

# HCPL0600, HCPL0601, HCPL0611, HCPL0630, HCPL0631, HCPL0661 High Speed-10 MBit/s Logic Gate Optocouplers

**Single Channel: HCPL0600, HCPL0601, HCPL0611**

**Dual Channel: HCPL0630, HCPL0631, HCPL0661**

## Features

- Compact SO8 package
- Very high speed-10 MBit/s
- Superior CMR
- Fan-out of 8 over -40°C to +85°C
- Logic gate output
- Strobable output (single channel devices)
- Wired OR-open collector
- U.L. recognized (File # E90700)
- VDE approval pending

- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

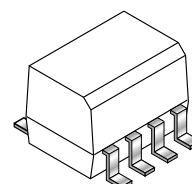
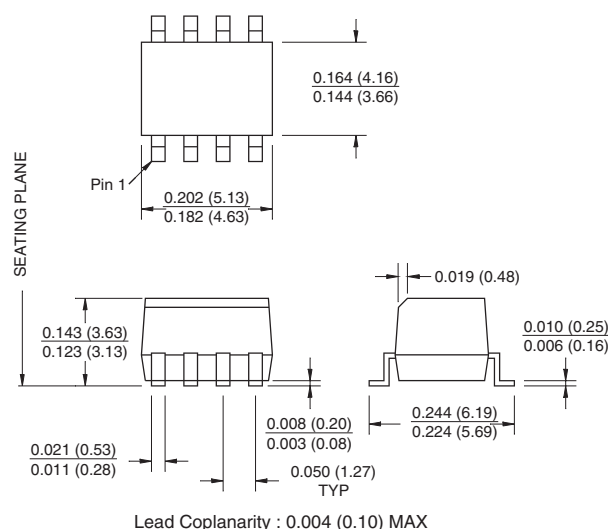
## Description

The HCPL06XX optocouplers consist of an AlGaAs LED, optically coupled to a very high speed integrated photo-detector logic gate with a strobable output (single channel devices). The devices are housed in a compact small-outline package. This output features an open collector, thereby permitting wired OR outputs. The HCPL0600 and HCPL0601 output consists of bipolar transistors on a bipolar process while the HCPL0611, HCPL0630 and HCPL0631 output consists of bipolar transistors on a CMOS process for reduced power consumption. The coupled parameters are guaranteed over the temperature range of -40°C to +85°C. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan out of 8). An internal noise shield provides superior common mode rejection.

## Applications

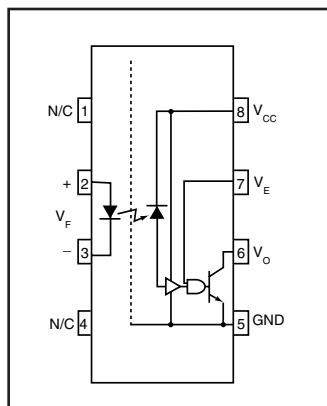
- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing

## Package Dimensions

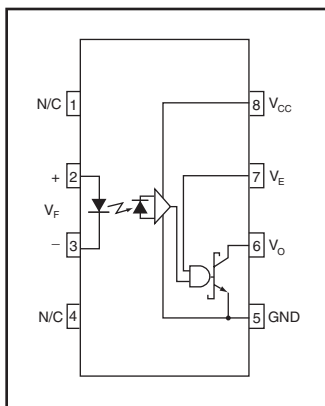


## NOTE

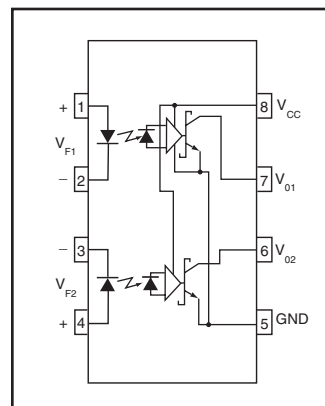
All dimensions are in inches (millimeters)



Single-channel circuit drawing (HCPL0600 and HCPL0601)



Single-channel circuit drawing (HCPL0611)



Dual-channel circuit drawing (HCPL0630, HCPL0631 and HCPL0661)

## TRUTH TABLE (Positive Logic)

| Input | Enable | Output |
|-------|--------|--------|
| H     | H      | L      |
| L     | H      | H      |
| H     | L      | H      |
| L     | L      | H      |
| H*    | NC*    | L*     |
| L*    | NC*    | H*     |

\*Dual channel devices or single channel devices with pin 7 not connected.  
A 0.1  $\mu$ F bypass capacitor must be connected between pins 8 and 5. (See note 1)

## Absolute Maximum Ratings (No derating required up to 85°C)

| Parameter                                                         |                | Symbol                     | Value       | Units |
|-------------------------------------------------------------------|----------------|----------------------------|-------------|-------|
| Storage Temperature                                               |                | $T_{STG}$                  | -40 to +125 | °C    |
| Operating Temperature                                             |                | $T_{OPR}$                  | -40 to +85  | °C    |
| <b>EMITTER</b><br>DC/Average Forward Input Current (each channel) | Single Channel | $I_F$                      | 50          | mA    |
|                                                                   | Dual Channel   |                            |             |       |
| Enable Input Voltage<br>Not to exceed VCC by more than 500 mV     | Single Channel | $V_E$                      | 5.5         | V     |
| Reverse Input Voltage (each channel)                              |                | $V_R$                      | 5.0         | V     |
| Power Dissipation                                                 | Single Channel | $P_I$                      | 45          | mW    |
|                                                                   | Dual Channel   |                            |             |       |
| <b>DETECTOR</b><br>Supply Voltage                                 |                | $V_{CC}$<br>(1 minute max) | 7.0         | V     |
| Output Current (each channel)                                     |                | $I_O$                      | 50          | mA    |
| Output Voltage (each channel)                                     |                | $V_O$                      | 7.0         | V     |
| Collector Output Power Dissipation                                | Single Channel | $P_O$                      | 85          | mW    |
|                                                                   | Dual Channel   |                            |             |       |

## Recommended Operating Conditions

| Parameter                  | Symbol   | Min  | Max      | Units     |
|----------------------------|----------|------|----------|-----------|
| Input Current, Low Level   | $I_{FL}$ | 0    | 250      | μA        |
| Input Current, High Level  | $I_{FH}$ | *6.3 | 15       | mA        |
| Supply Voltage, Output     | $V_{CC}$ | 4.5  | 5.5      | V         |
| Enable Voltage, Low Level  | $V_{EL}$ | 0    | 0.8      | V         |
| Enable Voltage, High Level | $V_{EH}$ | 2.0  | $V_{CC}$ | V         |
| Operating Temperature      | $T_A$    | -40  | +85      | °C        |
| Fan Out (TTL load)         | N        |      | 8        | TTL Loads |
| Output Pull-up             | $R_L$    | 330  | 4K       | Ω         |

