April 2006

# H11AA1-M, H11AA2-M, H11AA3-M, H11AA4-M
# AC Input/Phototransistor Optocouplers

## Features

- Bi-polar emitter input
- Built-in reverse polarity input protection
- Underwriters Laboratory (UL) recognized File #E90700, Volume 2
- VDE approved File #102497 (ordering option 'V')

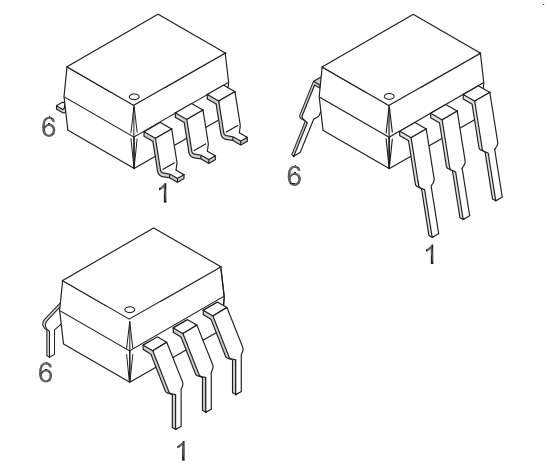
## Applications

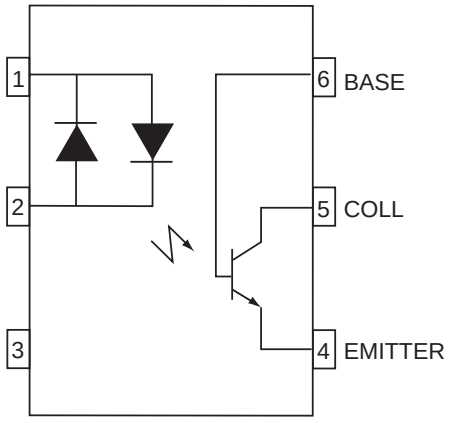
- AC line monitor
- Unknown polarity DC sensor
- Telephone line interface

## Description

The H11AAX-M series consists of two gallium-arsenide infrared emitting diodes connected in inverse parallel driving a single silicon phototransistor output.

## Package and Schematic



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

| Symbol | Parameter | Device | Value | Units |
|---|---|---|---|---|
| **TOTAL DEVICE** | | | | |
| $T_{STG}$ | Storage Temperature | All | -40 to +150 | °C |
| $T_{OPR}$ | Operating Temperature | All | -40 to +100 | °C |
| $T_{SOL}$ | Lead Solder Temperature | All | 260 for 10 sec | °C |
| $P_D$ | Total Device Power Dissipation | All | 250 | mW |
| | Derate Linearly From 25°C | | 2.94 | mW/°C |
| **EMITTER** | | | | |
| $I_F$ | Continuous Forward Current | All | 60 | mA |
| $I_F$(pk) | Forward Current – Peak (1µs pulse, 300 pps) | All | ±1.0 | A |
| $P_D$ | LED Power Dissipation | All | 120 | mW |
| | Derate Linearly From 25°C | | 1.41 | mW/°C |
| **DETECTOR** | | | | |
| $I_C$ | Continuous Collector Current | All | 50 | mA |
| $P_D$ | Detector Power Dissipation | All | 150 | mW |
| | Derate linearity from 25°C | | 1.76 | mW/°C |

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

### Individual Component Characteristics

| Symbol | Parameter | Test Conditions | Device | Min. | Typ.* | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **EMITTER** | | | | | | | |
| $V_F$ | Input Forward Voltage | $I_F$ = ±10mA | All | | 1.17 | 1.5 | V |
| $C_J$ | Capacitance | $V_F$ = 0 V, f = 1.0MHz | All | | 80 | | pF |
| **DETECTOR** | | | | | | | |
| $BV_{CEO}$ | Breakdown Voltage Collector to Emitter | $I_C$ = 1.0mA, $I_F$ = 0 | All | 30 | 100 | | V |
| $BV_{CBO}$ | Collector to Base | $I_C$ = 100µA, $I_F$ = 0 | All | 70 | 120 | | V |
| $BV_{EBO}$ | Emitter to Base | $I_E$ = 100µA, $I_F$ = 0 | All | 5 | 10 | | V |
| $BV_{ECO}$ | Emitter to Collector | $I_E$ = 100µA, $I_F$ = 0 | All | 7 | 10 | | V |
| $I_{CEO}$ | Leakage Current Collector to Emitter | $V_{CE}$ = 10 V, $I_F$ = 0 | H11AA1,3,4(-M) | | 1 | 50 | nA |
| | | | H11AA2-M | | 1 | 200 | |
| $C_{CE}$ | Capacitance Collector to Emitter | $V_{CE}$ = 0, f = 1MHz | All | | 10 | | pF |
| $C_{CB}$ | Collector to Base | $V_{CB}$ = 0, f = 1MHz | All | | 80 | | pF |
| $C_{EB}$ | Emitter to Base | $V_{EB}$ = 0, f = 1MHz | All | | 15 | | pF |

