

# 1.5 Amp Output Current IGBT Gate Drive Optocoupler

## Technical Data

### Features

- **Input Threshold Current ( $I_{FLH}$ ): 5 mA (Max.)**
- **Supply Current ( $I_{CC}$ ): 11 mA (Max.)**
- **Supply Voltage ( $V_{CC}$ ): 15-35 V**
- **Output Current ( $I_O$ ):  $\pm 0.5$  A (Min.)**
- **Switching Time ( $t_{PLH}/t_{PHL}$ ): 0.5  $\mu$ s (Max.)**
- **Isolation Voltage ( $V_{ISO}$ ): 2500 Vrms (Min.)**
- **UL 577 Recognized: File No. E55361**
- **CSA Approved**
- **VDE 0884 Approved with  $V_{IORM} = 630$  V<sub>peak</sub>**
- **8 kV/ $\mu$ s Minimum Common Mode Rejection (CMR) at  $V_{cm} = 1500$  V**
- **Creepage Distance: 7.4 mm. Clearance: 7.1 mm.**

### Applications

- **IGBT/MOSFET Gate Drive**
- **AC/Brushless DC Motor Drives**
- **Industrial Inverters**
- **Switch Mode Power Supplies**

### Description

The HCPL-T250 contains GaAs LED. The LED is optically coupled to an integrated circuit with a power output stage. This optocoupler is ideally suited for driving power IGBTs and MOSFETs used in motor control inverter applications. The high operating voltage range of the output stage provides the drive voltages required by gate controlled devices. The voltage and current supplied by this optocoupler makes it ideally suited for directly driving IGBTs with ratings up to 1200 V/25 A. For IGBTs with higher ratings, the HCPL-T250 can be used to drive a discrete power stage which drives the IGBT gate.

### Ordering Information

Specify Part Number followed by Option Number.

Example:

HCPL-T250 #XXX

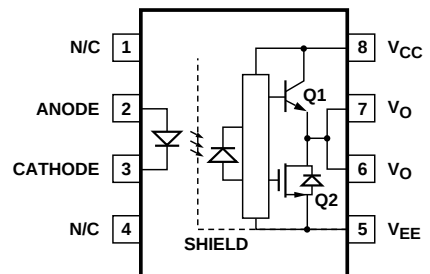
- No Option = Standard DIP Package, 50 per tube.
- 060 = VDE 0884  $V_{IORM} = 630$  V<sub>peak</sub> Option, 50 per tube.
- 300 = Gull Wing Surface Mount Option, 50 per tube.
- 500 = Tape and Reel Packaging Option, 1000 per reel.

A 0.1  $\mu$ F bypass capacitor must be connected between pins 5 and 8.

