

# 6-Pin DIP General Purpose Photodarlington Optocoupler

## 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M

### Description

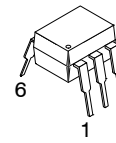
The 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, and TIL113M have a gallium arsenide infrared emitter optically coupled to a silicon planar photodarlington.

### Features

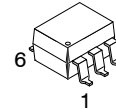
- High Sensitivity to Low Input Drive Current
- Meets or Exceeds All JEDEC Registered Specifications
- Safety and Regulatory Approvals:
  - ♦ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - ♦ DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

### Applications

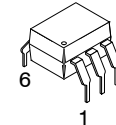
- Low Power Logic Circuits
- Telecommunications Equipment
- Portable Electronics
- Solid State Relays
- Interfacing Coupling Systems of Different Potentials and Impedances



PDIP6  
CASE 646BX

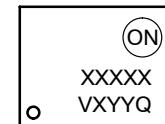


PDIP6  
S SUFFIX  
CASE 646BY



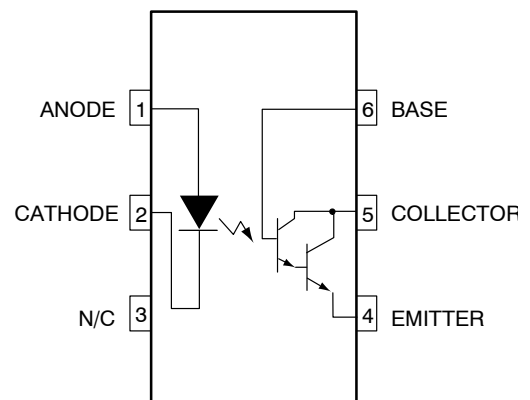
PDIP6  
T SUFFIX  
CASE 646BZ

### MARKING DIAGRAM



- ON = Logo  
 XXXXX = Specific Device Code  
 V = DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)  
 X = One-Digit Year Code  
 YY = Digit Work Week  
 Q = Assembly Package Code

### SCHEMATIC



### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

## 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M

**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            |
| Climatic Classification                                                             |                        | 55/100/21       |
| 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> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC  | 1360             | V <sub>peak</sub> |
|                       | Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC | 1594             | V <sub>peak</sub> |
| V <sub>IORM</sub>     | Maximum Working Insulation Voltage                                                                                                                             | 850              | V <sub>peak</sub> |
| V <sub>IOTM</sub>     | Highest Allowable Over-Voltage                                                                                                                                 | 6000             | V <sub>peak</sub> |
|                       | External Creepage                                                                                                                                              | ≥7               | mm                |
|                       | External Clearance                                                                                                                                             | ≥7               | mm                |
|                       | External Clearance (for Option TV, 0.4" Lead Spacing)                                                                                                          | ≥10              | mm                |
| DTI                   | Distance Through Insulation (Insulation Thickness)                                                                                                             | ≥0.5             | mm                |
| T <sub>S</sub>        | Case Temperature (Note 1)                                                                                                                                      | 175              | °C                |
| I <sub>S,INPUT</sub>  | Input Current (Note 1)                                                                                                                                         | 350              | mA                |
| P <sub>S,OUTPUT</sub> | Output Power (Note 1)                                                                                                                                          | 800              | 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 values – maximum values allowed in the event of a failure.

# 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M

## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                              | Value              | Unit  |
|---------------------|--------------------------------------------------------|--------------------|-------|
| <b>TOTAL DEVICE</b> |                                                        |                    |       |
| 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 seconds | °C    |
| P <sub>D</sub>      | Total Device Power Dissipation @ T <sub>A</sub> = 25°C | 270                | mW    |
|                     | Derate Above 25°C                                      | 3.3                | mW/°C |

