

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

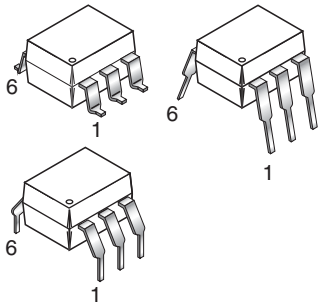
- Low power logic circuits
- Telecommunications equipment
- Portable electronics
- Solid state relays
- Interfacing coupling systems of different potentials and impedances

Description

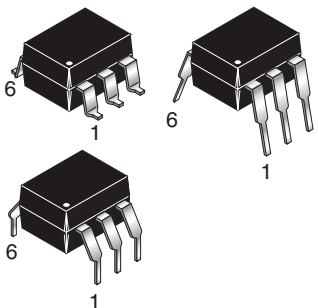
The 4N29, 4N30, 4N31, 4N32, 4N33 have a gallium arsenide infrared emitter optically coupled to a silicon planar photodarlington.

Packages

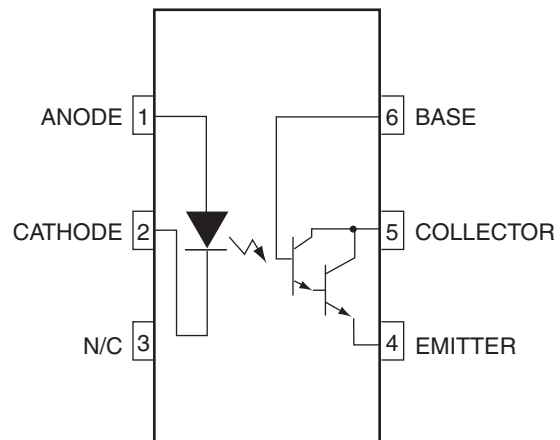
White Package (-M Suffix)



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)

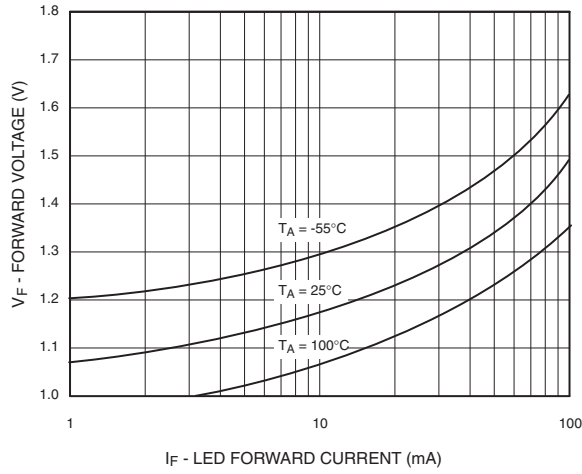


Fig. 2 LED Forward Voltage vs. Forward Current (White Package)

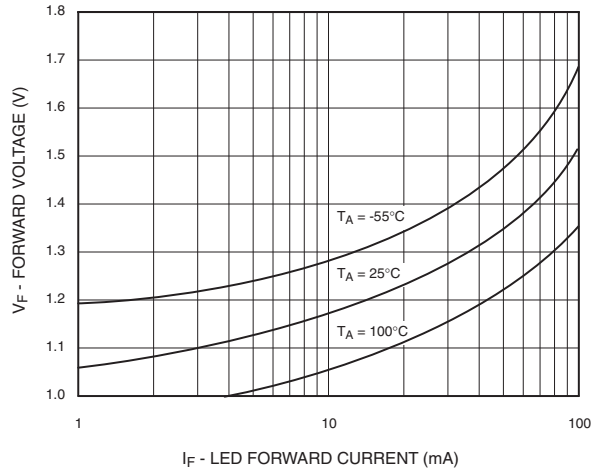


Fig.3 Normalized CTR vs. Forward Current (Black Package)

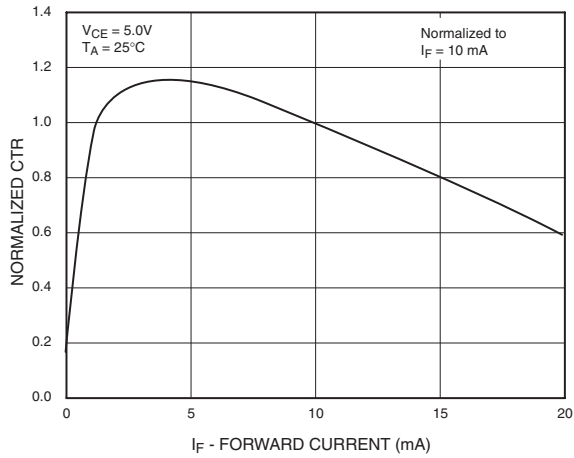


Fig.4 Normalized CTR vs. Forward Current (White Package)

