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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

November 2014

FCPF400N80ZL1

N-Channel SuperFET® II MOSFET

800 V, 11 A, 400 mΩ

Features

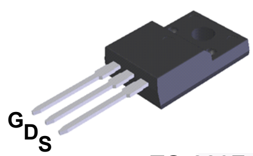
- Typ. $R_{DS(on)}$ = 340 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 43 nC)
- Low E_{oss} (Typ. 4.1 uJ @ 400 V)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 138 pF)
- 100% Avalanche Tested
- RoHS Compliant
- ESD Improved Capability

Applications

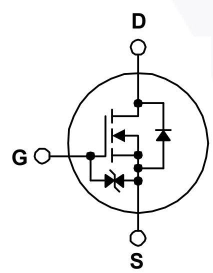
- AC-DC Power Supply
- LED Lighting

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. In addition, internal gate-source ESD diode allows to withstand over 2kV HBM surge stress. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as Audio, Laptop adapter, Lighting, ATX power and industrial power applications.



TO-220F



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

Symbol	Parameter			FCPF400N80ZL1	Unit
V_{DSS}	Drain to Source Voltage			800	V
V_{GSS}	Gate to Source Voltage	- DC		±20	V
		- AC	(f >1 Hz)	±30	
I_D	Drain Current	- Continuous (T_C = 25°C)		11*	A
		- Continuous (T_C = 100°C)		6.9*	
I_{DM}	Drain Current	- Pulsed	(Note 1)	33*	A
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	339	mJ
I_{AR}	Avalanche Current		(Note 1)	2.2	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	0.36	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)		35.7	W
		- Derate Above 25°C		0.29	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

*Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	FCPF400N80ZL1	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	3.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCPF400N80ZL1	FCPF400N80ZL1	TO-220F	Tube	N/A	N/A	50 units

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit

Off Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV_{DSS}	Drain to Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 1$ mA, $T_J = 25°C$	800	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1$ mA, Referenced to 25^oC	-	0.8	-	$V/^oC$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 800$ V, $V_{GS} = 0$ V	-	-	25	μA
		$V_{DS} = 640$ V, $T_C = 125^oC$	-	-	250	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 20$ V, $V_{DS} = 0$ V	-	-	±10	μA

On Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 1.1$ mA	2.5	-	4.5	V
		$V_{GS} = V_{DS}$, $I_D = 0.68$ mA	2.5	-	4.5	
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10$ V, $I_D = 5.5$ A	-	0.34	0.4	Ω
		$V_{GS} = 10$ V, $I_D = 7.1$ A	-	0.35	0.4	
		$V_{GS} = 10$ V, $I_D = 7.1$ A, $T_C = 150^oC$	-	0.89	-	
g_{FS}	Forward Transconductance	$V_{DS} = 20$ V, $I_D = 5.5$ A	-	12	-	S

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input Capacitance	$V_{DS} = 100$ V, $V_{GS} = 0$ V, f = 1 MHz	-	1770	2350	pF
C_{oss}	Output Capacitance		-	51	70	pF
C_{rss}	Reverse Transfer Capacitance		-	0.5	-	pF
C_{oss}	Output Capacitance	$V_{DS} = 480$ V, $V_{GS} = 0$ V, f = 1 MHz	-	28	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0$ V to 480 V, $V_{GS} = 0$ V	-	138	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 640$ V, $I_D = 11$ A, $V_{GS} = 10$ V (Note 4)	-	43	56	nC
Q_{gs}	Gate to Source Gate Charge		-	8.6	-	nC
Q_{gd}	Gate to Drain “Miller” Charge		-	17	-	nC
ESR	Equivalent Series Resistance	f = 1 MHz	-	2.3	-	Ω

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400$ V, $I_D = 11$ A, $V_{GS} = 10$ V, $R_g = 4.7$ Ω (Note 4)	-	20	50	ns
t_r	Turn-On Rise Time		-	12	34	ns
$t_{d(off)}$	Turn-Off Delay Time		-	51	112	ns
t_f	Turn-Off Fall Time		-	2.6	15	ns

