



# FCB36N60N

## N-Channel SupreMOS® MOSFET

### 600 V, 36 A, 90 mΩ

#### Features

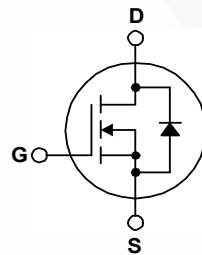
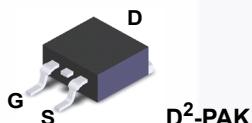
- $R_{DS(on)} = 81 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 18 \text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 86 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(\text{eff.})} = 361 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

#### Applications

- Solar Inverter
- AC-DC Power Supply

#### Description

The SupreMOS® MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, superior switching performance and ruggedness. SupreMOS MOSFET is suitable for high frequency switching power converter applications such as PFC, server/telecom power, FPD TV power, ATX power, and industrial power applications.



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

Symbol	Parameter		FCB36N60N	Unit
$V_{DSS}$	Drain to Source Voltage		600	V
$V_{GSS}$	Gate to Source Voltage		$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	36	A
		- Continuous ( $T_C = 100^\circ\text{C}$ )	22.7	
$I_{DM}$	Drain Current	- Pulsed	(Note 1)	A
$E_{AS}$	Single Pulsed Avalanche Energy		(Note 2)	1800
$I_{AR}$	Avalanche Current		(Note 1)	12
$E_{AR}$	Repetitive Avalanche Energy		(Note 1)	3.12
$dv/dt$	MOSFET $dv/dt$		100	V/ns
	Peak Diode Recovery $dv/dt$		(Note 3)	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	312	W
		- Derate Above $25^\circ\text{C}$	2.6	$\text{W}/^\circ\text{C}$
$T_J, T_{STG}$	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	$^\circ\text{C}$

#### Thermal Characteristics

Symbol	Parameter	FCB36N60N	Unit
$R_{\theta,JC}$	Thermal Resistance, Junction to Case, Max.	0.4	$^\circ\text{C}/\text{W}$
$R_{\theta,JA}$	Thermal Resistance, Junction to Ambient (1 in <sup>2</sup> Pad of 2-oz Copper), Max.	40	
$R_{\theta,JA}$	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	62.5	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCB36N60N	FCB36N60N	D <sup>2</sup> -PAK	Tape and Reel	330 mm	24 mm	800 units

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
--------	-----------	-----------------	------	------	------	------

### Off Characteristics

$\text{BV}_{\text{DSS}}$	Drain to Source Breakdown Voltage	$I_D = 1 \text{ mA}, V_{GS} = 0 \text{ V}, T_C = 25^\circ\text{C}$	600	-	-	V
$\Delta \text{BV}_{\text{DSS}} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1 \text{ mA}, \text{Referenced to } 25^\circ\text{C}$	-	0.7	-	$^\circ\text{C}$
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{DS} = 480 \text{ V}, V_{GS} = 0 \text{ V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 480 \text{ V}, V_{GS} = 0 \text{ V}, T_C = 125^\circ\text{C}$	-	-	100	
$I_{\text{GSS}}$	Gate to Body Leakage Current	$V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250 \mu\text{A}$	2.0	-	4.0	V
$R_{DS(\text{on})}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 18 \text{ A}$	-	81	90	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40 \text{ V}, I_D = 18 \text{ A}$	-	41	-	S

### Dynamic Characteristics

$C_{\text{iss}}$	Input Capacitance	$V_{DS} = 100 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	-	3595	4785	pF
$C_{\text{oss}}$	Output Capacitance		-	149	200	pF
$C_{\text{rss}}$	Reverse Transfer Capacitance		-	4	6	pF
$C_{\text{oss}}$	Output Capacitance	$V_{DS} = 380 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	-	80	-	pF
$C_{\text{oss(eff.)}}$	Effective Output Capacitance	$V_{DS} = 0 \text{ V to } 380 \text{ V}, V_{GS} = 0 \text{ V}$	-	361	-	pF
$Q_{\text{g(tot)}}$	Total Gate Charge at 10V	$V_{DS} = 380 \text{ V}, I_D = 18 \text{ A}, V_{GS} = 10 \text{ V}$	-	86	112	nC
$Q_{\text{gs}}$	Gate to Source Gate Charge	(Note 4)	-	15.4	-	nC
$Q_{\text{gd}}$	Gate to Drain "Miller" Charge		-	26.4	-	nC
ESR	Equivalent Series Resistance (G-S)	$f = 1 \text{ MHz}$	-	1	-	$\Omega$

