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FAIRCHILD SEMICONDUCTOR®

March 2007

# 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)

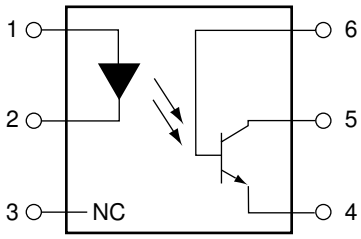
## Applications

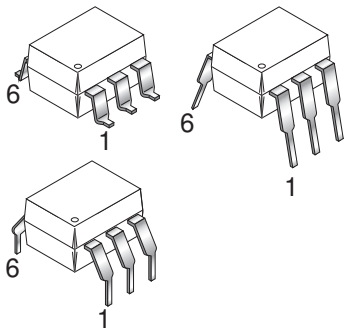
- Power supply regulators
- Digital logic inputs
- Microprocessor inputs

## 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.

## Functional Block Diagram




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

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

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| **TOTAL DEVICE** | | | |
| $T_{STG}$ | Storage Temperature | -55 to +150 | °C |
| $T_{OPR}$ | Operating Temperature | -55 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**

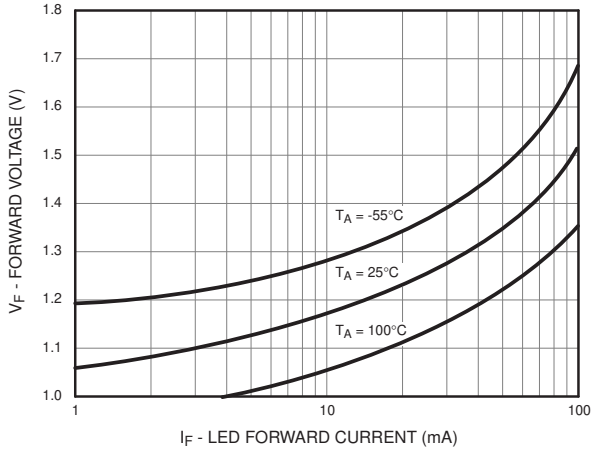



**Fig.2 Normalized CTR vs. Forward Current**

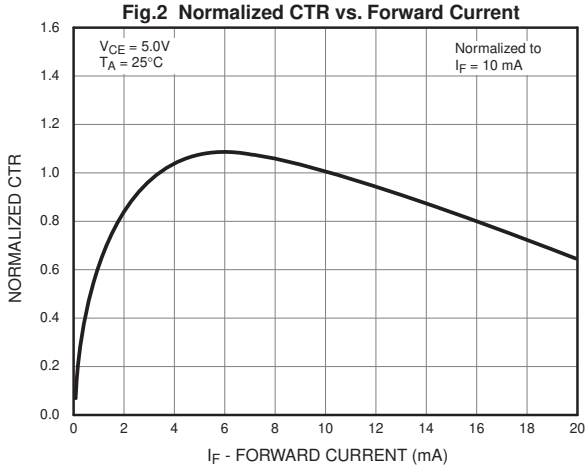



**Fig. 3 Normalized CTR vs. Ambient Temperature**

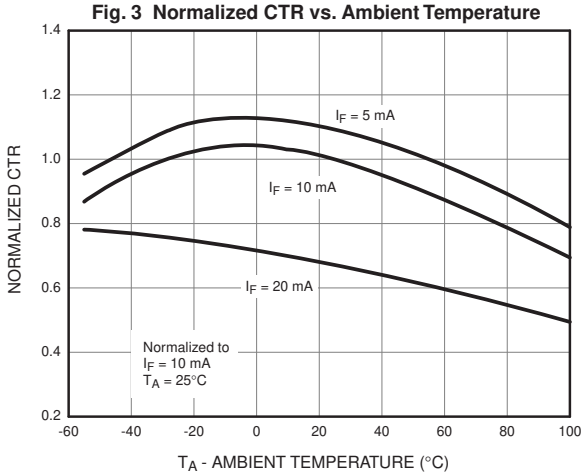



**Fig. 4 CTR vs. RBE (Unsaturated)**

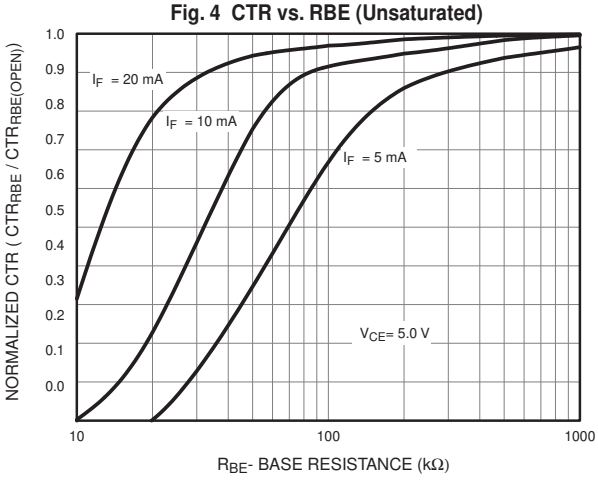



