

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

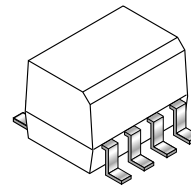
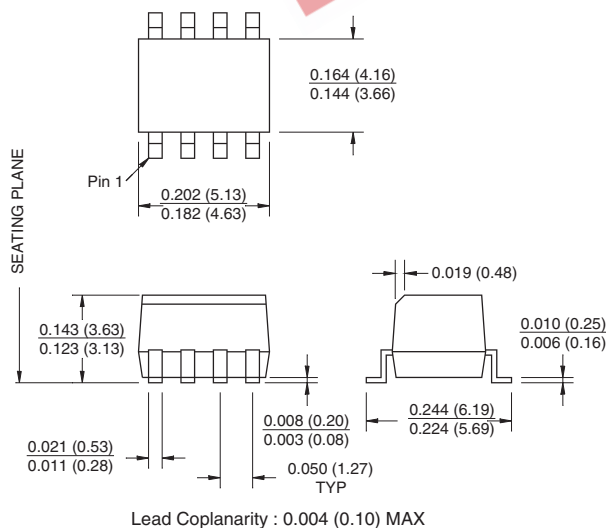
Description

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

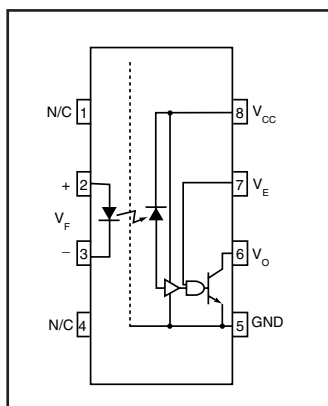
- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing

Package Dimensions

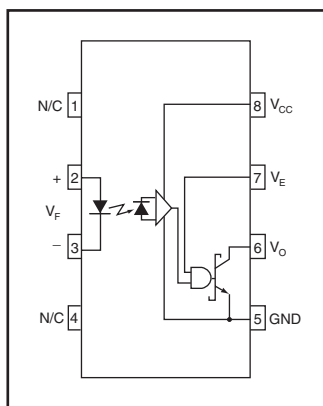


NOTE

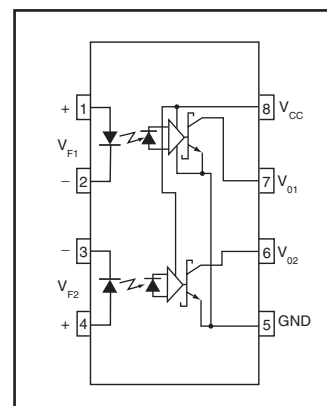
All dimensions are in inches (millimeters)



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 μ 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 |
| EMITTER DC/Average Forward Input Current (each channel) | Single Channel | 50 | mA |
| | Dual Channel | | |
| Enable Input Voltage Not to exceed VCC by more than 500 mV | Single Channel | 5.5 | V |
| Reverse Input Voltage (each channel) | | 5.0 | V |
| Power Dissipation | Single Channel | 45 | mW |
| | Dual Channel | | |
| DETECTOR Supply Voltage | V_{CC} (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 | 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 |
|-------------------------------------|---|-------------------------|----------|-------|------|------------------------|
| EMITTER | | | | | | |
| 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 | ($I_R = 10\ \mu\text{A}$) | 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/ $^{\circ}\text{C}$ |
| DETECTOR | | | | | | |
| High Level Supply Current | ($V_E = 0.5\text{ V}$) | Single Channel | | | 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 | | | 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 | | | -1.6 | mA |
| High Level Enable Current | ($V_{CC} = 5.5\text{ V}, V_E = 2.0\text{ V}$) | Single Channel | | | -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) | All | T_{PLH} | 20 | | 75 | ns | |
| | ($T_A = 25^{\circ}\text{C}$) ($R_L = 350\ \Omega, C_L = 15\text{ pF}$) (Fig. 12) | | | | | 100 | | |
| Propagation Delay Time to Output Low Level | (Note 4) | All | T_{PHL} | 25 | | 75 | ns | |
| | ($T_A = 25^{\circ}\text{C}$) ($R_L = 350\ \Omega, C_L = 15\text{ pF}$) (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 mA, V _{EH} = 3.5 V) (R _L = 350Ω, C _L = 15 pF) (Note 7) (Fig. 13) | HCPL0600 | t_{ELH} | | 20 | | ns | |
| | | HCPL0601 | | | | | | |
| | | HCPL0611 | | | | | | |
| Enable Propagation Delay Time to Output Low Level | (I _F = 7.5 mA, V _{EH} = 3.5 V) (R _L = 350Ω, C _L = 15 pF) (Note 8) (Fig. 13) | HCPL0600 | t_{EHL} | | 20 | | ns | |
| | | HCPL0601 | | | | | | |
| | | HCPL0611 | | | | | | |
| Common Mode Transient Immunity (at Output High Level) | (R _L = 350Ω) ($T_A = 25^{\circ}\text{C}$) (I _F = 0 mA, V _{OH} (Min.) = 2.0 V) (Note 9)(Fig. 14) | $ V_{CM} = 10\text{ V}$ | HCPL0600 HCPL0630 | $ ICM_H $ | | | V/ μs | |
| | | $ V_{CM} = 50\text{ V}$ | | | | | | 5000 |
| | | $ V_{CM} = 1,000\text{ V}$ | | | | | | 25,000 |
| Common Mode Transient Immunity (at Output Low Level) | (R _L = 350Ω) ($T_A = 25^{\circ}\text{C}$) (I _F = 7.5 mA, V _{OL} (Max.) = 0.8 V) (Note 10)(Fig. 14) | $ V_{CM} = 10\text{ V}$ | HCPL0600 HCPL0630 | $ ICM_H $ | | | V/ μs | |
| | | $ 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 | ($V_{CC} = 5.5\text{ V}$, $V_O = 5.5\text{ V}$) ($I_F = 250\ \mu\text{A}$, $V_E = 2.0\text{ V}$) (Note 2) | I_{OH} | | | 100 | μA |
| Low Level Output Voltage | ($V_{CC} = 5.5\text{ V}$, $I_F = 5\text{ mA}$) ($V_E = 2.0\text{ V}$, $I_{OL} = 13\text{ mA}$) (Note 2) | V_{OL} | | | 0.6 | V |
| Input Threshold Current | ($V_{CC} = 5.5\text{ V}$, $V_O = 0.6\text{ V}$, $V_E = 2.0\text{ V}$, $I_{OL} = 13\text{ mA}$) | 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 Insulation Leakage Current | (Relative humidity = 45%) ($T_A = 25^{\circ}\text{C}$, $t = 5\text{ s}$) ($V_{I-O} = 3000\text{ VDC}$) (Note 11) | I_{I-O} | | | 1.0* | μA |
| Withstand Insulation Test Voltage | ($R_H < 50\%$, $T_A = 25^{\circ}\text{C}$) (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} | | Ω |
| 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

