FAIRCHILD SEMICONDUCTOR®

April 2009

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
- Strobable output (single channel devices)
- Wired OR-open collector
- U.L. recognized (File # E90700)
- IEC60747-5-2 approved (VDE option)
  – HCPL0600, HCPL0601, HCPL0611 only

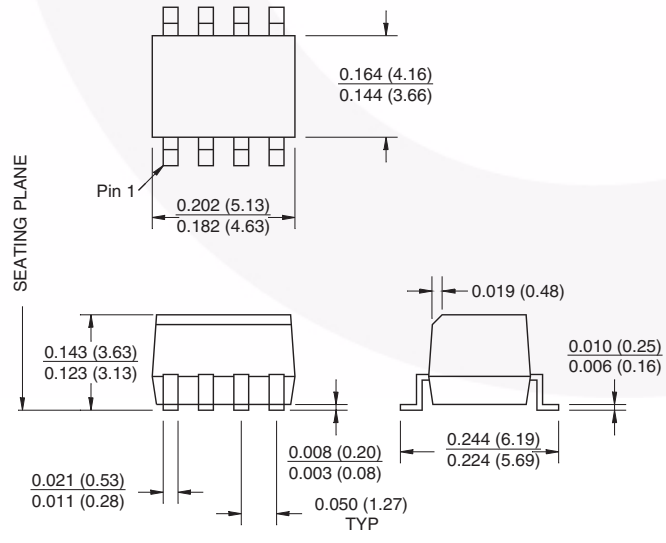
Applications

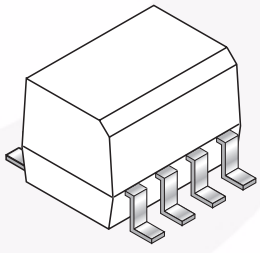
- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

Description

The HCPL06XX optocouplers consist of an AlGaAS LED, optically coupled to a very high speed integrated photo-detector logic gate with a strobable 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.

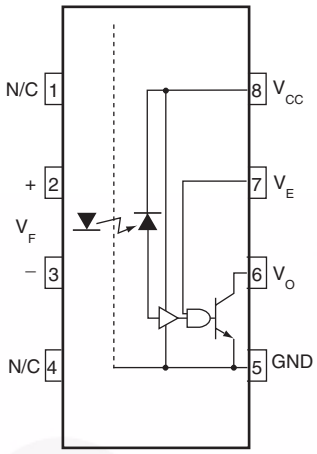
Package Dimensions



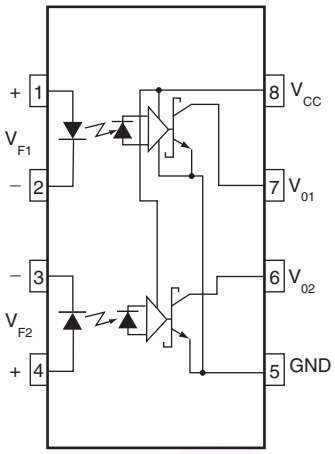


Lead Coplanarity : 0.004 (0.10) MAX

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)

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
EMITTER				
I_F	DC/Average Forward Input Current (each channel)	Single Channel	50	mA
		Dual Channel		
V_E	Enable Input Voltage Not to exceed VCC 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

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

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°C to +85°C unless otherwise specified.)

Individual Component Characteristics

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

Switching Characteristics (T_A = -40°C to +85°C, V_{CC} = 5 V, I_F = 7.5 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 = 350Ω, C_L = 15pF(3) (Fig. 20)	T_A = 25°C	All	20		75	ns
							100	
T_{PHL}	Propagation Delay Time to Output Low Level	R_L = 350Ω, C_L = 15pF(4) (Fig. 20)	T_A = 25°C	All	25		75	ns
							100	
$\lvert T_{PHL}-T_{PLH}\rvert$	Pulse Width Distortion	R_L = 350Ω, C_L = 15pF (Fig. 20)		All			35	ns
t_r	Output Rise Time (10-90%)	R_L = 350Ω, C_L = 15pF(5) (Fig. 20)		Single Ch		50		ns
				Dual Ch		17		
t_f	Output Fall Time (90-10%)	R_L = 350Ω, C_L = 15pF(6) (Fig. 20)		Single Ch		12		ns
				Dual Ch		5		
t_{ELH}	Enable Propagation Delay Time to Output High Level	I_F = 7.5mA, V_{EH} = 3.5V, R_L = 350Ω, C_L = 15pF(7) (Fig. 21)		HCPL0600 HCPL0601 HCPL0611		20		ns
t_{EHL}	Enable Propagation Delay Time to Output Low Level	I_F = 7.5mA, V_{EH} = 3.5V, R_L = 350Ω, C_L = 15 pF(8) (Fig. 21)		HCPL0600 HCPL0601 HCPL0611		20		ns
$\lvert CM_H\rvert$	Common Mode Transient Immunity (at Output High Level)	R_L = 350Ω, T_A =25°C, I_F = 0mA, V_{OH} (Min.) = 2.0 V(9) (Fig. 22, 23)	$\lvert V_{CM}\rvert$ = 10V	HCPL0600 HCPL0637				V/µs
			$\lvert V_{CM}\rvert$ = 50V	HCPL0601 HCPL0638	5000			
			$\lvert V_{CM}\rvert$ = 1,000V	HCPL0611	10,000			
				HCPL0639	25,000			
$\lvert CM_H\rvert$	Common Mode Transient Immunity (at Output Low Level)	R_L = 350Ω, T_A =25°C, I_F = 7.5mA, V_{OL} (Max.) = 0.8 V(10) (Fig. 22, 23)	$\lvert V_{CM}\rvert$ = 10V	HCPL0600 HCPL0637				V/µs
			$\lvert V_{CM}\rvert$ = 50V	HCPL0601 HCPL0638	5000			
			$\lvert V_{CM}\rvert$ = 1,000V	HCPL0611	10,000			
				HCPL0639	25,000			

