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# HCPL0600, HCPL0601, HCPL0611, HCPL0637, HCPL0638, HCPL0639 High Speed-10 MBit/s Logic Gate Optocouplers

Single Channel: HCPL0600, HCPL0601, HCPL0611

Dual Channel: HCPL0637, HCPL0638, HCPL0639

## Features

- Compact SO8 package
- Very high speed-10 MBit/s
- Superior CMR
- Logic gate output
- Strobable output (single channel devices)
- Wired OR-open collector
- U.L. recognized (File # E90700)
- IEC60747-5-2 approved (VDE option)  
– HCPL0600, HCPL0601, HCPL0611 only

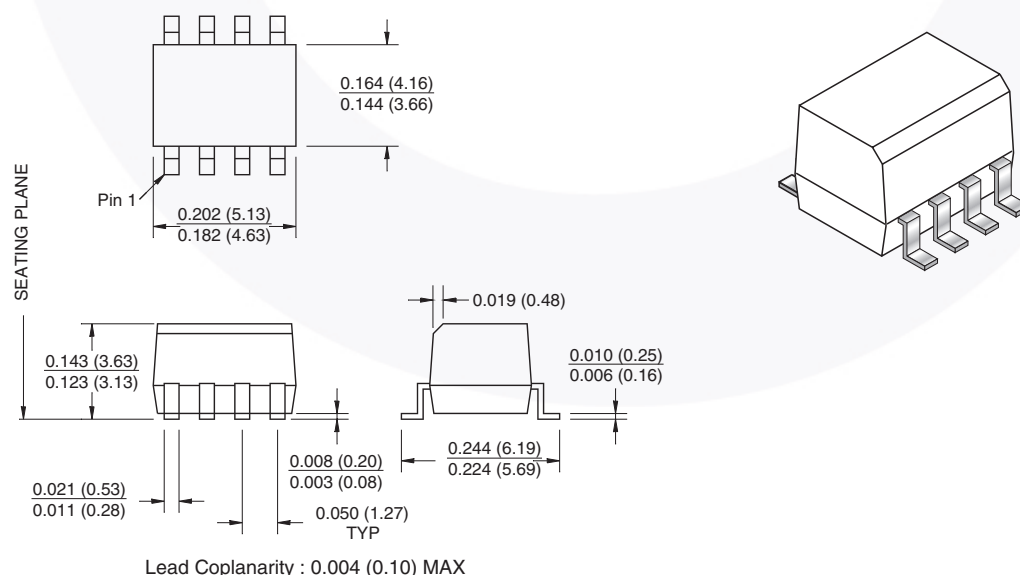
## Applications

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

## Description

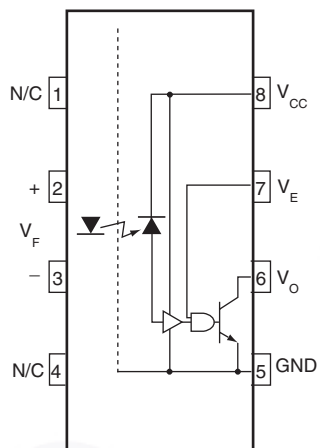
The HCPL06XX optocouplers consist of an AlGaAs LED, optically coupled to a very high speed integrated photo-detector logic gate with a strobable output (single channel devices). The devices are housed in a compact small-outline package. This output features an open collector, thereby permitting wired OR outputs. The HCPL0600, HCPL0601 and HCPL0611 output consists of bipolar transistors on a bipolar process while the HCPL0637, HCPL0638, and HCPL0639 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. An internal noise shield provides superior common mode rejection.

## Package Dimensions

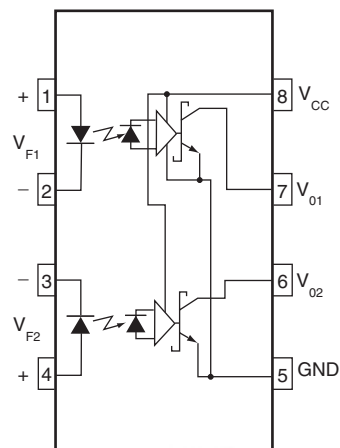


### Note:

All dimensions are in inches (millimeters)



**Single-channel circuit drawing**  
(HCPL0600, HCPL0601 and HCPL0611)



**Dual-channel circuit drawing**  
(HCPL0637, HCPL0638 and HCPL0639)

**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)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol                            | Parameter                                                    |                | Value       | Units |
|-----------------------------------|--------------------------------------------------------------|----------------|-------------|-------|
| T <sub>STG</sub>                  | Storage Temperature                                          |                | -40 to +125 | °C    |
| T <sub>OPR</sub>                  | Operating Temperature                                        |                | -40 to +85  | °C    |
| EMITTER                           |                                                              |                |             |       |
| I <sub>F</sub>                    | DC/Average Forward Input Current (each channel)              | Single Channel | 50          | mA    |
|                                   |                                                              | Dual Channel   |             |       |
| V <sub>E</sub>                    | Enable Input Voltage<br>Not to exceed VCC by more than 500mV | Single Channel | 5.5         | V     |
| V <sub>R</sub>                    | Reverse Input Voltage (each channel)                         |                | 5.0         | V     |
| P <sub>I</sub>                    | Power Dissipation                                            | Single Channel | 45          | mW    |
|                                   |                                                              | Dual Channel   |             |       |
| DETECTOR                          |                                                              |                |             |       |
| V <sub>CC</sub><br>(1 minute max) | Supply Voltage                                               |                | 7.0         | V     |
| I <sub>O</sub>                    | Output Current (each channel)                                | Single Channel | 50          | mA    |
|                                   |                                                              | Dual Channel   | 15          |       |
| V <sub>O</sub>                    | Output Voltage (each channel)                                |                | 7.0         | V     |
| P <sub>O</sub>                    | Collector Output Power Dissipation                           | Single Channel | 85          | mW    |
|                                   |                                                              | Dual Channel   | 85          |       |

