

# HCPL2730, HCPL2731 DUAL-CHANNEL OPTOCOUPLEDERS/OPTOISOLATORS

SOOS020 D3262, JUNE 1989

- Dual-Channel Optocouplers
- High Current Transfer Ratio . . . 1800% Typ at  $I_f = 0.5 \text{ mA}$
- Low Input Current Requirement . . . 0.5 mA
- High-Speed Switching . . . 100 kbit/s Typ
- High Common-Mode Transient Immunity . . . 500 V/ $\mu\text{s}$  Typ
- High-Voltage Electrical Insulation . . . 3000 V DC Min
- High Output Current Rating of 60 mA
- UL Recognized . . . File Number 65085

## description

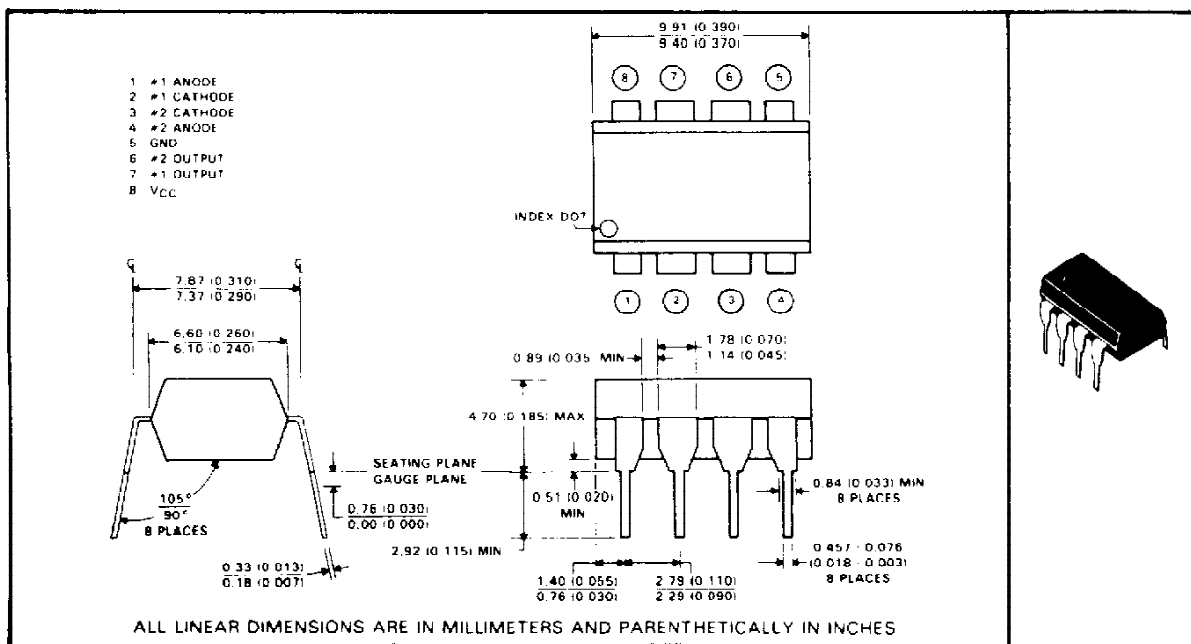
These devices are useful where large common-mode input signals exist, and in applications that require high-voltage isolation between circuits. Applications include line receivers, telephone ring detectors, power line monitors, high-voltage status indicators, and circuits that require isolation between input and output.

The HCPL2730 and HCPL2731 dual-channel high-gain optocouplers each consists of a pair of light-emitting diodes and integrated high-gain photon detectors. The VCC and output terminals may be tied together to achieve conventional photodarlington operation. An integrated emitter-base bypass resistor is provided for low leakage.

The HCPL2730 is designed for use primarily in TTL applications. An LED input current of 1.6 mA and a minimum current-transfer ratio of 300% from 0°C to 70°C allow operation with one TTL-load input and one TTL-load output utilizing a 2.2-k $\Omega$  pullup resistor.

The HCPL2731 is designed for use in CMOS, LSTTL, or other low-power applications. This device has a minimum current-transfer ratio of 400% for only 0.5-mA input current over an operating temperature range of 0°C to 70°C.

