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FAIRCHILD SEMICONDUCTOR®

January 2009

# 4N25M, 4N26M, 4N27M, 4N28M, 4N35M, 4N36M, 4N37M, H11A1M, H11A2M, H11A3M, H11A4M, H11A5M
# General Purpose 6-Pin Phototransistor Optocouplers

## Features

- UL recognized (File # E90700, Volume 2)
- VDE recognized (File # 102497)
  – Add option V (e.g., 4N25VM)

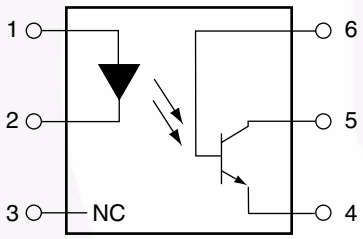
## Applications

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs

## Description

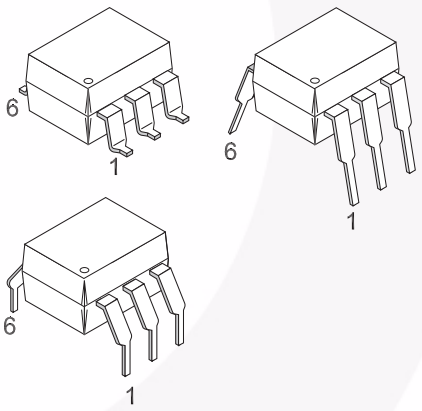
The general purpose optocouplers consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

## Schematic




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

## Package Outlines




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## Absolute Maximum Ratings ($T_A$ = 25°C unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| **TOTAL DEVICE** | | | |
| $T_{STG}$ | Storage Temperature | -40 to +150 | °C |
| $T_{OPR}$ | Operating Temperature | -40 to +100 | °C |
| $T_{SOL}$ | Wave solder temperature (see page 8 for reflow solder profile) | 260 for 10 sec | °C |
| $P_D$ | Total Device Power Dissipation @ $T_A$ = 25°C | 250 | mW |
| | Derate above 25°C | 2.94 | |
| **EMITTER** | | | |
| $I_F$ | DC/Average Forward Input Current | 60 | mA |
| $V_R$ | Reverse Input Voltage | 6 | V |
| $I_F$(pk) | Forward Current – Peak (300µs, 2% Duty Cycle) | 3 | A |
| $P_D$ | LED Power Dissipation @ $T_A$ = 25°C | 120 | mW |
| | Derate above 25°C | 1.41 | mW/°C |
| **DETECTOR** | | | |
| $V_{CEO}$ | Collector-Emitter Voltage | 30 | V |
| $V_{CBO}$ | Collector-Base Voltage | 70 | V |
| $V_{ECO}$ | Emitter-Collector Voltage | 7 | V |
| $P_D$ | Detector Power Dissipation @ $T_A$ = 25°C | 150 | mW |
| | Derate above 25°C | 1.76 | mW/°C |

## Electrical Characteristics ($T_A$ = 25°C unless otherwise specified)

### Individual Component Characteristics

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

### Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{ISO}$ | Input-Output Isolation Voltage | f = 60Hz, t = 1 sec | 7500 | | | Vac(pk) |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = 500 VDC | $10^{11}$ | | | Ω |
| $C_{ISO}$ | Isolation Capacitance | $V_{I-O}$ = &, f = 1MHz | | 0.2 | 2 | pF |

*Typical values at $T_A$ = 25°C

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## Electrical Characteristics (Continued) ($T_A$ = 25°C unless otherwise specified)

