



August 2014

FDP39N20 / FDPF39N20

N-Channel UniFET™ MOSFET

200 V, 39 A, 66 mΩ

Features

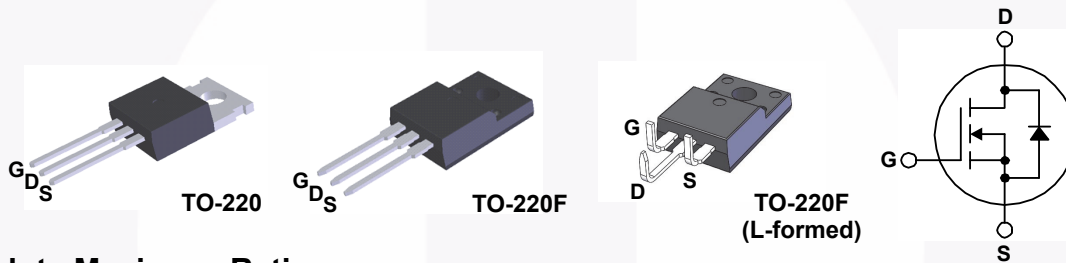
- $R_{DS(on)} = 66 \text{ m}\Omega$ (Max.) @ $V_{GS} = 10 \text{ V}$, $I_D = 19.5 \text{ A}$
- Low Gate Charge (Typ. 38 nC)
- Low C_{rss} (Typ. 57 pF)
- 100% Avalanche Tested

Applications

- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

Description

UniFET™ MOSFET is Fairchild Semiconductor's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.



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

Symbol	Parameter		FDP39N20	FDPF39N20 / FDPF39N20TLDTU	Unit
V_{DSS}	Drain-Source Voltage		200		V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	39	39 *	A
		- Continuous ($T_C = 100^\circ\text{C}$)	23.4	23.4 *	A
I_{DM}	Drain Current	- Pulsed (Note 1)	156	156 *	A
V_{GSS}	Gate-Source voltage		± 30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		860		mJ
I_{AR}	Avalanche Current (Note 1)		39		A
E_{AR}	Repetitive Avalanche Energy (Note 1)		25.1		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5		V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	251	37	W
		- Derate Above 25°C	2.0	0.29	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150		$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300		$^\circ\text{C}$

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	FDP39N20	FDPF39N20 / FDPF39N20TLDTU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.5	3.4	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	62.5	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDP39N20	FDP39N20	TO-220	Tube	N/A	N/A	50 units
FDPF39N20	FDPF39N20	TO-220F	Tube	N/A	N/A	50 units
FDPF39N20TLDTU	FDPF39N20T	TO-220F (L-formed)	Tube	N/A	N/A	50 units

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	200	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C	--	0.2	--	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = 160\text{ V}, T_C = 125^\circ\text{C}$	--	--	1 10	μA μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 19.5\text{ A}$	--	0.056	0.066	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 19.5\text{ A}$	--	28.5	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	1640	2130	pF
C_{oss}	Output Capacitance		--	400	520	pF
C_{rss}	Reverse Transfer Capacitance		--	57	85	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 100\text{ V}, I_D = 39\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 25\ \Omega$	--	30	70	ns
t_r	Turn-On Rise Time		--	160	330	ns
$t_{d(off)}$	Turn-Off Delay Time		--	150	310	ns
t_f	Turn-Off Fall Time		(Note 4)	--	150	310
Q_g	Total Gate Charge	$V_{DS} = 160\text{ V}, I_D = 39\text{ A},$ $V_{GS} = 10\text{ V}$	--	38	49	nC
Q_{gs}	Gate-Source Charge		--	11	--	nC
Q_{gd}	Gate-Drain Charge		(Note 4)	--	16.5	--
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	39	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	156	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 39\text{ A}$	--	--	1.4	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 39\text{ A},$ $dI_F/dt = 100\text{ A}/\mu\text{s}$	--	152	--	ns
Q_{rr}	Reverse Recovery Charge		--	1.1	--	μC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $L = 0.85\text{ mH}, I_{AS} = 39\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 39\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

