

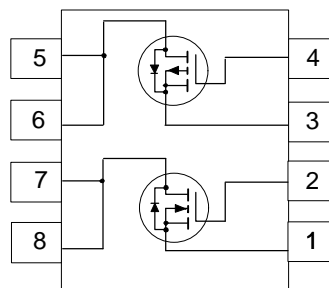
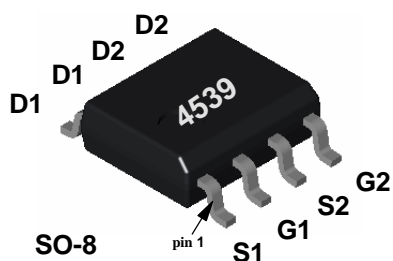
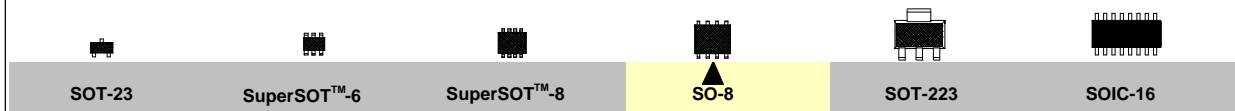
## Si4539DY Dual N & P-Channel Enhancement Mode Field Effect Transistor

### General Description

These dual N- and P-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance and provide superior switching performance. These devices are particularly suited for low voltage applications such as notebook computer power management and other battery powered circuits where fast switching, low in-line power loss, and resistance to transients are needed.

### Features

- N-Channel 7.0 A, 30 V,  $R_{DS(ON)}=0.028 \Omega @ V_{GS}=10 \text{ V}$   
 $R_{DS(ON)}=0.040 \Omega @ V_{GS}=4.5 \text{ V}$ .
- P-Channel -5.0 A, -30 V,  $R_{DS(ON)}=0.052 \Omega @ V_{GS}=-10 \text{ V}$   
 $R_{DS(ON)}=0.080 \Omega @ V_{GS}=-4.5 \text{ V}$ .
- High density cell design for extremely low  $R_{DS(ON)}$ .
- High power and current handling capability in a widely used surface mount package.
- Dual (N & P-Channel) MOSFET in surface mount package.



### Absolute Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	N-Channel	P-Channel	Units
$V_{DSS}$	Drain-Source Voltage	30	-30	V
$V_{GSS}$	Gate-Source Voltage	20	-20	V
$I_D$	Drain Current - Continuous (Note 1a)	7	-5	A
	- Pulsed	20	-20	
$P_D$	Power Dissipation for Dual Operation	2		W
	Power Dissipation for Single Operation (Note 1a)	1.6		
	(Note 1b)	1		
	(Note 1c)	0.9		
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 150		$^\circ\text{C}$

### THERMAL CHARACTERISTICS

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	78	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	40	$^\circ\text{C}/\text{W}$

Electrical Characteristics (T <sub>A</sub> = 25°C unless otherwise noted)							
Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>							
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	N-Ch	30			V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	P-Ch	-30			V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25 °C	N-Ch		30		mV/°C
		I <sub>D</sub> = -250 μA, Referenced to 25 °C	P-Ch		-25		
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 24 V, V <sub>GS</sub> = 0 V	N-Ch			1	μA
		V <sub>DS</sub> = -24 V, V <sub>GS</sub> = 0 V	P-Ch			-1	μA
I <sub>GSSF</sub>	Gate - Body Leakage, Forward	V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V	All			100	nA
I <sub>GSSR</sub>	Gate - Body Leakage, Reverse	V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V	All			-100	nA
<b>ON CHARACTERISTICS (Note 2)</b>							
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	N-Ch	1	1.7	3	V
		V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	P-Ch	-1	-1.5	-3	V
ΔV <sub>GS(th)</sub> /ΔT <sub>J</sub>	Gate Threshold Voltage Temp. Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25 °C	N-Ch		-4.4		mV/°C
		I <sub>D</sub> = -250 μA, Referenced to 25 °C	P-Ch		3.2		
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 7.0 A	N-Ch		0.024	0.028	Ω
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 6.0 A			0.035	0.04	
		V <sub>GS</sub> = -10 V, I <sub>D</sub> = -5.0 A	P-Ch		0.044	0.052	
		V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -4.0 A			0.068	0.08	
I <sub>D(on)</sub>	On-State Drain Current	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 5 V	N-Ch	20			A
		V <sub>GS</sub> = -10 V, V <sub>DS</sub> = -5 V	P-Ch	-20			
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 5 V, I <sub>D</sub> = -7 A	N-Ch		15		S
		V <sub>DS</sub> = -5 V, I <sub>D</sub> = -5 A	P-Ch		8		S
<b>DYNAMIC CHARACTERISTICS</b>							
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	N-Ch		650		pF
			P-Ch		730		
C <sub>oss</sub>	Input Capacitance		N-Ch		345		pF
			P-Ch		400		
C <sub>rss</sub>	Reverse Transfer Capacitance		N-Ch		90		pF
			P-Ch		90		

