

# 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
- VDE 0884 approval available as a test option  
– add option V (e.g., 4N29VM)

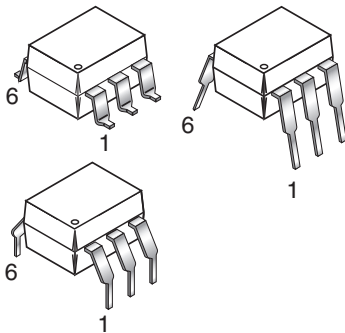
## Applications

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

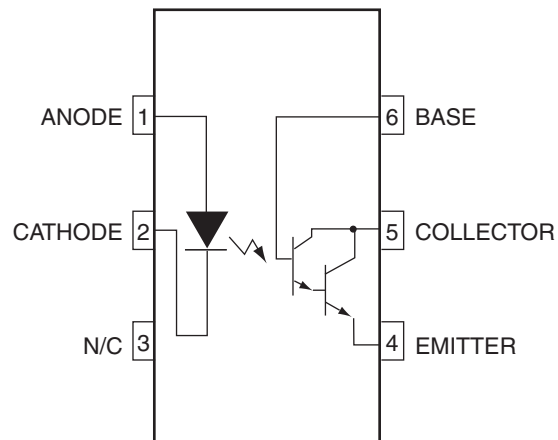
## Description

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

## Packages



## Schematic



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

| Symbol              | Parameter  | Value          | Units                |
|---------------------|--|----------------|----------------------|
| <b>TOTAL DEVICE</b> |  |                |                      |
| $T_{STG}$           | Storage Temperature  | -40 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 $25^\circ\text{C}$                            | 3.3            | mW/ $^\circ\text{C}$ |
| <b>EMITTER</b>      |  |                |                      |
| $I_F$               | Continuous Forward Current                                 | 80             | mA                   |
| $V_R$               | Reverse Voltage  | 3              | V                    |
| $I_F(\text{pk})$    | Forward Current – Peak (300 $\mu\text{s}$ , 2% Duty Cycle) | 3.0            | A                    |
| $P_D$               | LED Power Dissipation @ $T_A = 25^\circ\text{C}$           | 150            | mW                   |
|                     | Derate above $25^\circ\text{C}$                            | 2.0            | mW/ $^\circ\text{C}$ |
| <b>DETECTOR</b>     |  |                |                      |
| $BV_{CEO}$          | 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 $25^\circ\text{C}$                            | 2.0            | mW/ $^\circ\text{C}$ |
| $I_C$               | Continuous Collector Current                               | 150            | mA                   |

## Electrical Characteristics (T<sub>A</sub> = 25°C Unless otherwise specified.)

### Individual Component Characteristics

| Symbol            | Parameter                            | Test Conditions                            | Device             | Min. | Typ.  | Max. | Unit |
|-------------------|--------------------------------------|--|--------------------|------|-------|------|------|
| <b>EMITTER</b>    |                                      |  |                    |      |       |      |      |
| V <sub>F</sub>    | Input Forward Voltage*               | I <sub>F</sub> = 10mA                      | 4NXXM              |      | 1.2   | 1.5  | V    |
|                   |                                      |  | H11B1M,<br>TIL113M | 0.8  | 1.2   | 1.5  |      |
| I <sub>R</sub>    | Reverse Leakage Current*             | V <sub>R</sub> = 3.0V                      | 4NXXM              |      | 0.001 | 100  | μA   |
|                   |                                      | V <sub>R</sub> = 6.0V                      | H11B1M,<br>TIL113M |      | 0.001 | 10   |      |
| C                 | Capacitance*                         | V <sub>F</sub> = 0V, f = 1.0MHz            | All                |      | 150   |      | pF   |
| <b>DETECTOR</b>   |                                      |  |                    |      |       |      |      |
| BV <sub>CEO</sub> | Collector-Emitter Breakdown Voltage* | I <sub>C</sub> = 1.0mA, I <sub>B</sub> = 0 | 4NXXM,<br>TIL113M  | 30   | 60    |      | V    |
|                   |                                      |  | H11B1M             | 25   | 60    |      |      |
| BV <sub>CBO</sub> | Collector-Base Breakdown Voltage*    | I <sub>C</sub> = 100μA, I <sub>E</sub> = 0 | All                | 30   | 100   |      | V    |
| BV <sub>ECO</sub> | Emitter-Collector Breakdown Voltage* | I <sub>E</sub> = 100μA, I <sub>B</sub> = 0 | 4NXXM              | 5.0  | 10    |      | V    |
|                   |                                      |  | H11B1M,<br>TIL113M | 7    | 10    |      |      |
| I <sub>CEO</sub>  | Collector-Emitter Dark Current*      | V <sub>CE</sub> = 10V, Base Open           | All                |      | 1     | 100  | nA   |

