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August 2014

FDP39N20 / FDPF39N20

N-Channel UniFET™ MOSFET

200 V, 39 A, 66 mΩ

Features

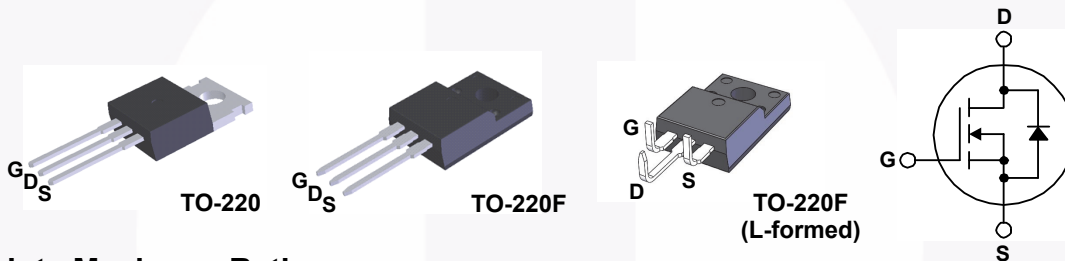
- $R_{DS(on)} = 66 \text{ m}\Omega$ (Max.) @ $V_{GS} = 10 \text{ V}$, $I_D = 19.5 \text{ A}$
- Low Gate Charge (Typ. 38 nC)
- Low C_{rss} (Typ. 57 pF)
- 100% Avalanche Tested

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 V, I _D = 250 μA	200	--	--	V
ΔBV _{DSS} / ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250 μA, Referenced to 25°C	--	0.2	--	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 200 V, V _{GS} = 0 V V _{DS} = 160 V, T _C = 125°C	-- --	-- --	1 10	μA μA
I _{GSSF}	Gate-Body Leakage Current, Forward	V _{GS} = 30 V, V _{DS} = 0 V	--	--	100	nA
I _{GSSR}	Gate-Body Leakage Current, Reverse	V _{GS} = -30 V, V _{DS} = 0 V	--	--	-100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250 μA	3.0	--	5.0	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 19.5 A	--	0.056	0.066	Ω
g _{FS}	Forward Transconductance	V _{DS} = 40 V, I _D = 19.5 A	--	28.5	--	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25 V, V _{GS} = 0 V, f = 1.0 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 V, I _D = 39 A, V _{GS} = 10 V, R _G = 25 Ω (Note 4)	--	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		--	150	310	ns
Q _g	Total Gate Charge	V _{DS} = 160 V, I _D = 39 A, V _{GS} = 10 V (Note 4)	--	38	49	nC
Q _{gs}	Gate-Source Charge		--	11	--	nC
Q _{gd}	Gate-Drain Charge		--	16.5	--	nC
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 V, I _S = 39 A	--	--	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 39 A, dI _F /dt =100 A/μs	--	152	--	ns
Q _{rr}	Reverse Recovery Charge		--	1.1	--	μC

Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $L = 0.85\text{ mH}, I_{AS} = 39\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, 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