**Fig. 5 CTR vs. RBE (Saturated)**

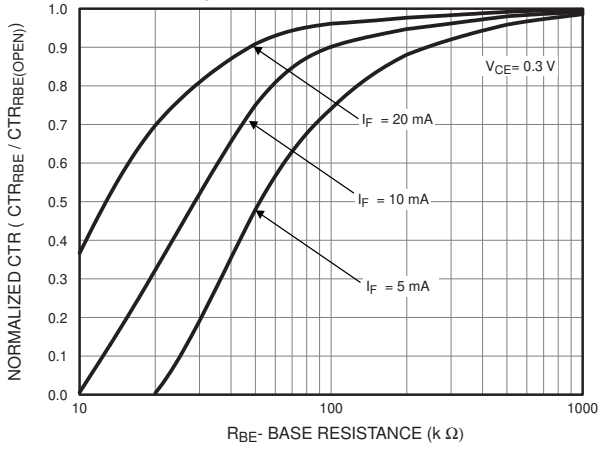



**Fig. 6 Collector-Emitter Saturation Voltage vs. Collector Current**

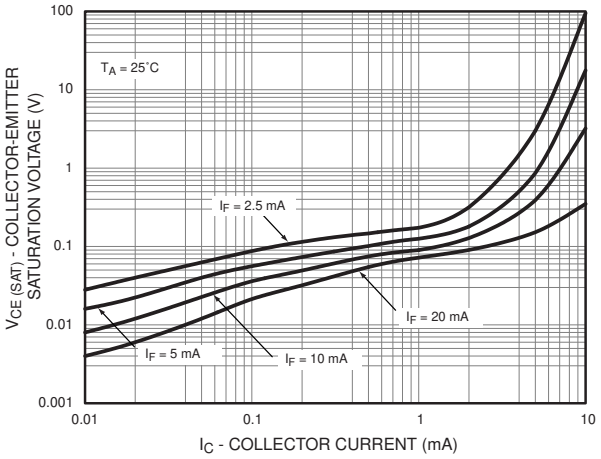


**Fig. 7 Switching Speed vs. Load Resistor**

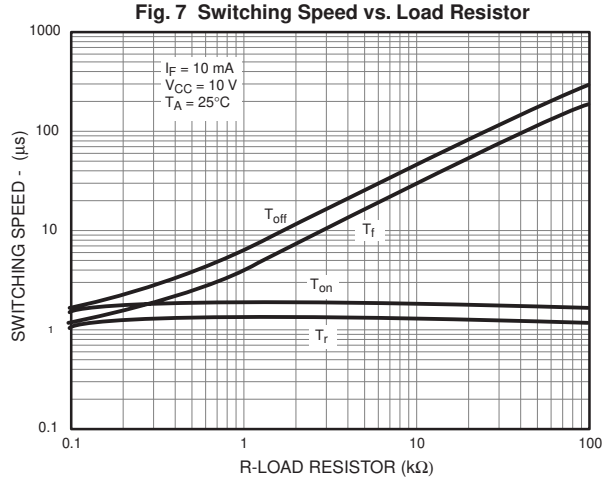



**Fig. 8 Normalized $t_{on}$ vs. $R_{BE}$**

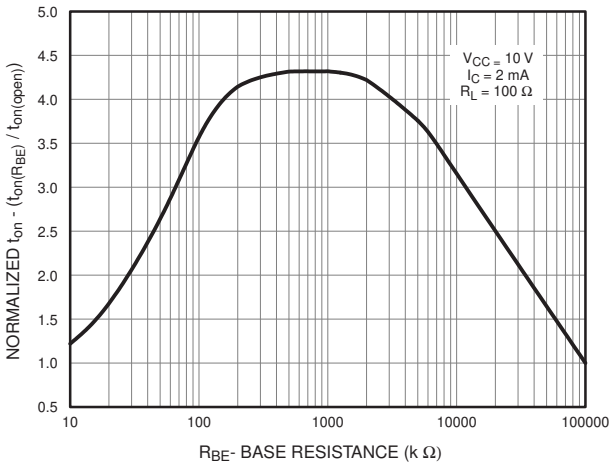



**Fig. 9 Normalized $t_{off}$ vs. $R_{BE}$**

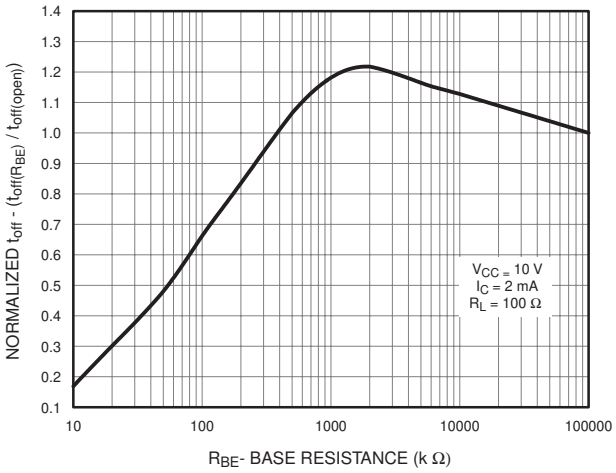
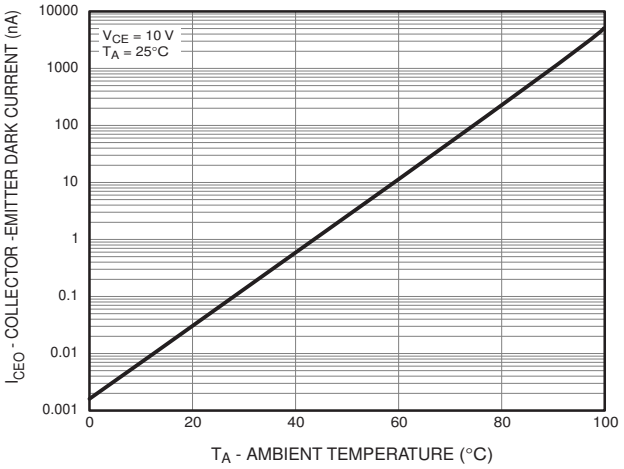
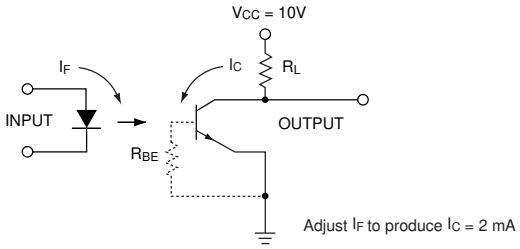