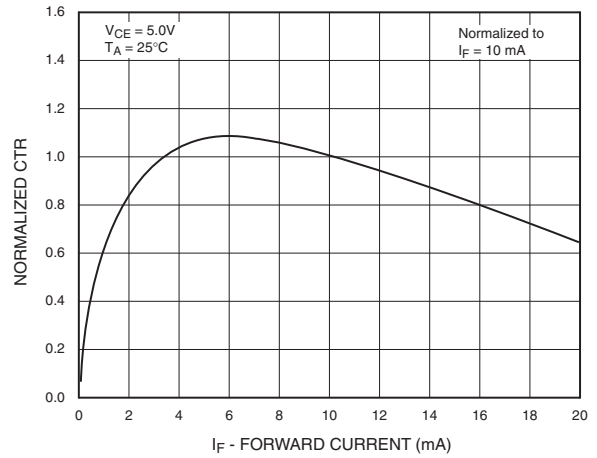


Fig. 5 Normalized CTR vs. Ambient Temperature (Black Package)

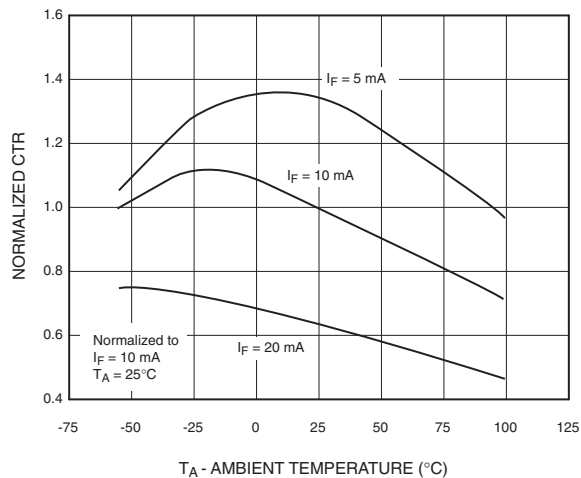
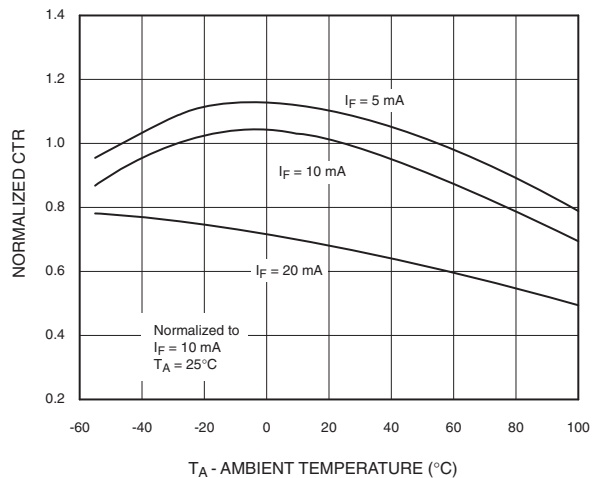


Fig. 6 Normalized CTR vs. Ambient Temperature (White Package)



Typical Performance Curves (Continued)

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

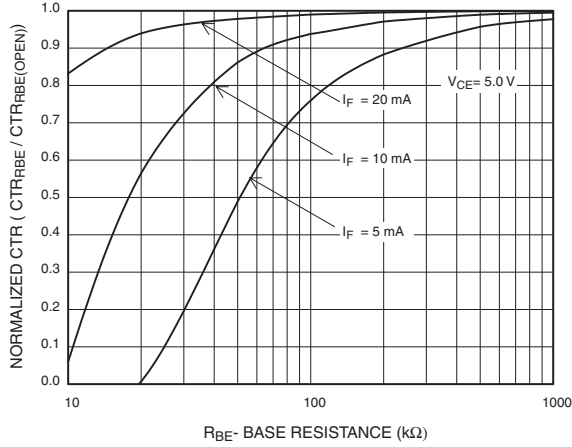


Fig. 8 CTR vs. RBE (Unsaturated) (White Package)

