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June 2014

FDB024N04AL7

N-Channel PowerTrench[®] MOSFET

40 V, 219 A, 2.4 mΩ

Features

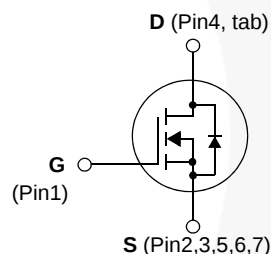
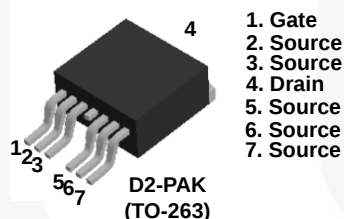
- $R_{DS(on)} = 2.0 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 80 \text{ A}$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advance PowerTrench[®] 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	± 20	V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$, Silicon Limited)	A
		- Continuous ($T_C = 100^\circ\text{C}$, Silicon Limited)	
		- Continuous ($T_C = 25^\circ\text{C}$, Package Limited)	
I_{DM}	Drain Current	- Pulsed (Note 1)	A
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	W
		- Derate Above 25°C	W/ $^\circ\text{C}$
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	$^\circ\text{C/W}$
$R_{\theta JA}$	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°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	μA
		$V_{DS} = 32\ \text{V}$, $T_C = 150^\circ\text{C}$	-	-	500	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 20\ \text{V}$, $V_{DS} = 0\ \text{V}$	-	-	± 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_{rss}	Reverse Transfer Capacitance		-	155	233	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 32\ \text{V}$, $I_D = 80\ \text{A}$, $V_{GS} = 10\ \text{V}$ (Note 4)	-	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		-	12	-	nC

Switching Characteristics

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

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 V, I _{SD} = 80 A	-	-	1.3	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _{SD} = 80 A, dI _F /dt = 100 A/μs	-	54	-	ns
Q _{rr}	Reverse Recovery Charge		-	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

