

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

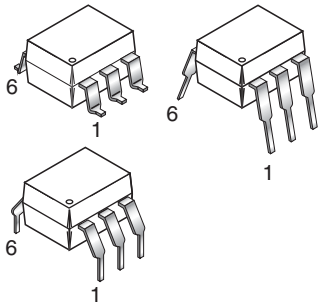
- Low power logic circuits
- Telecommunications equipment
- Portable electronics
- Solid state relays
- Interfacing coupling systems of different potentials and impedances

Description

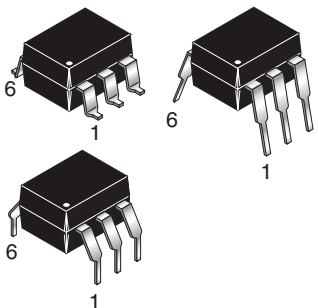
The 4N29, 4N30, 4N31, 4N32, 4N33 have a gallium arsenide infrared emitter optically coupled to a silicon planar photodarlington.

Packages

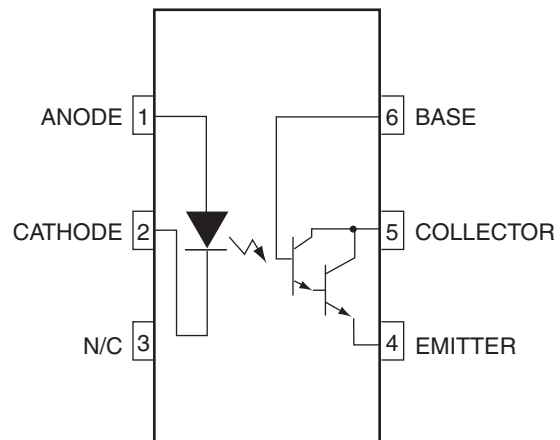
White Package (-M Suffix)



Black Package (No -M Suffix)



Schematic



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

Symbol	Parameter	Value	Units
TOTAL DEVICE			
T_{STG}	Storage Temperature	-55 to +150	$^\circ\text{C}$
T_{OPR}	Operating Temperature	-55 to +100	$^\circ\text{C}$
T_{SOL}	Lead Solder Temperature	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	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	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	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	Min.	Typ.	Max.	Unit
EMITTER						
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	μA
C	Capacitance*	$V_F = 0\text{V}$, $f = 1.0\text{MHz}$	–	150	–	pF
DETECTOR						
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
DC CHARACTERISTICS						
$I_{C(CTR)}$	Collector Output Current*(1, 2) 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*(2) 4N29, 4N30, 4N32, 4N33 4N31	$I_F = 8\text{mA}$, $I_C = 2.0\text{mA}$	–	–	1.0	V
			–	–	1.2	
AC CHARACTERISTICS						
t_{on}	Turn-on Time	$I_F = 200\text{mA}$, $I_C = 50\text{mA}$, $V_{CC} = 10\text{V}$	–	–	5.0	μS
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	μS
			–	–	40	
BW	Bandwidth ^(3, 4)		–	30	–	kHz

Isolation Characteristics

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

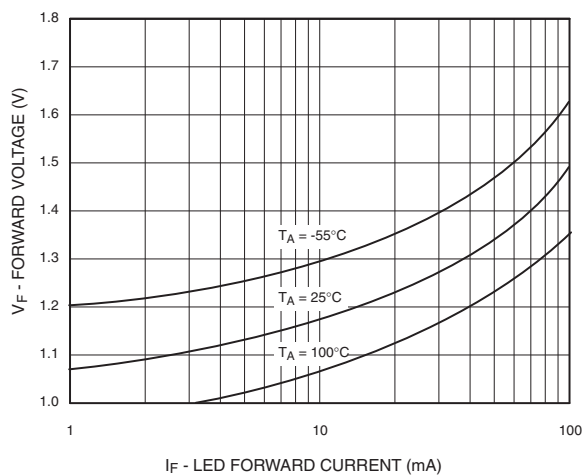


Fig. 2 LED Forward Voltage vs. Forward Current (White Package)

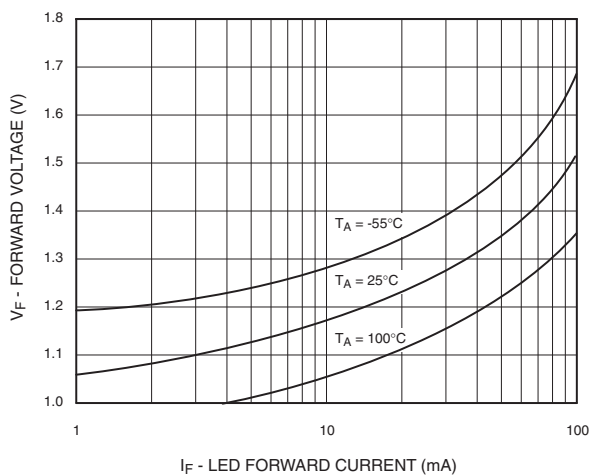


Fig.3 Normalized CTR vs. Forward Current (Black Package)

