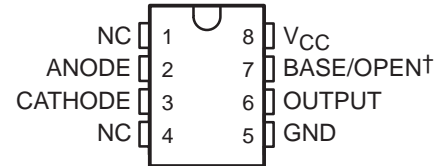


# 6N135, 6N136, HCPL4502 OPTOCOUPLEDERS/OPTOISOLATORS

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- Compatible with TTL Inputs
- High-Speed Switching . . . 1 Mbit/s Typ
- Bandwidth . . . 2 MHz Typ
- High Common-Mode Transient Immunity . . . 1000 V/ $\mu$ s Typ
- High-Voltage Electrical Insulation . . . 3000 Vdc Min
- Open-Collector Output
- UL Recognized . . . File Number 65085

6N135, 6N136, OR HCPL4502 PACKAGE  
(TOP VIEW)



† Terminal 7 is BASE on the 6N135 and 6N136 and OPEN on the HCPL4502

NC – No internal connection

## description

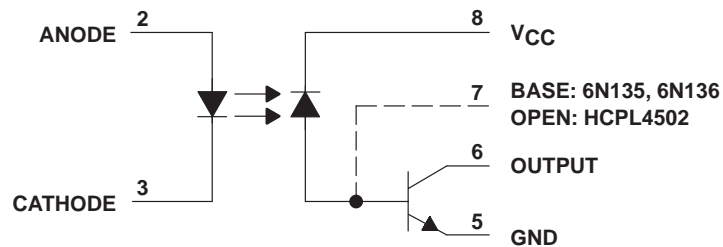
These high-speed optocouplers are designed for use in analog or digital interface applications that require high-voltage isolation between the input and output. Applications include line receivers that require high common-mode transient immunity, and analog or logic circuits that require input-to-output electrical isolation.

The 6N135, 6N136, and HCPL4502 optocouplers each consists of a light-emitting diode and an integrated photon detector composed of a photodiode and an open-collector output transistor. Separate connections are provided for the photodiode bias and the transistor-collector output. This feature, which reduces the transistor base-to-collector capacitance, results in speeds up to one hundred times that of a conventional phototransistor optocoupler.

The 6N135 is designed for TTL/CMOS, TTL/LSTTL, and wide-band analog applications.

The 6N136 and HCPL4502 are designed for high-speed TTL/TTL applications. The HCPL4502 has no base connection.

## schematic



# 6N135, 6N136, HCPL4502 OPTOCOUPERS/OPTOISOLATORS

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

Supply and output voltage range, $V_{CC}$ and $V_O$	–0.5 V to 15 V
Reverse input voltage	5 V
Emitter-base reverse voltage	5 V
Peak input forward current (pulse duration = 1 ms, 50% duty cycle, see Note 1)	50 mA
Peak transient input forward current (pulse duration 1 $\mu$ s, 300 Hz)	1 A
Average forward input current(see Note 2)	25 mA
Peak output current	16 mA
Average output current	8 mA
Base current	5 mA
Input power dissipation at (or below) 70°C free-air temperature (see Note 3)	45 mW
Output power dissipation at (or below) 70°C free-air temperature (see Note 4)	100 mW
Storage temperature range, $T_{stg}$	–55°C to 125°C
Operating free-air temperature range, $T_A$	–55°C to 100°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

‡ JEDEC registered data for 6N135 and 6N136

- NOTES:
1. Derate linearly above 70°C free-air temperature at the rate of 1.67 mA/°C.
  2. Derate linearly above 70°C free-air temperature at the rate of 0.83 mA/°C.
  3. Derate linearly above 70°C free-air temperature at the rate of 1.50 mW/°C.
  4. Derate linearly above 70°C free-air temperature at the rate of 3.33 mW/°C.