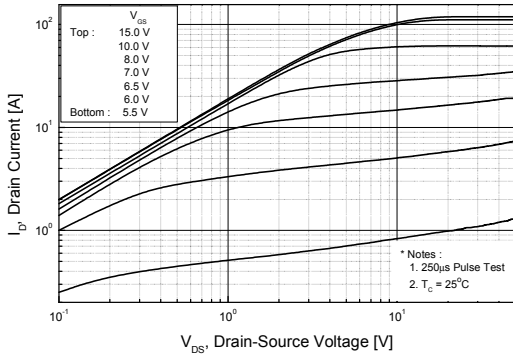


Figure 2. Transfer Characteristics

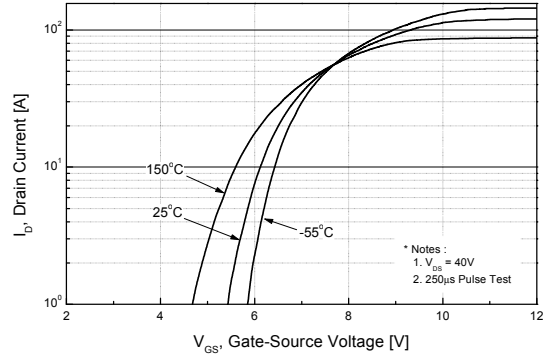


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

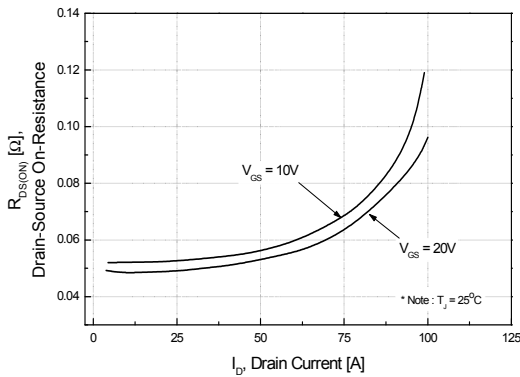


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

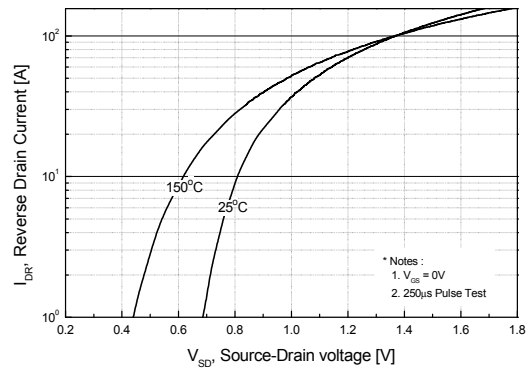


Figure 5. Capacitance Characteristics

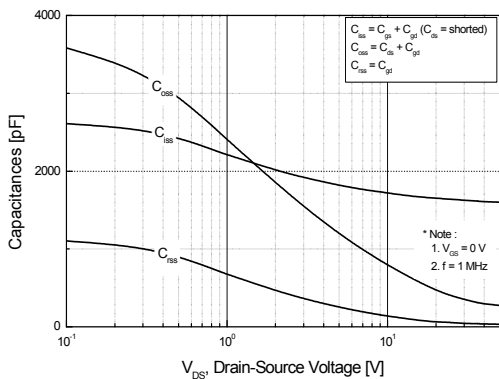
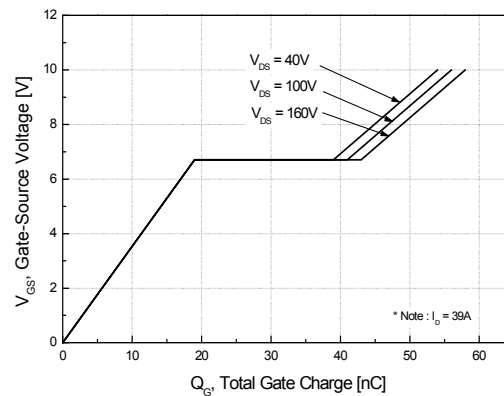