### Transfer Characteristics

| Symbol                    | Parameter                       | Test Conditions  | Device                      | Min.     | Typ. | Max. | Unit   |
|---------------------------|---------------------------------|--|-----------------------------|----------|------|------|--------|
| <b>DC CHARACTERISTICS</b> |                                 |  |                             |          |      |      |        |
| I <sub>C(CTR)</sub>       | Collector Output Current*(1, 2) | I <sub>F</sub> = 10mA, V <sub>CE</sub> = 10V,<br>I <sub>B</sub> = 0                            | 4N32M,<br>4N33M             | 50 (500) |      |      | mA (%) |
|                           |                                 |  | 4N29M,<br>4N30M             | 10 (100) |      |      |        |
|                           |                                 | I <sub>F</sub> = 1mA, V <sub>CE</sub> = 5V   | H11B1M                      | 5 (500)  |      |      |        |
|                           |                                 | I <sub>F</sub> = 10mA, V <sub>CE</sub> = 1V  | TIL113M                     | 30 (300) |      |      |        |
| V <sub>CE(SAT)</sub>      | Saturation Voltage*(2)          | I <sub>F</sub> = 8mA, I <sub>C</sub> = 2.0mA   | 4NXXM                       |          |      | 1.0  | V      |
|                           |                                 |  | TIL113M                     |          |      | 1.25 |        |
|                           |                                 | I <sub>F</sub> = 1mA, I <sub>C</sub> = 1mA   | H11B1M                      |          |      | 1.0  |        |
| <b>AC CHARACTERISTICS</b> |                                 |  |                             |          |      |      |        |
| t <sub>on</sub>           | Turn-on Time                    | I <sub>F</sub> = 200mA, I <sub>C</sub> = 50mA,<br>V <sub>CC</sub> = 10V, R <sub>L</sub> = 100Ω | 4NXXM,<br>TIL113M           |          |      | 5.0  | μS     |
|                           |                                 | I <sub>F</sub> = 10mA, V <sub>CE</sub> = 10V,<br>R <sub>L</sub> = 100Ω                         | H11B1M                      |          | 25   |      |        |
| t <sub>off</sub>          | Turn-off Time                   | I <sub>F</sub> = 200mA, I <sub>C</sub> = 50mA,<br>V <sub>CC</sub> = 10V, R <sub>L</sub> = 100Ω | 4N32M,<br>4N33M,<br>TIL113M |          |      | 100  | μS     |
|                           |                                 |  | 4N29M,<br>4N30M             |          |      | 40   |        |
|                           |                                 | I <sub>F</sub> = 10mA, V <sub>CE</sub> = 10V,<br>R <sub>L</sub> = 100Ω                         | H11B1M                      |          | 18   |      |        |
| BW                        | Bandwidth <sup>(3, 4)</sup>     |  |                             |          | 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 <sup>(5)</sup> | $I_{I-O} \leq 1\mu\text{A}$ , $V_{rms}$ , $t = 1\text{sec.}$ | All    | 7500      |      |      | Vac(peak) |
|           |   | VDC  | 4N32M* | 2500      |      |      | V         |
|           |   | VDC  | 4N33M* | 1500      |      |      |           |
| $R_{ISO}$ | Isolation Resistance <sup>(5)</sup>           | $V_{I-O} = 500\text{VDC}$                                    | All    | $10^{11}$ |      |      | $\Omega$  |
| $C_{ISO}$ | Isolation Capacitance <sup>(5)</sup>          | $V_{I-O} = \emptyset$ , $f = 1\text{MHz}$                    | All    |           | 0.8  |      | pF        |

