

6N137 OPTOCOUPLER/OPTOISOLATOR

SOOS003 D291B, JULY 1986

- Gallium Arsenide Phosphide LED Optically Coupled to Integrated Circuit Detector
- 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
- Plastic Dual-In-Line Package
- UL Recognized . . . File Number 65085

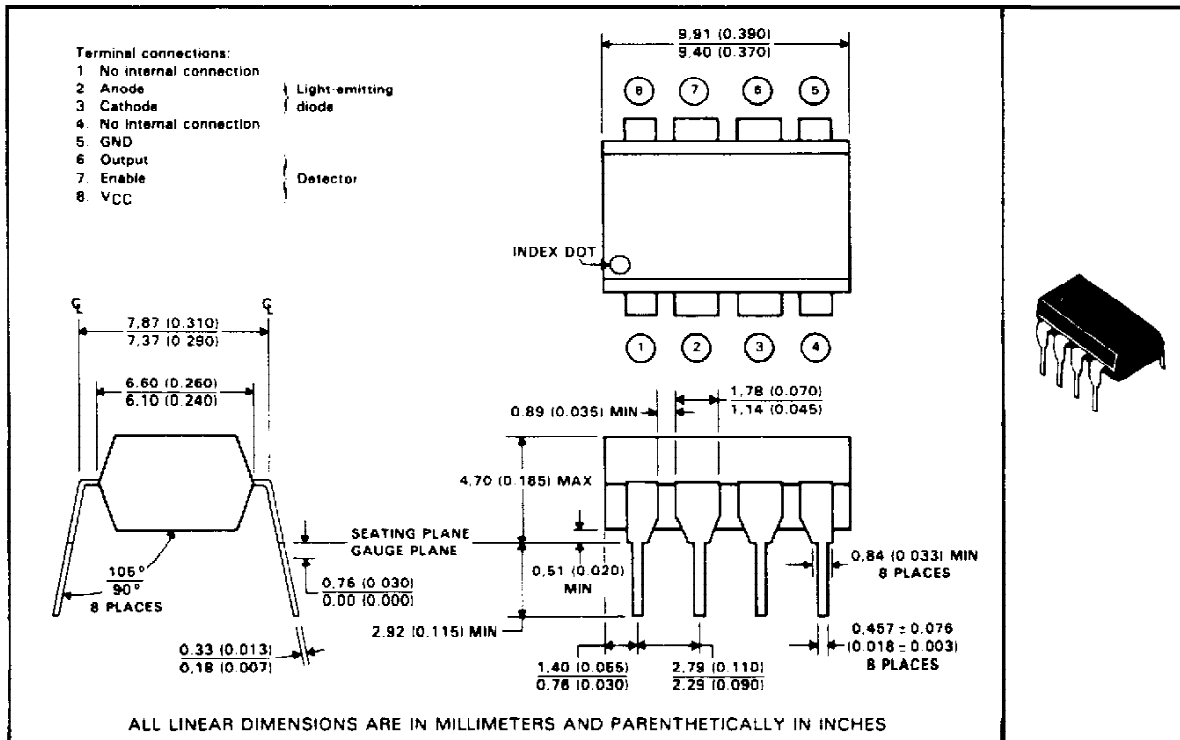
description

The 6N137 optocoupler is designed for use in high-speed digital interfacing applications that require high-voltage isolation between the input and output. Applications include line receivers, microprocessors or computer interface, digital programming of floating power supplies, motors, and other control systems.

The 6N137 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 6N137 is characterized for operation over the temperature range of 0°C to 70°C.

*mechanical data



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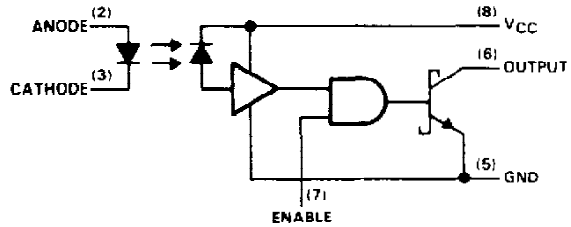
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6N137
OPTOCOUPLER/OPTOISOLATOR

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) (TI-guaranteed value) | 40 mA |
| (JEDEC-registered value) | 20 mA |
| Average forward input current (TI-guaranteed value) | 20 mA |
| (JEDEC-registered value) | 10 mA |
| Output current | 50 mA |
| Output power dissipation | 85 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 |

*JEDEC registered data

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.

