

# 6-Pin General Purpose Phototransistor Optocouplers

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

### Description

The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a standard plastic 6-pin dual-in-line package.

### Features

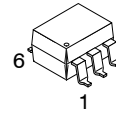
- Minimum Current Transfer Ratio at  $I_F = 10 \text{ mA}$ ,  $V_{CE} = 10 \text{ V}$ :
  - 10% for 4N27M and 4N28M
  - 20% for 4N25M and 4N26M
  - 100% for 4N35M and 4N36M and 4N37M
- Safety and Regulatory Approvals:
  - UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

### Applications

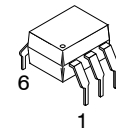
- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs



PDIP6  
CASE 646BX

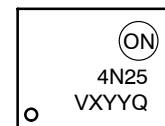


PDIP6  
S SUFFIX  
CASE 646BY



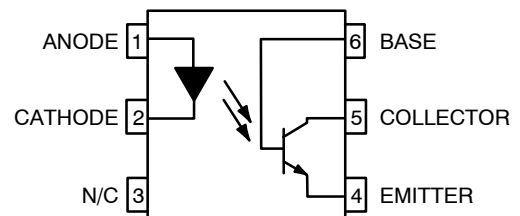
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CASE 646BZ

### MARKING DIAGRAM



- ON = Logo  
 4N25 = 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.

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

**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.

# 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                              | Max                | 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                                      | 2.94               | mW/°C |

## EMITTER

|                    |                                                |      |       |
|--------------------|------------------------------------------------|------|-------|
| I <sub>F</sub>     | DC / Average Forward Input Current             | 60   | mA    |
| V <sub>R</sub>     | Reverse Input Voltage                          | 6    | V     |
| I <sub>F(pk)</sub> | Forward Current – Peak (300 µs, 2% Duty Cycle) | 3    | A     |
| P <sub>D</sub>     | LED Power Dissipation @ T <sub>A</sub> = 25°C  | 120  | mW    |
|                    | Derate Above 25°C                              | 1.41 | mW/°C |

## DETECTOR

|                  |                                                    |      |       |
|------------------|----------------------------------------------------|------|-------|
| V <sub>CEO</sub> | Collector–to–Emitter Voltage                       | 30   | V     |
| V <sub>CBO</sub> | Collector–to–Base Voltage                          | 70   | V     |
| V <sub>ECO</sub> | Emitter–to–Collector Voltage                       | 7    | V     |
| P <sub>D</sub>   | Detector Power Dissipation @ T <sub>A</sub> = 25°C | 150  | mW    |
|                  | Derate Above 25°C                                  | 1.76 | mW/°C |

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.

# 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

## ELECTRICAL CHARACTERISTICS – INDIVIDUAL COMPONENT CHARACTERISTICS

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

| Symbol         | Parameter               | Test Conditions        | Min | Typ   | Max  | Unit |
|----------------|-------------------------|------------------------|-----|-------|------|------|
| <b>EMITTER</b> |                         |                        |     |       |      |      |
| V <sub>F</sub> | Input Forward Voltage   | I <sub>F</sub> = 10 mA | –   | 1.18  | 1.50 | V    |
| I <sub>R</sub> | Reverse Leakage Current | V <sub>R</sub> = 6.0 V | –   | 0.001 | 10   | μA   |

## DETECTOR

|                   |                                        |                                             |    |     |    |    |
|-------------------|----------------------------------------|---------------------------------------------|----|-----|----|----|
| BV <sub>CEO</sub> | Collector-to-Emitter Breakdown Voltage | I <sub>C</sub> = 1.0 mA, I <sub>F</sub> = 0 | 30 | 100 | –  | V  |
| BV <sub>CBO</sub> | Collector-to-Base Breakdown Voltage    | I <sub>C</sub> = 100 μA, I <sub>F</sub> = 0 | 70 | 120 | –  | V  |
| BV <sub>ECO</sub> | Emitter-to-Collector Breakdown Voltage | I <sub>E</sub> = 100 μA, I <sub>F</sub> = 0 | 7  | 10  | –  | V  |
| I <sub>CEO</sub>  | Collector-to-Emitter Dark Current      | V <sub>CE</sub> = 10 V, I <sub>F</sub> = 0  | –  | 1   | 50 | nA |
| I <sub>CBO</sub>  | Collector-to-Base Dark Current         | V <sub>CB</sub> = 10 V                      | –  | –   | 20 | nA |
| C <sub>CE</sub>   | Capacitance                            | V <sub>CE</sub> = 0 V, f = 1 MHz            | –  | 8   | –  | 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.