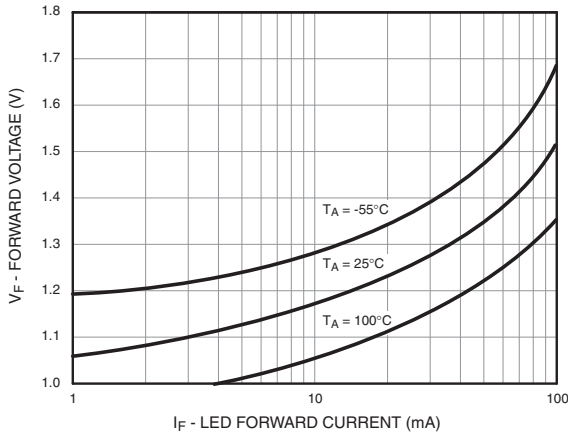
**Notes:**

\* Indicates JEDEC registered data.

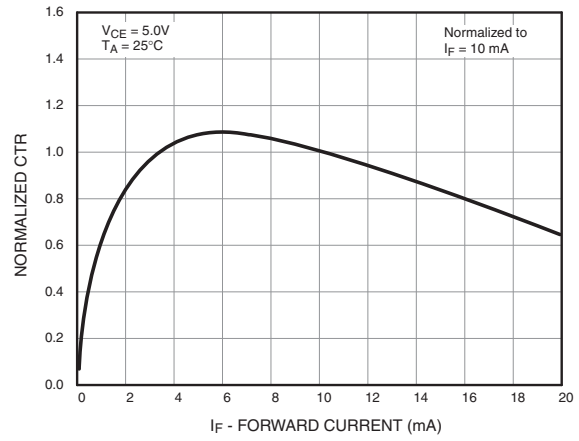
1. The current transfer ratio ( $I_C/I_F$ ) is the ratio of the detector collector current to the LED input current.
2. Pulse test: pulse width =  $300\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .
3.  $I_F$  adjusted to  $I_C = 2.0\text{mA}$  and  $I_C = 0.7\text{mA rms}$ .
4. The frequency at which  $I_C$  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.

## Typical Performance Curves

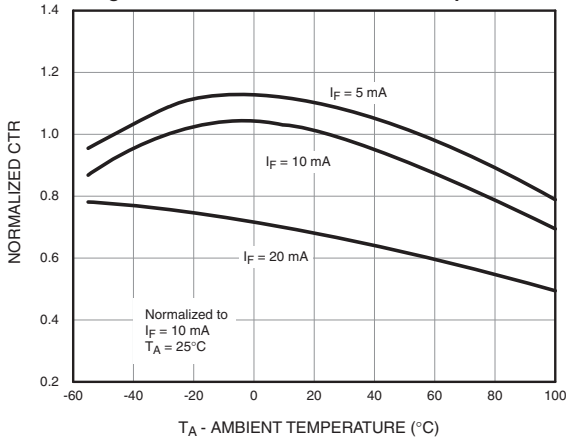
**Fig. 1 LED Forward Voltage vs. Forward Current**



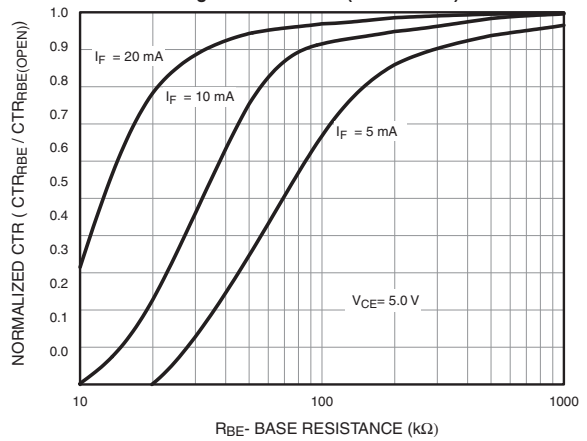
**Fig. 2 Normalized CTR vs. Forward Current**



