

## H11AA1M, H11AA2M, H11AA3M, H11AA4M 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')

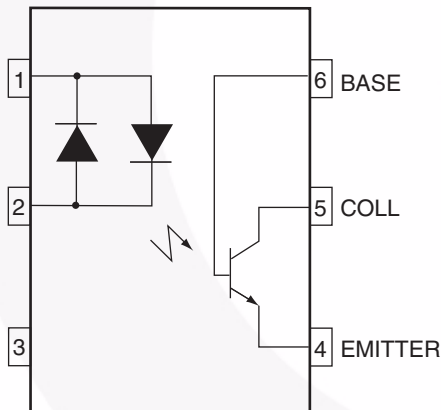
### Applications

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

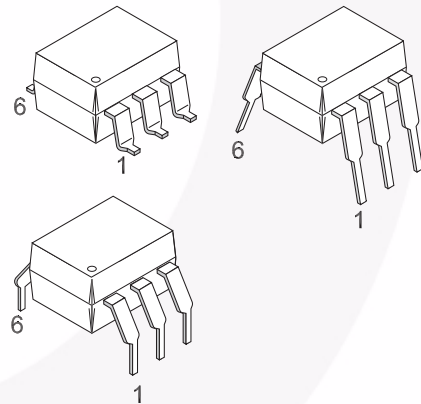
### Description

The H11AAXM series consists of two gallium-arsenide infrared emitting diodes connected in inverse parallel driving a single silicon phototransistor output.

### Schematic



### Package Outlines



**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  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	Device	Value	Units
<b>TOTAL DEVICE</b>				
$T_{STG}$	Storage Temperature	All	-40 to +150	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature	All	-40 to +100	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature	All	260 for 10 sec	$^\circ\text{C}$
$P_D$	Total Device Power Dissipation Derate Linearly From $25^\circ\text{C}$	All	250	mW
			2.94	mW/ $^\circ\text{C}$
<b>EMITTER</b>				
$I_F$	Continuous Forward Current	All	60	mA
$I_F(pk)$	Forward Current – Peak (1 $\mu\text{s}$ pulse, 300 pps)	All	$\pm 1.0$	A
$P_D$	LED Power Dissipation Derate Linearly From $25^\circ\text{C}$	All	120	mW
			1.41	mW/ $^\circ\text{C}$
<b>DETECTOR</b>				
$I_C$	Continuous Collector Current	All	50	mA
$P_D$	Detector Power Dissipation Derate linearity from $25^\circ\text{C}$	All	150	mW
			1.76	mW/ $^\circ\text{C}$

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified.)

**Individual Component Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>							
$V_F$	Input Forward Voltage	$I_F = \pm 10\text{mA}$	All		1.17	1.5	V
$C_J$	Capacitance	$V_F = 0\text{V}, f = 1.0\text{MHz}$	All		80		pF
<b>DETECTOR</b>							
$BV_{CEO}$	Breakdown Voltage Collector to Emitter	$I_C = 1.0\text{mA}, I_F = 0$	All	30	100		V
$BV_{CBO}$	Collector to Base	$I_C = 100\mu\text{A}, I_F = 0$	All	70	120		V
$BV_{EBO}$	Emitter to Base	$I_E = 100\mu\text{A}, I_F = 0$	All	5	10		V
$BV_{ECO}$	Emitter to Collector	$I_E = 100\mu\text{A}, I_F = 0$	All	7	10		V
$I_{CEO}$	Leakage Current Collector to Emitter	$V_{CE} = 10\text{V}, I_F = 0$	H11AA1M H11AA3M H11AA4M		1	50	nA
			H11AA2M		1	200	
$C_{CE}$	Capacitance Collector to Emitter	$V_{CE} = 0, f = 1\text{MHz}$	All		10		pF
$C_{CB}$	Collector to Base	$V_{CB} = 0, f = 1\text{MHz}$	All		80		pF
$C_{EB}$	Emitter to Base	$V_{EB} = 0, f = 1\text{MHz}$	All		15		pF