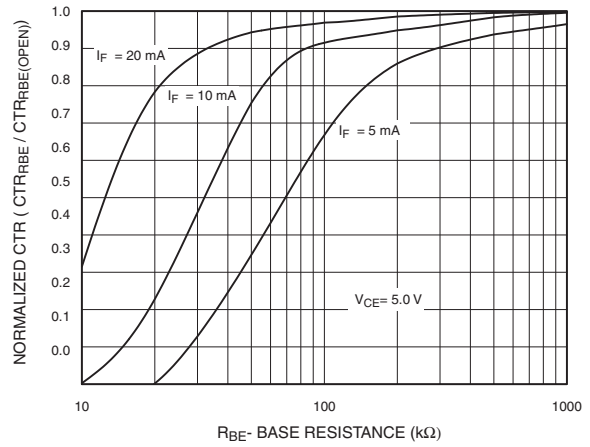


Fig. 9 CTR vs. RBE (Saturated) (Black Package)

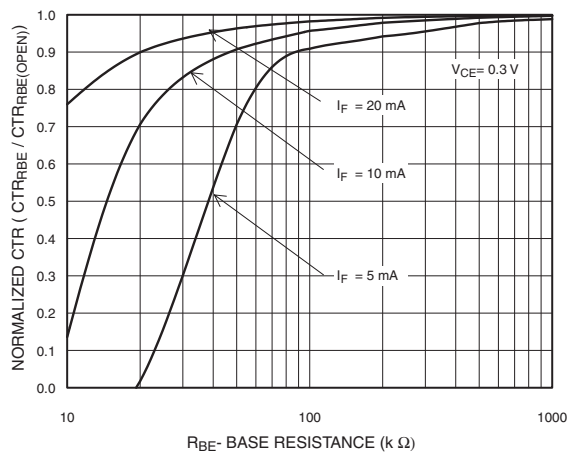


Fig. 10 CTR vs. RBE (Saturated) (White Package)

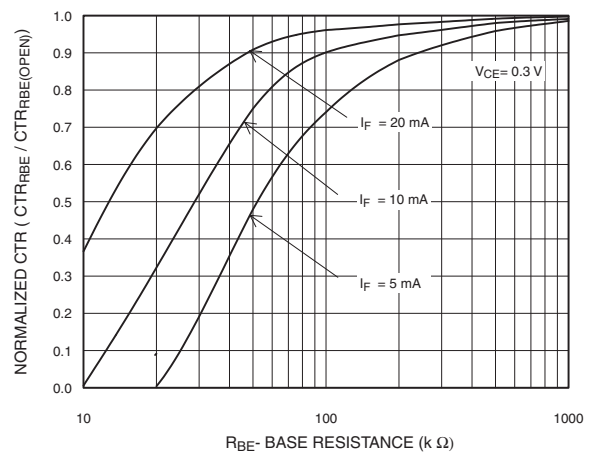


Fig. 11 Collector-Emitter Saturation Voltage vs. Collector Current (Black Package)

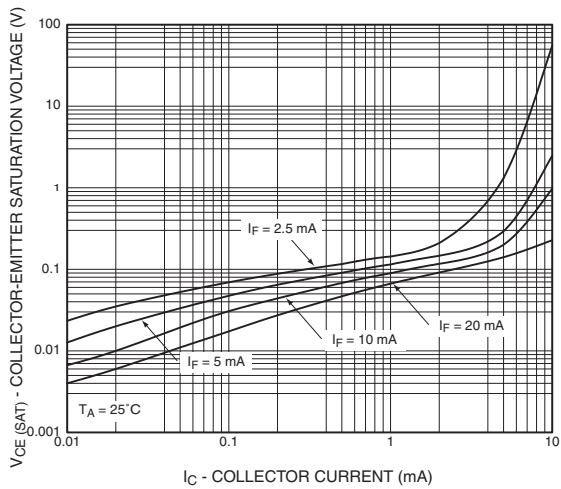
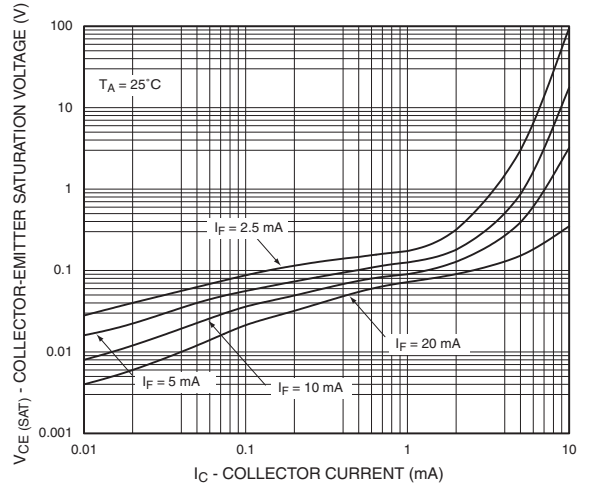


