FAIRCHILD SEMICONDUCTOR®

April 2009

# H11F1M, H11F2M, H11F3M
# Photo FET Optocouplers

## Features

As a remote variable resistor:

- ≤ 100Ω to ≥ 300MΩ
- ≤ 15pF shunt capacitance
- ≥ 100GΩ I/O isolation resistance

As an analog switch:

- Extremely low offset voltage
- 60 $V_{pk-pk}$ signal capability
- No charge injection or latch-up
- $t_{on}$, $t_{off}$ ≤ 15µS
- UL recognized (File #E90700)

## Applications

As a remote variable resistor:

- Isolated variable attenuator
- Automatic gain control
- Active filter fine tuning/band switching

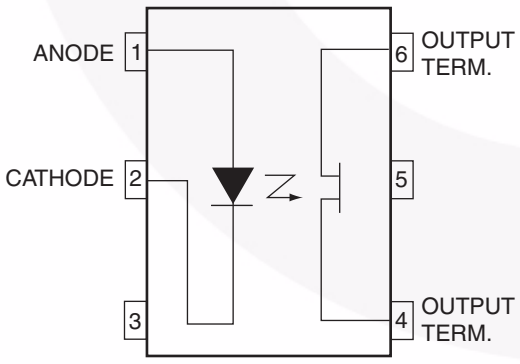
As an analog switch:

- Isolated sample and hold circuit
- Multiplexed, optically isolated A/D conversion

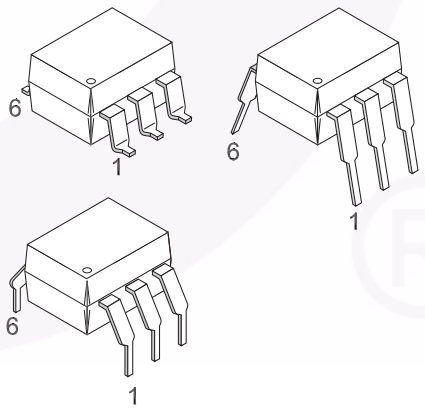
## General Description

The H11FXM series consists of a Gallium-Aluminum-Arsenide IRED emitting diode coupled to a symmetrical bilateral silicon photo-detector. The detector is electrically isolated from the input and performs like an ideal isolated FET designed for distortion-free control of low level AC and DC analog signals. The H11FXM series devices are mounted in dual in-line packages.

## Schematic




## Package Outlines



## 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 | 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 |
| **EMITTER** | | | | |
| $I_F$ | Continuous Forward Current | All | 60 | mA |
| $V_R$ | Reverse Voltage | All | 5 | V |
| $I_{F(pk)}$ | Forward Current – Peak (10µs pulse, 1% duty cycle) | All | 1 | A |
| $P_D$ | LED Power Dissipation 25°C Ambient | All | 100 | mW |
| | Derate Linearly from 25°C | | 1.33 | mW/°C |
| **DETECTOR** | | | | |
| $P_D$ | Detector Power Dissipation @ 25°C | All | 300 | mW |
| | Derate linearly from 25°C | | 4.0 | mW/°C |
| $BV_{4-6}$ | Breakdown Voltage (either polarity) | H11F1M, H11F2M | ±30 | V |
| | | H11F3M | ±15 | V |
| $I_{4-6}$ | Continuous Detector Current (either polarity) | All | ±100 | mA |

## 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 | $I_F$ = 16mA | All | | 1.3 | 1.75 | V |
| $I_R$ | Reverse Leakage Current | $V_R$ = 5V | All | | | 10 | µA |
| $C_J$ | Capacitance | V = 0 V, f = 1.0MHz | All | | 50 | | pF |
| **OUTPUT DETECTOR** | | | | | | | |
| $BV_{4-6}$ | Breakdown Voltage Either Polarity | $I_{4-6}$ = 10µA, $I_F$ = 0 | H11F1M, H11F2M | 30 | | | V |
| | | | H11F3M | 15 | | | |
| $I_{4-6}$ | Off-State Dark Current | $V_{4-6}$ = 15 V, $I_F$ = 0 | All | | | 50 | nA |
| | | $V_{4-6}$ = 15 V, $I_F$ = 0, $T_A$ = 100°C | All | | | 50 | µA |
| $R_{4-6}$ | Off-State Resistance | $V_{4-6}$ = 15 V, $I_F$ = 0 | All | 300 | | | MΩ |
| $C_{4-6}$ | Capacitance | $V_{4-6}$ = 15 V, $I_F$ = 0, f = 1MHz | All | | | 15 | pF |

