HCPL2502
OPTOCOUPLER/OPTOISOLATOR

D2963, NOVEMBER 1986

T-41-83

- Compatible with TTL Inputs
- High-Speed Switching . . . 1 Mbit/s Typ
- Narrow CTR Range
- Bandwidth . . . 2 MHz Typ
- High Common-Mode Transient Immunity . . . 1000 V/μs Typ
- High-Voltage Electrical Insulation . . . 3000 V DC Min
- Open-Collector Output
- UL Recognized . . . File Number E65085
- Directly Interchangeable with Hewlett Packard HCPL2502

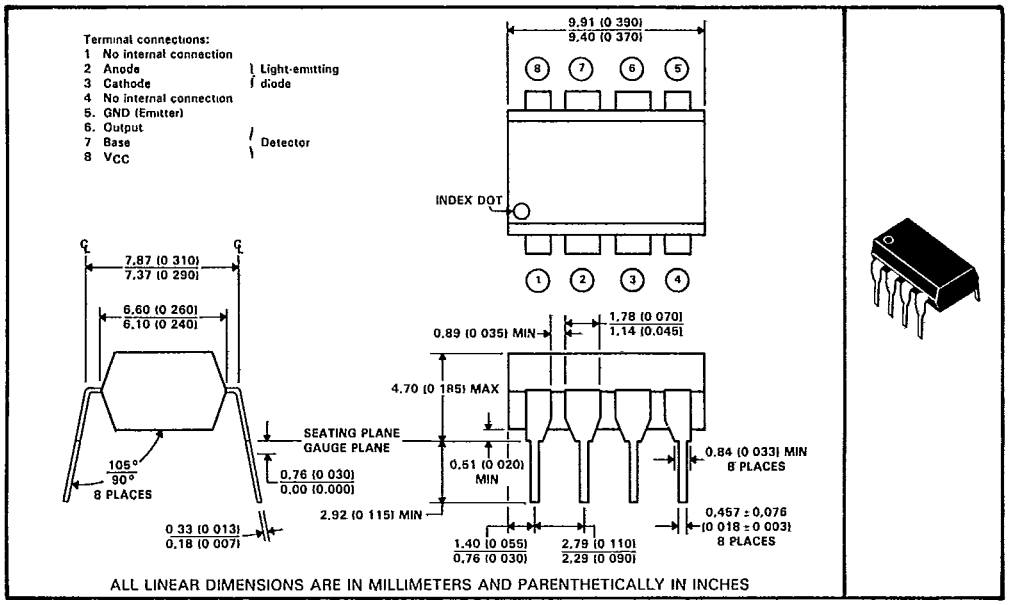
description

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 HCPL2502 optocoupler 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 HCPL2502 is designed for high-speed TTL/TTL applications where matched or known CTR is desired. CTR is 15 to 22% at I_F = 16 mA.

mechanical data



ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

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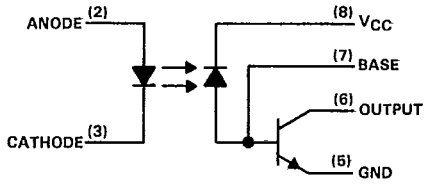
schematic