## mechanical data



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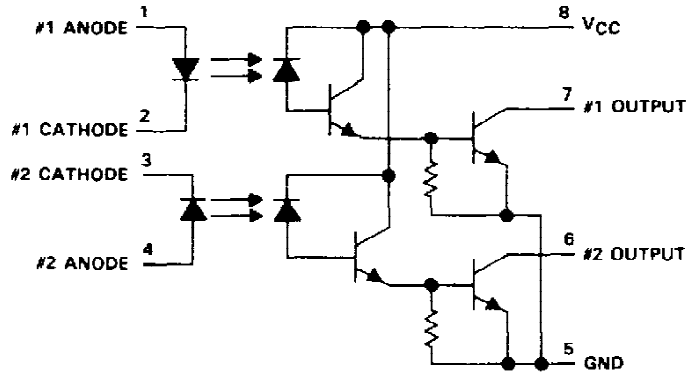
TEXAS  
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**HCPL2730, HCPL2731  
DUAL-CHANNEL OPTOCOUPLERS/OPTOISOLATORS**

schematic



**absolute maximum ratings at 25°C free-air temperature range (unless otherwise noted)**

Supply and output voltage range, $V_{CC}$ and $V_O$ : HCPL2730 .....	-0.5 V to 7 V
HCPL2731 .....	-0.5 to 18 V
Reverse input voltage .....	5 V
Peak input forward current per channel (pulse duration = 1 ms, 50% duty cycle) .....	40 mA
Average forward input current per channel at (or below) 50°C free-air temperature (see Note 1) .....	20 mA
Output current per channel at (or below) 35°C free-air temperature (see Note 2) .....	60 mA
Input power dissipation per channel at (or below) 50°C free-air temperature (see Note 3) .....	35 mW
Output power dissipation per channel at (or below) 35°C free-air temperature (see Note 4) .....	100 mW
Operating temperature range .....	-40°C to 85°C
Storage temperature range .....	-55°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C

- NOTES: 1. Derate linearly above 50°C free-air temperature at a rate of 0.67 mA/°C.  
 2. Derate linearly above 35°C free-air temperature at a rate of 1.2 mA/°C.  
 3. Derate linearly above 50°C free-air temperature at a rate of 1.0 mW/°C.  
 4. Derate linearly above 35°C free-air temperature at a rate of 2.0 mW/°C.

## HCPL2730, HCPL2731 DUAL-CHANNEL OPTOCOUPLEDERS/OPTOISOLATORS

electrical characteristics over operating free-air temperature range of 0°C to 70°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS	HCPL2730		HCPL2731		UNIT			
		MIN	TYP <sup>†</sup>	MAX	MIN		TYP <sup>†</sup>	MAX	
V <sub>F</sub>	Input forward voltage	I <sub>F</sub> = 1.6 mA, T <sub>A</sub> = 25°C		1.5	1.7	1.5	1.7	V	
α <sub>VF</sub>	Temperature coefficient of forward voltage	I <sub>F</sub> = 1.6 mA		-1.8		-1.8		mV/°C	
V <sub>BR</sub>	Input breakdown voltage	I <sub>R</sub> = 10 μA, T <sub>A</sub> = 25°C		5		5		V	
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = 4.5 V, I <sub>F</sub> = 1.6 mA, I <sub>OL</sub> = 4.8 mA, I <sub>B</sub> = 0		0.1		0.4		V	
		V <sub>CC</sub> = 4.5 V, I <sub>F</sub> = 1.6 mA, I <sub>OL</sub> = 8 mA, I <sub>B</sub> = 0				0.1			0.4
		V <sub>CC</sub> = 4.5 V, I <sub>F</sub> = 5 mA, I <sub>OL</sub> = 15 mA, I <sub>B</sub> = 0				0.1			0.4
		V <sub>CC</sub> = 4.5 V, I <sub>F</sub> = 12 mA, I <sub>OL</sub> = 24 mA, I <sub>B</sub> = 0				0.2			0.4
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 7 V, V <sub>O</sub> = 7 V, I <sub>F</sub> = 0, I <sub>B</sub> = 0		0.1		250		μA	
		V <sub>CC</sub> = 18 V, V <sub>O</sub> = 18 V, I <sub>F</sub> = 0, I <sub>B</sub> = 0				0.05			100
I <sub>CCH</sub>	Supply current, high-level output	V <sub>CC</sub> = 7 V, I <sub>O</sub> = 0, I <sub>F</sub> = 0, I <sub>B</sub> = 0		4				nA	
		V <sub>CC</sub> = 18 V, I <sub>O</sub> = 0, I <sub>F</sub> = 0, I <sub>B</sub> = 0				5			
I <sub>CCL</sub>	Supply current, low-level output	V <sub>CC</sub> = 7 V, I <sub>O</sub> = 0, I <sub>F1</sub> = 1.6 mA, I <sub>F2</sub> = 1.6 mA, I <sub>B</sub> = 0		0.4				mA	
		V <sub>CC</sub> = 18 V, I <sub>O</sub> = 0, I <sub>F1</sub> = 1.6 mA, I <sub>F2</sub> = 1.6 mA, I <sub>B</sub> = 0				0.6			
CTR	Current transfer ratio	V <sub>CC</sub> = 4.5 V, V <sub>O</sub> = 0.4 V, I <sub>F</sub> = 0.5 mA, I <sub>B</sub> = 0, See Note 5				400% 1800%			
		V <sub>CC</sub> = 4.5 V, V <sub>O</sub> = 0.4 V, I <sub>F</sub> = 1.6 mA, I <sub>B</sub> = 0, See Note 5		300% 1000%		500% 1600%			
r <sub>ii</sub>	Input-input resistance	V <sub>ii</sub> = 500 V		10 <sup>11</sup>		10 <sup>11</sup>		Ω	
r <sub>io</sub>	Input-output resistance	V <sub>io</sub> = 500 V, See Note 6		10 <sup>12</sup>		10 <sup>12</sup>		Ω	
I <sub>ii</sub>	Input-input insulation leakage current	V <sub>ii</sub> = 500 V, t = 5 s, RH = 45%		0.005		0.005		μA	
I <sub>io</sub>	Input-output insulation leakage current	V <sub>io</sub> = 3000 V, t = 5 s, T <sub>A</sub> = 25°C, RH = 45%, See Note 6				1		μA	
C <sub>i</sub>	Input capacitance	V <sub>F</sub> = 0, f = 1 MHz		60		60		pF	
C <sub>ii</sub>	Input-input capacitance	f = 1 MHz		0.25		0.25		pF	
C <sub>io</sub>	Input-output capacitance	f = 1 MHz, See Note 6		0.6		0.6		pF	

