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December 2015

FCP165N60E

N-Channel SuperFET® II Easy-Drive MOSFET

600 V, 23 A, 165 mΩ

Features

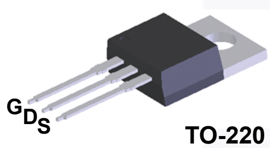
- 650 V @T_J = 150°C
- Typ. $R_{DS(on)}$ = 132 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 57 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff)}$ = 204 pF)
- 100% Avalanche Tested
- RoHS Compliant

Applications

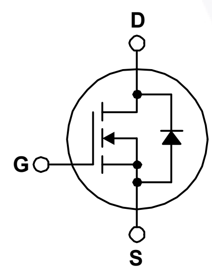
- Telecom / Sever Power Supplies
- Industrial Power Supplies

Description

SuperFET® II MOSFET is Fairchild Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET easy-drive series offers slightly slower rise and fall times compared to the SuperFET II MOSFET series. Noted by the "E" part number suffix, this family helps manage EMI issues and allows for easier design implementation. For faster switching in applications where switching losses must be at an absolute minimum, please consider the SuperFET II MOSFET series.



TO-220



Absolute Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter		FCP165N60E	Unit
V_{DSS}	Drain to Source Voltage		600	V
V_{GSS}	Gate to Source Voltage	- DC	±20	V
		- AC (f > 1 Hz)	±30	
I_D	Drain Current	- Continuous (T_C = 25°C)	23	A
		- Continuous (T_C = 100°C)	14	
I_{DM}	Drain Current	- Pulsed (Note 1)	69	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)		525	mJ
I_{AR}	Avalanche Current (Note 1)		5	A
E_{AR}	Repetitive Avalanche Energy (Note 1)		2.27	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
P_D	Power Dissipation	(T_C = 25°C)	227	W
		- Derate Above 25°C	1.82	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300	°C

Thermal Characteristics

Symbol	Parameter	FCP165N60E	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.55	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP165N60E	FCP165N60E	TO-220	Tube	N/A	N/A	50 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	V_{GS} = 0 V, I_D = 10 mA, T_J = 25°C	600	-	-	V
		V_{GS} = 0 V, I_D = 10 mA, T_J = 150°C	650	-	-	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 10 mA, Referenced to 25°C	-	0.7	-	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	-	-	1	μA
		V_{DS} = 480 V, V_{GS} = 0 V, T_C = 125°C	-	1.46	-	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 μA	2.5	-	3.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 11.5 A	-	132	165	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 20 V, I_D = 11.5 A	-	20	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 380 V, V_{GS} = 0 V, f = 1 MHz	-	1830	2434	pF
C_{oss}	Output Capacitance		-	50	67	pF
C_{rss}	Reverse Transfer Capacitance		-	8.6	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	V_{DS} = 0 V to 480 V, V_{GS} = 0 V	-	204	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	V_{DS} = 380 V, I_D = 11.5 A, V_{GS} = 10 V (Note 4)	-	57	75	nC
Q_{gs}	Gate to Source Gate Charge		-	8.3	-	nC
Q_{gd}	Gate to Drain “Miller” Charge		-	24	-	nC
ESR	Equivalent Series Resistance	f = 1 MHz	-	6	-	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 380 V, I_D = 11.5 A, V_{GS} = 10 V, R_g = 4.7 Ω (Note 4)	-	22	55	ns
t_r	Turn-On Rise Time		-	18	46	ns
$t_{d(off)}$	Turn-Off Delay Time		-	100	210	ns
t_f	Turn-Off Fall Time		-	18	47	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	23	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	69	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 11.5 A	-	-	1.2	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_{SD} = 11.5 A, dI_F/dt = 100 A/μs	-	326	-	ns
Q_{rr}	Reverse Recovery Charge		-	5.3	-	μC

Notes:

1. Repetitive rating: pulse width limited by maximum junction temperature.
2. I_{AS} = 5.0 A, R_G = 25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ 11.5 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 380 V, Starting T_J = 25°C
4. Essentially independent of operating temperature.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