absolute maximum ratings at 25°C free-air temperature (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 μs, 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
Operating free-air temperature range	−55°C to 100°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 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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electrical characteristics over operating free-air temperature range of 0 °C to 70 °C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_F	Input forward voltage	I_F = 16 mA,	T_A = 25°C		1.6	1.7	V
α_{VF}	Temperature coefficient of forward voltage	I_F = 16 mA			−1.8		mV/°C
V_{BR}	Input breakdown voltage	I_R = 10 μA,	T_A = 25°C	5			V
V_{OL}	Low-level output voltage	V_{CC} = 4.5 V, I_{OL} = 2.4 mA,	I_F = 16 mA, I_B = 0		0.1	0.4	V
I_{OH}	High-level output current	I_F = 0, I_B = 0, T_A = 25°C	V_{CC} = V_O = 5.5 V		3	500	nA
			V_{CC} = V_O = 15 V		0.01	1	μA
I_{OH}	High-level output current	V_{CC} = 15 V, I_F = 0,	V_O = 15 V, I_B = 0			50	μA
I_{CCH}	Supply current, high-level output	V_{CC} = 15 V, I_F = 0, T_A = 25°C	I_O = 0, I_B = 0,		0.02	1	μA
I_{CCH}	Supply current, high-level output	V_{CC} = 15 V, I_F = 0,	I_O = 0, I_B = 0			2	μA
I_{CCL}	Supply current, low-level output	V_{CC} = 15 V, I_F = 16 mA,	I_O = 0, I_B = 0		40		μA
h_{FE}	Transistor forward current transfer ratio	V_O = 5 V,	I_O = 3 mA		100		
CTR	Current transfer ratio	V_{CC} = 4.5 V, I_F = 16 mA, T_A = 25°C,	V_O = 0.4 V, I_B = 0, See Note 5	15%		22%	
r_{IO}	Input-output resistance	V_{IO} = 500 V, See Note 6	T_A = 25°C,		10^{12}		Ω
I_{IO}	Input-output insulation leakage current	V_{IO} = 3000 V, T_A = 25°C, See Note 6	t = 5 s, RH = 45%,			1	μA
C_i	Input capacitance	V_F = 0,	f = 1 MHz		60		pF
C_{io}	Input-output capacitance	f = 1 MHz,	See Note 6		0.6		pF

† All typical values are at T_A = 25°C.

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.

operating characteristics at V_{CC} = 5 V, I_F = 16 mA, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
BW	Bandwidth (−3 dB)	R_L = 100 Ω, See Note 7		2		MHz

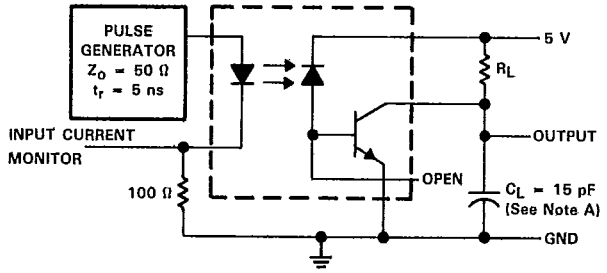
NOTE 7: Bandwidth is the range of frequencies within which the ac output voltage is not more than 3 dB below the low-frequency value.

switching characteristics at V_{CC} = 5 V, I_F = 16 mA, T_A = 25°C (unless otherwise noted)

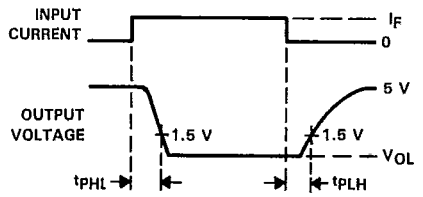
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	R_L = 1.9 kΩ, See Note 8, See Figure 1		0.6	0.8	μs
t_{PHL}	Propagation delay time, high-to-low-level output	R_L = 1.9 kΩ, See Note 8, See Figure 1		0.6	0.8	μs
$\frac{dV_{CM}}{dt}$ (H)	Common-mode input transient immunity, high-level output	ΔV_{CM} = 10 V, I_F = 0, R_L = 1.9 kΩ, See Notes 8 and 9, See Figure 2	−1000			V/μs
$\frac{dV_{CM}}{dt}$ (L)	Common-mode input transient immunity, low-level output	ΔV_{CM} = −10 V, I_F = 16 mA, R_L = 1.9 kΩ, See Figure 2, See Notes 8 and 9	−1000			V/μs

NOTES: 8. The 1.9-kΩ load represents one TTL unit load of 1.6 mA and a 5.6-kΩ pullup resistor.
9. 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

