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# FCB20N60F

## N-Channel SuperFET® FRFET® MOSFET

600 V, 20 A, 190 mΩ

### Features

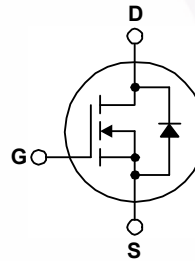
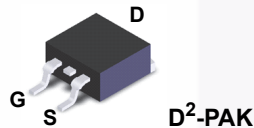
- 650 V @ $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 150\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 75\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss,eff} = 165\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Applications

- Lighting
- AC-DC Power Supply
- Solar Inverter

### 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. SuperFET FRFET® MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.



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

Symbol	Parameter	FCB20N60FTM	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	20
		- Continuous ( $T_C = 100^\circ\text{C}$ )	12.5
$I_{DM}$	Drain Current	- Pulsed (Note 1)	60
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	690
$I_{AR}$	Avalanche Current	(Note 1)	20
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	20.8
$dv/dt$	Peak Diode Recovery $dv/dt$	(Note 3)	50
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	208
		- Derate above $25^\circ\text{C}$	1.67
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCB20N60FTM	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.6	$^\circ\text{C/W}$
$R_{\theta JA}$	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

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCB20N60F	FCB20N60FTM	D <sup>2</sup> -PAK	330mm	24m	800

## 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 <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 $\mu$ A, T <sub>C</sub> = 25°C	600	-	-	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 $\mu$ A, T <sub>C</sub> = 150°C	-	650	-	V
$\Delta$ BV <sub>DSS</sub> / $\Delta$ T <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 $\mu$ A, Referenced to 25°C	-	0.6	-	V/°C
BV <sub>DS</sub>	Drain-Source Avalanche Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 20 A	-	700	-	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V	-	-	1	$\mu$ A
		V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125°C	-	-	10	
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>GS</sub> = $\pm$ 30 V, V <sub>DS</sub> = 0 V	-	-	$\pm$ 100	nA

### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 $\mu$ A	3.0	-	5.0	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A	-	0.15	0.19	$\Omega$
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 10 A	-	17	-	S

### Dynamic Characteristics

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V f = 1.0 MHz	-	2370	3080	pF
C <sub>oss</sub>	Output Capacitance		-	1280	1665	pF
C <sub>riss</sub>	Reverse Transfer Capacitance		-	95	-	pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	-	65	85	pF
C <sub>oss</sub> eff.	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	-	165	-	pF

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 20 A R <sub>G</sub> = 25 $\Omega$	-	62	135	ns	
t <sub>r</sub>	Turn-On Rise Time		-	140	290	ns	
t <sub>d(off)</sub>	Turn-Off Delay Time		-	230	470	ns	
t <sub>f</sub>	Turn-Off Fall Time		(Note 4)	-	65	140	ns
Q <sub>g(tot)</sub>	Total Gate Charge at 10V		V <sub>DS</sub> = 480 V, I <sub>D</sub> = 20 A, V <sub>GS</sub> = 10 V	-	75	98	nC
Q <sub>gs</sub>	Gate to Source Gate Charge	(Note 4)	-	13.5	18	nC	
Q <sub>gd</sub>	Gate to Drain "Miller" Charge		-	36	-	nC	

### Drain-Source Diode Characteristics

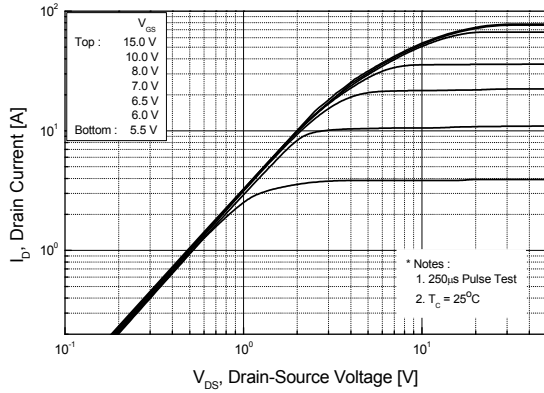
I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	-	-	20	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	-	-	60	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 20 A	-	-	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 20 A	-	160	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI <sub>F</sub> /dt = 100 A/ $\mu$ s	-	1.1	-	$\mu$ C

