

# 8-Pin DIP Low Input Current High Gain Split Darlington Optocouplers

**Single-Channel: 6N138M, 6N139M**  
**Dual-Channel: HCPL2730M, HCPL2731M**

## Description

The single-channel, 6N138M, 6N139M and dual-channel HCPL2730M, HCPL2731M optocouplers consist of an AlGaAs LED optically coupled to a high gain split darlington photodetector.

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. In the dual channel devices, HCPL2730M and HCPL2731M, an integrated emitter-base resistor provides superior stability over temperature.

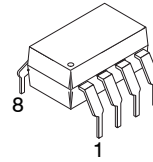
The combination of a very low input current of 0.5 mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out TTL requirements. An internal noise shield provides exceptional common mode rejection of 10 kV/μs.

## Features

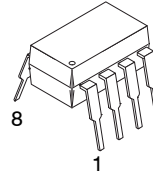
- Low Current – 0.5 mA
- Superior CTR – 2000%
- Superior CMR – 10 kV/μs
- CTR Guaranteed 0 to 70°C
- Dual Channel – HCPL2730M, HCPL2731M
- Safety and Regulatory Approvals
- UL1577, 5,000 VAC<sub>RMS</sub> for 1 Minute
- DIN EN/IEC60747-5-5
- These are Pb-Free Devices

## Applications

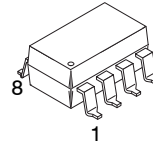
- Digital Logic Ground Isolation
- Telephone Ring Detector
- EIA-RS-232C Line Receiver
- High Common Mode Noise Line Receiver
- μP Bus Isolation
- Current Loop Receiver



PDIP8 6.6x3.81, 2.54P  
CASE 646BW

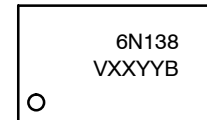


PDIP8 9.655x6.6, 2.54P  
CASE 646CQ



PDIP8 GW  
CASE 709AC

## MARKING DIAGRAM



|       |                                                                                   |
|-------|-----------------------------------------------------------------------------------|
| 6N138 | = Device Number                                                                   |
| V     | = DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option) |
| XX    | = Two-Digit Year Code, e.g., '16'                                                 |
| YY    | = Two-Digit Work Week, Ranging from '01' to '53'                                  |
| B     | = Assembly Package Code                                                           |

## ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

## Related Resources

- <https://www.onsemi.com/products/interfaces/high-performance-optocouplers/high-performance-transistor-optocouplers>
- <https://www.onsemi.com/products/interfaces/high-performance-optocouplers/high-performance-transistor-optocouplers/hcpl0700>
- <https://www.onsemi.com/products/interfaces/high-performance-optocouplers/high-performance-transistor-optocouplers/hcpl0731>

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

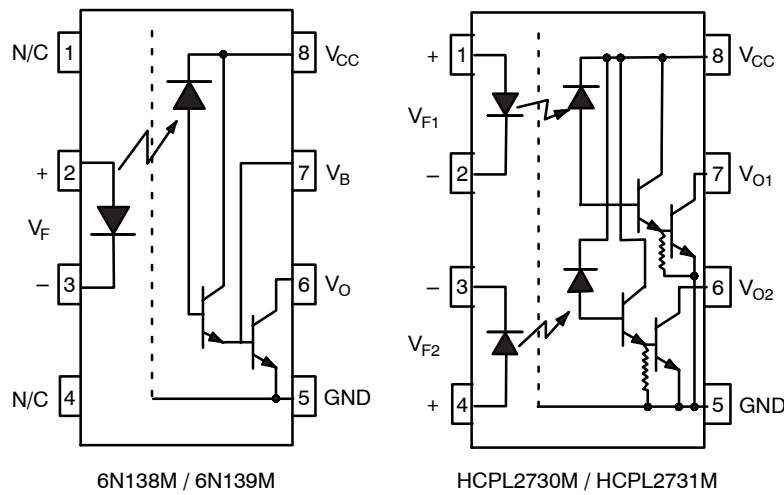


Figure 1. Schematics

**SAFETY AND INSULATION RATINGS** (As per DIN EN/IEC 60747-5-5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.)

| Parameter                                                                           |                                        | Characteristics |
|-------------------------------------------------------------------------------------|----------------------------------------|-----------------|
| Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage | <150 V <sub>RMS</sub>                  | I–IV            |
|                                                                                     | <300 V <sub>RMS</sub>                  | I–IV            |
|                                                                                     | <450 V <sub>RMS</sub>                  | I–III           |
|                                                                                     | <600 V <sub>RMS</sub>                  | I–III           |
|                                                                                     | <1,000 V <sub>RMS</sub> (Option T, TS) | I–III           |
| Climatic Classification                                                             |                                        | 40/100/21       |
| Pollution Degree (DIN VDE 0110/1.89)                                                |                                        | 2               |
| Comparative Tracking Index                                                          |                                        | 175             |

| Symbol                | Parameter                                                                                                                                                      | Value            | Unit              |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------|
| V <sub>PR</sub>       | Input-to-Output Test Voltage, Method A, V <sub>IORM</sub> x 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC  | 2,262            | V <sub>peak</sub> |
|                       | Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> x 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC | 2,651            | V <sub>peak</sub> |
| V <sub>IORM</sub>     | Maximum Working Insulation Voltage                                                                                                                             | 1,414            | V <sub>peak</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over-Voltage                                                                                                                                 | 6,000            | V <sub>peak</sub> |
|                       | External Creepage                                                                                                                                              | ≥8.0             | mm                |
|                       | External Clearance                                                                                                                                             | ≥7.4             | mm                |
|                       | External Clearance (for Option TV, 0.4" Lead Spacing)                                                                                                          | ≥10.16           | mm                |
| DTI                   | Distance Through Insulation (Insulation Thickness)                                                                                                             | ≥0.5             | mm                |
| T <sub>S</sub>        | Case Temperature (Note 1)                                                                                                                                      | 150              | °C                |
| I <sub>S,INPUT</sub>  | Input Current (Note 1)                                                                                                                                         | 200              | mA                |
| P <sub>S,OUTPUT</sub> | Output Power (Duty Factor ≤ 2.7%) (Note 1)                                                                                                                     | 300              | mW                |
| R <sub>IO</sub>       | Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V (Note 1)                                                                                     | >10 <sup>9</sup> | Ω                 |

1. Safety limit value – maximum values allowed in the event of a failure.

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol           | Parameter               | Device | Value        | Unit |
|------------------|-------------------------|--------|--------------|------|
| T <sub>STG</sub> | Storage Temperature     |        | –40 to +125  | °C   |
| T <sub>OPR</sub> | Operating Temperature   |        | –40 to +100  | °C   |
| T <sub>J</sub>   | Junction Temperature    |        | –40 to +125  | °C   |
| T <sub>SOL</sub> | Lead Solder Temperature |        | 260 for 10 s | °C   |

