FAIRCHILD SEMICONDUCTOR®

March 2013

FCP9N60N / FCPF9N60NT

N-Channel SupreMOS® MOSFET

600 V, 9 A, 385 mΩ

Features

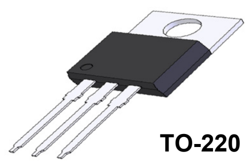
- $R_{DS(on)}$ = 330 mΩ (Typ.)@ V_{GS} = 10 V, I_D = 4.5 A
- Ultra low gate charge (Typ. Q_g = 22 nC)
- Low effective output capacitance (Typ. C_{oss}.eff = 106 pF)
- 100% avalanche tested
- RoHS compliant

Application

- LCD/LED/PDP TV
- Lighting
- 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 differentiate it from the conventional MOSFETs. This advanced technology and pre-cise process control provide lowest Rsp on-resistance, superior switching performance and ruggedness. SupreMOS MOSFET is suitable for high frequency switching power converter applica-tions such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.



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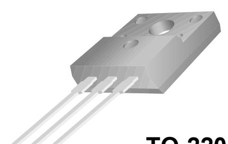
TO-220



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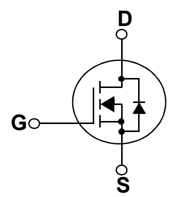


MOSFET Maximum Ratings T_C = 25°C unless otherwise noted*

Symbol	Parameter		FCP9N60N	FCPF9N60NT	Unit
V_{DSS}	Drain to Source Voltage		600		V
V_{GSS}	Gate to Source Voltage		±30		V
I_D	Drain Current	-Continuous (T_C = 25°C)	9.0	9.0*	A
		-Continuous (T_C = 100°C)	5.7	5.7*	
I_{DM}	Drain Current	- Pulsed (Note 1)	27	27*	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		135		mJ
I_{AR}	Avalanche Current		3		A
E_{AR}	Repetitive Avalanche Energy		0.83		mJ
dv/dt	MOSFET dv/dt Ruggedness		100		V/ns
	Peak Diode Recovery dv/dt (Note 3)		20		V/ns
P_D	Power Dissipation	(T_C = 25°C)	83.3	29.8	W
		- Derate above 25°C	0.67	0.24	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150		°C
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds		300		°C

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	FCP9N60N	FCPF9N60NT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.5	4.2	°C/W
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink (Typical)	0.5	0.5	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP9N60N	FCP9N60N	TO-220	-	-	50
FCPF9N60NT	FCPF9N60NT	TO-220F	-	-	50

Electrical Characteristics $T_C = 25^oC$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 1$ mA, $V_{GS} = 0$ V, $T_C = 25^oC$	600	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 1$ mA, Referenced to 25^oC	-	0.72	-	V/^{o}C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 480$ V, $V_{GS} = 0$ V	-	-	10	μA
		$V_{DS} = 480$ V, $V_{GS} = 0$ V, $T_C = 125^oC$	-	-	100	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm30$ V, $V_{DS} = 0$ V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250$ μA	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10$ V, $I_D = 4.5$ A	-	0.33	0.385	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40$ V, $I_D = 4.5$ A	-	7.5	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 100$ V, $V_{GS} = 0$ V f = 1 MHz	-	930	1240	pF
C_{oss}	Output Capacitance		-	35	50	pF
C_{rss}	Reverse Transfer Capacitance		-	2	4	pF
C_{oss}	Output Capacitance	$V_{DS} = 380$ V, $V_{GS} = 0$ V, f = 1 MHz	-	20	-	pF
C_{oss}eff.	Effective Output Capacitance	$V_{DS} = 0$ V to 480 V, $V_{GS} = 0$ V	-	106	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380$V, $I_D = 4.5$A, $V_{GS} = 10$ V (Note 4)	-	22.0	29	nC
Q_{gs}	Gate to Source Gate Charge		-	4.1	-	nC
Q_{gd}	Gate to Drain “Miller” Charge		-	7.1	-	nC
ESR	Equivalent Series Resistance (G-S)	Drain Open		2.9		Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380$ V, $I_D = 4.5$ A $R_G = 4.7$ Ω (Note 4)	-	12.7	35.4	ns
t_r	Turn-On Rise Time		-	8.7	27.4	ns
$t_{d(off)}$	Turn-Off Delay Time		-	36.9	83.8	ns
t_f	Turn-Off Fall Time		-	10.2	30.4	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	9.0	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	27	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_{SD} = 4.5$ A	-	-	1.2	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_{SD} = 4.5$ A $dI_F/dt = 100$ A/μs	-	213	-	ns
Q_{rr}	Reverse Recovery Charge		-	2.2	-	μC

