

# 4N29, 4N30, 4N31, 4N32, 4N33 General Purpose 6-Pin Photodarlington Optocoupler

## Features

- High sensitivity to low input drive current
- Meets or exceeds all JEDEC Registered Specifications
- VDE 0884 approval available as a test option  
– add option .300. (e.g., 4N29.300)

## Applications

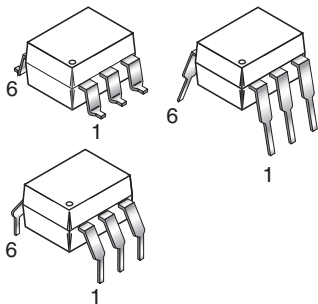
- Low power logic circuits
- Telecommunications equipment
- Portable electronics
- Solid state relays
- Interfacing coupling systems of different potentials and impedances

## Description

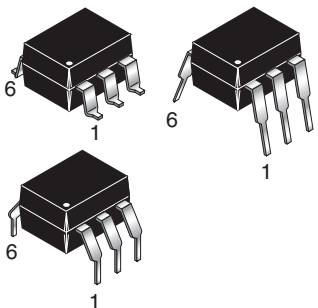
The 4N29, 4N30, 4N31, 4N32, 4N33 have a gallium arsenide infrared emitter optically coupled to a silicon planar photodarlington.

## Packages

### White Package (-M Suffix)

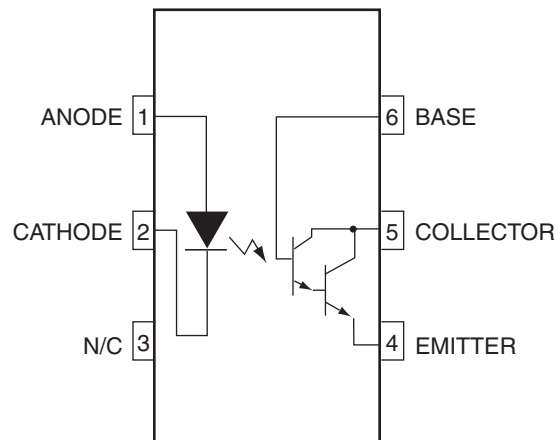


### Black Package (No -M Suffix)



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## Schematic



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

Symbol	Parameter	Device	Value	Units
<b>TOTAL DEVICE</b>				
$T_{STG}$	Storage Temperature	Non M	-55 to +150	$^\circ\text{C}$
		M	-40 to +150	
$T_{OPR}$	Operating Temperature	Non M	-55 to +100	$^\circ\text{C}$
		M	-40 to +100	
$T_{SOL}$	Lead Solder Temperature	All	260 for 10 sec	$^\circ\text{C}$
$P_D$	Total Device Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	All	250	mW
			3.3	mW/ $^\circ\text{C}$
<b>EMITTER</b>				
$I_F$	Continuous Forward Current	All	80	mA
$V_R$	Reverse Voltage	All	3	V
$I_F(\text{pk})$	Forward Current – Peak (300 $\mu\text{s}$ , 2% Duty Cycle)	All	3.0	A
$P_D$	LED Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	All	150	mW
			2.0	mW/ $^\circ\text{C}$
<b>DETECTOR</b>				
$BV_{CEO}$	Collector-Emitter Breakdown Voltage	All	30	V
$BV_{CBO}$	Collector-Base Breakdown Voltage	All	30	V
$BV_{ECO}$	Emitter-Collector Breakdown Voltage	All	5	V
$P_D$	Detector Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	All	150	mW
			2.0	mW/ $^\circ\text{C}$
$I_C$	Continuous Collector Current	All	150	mA

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>EMITTER</b>						
$V_F$	Input Forward Voltage*	$I_F = 10\text{mA}$	–	1.2	1.5	V
$I_R$	Reverse Leakage Current*	$V_R = 3.0\text{V}$	–	0.001	100	$\mu\text{A}$
C	Capacitance*	$V_F = 0\text{V}$ , $f = 1.0\text{MHz}$	–	150	–	pF
<b>DETECTOR</b>						
$BV_{CEO}$	Collector-Emitter Breakdown Voltage*	$I_C = 1.0\text{mA}$ , $I_B = 0$	30	60	–	V
$BV_{CBO}$	Collector-Base Breakdown Voltage*	$I_C = 100\mu\text{A}$ , $I_E = 0$	30	100	–	V
$BV_{ECO}$	Emitter-Collector Breakdown Voltage*	$I_E = 100\mu\text{A}$ , $I_B = 0$	5.0	8	–	V
$I_{CEO}$	Collector-Emitter Dark Current*	$V_{CE} = 10\text{V}$ , Base Open	–	1	100	nA
$h_{FE}$	DC Current Gain	$V_{CE} = 5.0\text{V}$ , $I_C = 500\mu\text{A}$	–	5000	–	

