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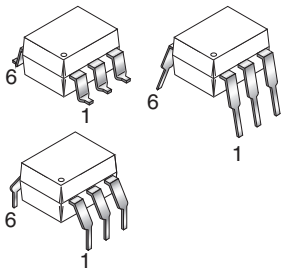
FAIRCHILD
SEMICONDUCTOR®

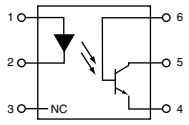
# GENERAL PURPOSE 6-PIN PHOTOTRANSISTOR OPTOCOUPLERS

| | | | | | |
|---|---|---|---|---|---|
| **4N25** | **4N26** | **4N27** | **4N28** | **4N35** | **4N36** |
| **4N37** | **H11A1** | **H11A2** | **H11A3** | **H11A4** | **H11A5** |

## WHITE PACKAGE (-M SUFFIX)

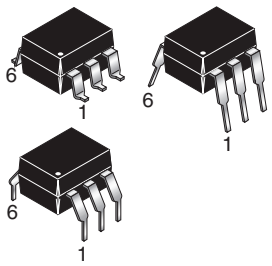



## SCHEMATIC




PIN 1. ANODE
2. CATHODE
3. NO CONNECTION
4. EMITTER
5. COLLECTOR
6. BASE

## BLACK PACKAGE (NO -M SUFFIX)




## DESCRIPTION

The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

## FEATURES

- Also available in white package by specifying -M suffix, eg. 4N25-M
- UL recognized (File # E90700)
- VDE recognized (File # 94766)
  - Add option V for white package (e.g., 4N25V-M)
  - Add option 300 for black package (e.g., 4N25.300)

## APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs

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**ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25°C unless otherwise specified)

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| **TOTAL DEVICE** | | | |
| Storage Temperature | $T_{STG}$ | -55 to +150 | °C |
| Operating Temperature | $T_{OPR}$ | -55 to +100 | °C |
| Wave solder temperature (see page 14 for reflow solder profiles) | $T_{SOL}$ | 260 for 10 sec | °C |
| Total Device Power Dissipation @ $T_A$ = 25°C | $P_D$ | 250 | mW |
| Derate above 25°C | | 3.3 (non-M), 2.94 (-M) | |
| **EMITTER** | | | |
| DC/Average Forward Input Current | $I_F$ | 100 (non-M), 60 (-M) | mA |
| Reverse Input Voltage | $V_R$ | 6 | V |
| Forward Current - Peak (300µs, 2% Duty Cycle) | $I_F$(pk) | 3 | A |
| LED Power Dissipation @ $T_A$ = 25°C | $P_D$ | 150 (non-M), 120 (-M) | mW |
| Derate above 25°C | | 2.0 (non-M), 1.41 (-M) | mW/°C |
| **DETECTOR** | | | |
| Collector-Emitter Voltage | $V_{CEO}$ | 30 | V |
| Collector-Base Voltage | $V_{CBO}$ | 70 | V |
| Emitter-Collector Voltage | $V_{ECO}$ | 7 | V |
| Detector Power Dissipation @ $T_A$ = 25°C | $P_D$ | 150 | mW |
| Derate above 25°C | | 2.0 (non-M), 1.76 (-M) | mW/°C |

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## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C unless otherwise specified)

### INDIVIDUAL COMPONENT CHARACTERISTICS

| Parameter | Test Conditions | Symbol | Min | Typ* | Max | Unit |
|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | |
| Input Forward Voltage | ($I_F$ = 10 mA) | $V_F$ | | 1.18 | 1.50 | V |
| Reverse Leakage Current | ($V_R$ = 6.0 V) | $I_R$ | | 0.001 | 10 | µA |
| **DETECTOR** | | | | | | |
| Collector-Emitter Breakdown Voltage | ($I_C$ = 1.0 mA, $I_F$ = 0) | $BV_{CEO}$ | 30 | 100 | | V |
| Collector-Base Breakdown Voltage | ($I_C$ = 100 µA, $I_F$ = 0) | $BV_{CBO}$ | 70 | 120 | | V |
| Emitter-Collector Breakdown Voltage | ($I_E$ = 100 µA, $I_F$ = 0) | $BV_{ECO}$ | 7 | 10 | | V |
| Collector-Emitter Dark Current | ($V_{CE}$ = 10 V, $I_F$ = 0) | $I_{CEO}$ | | 1 | 50 | nA |
| Collector-Base Dark Current | ($V_{CB}$ = 10 V) | $I_{CBO}$ | | | 20 | nA |
| Capacitance | ($V_{CE}$ = 0 V, f = 1 MHz) | $C_{CE}$ | | 8 | | pF |

### ISOLATION CHARACTERISTICS

| Characteristic | Test Conditions | Symbol | Min | Typ* | Max | Units |
|---|---|---|---|---|---|---|
| Input-Output Isolation Voltage | (Non '-M', Black Package) (f = 60 Hz, t = 1 min) | $V_{ISO}$ | 5300 | | | Vac(rms) |
| | ('-M', White Package) (f = 60 Hz, t = 1 sec) | | 7500 | | | Vac(pk) |
| Isolation Resistance | ($V_{I-O}$ = 500 VDC) | $R_{ISO}$ | $10^{11}$ | | | Ω |
| Isolation Capacitance | ($V_{I-O}$ = &, f = 1 MHz) | $C_{ISO}$ | | 0.5 | | pF |
| | ('-M' White Package) | | | 0.2 | 2 | pF |

