

# CNY171, CNY172, CNY173, CNY174, CNY17F1, CNY17F2, CNY17F3, CNY17F4, MOC8101, MOC8102, MOC8103, MOC8104, MOC8105, MOC8106, MOC8107, MOC8108 Phototransistor Optocouplers

## Features

- CNY171/2/3/4 and CNY17F1/2/3/4 are also available in white package by specifying M suffix (eg. CNY17F2M)
- UL recognized (File # E90700)
- VDE recognized
  - Add option V for white package (e.g., CNY17F2VM)
  - File #102497
  - Add option '300' for black package (e.g., CNY17F2300)
  - File #94766
- Current transfer ratio in select groups
- High  $BV_{CEO}$ —70V minimum (CNY17X/M, CNY17FX/M, MOC8106/7/8)
- Closely matched current transfer ratio (CTR) minimizes unit-to-unit variation.
- Very low coupled capacitance along with no chip to pin 6 base connection for minimum noise susceptibility (CNY17FX/M, MOC810X)

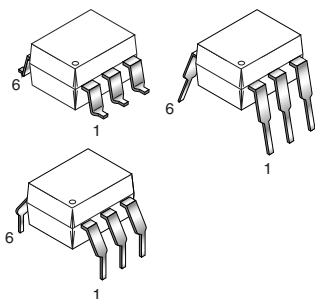
## Applications

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

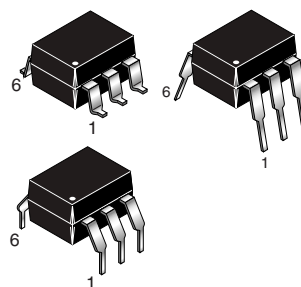
## Description

The CNY17, CNY17F and MOC810X devices consist of a Gallium Arsenide IRED coupled with an NPN phototransistor in a dual in-line package.

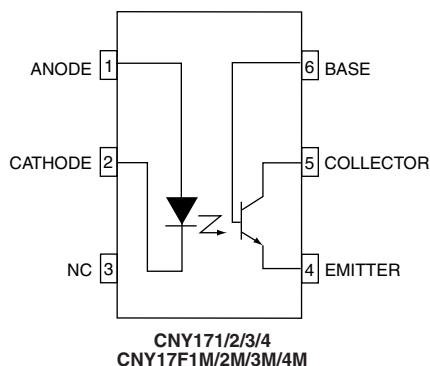
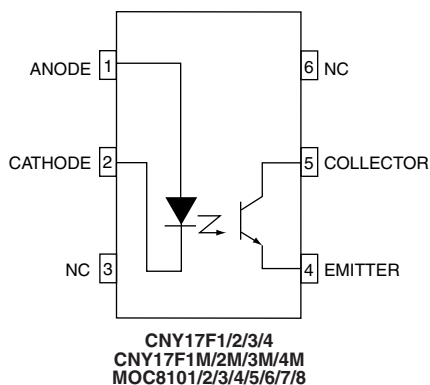
## White Package (-M Suffix)



## Black Package (No -M Suffix)



## Schematic



**Absolute Maximum Ratings**

| Parameters                                                | Symbol              | Device                              | Value          | Units |
|-----------------------------------------------------------|---------------------|-------------------------------------|----------------|-------|
| TOTAL DEVICE                                              |                     |                                     |                |       |
| Storage Temperature                                       | T <sub>STG</sub>    | M                                   | -40 to +150    | °C    |
|                                                           |                     | non M                               | -55 to +150    |       |
| Operating Temperature                                     | T <sub>OPR</sub>    | M                                   | -40 to +100    | °C    |
|                                                           |                     | non M                               | -55 to +100    |       |
| Lead Solder Temperature                                   | T <sub>SOL</sub>    | All                                 | 260 for 10 sec | °C    |
| Total Device Power Dissipation @ 25°C (LED plus detector) | P <sub>D</sub>      | M                                   | 250            | mW    |
| Derate Linearly From 25°C                                 |                     | non M                               | 250            |       |
|                                                           |                     | M                                   | 2.94           | mW/°C |
|                                                           |                     | non M                               | 3.30           |       |
| EMITTER                                                   |                     |                                     |                |       |
| Continuous Forward Current                                | I <sub>F</sub>      | M                                   | 60             | mA    |
|                                                           |                     | non M                               | 100            |       |
| Reverse Voltage                                           | V <sub>R</sub>      | All                                 | 6              | V     |
| Forward Current - Peak (1 μs pulse, 300 pps)              | I <sub>F</sub> (pk) | M                                   | 1.5            | A     |
|                                                           |                     | non M                               | 1.0            |       |
| LED Power Dissipation 25°C Ambient                        | P <sub>D</sub>      | M                                   | 120            | mW    |
|                                                           |                     | non M                               | 150            |       |
|                                                           |                     | M                                   | 1.41           | mW/°C |
|                                                           |                     | non M                               | 1.8            |       |
| DETECTOR                                                  |                     |                                     |                |       |
| Continuous Collector Current                              | I <sub>C</sub>      | All                                 | 50             | mA    |
| Collector-Emitter Voltage                                 | V <sub>CEO</sub>    | CNY17X/M, CNY17FX/M,<br>MOC8106/7/8 | 70             | V     |
|                                                           |                     | MOC8101/2/3/4/5                     | 30             | V     |
| Emitter Collector Voltage                                 | V <sub>ECO</sub>    | All                                 | 7              | V     |
| Detector Power Dissipation @ 25°C                         | P <sub>D</sub>      | M                                   | 150            | mW    |
|                                                           |                     | non M                               | 150            |       |
|                                                           |                     | M                                   | 1.76           | mW/°C |
|                                                           |                     | non M                               | 2.0            |       |

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified.)<sup>(1)</sup>**Individual Component Characteristics**

| Parameters              | Test Conditions                           | Symbol | Device                | Min | Typ   | Max  | Units         |
|-------------------------|-------------------------------------------|--------|-----------------------|-----|-------|------|---------------|
| <b>EMITTER</b>          |                                           |        |                       |     |       |      |               |
| Input Forward Voltage   | $I_F = 60\text{ mA}$                      | $V_F$  | CNY17FX/M<br>CNY17X/M | 1.0 | 1.35  | 1.65 | V             |
|                         | $I_F = 10\text{ mA}$                      |        | MOC810X               | 1.0 | 1.15  | 1.50 |               |
| Capacitance             | $V_F = 0\text{ V}$ , $f = 1.0\text{ MHz}$ | $C_J$  | All                   |     | 18    |      | pF            |
| Reverse Leakage Current | $V_R = 6\text{ V}$                        | $I_R$  | All                   |     | 0.001 | 10   | $\mu\text{A}$ |