### Transfer Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ.* | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| CTR | Current Transfer Ratio, Collector to Emitter | $I_F$ = 10mA, $V_{CE}$ = 10V | 4N35M, 4N36M, 4N37M | 100 | | | % |
| | | | H11A1M | 50 | | | |
| | | | H11A5M | 30 | | | |
| | | | 4N25M, 4N26M H11A2M, H11A3M | 20 | | | |
| | | | 4N27M, 4N28M H11A4M | 10 | | | |
| | | $I_F$ = 10mA, $V_{CE}$ = 10V, $T_A$ = -55°C | 4N35M, 4N36M, 4N37M | 40 | | | |
| | | $I_F$ = 10mA, $V_{CE}$ = 10V, $T_A$ = +100°C | 4N35M, 4N36M, 4N37M | 40 | | | |
| $V_{CE\ (SAT)}$ | Collector-Emitter Saturation Voltage | $I_C$ = 2mA, $I_F$ = 50mA | 4N25M, 4N26M, 4N27M, 4N28M, | | | 0.5 | V |
| | | $I_C$ = 0.5mA, $I_F$ = 10mA | 4N35M, 4N36M, 4N37M | | | 0.3 | |
| | | | H11A1M, H11A2M, H11A3M, H11A4M, H11A5M | | | 0.4 | |
| **AC CHARACTERISTICS** | | | | | | | |
| $T_{ON}$ | Non-Saturated Turn-on Time | $I_F$ = 10mA, $V_{CC}$ = 10V, $R_L$ = 100Ω (Fig. 11) | 4N25M, 4N26M, 4N27M, 4N28M, H11A1M, H11A2M, H11A3M, H11A4, H11A5M | | 2 | | µs |
| | | $I_C$ = 2mA, $V_{CC}$ = 10V, $R_L$ = 100Ω (Fig. 11) | 4N35M, 4N36M, 4N37M | | 2 | 10 | µs |
| $T_{OFF}$ | Turn-off Time | $I_F$ = 10mA, $V_{CC}$ = 10V, $R_L$ = 100Ω (Fig. 11) | 4N25M, 4N26M, 4N27M, 4N28M, H11A1M, H11A2M, H11A3M, H11A4M, H11A5M | | 2 | | µs |
| | | $I_C$ = 2mA, $V_{CC}$ = 10V, $R_L$ = 100Ω (Fig. 11) | 4N35M, 4N36M, 4N37M | | 2 | 10 | |

* Typical values at $T_A$ = 25°C

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## Typical Performance Curves