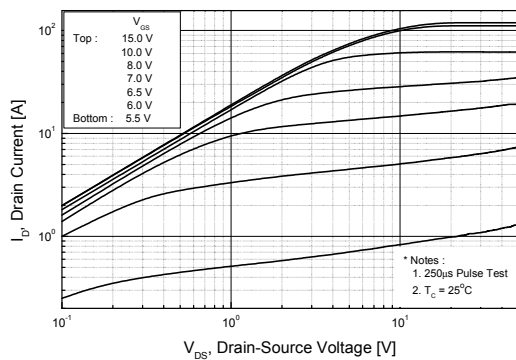


Figure 2. Transfer Characteristics

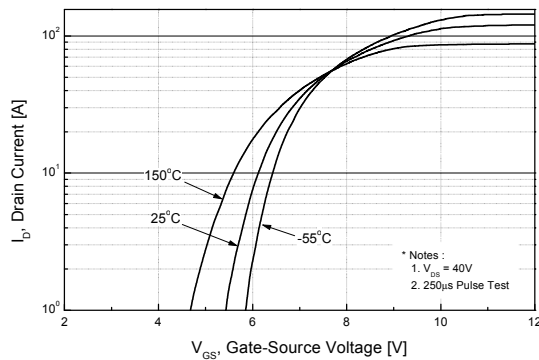


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

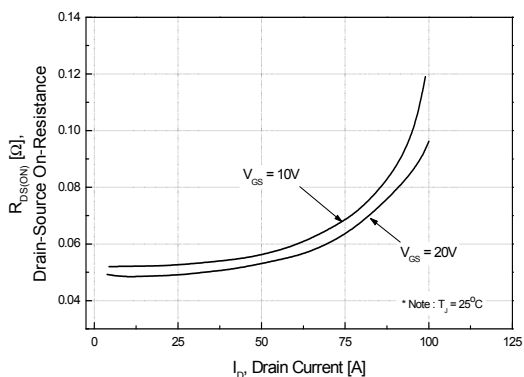


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

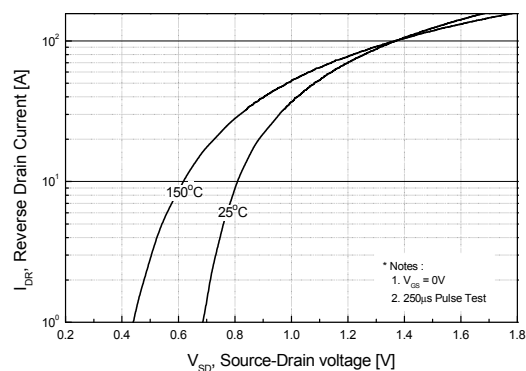


Figure 5. Capacitance Characteristics

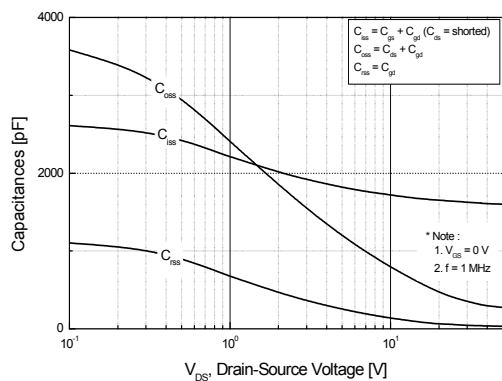
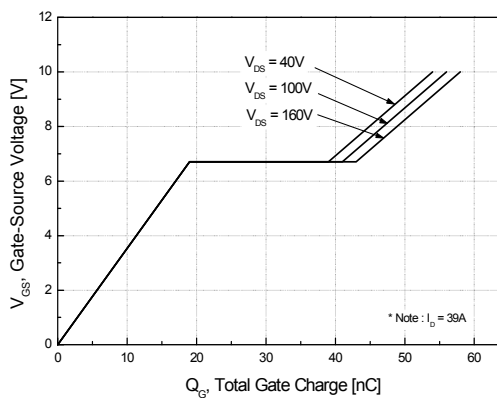