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# 6N135, 6N136, HCPL4502 OPTOCOUPERS/OPTOISOLATORS

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

PARAMETER	TEST CONDITIONS	6N135			6N136, HCPL4502			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_F$ ‡	Input forward voltage	$I_F = 16 \text{ mA}$ , $T_A = 25^\circ\text{C}$		1.6	1.7	1.6	1.7	V
$\infty V_F$	Temperature coefficient of forward voltage	$I_F = 16 \text{ mA}$		-1.8		-1.8		mV/°C
$V_{BR}$ ‡	Input breakdown voltage	$I_R = 10 \mu\text{A}$ , $T_A = 25^\circ\text{C}$		5		5		V
$V_{OL}$	Low-level output voltage	$V_{CC} = 4.5 \text{ V}$ , $I_F = 16 \text{ mA}$ , $I_B = 0$	$I_{OL} = 1.1 \text{ mA}$	0.1		0.4		V
			$I_{OL} = 2.4 \text{ mA}$			0.1		
$I_{OH}$ ‡	High-level output current	$I_F = 0$ , $I_B = 0$ , $T_A = 25^\circ\text{C}$	$V_{CC} = V_O = 5.5 \text{ V}$	3		500		nA
			$V_{CC} = V_O = 15 \text{ V}$	0.01		1		$\mu\text{A}$
$I_{OH}$	High-level output current	$V_{CC} = 15 \text{ V}$ , $I_F = 0$ ,	$V_O = 15 \text{ V}$ , $I_B = 0$	50		50		$\mu\text{A}$
$I_{CCH}$ ‡	Supply current, high-level output	$V_{CC} = 15 \text{ V}$ , $I_F = 0$ , $T_A = 25^\circ\text{C}$	$I_O = 0$ , $I_B = 0$ ,	0.02		1		$\mu\text{A}$
$I_{CCH}$	Supply current, high-level output	$V_{CC} = 15 \text{ V}$ , $I_F = 0$ ,	$I_O = 0$ , $I_B = 0$	2		2		$\mu\text{A}$
$I_{CCL}$	Supply current, low-level output	$V_{CC} = 15 \text{ V}$ , $I_F = 16 \text{ mA}$ ,	$I_O = 0$ , $I_B = 0$	40		40		$\mu\text{A}$
$h_{FE}$	Transistor forward current transfer ratio	$V_O = 5 \text{ V}$ ,	$I_O = 3 \text{ mA}$	100		100 (6N136 only)		
$CTR$ ‡	Current transfer ratio	$V_{CC} = 4.5 \text{ V}$ , $I_F = 16 \text{ mA}$ , $T_A = 25^\circ\text{C}$ ,	$V_O = 0.4 \text{ V}$ , $I_B = 0$ , See Note 5	7% 18%		19% 24%		
$CTR$	Current transfer ratio	$V_{CC} = 4.5 \text{ V}$ , $I_F = 16 \text{ mA}$ , See Note 5	$V_O = 0.5 \text{ V}$ , $I_B = 0$ ,	5%		15%		
$r_{IO}$	Input-output resistance	$V_{IO} = 500 \text{ V}$ , See Note 6	$T_A = 25^\circ\text{C}$ ,	$10^{12}$		$10^{12}$		$\Omega$
$I_{IO}$ ‡	Input-output insulation leakage current	$V_{IO} = 3000 \text{ V}$ , $T_A = 25^\circ\text{C}$ , See Note 6	$t = 5 \text{ s}$ , RH = 45%,	1		1		$\mu\text{A}$
$C_i$	Input capacitance	$V_F = 0$ ,	$f = 1 \text{ MHz}$	60		60		pF
$C_{io}$	Input-output capacitance	$f = 1 \text{ MHz}$ ,	See Note 6	0.6		0.6		pF

† All typical values are at  $T_A = 25^\circ\text{C}$ .

‡ JEDEC registered data for 6N135 and 6N136

- 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 with terminals 2 and 3 shorted together and terminals 5, 6, 7, and 8 shorted together.

# 6N135, 6N136, HCPL4502 OPTOCOUPPLERS/OPTOISOLATORS

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## operating characteristics, $V_{CC} = 5\text{ V}$ , $I_F = 16\text{ mA}$ , $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	6N135			6N136, HCPL4502			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
BW Bandwidth (–3 dB)	$R_L = 100\ \Omega$ , See Note 7	2			2			MHz

NOTE 7: Bandwidth is the range of frequencies within which the ac output voltage is not more than 3 dB below the low-frequency value.