Notes:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS} = 3$ A, $R_G = 25$ Ω, Starting $T_J = 25°C$
3. $I_{SD} \leq 9$ A, di/dt ≤ 200 A/μs, $V_{DD} = 380$ V, Starting $T_J = 25°C$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

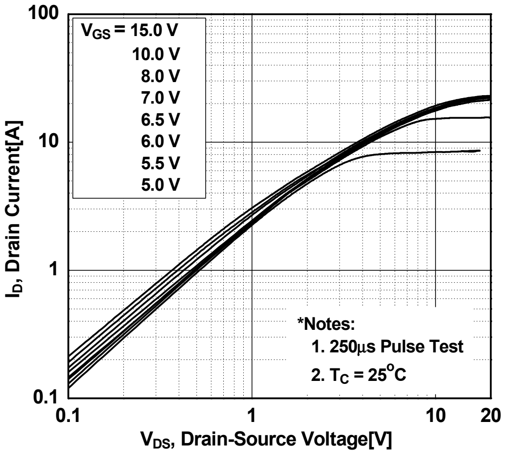


Figure 2. Transfer Characteristics

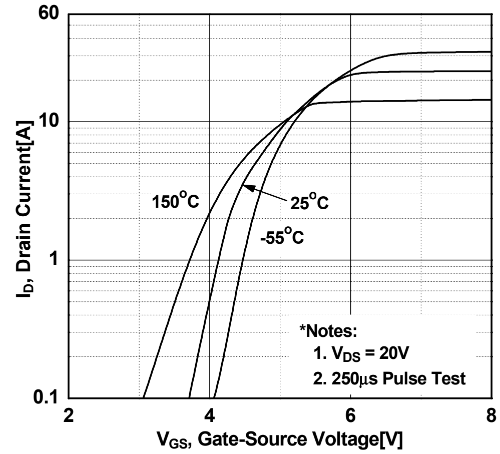


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

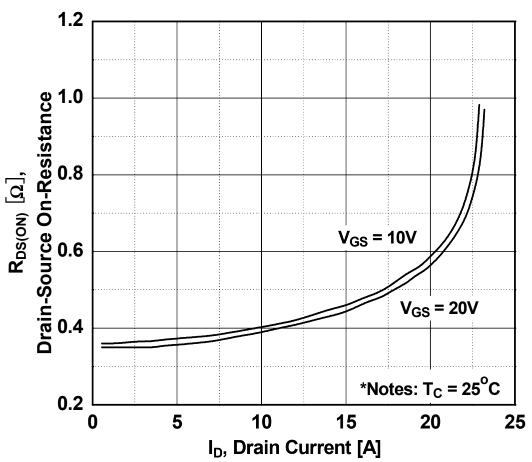


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

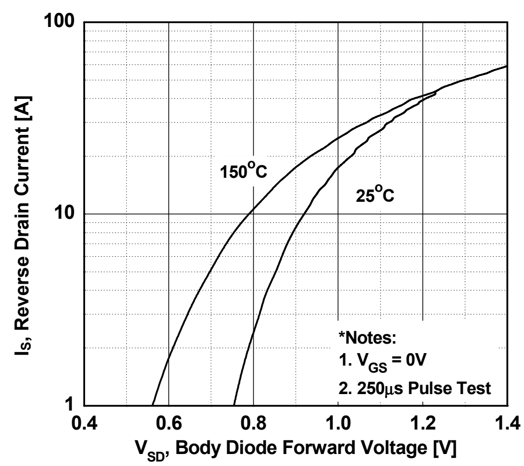


Figure 5. Capacitance Characteristics

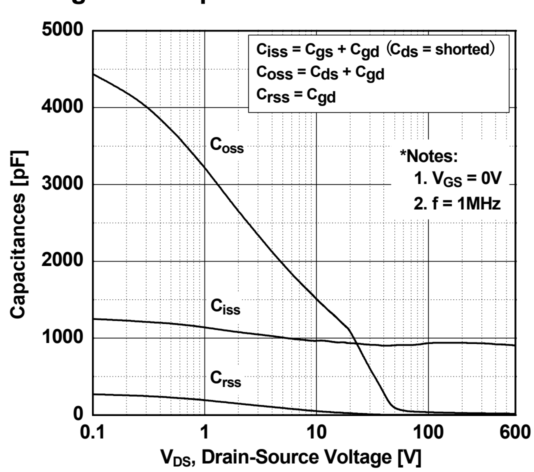
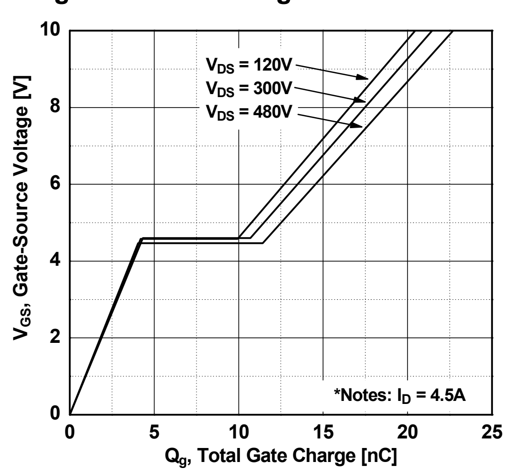


