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March 2014

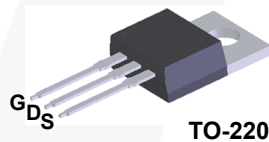
FCP11N60/FCPF11N60

General Description

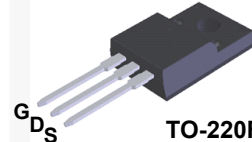
SuperFET® MOSFET is Fairchild Semiconductor's first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.

Features

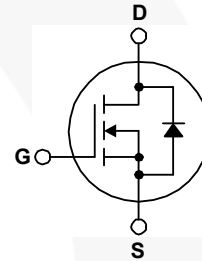
- 650V @ $T_j = 150^\circ\text{C}$
- Typ. $R_{ds(on)} = 0.32\Omega$
- Ultra low gate charge (typ. $Q_g = 40\text{nC}$)
- Low effective output capacitance (typ. $C_{oss,eff} = 95\text{pF}$)
- 100% avalanche tested
- RoHS Compliant



TO-220



TO-220F



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

Symbol	Parameter	FCP11N60	FCPF11N60	Units
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$)	11	11*	A
	- Continuous ($T_C = 100^\circ\text{C}$)	7	7*	A
I_{DM}	Drain Current - Pulsed (Note 1)	33	33*	A
V_{GSS}	Gate-Source Voltage	± 30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	340		mJ
I_{AR}	Avalanche Current (Note 1)	11		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	12.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)	125	36	W
	- Derate above 25°C	1.0	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 purposes, 1/8" from case for 5 seconds	300		$^\circ\text{C}$

* Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	FCP11N60	FCPF11N60	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.0	3.5	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink	0.5	--	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C}/\text{W}$

FCP11N60 / FCPF11N60 — N-Channel SuperFET® MOSFET

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP11N60	FCP11N60	TO-220	Tube	N/A	N/A	50 units
FCPF11N60	FCPF11N60	TO-220F	Tube	N/A	N/A	50 units
FCPF11N60T	FCPF11N60T	TO-220F	Tube	N/A	N/A	50 units

Electrical Characteristics

$T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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Off Characteristics

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_J = 25^\circ\text{C}$	600	--	--	V
		$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_J = 150^\circ\text{C}$	--	650	--	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C	--	0.6	--	$V/^\circ\text{C}$
BV_{DS}	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 11\text{ A}$	--	700	--	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 5.5\text{ A}$	--	0.32	0.38	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 5.5\text{ A}$ (Note 4)	--	9.7	--	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	1148	1490	pF
C_{oss}	Output Capacitance		--	671	870	pF
C_{rss}	Reverse Transfer Capacitance		--	63	82	pF
C_{oss}	Output Capacitance	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	35	--	pF
$C_{oss\ eff.}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	--	95	--	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{ V}, I_D = 11\text{ A},$ $R_G = 25\ \Omega$	--	34	80	ns
t_r	Turn-On Rise Time		--	98	205	ns
$t_{d(off)}$	Turn-Off Delay Time		--	119	250	ns
t_f	Turn-Off Fall Time		(Note 4, 5)	--	56	120
Q_g	Total Gate Charge	$V_{DS} = 480\text{ V}, I_D = 11\text{ A},$ $V_{GS} = 10\text{ V}$	--	40	52	nC
Q_{gs}	Gate-Source Charge		--	7.2	--	nC
Q_{gd}	Gate-Drain Charge		(Note 4, 5)	--	21	--

Drain-Source Diode Characteristics and Maximum Ratings

I_S	Maximum Continuous Drain-Source Diode Forward Current	--	--	11	A	
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current	--	--	33	A	
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 11\text{ A}$	--	--	1.4	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 11\text{ A},$	--	390	--	ns
Q_{rr}	Reverse Recovery Charge	$dI_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	5.7	--	μC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $I_{AS} = 5.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 11\text{ A}, dI/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width $\leq 300\ \mu\text{s}$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

