

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

Features

- High sensitivity to low input drive current
- Meets or exceeds all JEDEC Registered Specifications
- UL, C-UL approved, File #E90700, Volume 2
- IEC 60747-5-2 approved (ordering option V)

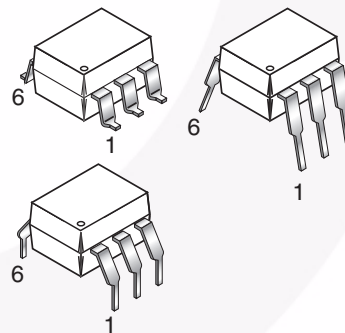
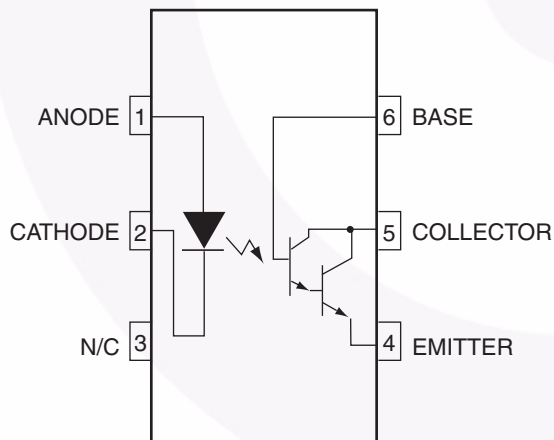
Applications

- Low power logic circuits
- Telecommunications equipment
- Portable electronics
- Solid state relays
- Interfacing coupling systems of different potentials and impedances

Description

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

Schematic



Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ unless otherwise specified.)

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 | Units |
|---------------------|--|----------------|----------------------------|
| TOTAL DEVICE | | | |
| T_{STG} | Storage Temperature | -50 to +150 | $^\circ\text{C}$ |
| T_{OPR} | Operating Temperature | -40 to +100 | $^\circ\text{C}$ |
| T_{SOL} | Lead Solder Temperature (Wave) | 260 for 10 sec | $^\circ\text{C}$ |
| P_D | Total Device Power Dissipation @ $T_A = 25^\circ\text{C}$ | 250 | mW |
| | Derate above 25°C | 3.3 | $\text{mW}/^\circ\text{C}$ |
| EMITTER | | | |
| I_F | Continuous Forward Current | 80 | mA |
| V_R | Reverse Voltage | 3 | V |
| $I_F(\text{pk})$ | Forward Current – Peak (300 μs , 2% Duty Cycle) | 3.0 | A |
| P_D | LED Power Dissipation @ $T_A = 25^\circ\text{C}$ | 150 | mW |
| | Derate above 25°C | 2.0 | $\text{mW}/^\circ\text{C}$ |
| 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 @ $T_A = 25^\circ\text{C}$ | 150 | mW |
| | Derate above 25°C | 2.0 | $\text{mW}/^\circ\text{C}$ |
| I_C | Continuous Collector Current | 150 | mA |

Electrical Characteristics ($T_A = 25^\circ\text{C}$ Unless otherwise specified.)**Individual Component Characteristics**

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

Transfer Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|---------------------------|---------------------------------|---|-----------------------------|----------|------|------|---------------|
| DC CHARACTERISTICS | | | | | | | |
| $I_{C(CTR)}$ | Collector Output Current*(1, 2) | $I_F = 10\text{mA}, V_{CE} = 10\text{V}, I_B = 0$ | 4N32M, 4N33M | 50 (500) | | | mA (%) |
| | | | 4N29M, 4N30M | 10 (100) | | | |
| | | $I_F = 1\text{mA}, V_{CE} = 5\text{V}$ | H11B1M | 5 (500) | | | |
| | | $I_F = 10\text{mA}, V_{CE} = 1\text{V}$ | TIL113M | 30 (300) | | | |
| $V_{CE(SAT)}$ | Saturation Voltage*(2) | $I_F = 8\text{mA}, I_C = 2.0\text{mA}$ | 4NXXM | | | 1.0 | V |
| | | | TIL113M | | | 1.25 | |
| | | $I_F = 1\text{mA}, I_C = 1\text{mA}$ | H11B1M | | | 1.0 | |
| AC CHARACTERISTICS | | | | | | | |
| t_{on} | Turn-on Time | $I_F = 200\text{mA}, I_C = 50\text{mA}, V_{CC} = 10\text{V}, R_L = 100\Omega$ | 4NXXM, TIL113M | | | 5.0 | μs |
| | | $I_F = 10\text{mA}, V_{CE} = 10\text{V}, R_L = 100\Omega$ | H11B1M | | 25 | | |
| t_{off} | Turn-off Time | $I_F = 200\text{mA}, I_C = 50\text{mA}, V_{CC} = 10\text{V}, R_L = 100\Omega$ | 4N32M, 4N33M, TIL113M | | | 100 | μs |
| | | | 4N29M, 4N30M | | | 40 | |
| | | $I_F = 10\text{mA}, V_{CE} = 10\text{V}, R_L = 100\Omega$ | H11B1M | | 18 | | |
| BW | Bandwidth*(3, 4) | | | | 30 | | kHz |

