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December 2014

# 4N29M, 4N30M, 4N32M, 4N33M, H11B1M, TIL113M
# 6-Pin DIP General Purpose Photodarlington Optocoupler

## Features

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

## Description

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

## Applications

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

## Schematic

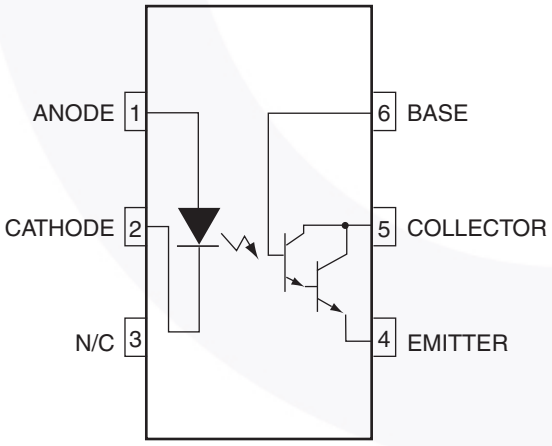



**Figure 1. Schematic**

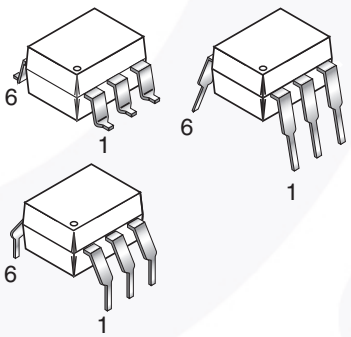



**Figure 2. Package Outlines**



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## 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 $V_{RMS}$ | I–IV |
| | < 300 $V_{RMS}$ | I–IV |
| Climatic Classification | | 55/100/21 |
| Pollution Degree (DIN VDE 0110/1.89) | | 2 |
| Comparative Tracking Index | | 175 |

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{PR}$ | Input-to-Output Test Voltage, Method A, $V_{IORM}$ x 1.6 = $V_{PR}$, Type and Sample Test with $t_m$ = 10 s, Partial Discharge < 5 pC | 1360 | $V_{peak}$ |
| | Input-to-Output Test Voltage, Method B, $V_{IORM}$ x 1.875 = $V_{PR}$, 100% Production Test with $t_m$ = 1 s, Partial Discharge < 5 pC | 1594 | $V_{peak}$ |
| $V_{IORM}$ | Maximum Working Insulation Voltage | 850 | $V_{peak}$ |
| $V_{IOTM}$ | Highest Allowable Over-Voltage | 6000 | $V_{peak}$ |
| | 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 |
| $T_S$ | Case Temperature[1] | 175 | °C |
| $I_{S,INPUT}$ | Input Current[1] | 350 | mA |
| $P_{S,OUTPUT}$ | Output Power[1] | 800 | mW |
| $R_{IO}$ | Insulation Resistance at $T_S$, $V_{IO}$ = 500 V[1] | > $10^9$ | Ω |

**Note:**

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

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## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| **TOTAL DEVICE** | | | |
| $T_{STG}$ | Storage Temperature | -40 to +125 | °C |
| $T_{OPR}$ | Operating Temperature | -40 to +100 | °C |
| $T_J$ | Junction Temperature | -40 to +125 | °C |
| $T_{SOL}$ | Lead Solder Temperature | 260 for 10 seconds | °C |
| $P_D$ | Total Device Power Dissipation @ $T_A$ = 25°C | 270 | mW |
| | Derate Above 25°C | 3.3 | mW/°C |
| **EMITTER** | | | |
| $I_F$ | Continuous Forward Current | 80 | mA |
| $V_R$ | Reverse Voltage | 3 | V |
| $I_F$(pk) | Forward Current – Peak (300 µs, 2% Duty Cycle) | 3.0 | A |
| $P_D$ | LED Power Dissipation @ $T_A$ = 25°C | 120 | mW |
| | Derate above 25°C | 2.0 | mW/°C |
| **DETECTOR** | | | |
| $BV_{CEO}$ | Collector-Emitter Breakdown Voltage | 30 | V |
| $BV_{CBO}$ | Collector-Base Breakdown Voltage | 30 | V |
| $BV_{ECO}$ | Emitter-Collector Breakdown Voltage | 5 | V |
| $P_D$ | Detector Power Dissipation @ $T_A$ = 25°C | 150 | mW |
| | Derate Above 25°C | 2.0 | mW/°C |
| $I_C$ | Continuous Collector Current | 150 | mA |

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## Electrical Characteristics

$T_A$ = 25°C Unless otherwise specified.