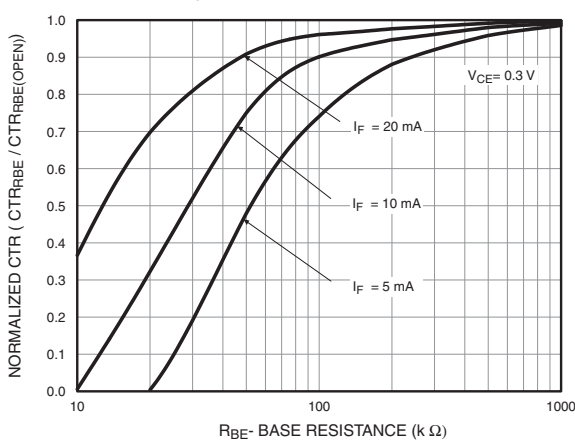
**Fig. 3 Normalized CTR vs. Ambient Temperature**



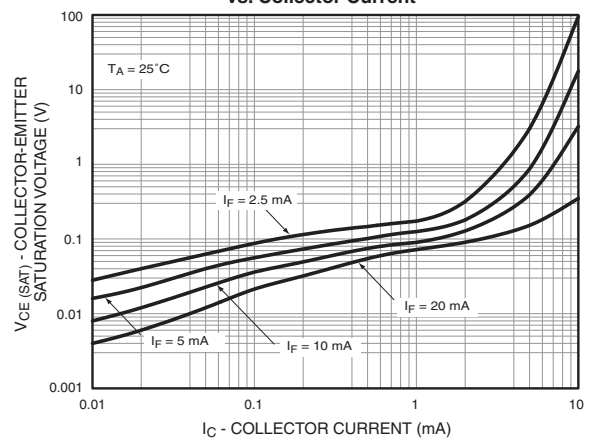
**Fig. 4 CTR vs. RBE (Unsaturated)**



**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

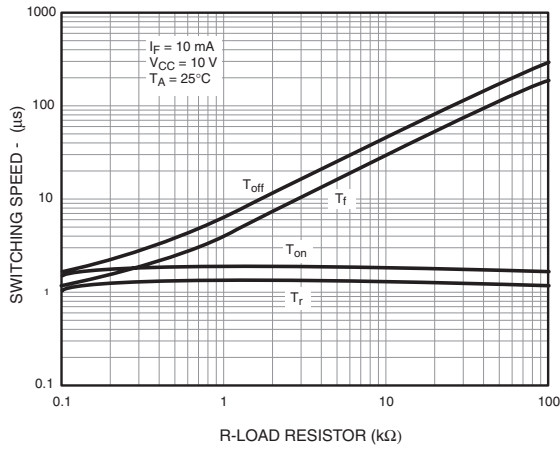


Fig. 8 Normalized  $t_{on}$  vs.  $R_{BE}$

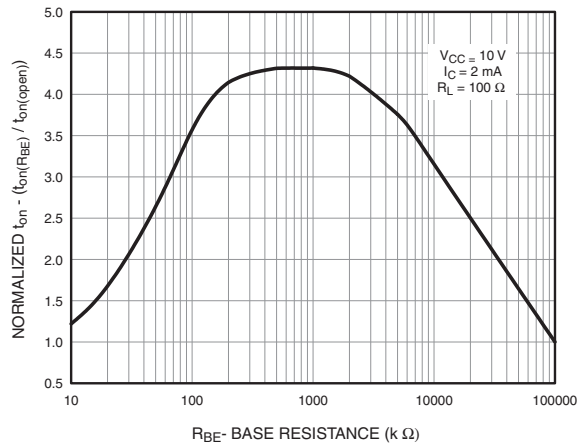


Fig. 9 Normalized  $t_{off}$  vs.  $R_{BE}$

