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# FCB070N65S3

## N-Channel SuperFET® III MOSFET

650 V, 44 A, 70 mΩ

### Features

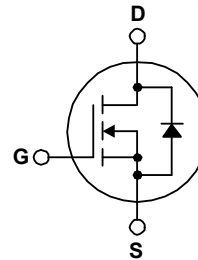
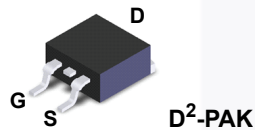
- 700 V @  $T_J = 150^\circ\text{C}$
- $R_{DS(on)} = 62\text{ m}\Omega$  (Typ.)
- Ultra Low Gate Charge (Typ.  $Q_g = 78\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 715\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar

### Description

SuperFET® III MOSFET is ON 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 advance technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SuperFET III MOSFET is very suitable for various AC/DC power conversion for system miniaturization and higher efficiency.



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

Symbol	Parameter	FCB070N65S3	Unit
$V_{DSS}$	Drain to Source Voltage	650	V
$V_{GSS}$	Gate to Source Voltage	- DC	$\pm 30$
		- AC ( $f > 1\text{ Hz}$ )	$\pm 30$
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	44
		- Continuous ( $T_C = 100^\circ\text{C}$ )	28
$I_{DM}$	Drain Current	- Pulsed (Note 1)	110
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	214
$I_{AS}$	Avalanche Current	(Note 1)	4.8
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	3.12
dv/dt	MOSFET dv/dt		100
	Peak Diode Recovery dv/dt	(Note 3)	20
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	312
		- Derate Above $25^\circ\text{C}$	2.5
$T_J, T_{STG}$	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	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCB070N65S3	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.4	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	62.5	
	Thermal Resistance, Junction to Ambient (1 in <sup>2</sup> Pad of 2-oz Copper), Max.	40	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCB070N65S3	FCB070N65S3	D <sup>2</sup> -PAK	Tape and Reel	330 mm	24 mm	800 units

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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### Off Characteristics

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	650	-	-	V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$	700	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.72	-	V/ $^\circ\text{C}$
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$	-	2.2	-	
I <sub>GSS</sub>	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 4.4\text{ mA}$	2.5	-	4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 22\text{ A}$	-	62	70	m $\Omega$
g <sub>FS</sub>	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 22\text{ A}$	-	29	-	S

### Dynamic Characteristics

C <sub>iss</sub>	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}$	-	3090	-	pF
C <sub>oss</sub>	Output Capacitance	$f = 1\text{ MHz}$	-	68	-	pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	715	-	pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	104	-	pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10V	$V_{DS} = 400\text{ V}, I_D = 22\text{ A}$	-	78	-	nC
Q <sub>gs</sub>	Gate to Source Gate Charge	$V_{GS} = 10\text{ V}$	-	18	-	nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge	(Note 4)	-	30	-	nC
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$	-	0.6	-	$\Omega$

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 22\text{ A}, V_{GS} = 10\text{ V}, R_g = 4.7\text{ }\Omega$	-	26	-	ns
t <sub>r</sub>	Turn-On Rise Time		-	52	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	89	-	ns
t <sub>f</sub>	Turn-Off Fall Time		(Note 4)	-	16	-

### Drain-Source Diode Characteristics

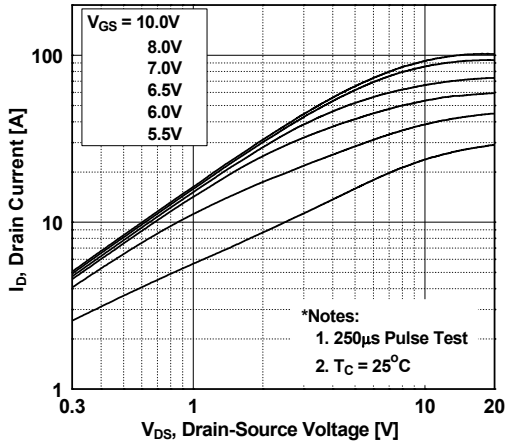
I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current	-	-	44	A	
I <sub>SM</sub>	Maximum Pulsed Source to Drain Diode Forward Current	-	-	110	A	
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 22\text{ A}$	-	-	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 22\text{ A}$	-	435	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge	$di/dt = 100\text{ A}/\mu\text{s}$	-	9.2	-	$\mu\text{C}$