Note
* Typical values at $T_A$ = 25°C

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**TRANSFER CHARACTERISTICS** ($T_A$ = 25°C Unless otherwise specified.)

| DC Characteristic | Test Conditions | Symbol | Device | Min | Typ* | Max | Unit |
|---|---|---|---|---|---|---|---|
| Current Transfer Ratio, Collector to Emitter | ($I_F$ = 10 mA, $V_{CE}$ = 10 V) | CTR | 4N35 4N36 4N37 | 100 | | | % |
| | | | H11A1 | 50 | | | |
| | | | H11A5 | 30 | | | |
| | | | 4N25 4N26 H11A2 H11A3 | 20 | | | |
| | | | 4N27 4N28 H11A4 | 10 | | | |
| | ($I_F$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = -55°C) | | 4N35 4N36 4N37 | 40 | | | |
| | ($I_F$ = 10 mA, $V_{CE}$ = 10 V, $T_A$ = +100°C) | | 4N35 4N36 4N37 | 40 | | | |
| Collector-Emitter Saturation Voltage | ($I_C$ = 2 mA, $I_F$ = 50 mA) | $V_{CE\ (SAT)}$ | 4N25 4N26 4N27 4N28 | | | 0.5 | V |
| | ($I_C$ = 0.5 mA, $I_F$ = 10 mA) | | 4N35 4N36 4N37 | | | 0.3 | |
| | | | H11A1 H11A2 H11A3 H11A4 H11A5 | | | 0.4 | |
| **AC Characteristic** Non-Saturated Turn-on Time | ($I_F$ = 10 mA, $V_{CC}$ = 10 V, $R_L$ = 100Ω) (Fig.20) | $T_{ON}$ | 4N25 4N26 4N27 4N28 H11A1 H11A2 H11A3 H11A4 H11A5 | | 2 | | µs |
| Non Saturated Turn-on Time | ($I_C$ = 2 mA, $V_{CC}$ = 10 V, $R_L$ = 100Ω) (Fig.20) | $T_{ON}$ | 4N35 4N36 4N37 | | 2 | 10 | µs |

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**TRANSFER CHARACTERISTICS** ($T_A$ = 25°C Unless otherwise specified.) (Continued)

| AC Characteristic | Test Conditions | Symbol | Device | Min | Typ* | Max | Unit |
|---|---|---|---|---|---|---|---|
| Turn-off Time | ($I_F$ = 10 mA, $V_{CC}$ = 10 V, $R_L$ = 100Ω) (Fig.20) | $T_{OFF}$ | 4N25<br>4N26<br>4N27<br>4N28<br>H11A1<br>H11A2<br>H11A3<br>H11A4<br>H11A5 | | 2 | | µs |
| | ($I_C$ = 2 mA, $V_{CC}$ = 10 V, $R_L$ = 100Ω) (Fig.20) | | 4N35<br>4N36<br>4N37 | | 2 | 10 | |

* Typical values at $T_A$ = 25°C

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## TYPICAL PERFORMANCE CURVES