**Fig. 10 Dark Current vs. Ambient Temperature**




TEST CIRCUIT




WAVE FORMS

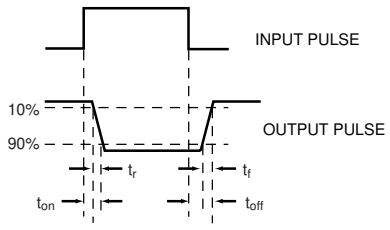
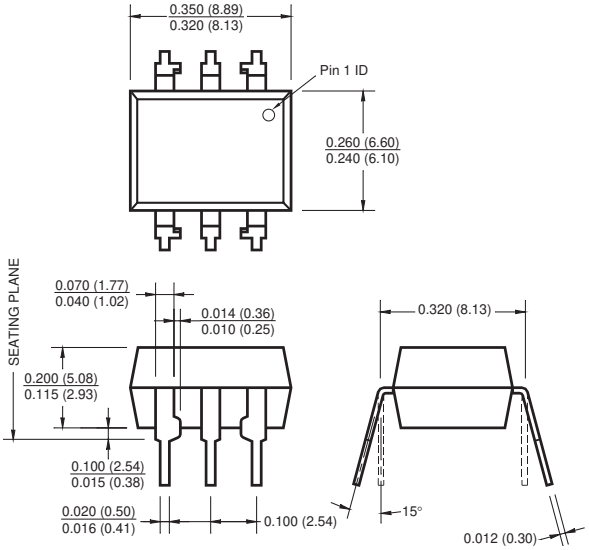


