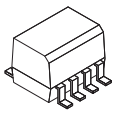
# Low Input Current High Gain Split Darlington Optocouplers

**Single Channel: HCPL0700, HCPL0701,**
**Dual Channel: HCPL0731**

# HCPL0700, HCPL0701, HCPL0731



**SOIC8**
**CASE 751DZ**

**MARKING DIAGRAM**




| | |
|---|---|
| XXX | = Specific Device Code<br>XXX = 700, 701, 731 |
| V | = VDE Mark (only appears on parts ordered with VDE option) |
| X | = Year Code |
| YY | = Work Week |
| S | = Assembly Package Code |

**ORDERING INFORMATION**

See detailed ordering and shipping information on page 9 of this data sheet.

## Description

The HCPL0700, HCPL0701 and HCPL0731 optocouplers consist of an AlGaAs LED optically coupled to a high gain split darlington photodetector housed in a compact 8−pin small outline package. The HCPL0731 device have two channels per package for optimum mounting density.

The split darlington configuration separating the input photodiode and the first stage gain from the output transistor permits lower output saturation voltage and higher speed operation than possible with conventional darlington phototransistor optocoupler.

The combination of a very low input current of 0.5 mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan−out TTL requirements.

## Features

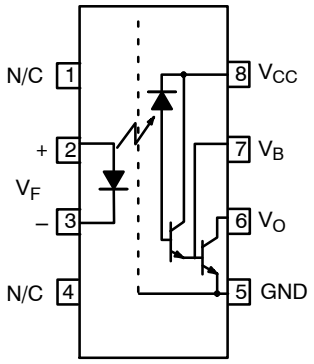
- Low input current: 0.5 mA
- Superior CTR: 2000%
- Superior CMR – 10 kV/μs
- CTR guaranteed 0°C to 70°C
- U.L. Recognized (file# E90700)
- VDE 0884 recognized (file# 136616)
- BSI recognized (file# 8661, 8662)
  – HCPL0700/0701 only
- These are Pb−Free Devices

## Applications

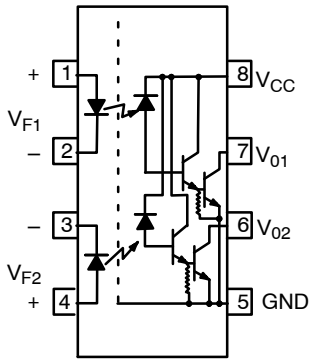
- Digital Logic Ground Isolation
- Telephone Ring Detector
- EIA−RS−232C Line Receiver
- High Common Mode Noise Line Receiver
- μP Bus Isolation
- Current Loop Receiver

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## SCHEMATICS




**HCPL0700 / HCPL0701**




**HCPL0731**

### TRUTH TABLE

| LED | $V_O$ |
|---|---|
| ON | LOW |
| OFF | HIGH |

### ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C unless otherwise noted)

| Symbol | Rating | | Value | Unit |
|---|---|---|---|---|
| $T_{STG}$ | Storage Temperature | | –40 to +125 | °C |
| $T_{OPR}$ | Operating Temperature | | –40 to +85 | °C |
| | Reflow Temperature Profile (Refer to page 9) | | | |
| **EMITTER** | | | | |
| $I_F$ (avg) | DC/Average Forward Input Current | | 20 | mA |
| $I_F$ (pk) | Peak Forward Input Current (50% duty cycle, 1 ms P.W.) | | 40 | mA |
| $I_F$ (trans) | Peak Transient Input Current – (≤1 μs P.W., 300 pps) | | 1.0 | A |
| $V_R$ | Reverse Input Voltage | | 5 | V |
| $P_D$ | Input Power Dissipation | | 35 | mW |
| **DETECTOR** | | | | |
| $I_O$ (avg) | Average Output Current (Pin 6) | | 60 | mA |
| $V_{EBR}$ | Emitter–Base Reverse Voltage | HCPL0700/HCPL0701 | 0.5 | V |
| $V_{CC}$, $V_O$ | Supply Voltage, Output Voltage | HCPL0700 | –0.5 to 7 | V |
| | | HCPL0701/HCPL0731 | –0.5 to 18 | |
| $P_D$ | Output Power Dissipation | | 100 | mW |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