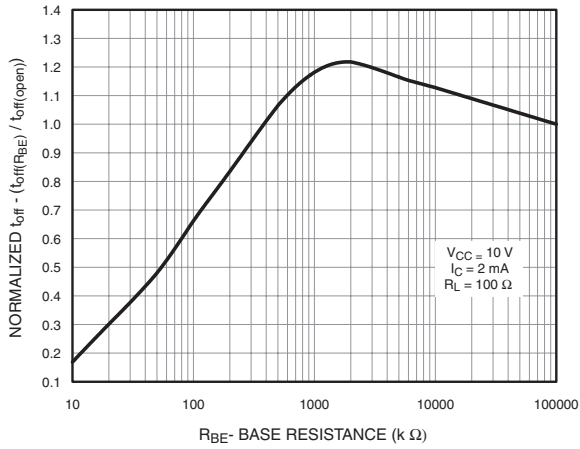
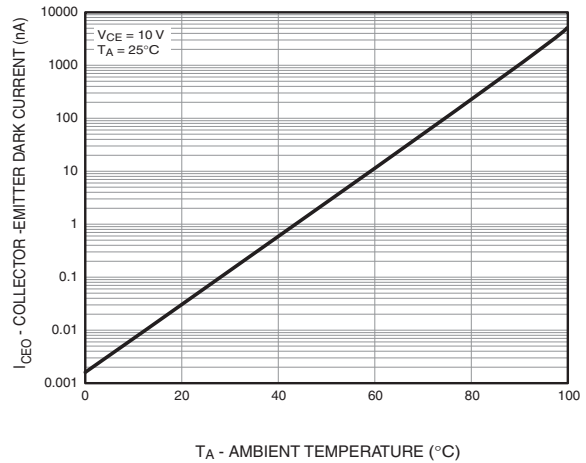
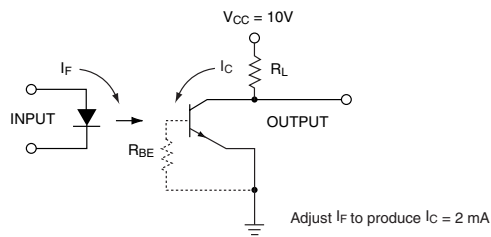


Fig. 10 Dark Current vs. Ambient Temperature



TEST CIRCUIT



WAVE FORMS

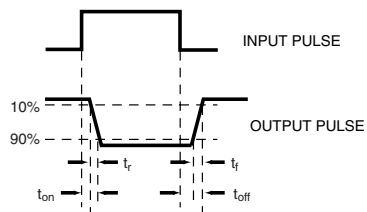
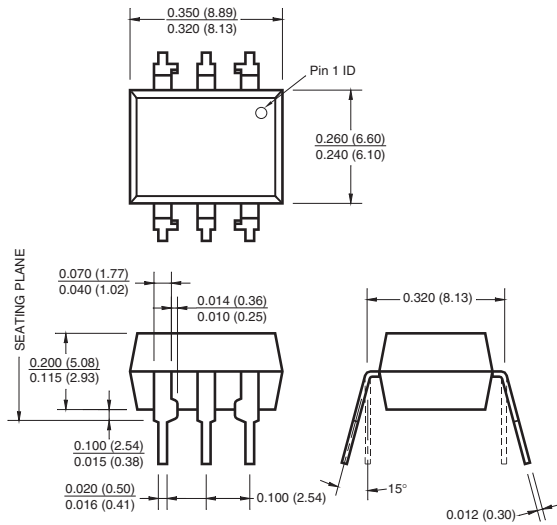


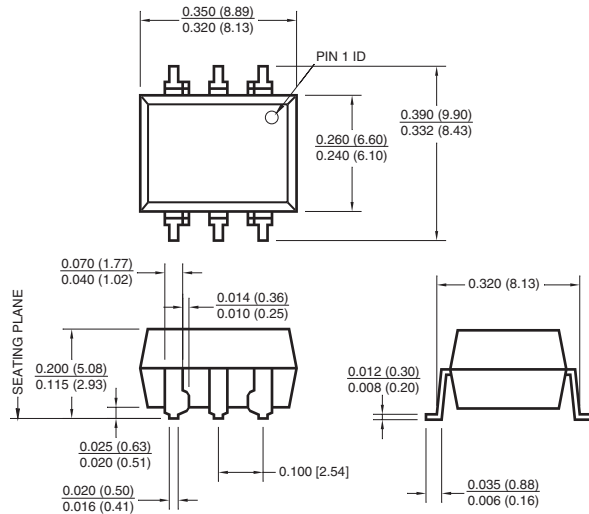
Figure 11. Switching Time Test Circuit and Waveforms