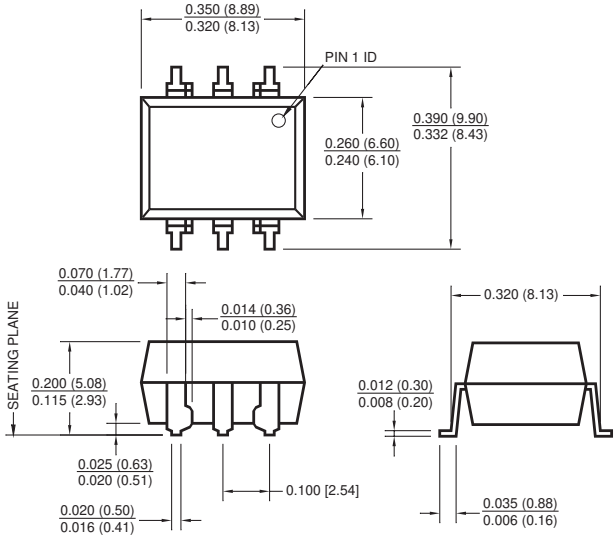

**Figure 11. Switching Time Test Circuit and Waveforms**

## Package Dimensions

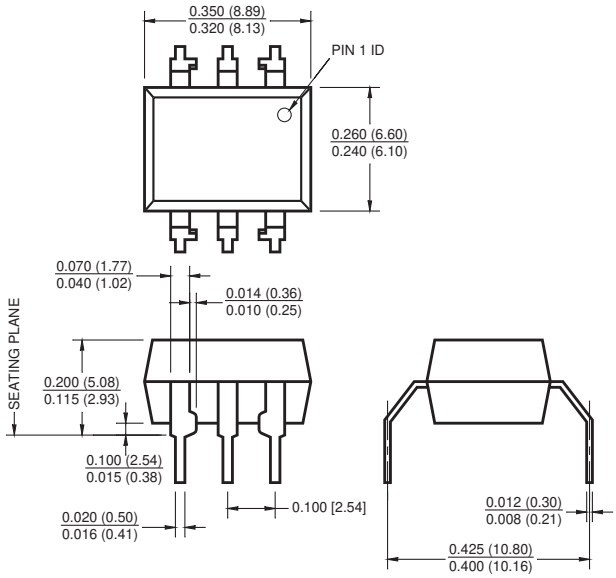
### Through Hole



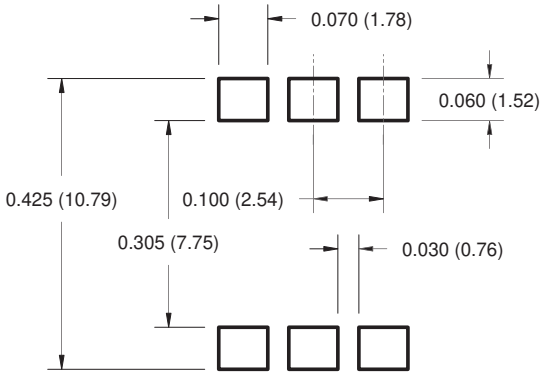

### Surface Mount




### 0.4" Lead Spacing




### Recommended Pad Layout for Surface Mount Leadform

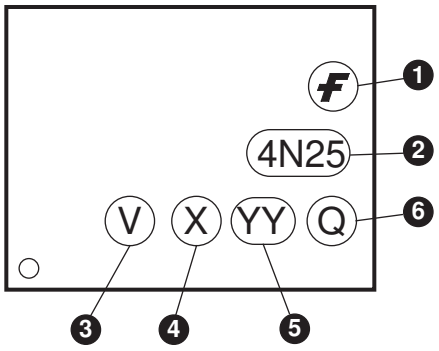



**Note:**
All dimensions are in inches (millimeters)

## 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 |

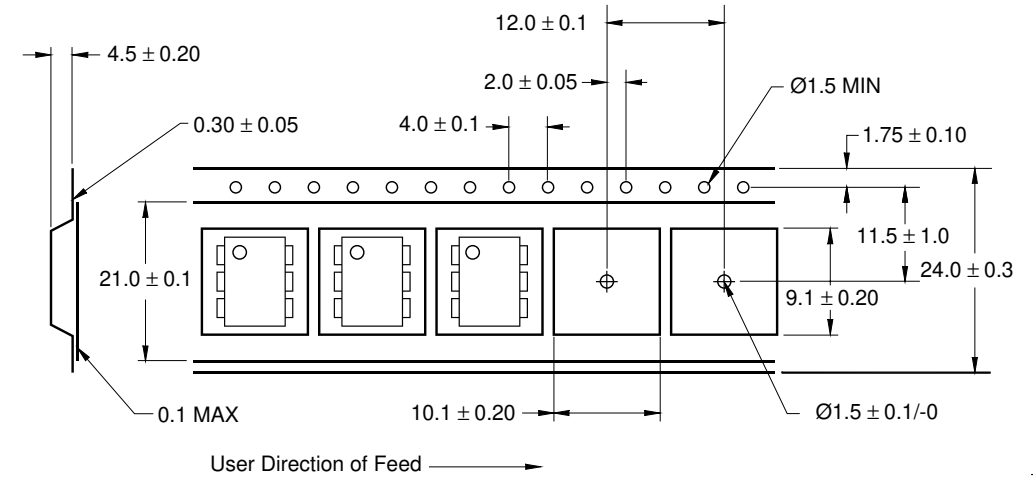
## Marking Information



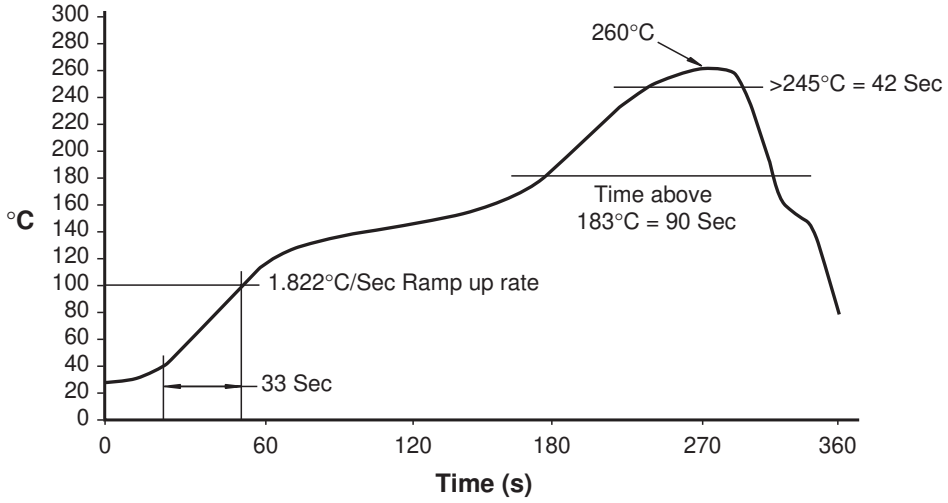

| Definitions | |
|---|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., ‘7’ |
| 5 | Two digit work week ranging from ‘01’ to ‘53’ |
| 6 | Assembly package code |

*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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RapidConnect™
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SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SyncFET™
TCM™
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Rev. I24

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