**Transfer Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>DC CHARACTERISTICS</b>						
$I_{C(CTR)}$	Collector Output Current <sup>*(1, 2)</sup> 4N32, 4N33 4N29, 4N30 4N31	$I_F = 10\text{mA}$ , $V_{CE} = 10\text{V}$ , $I_B = 0$	50 (500)	–	–	mA (%)
			10 (100)	–	–	
			5 (50)	–	–	
$V_{CE(SAT)}$	Saturation Voltage <sup>*(2)</sup> 4N29, 4N30, 4N32, 4N33 4N31	$I_F = 8\text{mA}$ , $I_C = 2.0\text{mA}$	–	–	1.0	V
			–	–	1.2	
<b>AC CHARACTERISTICS</b>						
$t_{on}$	Turn-on Time	$I_F = 200\text{mA}$ , $I_C = 50\text{mA}$ , $V_{CC} = 10\text{V}$	–	–	5.0	$\mu\text{S}$
$t_{off}$	Turn-off Time 4N32, 4N33 4N29, 4N30, 4N31	$I_F = 200\text{mA}$ , $I_C = 50\text{mA}$ , $V_{CC} = 10\text{V}$	–	–	100	$\mu\text{S}$
			–	–	40	
BW	Bandwidth <sup>(3, 4)</sup>		–	30	–	kHz

**Isolation Characteristics**

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Units
$V_{ISO}$	Input-Output Isolation Voltage <sup>(5)</sup> 4N29, 4N30, 4N31, 4N32, 4N33	$I_{I-O} \leq 1\mu\text{A}$ , $V_{rms}$ , $t = 1\text{min.}$	5300	–	–	Vac(rms)
	4N32*	VDC	2500	–	–	V
	4N33*	VDC	1500	–	–	
$R_{ISO}$	Isolation Resistance <sup>(5)</sup>	$V_{I-O} = 500\text{VDC}$	–	$10^{11}$	–	$\Omega$
$C_{ISO}$	Isolation Capacitance <sup>(5)</sup>	$V_{I-O} = \emptyset$ , $f = 1\text{MHz}$	–	0.8	–	pF

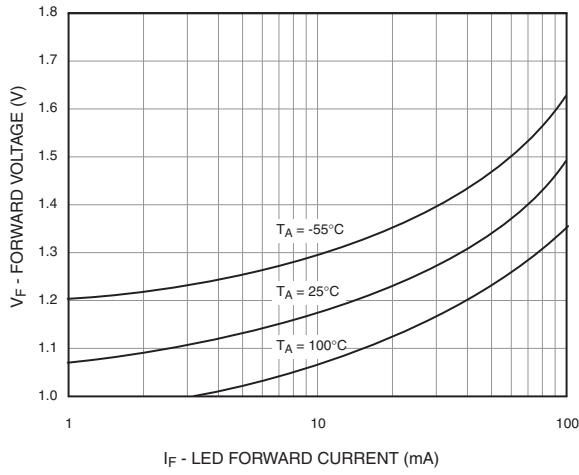
**Notes:**

\* Indicates JEDEC registered data.

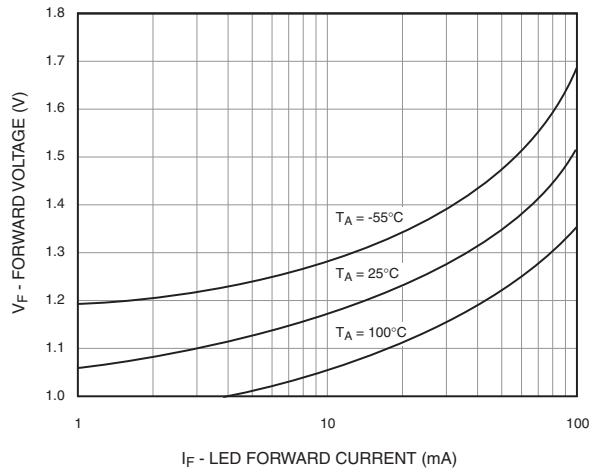
- The current transfer ratio ( $I_C/I_F$ ) is the ratio of the detector collector current to the LED input current with  $V_{CE} @ 10\text{V}$ .
- Pulse test: pulse width =  $300\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .
- $I_F$  adjusted to  $I_C = 2.0\text{mA}$  and  $I_C = 0.7\text{mA rms}$ .
- The frequency at which  $I_C$  is 3dB down from the 1kHz value.
- For this test, LED pins 1 and 2 are common, and phototransistor pins 4, 5 and 6 are common.

## Typical Performance Curves

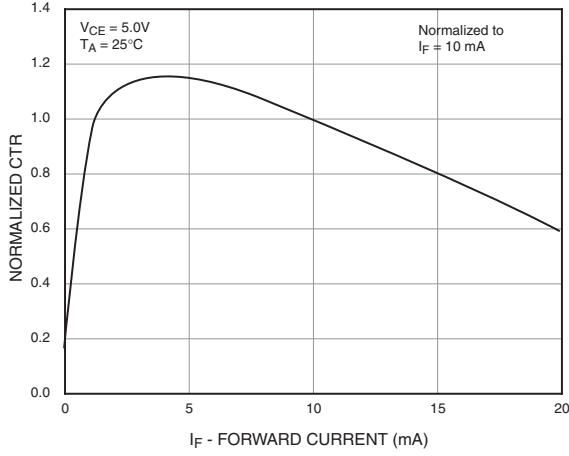
**Fig. 1 LED Forward Voltage vs. Forward Current (Black Package)**