<sup>†</sup>All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, unless otherwise noted.

NOTES: 5. Current transfer ratio is defined as the ratio of output collector current I<sub>O</sub> to the forward LED input current I<sub>F</sub> times 100%.

6. These parameters are measured between pins 2 and 3 shorted together and pins 5, 6, 7 and 8 shorted together.

## HCPL2730, HCPL2731 DUAL-CHANNEL OPTOCOUPLEDERS/OPTOISOLATORS

switching characteristics at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

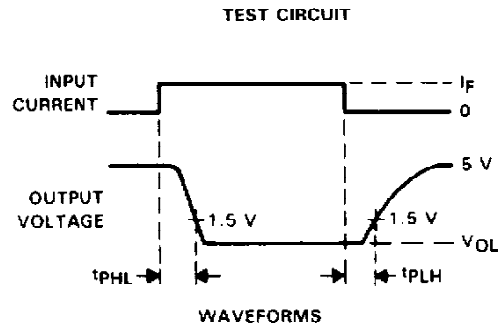
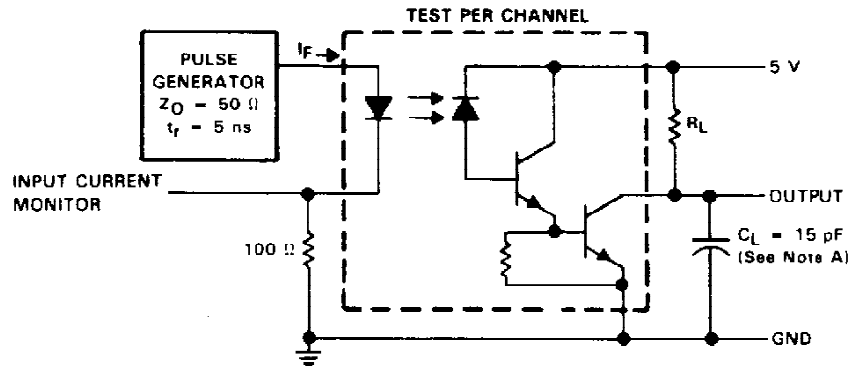
PARAMETER	TEST CONDITIONS	HCPL2730			HCPL2731			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$t_{PHL}$ Propagation delay time, high-to-low level output	$I_F = 1.6\text{ mA}$ , $R_L = 2.2\text{ k}\Omega$ , See Figure 1		2	20		2	20	$\mu\text{s}$
	$I_F = 0.5\text{ mA}$ , $R_L = 4.7\text{ k}\Omega$ , See Figure 1					7	100	
	$I_F = 12\text{ mA}$ , $R_L = 270\ \Omega$ , See Figure 1		0.4	2		0.4	2	
$t_{PLH}$ Propagation delay time, low-to-high-level output	$I_F = 1.6\text{ mA}$ , $R_L = 2.2\text{ k}\Omega$ , See Figure 1		4	35		5	35	$\mu\text{s}$
	$I_F = 0.5\text{ mA}$ , $R_L = 4.7\text{ k}\Omega$ , See Figure 1					6	60	
	$I_F = 12\text{ mA}$ , $R_L = 270\ \Omega$ , See Figure 1		3	10		2	10	
$\frac{dV_{CM}}{dt}$ (H) Common-mode input transient immunity, high-level output	$V_{CM} = 10\text{ V}_{p-p}$ , $I_F = 0$ , $R_L = 2.2\text{ k}\Omega$ , See Notes 7 and 8, See Figure 2		500			500		$\text{V}/\mu\text{s}$
$\frac{dV_{CM}}{dt}$ (L) Common-mode input transient immunity, low-level output	$V_{CM} = 10\text{ V}_{p-p}$ , $I_F = 1.6\text{ mA}$ , $R_L = 2.2\text{ k}\Omega$ , See Figure 2 See Notes 7 and 8		-500			-500		$\text{V}/\mu\text{s}$

