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# FQB50N06 / FQI50N06

## N-Channel QFET® MOSFET

### 60 V, 50 A, 22 mΩ

#### Description

This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, audio amplifier, DC motor control, and variable switching power applications.

#### Features

- 50 A, 60 V,  $R_{DS(on)} = 22 \text{ mΩ}$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 25 \text{ A}$
- Low Gate Charge (Typ. 31 nC)
- Low  $Crss$  Typ. 65 pF)
- 100% Avalanche Tested
- 175°C Maximum Junction Temperature Rating



#### Absolute Maximum Ratings

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

Symbol	Parameter	FQB50N06TM / FQI50N06TU	Unit
$V_{DSS}$	Drain-Source Voltage	60	V
$I_D$	Current - Continuous ( $T_C = 25^\circ\text{C}$ )	50	A
	- Continuous ( $T_C = 100^\circ\text{C}$ )	35.4	A
$I_{DM}$	Drain Current - Pulsed	(Note 1)	A
$V_{GS}$	Gate-Source Voltage	$\pm 25$	V
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	mJ
$I_{AP}$	Avalanche Current	(Note 1)	A
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$	(Note 3)	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ\text{C}$ ) *	3.75	W
	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	120	W
	- Derate above 25°C	0.8	W/°C
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +175	°C
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	°C

#### Thermal Characteristics

Symbol	Parameter	FQB50N06TM FQI50N06TU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.24	°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
FQB50N06	FQB50N06TM	D2-PAK	330mm	24mm	800
FQI50N06	FQI50N06TU	I2-PAK	-	-	50

## 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

$\text{BV}_{\text{DSS}}$	Drain-Source Breakdown Voltage	$V_{\text{GS}} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$	60	--	--	V
$\Delta \text{BV}_{\text{DSS}} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.06	--	$\text{V}/^\circ\text{C}$
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{\text{DS}} = 60 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$	--	--	--	$\mu\text{A}$
		$V_{\text{DS}} = 48 \text{ V}$ , $T_C = 150^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{\text{GSSF}}$	Gate-Body Leakage Current, Forward	$V_{\text{GS}} = 25 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$	--	--	10	$\text{nA}$
$I_{\text{GSSR}}$	Gate-Body Leakage Current, Reverse	$V_{\text{GS}} = -25 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$	--	--	100	$\text{nA}$

### On Characteristics

$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_D = 250 \mu\text{A}$	--.0	--	4.0	V
$R_{\text{DS(on)}}$	Static Drain-Source On-Resistance	$V_{\text{GS}} = 10 \text{ V}$ , $I_D = 25 \text{ A}$	--	0.018	0.022	$\Omega$
$g_{\text{FS}}$	Forward Transconductance	$V_{\text{DS}} = -25 \text{ V}$ , $I_D = 25 \text{ A}$	--	22	--	S

### Dynamic Characteristics

$C_{\text{iss}}$	Input Capacitance	$V_{\text{DS}} = 25 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$ , 1.0 MHz	--	1150	1540	pF
$C_{\text{oss}}$	Output Capacitance	$V_{\text{DS}} = 48 \text{ V}$ , $V_{\text{GS}} = 10 \text{ V}$ , 1.0 MHz	--	440	580	pF
$C_{\text{rss}}$	Reverse Transfer Capacitance	$V_{\text{DS}} = 25 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$ , 1.0 MHz	--	65	90	pF

### Switching Characteristics

$t_{\text{d(on)}}$	Turn-On Delay Time	$V_{\text{DD}} = 30 \text{ V}$ , $I_D = 25 \text{ A}$ , $R_G = 25 \Omega$	--	15	40	ns
$t_r$	Turn-On Rise Time	$V_{\text{DD}} = 30 \text{ V}$ , $I_D = 25 \text{ A}$ , $R_G = 25 \Omega$	--	105	220	ns
$t_{\text{d(off)}}$	Turn-Off Delay Time	$V_{\text{DD}} = 30 \text{ V}$ , $I_D = 25 \text{ A}$ , $R_G = 25 \Omega$	--	60	130	ns
$t_f$	Turn-Off Fall Time	$V_{\text{DD}} = 30 \text{ V}$ , $I_D = 25 \text{ A}$ , $R_G = 25 \Omega$	--	65	140	ns
$Q_g$	Total Gate Charge	$V_{\text{DS}} = 48 \text{ V}$ , $I_D = 50 \text{ A}$ , $V_{\text{GS}} = 10 \text{ V}$	--	31	41	nC
$Q_{\text{gs}}$	Gate-Source Charge	$V_{\text{DS}} = 48 \text{ V}$ , $I_D = 50 \text{ A}$ , $V_{\text{GS}} = 10 \text{ V}$	--	8	--	nC
$Q_{\text{cr}}$	Gate-Drain Charge	$V_{\text{DS}} = 48 \text{ V}$ , $I_D = 50 \text{ A}$ , $V_{\text{GS}} = 10 \text{ V}$	--	13	--	nC

### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	50	A	
$I_{\text{SM}}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	200	A	
$V_{\text{SD}}$	Drain-Source Diode Forward Voltage	$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 50 \text{ A}$	--	--	1.5	V
$t_{\text{rr}}$	Reverse Recovery Time	$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 50 \text{ A}$ , $dI_F / dt = 100 \text{ A}/\mu\text{s}$	--	52	--	ns
$Q_{\text{rr}}$	Reverse Recovery Charge	$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 50 \text{ A}$ , $dI_F / dt = 100 \text{ A}/\mu\text{s}$	--	75	--	nC

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 230\mu\text{H}$ ,  $I_{AS} = 50\text{A}$ ,  $V_{DD} = 25\text{V}$ ,  $R_G = 25 \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 50\text{A}$ ,  $dI/dt \leq 300\text{A}/\mu\text{s}$ ,  $V_{DD} \leq \text{BV}_{\text{DSS}}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially independent of operating temperature

## Typical Characteristics

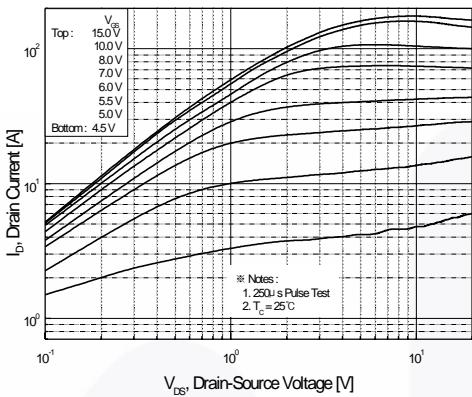


Figure 1. On-Region Characteristics

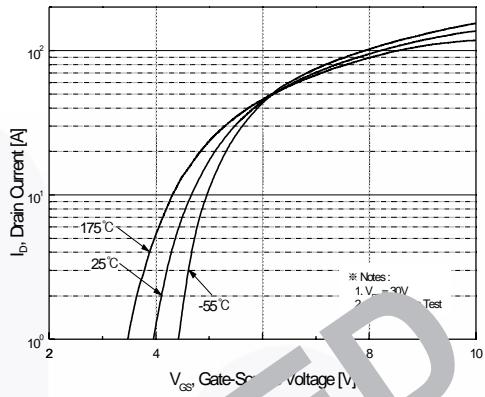


Figure 2. Transfer Characteristics

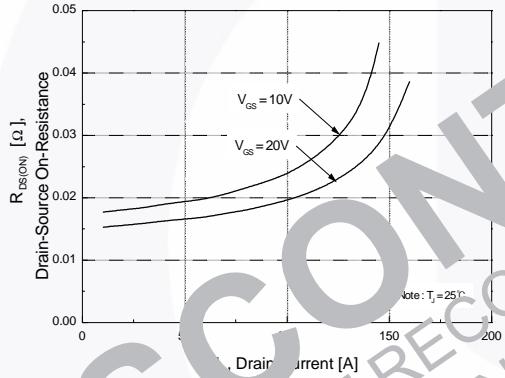


Figure 3. On-Resistance Variation vs. Current and Gate Voltage

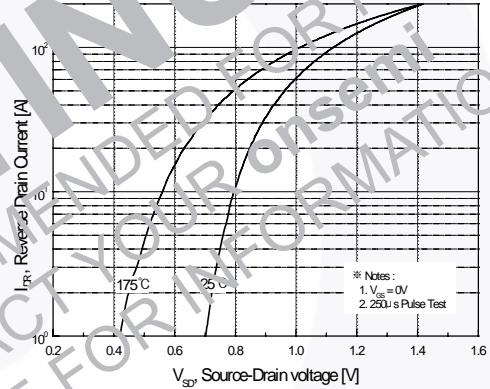


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

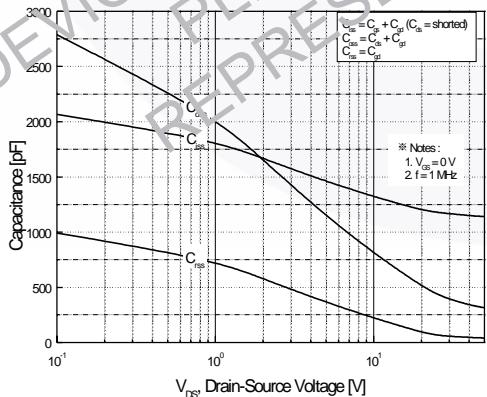


Figure 5. Capacitance Characteristics

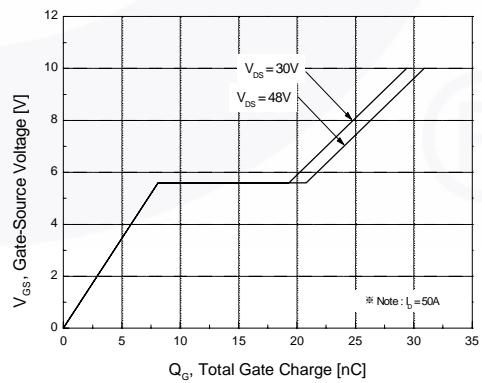
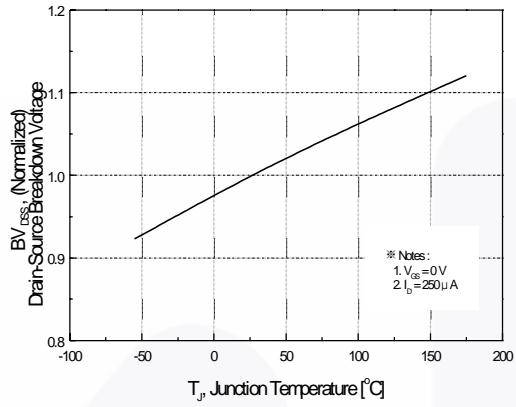
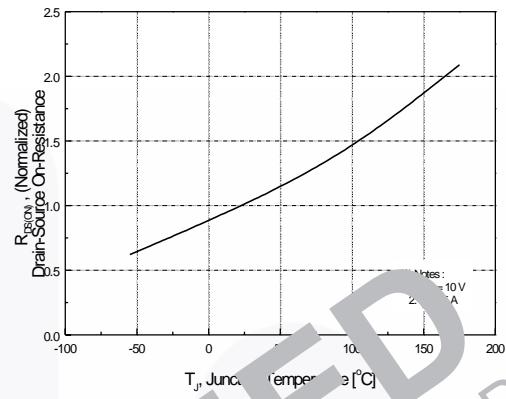


Figure 6. Gate Charge Characteristics

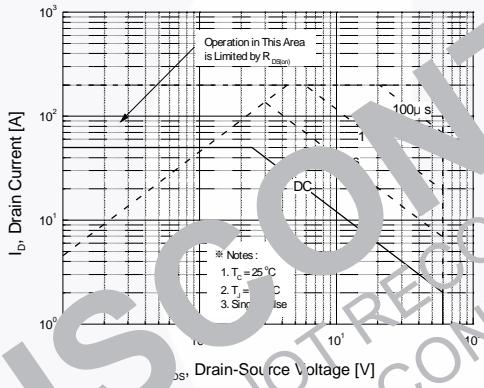
## Typical Characteristics (Continued)



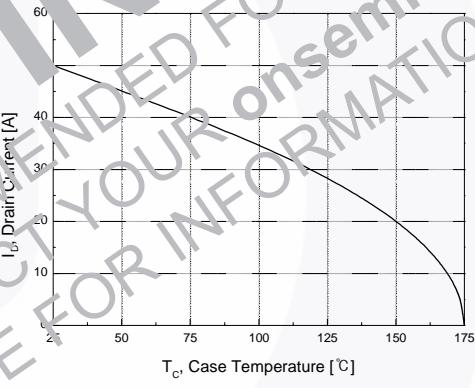
**Figure 7. Breakdown Voltage Variation vs. Temperature**