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

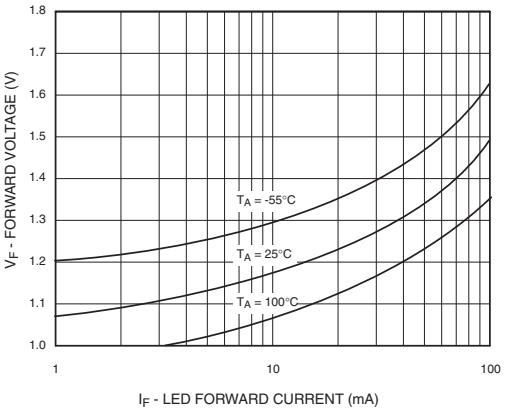


**Fig. 2 LED Forward Voltage vs. Forward Current (White Package)**

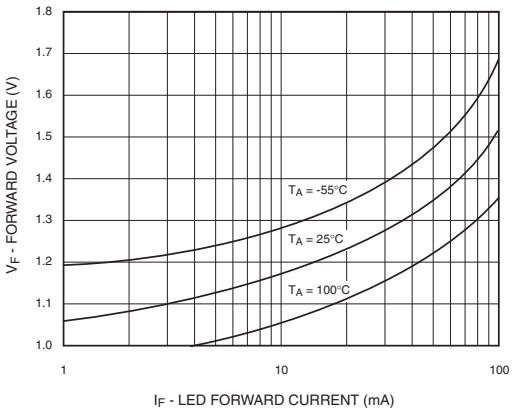


**Fig.3 Normalized CTR vs. Forward Current (Black Package)**

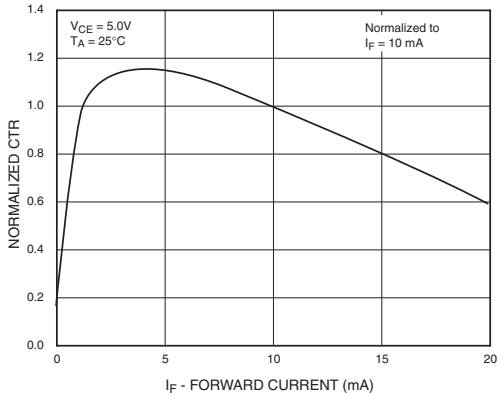


**Fig.4 Normalized CTR vs. Forward Current (White Package)**

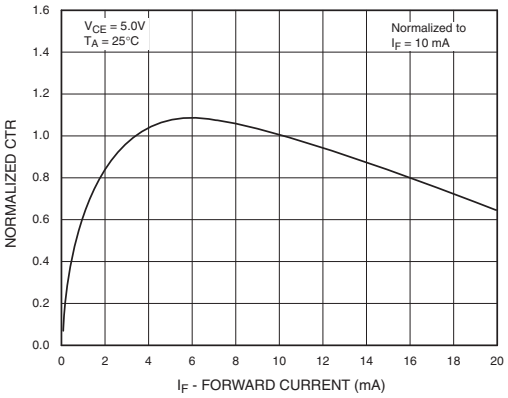


**Fig. 5 Normalized CTR vs. Ambient Temperature (Black Package)**

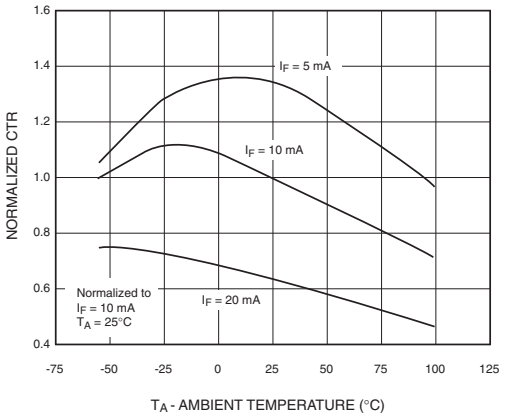


**Fig. 6 Normalized CTR vs. Ambient Temperature (White Package)**

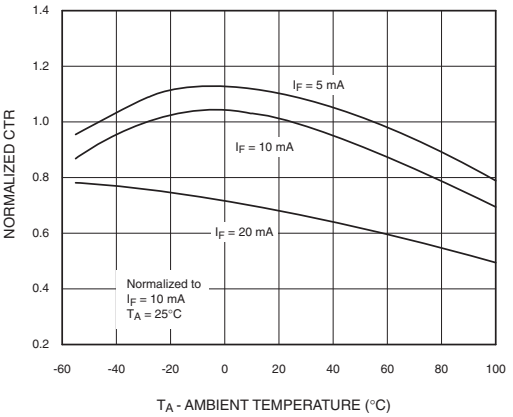


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**Fig. 7 CTR vs. RBE (Unsaturated) (Black Package)**