Transfer Characteristics (T_A = -40°C to +85°C unless otherwise specified.)

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

Isolation Characteristics (T_A = -40°C to +85°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°C, t = 5s, V_{I-O} = 3000 VDC(11)			1.0*	µA
V_{ISO}	Withstand Insulation Test Voltage	R_H < 50%, T_A = 25°C, I_{I-O} ≤ 2µA, t = 1 min.(11)	3750			V_{RMS}
R_{I-O}	Resistance (Input to Output)	V_{I-O} = 500V(11)		10^{12}		Ω
C_{I-O}	Capacitance (Input to Output)	f = 1MHz(11)		0.6		pF

*All typical values are at V_{CC} = 5 V, T_A = 25°C

Notes:

1. The V_{CC} supply to each optoisolator must be bypassed by a 0.1µF 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 3.75mA 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 3.75mA 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} > 2.0V). Measured in volts per microsecond (V/µs).
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} < 0.8V). Measured in volts per microsecond (V/µs).
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

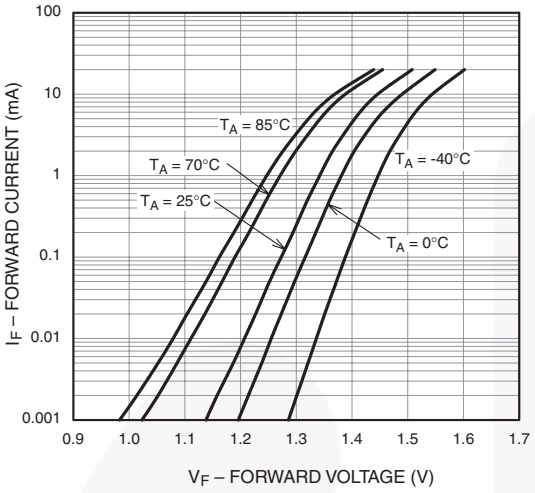


Fig. 2 Output Voltage vs. Forward Current

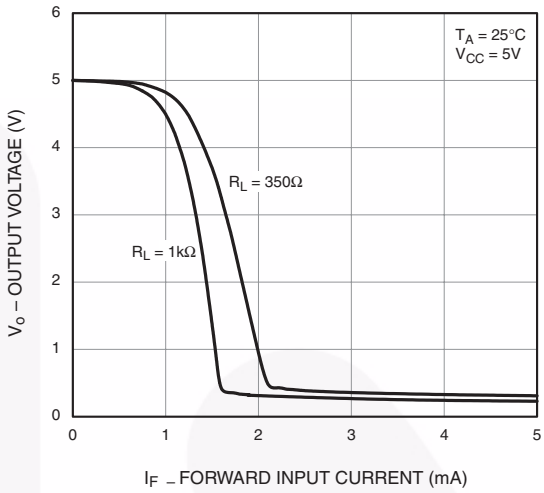


Fig. 3 Input Threshold Current vs. Temperature

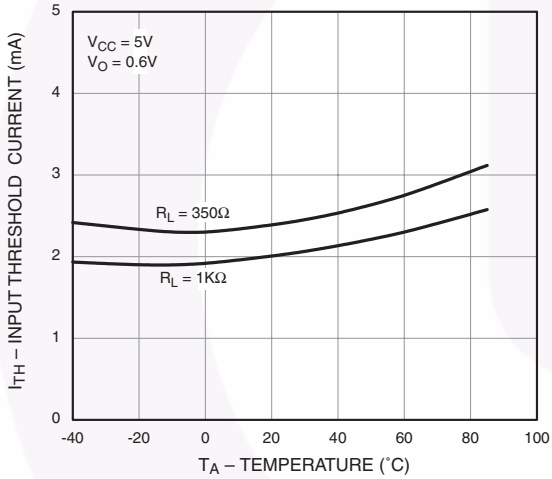
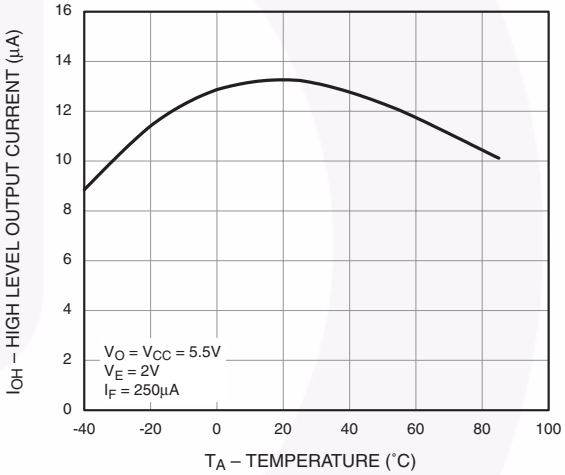