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

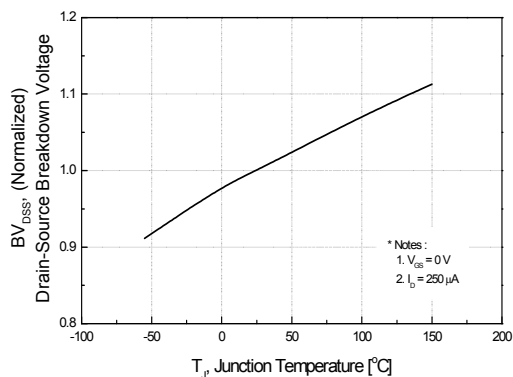


Figure 8. On-Resistance Variation vs. Temperature

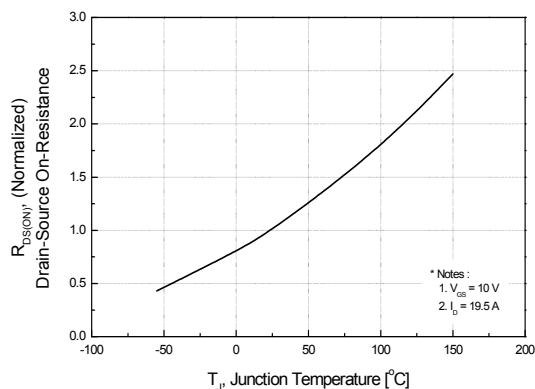


Figure 9-1. Maximum Safe Operating Area - FDP39N20

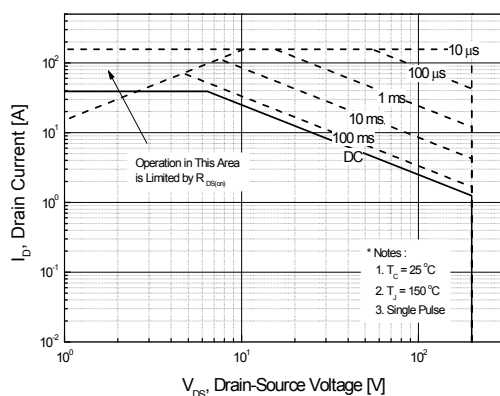


Figure 9-2. Maximum Safe Operating Area - FDPF39N20

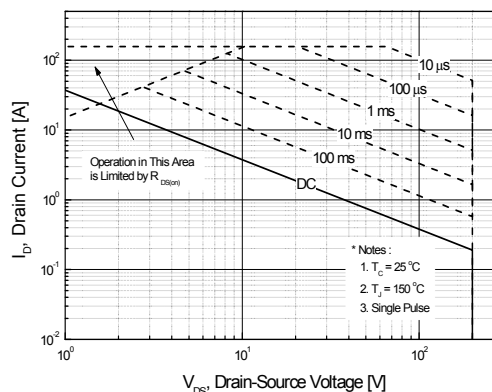
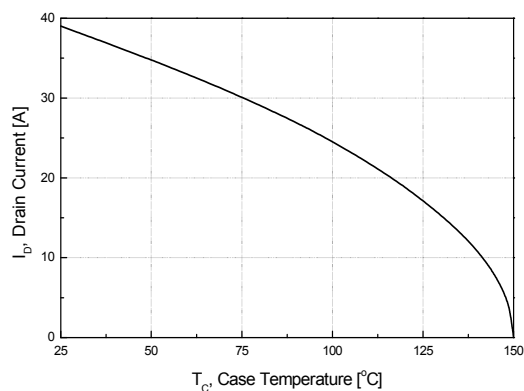


Figure 10. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve - FDP39N20

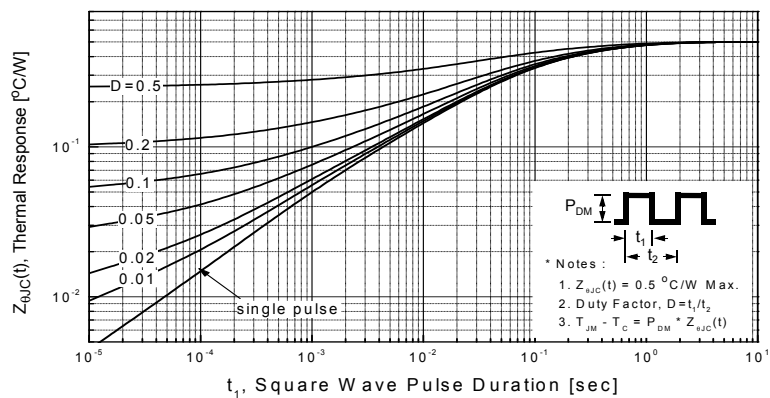
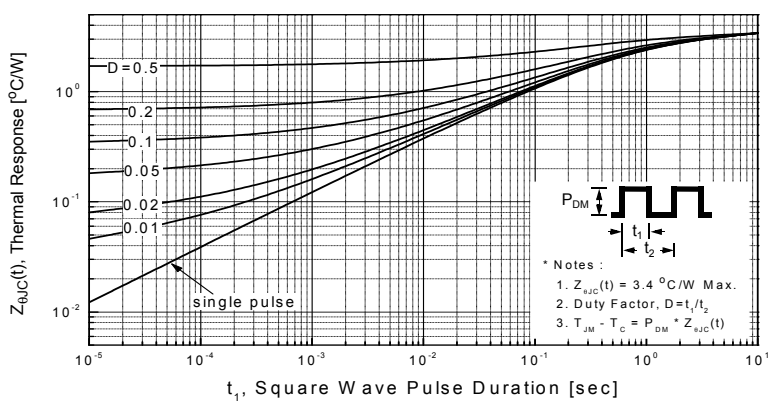