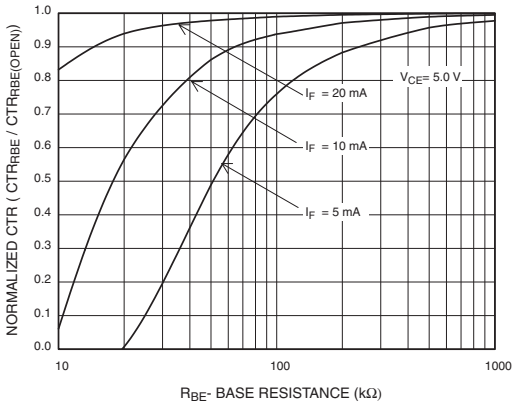


**Fig. 8 CTR vs. RBE (Unsaturated) (White Package)**

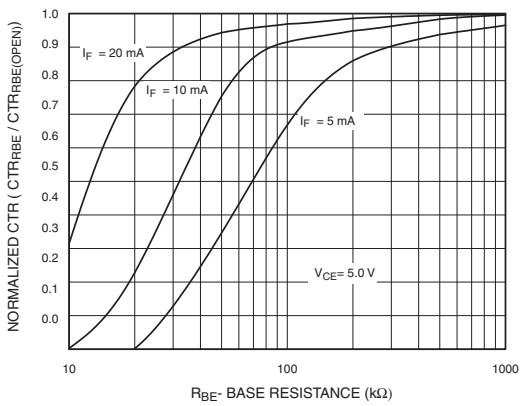


**Fig. 9 CTR vs. RBE (Saturated) (Black Package)**

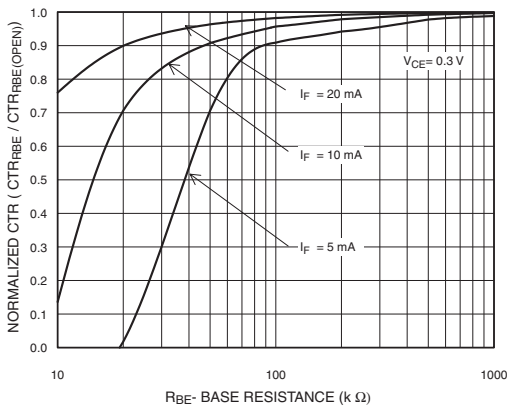


**Fig. 10 CTR vs. RBE (Saturated) (White Package)**

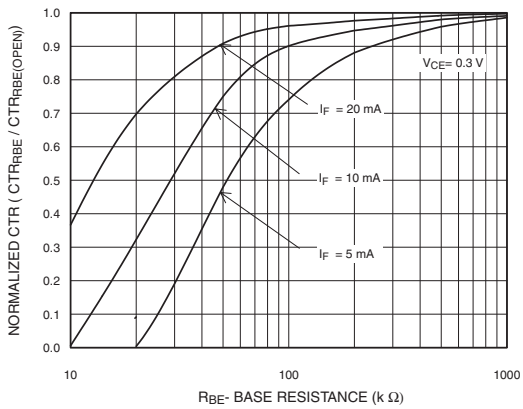


**Fig. 11 Collector-Emitter Saturation Voltage vs Collector Current (Black Package)**

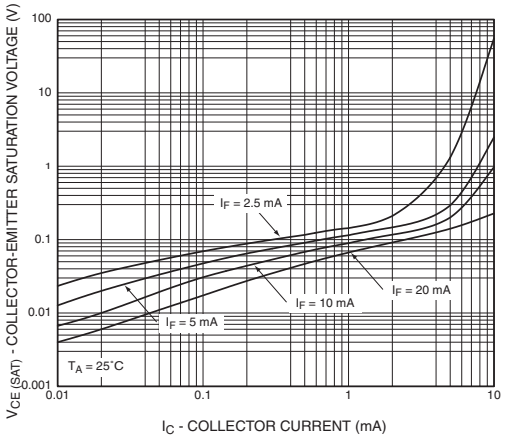


**Fig. 12 Collector-Emitter Saturation Voltage vs Collector Current (White Package)**

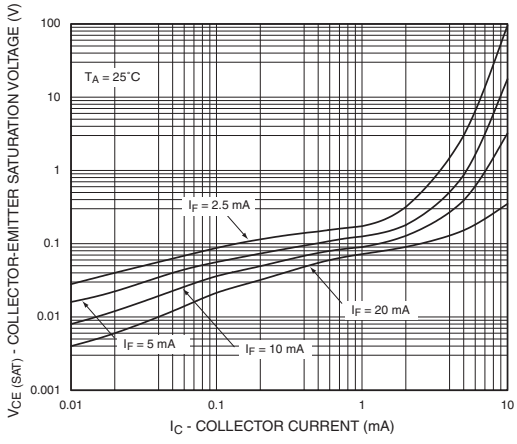


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**Fig. 13 Switching Speed vs. Load Resistor (Black Package)**