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol          | Parameter                  |                     | Min. | Max.            | Units     |
|-----------------|----------------------------|---------------------|------|-----------------|-----------|
| I <sub>FL</sub> | Input Current, Low Level   |                     | 0    | 250             | μA        |
| I <sub>FH</sub> | Input Current, High Level  |                     | *6.3 | 15              | mA        |
| V <sub>CC</sub> | Supply Voltage, Output     |                     | 4.5  | 5.5             | V         |
| V <sub>EL</sub> | Enable Voltage, Low Level  | Single Channel only | 0    | 0.8             | V         |
| V <sub>EH</sub> | Enable Voltage, High Level | Single Channel only | 2.0  | V <sub>CC</sub> | V         |
| T <sub>A</sub>  | Operating Temperature      |                     | -40  | +85             | °C        |
| N               | Fan Out (TTL load)         | Single Channel      |      | 8               | TTL Loads |
|                 |                            | Dual Channel        |      | 5               |           |
| R <sub>L</sub>  | Output Pull-up             |                     | 330  | 4K              | Ω         |

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

# Electrical Characteristics (T<sub>A</sub> = -40°C to +85°C unless otherwise specified.)

## Individual Component Characteristics

| Symbol                           | Parameter                           | Test Conditions                                                         | Min.           | Typ.* | Max.        | Unit  |
|----------------------------------|-------------------------------------|-------------------------------------------------------------------------|----------------|-------|-------------|-------|
| <b>EMITTER</b>                   |                                     |                                                                         |                |       |             |       |
| V <sub>F</sub>                   | Input Forward Voltage               | I <sub>F</sub> = 10mA<br>T <sub>A</sub> = 25°C                          |                |       | 1.8<br>1.75 | V     |
| B <sub>VR</sub>                  | Input Reverse Breakdown Voltage     | I <sub>R</sub> = 10μA                                                   | 5.0            |       |             | V     |
| ΔV <sub>F</sub> /ΔT <sub>A</sub> | Input Diode Temperature Coefficient | I <sub>F</sub> = 10mA                                                   |                | -1.5  |             | mV/°C |
| <b>DETECTOR</b>                  |                                     |                                                                         |                |       |             |       |
| I <sub>CCH</sub>                 | High Level Supply Current           | I <sub>F</sub> = 0mA, V <sub>CC</sub> = 5.5V<br>V <sub>E</sub> = 0.5 V  | Single Channel |       | 10          | mA    |
|                                  |                                     |                                                                         | Dual Channel   |       | 15          |       |
| I <sub>CCL</sub>                 | Low Level Supply Current            | I <sub>F</sub> = 10mA, V <sub>CC</sub> = 5.5V<br>V <sub>E</sub> = 0.5 V | Single Channel |       | 13          | mA    |
|                                  |                                     |                                                                         | Dual Channel   |       | 21          |       |
| I <sub>EL</sub>                  | Low Level Enable Current            | V <sub>CC</sub> = 5.5V, V <sub>E</sub> = 0.5V                           | Single Channel |       | -1.6        | mA    |
| I <sub>EH</sub>                  | High Level Enable Current           | V <sub>CC</sub> = 5.5V, V <sub>E</sub> = 2.0V                           | Single Channel |       | -1.6        | mA    |
| V <sub>EH</sub>                  | High Level Enable Voltage           | V <sub>CC</sub> = 5.5V, I <sub>F</sub> = 10mA                           | Single Channel | 2.0   |             | V     |
| V <sub>EL</sub>                  | Low Level Enable Voltage            | V <sub>CC</sub> = 5.5V, I <sub>F</sub> = 10mA <sup>(2)</sup>            | Single Channel |       | 0.8         | V     |

## Switching Characteristics (T<sub>A</sub> = -40°C to +85°C, V<sub>CC</sub> = 5 V, I<sub>F</sub> = 7.5 mA unless otherwise specified.)

| Symbol                              | AC Characteristics                                    | Test Conditions                                                                                                                    | Device                                                                                                                                                     | Min.                                | Typ. | Max.      | Unit |
|-------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------|-----------|------|
| T <sub>PLH</sub>                    | Propagation Delay Time to Output High Level           | R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(3)</sup><br>(Fig. 20)<br>T <sub>A</sub> = 25°C                                  | All                                                                                                                                                        | 20                                  |      | 75<br>100 | ns   |
| T <sub>PHL</sub>                    | Propagation Delay Time to Output Low Level            | R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(4)</sup><br>(Fig. 20)<br>T <sub>A</sub> = 25°C                                  | All                                                                                                                                                        | 25                                  |      | 75<br>100 | ns   |
| T <sub>PHL</sub> - T <sub>PLH</sub> | Pulse Width Distortion                                | R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF (Fig. 20)                                                                             | All                                                                                                                                                        |                                     |      | 35        | ns   |
| t <sub>r</sub>                      | Output Rise Time (10-90%)                             | R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(5)</sup> (Fig. 20)                                                              | Single Ch                                                                                                                                                  |                                     | 50   |           | ns   |
|                                     |                                                       |                                                                                                                                    | Dual Ch                                                                                                                                                    |                                     | 17   |           |      |
| t <sub>f</sub>                      | Output Fall Time (90-10%)                             | R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(6)</sup> (Fig. 20)                                                              | Single Ch                                                                                                                                                  |                                     | 12   |           | ns   |
|                                     |                                                       |                                                                                                                                    | Dual Ch                                                                                                                                                    |                                     | 5    |           |      |
| t <sub>ELH</sub>                    | Enable Propagation Delay Time to Output High Level    | I <sub>F</sub> = 7.5mA, V <sub>EH</sub> = 3.5V, R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15pF <sup>(7)</sup> (Fig. 21)              | HCPL0600<br>HCPL0601<br>HCPL0611                                                                                                                           |                                     | 20   |           | ns   |
| t <sub>EHL</sub>                    | Enable Propagation Delay Time to Output Low Level     | I <sub>F</sub> = 7.5mA, V <sub>EH</sub> = 3.5V, R <sub>L</sub> = 350Ω, C <sub>L</sub> = 15 pF <sup>(8)</sup> (Fig. 21)             | HCPL0600<br>HCPL0601<br>HCPL0611                                                                                                                           |                                     | 20   |           | ns   |
| ICM <sub>H</sub>                    | Common Mode Transient Immunity (at Output High Level) | R <sub>L</sub> = 350Ω, T <sub>A</sub> = 25°C, I <sub>F</sub> = 0mA, V <sub>OH</sub> (Min.) = 2.0 V <sup>(9)</sup> (Fig. 22, 23)    | V <sub>CM</sub>   = 10V<br>HCPL0600<br>HCPL0637<br> V <sub>CM</sub>   = 50V<br>HCPL0601<br>HCPL0638<br> V <sub>CM</sub>   = 1,000V<br>HCPL0611<br>HCPL0639 | 5,000<br>10,000<br>15,000<br>25,000 |      |           | V/μs |
| ICM <sub>L</sub>                    | Common Mode Transient Immunity (at Output Low Level)  | R <sub>L</sub> = 350Ω, T <sub>A</sub> = 25°C, I <sub>F</sub> = 7.5mA, V <sub>OL</sub> (Max.) = 0.8 V <sup>(10)</sup> (Fig. 22, 23) | V <sub>CM</sub>   = 10V<br>HCPL0600<br>HCPL0637<br> V <sub>CM</sub>   = 50V<br>HCPL0601<br>HCPL0638<br> V <sub>CM</sub>   = 1,000V<br>HCPL0611<br>HCPL0639 | 5,000<br>10,000<br>15,000<br>25,000 |      |           | V/μs |