## EMITTER

|                    |                                                |     |       |
|--------------------|------------------------------------------------|-----|-------|
| I <sub>F</sub>     | Continuous Forward Current                     | 80  | mA    |
| V <sub>R</sub>     | Reverse Voltage                                | 3   | V     |
| I <sub>F(pk)</sub> | Forward Current – Peak (300 μs, 2% Duty Cycle) | 3.0 | A     |
| P <sub>D</sub>     | LED Power Dissipation @ T <sub>A</sub> = 25°C  | 120 | mW    |
|                    | Derate Above 25°C                              | 2.0 | mW/°C |

## DETECTOR

|                   |                                                    |     |       |
|-------------------|----------------------------------------------------|-----|-------|
| BV <sub>CEO</sub> | Collector–Emitter Breakdown Voltage                | 30  | V     |
| BV <sub>CBO</sub> | Collector–Base Breakdown Voltage                   | 30  | V     |
| BV <sub>ECO</sub> | Emitter–Collector Breakdown Voltage                | 5   | V     |
| P <sub>D</sub>    | Detector Power Dissipation @ T <sub>A</sub> = 25°C | 150 | mW    |
|                   | Derate Above 25°C                                  | 2.0 | mW/°C |
| I <sub>C</sub>    | Continuous Collector Current                       | 150 | mA    |

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.

## ELECTRICAL CHARACTERISTICS – INDIVIDUAL COMPONENT CHARACTERISTICS

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

| Symbol         | Parameter                        | Test Conditions                   | Device          | Min | Typ   | Max | Unit |
|----------------|----------------------------------|-----------------------------------|-----------------|-----|-------|-----|------|
| <b>EMITTER</b> |                                  |                                   |                 |     |       |     |      |
| V <sub>F</sub> | Input Forward Voltage (Note 2)   | I <sub>F</sub> = 10 mA            | 4NXXM           | –   | 1.2   | 1.5 | V    |
|                |                                  |                                   | H11B1M, TIL113M | 0.8 | 1.2   | 1.5 | V    |
| I <sub>R</sub> | Reverse Leakage Current (Note 2) | V <sub>R</sub> = 3.0 V            | 4NXXM           | –   | 0.001 | 100 | μA   |
|                |                                  | V <sub>R</sub> = 6.0 V            | H11B1M, TIL113M | –   | 0.001 | 10  | μA   |
| C              | Capacitance (Note 2)             | V <sub>F</sub> = 0 V, f = 1.0 MHz | All             | –   | 150   | –   | pF   |

## DETECTOR

|                   |                                              |                                             |                 |     |     |     |    |
|-------------------|----------------------------------------------|---------------------------------------------|-----------------|-----|-----|-----|----|
| BV <sub>CEO</sub> | Collector–Emitter Breakdown Voltage (Note 2) | I <sub>C</sub> = 1.0 mA, I <sub>B</sub> = 0 | 4NXXM, TIL113M  | 30  | 60  | –   | V  |
|                   |                                              |                                             | H11B1M          | 25  | 60  | –   | V  |
| BV <sub>CBO</sub> | Collector–Base Breakdown Voltage (Note 2)    | I <sub>C</sub> = 100 μA, I <sub>E</sub> = 0 | All             | 30  | 100 | –   | V  |
| BV <sub>ECO</sub> | Emitter–Collector Breakdown Voltage (Note 2) | I <sub>E</sub> = 100 μA, I <sub>B</sub> = 0 | 4NXXM           | 5.0 | 10  | –   | V  |
|                   |                                              |                                             | H11B1M, TIL113M | 7   | 10  | –   | V  |
| I <sub>CEO</sub>  | Collector–Emitter Dark Current (Note 2)      | V <sub>CE</sub> = 10 V, Base Open           | All             | –   | 1   | 100 | nA |

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.