*CAUTION: It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.*

## HCPL-T250

### Functional Diagram

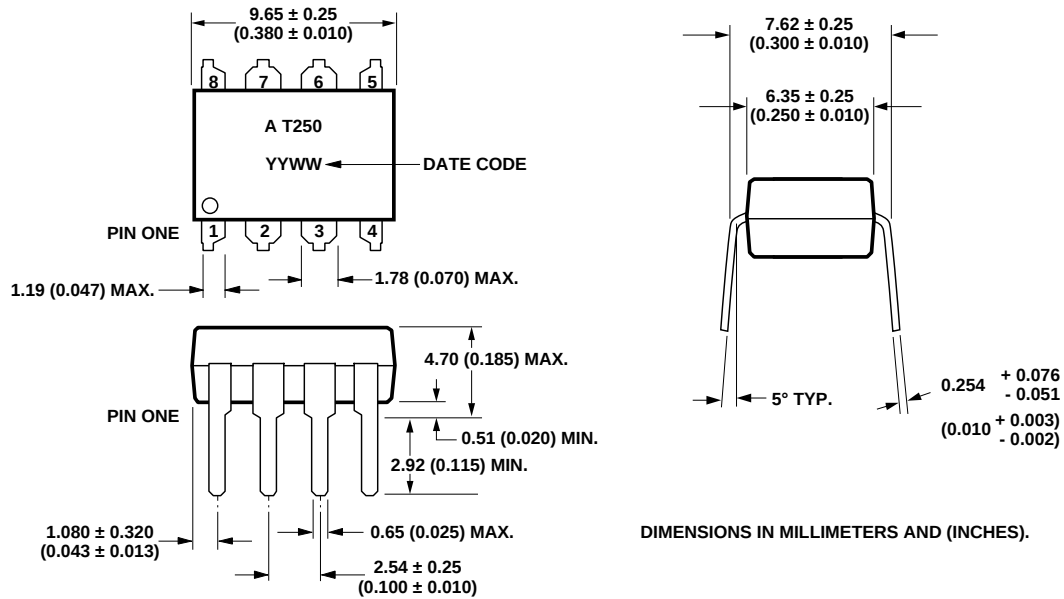


### Truth Table

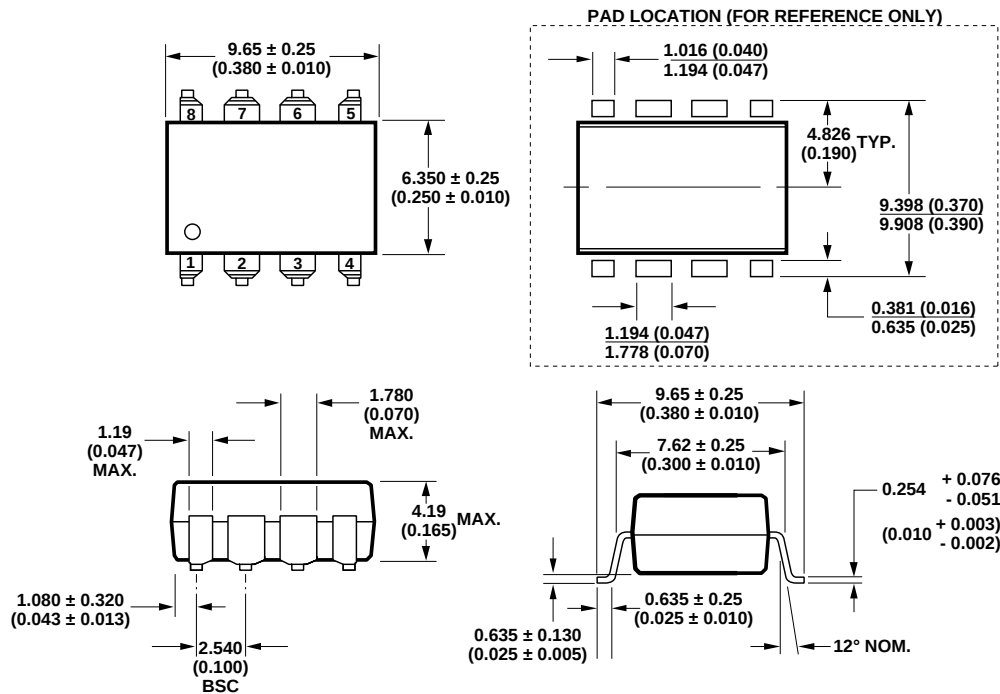
| LED | V <sub>out</sub> |
|-----|------------------|
| ON  | LOW              |
| OFF | HIGH             |

## Package Outline Drawings

### Standard DIP Package



### Gull Wing Surface Mount Option 300



DIMENSIONS IN MILLIMETERS (INCHES).

LEAD COPLANARITY = 0.10 mm (0.004 inches).

### Regulatory Information

The HCPL-T250 has been approved by the following organizations:

#### CSA

Approved under CSA Component Acceptance Notice #5, File CA 88324.

#### UL

Recognized under UL 1577, Component Recognition Program, File E55361.

#### VDE

Approved under VDE 0884/06.92 with  $V_{IORM} = 630 V_{peak}$ .