Electrical Characteristics ($T_A = 25^\circ\text{C}$ Unless otherwise specified.) (Continued)**Isolation Characteristics**

| Symbol | Characteristic | Test Conditions | Device | Min. | Typ. | Max. | Units |
|------------------|---|--|--------|-----------|------|------|----------------------|
| V_{ISO} | Input-Output Isolation Voltage ⁽⁵⁾ | $f = 60\text{Hz}$, $t = 1 \text{ sec.}$ | All | 7500 | | | $V_{\text{AC PEAK}}$ |
| | | VDC | 4N32M* | 2500 | | | V |
| | | VDC | 4N33M* | 1500 | | | |
| R_{ISO} | Isolation Resistance ⁽⁵⁾ | $V_{\text{I-O}} = 500\text{VDC}$ | All | 10^{11} | | | Ω |
| C_{ISO} | Isolation Capacitance ⁽⁵⁾ | $V_{\text{I-O}} = \emptyset$, $f = 1\text{MHz}$ | All | | 0.8 | | pF |

* Indicates JEDEC registered data.

Notes:

1. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current.
2. Pulse test: pulse width = $300\mu\text{s}$, duty cycle $\leq 2.0\%$.
3. I_F adjusted to $I_C = 2.0\text{mA}$ and $I_C = 0.7\text{mA rms}$.
4. The frequency at which I_C is 3dB down from the 1kHz value.
5. For this test, LED pins 1 and 2 are common, and phototransistor pins 4, 5 and 6 are common.

Safety and Insulation Ratings

As per IEC 60747-5-2, 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.

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-------------------|--|--------|-----------|------|-------------------|
| | Installation Classifications per DIN VDE 0110/1.89 Table 1 | | | | |
| | For Rated Main Voltage < 150Vrms | | I-IV | | |
| | For Rated Main voltage < 300Vrms | | I-IV | | |
| | Climatic Classification | | 55/100/21 | | |
| | Pollution Degree (DIN VDE 0110/1.89) | | 2 | | |
| CTI | Comparative Tracking Index | 175 | | | |
| V_{PR} | Input to Output Test Voltage, Method b, $V_{\text{IORM}} \times 1.875 = V_{\text{PR}}$, 100% Production Test with $t_m = 1 \text{ sec}$, Partial Discharge < 5pC | 1594 | | | V_{peak} |
| | Input to Output Test Voltage, Method a, $V_{\text{IORM}} \times 1.5 = V_{\text{PR}}$, Type and Sample Test with $t_m = 60 \text{ sec}$, Partial Discharge < 5pC | 1275 | | | V_{peak} |
| V_{IORM} | Max. Working Insulation Voltage | 850 | | | V_{peak} |
| V_{IOTM} | Highest Allowable Over Voltage | 6000 | | | V_{peak} |
| | External Creepage | 7 | | | mm |
| | External Clearance | 7 | | | mm |
| | Insulation Thickness | 0.5 | | | mm |
| RIO | Insulation Resistance at T_s , $V_{\text{IO}} = 500\text{V}$ | 10^9 | | | Ω |