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

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

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

| Symbol    | Characteristics                            | Test Conditions                                                                                               | Min. | Typ.*     | Max. | Unit          |
|-----------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------|------|-----------|------|---------------|
| $I_{I-O}$ | Input-Output<br>Insulation Leakage Current | Relative humidity = 45%,<br>$T_A = 25^\circ\text{C}$ , $t = 5\text{s}$ ,<br>$V_{I-O} = 3000\text{VDC}^{(11)}$ |      |           | 1.0* | $\mu\text{A}$ |
| $V_{ISO}$ | Withstand Insulation Test Voltage          | $R_H < 50\%$ , $T_A = 25^\circ\text{C}$ ,<br>$I_{I-O} \leq 2\mu\text{A}$ , $t = 1\text{min.}^{(11)}$          | 3750 |           |      | $V_{RMS}$     |
| $R_{I-O}$ | Resistance (Input to Output)               | $V_{I-O} = 500\text{V}^{(11)}$                                                                                |      | $10^{12}$ |      | $\Omega$      |
| $C_{I-O}$ | Capacitance (Input to Output)              | $f = 1\text{MHz}^{(11)}$                                                                                      |      | 0.6       |      | pF            |

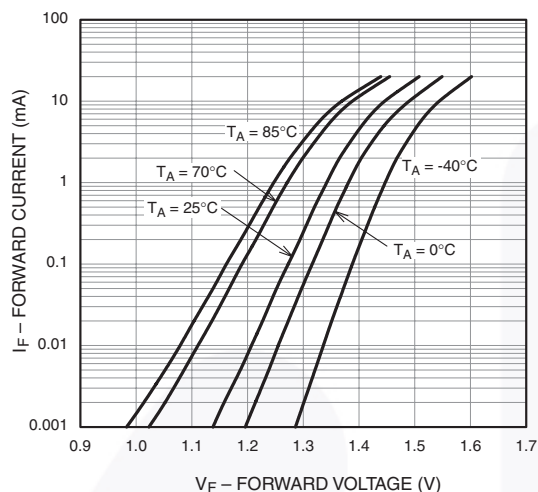
\*All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$

**Notes:**

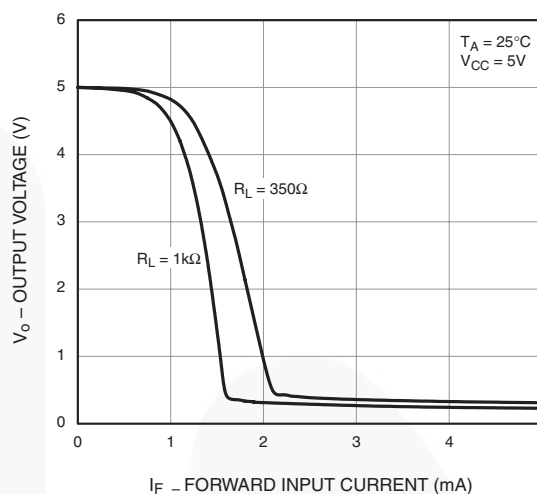
1. The  $V_{CC}$  supply to each optoisolator must be bypassed by a  $0.1\mu\text{F}$  capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package  $V_{CC}$  and GND pins of each device.
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 3.75mA level on the HIGH to LOW transition of the input current pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
4.  $t_{PHL}$  – Propagation delay is measured from the 3.75mA level on the LOW to HIGH transition of the input current pulse to the 1.5V 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 1.5V level on the HIGH to LOW transition of the input voltage pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
8.  $t_{EHL}$  – Enable input propagation delay is measured from the 1.5V level on the LOW to HIGH transition of the input voltage pulse to the 1.5V 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, HCPL0601 and HCPL0611 only)

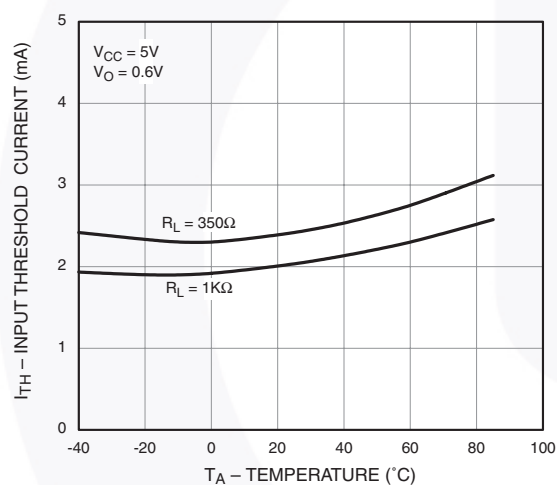
**Fig. 1 Forward Current vs. Input Forward Voltage**