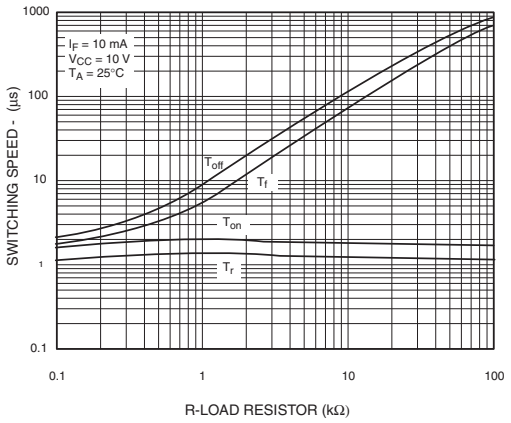


**Fig. 14 Switching Speed vs. Load Resistor (White Package)**

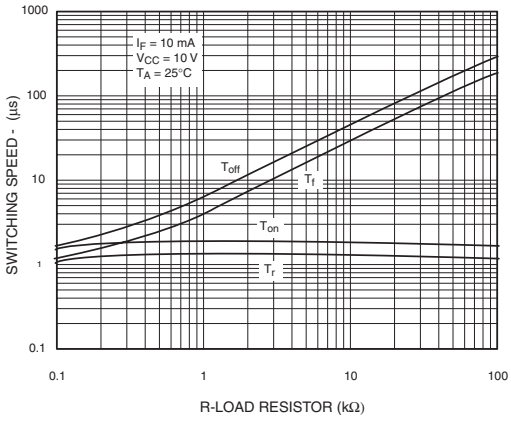


**Fig. 15 Normalized $t_{on}$ vs. $R_{BE}$ (Black Package)**

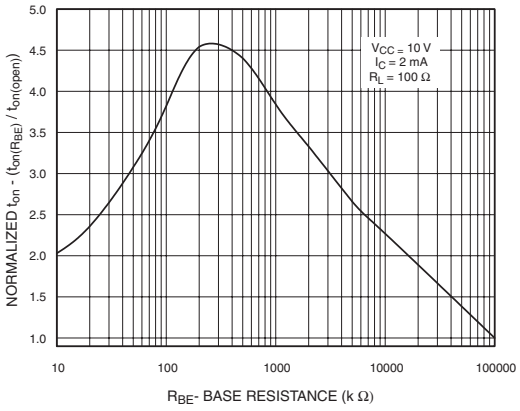


**Fig. 16 Normalized $t_{on}$ vs. $R_{BE}$ (White Package)**

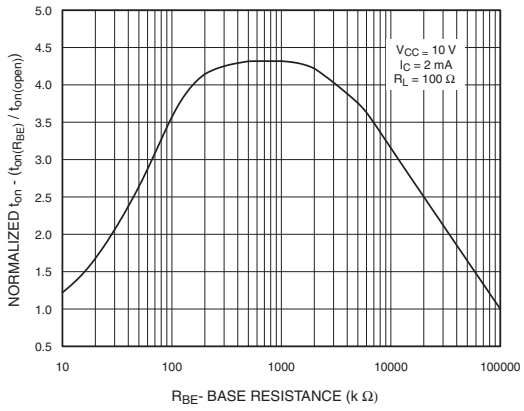


**Fig. 17 Normalized $t_{off}$ vs. $R_{BE}$ (Black Package)**

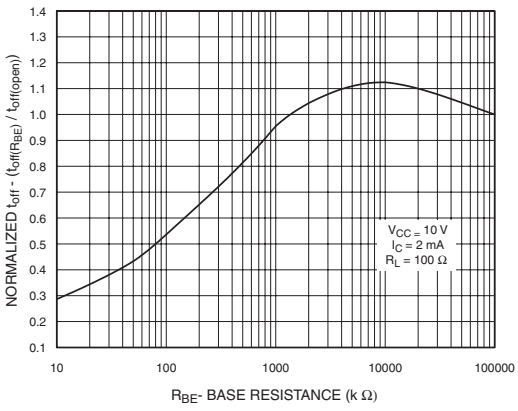


**Fig. 18 Normalized $t_{off}$ vs. $R_{BE}$ (White Package)**

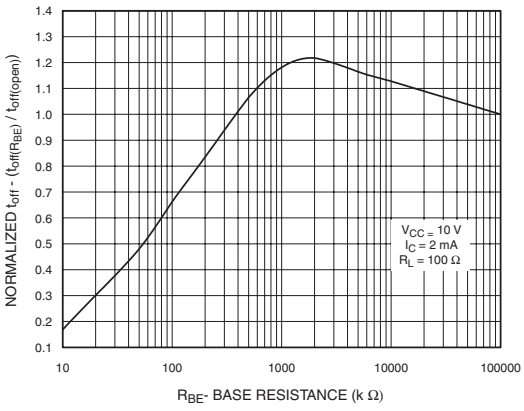


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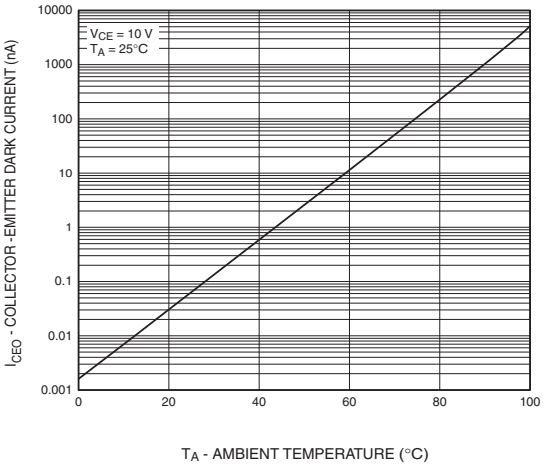
**Fig. 19 Dark Current vs. Ambient Temperature**



