



June 2014

# FDB024N04AL7

## N-Channel PowerTrench<sup>®</sup> MOSFET

40 V, 219 A, 2.4 mΩ

### Features

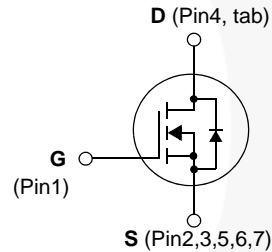
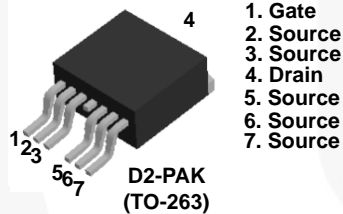
- $R_{DS(on)} = 2.0 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 80 \text{ A}$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

### Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advance PowerTrench<sup>®</sup> process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.

### Applications

- Synchronous Rectification for ATX / Server / Telecom PSU
- Battery Protection Circuit
- Motor drives and Uninterruptible Power Supplies



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

Symbol	Parameter	FDB024N04AL7	Unit
$V_{DSS}$	Drain to Source Voltage	40	V
$V_{GSS}$	Gate to Source Voltage	$\pm 20$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ , Silicon Limited)	219*
		- Continuous ( $T_C = 100^\circ\text{C}$ , Silicon Limited)	155*
		- Continuous ( $T_C = 25^\circ\text{C}$ , Package Limited)	100
$I_{DM}$	Drain Current	- Pulsed (Note 1)	876
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	864
$dv/dt$	Peak Diode Recovery $dv/dt$	(Note 3)	6.0
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	214
		- Derate Above $25^\circ\text{C}$	1.43
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +175	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

\*Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 100 A.

### Thermal Characteristics

Symbol	Parameter	FDB024N04AL7	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.7	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDB024N04AL7	FDB024N04A	D2PAK-7L	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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250 \mu\text{A}$ , $V_{GS} = 0 \text{ V}$ , $T_C = 25^\circ\text{C}$	40	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	30	-	$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 32 \text{ V}$ , $V_{GS} = 0 \text{ V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 32 \text{ V}$ , $T_C = 150^\circ\text{C}$	-	-	500	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20 \text{ V}$ , $V_{DS} = 0 \text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250 \mu\text{A}$	1.0	-	3.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}$ , $I_D = 80 \text{ A}$	-	2.0	2.4	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 10 \text{ V}$ , $I_D = 80 \text{ A}$	-	368	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	-	5490	7300	pF
$C_{oss}$	Output Capacitance		-	1220	1620	pF
$C_{riss}$	Reverse Transfer Capacitance		-	155	233	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 32 \text{ V}$ , $I_D = 80 \text{ A}$ , $V_{GS} = 10 \text{ V}$	-	84	109	nC
$Q_{gs}$	Gate to Source Gate Charge		-	19	-	nC
$Q_{gs2}$	Gate Charge Threshold to Plateau		-	9.5	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		(Note 4)	-	12	-

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 20 \text{ V}$ , $I_D = 80 \text{ A}$ , $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$	-	17	44	ns
$t_r$	Turn-On Rise Time		-	8	26	ns
$t_{d(off)}$	Turn-Off Delay Time		-	71	152	ns
$t_f$	Turn-Off Fall Time		(Note 4)	-	17	44
ESR	Equivalent Series Resistance (G-S)	$f = 1 \text{ MHz}$	-	1.1	-	$\Omega$

### Drain-Source Diode Characteristics

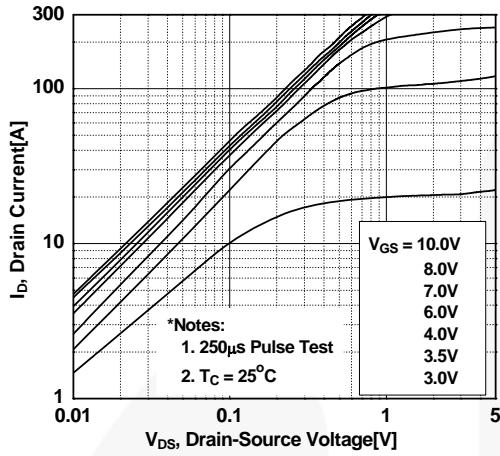
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	219	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	876	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 80 \text{ A}$	-	-	1.3	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 80 \text{ A}$ ,	-	54	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100 \text{ A}/\mu\text{s}$	-	49	-	nC