*Typical values at $T_A$ = 25°C

## Transfer Characteristics ($T_A$ = 25°C Unless otherwise specified.)

| Symbol | Characteristics | Test Conditions | Device | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|---|
| $CTR_{CE}$ | Current Transfer Ratio, Collector to Emitter | $I_F$ = ±10mA, $V_{CE}$ = 10V | H11AA4-M | 100 | | | % |
| | | | H11AA3-M | 50 | | | |
| | | | H11AA1-M | 20 | | | |
| | | | H11AA2-M | 10 | | | |
| | Current Transfer Ratio, Symmetry | $I_F$ = ±10mA, $V_{CE}$ = 10V (Figure 11) | All | .33 | | 3.0 | |
| $V_{CE(SAT)}$ | Saturation Voltage, Collector to Emitter | $I_F$ = ±10mA, $I_{CE}$ = 0.5mA | All | | | .40 | V |

## Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|
| $C_{I-O}$ | Package Capacitance Input/Output | $V_{I-O}$ = 0, f = 1MHz | | 0.7 | | pF |
| $V_{ISO}$ | Isolation Voltage | f = 60 Hz, t = 1 sec. | 7500 | | | Vac(pk) |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = 500 VDC | $10^{11}$ | | | Ω |

*Typical values at $T_A$ = 25°C

## Typical Performance Characteristics

**Fig. 1 Input Voltage vs. Input Current**

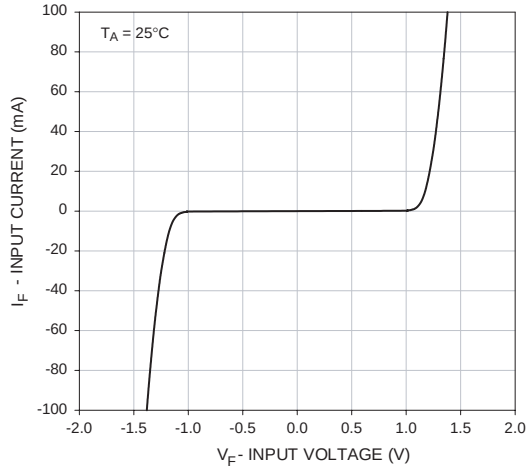



**Fig. 2 Normalized CTR vs. Forward Current**

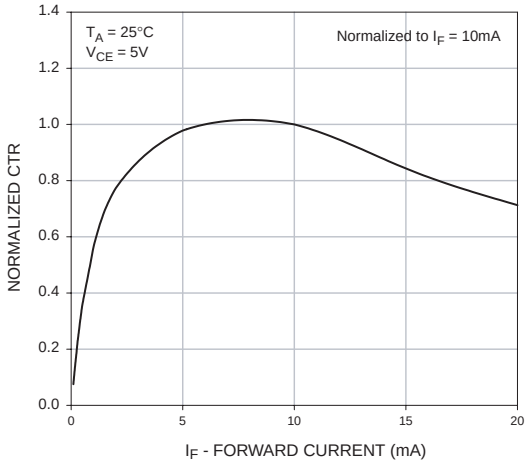



**Fig. 3 Normalized CTR vs. Ambient Temperature**

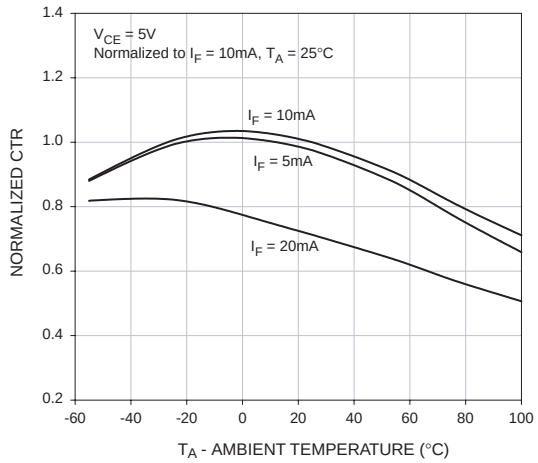



**Fig. 4 CTR vs. RBE (Unsaturated)**

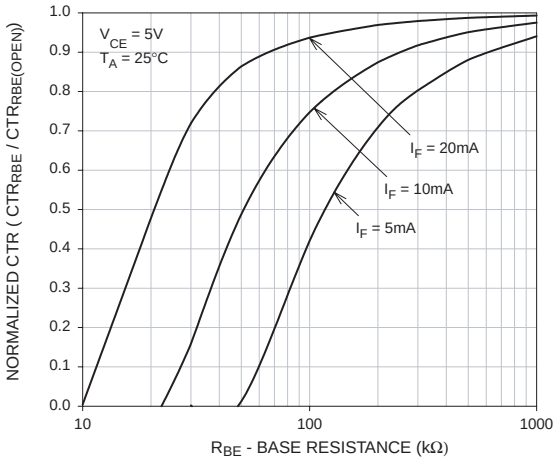



**Fig. 5 CTR vs. RBE (Saturated)**

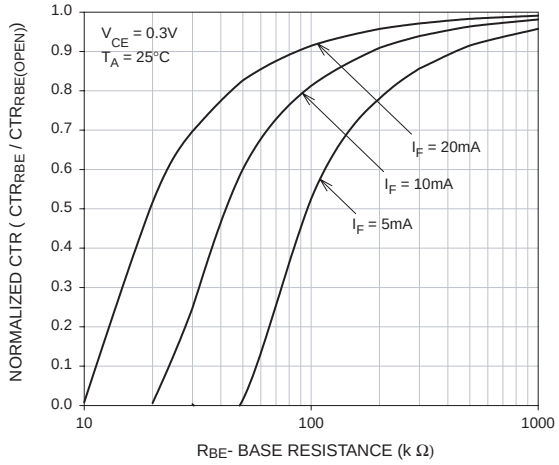
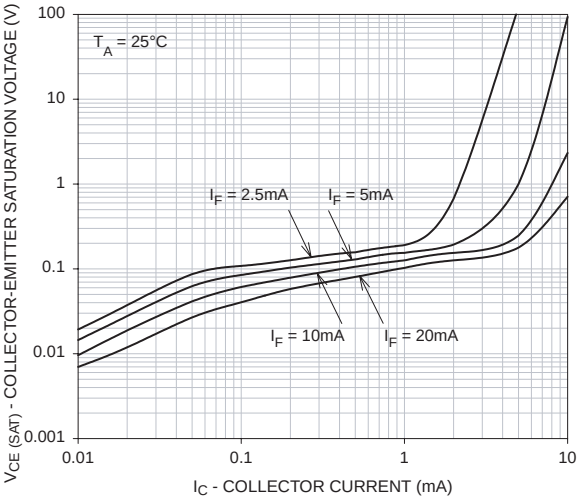