\*6.3 mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0 mA or less

## Electrical Characteristics ( $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ Unless otherwise specified.)

### Individual Component Characteristics

| Parameter                           | Test Conditions                                            | Symbol                  | Min       | Typ** | Max  | Unit                   |
|-------------------------------------|------------------------------------------------------------|-------------------------|-----------|-------|------|------------------------|
| <b>EMITTER</b>                      |                                                            |                         |           |       |      |                        |
| Input Forward Voltage               | ( $I_F = 10\text{ mA}$ )                                   | $V_F$                   |           |       | 1.8  | V                      |
|                                     | $T_A = 25^{\circ}\text{C}$                                 |                         |           |       | 1.75 |                        |
| Input Reverse Breakdown Voltage     | ( $I_R = 10\text{ }\mu\text{A}$ )                          | $B_{VR}$                | 5.0       |       |      | V                      |
| Input Capacitance                   | ( $V_F = 0$ , $f = 1\text{ MHz}$ )                         | $C_{IN}$                |           |       |      | pF                     |
| Input Diode Temperature Coefficient | ( $I_F = 10\text{ mA}$ )                                   | $\Delta V_F/\Delta T_A$ |           |       |      | mV/ $^{\circ}\text{C}$ |
| <b>DETECTOR</b>                     |                                                            |                         |           |       |      |                        |
| High Level Supply Current           | ( $V_E = 0.5\text{ V}$ )                                   | Single Channel          | $I_{CCH}$ |       | 10   | mA                     |
|                                     | ( $I_F = 0\text{ mA}$ , $V_{CC} = 5.5\text{ V}$ )          | Dual Channel            |           |       | 15   |                        |
| Low Level Supply Current            | ( $V_E = 0.5\text{ V}$ )                                   | Single Channel          | $I_{CCL}$ |       | 13   | mA                     |
|                                     | ( $I_F = 10\text{ mA}$ , $V_{CC} = 5.5\text{ V}$ )         | Dual Channel            |           |       | 21   |                        |
| Low Level Enable Current            | ( $V_{CC} = 5.5\text{ V}$ , $V_E = 0.5\text{ V}$ )         | Single Channel          | $I_{EL}$  |       | -1.6 | mA                     |
| High Level Enable Current           | ( $V_{CC} = 5.5\text{ V}$ , $V_E = 2.0\text{ V}$ )         | Single Channel          | $I_{EH}$  |       | -1.6 | mA                     |
| High Level Enable Voltage           | ( $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ )         | Single Channel          | $V_{EH}$  | 2.0   |      | V                      |
| Low Level Enable Voltage            | ( $V_{CC} = 5.5\text{ V}$ , $I_F = 10\text{ mA}$ )(Note 2) | Single Channel          | $V_{EL}$  |       | 0.8  | V                      |

### Switching Characteristics ( $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ , $V_{CC} = 5\text{ V}$ , $I_F = 7.5\text{ mA}$ Unless otherwise specified.)

| AC Characteristics                                    | Test Conditions                                                                                                                            | Device                           | Symbol                | Min    | Typ | Max | Unit             |
|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------|--------|-----|-----|------------------|
| Propagation Delay Time to Output High Level           | (Note 3) ( $T_A = 25^{\circ}\text{C}$ )                                                                                                    | All                              | $T_{PLH}$             | 20     |     | 75  | ns               |
|                                                       | ( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Fig. 12)                                                                                      |                                  |                       |        |     | 100 |                  |
| Propagation Delay Time to Output Low Level            | (Note 4) ( $T_A = 25^{\circ}\text{C}$ )                                                                                                    | All                              | $T_{PHL}$             | 25     |     | 75  | ns               |
|                                                       | ( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Fig. 12)                                                                                      |                                  |                       |        |     | 100 |                  |
| Pulse Width Distortion                                | ( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Fig. 12)                                                                                      | All                              | $ T_{PHL} - T_{PLH} $ |        |     | 35  | ns               |
| Output Rise Time (10-90%)                             | ( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Note 5)(Fig. 12)                                                                              | All                              | $t_r$                 |        | 50  |     | ns               |
| Output Fall Time (90-10%)                             | ( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Note 6)(Fig. 12)                                                                              | All                              | $t_f$                 |        | 12  |     | ns               |
| Enable Propagation Delay Time to Output High Level    | ( $I_F = 7.5\text{ mA}$ , $V_{EH} = 3.5\text{ V}$ )<br>( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Note 7)(Fig. 13)                       | HCPL0600<br>HCPL0601<br>HCPL0611 | $t_{ELH}$             |        | 20  |     | ns               |
| Enable Propagation Delay Time to Output Low Level     | ( $I_F = 7.5\text{ mA}$ , $V_{EH} = 3.5\text{ V}$ )<br>( $R_L = 350\Omega$ , $C_L = 15\text{ pF}$ )(Note 8)(Fig. 13)                       | HCPL0600<br>HCPL0601<br>HCPL0611 | $t_{EHL}$             |        | 20  |     | ns               |
| Common Mode Transient Immunity (at Output High Level) | ( $R_L = 350\Omega$ ) ( $T_A = 25^{\circ}\text{C}$ )<br>( $I_F = 0\text{ mA}$ , $V_{OH}(\text{Min.}) = 2.0\text{ V}$ )(Note 9)(Fig. 14)    | $ V_{CM}  = 10\text{ V}$         | $ICM_H$               |        |     |     | V/ $\mu\text{s}$ |
|                                                       |                                                                                                                                            | $ V_{CM}  = 50\text{ V}$         |                       | 5000   |     |     |                  |
|                                                       |                                                                                                                                            | $ V_{CM}  = 1,000\text{ V}$      |                       | 25,000 |     |     |                  |
| Common Mode Transient Immunity (at Output Low Level)  | ( $R_L = 350\Omega$ ) ( $T_A = 25^{\circ}\text{C}$ )<br>( $I_F = 7.5\text{ mA}$ , $V_{OL}(\text{Max.}) = 0.8\text{ V}$ )(Note 10)(Fig. 14) | $ V_{CM}  = 10\text{ V}$         | $ICM_H$               |        |     |     | V/ $\mu\text{s}$ |
|                                                       |                                                                                                                                            | $ V_{CM}  = 50\text{ V}$         |                       | 5000   |     |     |                  |
|                                                       |                                                                                                                                            | $ V_{CM}  = 1,000\text{ V}$      |                       | 25,000 |     |     |                  |