- 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.
- Enable Input - No pull up resistor required as the device has an internal pull up resistor.
- t_{PLH} - Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- t_{PHL} - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- t_r - Rise time is measured from the 90% to the 10% levels on the LOW to HIGH transition of the output pulse.
- t_f - Fall time is measured from the 10% to the 90% levels on the HIGH to LOW transition of the output pulse.
- t_{ELH} - Enable input propagation delay is measured from the 1.5 V level on the HIGH to LOW transition of the input voltage pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- t_{EHL} - Enable input propagation delay is measured from the 1.5 V level on the LOW to HIGH transition of the input voltage pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- 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 ($\text{V}/\mu\text{s}$).
- 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 ($\text{V}/\mu\text{s}$).
- 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

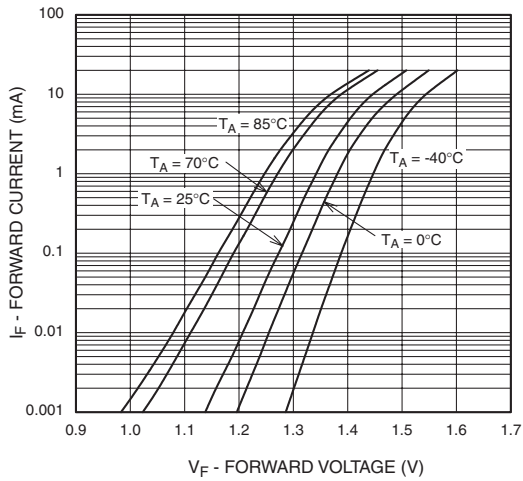


Fig. 2 Output Voltage vs. Forward Current

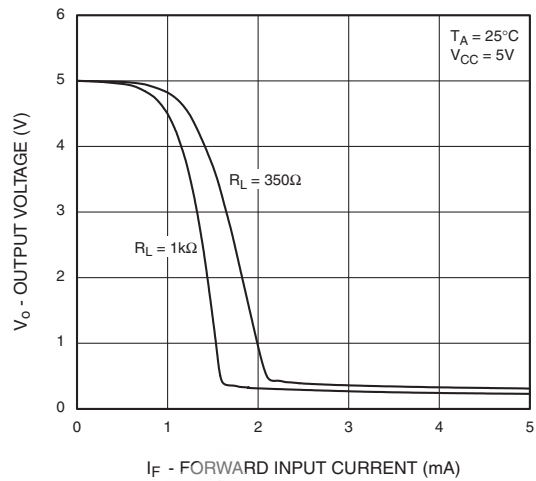


Fig. 3 Input Threshold Current vs. Temperature

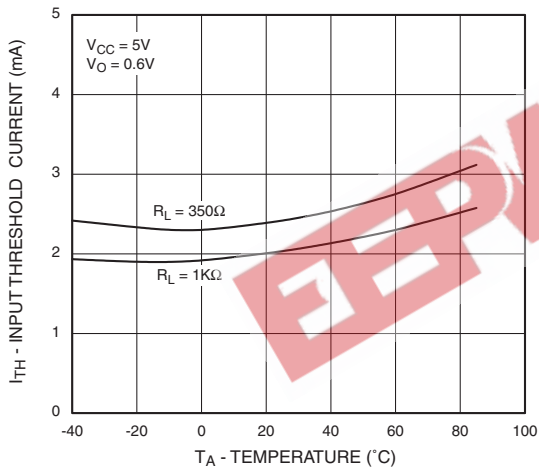
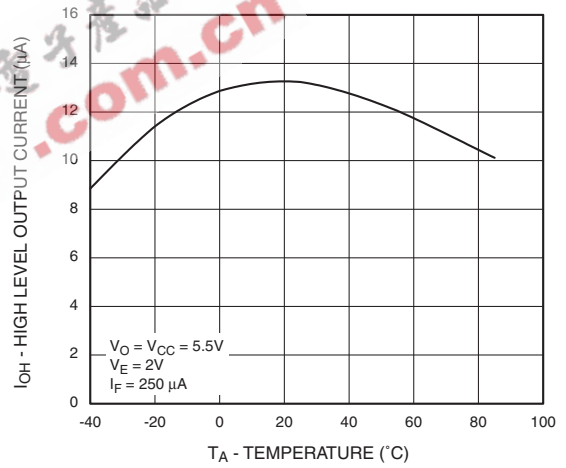