- NOTES: 7. Common-mode transient immunity, high-level output, is the maximum rate of rise of the common-mode input voltage that does not cause the output voltage to drop below 2 V. Common-mode input transient immunity, low-level output, is the maximum rate of fall of the common-mode input voltage that does not cause the output voltage to rise above 0.8 V.
8. In applications where  $dV/dt$  may exceed 50,000  $\text{V}/\mu\text{s}$  (such as static discharge) a series resistor,  $R_{CC}$ , should be included to protect the detector IC from destructively high surge currents. The recommended value is:

$$R_{CC} = \frac{1}{0.15 I_F (\text{mA})} \text{ k}\Omega$$

**HCPL2730, HCPL2731**  
**DUAL-CHANNEL OPTOCOUPLERS/OPTOISOLATORS**

**PARAMETER MEASUREMENT INFORMATION**

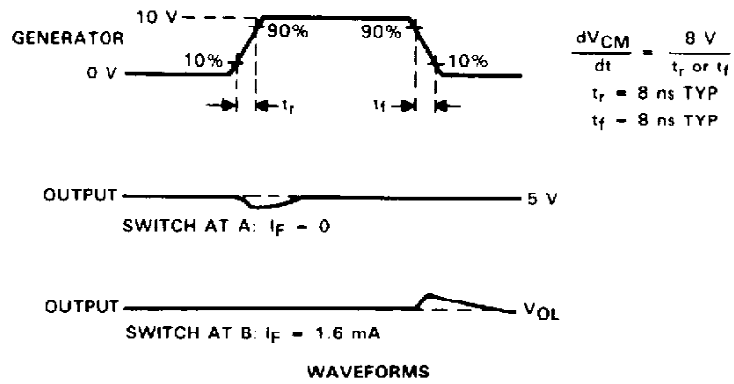
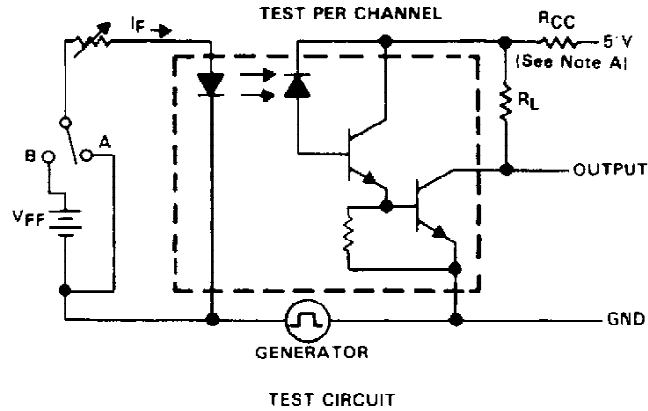


NOTE A:  $C_L$  includes probe and stray capacitances.