**Electrical Characteristics** (continued)

**SWITCHING CHARACTERISTICS** (Note 2)

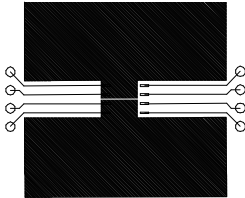
Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
$t_{D(on)}$	Turn - On Delay Time	$V_{DS} = 10\text{ V}, I_D = 1\text{ A}$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$	N-Ch		8	16	ns
			P-Ch		11	20	
$t_r$	Turn - On Rise Time		N-Ch		14	25	ns
			P-Ch		10	18	
$t_{D(off)}$	Turn - Off Delay Time	$V_{DS} = -10\text{ V}, I_D = -1\text{ A}$ $V_{GS} = -10\text{ V}, R_{GEN} = 6\ \Omega$	N-Ch		23	37	ns
			P-Ch		90	125	
$t_f$	Turn - Off Fall Time		N-Ch		9	18	ns
			P-Ch		55	80	
$Q_g$	Total Gate Charge	$V_{DS} = 10\text{ V}, I_D = 7\text{ A},$ $V_{GS} = 10\text{ V}$	N-Ch		18	26	nC
			P-Ch		19	27	
$Q_{gs}$	Gate-Source Charge	$V_{DS} = -10\text{ V}, I_D = -5\text{ A},$ $V_{GS} = -10\text{ V}$	N-Ch		3.2		nC
			P-Ch		3.5		
$Q_{gd}$	Gate-Drain Charge	$V_{GS} = -10\text{ V}$	N-Ch		4.3		nC
			P-Ch		3.6		

**DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS**

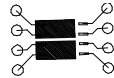
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		N-Ch			1.3	A
			P-Ch			-1.3	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 1.3\text{ A}$ (Note 2)	N-Ch		0.75	1.2	V
		$V_{GS} = 0\text{ V}, I_S = -1.3\text{ A}$ (Note 2)	P-Ch		-0.75	-1.2	V

Notes:

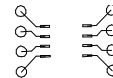
1.  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a. 78°C/W on a 0.5 in<sup>2</sup> pad of 2oz copper.



b. 125°C/W on a 0.02 in<sup>2</sup> pad of 2oz copper.



c. 135°C/W on a 0.003 in<sup>2</sup> pad of 2oz copper.

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

Typical Electrical Characteristics: N-Channel

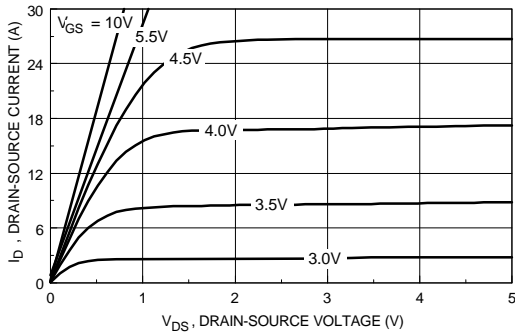


Figure 1. On-Region Characteristics.