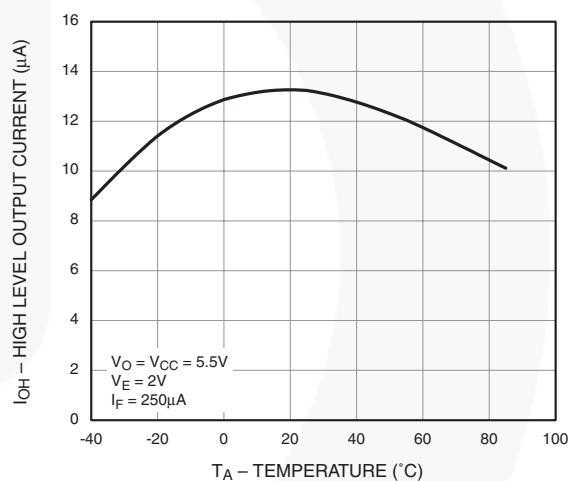
**Fig. 2 Output Voltage vs. Forward Current**



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



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



## Typical Performance Curves (HCPL0600, HCPL0601 and HCPL0611 only)

Fig. 5 Low Level Output Voltage vs. Temperature

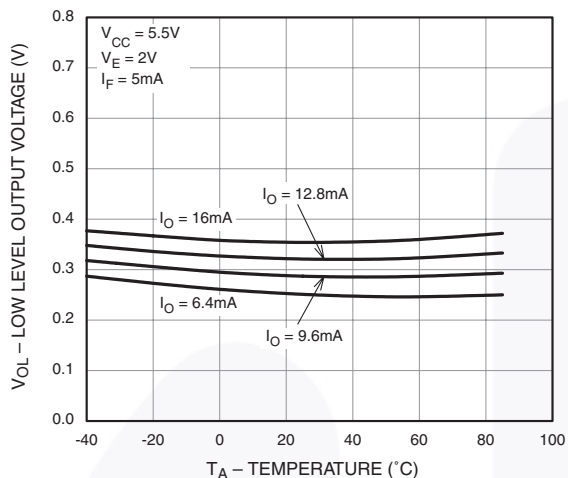


Fig. 6 Low Level Output Current vs. Temperature

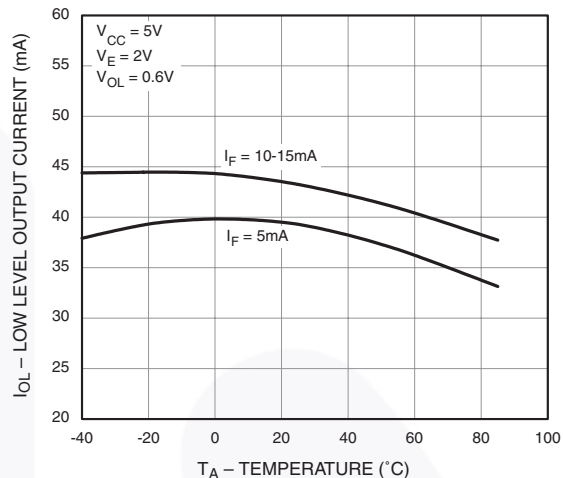


Fig. 7 Propagation Delay vs. Temperature

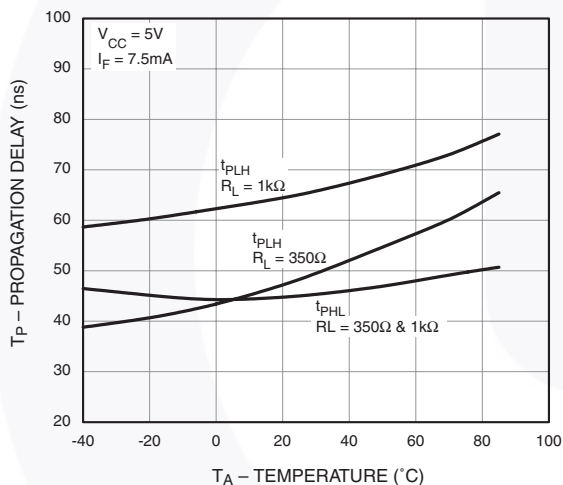
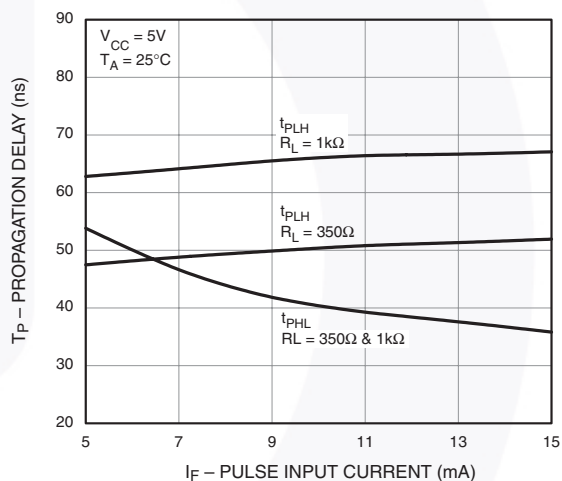