# Transfer Characteristics ( $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ Unless otherwise specified.)

| DC Characteristics        | Test Conditions                                                                                                          | Symbol   | Min | Typ** | Max | Unit          |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------|----------|-----|-------|-----|---------------|
| High Level Output Current | ( $V_{CC} = 5.5\text{ V}$ , $V_O = 5.5\text{ V}$ )<br>( $I_F = 250\text{ }\mu\text{A}$ , $V_E = 2.0\text{ V}$ ) (Note 2) | $I_{OH}$ |     |       | 100 | $\mu\text{A}$ |
| Low Level Output Voltage  | ( $V_{CC} = 5.5\text{ V}$ , $I_F = 5\text{ mA}$ )<br>( $V_E = 2.0\text{ V}$ , $I_{OL} = 13\text{ mA}$ ) (Note 2)         | $V_{OL}$ |     |       | 0.6 | V             |
| Input Threshold Current   | ( $V_{CC} = 5.5\text{ V}$ , $V_O = 0.6\text{ V}$ ,<br>$V_E = 2.0\text{ V}$ , $I_{OL} = 13\text{ mA}$ )                   | $I_{FT}$ |     |       | 5   | mA            |

# Isolation Characteristics ( $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ Unless otherwise specified.)

| Characteristics                            | Test Conditions                                                                                                                | Symbol    | Min  | Typ**     | Max  | Unit          |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------|------|-----------|------|---------------|
| Input-Output<br>Insulation Leakage Current | (Relative humidity = 45%)<br>( $T_A = 25^{\circ}\text{C}$ , $t = 5\text{ s}$ )<br>( $V_{I-O} = 3000\text{ VDC}$ )<br>(Note 11) | $I_{I-O}$ |      |           | 1.0* | $\mu\text{A}$ |
| Withstand Insulation Test Voltage          | ( $R_H < 50\%$ , $T_A = 25^{\circ}\text{C}$ )<br>(Note 11) ( $t = 1\text{ min.}$ )                                             | $V_{ISO}$ | 2500 |           |      | $V_{RMS}$     |
| Resistance (Input to Output)               | ( $V_{I-O} = 500\text{ V}$ ) (Note 11)                                                                                         | $R_{I-O}$ |      | $10^{12}$ |      | $\Omega$      |
| Capacitance (Input to Output)              | ( $f = 1\text{ MHz}$ ) (Note 11)                                                                                               | $C_{I-O}$ |      | 0.6       |      | pF            |

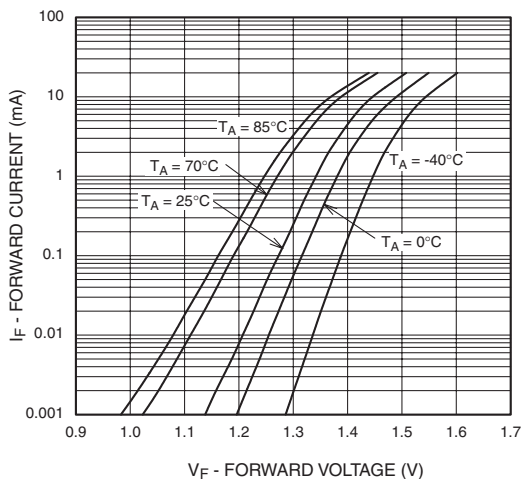
\*\* All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^{\circ}\text{C}$

## NOTES

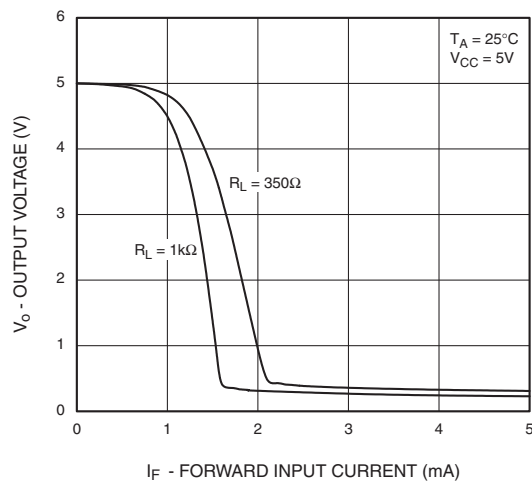
1. The  $V_{CC}$  supply to each optoisolator must be bypassed by a  $0.1\text{ }\mu\text{F}$  capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package  $V_{CC}$  and GND pins of each device.
2. Enable Input - No pull up resistor required as the device has an internal pull up resistor.
3.  $t_{PLH}$  - Propagation delay is measured from the  $3.75\text{ mA}$  level on the HIGH to LOW transition of the input current pulse to the  $1.5\text{ V}$  level on the LOW to HIGH transition of the output voltage pulse.
4.  $t_{PHL}$  - Propagation delay is measured from the  $3.75\text{ mA}$  level on the LOW to HIGH transition of the input current pulse to the  $1.5\text{ V}$  level on the HIGH to LOW transition of the output voltage pulse.
5.  $t_r$  - Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
6.  $t_f$  - Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
7.  $t_{ELH}$  - Enable input propagation delay is measured from the  $1.5\text{ V}$  level on the HIGH to LOW transition of the input voltage pulse to the  $1.5\text{ V}$  level on the LOW to HIGH transition of the output voltage pulse.
8.  $t_{EHL}$  - Enable input propagation delay is measured from the  $1.5\text{ V}$  level on the LOW to HIGH transition of the input voltage pulse to the  $1.5\text{ V}$  level on the HIGH to LOW transition of the output voltage pulse.
9.  $CM_H$  - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e.,  $V_{OUT} > 2.0\text{ V}$ ). Measured in volts per microsecond ( $\text{V}/\mu\text{s}$ ).
10.  $CM_L$  - The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e.,  $V_{OUT} < 0.8\text{ V}$ ). Measured in volts per microsecond ( $\text{V}/\mu\text{s}$ ).
11. Device considered a two-terminal device: Pins 1,2,3 and 4 shorted together, and Pins 5,6,7 and 8 shorted together.

## Typical Performance Curves (HCPL0600 and HCPL0601 only)

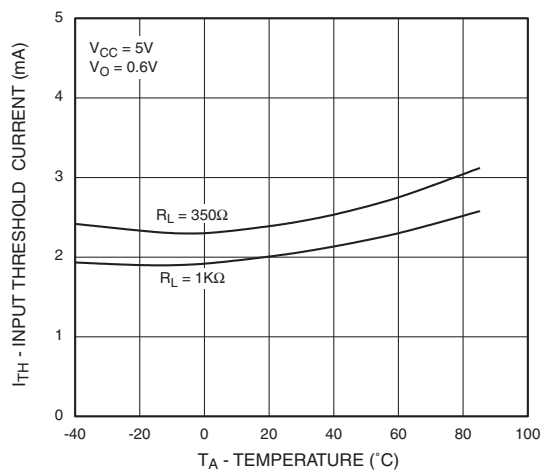
**Fig. 1 Forward Current vs. Input Forward Voltage**