Fig. 4 High Level Output Current vs. Temperature



Typical Performance Curves (HCPL0600, HCPL0601 and HCPL0611 only)

Fig. 5 Low Level Output Voltage vs. Temperature

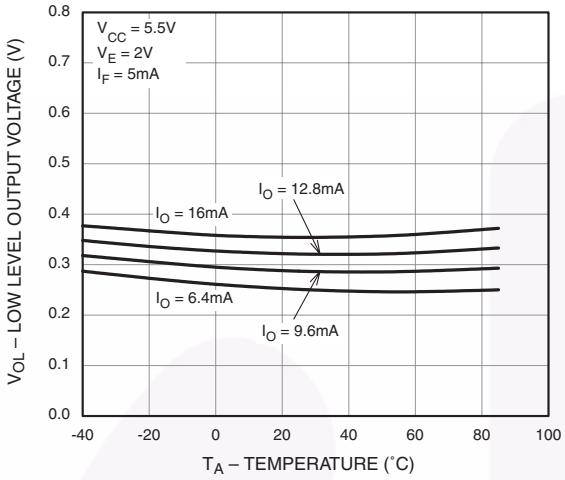


Fig. 6 Low Level Output Current vs. Temperature

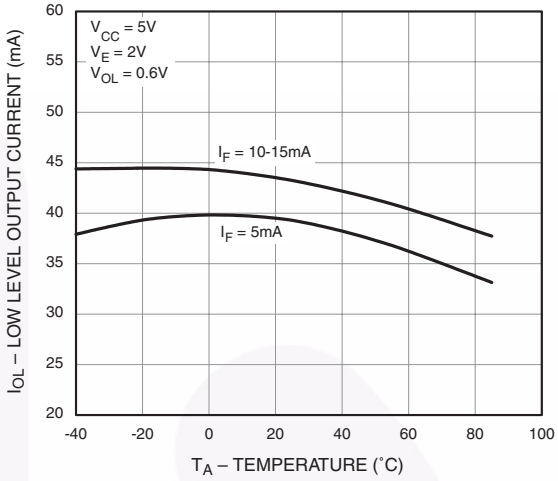


Fig. 7 Propagation Delay vs. Temperature

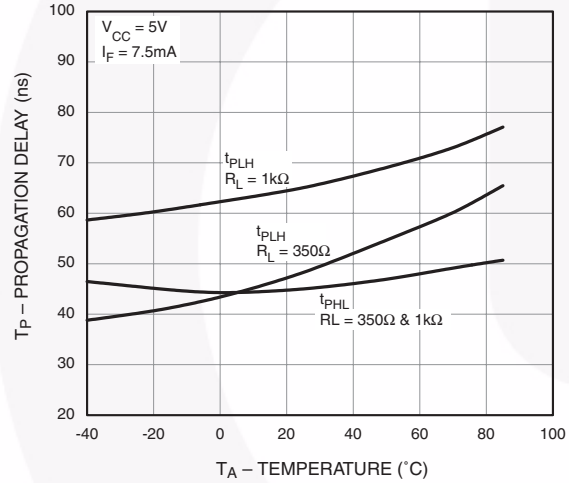
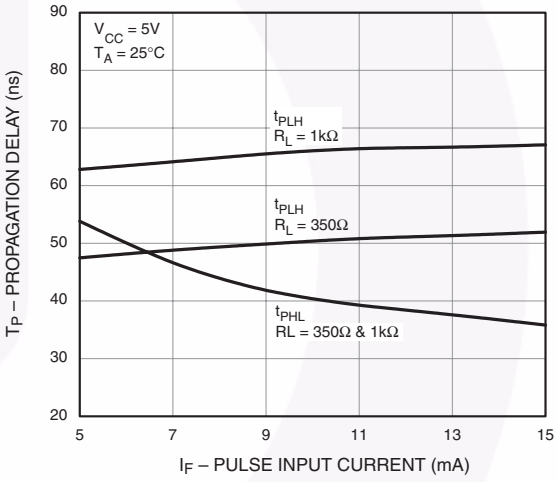


