

# 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)

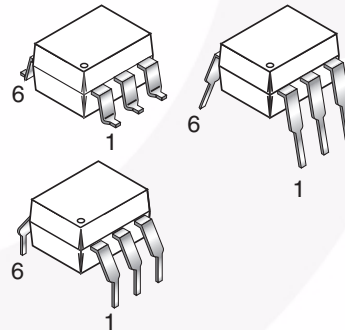
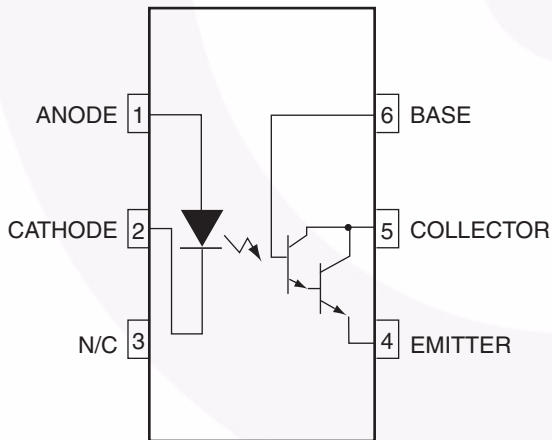
## Applications

- 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
<b>TOTAL DEVICE</b>			
$T_{STG}$	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 $25^\circ\text{C}$	3.3	$\text{mW}/^\circ\text{C}$
<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	$\text{mW}/^\circ\text{C}$
<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	$\text{mW}/^\circ\text{C}$
$I_C$	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
<b>EMITTER</b>							
$V_F$	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	$\mu\text{A}$
		$V_R = 6.0\text{V}$	H11B1M, TIL113M		0.001	10	
C	Capacitance*	$V_F = 0\text{V}, f = 1.0\text{MHz}$	All		150		pF
<b>DETECTOR</b>							
$BV_{CEO}$	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
<b>DC CHARACTERISTICS</b>							
$I_{C(CTR)}$	Collector Output Current* <sup>(1, 2)</sup>	$I_F = 10\text{mA}, V_{CE} = 10\text{V}, I_B = 0$	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* <sup>(2)</sup>	$I_F = 8\text{mA}, I_C = 2.0\text{mA}$	4NXXM			1.0	V
			TIL113M			1.25	
		$I_F = 1\text{mA}, I_C = 1\text{mA}$	H11B1M			1.0	
<b>AC CHARACTERISTICS</b>							
$t_{on}$	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	$\mu\text{s}$
		$I_F = 10\text{mA}, V_{CE} = 10\text{V}, R_L = 100\Omega$	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	$\mu\text{s}$
			4N29M, 4N30M			40	
		$I_F = 10\text{mA}, V_{CE} = 10\text{V}, R_L = 100\Omega$	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
$V_{\text{ISO}}$	Input-Output Isolation Voltage <sup>(5)</sup>	f = 60Hz, t = 1 sec.	All	7500			$V_{\text{AC PEAK}}$
		VDC	4N32M*	2500			V
		VDC	4N33M*	1500			
$R_{\text{ISO}}$	Isolation Resistance <sup>(5)</sup>	$V_{\text{I-O}} = 500\text{VDC}$	All	$10^{11}$			$\Omega$
$C_{\text{ISO}}$	Isolation Capacitance <sup>(5)</sup>	$V_{\text{I-O}} = \emptyset$ , f = 1MHz	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			
$V_{\text{PR}}$	Input to Output Test Voltage, Method b, $V_{\text{IORM}} \times 1.875 = V_{\text{PR}}$ , 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5pC	1594			$V_{\text{peak}}$
	Input to Output Test Voltage, Method a, $V_{\text{IORM}} \times 1.5 = V_{\text{PR}}$ , Type and Sample Test with $t_m = 60$ sec, Partial Discharge < 5pC	1275			$V_{\text{peak}}$
$V_{\text{IORM}}$	Max. Working Insulation Voltage	850			$V_{\text{peak}}$
$V_{\text{IOTM}}$	Highest Allowable Over Voltage	6000			$V_{\text{peak}}$
	External Creepage	7			mm
	External Clearance	7			mm
	Insulation Thickness	0.5			mm
RIO	Insulation Resistance at $T_s$ , $V_{\text{IO}} = 500\text{V}$	$10^9$			$\Omega$