## Package Dimensions

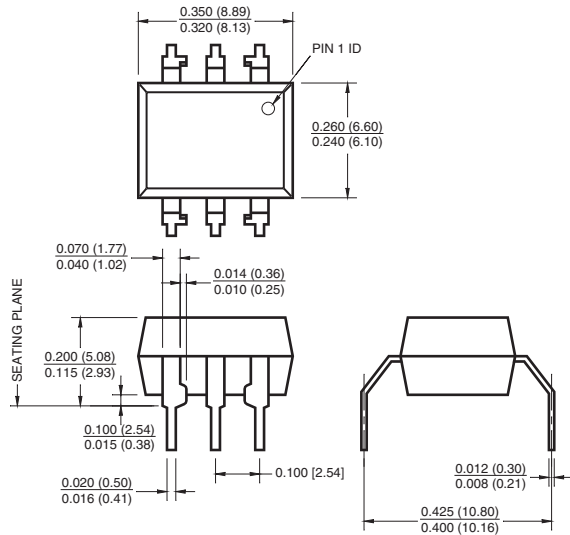
### Through Hole



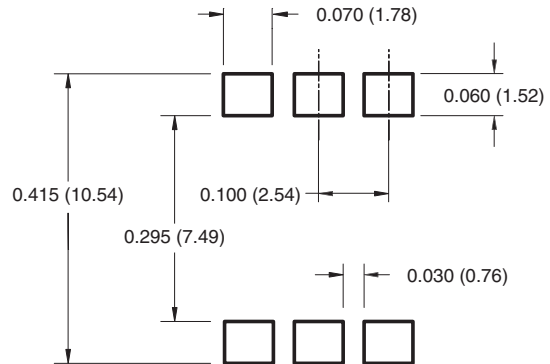
### Surface Mount



### 0.4" Lead Spacing



### Recommended Pay Layout for Surface Mount Leadform



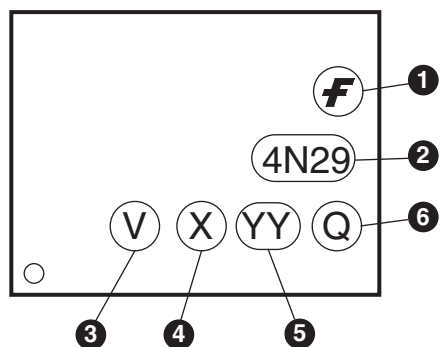
### Note:

All dimensions are in inches (millimeters).

## Ordering Information

| Suffix    | Example   | Option                               |
|-----------|-----------|--------------------------------------|
| No Suffix | 4N32M     | Standard Through Hole Device         |
| S         | 4N32SM    | Surface Mount Lead Bend              |
| SR2       | 4N32SR2M  | Surface Mount; Tape and 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 |