Fig. 8 Propagation Delay vs. Pulse Input Current



Typical Performance Curves (HCPL0600, HCPL0601 and HCPL0611 only)

Fig. 9 Typical Enable Propagation Delay vs. Temparature

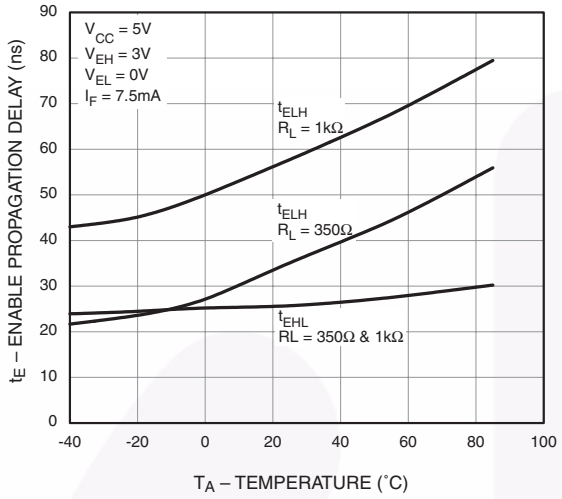


Fig. 10 Typical Rise and Fall Time vs. Temperature

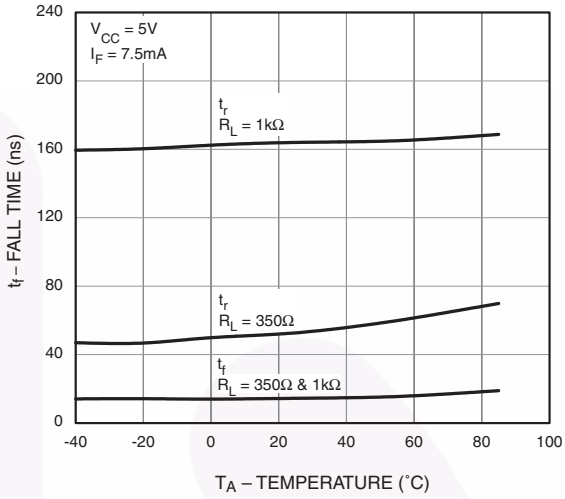
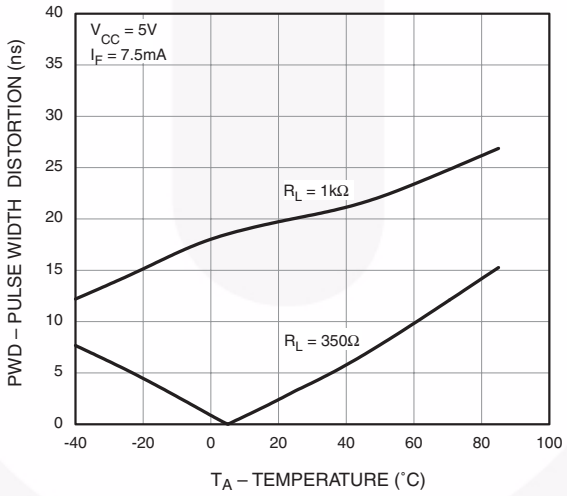


Fig. 11 Typical Pulse Width Distortion vs. Temperature



Typical Performance Curves (HCPL0637, HCPL0638 and HCPL0639 only)