#### Notes:

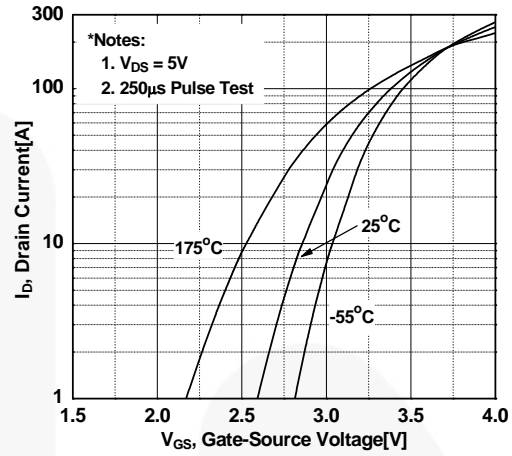
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $L = 3 \text{ mH}$ ,  $I_{AS} = 24 \text{ A}$ ,  $V_{DD} = 40 \text{ V}$ ,  $R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 80 \text{ A}$ ,  $di/dt \leq 200 \text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

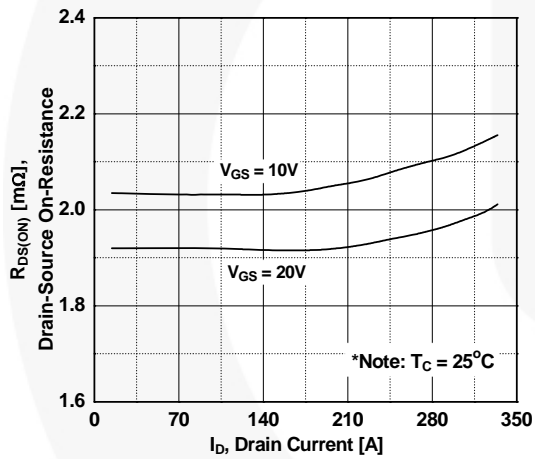
**Figure 1. On-Region Characteristics**



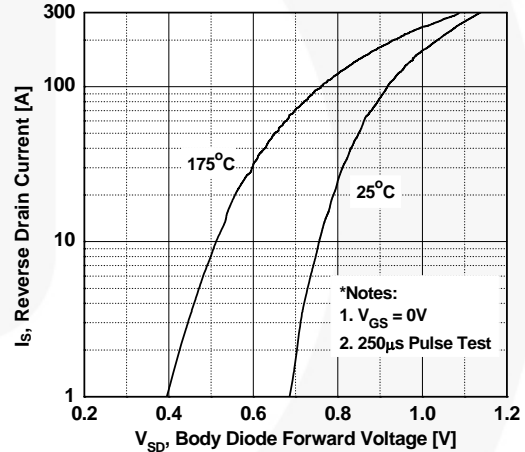
**Figure 2. Transfer Characteristics**



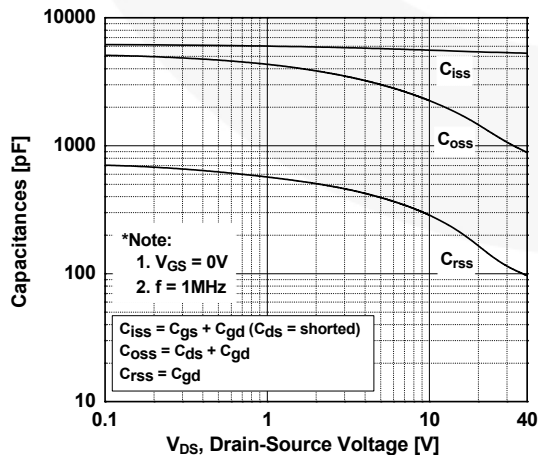
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



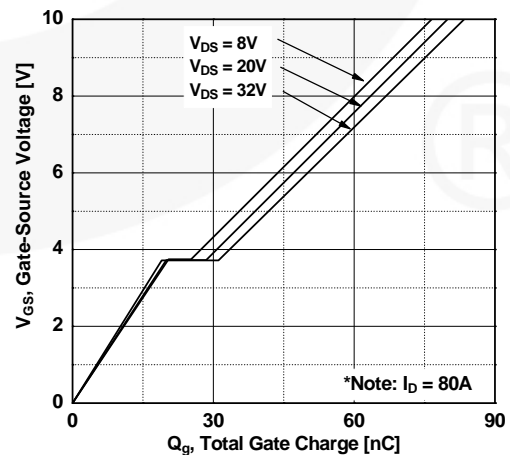
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