**Individual Component Characteristics (Continued)**

| Parameters                                | Test Conditions                  | Symbol     | Device                                           | Min | Typ | Max | Units |
|-------------------------------------------|----------------------------------|------------|--------------------------------------------------|-----|-----|-----|-------|
| <b>DETECTOR</b>                           |                                  |            |                                                  |     |     |     |       |
| Breakdown Voltage<br>Collector to Emitter | $I_C = 1.0 \text{ mA}, I_F = 0$  | $BV_{CEO}$ | MOC8101/2/3/4/5                                  | 30  | 100 |     | V     |
|                                           |                                  |            | MOC8106/7/8<br>CNY17F1/2/3/4/M<br>CNY171/2/3/4/M | 70  | 100 |     |       |
| Collector to Base                         | $I_C = 10 \mu\text{A}, I_F = 0$  | $BV_{CBO}$ | CNY171/2/3/4/M                                   | 70  | 120 |     |       |
| Emitter to Collector                      | $I_E = 100 \mu\text{A}, I_F = 0$ | $BV_{ECO}$ | All                                              | 7   | 10  |     |       |
| Leakage Current<br>Collector to Emitter   | $V_{CE} = 10 \text{ V}, I_F = 0$ | $I_{CEO}$  | All                                              |     | 1   | 50  | nA    |
| Collector to Base                         | $V_{CB} = 10 \text{ V}, I_F = 0$ | $I_{CBO}$  | CNY171/2/3/4/M                                   |     |     | 20  | nA    |
| Capacitance<br>Collector to Emitter       | $V_{CE} = 0, f = 1 \text{ MHz}$  | $C_{CE}$   | All                                              |     | 8   |     | pF    |
| Collector to Base                         | $V_{CB} = 0, f = 1 \text{ MHz}$  | $C_{CB}$   | CNY171/2/3/4/M                                   |     | 20  |     | pF    |
| Emitter to Base                           | $V_{EB} = 0, f = 1 \text{ MHz}$  | $C_{EB}$   | CNY171/2/3/4/M                                   |     | 10  |     | pF    |

**Isolation Characteristics**

| Characteristic                 | Test Conditions                              | Symbol    | Device            | Min       | Typ** | Max | Units     |
|--------------------------------|----------------------------------------------|-----------|-------------------|-----------|-------|-----|-----------|
| Input-Output Isolation Voltage | $f = 60 \text{ Hz}, t = 1 \text{ min. (4)}$  | $V_{ISO}$ | Black Package     | 5300      |       |     | Vac(rms)* |
|                                | $f = 60 \text{ Hz}, t = 1 \text{ sec. (4)}$  |           | 'M' White Package | 7500      |       |     | Vac(pk)   |
| Isolation Resistance           | $V_{I-O} = 500 \text{ VDC (4)}$              | $R_{ISO}$ | All               | $10^{11}$ |       |     | $\Omega$  |
| Isolation Capacitance          | $V_{I-O} = \emptyset, f = 1 \text{ MHz (4)}$ | $C_{ISO}$ | Black Package     |           | 0.5   |     | pF        |
|                                |                                              |           | 'M' White Package |           | 0.2   |     |           |

Note

\* 5300 Vac(rms) for 1 minute equates to approximately 9000 Vac (pk) for 1 second

\*\* Typical values at  $T_A = 25^\circ\text{C}$

**Transfer Characteristics** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified.)<sup>(1)</sup>

| DC Characteristics                   |                       | Test Conditions                                    | Symbol               | Min | Typ | Max | Units |
|--------------------------------------|-----------------------|----------------------------------------------------|----------------------|-----|-----|-----|-------|
| Coupled                              |                       |                                                    |                      |     |     |     |       |
| Output Collector Current             | MOC8101               | (I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V)   | (CTR) <sup>(2)</sup> | 50  | —   | 80  | %     |
|                                      | MOC8102               |                                                    |                      | 73  | —   | 117 |       |
|                                      | MOC8103               |                                                    |                      | 108 | —   | 173 |       |
|                                      | MOC8104               |                                                    |                      | 160 | —   | 256 |       |
|                                      | MOC8105               |                                                    |                      | 65  | —   | 133 |       |
|                                      | MOC8106               |                                                    |                      | 50  | —   | 150 |       |
|                                      | MOC8107               |                                                    |                      | 100 | —   | 300 |       |
|                                      | MOC8108               |                                                    |                      | 250 | —   | 600 |       |
|                                      | CNY17F1/1M            | (I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 5 V)    |                      | 40  | —   | 80  |       |
|                                      | CNY17F2/2M            |                                                    |                      | 63  | —   | 125 |       |
|                                      | CNY17F3/3M            |                                                    |                      | 100 | —   | 200 |       |
|                                      | CNY17F4/4M            |                                                    |                      | 160 | —   | 320 |       |
|                                      | CNY171/1M             |                                                    |                      | 40  | —   | 80  |       |
|                                      | CNY172/2M             |                                                    |                      | 63  | —   | 125 |       |
|                                      | CNY173/3M             |                                                    |                      | 100 | —   | 200 |       |
|                                      | CNY174/4M             |                                                    |                      | 160 | —   | 320 |       |
| Collector-Emitter Saturation Voltage | CNY17XM/FXM           | (I <sub>C</sub> = 2.5 mA, I <sub>F</sub> = 10 mA)  | V <sub>CE(sat)</sub> | —   | —   | 0.4 | V     |
|                                      | MOC8101/2/3/4/5/6/7/8 | (I <sub>C</sub> = 500 μA, I <sub>F</sub> = 5.0 mA) |                      |     |     |     |       |
|                                      | CNY17X/FX             | (I <sub>F</sub> = 10 mA, I <sub>C</sub> = 2.5 mA)  |                      | —   | —   | 0.3 |       |

| AC Characteristics <sup>(3)</sup>   |                 | Test Conditions                                                        | Symbol    | Min | Typ* | Max | Units         |
|-------------------------------------|-----------------|------------------------------------------------------------------------|-----------|-----|------|-----|---------------|
| <b>Non-Saturated Switching Time</b> |                 |                                                                        |           |     |      |     |               |
| Turn-On Time                        | MOC8101/2/3/4/5 | $(I_C = 2.0\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\text{ }\Omega)$ | $t_{on}$  | —   | 2    | 20  | $\mu\text{s}$ |
|                                     | MOC8106/7/8     |                                                                        |           |     |      | —   |               |
|                                     | CNY17X/FX       |                                                                        |           |     |      | 10  |               |
| Turn-Off Time                       | MOC8101/2/3/4/5 | $(I_C = 2.0\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\text{ }\Omega)$ | $t_{off}$ | —   | 3    | 20  | $\mu\text{s}$ |
|                                     | MOC8106/7/8     |                                                                        |           |     |      | —   |               |
|                                     | CNY17X/FX       |                                                                        |           |     |      | 10  |               |
| Delay Time                          | CNY17XM/FXM     | $(I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega)$    | $t_d$     | —   | —    | 5.6 | $\mu\text{s}$ |
| Rise Time                           | All Devices     | $(I_C = 2.0\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\text{ }\Omega)$ | $t_r$     | —   | 1    | —   | $\mu\text{s}$ |
|                                     | CNY17XM/FXM     | $(I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega)$    |           | —   | —    | 4.0 |               |
| Storage Time                        | CNY17XM/FXM     | $(I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega)$    | $t_s$     | —   | —    | 4.1 | $\mu\text{s}$ |
| Fall Time                           | All Devices     | $(I_C = 2.0\text{ mA}, V_{CC} = 10\text{ V}, R_L = 100\text{ }\Omega)$ | $t_f$     | —   | 2    | —   | $\mu\text{s}$ |
|                                     | CNY17XM/FXM     | $(I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega)$    |           | —   | —    | 3.5 |               |