#### Notes:

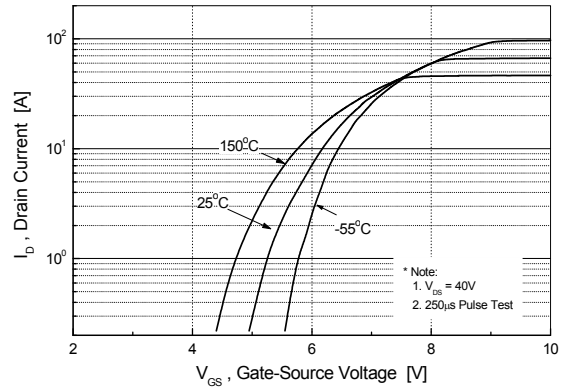
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 10 A, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25  $\Omega$ , Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub>  $\leq$  20 A, di/dt  $\leq$  1200 A/ $\mu$ s, V<sub>DD</sub>  $\leq$  BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

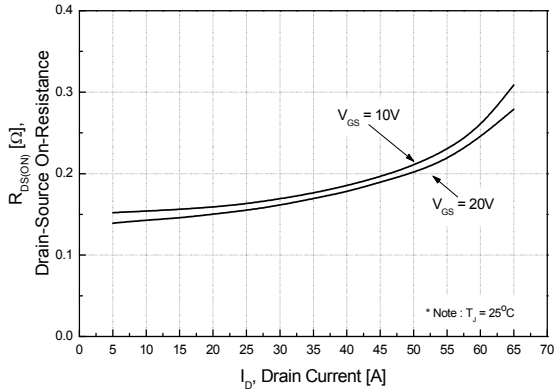
**Figure 1. On-Region Characteristics**



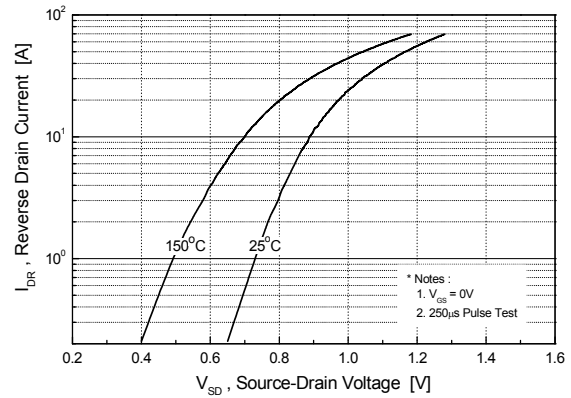
**Figure 2. Transfer Characteristics**



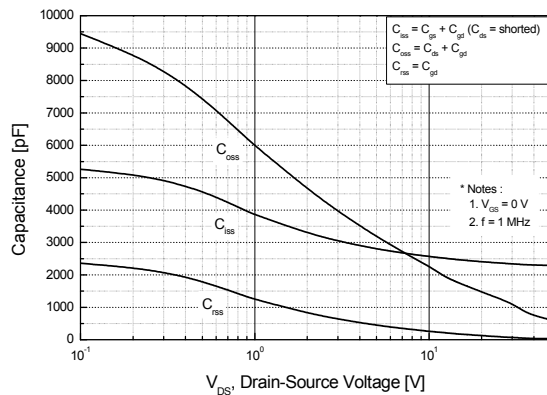
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



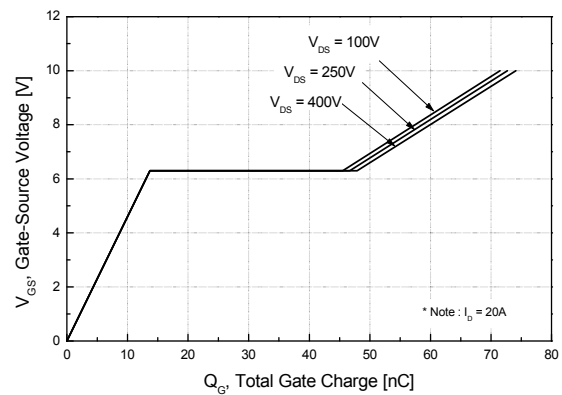
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