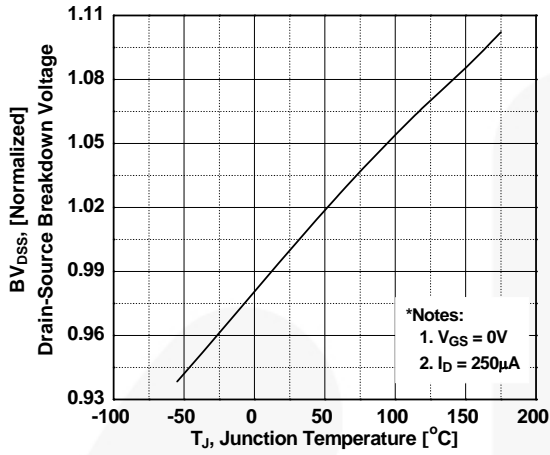


**Figure 6. Gate Charge Characteristics**

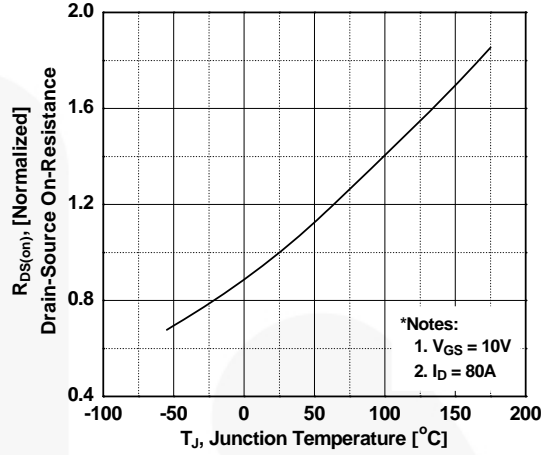


## Typical Performance Characteristics (Continued)

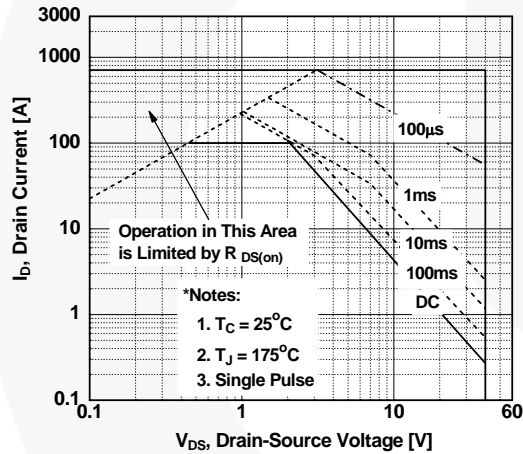
**Figure 7. Breakdown Voltage Variation vs. Temperature**



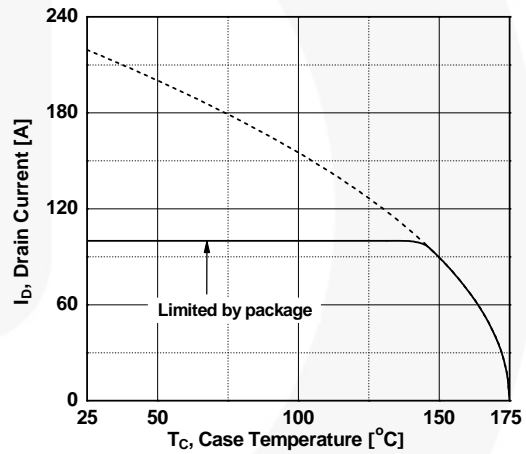
**Figure 8. On-Resistance Variation vs. Temperature**



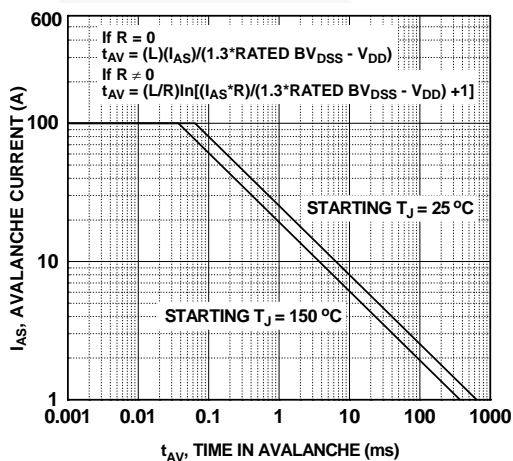
**Figure 9. Maximum Safe Operating Area**