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**ELECTRICAL CHARACTERISTICS** ($T_A$ = 0 to 70°C unless otherwise noted)

| Symbol | Parameter | Test Condition | | Device | Min | Typ* | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| **INDIVIDUAL COMPONENT CHARACTERISTICS** | | | | | | | | |
| **EMITTER** | | | | | | | | |
| $V_F$ | Input Forward Voltage | $I_F$ = 1.6 mA | $T_A$ = 25°C | HCPL0700/01 | 1.0 | 1.25 | 1.7 | V |
| | | | | HCPL0731 | | 1.35 | | |
| | | | | All | – | – | 1.75 | |
| $BV_R$ | Input Reverse breakdown Voltage | $T_A$ = 25°C, $I_R$ = 10 μA | | All | 5.0 | – | – | V |
| **DETECTOR** | | | | | | | | |
| $I_{OH}$ | Logic High Output Current | $I_F$ = 0 mA, $V_O$ = $V_{CC}$ = 18 V | | HCPL0701/31 | – | 0.01 | 100 | μA |
| | | $I_F$ = 0 mA, $V_O$ = $V_{CC}$ = 7 V | | HCPL0700 | – | 0.01 | 250 | |
| $I_{CCL}$ | Logic Low Supply Current | $I_F$ = 1.6 mA, $V_O$ = Open, $V_{CC}$ = 18 V | | HCPL0700/01 | – | 0.4 | 1.5 | mA |
| | | $V_{O1}$ = $V_{O2}$ = Open, $V_{CC}$ = 18 V | | HCPL0731 | – | 1 | – | |
| $I_{CCH}$ | Logic High Supply Current | $I_F$ = 0 mA, $V_O$ = Open, $V_{CC}$ = 18 V | | HCPL0700/01 | – | – | 10 | μA |
| | | $V_{O1}$ = $V_{O2}$ = Open, $V_{CC}$ = 18 V | | HCPL0731 | – | 0.01 | – | |
| **TRANSFER CHARACTERISTICS** | | | | | | | | |
| CTR | COUPLED | $I_F$ = 0.5 mA, $V_O$ = 0.4 V, $V_{CC}$ = 4.5 V | | HCPL0700/31 | 400 | – | 5000 | % |
| | Current Transfer Ratio (Notes 1, 2) | $I_F$ = 1.6 mA, $V_O$ = 0.4 V, $V_{CC}$ = 4.5 V | | HCPL0700 | 300 | – | 2600 | |
| | | | | HCPL0701 | 500 | – | 2600 | |
| | | | | HCPL0731 | 500 | – | 5000 | |
| $V_{OL}$ | Logic Low Output Voltage | $I_F$ = 0.5 mA, $I_O$ = 2 mA, $V_{CC}$ = 4.5 V | | HCPL0701 HCPL0731 | – | – | 0.4 | V |
| | | $I_F$ = 1.6 mA, $I_O$ = 8 mA, $V_{CC}$ = 4.5 V | | | – | – | 0.4 | |
| | | $I_F$ = 5 mA, $I_O$ = 15 mA, $V_{CC}$ = 4.5 V | | | – | – | 0.4 | |
| | | $I_F$ = 12 mA, $I_O$ = 24 mA, $V_{CC}$ = 4.5 V | | | – | – | 0.4 | |
| | | $I_F$ = 1.6 mA, $I_O$ = 4.8 mA, $V_{CC}$ = 4.5 V | | HCPL0700 | – | – | 0.4 | |
| **ISOLATION CHARACTERISTICS** | | | | | | | | |
| $I_{I-O}$ | Input−Output Insulation Leakage Current | Relative humidity = 45%, $T_A$ = 25°C, t = 5 s, $V_{I-O}$ = 3000 VDC (Note 4) | | | – | – | 1.0 | μA |
| $V_{ISO}$ | Withstand Insulation Test Voltage | $R_H \le 50\%$, $T_A$ = 25°C, $I_{I-O} \le 2$ μA, t = 1 min. (Notes 4, 5) | | | 2500 | – | – | $V_{RMS}$ |
| $R_{I-O}$ | Resistance (Input to Output) | $V_{I-O}$ = 500 VDC (Note 4) | | | – | $10^{12}$ | – | Ω |



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**ELECTRICAL CHARACTERISTICS** ($T_A$ = 0 to 70°C unless otherwise noted) (continued)