## ELECTRICAL CHARACTERISTICS – TRANSFER CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                    | Parameter                                    | Test Conditions                                                         | Device                     | Min | Typ | Max | Unit |
|---------------------------|----------------------------------------------|-------------------------------------------------------------------------|----------------------------|-----|-----|-----|------|
| <b>DC CHARACTERISTICS</b> |                                              |                                                                         |                            |     |     |     |      |
| CTR                       | Current Transfer Ratio, Collector-to-Emitter | I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V                          | 4N35M, 4N36M, 4N37M        | 100 | –   | –   | %    |
|                           |                                              |                                                                         | 4N25M, 4N26M               | 20  | –   | –   |      |
|                           |                                              |                                                                         | 4N27M, 4N28M               | 10  | –   | –   |      |
|                           |                                              | I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V, T <sub>A</sub> = –55°C  | 4N35M, 4N36M, 4N37M        | 40  | –   | –   |      |
|                           |                                              | I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V, T <sub>A</sub> = +100°C | 4N35M, 4N36M, 4N37M        | 40  | –   | –   |      |
| V <sub>CE</sub> (SAT)     | Collector-to-Emitter Saturation Voltage      | I <sub>C</sub> = 2 mA, I <sub>F</sub> = 50 mA                           | 4N25M, 4N26M, 4N27M, 4N28M | –   | –   | 0.5 | V    |
|                           |                                              | I <sub>C</sub> = 0.5 mA, I <sub>F</sub> = 10 mA                         | 4N35M, 4N36M, 4N37M        | –   | –   | 0.3 |      |

## AC CHARACTERISTIC

|                  |                            |                                                                                    |                            |   |   |    |    |
|------------------|----------------------------|------------------------------------------------------------------------------------|----------------------------|---|---|----|----|
| T <sub>ON</sub>  | Non-Saturated Turn-on Time | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11) | 4N25M, 4N26M, 4N27M, 4N28M | – | 2 | –  | μs |
|                  |                            | I <sub>C</sub> = 2 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11)  | 4N35M, 4N36M, 4N37M        | – | 2 | 10 |    |
| T <sub>OFF</sub> | Turn-off Time              | I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11) | 4N25M, 4N26M, 4N27M, 4N28M | – | 2 | –  | μs |
|                  |                            | I <sub>C</sub> = 2 mA, V <sub>CC</sub> = 10 V, R <sub>L</sub> = 100 Ω (Figure 11)  | 4N35M, 4N36M, 4N37M        | – | 2 | 10 |    |

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.

## ELECTRICAL CHARACTERISTICS – ISOLATION CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol           | Parameter                      | Test Conditions                                    | Min              | Typ | Max | Unit               |
|------------------|--------------------------------|----------------------------------------------------|------------------|-----|-----|--------------------|
| V <sub>ISO</sub> | Input-Output Isolation Voltage | t = 1 Minute                                       | 4170             | –   | –   | V <sub>ACRMS</sub> |
| C <sub>ISO</sub> | Isolation Capacitance          | V <sub>I-O</sub> = 0 V, f = 1 MHz                  | –                | 0.2 | –   | pF                 |
| R <sub>ISO</sub> | Isolation Resistance           | V <sub>I-O</sub> = ±500 VDC, T <sub>A</sub> = 25°C | 10 <sup>11</sup> | –   | –   | Ω                  |