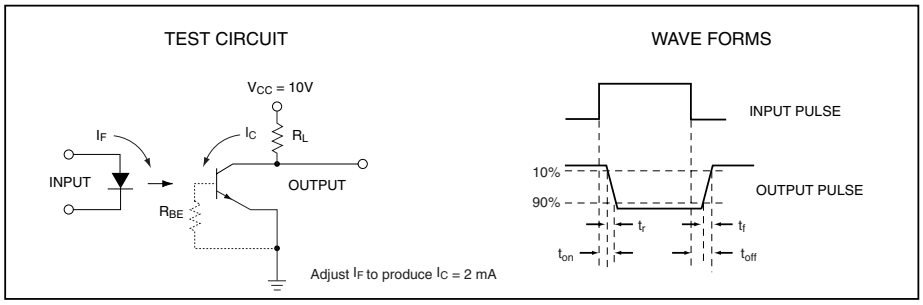



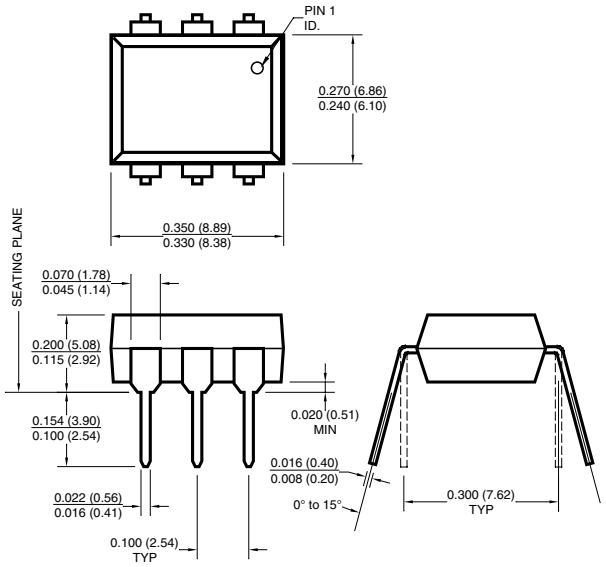

**Figure 20. Switching Time Test Circuit and Waveforms**

# GENERAL PURPOSE 6-PIN PHOTOTRANSISTOR OPTOCOUPLERS

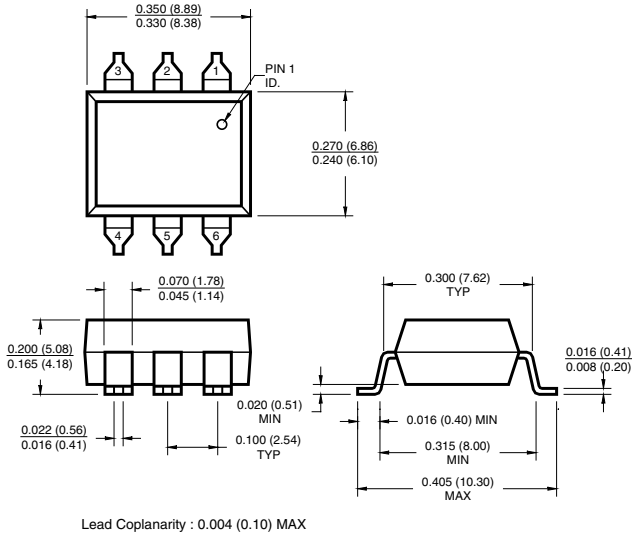
| | | | | | |
|---|---|---|---|---|---|
| 4N25 | 4N26 | 4N27 | 4N28 | 4N35 | 4N36 |
| 4N37 | H11A1 | H11A2 | H11A3 | H11A4 | H11A5 |

## Black Package (No -M Suffix)

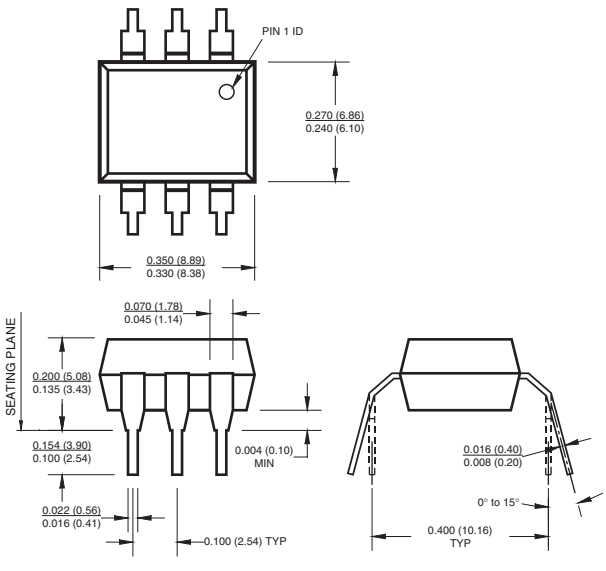
### Package Dimensions (Through Hole)



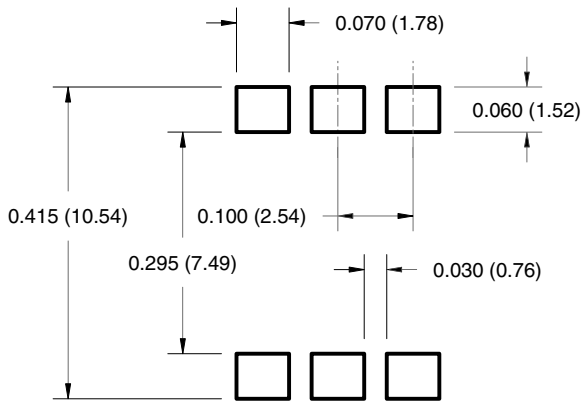

### Package Dimensions (Surface Mount)




### Package Dimensions (0.4" Lead Spacing)




### Recommended Pad Layout for Surface Mount Leadform




**NOTE**
All dimensions are in inches (millimeters)

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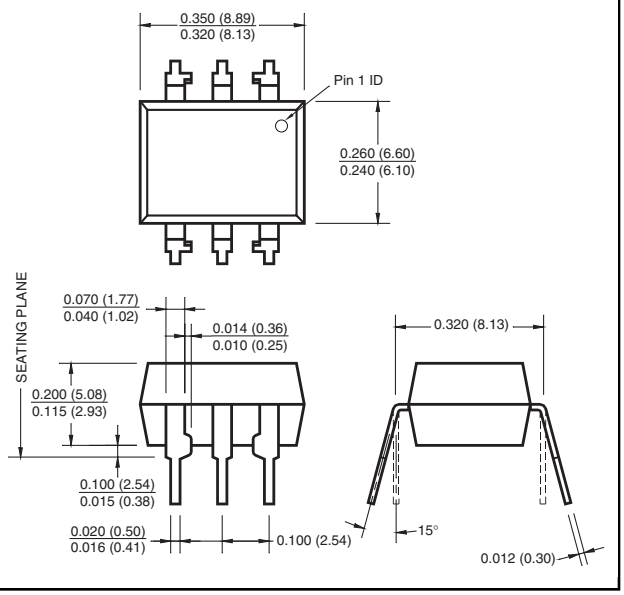
# GENERAL PURPOSE 6-PIN PHOTOTRANSISTOR OPTOCOUPLERS