Drain-Source Diode Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	11	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	33	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_{SD} = 11$ A	-	-	1.2	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_{SD} = 11$ A, $dI_F/dt = 100$ A/μs	-	395	-	ns
Q_{rr}	Reverse Recovery Charge		-	7.4	-	μC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $I_{AS} = 2.2$ A, $V_{DD} = 50$ V, $R_G = 25$ Ω, starting $T_J = 25°C$.
3. $I_{SD} \le 11$ A, di/dt ≤ 200 A/μs, $V_{DD} \le BV_{DSS}$, starting $T_J = 25°C$.
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

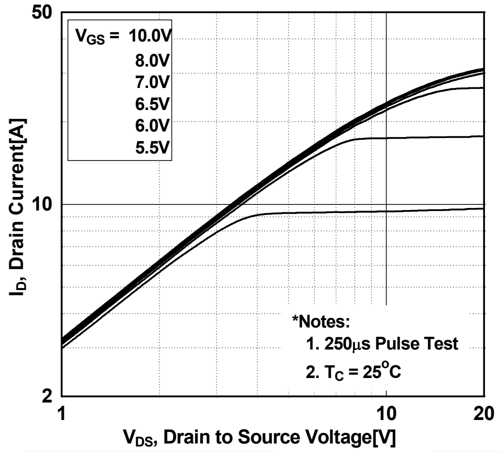


Figure 2. Transfer Characteristics

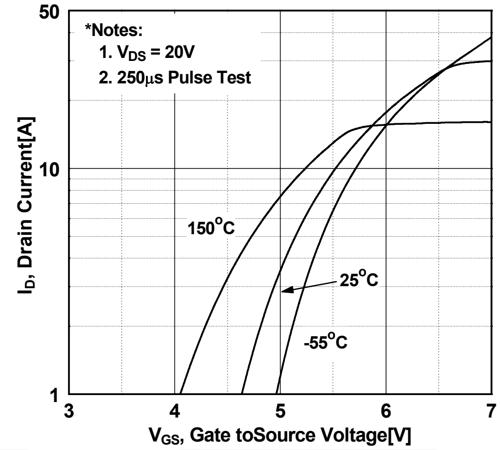


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

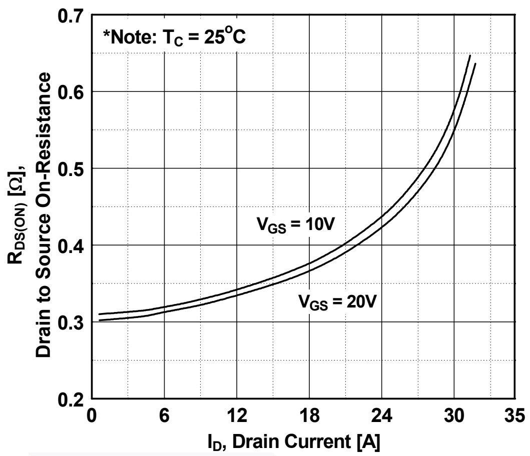


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

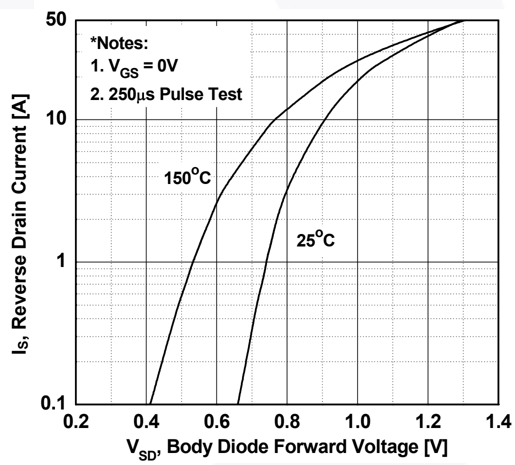


Figure 5. Capacitance Characteristics

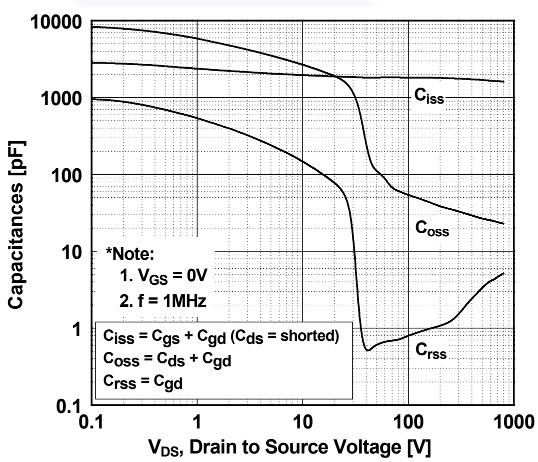
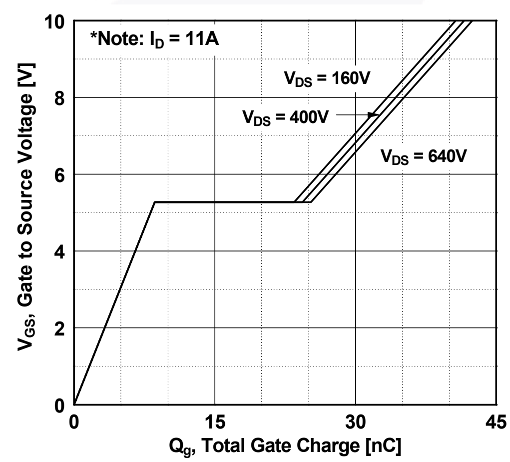


