FAIRCHILD SEMICONDUCTOR®

July 2005

HCPL0600, HCPL0601, HCPL0611, HCPL0630, HCPL0631, HCPL0661 High Speed-10 MBit/s Logic Gate Optocouplers

Single Channel: HCPL0600, HCPL0601, HCPL0611
Dual Channel: HCPL0630, HCPL0631, HCPL0661

Features

- Compact SO8 package
- Very high speed-10 MBit/s
- Superior CMR
- Fan-out of 8 over -40°C to +85°C
- Logic gate output
- Strobable output (single channel devices)
- Wired OR-open collector
- U.L. recognized (File # E90700)
- VDE approval pending

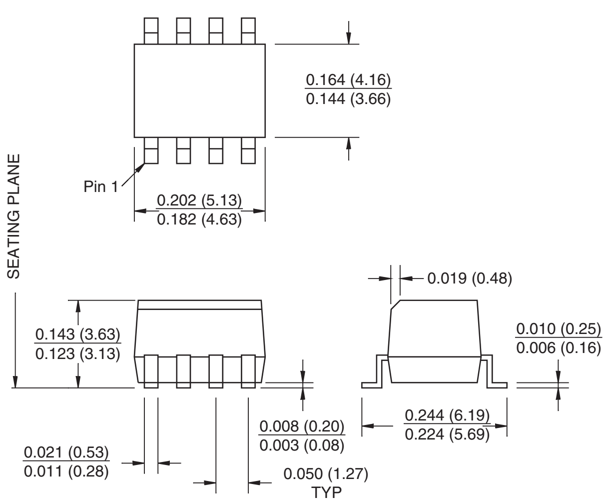
Applications

- 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

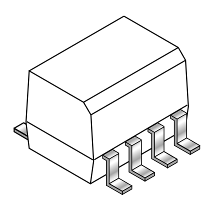
Description

The HCPL06XX optocouplers consist of an AlGaAS LED, optically coupled to a very high speed integrated photo-detector logic gate with a 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 and HCPL0601 output consists of bipolar transistors on a bipolar process while the HCPL0611, HCPL0630 and HCPL0631 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. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan out of 8). An internal noise shield provides superior common mode rejection.

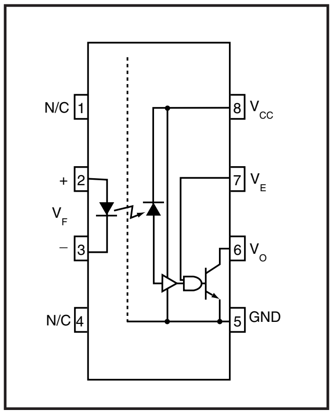
Package Dimensions



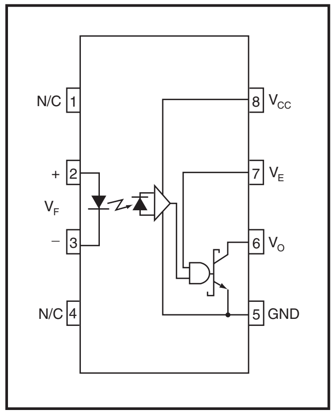
Lead Coplanarity : 0.004 (0.10) MAX



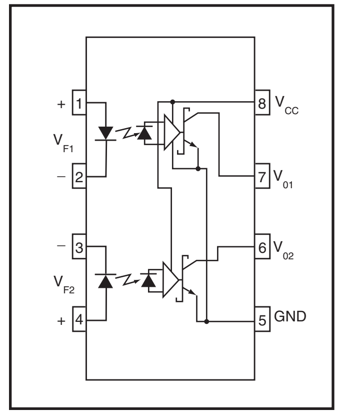
NOTE
All dimensions are in inches (millimeters)



Single-channel circuit drawing (HCPL0600 and HCPL0601)



Single-channel circuit drawing (HCPL0611)



Dual-channel circuit drawing (HCPL0630, HCPL0631 and HCPL0661)

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 0.1 µF bypass capacitor must be connected between pins 8 and 5. (See note 1)

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

Parameter		Symbol	Value	Units
Storage Temperature		T_{STG}	-40 to +125	°C
Operating Temperature		T_{OPR}	-40 to +85	°C
EMITTER DC/Average Forward Input Current (each channel)	Single Channel	I_F	50	mA
	Dual Channel			
Enable Input Voltage Not to exceed VCC by more than 500 mV	Single Channel	V_E	5.5	V
Reverse Input Voltage (each channel)		V_R	5.0	V
Power Dissipation	Single Channel	P_I	45	mW
	Dual Channel			
DETECTOR Supply Voltage		V_{CC} (1 minute max)	7.0	V
Output Current (each channel)		I_O	50	mA
Output Voltage (each channel)		V_O	7.0	V
Collector Output Power Dissipation	Single Channel	P_O	85	mW
	Dual Channel			

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Units
Input Current, Low Level	I_{FL}	0	250	µA
Input Current, High Level	I_{FH}	*6.3	15	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
Enable Voltage, Low Level	V_{EL}	0	0.8	V
Enable Voltage, High Level	V_{EH}	2.0	V_{CC}	V
Operating Temperature	T_A	-40	+85	°C
Fan Out (TTL load)	N		8	TTL Loads
Output Pull-up	R_L	330	4K	Ω

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

Electrical Characteristics (T_A = -40°C to +85°C Unless otherwise specified.)

