SOOS020 D3262, JUNE 1989

- **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

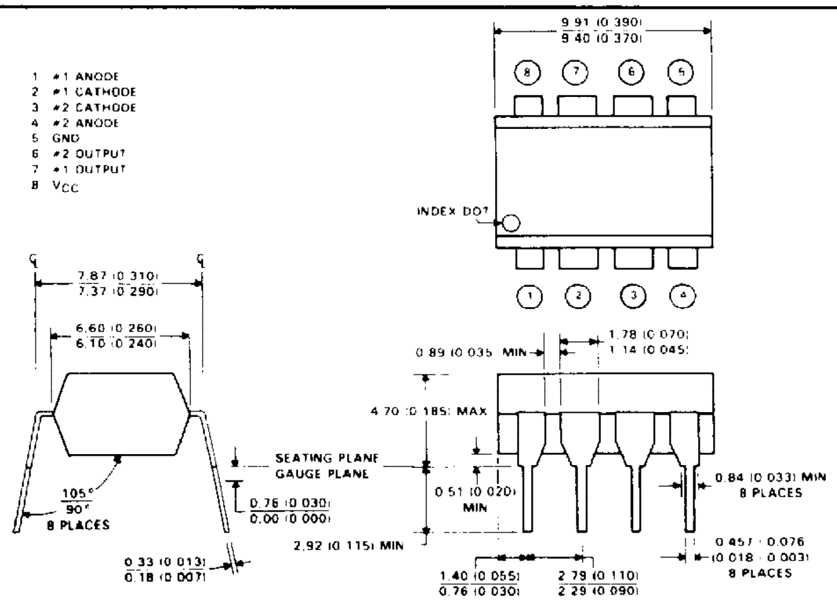
These devices are useful where large common-mode input signals exist, and in applications that require high-voltage isolation between circuits. Applications include line receivers, telephone ring detectors, power line monitors, high-voltage status indicators, and circuits that require isolation between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

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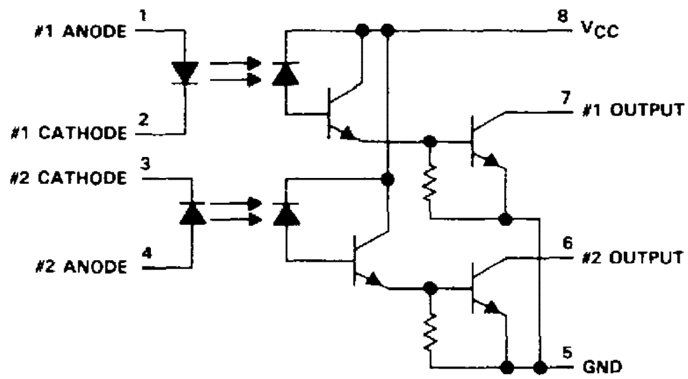
schematic



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

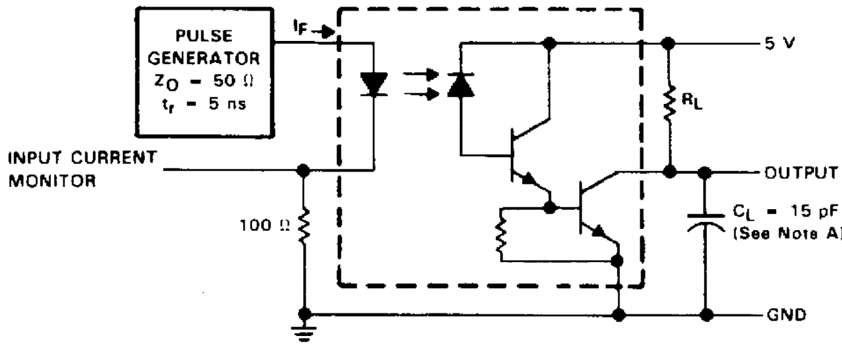
PARAMETER		TEST CONDITIONS	HCPL2730 MIN	HCPL2730 TYP	HCPL2730 MAX	HCPL2731 MIN	HCPL2731 TYP	HCPL2731 MAX	UNIT
t_{PHL}	Propagation delay time, high-to-low level output	I_F = 1.6 mA, R_L = 2.2 kΩ, See Figure 1		2	20		2	20	μs
		I_F = 0.5 mA, R_L = 4.7 kΩ See Figure 1					7	100	
		I_F = 12 mA, R_L = 270 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.