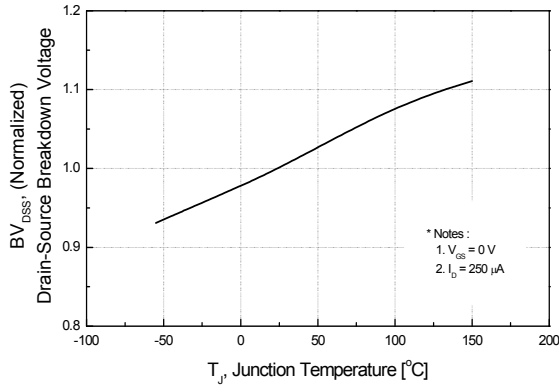


**Figure 6. Gate Charge Characteristics**

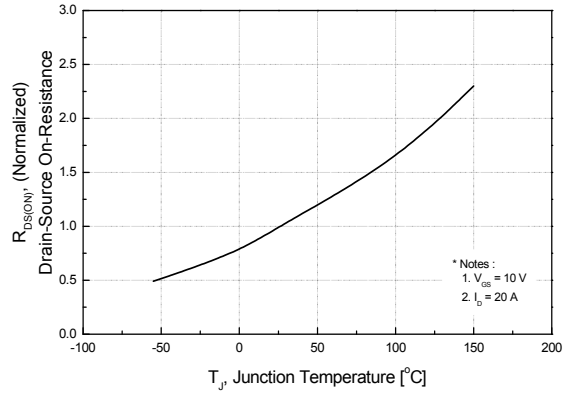


## Typical Performance Characteristics (Continued)

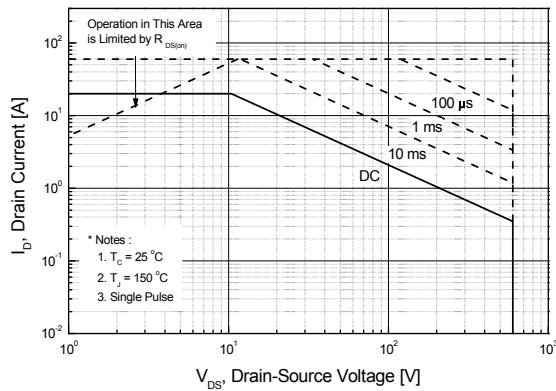
**Figure 7. Breakdown Voltage Variation vs. Temperature**



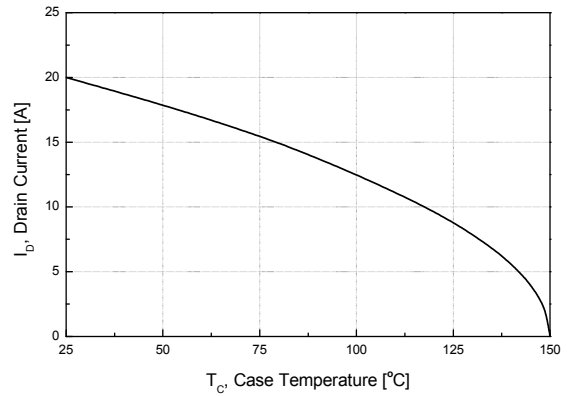
**Figure 8. On-Resistance Variation vs. Temperature**



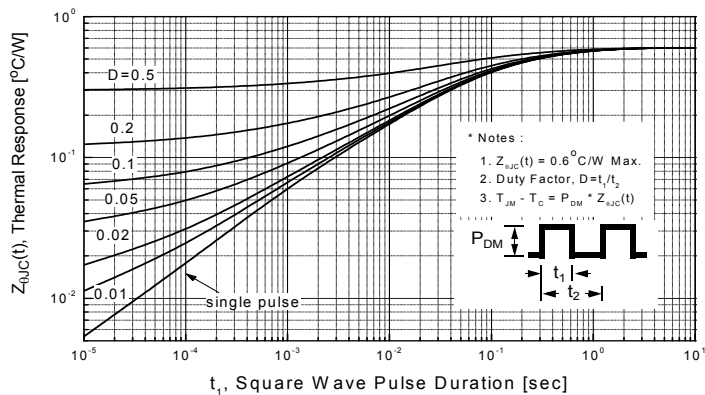
**Figure 9. Maximum Safe Operating Area**