Individual Component Characteristics

Parameter	Test Conditions		Symbol	Min	Typ**	Max	Unit
EMITTER		(I_F = 10 mA)	V_F			1.8	V
Input Forward Voltage		T_A =25°C				1.75	
Input Reverse Breakdown Voltage		(I_R = 10 µA)	B_{VR}	5.0			V
Input Capacitance		(V_F = 0, f = 1 MHz)	C_{IN}				pF
Input Diode Temperature Coefficient		(I_F = 10 mA)	ΔVF/ΔTA				mV/°C
DETECTOR	(V_E = 0.5 V)	Single Channel	I_{CCH}			10	mA
High Level Supply Current	(I_F = 0 mA, V_{CC} = 5.5 V)	Dual Channel				15	
Low Level Supply Current	(V_E = 0.5 V)	Single Channel	I_{CCL}			13	mA
	(I_F = 10 mA, V_{CC} = 5.5V)	Dual Channel				21	
Low Level Enable Current	(V_{CC} = 5.5 V, V_E = 0.5 V)	Single Channel	I_{EL}			-1.6	mA
High Level Enable Current	(V_{CC} = 5.5 V, V_E = 2.0 V)	Single Channel	I_{EH}			-1.6	mA
High Level Enable Voltage	(V_{CC} = 5.5 V, I_F = 10 mA)	Single Channel	V_{EH}	2.0			V
Low Level Enable Voltage	(V_{CC} = 5.5 V, I_F = 10 mA)(Note 2)	Single Channel	V_{EL}			0.8	V

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

AC Characteristics	Test Conditions		Device	Symbol	Min	Typ	Max	Unit
Propagation Delay Time to Output High Level	(Note 3)	(T_A =25°C)	All	T_{PLH}	20		75	ns
	(R_L = 350Ω, C_L = 15 pF) (Fig. 12)						100	
Propagation Delay Time to Output Low Level	(Note 4)	(T_A =25°C)	All	T_{PHL}	25		75	ns
	(R_L = 350Ω, C_L = 15 pF) (Fig. 12)						100	
Pulse Width Distortion	(R_L = 350Ω, C_L = 15 pF) (Fig. 12)		All	$\|T_{PHL}-T_{PLH}\|$			35	ns
Output Rise Time (10-90%)	(R_L = 350Ω, C_L = 15 pF)(Note 5) (Fig. 12)		All	t_r		50		ns
Output Fall Time (90-10%)	(R_L = 350Ω, C_L = 15 pF)(Note 6) (Fig. 12)		All	t_f		12		ns
Enable Propagation Delay Time to Output High Level	(I_F = 7.5 mA, V_{EH} = 3.5 V) (R_L = 350Ω, C_L = 15 pF) (Note 7) (Fig. 13)		HCPL0600 HCPL0601 HCPL0611	t_{ELH}		20		ns
Enable Propagation Delay Time to Output Low Level	(I_F = 7.5 mA, V_{EH} = 3.5 V) (R_L = 350Ω, C_L = 15 pF) (Note 8) (Fig. 13)		HCPL0600 HCPL0601 HCPL0611	t_{EHL}		20		ns
Common Mode Transient Immunity (at Output High Level)	(R_L = 350Ω) (T_A =25°C) (I_F = 0 mA, V_{OH} (Min.) = 2.0 V) (Note 9)(Fig. 14)	$\|V_{CM}\|$ = 10 V	HCPL0600 HCPL0630	$\|CM_H\|$				V/µs
		$\|V_{CM}\|$ = 50 V	HCPL0601 HCPL0631		5000			
		$\|V_{CM}\|$ = 1,000 V	HCPL0611 HCPL0661		25,000			
Common Mode Transient Immunity (at Output Low Level)	(R_L = 350Ω) (T_A =25°C) (I_F = 7.5 mA, V_{OL} (Max.) = 0.8 V) (Note 10)(Fig. 14)	$\|V_{CM}\|$ = 10 V	HCPL0600 HCPL0630	$\|CM_H\|$				V/µs
		$\|V_{CM}\|$ = 50 V	HCPL0601 HCPL0631		5000			
		$\|V_{CM}\|$ = 1,000 V	HCPL0611 HCPL0661		25,000			

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

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

Isolation Characteristics (T_A = -40°C to +85°C Unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ**	Max	Unit
Input-Output Insulation Leakage Current	(Relative humidity = 45%) (T_A = 25°C, t = 5 s) (V_{I-O} = 3000 VDC) (Note 11)	I_{I-O}			1.0*	µA
Withstand Insulation Test Voltage	(R_H < 50%, T_A = 25°C) (Note 11) (t = 1 min.)	V_{ISO}	2500			V_{RMS}
Resistance (Input to Output)	(V_{I-O} = 500 V) (Note 11)	R_{I-O}		10^{12}		Ω
Capacitance (Input to Output)	(f = 1 MHz) (Note 11)	C_{I-O}		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 3.75 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 V). 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} < 0.8 V). 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 and HCPL0601 only)