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

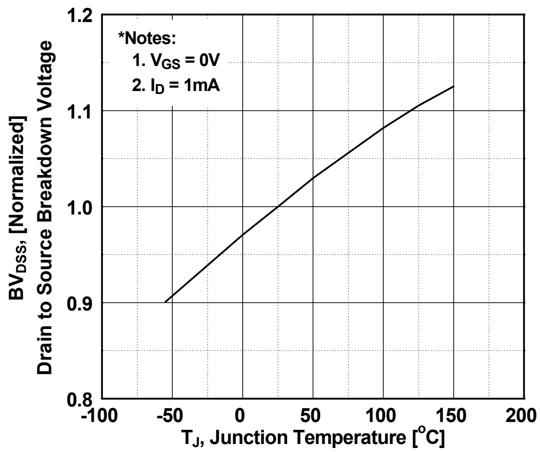


Figure 8. On-Resistance Variation vs. Temperature

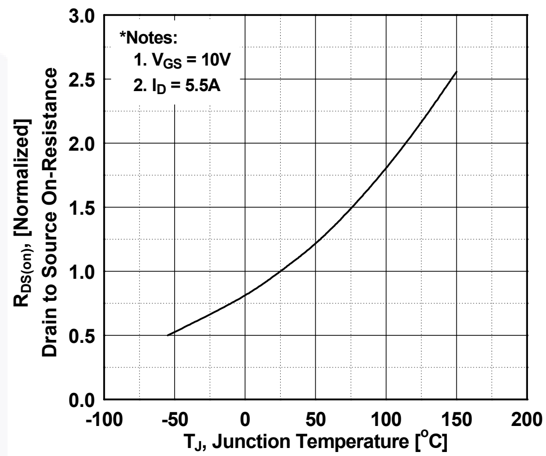


Figure 9. Maximum Safe Operating Area

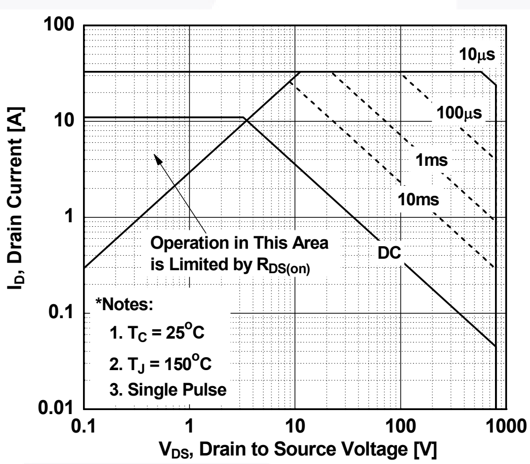


Figure 10. Maximum Drain Current vs. Case Temperature

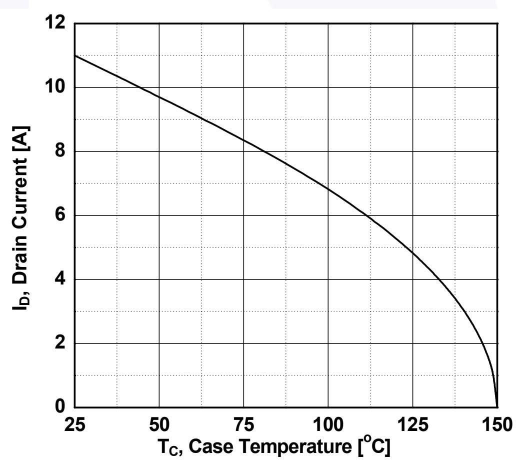
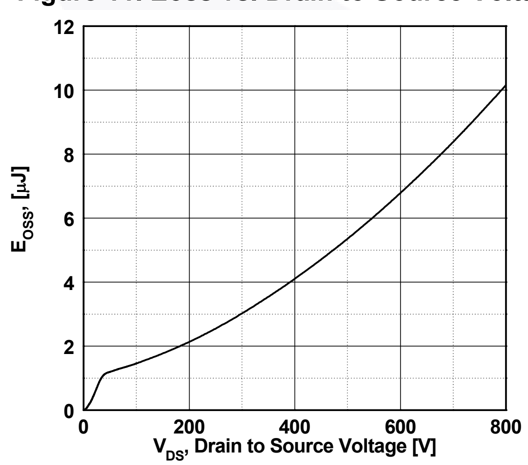
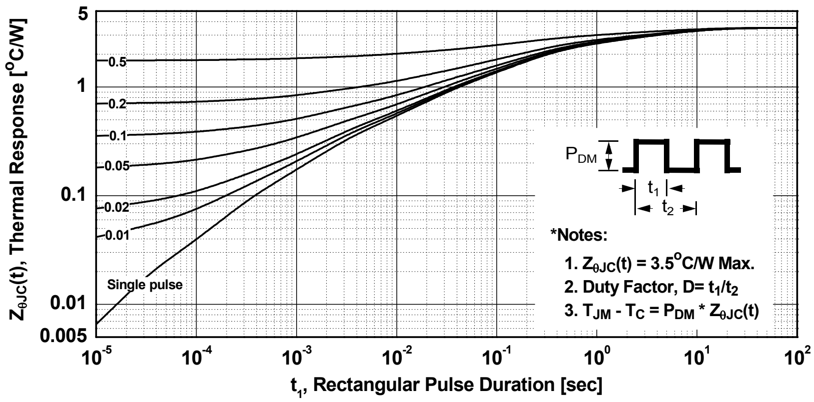