**FIGURE 1. SWITCHING TEST CIRCUIT AND WAVEFORMS**

**HCPL2730, HCPL2731  
DUAL-CHANNEL OPTOCOUPPLERS/OPTOISOLATORS**

**PARAMETER MEASUREMENT INFORMATION**



NOTE A: In applications where  $dV/dt$  may exceed  $50,000 \text{ V}/\mu\text{s}$  (such as static discharge) a series resistor,  $R_{CC}$ , should be included to protect the detector IC from destructively high surge currents. The recommended value is:

$$R_{CC} = \frac{1}{0.15 I_F (\text{mA})} \text{ k}\Omega$$

**FIGURE 2. TRANSIENT IMMUNITY TEST CIRCUIT AND WAVEFORMS**

# HCPL2730, HCPL2731 DUAL-CHANNEL OPTOCOUPLEDERS/OPTOISOLATORS

## TYPICAL CHARACTERISTICS

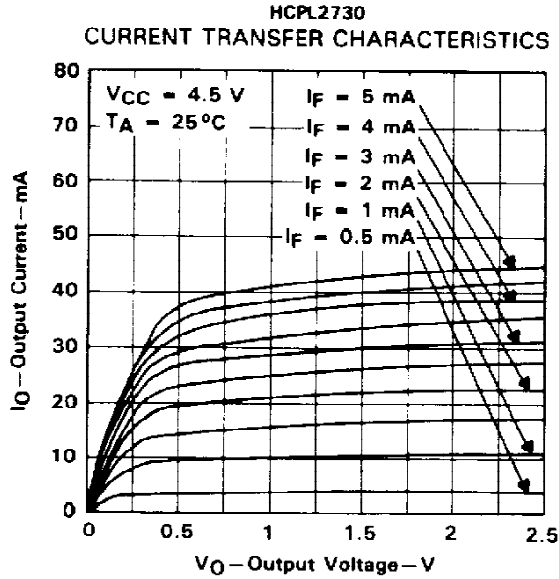


FIGURE 3

