

ISL9R460PF2

4A, 600V Stealth™ Diode

General Description

The ISL9R460PF2 is a Stealth™ diode optimized for low loss performance in high frequency hard switched applications. The Stealth™ family exhibits low reverse recovery current (I_{RRM}) and exceptionally soft recovery under typical operating conditions.

This device is intended for use as a free wheeling or boost diode in power supplies and other power switching applications. The low I_{RRM} and short t_a phase reduce loss in switching transistors. The soft recovery minimizes ringing, expanding the range of conditions under which the diode may be operated without the use of additional snubber circuitry. Consider using the Stealth™ diode with an SMPS IGBT to provide the most efficient and highest power density design at lower cost.

Formerly developmental type TA49408.

Features

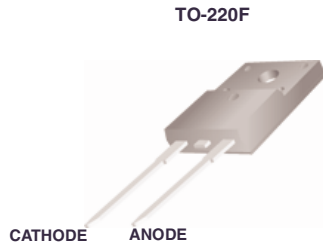
- Soft Recovery $t_b / t_a > 3$
- Fast Recovery $t_{rr} < 20ns$
- Operating Temperature 150°C
- Reverse Voltage 600V
- Avalanche Energy Rated

Applications

- Switch Mode Power Supplies
- Hard Switched PFC Boost Diode
- UPS Free Wheeling Diode
- Motor Drive FWD
- SMPS FWD
- Snubber Diode

Package

Symbol



Device Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Ratings | Units |
|----------------|---|------------|-------|
| V_{RRM} | Peak Repetitive Reverse Voltage | 600 | V |
| V_{RWM} | Working Peak Reverse Voltage | 600 | V |
| V_R | DC Blocking Voltage | 600 | V |
| $I_{F(AV)}$ | Average Rectified Forward Current ($T_C = 108^\circ\text{C}$) | 4 | A |
| I_{FRM} | Repetitive Peak Surge Current (20kHz Square Wave) | 8 | A |
| I_{FSM} | Nonrepetitive Peak Surge Current (Halfwave 1 Phase 60Hz) | 50 | A |
| P_D | Power Dissipation | 22 | W |
| E_{AVL} | Avalanche Energy (0.5A, 80mH) | 10 | mJ |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to 150 | °C |
| T_L | Maximum Temperature for Soldering | | |
| T_{PKG} | Leads at 0.063in (1.6mm) from Case for 10s | 300 | °C |
| | Package Body for 10s, See Techbrief TB334 | 260 | °C |

CAUTION: Stresses above those listed in "Device Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Package Marking and Ordering Information

| Device Marking | Device | Package | Tape Width | Quantity |
|----------------|-------------|---------|------------|----------|
| R460PF2 | ISL9R460PF2 | TO-220F | N/A | 50 Units |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

Off State Characteristics

| Symbol | Parameter | Test Conditions | $T_C = 25^\circ\text{C}$ | | | | |
|--------|-------------------------------|---------------------|---------------------------|---|-----|---------------|--|
| | | | $T_C = 125^\circ\text{C}$ | | | | |
| I_R | Instantaneous Reverse Current | $V_R = 600\text{V}$ | - | - | 100 | μA | |
| | | | - | - | 1.0 | mA | |

On State Characteristics

| Symbol | Parameter | Test Conditions | $T_C = 25^\circ\text{C}$ | | | | |
|--------|-------------------------------|-------------------|---------------------------|-----|-----|---|--|
| | | | $T_C = 125^\circ\text{C}$ | | | | |
| V_F | Instantaneous Forward Voltage | $I_F = 4\text{A}$ | - | 2.0 | 2.4 | V | |
| | | | - | 1.6 | 2.0 | V | |

Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|----------------------|-------------------------------------|-----|-----|-----|-------------|
| C_J | Junction Capacitance | $V_R = 10\text{V}, I_F = 0\text{A}$ | - | 19 | - | pF |