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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 |
| αV _F 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, V _{I(EN)} = 2 V, I _F = 5 mA, I _{OL} = 13 mA | | 0.23 | 0.6 | V |
| *I _{OH} High-level output current | V _{CC} = 5.5 V, V _O = 5.5 V, V _{I(EN)} = 2 V, I _F = 250 μA | | | 250 | μA |
| I _{H(EN)} High-level enable input current | V _{CC} = 5.5 V, V _{I(EN)} = 2 V | | -0.2 | | mA |
| *I _{L(EN)} Low-level enable input current | V _{CC} = 5.5 V, V _{I(EN)} = 0.5 V | | -0.5 | -2 | mA |
| *I _{CCH} Supply current, high-level output | V _{CC} = 5.5 V, V _{I(EN)} = 0.5 V, I _F = 0 | | 10 | 15 | mA |
| *I _{CCL} Supply current, low-level output | V _{CC} = 5.5 V, V _{I(EN)} = 0.5 V, I _F = 10 mA | | 13 | 18 | mA |
| *I _{IO} Input-output insulation leakage current | V _{IO} = 3000 V, t = 5 s, T _A = 25°C, RH = 45%, See Note 1 | | | 1 | μA |
| r _{IO} Input-output resistance | V _{IO} = 500 V, T _A = 25°C, See Note 1 | | 10 ¹² | | Ω |
| C _i Input capacitance | V _F = 0, f = 1 MHz | | 60 | | pF |
| C _{IO} Input-output capacitance | f = 1 MHz, T _A = 25°C, See Note 1 | | 0.6 | | pF |

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† 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, R _L = 350 Ω, C _L = 15 pF, See Figure 1 | | 42 | 75 | ns |
| *t _{PHL} Propagation delay time, high-to-low level output, from LED input | I _F = 7.5 mA, R _L = 350 Ω, C _L = 15 pF, See Figure 1 | | 42 | 75 | ns |
| t _{PLH(EN)} Propagation delay time, low-to-high level output, from enable | I _F = 7.5 mA, R _L = 350 Ω, C _L = 15 pF, See Figure 2 | | 40 | | ns |
| t _{PHL(EN)} Propagation delay time, high-to-low-level output, from enable | I _F = 7.5 mA, R _L = 350 Ω, C _L = 15 pF, See Figure 2 | | 25 | | ns |
| t _r Rise time | I _F = 7.5 mA, R _L = 350 Ω, C _L = 15 pF | | 20 | | ns |
| t _f Fall time | I _F = 7.5 mA, R _L = 350 Ω, C _L = 15 pF | | 30 | | ns |
| $\frac{dV_{CM}}{dt}$ (H) Common mode input transient immunity, high-level output | ΔV _{CM} = 10 V, I _F = 0, R _L = 350 Ω, See Note 2 and Figure 3 | | 50 | | V/μs |
| $\frac{dV_{CM}}{dt}$ (L) Common-mode input transient immunity, low-level output | ΔV _{CM} = -10 V, I _F = 5 mA, R _L = 350 Ω, See Note 2 and Figure 3 | | -150 | | V/μs |

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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, 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.