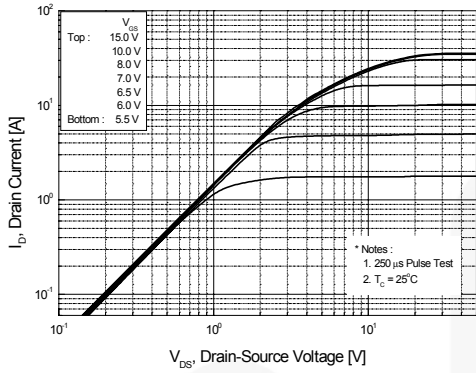


Figure 1. On-Region Characteristics

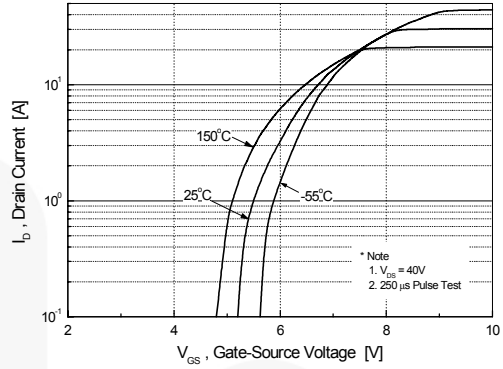


Figure 2. Transfer Characteristics

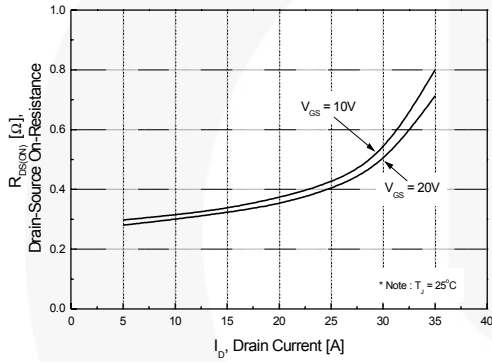


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

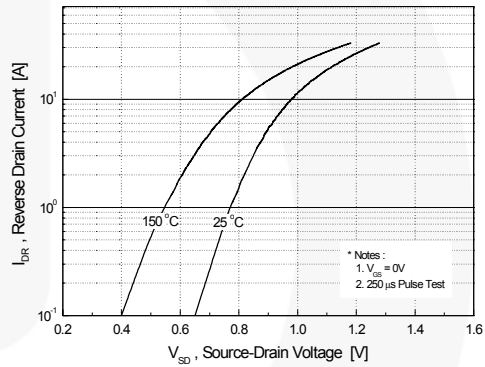


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

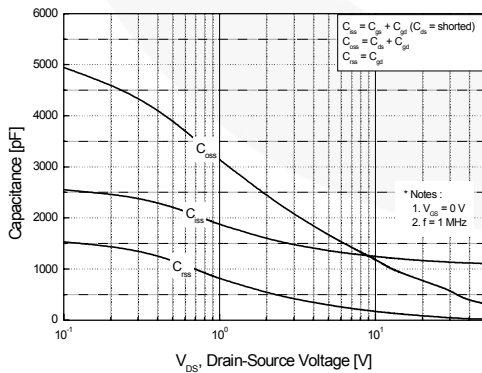


Figure 5. Capacitance Characteristics

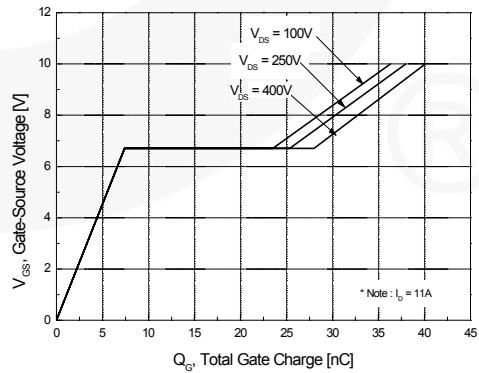


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