### Switching Characteristics

$t_{\text{d(on)}}$	Turn-On Delay Time	$V_{DD} = 380 \text{ V}, I_D = 18 \text{ A}, V_{GS} = 10 \text{ V}, R_G = 4.7 \Omega$	-	23	56	ns
$t_r$	Turn-On Rise Time		-	22	54	ns
$t_{\text{d(off)}}$	Turn-Off Delay Time		-	94	198	ns
$t_f$	Turn-Off Fall Time		(Note 4)	-	4	18

### Drain-Source Diode Characteristics

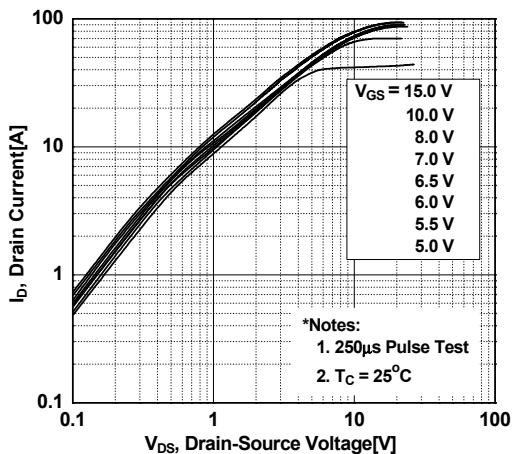
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	36	A	
$I_{\text{SM}}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	108	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 18 \text{ A}$	-	-	1.2	V
$t_{\text{rr}}$	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_{SD} = 18 \text{ A}, \frac{dI_F}{dt} = 100 \text{ A}/\mu\text{s}$	-	574	-	ns
$Q_{\text{rr}}$	Reverse Recovery Charge		-	10	-	$\mu\text{C}$

#### Notes:

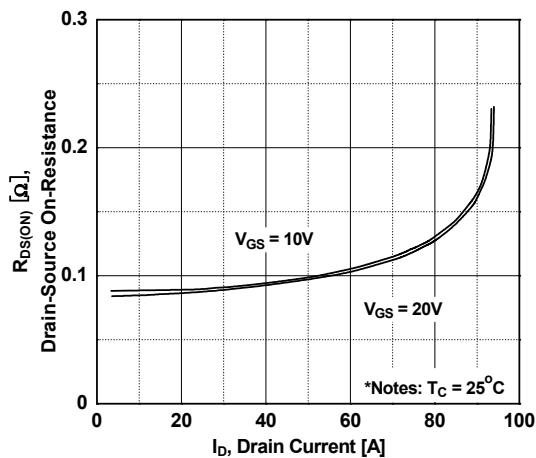
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 12 \text{ A}, R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 36 \text{ A}, \frac{dI}{dt} \leq 200 \text{ A}/\mu\text{s}, V_{DD} = 380 \text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

