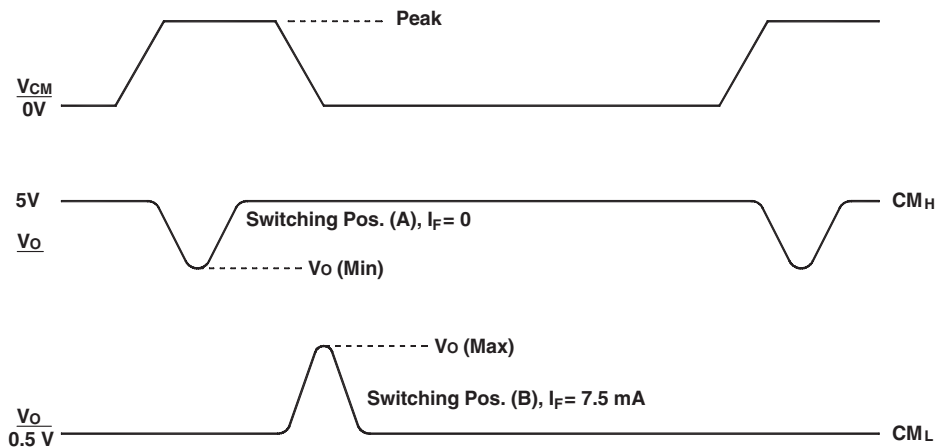
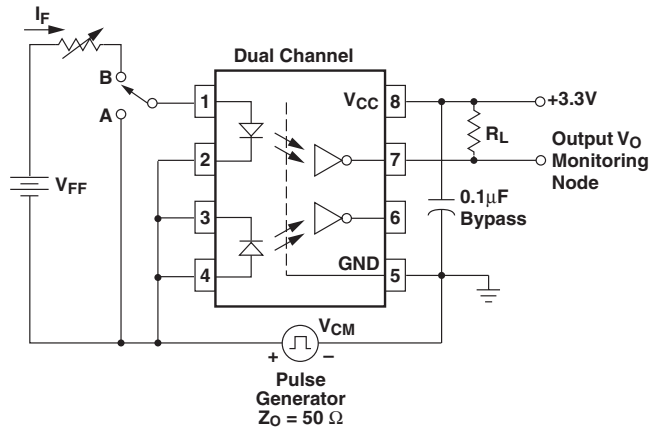


Fig. 22 Test Circuit Common Mode Transient Immunity (HCPL0600, HCPL0601 and HCPL0611)



Test Circuit for HCPL0637, HCPL0638 and HCPL0639

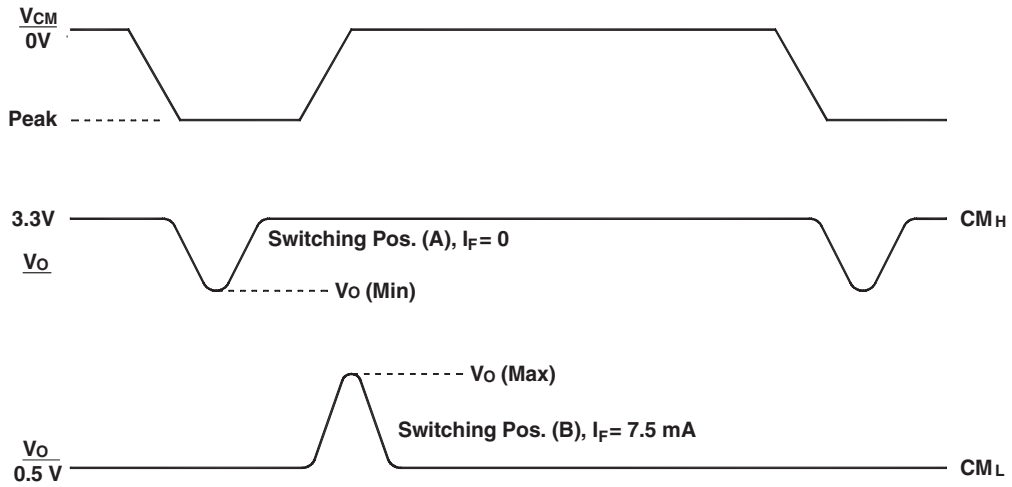
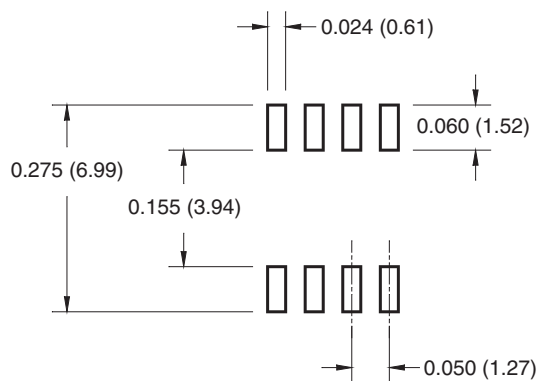


Fig. 23 Test Circuit Common Mode Transient Immunity (HCPL0637, HCPL0638 and HCPL0639)