#### Notes:

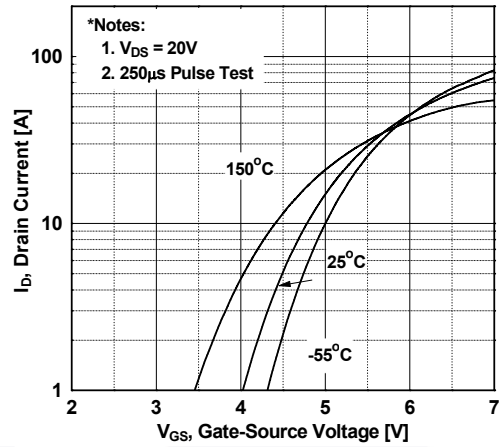
1. Repetitive rating: pulse width limited by maximum junction temperature.
2.  $I_{AS} = 4.8\text{ A}, R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 44\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristic.

## Typical Performance Characteristics

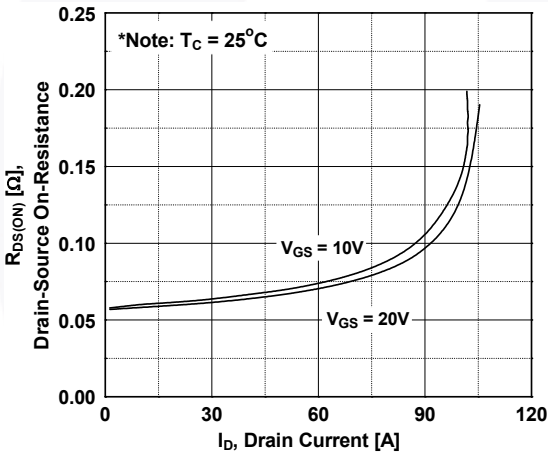
**Figure 1. On-Region Characteristics**



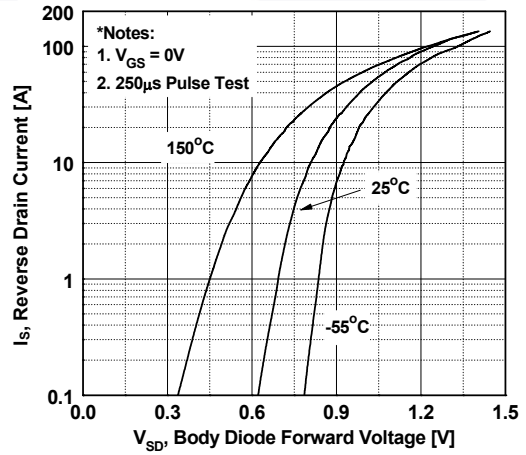
**Figure 2. Transfer Characteristics**



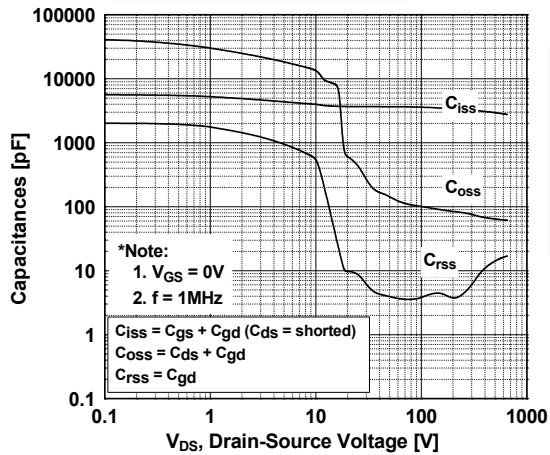
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