### Insulation and Safety Related

| Parameter                                         | Symbol | Value      | Units | Conditions                                                                                   |
|---------------------------------------------------|--------|------------|-------|----------------------------------------------------------------------------------------------|
| Minimum External Air Gap (Clearance)              | L(101) | 7.1        | mm    | Measured from input terminals to output terminals, shortest distance through air.            |
| Minimum External Tracking (Creepage)              | L(102) | 7.4        | mm    | Measured from input terminals to output terminals, shortest distance path along body.        |
| Minimum Internal Plastic Gap (Internal Clearance) |        | 0.08       | mm    | Insulation thickness between emitter and detector; also known as distance through insulation |
| Tracking Resistance (Comparative Tracking Index)  | CTI    | $\geq 175$ | Volts | DIN IEC 112/VDE 0303 Part 1                                                                  |
| Isolation Group                                   |        | IIIa       |       | Material Group (DIN VDE 0110, 1/89, Table 1)                                                 |

### Absolute Maximum Ratings (Compared with HCPL-3120)

| Parameter                                                            | Symbol                                                         | Units              | HCPL-3120 |          | HCPL-T250 |          | Note |
|----------------------------------------------------------------------|----------------------------------------------------------------|--------------------|-----------|----------|-----------|----------|------|
|                                                                      |                                                                |                    | Min.      | Max.     | Min.      | Max.     |      |
| Operating Temperature                                                | $T_A$                                                          | $^{\circ}\text{C}$ | -40       | 100      | -20       | 70       |      |
| “High” Peak Output Current                                           | $I_{OH(PEAK)}$                                                 | A                  |           | 2.5      |           | 1.5      | 1    |
| “High” Peak Output Current                                           | $I_{OL(PEAK)}$                                                 | A                  |           | 2.5      |           | 1.5      |      |
| Storage Temperature                                                  | $T_S$                                                          | $^{\circ}\text{C}$ | -55       | 125      | -55       | 125      |      |
| Average Input Current                                                | $I_{F(AVG)}$                                                   | mA                 |           | 25       |           | 20       | 2    |
| Peak Transient Input Current (<1 $\mu\text{s}$ Pulse Width, 300 pps) | $I_{F(TRAN)}$                                                  | A                  |           | 1.0      |           | 1.0      |      |
| Reverse Input Voltage                                                | $V_R$                                                          | V                  |           | 5        |           | 5        |      |
| Supply Voltage                                                       | $(V_{CC} - V_{EE})$                                            | V                  | 0         | 35       | 0         | 35       |      |
| Output Voltage                                                       | $V_O$                                                          | V                  | 0         | $V_{CC}$ | 0         | $V_{CC}$ |      |
| Output Power Dissipation                                             | $P_O$                                                          | mW                 |           | 250      |           | 250      | 3    |
| Lead Solder Temperature                                              | 260 $^{\circ}\text{C}$ for 10 sec., 1.6 mm below seating plane |                    |           |          |           |          |      |
| Solder Reflow Temperature Profile                                    | See Package Outline Drawings section                           |                    |           |          |           |          |      |

#### Notes:

- Maximum pulse width = 10  $\mu\text{s}$ , maximum duty cycle = 0.2%. See HCPL-3120 Applications section for additional details on limiting  $I_{OH(PEAK)}$ .
- Derate linearly above 70 $^{\circ}\text{C}$  free-air temperature at a rate of 0.3 mA/ $^{\circ}\text{C}$ .
- Derate linearly above 70 $^{\circ}\text{C}$  free-air temperature at a rate of 4.8 mW/ $^{\circ}\text{C}$ .

## Recommended Operating Conditions

| Parameter            | Symbol            | Min. | Max. | Units |
|----------------------|-------------------|------|------|-------|
| Power Supply Voltage | $V_{CC} - V_{EE}$ | 15   | 30   | V     |
| Input Current (ON)   | $I_{F(ON)}$       | 7    | 16   | mA    |
| Input Voltage (OFF)  | $V_{F(OFF)}$      | -3.0 | 0.8  | V     |

## DC Electrical Specifications (Compared with HCPL-3120)

Over recommended operating conditions ( $I_{F(ON)} = 7$  to 16 mA,  $V_{F(OFF)} = -3.0$  to 0.8 V,  $V_{CC} = 15$  to 30 V,  $V_{EE} = \text{Ground}$ ) unless otherwise specified.