Typical Performance Curves

Fig. 1 LED Forward Voltage vs. Forward Current

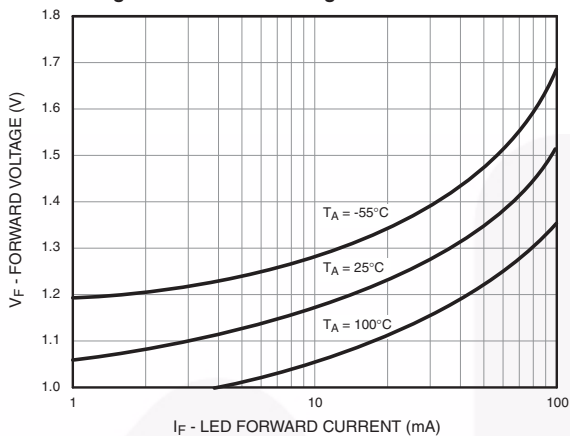


Fig. 2 Normalized CTR vs. Forward Current

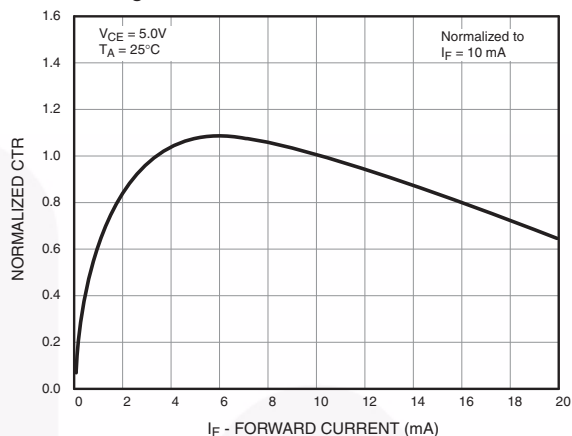


Fig. 3 Normalized CTR vs. Ambient Temperature

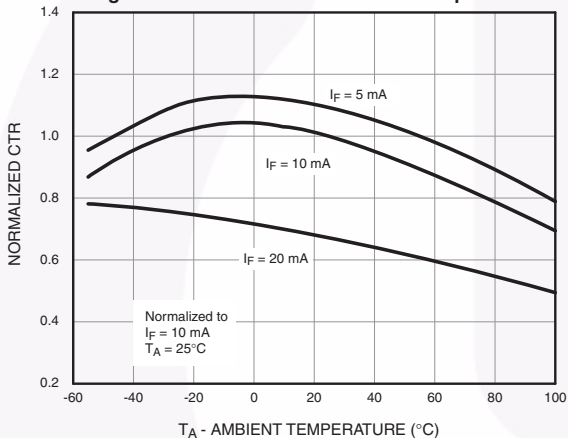


Fig. 4 CTR vs. RBE (Unsaturated)

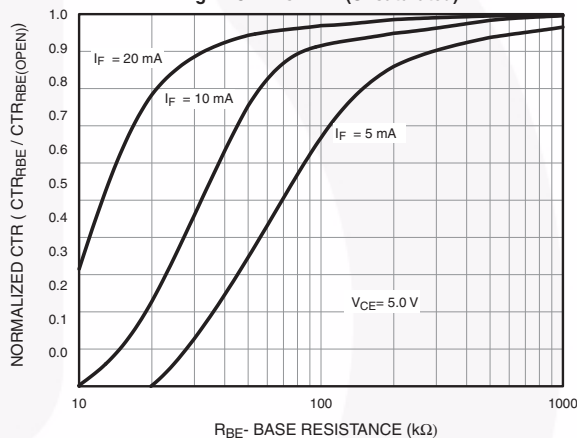


Fig. 5 CTR vs. RBE (Saturated)

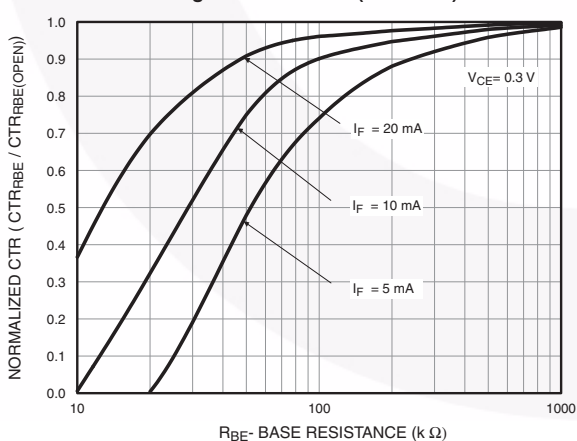
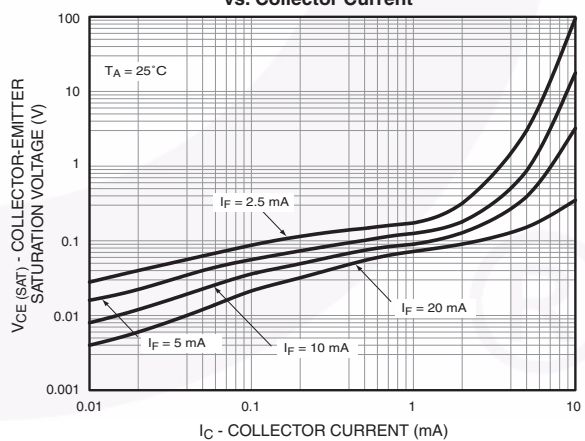