Fig. 12 Input Forward Current vs. Forward Voltage

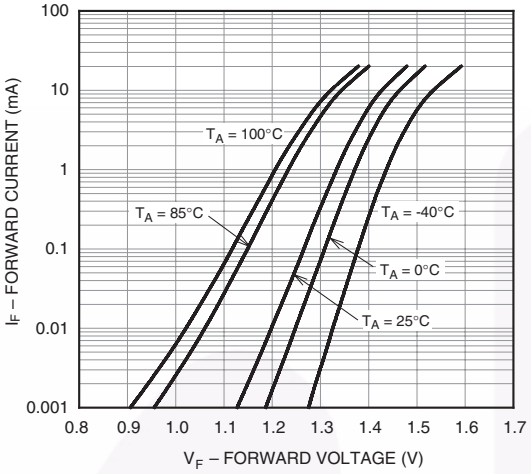


Fig. 13 Input Threshold Current vs. Ambient Temperature

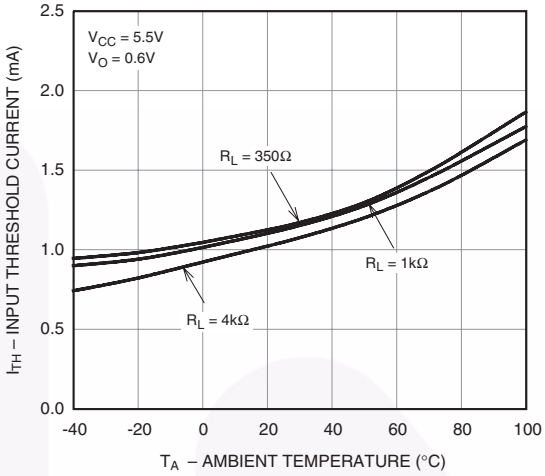


Fig. 14 High Level Output Current vs. Ambient Temperature

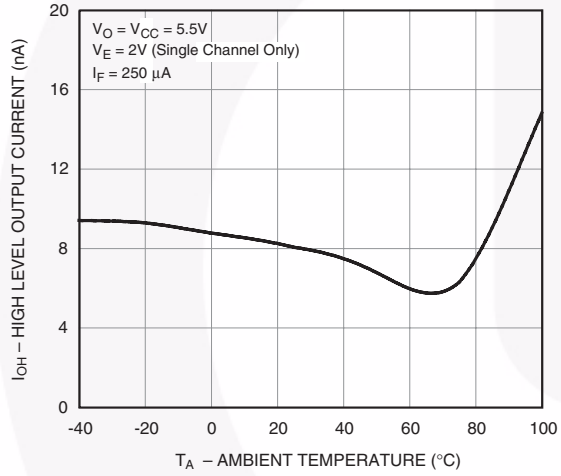


Fig. 15 Low Level Output Current vs. Ambient Temperature

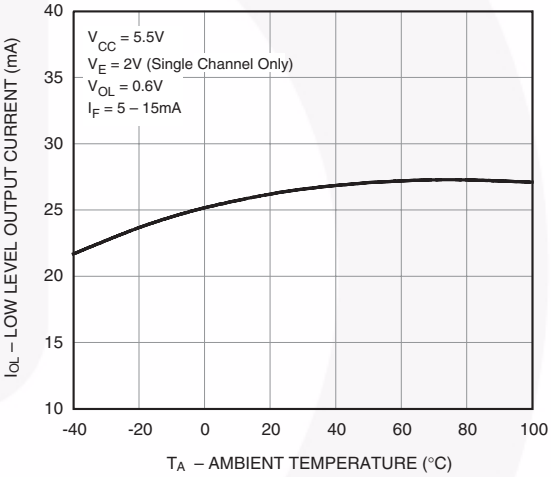


Fig. 16 Low Level Output Voltage vs. Ambient Temperature

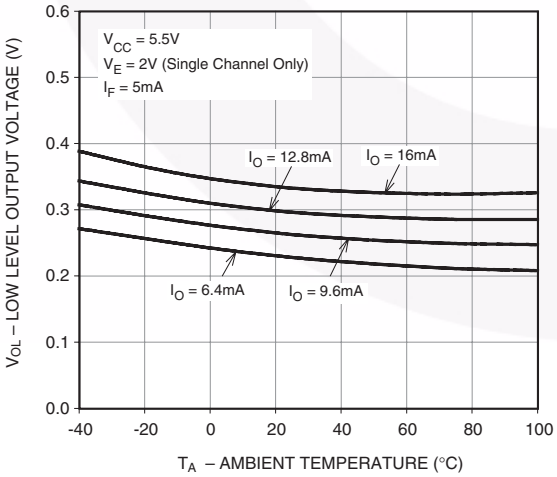
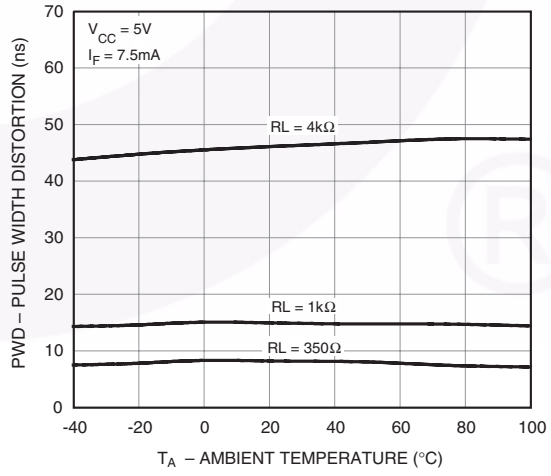


Fig. 17 Pulse Width Distortion vs. Ambient Temperature



Typical Performance Curves (HCPL0637, HCPL0638 and HCPL0639 only)

