HCPL2601
OPTOCOUPLER/OPTOISOLATOR

SOOS009 D2968, NOVEMBER 1986

- Gallium Arsenide Phosphide LED Optically Coupled to an Integrated Circuit Detector
- Internal Shield for Common-Mode Rejection
- Compatible with TTL and LSTTL Inputs
- Low Input Current Required to Turn Output On . . . 5 mA Max
- High-Voltage Electrical Insulation . . . 3000 V DC Min
- High-Speed Switching . . . 75 ns Max
- UL Recognized . . . File Number E65085
- Directly Interchangeable with Hewlett Packard HCPL2601

description

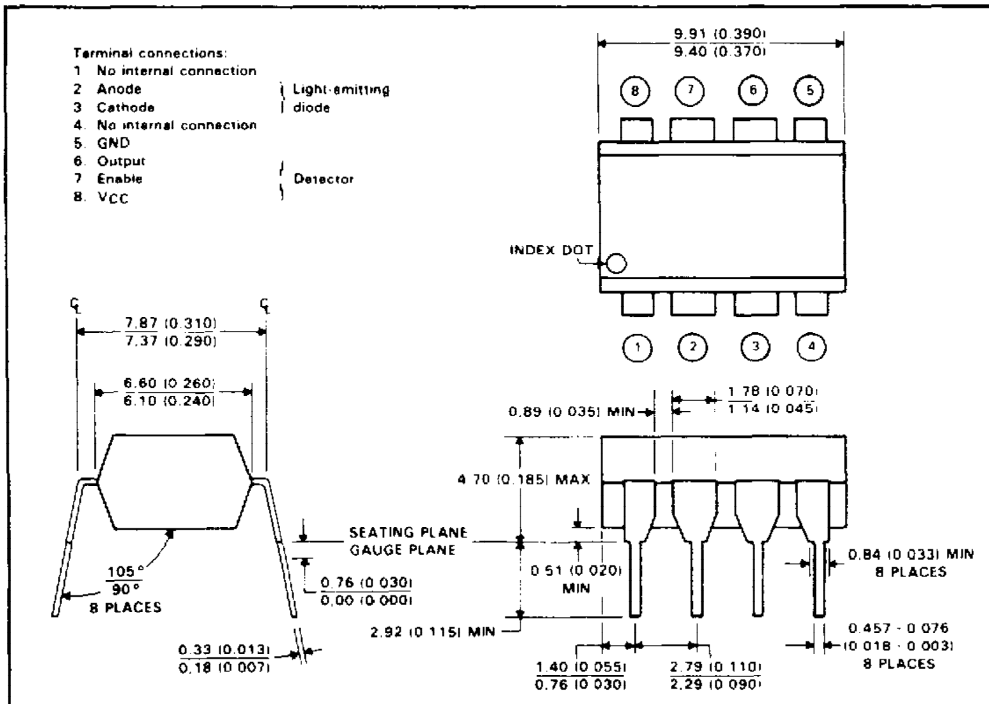
The HCPL2601 optocoupler is designed for use in high-speed digital interfacing applications that require high-voltage isolation between the input and output. It is recommended for use in extremely high ground-noise and induced-noise environments. Applications include line receivers, microprocessors or computer interface, digital programming of floating power supplies, motors, and other control systems.

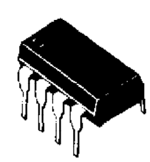
The HCPL2601 high-speed optocoupler consists of a GaAsP light-emitting diode and an integrated light detector composed of a photodiode, a high-gain amplifier, and a Schottky-clamped open-collector output transistor. An input diode forward current of 5 milliamperes will switch the output transistor low, providing an on-state drive current of 13 milliamperes (eight 1.6-milliampere TTL loads). A TTL-compatible enable input is provided for applications that require output-transistor gating.

The HCPL2601 is mounted in a standard 8-pin dual-in-line plastic package.

The HCPL2601 is characterized for operation over the temperature range of 0°C to 70°C. The internal shield provides a guaranteed common-mode transient immunity of 1000 volts/microsecond minimum.