Switching Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-----------|----------------------------------|--|-----|-----|-----|------------------------|
| t_{rr} | Reverse Recovery Time | $I_F = 1\text{A}, di_F/dt = 100\text{A}/\mu\text{s}, V_R = 30\text{V}$ | - | 17 | 20 | ns |
| | | $I_F = 4\text{A}, di_F/dt = 100\text{A}/\mu\text{s}, V_R = 30\text{V}$ | - | 19 | 22 | ns |
| t_{rr} | Reverse Recovery Time | $I_F = 4\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 25^\circ\text{C}$ | - | 17 | - | ns |
| I_{RRM} | Maximum Reverse Recovery Current | $I_F = 4\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 25^\circ\text{C}$ | - | 2.6 | - | A |
| Q_{RR} | Reverse Recovered Charge | $I_F = 4\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 25^\circ\text{C}$ | - | 22 | - | nC |
| t_{rr} | Reverse Recovery Time | $I_F = 4\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 77 | - | ns |
| S | Softness Factor (t_b/t_a) | $I_F = 4\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 4.2 | - | |
| I_{RRM} | Maximum Reverse Recovery Current | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 2.8 | - | A |
| Q_{RR} | Reverse Recovered Charge | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 100 | - | nC |
| t_{rr} | Reverse Recovery Time | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 54 | - | ns |
| S | Softness Factor (t_b/t_a) | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 3.5 | - | |
| I_{RRM} | Maximum Reverse Recovery Current | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 4.3 | - | A |
| Q_{RR} | Reverse Recovered Charge | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 110 | - | nC |
| di_M/dt | Maximum di/dt during t_b | $I_F = 4\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$ | - | 500 | - | $\text{A}/\mu\text{s}$ |

Thermal Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-----------------|--|-----------------|-----|-----|-----|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | | - | - | 5.7 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient | TO-220F | - | - | 70 | $^\circ\text{C}/\text{W}$ |