**Fig. 1 LED Forward Voltage vs. Forward Current**

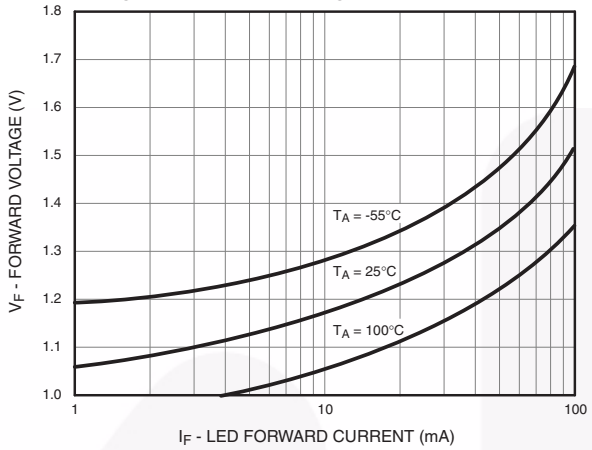



**Fig. 2 Normalized CTR vs. Forward Current**

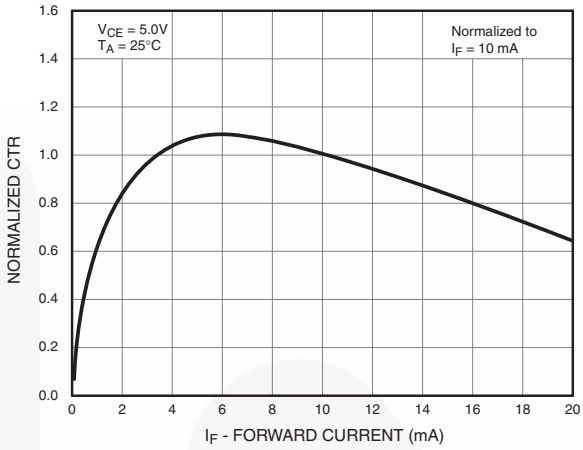



**Fig. 3 Normalized CTR vs. Ambient Temperature**

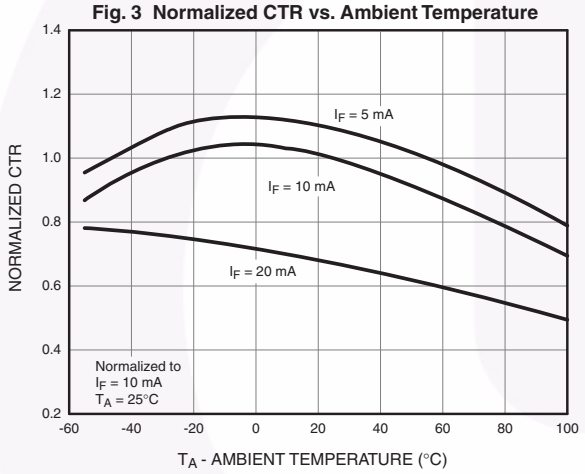



**Fig. 4 CTR vs. RBE (Unsaturated)**

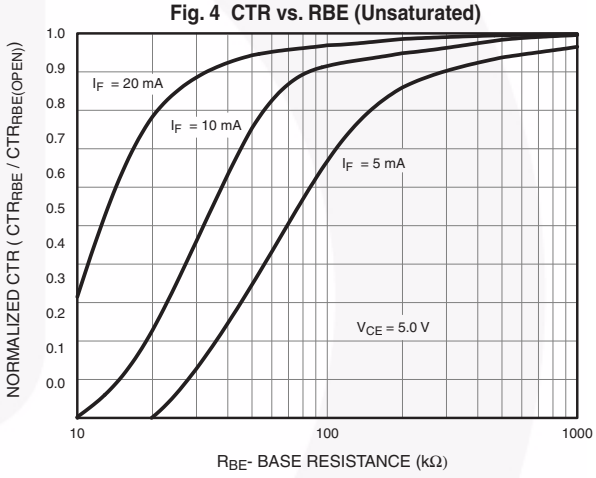



**Fig. 5 CTR vs. RBE (Saturated)**

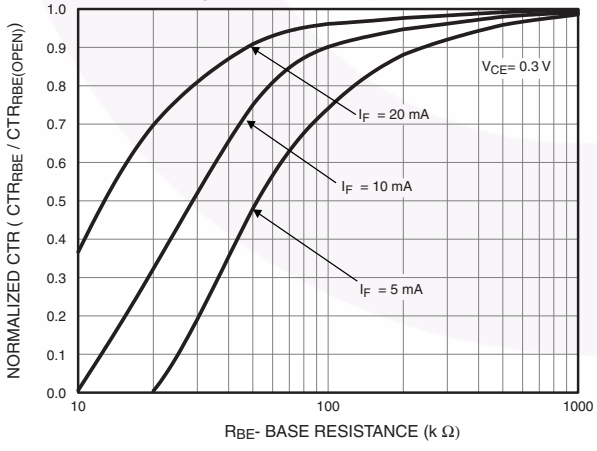
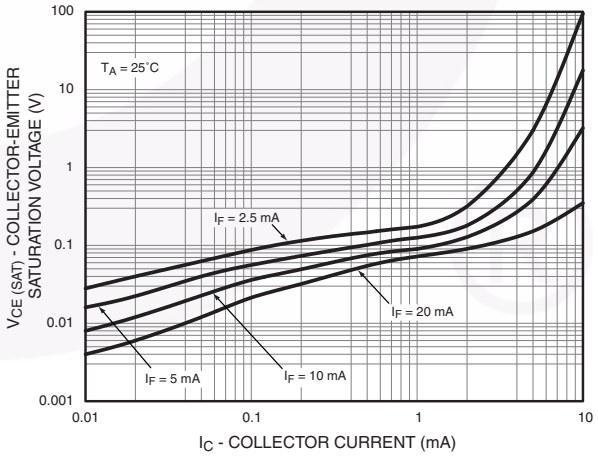