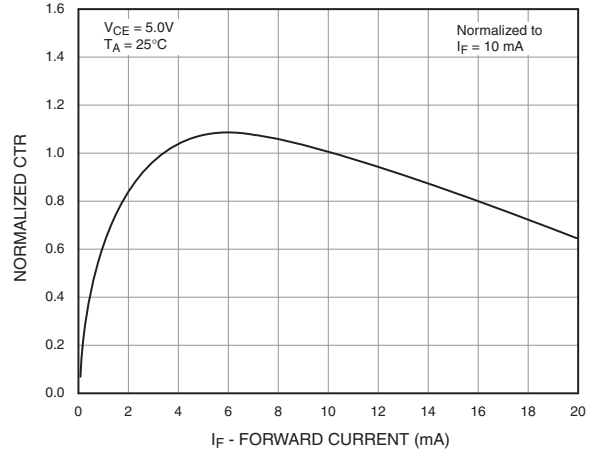
**Fig. 2 LED Forward Voltage vs. Forward Current (White Package)**



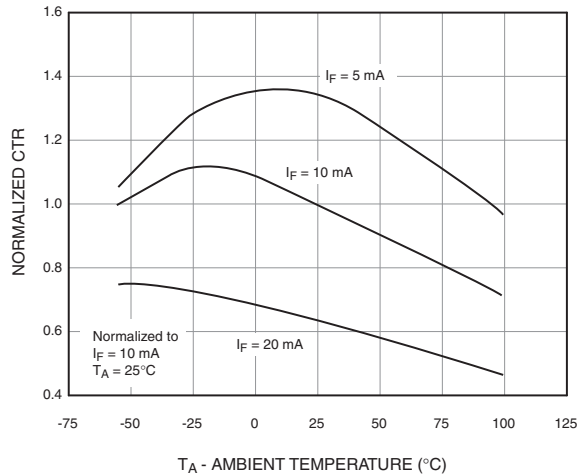
**Fig.3 Normalized CTR vs. Forward Current (Black Package)**



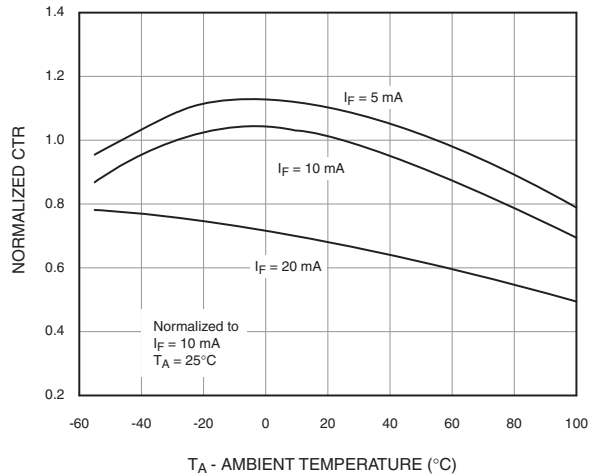
**Fig.4 Normalized CTR vs. Forward Current (White Package)**