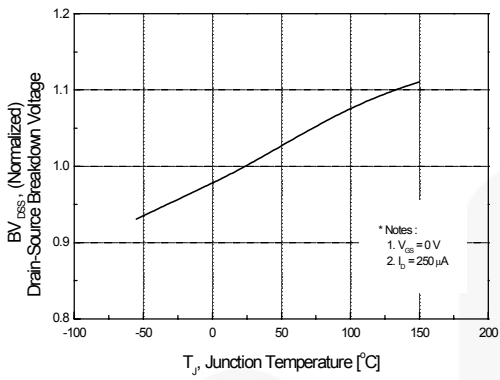


Figure 7. Breakdown Voltage Variation vs. Temperature

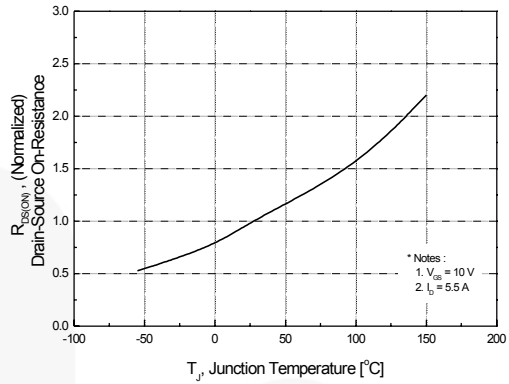


Figure 8. On-Resistance Variation vs. Temperature

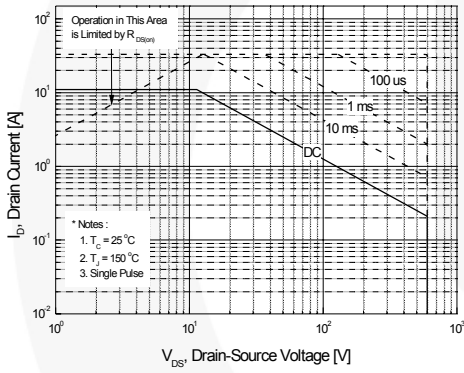


Figure 9-1. Maximum Safe Operating Area for FCP11N60

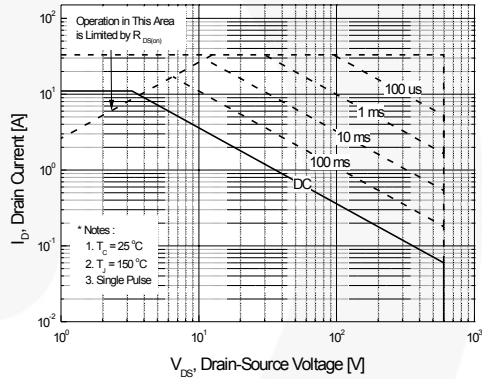


Figure 9-2. Maximum Safe Operating Area for FCPF11N60

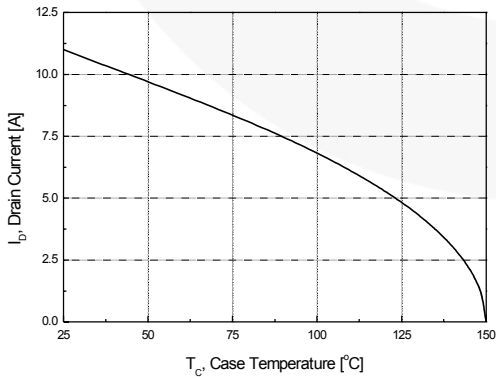


Figure 10. Maximum Drain Current vs. Case Temperature

Typical Characteristics (Continued)