Fig. 12 Collector-Emitter Saturation Voltage vs. Collector Current (White Package)



Typical Performance Curves (Continued)

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

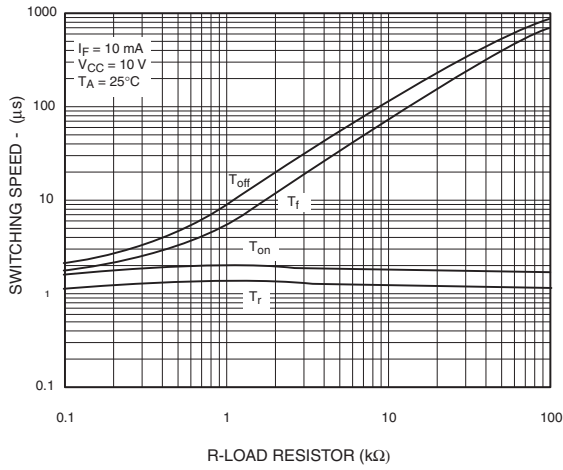


Fig. 14 Switching Speed vs. Load Resistor (White Package)

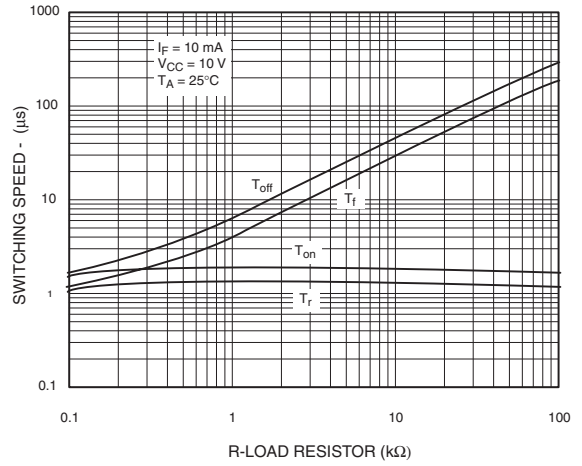


Fig. 15 Normalized t_{on} vs. R_{BE} (Black Package)

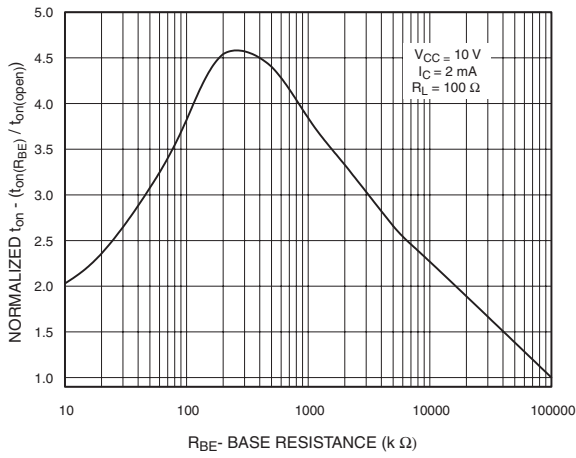


Fig. 16 Normalized t_{on} vs. R_{BE} (White Package)

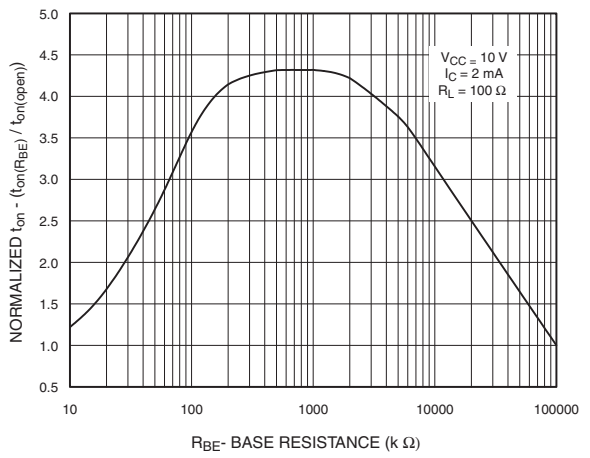


Fig. 17 Normalized t_{off} vs. R_{BE} (Black Package)