### Transfer Characteristics

| Symbol | Characteristics | Test Conditions | Device | Min | Typ* | Max | Units |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| $R_{4-6}$ | On-State Resistance | $I_F$ = 16mA, $I_{4-6}$ = 100µA | H11F1M | | | 200 | Ω |
| | | | H11F2M | | | 330 | |
| | | | H11F3M | | | 470 | |
| $R_{6-4}$ | On-State Resistance | $I_F$ = 16mA, $I_{6-4}$ = 100µA | H11F1M | | | 200 | Ω |
| | | | H11F2M | | | 330 | |
| | | | H11F3M | | | 470 | |
| | Resistance, non-linearity and assymetry | $I_F$ = 16mA, $I_{4-6}$ = 25µA RMS, f = 1kHz | All | | 2 | | % |
| **AC CHARACTERISTICS** | | | | | | | |
| $t_{on}$ | Turn-On Time | $R_L$ = 50Ω, $I_F$ = 16mA, $V_{4-6}$ = 5V | All | | | 25 | µs |
| $t_{off}$ | Turn-Off Time | $R_L$ = 50Ω, $I_F$ = 16mA, $V_{4-6}$ = 5V | All | | | 25 | µs |

### Isolation Characteristics

| Symbol | Characteristic | Test Conditions | Device | Min. | Typ.* | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{ISO}$ | Isolation Voltage | f = 60Hz, t = 1 sec. | All | 7500 | | | $V_{AC}$PEAK |
| $R_{ISO}$ | Isolation Resistance | $V_{I-O}$ = 500 VDC | All | $10^{11}$ | | | Ω |
| $C_{ISO}$ | Isolation Capacitance | f = 1MHz | All | | 0.2 | | pF |