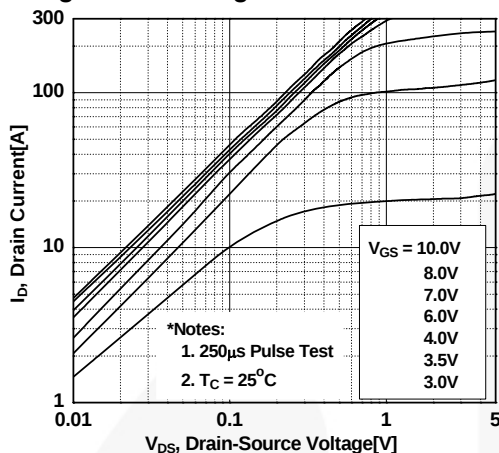


Figure 2. Transfer Characteristics

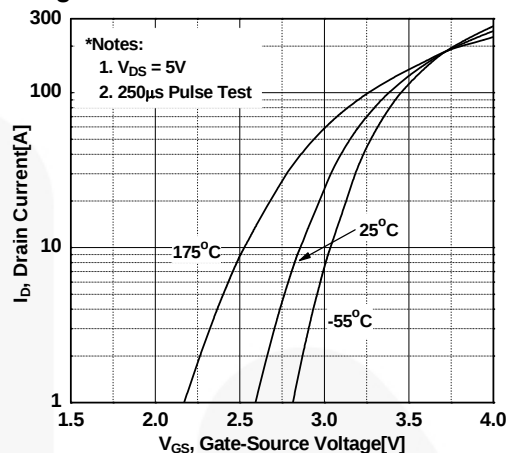


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

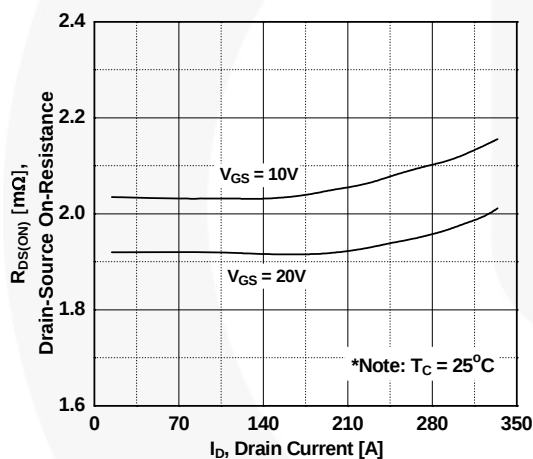


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

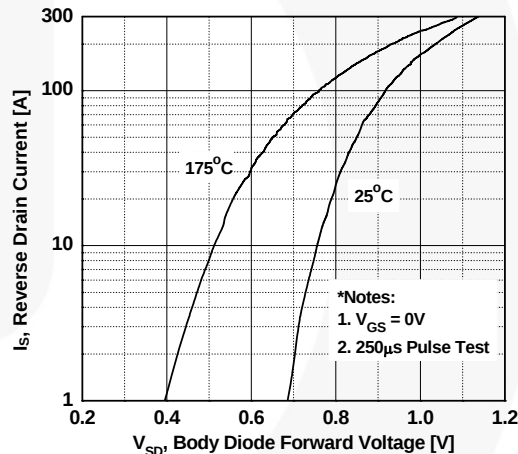


Figure 5. Capacitance Characteristics

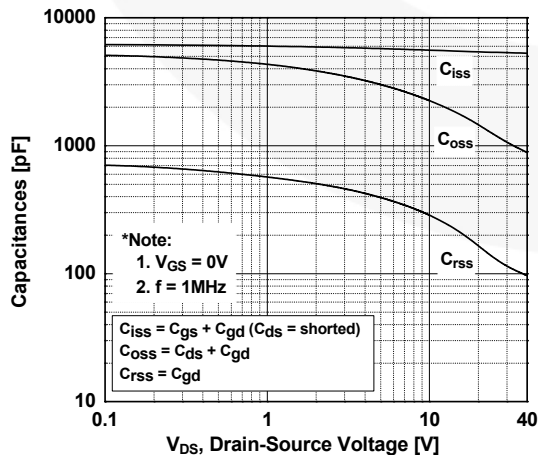
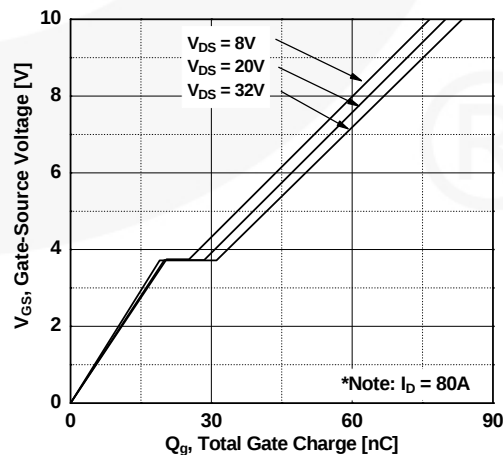


