HCPL2601
OPTOCOUPLER/OPTOISOLATOR

- 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 E66086
- 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-milliamper 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

Terminal connections:
1. No external connection
2. Anode
3. Cathode
4. No external connection
5. GND
6. Output
7. Enable
8. VCC

Light emitting
Detector

INDEX DOT

SEATING PLANE GAUGE PLANE

GAGE PLANE

All linear dimensions are in millimeters and parenthetically in inches.
HCPL2601
OPTOCOUPLER/OPTOISOLATOR

FUNCTION TABLE

<table>
<thead>
<tr>
<th>INPUT</th>
<th>ENABLE</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>H</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

logic diagram (positive logic)

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

Supply voltage, VCC ........................................ 7 V
Reverse input voltage ....................................... 5 V
Enable input voltage (not to exceed VCC 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

<table>
<thead>
<tr>
<th>MIN</th>
<th>NOM</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>4.5</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>VB(H)</td>
<td>7</td>
<td>VCC</td>
<td>V</td>
</tr>
<tr>
<td>VB(L)</td>
<td>0</td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td>IF(on)</td>
<td>6.3</td>
<td>15</td>
<td>mA</td>
</tr>
<tr>
<td>IF(off)</td>
<td>0</td>
<td>250</td>
<td>μA</td>
</tr>
<tr>
<td>IOH</td>
<td>0</td>
<td>1.3</td>
<td>mA</td>
</tr>
<tr>
<td>TA</td>
<td>D</td>
<td>70</td>
<td>°C</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP†</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vf</td>
<td>Input forward voltage</td>
<td>1.6</td>
<td>1.76</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VTF</td>
<td>Temperature coefficient of forward voltage</td>
<td>1.8</td>
<td></td>
<td>mV/°C</td>
<td></td>
</tr>
<tr>
<td>VBR</td>
<td>Input reverse breakdown voltage</td>
<td>5</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VIL</td>
<td>Low-level output voltage</td>
<td>VCC = 5.5 V, VIL = 2 V, Ip = 10 mA.</td>
<td>0.24</td>
<td>0.6</td>
<td>V</td>
</tr>
<tr>
<td>I0H</td>
<td>High-level output current</td>
<td>VCC = 5.5 V, VO = 5.5 V, Ip = 250 μA.</td>
<td>250</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>VILN</td>
<td>High-level enable input current</td>
<td>VCC = 5.5 V, VIL = 2 V, Ip = 250 μA.</td>
<td>-0.2</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>VILN</td>
<td>Low-level enable input current</td>
<td>VCC = 5.5 V, VIL = 0.5 V, Ip = 250 μA.</td>
<td>-0.2</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>ICCH</td>
<td>Supply current, high-level output</td>
<td>VCC = 5.5 V, VIL = 0.5 V, Ip = 10 mA.</td>
<td>10</td>
<td>15</td>
<td>mA</td>
</tr>
<tr>
<td>ICCL</td>
<td>Supply current, low-level output</td>
<td>VILN = 3000 V, Io = 10 mA,</td>
<td>1</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>ID</td>
<td>Input output insulation leakage current</td>
<td>VILN = 500 V, TA = 25 °C, RH = 45 %,</td>
<td>1012</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>C1</td>
<td>Input capacitance</td>
<td>1</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>C2</td>
<td>Input-output capacitance</td>
<td>1</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
</tbody>
</table>

† All typical values are at VCC = 5 V, TA = 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 VCC = 5 V, TA = 25 °C

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP†</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>tPLH</td>
<td>Propagation delay time, low to high level output, from LED input</td>
<td>42</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tPLH</td>
<td>Propagation delay time, high to low level output, from LED input</td>
<td>42</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tPHIEN</td>
<td>Propagation delay time, low to high level output, from enable</td>
<td>40</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tPHIEN</td>
<td>Propagation delay time, high to low level output, from enable</td>
<td>25</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tr</td>
<td>Rise time</td>
<td>20</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>tf</td>
<td>Fall time</td>
<td>30</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>dVCM/dt (IH)</td>
<td>Common-mode input transient immunity, high level output</td>
<td>11000</td>
<td>10000</td>
<td>V/μs</td>
<td></td>
</tr>
<tr>
<td>dVCM/dt (IL)</td>
<td>Common-mode input transient immunity, low level output</td>
<td>-1000</td>
<td>-1000</td>
<td>V/μs</td>
<td></td>
</tr>
</tbody>
</table>

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.
FIGURE 1. t\text{PLH} AND t\text{PHL} FROM LED INPUT TEST CIRCUIT AND WAVEFORMS

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

NOTE A: C\text{L} is approximately 15 pF, which includes probe and stray wiring capacitances.
PARAMETER MEASUREMENT INFORMATION

TEST CIRCUIT

VOLTAGE WAVEFORMS

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

\[ I_f = \text{Forward Current} - \text{mA} \]
\[ V_f = \text{Forward Voltage} - \text{V} \]

\[ T_A = 25^\circ \text{C} \]

FIGURE 5

LOW-LEVEL OUTPUT VOLTAGE
VS
FREE-AIR TEMPERATURE

\[ V_{OL} = \text{Low-Level Output Voltage} - \text{V} \]

\[ T_A = \text{Free-Air Temperature} - ^\circ \text{C} \]

VCC = 5.5 V
V(IN) = 2 V
IF = 5 mA
IOL = 13 mA

FIGURE 6

HIGH-LEVEL OUTPUT CURRENT
VS
FREE-AIR TEMPERATURE

\[ I_{OH} = \text{High-Level Output Current} - \text{mA} \]

\[ V_{CC} = 5.5 \text{ V} \]
\[ V_{O} = 5.5 \text{ V} \]
\[ I_F = 250 \mu\text{A} \]

FIGURE 7
TYPICAL CHARACTERISTICS

PROPAGATION DELAY TIME FROM LED INPUT

VCC = 5 V
RL = 250 Ω
TA = 25°C

FIGURE 8

PROPAGATION DELAY TIME FROM LED INPUT

VCC = 5 V
I(L) = 7.5 mA
TA = 25°C

FIGURE 9
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