*All Typical values at $T_A$ = 25°C

## Typical Performance Curves

**Figure 1. Resistance vs. Input Current**

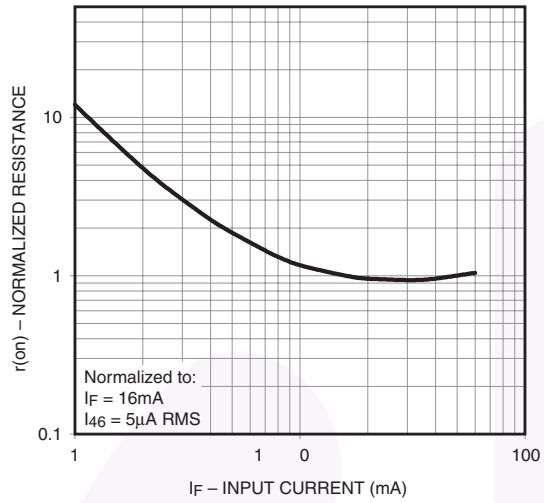



**Figure 2. Output Characteristics**

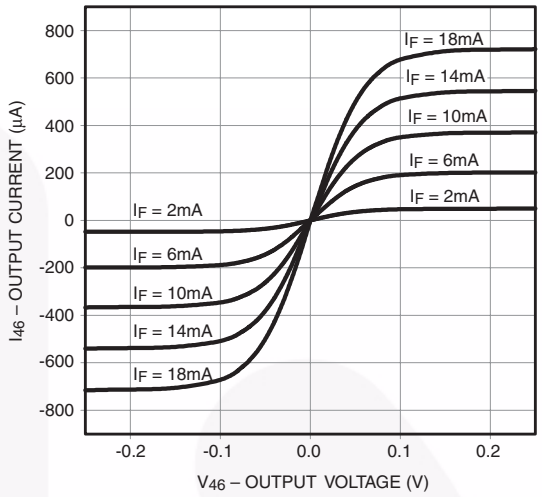



**Figure 3. LED Forward Voltage vs. Forward Current**

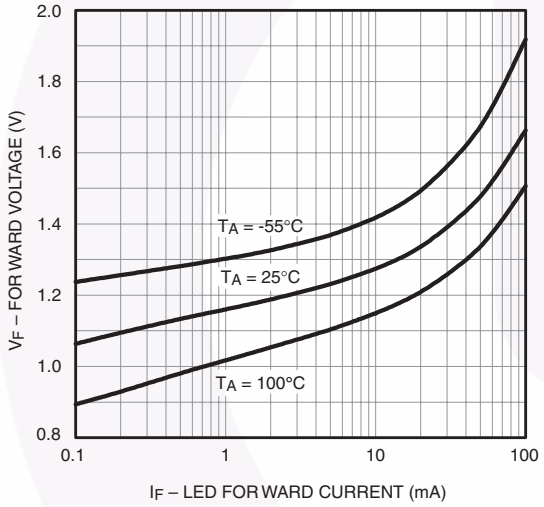



**Figure 4. Off-state Current vs. Ambient Temperature**

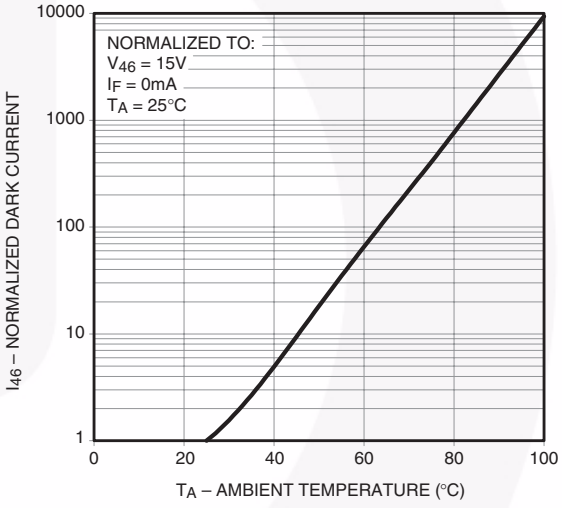
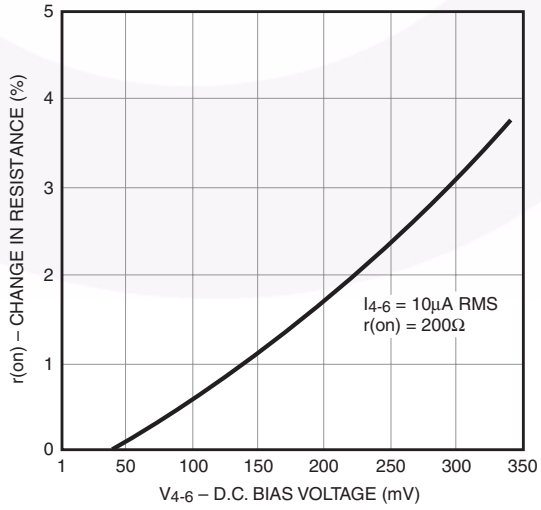


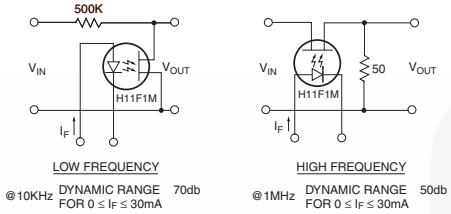

**Figure 5. Resistive Non-Linearity vs. D.C. Bias**



# Typical Applications

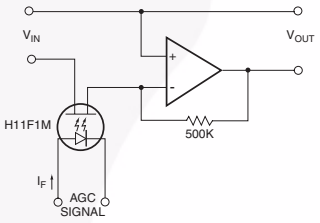
## As a Variable Resistor

### ISOLATED VARIABLE ATTENUATORS



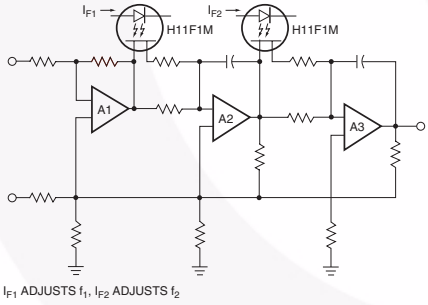

Distortion free attenuation of low level A.C. signals is accomplished by varying the IRED current, $I_F$ Note the wide dynamic range and absence of coupling capacitors; D.C. level shifting or parasitic feedback to the controlling function.

### AUTOMATIC GAIN CONTROL




This simple circuit provides over 70db of stable gain control for an AGC signal range of from 0 to 30mA. This basic circuit can be used to provide programmable fade and attack for electronic music.

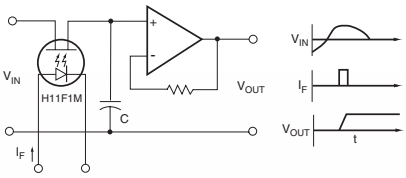
### ACTIVE FILTER FINE TUNING/BAND SWITCHING




The linearity of resistance and the low offset voltage of the H11FXM allows the remote tuning or band-switching of active filters without switching glitches or distortion. This schematic illustrates the concept, with current to the H11F1M IRED's controlling the filter's transfer characteristic.