**Fig. 5 Normalized CTR vs. Ambient Temperature (Black Package)**

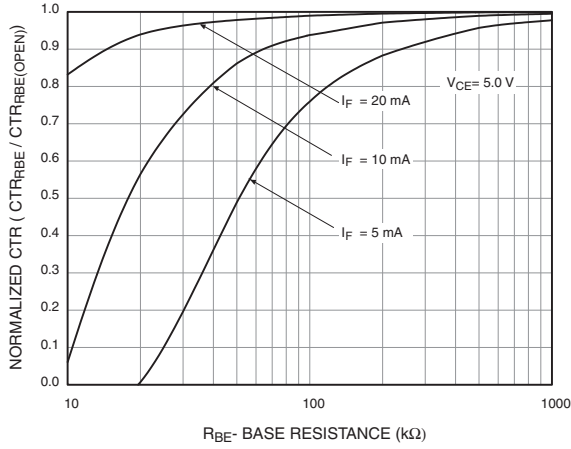


**Fig. 6 Normalized CTR vs. Ambient Temperature (White Package)**

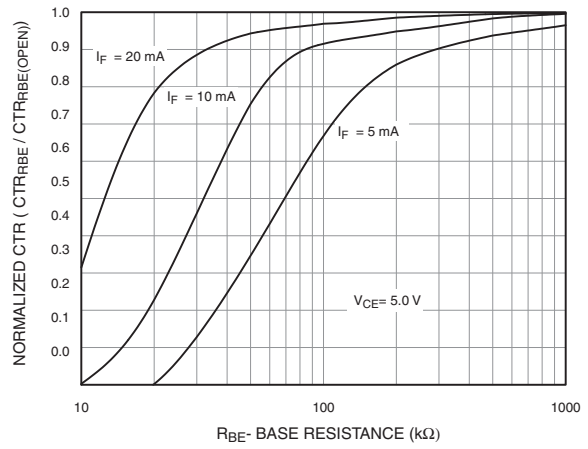


**Typical Performance Curves (Continued)**

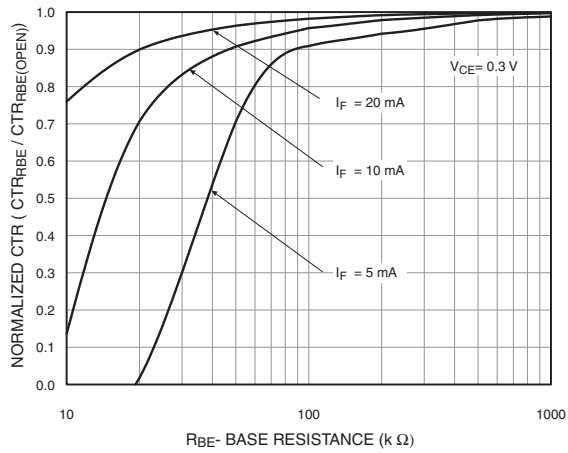
**Fig. 7 CTR vs. RBE (Unsaturated) (Black Package)**



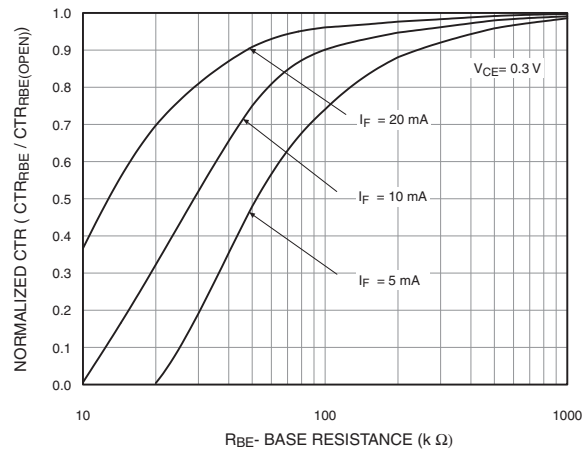
**Fig. 8 CTR vs. RBE (Unsaturated) (White Package)**



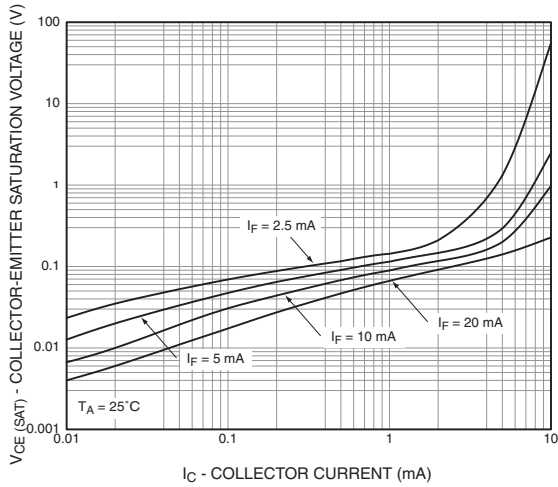
**Fig. 9 CTR vs. RBE (Saturated) (Black Package)**



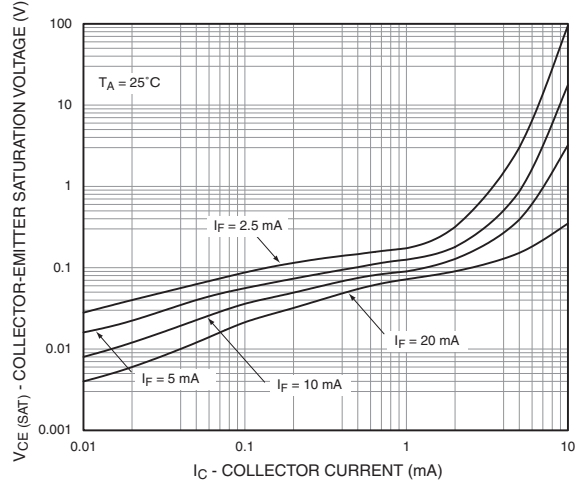
**Fig. 10 CTR vs. RBE (Saturated) (White Package)**



**Fig. 11 Collector-Emitter Saturation Voltage vs. Collector Current (Black Package)**



**Fig. 12 Collector-Emitter Saturation Voltage vs. Collector Current (White Package)**



Typical Performance Curves (Continued)

Fig. 13 Switching Speed vs. Load Resistor (Black Package)

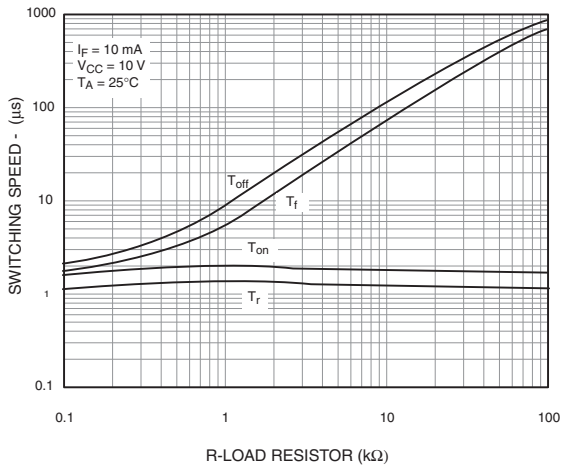


Fig. 14 Switching Speed vs. Load Resistor (White Package)