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

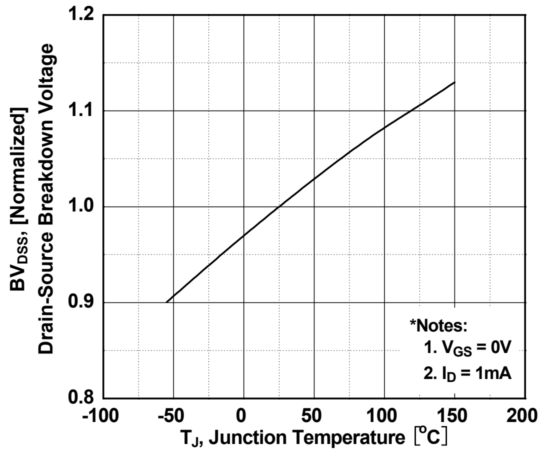


Figure 8. On-Resistance Variation vs. Temperature

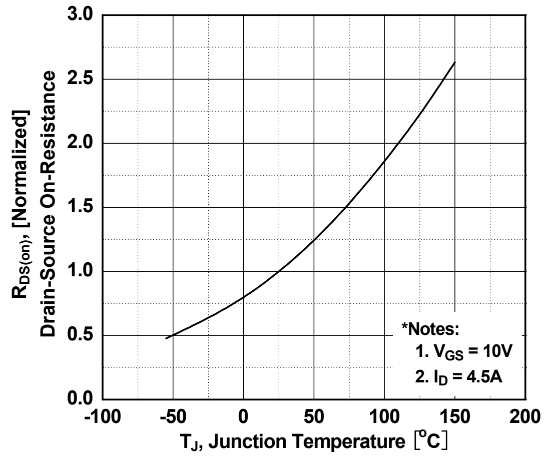


Figure 9. Maximum Safe Operating Area _ FCP9N60N

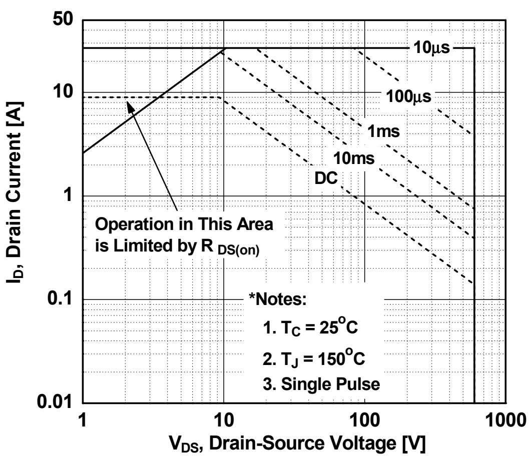


Figure 10. Maximum Safe Operating Area _ FCPF9N60NT