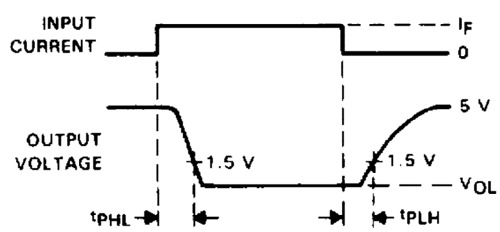
8. In applications where dV/dt may exceed 50,000 V/μs (such as static discharge) a series resistor, R_{CC}, should be included to protect the detector IC from destructively high surge currents. The recommended value is:

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

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

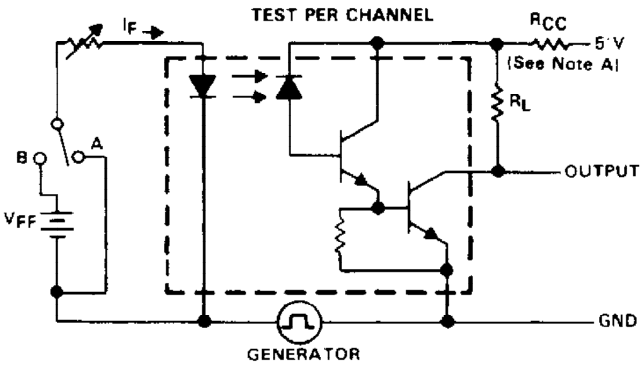


WAVEFORMS

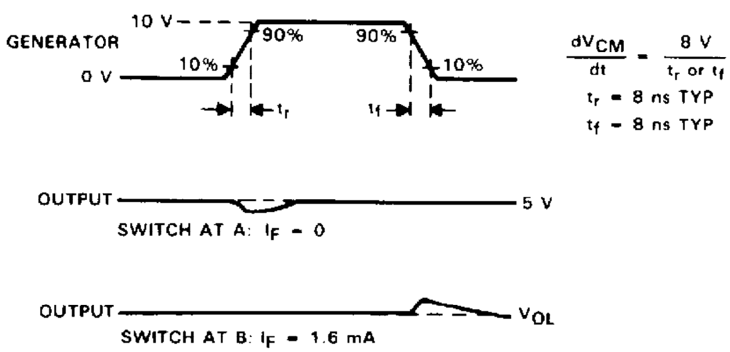
NOTE A: C_L includes probe and stray capacitances.

