SOOS005 D3012, JULY 1986

- Compatible with TTL Inputs
- High Current Transfer Ratio . . . 800% Typ at I_F = 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

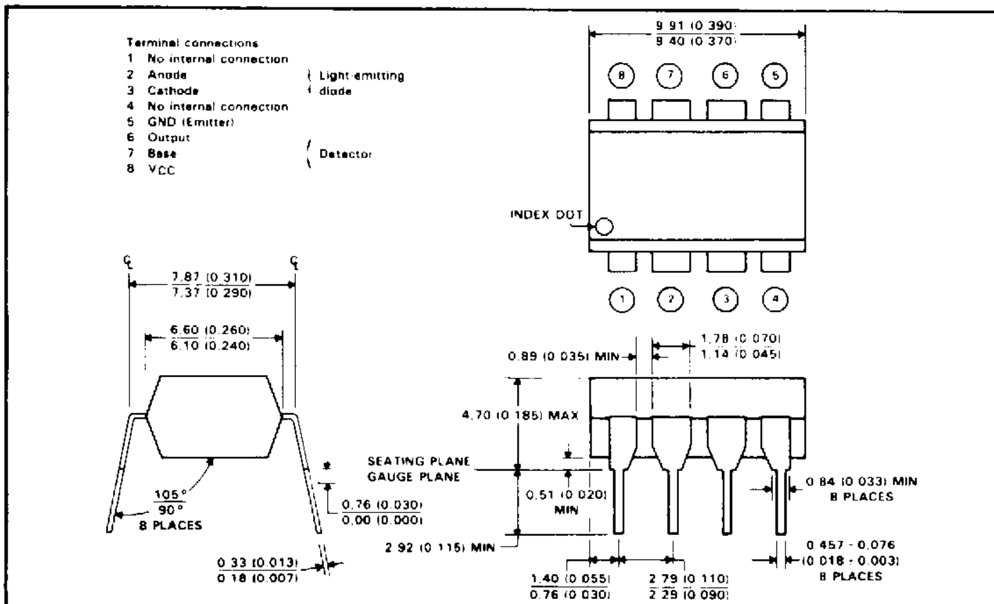
These devices are useful where large common-mode input signals exist, and in applications that require high-voltage isolation between circuits. Applications include line receivers, telephone ring detectors, power line monitors, high-voltage status indicators, and circuits that require isolation between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

The 6N138 and 6N139 high-gain optocouplers each consists of a GaAsP light-emitting diode and an integrated high-gain photon detector composed of a photodiode and a split-Darlington output stage. The V_{CC} and output terminals may be tied together to achieve conventional photodarlington operation. A separate base access terminal allows gain-bandwidth adjustments.

The 6N138 is designed for use primarily in TTL applications. An LED input current of 1.6 milliamperes and a current-transfer ratio of 300% from 0°C to 70°C allows operation with one TTL load input and one TTL load output utilizing a 2.2-kΩ pullup resistor.

The 6N139 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 milliampere 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

*JEDEC registered data. This data sheet contains all applicable registered data in effect at the time of publication.

TEXAS INSTRUMENTS
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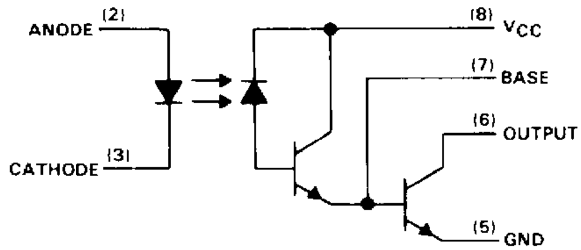
schematic



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

Supply and output voltage range, V_{CC} and V_O: 6N138	−0.5 V to 7 V
6N139	−0.5 to 18 V
Reverse input voltage	5 V
Emitter-base reverse voltage	0.5 V
Peak input forward current (pulse duration = 1 ms, 50% duty cycle)	40 mA
Peak transient input forward current (pulse duration ≤ 1 μs, 300 pps)	1 A
Average forward input current at (or below) 50 °C free-air temperature (see Note 1)	20 mA
Output current at (or below) 25 °C free-air temperature (see Note 2)	60 mA
Input power dissipation at (or below) 50 °C free-air temperature (see Note 3)	35 mW
Output power dissipation at (or below) 25 °C free-air temperature (see Note 4)	100 mW
Storage temperature range	−55 °C to 125 °C
Operating temperature range	0 °C to 100 °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 0.4 mA/°C.
2. Derate linearly above 25 °C free air temperature at a rate of 0.8 mA/°C.
3. Derate linearly above 50 °C free air temperature at a rate of 0.7 mW/°C.
4. Derate linearly above 25 °C free-air temperature at a rate of 1.33 mW/°C.