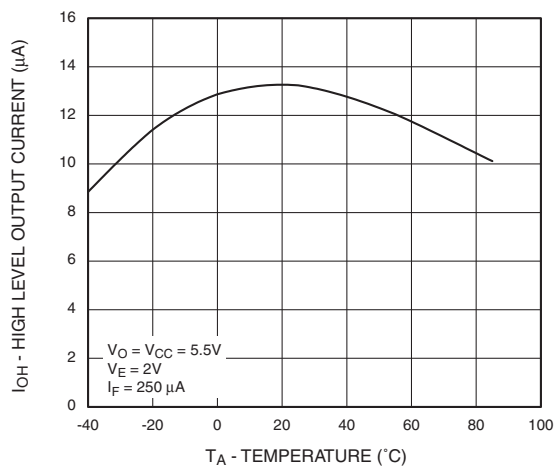
**Fig. 2 Output Voltage vs. Forward Current**



**Fig. 3 Input Threshold Current vs. Temperature**



**Fig. 4 High Level Output Current vs. Temperature**



## Typical Performance Curves (HCPL0600 and HCPL0601 only)

Fig. 5 Low Level Output Voltage vs. Temperature

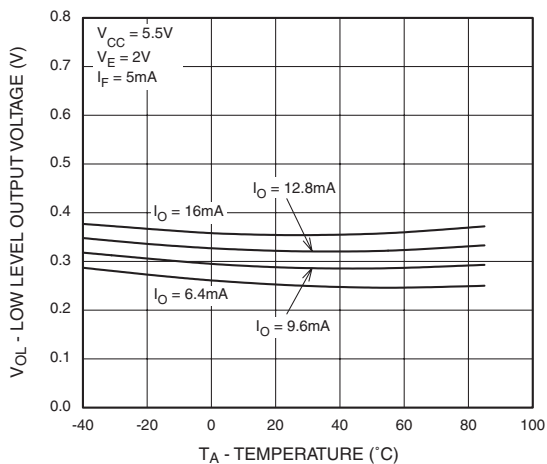


Fig. 6 Low Level Output Current vs. Temperature

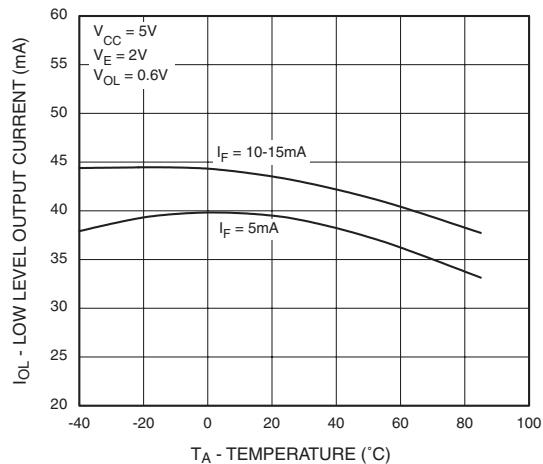


Fig. 7 Propagation Delay vs. Temperature

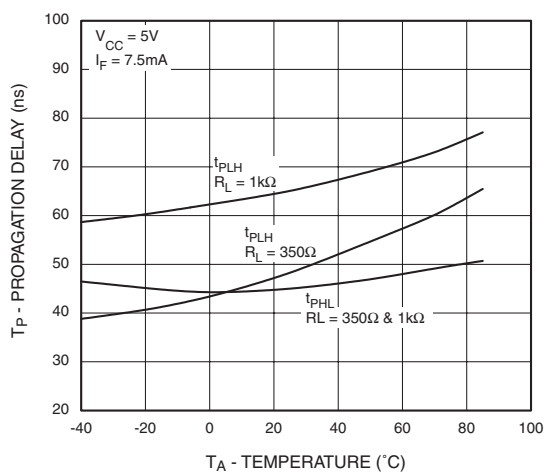
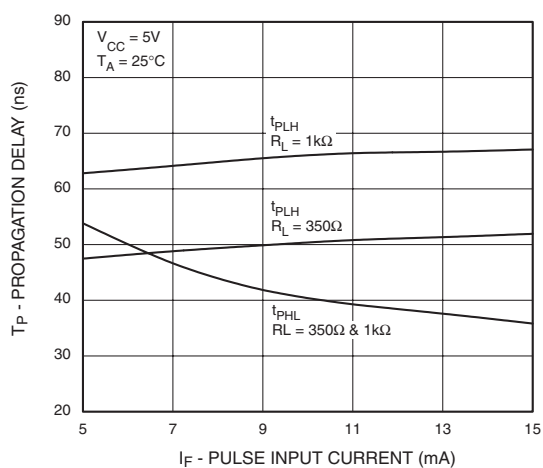