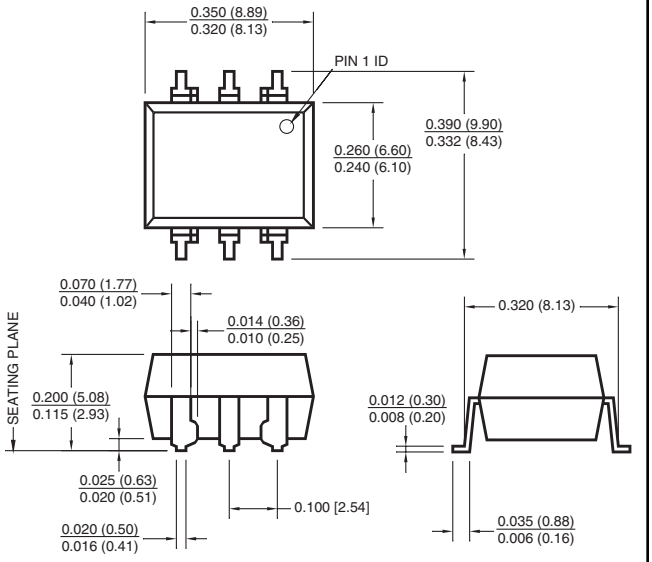
| | | | | | |
|---|---|---|---|---|---|
| 4N25 | 4N26 | 4N27 | 4N28 | 4N35 | 4N36 |
| 4N37 | H11A1 | H11A2 | H11A3 | H11A4 | H11A5 |

## White Package (-M Suffix)

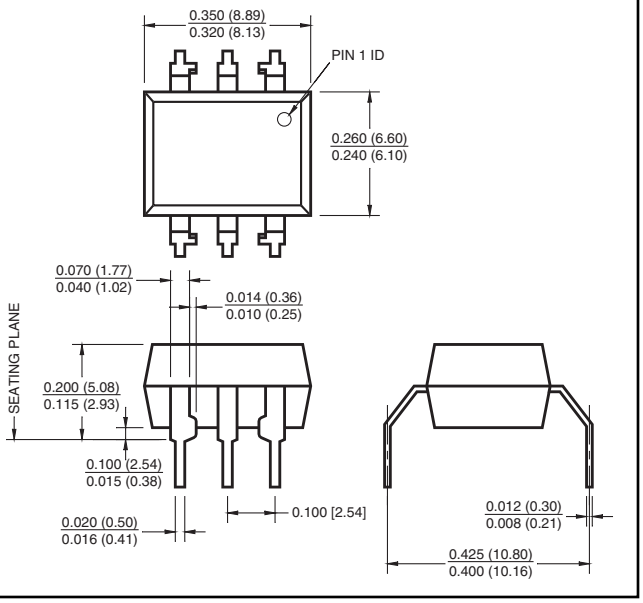
### Package Dimensions (Through Hole)



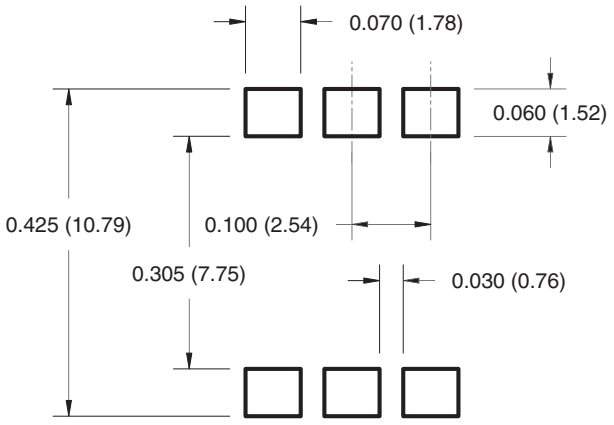

### Package Dimensions (Surface Mount)




### Package Dimensions (0.4" Lead Spacing)




### Recommended Pad Layout for Surface Mount Leadform




**NOTE**
All dimensions are in inches (millimeters)

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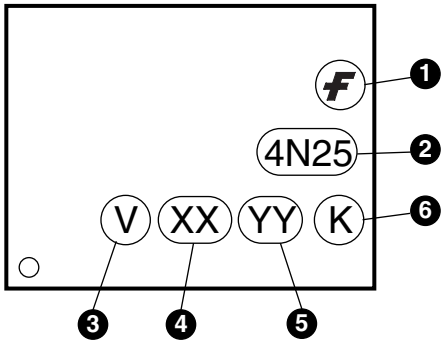
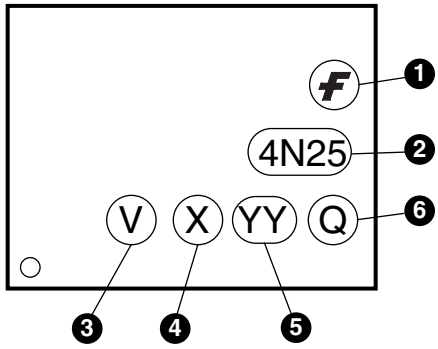
## ORDERING INFORMATION

| Order Entry Identifier | | |
|---|---|---|
| **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<br>• Two digits for black package parts, e.g., '03'<br>• 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.