mechanical data



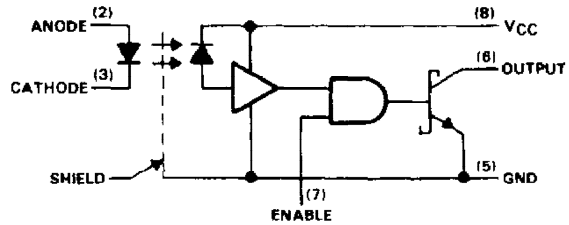


ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

FUNCTION TABLE

INPUT	ENABLE	OUTPUT
$I_{F(on)}$	H	L
$I_{F(off)}$	X	H
X	L	H

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} . . . 7 V
Reverse input voltage . . . 5 V
Enable input voltage (not to exceed V_{CC} by more than 500 mV) . . . 5.5 V
Output voltage . . . 7 V
Peak forward input current (≤ 1 ms duration) . . . 40 mA
Average forward input current . . . 20 mA
Output current . . . 25 mA
Output power dissipation . . . 40 mW
Storage temperature range . . . −55°C to 125°C
Operating free-air temperature range . . . 0°C to 70°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . 260°C

recommended operating conditions

		MIN	NOM	MAX	UNIT
V_{CC}	Output supply voltage (see Note 1)	4.5	5	5.5	V
$V_{IH(EN)}$	High-level enable input voltage (see Note 2)	2		V_{CC}	V
$V_{IL(EN)}$	Low-level enable input voltage	0		0.8	V
$I_{F(on)}$	Input forward current to turn output on	6.3		15	mA
$I_{F(off)}$	Input forward current to turn output off	0		250	μA
I_{OL}	Low-level (on-state) output current			13	mA
T_A	Operating free-air temperature	0		70	°C

NOTES: 1. All voltage values are with respect to GND (pin 5).
2. No external pullup is required at the enable input; an open circuit will establish the high level.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

	PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_F	Input forward voltage	I_F = 10 mA,	T_A = 25°C		1.6	1.75	V
α_{VF}	Temperature coefficient of forward voltage	I_F = 10 mA			−1.8		mV/°C
V_{BR}	Input reverse breakdown voltage	I_R = 10 μA,	T_A = 25°C	5			V
V_{OL}	Low-level output voltage	V_{CC} = 5.5 V, I_F = 5 mA,	$V_{(EN)}$ = 2 V, I_{OL} = 13 mA		0.23	0.6	V
I_{OH}	High-level output current	V_{CC} = 5.5 V, $V_{(EN)}$ = 2 V,	V_O = 5.5 V, I_F = 250 μA			250	μA
$I_{IH(EN)}$	High-level enable input current	V_{CC} = 5.5 V,	$V_{(EN)}$ = 2 V		−0.2		mA
$I_{IL(EN)}$	Low-level enable input current	V_{CC} = 5.5 V,	$V_{(EN)}$ = 0.5 V		−0.5	−2	mA
I_{CCH}	Supply current, high-level output	V_{CC} = 5.5 V, I_F = 0	$V_{(EN)}$ = 0.5 V,		10	15	mA
I_{CCL}	Supply current, low-level output	V_{CC} = 5.5 V, I_F = 10 mA	$V_{(EN)}$ = 0.5 V,		13	19	mA
I_{IO}	Input-output insulation leakage current	V_{IO} = 3000 V, T_A = 25°C, See Note 1	t = 5 s, RH = 45%,			1	μA
r_{IO}	Input-output resistance	V_{IO} = 500 V, See Note 1	T_A = 25°C,		10^{12}		Ω
C_i	Input capacitance	V_F = 0,	f = 1 MHz		60		pF
C_{io}	Input-output capacitance	f = 1 MHz, See Note 1	T_A = 25°C,		0.6		pF

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

NOTE 1: 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		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high level output, from LED input	I_F = 7.5 mA, C_L = 15 pF,	R_L = 350 Ω, See Figure 1		42	75	ns
t_{PHL}	Propagation delay time, high-to-low level output, from LED input	I_F = 7.5 mA, C_L = 15 pF,	R_L = 350 Ω, See Figure 1		42	75	ns
$t_{PLH(EN)}$	Propagation delay time, low-to-high level output, from enable	I_F = 7.5 mA, C_L = 15 pF,	R_L = 350 Ω, See Figure 2		40		ns
$t_{PHL(EN)}$	Propagation delay time, high-to-low level output, from enable	I_F = 7.5 mA, C_L = 15 pF,	R_L = 350 Ω, See Figure 2		25		ns
t_r	Rise time	I_F = 7.5 mA, C_L = 15 pF	R_L = 350 Ω,		20		ns
t_f	Fall time	I_F = 7.5 mA, C_L = 15 pF	R_L = 350 Ω,		30		ns
$\frac{dV_{CM}}{dt}$ (H)	Common-mode input transient immunity, high-level output	ΔV_{CM} = 50 V, R_L = 350 Ω,	I_F = 0, See Note 2 and Figure 3	1000	10000		V/μs
$\frac{dV_{CM}}{dt}$ (L)	Common-mode input transient immunity, low-level output	ΔV_{CM} = −50 V, R_L = 350 Ω,	I_F = 7.5 mA, See Note 2 and Figure 3	−1000	−1000		V/μs