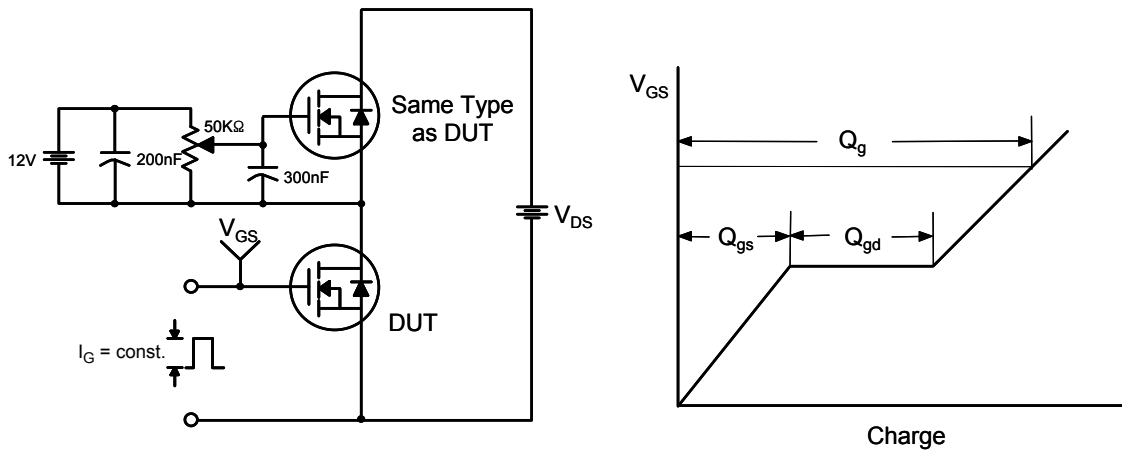
**Figure 10. Maximum Drain Current vs. Case Temperature**



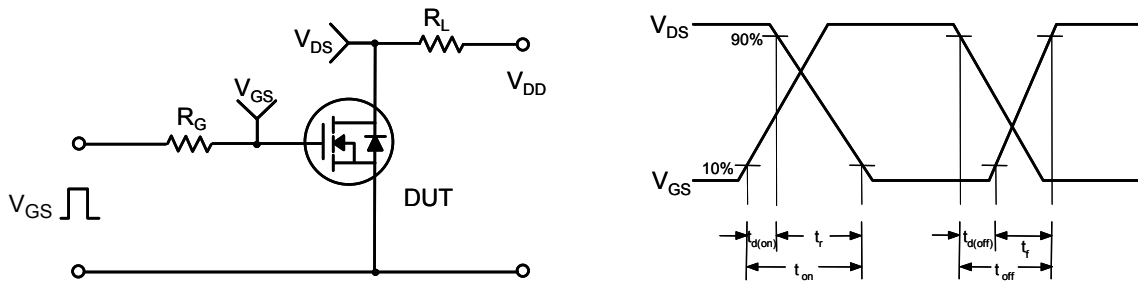
**Figure 11. Transient Thermal Response Curve**