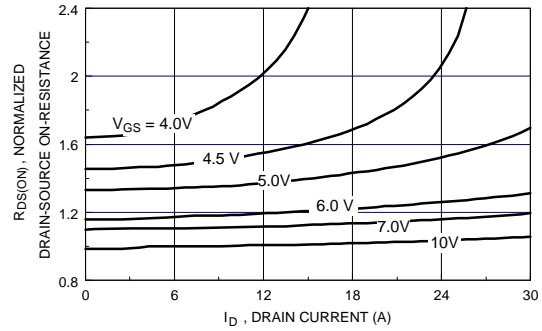


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

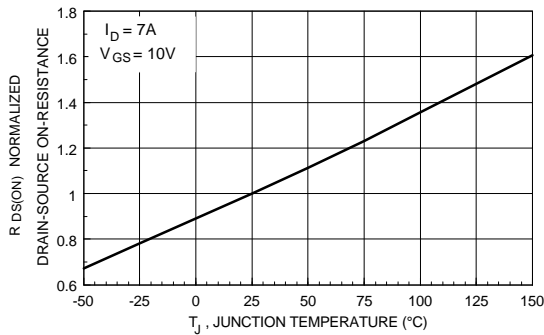


Figure 3. On-Resistance Variation with Temperature.

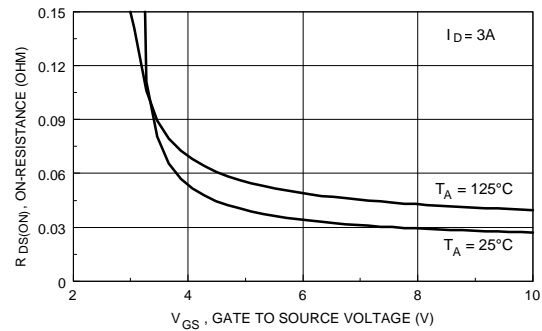


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

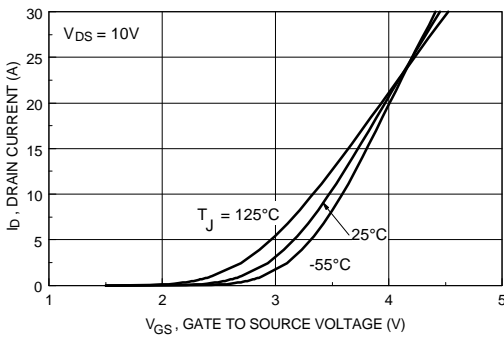


Figure 5. Transfer Characteristics.

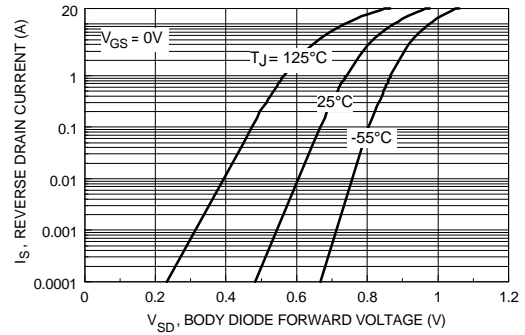


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Electrical Characteristics: N-Channel (continued)

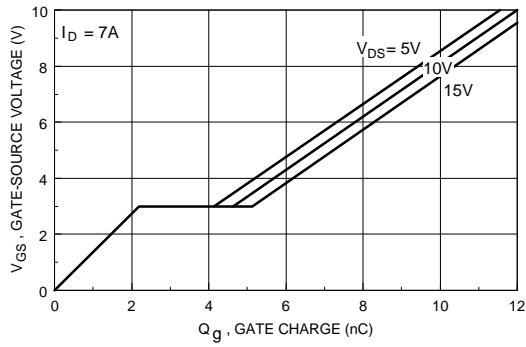


Figure 7. Gate Charge Characteristics.