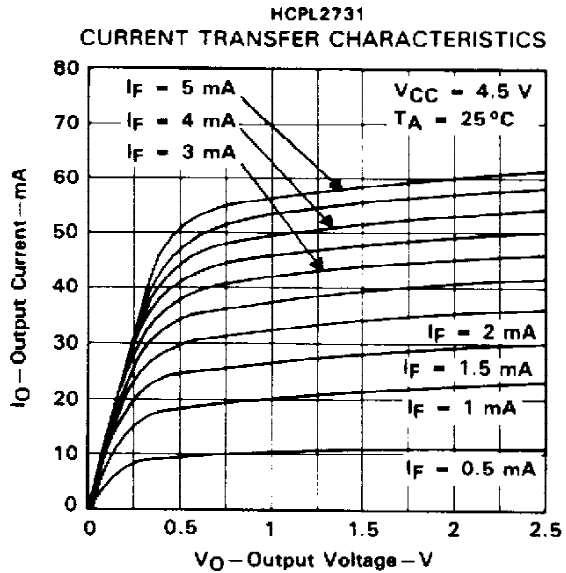


FIGURE 4

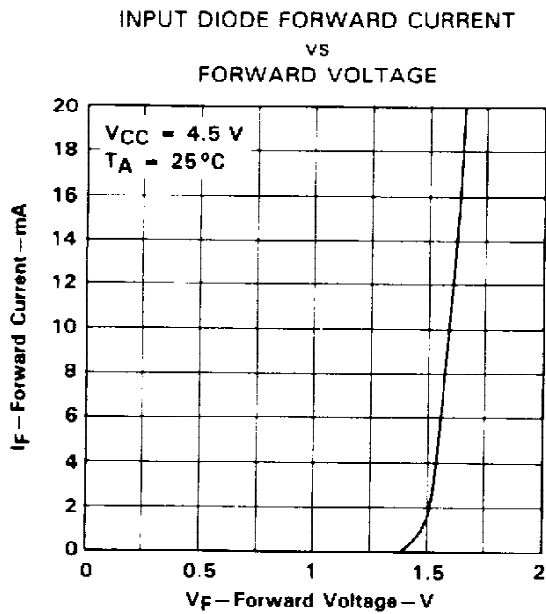


FIGURE 5

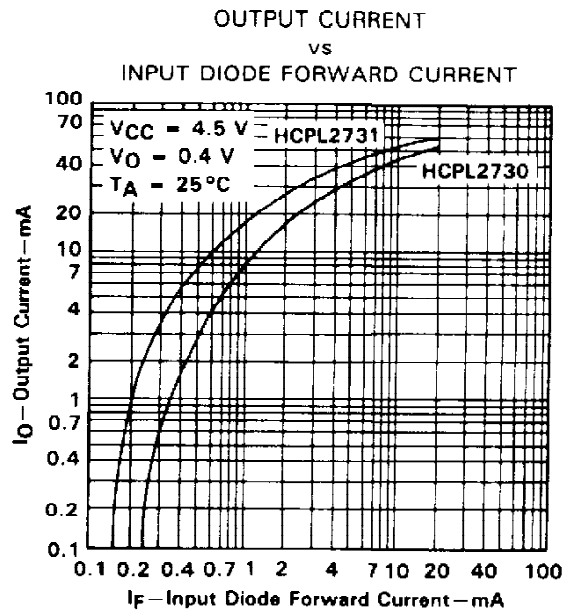


FIGURE 6

**HCPL2730, HCPL2731  
DUAL-CHANNEL OPTOCOUPLEDERS/OPTOISOLATORS**

**TYPICAL CHARACTERISTICS**

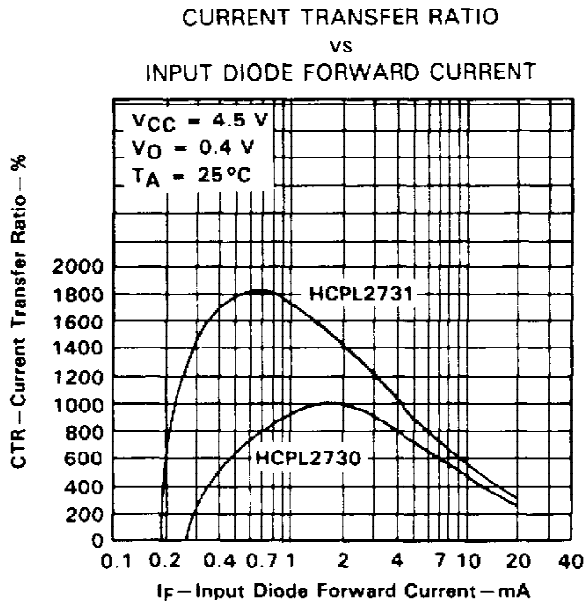


FIGURE 7

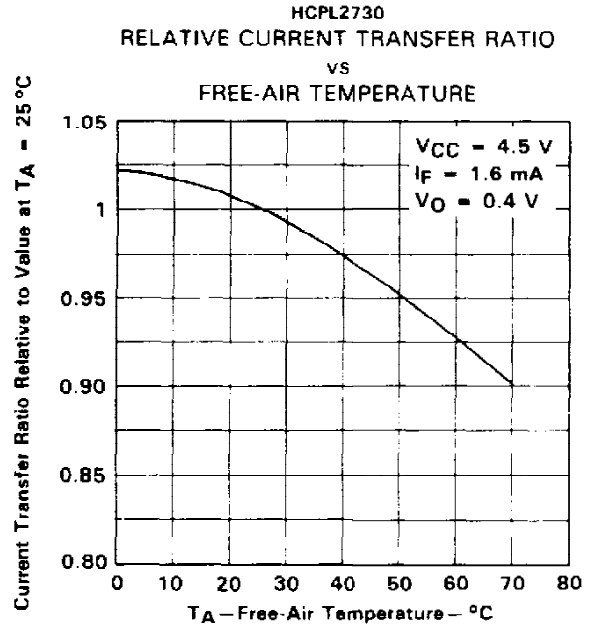


FIGURE 8

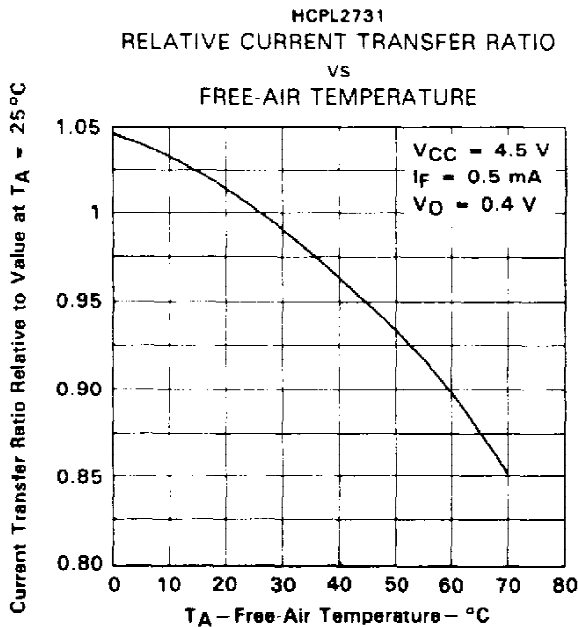


FIGURE 9

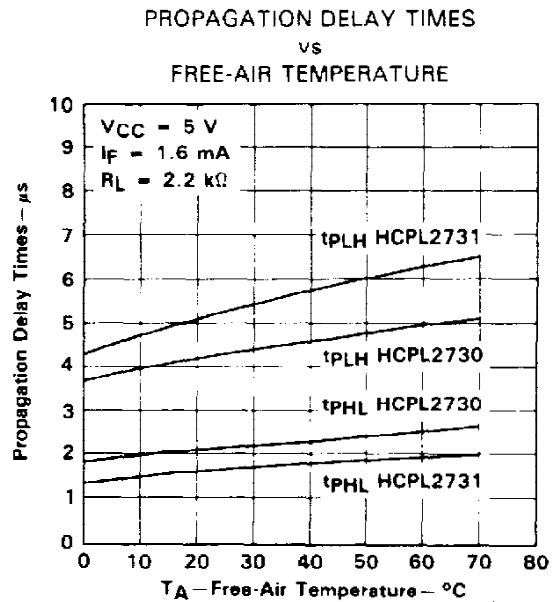


FIGURE 10



**HCPL2730, HCPL2731  
DUAL-CHANNEL OPTOCOUPPLERS/OPTOISOLATORS**

**TYPICAL CHARACTERISTICS**

PROPAGATION DELAY TIMES  
vs  
FREE-AIR TEMPERATURE

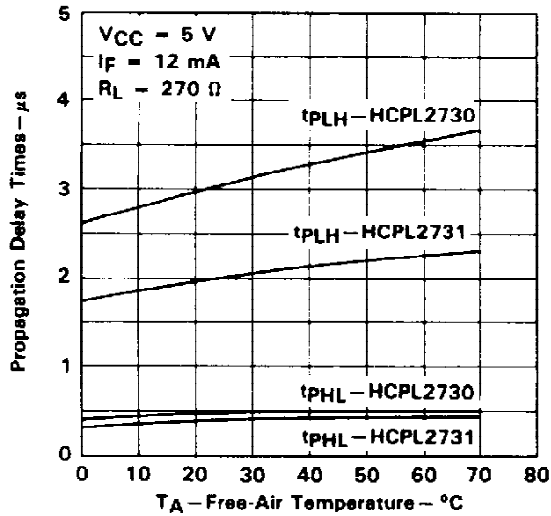


FIGURE 11

HCPL2731  
PROPAGATION DELAY TIMES  