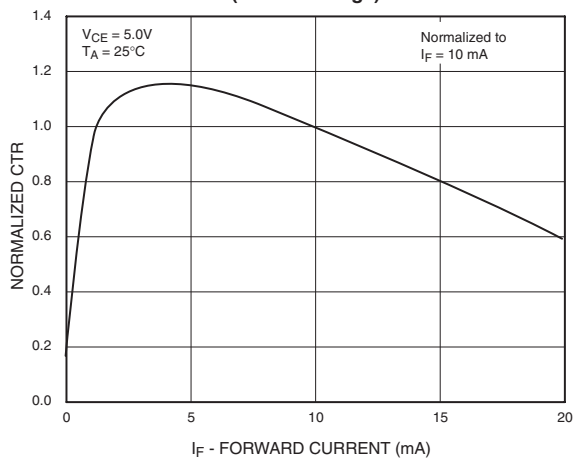


Fig.4 Normalized CTR vs. Forward Current (White Package)

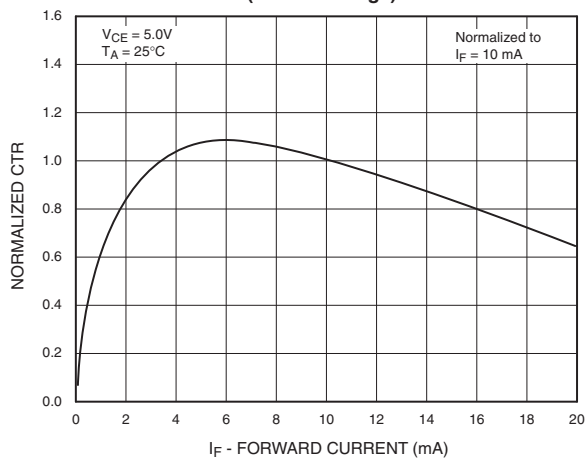


Fig. 5 Normalized CTR vs. Ambient Temperature (Black Package)

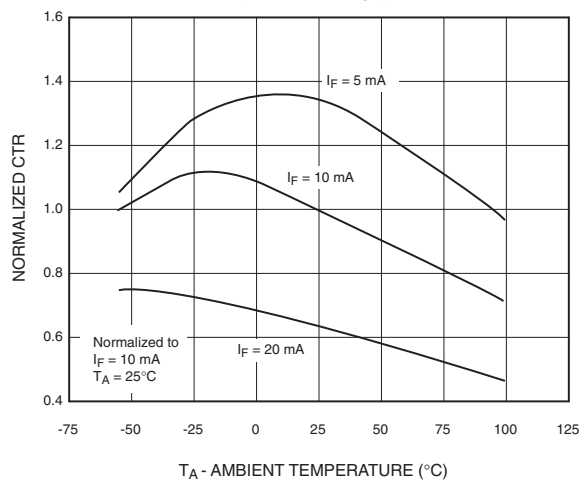
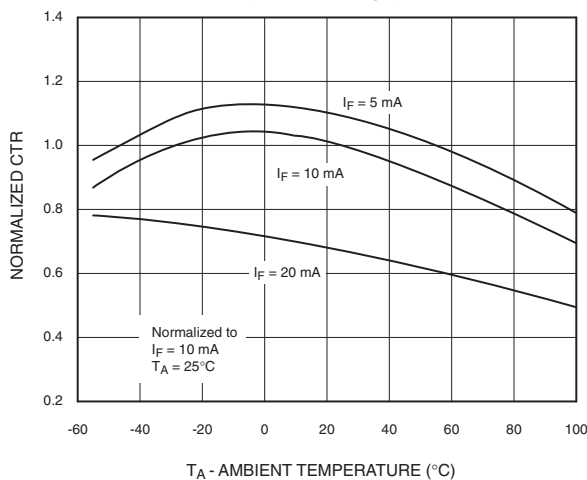


Fig. 6 Normalized CTR vs. Ambient Temperature (White Package)



Typical Performance Curves (Continued)

