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

description

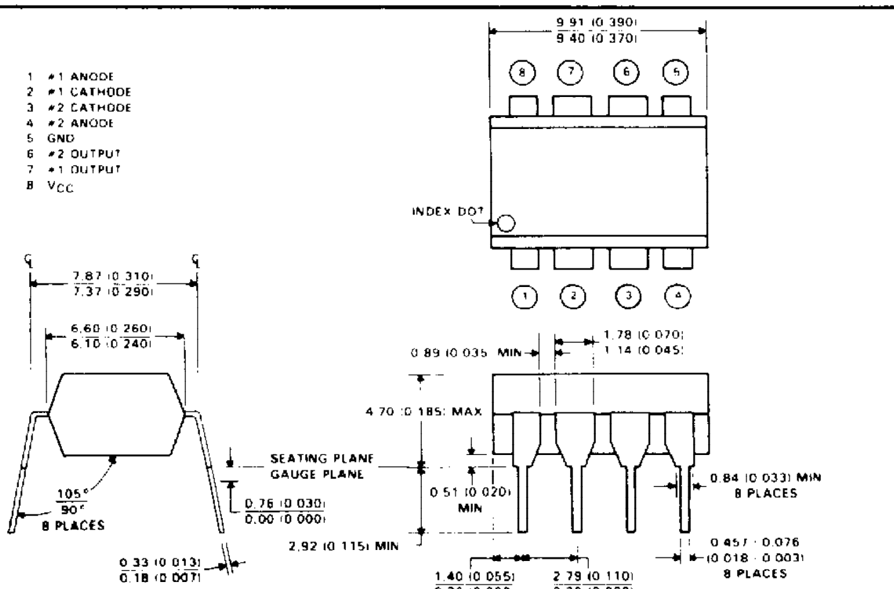
These devices are useful where large common-mode input signals exist, and in applications that require high-voltage isolation between circuits. Applications include line receivers, telephone ring detectors, power line monitors, high-voltage status indicators, and circuits that require isolation between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

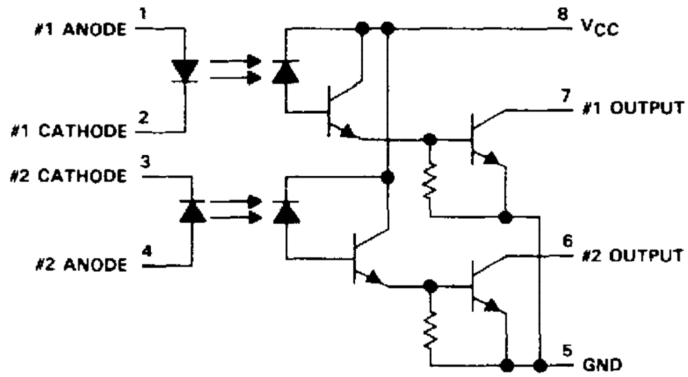
The HCPL2731 is designed for use in CMOS, LSTTL, or other low-power applications. This device has a minimum current-transfer ratio of 400% for only 0.5-mA input current over an operating temperature range of 0°C to 70°C.

mechanical data



ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

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 0.57 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.