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

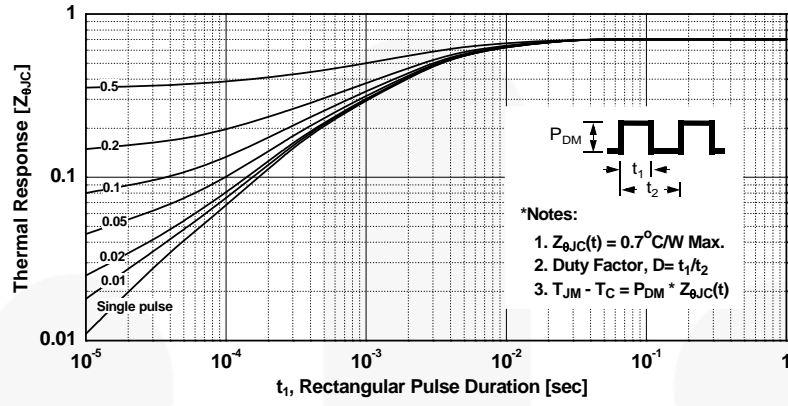


**Figure 11. Unclamped Inductive Switching Capability**

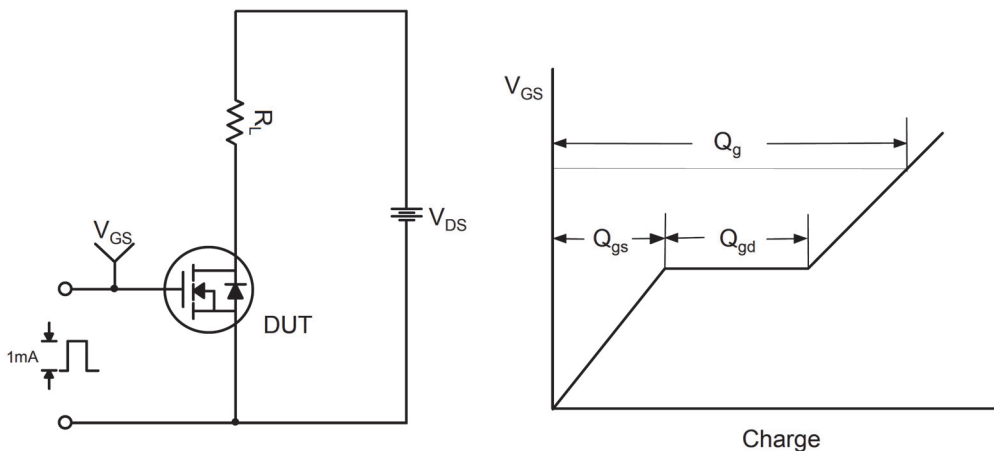


Typical Performance Characteristics (Continued)

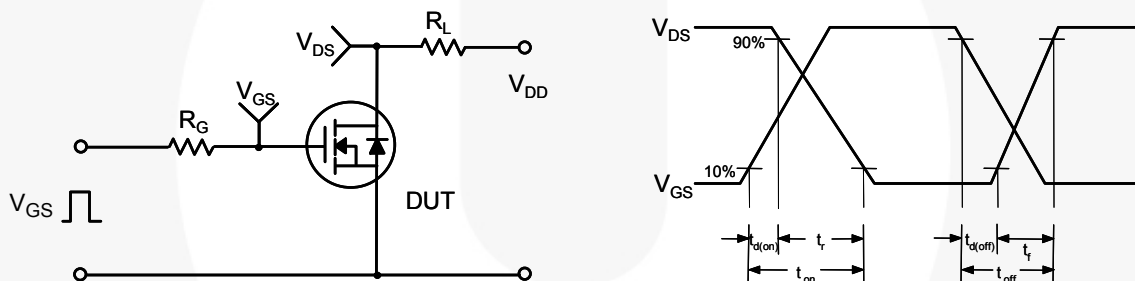
Figure 12. Transient Thermal Response Curve