## switching characteristics at $V_{CC} = 5\text{ V}$ , $I_F = 16\text{ mA}$ , $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	6N135			6N136, HCPL4502			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$t_{PLH}^\dagger$	Propagation delay time, low-to-high-level output $R_L = 4.1\text{ k}\Omega$ , See Figure 1	1 1.5						$\mu\text{s}$
	$R_L = 1.9\text{ k}\Omega$ , See Figure 1				0.6 0.8			
$t_{PHL}^\dagger$	Propagation delay time, high-to-low-level output $R_L = 4.1\text{ k}\Omega$ , See Figure 1	0.7 1.5						$\mu\text{s}$
	$R_L = 1.9\text{ k}\Omega$ , See Figure 1				0.6 0.8			
$\frac{dV_{CM}}{dt}$ (H)	Common-mode input transient immunity, high-level output $\Delta V_{CM} = 10\text{ V}$ , $R_L = 4.1\text{ k}\Omega$ , See Figure 2	1000						$\text{V}/\mu\text{s}$
	$\Delta V_{CM} = 10\text{ V}$ , $R_L = 1.9\text{ k}\Omega$ , See Figure 2				1000			
$\frac{dV_{CM}}{dt}$ (L)	Common-mode input transient immunity, low-level output $\Delta V_{CM} = 10\text{ V}$ , See Notes 9 and 10, $R_L = 4.1\text{ k}\Omega$ , See Figure 2	1000						$\text{V}/\mu\text{s}$
	$\Delta V_{CM} = 10\text{ V}$ , See Notes 9 and 10, $R_L = 1.9\text{ k}\Omega$ , See Figure 2				1000			

$^\dagger$  JEDEC registered data for 6N135 and 6N136

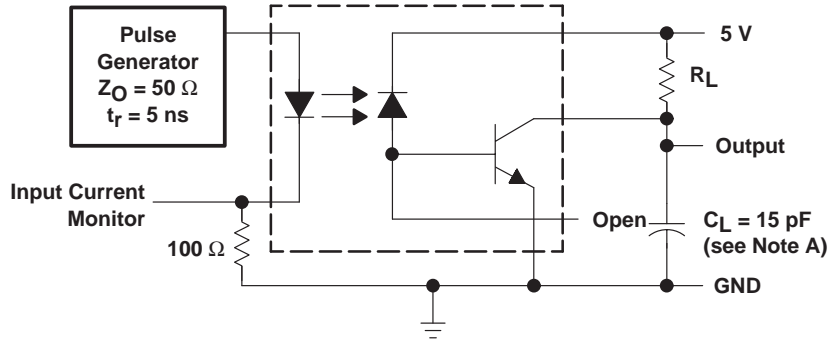
NOTES: 8. The 4.1-k $\Omega$  load represents one LSTTL unit load of 0.36 mA and a 6.1-k $\Omega$  pullup resistor.

9. The 1.9-k $\Omega$  load represents one TTL unit load of 1.6 mA and a 5.6-k $\Omega$  pullup resistor.

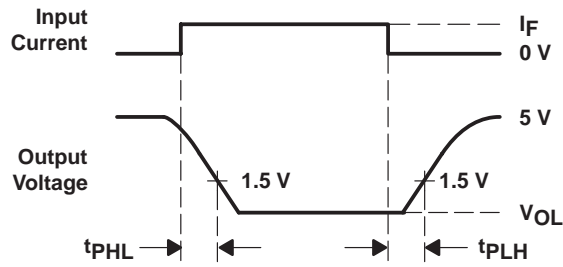
10. Common-mode transient immunity, high-level output, is the maximum rate of rise of the common-mode input voltage that does not cause the output voltage to drop below 2 V. Common-mode input transient immunity, low-level output, is the maximum rate of fall of the common-mode input voltage that does not cause the output voltage to rise above 0.8 V.



PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



WAVEFORMS

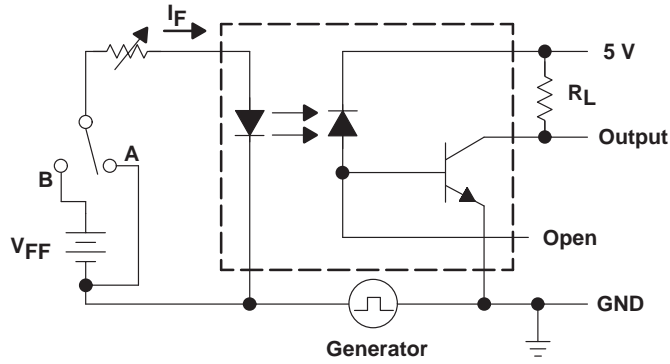
NOTE A:  $C_L$  includes probe and stray capacitance.

Figure 1. Switching Test Circuit and Waveforms

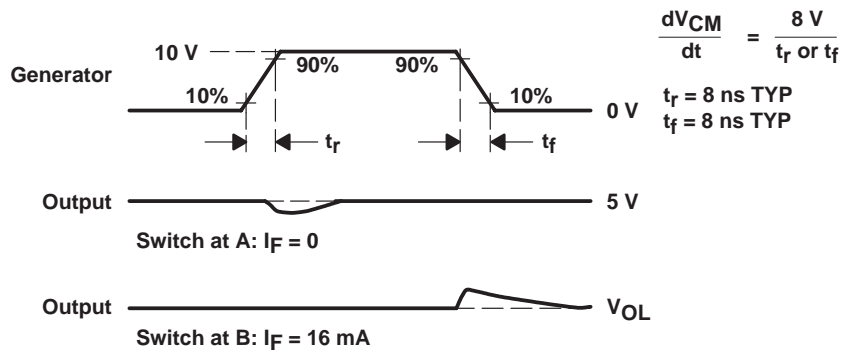
# 6N135, 6N136, HCPL4502 OPTOCOUPPLERS/OPTOISOLATORS

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## PARAMETER MEASUREMENT INFORMATION