### EMITTER

|                        |                                                                    |     |    |    |
|------------------------|--------------------------------------------------------------------|-----|----|----|
| I <sub>F</sub> (avg)   | DC/Average Forward Input Current Per Channel                       | All | 20 | mA |
| I <sub>F</sub> (pk)    | Peak Forward Input Current Per Channel (50% Duty Cycle, 1 ms P.W.) | All | 40 | mA |
| I <sub>F</sub> (trans) | Peak Transient Input Current Per Channel (≤1 μs P.W., 300 pps)     | All | 1  | A  |
| V <sub>R</sub>         | Reverse Input Voltage Per Channel                                  | All | 5  | V  |
| P <sub>D</sub>         | Input Power Dissipation Per Channel (Note 2)                       | All | 35 | mW |

### DETECTOR

|                                  |                                      |                   |              |    |
|----------------------------------|--------------------------------------|-------------------|--------------|----|
| I <sub>O</sub> (avg)             | Average Output Current Per Channel   | All               | 60           | mA |
| V <sub>ER</sub>                  | Emitter–Base Reverse Voltage         | 6N138M, 6N139M    | 0.5          | V  |
| V <sub>CC</sub> , V <sub>O</sub> | Supply Voltage, Output Voltage       | 6N138M, HCPL2730M | –0.5 to 7.0  | V  |
|                                  |                                      | 6N139M, HCPL2731M | –0.5 to 18.0 |    |
| P <sub>O</sub>                   | Output Power Dissipation Per Channel | All               | 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.

2. No derating required for devices operated within the T<sub>OPR</sub> specification (6N138M and 6N139M only).

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

## ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Device | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|--------|-----------------|-----|-----|-----|------|
|--------|-----------|--------|-----------------|-----|-----|-----|------|

**INDIVIDUAL COMPONENT CHARACTERISTICS** ( $V_{CC} = 5.0\text{ V}$ ,  $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$  unless otherwise specified. Typical value is measured at  $T_A = 25^\circ\text{C}$ .)

| EMITTER                   |                                            |                |                                                                      |                                                                     |     |        |      |                      |
|---------------------------|--------------------------------------------|----------------|----------------------------------------------------------------------|---------------------------------------------------------------------|-----|--------|------|----------------------|
| $V_F$                     | Input Forward Voltage                      | All            | $I_F = 1.6\text{ mA}$ , $T_A = 25^\circ\text{C}$                     |                                                                     | –   | 1.30   | 1.70 | V                    |
|                           |                                            |                | $I_F = 1.6\text{ mA}$                                                |                                                                     | –   | –      | 1.75 |                      |
| $BV_R$                    | Input Reverse Breakdown Voltage            | All            | $I_R = 10\text{ }\mu\text{A}$ , $T_A = 25^\circ\text{C}$             |                                                                     | 5.0 | 19.0   | –    | V                    |
| $\Delta V_F / \Delta T_A$ | Temperature Coefficient of Forward Voltage | All            | $I_F = 1.6\text{ mA}$                                                |                                                                     | –   | –1.94  | –    | mV/ $^\circ\text{C}$ |
| DETECTOR                  |                                            |                |                                                                      |                                                                     |     |        |      |                      |
| $I_{CCL}$                 | Logic Low Supply Current                   | 6N138M, 6N139M | $I_F = 1.6\text{ mA}$ , $V_O = \text{Open}$ , $V_{CC} = 18\text{ V}$ |                                                                     | –   | 0.4    | 1.5  | mA                   |
|                           |                                            | HCPL2730M      | $V_{CC} = 7\text{ V}$                                                | $I_{F1} = I_{F2} = 1.6\text{ mA}$ , $V_{O1} = V_{O2} = \text{Open}$ | –   | 1.25   | 3    |                      |
|                           |                                            | HCPL2731M      | $V_{CC} = 18\text{ V}$                                               |                                                                     |     |        |      |                      |
| $I_{CCH}$                 | Logic High Supply Current                  | 6N138M, 6N139M | $I_F = 0\text{ mA}$ , $V_O = \text{Open}$ , $V_{CC} = 18\text{ V}$   |                                                                     | –   | 0.0003 | 10   | $\mu\text{A}$        |
|                           |                                            | HCPL2730M      | $V_{CC} = 7\text{ V}$                                                | $I_{F1} = I_{F2} = 0\text{ mA}$ , $V_{O1} = V_{O2} = \text{Open}$   | –   | 0.0003 | 20   |                      |
|                           |                                            | HCPL2731M      | $V_{CC} = 18\text{ V}$                                               |                                                                     |     |        |      |                      |

## TRANSFER CHARACTERISTICS

| COUPLED  |                                             |           |                                                                            |     |        |     |               |
|----------|---------------------------------------------|-----------|----------------------------------------------------------------------------|-----|--------|-----|---------------|
| CTR      | Current Transfer Ratio (Note 3)<br>(Note 4) | 6N138M    | $I_F = 1.6\text{ mA}$ , $V_O = 0.4\text{ V}$ ,<br>$V_{CC} = 4.5\text{ V}$  | 300 | 1600   | –   | %             |
|          |                                             | HCPL2730M |                                                                            |     | 2400   |     |               |
|          |                                             | 6N139M    | $I_F = 0.5\text{ mA}$ , $V_O = 0.4\text{ V}$ ,<br>$V_{CC} = 4.5\text{ V}$  | 400 | 2000   | –   |               |
|          |                                             | HCPL2731M |                                                                            |     | 3500   |     |               |
|          |                                             | 6N139M    | $I_F = 1.6\text{ mA}$ , $V_O = 0.4\text{ V}$ ,<br>$V_{CC} = 4.5\text{ V}$  | 500 | 1600   | –   |               |
|          |                                             | HCPL2731M |                                                                            |     | 2400   |     |               |
| $I_{OH}$ | Logic High Output Current                   | 6N138M    | $I_F = 0\text{ mA}$ , $V_O = V_{CC} = 7\text{ V}$                          | –   | 0.001  | 250 | $\mu\text{A}$ |
|          |                                             | HCPL2730M |                                                                            |     |        |     |               |
|          |                                             | 6N139M    | $I_F = 0\text{ mA}$ , $V_O = V_{CC} = 18\text{ V}$                         | –   | 0.0036 | 100 |               |
|          |                                             | HCPL2731M |                                                                            |     |        |     |               |
| $V_{OL}$ | Logic Low Output Voltage<br>(Note 4)        | 6N138M    | $I_F = 1.6\text{ mA}$ , $I_O = 4.8\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$ | –   | 0.06   | 0.4 | V             |
|          |                                             | HCPL2730M |                                                                            |     | 0.05   |     |               |
|          |                                             | 6N139M    | $I_F = 0.5\text{ mA}$ , $I_O = 2\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$   | –   | 0.05   | 0.4 |               |
|          |                                             | 6N139M    | $I_F = 1.6\text{ mA}$ , $I_O = 8\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$   | –   | 0.093  | 0.4 |               |
|          |                                             | HCPL2731M |                                                                            |     | 0.08   |     |               |
|          |                                             | 6N139M    | $I_F = 5\text{ mA}$ , $I_O = 15\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$    | –   | 0.13   | 0.4 |               |
|          |                                             | HCPL2731M |                                                                            |     | 0.12   |     |               |
|          |                                             | 6N139M    | $I_F = 12\text{ mA}$ , $I_O = 24\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$   | –   | 0.18   | 0.4 |               |
|          |                                             | HCPL2731M |                                                                            |     | 0.17   |     |               |