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

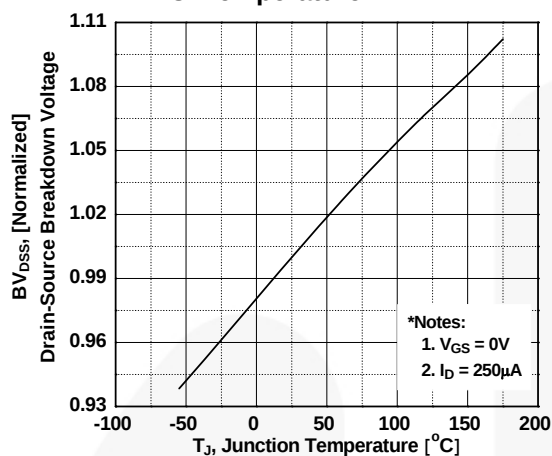


Figure 8. On-Resistance Variation vs. Temperature

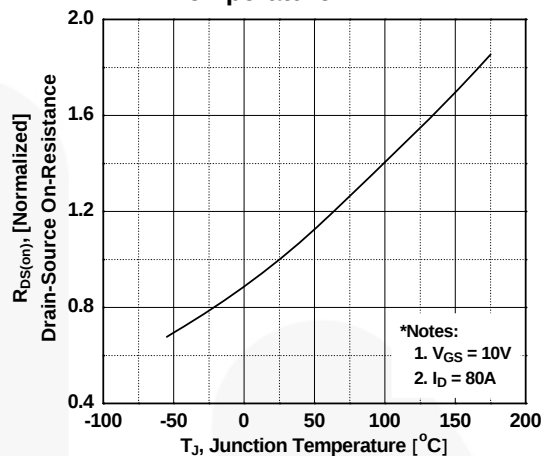


Figure 9. Maximum Safe Operating Area

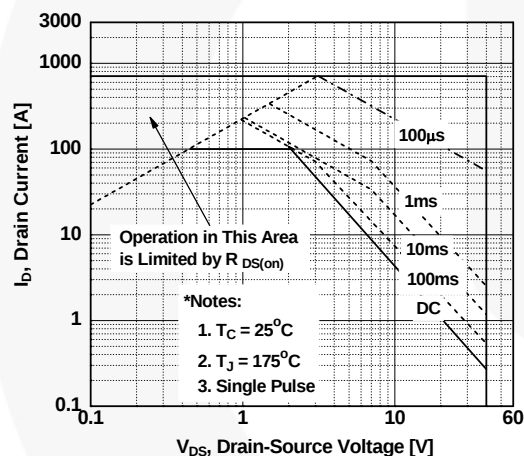


Figure 10. Maximum Drain Current vs. Case Temperature

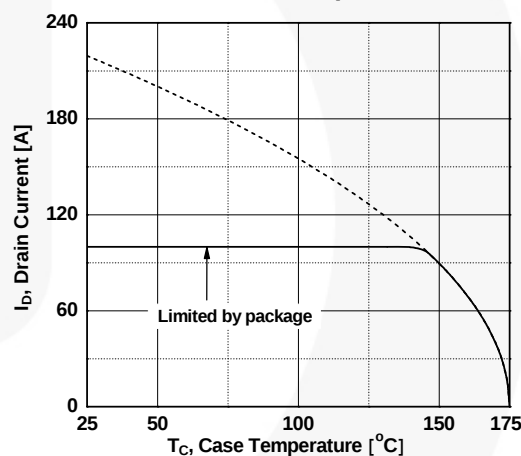
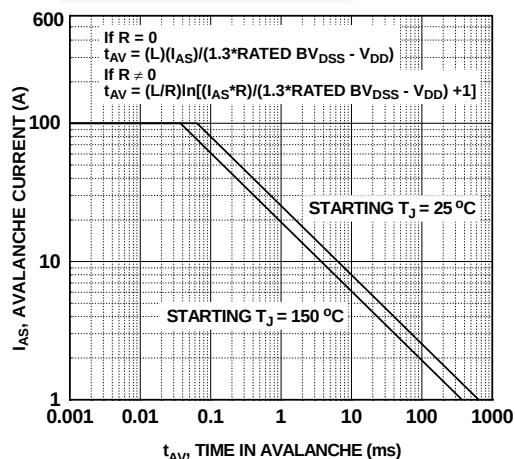