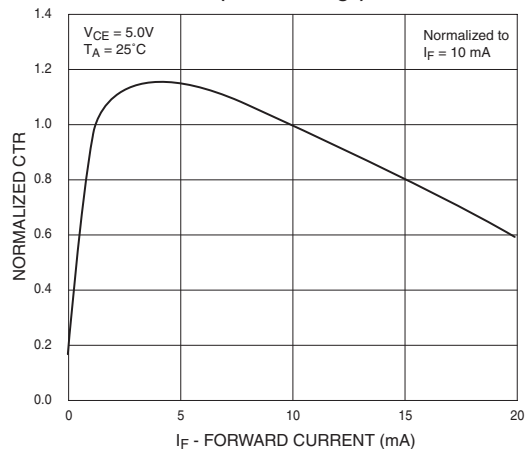
**Transfer Characteristics (continued)** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified.)<sup>(1)</sup>

| AC Characteristics <sup>(3)</sup> |                                   | Test Conditions                                                        | Symbol           | Min                                                                    | Typ | Max  | Units |
|-----------------------------------|-----------------------------------|------------------------------------------------------------------------|------------------|------------------------------------------------------------------------|-----|------|-------|
| Saturated Switching Times         |                                   |                                                                        |                  |                                                                        |     |      |       |
| Turn-on Time                      | CNY171/F1                         | (I <sub>F</sub> = 20 mA, V <sub>CE</sub> = 0.4 V)                      | t <sub>on</sub>  | —                                                                      | —   | 5.5  | μs    |
|                                   | CNY172/F2                         | (I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 0.4 V)                      |                  | —                                                                      | —   | 8.0  |       |
|                                   | CNY173/F3                         |                                                                        |                  |                                                                        |     |      |       |
|                                   | CNY174/F4                         |                                                                        |                  |                                                                        |     |      |       |
| Rise Time                         | CNY171/F1                         | (I <sub>F</sub> = 20 mA, V <sub>CE</sub> = 0.4 V)                      | t <sub>r</sub>   | —                                                                      | —   | 4.0  | μs    |
|                                   | CNY172/F1                         | (I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 0.4 V)                      |                  | —                                                                      | —   | 6.0  |       |
|                                   | CNY173/F3                         |                                                                        |                  |                                                                        |     |      |       |
|                                   | CNY174/F4                         |                                                                        |                  |                                                                        |     |      |       |
|                                   | CNY171M/F1M                       |                                                                        |                  | (I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 KΩ) | —   | —    |       |
|                                   | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M | (I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 KΩ) |                  | —                                                                      | —   | 6.0  |       |
| Delay Time                        | CNY171M/F1M                       | (I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 KΩ) | t <sub>d</sub>   | —                                                                      | —   | 5.5  | μs    |
|                                   | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M | (I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5 V, R <sub>L</sub> = 1 KΩ) |                  | —                                                                      | —   | 8.0  |       |
| Turn-off Time                     | CNY171/F1                         | (I <sub>F</sub> = 20 mA, V <sub>CE</sub> = 0.4 V)                      | t <sub>off</sub> | —                                                                      | —   | 34   | μs    |
|                                   | CNY172/F2                         | (I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 0.4 V)                      |                  | —                                                                      | —   | 39   |       |
|                                   | CNY173/F3                         |                                                                        |                  |                                                                        |     |      |       |
|                                   | CNY174/F4                         |                                                                        |                  |                                                                        |     |      |       |
| Fall Time                         | CNY171/F1                         | (I <sub>F</sub> = 20 mA, V <sub>CE</sub> = 0.4 V)                      | t <sub>f</sub>   | —                                                                      | —   | 20   | μs    |
|                                   | CNY172/F2                         | (I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 0.4 V)                      |                  | —                                                                      | —   | 24   |       |
|                                   | CNY173/F3                         |                                                                        |                  |                                                                        |     |      |       |
|                                   | CNY174/F4                         |                                                                        |                  |                                                                        |     |      |       |
|                                   | CNY171M/F1M                       |                                                                        |                  | (I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 1KΩ)   | —   | —    |       |
|                                   | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M | (I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 1KΩ)   |                  | —                                                                      | —   | 24.0 | μs    |
| Storage Time                      | CNY171M/F1M                       | (I <sub>F</sub> = 20 mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 1KΩ)   | t <sub>s</sub>   | —                                                                      | —   | 34.0 | μs    |
|                                   | CNY172M/3M/4M<br>CNY17F2M/F3M/F4M | (I <sub>F</sub> = 10 mA, V <sub>CC</sub> = 5V, R <sub>L</sub> = 1KΩ)   |                  | —                                                                      | —   | 39.0 |       |

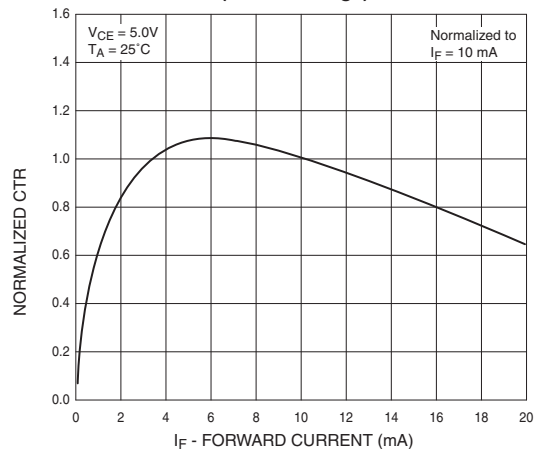
\*\* All typicals at  $T_A = 25^\circ\text{C}$ **Notes:**

1. Always design to the specified minimum/maximum electrical limits (where applicable).
2. Current Transfer Ratio (CTR) =  $I_C/I_F \times 100\%$ .
3. For test circuit setup and waveforms, refer to Figures 20.
4. For this test, Pins 1 and 2 are common, and Pins 4 and 5 are common.

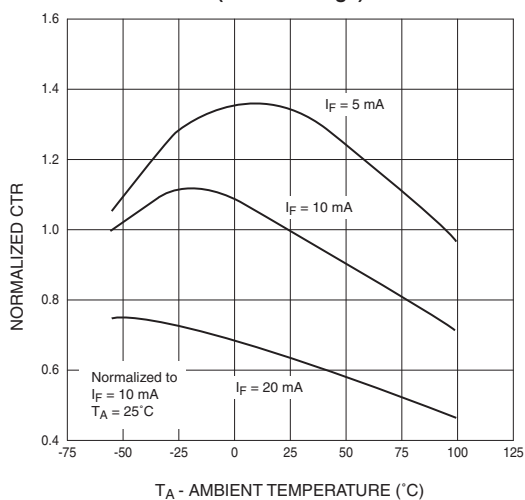
**Fig.1 Normalized CTR vs. Forward Current  
(Black Package)**



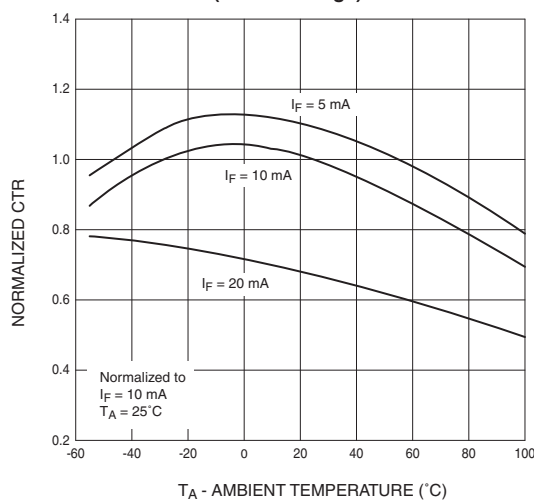
**Fig.2 Normalized CTR vs. Forward Current  
(White Package)**