### Individual Component Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | | |
| $V_F$ | Input Forward Voltage(2) | $I_F$ = 10 mA | 4NXXM | | 1.2 | 1.5 | V |
| | | | H11B1M, TIL113M | 0.8 | 1.2 | 1.5 | V |
| $I_R$ | Reverse Leakage Current(2) | $V_R$ = 3.0 V | 4NXXM | | 0.001 | 100 | µA |
| | | $V_R$ = 6.0 V | H11B1M, TIL113M | | 0.001 | 10 | µA |
| C | Capacitance(2) | $V_F$ = 0V, f = 1.0 MHz | All | | 150 | | pF |
| **DETECTOR** | | | | | | | |
| $BV_{CEO}$ | Collector-Emitter Breakdown Voltage(2) | $I_C$ = 1.0 mA, $I_B$ = 0 | 4NXXM, TIL113M | 30 | 60 | | V |
| | | | H11B1M | 25 | 60 | | V |
| $BV_{CBO}$ | Collector-Base Breakdown Voltage(2) | $I_C$ = 100 µA, $I_E$ = 0 | All | 30 | 100 | | V |
| $BV_{ECO}$ | Emitter-Collector Breakdown Voltage(2) | $I_E$ = 100 µA, $I_B$ = 0 | 4NXXM | 5.0 | 10 | | V |
| | | | H11B1M, TIL113M | 7 | 10 | | V |
| $I_{CEO}$ | Collector-Emitter Dark Current(2) | $V_{CE}$ = 10 V, Base Open | All | | 1 | 100 | nA |

**Notes:**

2. Indicates JEDEC registered data.

## Electrical Characteristics (Continued)

$T_A$ = 25°C Unless otherwise specified.

### Transfer Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| $I_{C(CTR)}$ | Collector Output Current[3][4][5] | $I_F$ = 10 mA, $V_{CE}$ = 10 V, $I_B$ = 0 | 4N32M, 4N33M | 50 (500) | | | mA (%) |
| | | | 4N29M, 4N30M | 10 (100) | | | mA (%) |
| | | $I_F$ = 1 mA, $V_{CE}$ = 5 V | H11B1M | 5 (500) | | | mA (%) |
| | | $I_F$ = 10 mA, $V_{CE}$ = 1 V | TIL113M | 30 (300) | | | mA (%) |
| $V_{CE(SAT)}$ | Saturation Voltage[3][5] | $I_F$ = 8 mA, $I_C$ = 2.0 mA | 4NXXM | | | 1.0 | V |
| | | | TIL113M | | | 1.25 | V |
| | | $I_F$ = 1 mA, $I_C$ = 1 mA | H11B1M | | | 1.0 | V |
| **AC CHARACTERISTICS** | | | | | | | |
| $t_{on}$ | Turn-on Time | $I_F$ = 200 mA, $I_C$ = 50 mA, $V_{CC}$ = 10 V, $R_L$ = 100 Ω | 4NXXM, TIL113M | | | 5.0 | µs |
| | | $I_F$ = 10 mA, $V_{CE}$ = 10 V, $R_L$ = 100 Ω | H11B1M | | 25 | | µs |
| $t_{off}$ | Turn-off Time | $I_F$ = 200 mA, $I_C$ = 50 mA, $V_{CC}$ = 10 V, $R_L$ = 100 Ω | 4N32M, 4N33M, TIL113M | | | 100 | µs |
| | | | 4N29M, 4N30M | | | 40 | µs |
| | | $I_F$ = 10 mA, $V_{CE}$ = 10 V, $R_L$ = 100 Ω | H11B1M | | 18 | | µs |
| BW | Bandwidth[6][7] | | | | 30 | | kHz |

**Notes:**

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 µs, duty cycle ≤ 2.0% .
6. $I_F$ adjusted to $I_C$ = 2.0 mA and $I_C$ = 0.7 mA rms.
7. The frequency at which $I_C$ is 3 dB down from the 1 kHz value.

### Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{ISO}$ | Input-Output Isolation Voltage | t = 1 Minute | 4170 | | | $VAC_{RMS}$ |
| $C_{ISO}$ | Isolation Capacitance | $V_{I-O}$ = 0 V, f = 1 MHz | | 0.2 | | pF |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = ±500 VDC, $T_A$ = 25°C | $10^{11}$ | | | Ω |

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## Typical Performance Curves

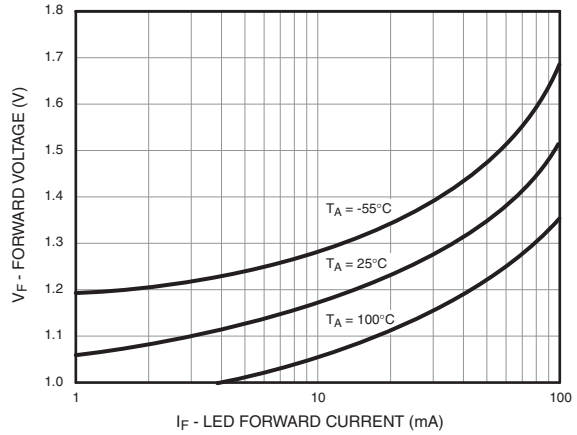



**Figure 3. LED Forward Voltage vs. Forward Current**

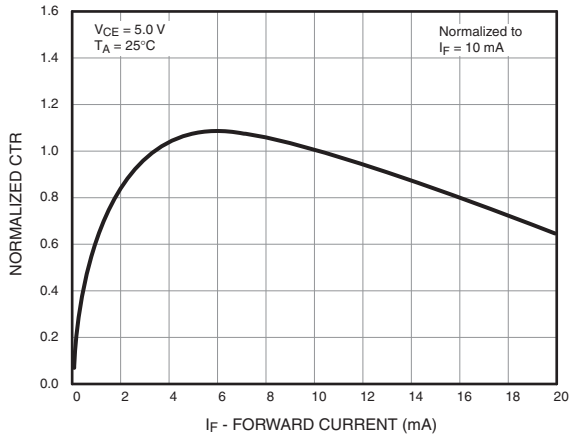



**Figure 4. Normalized CTR vs. Forward Current**

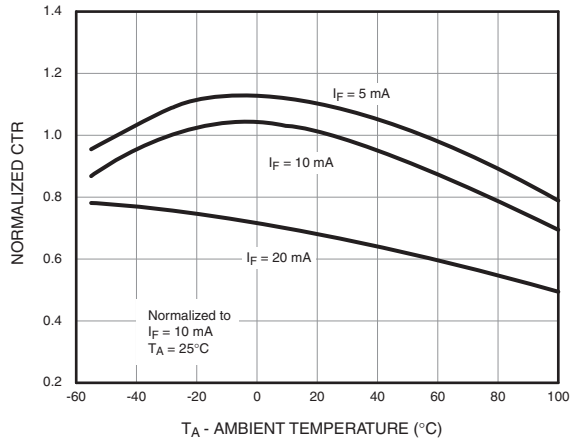



**Figure 5. Normalized CTR vs. Ambient Temperature**

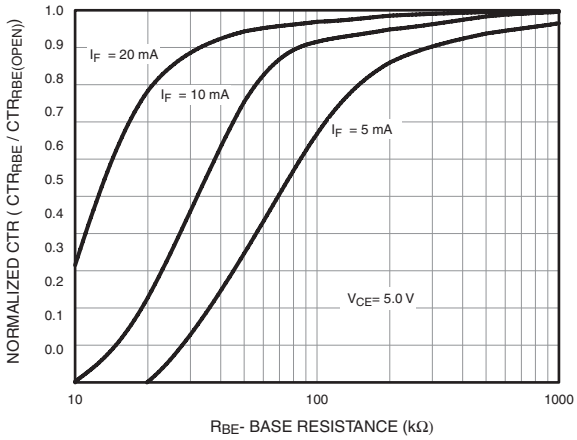



**Figure 6. CTR vs. RBE (Unsaturated)**

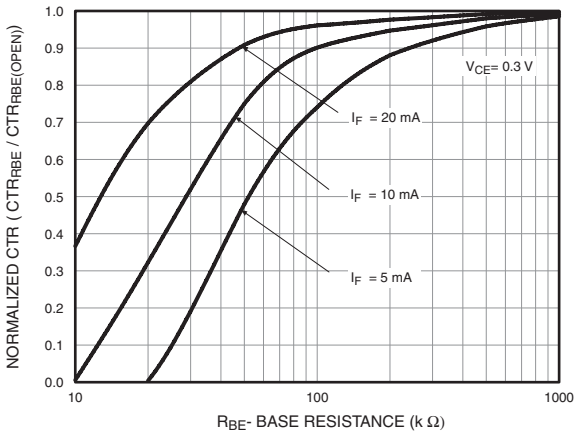



**Figure 7. CTR vs. RBE (Saturated)**

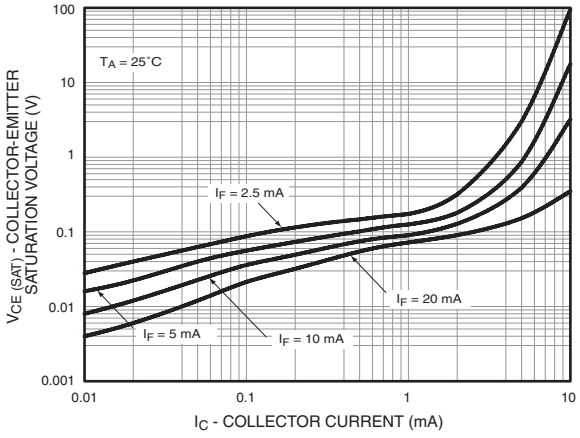