Figure 11. Unclamped Inductive Switching Capability



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve

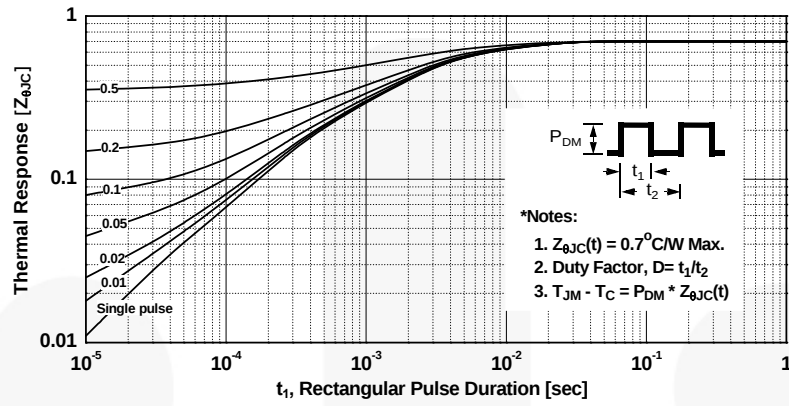


Figure 13. Gate Charge Test Circuit & Waveform

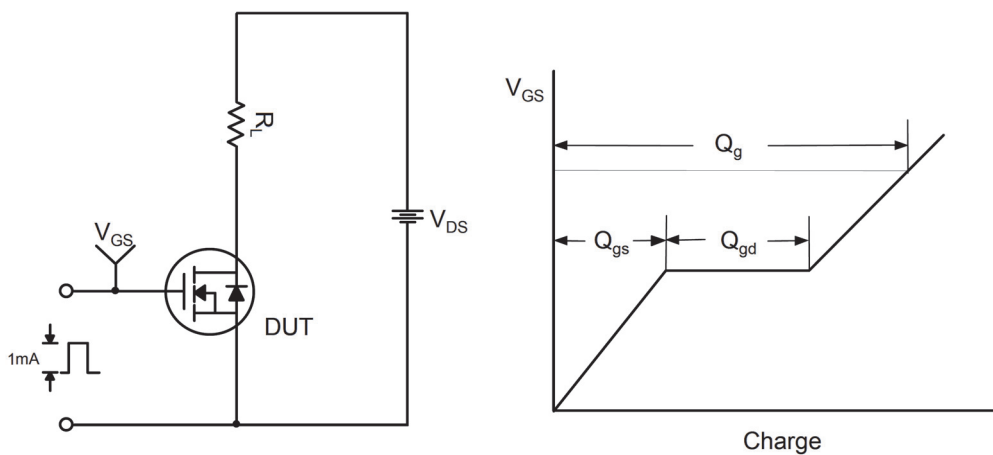


Figure 14. Resistive Switching Test Circuit & Waveforms

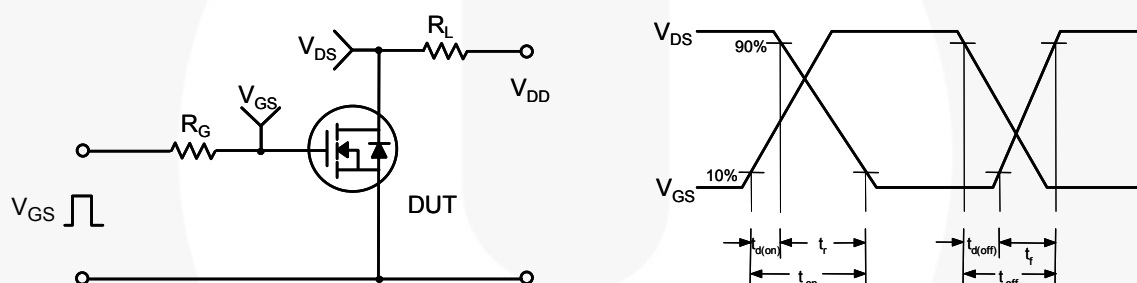
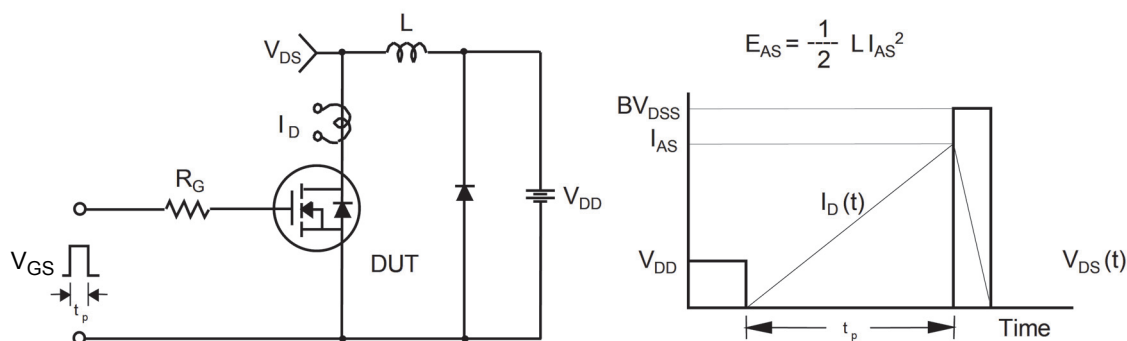