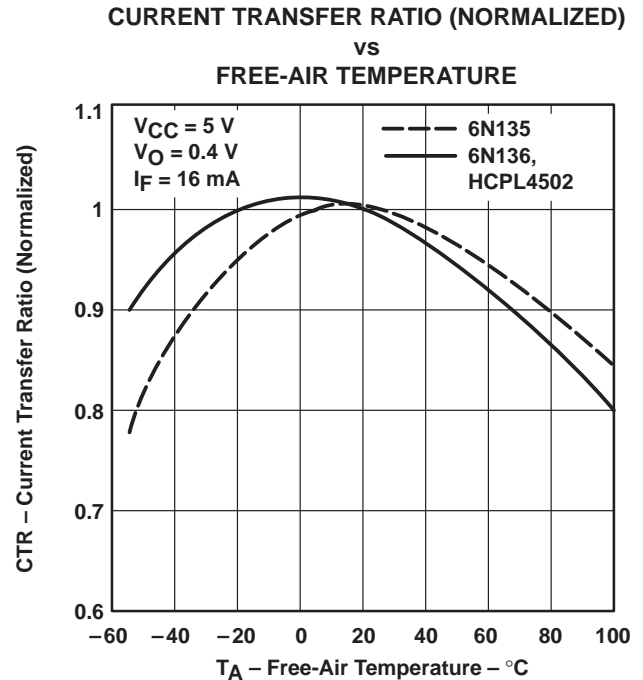
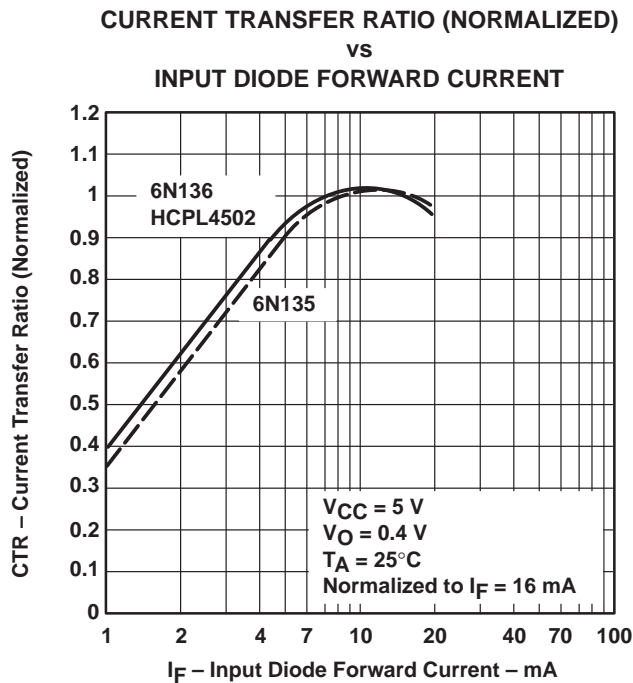
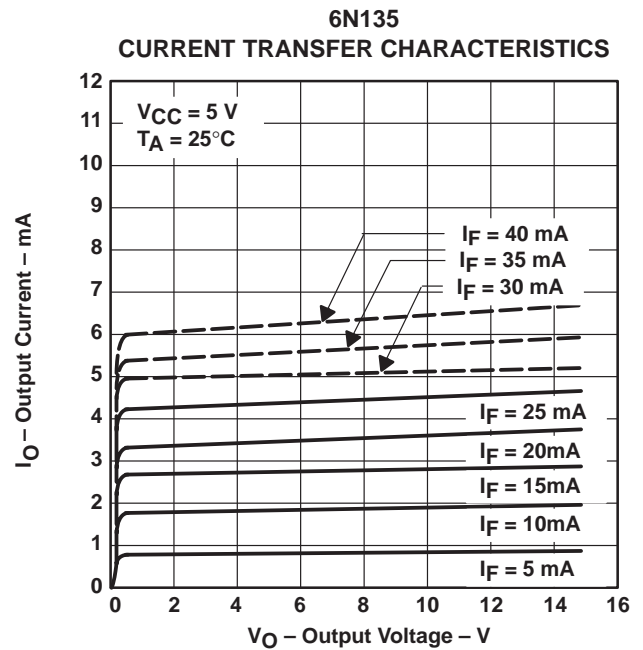
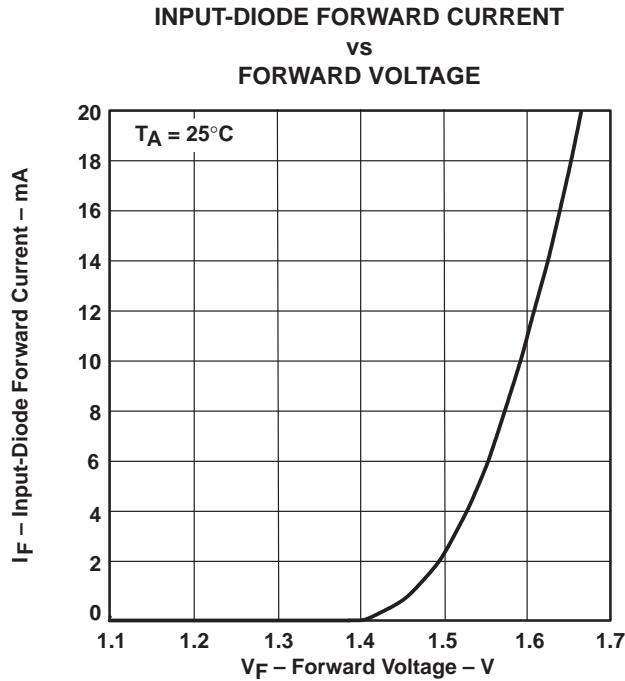
TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 2. Transient Immunity Test Circuit and Waveforms

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT CURRENT  
vs  
FREE-AIR TEMPERATURE