## Typical Performance Curves

Fig. 1 LED Forward Voltage vs. Forward Current

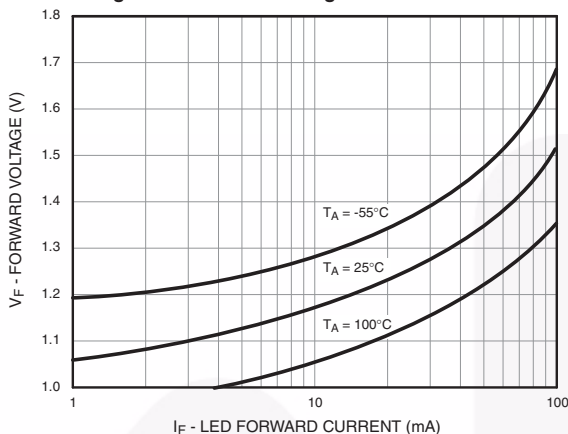


Fig. 2 Normalized CTR vs. Forward Current

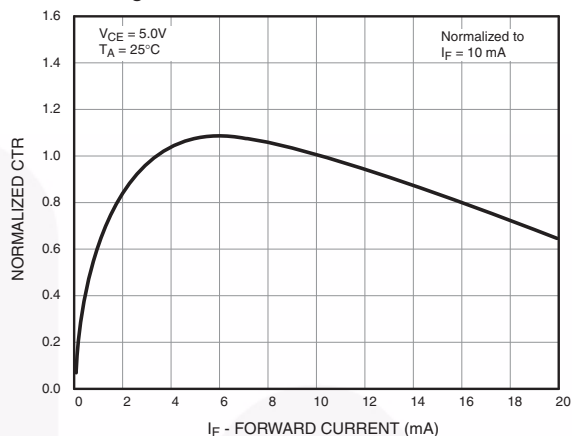


Fig. 3 Normalized CTR vs. Ambient Temperature

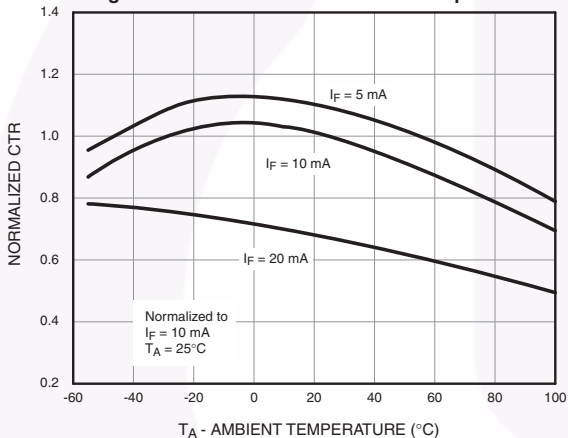


Fig. 4 CTR vs. RBE (Unsaturated)

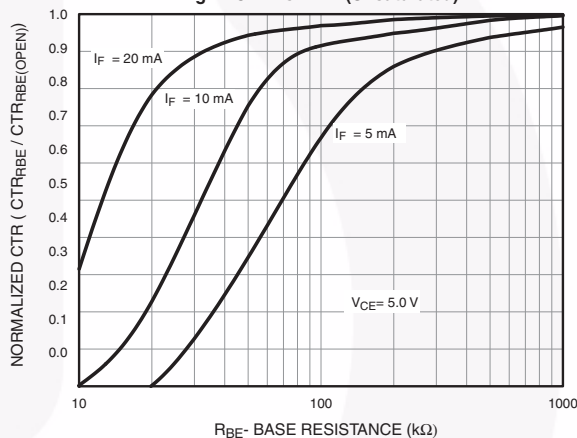


Fig. 5 CTR vs. RBE (Saturated)