**Figure 13. Gate Charge Test Circuit & Waveform**



**Figure 14. Resistive Switching Test Circuit & Waveforms**



**Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms**

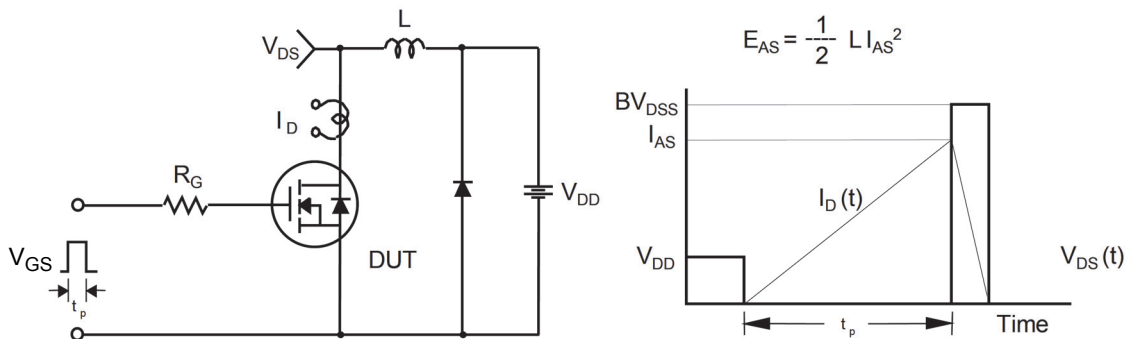
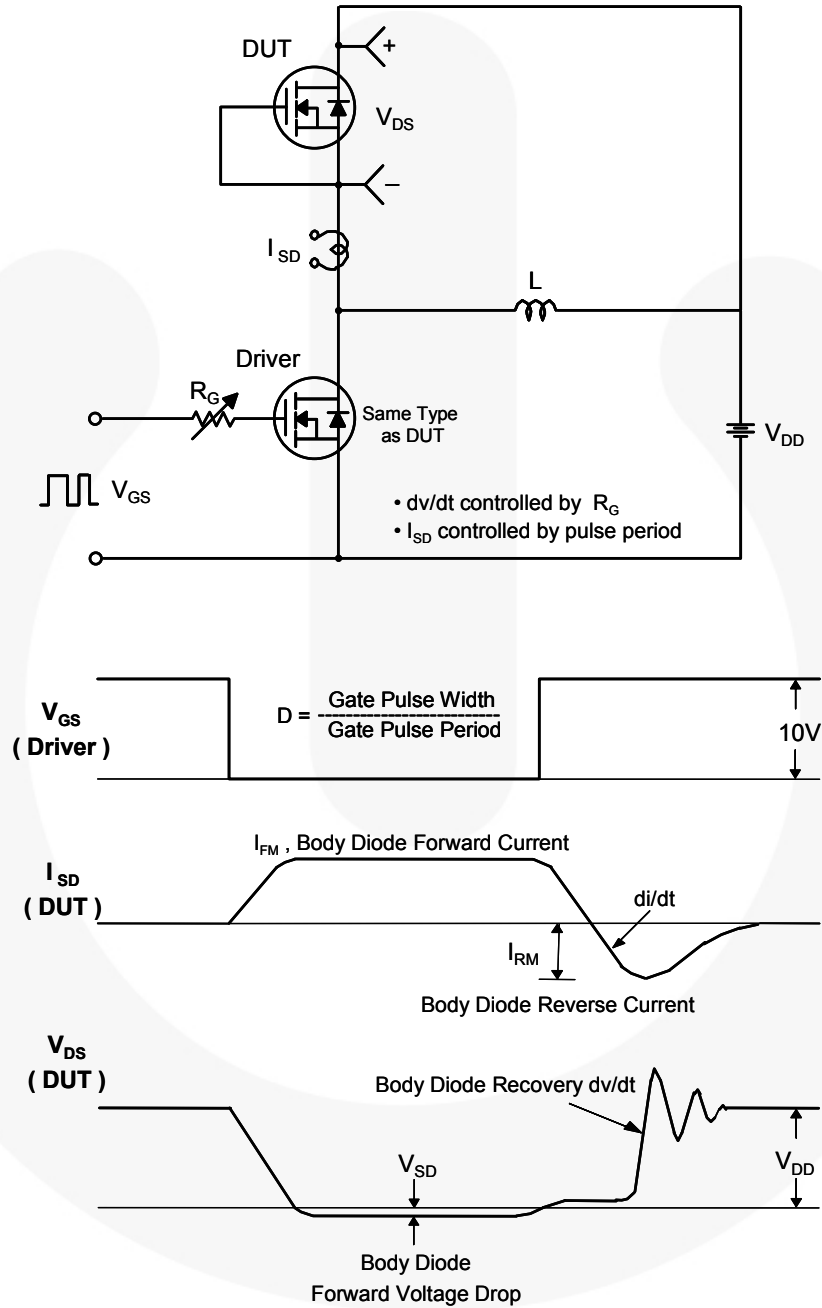