Fig. 1 Forward Current vs. Input Forward Voltage

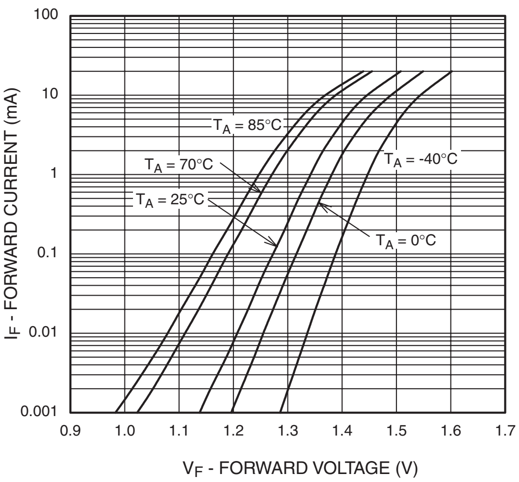


Fig. 2 Output Voltage vs. Forward Current

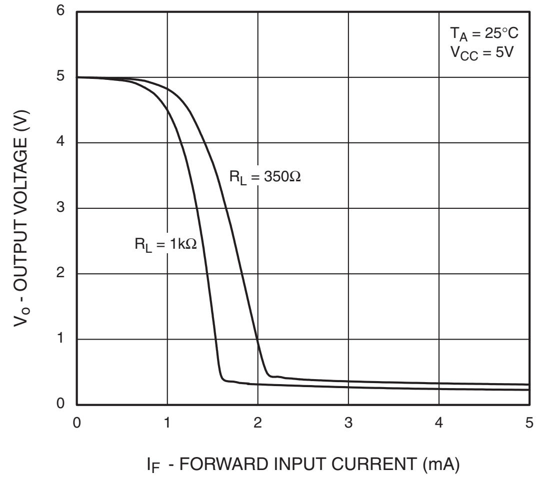


Fig. 3 Input Threshold Current vs. Temperature

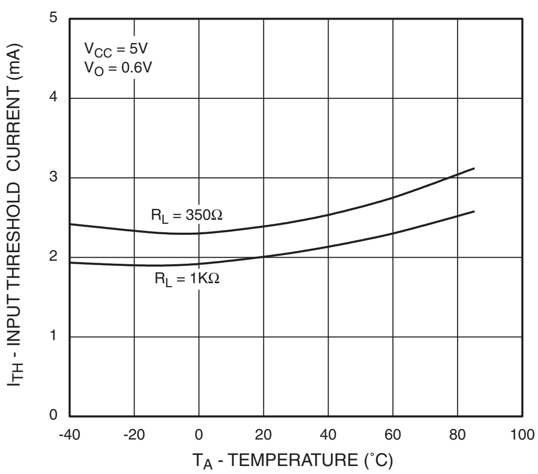
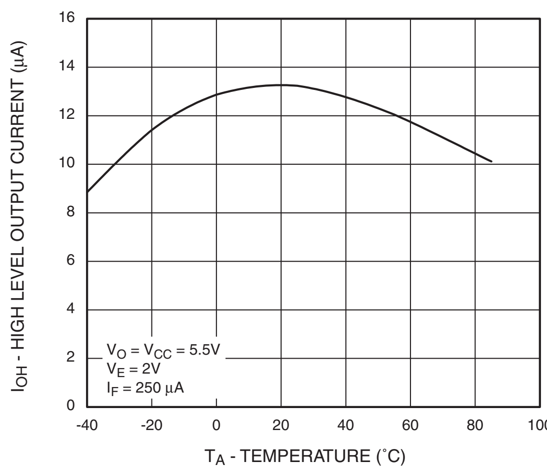


Fig. 4 High Level Output Current vs. Temperature



Typical Performance Curves (HCPL0600 and HCPL0601 only)