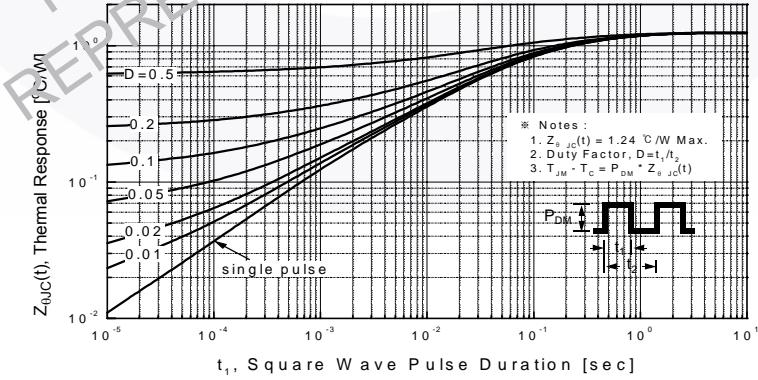
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



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



**Figure 11. Transient Thermal Response Curve**

Figure 12. Gate Charge Test Circuit &amp; Waveform

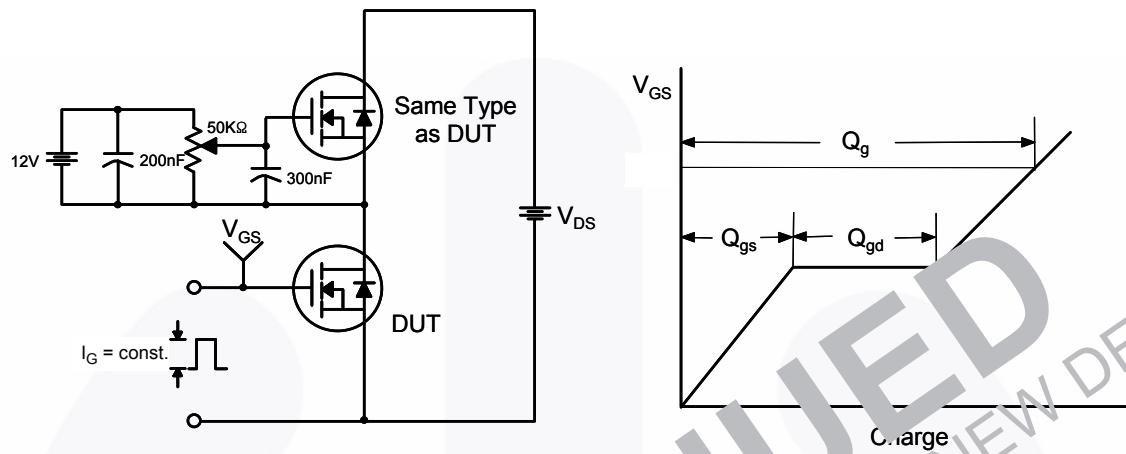


Figure 13. Resistive Switching Test Circuit &amp; Waveforms

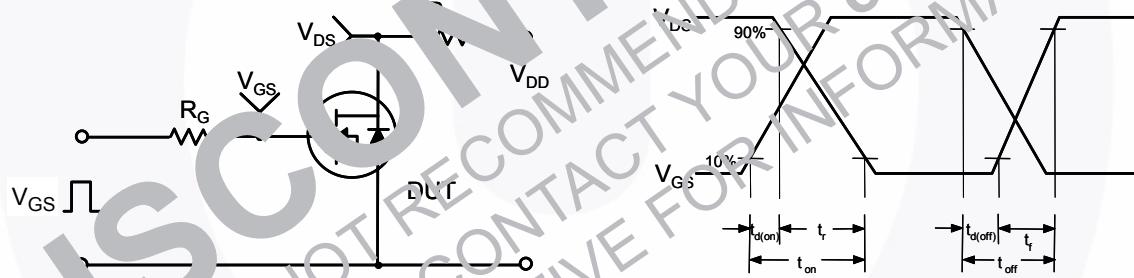