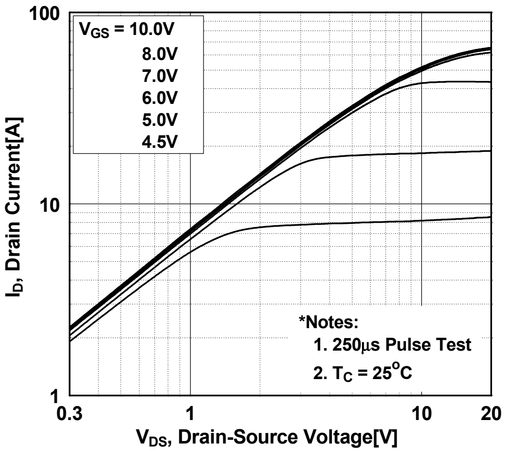


Figure 2. Transfer Characteristics

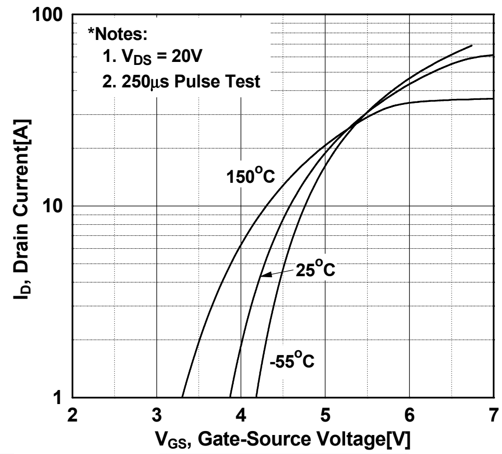


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

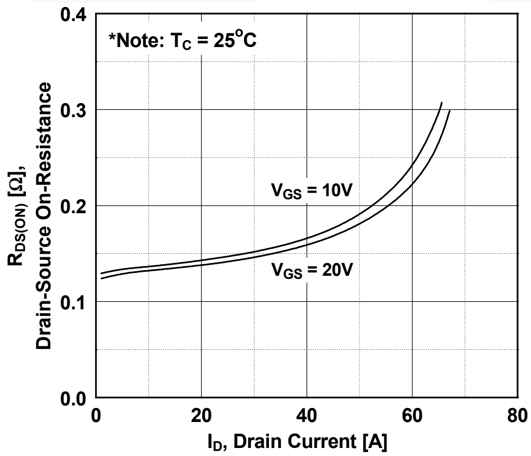


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

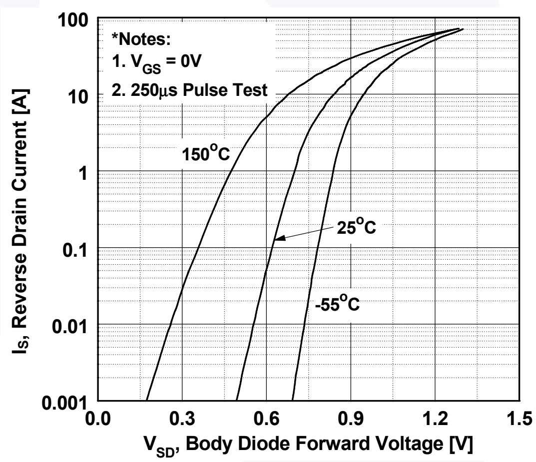


Figure 5. Capacitance Characteristics

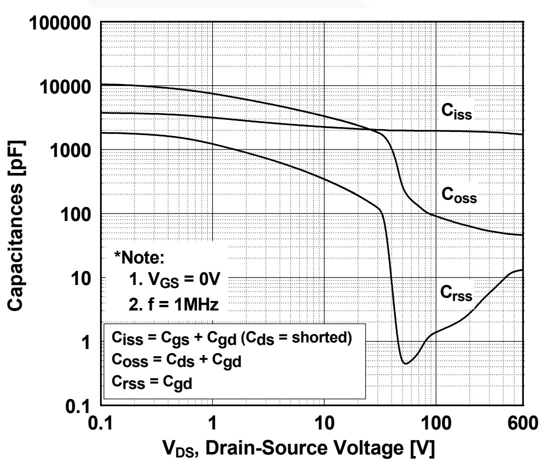
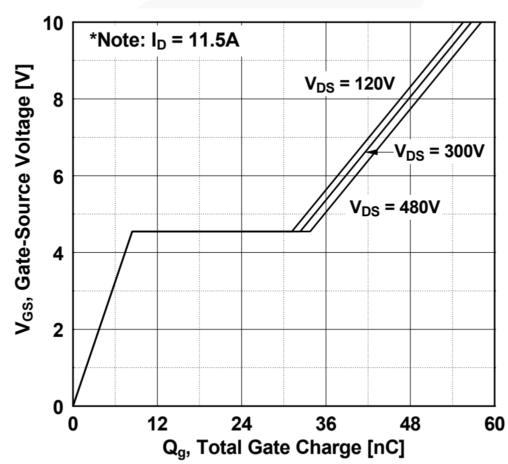