**Fig. 6 Collector-Emitter Saturation Voltage vs Collector Current**



## Typical Performance Characteristics (Continued)

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

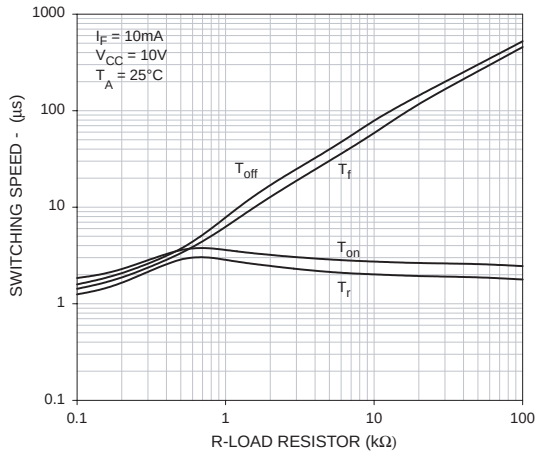



**Fig. 8 Normalized $t_{on}$ vs. $R_{BE}$**

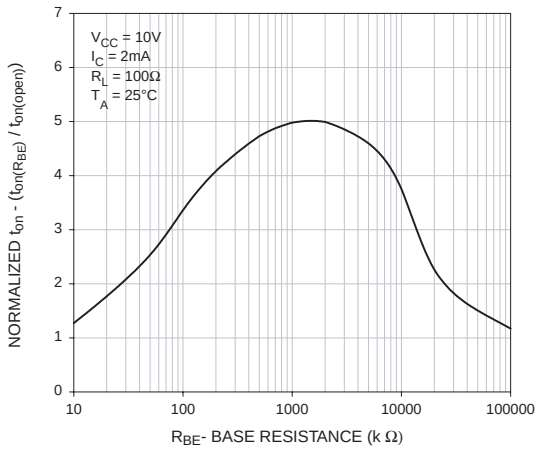



**Fig. 9 Normalized $t_{off}$ vs. $R_{BE}$**

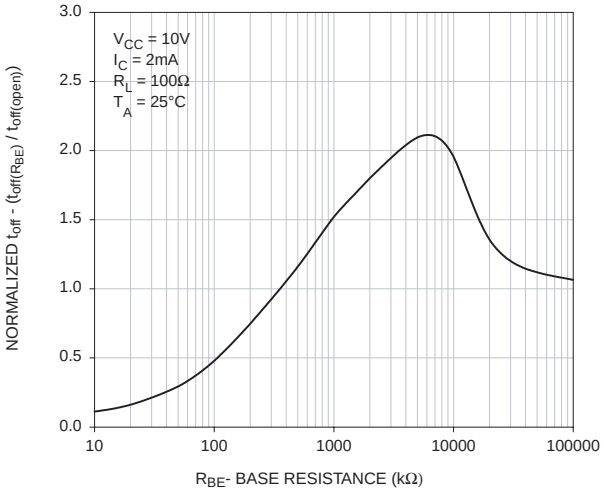



**Fig. 10 Dark Current vs. Ambient Temperature**

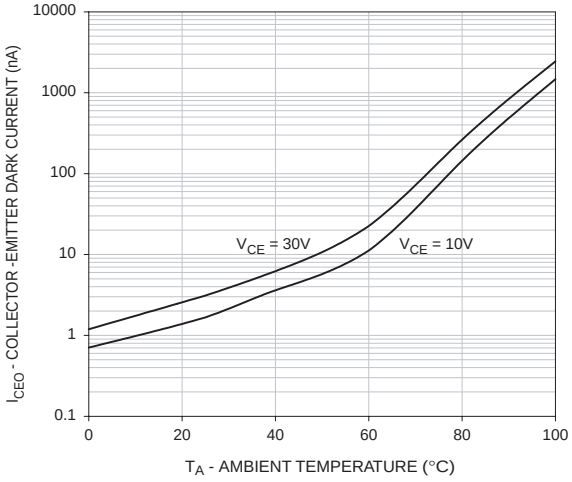
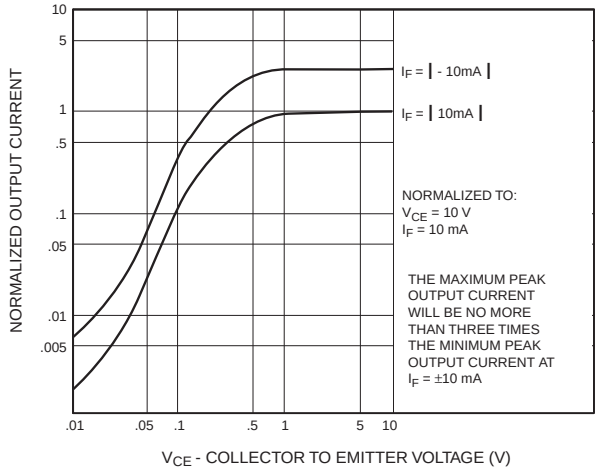
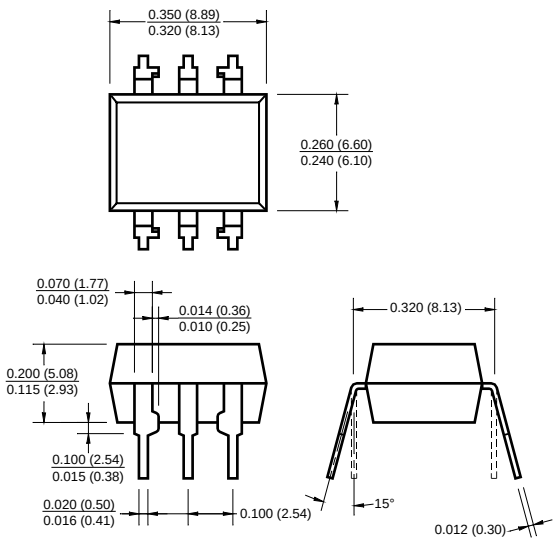