NOTE 2: Common-mode input 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

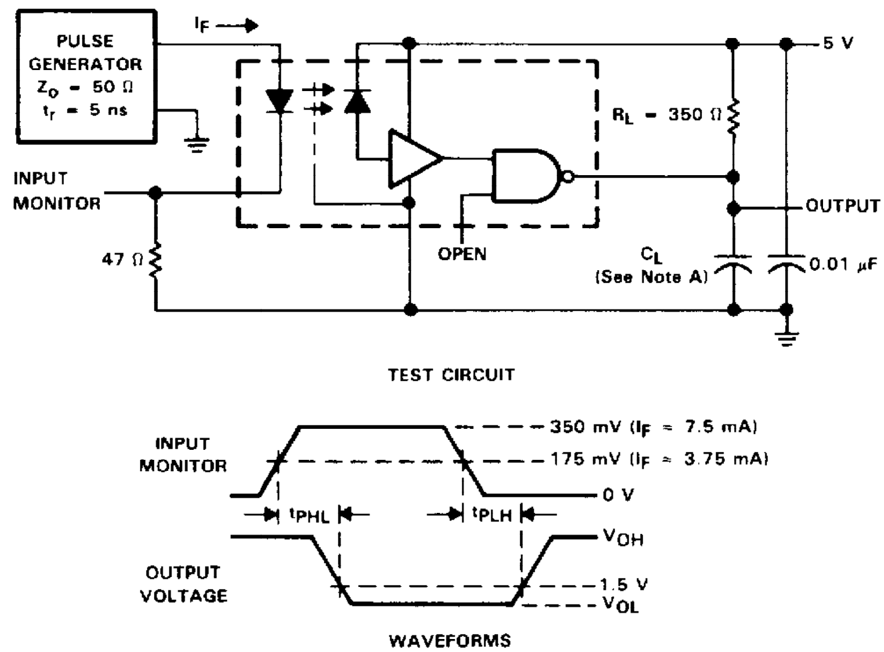


FIGURE 1. t_{PLH} AND t_{PHL} FROM LED INPUT TEST CIRCUIT AND WAVEFORMS

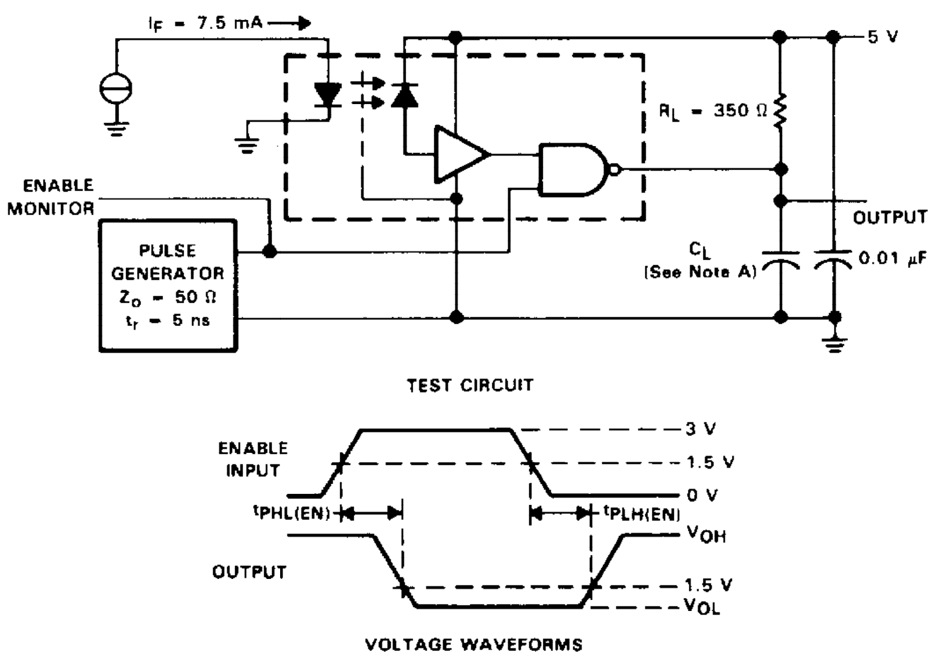


FIGURE 2. $t_{PLH(EN)}$ AND $t_{PHL(EN)}$ FROM ENABLE TEST CIRCUIT AND WAVEFORMS

NOTE A: C_L is approximately 15 pF, which includes probe and stray wiring capacitances.