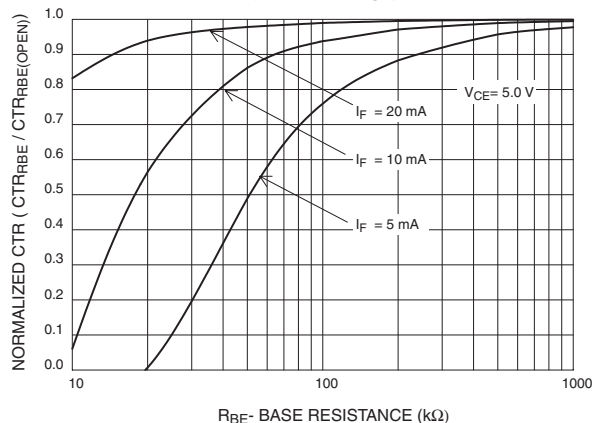
**Fig. 3 Normalized CTR vs. Ambient Temperature  
(Black Package)**



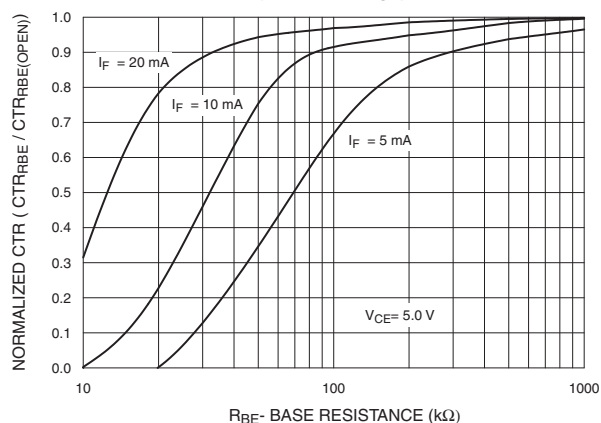
**Fig. 4 Normalized CTR vs. Ambient Temperature  
(White Package)**



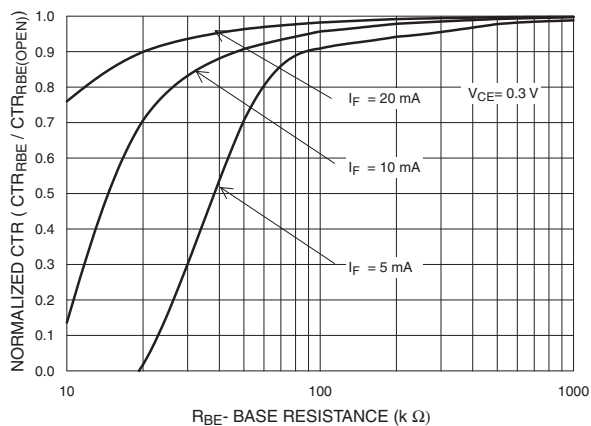
**Fig. 5 CTR vs. RBE (Unsaturated)  
(Black Package)**



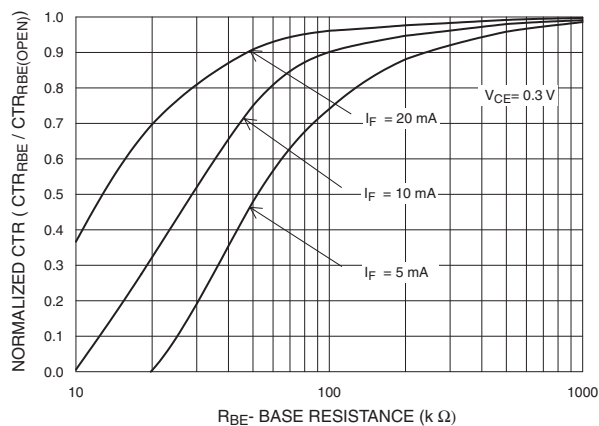
**Fig. 6 CTR vs. RBE (Unsaturated)  
(White Package)**



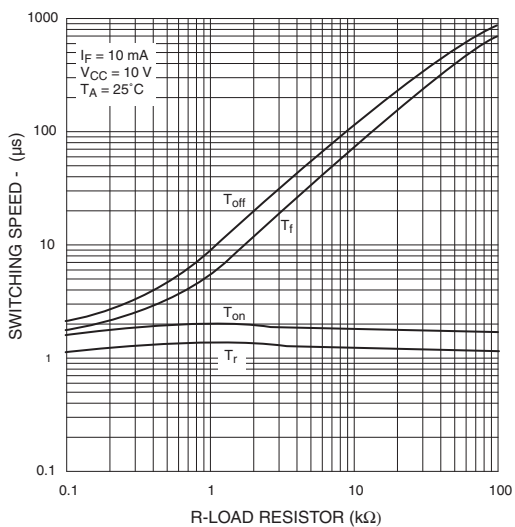
**Fig. 7 CTR vs. R<sub>BE</sub> (Saturated)  
(Black Package)**



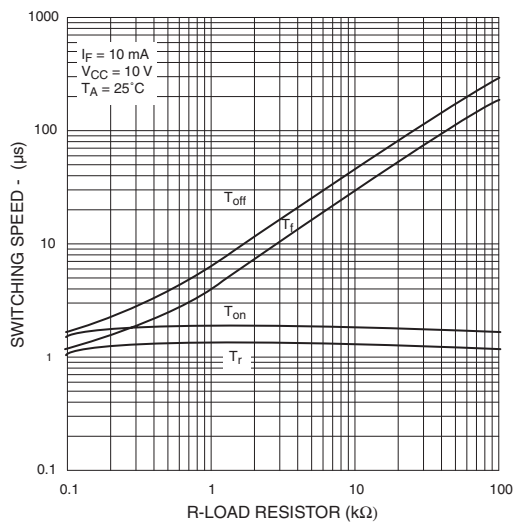
**Fig. 8 CTR vs. R<sub>BE</sub> (Saturated)  
(White Package)**



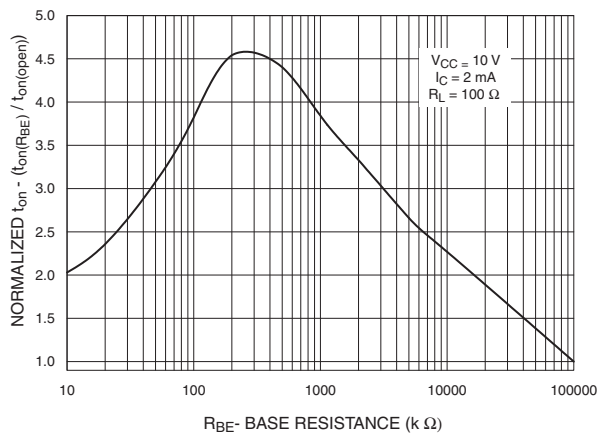
**Fig. 9 Switching Speed vs. Load Resistor  
(Black Package)**



**Fig. 10 Switching Speed vs. Load Resistor  
(White Package)**



**Fig. 11 Normalized t<sub>on</sub> vs. R<sub>BE</sub>  
(Black Package)**



**Fig. 12 Normalized t<sub>on</sub> vs. R<sub>BE</sub>  
(White Package)**

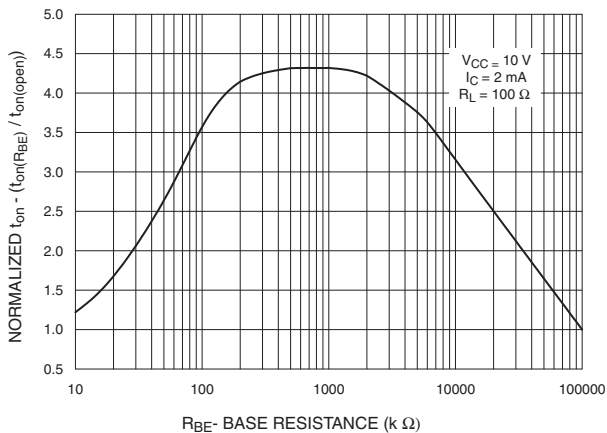


Fig. 13 Normalized  $t_{off}$  vs.  $R_{BE}$   
(Black Package)