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

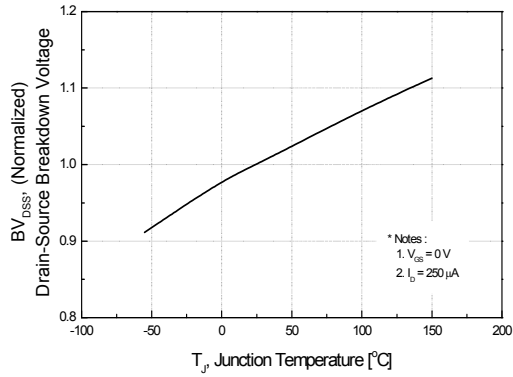


Figure 8. On-Resistance Variation vs. Temperature

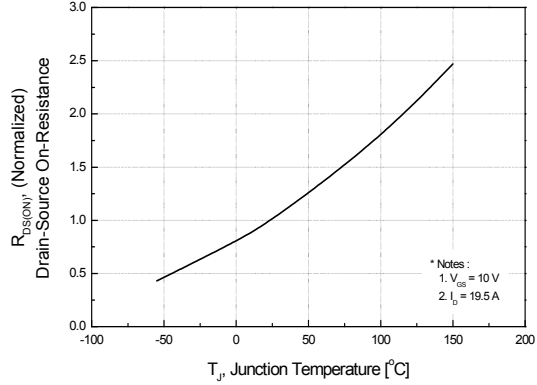


Figure 9-1. Maximum Safe Operating Area - FDP39N20

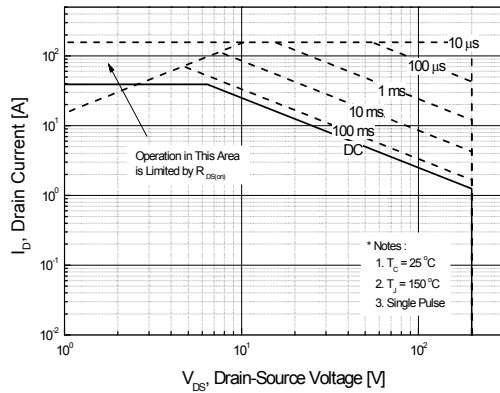


Figure 9-2. Maximum Safe Operating Area - FDPF39N20

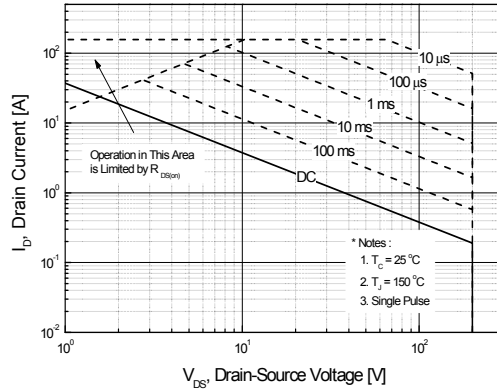
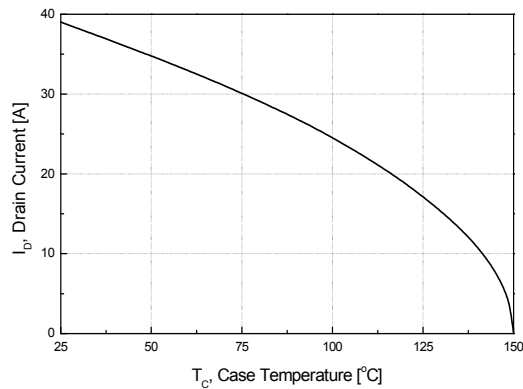


Figure 10. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve - FDP39N20

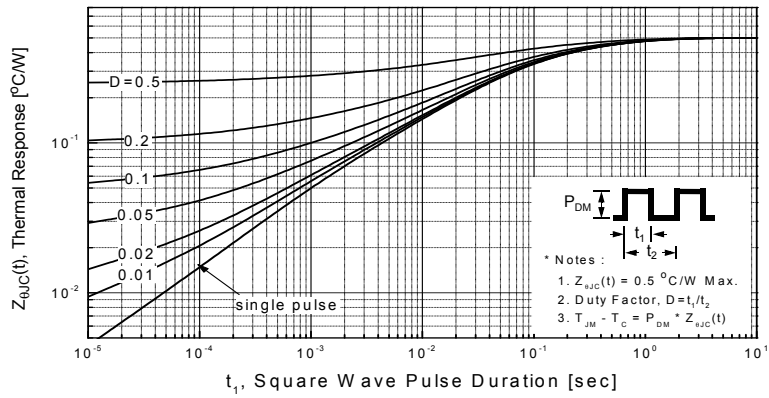
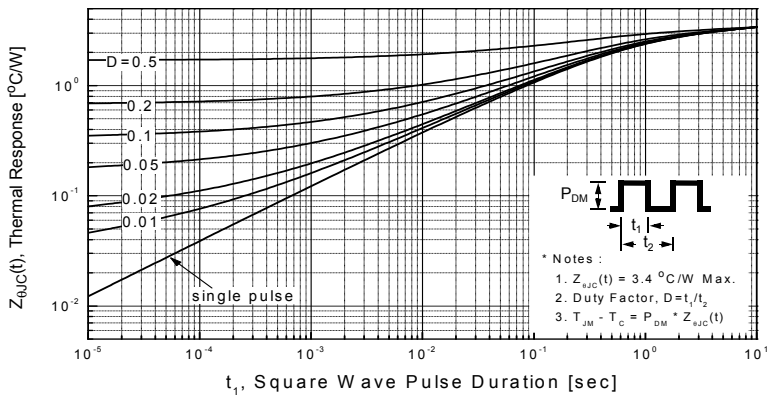