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PARAMETER MEASUREMENT INFORMATION

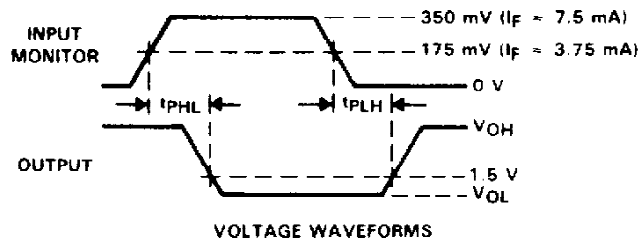
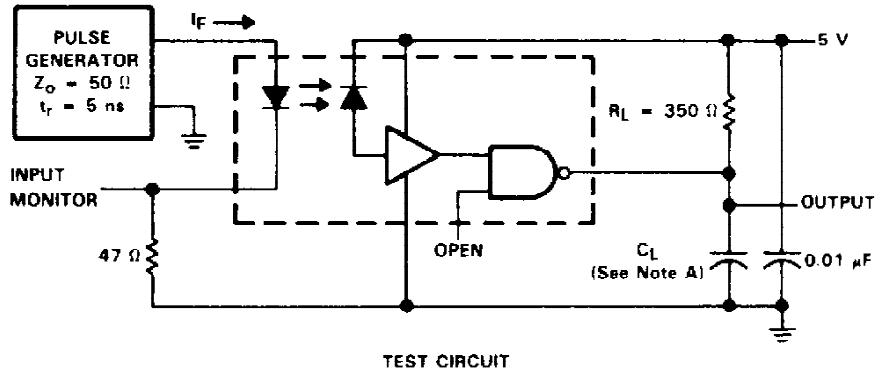


FIGURE 1. t_{PLH} AND t_{PHL} FROM LED INPUT TEST CIRCUIT AND WAVEFORMS

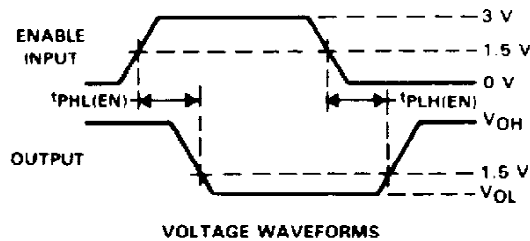
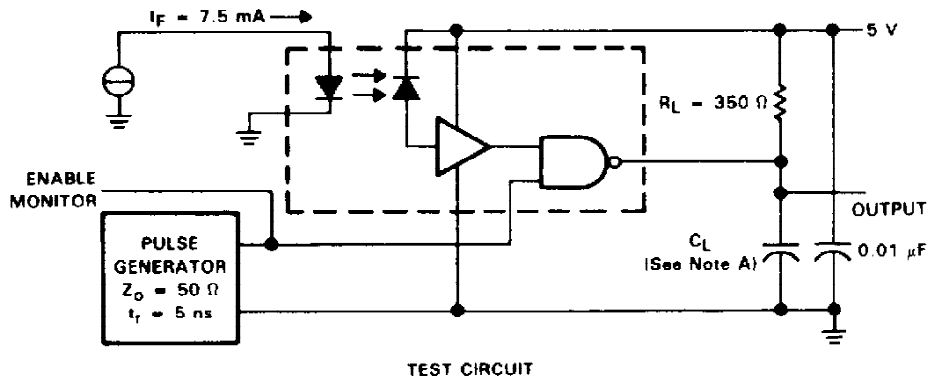