PARAMETER MEASUREMENT INFORMATION

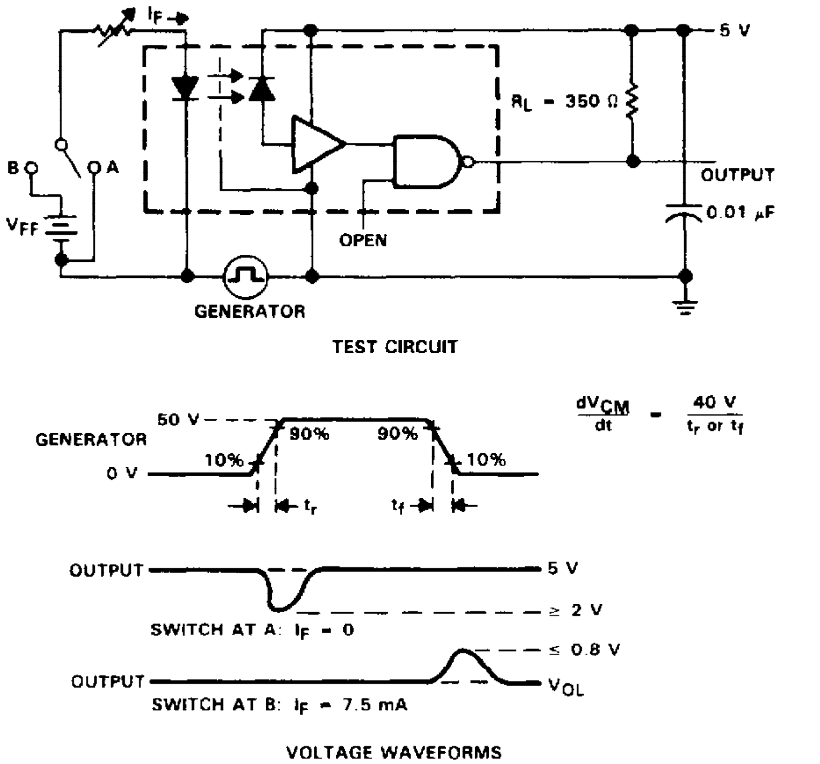


FIGURE 3. TRANSIENT IMMUNITY TEST CIRCUIT AND WAVEFORMS

TYPICAL APPLICATION INFORMATION

A ceramic capacitor (0.01 μF to 0.1 μF) should be connected between pins 8 and 5 to stabilize the high-gain amplifier. The total lead length between the capacitor and the optocoupler should not exceed 20 mm (0.8 inches). Failure to provide a bypass capacitor may result in impaired switching characteristics.