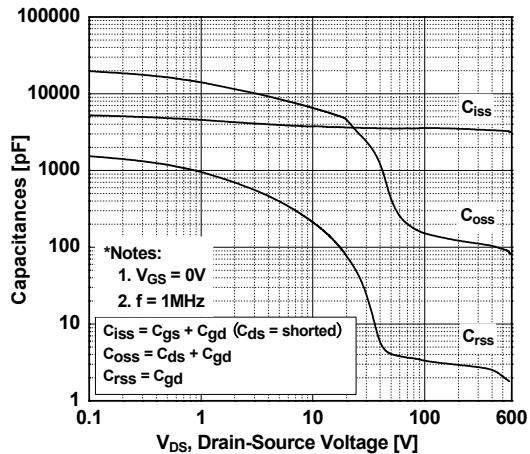
**Figure 1. On-Region Characteristics**



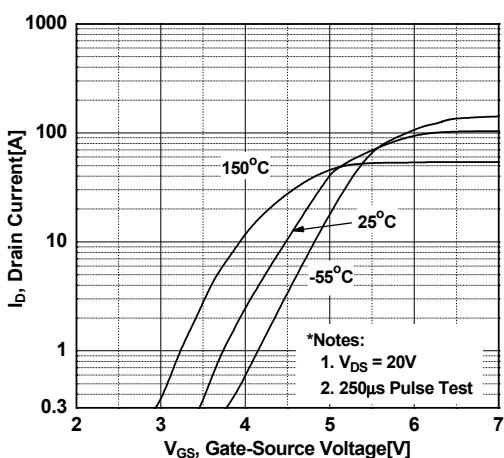
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



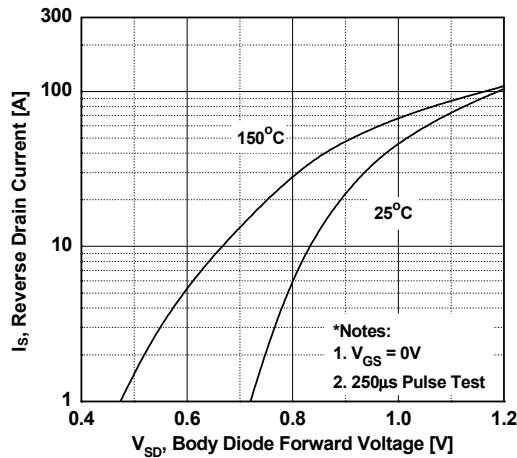
**Figure 5. Capacitance Characteristics**