Fig. 18 Propagation Delay vs. Ambient Temperature

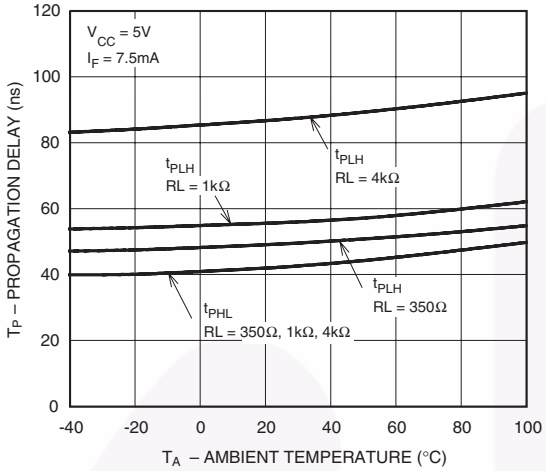
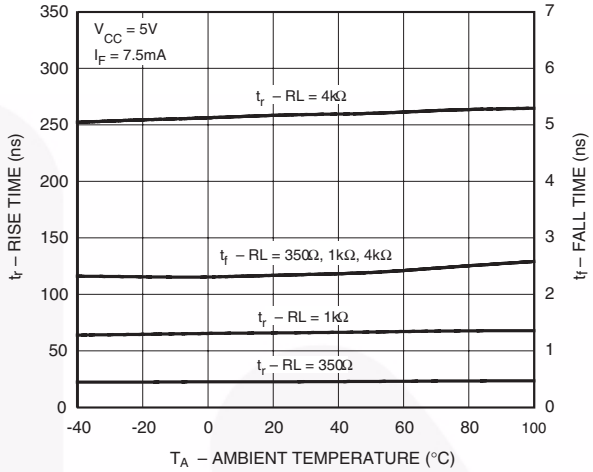


Fig. 19 Rise and Fall Times vs. Ambient Temperature



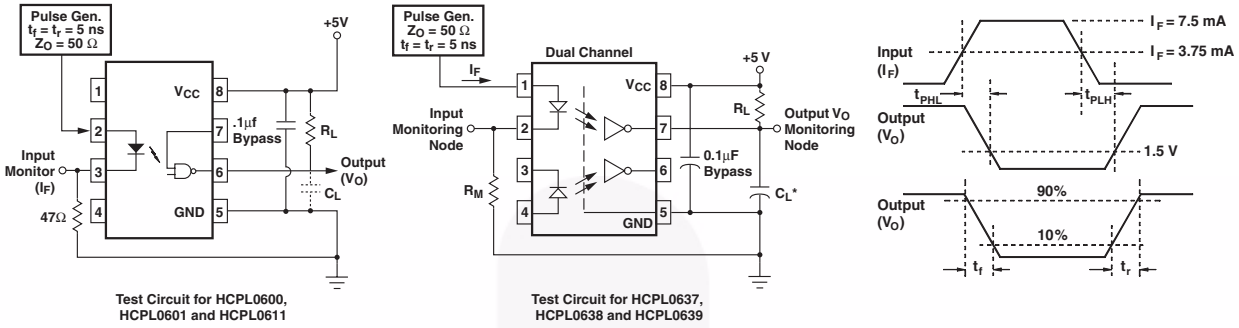


Fig. 20 Test Circuit and Waveforms for t_{PLH}, t_{PHL}, t_r and t_f.

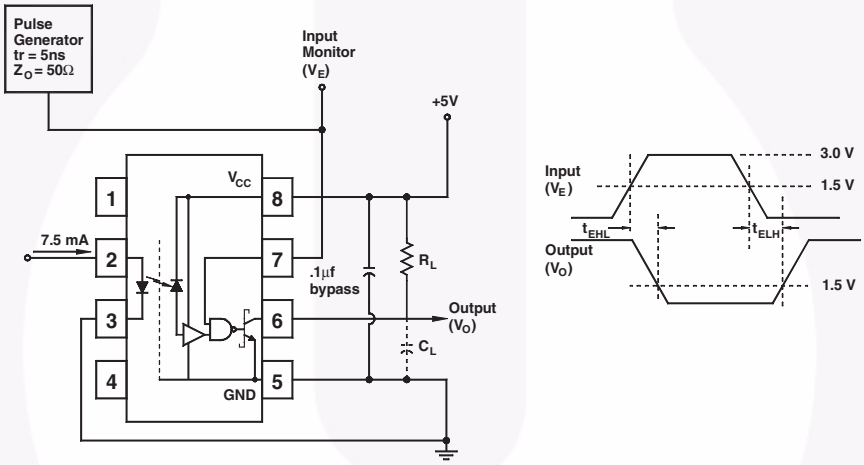
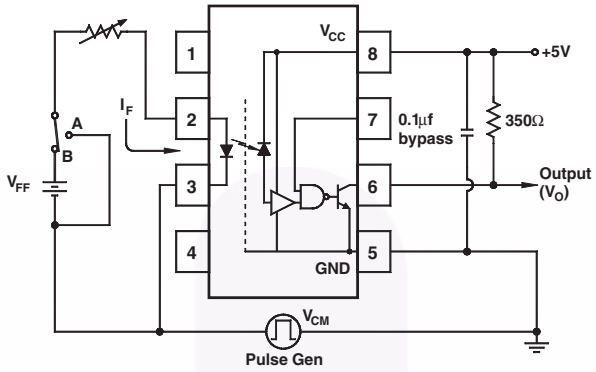


Fig. 21 Test Circuit t_{EHL} and t_{ELH}.