2. Indicates JEDEC registered data.

# 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M

## ELECTRICAL CHARACTERISTICS – TRANSFER CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol                    | Parameter                                              | Test Conditions                                              | Device          | Min      | Typ | Max  | Unit   |
|---------------------------|--------------------------------------------------------|--------------------------------------------------------------|-----------------|----------|-----|------|--------|
| <b>DC CHARACTERISTICS</b> |                                                        |                                                              |                 |          |     |      |        |
| $I_{C(CTR)}$              | Collector Output Current<br>(Note 3) (Note 4) (Note 5) | $I_F = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ ,<br>$I_B = 0$ | 4N32M,<br>4N33M | 50 (500) | –   | –    | mA (%) |
|                           |                                                        |                                                              | 4N29M,<br>4N30M | 10 (100) | –   | –    | mA (%) |
|                           |                                                        | $I_F = 1\text{ mA}$ , $V_{CE} = 5\text{ V}$                  | H11B1M          | 5 (500)  | –   | –    | mA (%) |
|                           |                                                        | $I_F = 10\text{ mA}$ , $V_{CE} = 1\text{ V}$                 | TIL113M         | 30 (300) | –   | –    | mA (%) |
| $V_{CE(SAT)}$             | Saturation Voltage (Note 3) (Note 5)                   | $I_F = 8\text{ mA}$ , $I_C = 2.0\text{ mA}$                  | 4NXXM           | –        | –   | 1.0  | V      |
|                           |                                                        |                                                              | TIL113M         | –        | –   | 1.25 | V      |
|                           |                                                        | $I_F = 1\text{ mA}$ , $I_C = 1\text{ mA}$                    | H11B1M          | –        | –   | 1.0  | V      |

## AC CHARACTERISTIC

|           |                             |                                                                                                |                             |   |    |     |               |
|-----------|-----------------------------|------------------------------------------------------------------------------------------------|-----------------------------|---|----|-----|---------------|
| $t_{ON}$  | Turn-on Time                | $I_F = 200\text{ mA}$ , $I_C = 50\text{ mA}$ ,<br>$V_{CC} = 10\text{ V}$ , $R_L = 100\ \Omega$ | 4NXXM,<br>TIL113M           | – | –  | 5.0 | $\mu\text{s}$ |
|           |                             | $I_F = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ ,<br>$R_L = 100\ \Omega$                         | H11B1M                      | – | 25 | –   | $\mu\text{s}$ |
| $t_{OFF}$ | Turn-off Time               | $I_F = 200\text{ mA}$ , $I_C = 50\text{ mA}$ ,<br>$V_{CC} = 10\text{ V}$ , $R_L = 100\ \Omega$ | 4N32M,<br>4N33M,<br>TIL113M | – | –  | 100 | $\mu\text{s}$ |
|           |                             |                                                                                                | 4N29M,<br>4N30M             | – | –  | 40  | $\mu\text{s}$ |
|           |                             | $I_F = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$ ,<br>$R_L = 100\ \Omega$                         | H11B1M                      | – | 18 | –   | $\mu\text{s}$ |
| BW        | Bandwidth (Note 6) (Note 7) |                                                                                                |                             | – | 30 | –   | kHz           |

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.

3. Indicates JEDEC registered data.

4. The current transfer ratio ( $I_C/I_F$ ) is the ratio of the detector collector current to the LED input current.

5. Pulse test: pulse width = 300  $\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

6.  $I_F$  adjusted to  $I_C = 2.0\text{ mA}$  and  $I_C = 0.7\text{ mA rms}$ .

7. The frequency at which  $I_C$  is 3 dB down from the 1 kHz value.

## ELECTRICAL CHARACTERISTICS – ISOLATION CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol    | Parameter                      | Test Conditions                                           | Min       | Typ | Max | Unit               |
|-----------|--------------------------------|-----------------------------------------------------------|-----------|-----|-----|--------------------|
| $V_{ISO}$ | Input–Output Isolation Voltage | $t = 1\text{ Minute}$                                     | 4170      | –   | –   | VAC <sub>RMS</sub> |
| $C_{ISO}$ | Isolation Capacitance          | $V_{I-O} = 0\text{ V}$ , $f = 1\text{ MHz}$               | –         | 0.2 | –   | pF                 |
| $R_{ISO}$ | Isolation Resistance           | $V_{I-O} = \pm 500\text{ VDC}$ , $T_A = 25^\circ\text{C}$ | $10^{11}$ | –   | –   | $\Omega$           |

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.