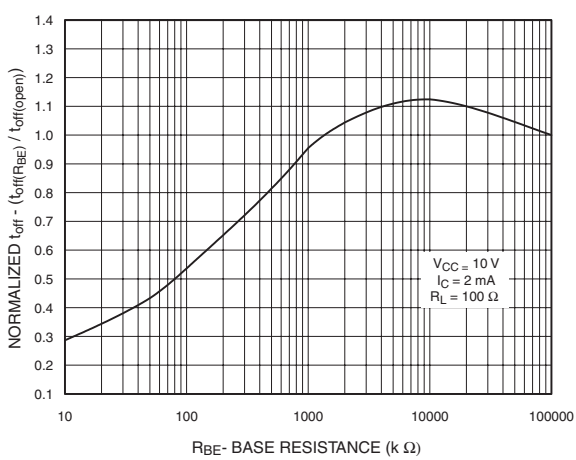
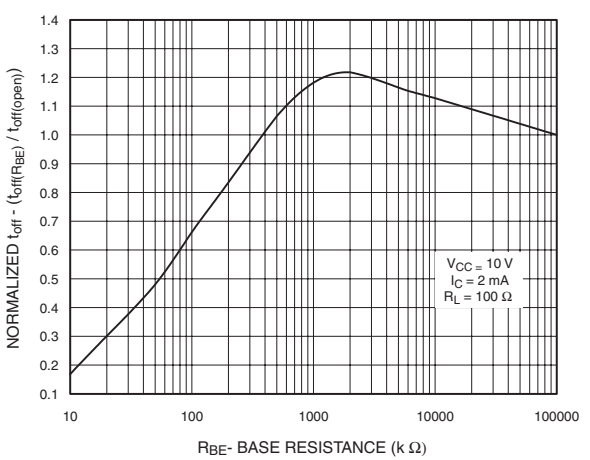


Fig. 18 Normalized t_{off} vs. R_{BE} (White Package)



Typical Performance Curves (Continued)

Fig. 19 Dark Current vs. Ambient Temperature

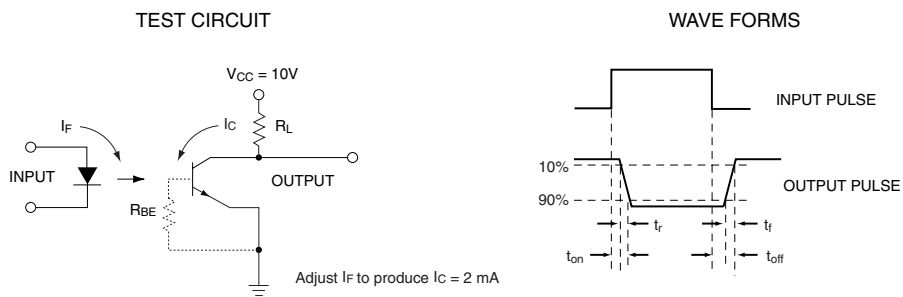
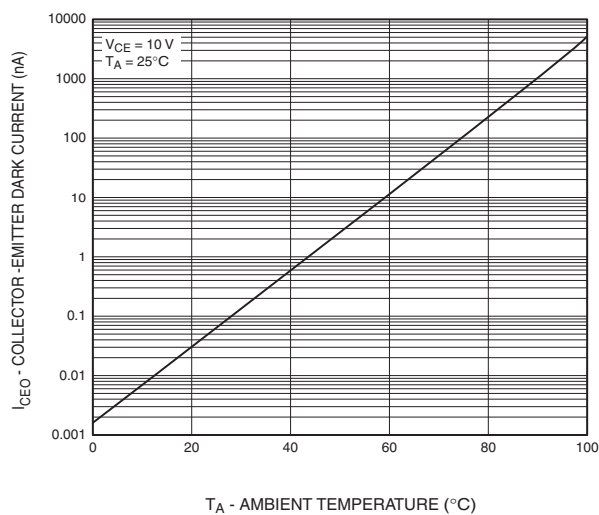
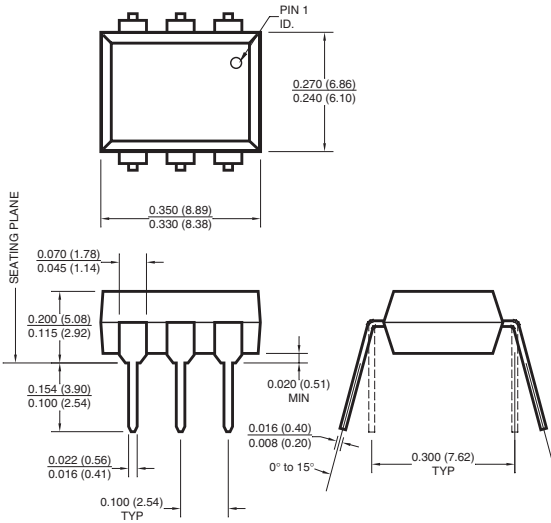