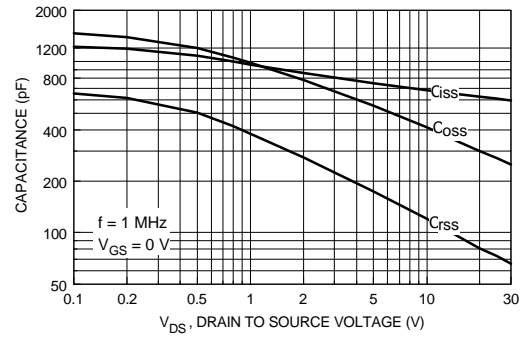


Figure 8. Capacitance Characteristics.

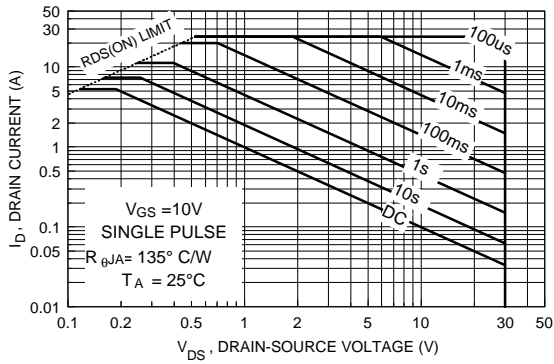


Figure 9. Maximum Safe Operating Area.

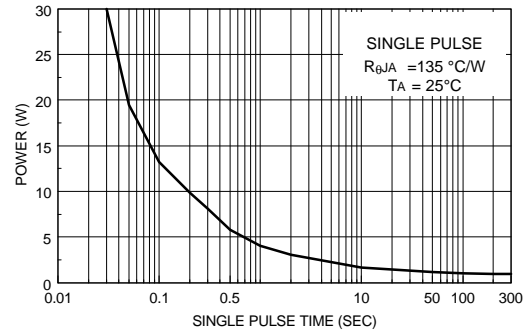


Figure 10. Single Pulse Maximum Power Dissipation.

Typical Electrical Characteristics: P-Channel

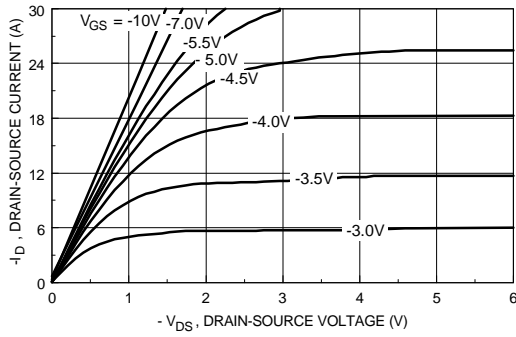


Figure 11. On-Region Characteristics.

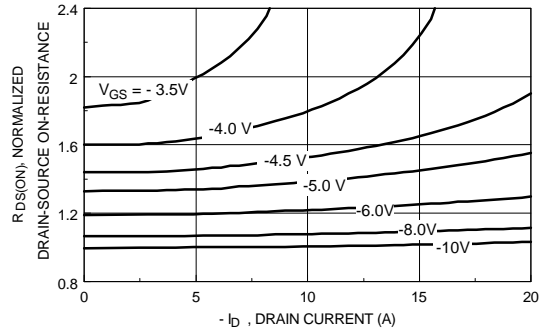


Figure 12. On-Resistance Variation with Drain Current and Gate Voltage.

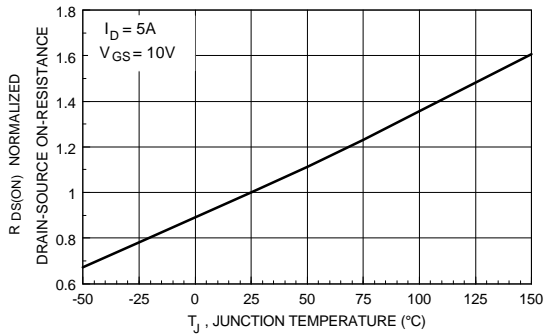


Figure 13. On-Resistance Variation with Temperature.