**Fig. 6 Collector-Emitter Saturation Voltage vs. Collector Current**



## Typical Performance Curves (Continued)

**Fig. 7 Switching Speed vs. Load Resistor**

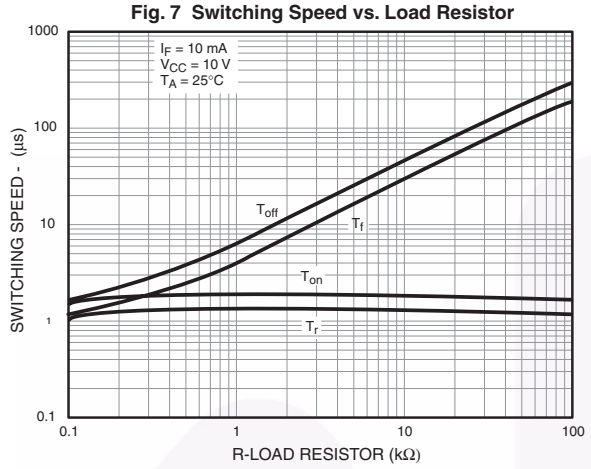



**Fig. 8 Normalized $t_{on}$ vs. $R_{BE}$**

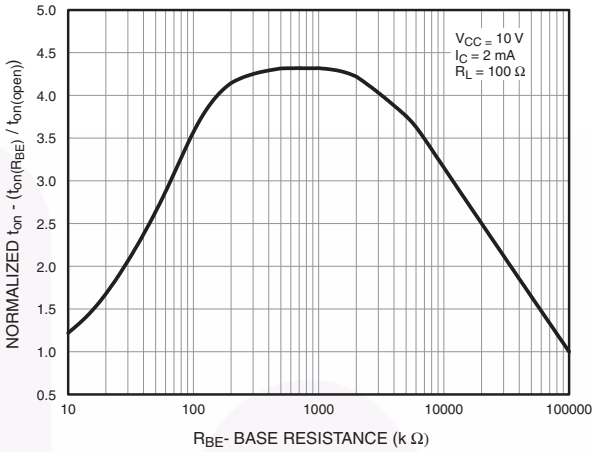



**Fig. 9 Normalized $t_{off}$ vs. $R_{BE}$**

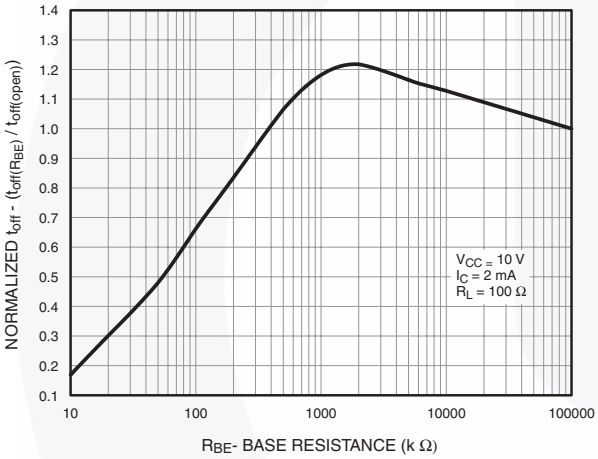
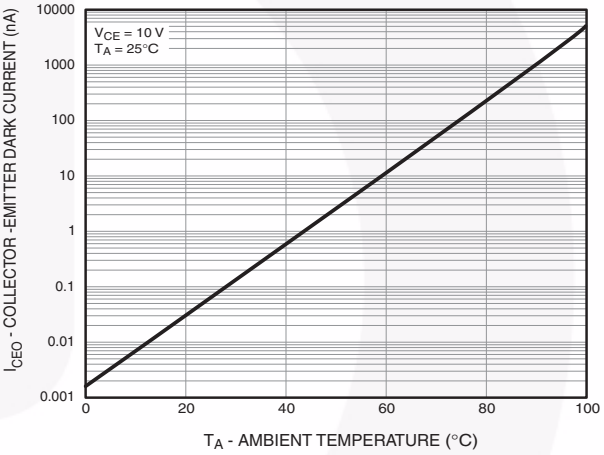
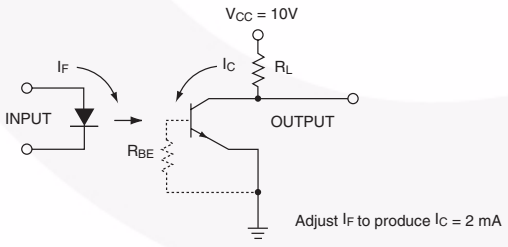



**Fig. 10 Dark Current vs. Ambient Temperature**




TEST CIRCUIT




WAVE FORMS

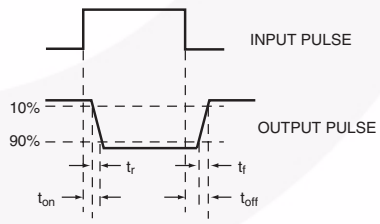
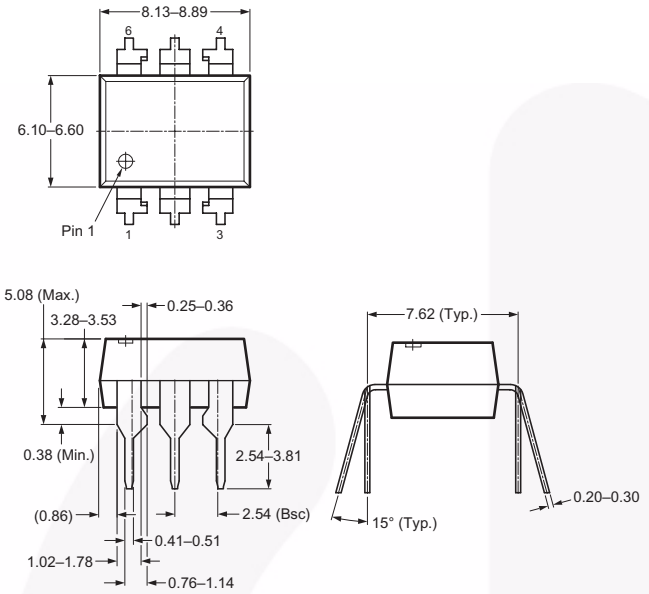