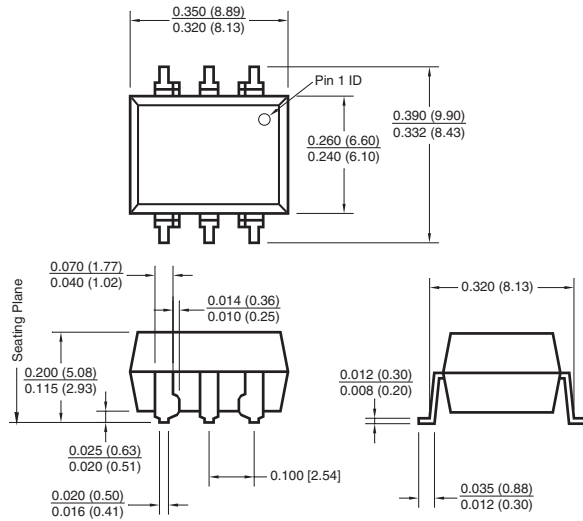
Figure 20. Switching Time Test Circuit and Waveforms

Black Package (No -M Suffix)

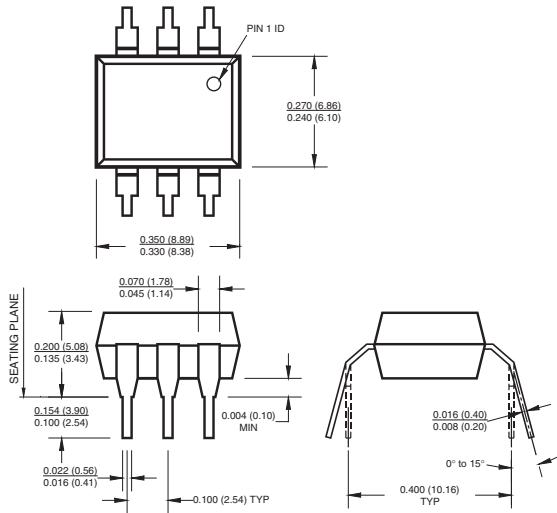
Package Dimensions (Through Hole)



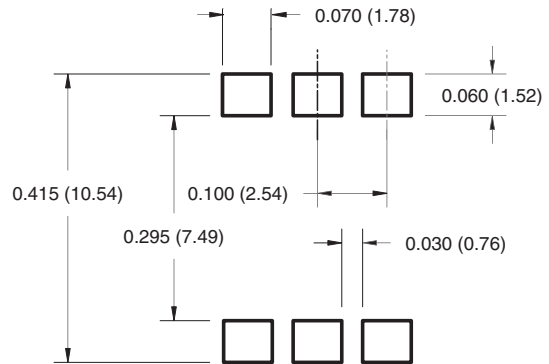
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform

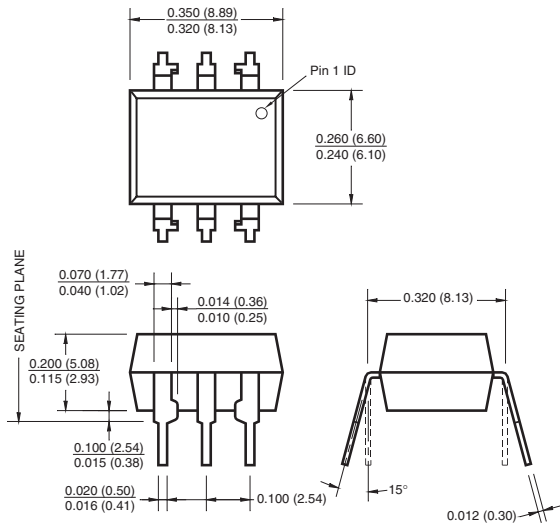


Note:

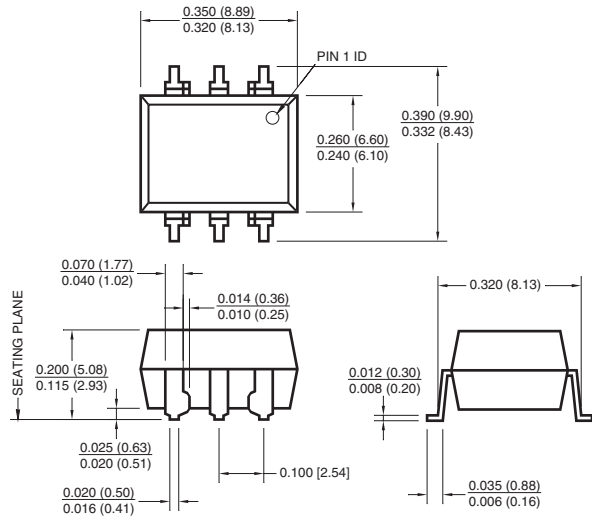
All dimensions are in inches (millimeters).