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

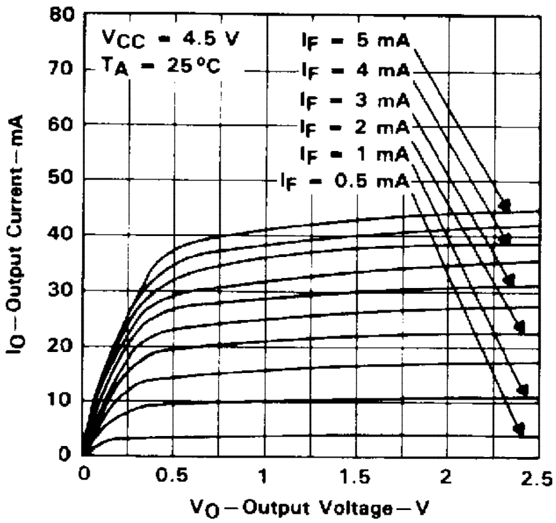


FIGURE 3

HCPL2731
CURRENT TRANSFER CHARACTERISTICS

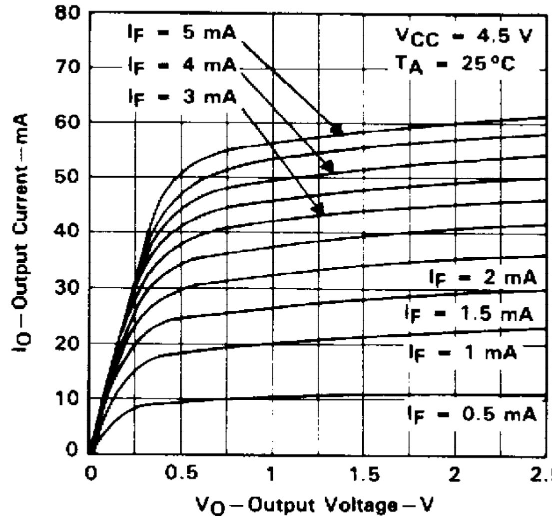


FIGURE 4

INPUT DIODE FORWARD CURRENT
vs
FORWARD VOLTAGE

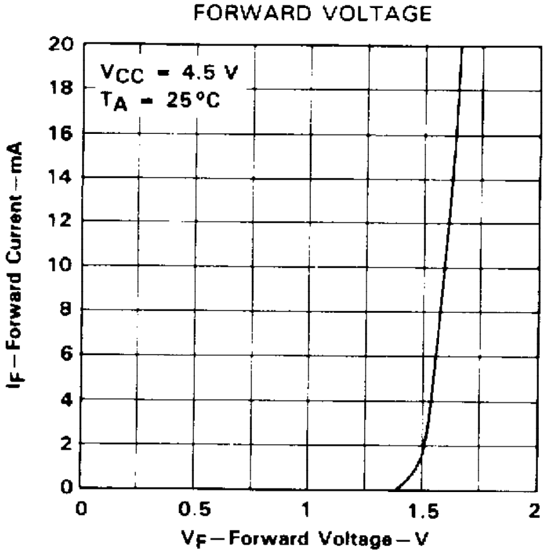


FIGURE 5

OUTPUT CURRENT
vs
INPUT DIODE FORWARD CURRENT

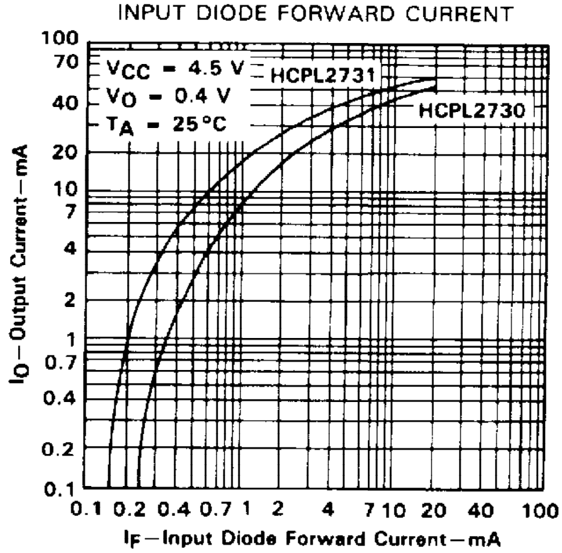


FIGURE 6

TYPICAL CHARACTERISTICS

CURRENT TRANSFER RATIO
vs
INPUT DIODE FORWARD CURRENT

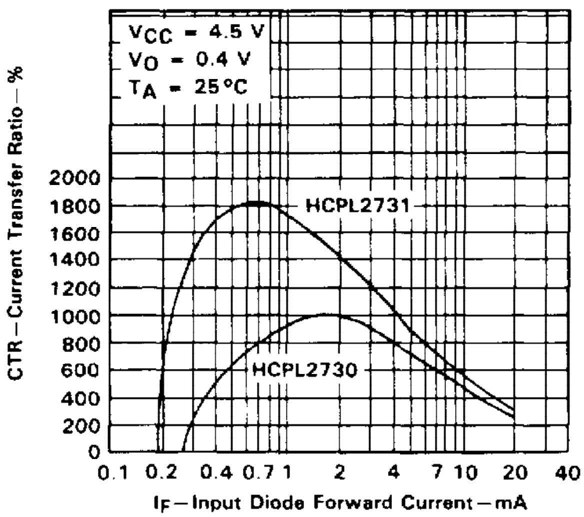


FIGURE 7

HCPL2730
RELATIVE CURRENT TRANSFER RATIO
vs
FREE-AIR TEMPERATURE