| Symbol | Parameter | Test Condition | Device | Min | Typ* | Max | Unit |
|---|---|---|---|---|---|---|---|
| **SWITCHING CHARACTERISTICS** (VCC = 5 V) | | | | | | | |
| $T_{PHL}$ | Propagation Delay Time to Logic Low (Note 2) (Figure 14) | $R_L$ = 4.7 kΩ, $I_F$ = 0.5 mA | HCPL0701 | – | – | 30 | μs |
| | | | HCPL0731 | – | – | 120 | |
| | | $T_A$ = 25°C | HCPL0701 | – | 3 | 25 | |
| | | | HCPL0731 | – | 5 | 100 | |
| | | $R_L$ = 270 Ω, $I_F$ = 12 mA | HCPL0701 | – | – | 2 | |
| | | | HCPL0731 | – | – | 3 | |
| | | $T_A$ = 25°C | HCPL0701 | – | 0.3 | 1 | |
| | | | HCPL0731 | – | 0.4 | 2 | |
| | | $R_L$ = 2.2 kΩ, $I_F$ = 1.6 mA | HCPL0700 | – | – | 15 | |
| | | | HCPL0731 | – | – | 25 | |
| | | $T_A$ = 25°C | HCPL0700 | – | 1 | 10 | |
| | | | HCPL0731 | – | 2 | 20 | |
| $T_{PLH}$ | Propagation Delay Time to Logic High (Note 2) (Figure 14) | $R_L$ = 4.7 kΩ, $I_F$ = 0.5 mA | HCPL0701/31 | – | – | 90 | μs |
| | | $T_A$ = 25°C | HCPL0701/31 | – | 12 | 60 | |
| | | $R_L$ = 270 Ω, $I_F$ = 12 mA | HCPL0701 | – | – | 10 | |
| | | | HCPL0731 | – | – | 15 | |
| | | $T_A$ = 25°C | HCPL0701 | – | 1.6 | 7 | |
| | | | HCPL0731 | – | 1.6 | 10 | |
| | | $R_L$ = 2.2 kΩ, $I_F$ = 1.6 mA | HCPL0700/31 | – | – | 50 | |
| | | $T_A$ = 25°C | HCPL0700/31 | – | 7 | 35 | |
| $\|CM_H\|$ | Common Mode Transient Immunity at Logic High | $I_F$ = 0 mA, $\|V_{CM}\|$ = 10 $V_{P-P}$, $T_A$ = 25°C, $R_L$ = 2.2 kΩ (Note 3) (Figure 15) | All | 1,000 | 10,000 | – | V/μs |
| $\|CM_L\|$ | Common Mode Transient Immunity at Logic Low | $I_F$ = 1.6 mA, $\|V_{CM}\|$ = 10 $V_{P-P}$, $T_A$ = 25°C, $R_L$ = 2.2 kΩ (Note 3) (Figure 15) | All | 1,000 | 10,000 | – | V/μs |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. Current Transfer Ratio is defined as a ratio of output collector current, $I_O$, to the forward LED input current, $_{IF}$, times 100%.
2. Pin 7 open. Use of a resistor between pins 5 and 7 will decrease gain and delay time.
3. Common mode transient immunity in logic high level is the maximum tolerable (positive) $dV_{CM}/dt$ on the leading edge of the common mode pulse signal, $V_{CM}$, to assure that the output will remain in a logic high state (i.e., $V_O >$ 2.0 V). Common mode transient immunity in logic low level is the maximum tolerable (negative) $dV_{CM}$/dton the trailing edge of the common mode pulse signal, $V_{CM}$, to assure that the output will remain in a logic low state(i.e., $V_O$ < 0.8 V).
4. Device is considered a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
5. 2500 VAC RMS for 1 minute duration is equivalent to 3000 VAC RMS for 1 second duration.

*All typicals at $T_A$ = 25°C



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## TYPICAL PERFORMANCE CURVES