Figure 11-2. Transient Thermal Response Curve - FDPF39N20



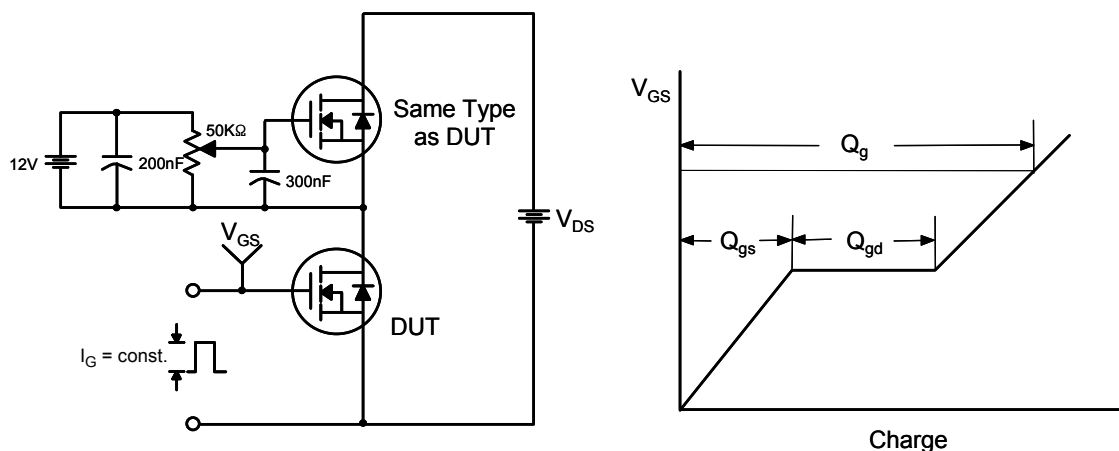


Figure 12. Gate Charge Test Circuit & Waveform

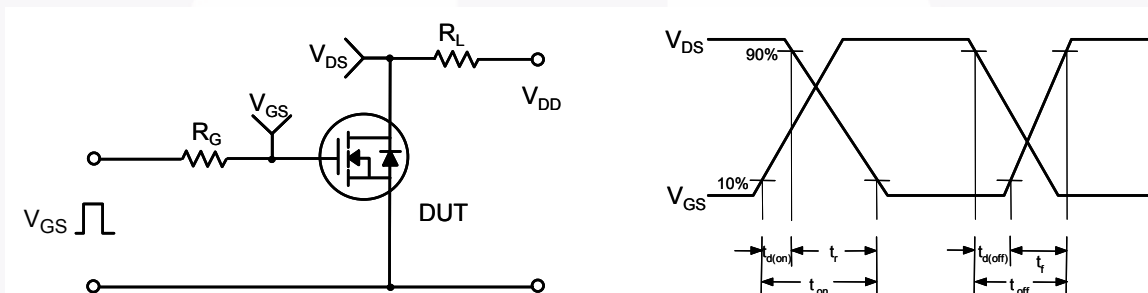