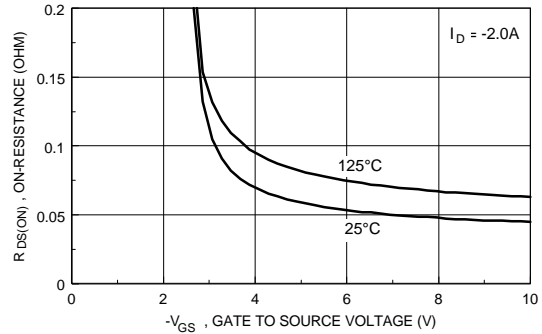


Figure 14. On-Resistance Variation with Gate-to-Source Voltage.

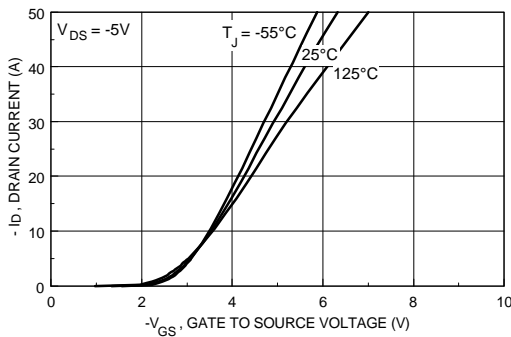


Figure 15. Transfer Characteristics.

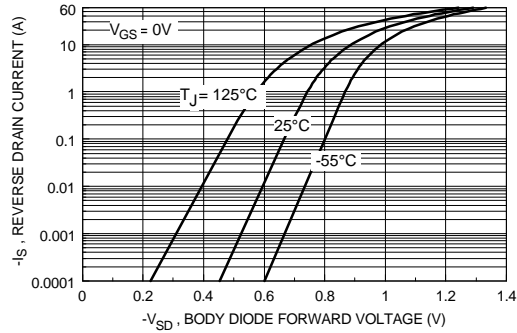


Figure 16. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Electrical Characteristics: P-Channel (continued)

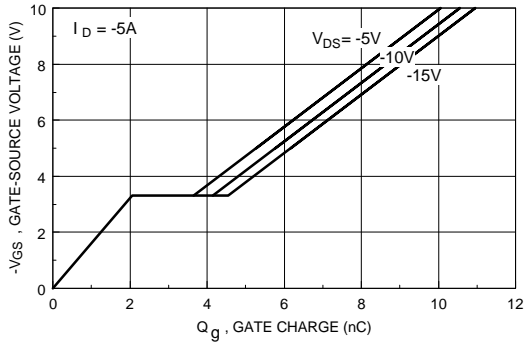


Figure 17. Gate Charge Characteristics.

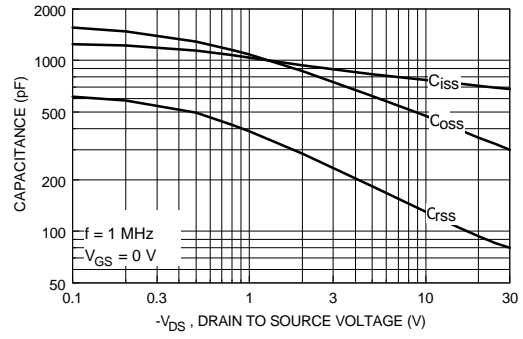


Figure 18. Capacitance Characteristics.

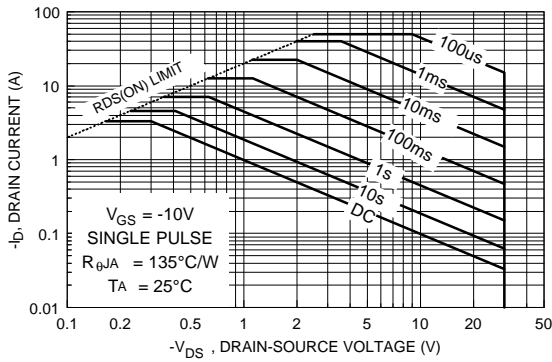


Figure 19. Maximum Safe Operating Area.