Fig. 6 Collector-Emitter Saturation Voltage vs. Collector Current



Typical Performance Curves (Continued)

Fig. 7 Switching Speed vs. Load Resistor

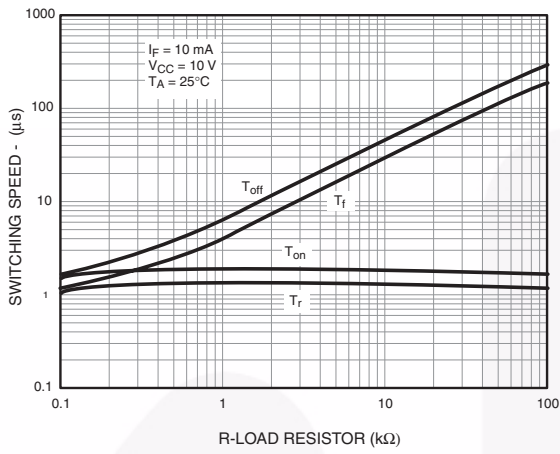


Fig. 8 Normalized t_{on} vs. R_{BE}

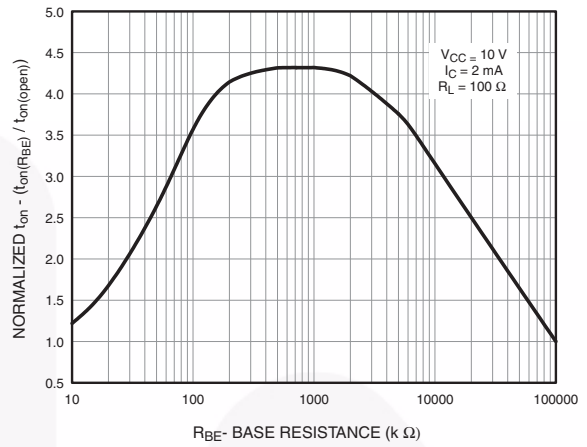


Fig. 9 Normalized t_{off} vs. R_{BE}

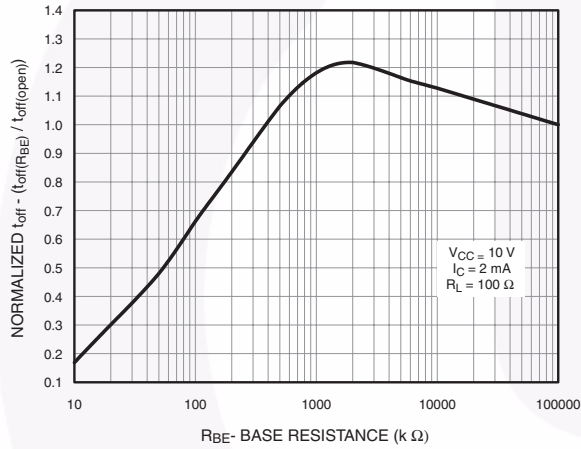
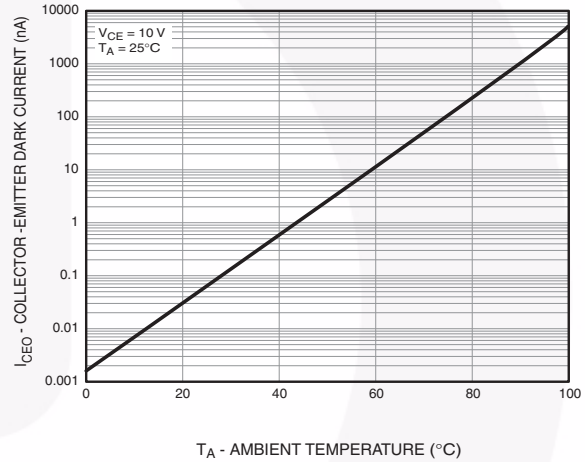
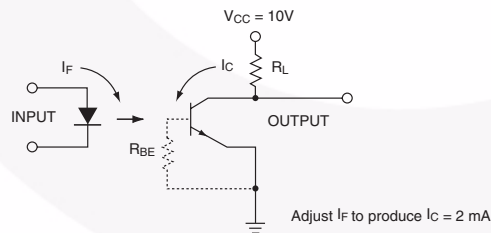