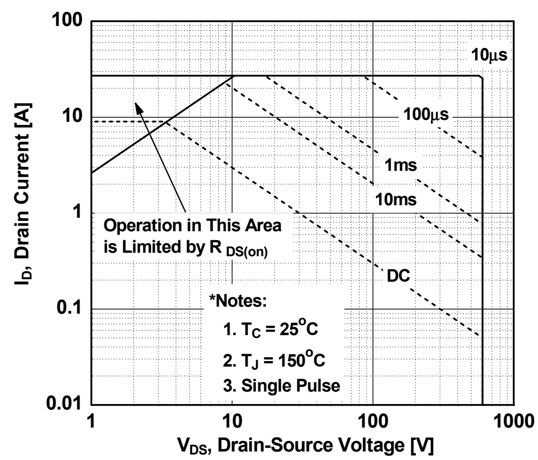
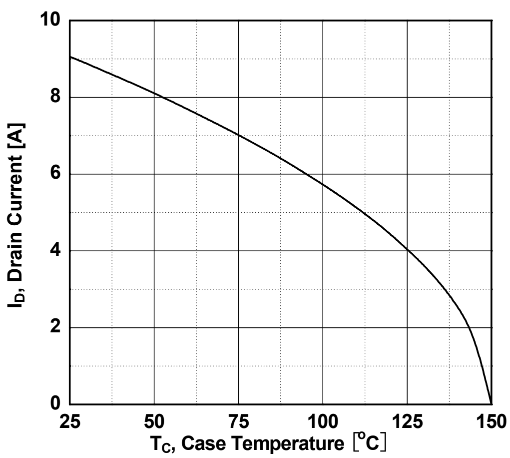


Figure 11. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve _ FCP9N60N

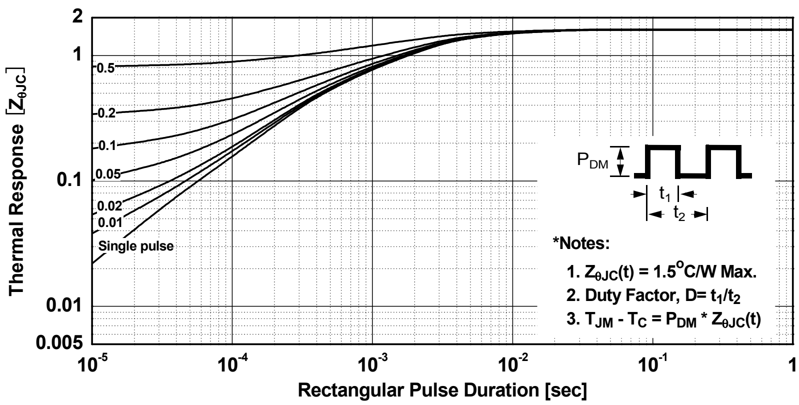
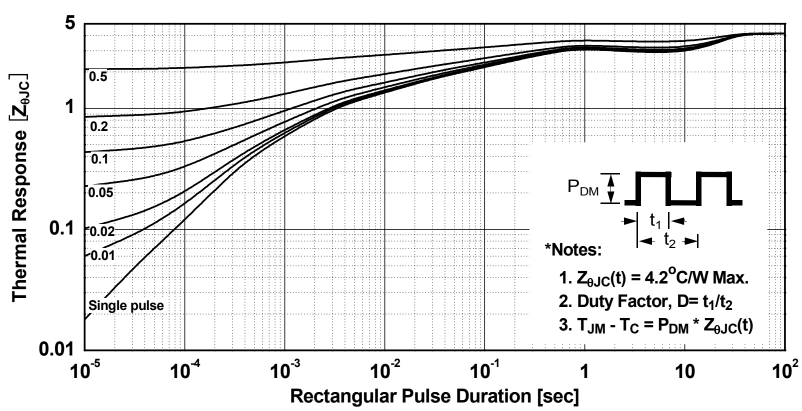
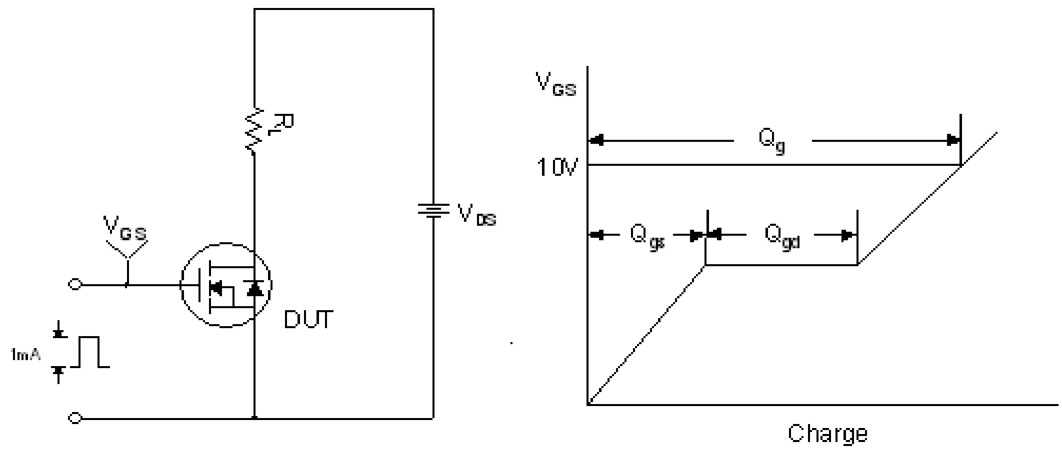