Fig. 5 Low Level Output Voltage vs. Temperature

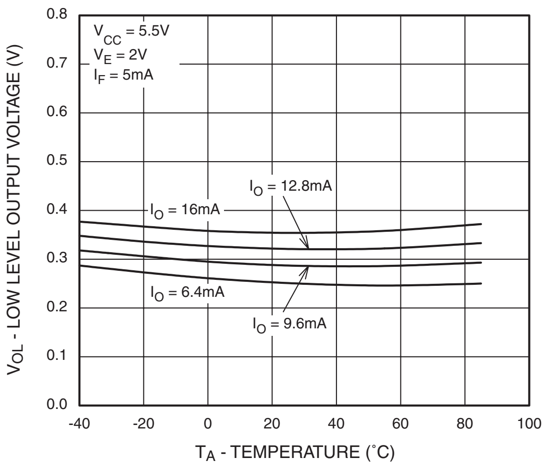


Fig. 6 Low Level Output Current vs. Temperature

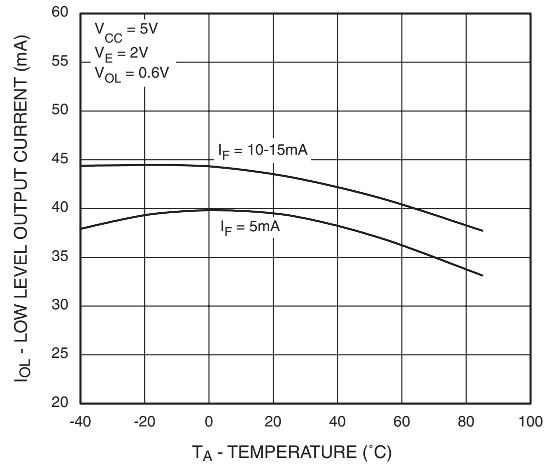


Fig. 7 Propagation Delay vs. Temperature

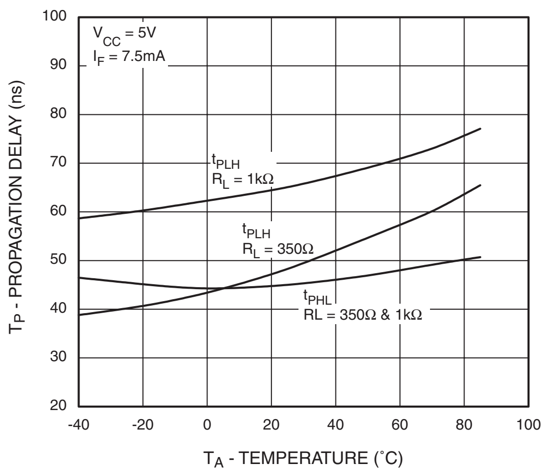
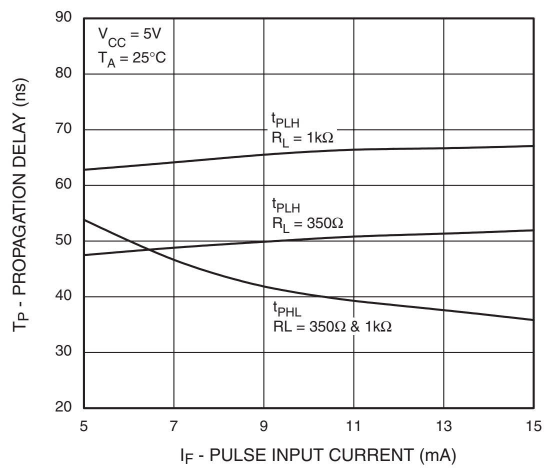


Fig. 8 Propagation Delay vs. Pulse Input Current



Typical Performance Curves (HCPL0600 and HCPL0601 only)

Fig. 9 Typical Enable Propagation Delay vs. Temparature

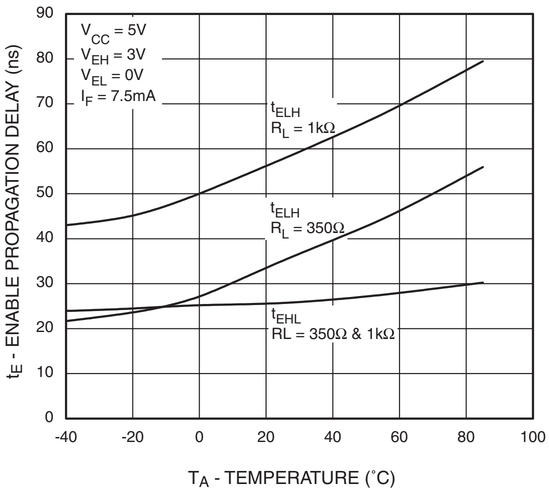


Fig. 10 Typical Rise and Fall Time vs. Temperature

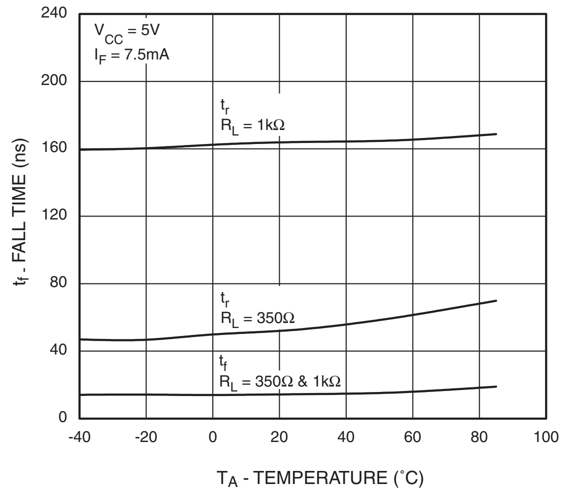
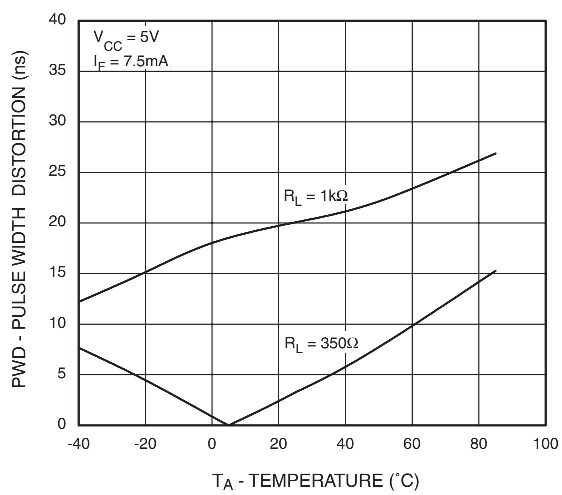


Fig. 11 Typical Pulse Width Distortion vs. Temperature



Typical Performance Curves (HCPL0611, HCPL0630, HCPL0631 and HCPL0661 only)

Fig. 12 Input Forward Current vs. Forward Voltage

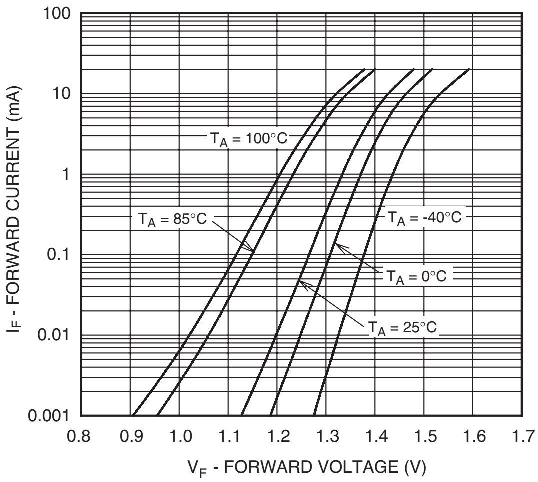


Fig. 13 Input Threshold Current vs. Ambient Temperature (HCPL0611 only)