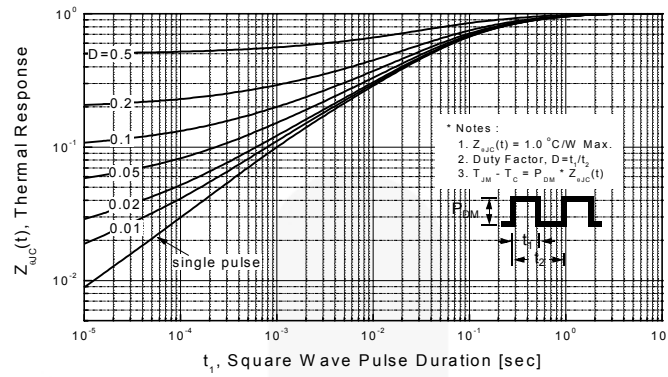


Figure 11-1. Transient Thermal Response Curve for FCP11N60

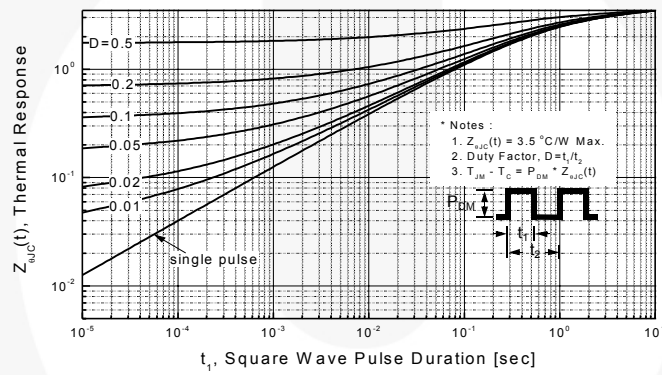


Figure 11-2. Transient Thermal Response Curve for FCPF11N60

Figure 12. Gate Charge Test Circuit & Waveform