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

## ELECTRICAL CHARACTERISTICS (continued)

| Symbol                                                                                                                                                                                          | Parameter                                                         | Device                       | Test Conditions                                                                                                | Min   | Typ    | Max | Unit                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------|-------|--------|-----|------------------------|
| <b>SWITCHING CHARACTERISTICS</b> ( $V_{CC} = 5.0\text{ V}$ , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ unless otherwise specified. Typical value is measured at $T_A = 25^\circ\text{C}$ .) |                                                                   |                              |                                                                                                                |       |        |     |                        |
| $t_{PHL}$                                                                                                                                                                                       | Propagation Delay Time to Logic LOW (Note 4) (Figure 14)          | 6N139M                       | $R_L = 270\ \Omega$ , $I_F = 12\text{ mA}$                                                                     | –     | 0.2    | 2   | $\mu\text{s}$          |
|                                                                                                                                                                                                 |                                                                   | HCPL2730M, HCPL2731M         | $R_L = 270\ \Omega$ , $I_F = 12\text{ mA}$                                                                     | –     | 0.5    | 3   |                        |
|                                                                                                                                                                                                 |                                                                   | 6N138M                       | $R_L = 2.2\text{ k}\Omega$ , $I_F = 1.6\text{ mA}$                                                             | –     | 1.0    | 15  |                        |
|                                                                                                                                                                                                 |                                                                   | HCPL2730M, HCPL2731M         | $R_L = 2.2\text{ k}\Omega$ , $I_F = 1.6\text{ mA}$                                                             | –     | 2.5    | 25  |                        |
|                                                                                                                                                                                                 |                                                                   | 6N139M                       | $R_L = 4.7\text{ k}\Omega$ , $I_F = 0.5\text{ mA}$                                                             | –     | 2.5    | 30  |                        |
|                                                                                                                                                                                                 |                                                                   | HCPL2731M                    | $R_L = 4.7\text{ k}\Omega$ , $I_F = 0.5\text{ mA}$                                                             | –     | 8.4    | 120 |                        |
| $t_{PLH}$                                                                                                                                                                                       | Propagation Delay Time to Logic HIGH (Note 4) (Figure 14)         | 6N139M                       | $R_L = 270\ \Omega$ , $I_F = 12\text{ mA}$                                                                     | –     | 1.3    | 10  | $\mu\text{s}$          |
|                                                                                                                                                                                                 |                                                                   | HCPL2730M, HCPL2731M         | $R_L = 270\ \Omega$ , $I_F = 12\text{ mA}$                                                                     | –     | 1.0    | 15  |                        |
|                                                                                                                                                                                                 |                                                                   | 6N138M, HCPL2730M, HCPL2731M | $R_L = 2.2\text{ k}\Omega$ , $I_F = 1.6\text{ mA}$                                                             | –     | 7.3    | 50  |                        |
|                                                                                                                                                                                                 |                                                                   | 6N139M, HCPL2731M            | $R_L = 4.7\text{ k}\Omega$ , $I_F = 0.5\text{ mA}$                                                             | –     | 13.6   | 90  |                        |
| $ CM_H $                                                                                                                                                                                        | Common Mode Transient Immunity at Logic High (Note 5) (Figure 15) | All                          | $I_F = 0\text{ mA}$ , $ V_{CM}  = 10\text{ V}_{P-P}$ , $R_L = 2.2\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$   | 1,000 | 10,000 | –   | $\text{V}/\mu\text{s}$ |
| $ CM_L $                                                                                                                                                                                        | Common Mode Transient Immunity at Logic Low (Note 5) (Figure 15)  | All                          | $I_F = 1.6\text{ mA}$ , $ V_{CM}  = 10\text{ V}_{P-P}$ , $R_L = 2.2\text{ k}\Omega$ , $T_A = 25^\circ\text{C}$ | 1,000 | 10,000 | –   | $\text{V}/\mu\text{s}$ |

## ISOLATION CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise specified.)

|           |                                                     |                      |                                                                                                                      |       |           |   |                    |
|-----------|-----------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------|-------|-----------|---|--------------------|
| $V_{ISO}$ | Withstand Insulation Test Voltage (Note 6) (Note 7) | All                  | $RH \leq 50\%$ , $T_A = 25^\circ\text{C}$ , $I_{I-O} \leq 10\ \mu\text{A}$ , $t = 1\text{ min}$ , $f = 50\text{ Hz}$ | 5,000 | –         | – | $\text{VAC}_{RMS}$ |
| $R_{I-O}$ | Resistance (Input to Output) (Note 6)               | All                  | $V_{I-O} = 500\text{ V}_{DC}$                                                                                        | –     | $10^{11}$ | – | $\Omega$           |
| $C_{I-O}$ | Capacitance (Input to Output) (Note 6) (Note 8)     | All                  | $f = 1\text{ MHz}$ , $V_{I-O} = 0\text{ V}$                                                                          | –     | 1         | – | $\text{pF}$        |
| $I_{I-I}$ | Input–Input Insulation Leakage Current (Note 9)     | HCPL2730M, HCPL2731M | $RH \leq 45\%$ , $V_{I-I} = 500\text{ V}_{DC}$ , $t = 5\text{ s}$                                                    | –     | 0.005     | – | $\mu\text{A}$      |
| $R_{I-I}$ | Input–Input Resistance (Note 9)                     | HCPL2730M, HCPL2731M | $V_{I-I} = 500\text{ V}_{DC}$                                                                                        | –     | $10^{11}$ | – | $\Omega$           |
| $C_{I-I}$ | Input–Input Capacitance (Note 9)                    | HCPL2730M, HCPL2731M | $f = 1\text{ MHz}$                                                                                                   | –     | 0.03      | – | $\text{pF}$        |

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.

- Current Transfer Ratio is defined as a ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100%.
- Pin 7 open. (6N138M and 6N139M only)
- 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.,  $V_O > 2.0\text{ V}$ ). Common mode transient immunity in logic LOW level is the maximum tolerable (negative)  $dV_{CM}/dt$  on 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.,  $V_O < 0.8\text{ V}$ ).
- 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.
- 5000  $\text{VAC}_{RMS}$  for 1 minute duration is equivalent to 6000  $\text{VAC}_{RMS}$  for 1 second duration.
- For dual channel devices,  $C_{I-O}$  is measured by shorting pins 1 and 2 or pins 3 and 4 together and pins 5 through 8 shorted together.
- Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

## ELECTRICAL CHARACTERISTICS (continued)

(T<sub>A</sub> = 25°C unless otherwise specified.)