Fig. 8 Propagation Delay vs. Pulse Input Current



## Typical Performance Curves (HCPL0600 and HCPL0601 only)

Fig. 9 Typical Enable Propagation Delay vs. Temperature

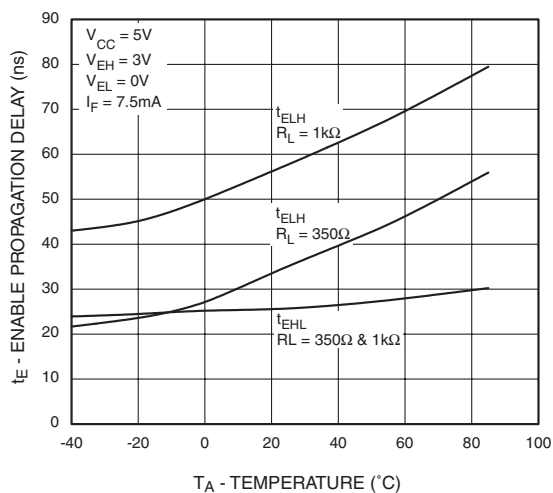


Fig. 10 Typical Rise and Fall Time vs. Temperature

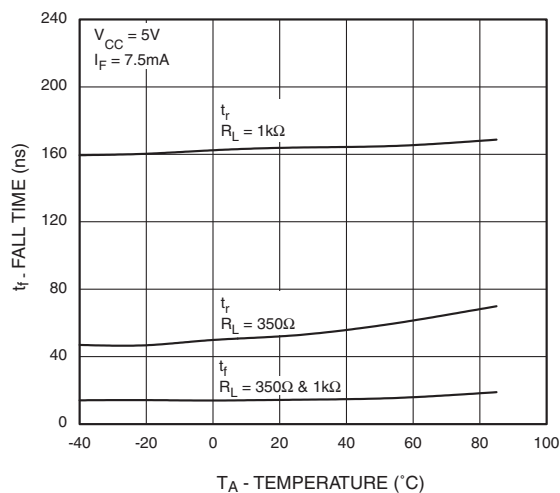
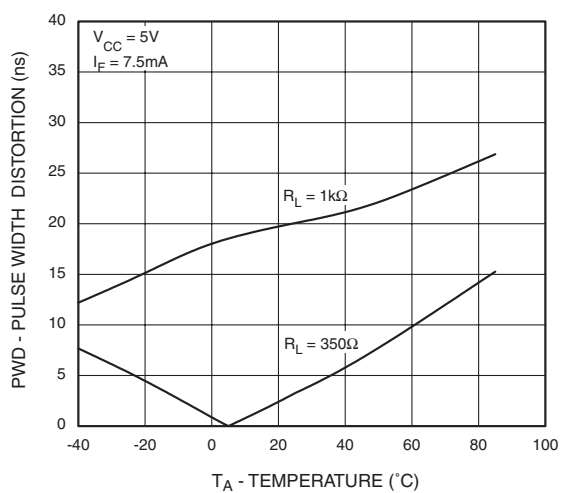
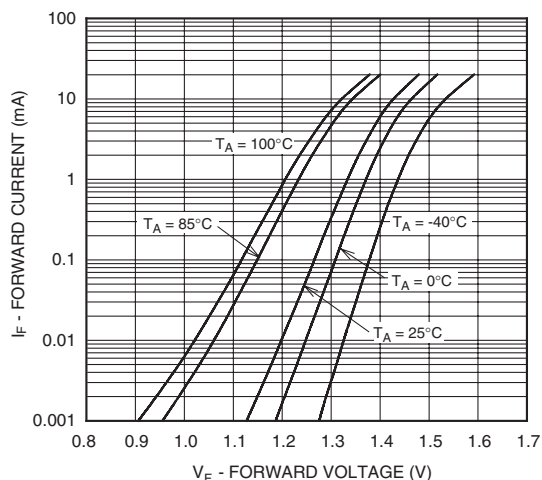


Fig. 11 Typical Pulse Width Distortion vs. Temperature

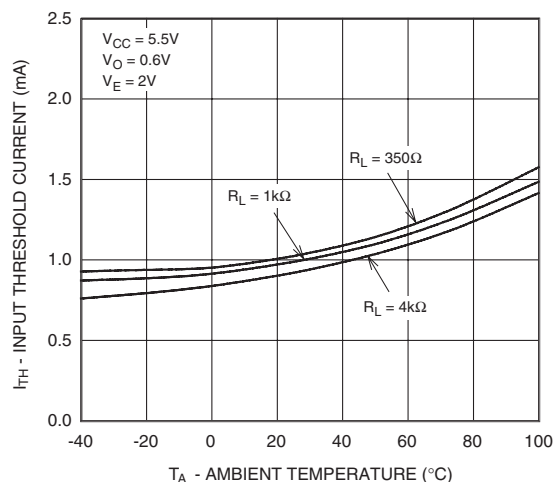


# Typical Performance Curves (HCPL0611, HCPL0630, HCPL0631 and HCPL0661 only)

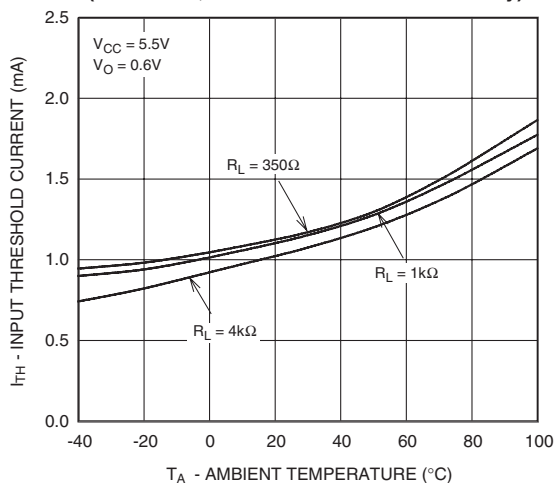
**Fig. 12 Input Forward Current vs. Forward Voltage**



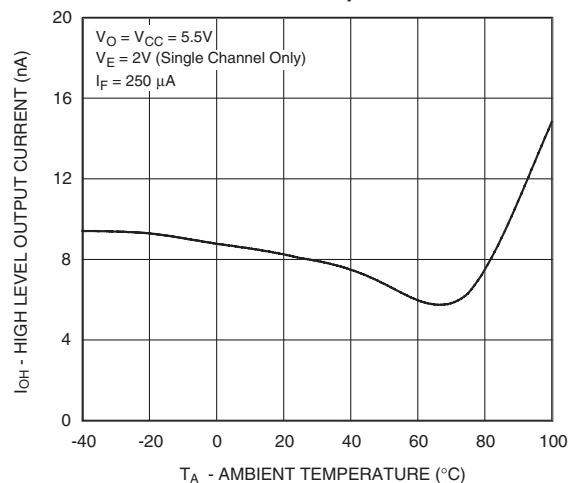
**Fig. 13 Input Threshold Current vs. Ambient Temperature (HCPL0611 only)**



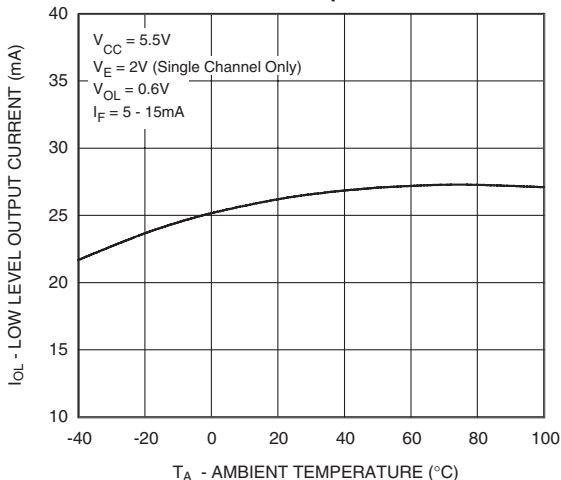
**Fig. 14 Input Threshold Current vs. Ambient Temperature (HCPL0630, HCPL0631 and HCPL0661 only)**



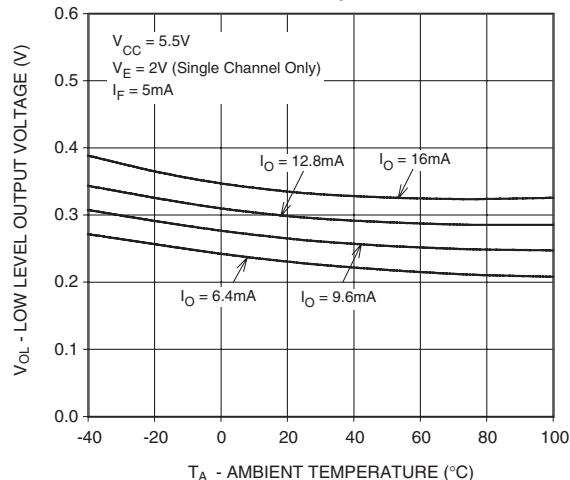
**Fig. 15 High Level Output Current vs. Ambient Temperature**