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

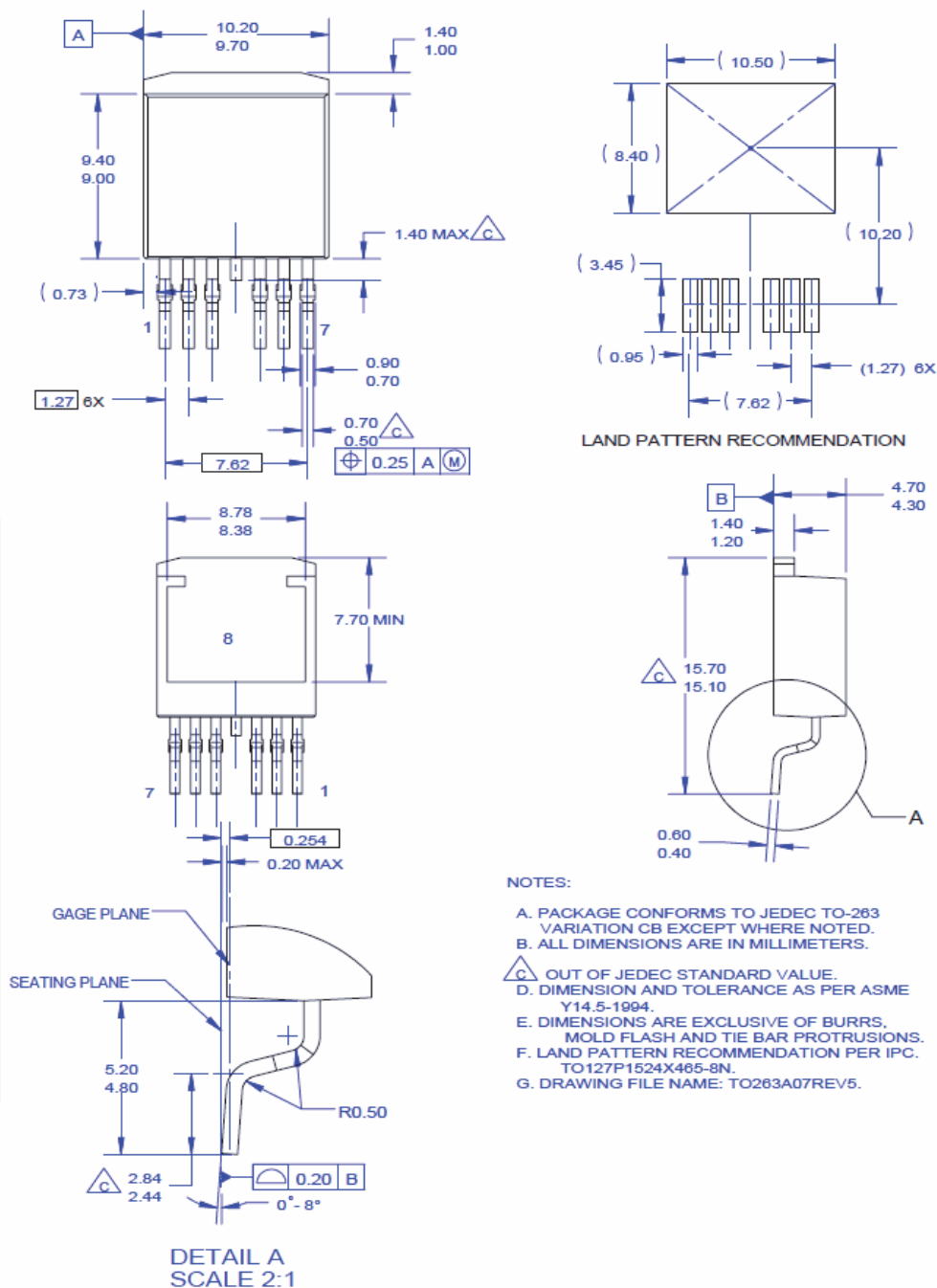


The diagram illustrates a test setup for a MOSFET's body diode. The MOSFET, labeled DUT, is connected in a common-source configuration. Its gate is driven by a pulse generator V_{GS} through a gate resistor R_G . The drain is connected to a load inductor L and a DC supply V_{DD} . The source is connected to ground through a current source I_{SD} . The MOSFET's body diode is represented by a diode symbol. The voltage across the diode is V_{DS} , and the current through it is I_{SD} . The driver MOSFET is noted as being the same type as the DUT.

Below the circuit, three waveforms are shown:

- V_{GS} (Driver):** A square wave pulse. The duty cycle is defined as $D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$. The pulse amplitude is 10V.
- I_{SD} (DUT):** The source-drain current. It shows a forward current I_{FM} during the gate pulse, followed by a reverse current I_{RM} during the recovery phase. The recovery phase is characterized by a di/dt slope.
- V_{DS} (DUT):** The drain-source voltage. It shows a forward voltage drop V_{SD} during the pulse, followed by a recovery phase with a dv/dt slope, and finally a reverse voltage V_{DD} .

Mechanical Dimensions

Figure 17. TO263 (D²PAK), Molded, 7-Lead, Surface Mount

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