**Figure 8. Collector-Emitter Saturation Voltage vs. Collector Current**

## Typical Performance Curves (Continued)

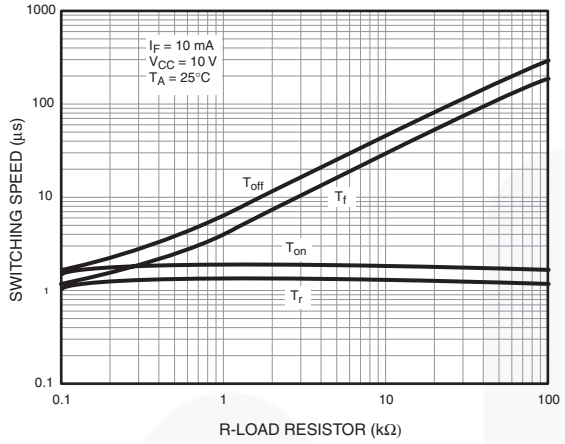



**Figure 9. Switching Speed vs. Load Resistor**

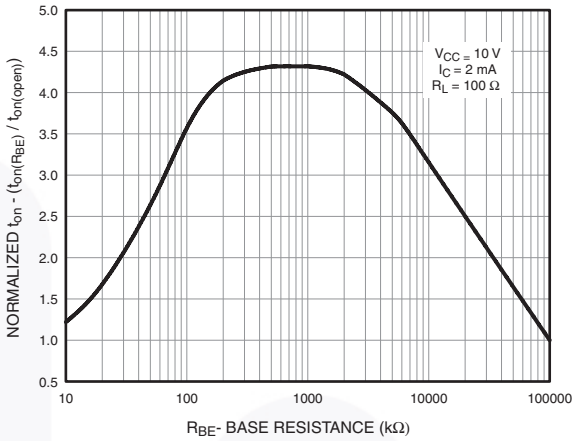



**Figure 10. Normalized $t_{on}$ vs. $R_{BE}$**

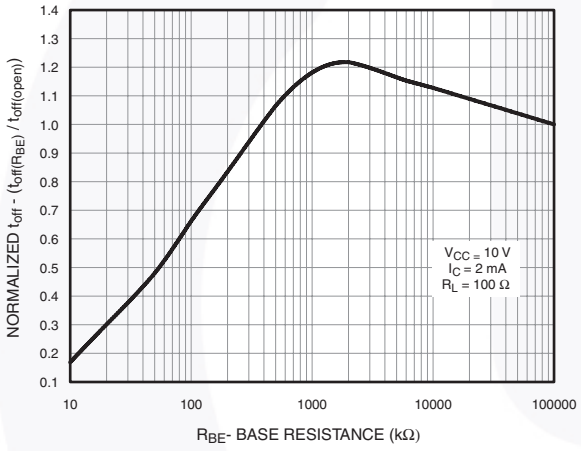



**Figure 11. Normalized $t_{off}$ vs. $R_{BE}$**

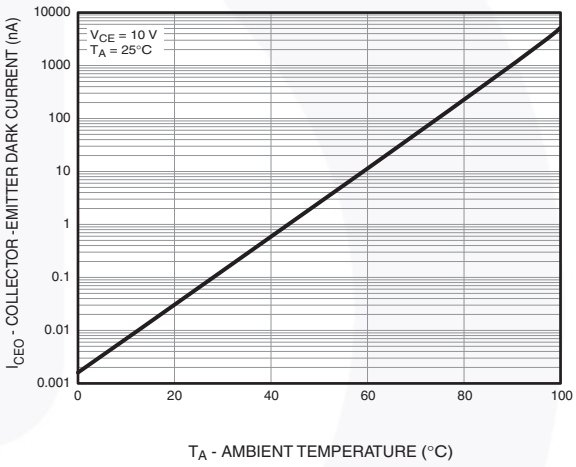



**Figure 12. Dark Current vs. Ambient Temperature**

## Switching Time Test Circuit and Waveform

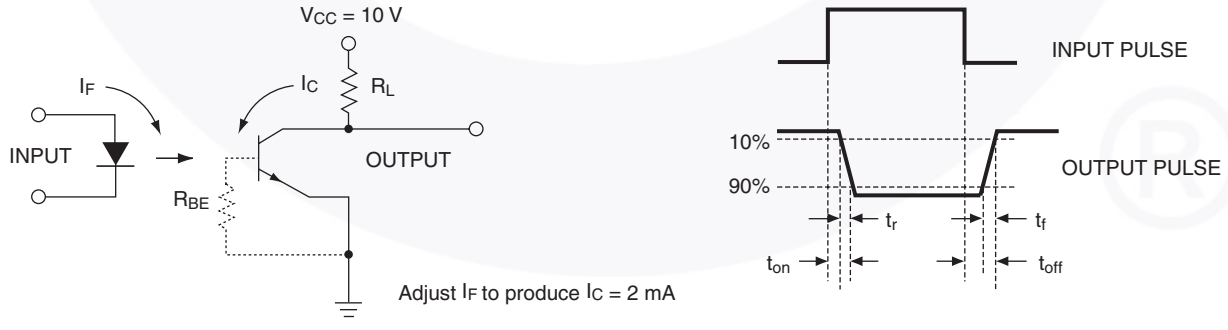