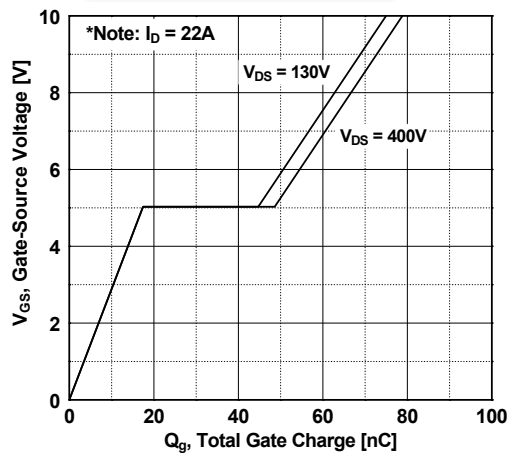
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

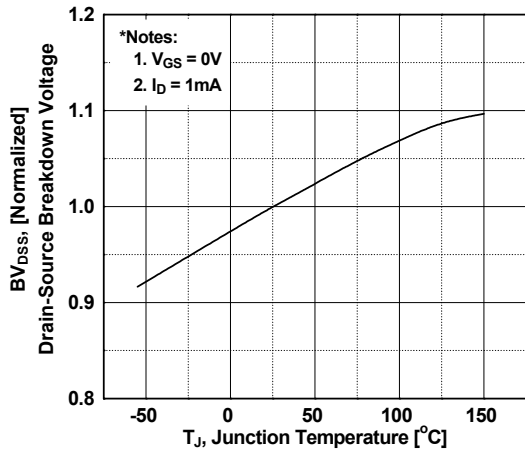


Figure 8. On-Resistance Variation vs. Temperature

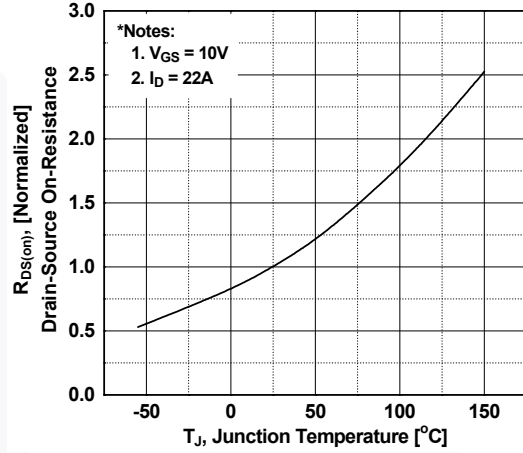