FIGURE 2. t_{PLH(EN)} AND t_{PHL(EN)} FROM ENABLE TEST CIRCUIT AND WAVEFORMS

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

PARAMETER MEASUREMENT INFORMATION

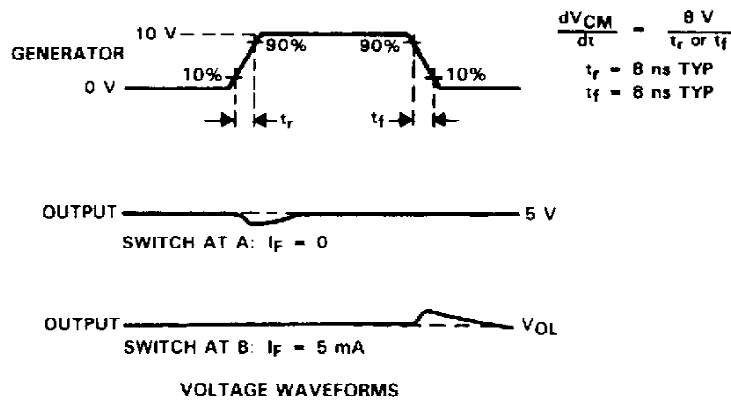
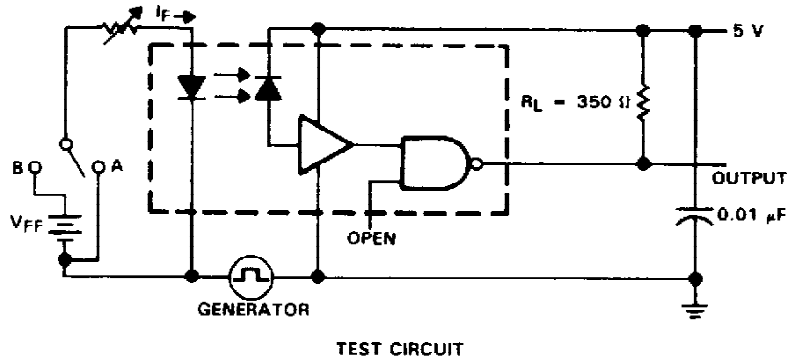


FIGURE 3. TRANSIENT IMMUNITY TEST CIRCUIT AND WAVEFORMS

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.