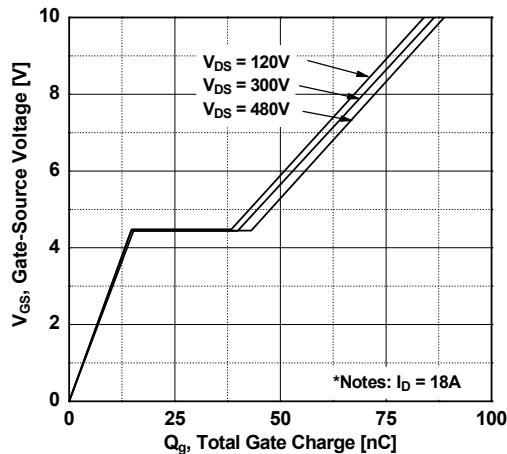
**Figure 2. Transfer Characteristics**



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



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

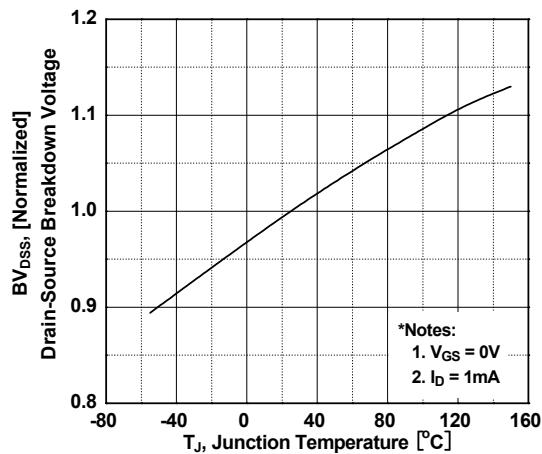


Figure 8. On-Resistance Variation vs. Temperature

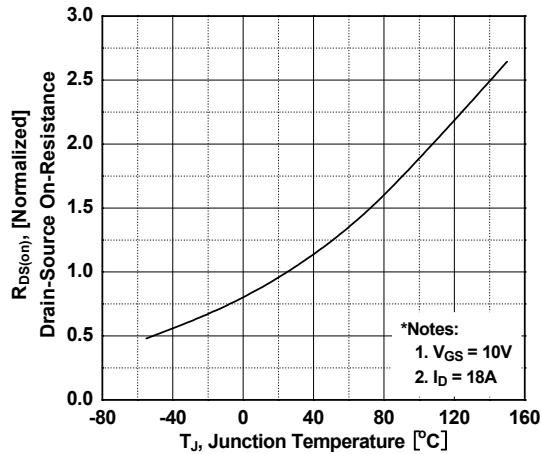


Figure 9. Maximum Safe Operating Area

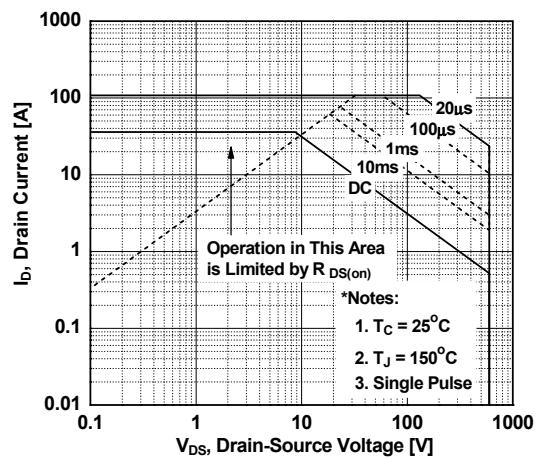


Figure 10. Maximum Drain Current vs. Case Temperature

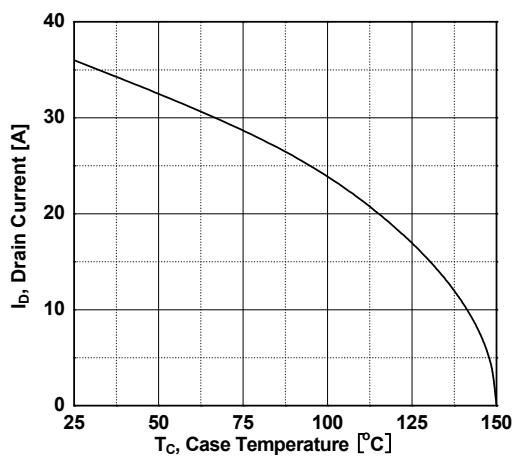
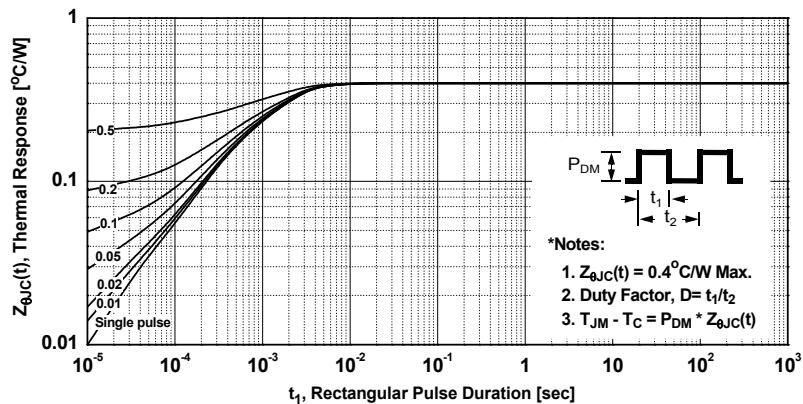