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

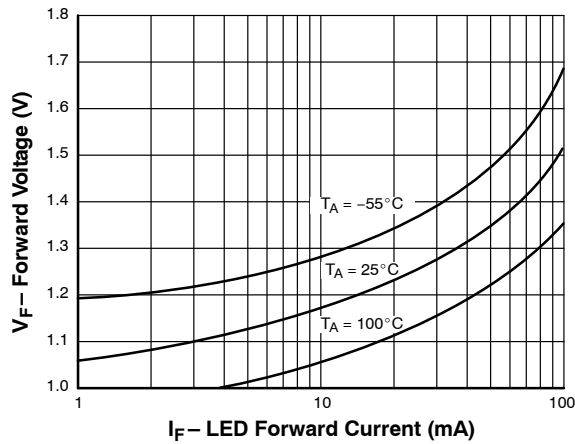


Figure 1. LED Forward Voltage vs. Forward Current

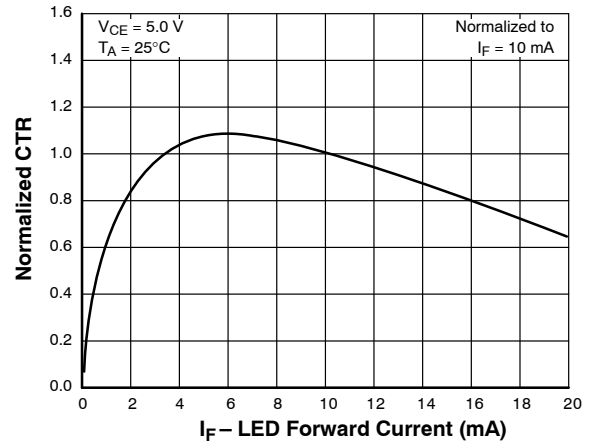


Figure 2. Normalized CTR vs. Forward Current

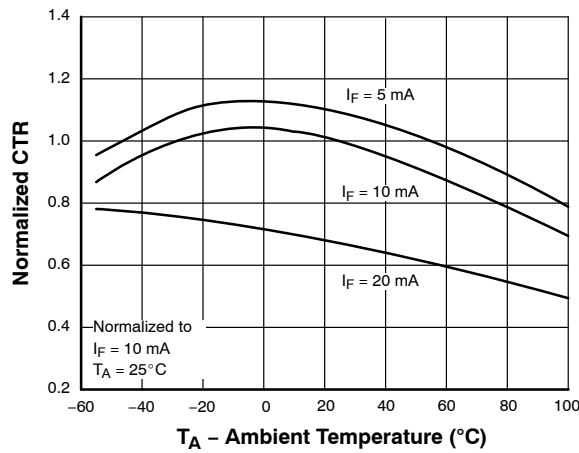


Figure 3. Normalized CTR vs. Ambient Temperature

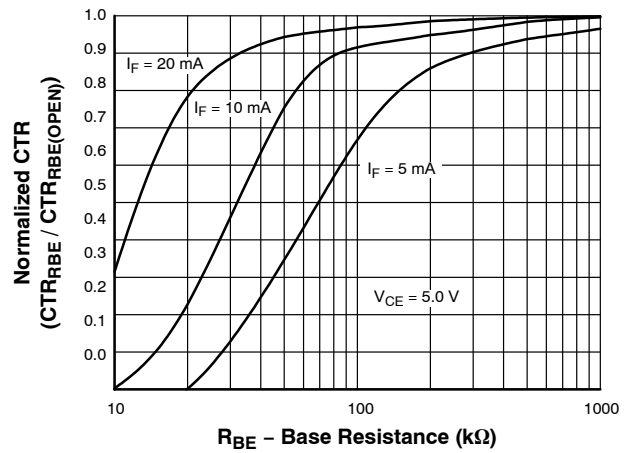


Figure 4. CTR vs. R\_BE (Unsaturated)

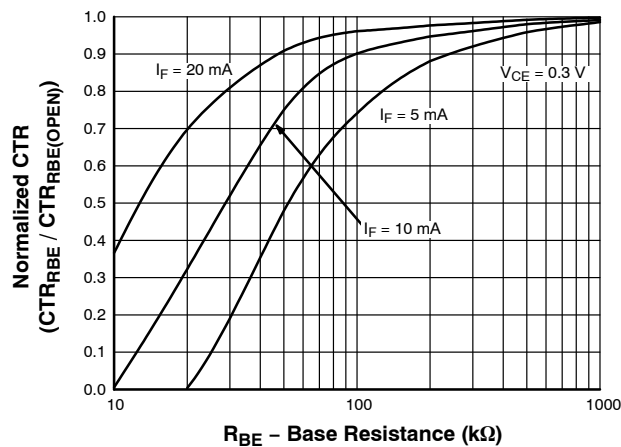


Figure 5. CTR vs. R\_BE (Saturated)