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

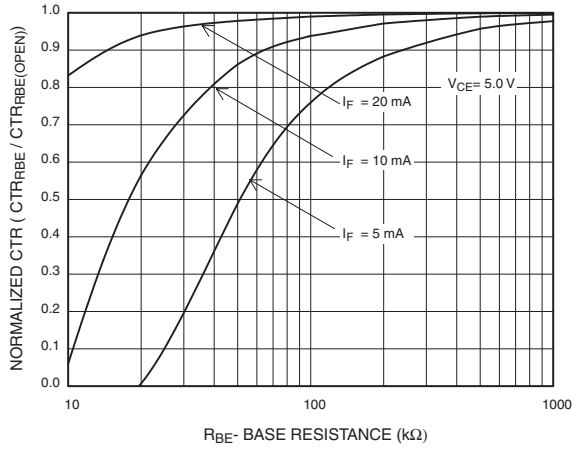


Fig. 8 CTR vs. RBE (Unsaturated) (White Package)

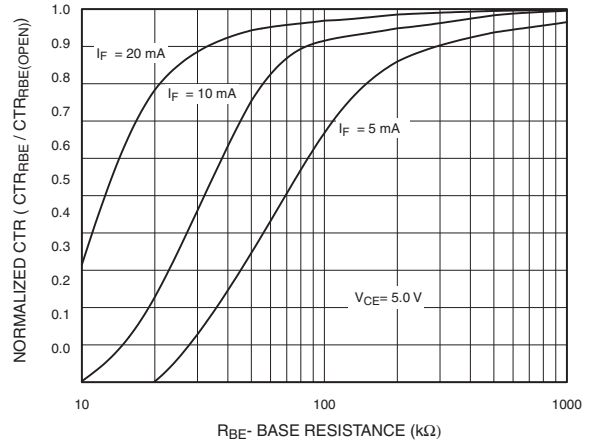


Fig. 9 CTR vs. RBE (Saturated) (Black Package)

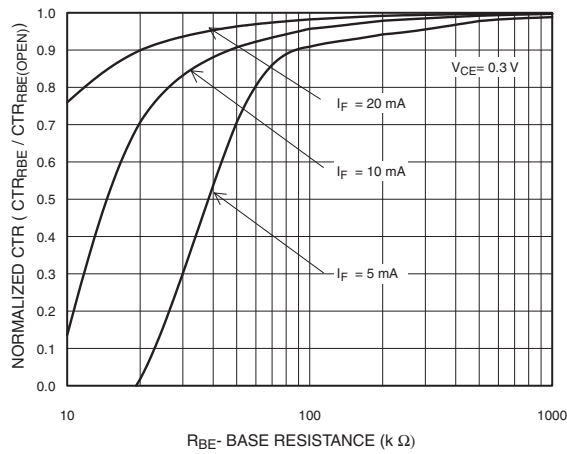


Fig. 10 CTR vs. RBE (Saturated) (White Package)

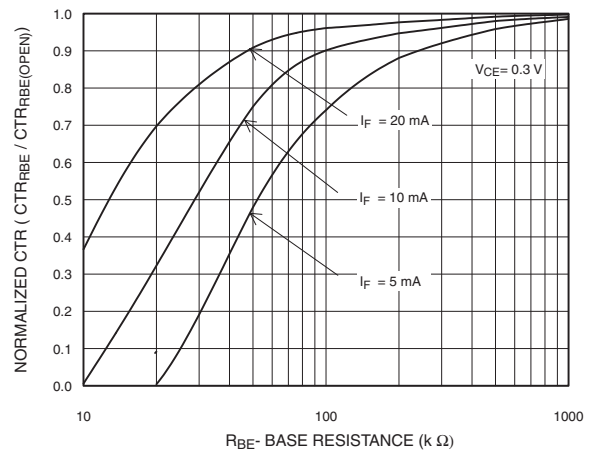


Fig. 11 Collector-Emitter Saturation Voltage vs. Collector Current (Black Package)

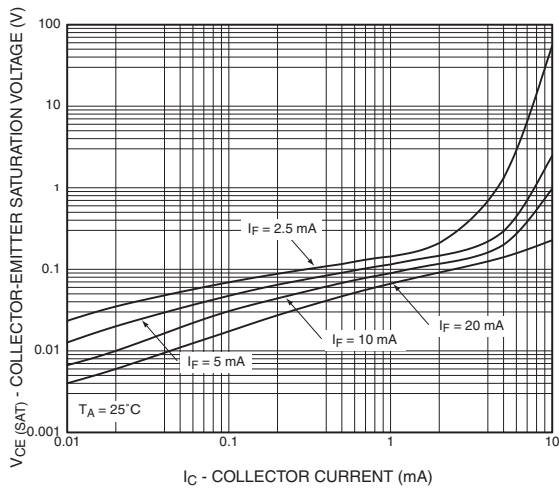
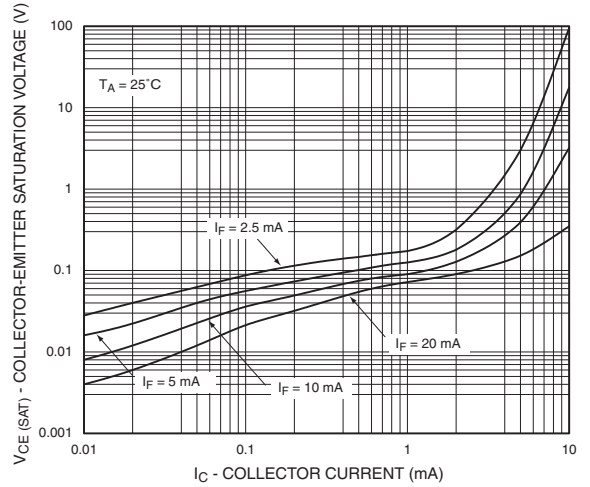