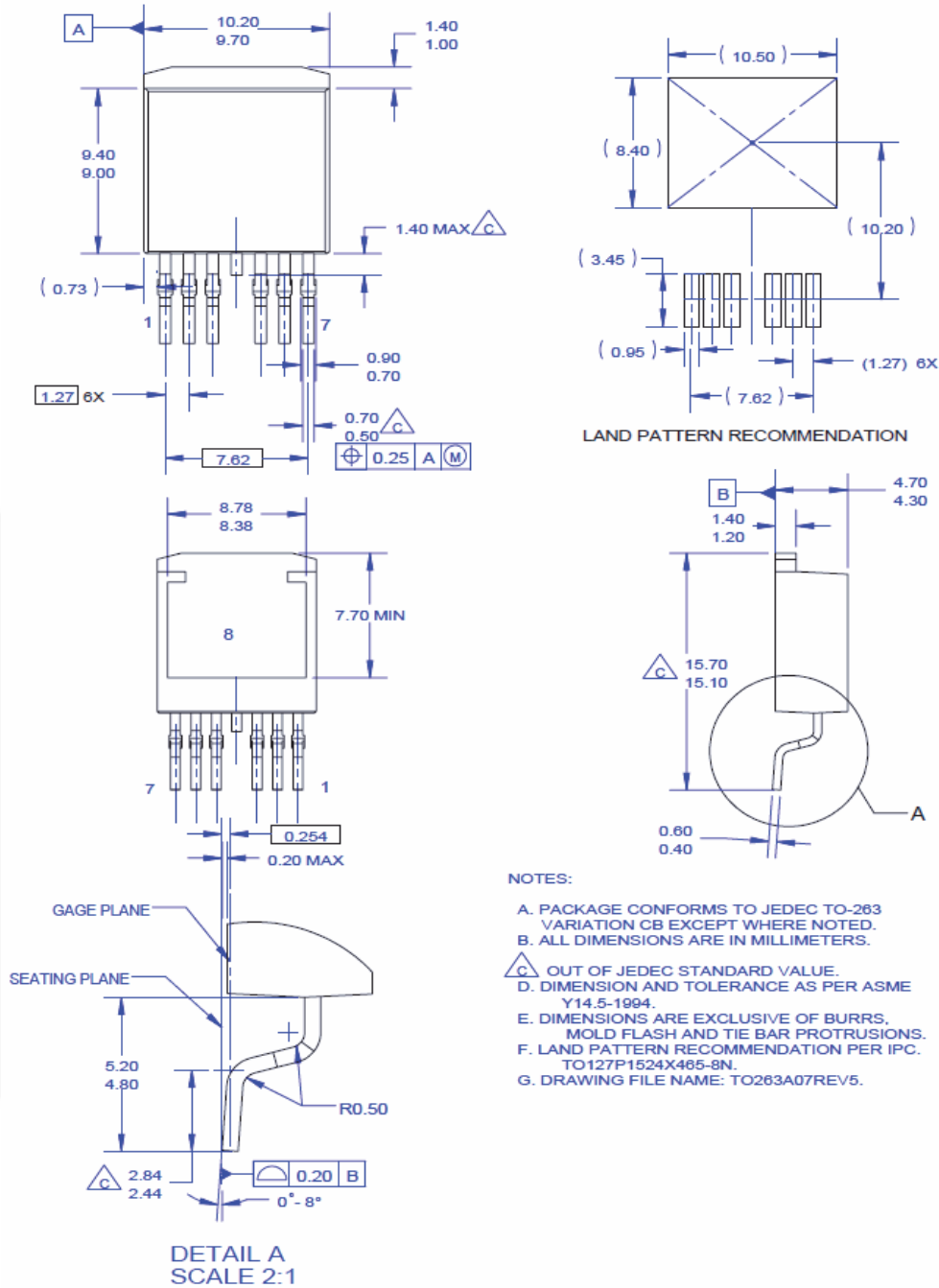


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Mechanical Dimensions



**Figure 17. TO263 (D<sup>2</sup>PAK), Molded, 7-Lead, Surface Mount**

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