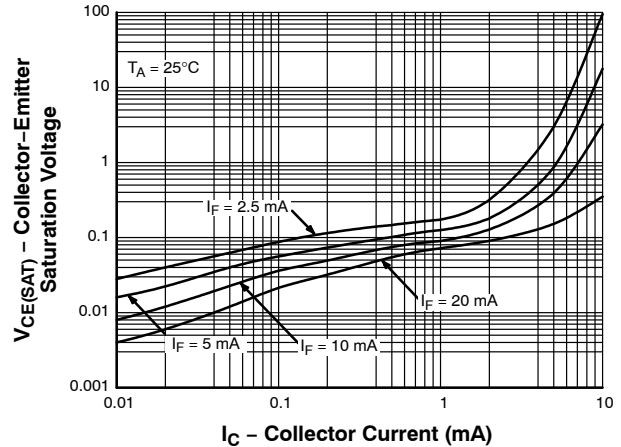


Figure 6. Collector-Emitter Saturation Voltage vs. Collector Current

# 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

## TYPICAL PERFORMANCE CURVES (continued)

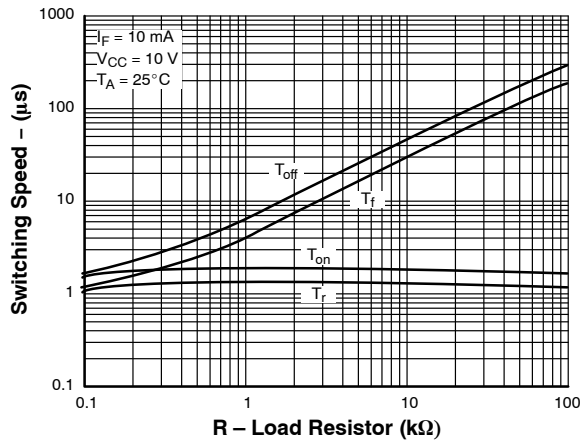


Figure 7. Switching Speed vs. Load Resistor

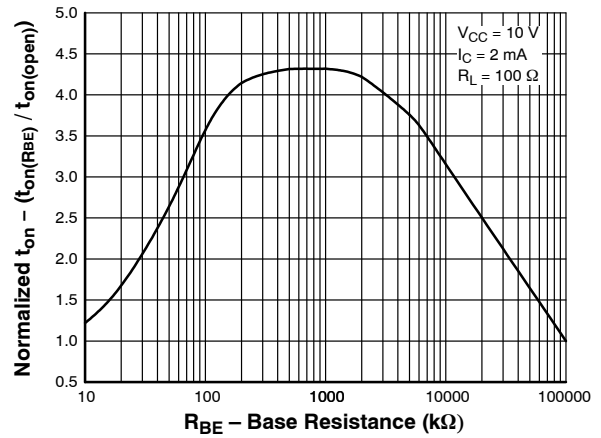


Figure 8. Normalized ton vs. RBE

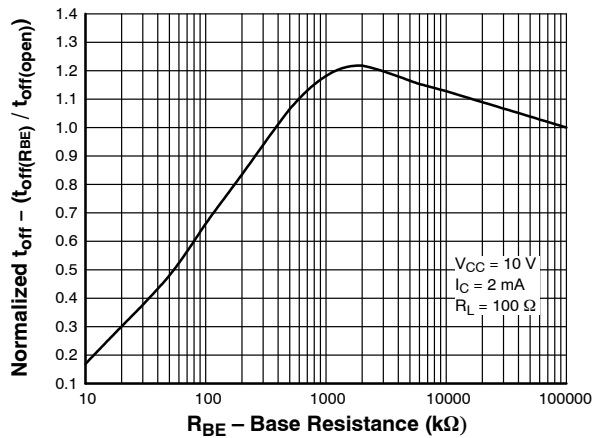


Figure 9. Normalized toff vs. RBE

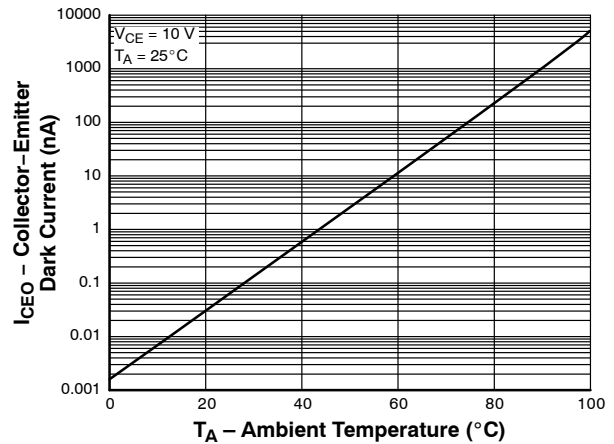


Figure 10. Dark Current vs. Ambient Temperature

## SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

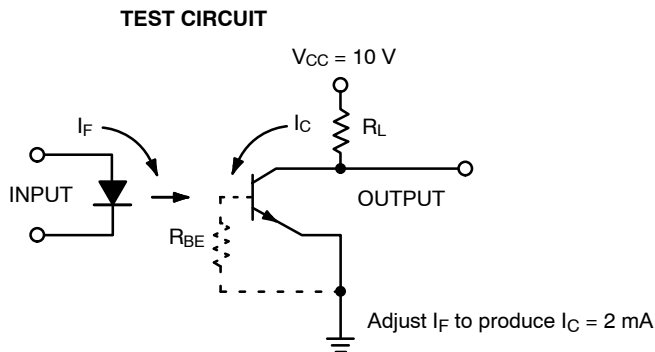
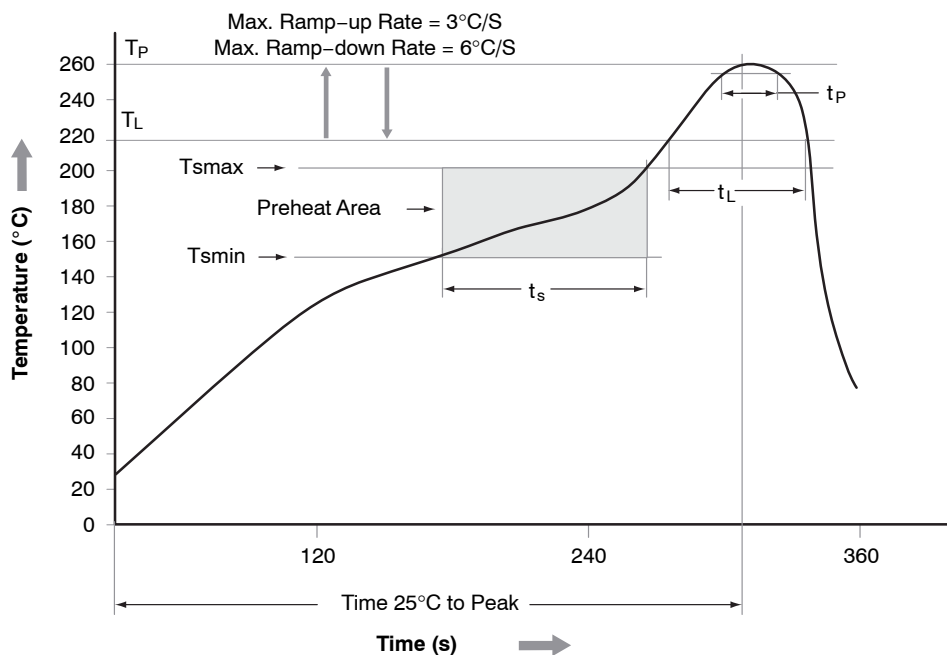


Figure 11. Switching Time Test Circuit and Waveform

# REFLOW PROFILE



| Profile Feature                                  | Pb-Free Assembly Profile |
|--------------------------------------------------|--------------------------|
| Temperature Min. ( $T_{smin}$ )                  | 150°C                    |
| Temperature Max. ( $T_{smax}$ )                  | 200°C                    |
| Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ ) | 60–120 seconds           |
| Ramp-up Rate ( $t_L$ to $t_p$ )                  | 3°C/second max.          |
| 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.           |

Figure 12. Reflow Profile

## 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M

### ORDERING INFORMATION (Note 2)

| Part Number | Package                                                     | Shipping <sup>†</sup>    |