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

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.*	Max.	Units
$CTR_{CE}$	Current Transfer Ratio, Collector to Emitter	$I_F = \pm 10\text{mA}, V_{CE} = 10\text{V}$	H11AA4M	100			%
			H11AA3M	50			
			H11AA1M	20			
			H11AA2M	10			
	Current Transfer Ratio, Symmetry	$I_F = \pm 10\text{mA}, V_{CE} = 10\text{V}$ (Figure 11)	All	.33		3.0	
$V_{CE(SAT)}$	Saturation Voltage, Collector to Emitter	$I_F = \pm 10\text{mA}, I_{CE} = 0.5\text{mA}$	All			.40	V

**Isolation Characteristics**

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

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

## Safety and Insulation Ratings

As per IEC 60747-5-2, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1				
	For Rated Main Voltage < 150Vrms		I-IV		
	For Rated Main voltage < 300Vrms		I-IV		
	Climatic Classification		55/100/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index	175			
V <sub>PR</sub>	Input to Output Test Voltage, Method b, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 sec, Partial Discharge < 5pC	1594			V <sub>peak</sub>
	Input to Output Test Voltage, Method a, V <sub>IORM</sub> × 1.5 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 60 sec, Partial Discharge < 5pC	1275			V <sub>peak</sub>
V <sub>IORM</sub>	Max. Working Insulation Voltage	850			V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over Voltage	6000			V <sub>peak</sub>
	External Creepage	7			mm
	External Clearance	7			mm
	Insulation Thickness	0.5			mm
RIO	Insulation Resistance at T <sub>s</sub> , V <sub>IO</sub> = 500V	10 <sup>9</sup>			Ω

## Typical Performance Characteristics

Fig. 1 Input Voltage vs. Input Current

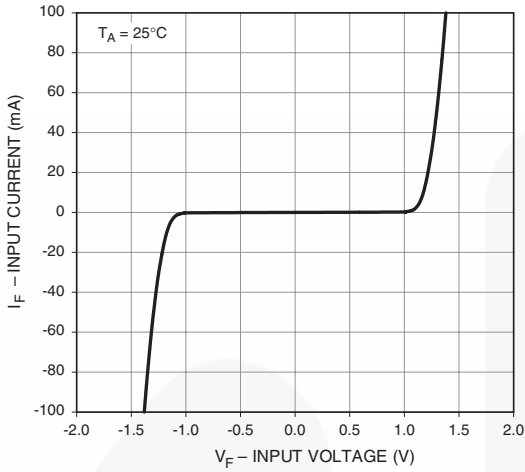


Fig. 2 Normalized CTR vs. Forward Current

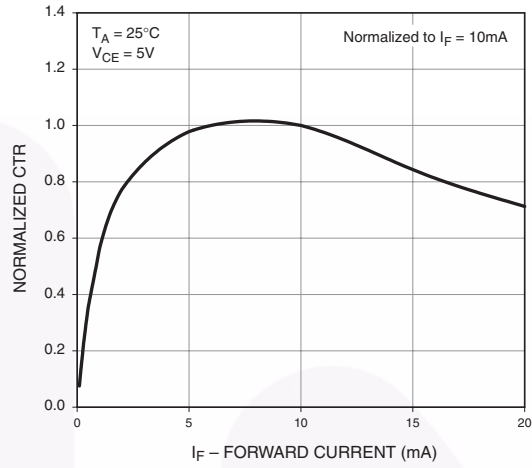


Fig. 3 Normalized CTR vs. Ambient Temperature

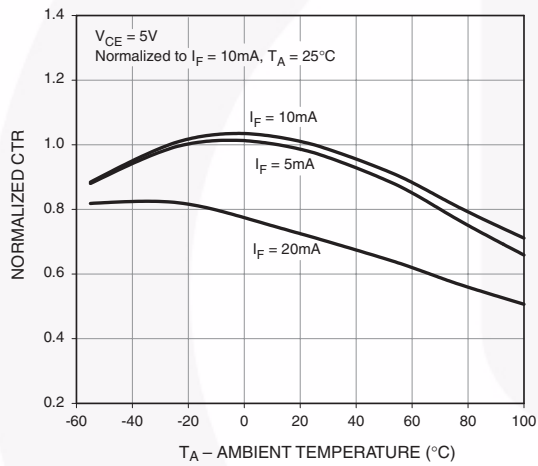


Fig. 4 CTR vs. RBE (Unsaturated)