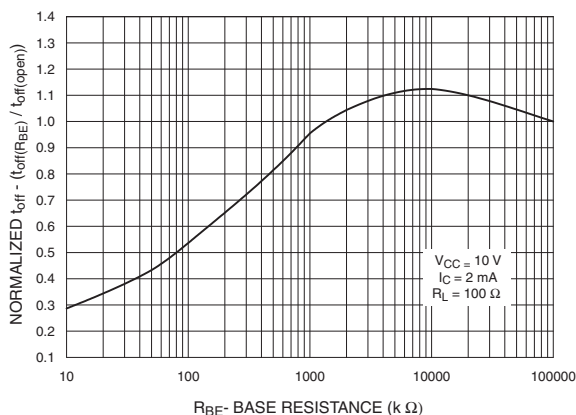


Fig. 14 Normalized  $t_{off}$  vs.  $R_{BE}$   
(White Package)

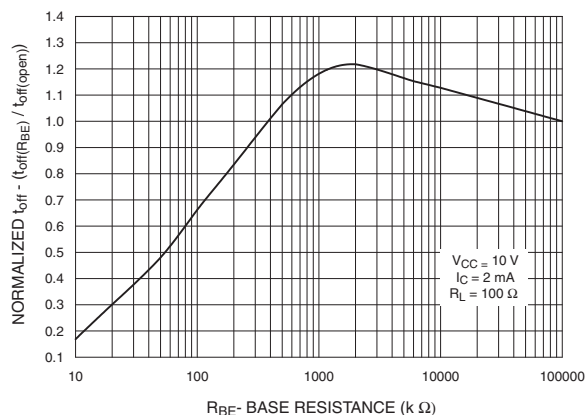


Fig. 15 LED Forward Voltage vs. Forward Current  
(Black Package)

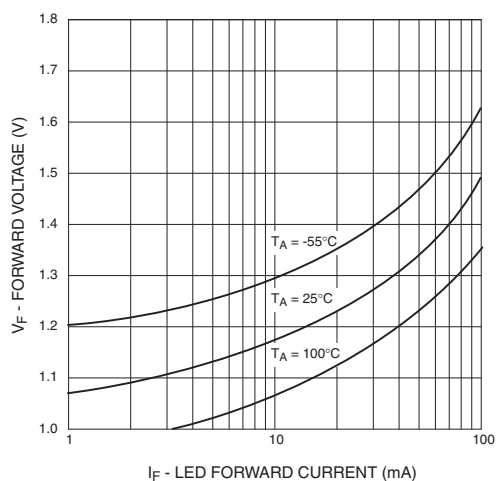


Fig. 16 LED Forward Voltage vs. Forward Current  
(White Package)

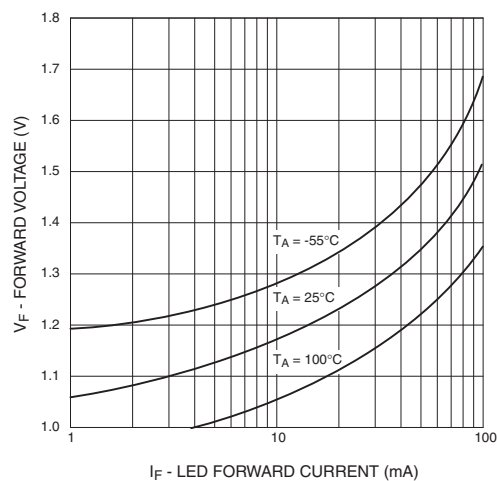


Fig. 17 Collector-Emitter Saturation Voltage vs Collector Current  
(Black Package)

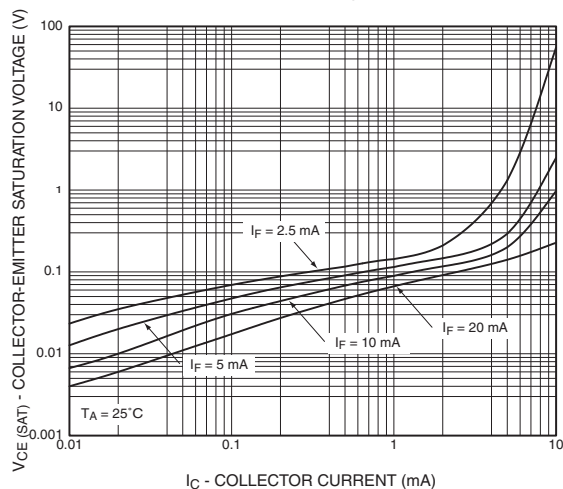


Fig. 18 Collector-Emitter Saturation Voltage vs Collector Current  
(White Package)

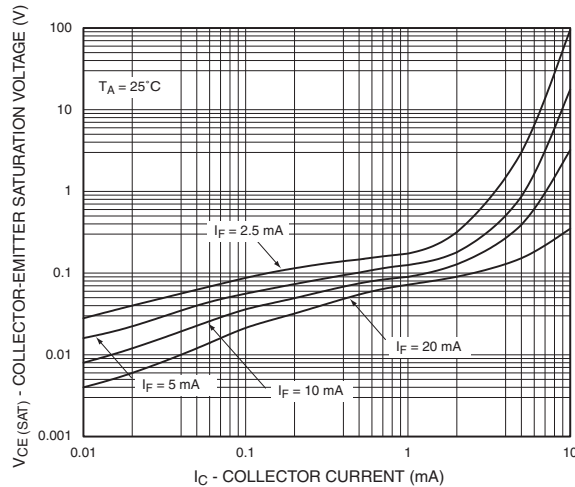




Fig. 19 Dark Current vs. Ambient Temperature  
(Black Package)

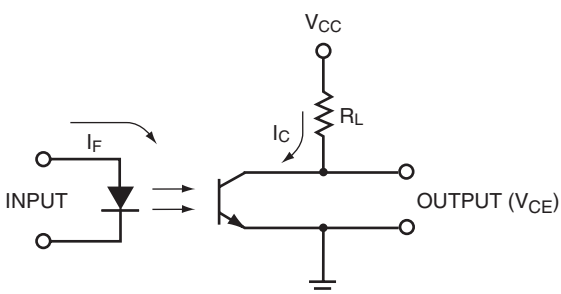
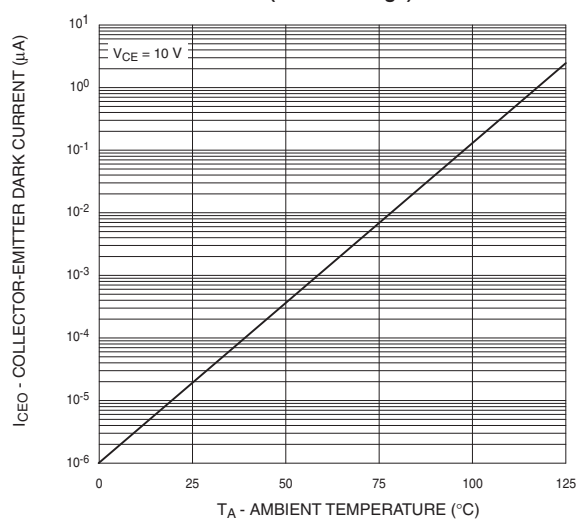