Test Circuit for HCPL0600, HCPL0601, and HCPL0611

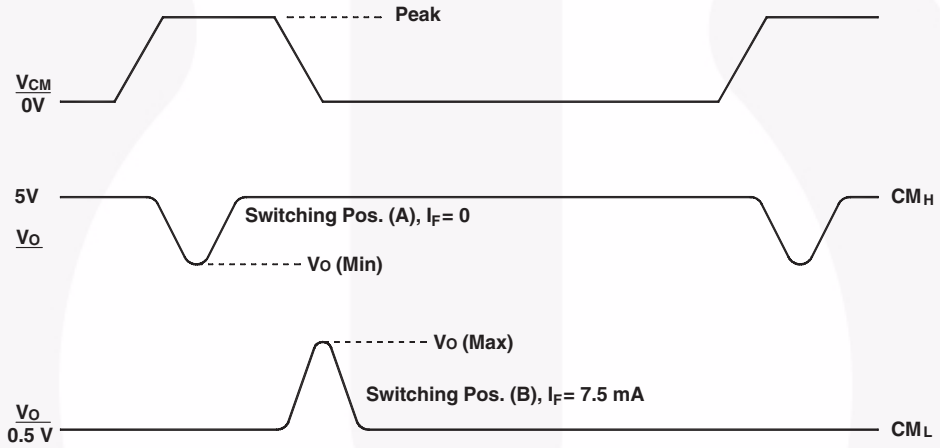
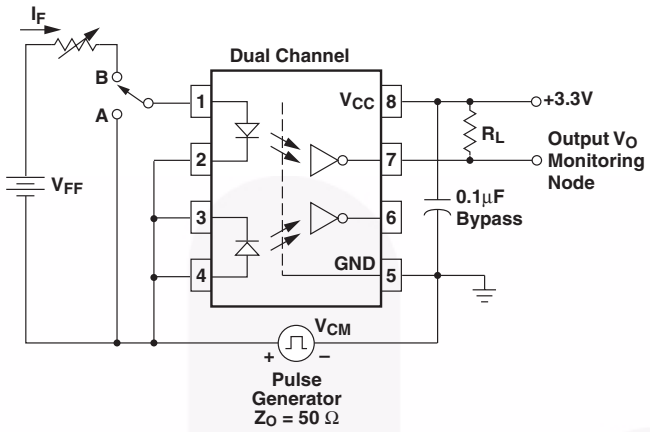


Fig. 22 Test Circuit Common Mode Transient Immunity (HCPL0600, HCPL0601 and HCPL0611)



Test Circuit for HCPL0637, HCPL0638 and HCPL0639

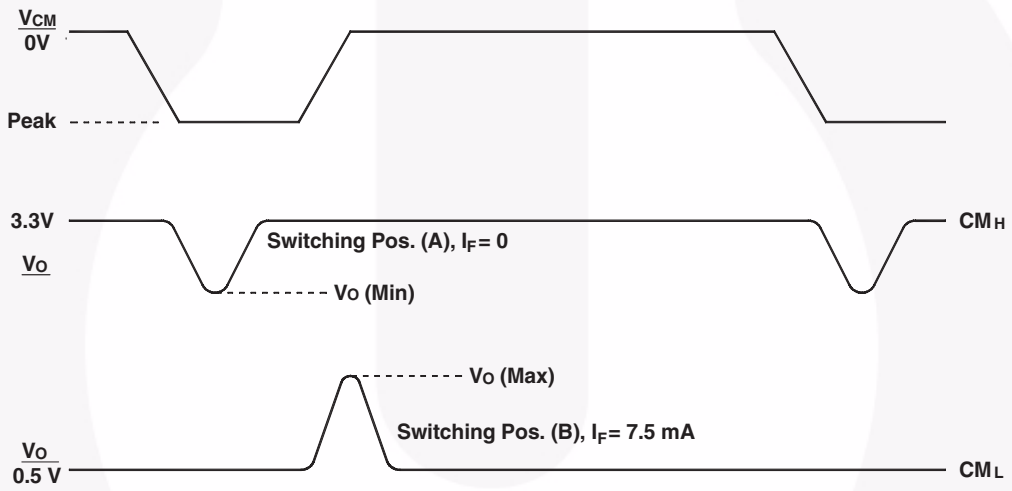
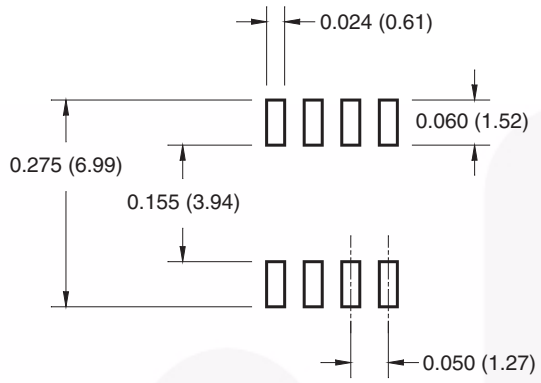


Fig. 23 Test Circuit Common Mode Transient Immunity (HCPL0637, HCPL0638 and HCPL0639)