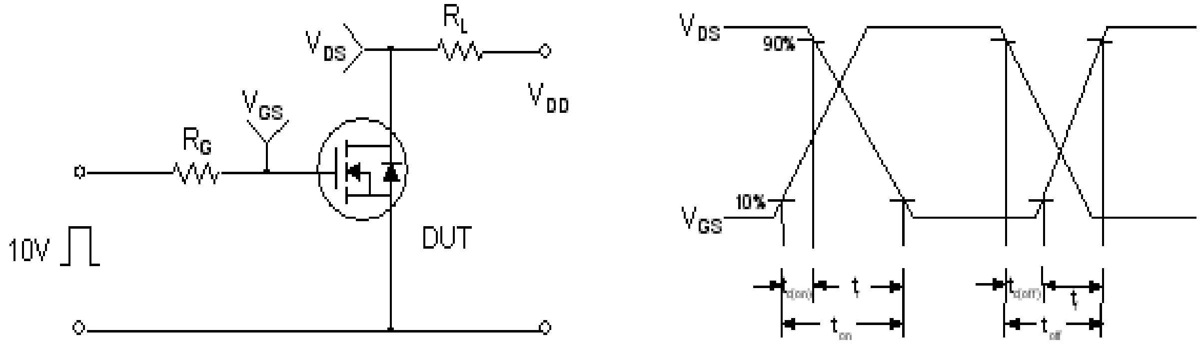
Figure 13. Transient Thermal Response Curve _ FCPF9N60NT