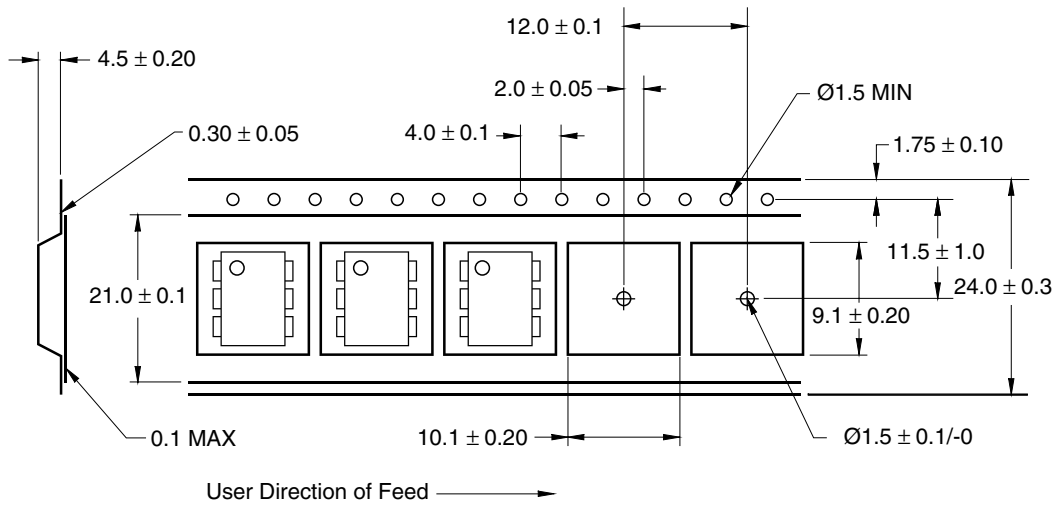
## Marking Information



| 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  |



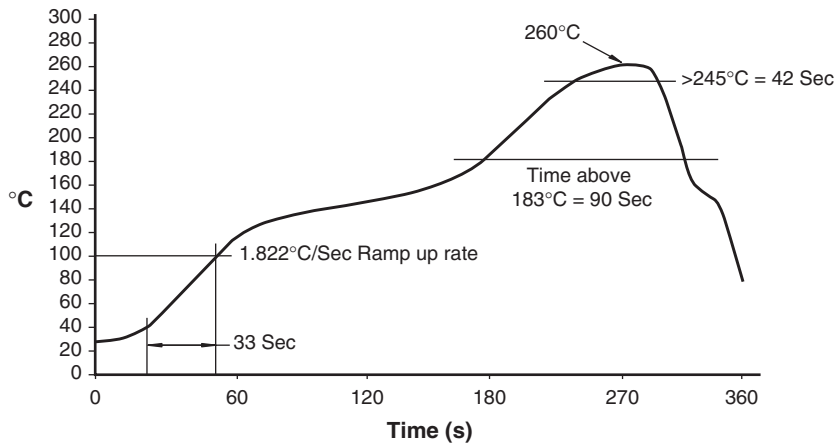
### Tape Dimensions



**Note:**

All dimensions are in millimeters.


### Reflow Soldering Profile





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| ActiveArray <sup>™</sup>                         | ImpliedDisconnect <sup>™</sup> | Programmable Active Droop <sup>™</sup>   | TINYOPTO <sup>™</sup>       |
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| CoolFET <sup>™</sup>                             | MICROCOUPLER <sup>™</sup>      | QT Optoelectronics <sup>™</sup>  | TruTranslation <sup>™</sup> |
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| Current Transfer Logic <sup>™</sup>              | MSX <sup>™</sup>               | ScalarPump <sup>™</sup>  | VCX <sup>™</sup>            |
| DOME <sup>™</sup>                                | MSXPro <sup>™</sup>            | SMART START <sup>™</sup>   | Wire <sup>™</sup>           |
| E <sup>2</sup> COS <sup>™</sup>                  | OCX <sup>™</sup>               | SPM <sup>®</sup>   |                             |
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| FASTr <sup>™</sup>                               | POP <sup>™</sup>               | SyncFET <sup>™</sup>   |                             |
| FPS <sup>™</sup>                                 | Power220 <sup>®</sup>          | TCM <sup>™</sup>   |                             |
| FRFET <sup>®</sup>                               | Power247 <sup>®</sup>          | The Power Franchise <sup>®</sup>   |                             |
| GlobalOptoisolator <sup>™</sup>                  | PowerEdge <sup>™</sup>         |  <sup>™</sup> |                             |
| GTO <sup>™</sup>                                 | PowerSaver <sup>™</sup>        | TinyBoost <sup>™</sup>   |                             |

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### Definition of Terms

| Datasheet Identification | Product Status         | Definition   |
|--------------------------|------------------------|--|
| Advance Information      | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.   |
| Preliminary              | First Production       | This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
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