**Fig. 11 Output Symmetry Characteristics**

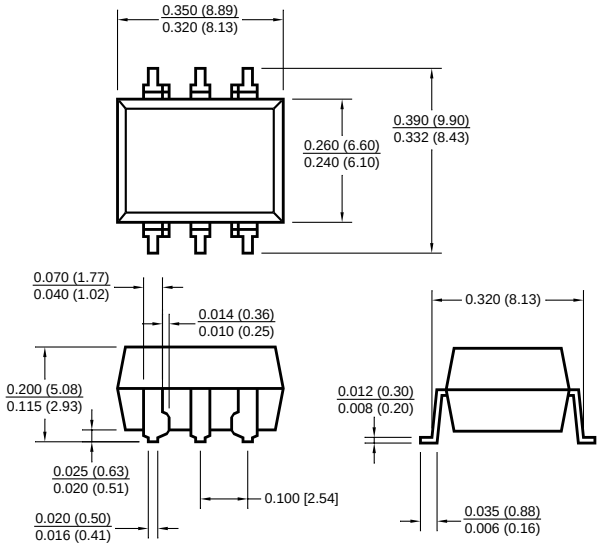


## Mechanical Dimensions

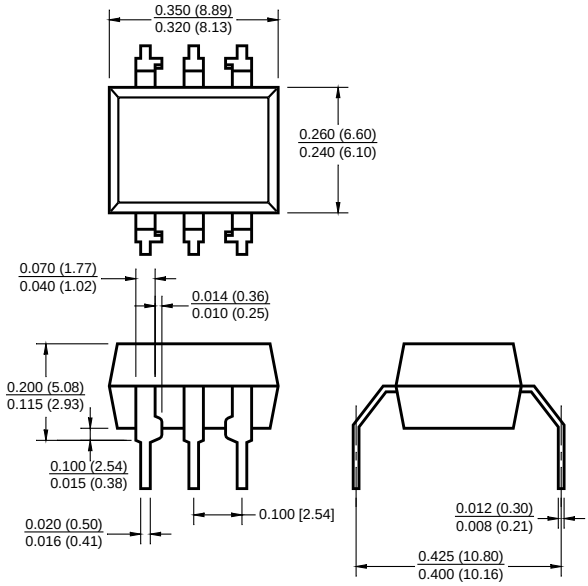
### Package Dimensions (Through Hole)