White Package (-M Suffix)

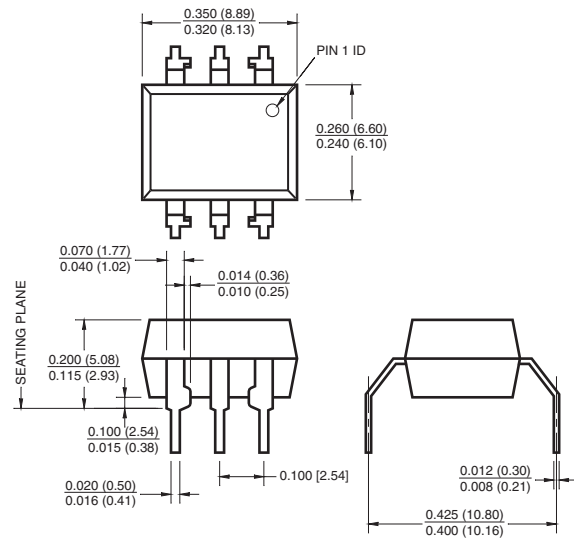
Package Dimensions (Through Hole)



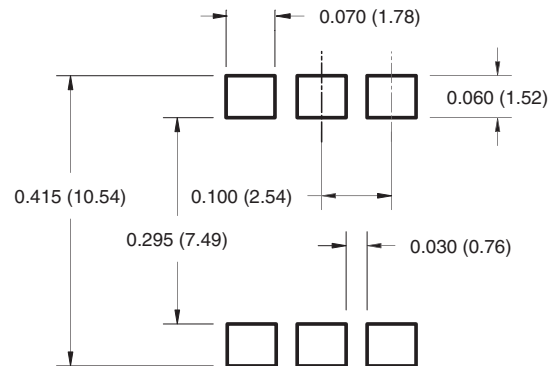
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform



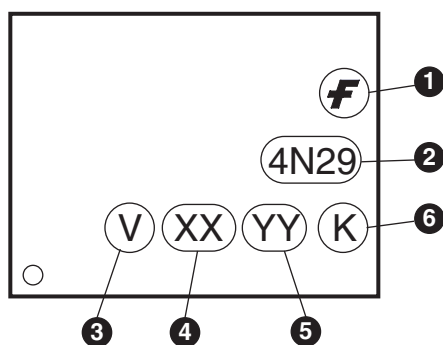
Note:

All dimensions are in inches (millimeters).