Figure 14. Unclamped Inductive Switching Test Circuit &amp; Waveforms

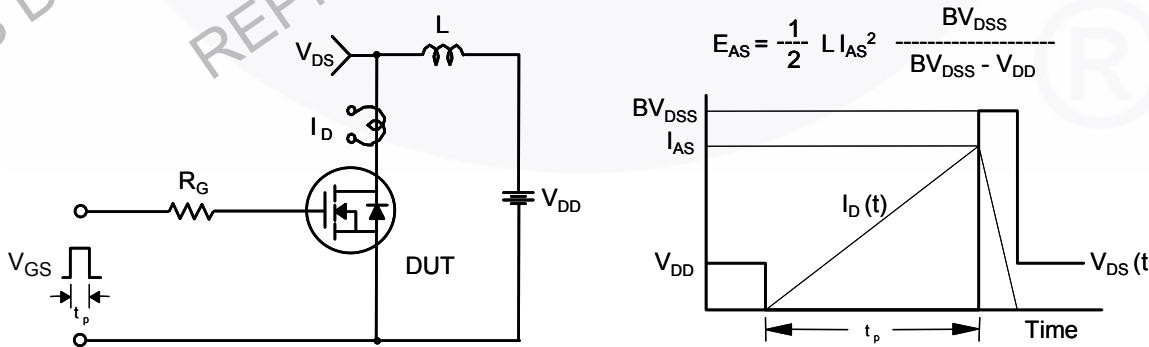
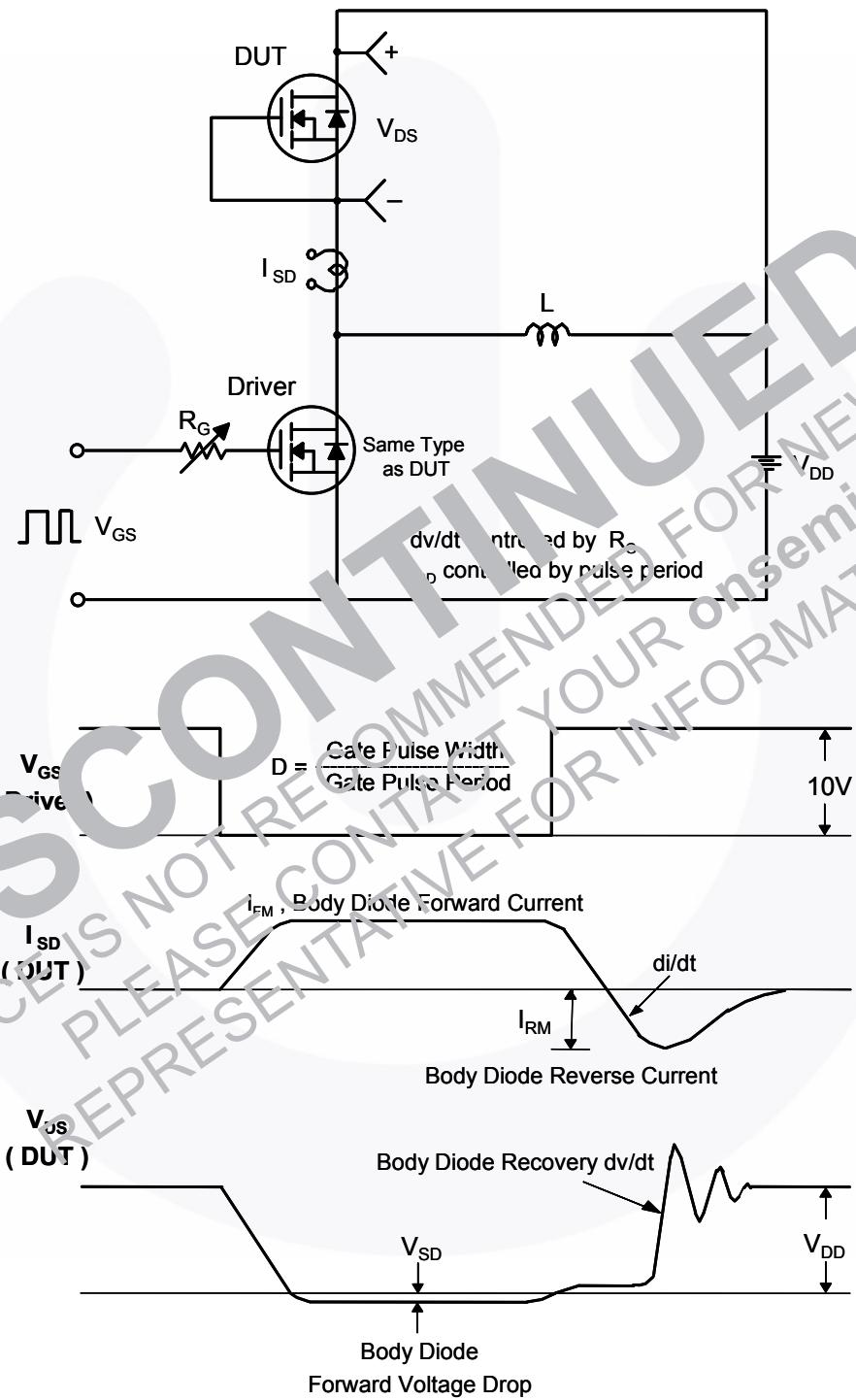
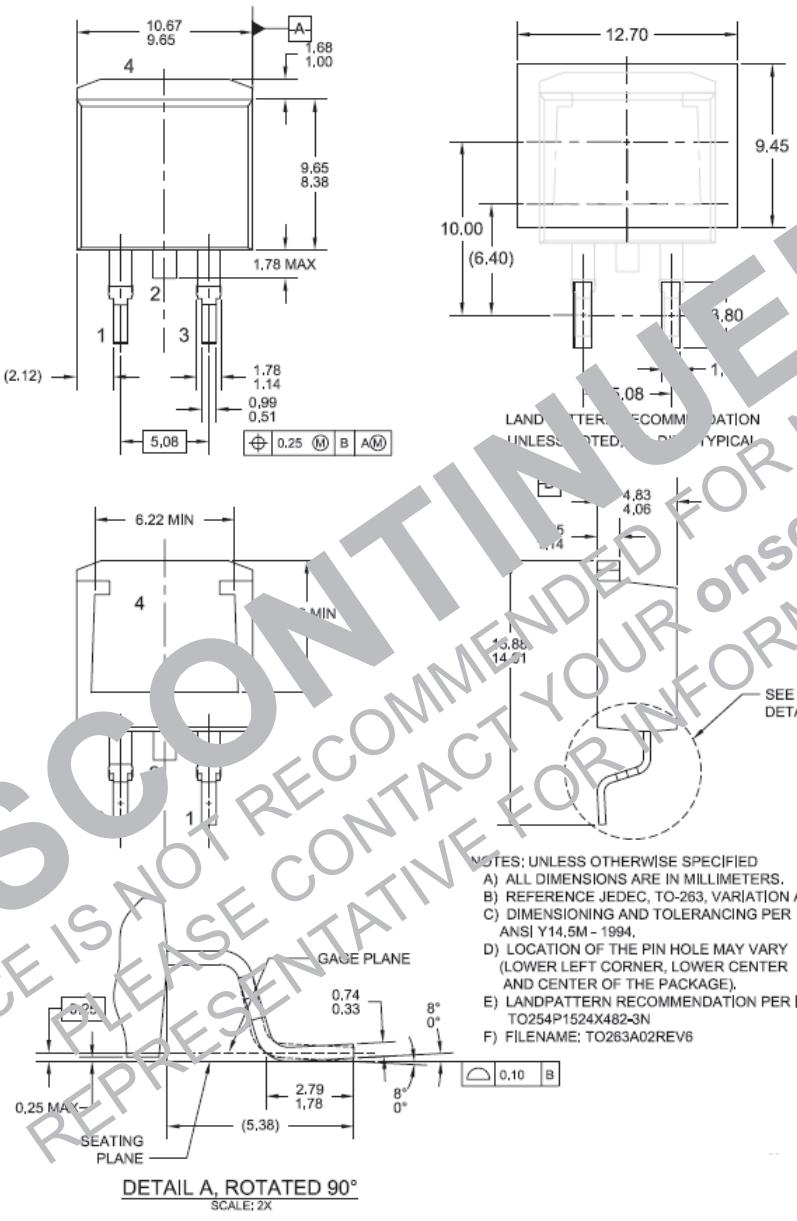