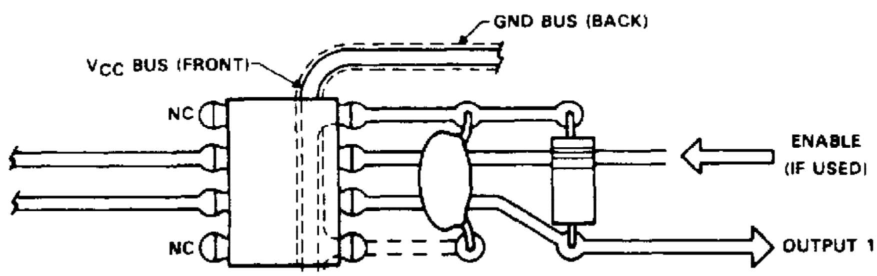


FIGURE 4. RECOMMENDED PRINTED CIRCUIT BOARD LAYOUT

TYPICAL CHARACTERISTICS

INPUT DIODE FORWARD CURRENT
vs
FORWARD VOLTAGE

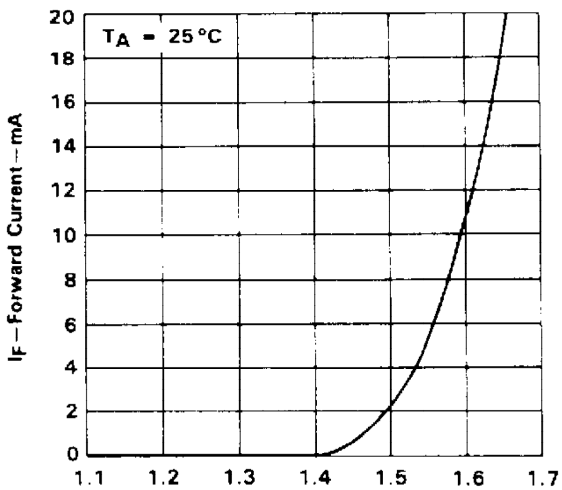


FIGURE 5

LOW-LEVEL OUTPUT VOLTAGE
vs
FREE – AIR TEMPERATURE

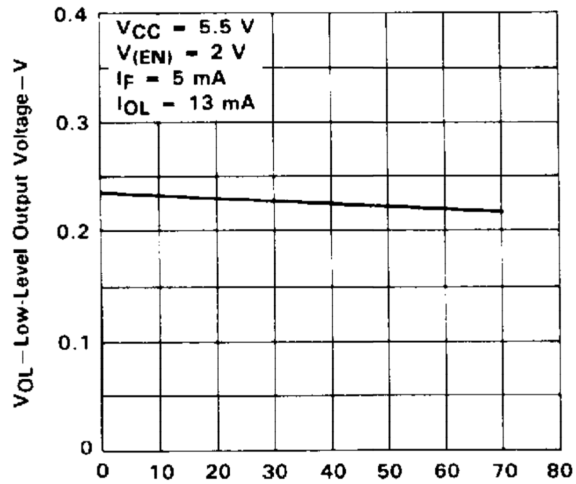


FIGURE 6

HIGH-LEVEL OUTPUT CURRENT
vs
FREE-AIR TEMPERATURE

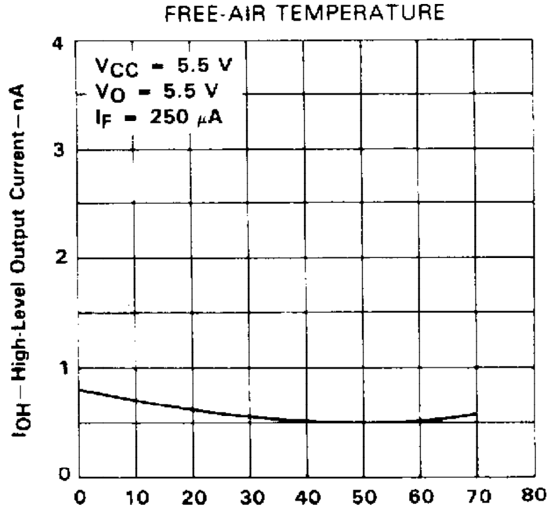


FIGURE 7

TYPICAL CHARACTERISTICS

PROPAGATION DELAY TIME FROM LED INPUT
vs
PULSE FORWARD CURRENT

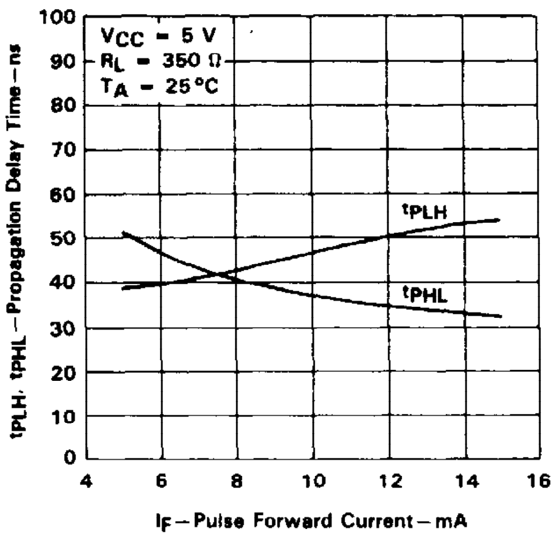


FIGURE 8

PROPAGATION DELAY TIME FROM LED INPUT
vs
LOAD RESISTANCE

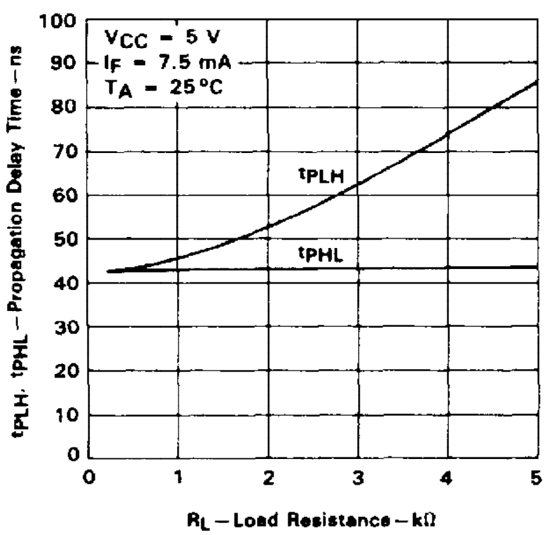


FIGURE 9

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