Figure 11-2. Transient Thermal Response Curve - FDPF39N20



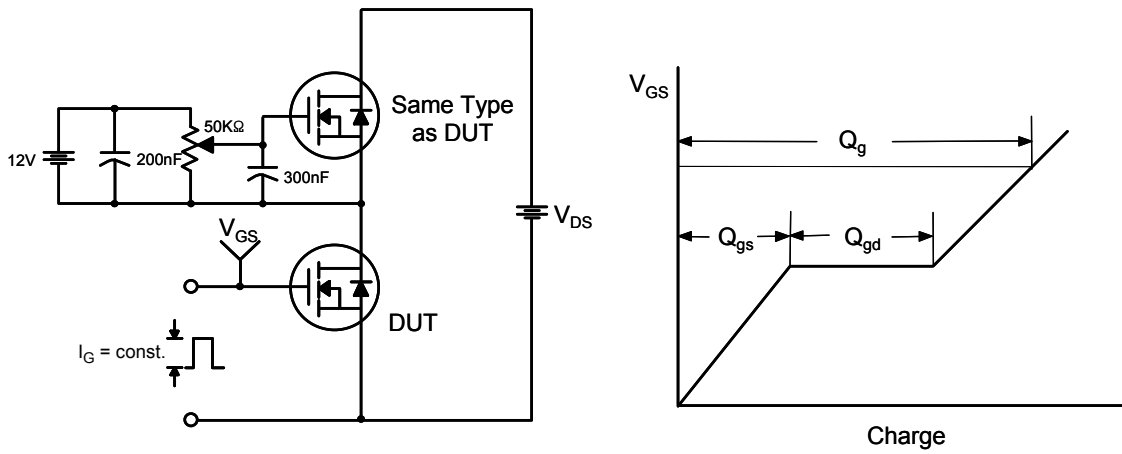


Figure 12. Gate Charge Test Circuit & Waveform



Figure 13. Resistive Switching Test Circuit & Waveforms



Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

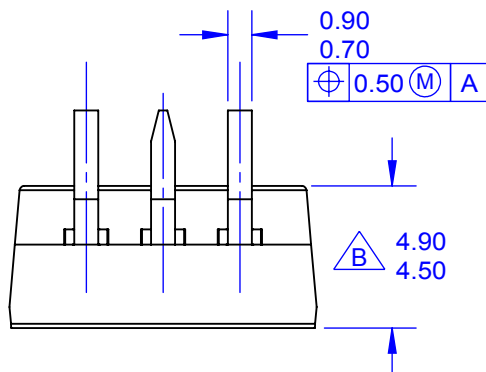
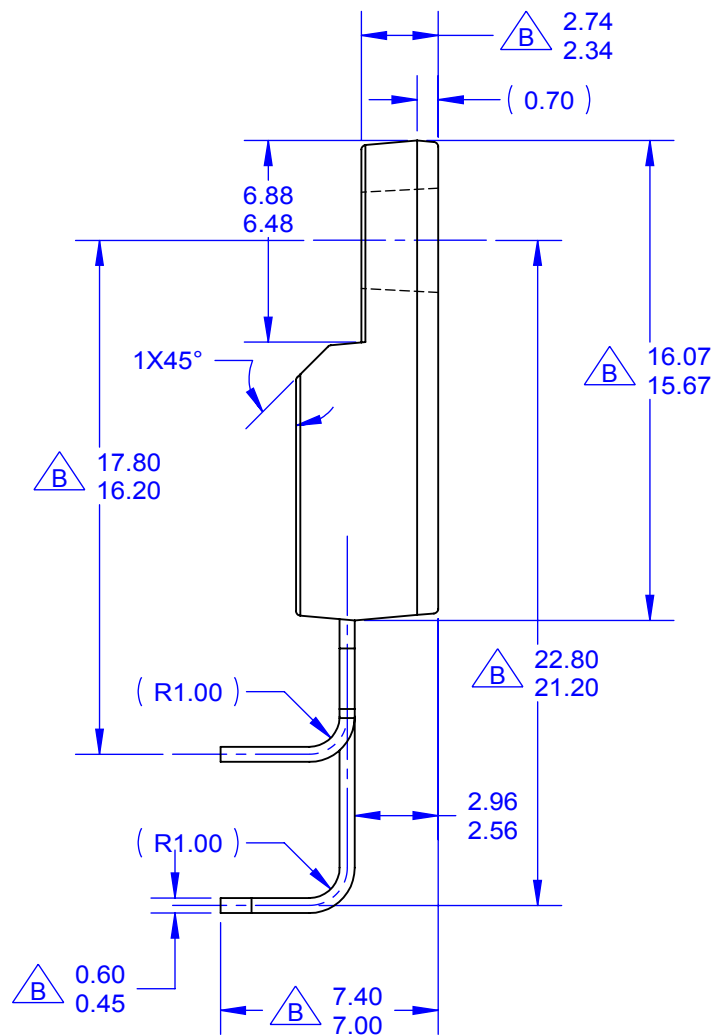
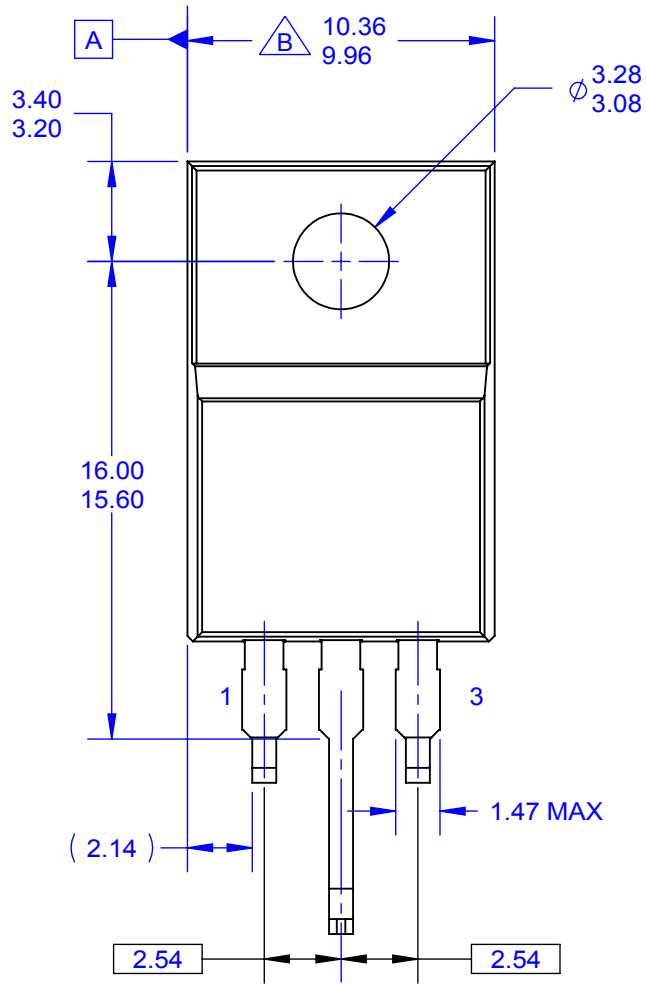


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

THIS DRAWING IS THE PROPERTY OF FAIRCHILD SEMICONDUCTOR CORPORATION. NO USE THEREOF SHALL BE MADE OTHER THAN AS A REFERENCE FOR PROPOSALS AS SUBMITTED TO FAIRCHILD SEMICONDUCTOR CORPORATION FOR JOBS TO BE EXECUTED IN CONFORMITY WITH SUCH PROPOSALS UNLESS THE CONSENT OF SAID FAIRCHILD SEMICONDUCTOR CORPORATION HAS PREVIOUSLY BEEN OBTAINED. NO PART OF THIS DRAWING SHALL BE COPIED OR DUPLICATED OR ITS CONTENTS DISCLOSED. THE INFORMATION CONTAINED ON THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY.