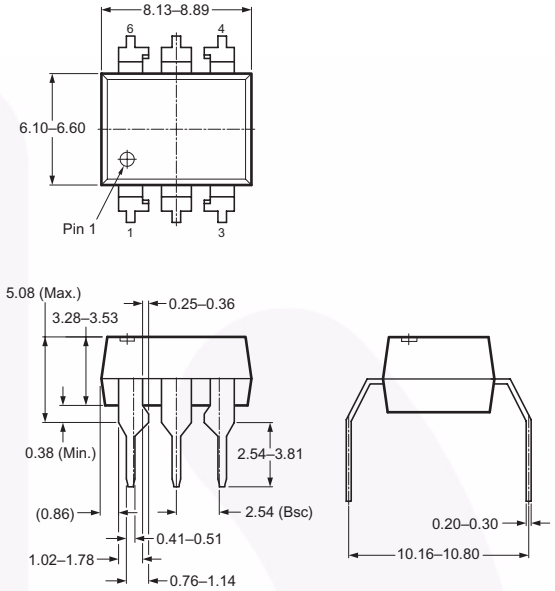

**Figure 11. Switching Time Test Circuit and Waveforms**

## Package Dimensions

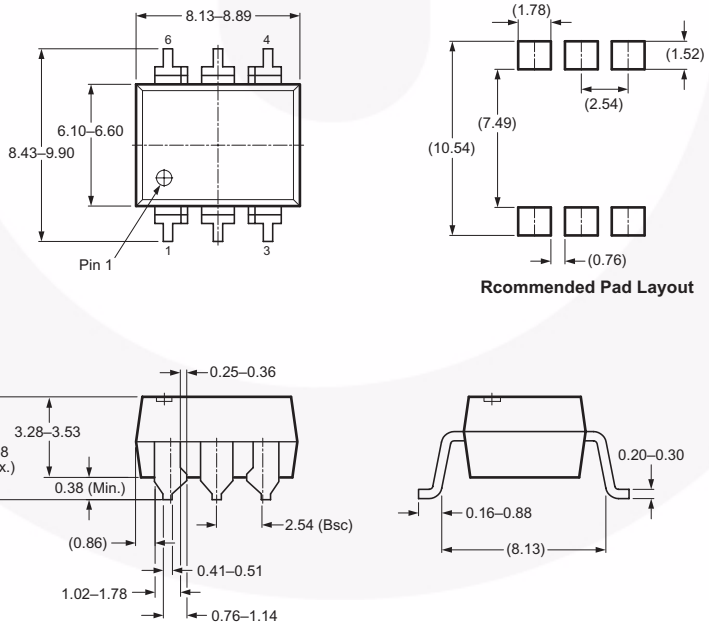
### Through Hole




### 0.4" Lead Spacing




### Surface Mount

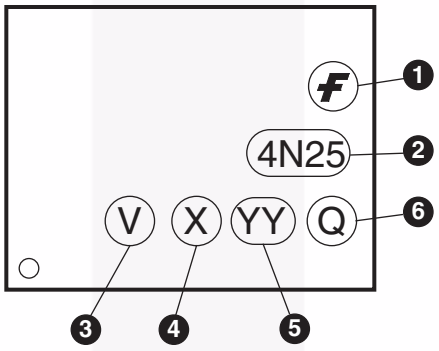



**Note:**
All dimensions in mm.

## Ordering Information

| Option | Order Entry Identifier (Example) | Description |
|---|---|---|
| No option | 4N25M | Standard Through Hole Device |
| S | 4N25SM | Surface Mount Lead Bend |
| SR2 | 4N25SR2M | Surface Mount; Tape and Reel |
| T | 4N25TM | 0.4" Lead Spacing |
| V | 4N25VM | VDE 0884 |
| TV | 4N25TVM | VDE 0884, 0.4" Lead Spacing |
| SV | 4N25SVM | VDE 0884, Surface Mount |
| SR2V | 4N25SR2VM | VDE 0884, Surface Mount, Tape and Reel |