**Figure 13. Switching Time Test Circuit and Waveform**

## Reflow Profile

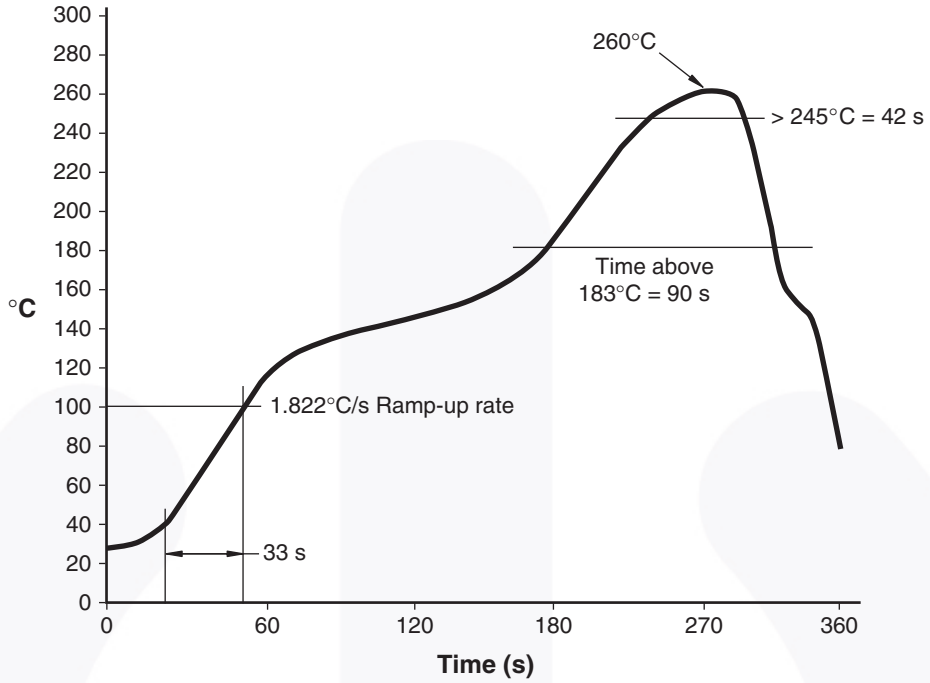



**Figure 14. Reflow Profile**

## Ordering Information

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

**Note:**

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

## Marking Information

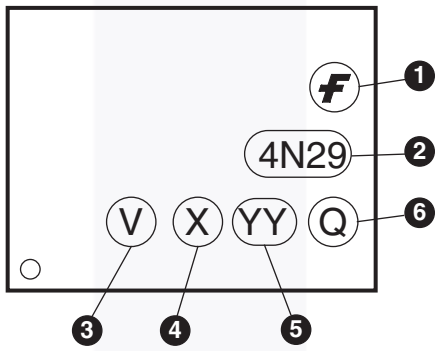
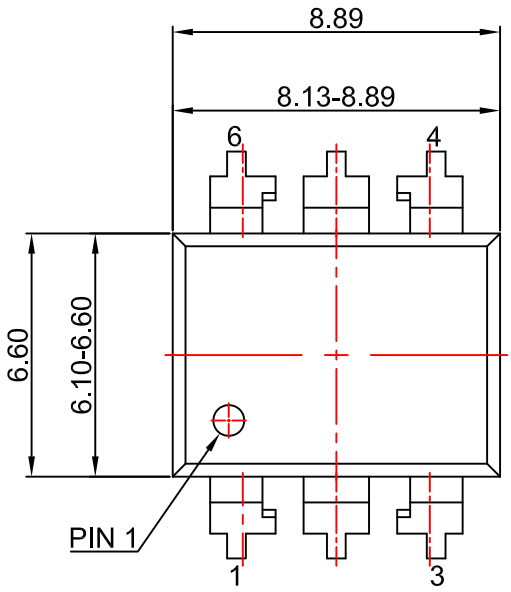
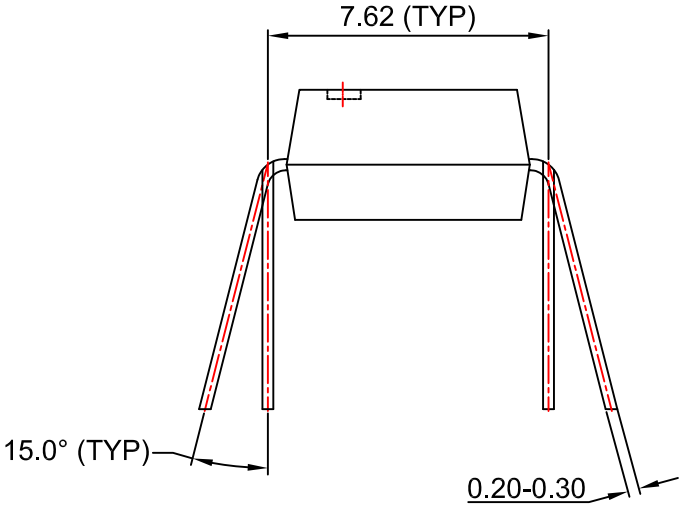