Fig. 8 Propagation Delay vs. Pulse Input Current



## Typical Performance Curves (HCPL0600, HCPL0601 and HCPL0611 only)

Fig. 9 Typical Enable Propagation Delay vs. Temperature

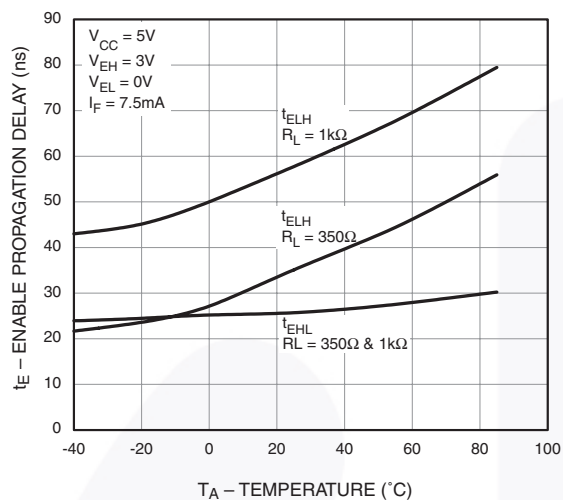


Fig. 10 Typical Rise and Fall Time vs. Temperature

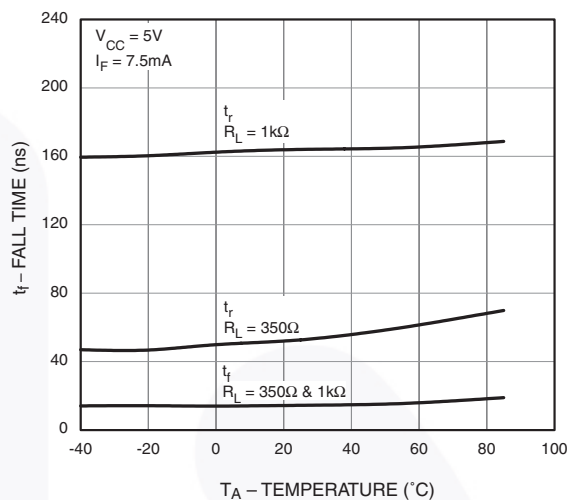
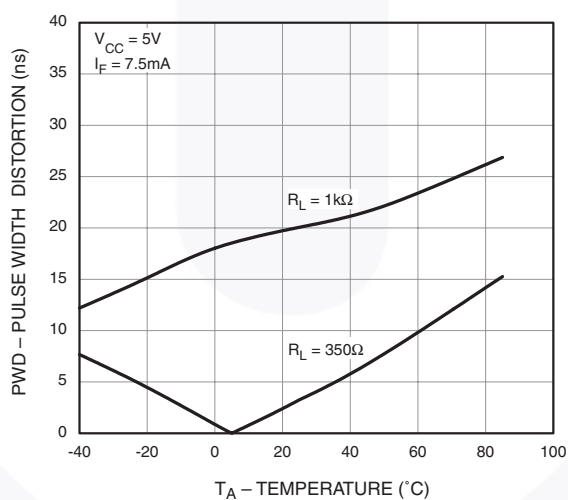