vs  
FREE-AIR TEMPERATURE

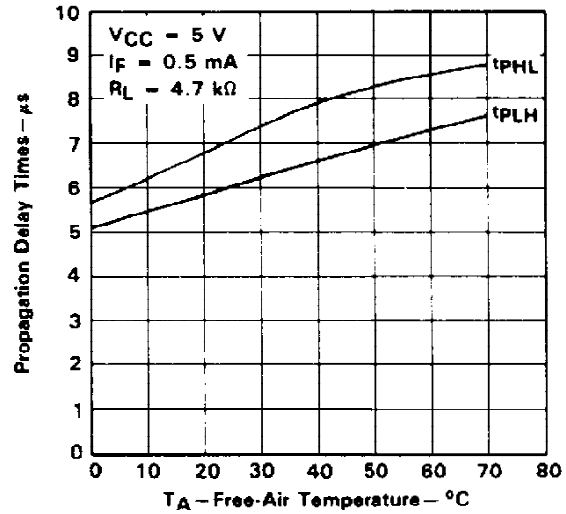


FIGURE 12

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Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
HCPL2730	OBSOLETE	PDIP	N	8		TBD	Call TI	Call TI
HCPL2731	OBSOLETE	PDIP	N	8		TBD	Call TI	Call TI

<sup>(1)</sup> The marketing status values are defined as follows:

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**TBD:** The Pb-Free/Green conversion plan has not been defined.

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<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
		Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
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