TYPICAL PERFORMANCE CURVES

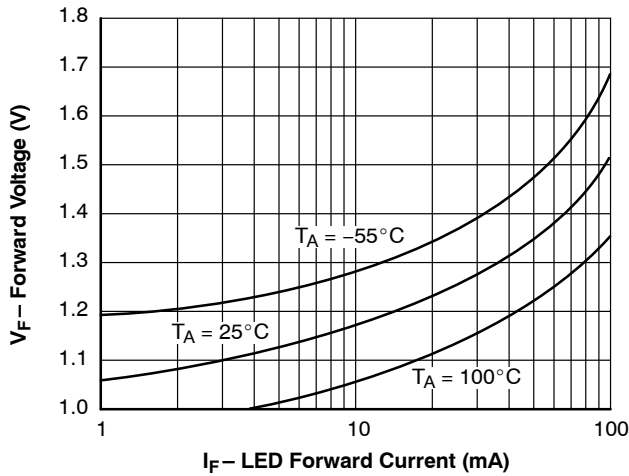


Figure 1. LED Forward Voltage vs. Forward Current

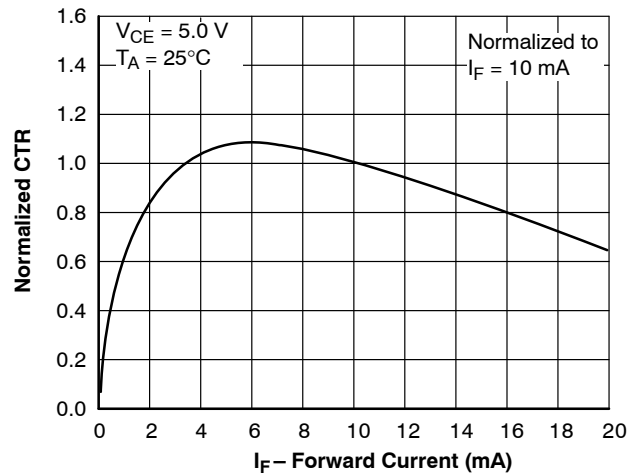


Figure 2. Normalized CTR vs. Forward Current

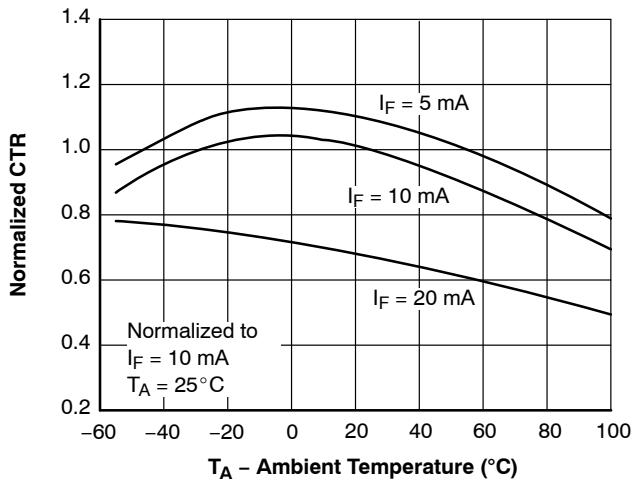


Figure 3. Normalized CTR vs. Ambient Temperature