Fig. 12 Collector-Emitter Saturation Voltage vs. Collector Current (White Package)



Typical Performance Curves (Continued)

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

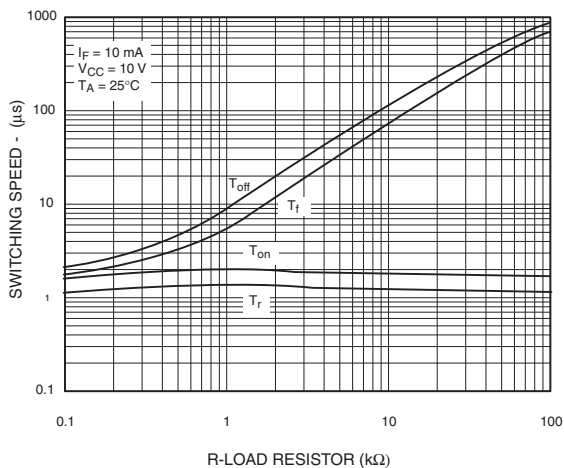


Fig. 14 Switching Speed vs. Load Resistor (White Package)

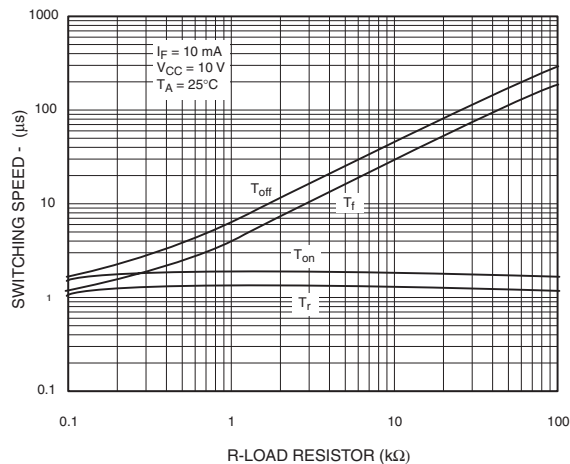


Fig. 15 Normalized t_{on} vs. R_{BE} (Black Package)

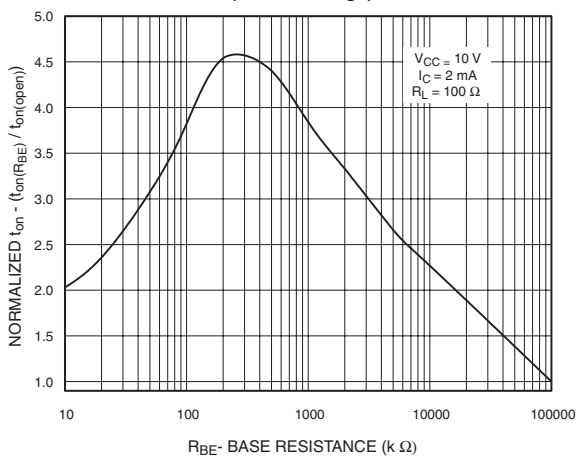


Fig. 16 Normalized t_{on} vs. R_{BE} (White Package)

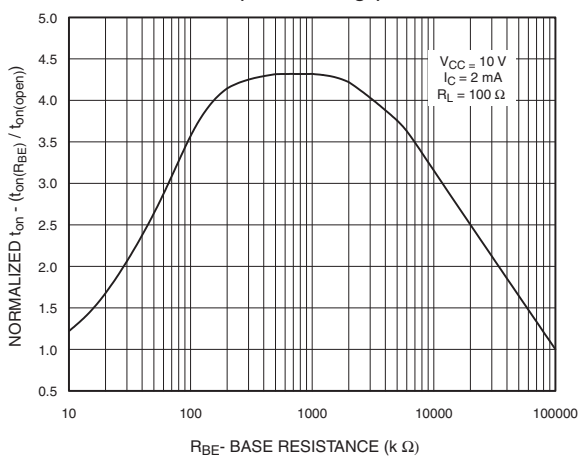


Fig. 17 Normalized t_{off} vs. R_{BE} (Black Package)