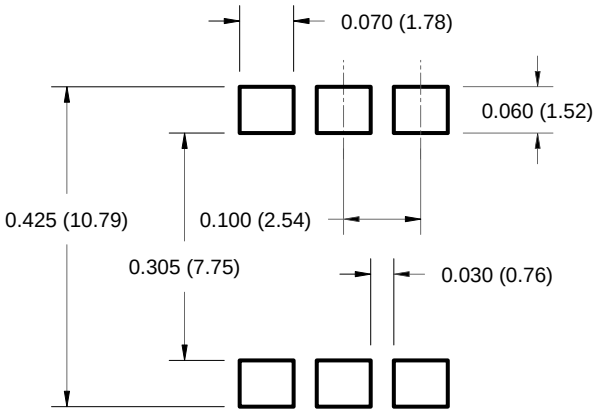

### Package Dimensions (Surface Mount)




### Package Dimensions (0.4" Lead Spacing)




### Recommended Pad Layout for Surface MountLeadform

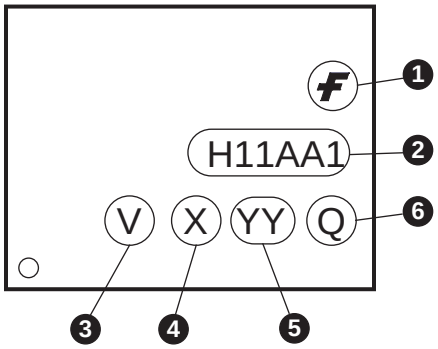



**Note:**
All dimensions are in inches (millimeters).

## Ordering Information

| Option/Order Entry Identifier | Description |
|---|---|
| S | Surface Mount Lead Bend |
| SR2 | Surface Mount; Tape and Reel |
| T | 0.4" Lead Spacing |
| V | VDE 0884 |
| TV | VDE 0884, 0.4" Lead Spacing |
| SV | VDE 0884, Surface Mount |
| SR2V | VDE 0884, Surface Mount, Tape & Reel |

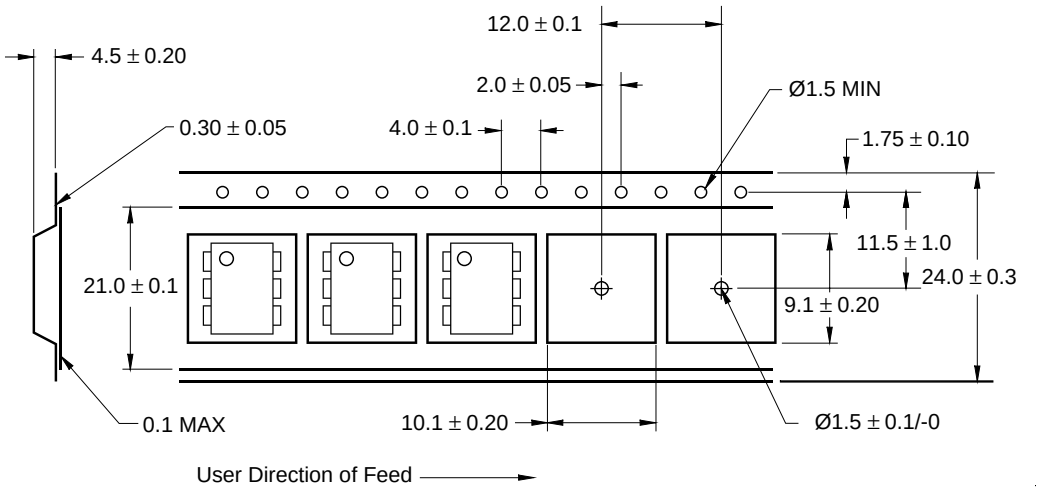
## Marking Information



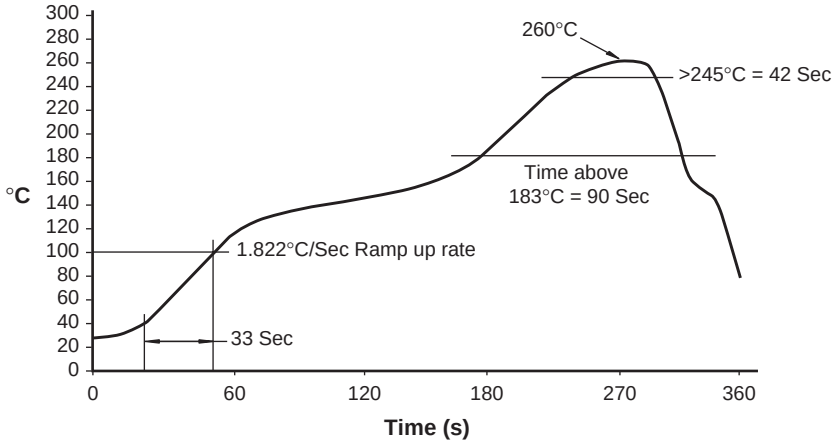

| Definitions | |
|---|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., '3' |
| 5 | Two digit work week ranging from '01' to '53' |
| 6 | Assembly package code |

*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 Specifications




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



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