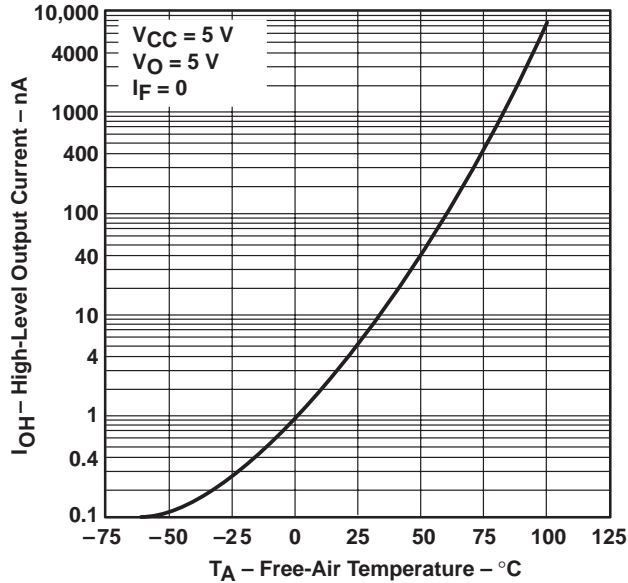


Figure 7

DIFFERENTIAL CURRENT TRANSFER RATIO  
vs  
INPUT-DIODE QUIESCENT FORWARD CURRENT

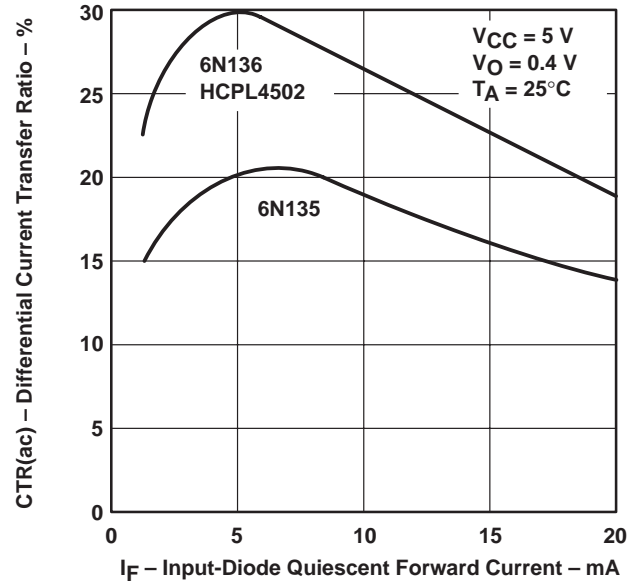


Figure 8

FREQUENCY RESPONSE (NORMALIZED)  
vs  
FREQUENCY

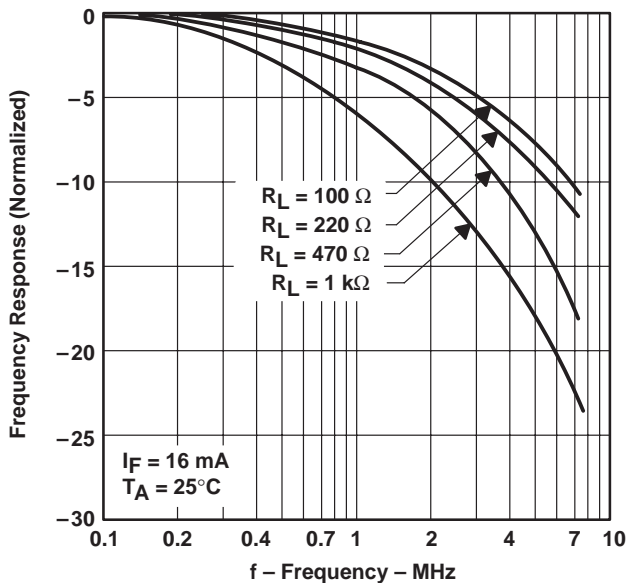


Figure 9

PROPAGATION DELAY TIME  
vs  
FREE-AIR TEMPERATURE

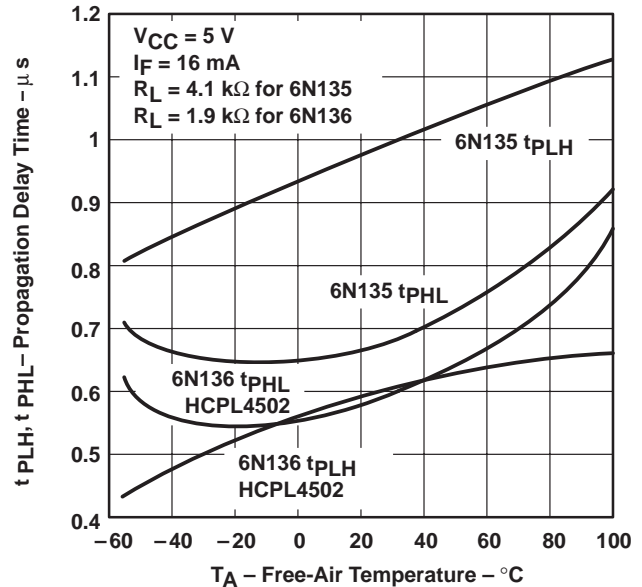