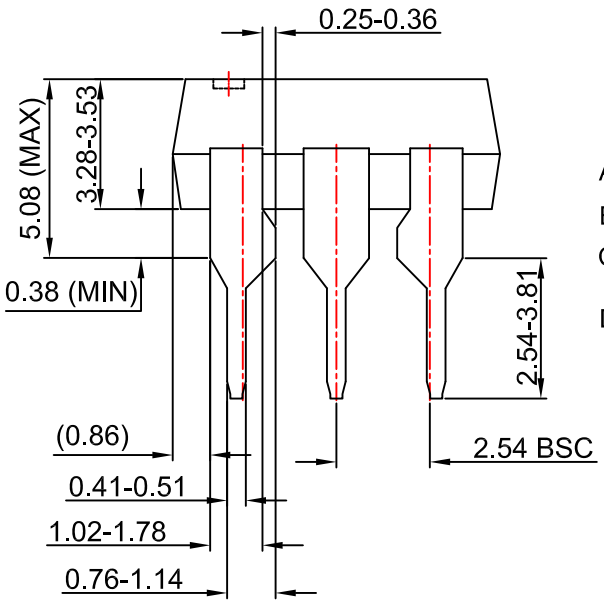

**Figure 15. Top Mark**

**Table 1. Top Mark Definitions**

| | |
|---|---|
| 1 | Fairchild Logo |
| 2 | Device Number |
| 3 | DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option) |
| 4 | One-Digit Year Code, e.g., “4” |
| 5 | Digit Work Week, Ranging from “01” to “53” |
| 6 | Assembly Package Code |




NOTES:

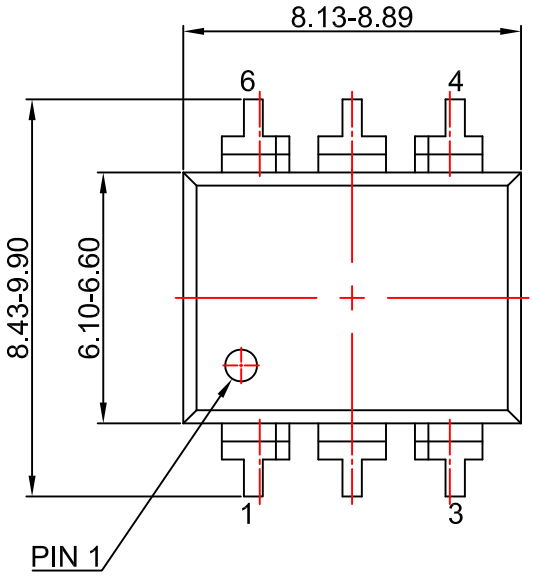
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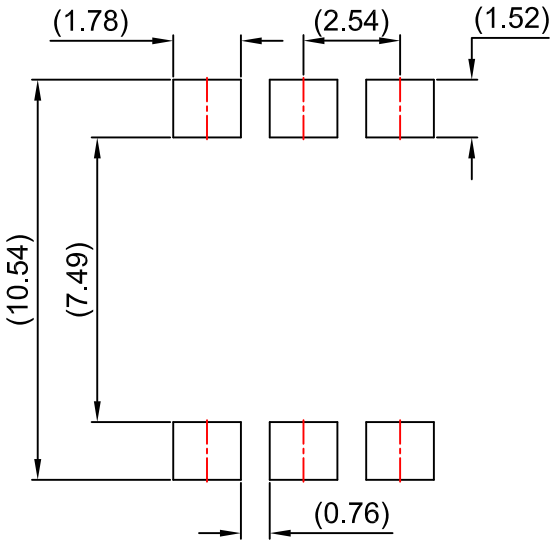
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C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