Figure 11. Transient Thermal Response Curve



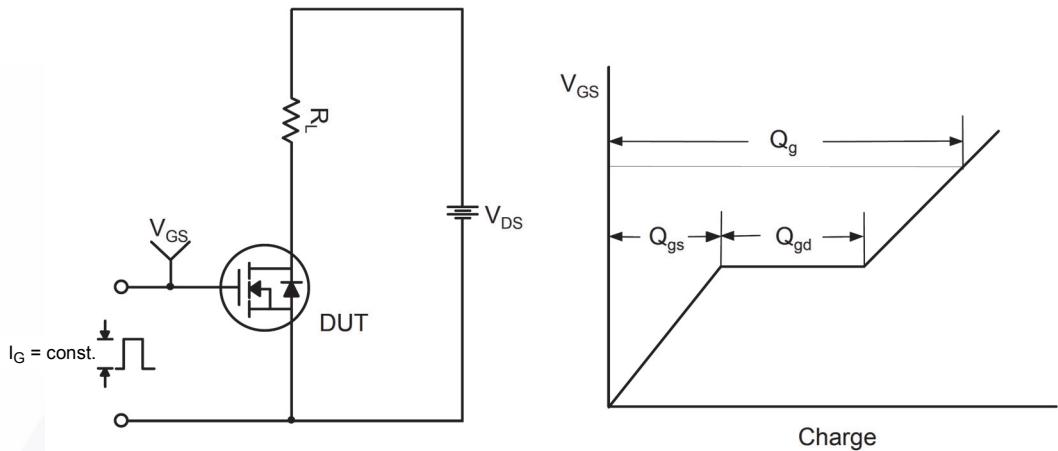


Figure 12. Gate Charge Test Circuit & Waveform

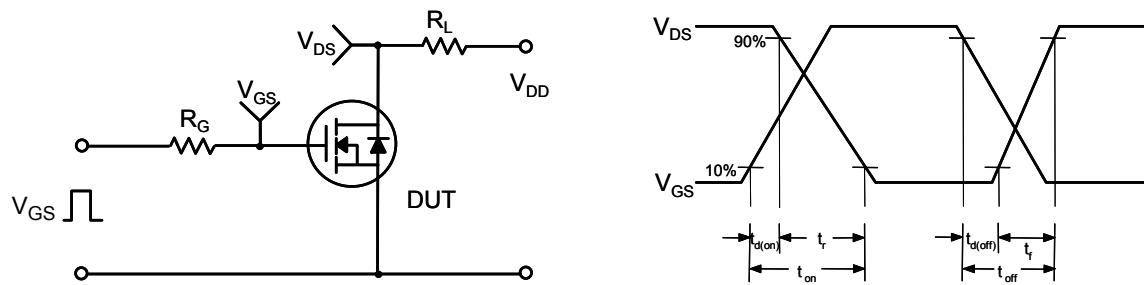


Figure 13. Resistive Switching Test Circuit & Waveforms