Current Limiting Resistor Calculations:

$$R_1 \text{ (Non-Invert)} = \frac{V_{CC1} - V_{DF} - V_{OL1}}{I_F} \quad (\text{eq. 1})$$

$$R_1 \text{ (Invert)} = \frac{V_{CC1} - V_{OH1} - V_{DF}}{I_F} \quad (\text{eq. 2})$$

$$R_2 = \frac{V_{CC2} - V_{OLX} (@ I_L - I_2)}{I_L} \quad (\text{eq. 3})$$

Where:

V<sub>CC1</sub> = Input Supply Voltage

V<sub>CC2</sub> = Output Supply Voltage

V<sub>DF</sub> = Diode Forward Voltage

V<sub>OL1</sub> = Logic "0" Voltage of Driver

V<sub>OH1</sub> = Logic "1" Voltage of Driver

I<sub>F</sub> = Diode Forward Current

V<sub>OLX</sub> = Saturation Voltage of Output Transistor

I<sub>L</sub> = Load Current Through Resistor R<sub>2</sub>

I<sub>2</sub> = Input Current of Output Gate

| INPUT CONFIGURATION |          | R <sub>1</sub> (Ω) | R <sub>2</sub> (Ω) @ OUTPUT CONFIGURATION |             |      |       |       |        |       |
|---------------------|----------|--------------------|-------------------------------------------|-------------|------|-------|-------|--------|-------|
|                     |          |                    | CMOS @ 5 V                                | CMOS @ 10 V | 74XX | 74LXX | 74SXX | 74LSXX | 74HXX |
| CMOS @ 5 V          | NON-INV. | 2000               | 1000                                      | 2200        | 750  | 1000  | 1000  | 1000   | 560   |
|                     | INV.     | 510                |                                           |             |      |       |       |        |       |
| CMOS @ 10 V         | NON-INV. | 5100               |                                           |             |      |       |       |        |       |
|                     | INV.     | 4700               |                                           |             |      |       |       |        |       |
| 74XX                | NON-INV. | 2200               |                                           |             |      |       |       |        |       |
|                     | INV.     | 180                |                                           |             |      |       |       |        |       |
| 74LXX               | NON-INV. | 1800               |                                           |             |      |       |       |        |       |
|                     | INV.     | 100                |                                           |             |      |       |       |        |       |
| 74SXX               | NON-INV. | 2000               |                                           |             |      |       |       |        |       |
|                     | INV.     | 360                |                                           |             |      |       |       |        |       |
| 74LSXX              | NON-INV. | 2000               |                                           |             |      |       |       |        |       |
|                     | INV.     | 180                |                                           |             |      |       |       |        |       |
| 74HXX               | NON-INV. | 2000               |                                           |             |      |       |       |        |       |
|                     | INV.     | 180                |                                           |             |      |       |       |        |       |

Figure 2. Resistor Values for Logic Interface

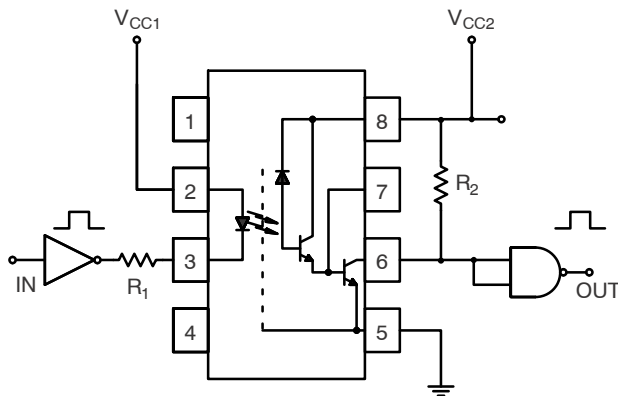


Figure 3. Non-Inverting Logic Interface

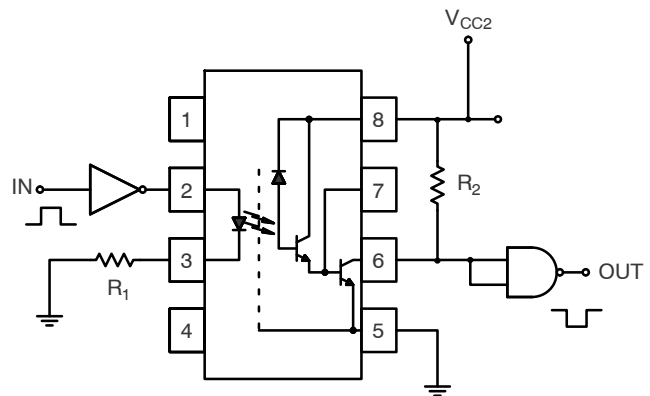


Figure 4. Inverting Logic Interface

# Typical Performance Curves

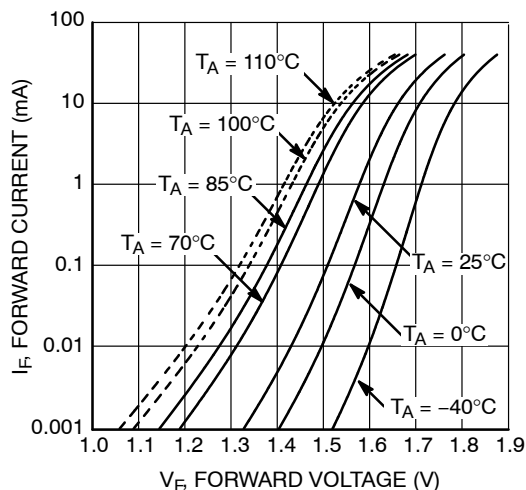


Figure 5. LED Forward Current vs. Forward Voltage

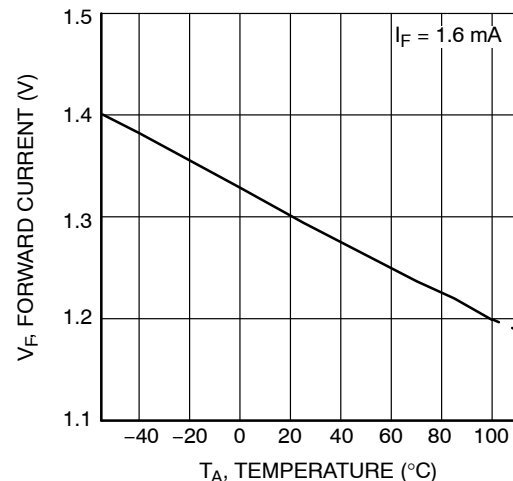


Figure 6. LED Forward Current vs. Temperature

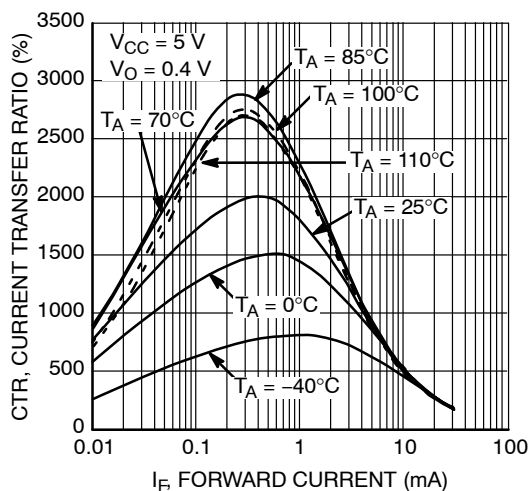


Figure 7. Current Transfer Ratio vs. Forward Current (6N138M / 6N139M Only)