Fig. 4 High Level Output Current vs. Temperature



Typical Performance Curves (HCPL0600 and HCPL0601 only)

Fig. 5 Low Level Output Voltage vs. Temperature

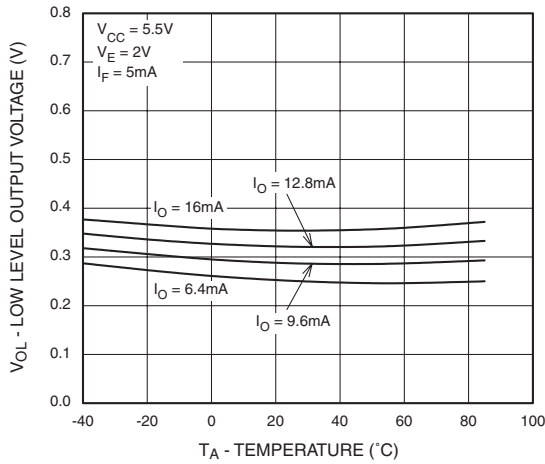


Fig. 6 Low Level Output Current vs. Temperature

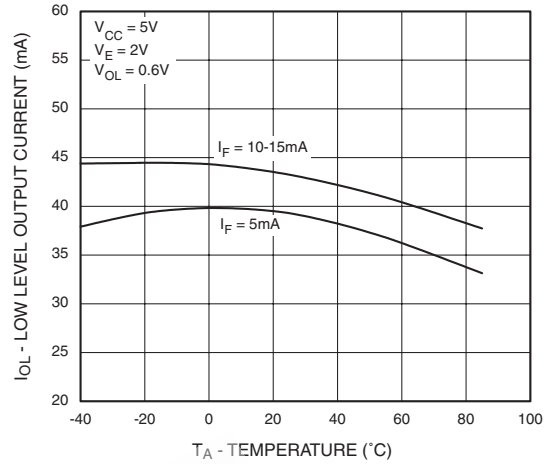


Fig. 7 Propagation Delay vs. Temperature

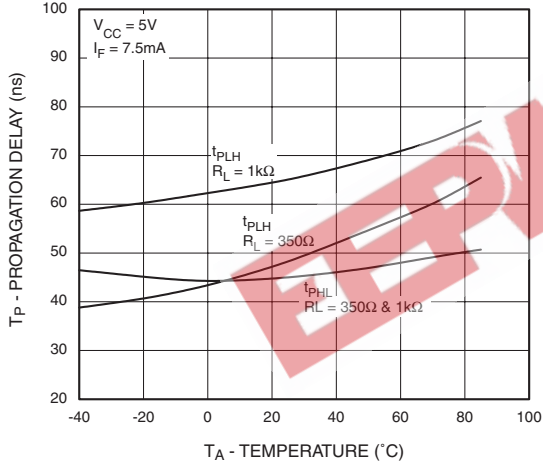
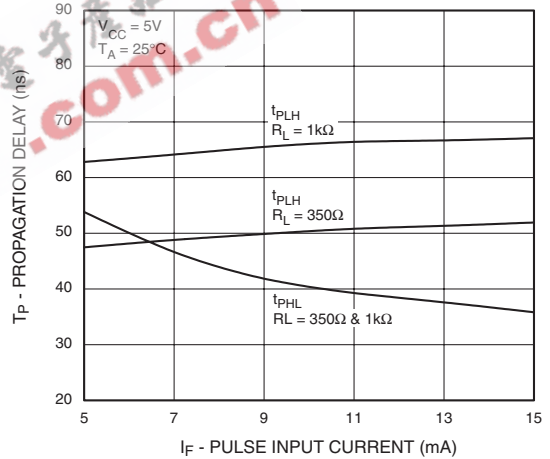


Fig. 8 Propagation Delay vs. Pulse Input Current



Typical Performance Curves (HCPL0600 and HCPL0601 only)