Figure 9. Maximum Safe Operating Area

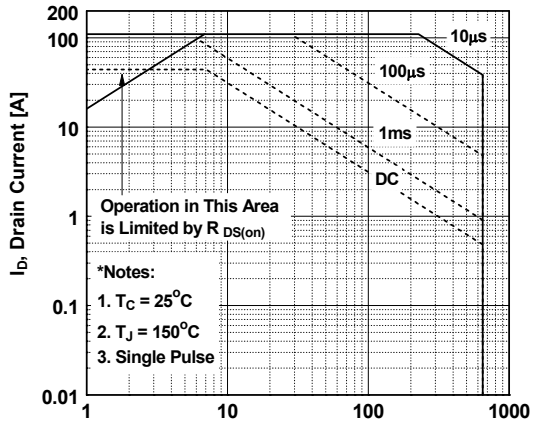


Figure 10. Maximum Drain Current vs. Case Temperature

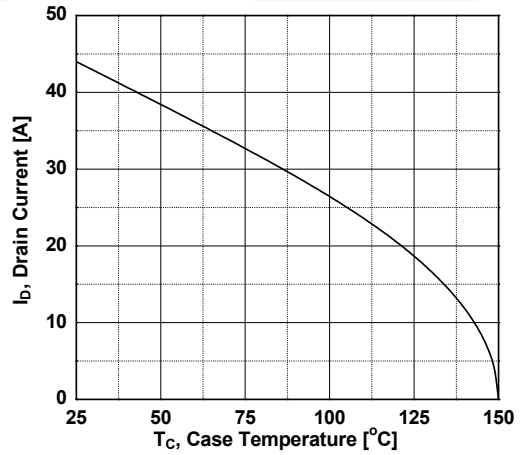
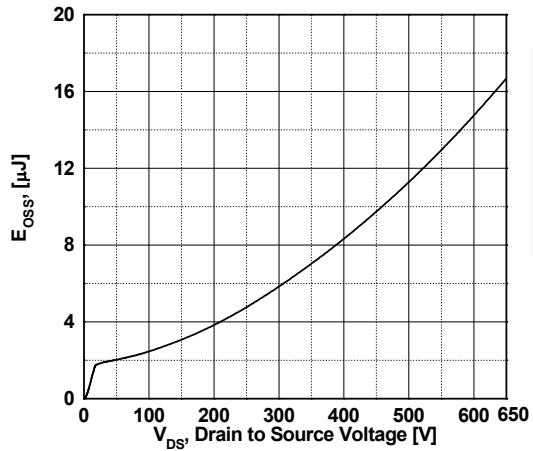
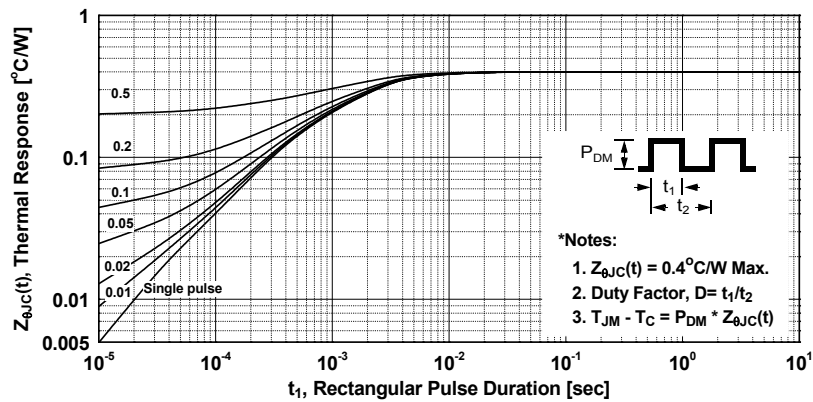