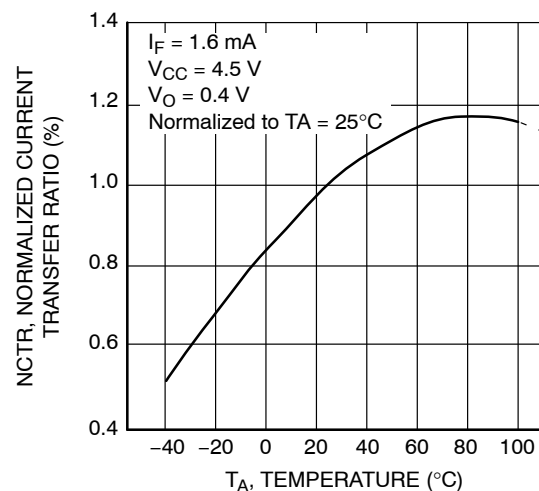


Figure 8. Normalized Current Transfer Ratio vs. Ambient Temperature (6N138M / 6N139M Only)

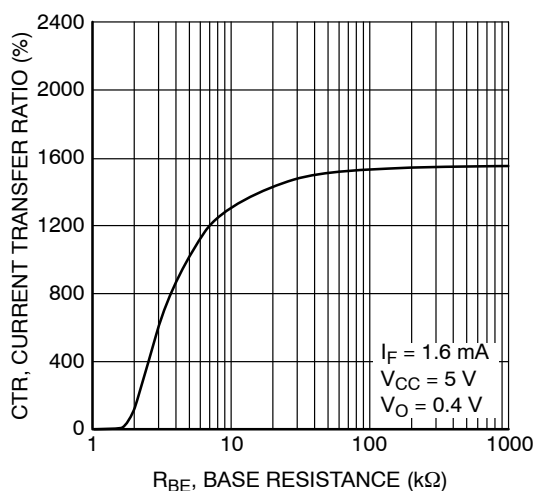


Figure 9. Current Transfer Ratio vs. Base-Emitter Resistance (6N138M / 6N139M Only)

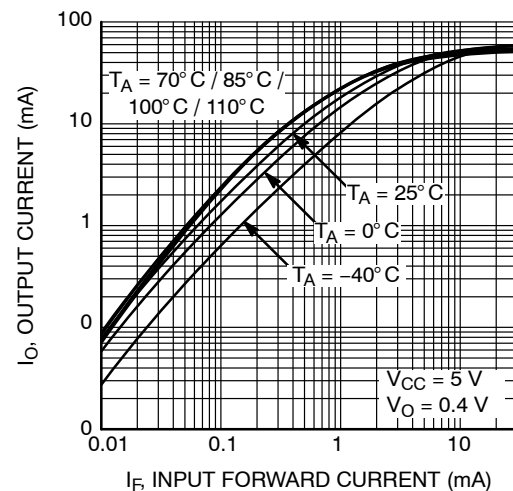


Figure 10. Output Current vs. Input Diode Forward Current (6N138M / 6N139M Only)

Typical Performance Curves (continued)

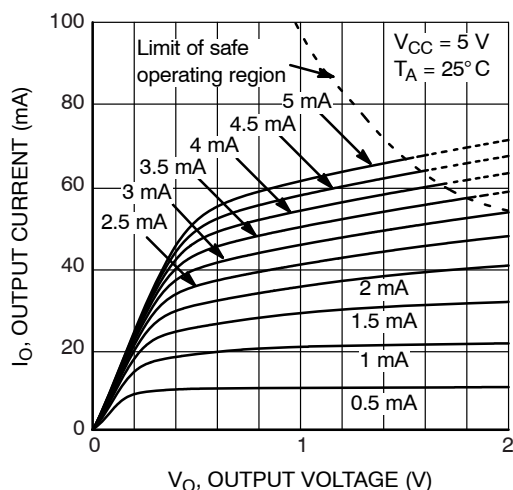


Figure 11. Output Current vs Output Voltage (6N138M / 6N139M Only)

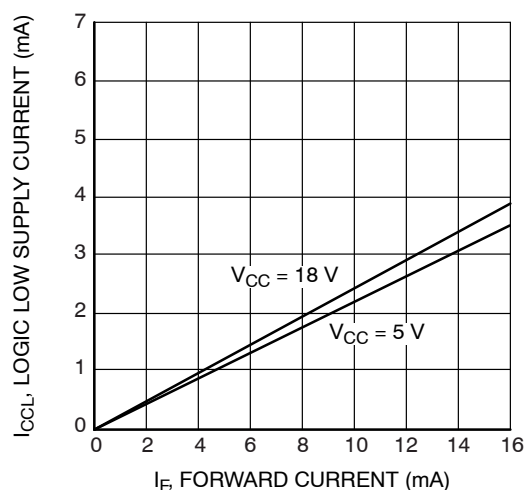


Figure 12. Logic Low Supply Current vs. Input Diode Forward Current (6N138M / 6N139M Only)

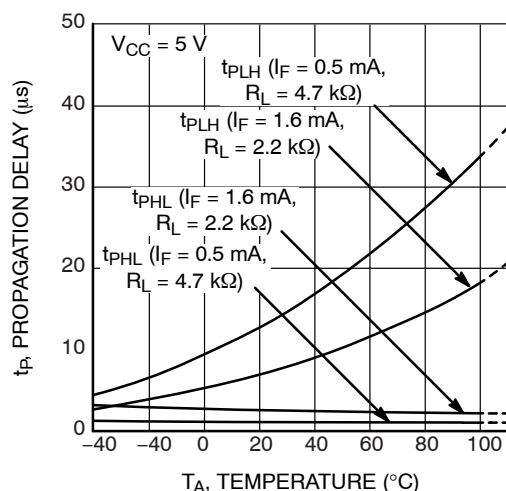
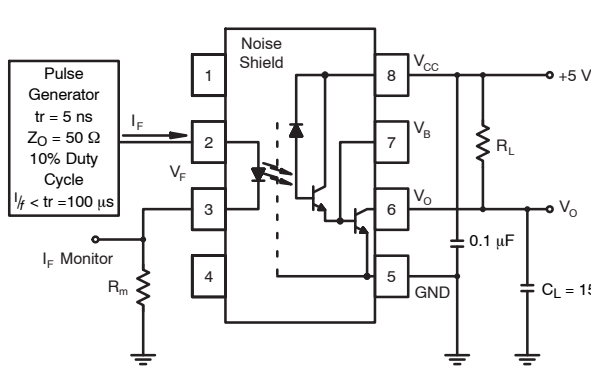