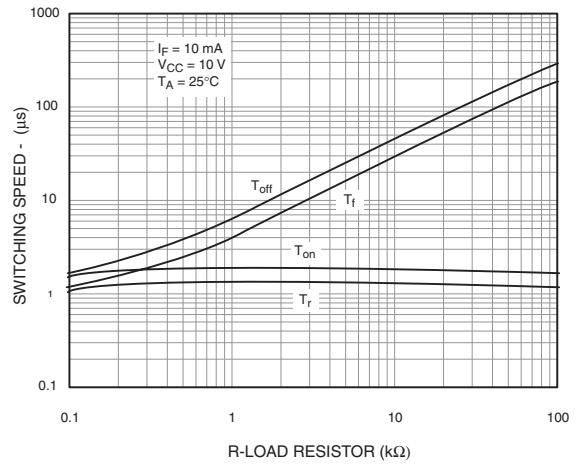


Fig. 15 Normalized  $t_{on}$  vs.  $R_{BE}$  (Black Package)

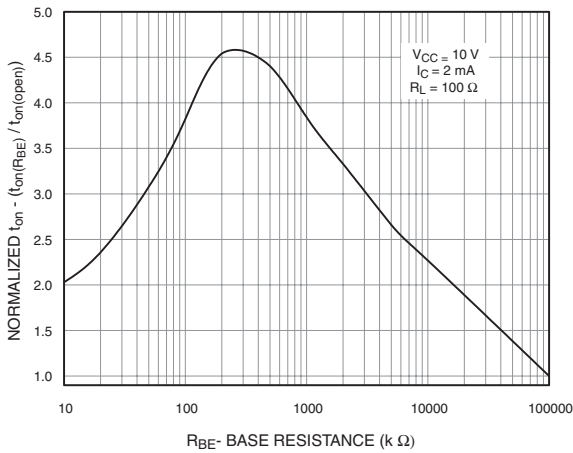


Fig. 16 Normalized  $t_{on}$  vs.  $R_{BE}$  (White Package)

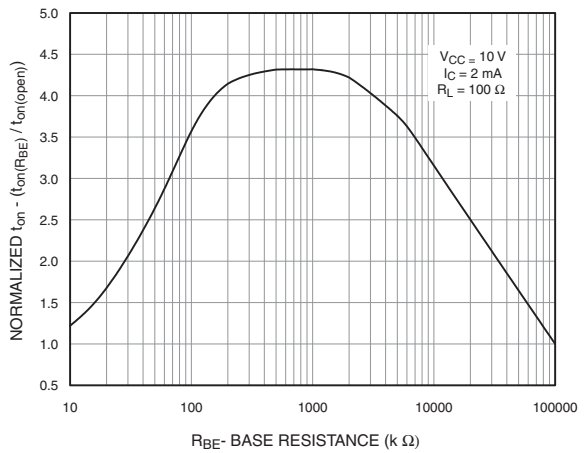


Fig. 17 Normalized  $t_{off}$  vs.  $R_{BE}$  (Black Package)

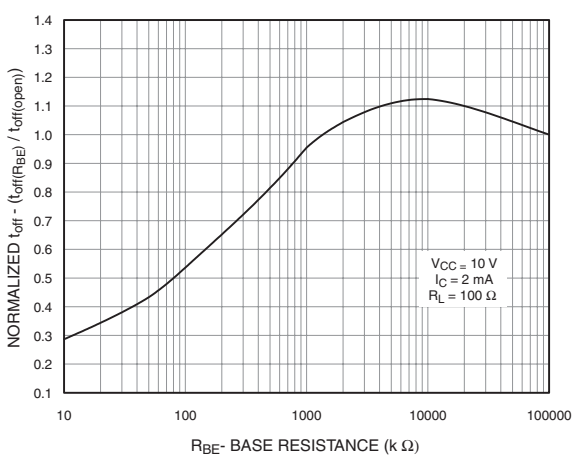
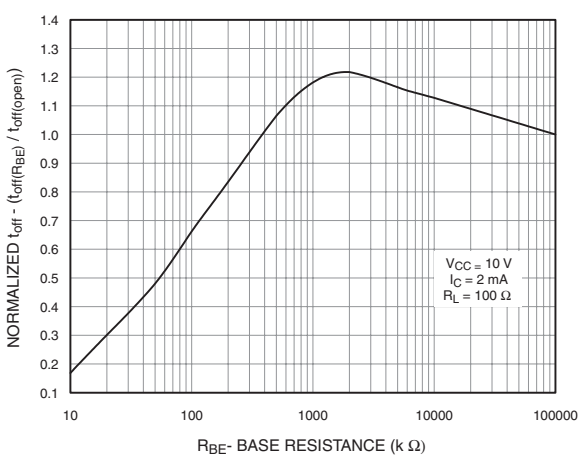
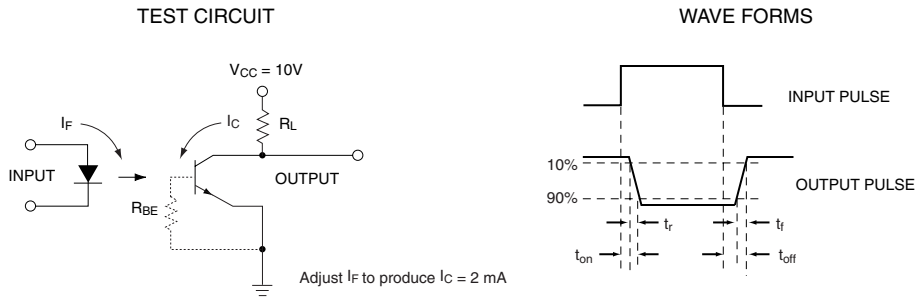
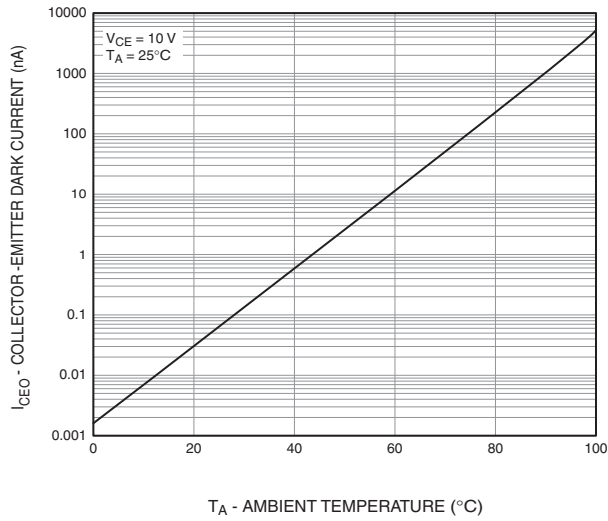