Figure 11. Eoss vs. Drain to Source Voltage



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



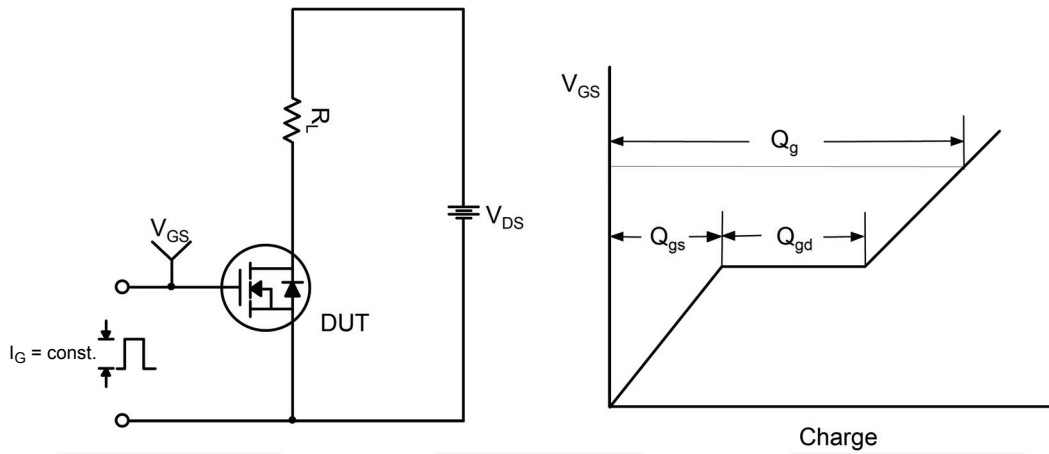


Figure 13. Gate Charge Test Circuit & Waveform

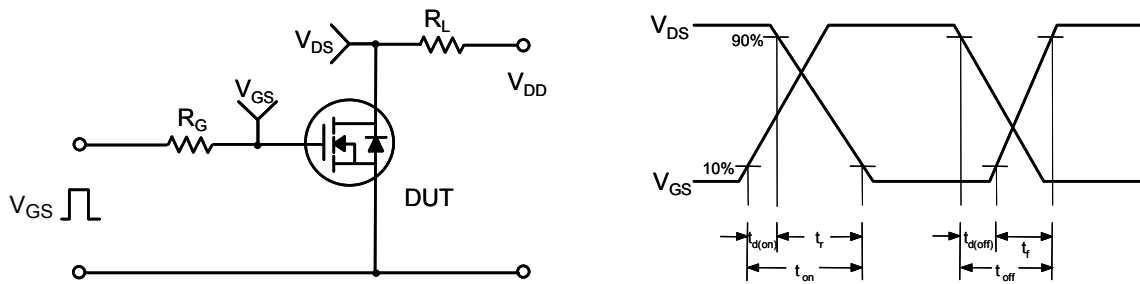