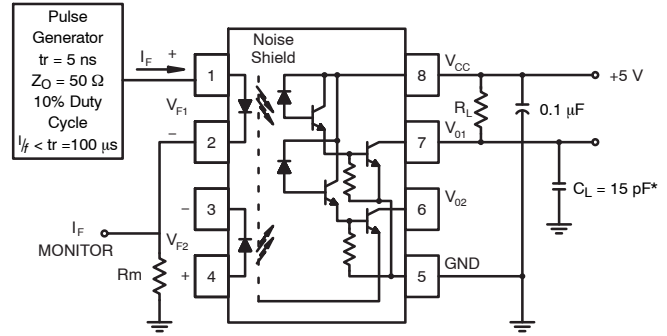
Figure 13. Propagation Delay vs. Temperature (6N138M / 6N139M Only)

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

## Test Circuits



Test Circuit for 6N138M, 6N139M



Test Circuit for HCPL2730M and HCPL2731M

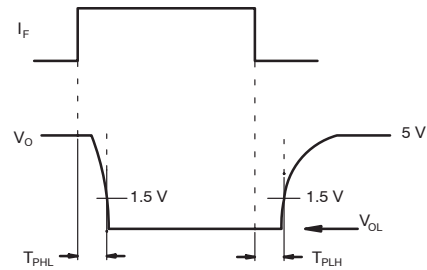
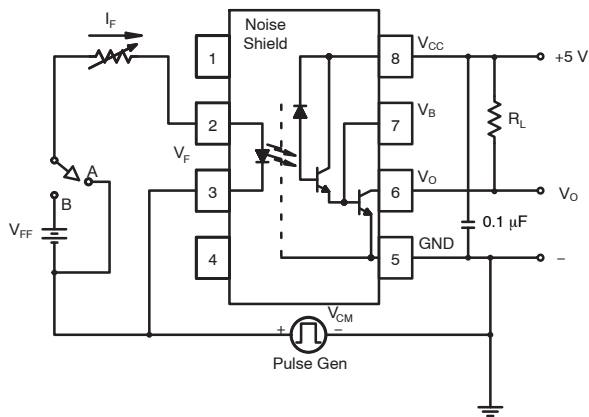
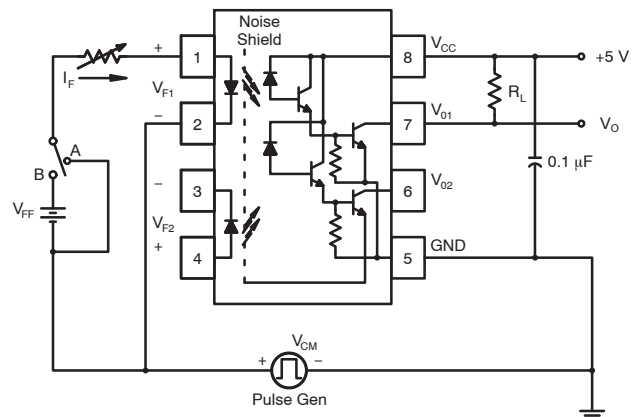


Figure 14. Switching Time Test Circuit



Test Circuit for 6N138M and 6N139M



Test Circuit for HCPL2730M and HCPL2731M

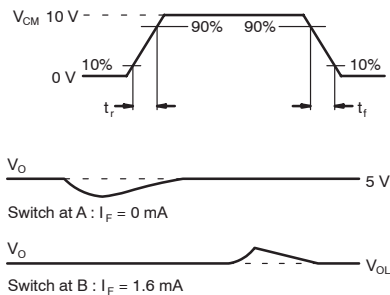
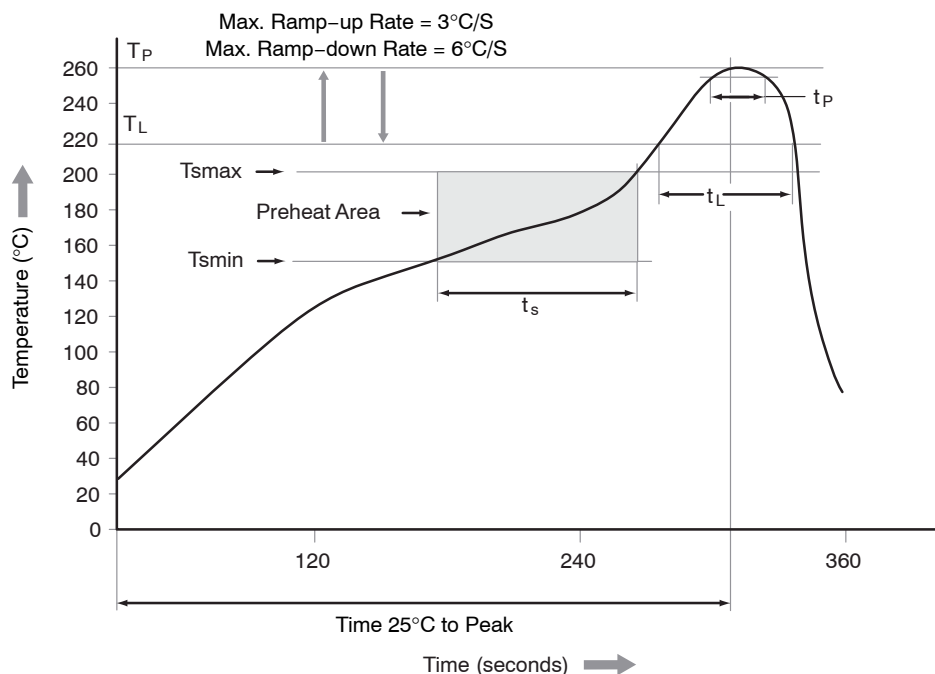


Figure 15. Common Mode Immunity Test Circuit

### Reflow Profile



| Profile Feature                                                     | Pb-Free Assembly Profile |
|---------------------------------------------------------------------|--------------------------|
| Temperature Min. (T <sub>min</sub> )                                | 150°C                    |
| Temperature Max. (T <sub>max</sub> )                                | 200°C                    |
| Time (t <sub>s</sub> ) from (T <sub>min</sub> to T <sub>max</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.           |