Fig. 18 Normalized  $t_{off}$  vs.  $R_{BE}$  (White Package)



**Typical Performance Curves** (Continued)

**Fig. 19 Dark Current vs. Ambient Temperature**



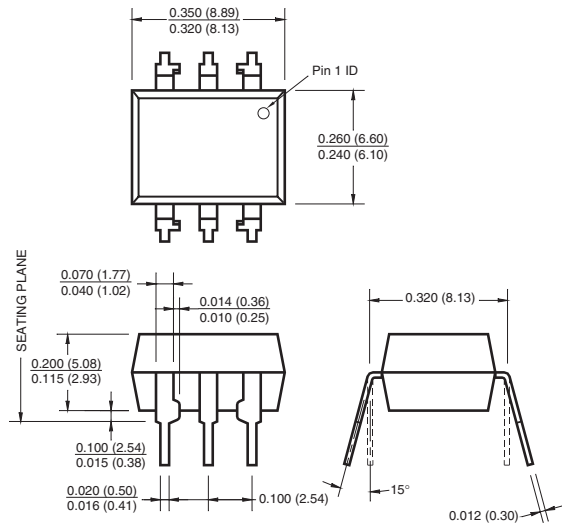
**Figure 20. Switching Time Test Circuit and Waveforms**



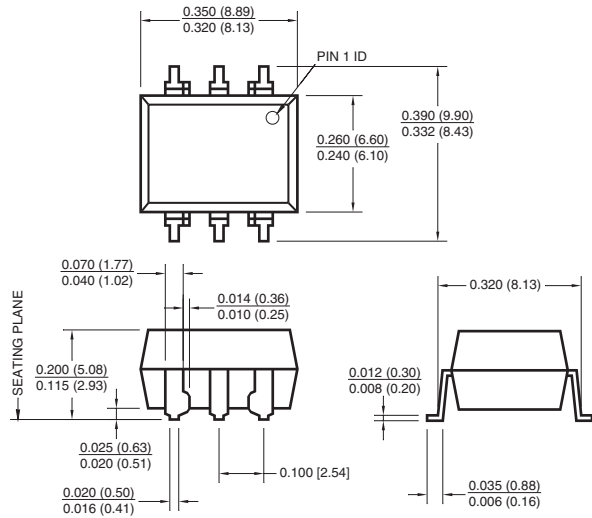


## White Package (-M Suffix)

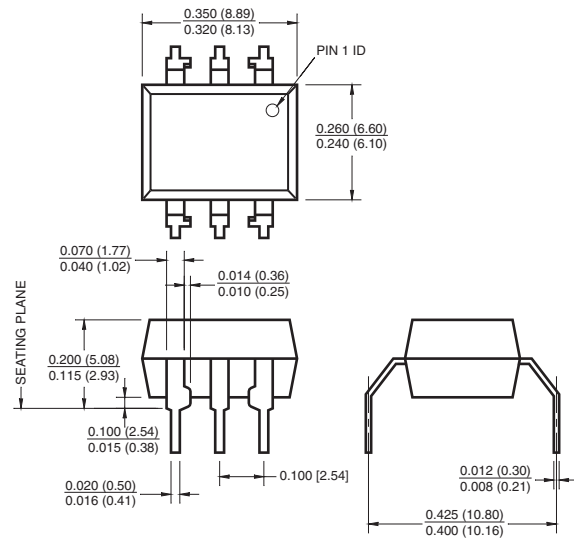
### Package Dimensions (Through Hole)