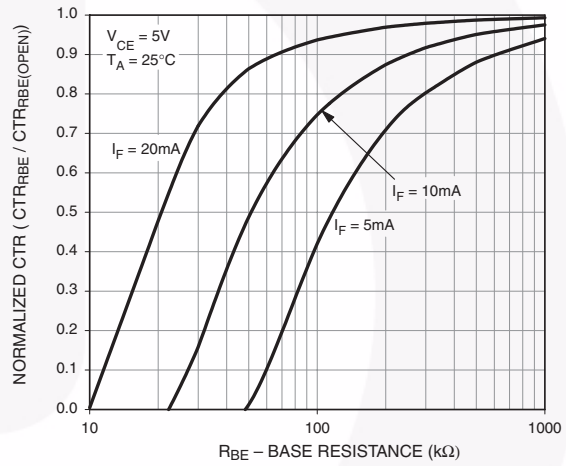


Fig. 5 CTR vs. RBE (Saturated)

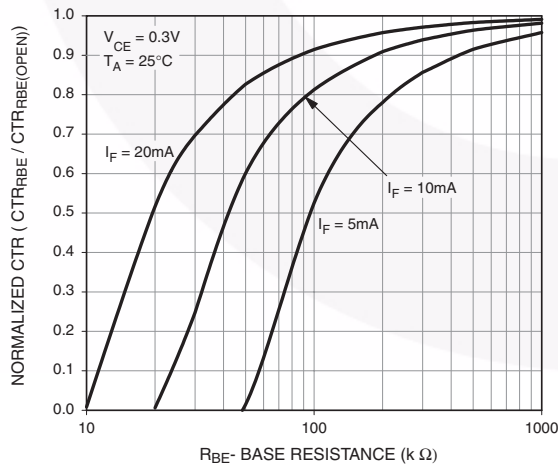
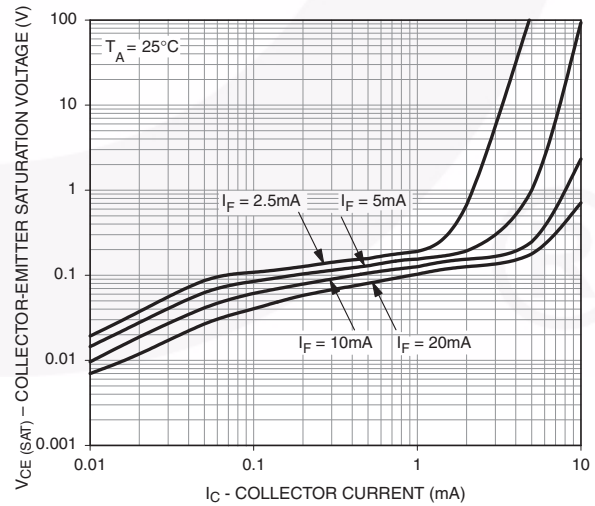


Fig. 6 Collector-Emitter Saturation Voltage vs. Collector Current



Typical Performance Characteristics (Continued)