Fig. 10 Dark Current vs. Ambient Temperature



TEST CIRCUIT



WAVE FORMS

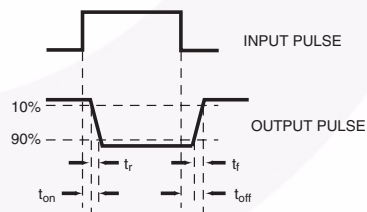
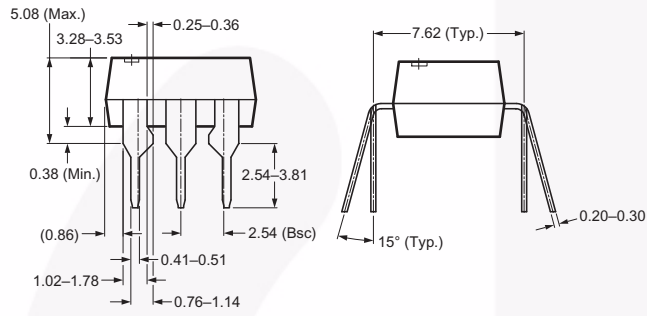
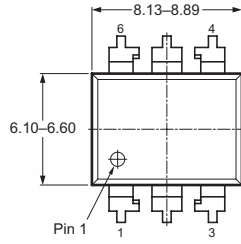


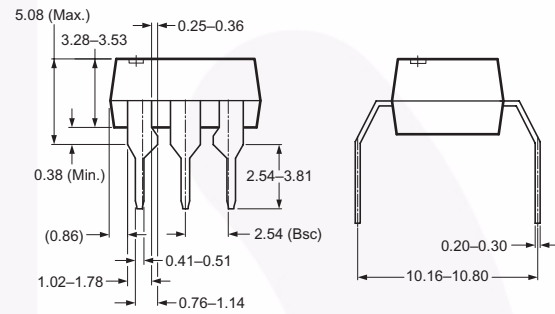
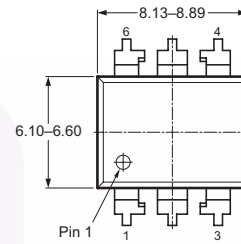
Figure 11. Switching Time Test Circuit and Waveforms

Package Dimensions

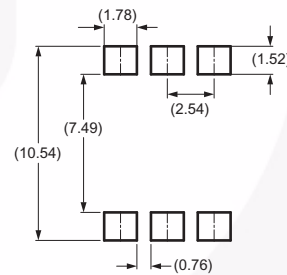
Through Hole



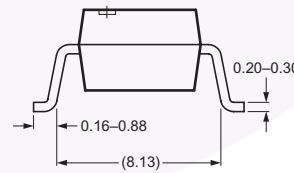
0.4" Lead Spacing



Surface Mount



Recommended Pad Layout

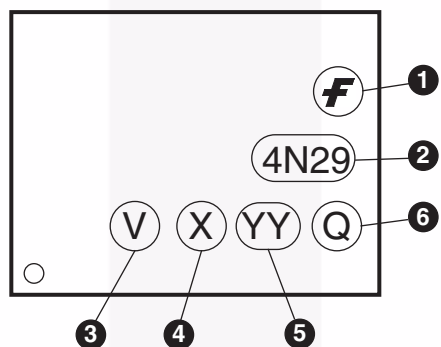


Note:
All dimensions in mm.