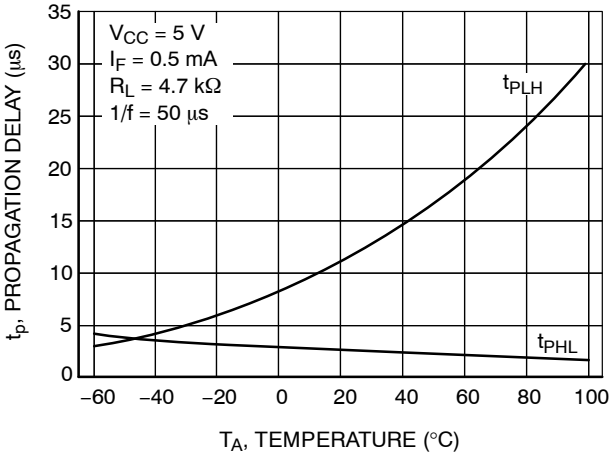



**Figure 1. Propagation Delay vs. Temperature (HCPL0700, HCPL0701)**

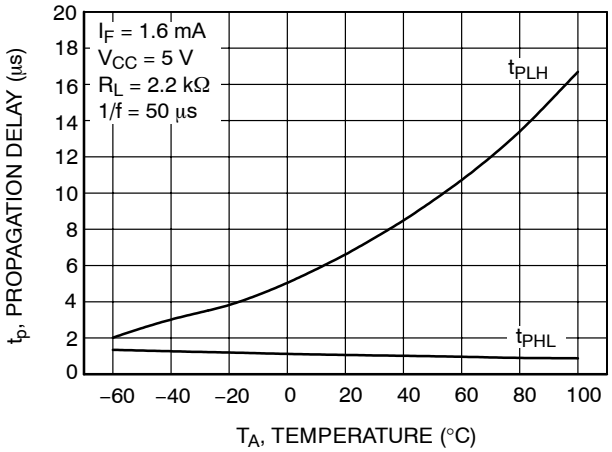



**Figure 2. Propagation Delay vs. Temperature (HCPL0700, HCPL0701)**

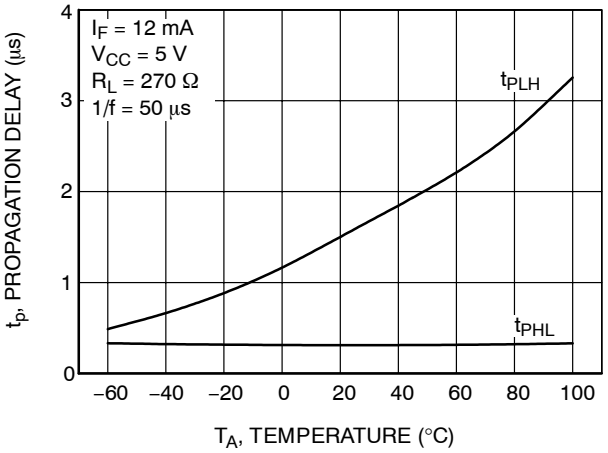



**Figure 3. Propagation Delay vs. Temperature (HCPL0700, HCPL0701)**

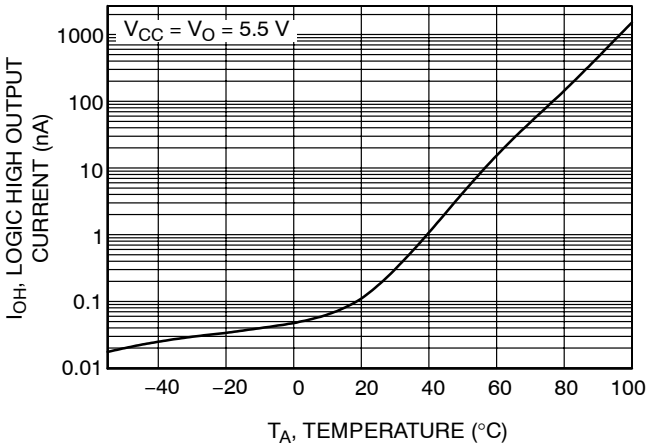



**Figure 4. Logic High Output Current vs. Temperature (HCPL0700, HCPL0701)**

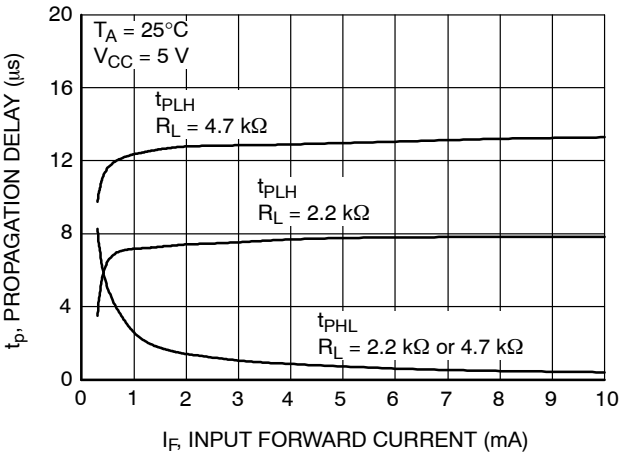



**Figure 5. Propagation Delay vs. Input Forward Current (HCPL0731)**

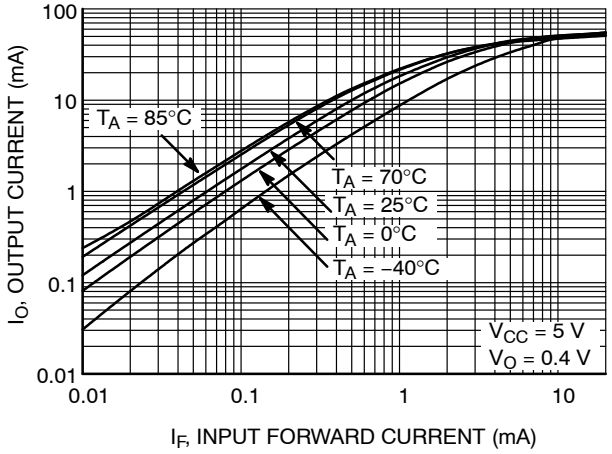



**Figure 6. Output Current vs. Input Forward Current (HCPL0700, HCPL0701)**



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## TYPICAL PERFORMANCE CURVES (continued)