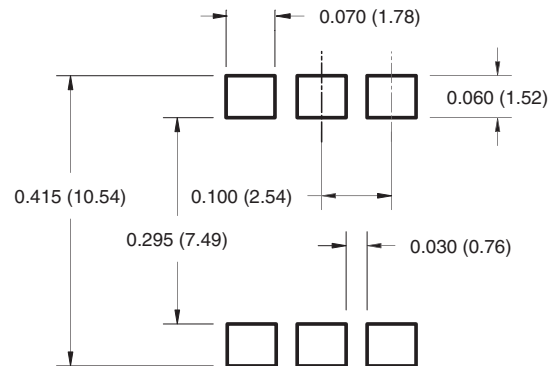
### Package Dimensions (Surface Mount)



### Package Dimensions (0.4" Lead Spacing)



### Recommended Pad Layout for Surface Mount Leadform



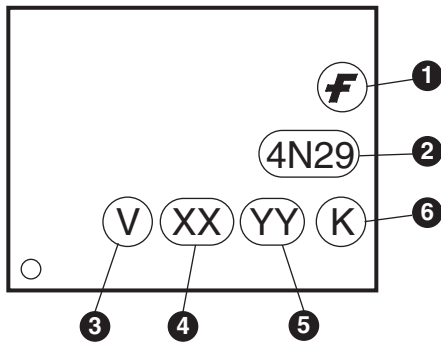
**Note:**

All dimensions are in inches (millimeters).

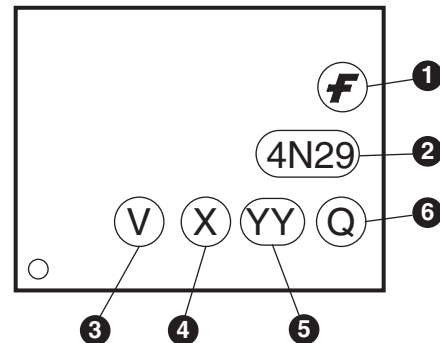
## Ordering Information

Black Package (No Suffix)	Example	White Package (-M Suffix)	Example	Option
No Suffix	4N32	No Suffix	4N32M	Standard Through Hole Device
.S	4N32S	S	4N32SM	Surface Mount Lead Bend
.SD	4N32SD	SR2	4N32SR2M	Surface Mount; Tape and reel
.W	4N32W	T	4N32TM	0.4" Lead Spacing
.300	4N32300	V	4N32VM	VDE 0884
.300W	4N32300W	TV	4N32TVM	VDE 0884, 0.4" Lead Spacing
.3S	4N323S	SV	4N32SVM	VDE 0884, Surface Mount
.3SD	4N323SD	SR2V	4N32SR2VM	VDE 0884, Surface Mount, Tape & Reel

## Marking Information



**Black Package, No Suffix**



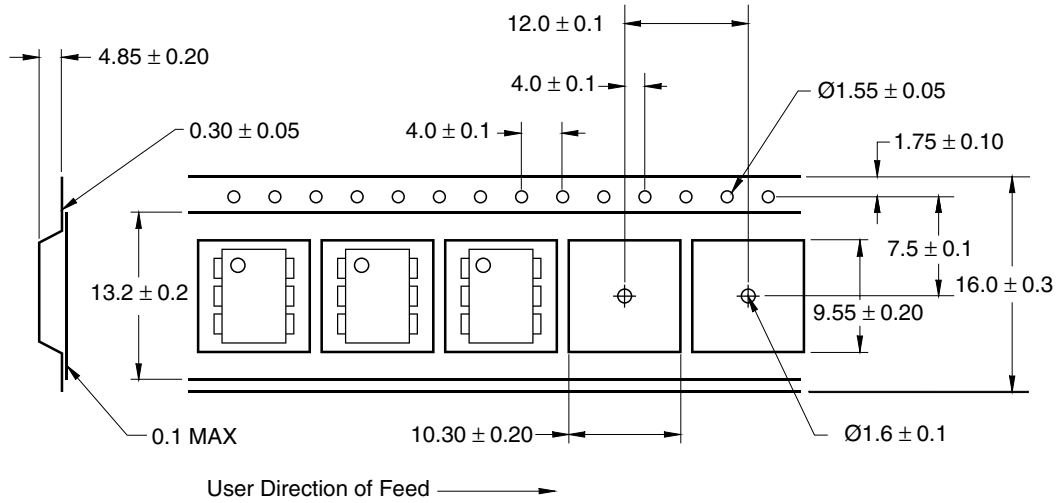
**White Package, -M Suffix**

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 or two digit year code <ul style="list-style-type: none"> <li>• Two digits for black package parts, e.g., '07'</li> <li>• One digit for white package parts, e.g., '7'</li> </ul>
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