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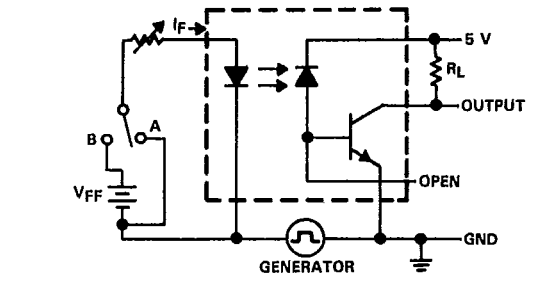
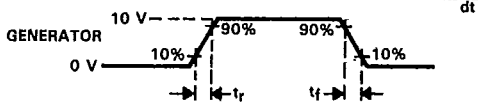
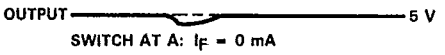
PARAMETER MEASUREMENT INFORMATION



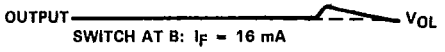
TEST CIRCUIT

$$\frac{dV_{CM}}{dt} = \frac{8\ V}{t_r \text{ or } t_f}$$





SWITCH AT A: I_F = 0 mA



SWITCH AT B: I_F = 16 mA

VOLTAGE WAVEFORMS

FIGURE 2. TRANSIENT IMMUNITY TEST CIRCUIT AND WAVEFORMS

TYPICAL CHARACTERISTICS

INPUT DIODE FORWARD CURRENT
vs
FORWARD VOLTAGE

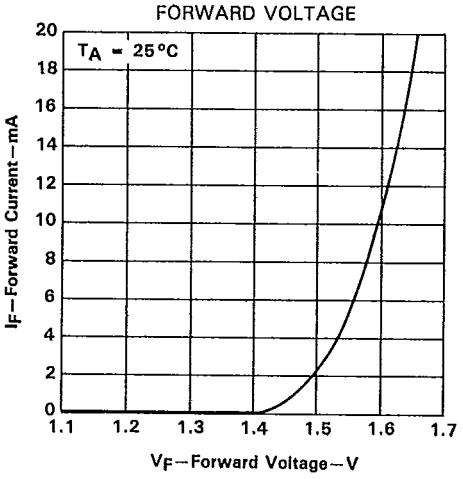


FIGURE 3

CURRENT TRANSFER CHARACTERISTICS

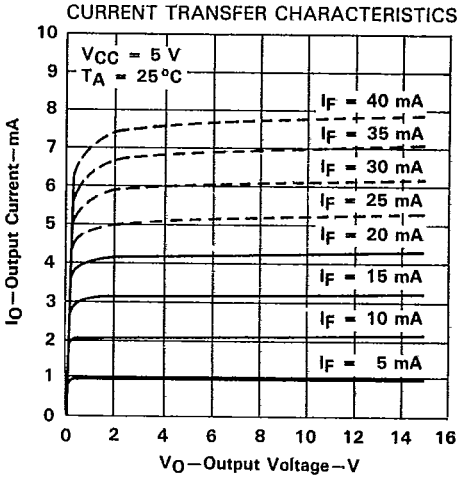


FIGURE 4

NORMALIZED CURRENT TRANSFER RATIO
vs
INPUT DIODE FORWARD CURRENT

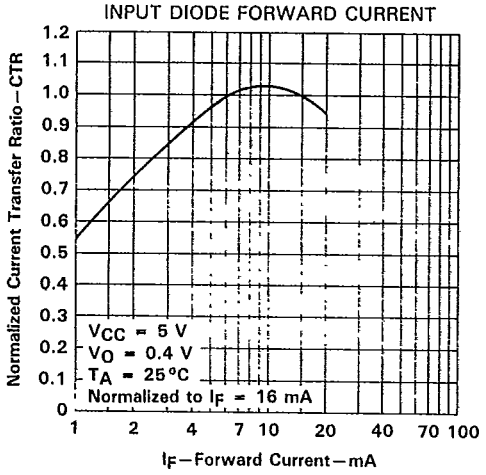


FIGURE 5

NORMALIZED CURRENT TRANSFER RATIO
vs
FREE-AIR TEMPERATURE

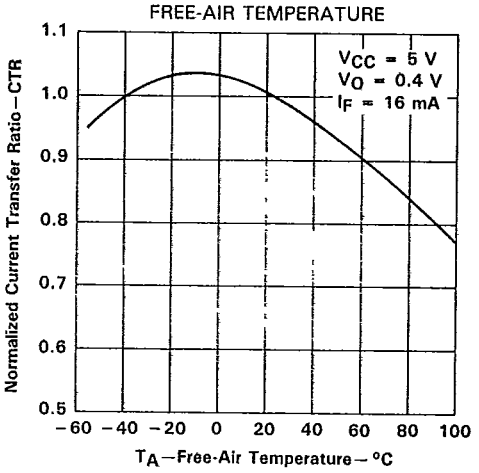


FIGURE 6

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TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT CURRENT
vs
FREE-AIR TEMPERATURE