Figure 13. Resistive Switching Test Circuit & Waveforms

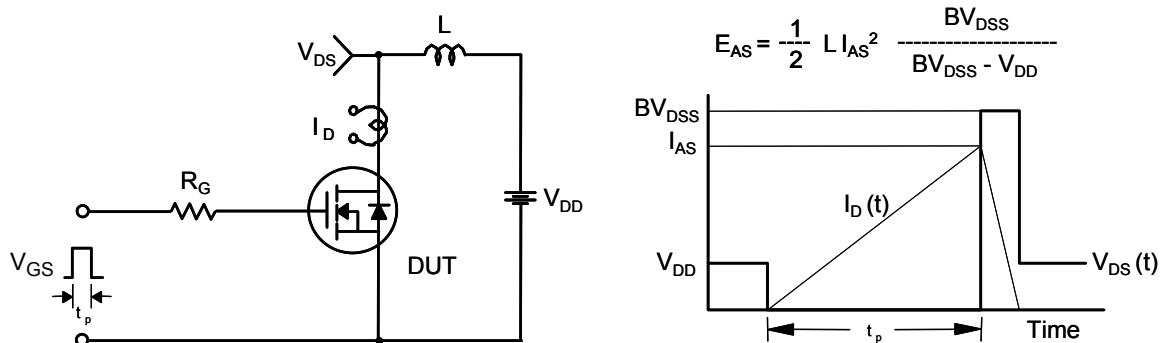


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

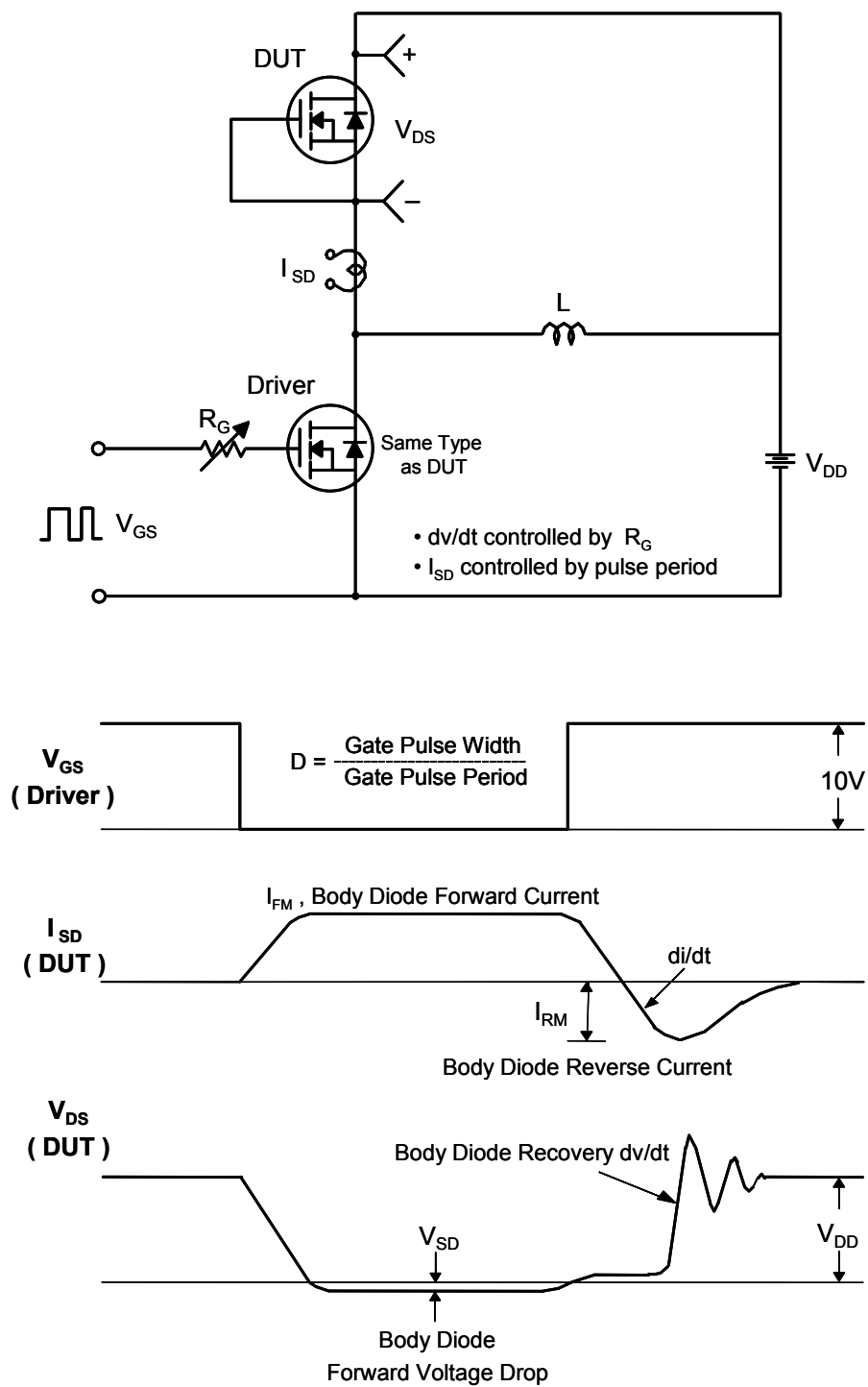