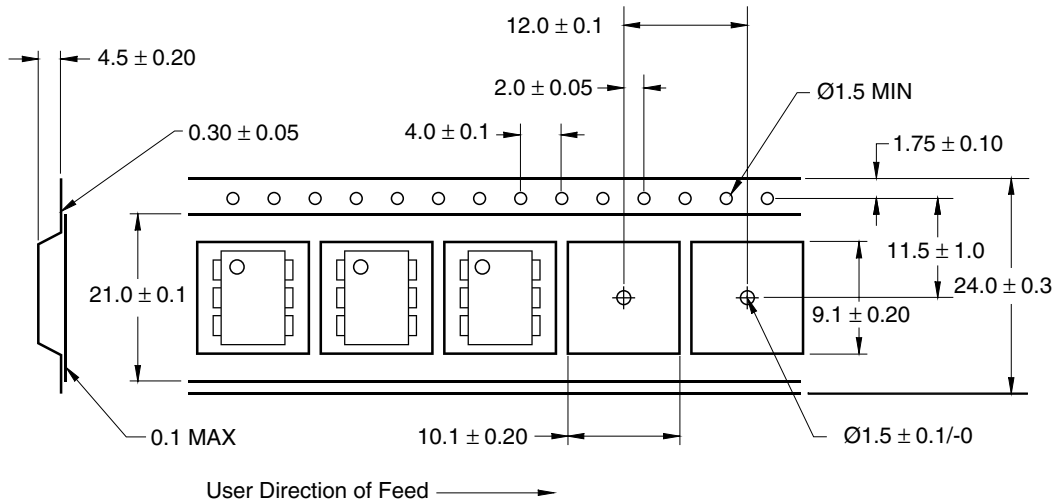
\*Note – Parts built in the white package (M suffix) that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in the portrait format.

## Tape Dimensions

### Black Package, No Suffix



### White Package, -M Suffix

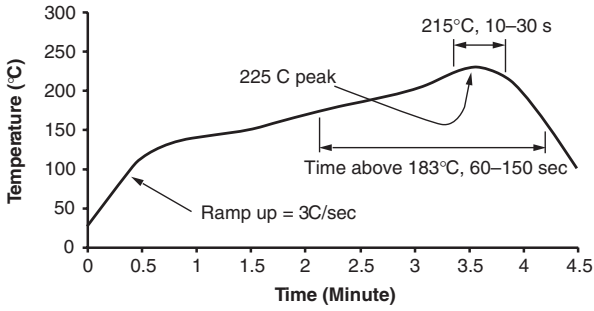


**Note:**

All dimensions are in millimeters.

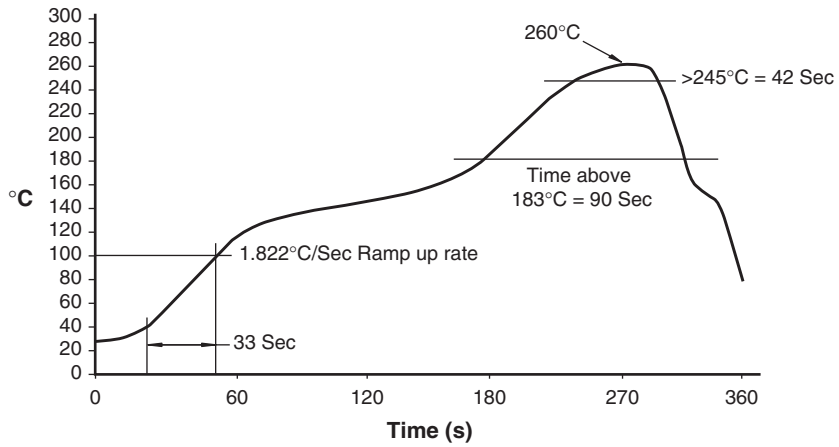
## Reflow Soldering Profile

### Black Package, No Suffix



- Peak reflow temperature: 225°C (package surface temperature)
- Time of temperature higher than 183°C for 60-150 seconds
- One time soldering reflow is recommended


### White Package, -M Suffix





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ActiveArray <sup>™</sup>	IntelliMAX <sup>™</sup>	Programmable Active Droop <sup>™</sup>	TinyLogic <sup>®</sup>
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DOME <sup>™</sup>	MSXPro <sup>™</sup>	ScalarPump <sup>™</sup>	UniFET <sup>™</sup>
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FACT Quiet Series <sup>™</sup>	OPTOPLANAR <sup>®</sup>	SuperFET <sup>™</sup>	
FACT <sup>®</sup>	PACMAN <sup>™</sup>	SuperSOT <sup>™</sup> -3	
FAST <sup>®</sup>	PDP-SPM <sup>™</sup>	SuperSOT <sup>™</sup> -6	
FASTr <sup>™</sup>	POP <sup>™</sup>	SuperSOT <sup>™</sup> -8	
FPS <sup>™</sup>	Power220 <sup>®</sup>	SyncFET <sup>™</sup>	
FRFET <sup>®</sup>	Power247 <sup>®</sup>	TCM <sup>™</sup>	
GlobalOptoisolator <sup>™</sup>	PowerEdge <sup>™</sup>	The Power Franchise <sup>®</sup>	
GTO <sup>™</sup>	PowerSaver <sup>™</sup>		
HiSeC <sup>™</sup>			

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- A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### 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.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

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