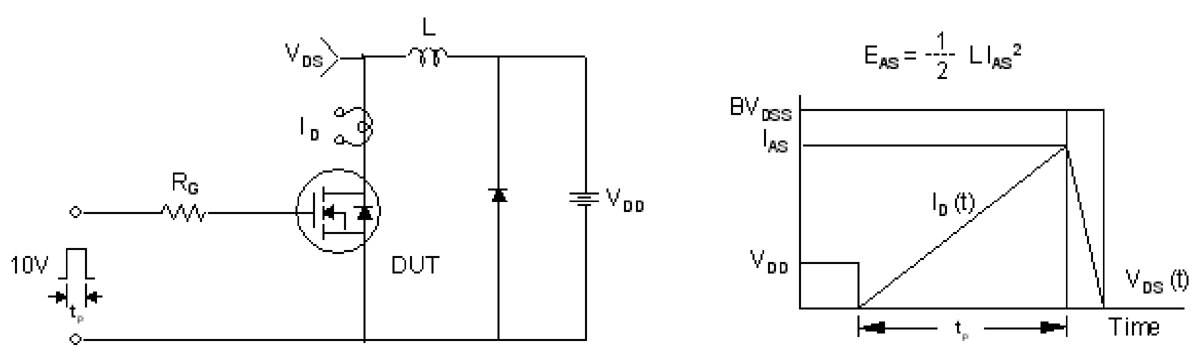
Gate Charge Test Circuit & Waveform



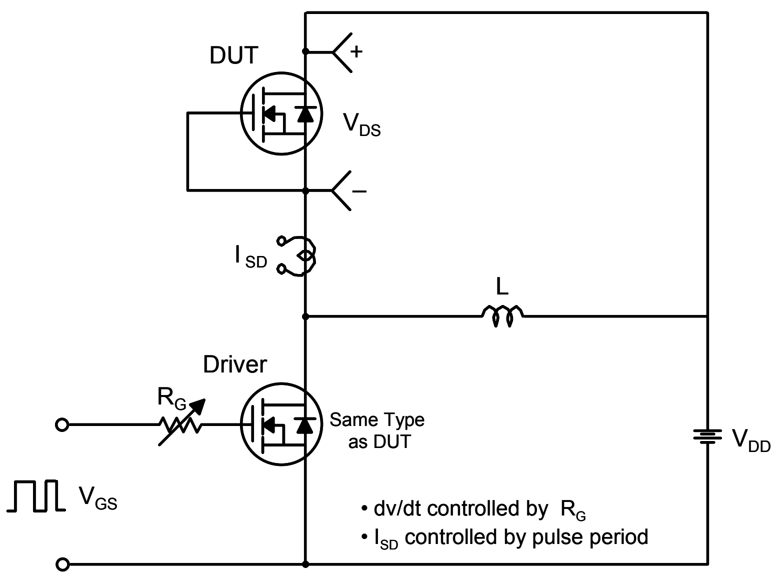
Resistive Switching Test Circuit & Waveforms