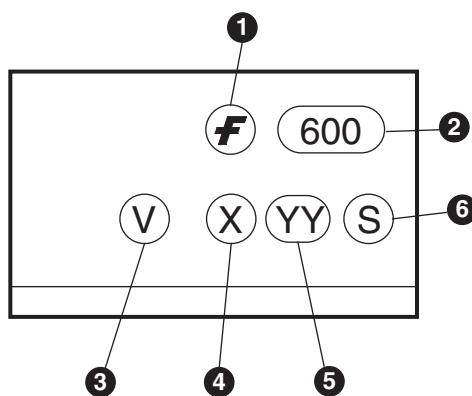
8-Pin Small Outline



Ordering Information

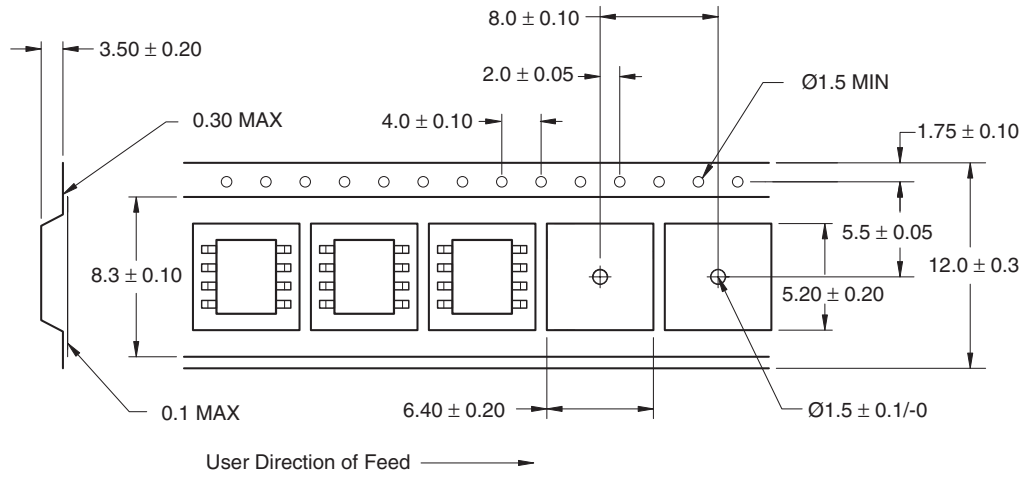
Option	Order Entry Identifier	Description
No Suffix	HCPL0600	Shipped in tubes (50 units per tube)
V	HCPL0600V	VDE0884 (pending approval)
R1	HCPL0600R1	Tape and Reel (500 units per reel)
R1V	HCPL0600R1V	VDE0884 (pending approval), Tape and Reel (500 units per reel)
R2	HCPL0600R2	Tape and Reel (2500 units per reel)
R2V	HCPL0600R2V	VDE0884 (pending approval), Tape and Reel (2500 units per reel)

Marking Information

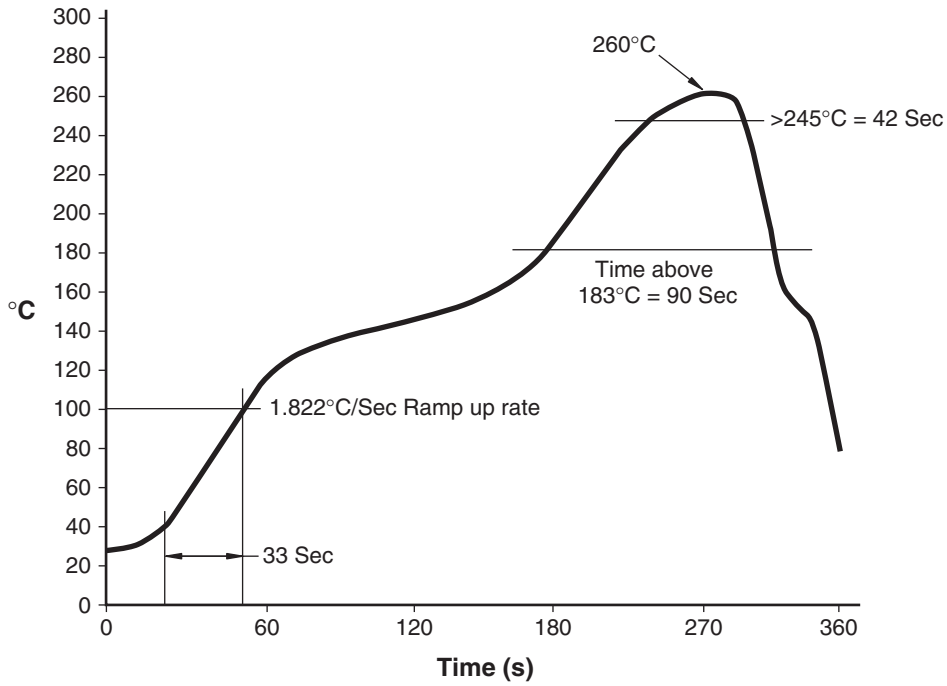


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Carrier Tape Specifications



Reflow Profile



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DOME™	ImpliedDisconnect™	Power247™	SuperSOT™-6	
EcoSPARK™	IntelliMAX™	PowerEdge™	SuperSOT™-8	
E ² C MOS™	ISOPLANAR™	PowerSaver™	SyncFET™	
EnSigna™	LittleFET™	PowerTrench®	TCM™	
FACT®	MICROCOUPLER™	QFET®	TinyBoost™	
FAST®	MicroFET™	QS™	TinyBuck™	
FAST _r ™	MicroPak™	QT Optoelectronics™	TinyPWM™	
FPST™	MICROWIRE™	Quiet Series™	TinyPower™	
FRFET™	MSX™	RapidConfigure™	TinyLogic®	
	MSXPro™	RapidConnect™	TINYOPTO™	
Across the board. Around the world.™		µSerDes™	TruTranslation™	
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Programmable Active Droop™				

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- A critical component is 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.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and 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.
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