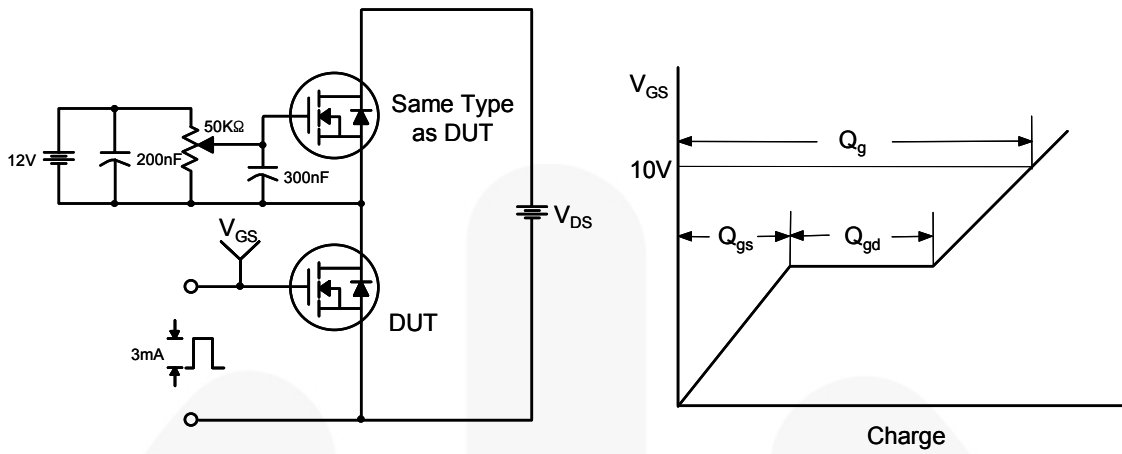


Figure 13. Resistive Switching Test Circuit & Waveforms

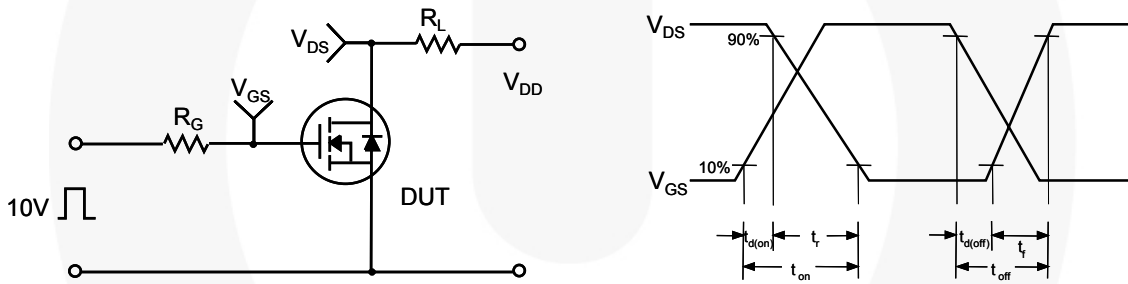


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

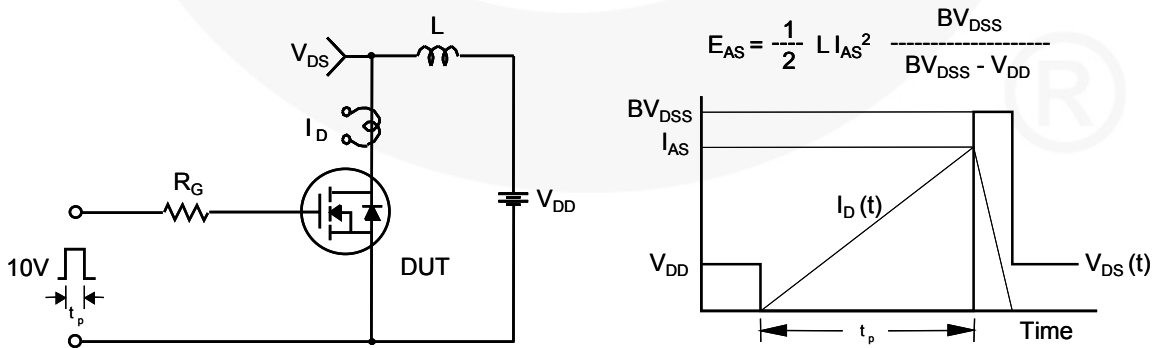
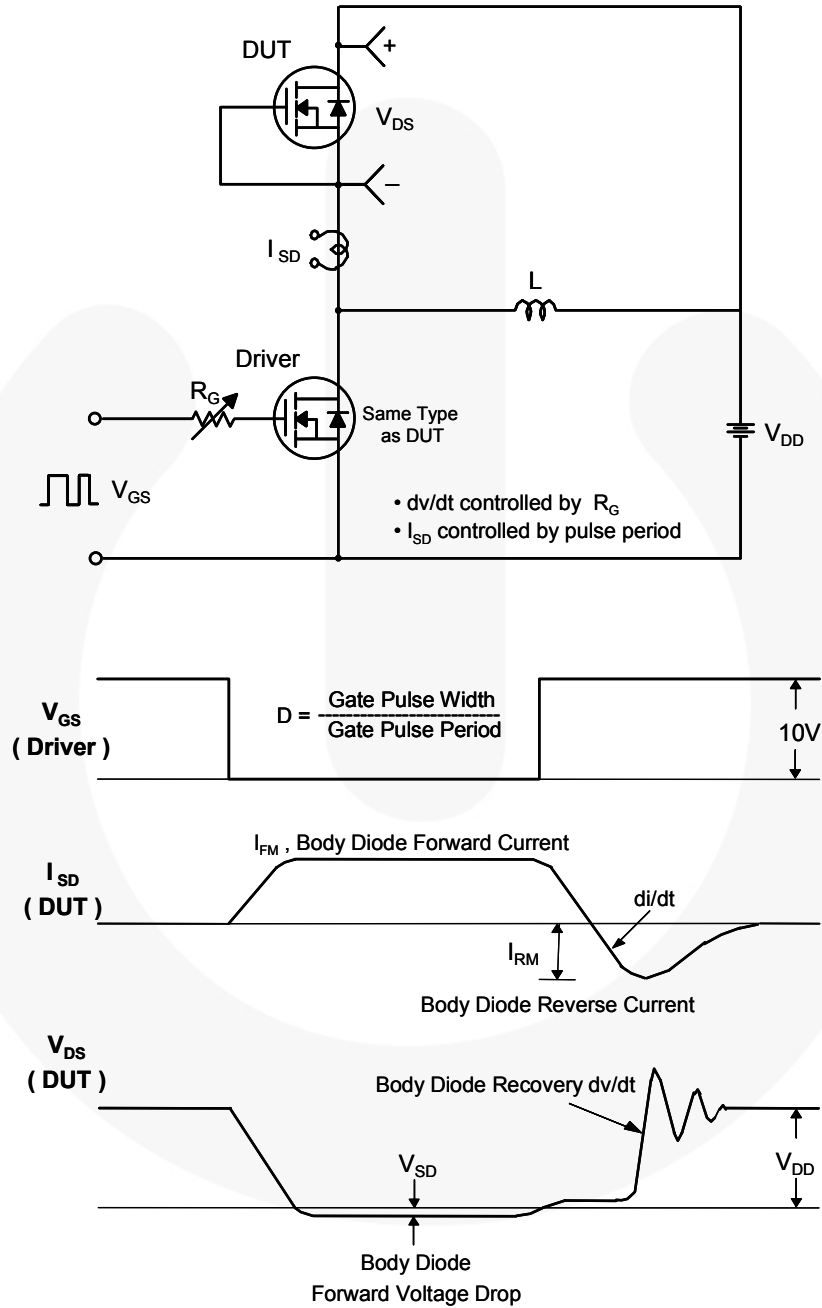