REVISIONS

NBR	DESCRIPTION	DATE	BY/APP'D
1	RELEASED TO DCC	12JUL09	KHLEE/ SUZHOU



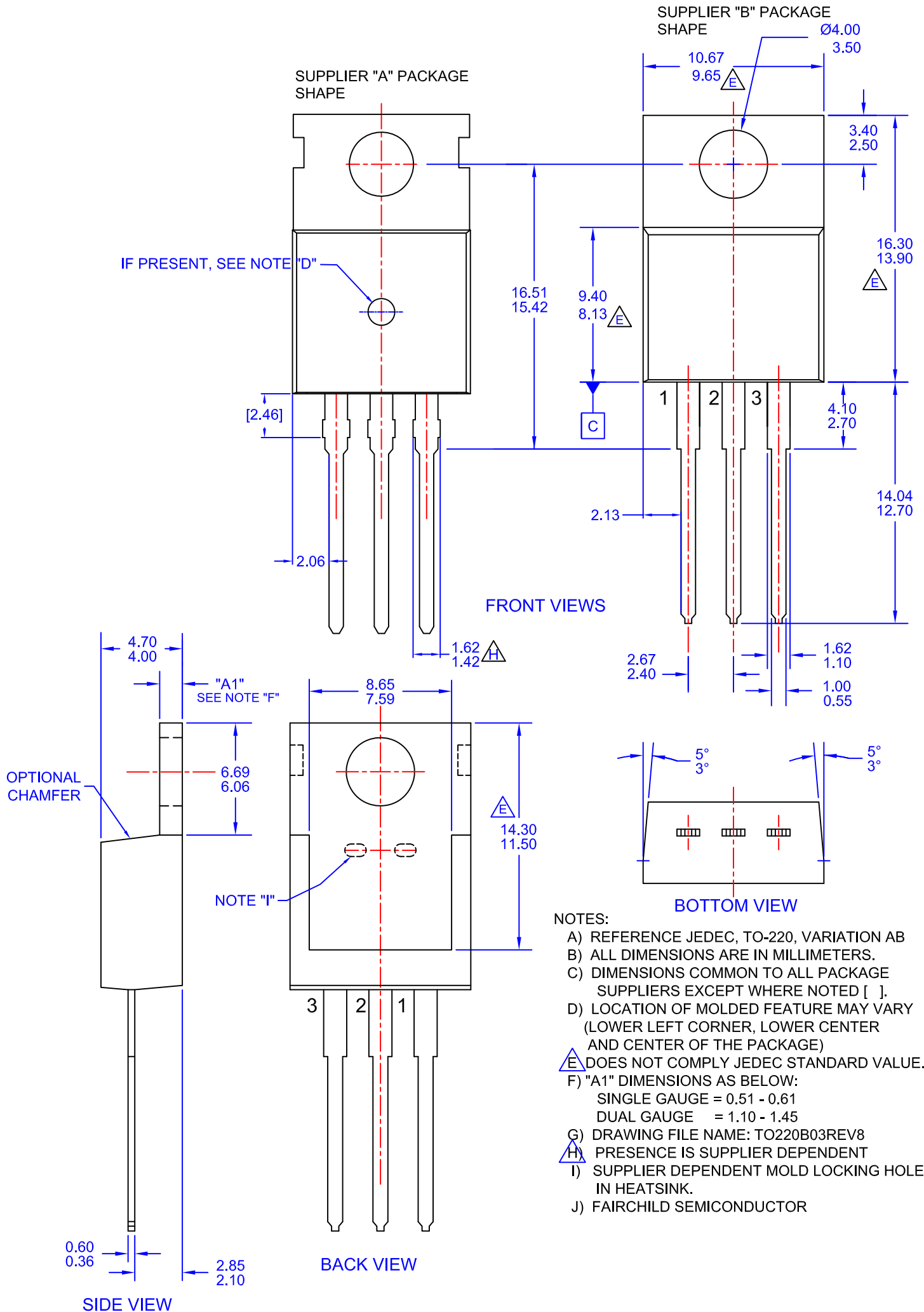
NOTES:

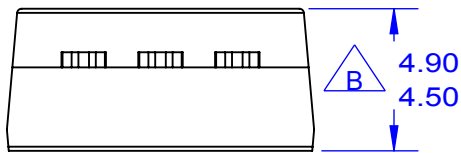
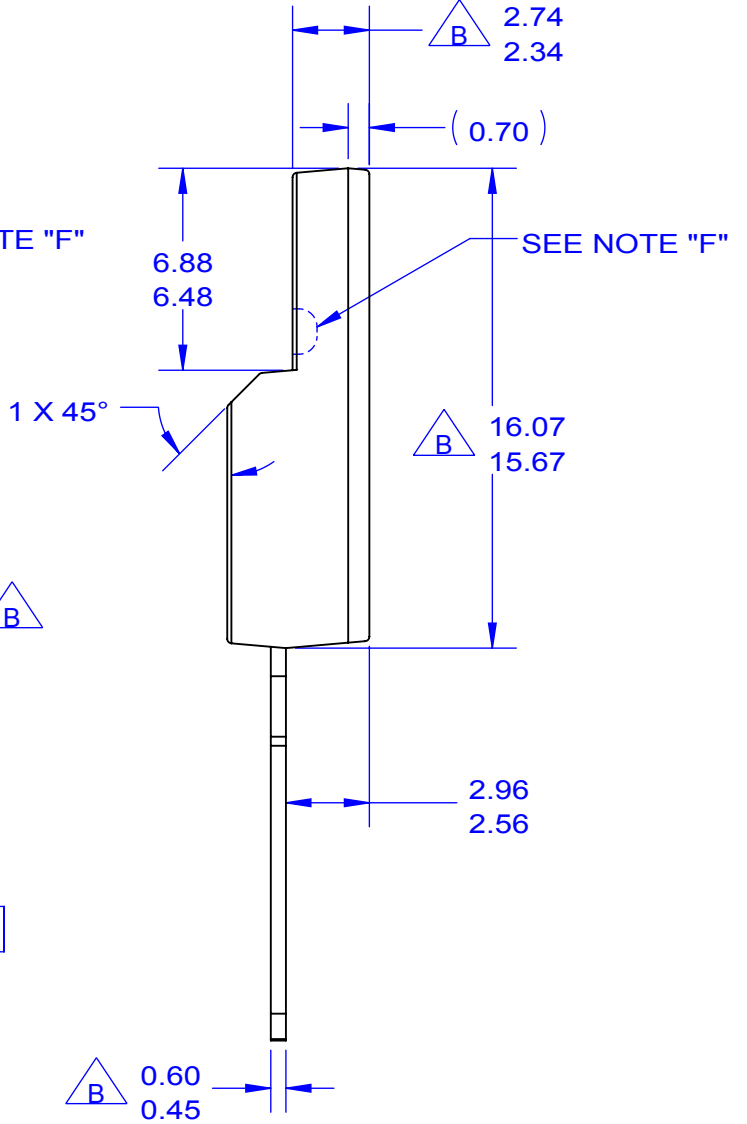
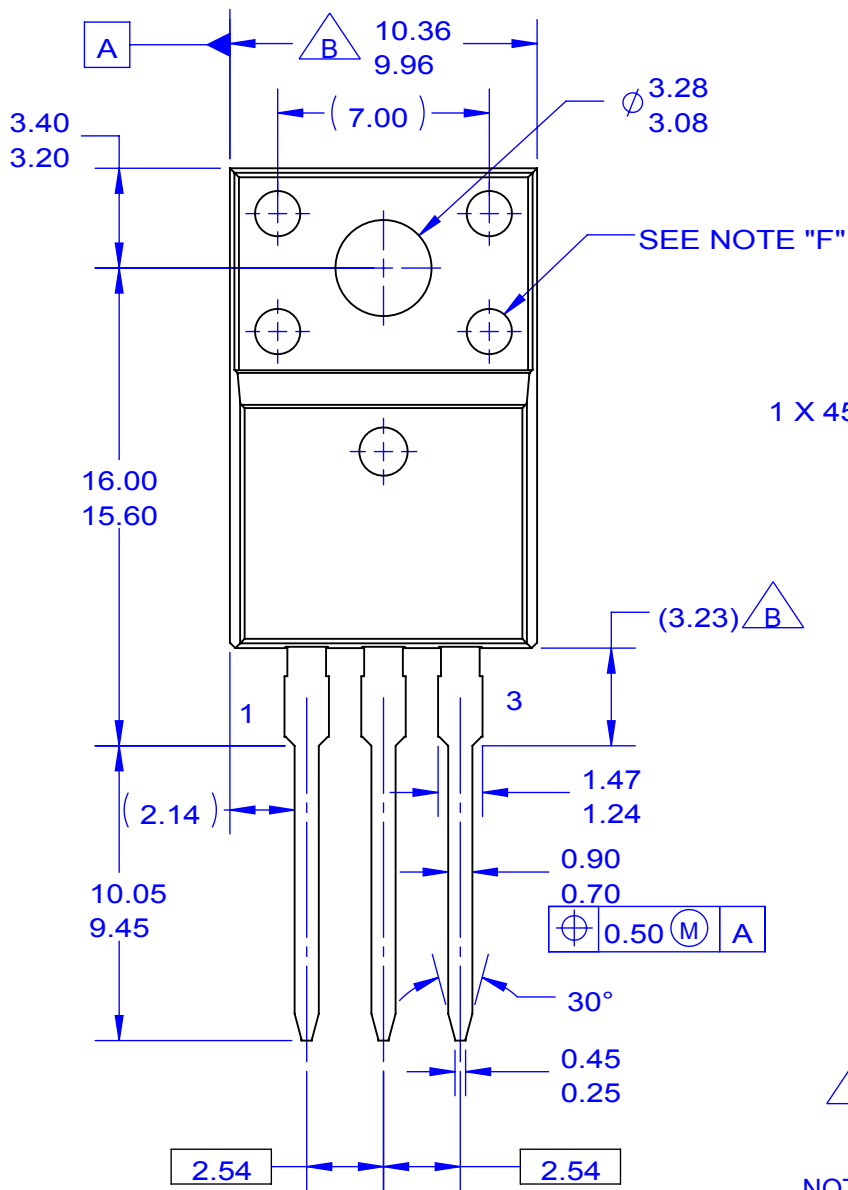
A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.