Typical Performance Curves $T_C = 25^\circ\text{C}$ unless otherwise noted

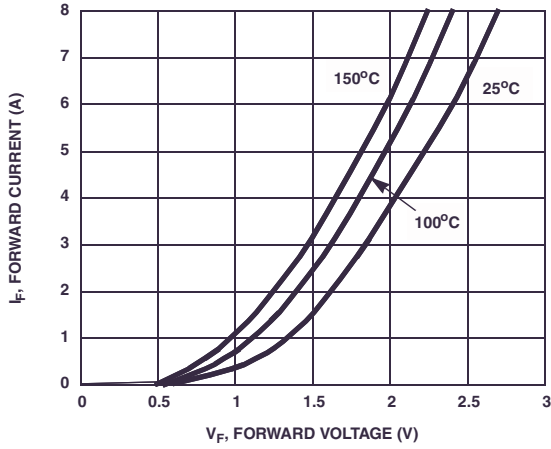


Figure 1. Forward Current vs Forward Voltage

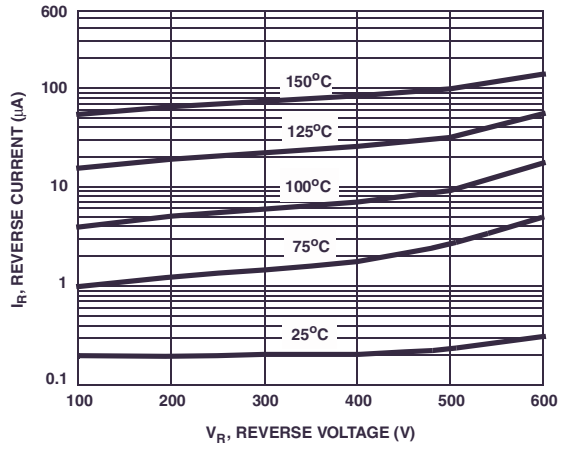


Figure 2. Reverse Current vs Reverse Voltage

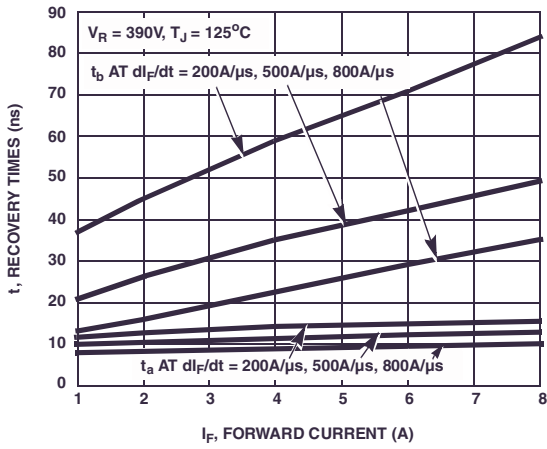


Figure 3. t_a and t_b Curves vs Forward Current

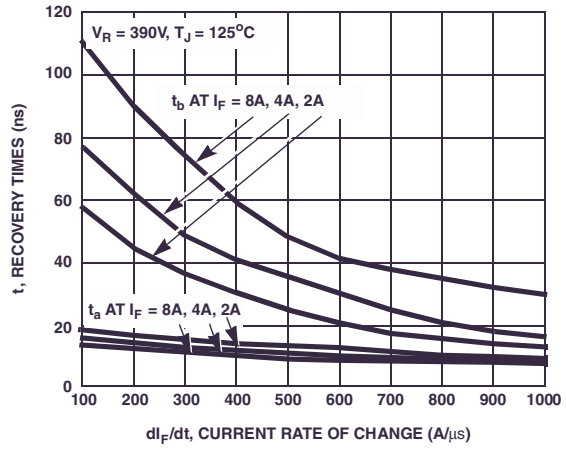


Figure 4. t_a and t_b Curves vs di_F/dt

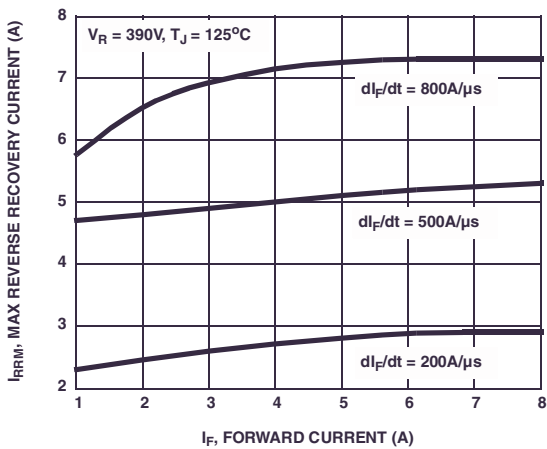


Figure 5. Maximum Reverse Recovery Current vs Forward Current

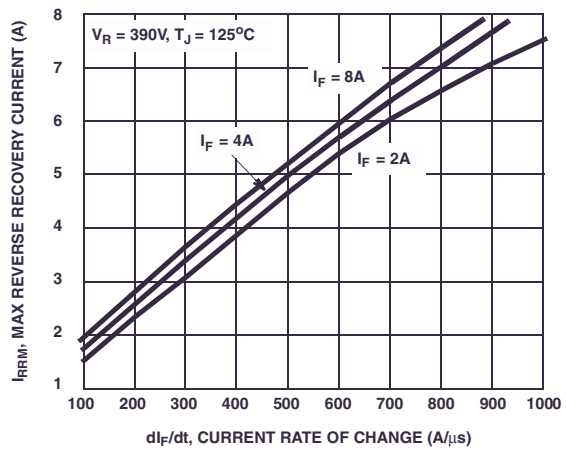


Figure 6. Maximum Reverse Recovery Current vs di_F/dt

Typical Performance Curves $T_C = 25^\circ\text{C}$ unless otherwise noted

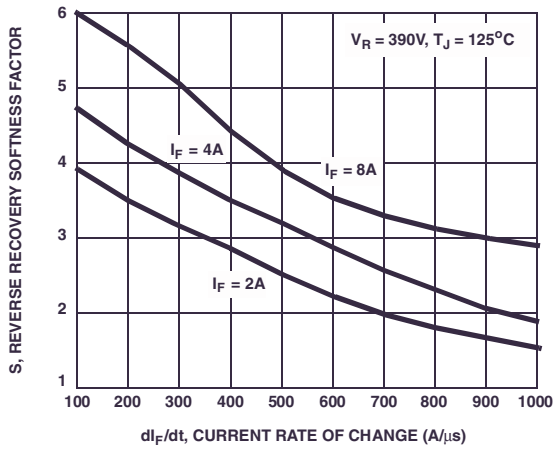


Figure 7. Reverse Recovery Softness Factor vs di_F/dt

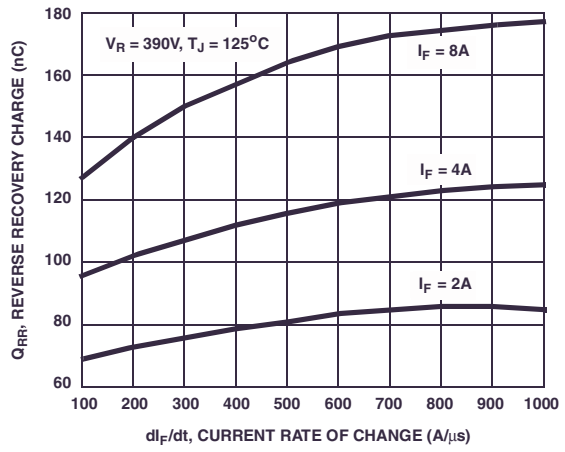


Figure 8. Reverse Recovery Charge vs di_F/dt

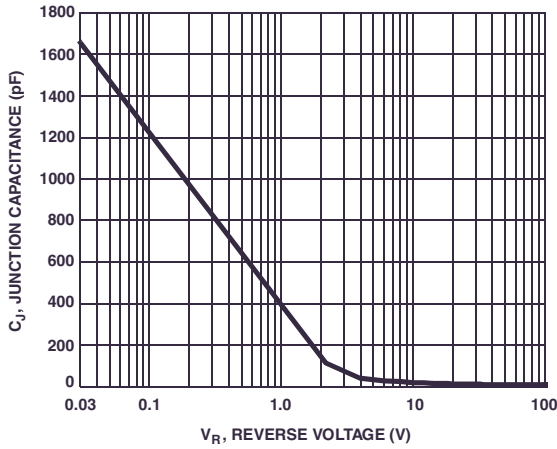


Figure 9. Junction Capacitance vs Reverse Voltage

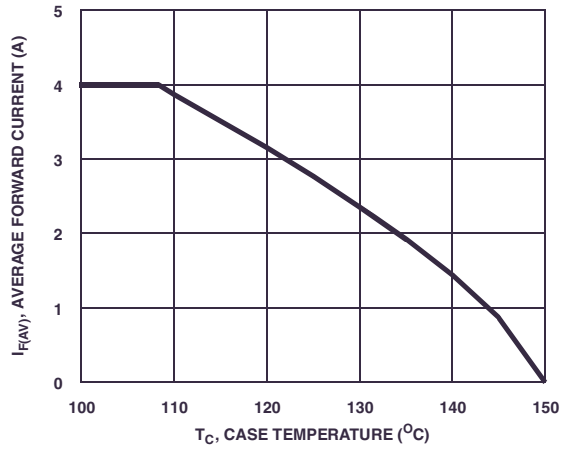