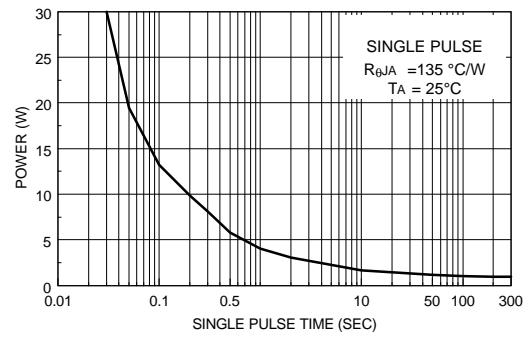


Figure 20. Single Pulse Maximum Power Dissipation.

Typical Thermal Characteristics: N & P-Channel (continued)

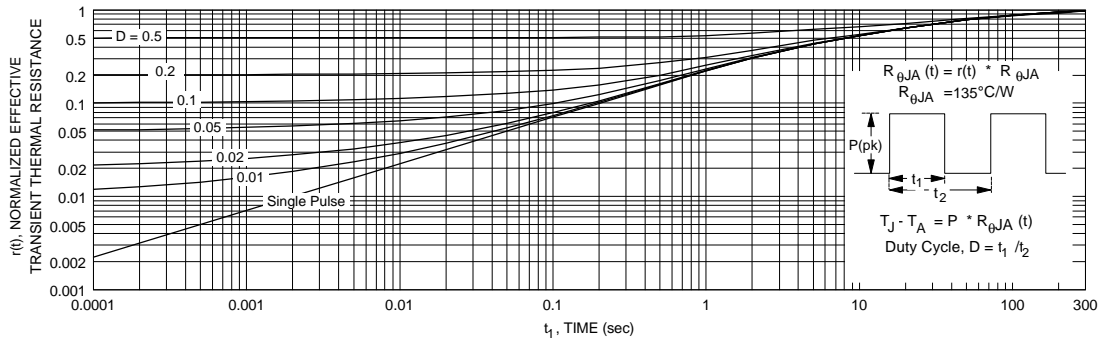


Figure 21. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in note 1.  
 Transient thermal response will change depending on the circuit board design.



## 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.

ACE <sup>x</sup> <sup>TM</sup>	FAST <sup>r</sup> <sup>TM</sup>	PowerTrench <sup>®</sup>	SyncFET <sup>TM</sup>
Bottomless <sup>TM</sup>	GlobalOptoisolator <sup>TM</sup>	QFET <sup>TM</sup>	TinyLogic <sup>TM</sup>
CoolFET <sup>TM</sup>	GTO <sup>TM</sup>	QS <sup>TM</sup>	UHC <sup>TM</sup>
CROSSVOLT <sup>TM</sup>	HiSeC <sup>TM</sup>	QT Optoelectronics <sup>TM</sup>	VCX <sup>TM</sup>
DO <sup>M</sup> E <sup>TM</sup>	ISOP <sup>L</sup> ANAR <sup>TM</sup>	Quiet Series <sup>TM</sup>	
E <sup>2</sup> CMOS <sup>TM</sup>	MICROWIRE <sup>TM</sup>	SILENT SWITCHER <sup>®</sup>	
EnSigna <sup>TM</sup>	OPTOLOGIC <sup>TM</sup>	SMART START <sup>TM</sup>	
FACT <sup>TM</sup>	OPTOPLANAR <sup>TM</sup>	SuperSOT <sup>TM</sup> -3	
FACT Quiet Series <sup>TM</sup>	PACMAN <sup>TM</sup>	SuperSOT <sup>TM</sup> -6	
FAST <sup>®</sup>	POP <sup>TM</sup>	SuperSOT <sup>TM</sup> -8	

## 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.