**Fig. 16 Low Level Output Current vs. Ambient Temperature**

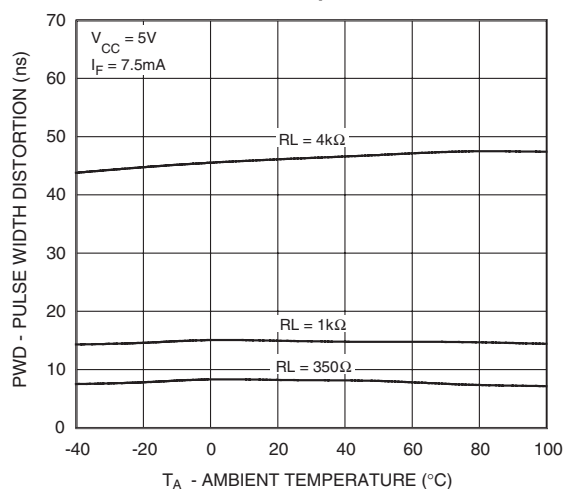


**Fig. 17 Low Level Output Voltage vs. Ambient Temperature**

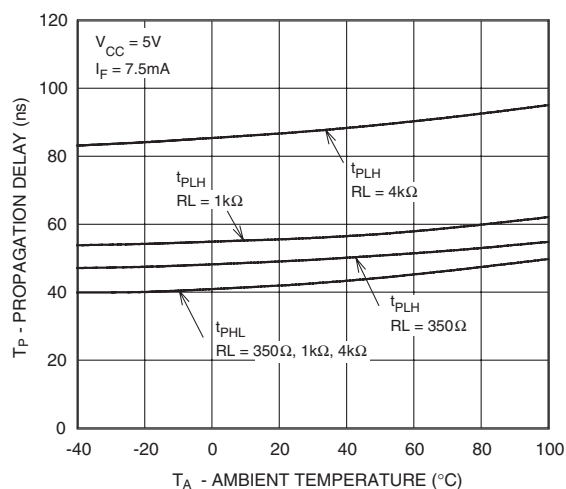


## Typical Performance Curves (HCPL0611, HCPL0630, HCPL0631 and HCPL0661 only)

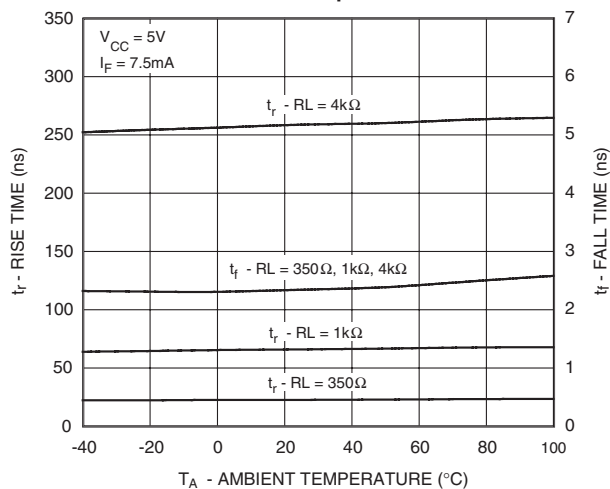
**Fig. 18 Pulse Width Distortion vs. Ambient Temperature**



**Fig. 19 Propagation Delay vs. Ambient Temperature**



**Fig. 20 Rise and Fall Times vs. Ambient Temperature**



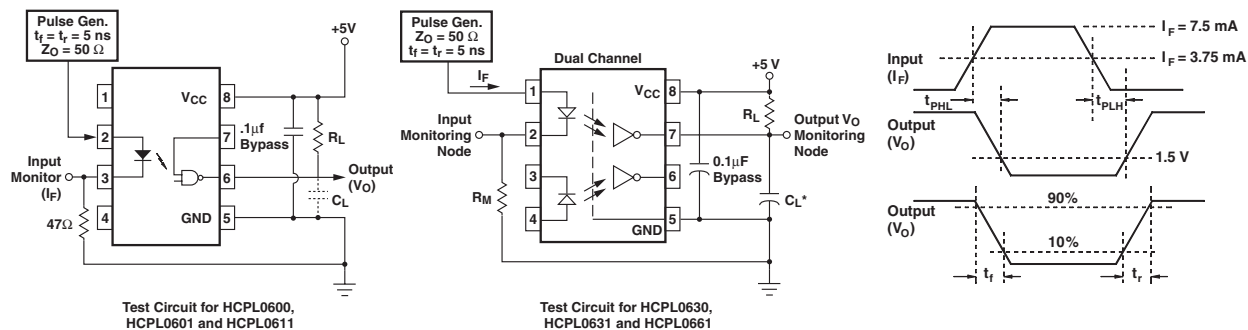


Fig. 21 Test Circuit and Waveforms for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ .

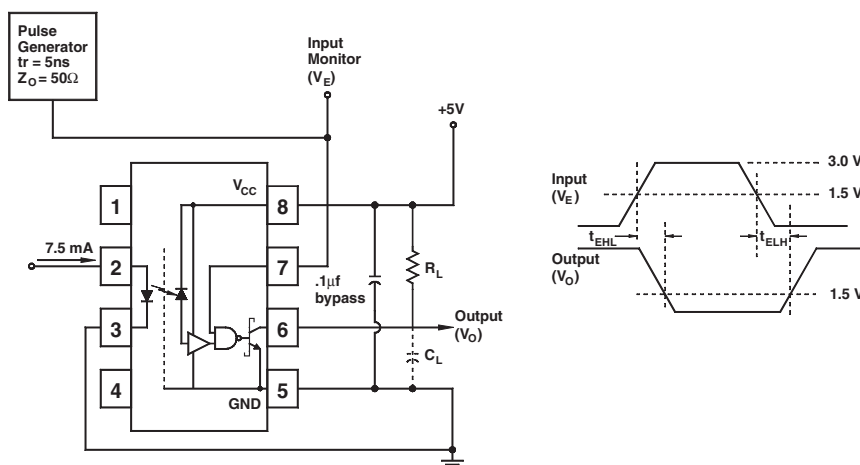
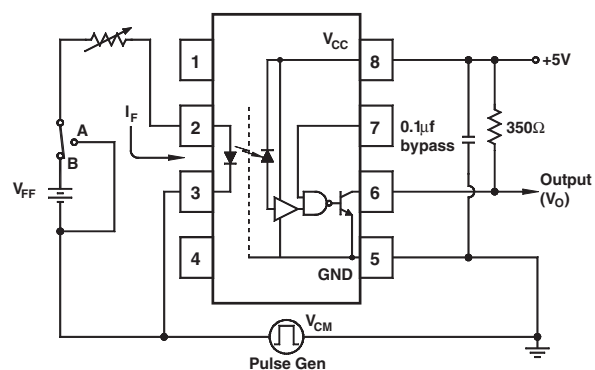


Fig. 22 Test Circuit  $t_{EHL}$  and  $t_{ELH}$ .