| Parameter                                  | Symbol                    | Units | HCPL-3120    |                |                | HCPL-T250    |                |                | Test Conditions                            | Note |
|--------------------------------------------|---------------------------|-------|--------------|----------------|----------------|--------------|----------------|----------------|--------------------------------------------|------|
|                                            |                           |       | Min.         | Typ.*          | Max.           | Min.         | Typ.*          | Max.           |                                            |      |
| Input Forward Voltage                      | $V_F$                     | V     | 1.2          | 1.5            | 1.8            |              | 1.6            | 1.8            | $I_F = 10$ mA                              |      |
| Temperature Coefficient of Forward Voltage | $\Delta V_F / \Delta T_A$ | mV/°C |              | -1.6           |                |              | -2.0           |                | $I_F = 10$ mA                              |      |
| Input Reverse Current                      | $I_R$                     | μA    |              |                | 10             |              |                | 10             | $V_R = 5$ V                                |      |
| Input Capacitance                          | $C_{IN}$                  | pF    |              | 60             |                |              | 60             | 250            | $V_F = 0$ V,<br>$F = 1$ MHz                |      |
| High Level Output Current                  | $I_{OH}$                  | A     | 0.5          | 1.5            |                | 0.5          | 1.5            |                | $V_O = V_{CC} - 4$ V                       |      |
|                                            |                           |       | 2.0          |                |                | N.A.         |                |                | $V_O = V_{CC} - 15$ V                      |      |
| Low Level Output Current                   | $I_{OL}$                  | A     | 0.5          | 2.0            |                | 0.5          | 2.0            |                | $V_O = V_{CC} - 4$ V                       |      |
|                                            |                           |       | 2.0          |                |                | N.A.         |                |                | $V_O = V_{CC} - 15$ V                      |      |
| High Level Output Voltage                  | $V_{OH}$                  | V     | $V_{CC} - 4$ | $V_{CC} - 3$   |                | $V_{CC} - 4$ | $V_{CC} - 3$   |                | $I_O = -100$ mA                            |      |
| Low Level Output Voltage                   | $V_{OL}$                  | V     |              | $V_{EE} + 0.1$ | $V_{EE} + 0.5$ |              | $V_{EE} + 0.8$ | $V_{EE} + 2.5$ | $I_O = 100$ mA                             |      |
| High Level Supply Current                  | $I_{CCH}$                 | mA    |              | 2.0            | 5              |              | 7              | 11             | Output Open<br>$I_F = 7$ to 16 mA          |      |
| Low Level Supply Current                   | $I_{CCL}$                 | mA    |              | 2.0            | 5              |              | 7.5            | 11             | Output Open<br>$V_F = -3.0$ to<br>$+0.8$ V |      |
| Threshold Input Current Low to High        | $I_{FLH}$                 | mA    |              | 2.3            | 5              |              | 1.2            | 5              | $I_O = 0$ mA,<br>$V_O > 5$ V               |      |
| Threshold Input Voltage High to Low        | $V_{FHL}$                 | V     | 0.8          |                |                | 0.8          |                |                |                                            |      |
| Supply Voltage                             | $V_{CC}$                  | V     | 15           |                | 30             | 15           |                | 30             |                                            |      |
| Capacitance (Input-Output)                 | $C_{I-O}$                 | pF    |              | 0.6            |                |              | 1.0            |                |                                            |      |
| Resistance (Input-Output)                  | $R_{I-O}$                 | Ω     |              | $10^{12}$      |                |              | $10^{12}$      |                |                                            |      |

\*All typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} - V_{EE} = 3^\circ\text{V}$ , unless otherwise noted.

### Switching Specifications (AC) (Compared with HCPL-3120)

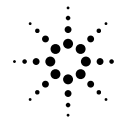
Over recommended operating conditions ( $T_A = -40$  to  $100^\circ\text{C}$ ,  $I_{F(ON)} = 7$  to  $16$  mA,  $V_{F(OFF)} = -3.0$  to  $0.8$  V,  $V_{CC} = 15$  to  $30$  V,  $V_{EE} = \text{Ground}$ ) unless otherwise specified.