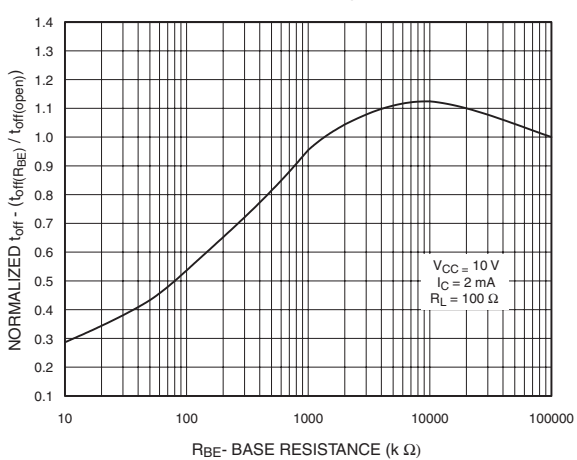
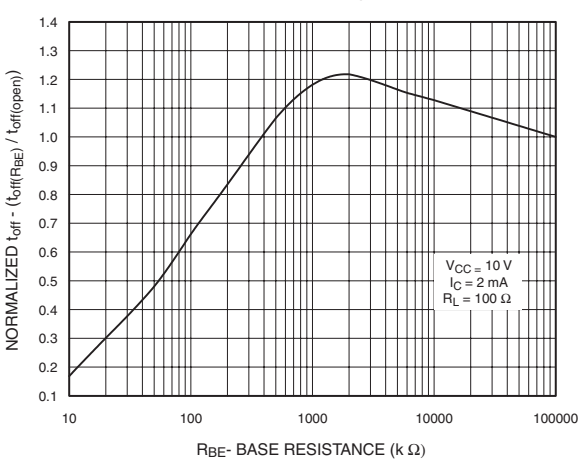


Fig. 18 Normalized t_{off} vs. R_{BE} (White Package)



Typical Performance Curves (Continued)

Fig. 19 Dark Current vs. Ambient Temperature

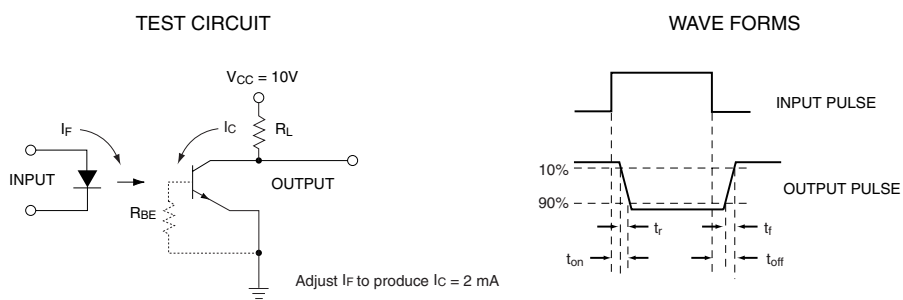
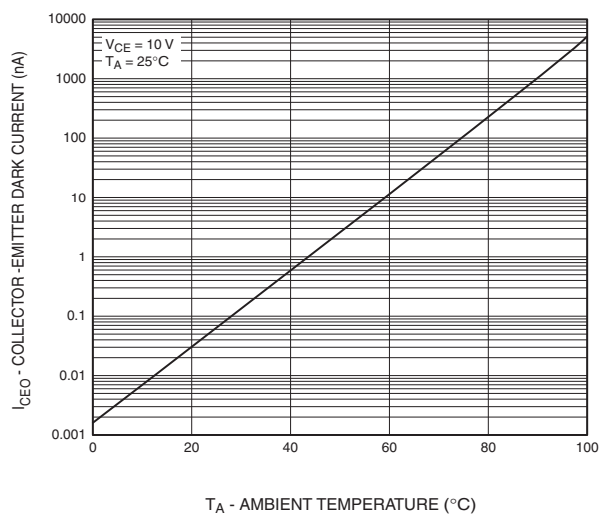
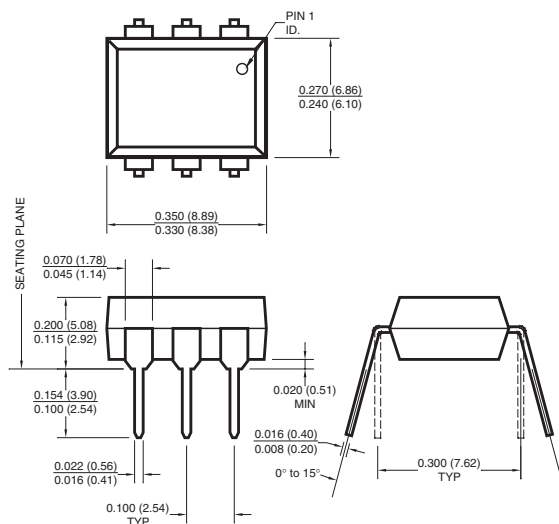