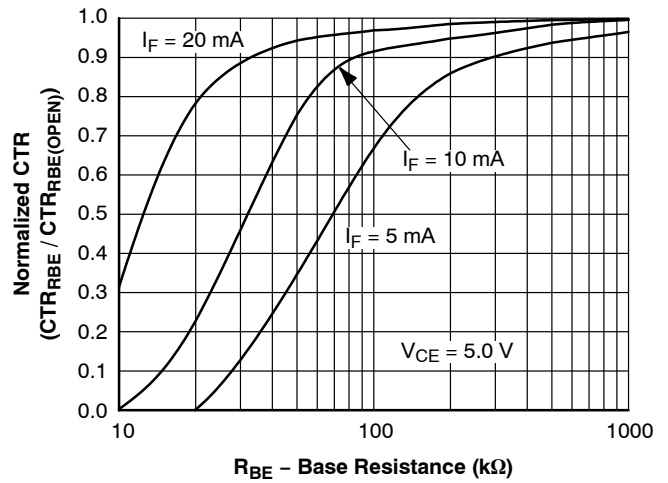


Figure 4. CTR vs. R\_BE (Unsaturated)

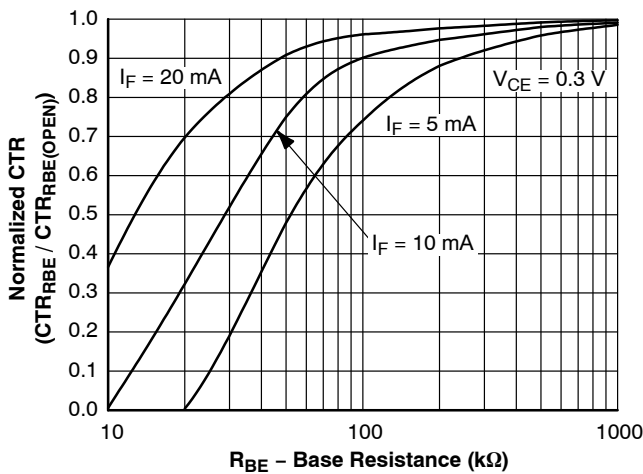


Figure 5. CTR vs. R\_BE (Saturated)

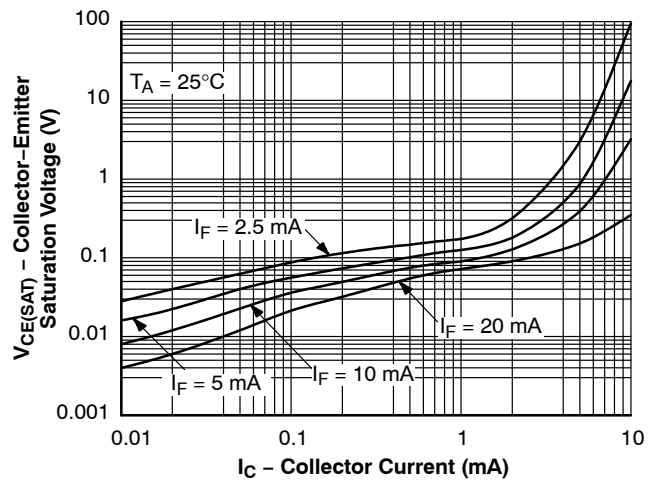


Figure 6. Collector-Emitter Saturation Voltage vs. Collector Current

TYPICAL PERFORMANCE CURVES (continued)