Fig. 7 Switching Speed vs. Load Resistor

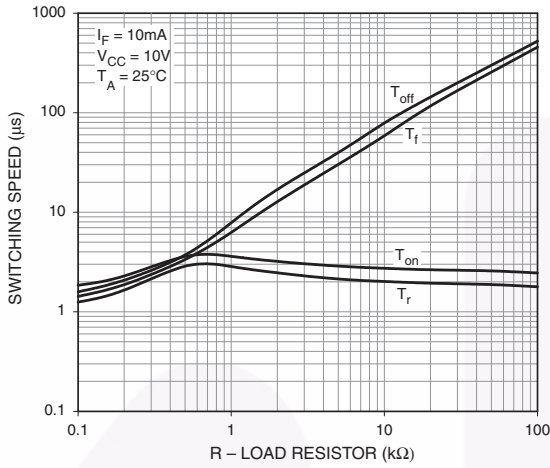


Fig. 8 Normalized  $t_{on}$  vs.  $R_{BE}$

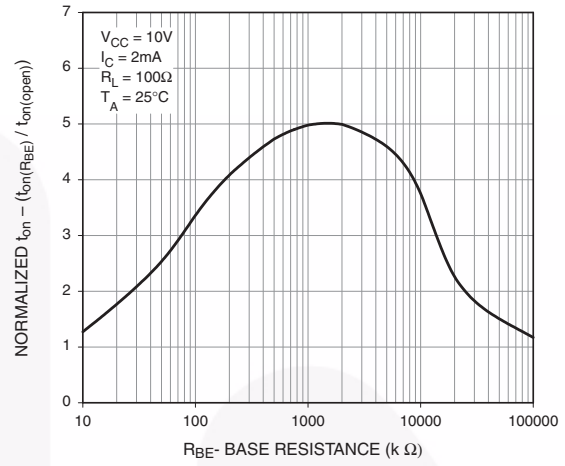


Fig. 9 Normalized  $t_{off}$  vs.  $R_{BE}$

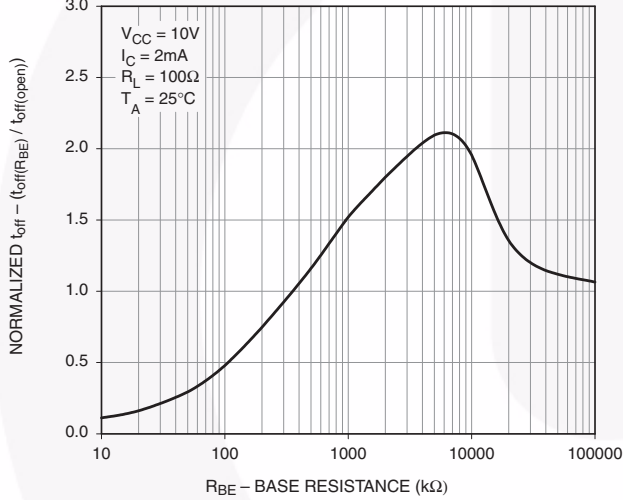


Fig. 10 Dark Current vs. Ambient Temperature

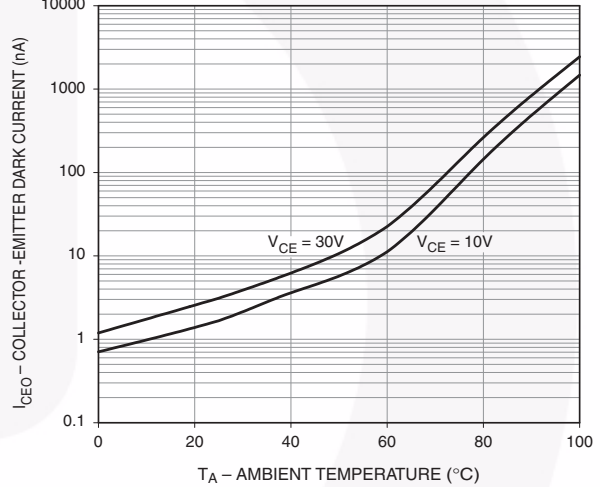
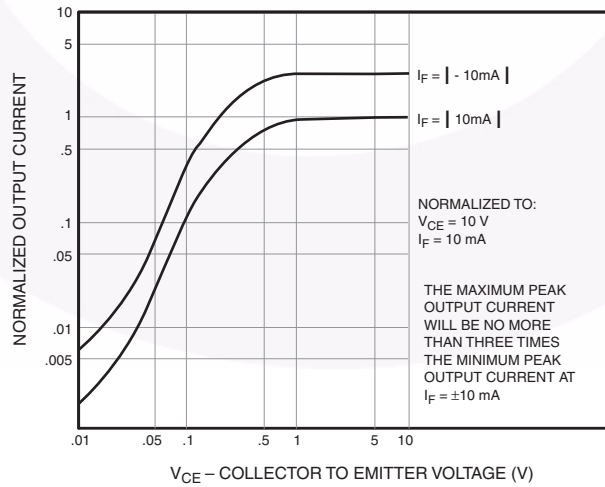
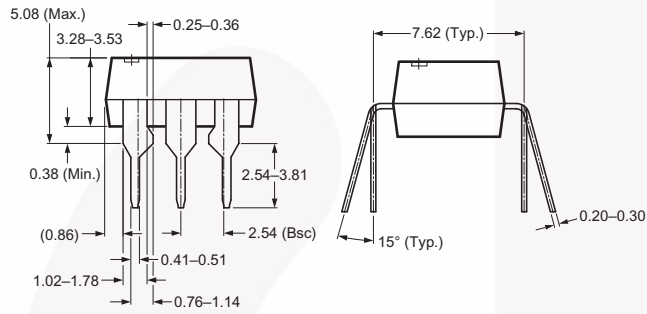