Fig. 9 Typical Enable Propagation Delay vs. Temperature

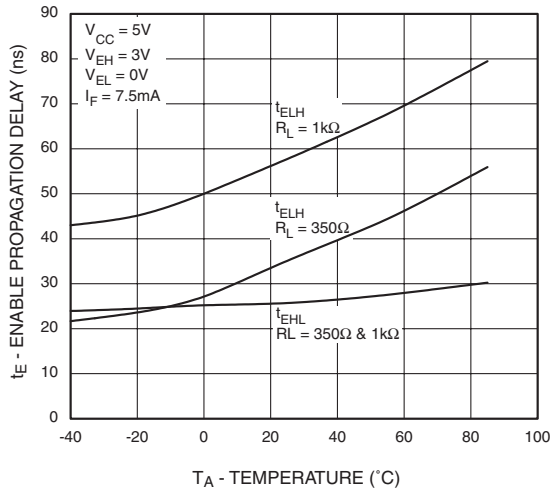


Fig. 10 Typical Rise and Fall Time vs. Temperature

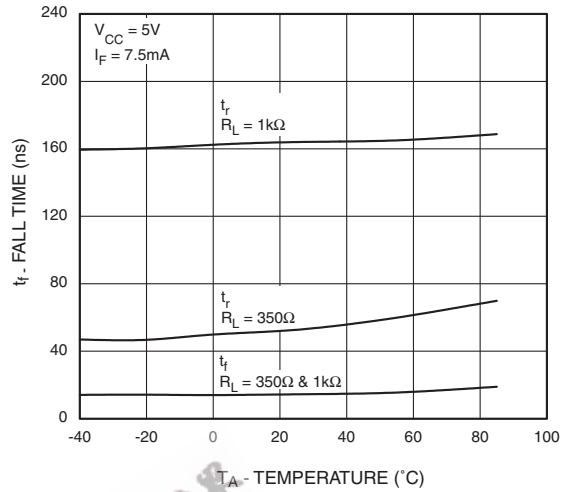
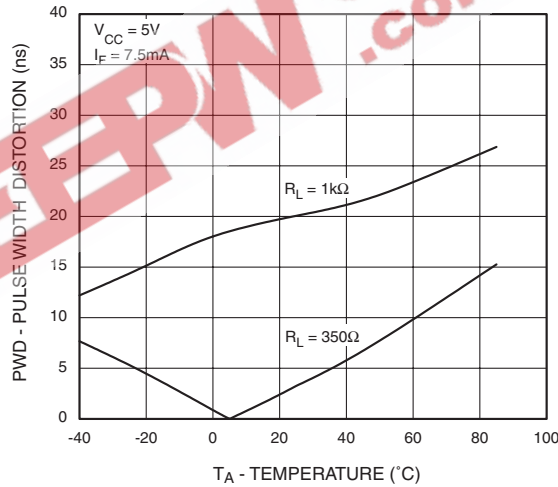


Fig. 11 Typical Pulse Width Distortion vs. Temperature



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

Fig. 12 Input Forward Current vs. Forward Voltage

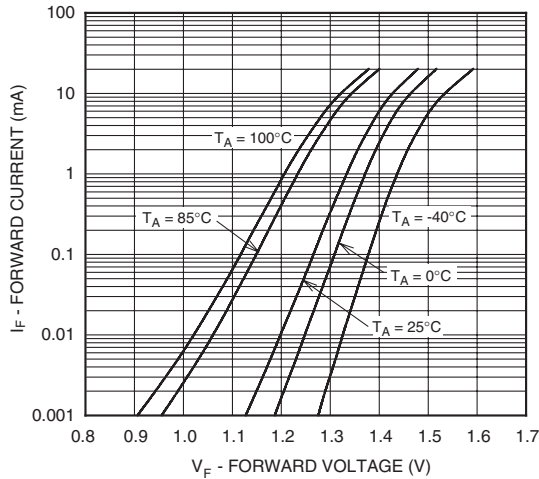


Fig. 13 Input Threshold Current vs. Ambient Temperature (HCPL0611 only)

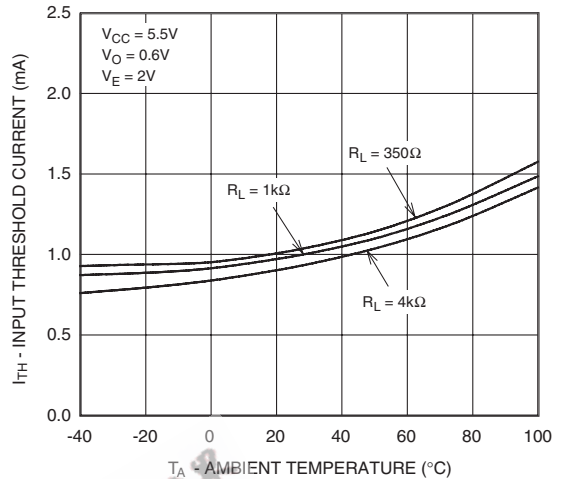


Fig. 14 Input Threshold Current vs. Ambient Temperature (HCPL0630, HCPL0631 and HCPL0661 only)