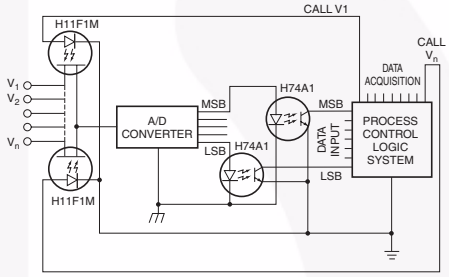
## As an Analog Signal Switch

### ISOLATED SAMPLE AND HOLD CIRCUIT



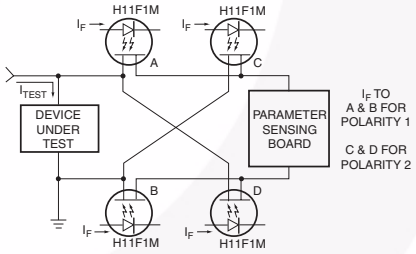

Accuracy and range are improved over conventional FET switches because the H11FXM has no charge injection from the control signal. The H11FXM also provides switching of either polarity input signal up to 30V magnitude.

### MULTIPLEXED, OPTICALLY-ISOLATED A/D CONVERSION




The optical isolation, linearity and low offset voltage of the H11FXM allows the remote multiplexing of low level analog signals from such transducers as thermocouplers, Hall effect devices, strain gauges, etc. to a single A/D converter.

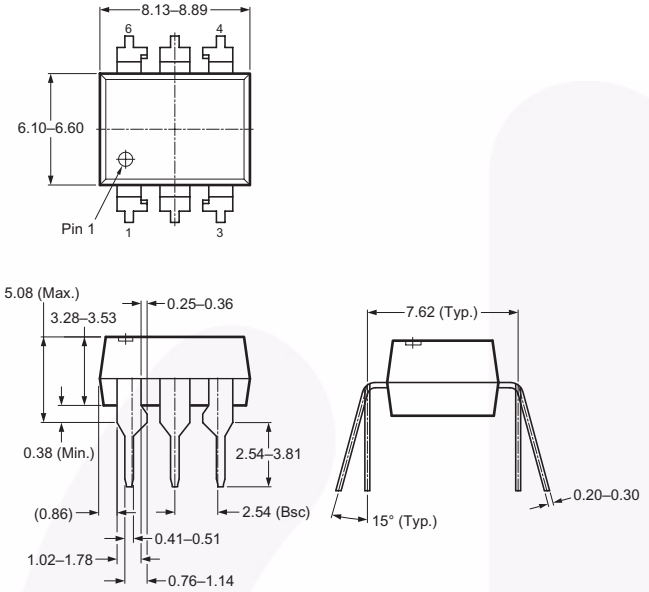
### TEST EQUIPMENT - KELVIN CONTACT POLARITY



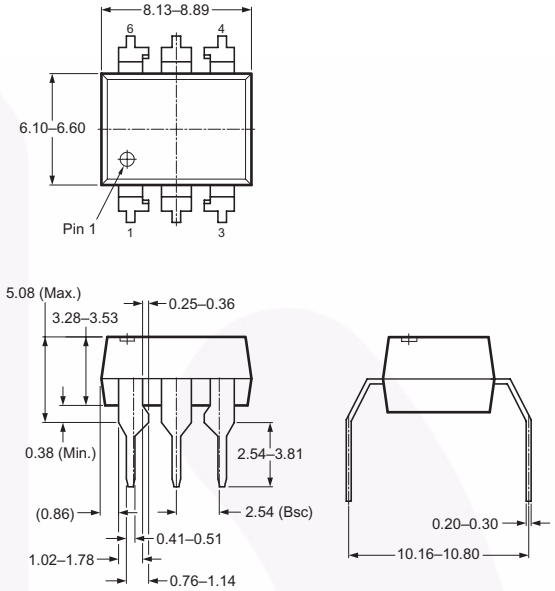

In many test equipment designs the auto polarity function uses reed relay contacts to switch the Kelvin Contact polarity. These reeds are normally one of the highest maintenance cost items due to sticking contacts and mechanical problems. The totally solid-State H11FXM eliminates these troubles while providing faster switching.