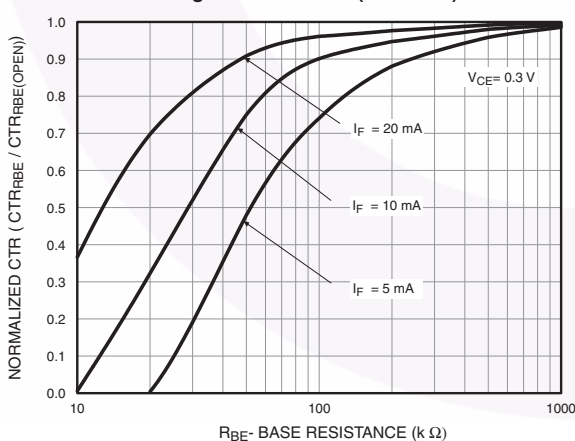
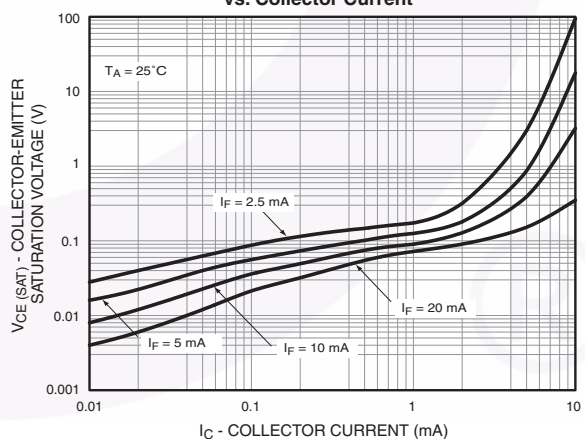


Fig. 6 Collector-Emitter Saturation Voltage vs. Collector Current



Typical Performance Curves (Continued)

Fig. 7 Switching Speed vs. Load Resistor

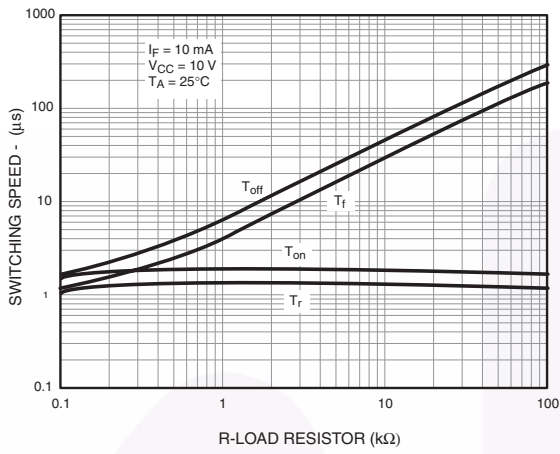


Fig. 8 Normalized  $t_{on}$  vs.  $R_{BE}$

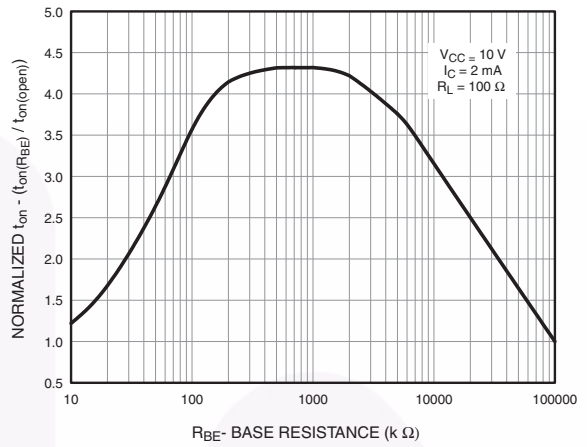


Fig. 9 Normalized  $t_{off}$  vs.  $R_{BE}$

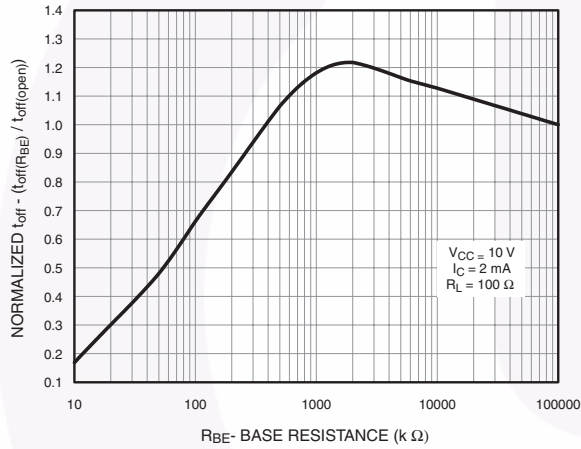
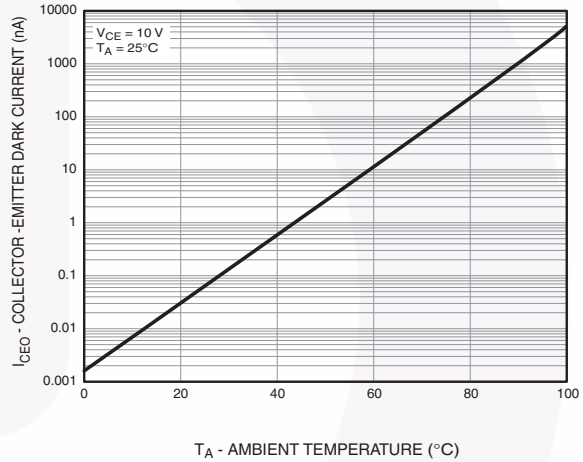
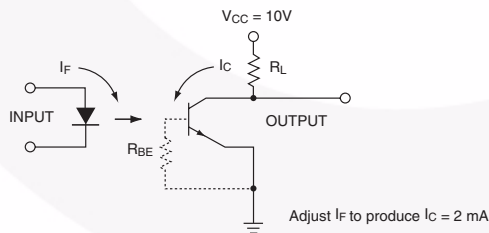