Figure 20. Switching Time Test Circuit

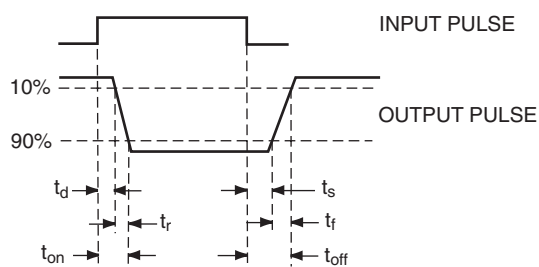
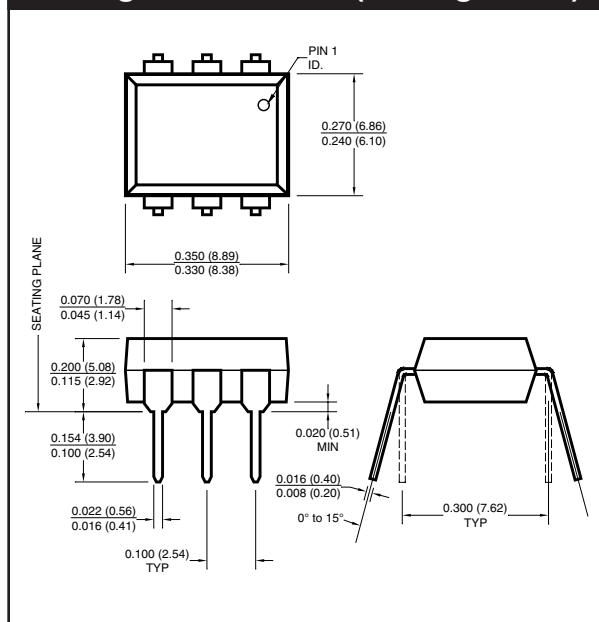


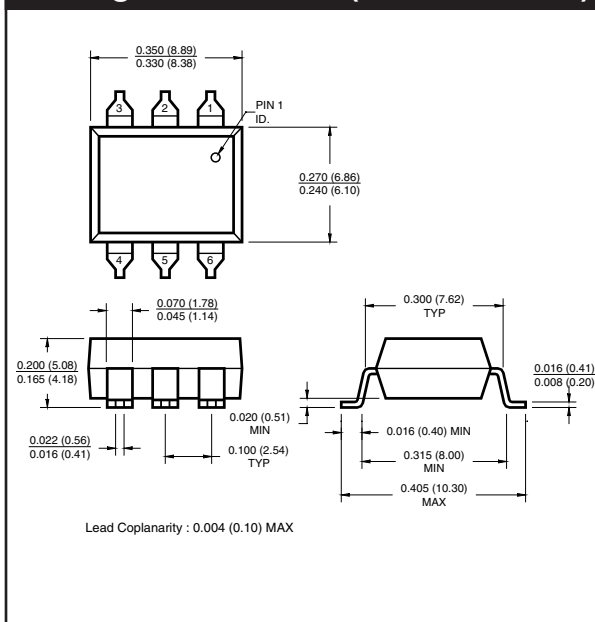
Figure 21. Switching Time Test Circuit

### Black Package (No -M Suffix)

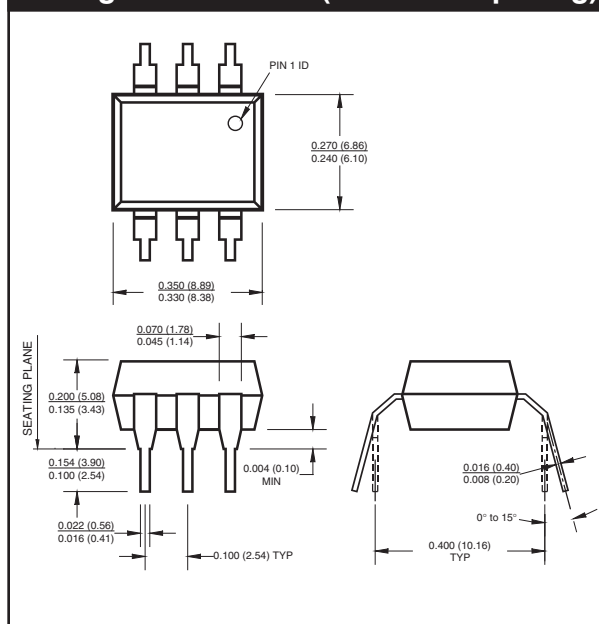
## Package Dimensions (Through Hole)



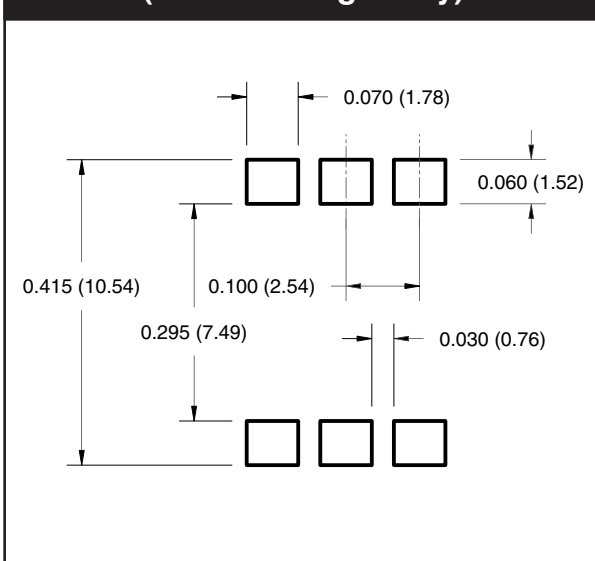
### Package Dimensions (Surface Mount)



### Package Dimensions (0.4" Lead Spacing)



### Recommended Pad Layout for Surface Mount Leadform (Black Package Only)

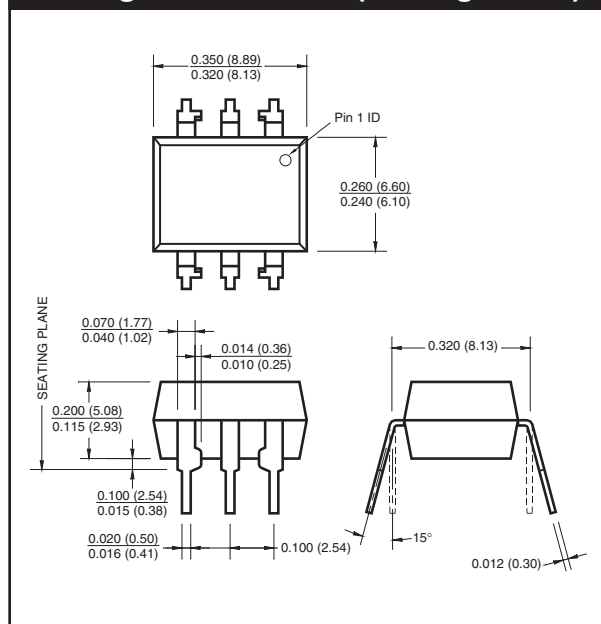


## NOTE

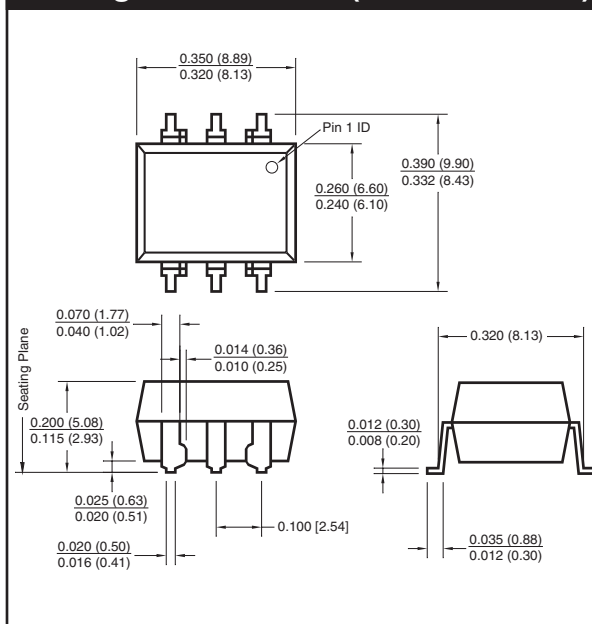
All dimensions are in inches (millimeters)