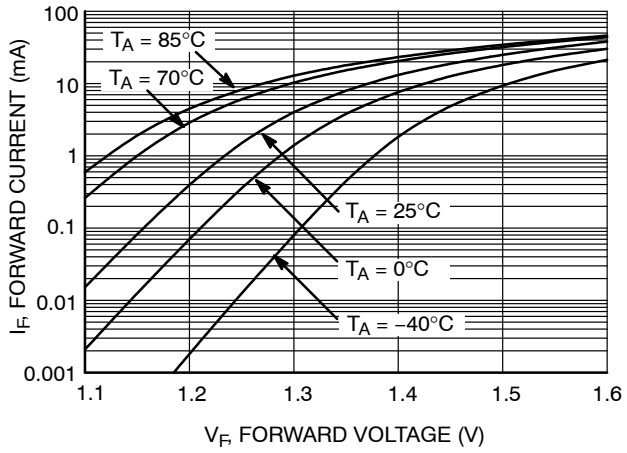



**Figure 7. Input Forward Current vs. Forward Voltage (HCPL0700, HCPL0701)**

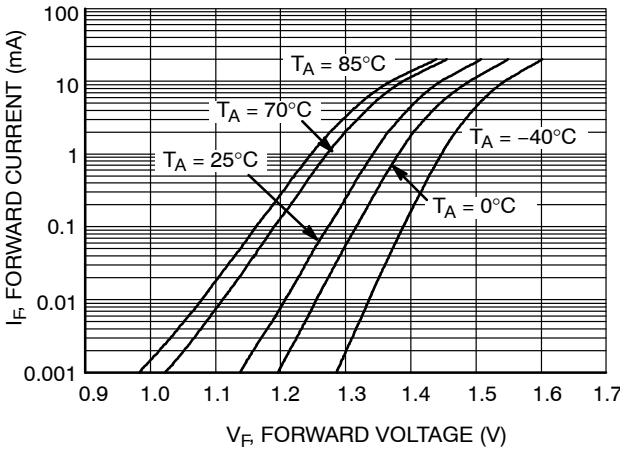



**Figure 8. Input Forward Current vs. Forward Voltage (HCPL0731)**

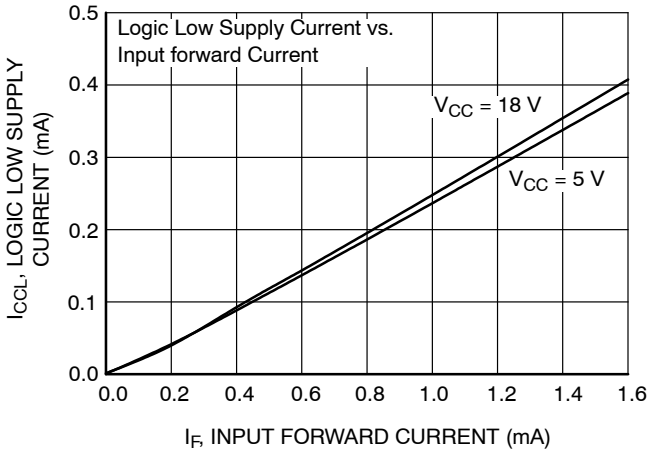



**Figure 9. Logic Low Supply Current vs. Input Forward Current (HCPL0700, HCPL0701)**

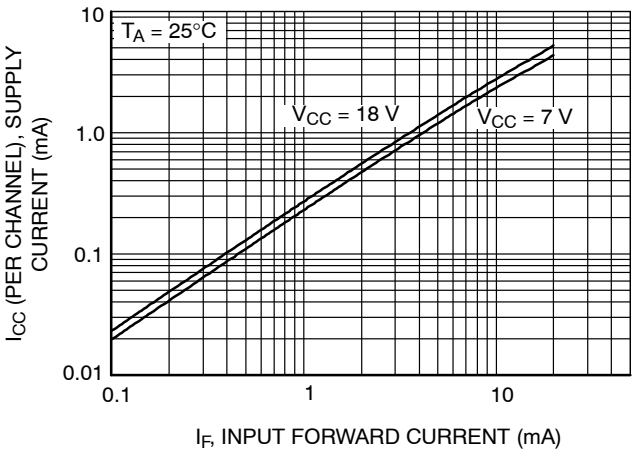