Figure 16. Reflow Profile

# Single-Channel: 6N138M, 6N139M Dual-Channel: HCPL2730M, HCPL2731M

## ORDERING INFORMATION

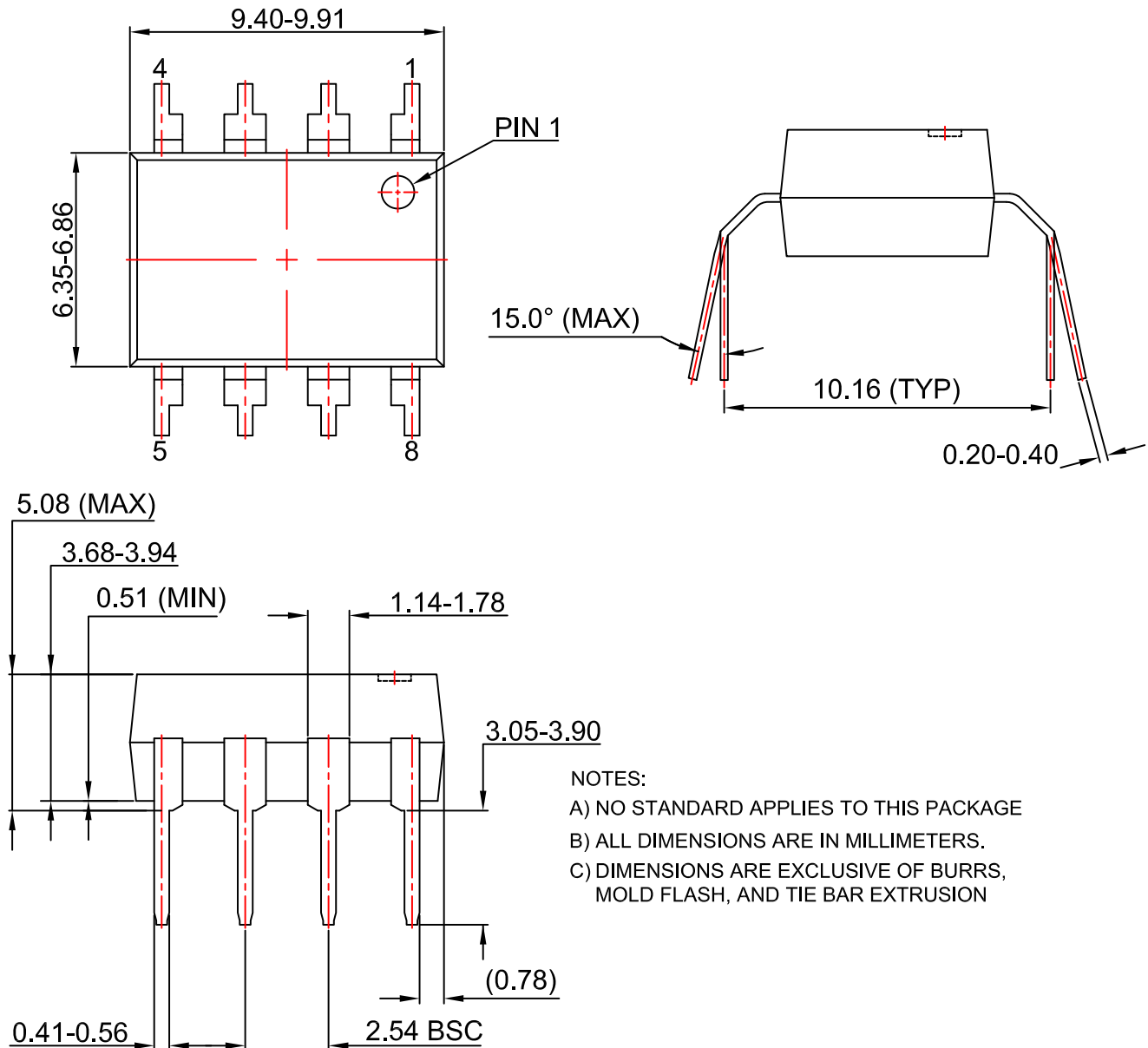
| Part Number | Package                                                                | Shipping <sup>†</sup>     |
|-------------|------------------------------------------------------------------------|---------------------------|
| 6N138M      | DIP 8-Pin<br>(Pb-Free)                                                 | 50 Units / Tube           |
| 6N138SM     | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 50 Units / Tube           |
| 6N138SDM    | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 1,000 Units / Tape & Reel |
| 6N139M      | DIP 8-Pin<br>(Pb-Free)                                                 | 50 Units / Tube           |
| 6N139SM     | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 50 Units / Tube           |
| 6N139SDM    | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 1,000 Units / Tape & Reel |
| 6N139VM     | DIP 8-Pin, DIN EN/IEC 60747-5-5 Option<br>(Pb-Free)                    | 50 Units / Tube           |
| 6N139SVM    | SMT 8-Pin (Lead Bend), DIN EN/IEC 60747-5-5 Option<br>(Pb-Free)        | 50 Units / Tube           |
| 6N139SDVM   | SMT 8-Pin (Lead Bend), DIN EN/IEC 60747-5-5 Option<br>(Pb-Free)        | 1,000 Units / Tape & Reel |
| 6N139TVM    | DIP 8-Pin, 0.4" Lead Spacing, DIN EN/IEC 60747-5-5 Option<br>(Pb-Free) | 50 Units / Tube           |
| HCPL2730M   | DIP 8-Pin<br>(Pb-Free)                                                 | 50 Units / Tube           |
| HCPL2730SM  | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 50 Units / Tube           |
| HCPL2730SDM | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 1,000 Units / Tape & Reel |
| HCPL2731M   | DIP 8-Pin<br>(Pb-Free)                                                 | 50 Units / Tube           |
| HCPL2731SM  | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 50 Units / Tube           |
| HCPL2731SDM | SMT 8-Pin (Lead Bend)<br>(Pb-Free)                                     | 1,000 Units / Tape & Reel |
| HCPL2731VM  | DIP 8-Pin, DIN EN/IEC 60747-5-5 Option<br>(Pb-Free)                    | 50 Units / Tube           |

<sup>†</sup>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.