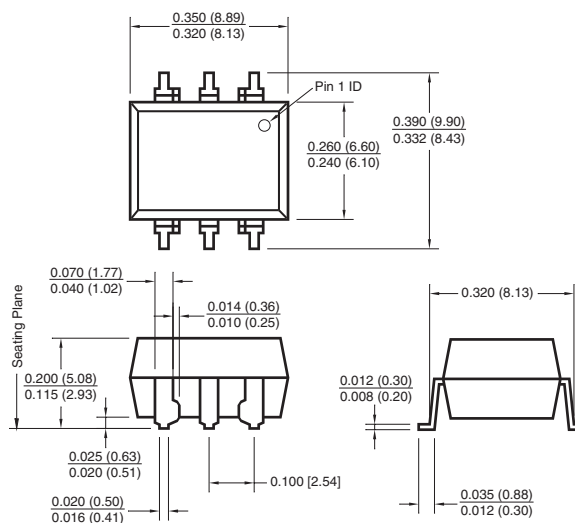
Figure 20. Switching Time Test Circuit and Waveforms

Black Package (No -M Suffix)

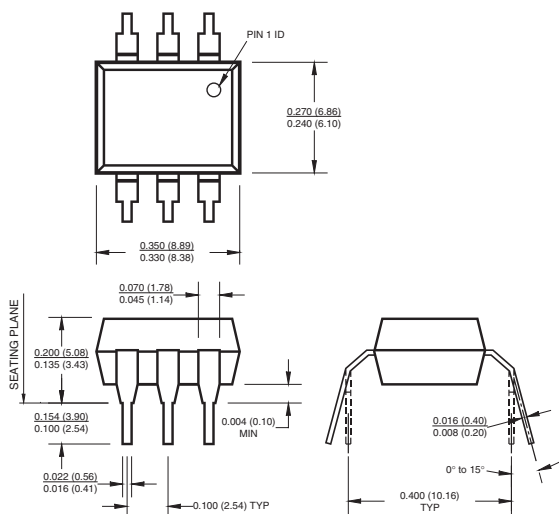
Package Dimensions (Through Hole)



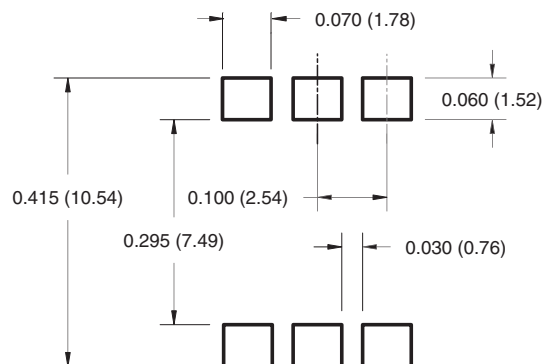
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform

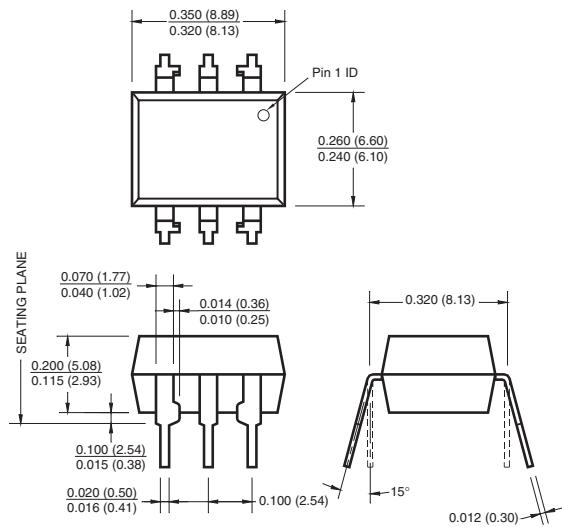


Note:

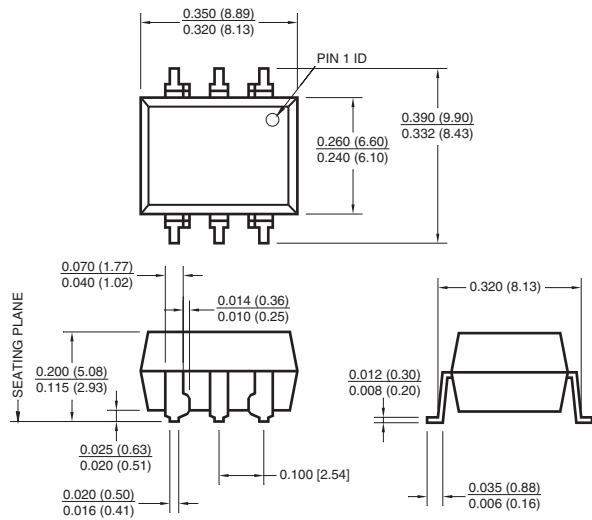
All dimensions are in inches (millimeters).