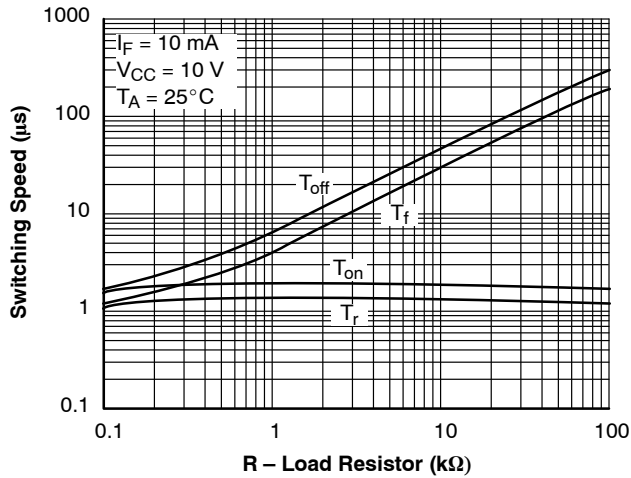


Figure 7. Switching Speed vs. Load Resistor

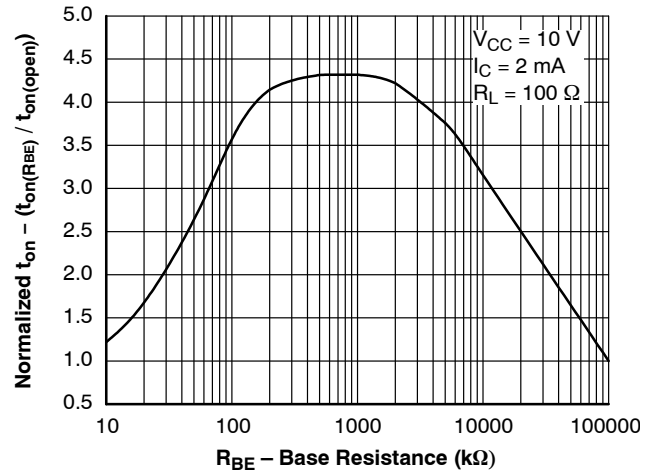


Figure 8. Normalized  $t_{on}$  vs.  $R_{BE}$

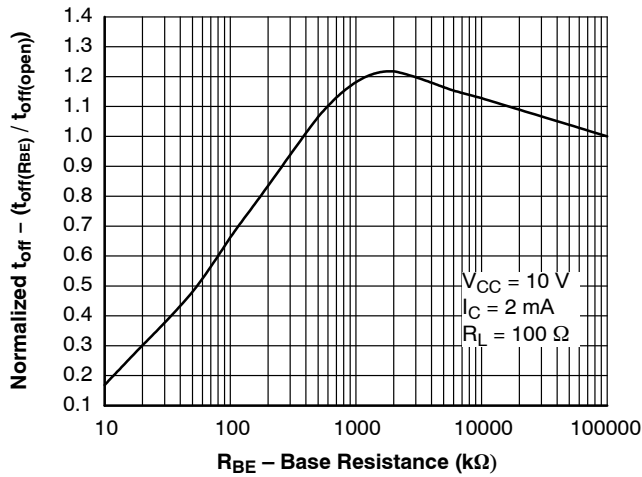


Figure 9. Normalized  $t_{off}$  vs.  $R_{BE}$

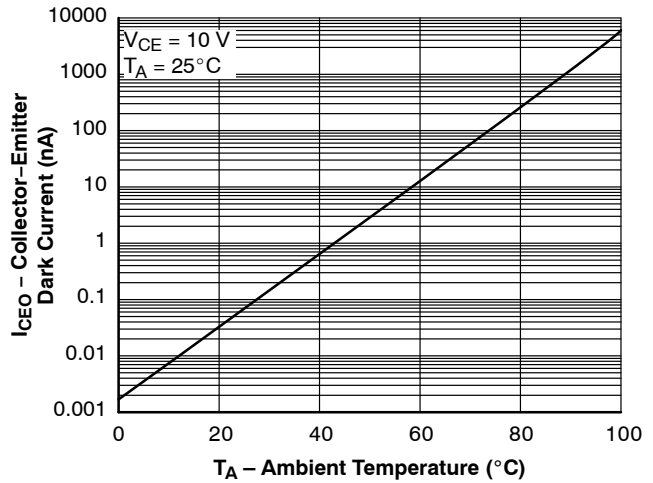


Figure 10. Dark Current vs. Ambient Temperature

SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

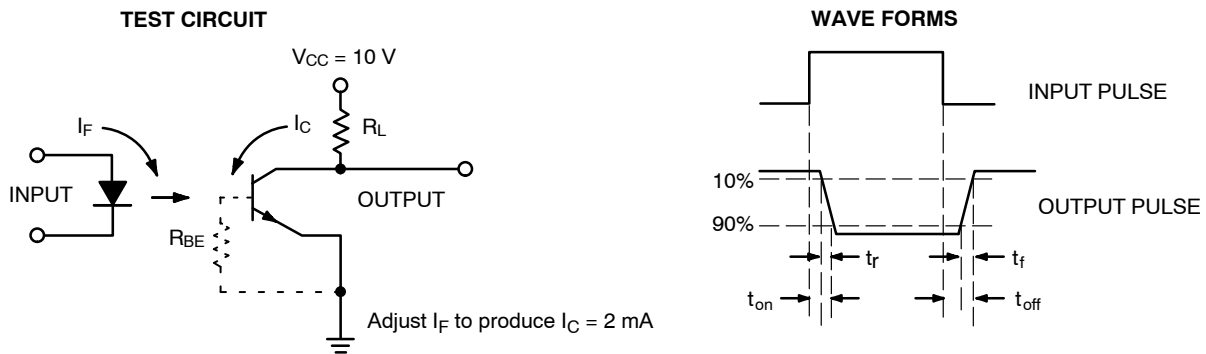


Figure 11. Switching Time Test Circuit and Waveforms

## REFLOW PROFILE

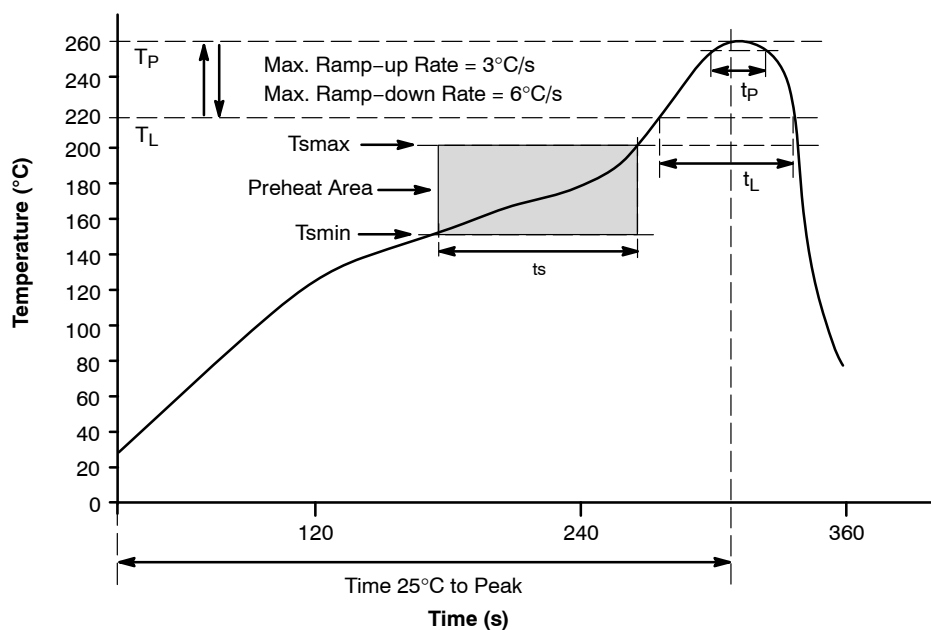


Figure 12. Reflow Profile

## 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 s                 |
| Ramp-up Rate (t <sub>L</sub> to t <sub>P</sub> )                    | 3°C/s max.               |
| Liquidous Temperature (T <sub>L</sub> )                             | 217°C                    |
| Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )           | 60–150 s                 |
| Peak Body Package Temperature                                       | 260°C +0°C / -5°C        |
| Time (t <sub>P</sub> ) within 5°C of 260°C                          | 30 s                     |
| Ramp-down Rate (T <sub>P</sub> to T <sub>L</sub> )                  | 6°C/s max.               |
| Time 25°C to Peak Temperature                                       | 8 min max.               |