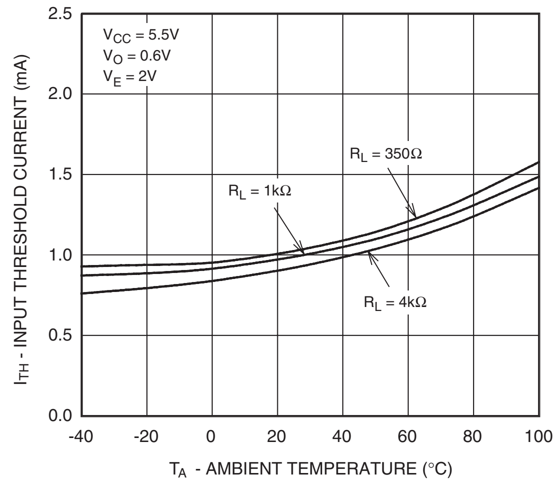


Fig. 14 Input Threshold Current vs. Ambient Temperature (HCPL0630, HCPL0631 and HCPL0661 only)

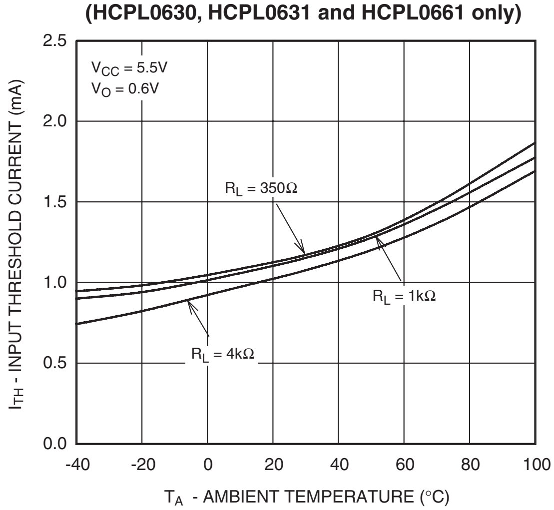


Fig. 15 High Level Output Current vs. Ambient Temperature

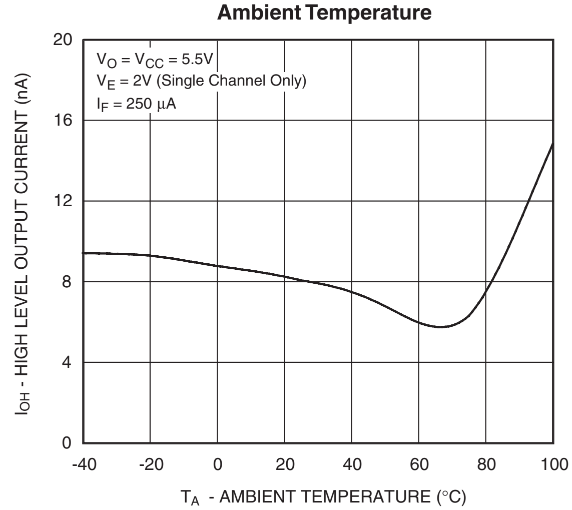


Fig. 16 Low Level Output Current vs. Ambient Temperature

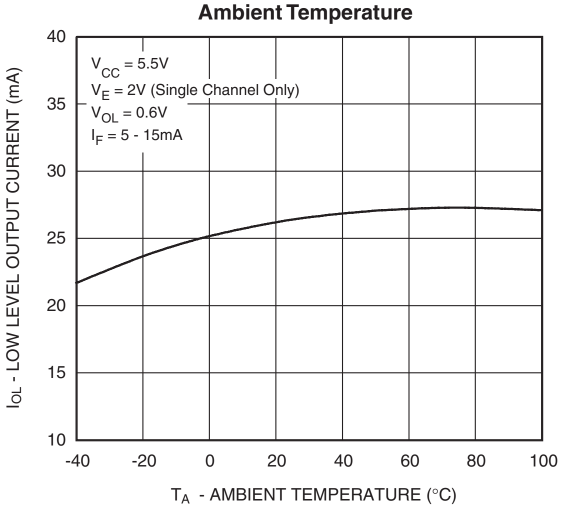
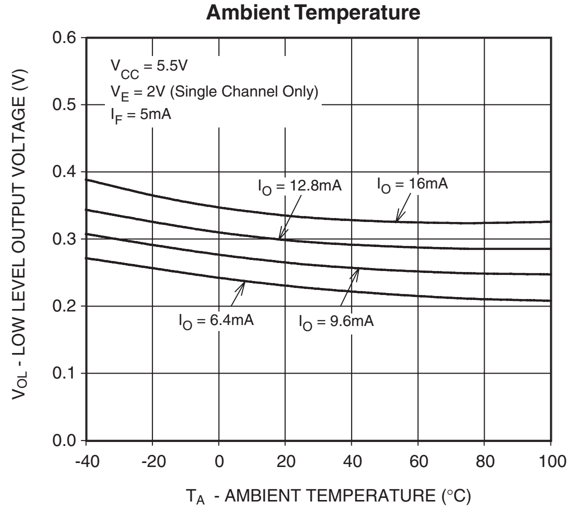


Fig. 17 Low Level Output Voltage vs. Ambient Temperature



Typical Performance Curves (HCPL0611, HCPL0630, HCPL0631 and HCPL0661 only)