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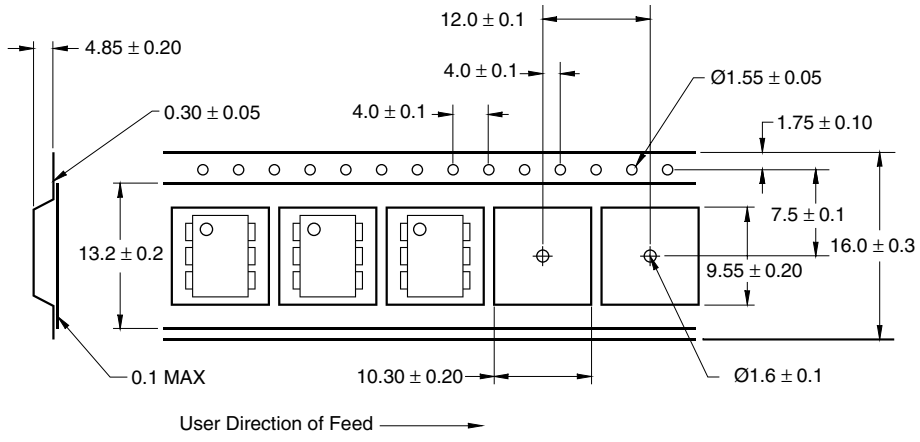
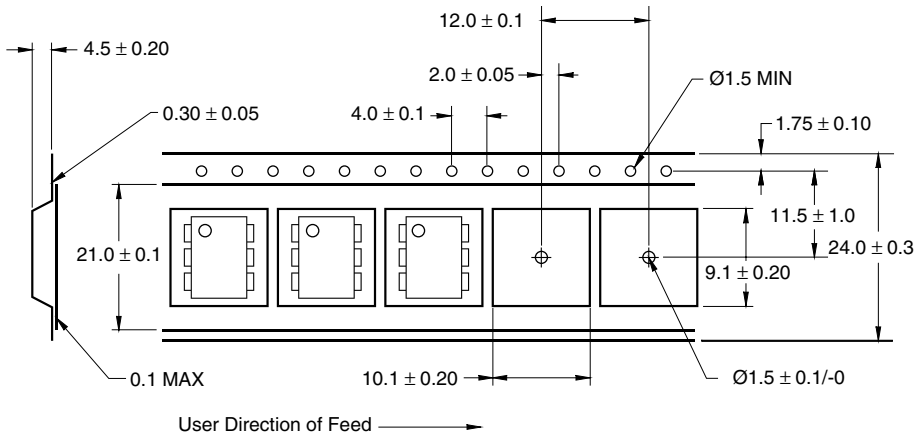
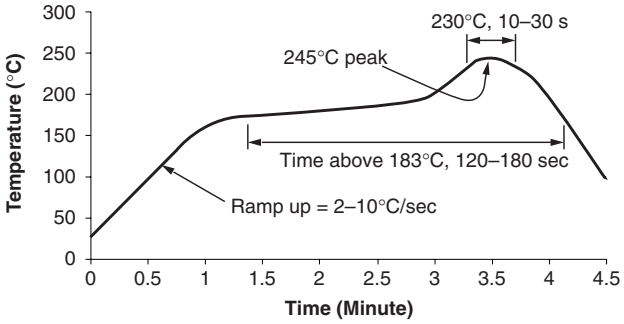
## QT Carrier Tape Specifications (Black Package, No Suffix)




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

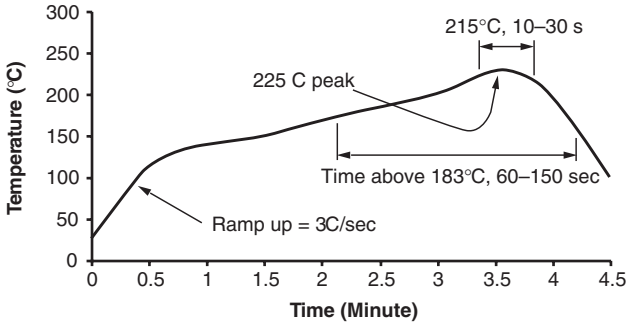


## Reflow Profile (White Package, -M Suffix)




- Peak reflow temperature: 245°C (package surface temperature)
- Time of temperature higher than 183°C for 120–180 seconds
- One time soldering reflow is recommended

## 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

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# GENERAL PURPOSE 6-PIN PHOTOTRANSISTOR OPTOCOUPLERS

| | | | | | |
|---|---|---|---|---|---|
| **4N25** | **4N26** | **4N27** | **4N28** | **4N35** | **4N36** |
| **4N37** | **H11A1** | **H11A2** | **H11A3** | **H11A4** | **H11A5** |

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