Figure 11. Eoss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



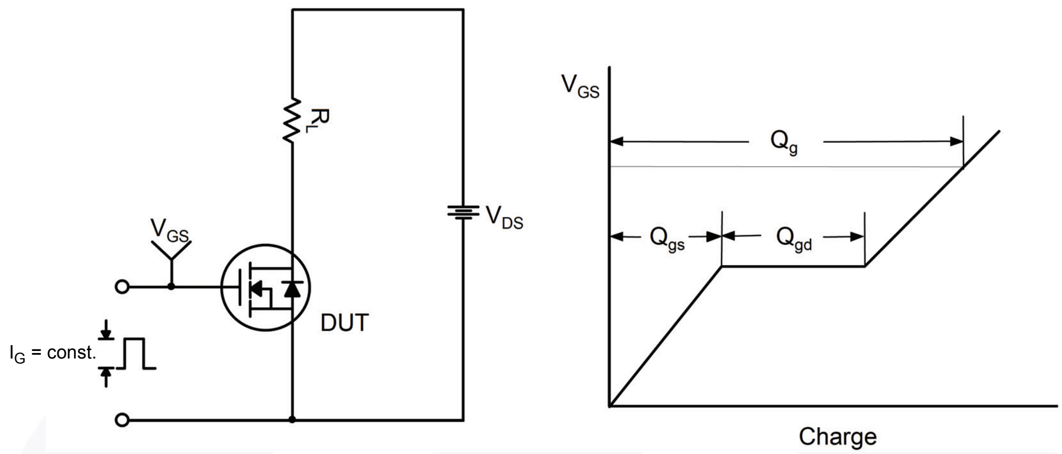


Figure 13. Gate Charge Test Circuit & Waveform

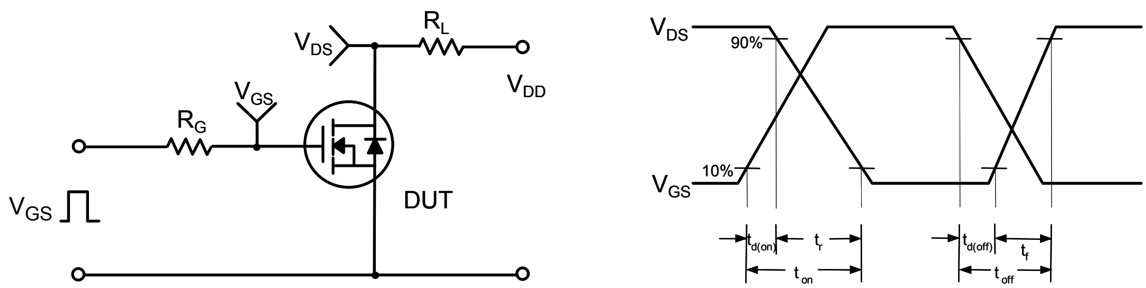