## White Package (-M Suffix)

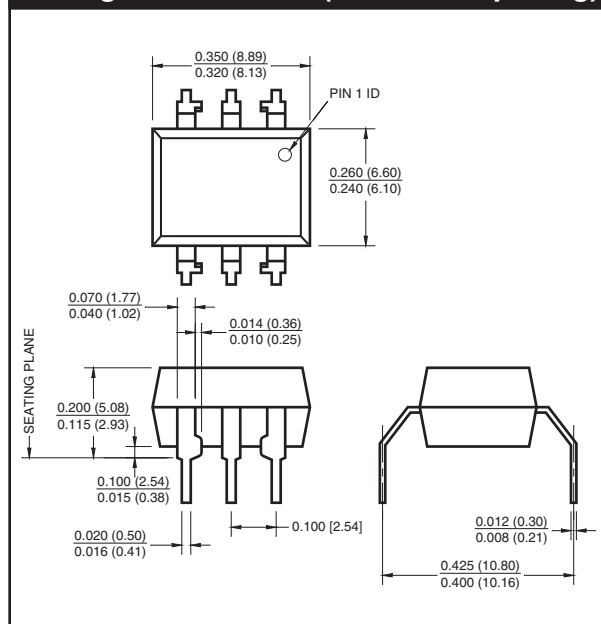
### Package Dimensions (Through Hole)



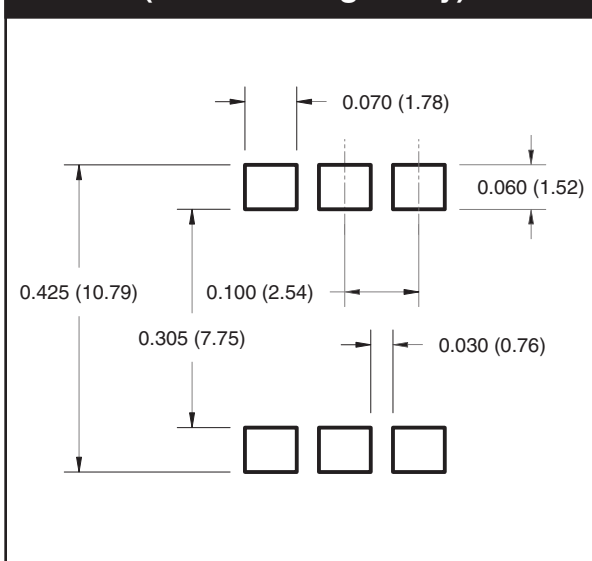
### Package Dimensions (Surface Mount)



### Package Dimensions (0.4" Lead Spacing)



### Recommended Pad Layout for Surface Mount Leadform (White Package Only)



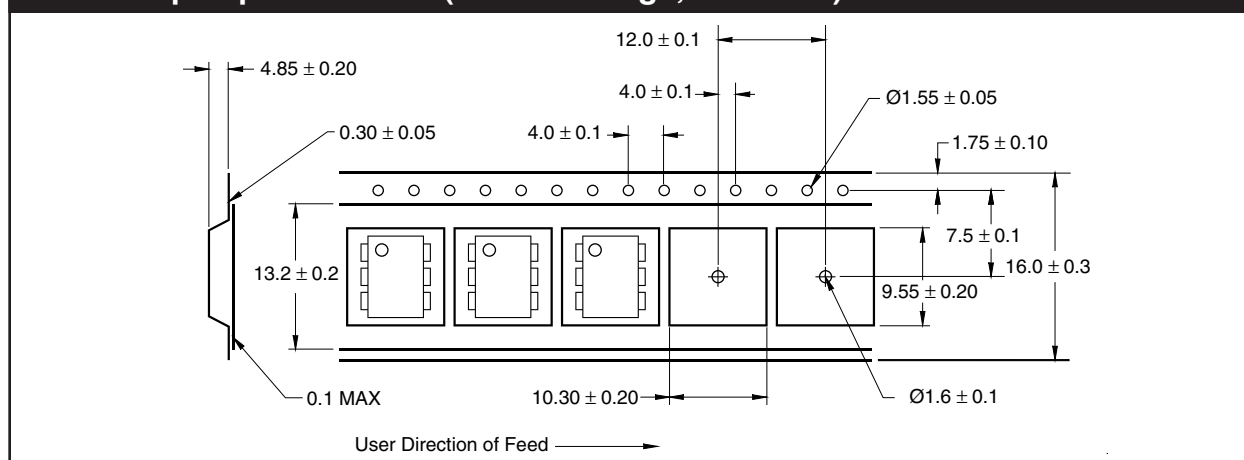
#### NOTE

All dimensions are in inches (millimeters)

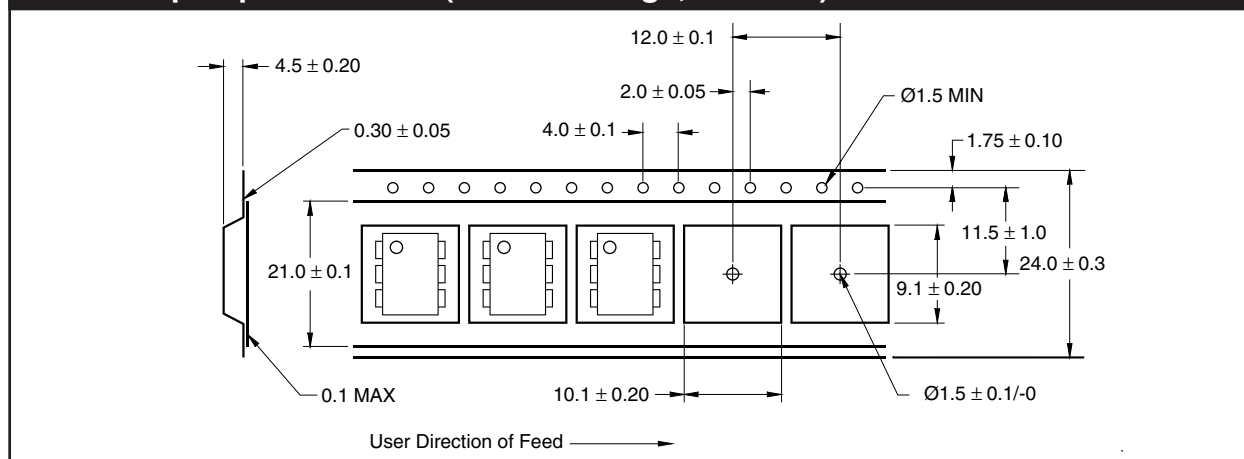
## Ordering Information

| Black Package Part Number Example (No Suffix) | White Package Part Number Example (M Suffix) | Description                              |
|-----------------------------------------------|----------------------------------------------|------------------------------------------|
| CNY171S                                       | CNY171SM                                     | Surface Mount Lead Bend                  |
| CNY171SD                                      | CNY171SR2M                                   | Surface Mount; Tape and reel             |
| CNY171W                                       | CNY171TM                                     | 0.4" Lead Spacing                        |
| CNY171300                                     | CNY171VM                                     | VDE Approved                             |
| CNY171300W                                    | CNY171TVM                                    | VDE Approved, 0.4" Lead Spacing          |
| CNY1713S                                      | CNY171SVM                                    | VDE Approved, Surface Mount              |
| CNY1713SD                                     | CNY171SR2VM                                  | VDE Approved, Surface Mount, Tape & Reel |