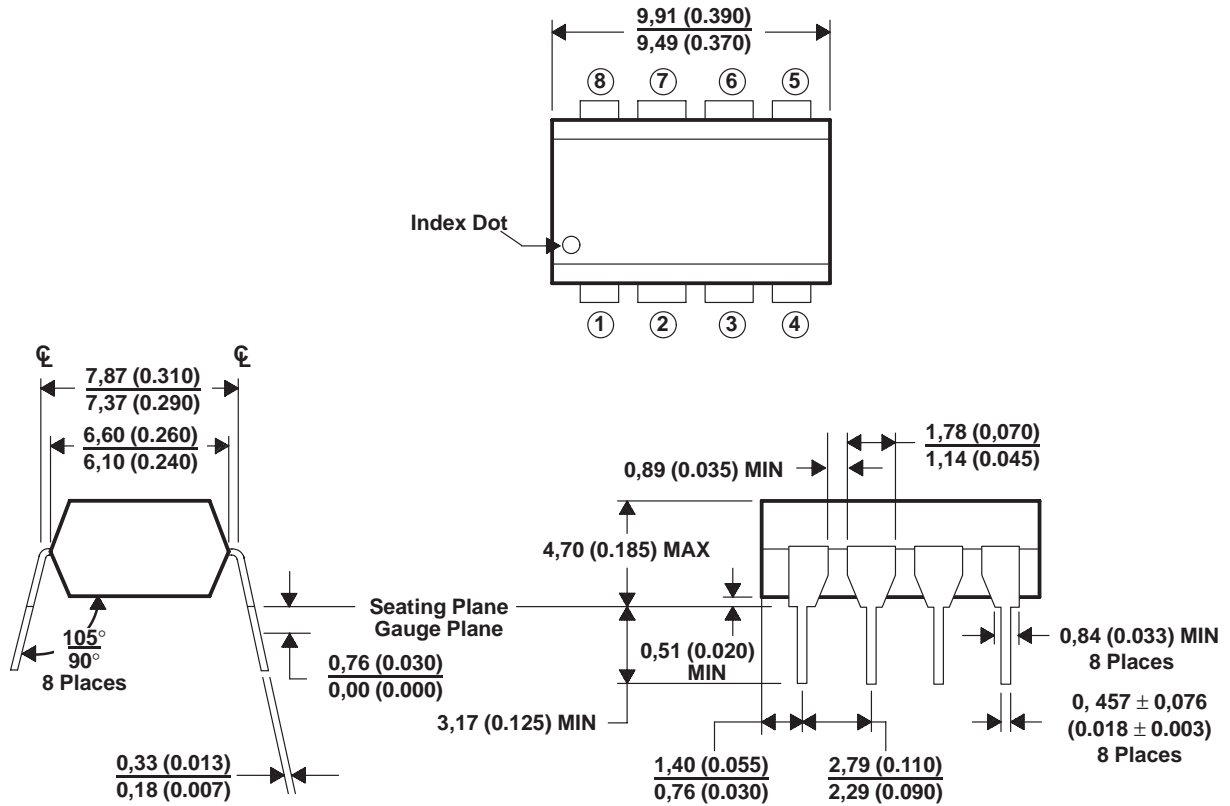


Figure 10



MECHANICAL INFORMATION



NOTES: A. JEDEC registered data. This data sheet contains all applicable registered data in effect at the time of publication.  
B. All linear dimensions are given in millimeters and parenthetically given in inches.

Figure 11. Packaging Specifications

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