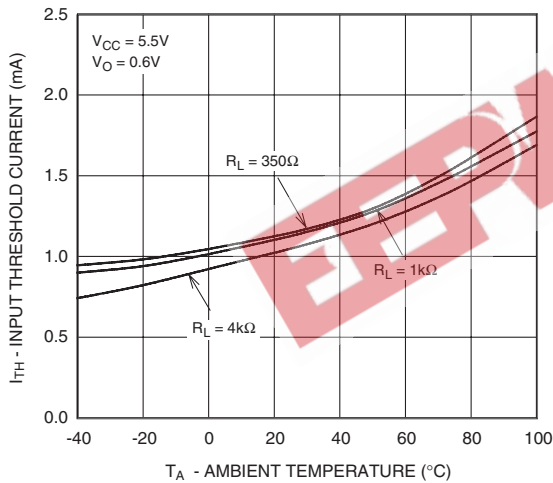


Fig. 15 High Level Output Current vs. Ambient Temperature

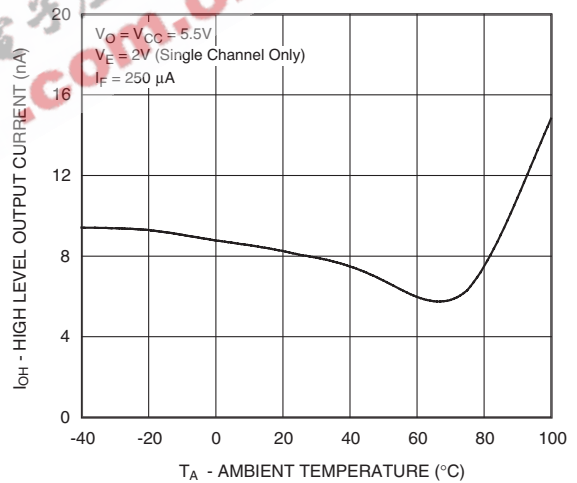


Fig. 16 Low Level Output Current vs. Ambient Temperature

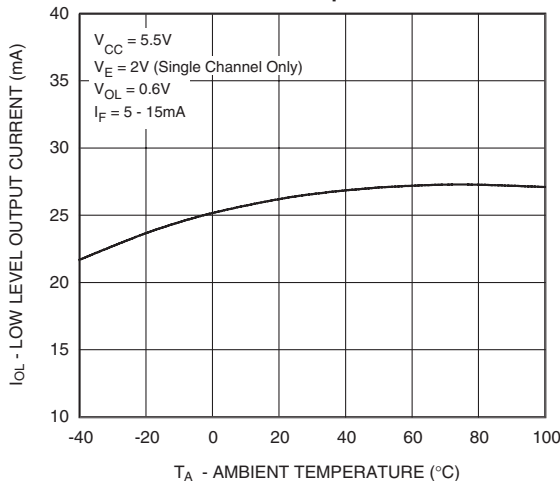
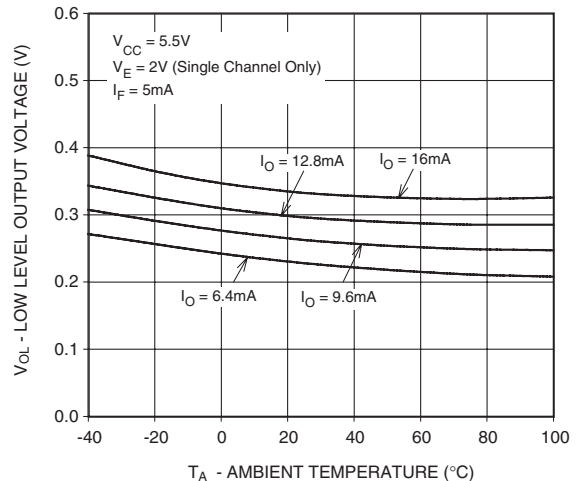


Fig. 17 Low Level Output Voltage vs. Ambient Temperature



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

Fig. 18 Pulse Width Distortion vs. Ambient Temperature

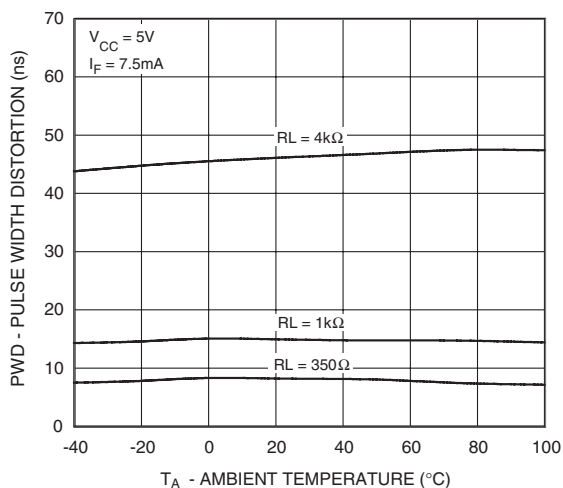


Fig. 19 Propagation Delay vs. Ambient Temperature

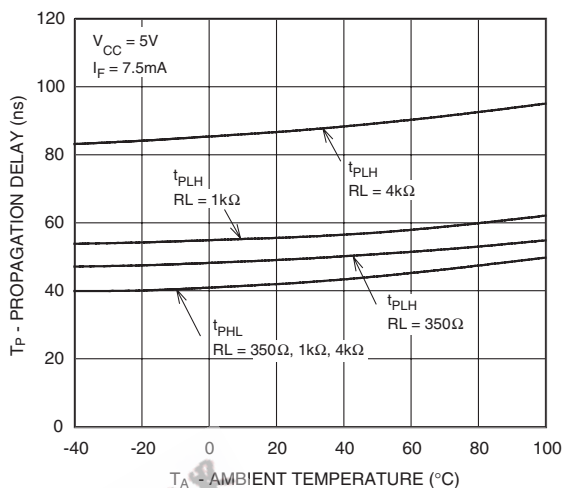
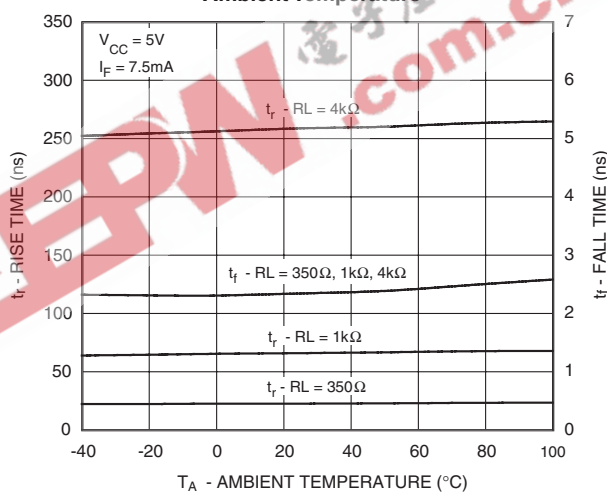