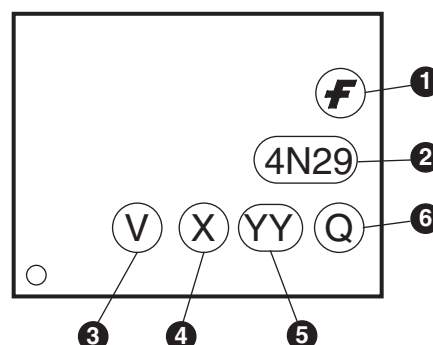
Ordering Information

| 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



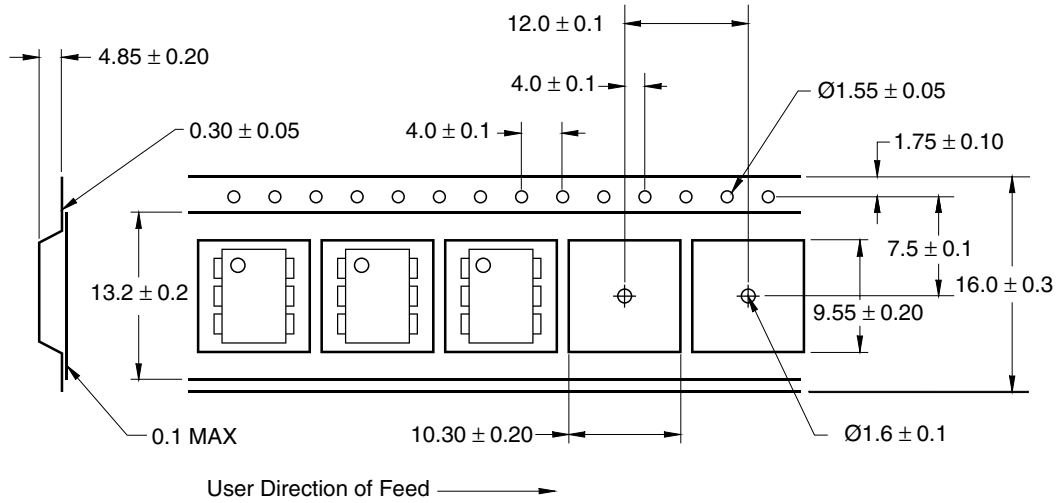
White Package, -M Suffix

| 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 |

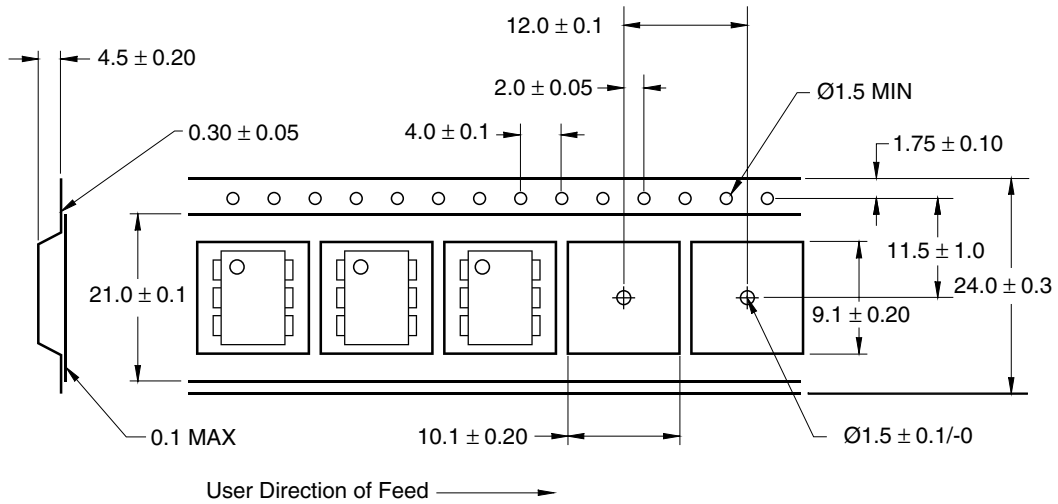
*Note – Parts built in the white package (M suffix) that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in the portrait format.

Tape Dimensions

Black Package, No Suffix



White Package, -M Suffix

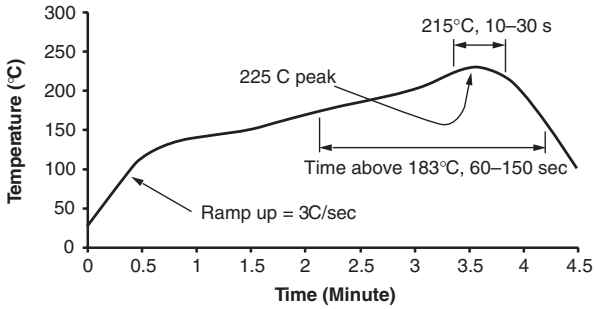


Note:

All dimensions are in millimeters.

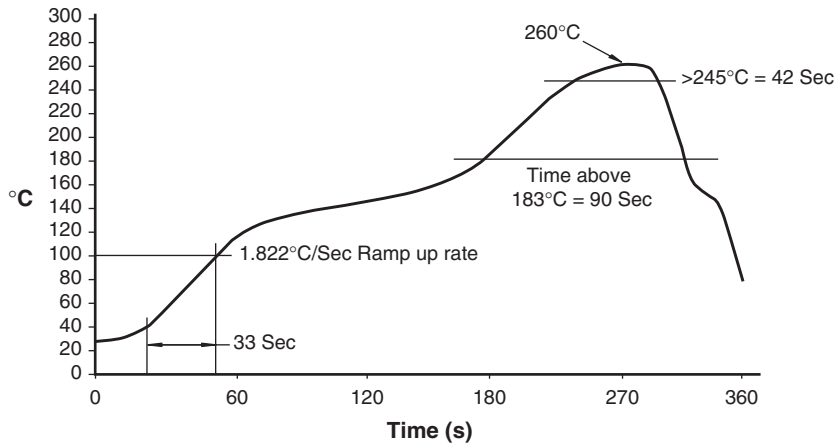
Reflow Soldering Profile

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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