Fig. 11 Output Symmetry Characteristics

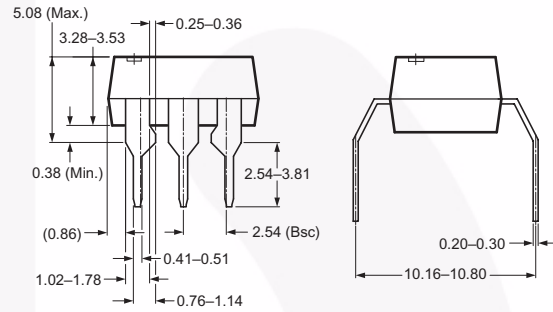
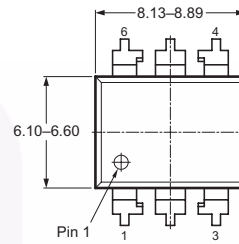


## Package Dimensions

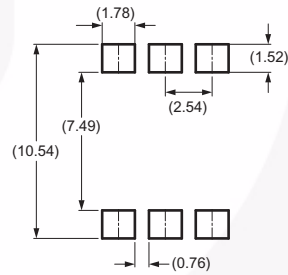
### Through Hole



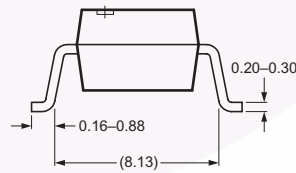
### 0.4" Lead Spacing



### Surface Mount



Recommended Pad Layout

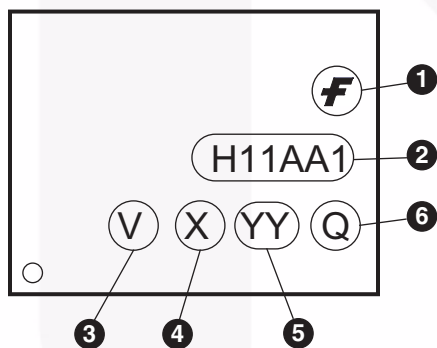


**Note:**  
All dimensions in mm.

## Ordering Information

Option	Order Entry Identifier (Example)	Description
No option	H11AA1M	Standard Through Hole Device
S	H11AA1SM	Surface Mount Lead Bend
SR2	H11AA1SR2M	Surface Mount; Tape and Reel
T	H11AA1TM	0.4" Lead Spacing
V	H11AA1VM	VDE 0884
TV	H11AA1TVM	VDE 0884, 0.4" Lead Spacing
SV	H11AA1SVM	VDE 0884, Surface Mount
SR2V	H11AA1SR2VM	VDE 0884, Surface Mount, Tape and Reel