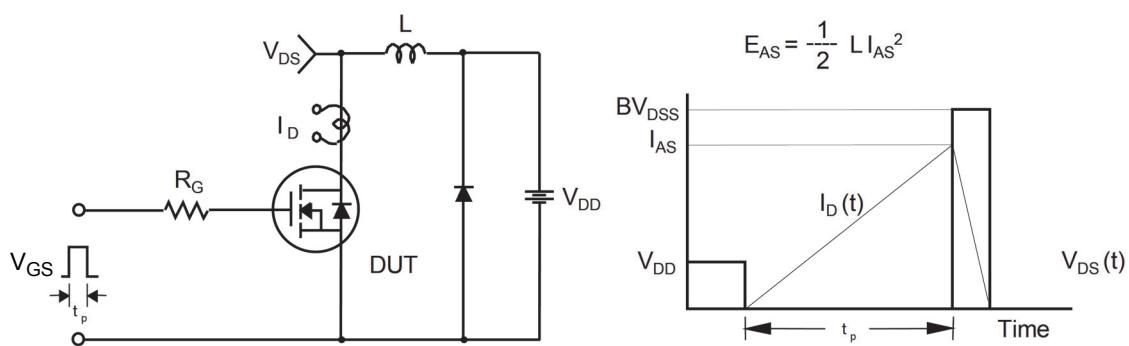


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

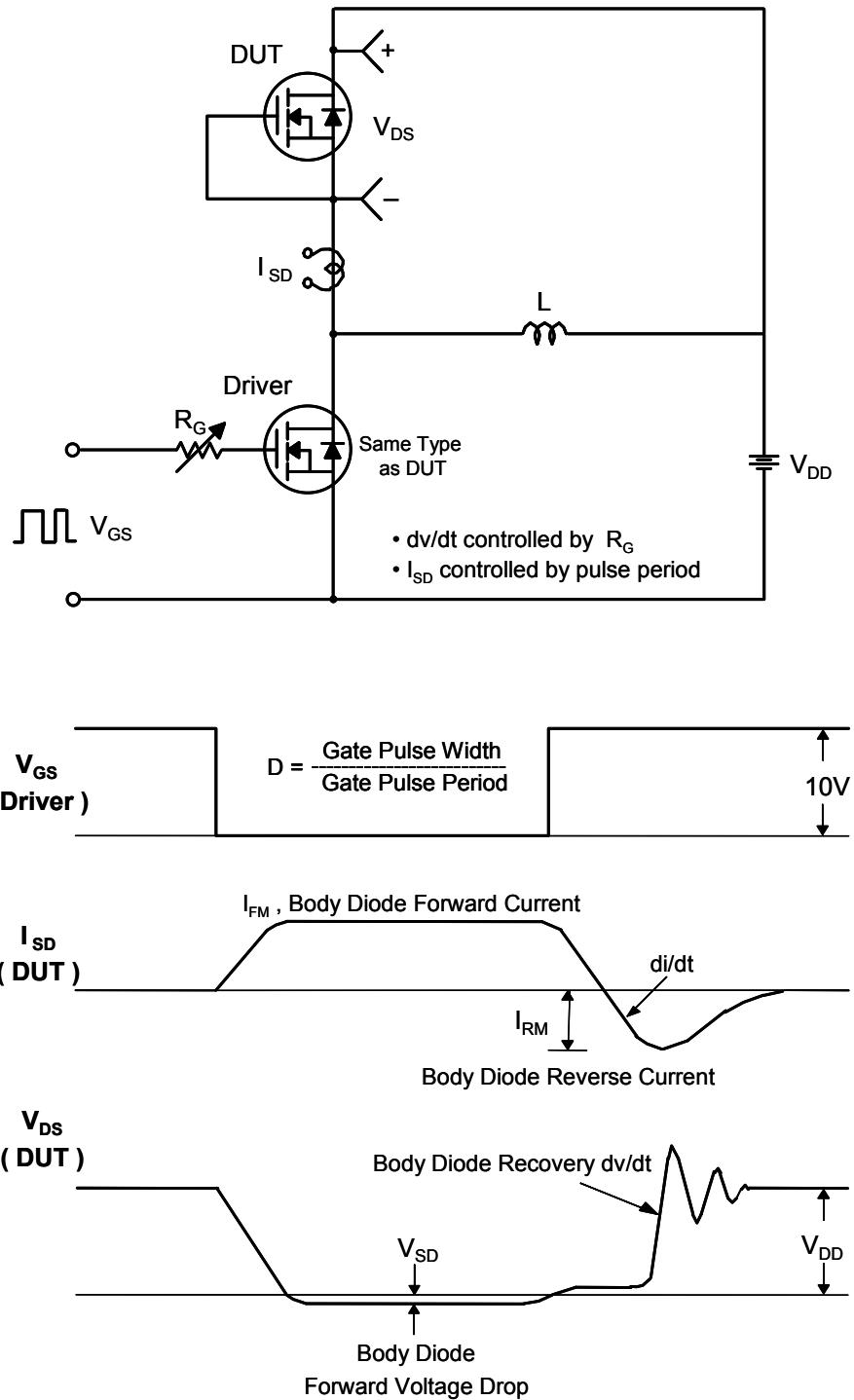
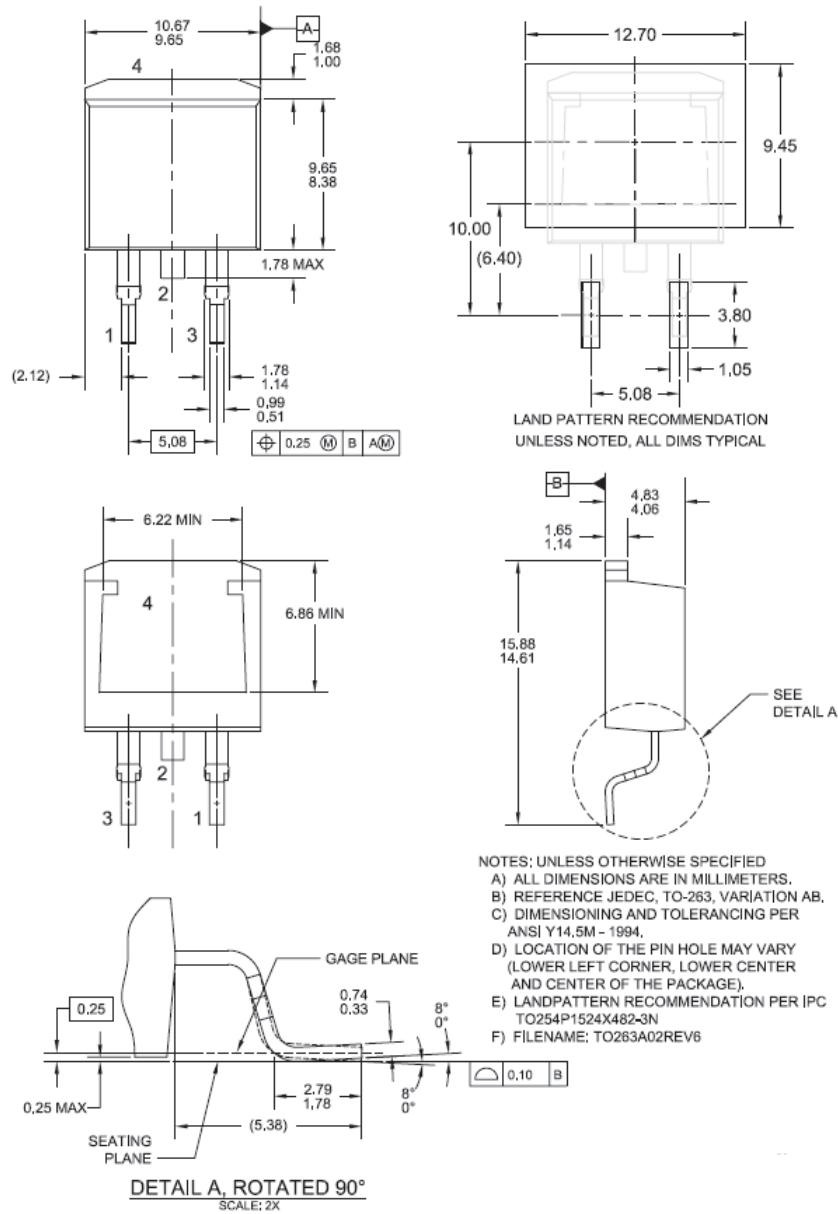