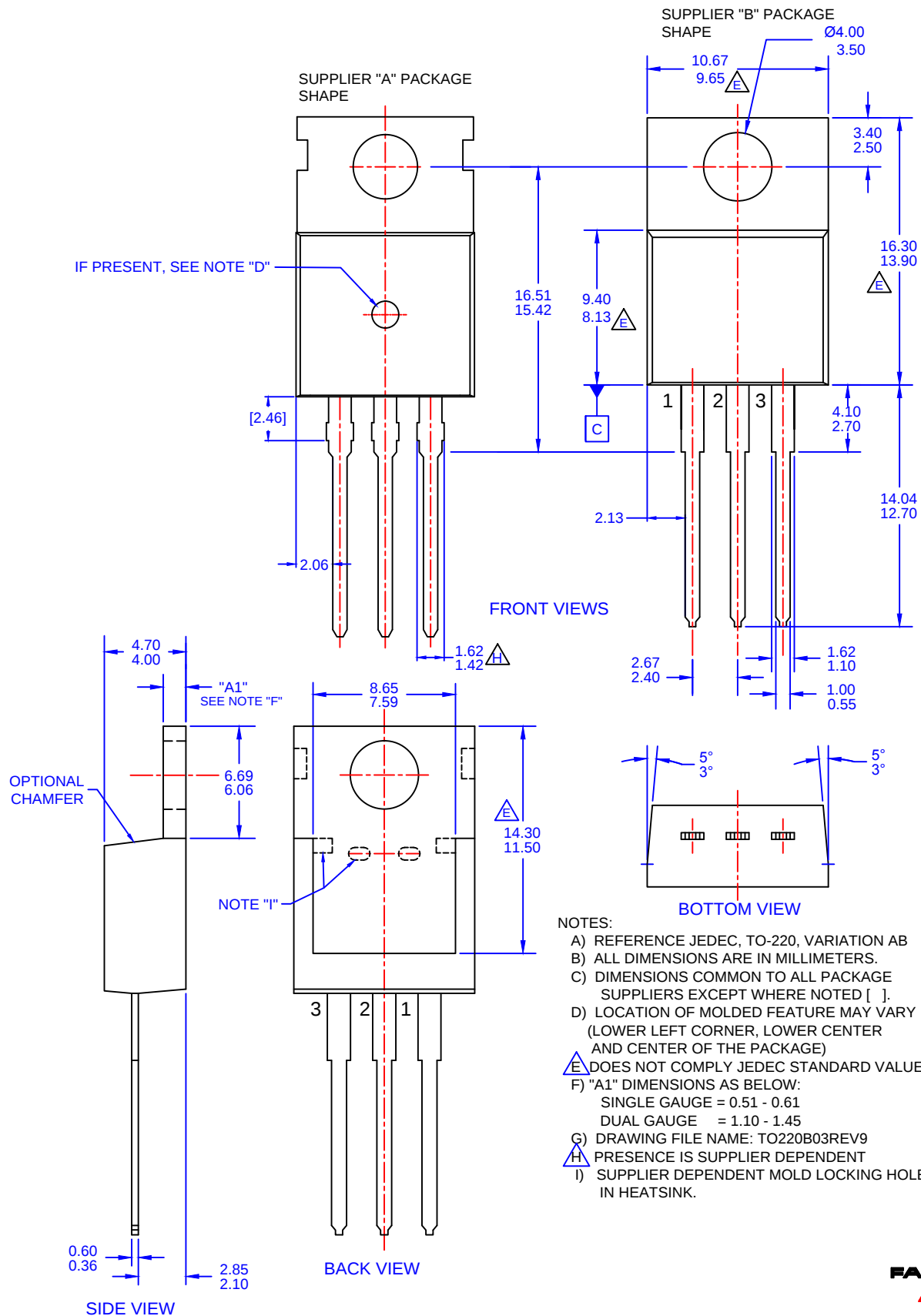
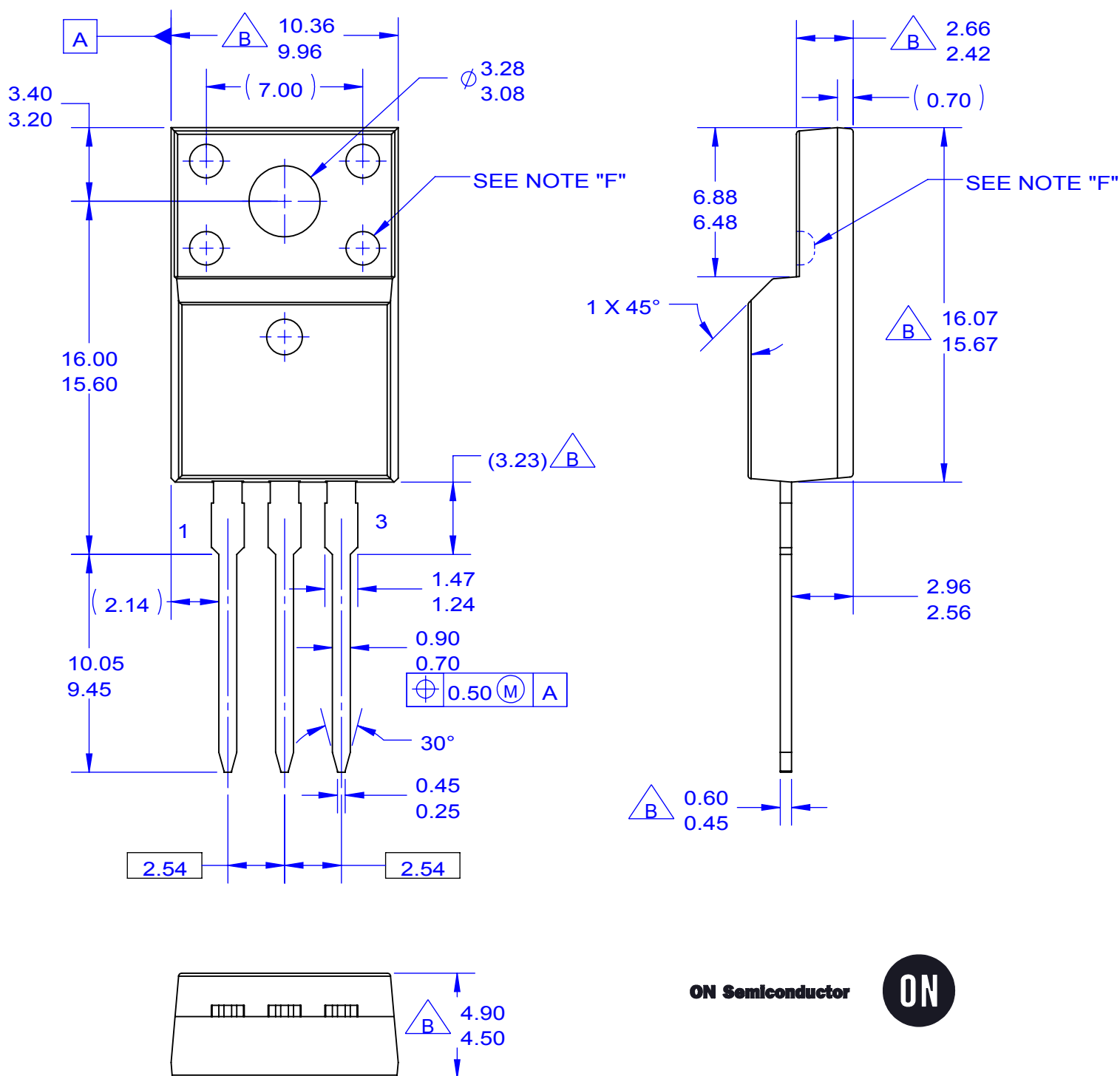


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



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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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: TO220M03REV5

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