*JEDEC registered data.

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

	PARAMETER	TEST CONDITIONS	6N138 MIN	6N138 TYP†	6N138 MAX	6N139 MIN	6N139 TYP†	6N139 MAX	UNIT
*V_F	Input forward voltage	I_F = 1.6 mA, T_A = 25°C		1.5	1.7		1.5	1.7	V
αV_F	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} = 6.4 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} = 5 V, V_O open, I_F = 0, I_B = 0		10			10		nA
I_{CCL}	Supply current, low-level output	V_{CC} = 5 V, V_O open, I_F = 1.6 mA, I_B = 0		0.2			0.2		mA
*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%	1650%		
		V_{CC} = 4.5 V, V_O = 0.4 V, I_F = 1.6 mA, I_B = 0, See Note 5	300%	1300%		500%	1400%		
r_{IO}	Input-output resistance	V_{IO} = 500 V, See Note 6		10^{12}			10^{12}		Ω
*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_{io}	Input-output capacitance	f = 1 MHz, See Note 6		0.6			0.6		pF

*JEDEC registered data

†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	6N138 MIN	6N138 TYP	6N138 MAX	6N139 MIN	6N139 TYP	6N139 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	10				μs
		I_F = 0.5 mA, R_L = 4.7 kΩ, See Figure 1					4	25	
		I_F = 12 mA, R_L = 270 Ω, See Figure 1					0.3	1	
*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				μs
		I_F = 0.5 mA, R_L = 4.7 kΩ, See Figure 1					10	60	
		I_F = 12 mA, R_L = 270 Ω, See Figure 1					3.5	7	
$\frac{dV_{CM}}{dt}$(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} = Vp-p, R_L = 2.2 kΩ, See Figure 2, See Notes 7 and 8		−500			500		V/μs

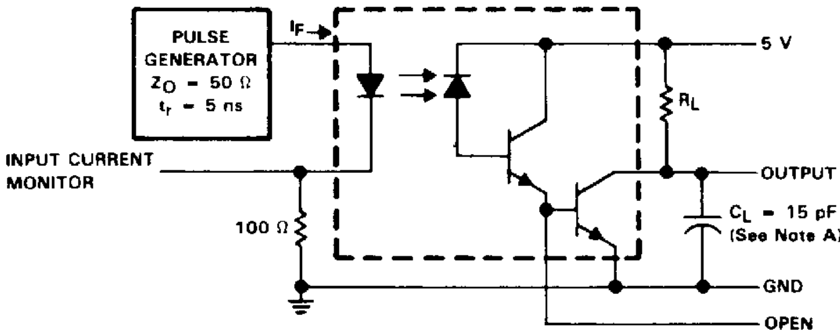
*JEDEC registered data

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.

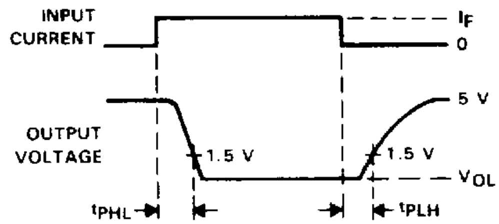
8. In applications where dV/dt may exceed 50,000 V/μs (such as static discharge) a series resistor, R_{CC}, should be included to protect the detector IC from destructively high surge currents. The recommended value is:

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

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

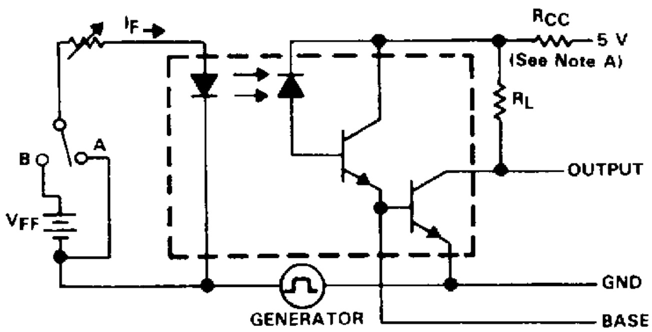


WAVEFORMS

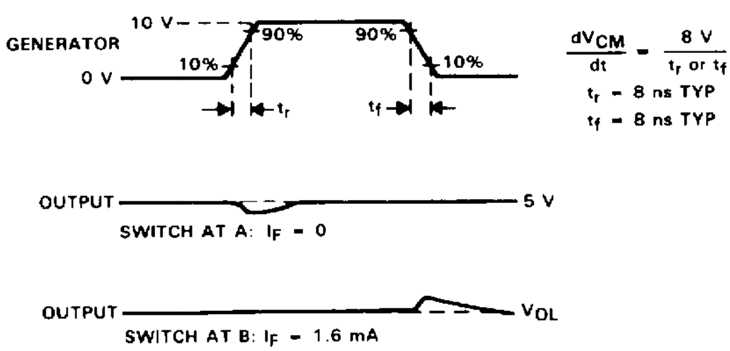
NOTE A. C_L includes probe and stray capacitances.

FIGURE 1. SWITCHING TEST CIRCUIT AND WAVEFORMS

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE 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:

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

FIGURE 2. TRANSIENT IMMUNITY TEST CIRCUIT AND WAVEFORMS

TYPICAL CHARACTERISTICS

6N138
CURRENT TRANSFER CHARACTERISTICS

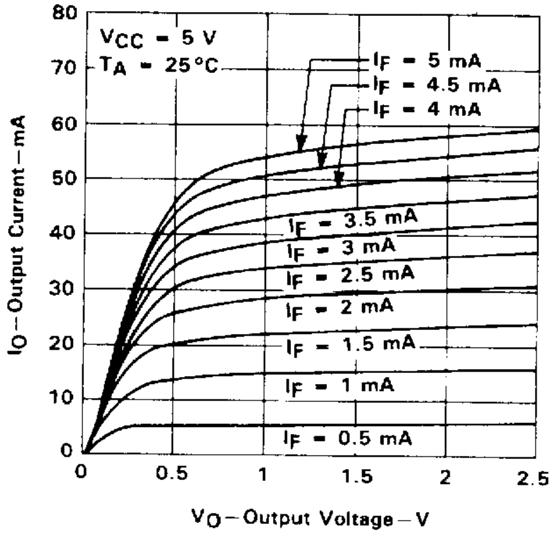


FIGURE 3

6N139
CURRENT TRANSFER CHARACTERISTICS

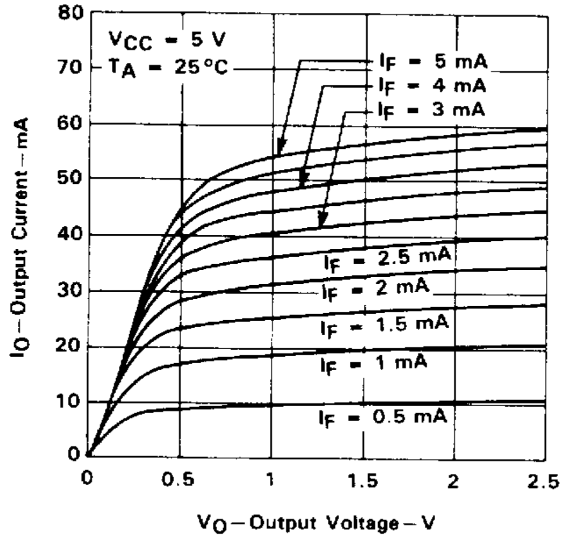


FIGURE 4

6N138
CURRENT TRANSFER RATIO
vs
INPUT DIODE FORWARD CURRENT

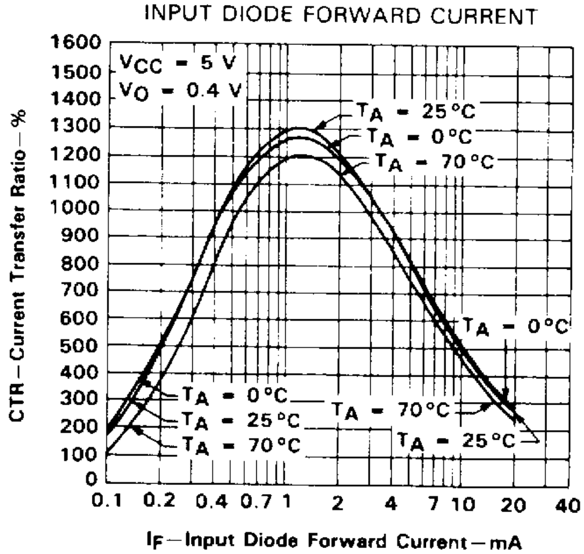


FIGURE 5

6N139
CURRENT TRANSFER RATIO
vs
INPUT DIODE FORWARD CURRENT

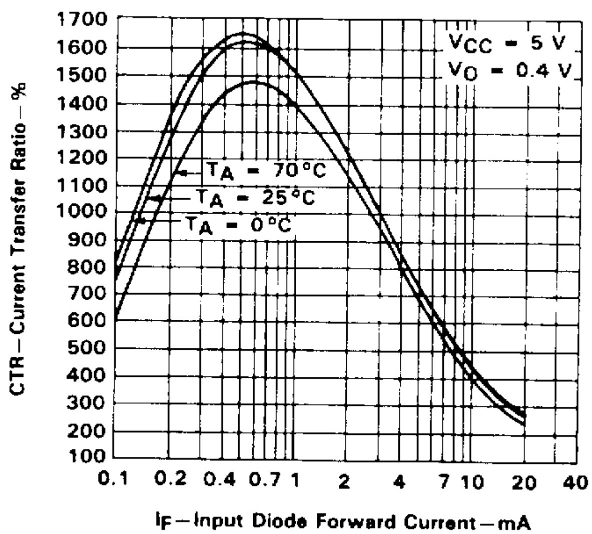


FIGURE 6

TYPICAL CHARACTERISTICS

6N138
OUTPUT CURRENT
vs
INPUT DIODE FORWARD CURRENT

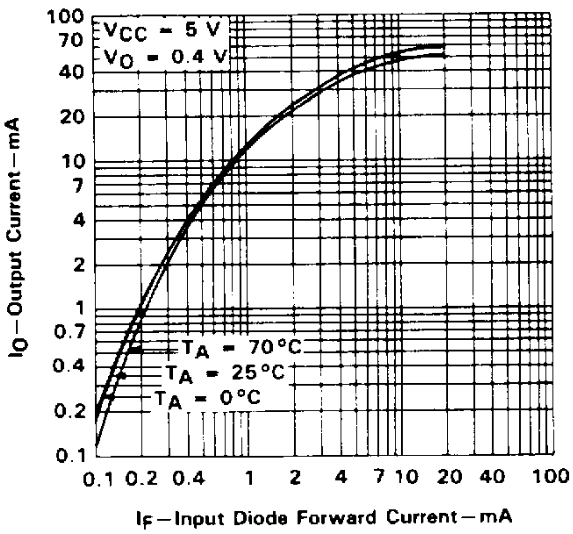