White Package (-M Suffix)

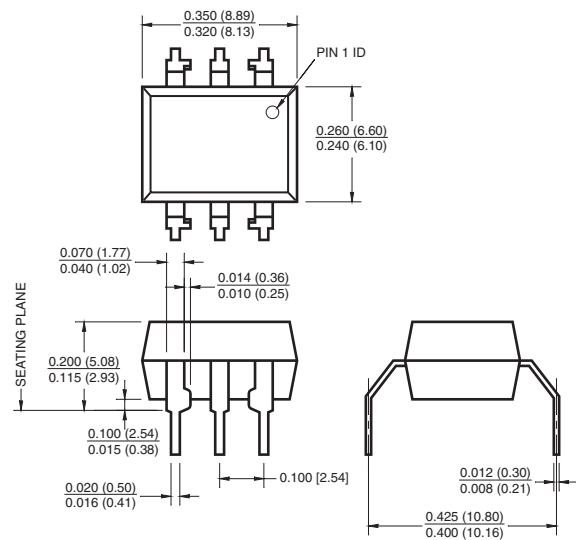
Package Dimensions (Through Hole)



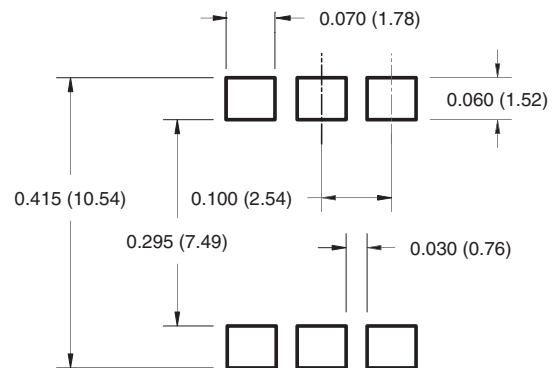
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform



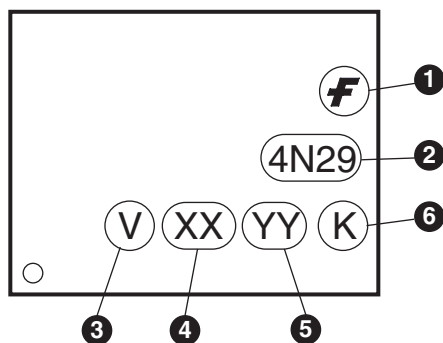
Note:

All dimensions are in inches (millimeters).

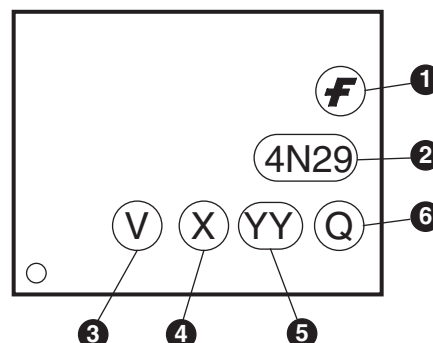
Ordering Information

Black Package (No Suffix)	White Package (-M Suffix)	Option
.S	S	Surface Mount Lead Bend
.SD	SR2	Surface Mount; Tape and reel
.W	T	0.4" Lead Spacing
.300	V	VDE 0884
.300W	TV	VDE 0884, 0.4" Lead Spacing
.3S	SV	VDE 0884, Surface Mount
.3SD	SR2V	VDE 0884, Surface Mount, Tape & Reel