Fig. 10 Dark Current vs. Ambient Temperature



TEST CIRCUIT



WAVE FORMS

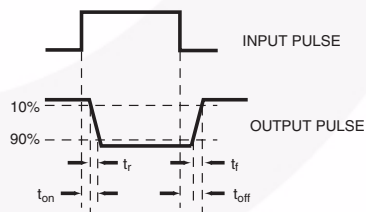
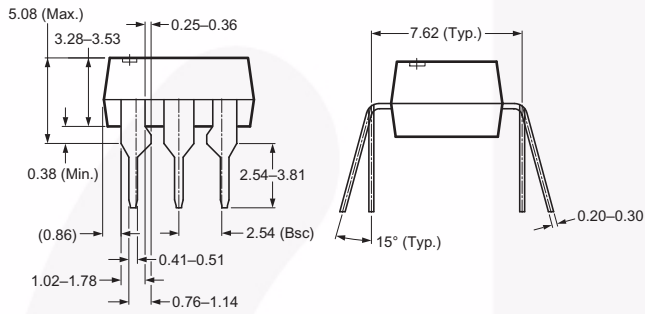
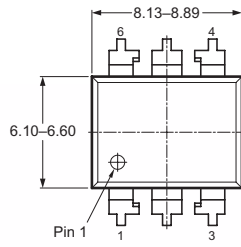


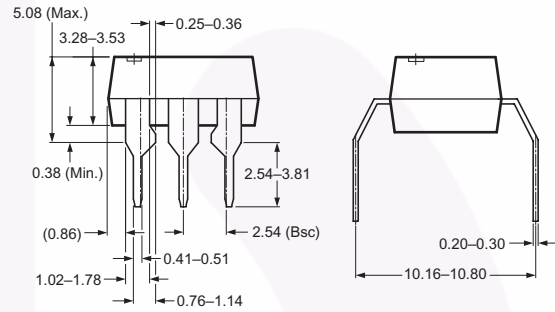
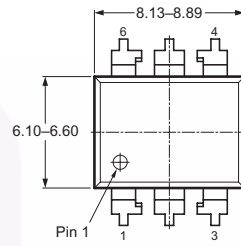
Figure 11. Switching Time Test Circuit and Waveforms

## Package Dimensions

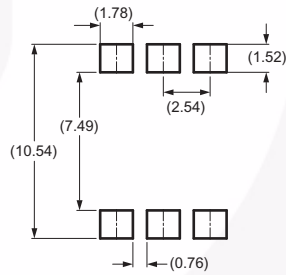
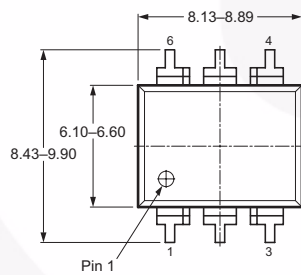
### Through Hole



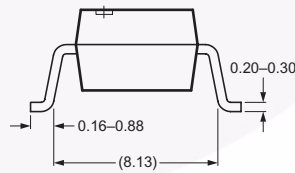
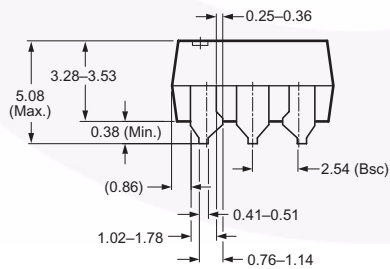
### 0.4" Lead Spacing