## Marking Information

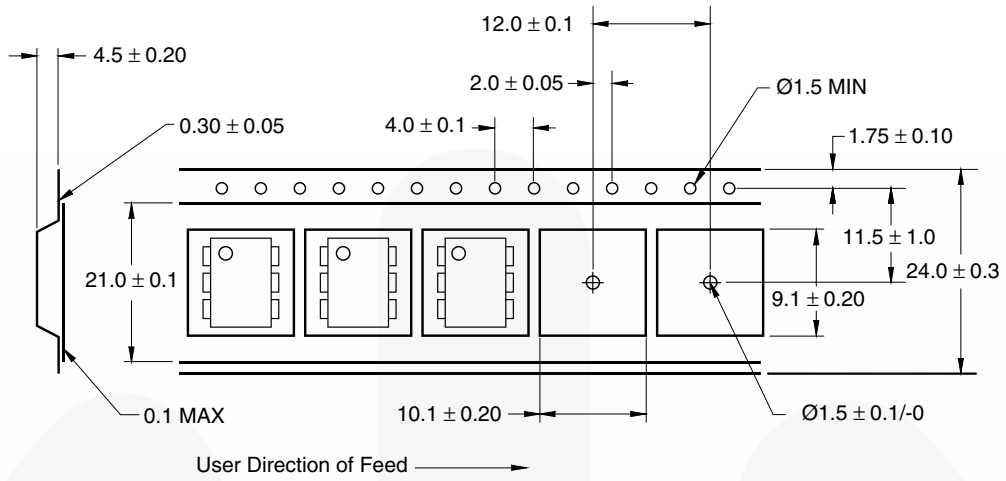


Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

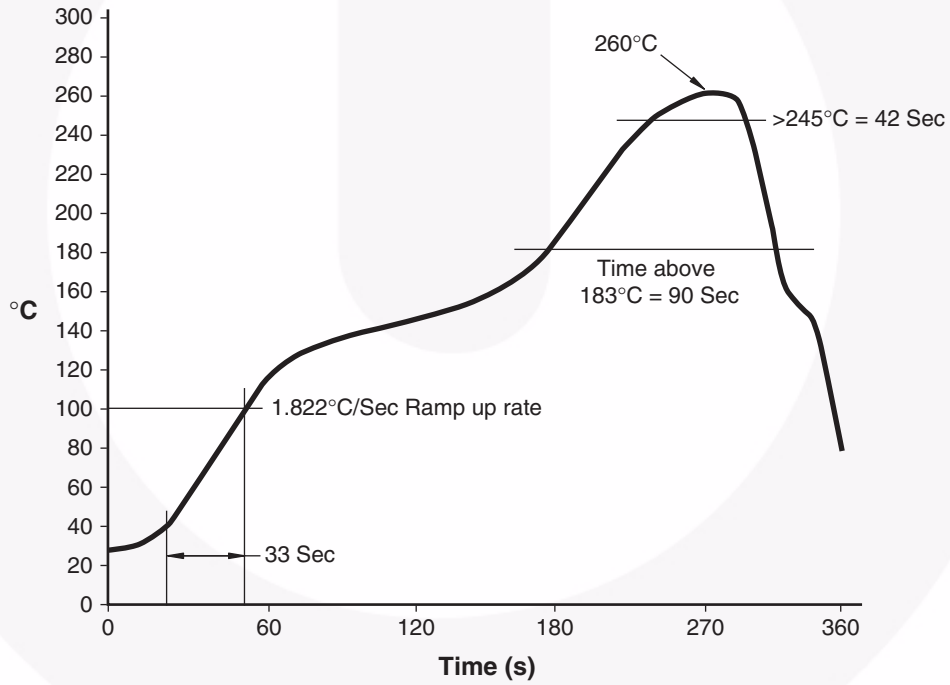
\*Note – Parts that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in portrait format.



### Carrier Tape Specification



### Reflow Profile





**TRADEMARKS**

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- |  |   |  |   |
|--|---|--|---|
| Auto-SPM™  | F-PFS™  | PowerTrench®   | The Power Franchise®  |
| Build it Now™  | FRFET®  | PowerXS™   | the <b>power</b> franchise  |
| CorePLUS™  | Global Power Resource SM  | Programmable Active Droop™   | TinyBoost™  |
| CorePOWER™   | Green FPS™  | QFET®  | TinyBuck™   |
| CROSSVOLT™   | Green FPS™ e-Series™  | QS™  | TinyLogic®  |
| CTL™   | Gmax™   | Quiet Series™  | TINYOPTO™   |
| Current Transfer Logic™  | GTO™  | RapidConfigure™  | TinyPower™  |
| EcoSPARK®  | IntelliMAX™   |  ™                | TinyPWM™  |
| EfficientMax™  | ISOPLANAR™  | Saving our world, 1mW/W/kW at a time™  | TinyWire™   |
| EZSWITCH™*   | MegaBuck™   | SmartMax™  | TriFault Detect™  |
|  ™* | MICROCOUPLER™   | SMART START™   | TRUECURRENT™*   |
|  ®  | MicroFET™   | SPM®   | μSerDes™  |
| Fairchild®   | MicroPak™   | STEALTH™   |  SerDes® |
| Fairchild Semiconductor®   | MillerDrive™  | SuperFET™  | UHC®  |
| FACT Quiet Series™   | MotionMax™  | SuperSOT™-3  | Ultra FRFET™  |
| FACT®  | Motion-SPM™   | SuperSOT™-6  | UniFET™   |
| FAST®  | OPTOLOGIC®  | SuperSOT™-8  | VCX™  |
| FastvCore™   | OPTOPLANAR®   | SupreMOS™  | VisualMax™  |
| FETBench™  |  ® | SyncFET™   | XS™   |
| FlashWriter®*  | PDP SPM™  | Sync-Lock™   |   |
| FPS™   | Power-SPM™  |  SYSTEM GENERAL®* |   |

\* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

**DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**ANTI-COUNTERFEITING POLICY**

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I40