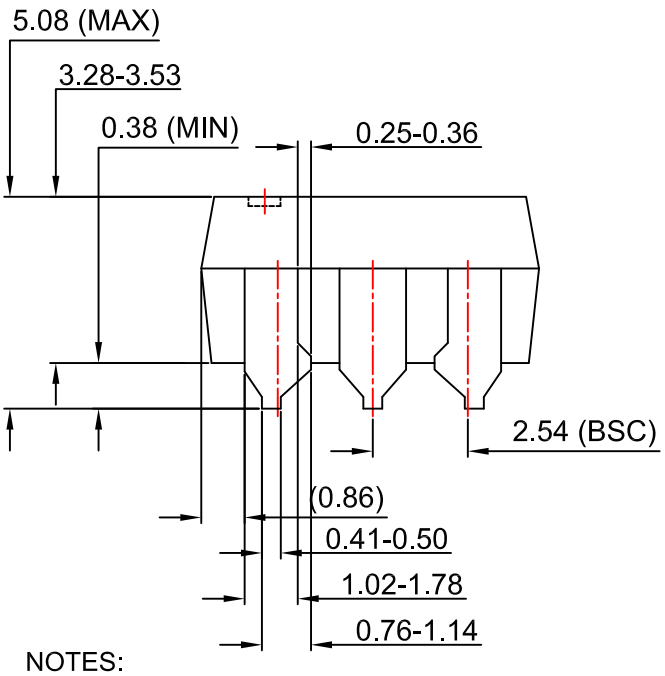
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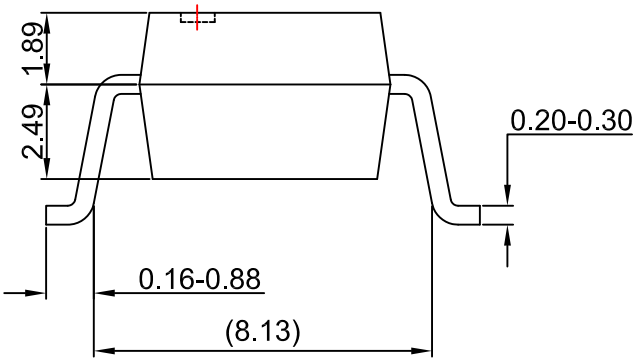
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LAND PATTERN RECOMMENDATION




NOTES:

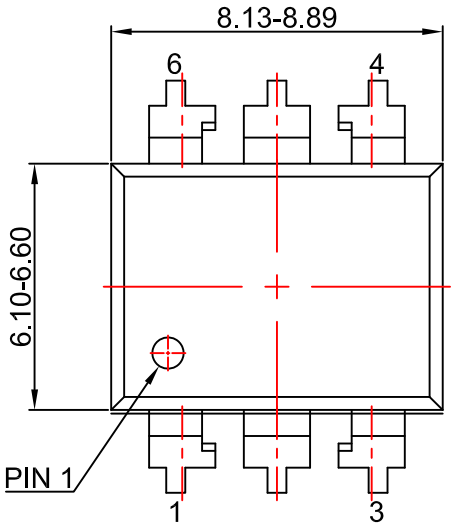
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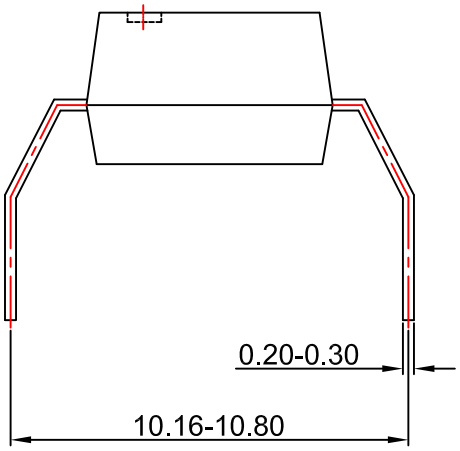
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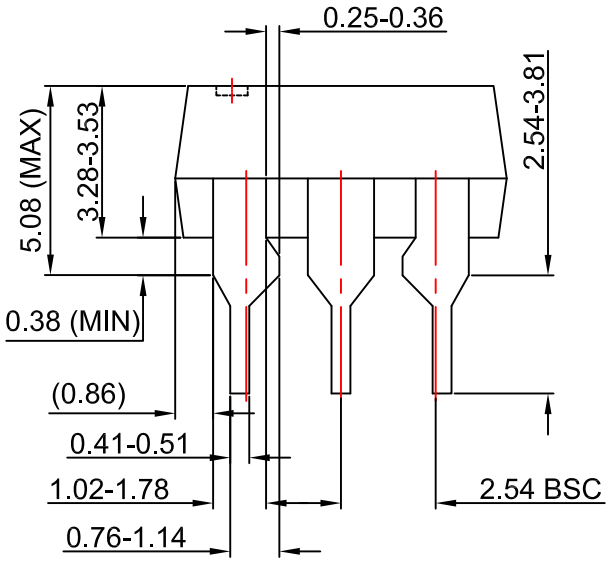
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