**Figure 12. Gate Charge Test Circuit & Waveform**



**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

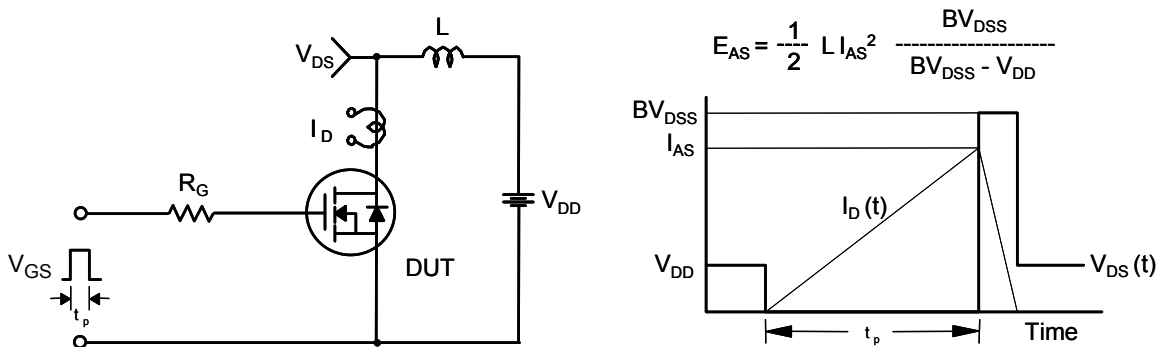
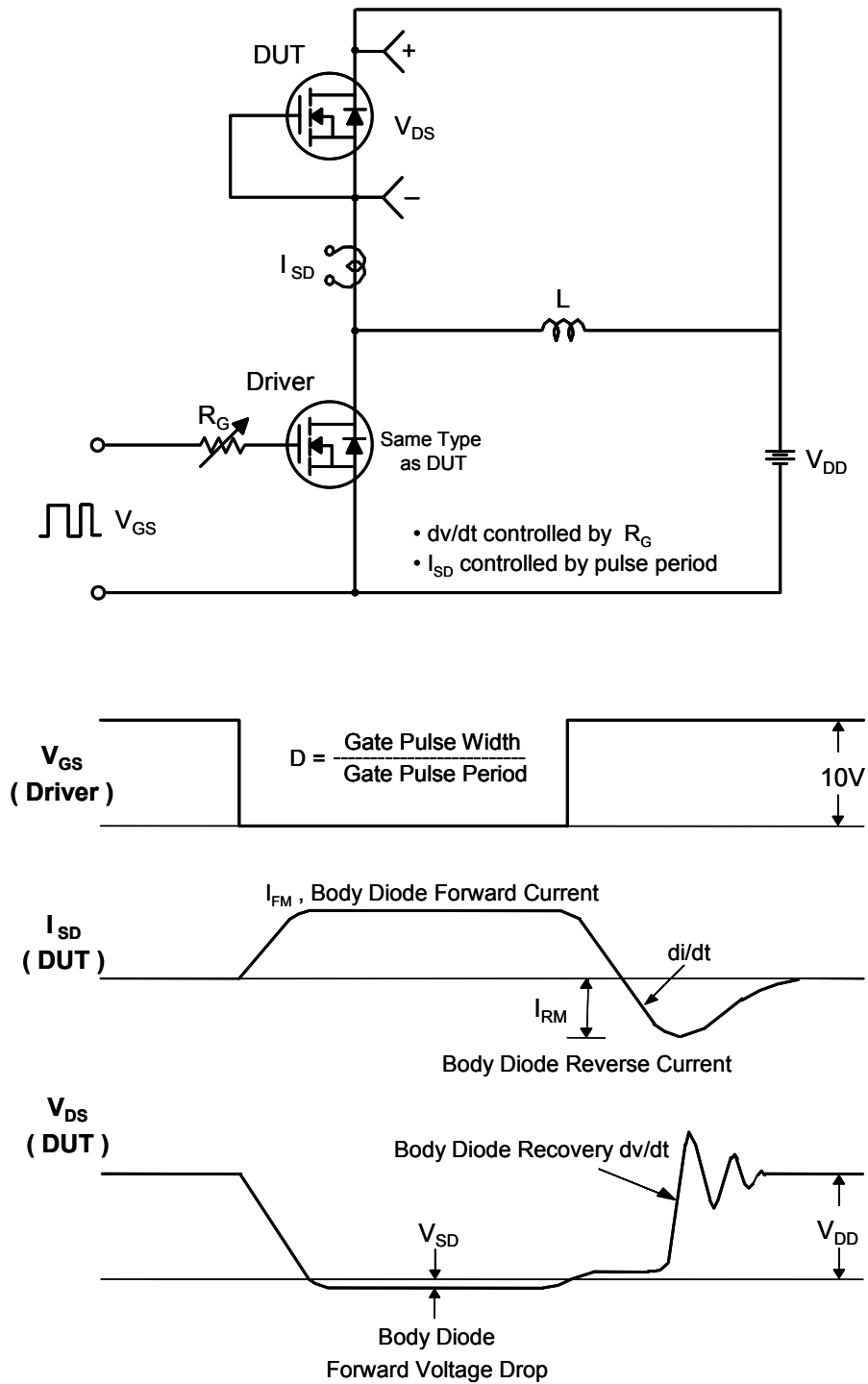
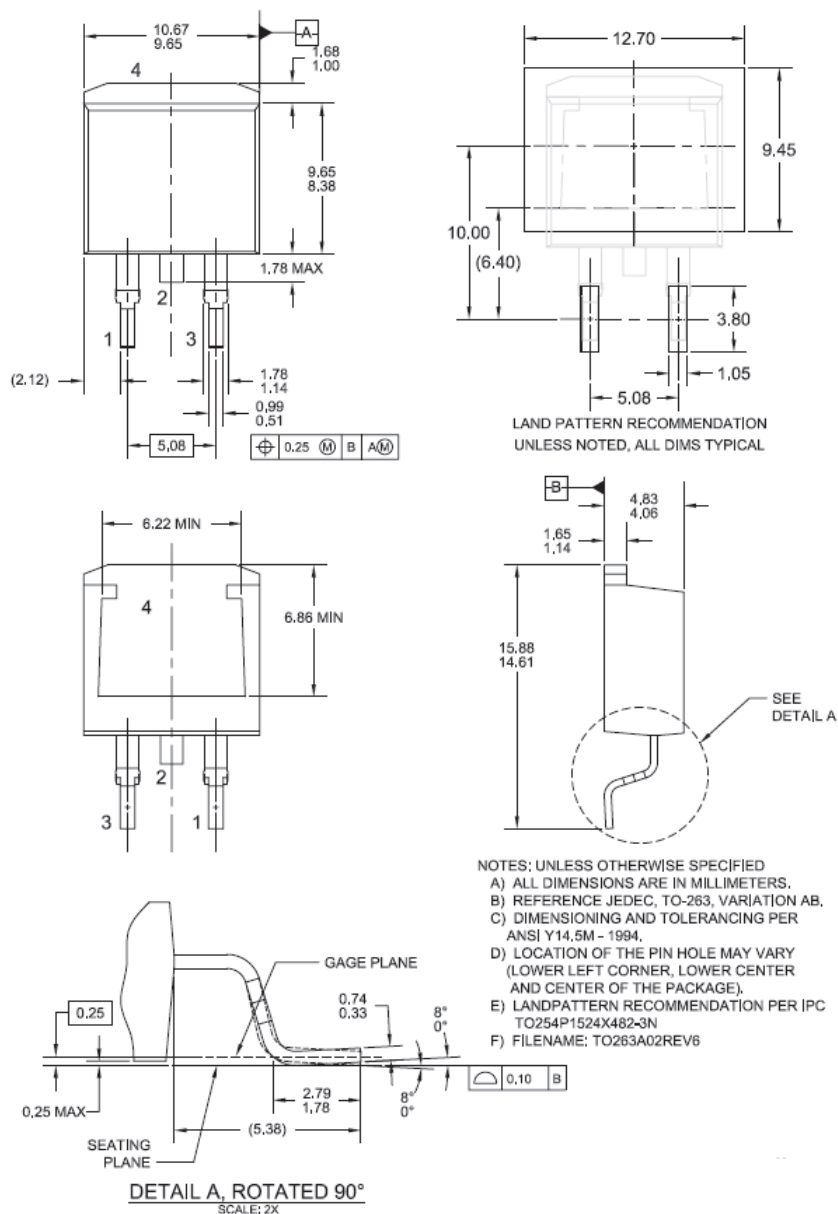


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Mechanical Dimensions

### TO-263 2L (D<sup>2</sup>PAK)



**Figure 16. 2LD, TO263, Surface Mount**

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Dimension in Millimeters



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| EfficientMax™            | MICROCOUPLER™                                   |                            | TRUECURRENT®*    |
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