FIGURE 7

6N139
OUTPUT CURRENT
vs
INPUT DIODE FORWARD CURRENT

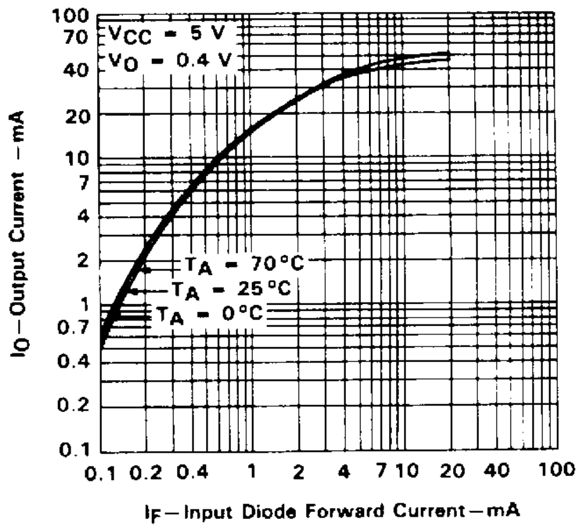


FIGURE 8

INPUT DIODE FORWARD CURRENT
vs
FORWARD VOLTAGE

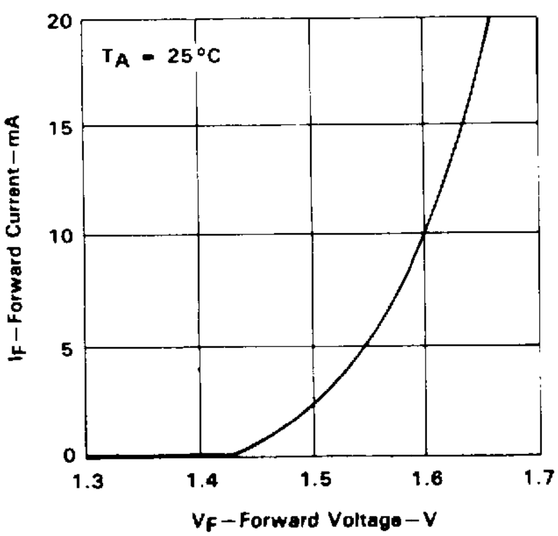


FIGURE 9

6N138
PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE

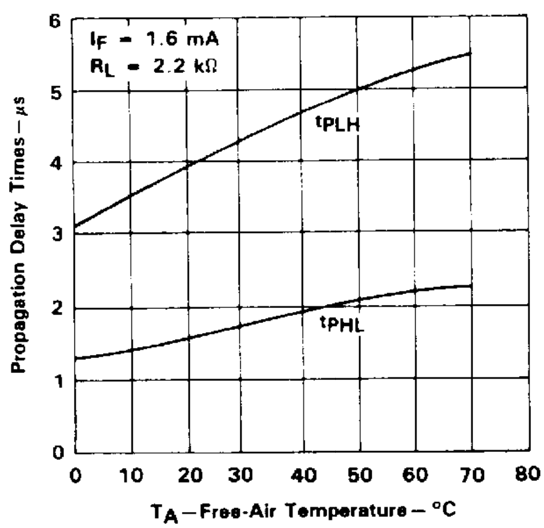


FIGURE 10

TYPICAL CHARACTERISTICS

6N139
PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE

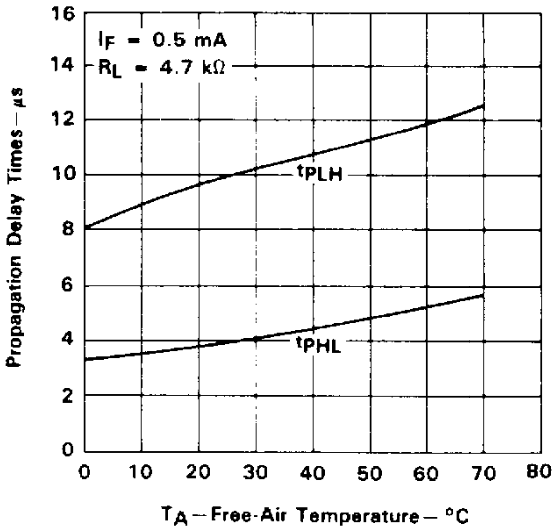


FIGURE 11

6N139
PROPAGATION DELAY TIMES
vs
FREE-AIR TEMPERATURE

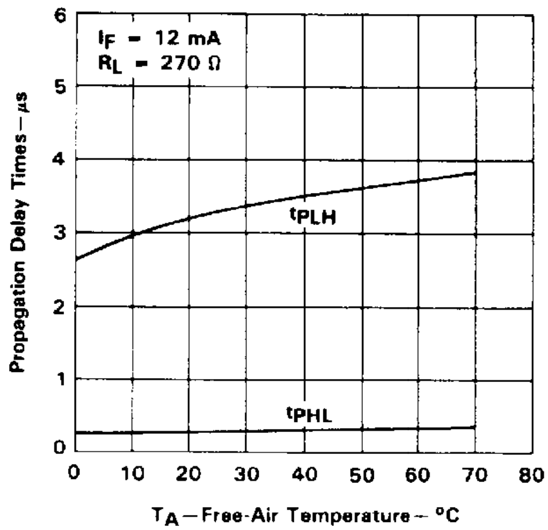


FIGURE 12

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