Fig. 20 Rise and Fall Times vs. Ambient Temperature



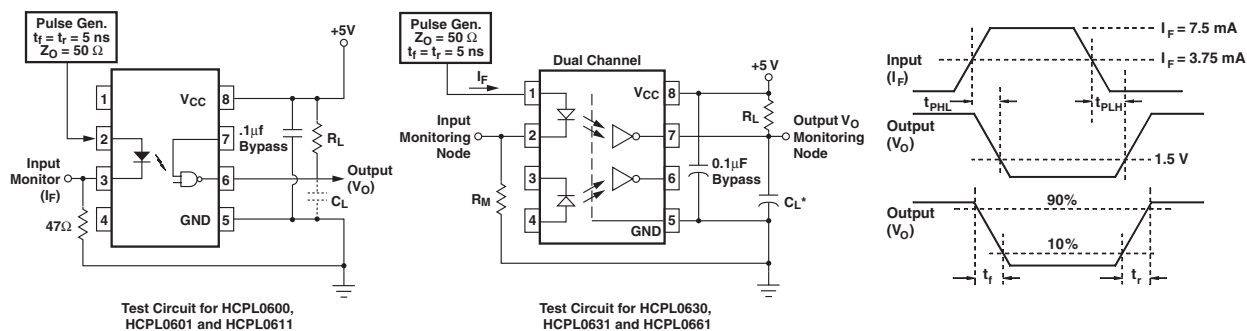


Fig. 21 Test Circuit and Waveforms for t_{PLH} , t_{PHL} , t_r and t_f .

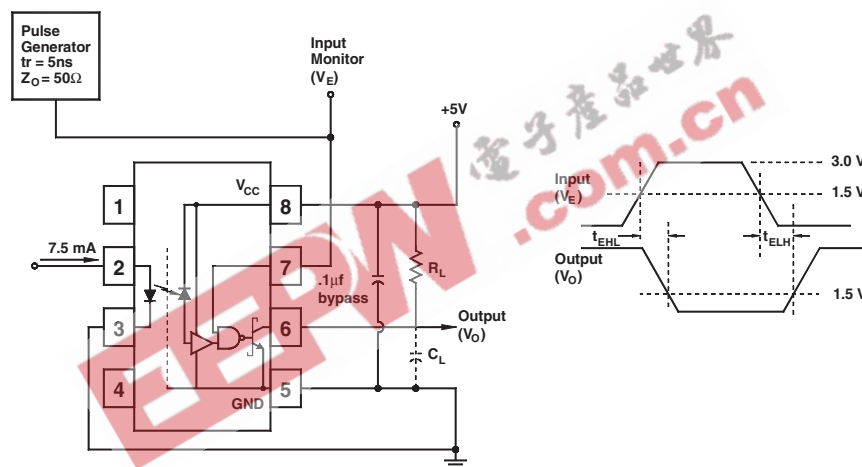
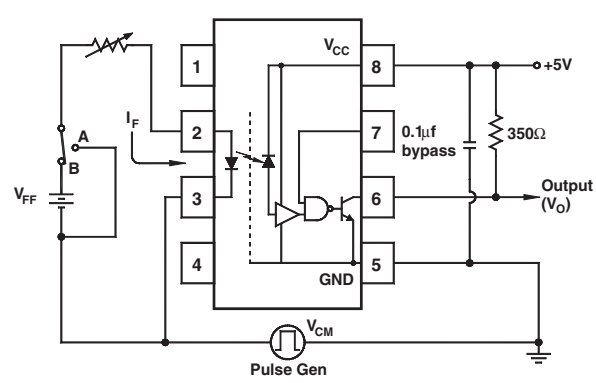


Fig. 22 Test Circuit t_{EHL} and t_{ELH} .



Test Circuit for HCPL0600, and HCPL0601

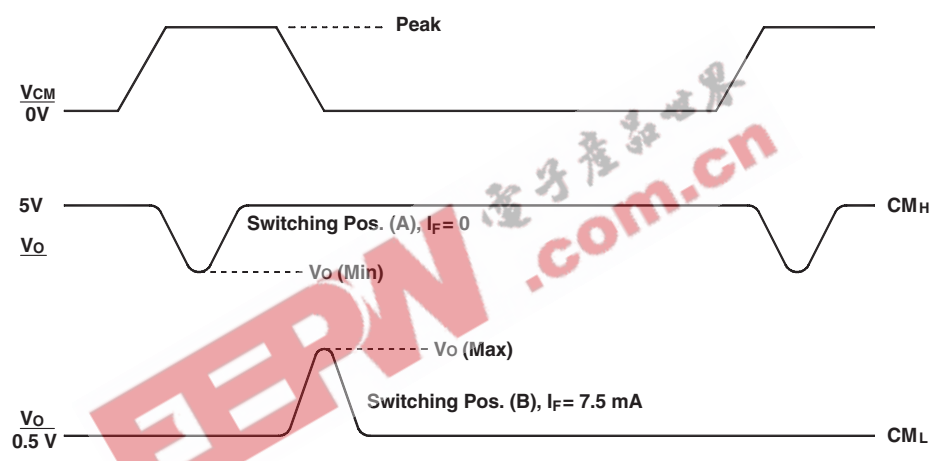


Fig. 23 Test Circuit Common Mode Transient Immunity (HCPL0600 and HCPL0601)