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## **Mechanical Dimensions**

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



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

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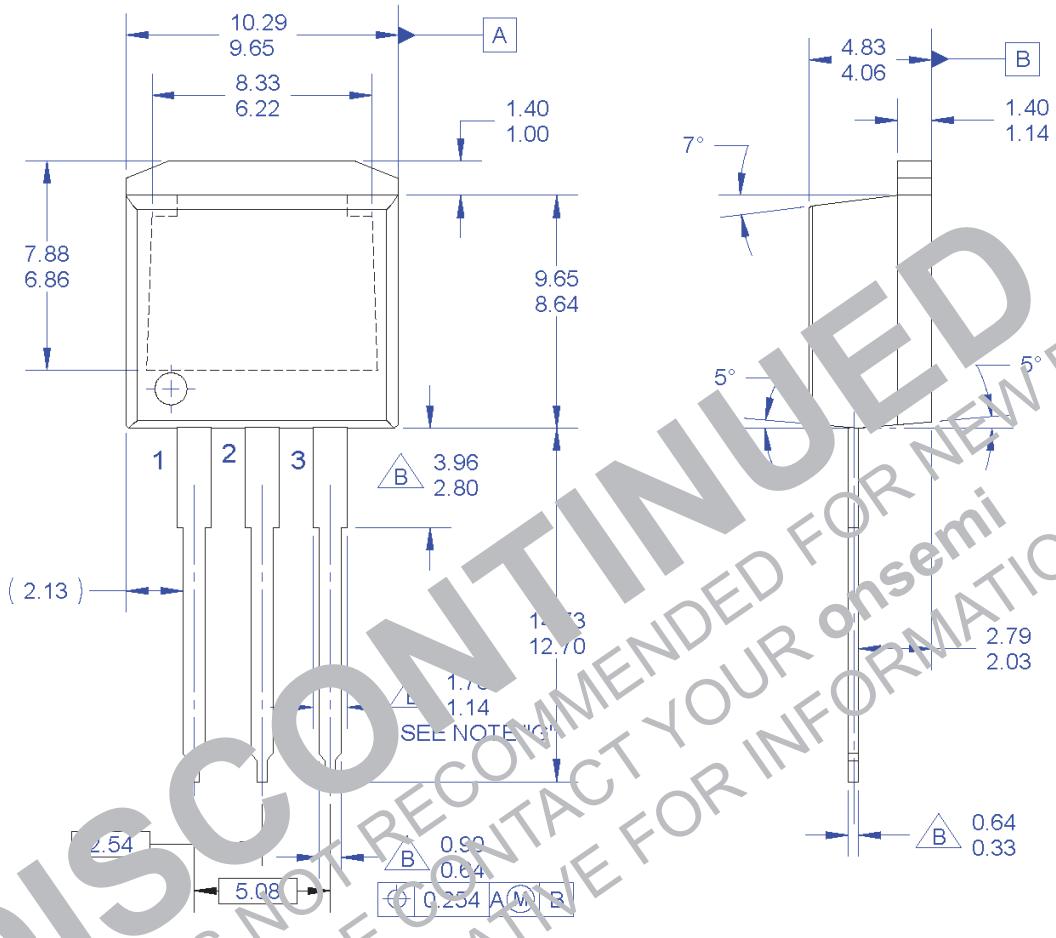
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Dimension in Millimeters

## Mechanical Dimensions

## TO-262 3L (I<sup>2</sup>PAK)



## NOTES:

- A. EXCEPT WHERE NOTED CONFORMS TO TO262 JEDEC VARIATION AA.
- B. DOES NOT COMPLY JEDEC 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 ANSI Y14.5-1994.
- F. LOCATION OF PIN HOLE MAY VARY  
(LOWER LEFT CORNER, LOWER CENTER  
AND CENTER OF PACKAGE)
- G. MAXIMUM WIDTH FOR F102 DEVICE = 1.35 MAX.
- H. DRAWING FILE NAME: TO262A03REV5

**Figure 17. 3LD, TO262, Jedec Variation AA (12PAK)**

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Dimension in Millimeters



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