Figure 14. Resistive Switching Test Circuit & Waveforms

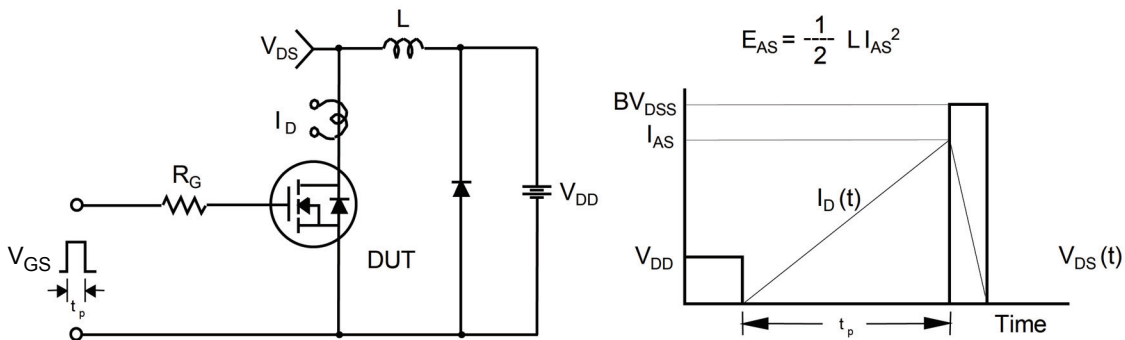


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

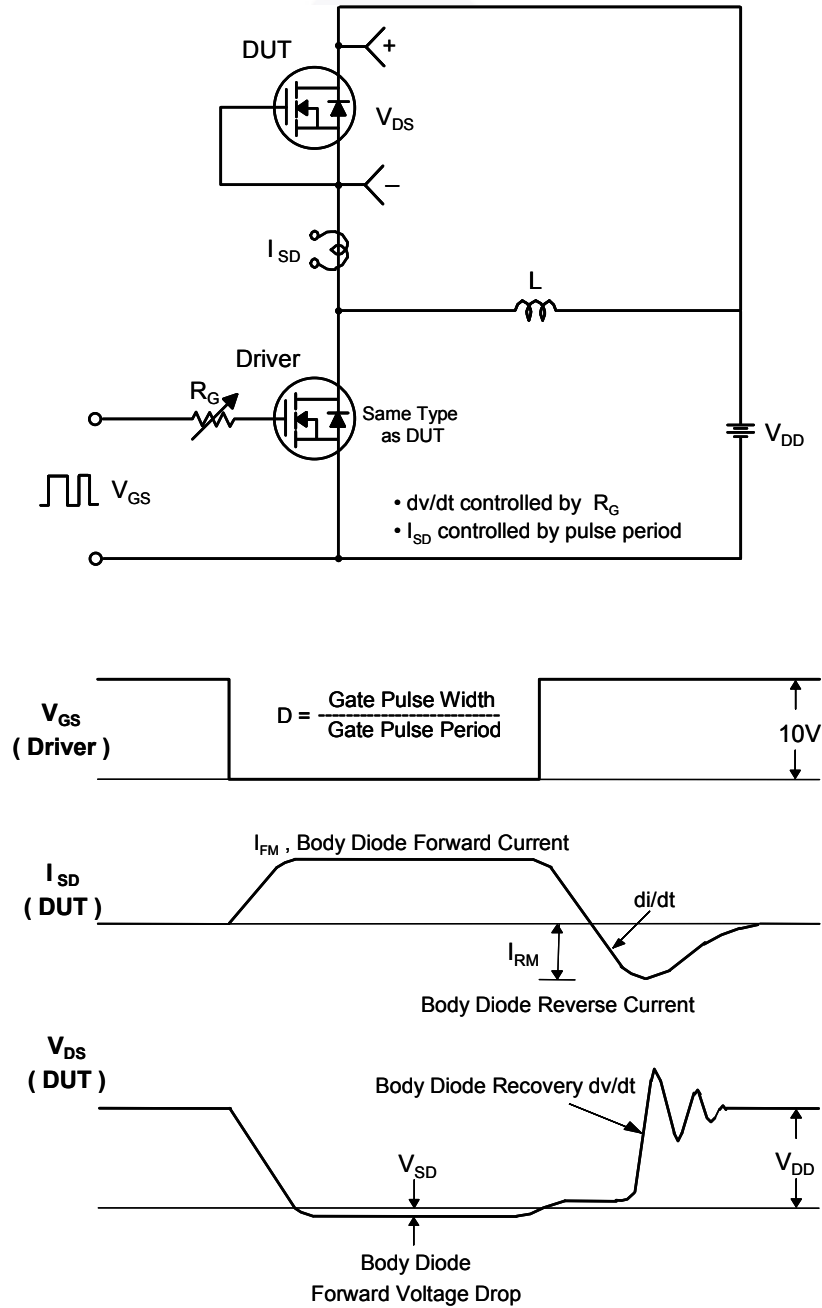
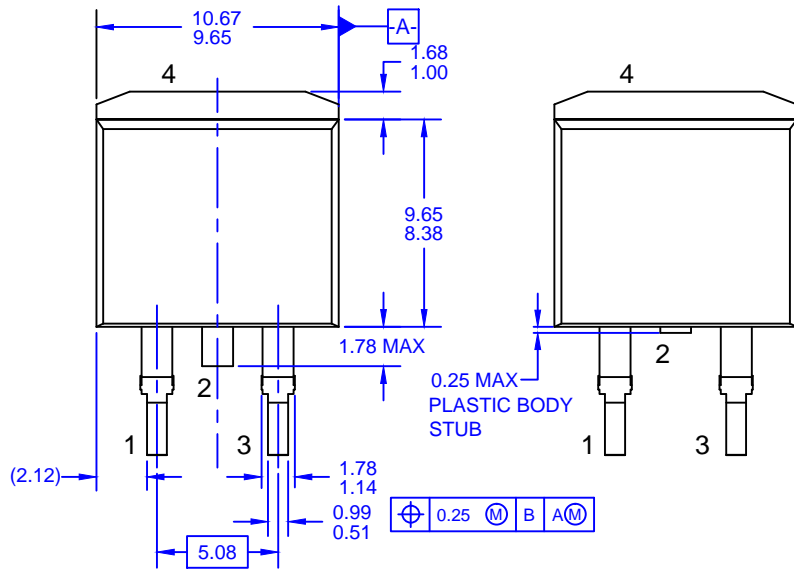
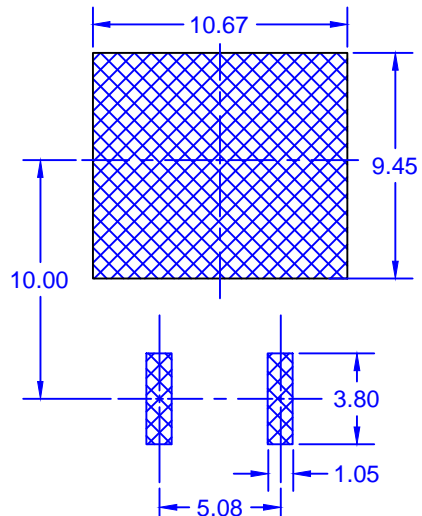


Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

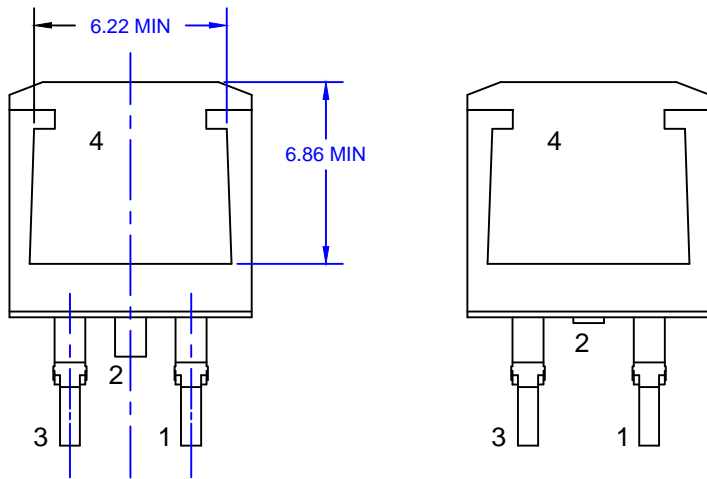




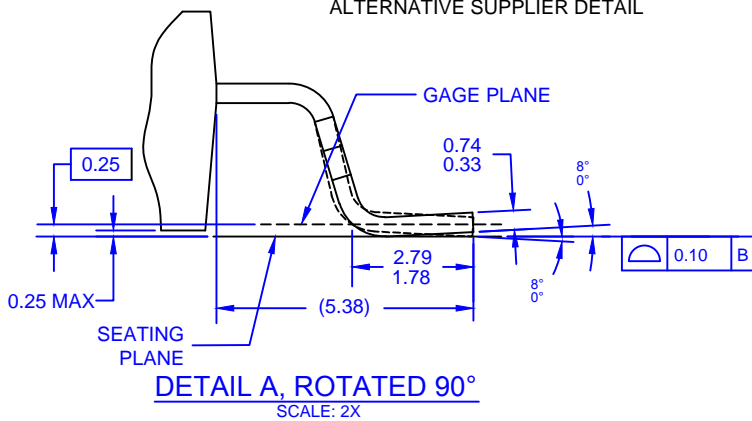
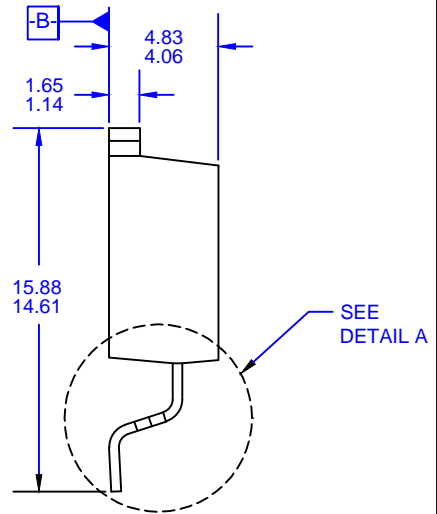
FRONT VIEW - DIODE PRODUCTS VERSION  
ALTERNATIVE SUPPLIER DETAIL



LAND PATTERN RECOMMENDATION  
UNLESS NOTED, ALL DIMS TYPICAL



BACK VIEW - DIODE PRODUCTS VERSION  
ALTERNATIVE SUPPLIER DETAIL



DETAIL A, ROTATED 90°  
SCALE: 2X

NOTES: UNLESS OTHERWISE SPECIFIED

- A) ALL DIMENSIONS ARE IN MILLIMETERS.
- B) REFERENCE JEDEC, TO-263, VARIATION AB.
- C) DIMENSIONING AND TOLERANCING PER DIMENSIONING AND TOLERANCING PER ASME Y14.5 - 2009.
- D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE).
- E) LANDPATTERN RECOMMENDATION PER IPC TO254P1524X482-3N
- F) FILENAME: TO263A02REV8



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