Fig. 11 Typical Pulse Width Distortion vs. Temperature



# Typical Performance Curves (HCPL0637, HCPL0638 and HCPL0639 only)

Fig. 12 Input Forward Current vs. Forward Voltage

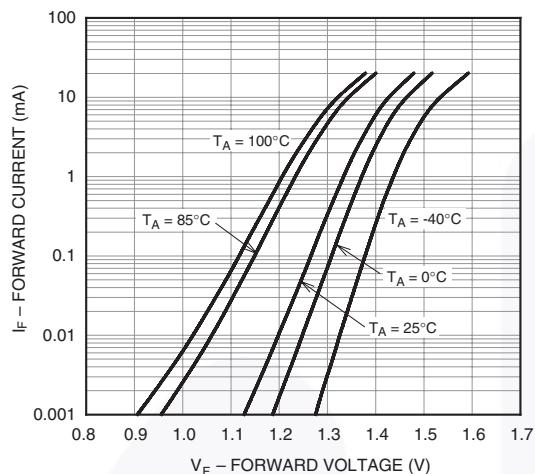


Fig. 13 Input Threshold Current vs. Ambient Temperature

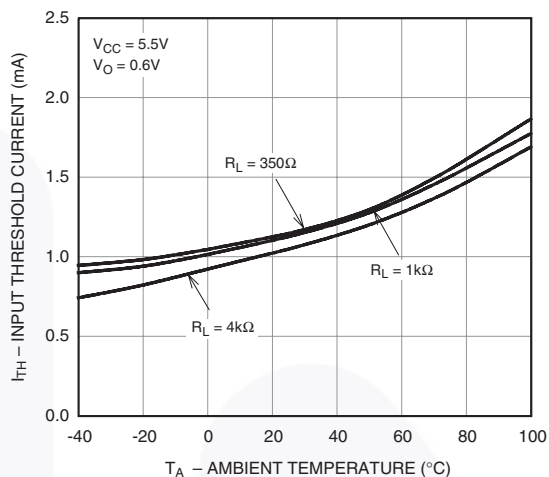


Fig. 14 High Level Output Current vs. Ambient Temperature

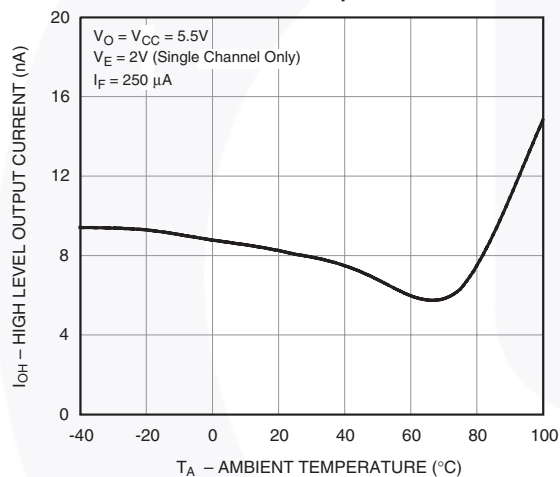


Fig. 15 Low Level Output Current vs. Ambient Temperature

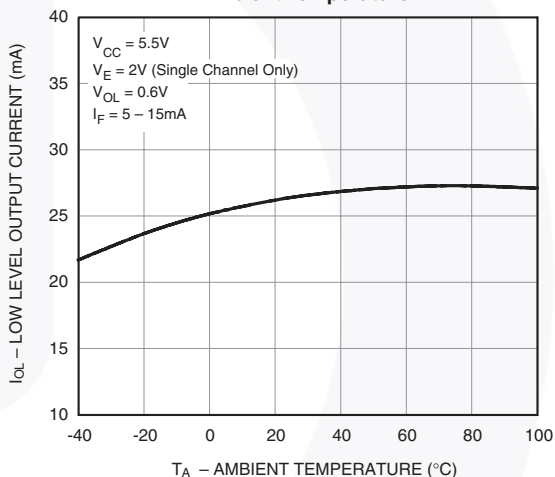


Fig. 16 Low Level Output Voltage vs. Ambient Temperature

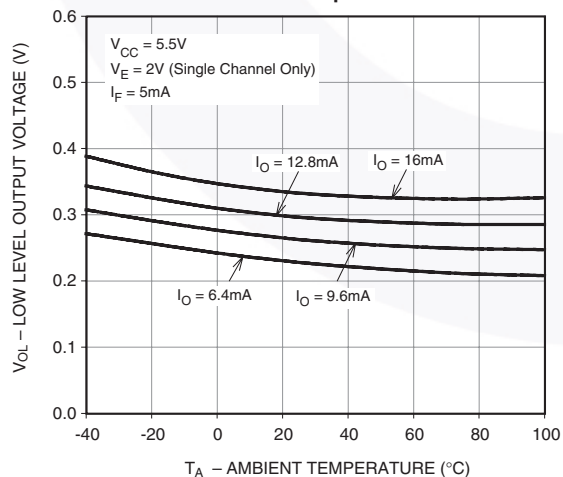
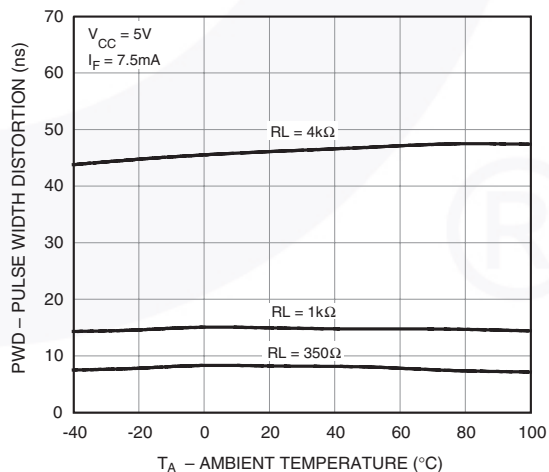
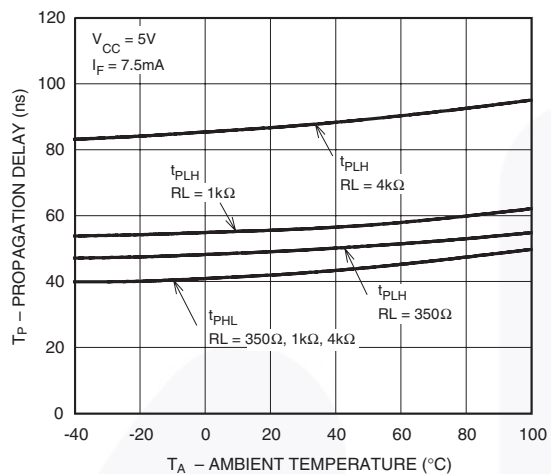


Fig. 17 Pulse Width Distortion vs. Ambient Temperature

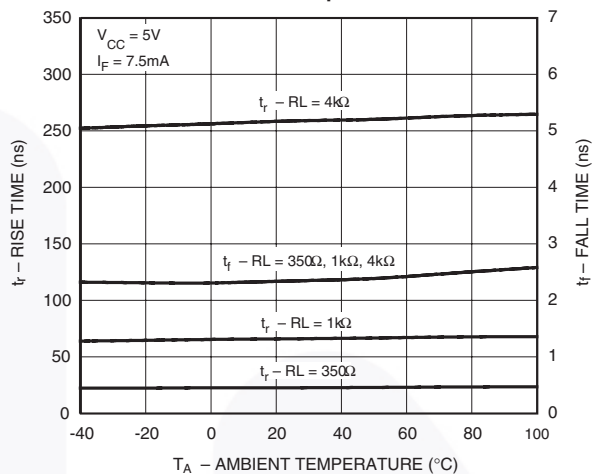


# Typical Performance Curves (HCPL0637, HCPL0638 and HCPL0639 only)

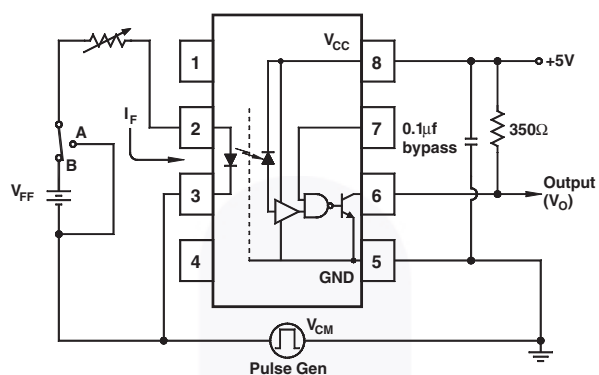
**Fig. 18 Propagation Delay vs. Ambient Temperature**