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Mechanical Dimensions



**Figure 16. TO263 (D<sup>2</sup>PAK), Molded, 2-Lead, Surface Mount**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

[http://www.fairchildsemi.com/package/packageDetails.html?id=PN\\_TT263-0R2](http://www.fairchildsemi.com/package/packageDetails.html?id=PN_TT263-0R2)



## 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™	Sync-Lock™
AX-CAP®*	FRFET®	SYSTEM GENERAL®*
BitSiC™	Global Power Resource™	TinyBoost®
Build it Now™	GreenBridge™	TinyBuck®
CorePLUS™	Green FPS™	TinyCalc™
CorePOWER™	Green FPS™ e-Series™	TinyLogic®
CROSSVOLT™	Gmax™	TINYOPTO™
CTL™	GTO™	TinyPower™
Current Transfer Logic™	IntelliMAX™	TinyPWM™
DEUXPEED®	ISOPLANAR™	TinyWire™
Dual Cool™	Marking Small Speakers Sound Louder and Better™	TransiC™
EcoSPARK®	MegaBuck™	TriFault Detect™
EfficientMax™	MICROCOUPLER™	TRUECURRENT®*
ESBC™	MicroFET™	µSerDes™
 ®	MicroPak™	UHC®
Fairchild®	MicroPak2™	Ultra FRFET™
Fairchild Semiconductor®	MillerDrive™	UniFET™
FACT Quiet Series™	MotionMax™	VCX™
FACT®	mWSaver®	VisualMax™
FAST®	OptoHIT™	VoltagePlus™
FastvCore™	OPTOLOGIC®	XS™
FETBench™	OPTOPLANAR®	
FPS™	SyncFET™	

\*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 here in:

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 application, 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 and 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. I66