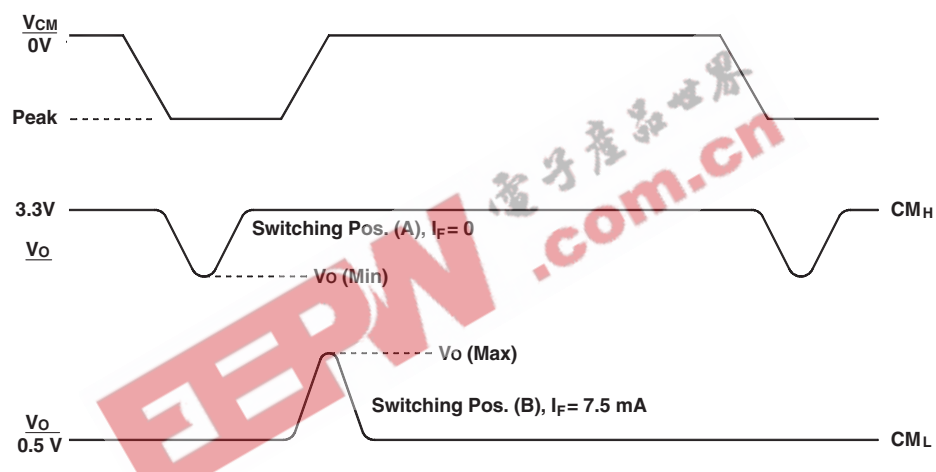
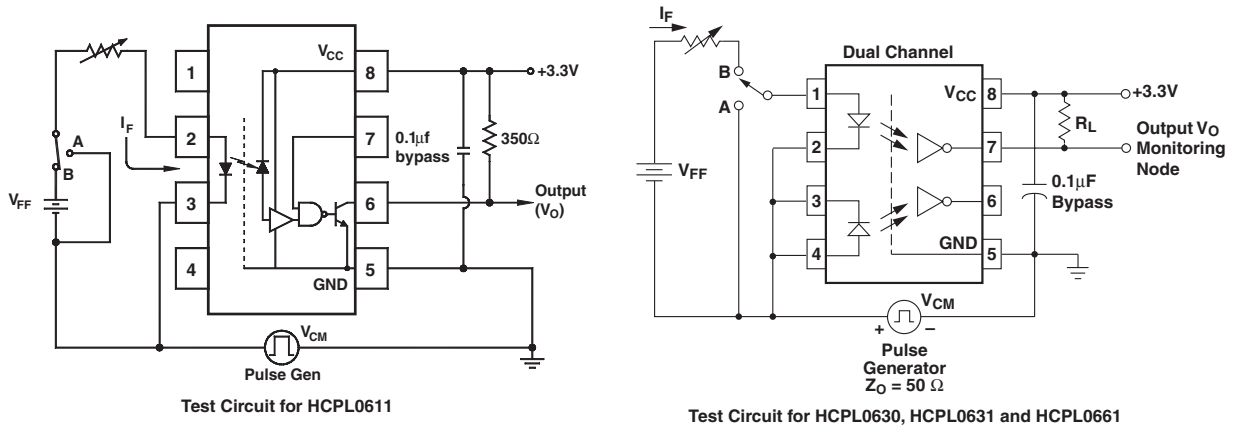
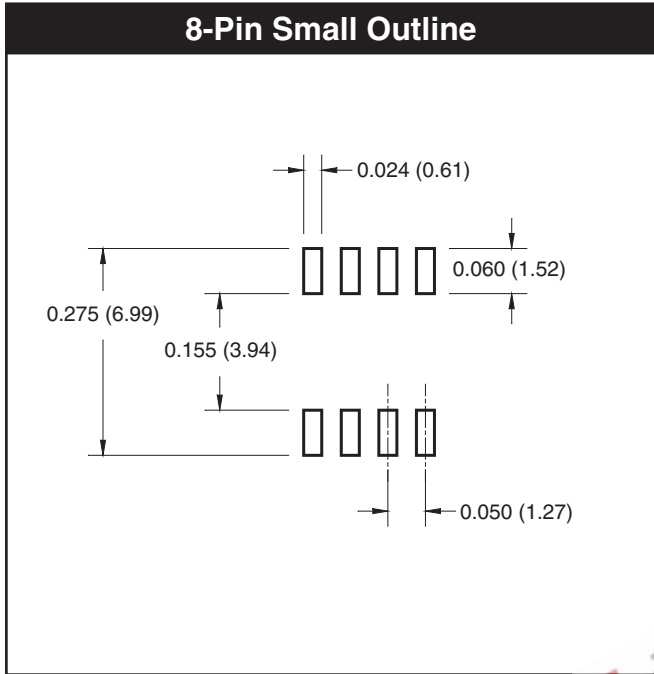


Fig. 24 Test Circuit Common Mode Transient Immunity (HCPL0611, HCPL0630, HCPL0631 and HCPL0661)