Fig. 18 Pulse Width Distortion vs. Ambient Temperature

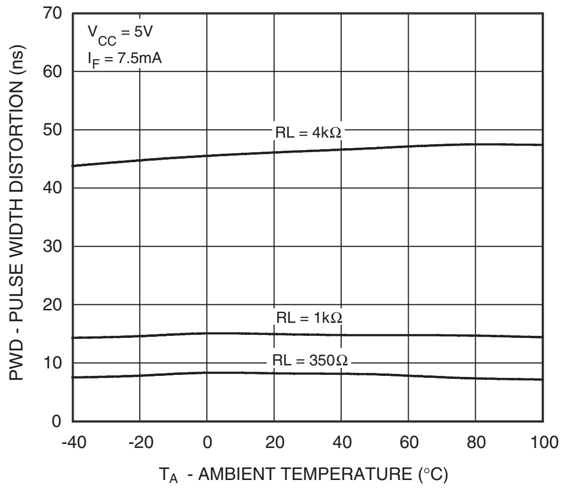


Fig. 19 Propagation Delay vs. Ambient Temperature

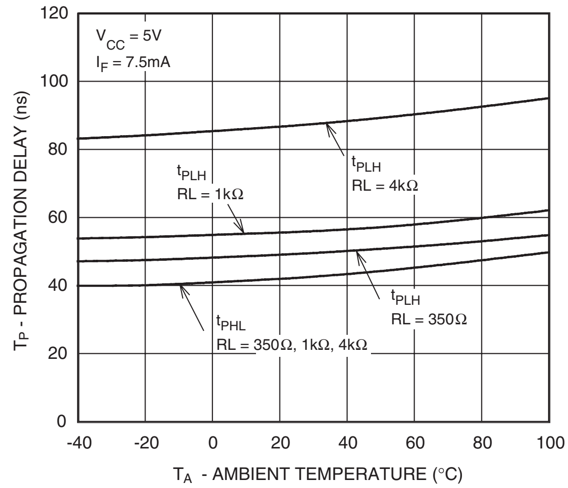
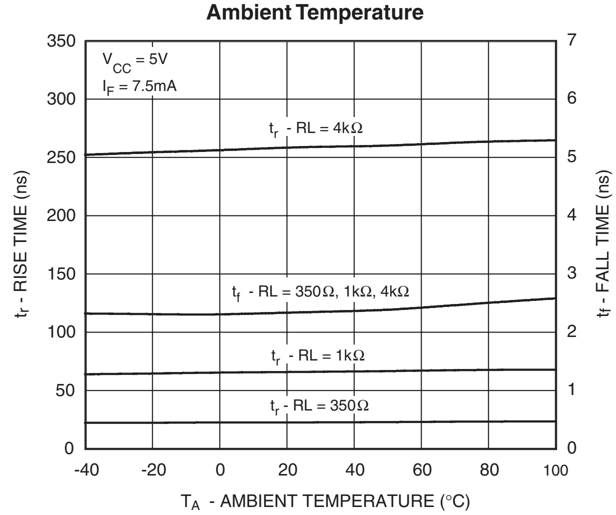


Fig. 20 Rise and Fall Times vs. Ambient Temperature



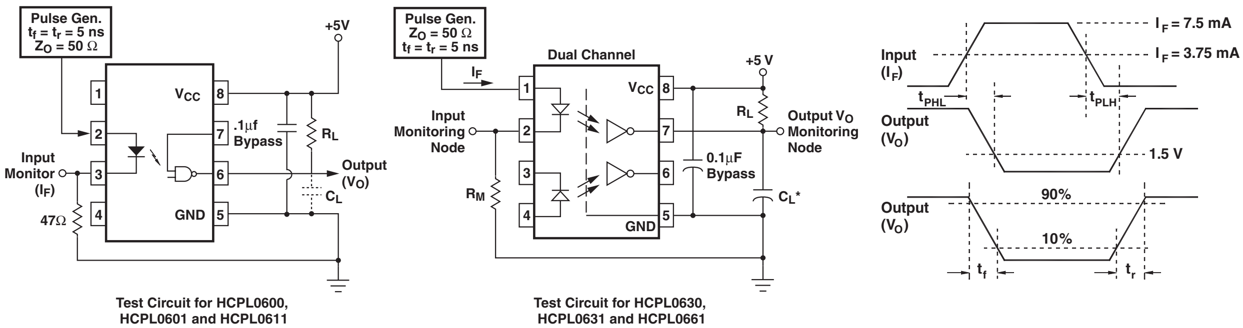


Fig. 21 Test Circuit and Waveforms for t_{PLH}, t_{PHL}, t_r and t_f.

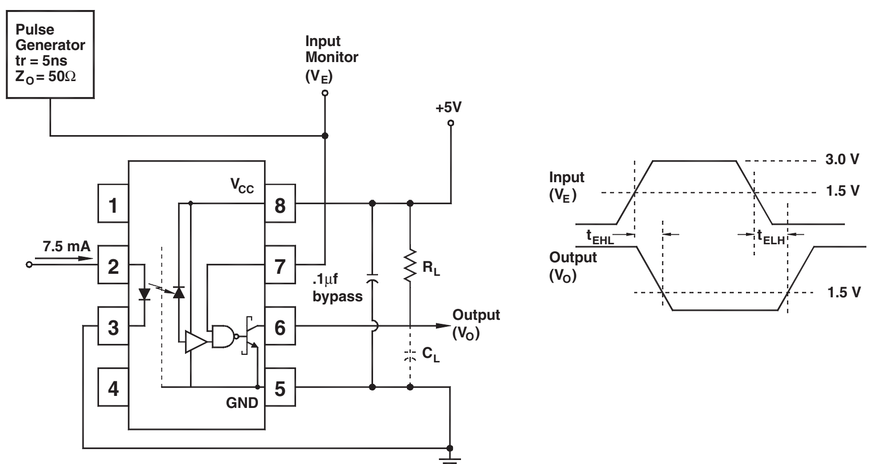
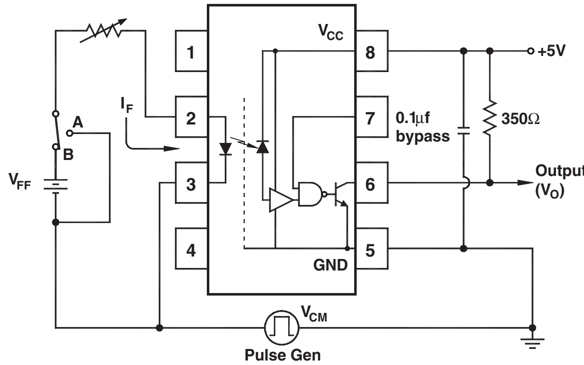