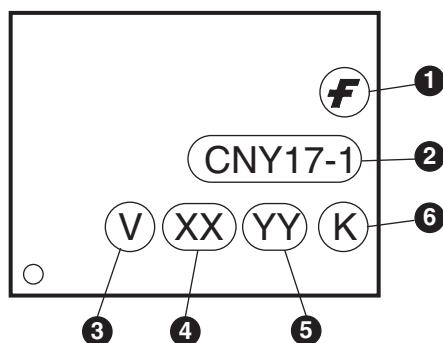
### Carrier Tape Specifications (Black Package, No Suffix)



### Carrier Tape Specifications (White Package, M Suffix)

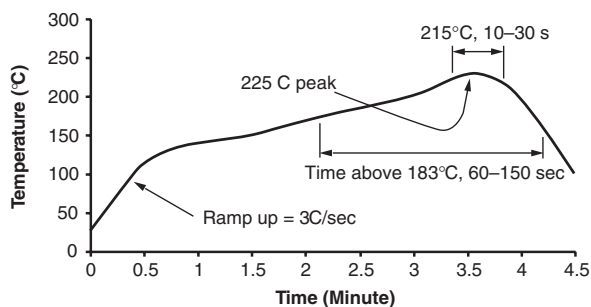


## Marking Information (Black package non 'M' suffix)



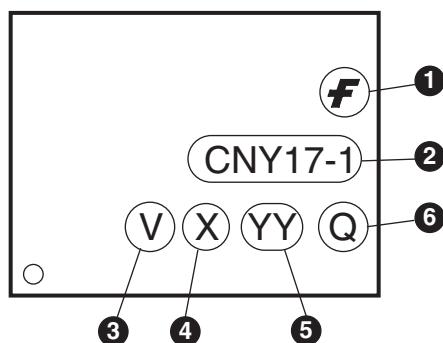
| Definitions |                                                                                        |
|-------------|----------------------------------------------------------------------------------------|
| 1           | Fairchild logo                                                                         |
| 2           | Device number                                                                          |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | Two digits year code, e.g., '03'; One digit year code for 'M' version, e.g. '5'        |
| 5           | Two digit work week ranging from '01' to '53'                                          |
| 6           | Assembly package code                                                                  |

## Reflow Profile (Black Package, No Suffix)



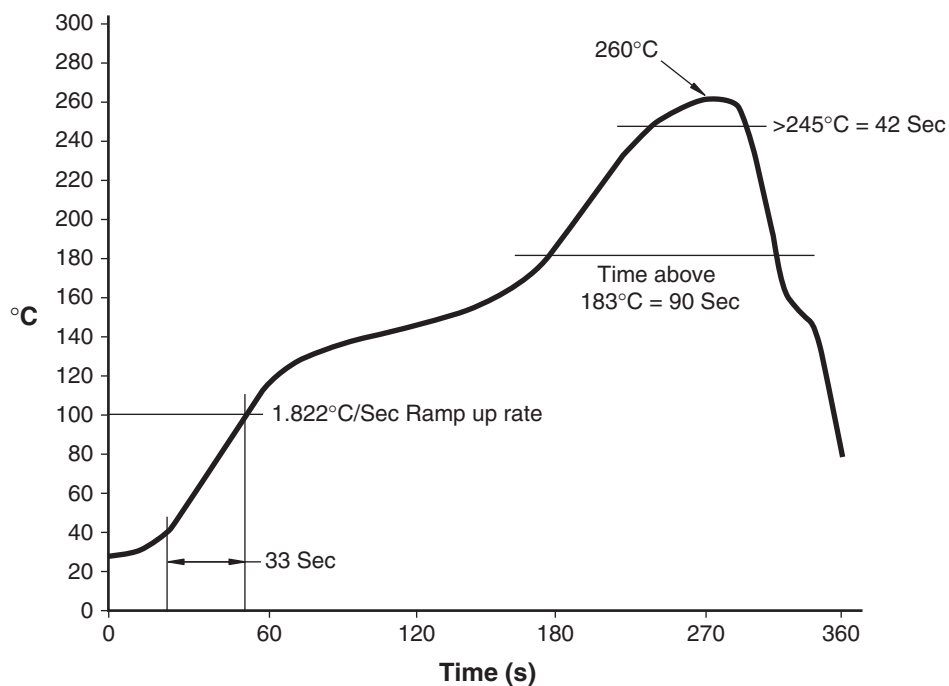
- Peak reflow temperature: 225°C (package surface temperature)
- Time of temperature higher than 183°C for 60–150 seconds
- One time soldering reflow is recommended

## Marking Information (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           | Single digit year code, e.g. '5'                                                       |
| 5           | Two digit work week ranging from '01' to '53'                                          |
| 6           | Assembly package code                                                                  |

## Reflow Profile (White Package, M Suffix)



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| ActiveArray <sup>™</sup>                         | FAST <sup>™</sup>               | LittleFET <sup>™</sup>    | PowerTrench <sup>®</sup>        | SyncFET <sup>™</sup>        |
| Bottomless <sup>™</sup>                          | FPS <sup>™</sup>                | MICROCOUPLER <sup>™</sup> | QFET <sup>®</sup>               | TinyLogic <sup>®</sup>      |
| Build it Now <sup>™</sup>                        | FRFET <sup>™</sup>              | MicroFET <sup>™</sup>     | QS <sup>™</sup>                 | TINYOPTO <sup>™</sup>       |
| CoolFET <sup>™</sup>                             | GlobalOptoisolator <sup>™</sup> | MicroPak <sup>™</sup>     | QT Optoelectronics <sup>™</sup> | TruTranslation <sup>™</sup> |
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| DOMET <sup>™</sup>                               | HiSeC <sup>™</sup>              | MSX <sup>™</sup>          | RapidConfigure <sup>™</sup>     | UltraFET <sup>®</sup>       |
| EcoSPARK <sup>™</sup>                            | I <sup>2</sup> C <sup>™</sup>   | MSXPro <sup>™</sup>       | RapidConnect <sup>™</sup>       | UniFET <sup>™</sup>         |
| E <sup>2</sup> CMOS <sup>™</sup>                 | i-Lo <sup>™</sup>               | OCX <sup>™</sup>          | μSerDes <sup>™</sup>            | VCX <sup>™</sup>            |
| EnSigna <sup>™</sup>                             | ImpliedDisconnect <sup>™</sup>  | OCXPro <sup>™</sup>       | SILENT SWITCHER <sup>®</sup>    | Wire <sup>™</sup>           |
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| The Power Franchise <sup>®</sup>                 |                                 | POP <sup>™</sup>          | SuperFET <sup>™</sup>           |                             |
| Programmable Active Droop <sup>™</sup>           |                                 | Power247 <sup>™</sup>     | SuperSOT <sup>™</sup> -3        |                             |
|                                                  |                                 | PowerEdge <sup>™</sup>    | SuperSOT <sup>™</sup> -6        |                             |

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