**Fig. 19 Rise and Fall Times vs. Ambient Temperature**







Test Circuit for HCPL0600, HCPL0601, and HCPL0611

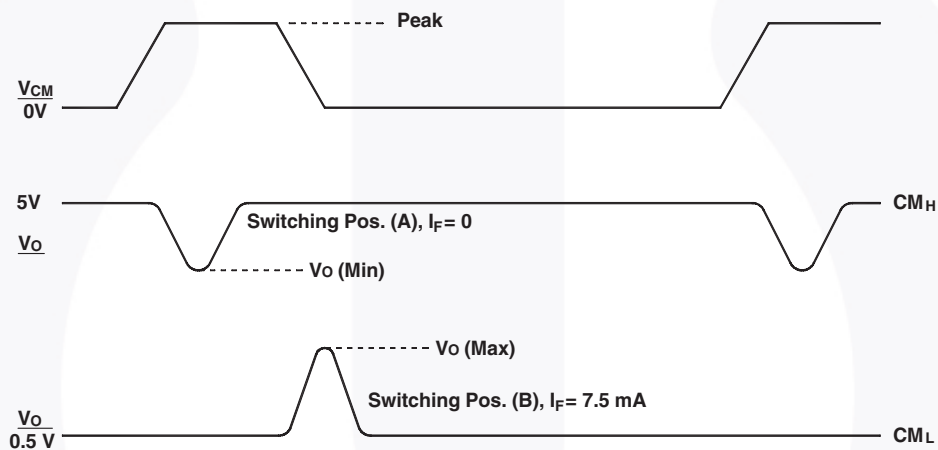
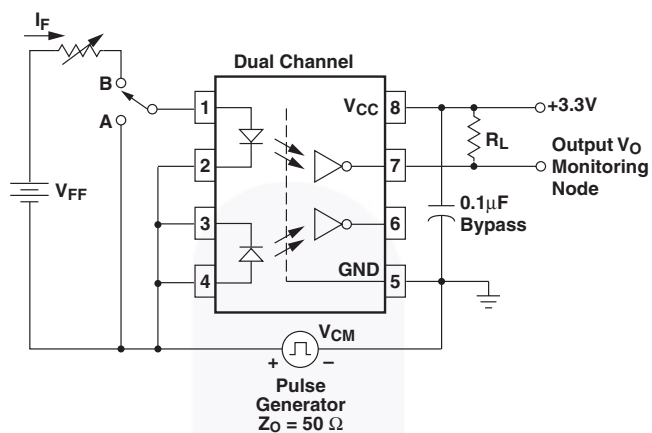


Fig. 22 Test Circuit Common Mode Transient Immunity (HCPL0600, HCPL0601 and HCPL0611)



Test Circuit for HCPL0637, HCPL0638 and HCPL0639

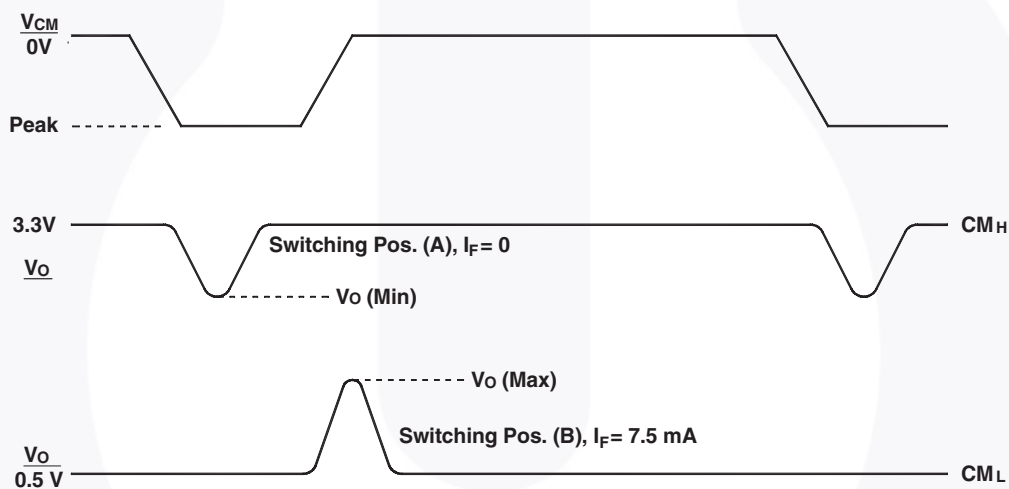
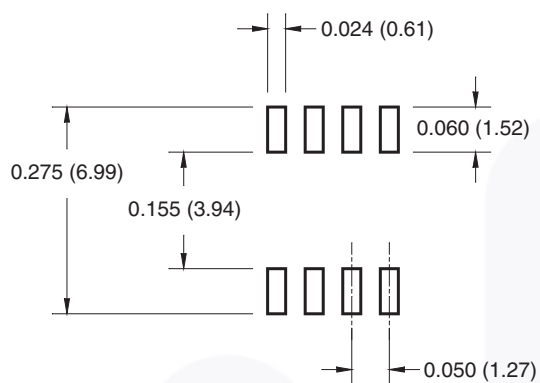


Fig. 23 Test Circuit Common Mode Transient Immunity (HCPL0637, HCPL0638 and HCPL0639)

## 8-Pin Small Outline

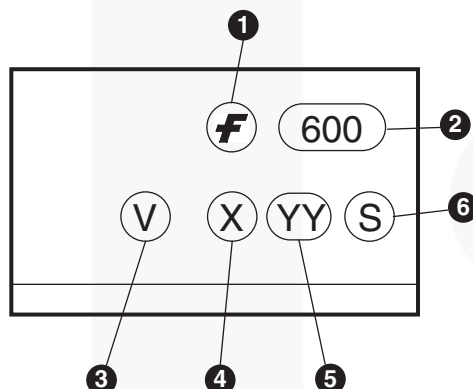


## Ordering Information

| Option    | Order Entry Identifier | Description                                                |
|-----------|------------------------|------------------------------------------------------------|
| No Suffix | HCPL0600               | Shipped in tubes (50 units per tube)                       |
| V*        | HCPL0600V              | IEC60747-5-2 approval                                      |
| R2        | HCPL0600R2             | Tape and Reel (2500 units per reel)                        |
| R2V*      | HCPL0600R2V            | IEC60747-5-2 approval, Tape and Reel (2500 units per reel) |