## 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M

### ORDERING INFORMATION

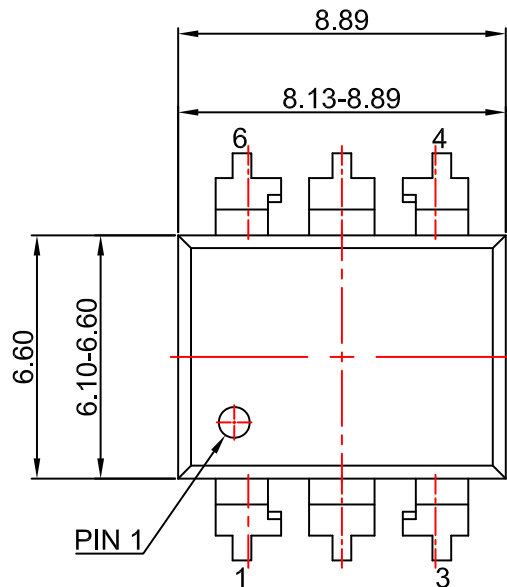
| Part Number | Package                                                  | Packing Method <sup>†</sup> |
|-------------|----------------------------------------------------------|-----------------------------|
| 4N29M       | DIP 6-Pin                                                | 50 Units / Tube             |
| 4N29SM      | SMT 6-Pin (Lead Bend)                                    | 50 Units / Tube             |
| 4N29SR2M    | SMT 6-Pin (Lead Bend)                                    | 1000 / Tape & Reel          |
| 4N29VM      | DIP 6-Pin, DIN EN/IEC60747-5-5 Option                    | 50 Units / Tube             |
| 4N29SVM     | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | 50 Units / Tube             |
| 4N29SR2VM   | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | 1000 / Tape & Reel          |
| 4N29TVM     | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | 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.

8. The product orderable part number system listed in this table also applies to the 4N30M, 4N32M, 4N33M, H11B1M and TIL113M devices.

**PDIP6 8.51x6.35, 2.54P**  
**CASE 646BX**  
**ISSUE O**

DATE 31 JUL 2016



**NOTES:**

- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

|                         |                               |                                                                                                                                                                                     |
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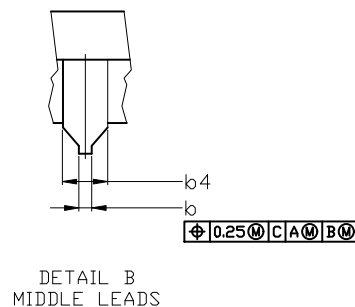
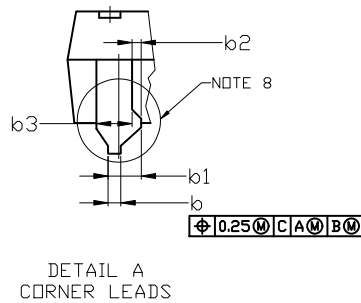
**PDIP6 8.51x6.35, 2.54P**  
**CASE 646BY**  
**ISSUE A**

DATE 15 JUL 2019


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS IS LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | ---         | ---  | 4.80 |
| A1  | 0.38        | ---  | ---  |
| A2  | 3.28        | 3.40 | 3.53 |
| A3  | 2.49 REF    |      |      |
| A4  | 1.89 REF    |      |      |
| b   | 0.41        | 0.46 | 0.51 |
| b1  | 0.76        | 0.92 | 1.14 |
| b2  | 0.25        | 0.28 | 0.36 |
| b3  | 1.02        | 1.40 | 1.78 |
| b4  | 1.778 REF   |      |      |
| c   | 0.20        | 0.25 | 0.30 |
| D   | 8.13        | 8.51 | 8.89 |
| D1  | 0.86 REF    |      |      |
| E   | 6.10        | 6.35 | 6.60 |
| E1  | 8.43        | 9.17 | 9.90 |
| E2  | 8.13 REF    |      |      |
| e   | 2.54 BSC    |      |      |
| L   | 0.16        | 0.52 | 0.88 |



- For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

|                         |                               |                                                                                                                                                                                  |
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