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†	MAX	MIN	TYP†	MAX	
V_F	Input forward voltage	I_F = 1.6 mA, T_A = 25 °C		1.5	1.7		1.5	1.7	V
α_{VF}	Temperature coefficient of forward voltage	I_F = 1.6 mA		−1.8			−1.8		mV/°C
V_{BR}	Input breakdown voltage	I_R = 10 μA, T_A = 25 °C	5			5			V
V_{OL}	Low-level output voltage	V_{CC} = 4.5 V, I_F = 1.6 mA, I_{OL} = 4.8 mA, I_B = 0		0.1	0.4				V
		V_{CC} = 4.5 V, I_F = 1.6 mA, I_{OL} = 8 mA, I_B = 0					0.1	0.4	
		V_{CC} = 4.5 V, I_F = 5 mA, I_{OL} = 15 mA, I_B = 0					0.1	0.4	
		V_{CC} = 4.5 V, I_F = 12 mA, I_{OL} = 24 mA, I_B = 0					0.2	0.4	
I_{OH}	High-level output current	V_{CC} = 7 V, V_O = 7 V, I_F = 0, I_B = 0		0.1	250				μA
		V_{CC} = 18 V, V_O = 18 V, I_F = 0, I_B = 0					0.05	100	
I_{CCH}	Supply current, high-level output	V_{CC} = 7 V, I_O = 0, I_F = 0, I_B = 0		4					nA
		V_{CC} = 18 V, I_O = 0, I_F = 0, I_B = 0					5		
I_{CCL}	Supply current, low-level output	V_{CC} = 7 V, I_O = 0, I_{F1} = 1.6 mA, I_{F2} = 1.6 mA, I_B = 0		0.4					mA
		V_{CC} = 18 V, I_O = 0, I_{F1} = 1.6 mA, I_{F2} = 1.6 mA, I_B = 0					0.6		
CTR	Current transfer ratio	V_{CC} = 4.5 V, V_O = 0.4 V, I_F = 0.5 mA, I_B = 0, See Note 5				400%	1800%		
		V_{CC} = 4.5V, V_O = 0.4 V, I_F = 1.6 mA, I_B = 0, See Note 5	300%	1000%		500%	1600%		
r_{ii}	Input-input resistance	V_{ii} = 500 V		10^{11}			10^{11}		Ω
r_{IO}	Input-output resistance	V_{IO} = 500 V, See Note 6		10^{12}			10^{12}		Ω
I_{ii}	Input-input insulation leakage current	V_{ii} = 500 V, t = 5 s, RH = 45%		0.005			0.005		μA
I_{IO}	Input-output insulation leakage current	V_{IO} = 3000 V, t = 5 s, T_A = 25 °C, RH = 45%, See Note 6			1			1	μA
C_i	Input capacitance	V_F = 0, f = 1 MHz		60			60		pF
C_{ii}	Input-input capacitance	f = 1 MHz		0.25			0.25		pF
C_{IO}	Input-output capacitance	f = 1 MHz, See Note 6		0.6			0.6		pF

† All typical values are at V_{CC} = 5 V, T_A = 25 °C, unless otherwise noted.

NOTES: 5. Current transfer ratio is defined as the ratio of output collector current I_O to the forward LED input current I_F times 100%.

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

switching characteristics at V_{CC} = 5 V, T_A = 25°C

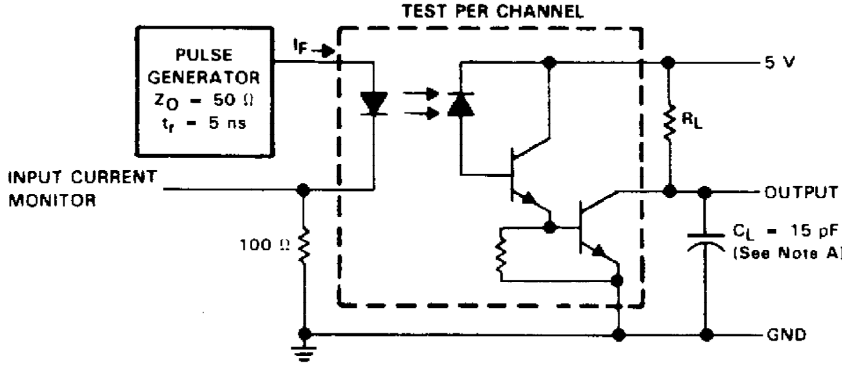
PARAMETER		TEST CONDITIONS	HCPL2730			HCPL2731			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PHL}	Propagation delay time, high-to-low level output	I_F = 1.6 mA, R_L = 2.2 kΩ, See Figure 1		2	20		2	20	μs
		I_F = 0.5 mA, R_L = 4.7 kΩ See Figure 1					7	100	
		I_F = 12 mA, R_L = 270 Ω, See Figure 1		0.4	2		0.4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

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.

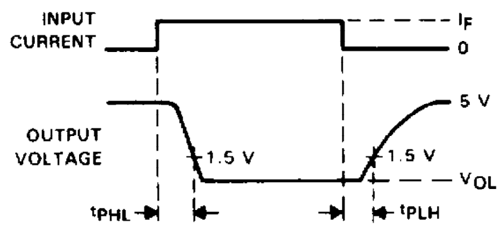
8. In applications where dV/dt may exceed 50,000 V/μs (such as static discharge) a series resistor, R_{CC}, should be included to protect the detector IC from destructively high surge currents. The recommended value is:

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

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

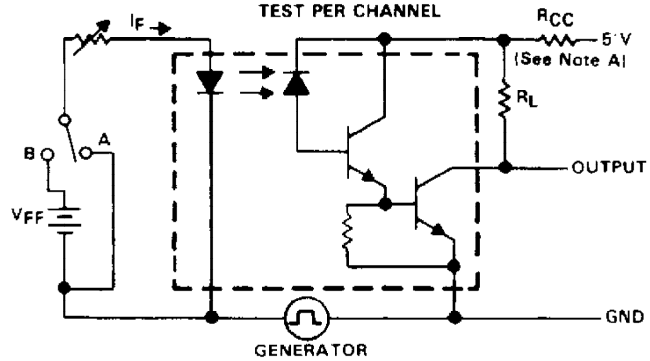


WAVEFORMS

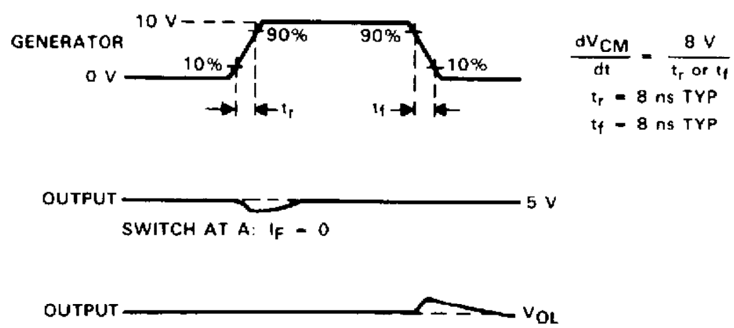
NOTE A: C_L includes probe and stray capacitances.

FIGURE 1. SWITCHING TEST CIRCUIT AND WAVEFORMS

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



WAVEFORMS

NOTE A: In applications where dV/dt may exceed 50,000 V/μs (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:

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

FIGURE 2. TRANSIENT IMMUNITY TEST CIRCUIT AND WAVEFORMS

TYPICAL CHARACTERISTICS

HCPL2730
CURRENT TRANSFER CHARACTERISTICS

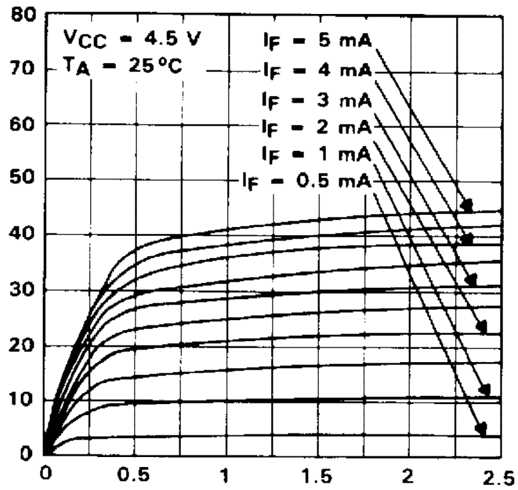


FIGURE 3

HCPL2731
CURRENT TRANSFER CHARACTERISTICS

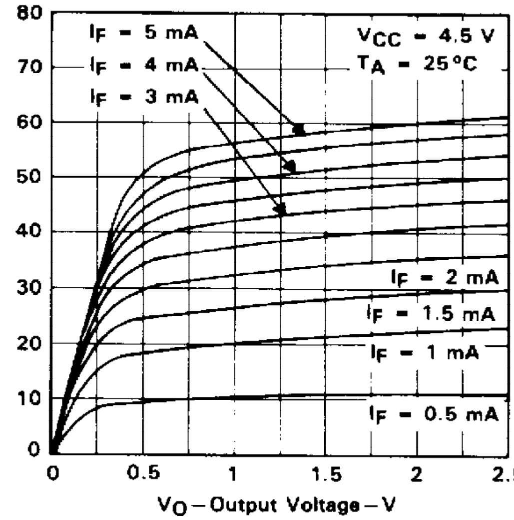


FIGURE 4

INPUT DIODE FORWARD CURRENT
vs
FORWARD VOLTAGE

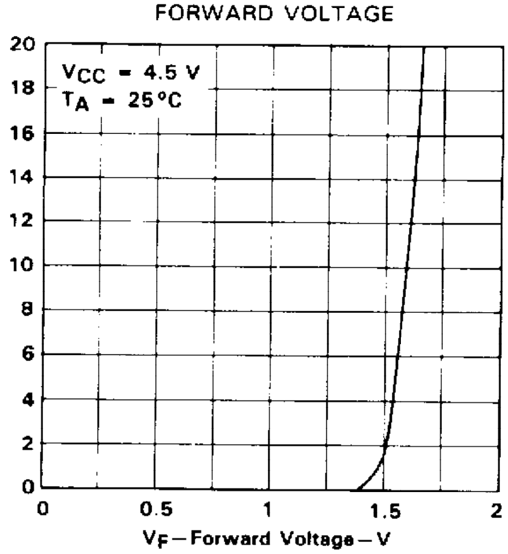


FIGURE 5

OUTPUT CURRENT
vs
INPUT DIODE FORWARD CURRENT