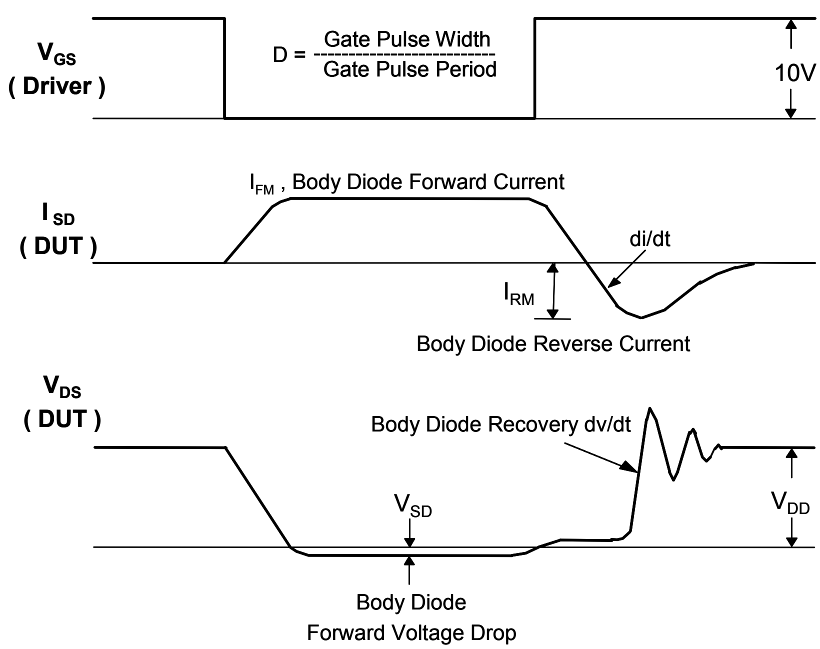


Unclamped Inductive Switching Test Circuit & Waveforms



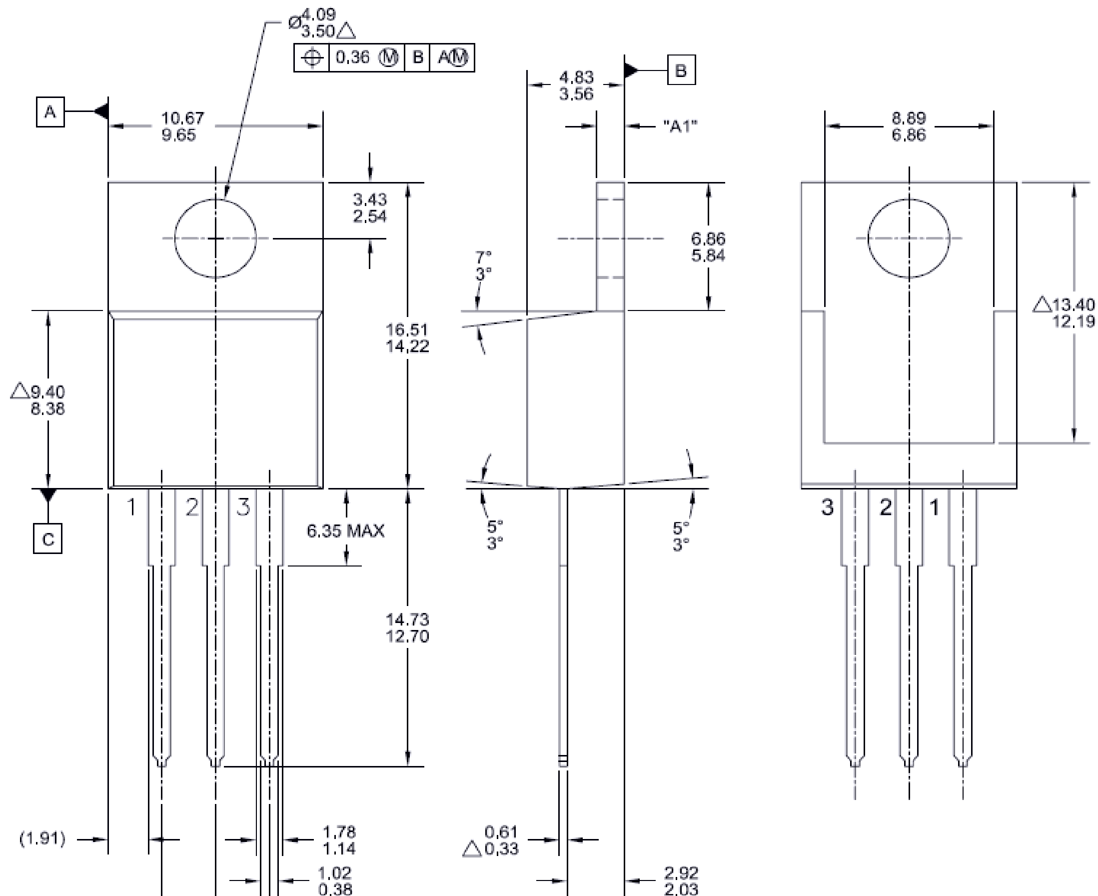
Peak Diode Recovery dv/dt Test Circuit & Waveforms