Ordering Information

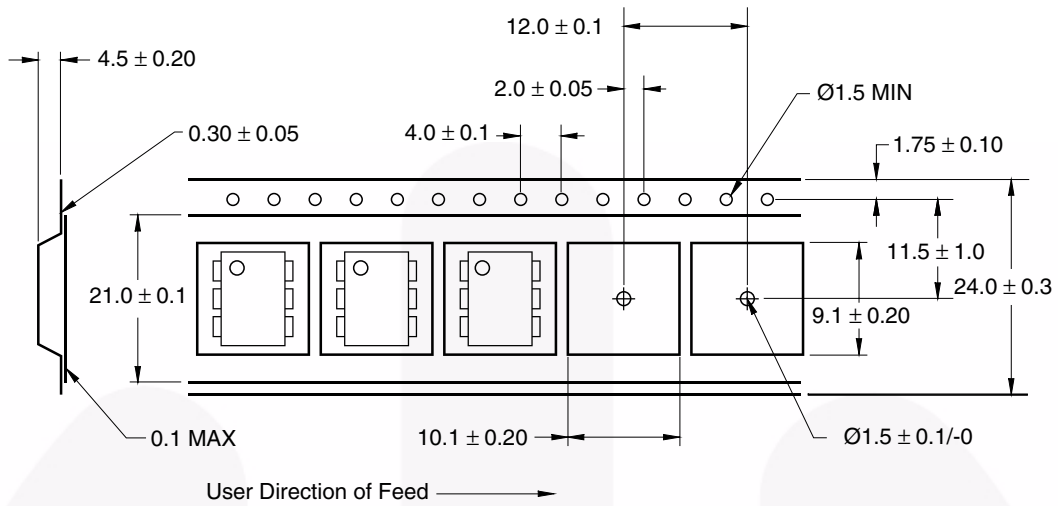
| Suffix | Example | Option |
|-----------|-----------|---|
| No Suffix | 4N32M | Standard Through Hole Device (50 units per tube) |
| S | 4N32SM | Surface Mount Lead Bend |
| SR2 | 4N32SR2M | Surface Mount; Tape and Reel (1,000 units per reel) |
| T | 4N32TM | 0.4" Lead Spacing |
| V | 4N32VM | VDE 0884 |
| TV | 4N32TVM | VDE 0884, 0.4" Lead Spacing |
| SV | 4N32SVM | VDE 0884, Surface Mount |
| SR2V | 4N32SR2VM | VDE 0884, Surface Mount, Tape & Reel (1,000 units per reel) |

Marking Information



| Definitions | |
|-------------|--|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., '7' |
| 5 | Two digit work week ranging from '01' to '53' |
| 6 | Assembly package code |

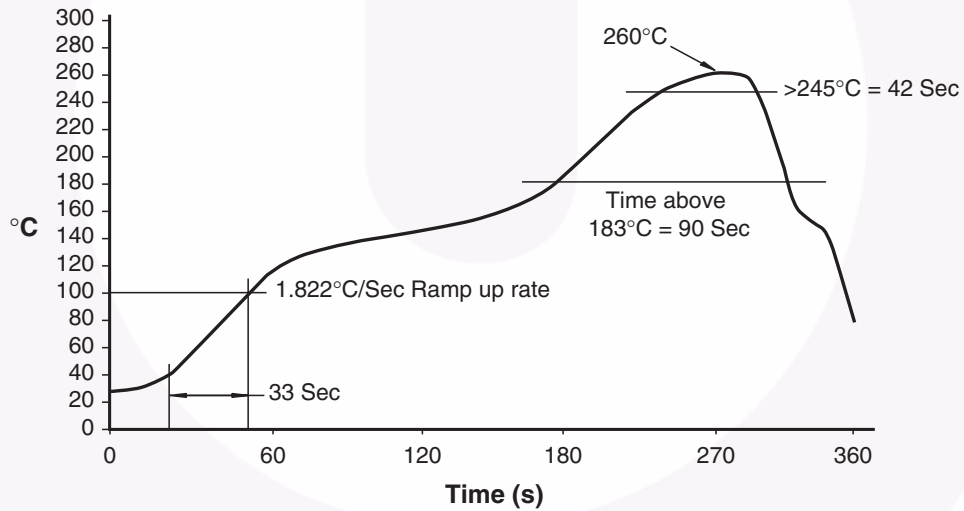
Tape Dimensions



Note:

All dimensions are in millimeters.

Reflow Soldering Profile





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|--------------------------|-----------------------|---|
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