**Figure 10. Supply Current vs. Input Forward Current (HCPL0731)**

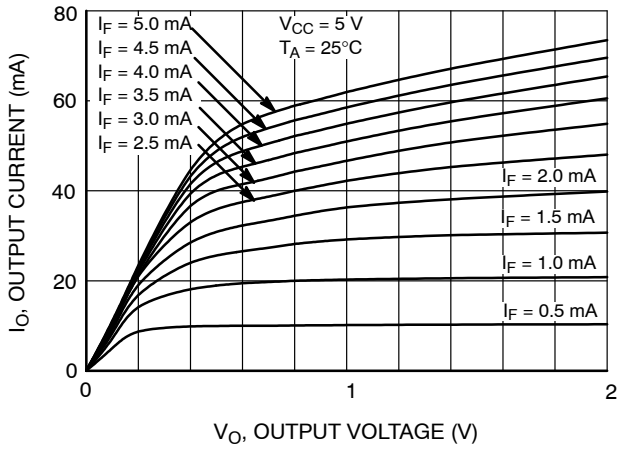



**Figure 11. DC Transfer Characteristics (HCPL0700, HCPL0701)**

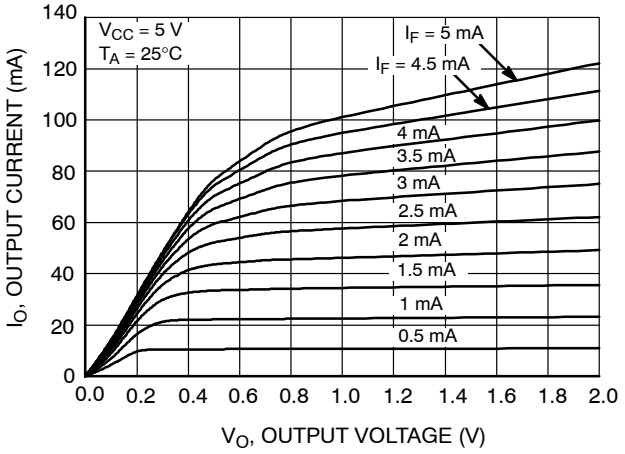



**Figure 12. DC Transfer Characteristics (HCPL0731)**



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## TYPICAL PERFORMANCE CURVES (continued)

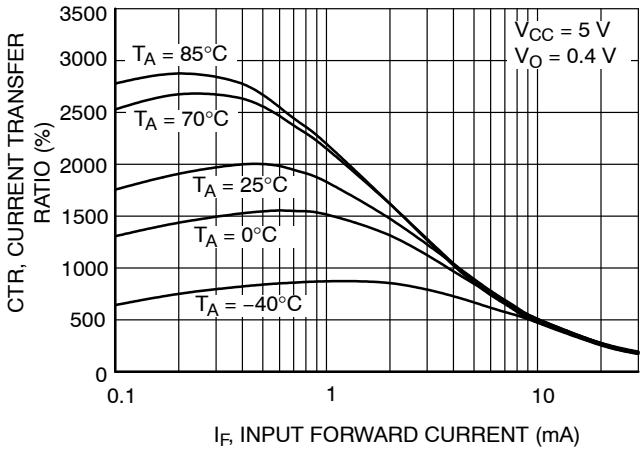
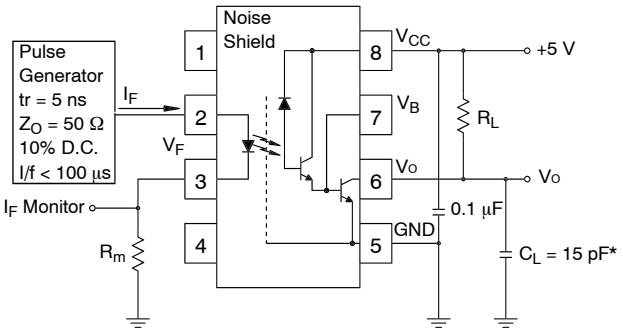