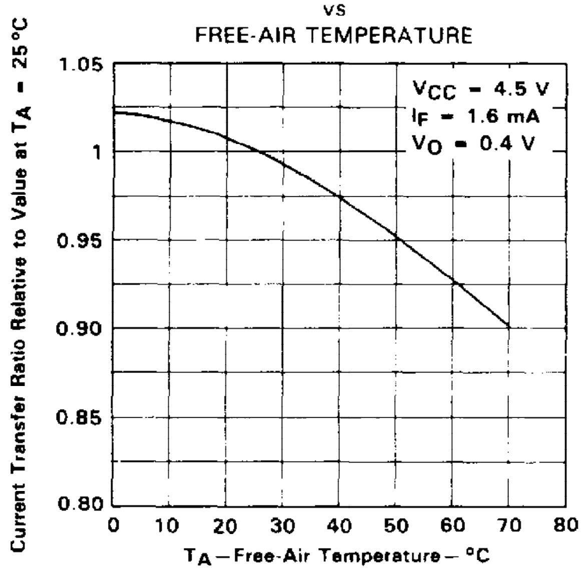


FIGURE 8

HCPL2731
RELATIVE CURRENT TRANSFER RATIO
vs
FREE-AIR TEMPERATURE

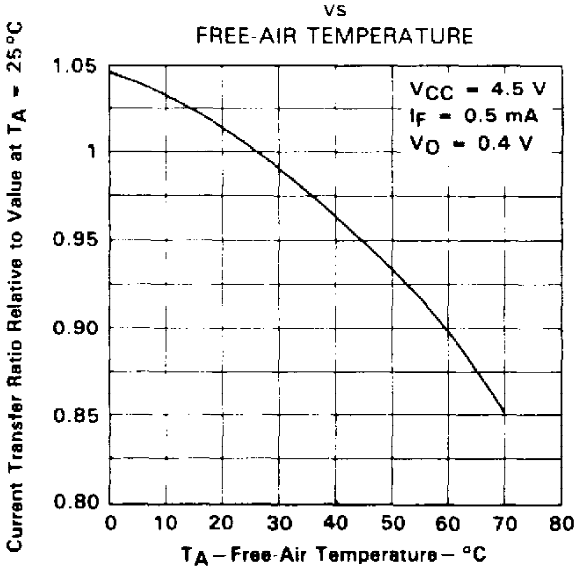


FIGURE 9

PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE

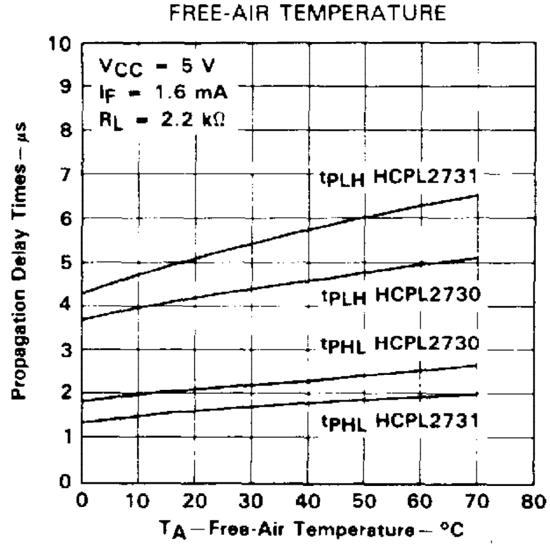


FIGURE 10

TYPICAL CHARACTERISTICS

PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE

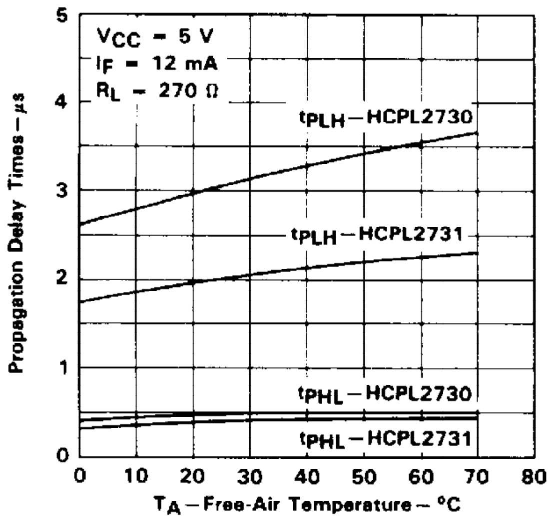


FIGURE 11

HCPL2731
PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE

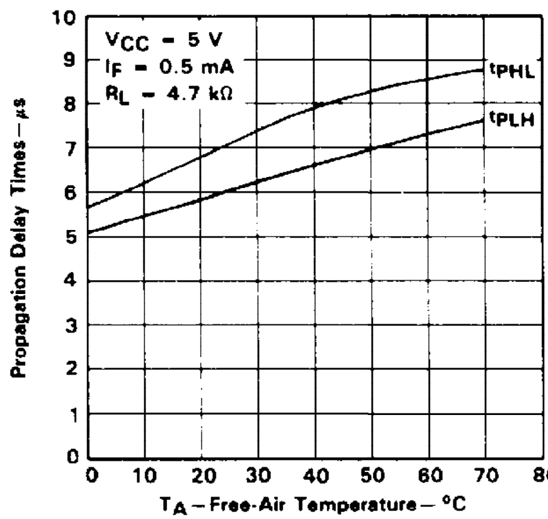


FIGURE 12

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