Marking Information



Black Package, No Suffix



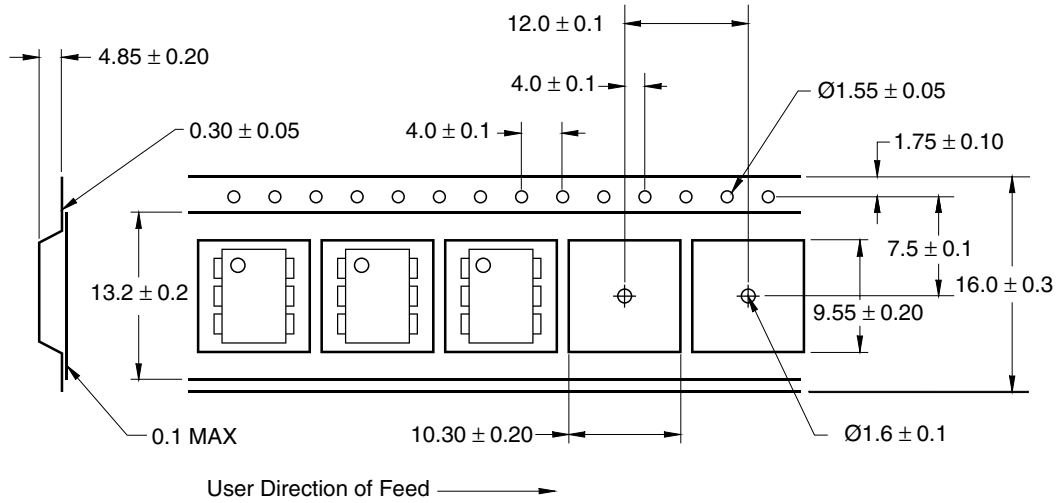
White Package, -M Suffix

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"> • Two digits for black package parts, e.g., '03' • One digit for white package parts, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

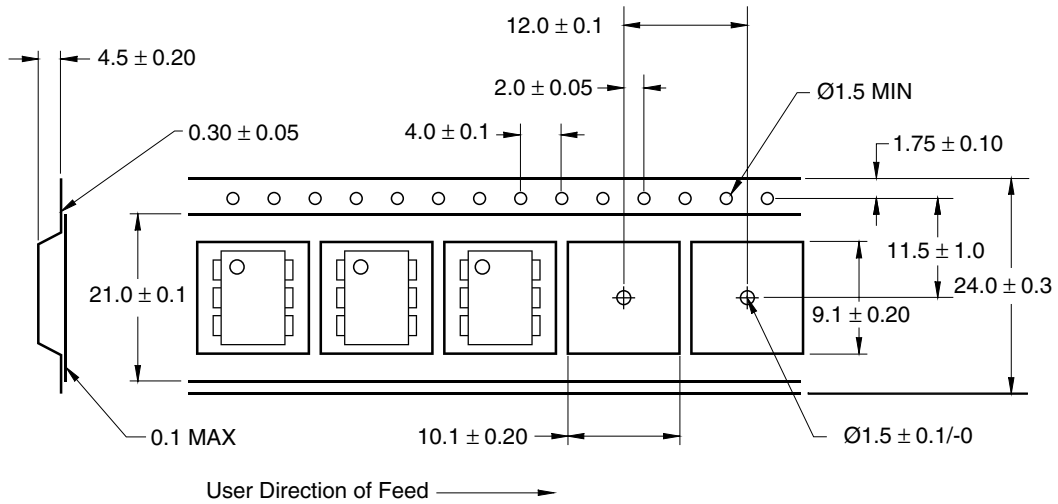
*Note – Parts built in the white package (M suffix) that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in the portrait format.

Tape Dimensions

Black Package, No Suffix



White Package, -M Suffix

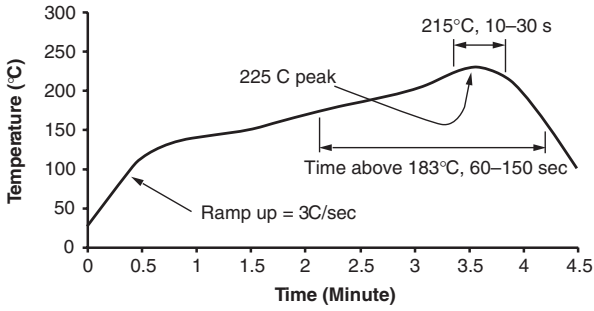


Note:

All dimensions are in millimeters.

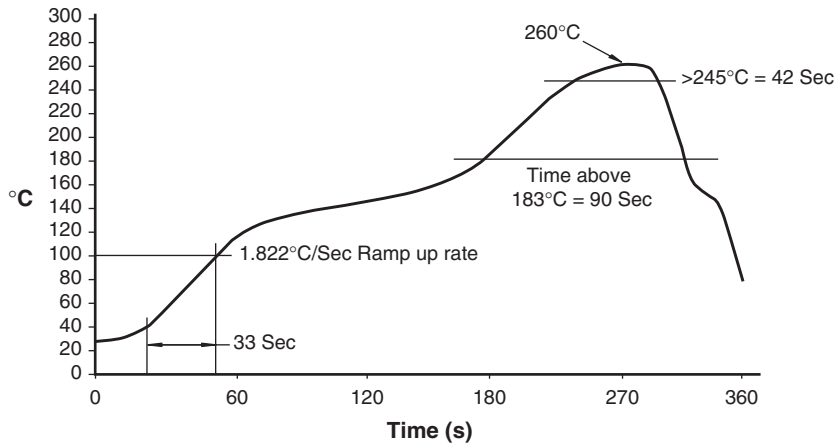
Reflow Soldering Profile

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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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, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order 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 in order to improve design.
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