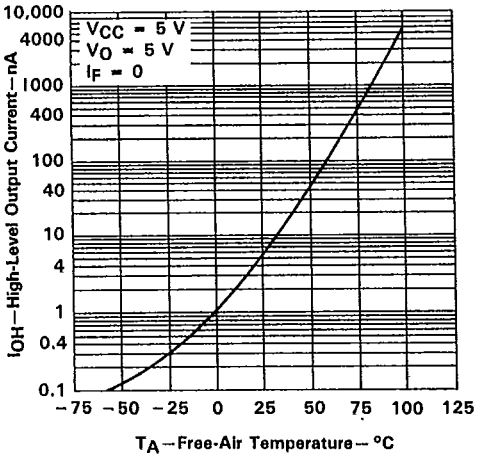

FIGURE 7

DIFFERENTIAL CURRENT TRANSFER RATIO
vs
INPUT DIODE QUIESCENT FORWARD CURRENT

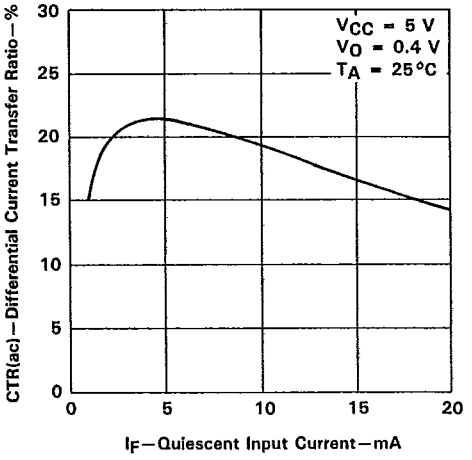

FIGURE 8

NORMALIZED FREQUENCY RESPONSE
vs
LOAD RESISTANCE

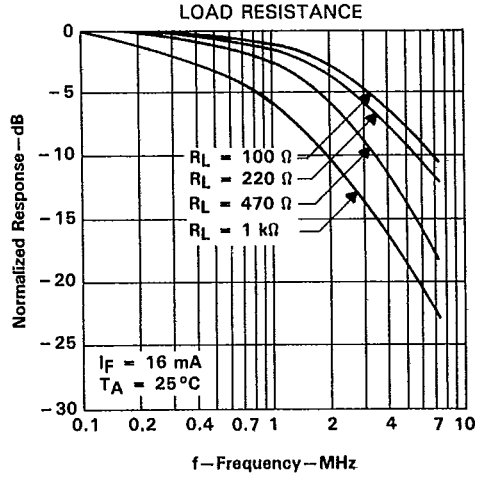

FIGURE 9

PROPAGATION DELAY TIME
vs
FREE-AIR TEMPERATURE

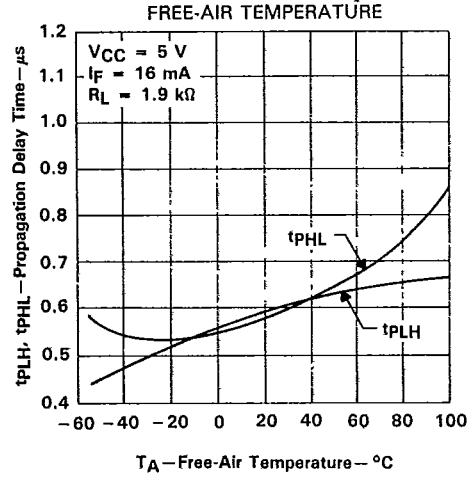

FIGURE 10