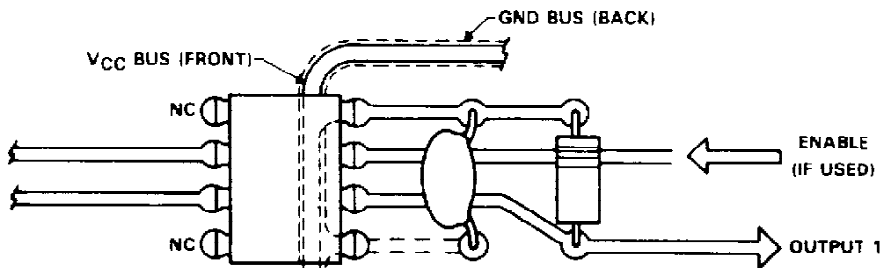


FIGURE 4. RECOMMENDED PRINTED CIRCUIT BOARD LAYOUT

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TYPICAL CHARACTERISTICS

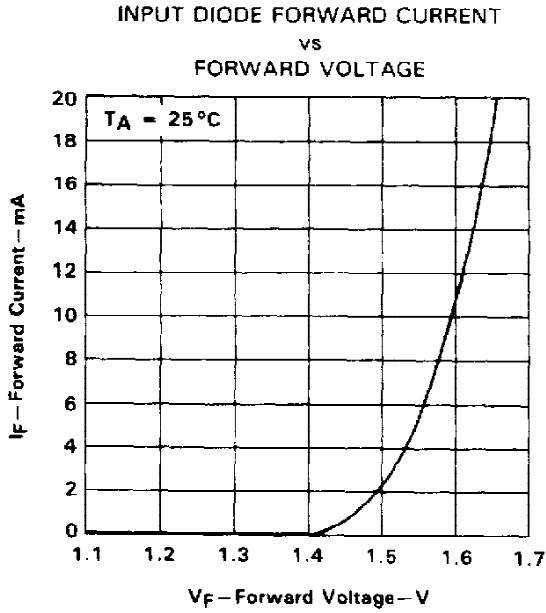


FIGURE 5

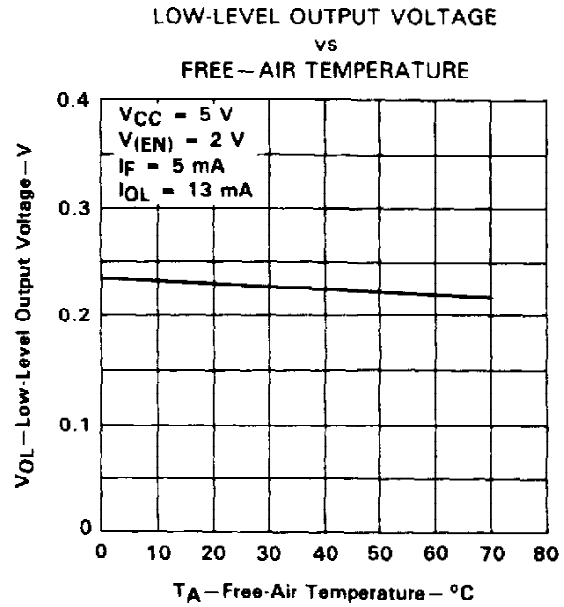


FIGURE 6

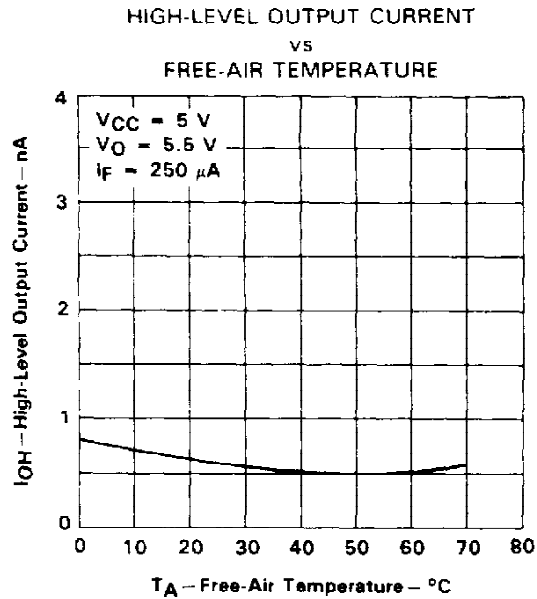


FIGURE 7

TYPICAL CHARACTERISTICS

PROPAGATION DELAY TIME FROM LED INPUT
vs
PULSE FORWARD CURRENT

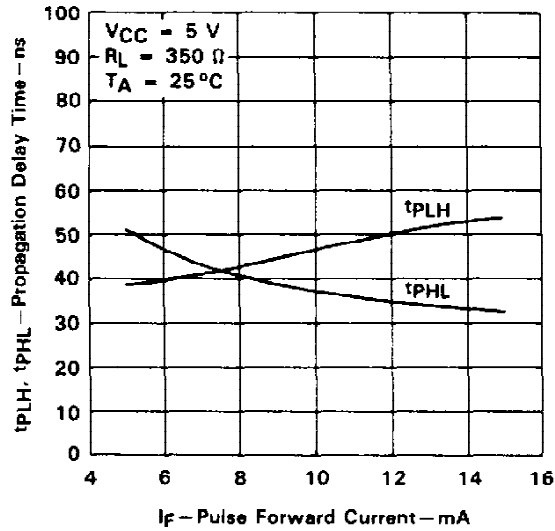


FIGURE 8

PROPAGATION DELAY TIME FROM LED INPUT
vs
LOAD RESISTANCE

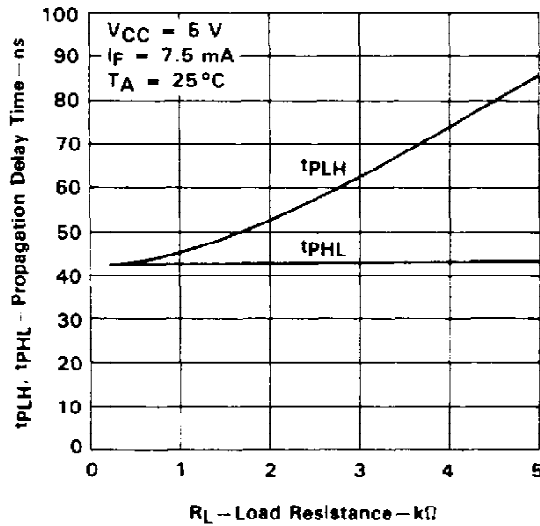


FIGURE 9

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