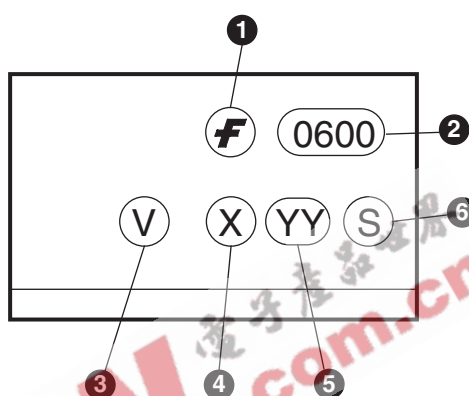


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Ordering Information

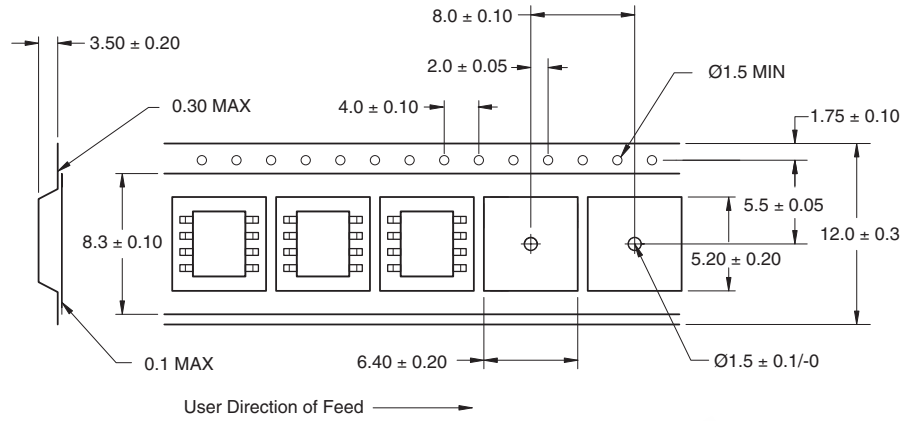
| Option | Order Entry Identifier | Description |
|-----------|------------------------|---|
| No Suffix | HCPL0600 | Shipped in tubes (50 units per tube) |
| V | HCPL0600V | VDE0884 (pending approval) |
| R1 | HCPL0600R1 | Tape and Reel (500 units per reel) |
| R1V | HCPL0600R1V | VDE0884 (pending approval),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

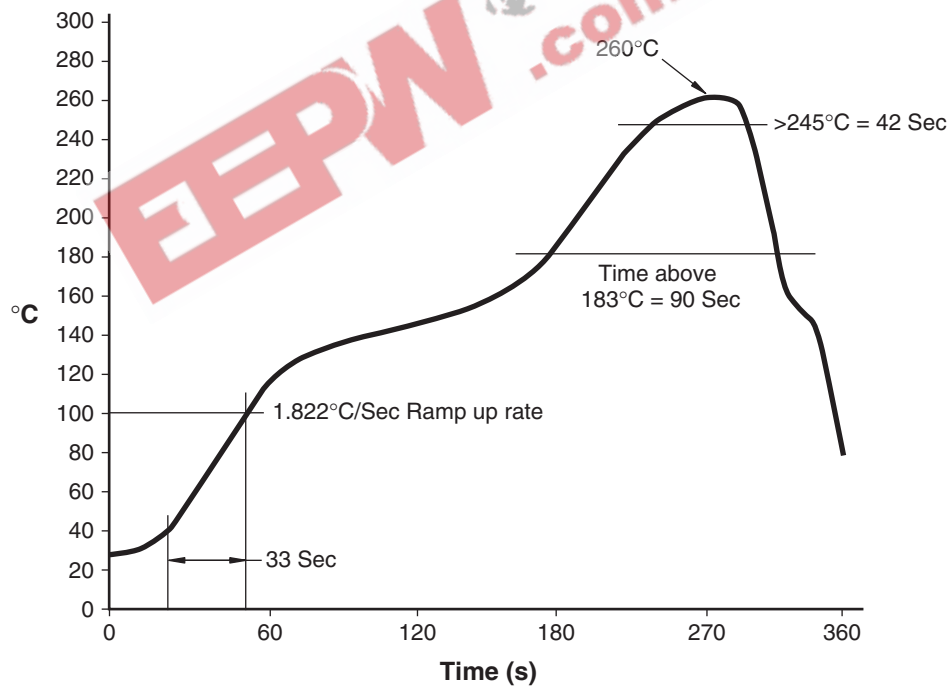


| Definitions | |
|-------------|--|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., '3' |
| 5 | Two digit work week ranging from '01' to '53' |
| 6 | Assembly package code |

Carrier Tape Specifications



Reflow Profile



TRADEMARKS

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| | | | | |
|--------------------------------------|---------------------|---------------|---------------------|-----------------|
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| ActiveArray™ | FASTr™ | LittleFET™ | PowerTrench® | SyncFET™ |
| Bottomless™ | FPS™ | MICROCOUPLER™ | QFET® | TinyLogic® |
| Build it Now™ | FRFET™ | MicroFET™ | QST™ | TINYOPTO™ |
| CoolFET™ | GlobalOptoisolator™ | MicroPak™ | QT Optoelectronics™ | TruTranslation™ |
| CROSSVOLT™ | GTO™ | MICROWIRE™ | Quiet Series™ | UHC™ |
| DOME™ | HiSeC™ | MSX™ | RapidConfigure™ | UltraFET® |
| EcoSPARK™ | I ² C™ | MSXPro™ | RapidConnect™ | UniFET™ |
| E ² CMOS™ | i-Lo™ | OCX™ | μSerDes™ | VCX™ |
| EnSigna™ | ImpliedDisconnect™ | OCXPro™ | SILENT SWITCHER® | Wire™ |
| FACT™ | IntelliMAX™ | OPTOLOGIC® | SMART START™ | |
| FACT Quiet Series™ | | OPTOPLANAR™ | SPM™ | |
| Across the board. Around the world.™ | | PACMAN™ | Stealth™ | |
| The Power Franchise® | | POP™ | SuperFET™ | |
| Programmable Active Droop™ | | Power247™ | SuperSOT™-3 | |
| | | PowerEdge™ | SuperSOT™-6 | |

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Definition of Terms

| Datasheet Identification | Product Status | Definition |
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