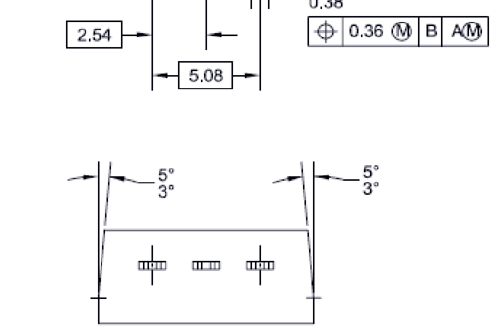




Mechanical Dimensions

TO-220



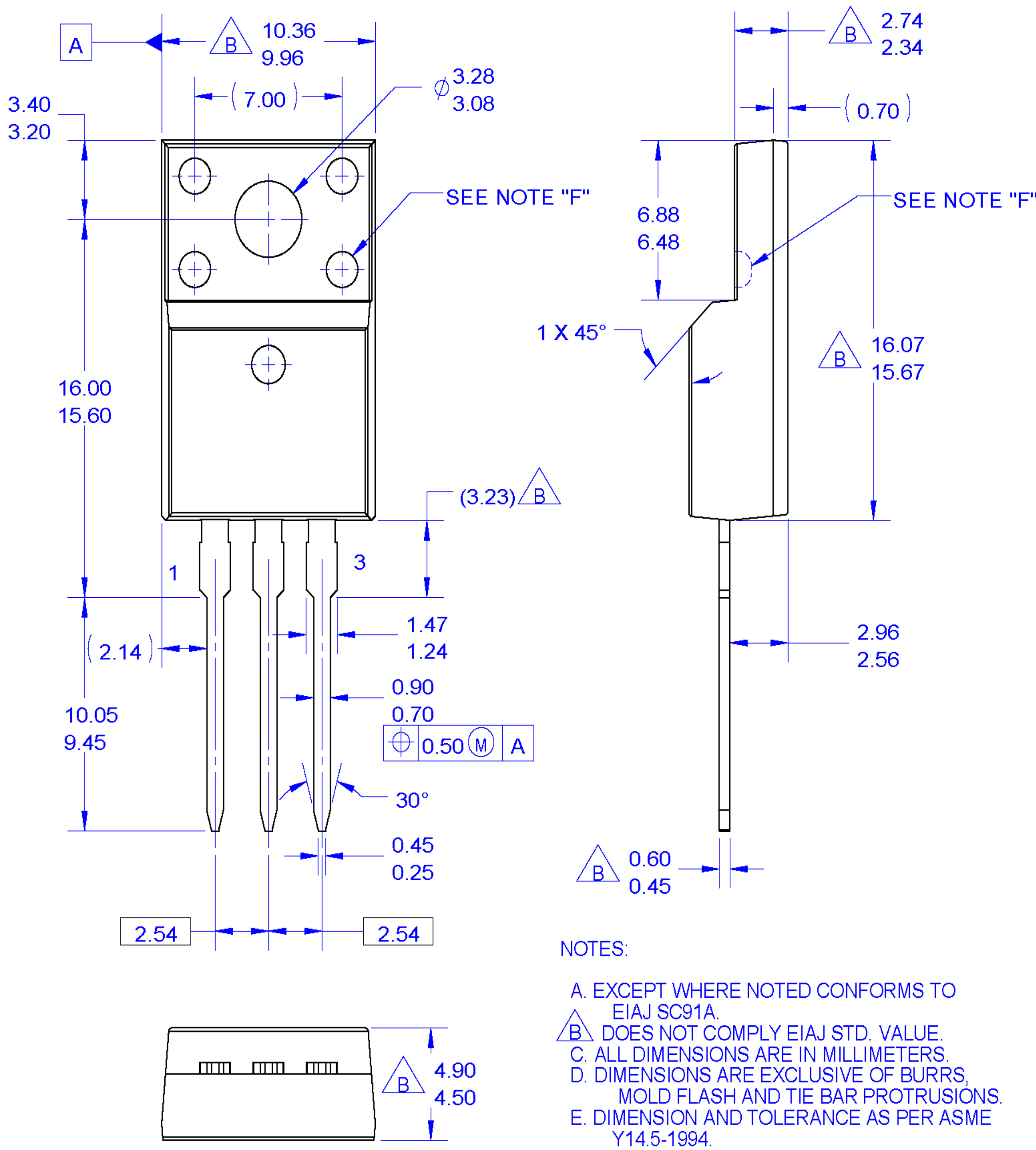


NOTES: UNLESS OTHERWISE SPECIFIED
A) REFERENCE JEDEC, TO-220, ISSUE K, VARIATION AB, DATED APRIL, 2002.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONING AND TOLERANCING PER ANSI Y14.5 - 1973
D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
E) DOES NOT COMPLY JEDEC STANDARD VALUE.
F) "A1" DIMENSIONS REPRESENT LIKE BELOW:
SINGLE GAUGE = 0.51 - 0.61
DUAL GAUGE = 1.14 - 1.40
G) DRAWING FILE NAME: TO220B03REV6

Dimensions in Millimeters

Mechanical Dimensions

TO-220F



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

Dimensions in Millimeters

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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.

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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. I64