Test Circuit for HCPL0600, and HCPL0601

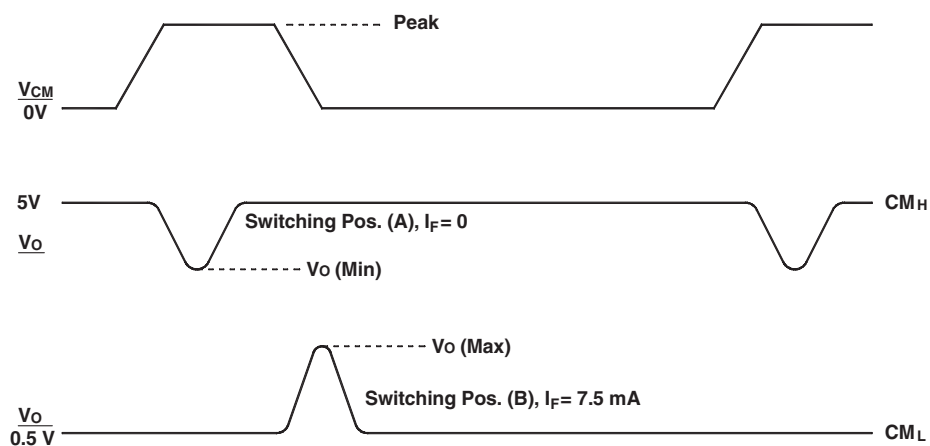


Fig. 23 Test Circuit Common Mode Transient Immunity (HCPL0600 and HCPL0601)

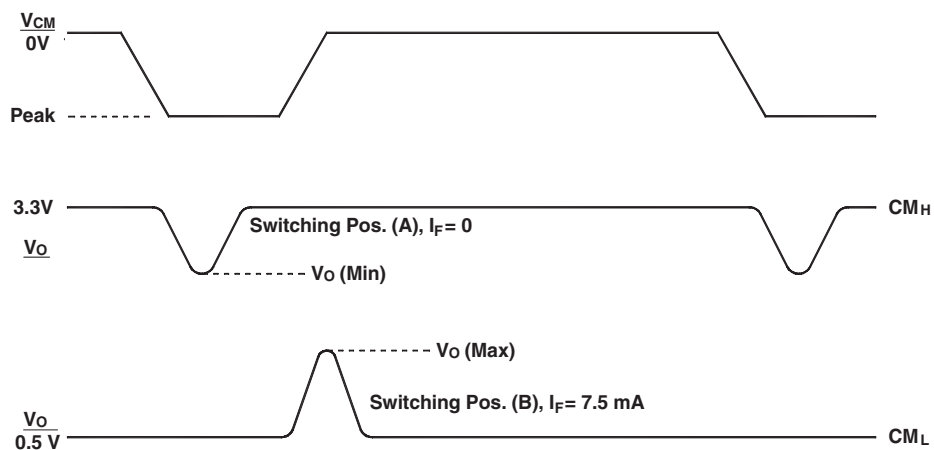
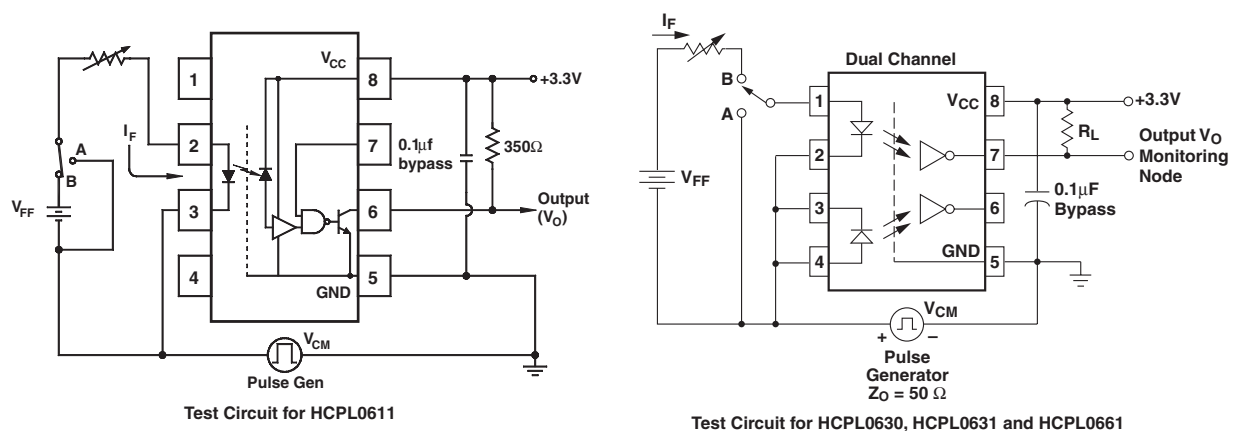
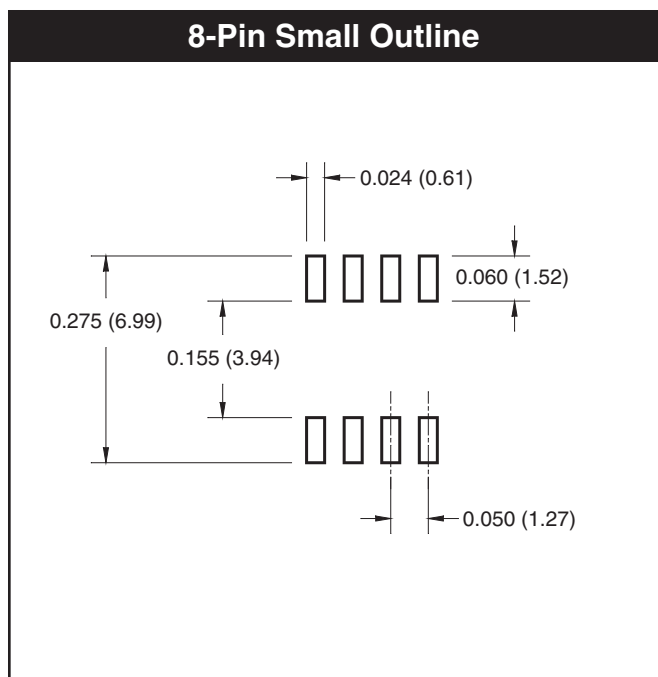


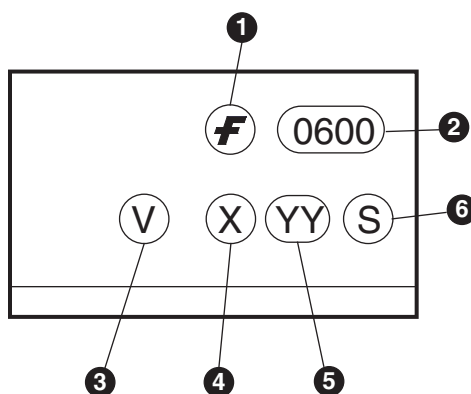
Fig. 24 Test Circuit Common Mode Transient Immunity (HCPL0611, HCPL0630, HCPL0631 and HCPL0661)