Figure 10. DC Current Derating Curve

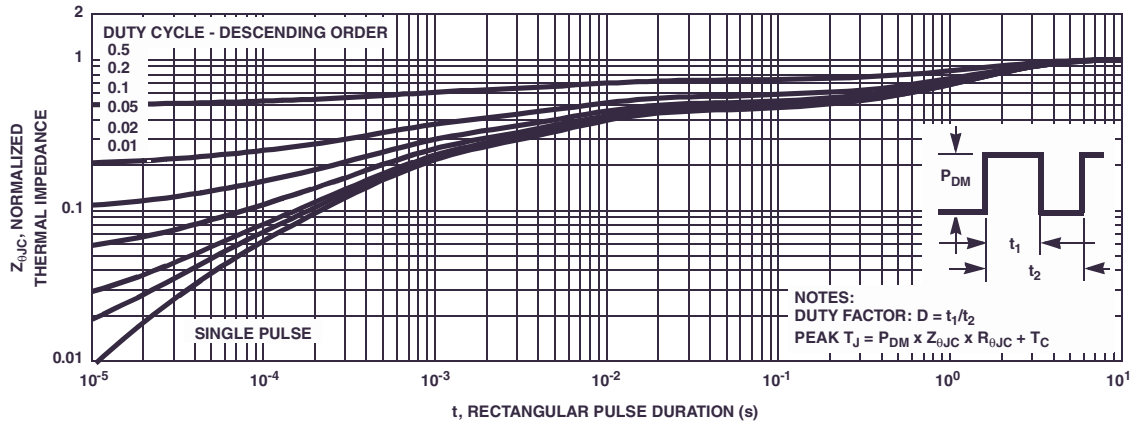


Figure 11. Normalized Maximum Transient Thermal Impedance

Test Circuit and Waveforms

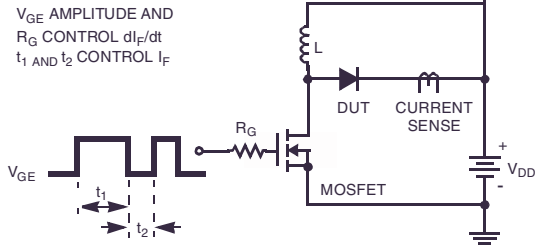


Figure 12. $I_{t_{rr}}$ Test Circuit

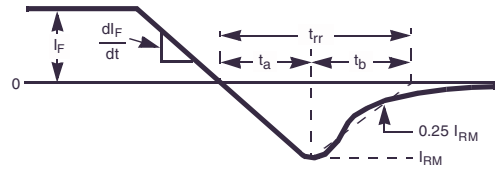


Figure 13. t_{rr} Waveforms and Definitions

$I = 0.5A$
 $L = 80mH$
 $R < 0.1\Omega$
 $V_{DD} = 200V$
 $E_{AVL} = 1/2LI^2 [V_{R(AVL)}/(V_{R(AVL)} - V_{DD})]$
 $Q_1 = IGBT (BV_{CES} > DUT V_{R(AVL)})$

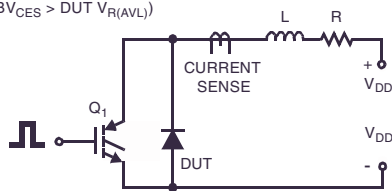


Figure 14. Avalanche Energy Test Circuit

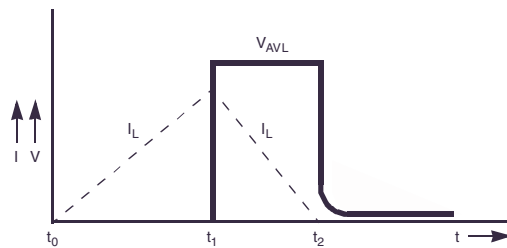


Figure 15. Avalanche Current and Voltage Waveforms

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

| | | | | |
|--------------------------------------|---------------------|--------------------|---------------------|-----------------|
| ACEx™ | FACT™ | ImpliedDisconnect™ | PACMAN™ | SPM™ |
| ActiveArray™ | FACT Quiet Series™ | ISOPLANAR™ | POP™ | Stealth™ |
| Bottomless™ | FAST® | LittleFET™ | Power247™ | SuperSOT™-3 |
| CoolFET™ | FASTr™ | MicroFET™ | PowerTrench® | SuperSOT™-6 |
| CROSSVOLT™ | FRFET™ | MicroPak™ | QFET® | SuperSOT™-8 |
| DOME™ | GlobalOptoisolator™ | MICROWIRE™ | QS™ | SyncFET™ |
| EcoSPARK™ | GTO™ | MSX™ | QT Optoelectronics™ | TinyLogic® |
| E ² CMOST™ | HiSeC™ | MSXPro™ | Quiet Series™ | TruTranslation™ |
| EnSigna™ | I ² C™ | OCX™ | RapidConfigure™ | UHC™ |
| Across the board. Around the world.™ | | OCXPro™ | RapidConnect™ | UltraFET® |
| The Power Franchise™ | | OPTOLOGIC® | SILENT SWITCHER® | VCX™ |
| Programmable Active Droop™ | | OPTOPLANAR™ | SMART START™ | |

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.

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, or (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 significant injury to the user.
2. A critical component is 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.

PRODUCT STATUS DEFINITIONS

Definition of Terms

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