**Figure 13. Current Transfer Ratio vs. Input Forward Current (HCPL0700, HCPL0701)**

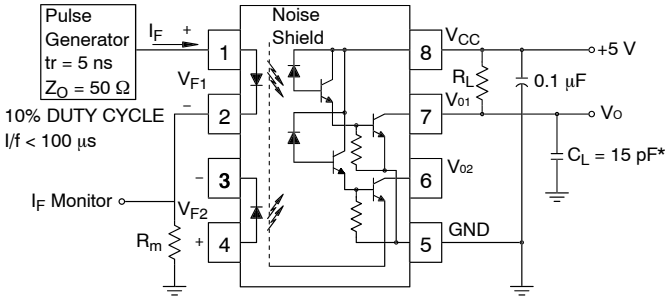


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## TEST CIRCUIT




Test Circuit for HCPL−0700 and HCPL−0701




Test Circuit for HCPL−0731

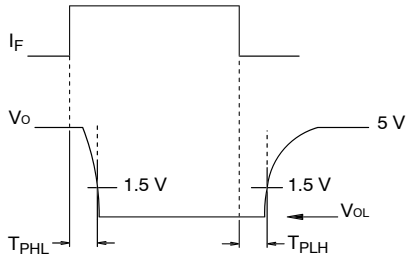
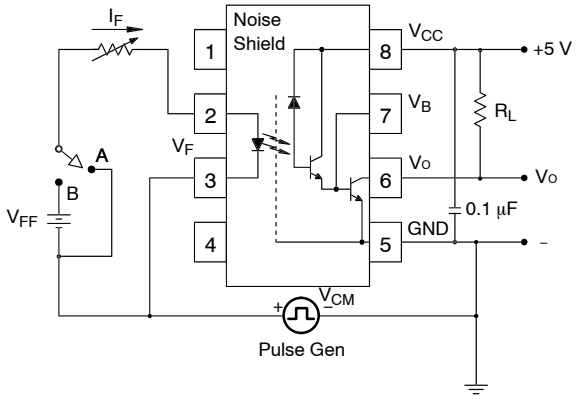
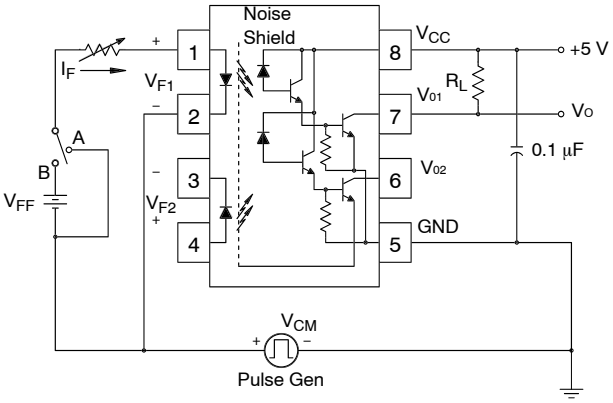