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

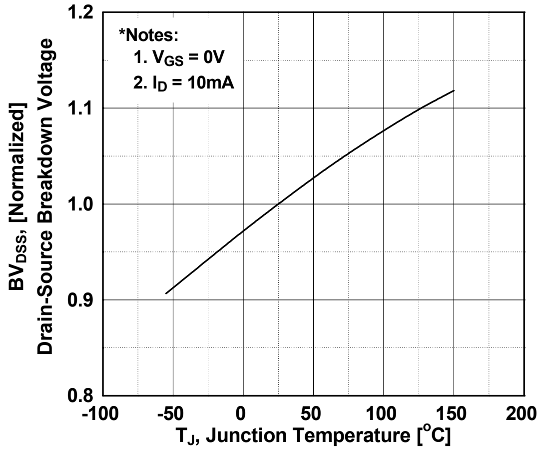


Figure 8. On-Resistance Variation vs. Temperature

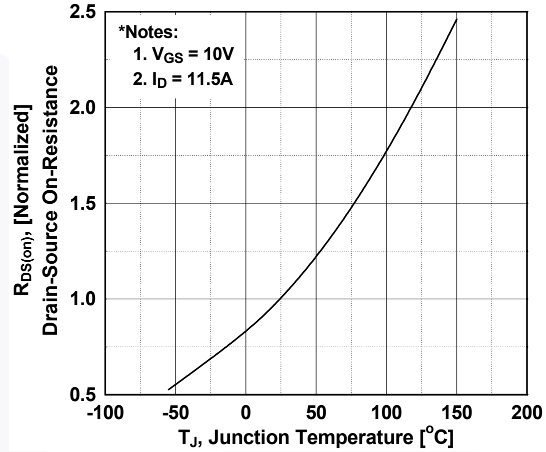


Figure 9. Maximum Safe Operating Area

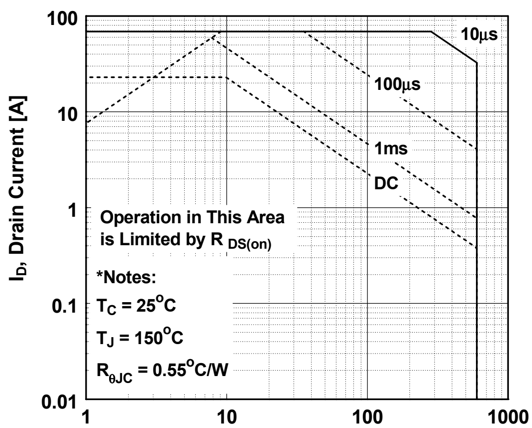


Figure 10. Maximum Drain Current vs. Case Temperature

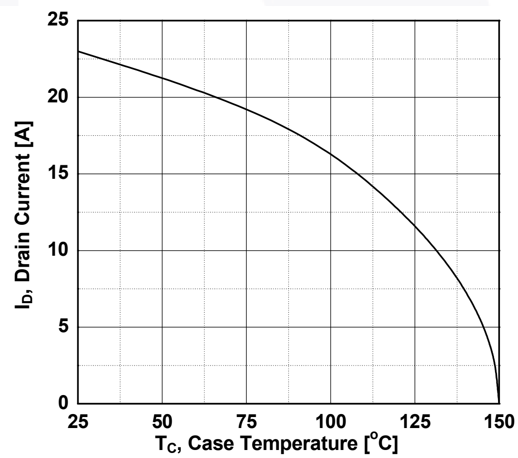
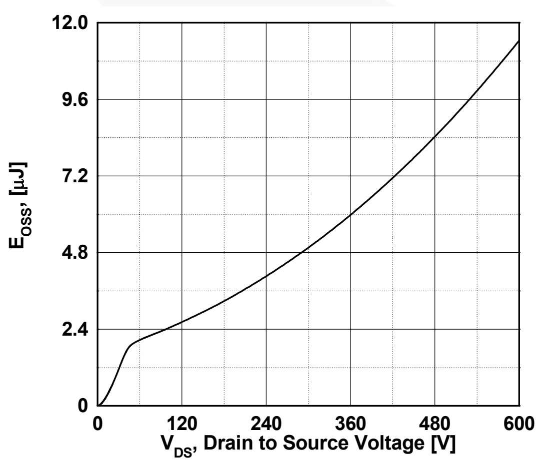
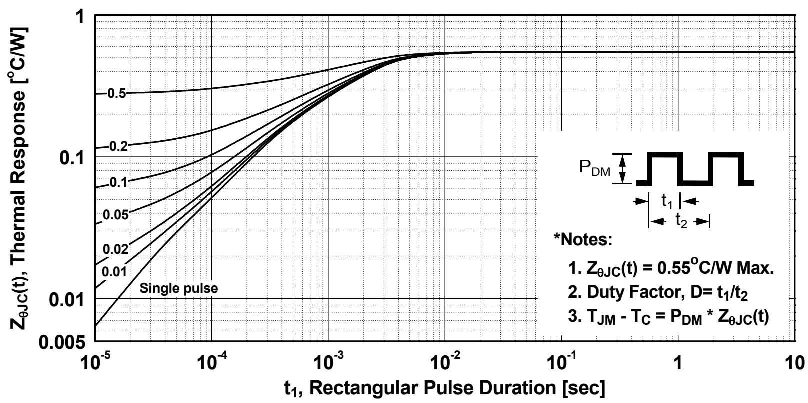