## Ordering Information

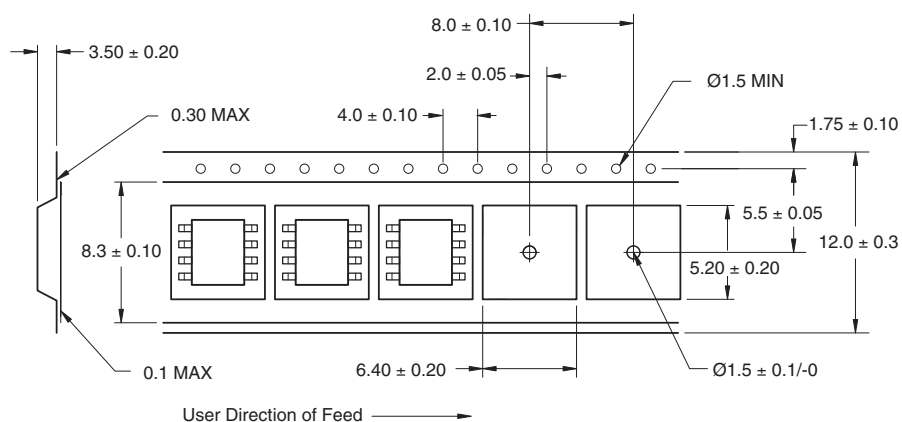
| Option    | Order Entry Identifier | Description                                                     |
|-----------|------------------------|-----------------------------------------------------------------|
| No Suffix | HCPL0600               | Shipped in tubes (50 units per tube)                            |
| V         | HCPL0600V              | VDE0884 (pending approval)                                      |
| R1        | HCPL0600R1             | Tape and Reel (500 units per reel)                              |
| R1V       | HCPL0600R1V            | VDE0884 (pending approval), Tape and Reel (500 units per reel)  |
| R2        | HCPL0600R2             | Tape and Reel (2500 units per reel)                             |
| R2V       | HCPL0600R2V            | VDE0884 (pending approval), Tape and Reel (2500 units per reel) |

## Marking Information

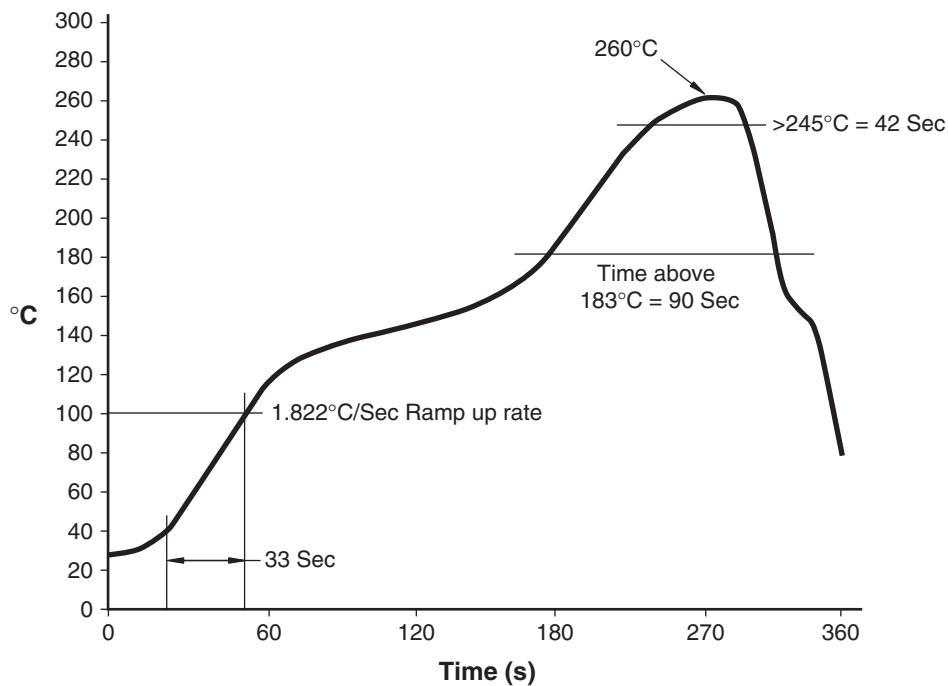


| Definitions |                                                                                        |
|-------------|----------------------------------------------------------------------------------------|
| 1           | Fairchild logo                                                                         |
| 2           | Device number                                                                          |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | One digit year code, e.g., '3'                                                         |
| 5           | Two digit work week ranging from '01' to '53'                                          |
| 6           | Assembly package code                                                                  |

## Carrier Tape Specifications



## Reflow Profile



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|--------------------------------------------------|---------------------------------|---------------------------|---------------------------------|-----------------------------|
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| ActiveArray <sup>™</sup>                         | FAST <sup>™</sup>               | LittleFET <sup>™</sup>    | PowerTrench <sup>®</sup>        | SyncFET <sup>™</sup>        |
| Bottomless <sup>™</sup>                          | FPS <sup>™</sup>                | MICROCOUPLER <sup>™</sup> | QFET <sup>®</sup>               | TinyLogic <sup>®</sup>      |
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| CROSSVOLT <sup>™</sup>                           | GTO <sup>™</sup>                | MICROWIRE <sup>™</sup>    | Quiet Series <sup>™</sup>       | UHC <sup>™</sup>            |
| DOVE <sup>™</sup>                                | HiSeC <sup>™</sup>              | MSX <sup>™</sup>          | RapidConfigure <sup>™</sup>     | UltraFET <sup>®</sup>       |
| EcoSPARK <sup>™</sup>                            | I <sup>2</sup> C <sup>™</sup>   | MSXPro <sup>™</sup>       | RapidConnect <sup>™</sup>       | UniFET <sup>™</sup>         |
| E <sup>2</sup> CMOS <sup>™</sup>                 | i-Lo <sup>™</sup>               | OCX <sup>™</sup>          | μSerDes <sup>™</sup>            | VCX <sup>™</sup>            |
| EnSigna <sup>™</sup>                             | ImpliedDisconnect <sup>™</sup>  | OCXPro <sup>™</sup>       | SILENT SWITCHER <sup>®</sup>    | Wire <sup>™</sup>           |
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| Across the board. Around the world. <sup>™</sup> |                                 | PACMAN <sup>™</sup>       | Stealth <sup>™</sup>            |                             |
| The Power Franchise <sup>®</sup>                 |                                 | POP <sup>™</sup>          | SuperFET <sup>™</sup>           |                             |
| Programmable Active Droop <sup>™</sup>           |                                 | Power247 <sup>™</sup>     | SuperSOT <sup>™</sup> -3        |                             |
|                                                  |                                 | PowerEdge <sup>™</sup>    | SuperSOT <sup>™</sup> -6        |                             |

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### Definition of Terms

| Datasheet Identification | Product Status         | Definition                                                                                                                                                                                                            |
|--------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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