**Figure 14. Switching Time Test Circuit**




Test Circuit for HCPL−0700 and HCPL−0701




Test Circuit for HCPL−0731

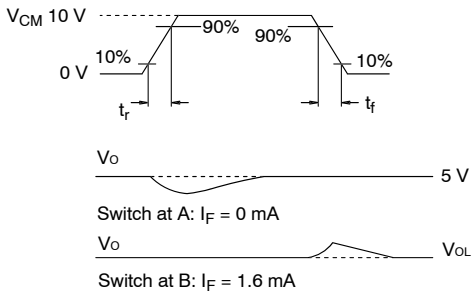



**Figure 15. Common Mode Immunity Test Circuit**



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## REFLOW PROFILE

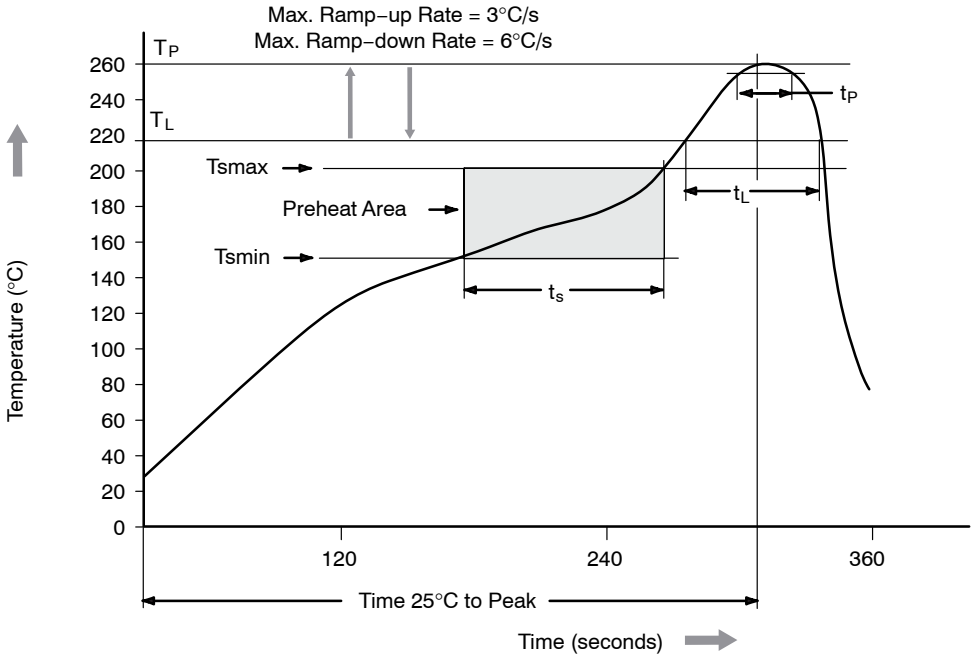



**Figure 16. Reflow Profile**

**Table 1.**

| Profile Feature | Pb−Free Assembly Profile |
|---|---|
| Temperature Min. (Tsmin) | 150°C |
| Temperature Max. (Tsmax) | 200°C |
| Time ($t_S$) from (Tsmin to Tsmax) | 60 – 120 seconds |
| Ramp−up Rate ($t_L$ to $t_P$) | 3°C/second maximum |
| Liquidous Temperature ($T_L$) | 217°C |
| Time ($t_L$) Maintained Above ($T_L$) | 60 – 150 seconds |
| Peak Body Package Temperature | 260°C +0°C / −5°C |
| Time ($t_P$) within 5°C of 260°C | 30 seconds |
| Ramp−down Rate ($T_P$ to $T_L$) | 6°C/second max. |
| Time 25°C to Peak Temperature | 8 minutes max. |

## ORDERING INFORMATION (Note 6)

| Part Number | Package | Shipping† |
|---|---|---|
| HCPL0700 | SOIC8 | 50 Units / Tube |
| HCPL0700R2 | SOIC8 | 2500 / Tape & Reel |
| HCPL0700V | SOIC8 (VDE 0884) | 50 Units / Tube |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

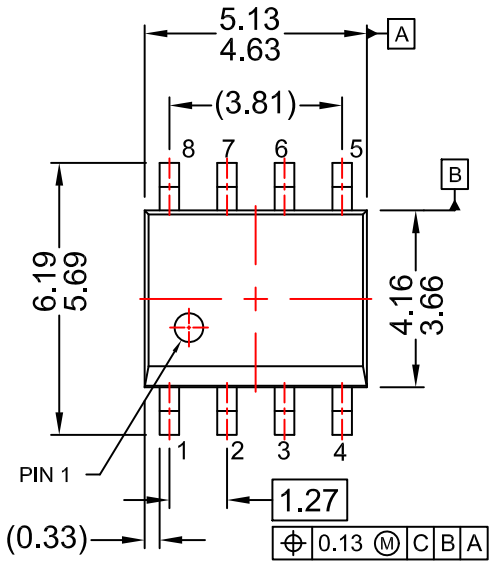
6. The product orderable part number system listed in this table also applies to the HCPL0701 and HCPL0731 products.

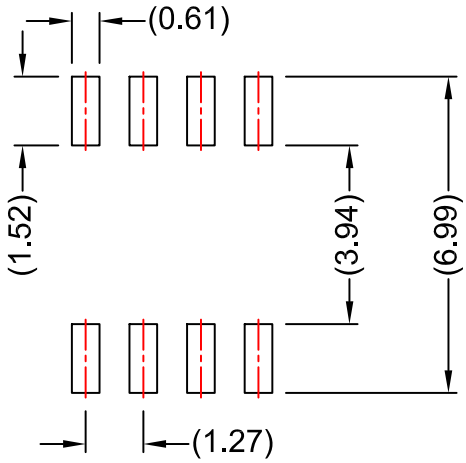


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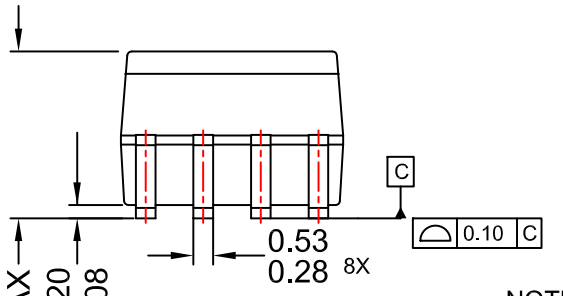
**SOIC8**
CASE 751DZ
ISSUE O

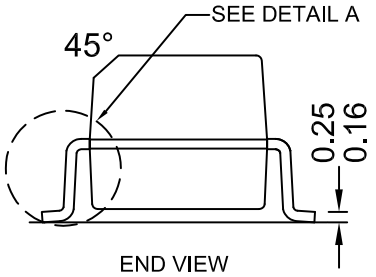
DATE 30 SEP 2016



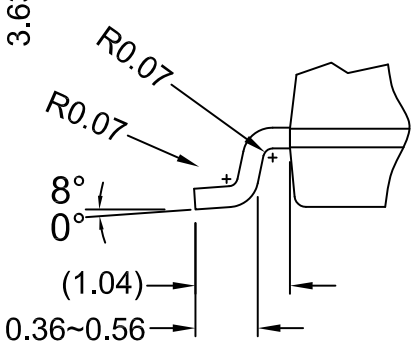




LAND PATTERN RECOMMENDATION




END VIEW




DETAIL A
SCALE: 2:1

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE
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