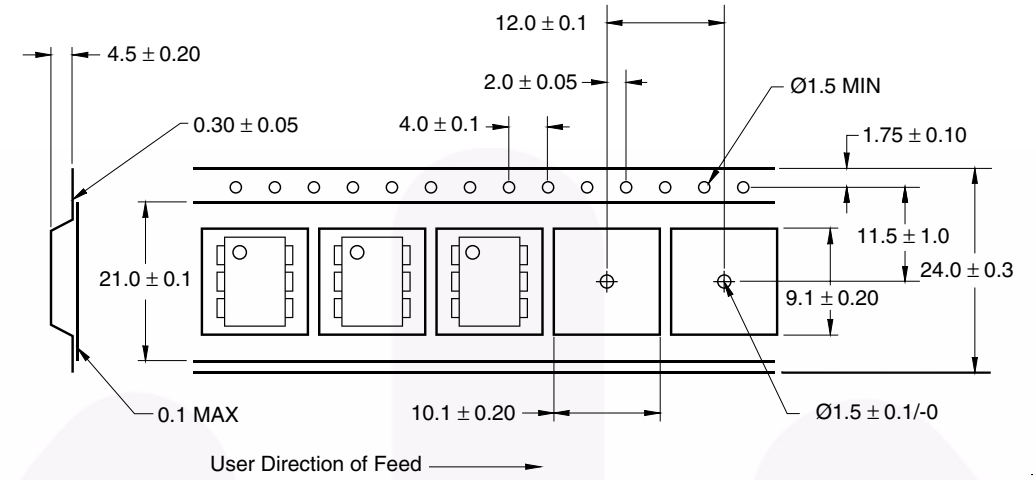
## Marking Information



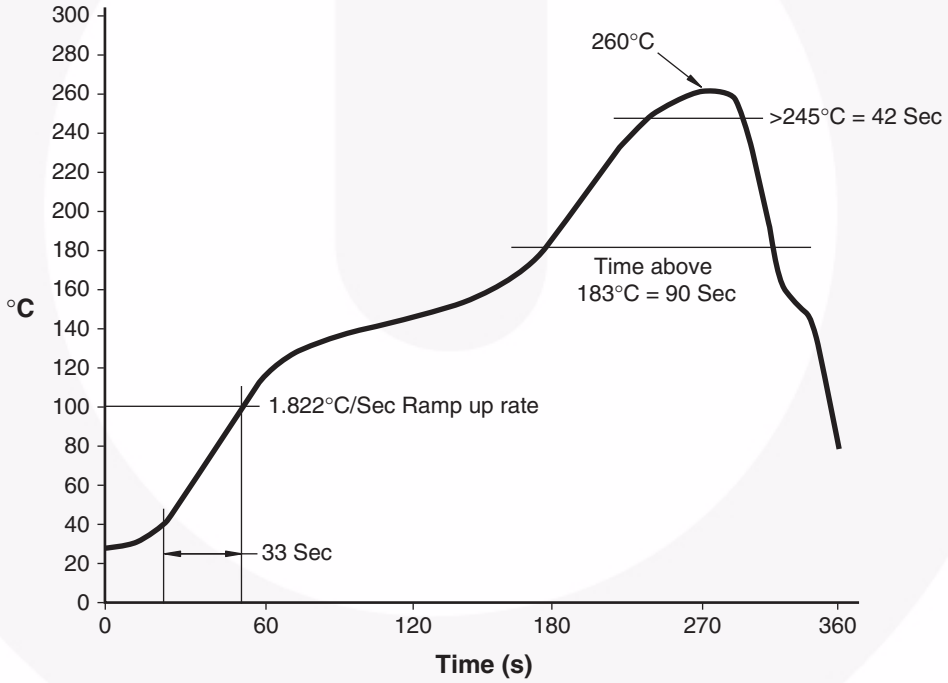

| Definitions | |
|---|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., ‘7’ |
| 5 | Two digit work week ranging from ‘01’ to ‘53’ |
| 6 | Assembly package code |

*Note – Parts that do not have the ‘V’ option (see definition 3 above) that are marked with date code ‘325’ or earlier are marked in portrait format.

## Carrier Tape Specification




## Reflow Profile



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