Figure 11. Eoss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



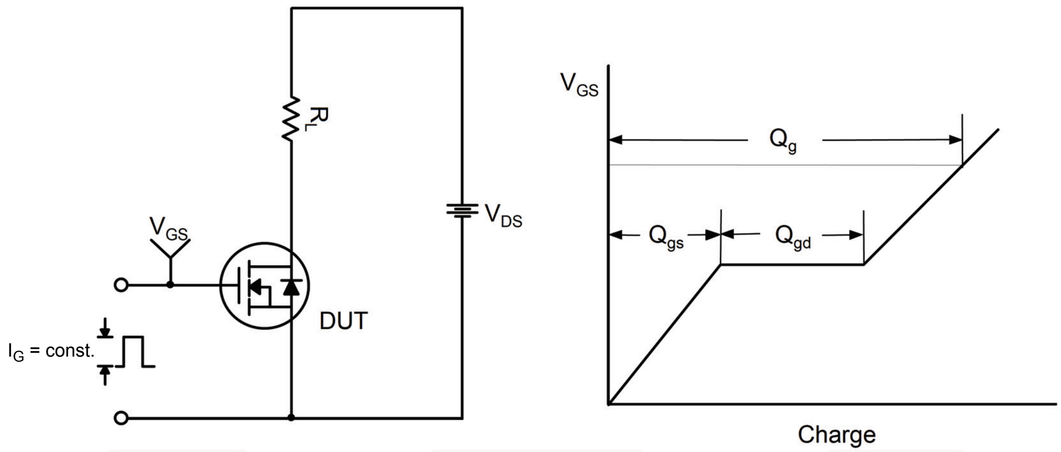


Figure 13. Gate Charge Test Circuit & Waveform

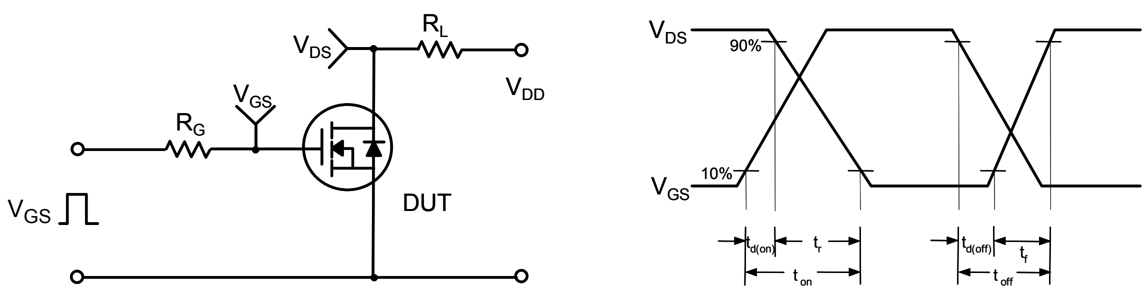


Figure 14. Resistive Switching Test Circuit & Waveforms

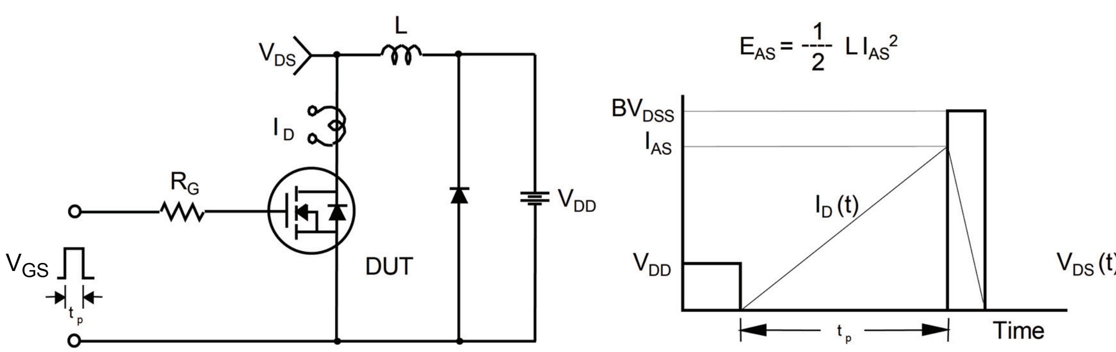


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