### Surface Mount



Recommended Pad Layout

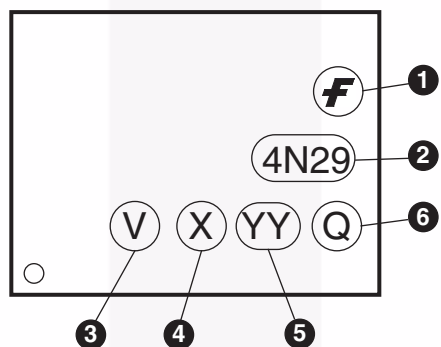


**Note:**  
All dimensions in mm.

## 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)

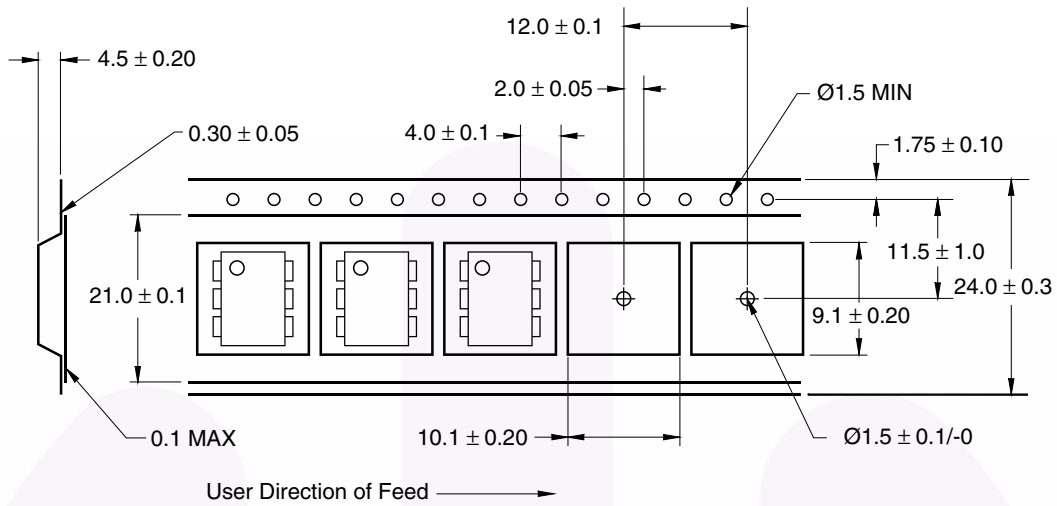
## Marking Information



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

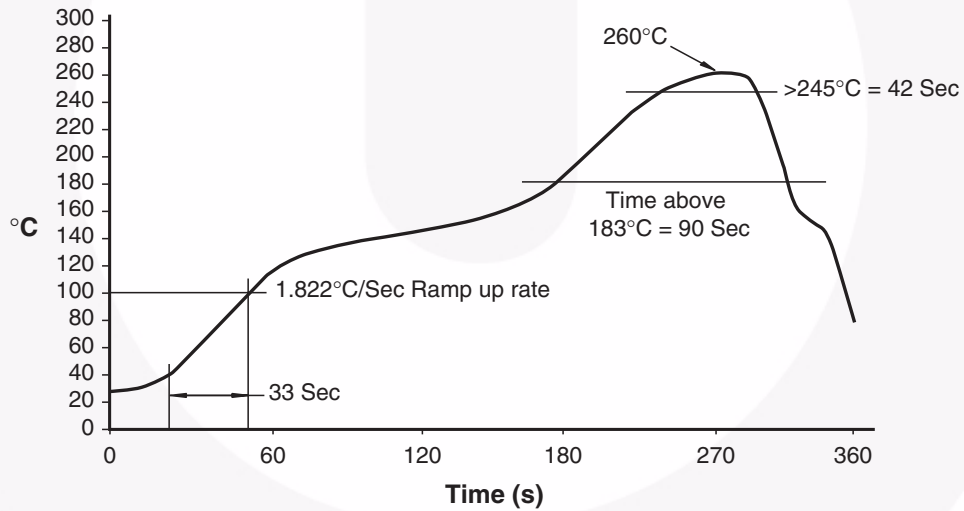


### Tape Dimensions



**Note:**  
All dimensions are in millimeters.





### Reflow Soldering Profile





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| FlashWriter®*  | PDP SPM™  | Sync-Lock™   |   |
| FPS™   | Power-SPM™  |  ™* |   |

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**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	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.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I40