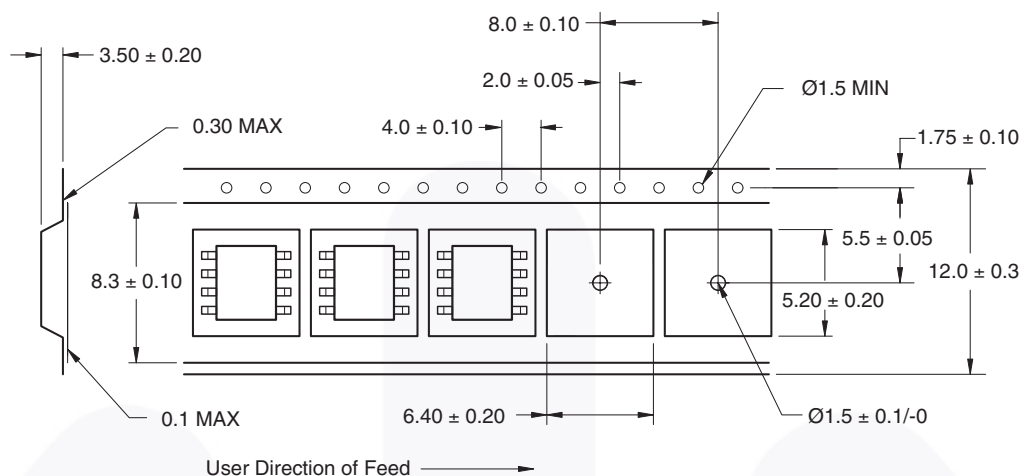
\*Available for HCPL0600, HCPL0601, HCPL0611 only.

## Marking Information

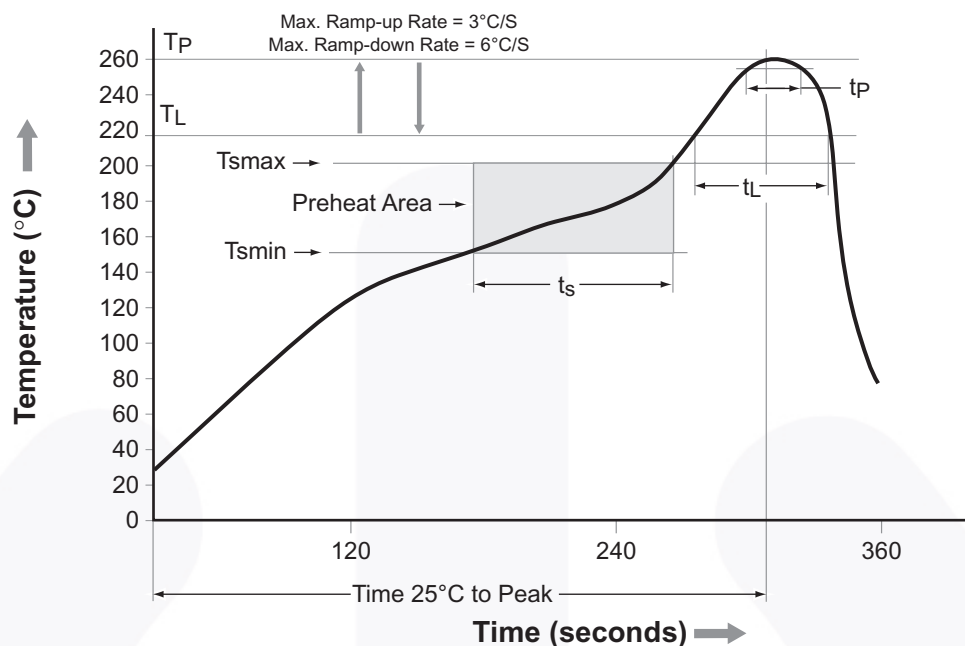


| Definitions |                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------|
| 1           | Fairchild logo                                                                                                            |
| 2           | Device number                                                                                                             |
| 3           | VDE mark indicates IEC60747-5-2 approval<br>(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                                                                                                     |

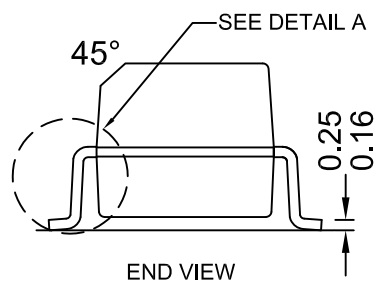
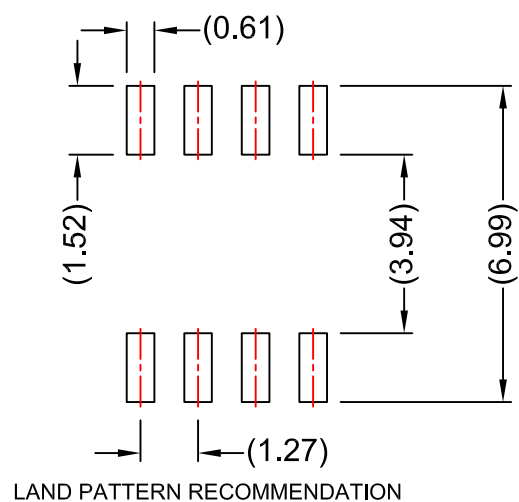
## Carrier Tape Specifications



## Reflow Profile



| Profile Feature                                                       | Pb-Free Assembly Profile |
|-----------------------------------------------------------------------|--------------------------|
| Temperature Min. (T <sub>smin</sub> )                                 | 150°C                    |
| Temperature Max. (T <sub>smax</sub> )                                 | 200°C                    |
| Time (t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> ) | 60–120 seconds           |
| Ramp-up Rate (t <sub>L</sub> to t <sub>P</sub> )                      | 3°C/second max.          |
| Liquidous Temperature (T <sub>L</sub> )                               | 217°C                    |
| Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )             | 60–150 seconds           |
| Peak Body Package Temperature                                         | 260°C +0°C / –5°C        |
| Time (t <sub>P</sub> ) within 5°C of 260°C                            | 30 seconds               |
| Ramp-down Rate (T <sub>P</sub> to T <sub>L</sub> )                    | 6°C/second max.          |
| Time 25°C to Peak Temperature                                         | 8 minutes max.           |



A) NO STANDARD APPLIES TO THIS PACKAGE  
B) ALL DIMENSIONS ARE IN MILLIMETERS.  
C) DIMENSIONS DO NOT INCLUDE MOLD  
FLASH OR BURRS.  
D) LANDPATTERN STANDARD: SOIC127P600X175-8M.  
E) DRAWING FILENAME: MKT-M08Erev5



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