## Package Dimensions

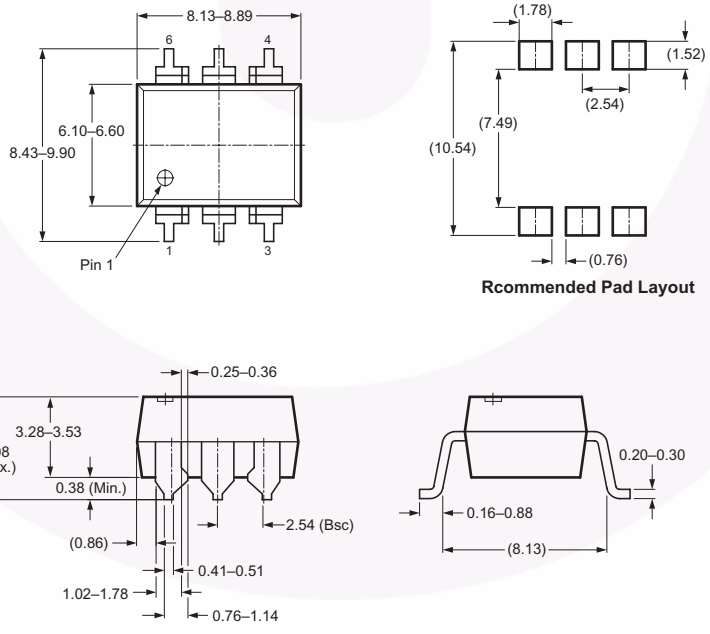
### Through Hole




### 0.4" Lead Spacing




### Surface Mount

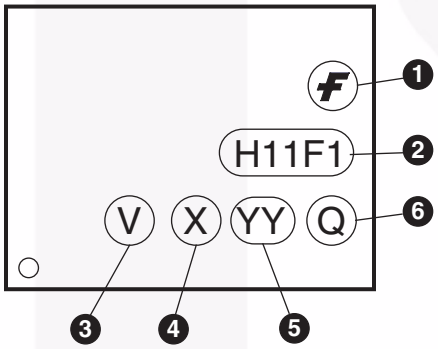



**Note:**
All dimensions in mm.

## Ordering Information

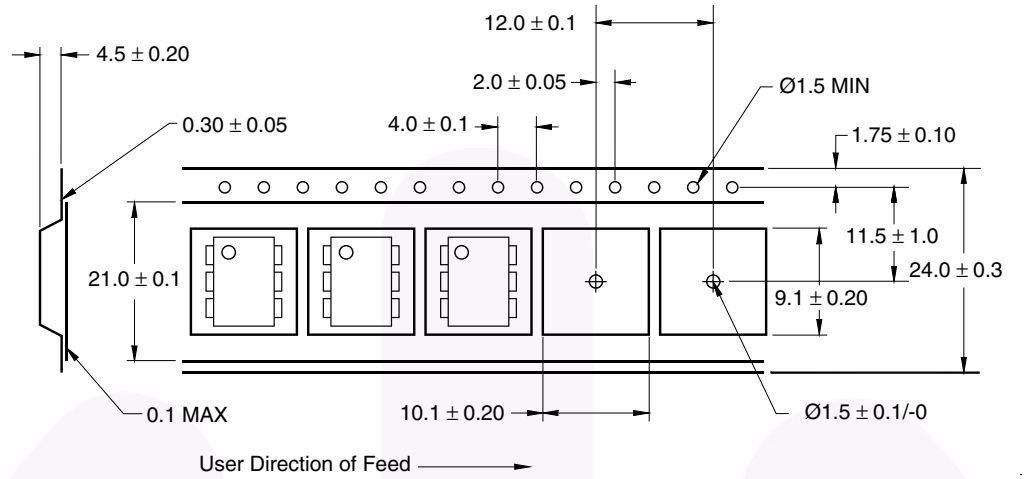
| Option | Order Entry Identifier (Example) | Description |
|---|---|---|
| No option | H11F1M | Standard Through Hole Device |
| S | H11F1SM | Surface Mount Lead Bend |
| SR2 | H11F1SR2M | Surface Mount; Tape and Reel |
| V | H11F1VM | IEC60747-5-2 approval |
| TV | H11F1TVM | IEC60747-5-2 approval, 0.4" Lead Spacing |
| SV | H11F1SVM | IEC60747-5-2 approval, Surface Mount |
| SR2V | H11F1SR2VM | IEC60747-5-2 approval, Surface Mount, Tape and Reel |