Fig. 22 Test Circuit t_{EHL} and t_{ELH}.



Test Circuit for HCPL0600, and HCPL0601

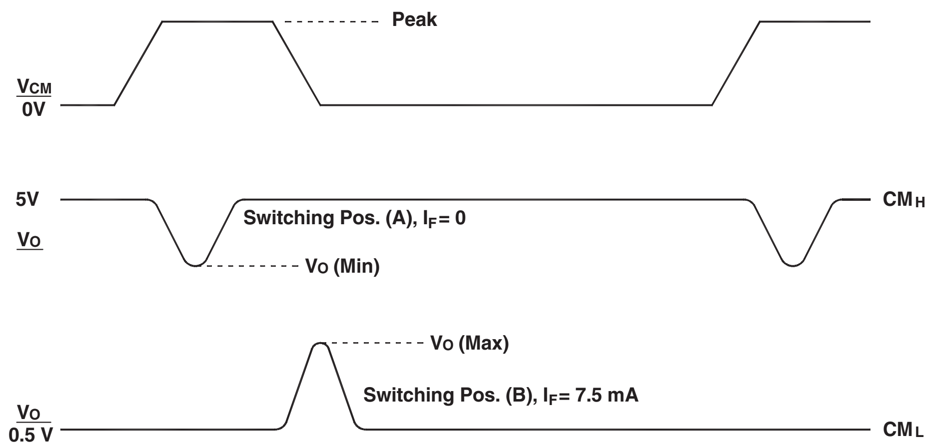
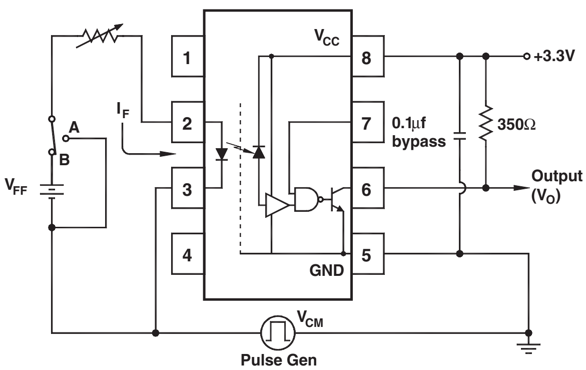
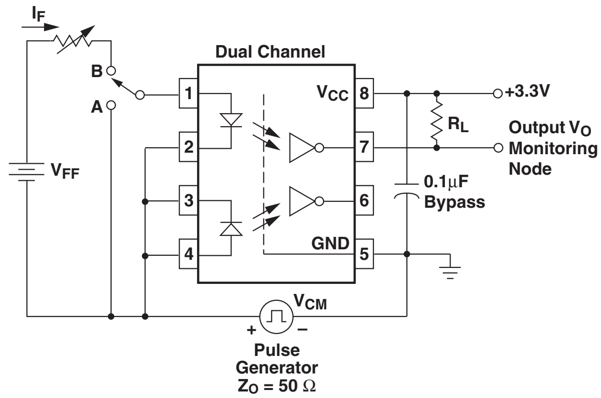


Fig. 23 Test Circuit Common Mode Transient Immunity (HCPL0600 and HCPL0601)



Test Circuit for HCPL0611



Test Circuit for HCPL0630, HCPL0631 and HCPL0661

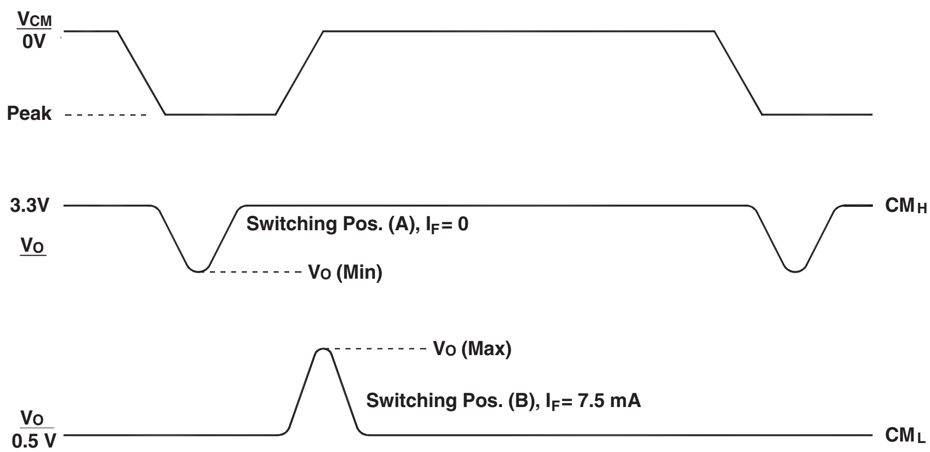
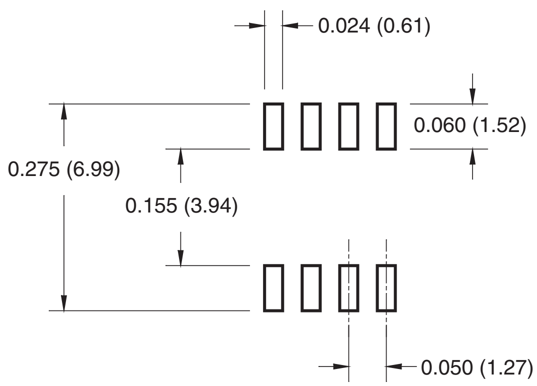