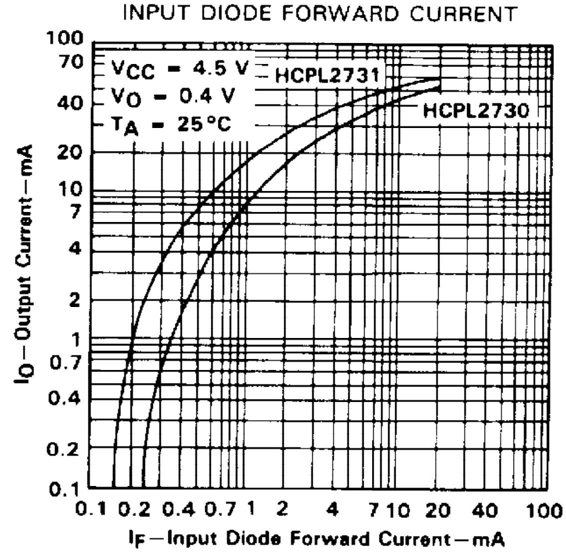


FIGURE 6

TYPICAL CHARACTERISTICS

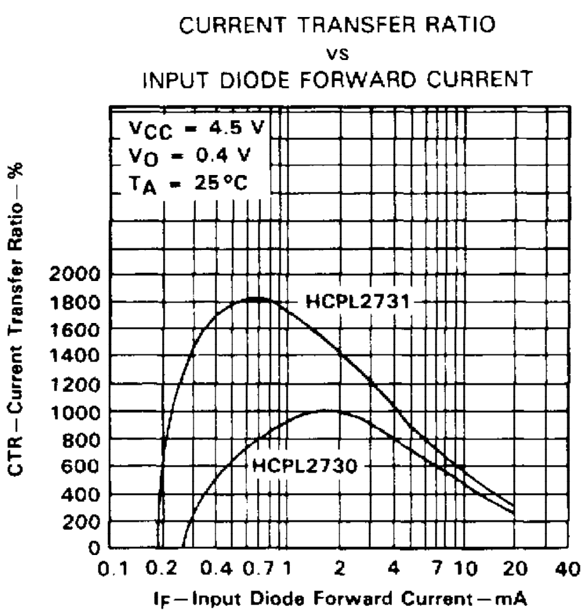


FIGURE 7

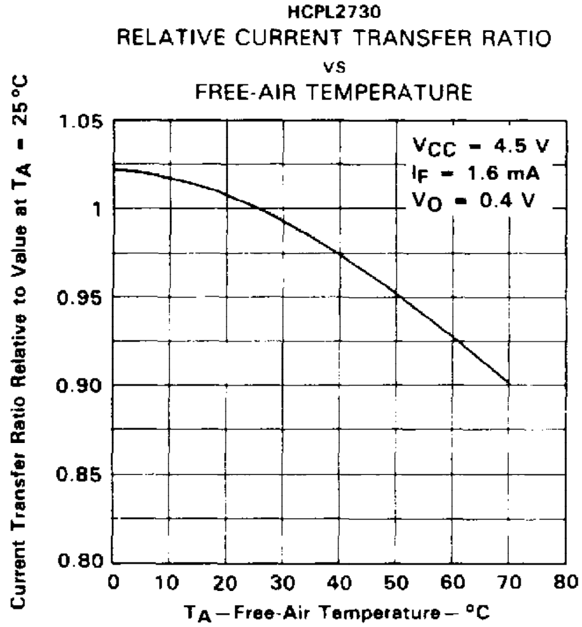


FIGURE 8

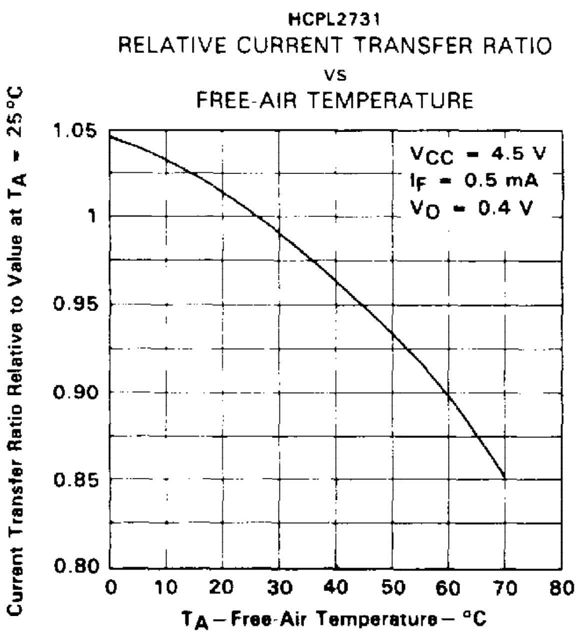


FIGURE 9

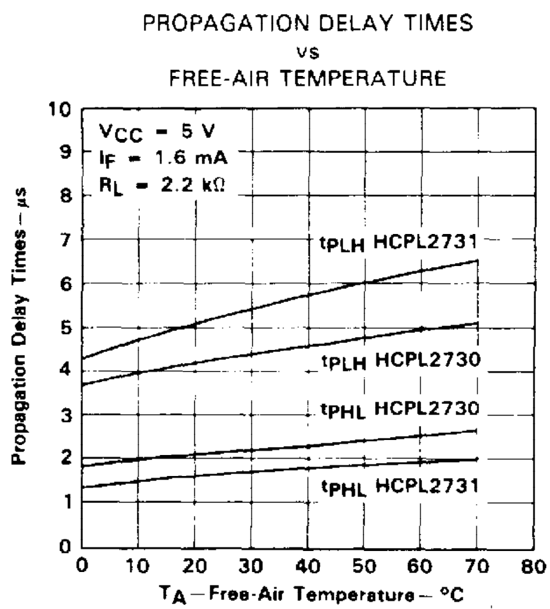


FIGURE 10

TYPICAL CHARACTERISTICS

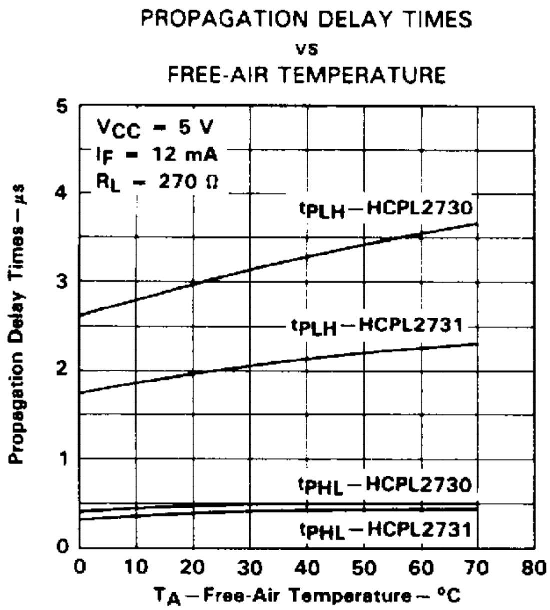


FIGURE 11

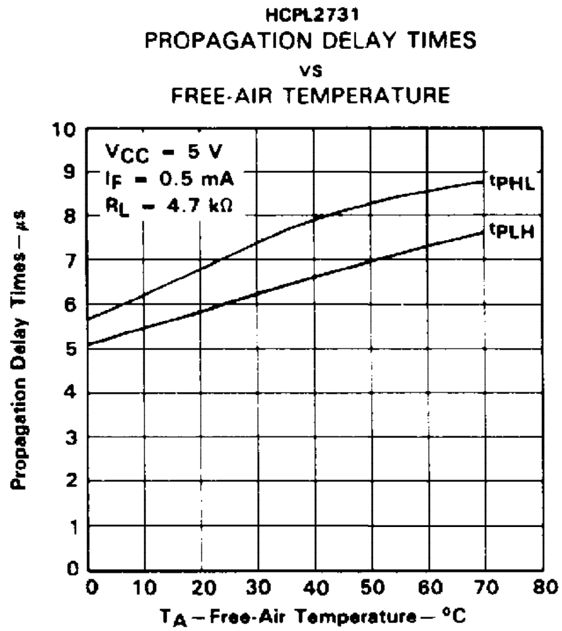


FIGURE 12

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.