Figure 14. Resistive Switching Test Circuit & Waveforms

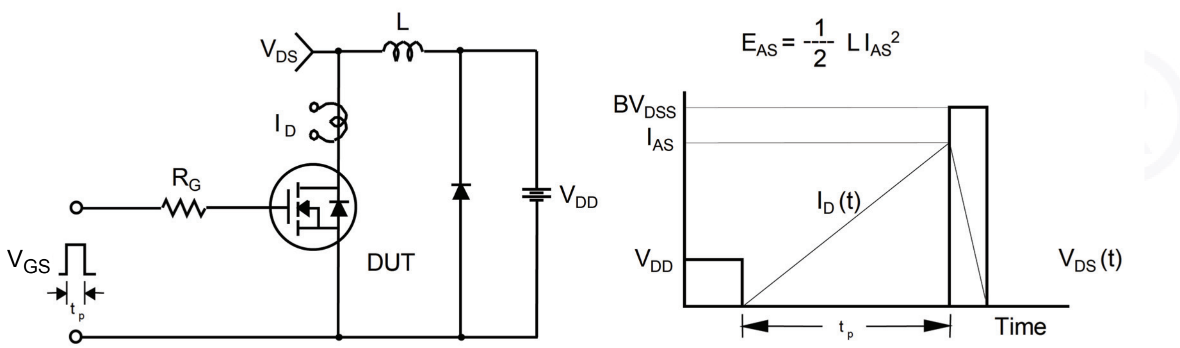


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

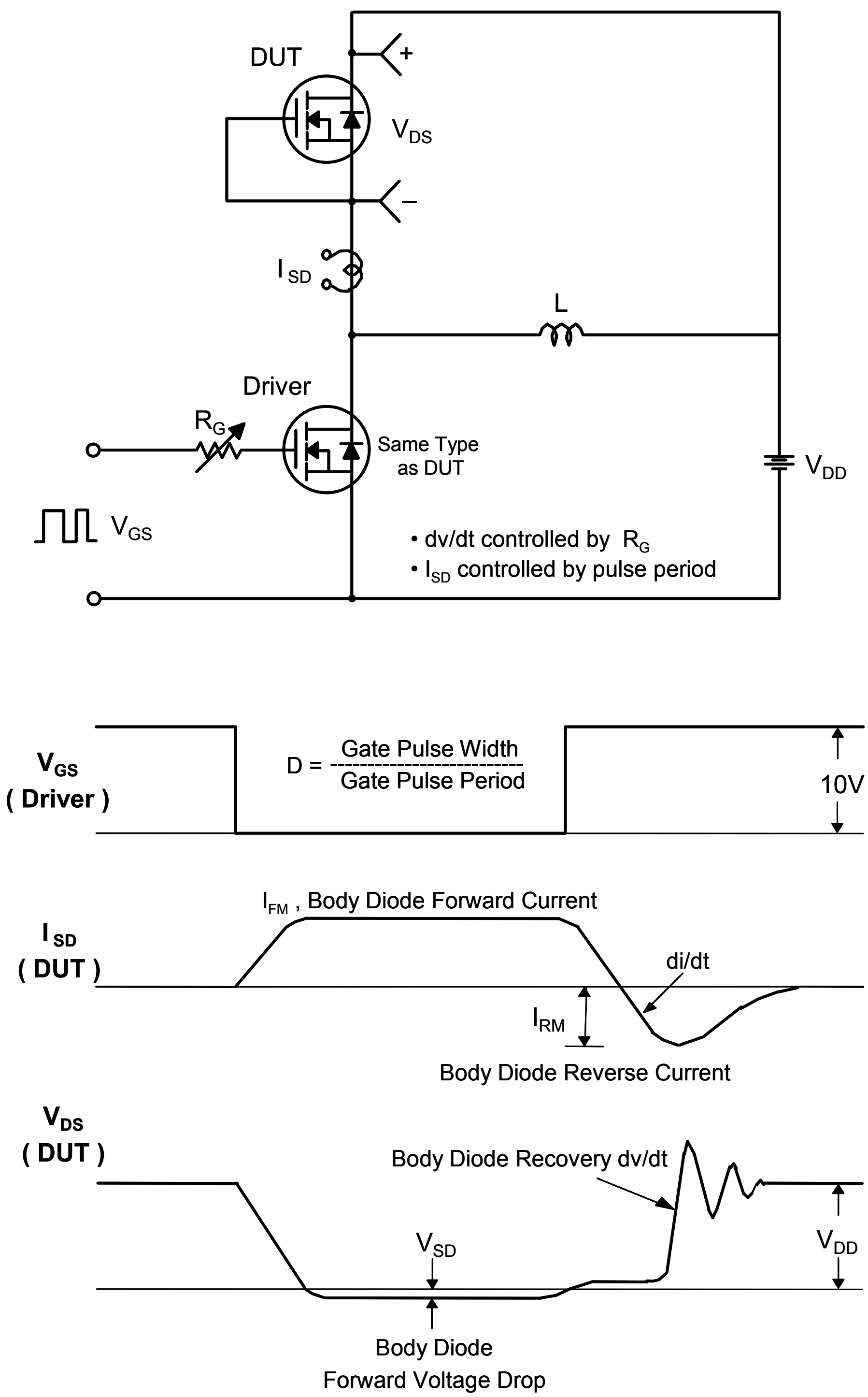
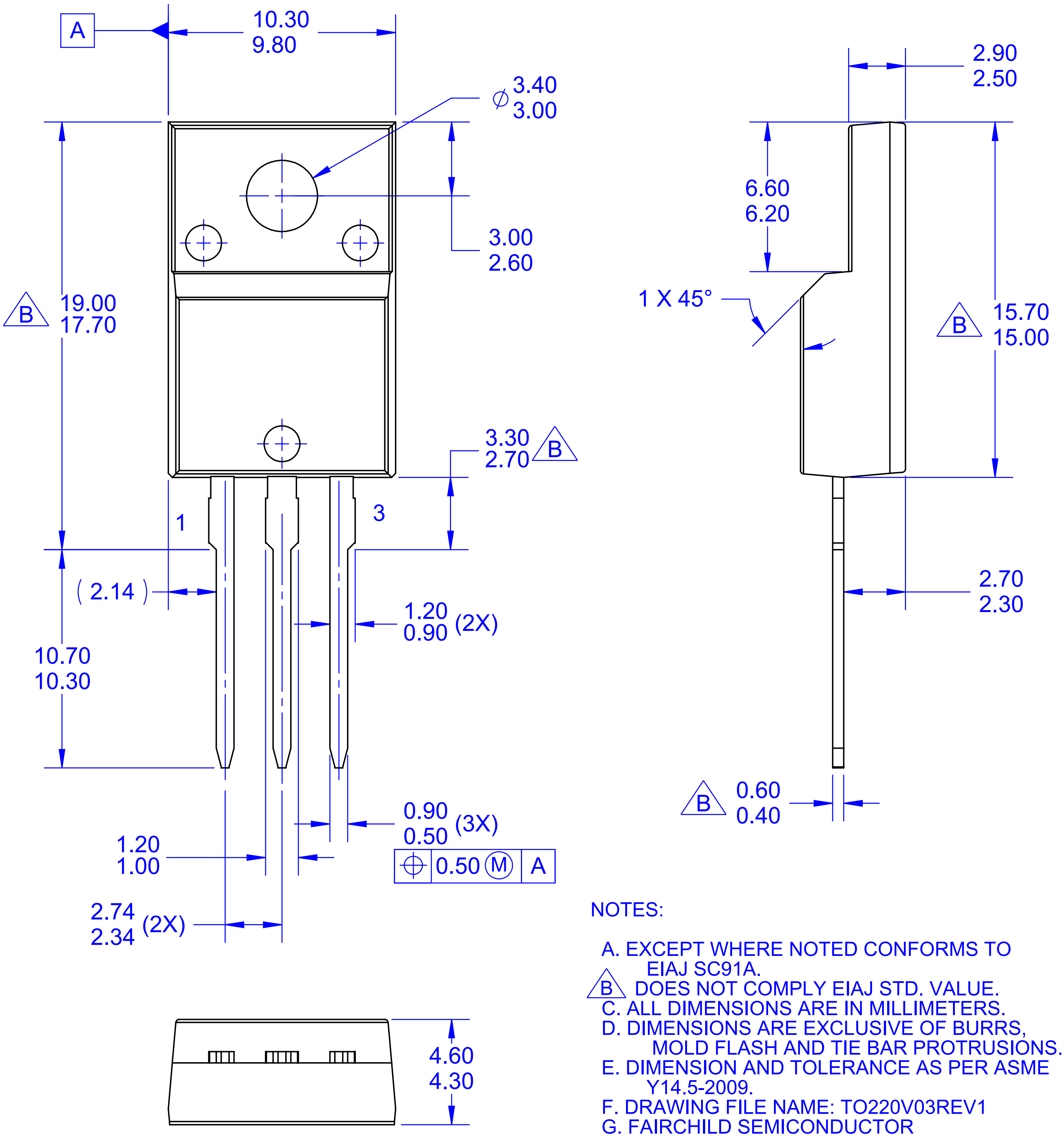


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms



NOTES:

A. 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 Y14.5-2009.

F. DRAWING FILE NAME: TO220V03REV1

G. FAIRCHILD SEMICONDUCTOR

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