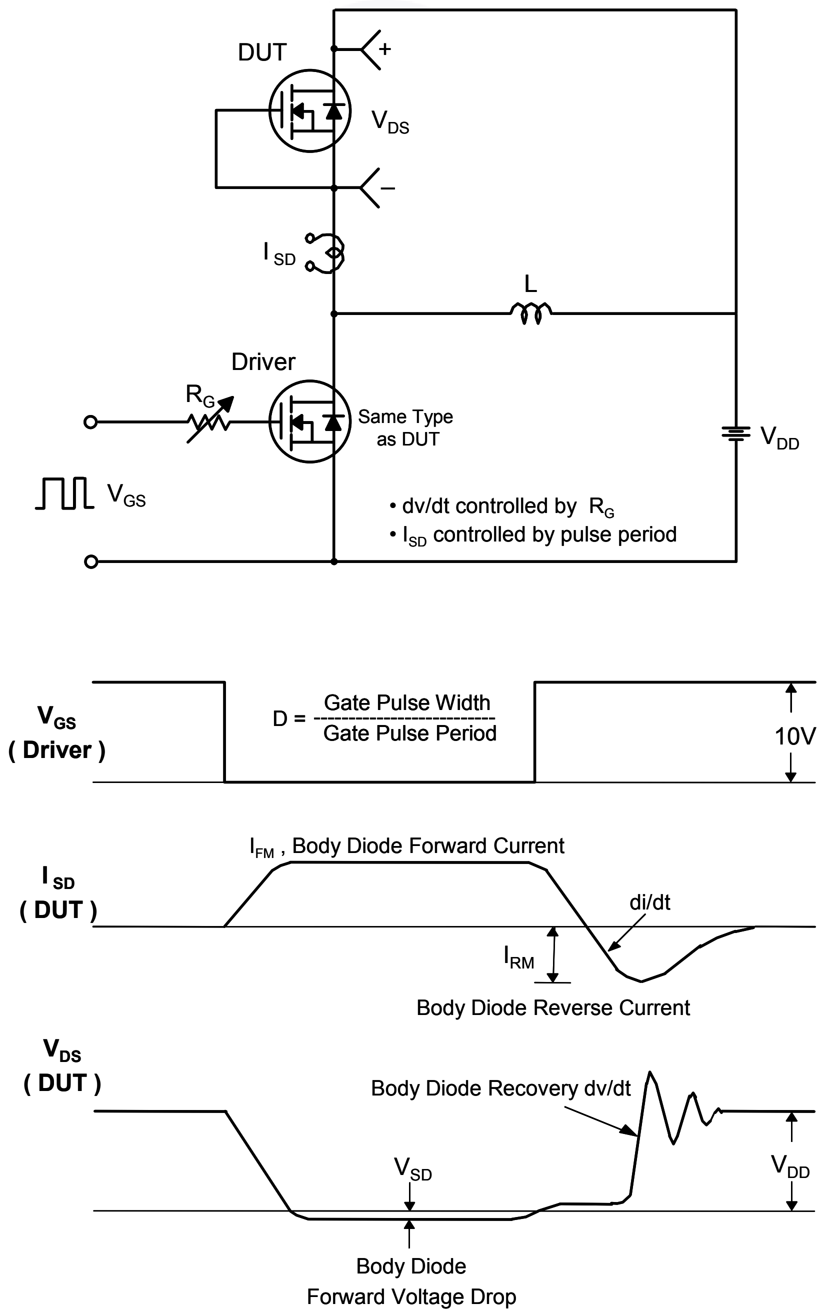
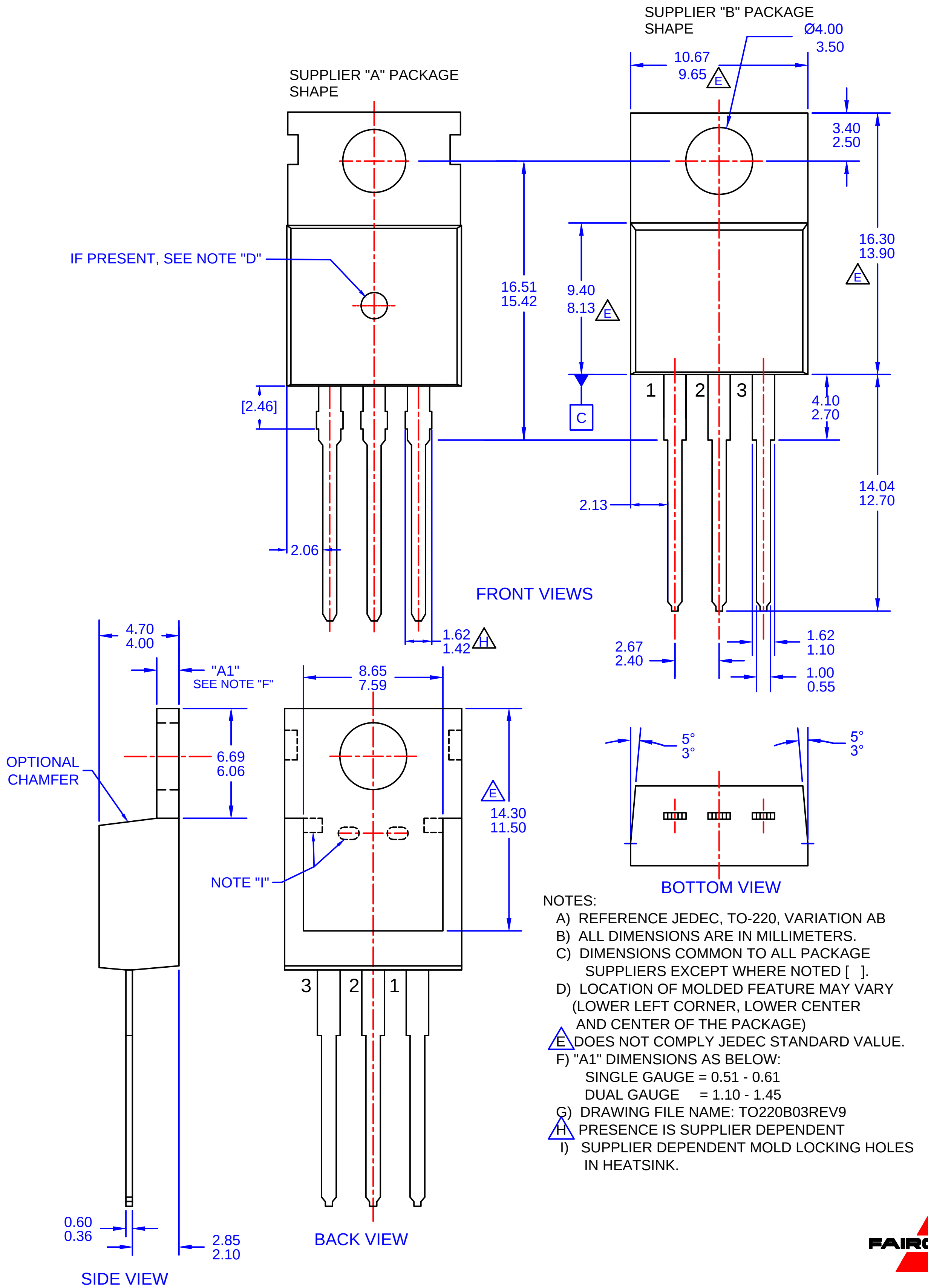


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms



NOTES:

A) REFERENCE JEDEC, TO-220, VARIATION AB

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].

D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)

E) DOES NOT COMPLY JEDEC STANDARD VALUE.

F) "A1" DIMENSIONS AS BELOW:
SINGLE GAUGE = 0.51 - 0.61
DUAL GAUGE = 1.10 - 1.45

G) DRAWING FILE NAME: TO220B03REV9

H) PRESENCE IS SUPPLIER DEPENDENT

I) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

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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.

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