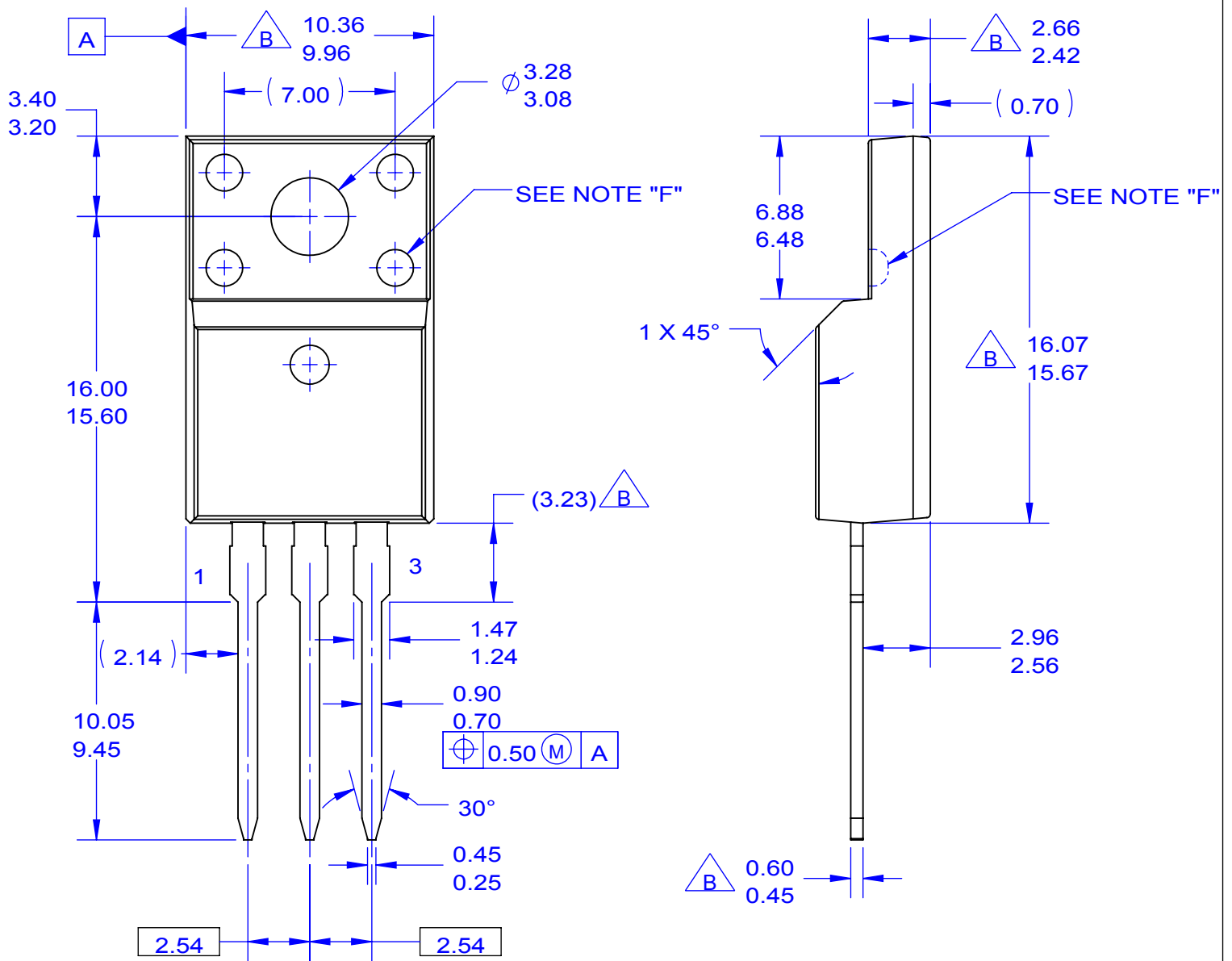
Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms





- 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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