| Parameter                                          | Symbol                       | Units                   | HCPL-3120<br>( $-40^\circ\text{C} \sim 100^\circ\text{C}$ ) |       |      | HCPL-T250<br>( $-20^\circ\text{C} \sim 70^\circ\text{C}$ ) |       |      | Test Conditions                                                                             | Note |
|----------------------------------------------------|------------------------------|-------------------------|-------------------------------------------------------------|-------|------|------------------------------------------------------------|-------|------|---------------------------------------------------------------------------------------------|------|
|                                                    |                              |                         | Min.                                                        | Typ.* | Max. | Min.                                                       | Typ.* | Max. |                                                                                             |      |
| Propagation Delay Time to High Output Level        | $t_{PHL}$                    | $\mu\text{s}$           | 0.1                                                         | 0.27  | 0.5  |                                                            | 0.27  | 0.5  | $R_g = 10\ \Omega$<br>$C_g = 10\ \text{nF}$ ,<br>$f = 10\ \text{kHz}$ ,<br>Duty Cycle = 50% |      |
| Propagation Delay Time to Low Output Level         | $T_{PLH}$                    | $\mu\text{s}$           | 0.1                                                         | 0.3   | 0.5  |                                                            | 0.3   | 0.5  |                                                                                             |      |
| Output Rise Time                                   | $t_R$                        | $\mu\text{s}$           |                                                             | 0.1   |      | N.A.                                                       |       |      |                                                                                             |      |
| Output Fall Time                                   | $t_F$                        | $\mu\text{s}$           |                                                             | 0.1   |      | N.A.                                                       |       |      |                                                                                             |      |
| Pulse Width Distortion                             | PWD                          | $\mu\text{s}$           |                                                             |       | 0.3  |                                                            |       | N.A. |                                                                                             |      |
| Propagation Delay Difference Between Any Two Parts | $(t_{PHL} - t_{PLH})$<br>PDD | $\mu\text{s}$           | -0.35                                                       |       | 0.35 | N.A.                                                       |       | N.A. |                                                                                             | 4    |
| Output High Level Common Mode Transient Immunity   | $ CM_H $                     | $\text{kV}/\mu\text{s}$ | 15                                                          | 30    |      | 5                                                          |       |      | $T_A = 25^\circ\text{C}$<br>$V_{CC} = 30\ \text{V}$                                         | 5    |
|                                                    |                              |                         |                                                             |       |      |                                                            |       |      | HCPL-3120<br>$I_F = 10\ \text{mA}$<br>$V_{CM} = 1500\ \text{V}$                             |      |
|                                                    |                              |                         |                                                             |       |      |                                                            |       |      | HCPL-T250<br>$I_F = 10\ \text{mA}$<br>$V_{CM} = 600\ \text{V}$                              |      |
| Output Low Level Common Mode Transient Immunity    | $ CM_L $                     | $\text{kV}/\mu\text{s}$ | 15                                                          | 30    |      | 5                                                          |       |      | $T_A = 25^\circ\text{C}$<br>$V_F = 0\ \text{V}$                                             | 5    |
|                                                    |                              |                         |                                                             |       |      |                                                            |       |      | HCPL-3120<br>$V_{CM} = 1500\ \text{V}$                                                      |      |
|                                                    |                              |                         |                                                             |       |      |                                                            |       |      | HCPL-T250<br>$V_{CM} = 600\ \text{V}$                                                       |      |

\*All typical values at  $T_A = 25^\circ\text{C}$  and  $V_{CC} - V_{EE} = 30\ \text{V}$ , unless otherwise noted.

#### Notes:

- The difference between  $t_{PHL}$  and  $t_{PLH}$  between any two HCPL-3120 parts under the same test condition.
- Common mode transient immunity in the high state is the maximum tolerable  $dV_{CM}/dt$  of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in the high state (i.e.,  $V_O > 15.0\ \text{V}$ ).
- Common mode transient immunity in a low state is the maximum tolerable  $dV_{CM}/dt$  of the common mode pulse,  $V_{CM}$ , to assure that the output will remain in a low state (i.e.,  $V_O < 1.0\ \text{V}$ ).



**Agilent Technologies**

Innovating the HP Way

*[www.semiconductor.agilent.com](http://www.semiconductor.agilent.com)*

Data subject to change.

Copyright © 1999 Agilent Technologies

5968-0977E (11/99)