## Marking Information

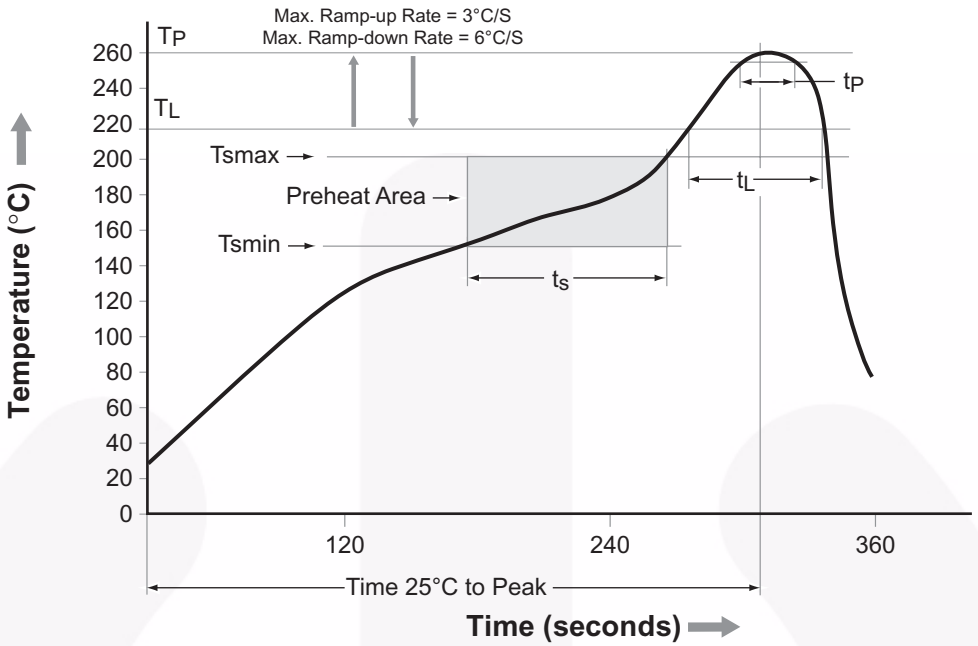



| Definitions | |
|---|---|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | One digit year code, e.g., ‘7’ |
| 5 | Two digit work week ranging from ‘01’ to ‘53’ |
| 6 | Assembly package code |

## Carrier Tape Specification



## Reflow Profile




| Profile Feature | Pb-Free Assembly Profile |
|---|---|
| Temperature Min. (Tsmin) | 150°C |
| Temperature Max. (Tsmax) | 200°C |
| Time ($t_S$) from (Tsmin to Tsmax) | 60–120 seconds |
| Ramp-up Rate ($t_L$ to $t_P$) | 3°C/second max. |
| Liquidous Temperature ($T_L$) | 217°C |
| Time ($t_L$) Maintained Above ($T_L$) | 60–150 seconds |
| Peak Body Package Temperature | 260°C +0°C / –5°C |
| Time ($t_P$) within 5°C of 260°C | 30 seconds |
| Ramp-down Rate ($T_P$ to $T_L$) | 6°C/second max. |
| Time 25°C to Peak Temperature | 8 minutes max. |

FAIRCHILD SEMICONDUCTOR®

## 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™
Build it Now™
CorePLUS™
CorePOWER™
*CROSSVOLT*™
CTL™
Current Transfer Logic™
EcoSPARK®
EfficentMax™
EZSWITCH™*
E²™*
F®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FETBench™
FlashWriter®*
FPS™
F-PFS™
FRFET®
Global Power Resource℠
Green FPS™
Green FPS™ e-Series™
G*max*™
GTO™
IntelliMAX™
ISOPLANAR™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MillerDrive™
MotionMax™
Motion-SPM™
OPTOLOGIC®
OPTOPLANAR®
®
PDP SPM™
Power-SPM™
PowerTrench®
PowerXS™
Programmable Active Droop™
QFET®
QS™
Quiet Series™
RapidConfigure™
™
Saving our world, 1mW/W/kW at a time™
SmartMax™
SMART START™
SPM®
STEALTH™
SuperFET™
SuperSOT™-3
SuperSOT™-6
SuperSOT™-8
SupreMOS™
SyncFET™
Sync-Lock™
SYSTEM GENERAL ®*
The Power Franchise®
the power franchise
TinyBoost™
TinyBuck™
TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TriFault Detect™
TRUECURRENT™*
µSerDes™
µSerDes
UHC®
Ultra FRFET™
UniFET™
VCX™
VisualMax™
XS™

* 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, 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