Fig. 24 Test Circuit Common Mode Transient Immunity (HCPL0611, HCPL0630, HCPL0631 and HCPL0661)

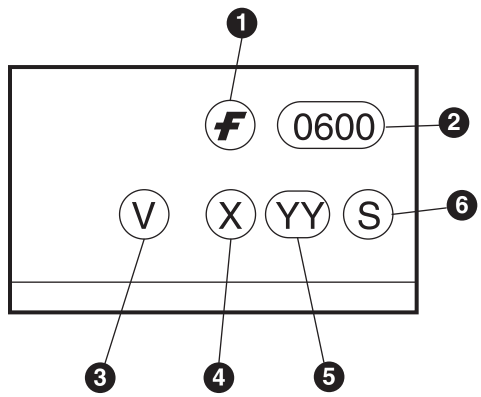
8-Pin Small Outline



Ordering Information

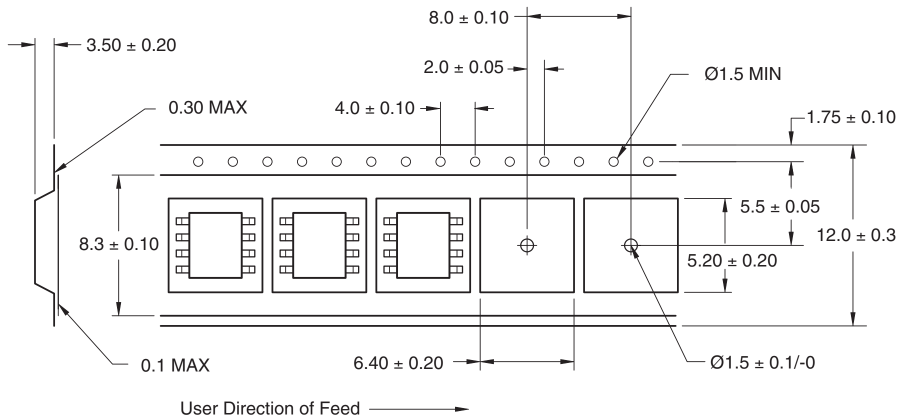
Option	Order Entry Identifier	Description
No Suffix	HCPL0600	Shipped in tubes (50 units per tube)
V	HCPL0600V	VDE0884 (pending approval)
R1	HCPL0600R1	Tape and Reel (500 units per reel)
R1V	HCPL0600R1V	VDE0884 (pending approval), Tape and Reel (500 units per reel)
R2	HCPL0600R2	Tape and Reel (2500 units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

Marking Information

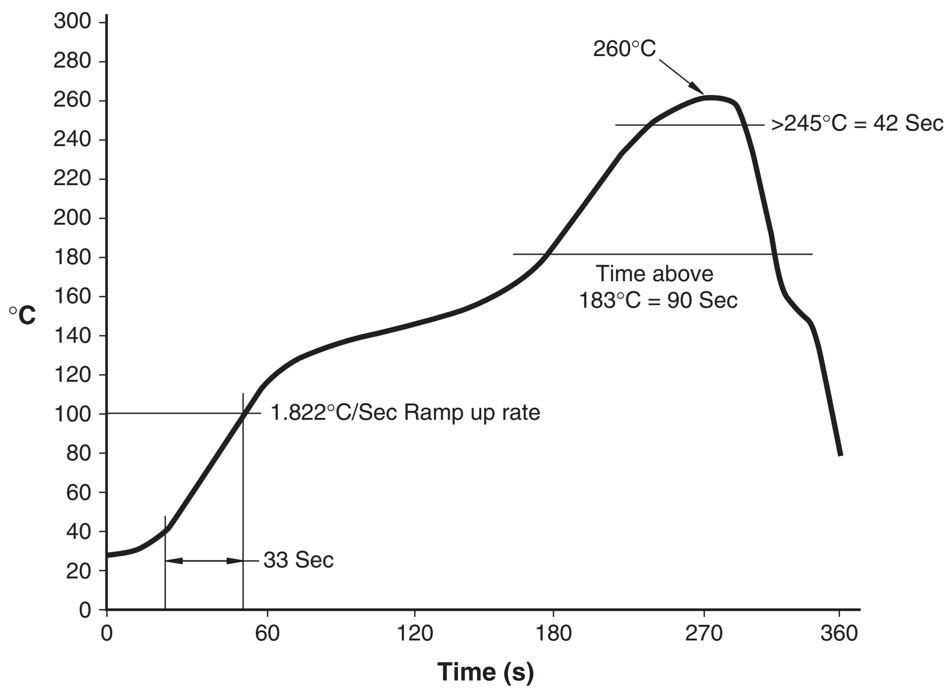


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., ‘3’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

Carrier Tape Specifications



Reflow Profile



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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, or (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 significant injury to the user.

2. 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 in order to improve design.
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