|-------------|-------------------------------------------------------------|--------------------------|
| 4N25M       | DIP 6-Pin                                                   | 50 Units / Tube          |
| 4N25SM      | SMT 6-Pin (Lead Bend)                                       | 50 Units / Tube          |
| 4N25SR2M    | SMT 6-Pin (Lead Bend)                                       | 1000 Units / Tape & Reel |
| 4N25VM      | DIP 6-Pin, DIN EN/IEC60747-5-5 Option                       | 50 Units / Tube          |
| 4N25SVM     | SMT 6-Pin (Lead Bend),<br>DIN EN/IEC60747-5-5 Option        | 50 Units / Tube          |
| 4N25SR2VM   | SMT 6-Pin (Lead Bend),<br>DIN EN/IEC60747-5-5 Option        | 1000 Units / Tape & Reel |
| 4N25TVM     | DIP 6-Pin, 0.4" Lead Spacing,<br>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.

2. The product orderable part number system listed in this table also applies to the 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, and 4N37M 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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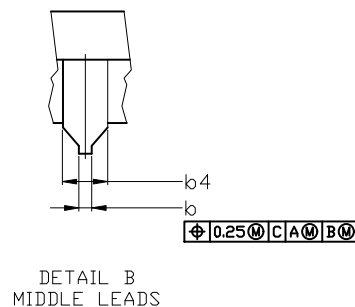
**PDIP6 8.51x6.35, 2.54P**  
**CASE 646BY**  
**ISSUE A**

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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CASE 646BZ  
ISSUE O

DATE 31 JUL 2016



**NOTES:**

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- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

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