8-Pin Small Outline

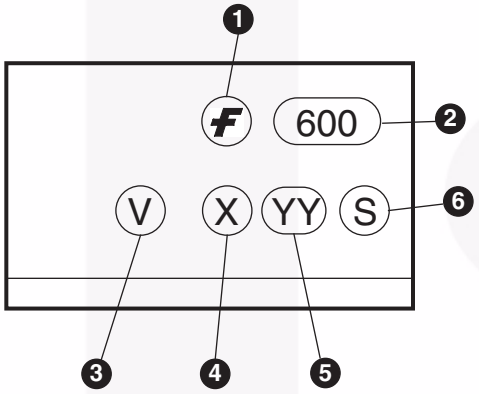


Ordering Information

Option	Order Entry Identifier	Description
No Suffix	HCPL0600	Shipped in tubes (50 units per tube)
V*	HCPL0600V	IEC60747-5-2 approval
R2	HCPL0600R2	Tape and Reel (2500 units per reel)
R2V*	HCPL0600R2V	IEC60747-5-2 approval, Tape and Reel (2500 units per reel)

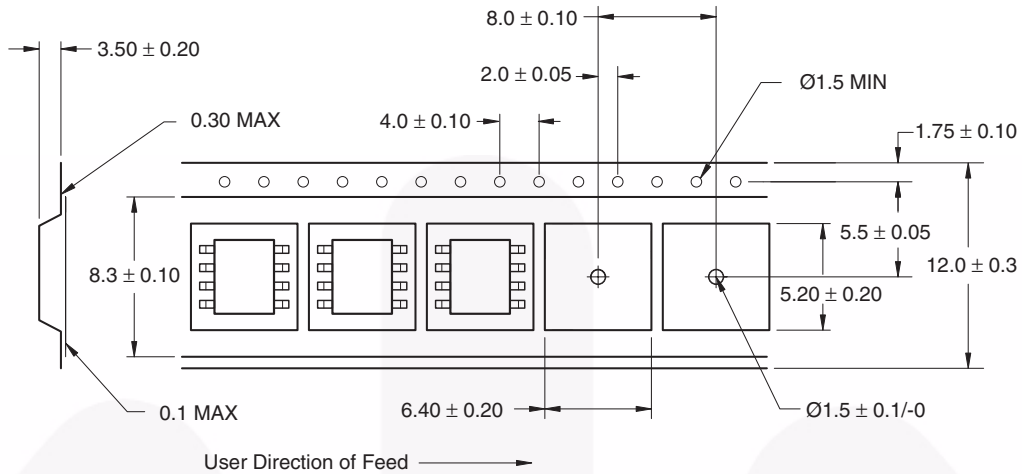
*Available for HCPL0600, HCPL0601, HCPL0611 only.

Marking Information

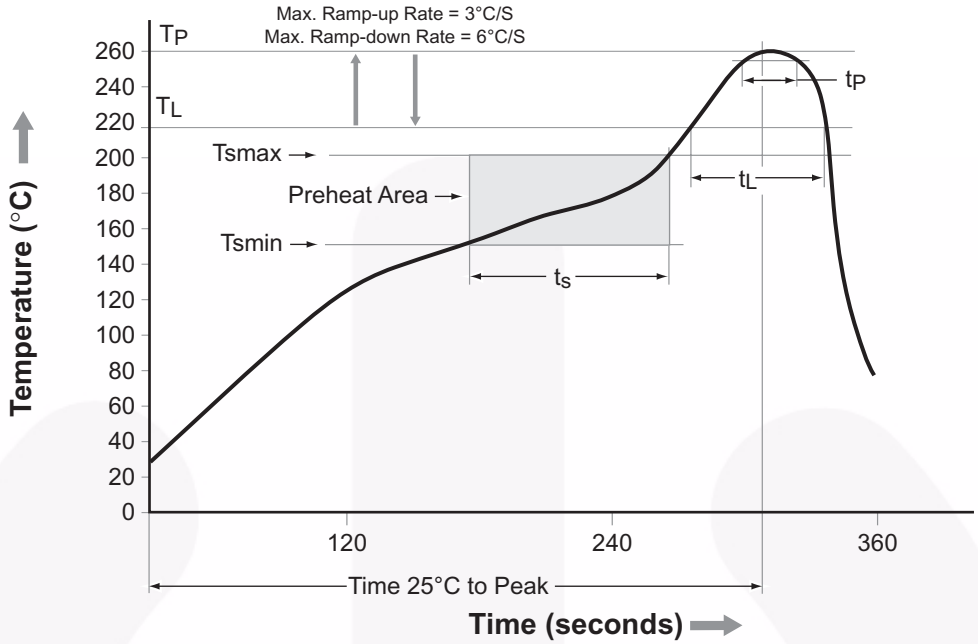


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark indicates IEC60747-5-2 approval (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., ‘3’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

Carrier Tape Specifications



Reflow Profile



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.

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Definition of Terms

Datasheet Identification	Product Status	Definition
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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.
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