B. DOES NOT COMPLY EIAJ STD VALUE.

C. ALL DIMENSIONS ARE IN MILLIMETERS.
 D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
 E. DIMENSIONS AND TOLERANCE AS PER ASME Y14.5-1994
 F. DRAWING FILE NAME: TO220Z03REV1

APPROVALS		DATE	FAIRCHILD SEMICONDUCTOR™			
DRAWN:	BOBOY MALDO	12JUL09	TO220, MOLDED, 3LD, FULLPACK, EIAJ SC91, L FORMED LEADS			
CHECKED:	KH LEE					
APPROVED:	BY HUANG					
APPROVED:	HOWARD ALLEN					
PROJECTION			SCALE	SIZE	DRAWING NUMBER	REV
			1:1	N/A	MKT-TO220Z03	1
			FORMERLY: N/A	SHEET: 1 OF 1		





NOTES:

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. OPTION 1 - WITH SUPPORT PIN HOLE.
OPTION 2 - NO SUPPORT PIN HOLE.
- G. DRAWING FILE NAME: TO220M03REV3



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.

AccuPower™	F-PFS™	OPTOPLANAR®	
AttitudeEngine™	FRFET®		TinyBoost®
Awinda®	Global Power Resource SM	PowerTrench®	TinyBuck®
AX-CAP®*	GreenBridge™	PowerXS™	TinyCalc™
BitSiC™	Green FPS™	Programmable Active Droop™	TinyLogic®
Build it Now™	Green FPS™ e-Series™	QFET®	TINYOPTO™
CorePLUS™	Gmax™	QS™	TinyPower™
CorePOWER™	GTO™	Quiet Series™	TinyPWM™
CROSSVOLT™	IntelliMAX™	RapidConfigure™	TinyWire™
CTL™	ISOPLANAR™		TranSiC™
Current Transfer Logic™	Making Small Speakers Sound Louder and Better™	Saving our world, 1mW/W/kW at a time™	TriFault Detect™
DEUXPEED®	MegaBuck™	SignalWise™	TRUECURRENT®*
Dual Cool™	MICROCOUPLER™	SmartMax™	μSerDes™
EcoSPARK®	MicroFET™	SMART START™	
EfficientMax™	MicroPak™	Solutions for Your Success™	UHC®
ESBC™	MicroPak2™	SPM®	Ultra FRFET™
	MillerDrive™	STEALTH™	UniFET™
Fairchild®	MotionMax™	SuperFET®	VCX™
Fairchild Semiconductor®	MotionGrid®	SuperSOT™-3	VisualMax™
FACT Quiet Series™	MTI®	SuperSOT™-6	VoltagePlus™
FACT®	MTX®	SuperSOT™-8	XS™
FAST®	MVN®	SupreMOS®	Xsens™
FastvCore™	mWSaver®	SyncFET™	仙童™
FETBench™	OptoHiT™	Sync-Lock™	
FPS™	OPTOLOGIC®		

* 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. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT [HTTP://WWW.FAIRCHILDSEMI.COM](http://www.fairchildsemi.com). 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. I73