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ISSUE O

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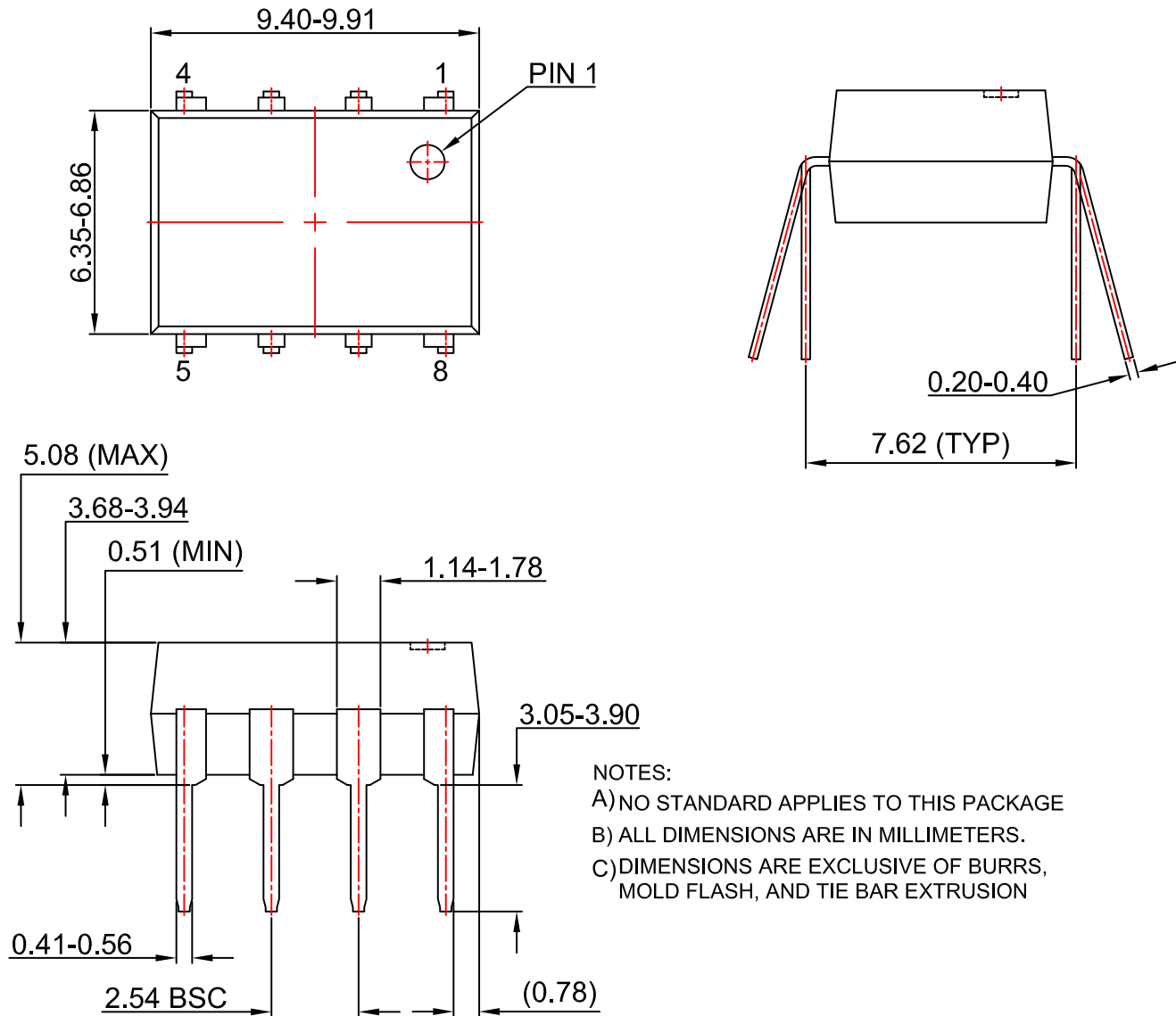


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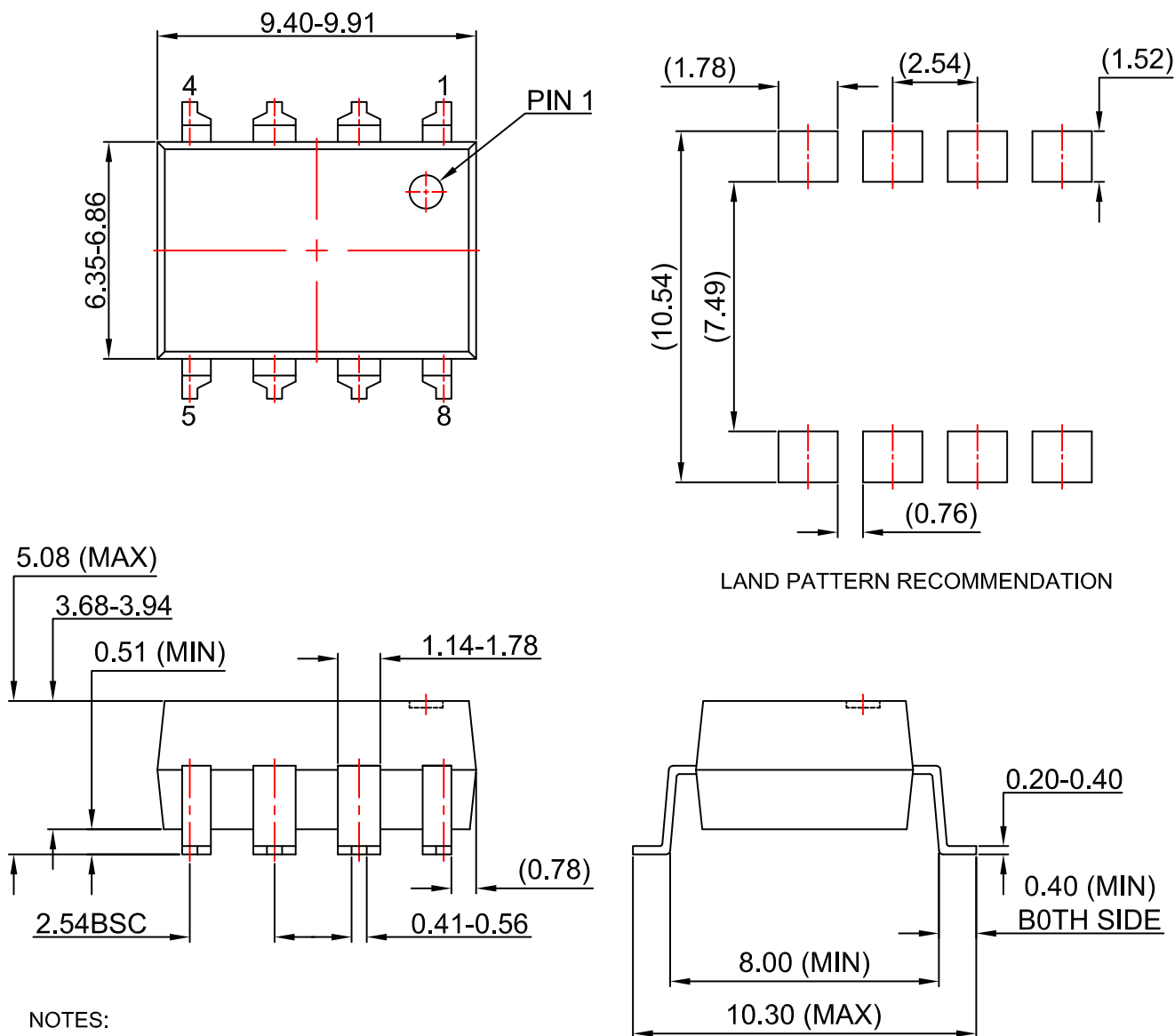


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