



ON Semiconductor®

FQD3N60CTM-WS

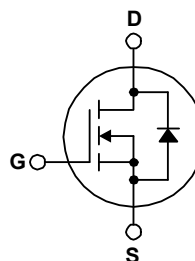
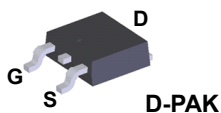
N-Channel QFET® MOSFET 600 V, 2.4 A, 3.4 Ω

Features

- 2.4 A, 600 V, $R_{DS(on)} = 3.4 \Omega$ (Max.) @ $V_{GS} = 10$ V, $I_D = 1.2$ A
- Low Gate Charge (Typ. 10.5 nC)
- Low C_{rss} (Typ. 5 pF)
- 100% Avalanche Tested

Description

This N-Channel enhancement mode power MOSFET is produced using ON 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, active power factor correction (PFC), and electronic lamp ballasts.



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

Symbol	Parameter	FQD3N60CTM_WS	Unit
V_{DSS}	Drain-Source Voltage	600	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$) - Continuous ($T_C = 100^\circ\text{C}$)	2.4	A
		1.5	A
I_{DM}	Drain Current - Pulsed (Note 1)	9.6	A
V_{GSS}	Gate-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	150	mJ
I_{AR}	Avalanche Current (Note 1)	2.4	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	4.0	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$) - Derate above 25°C	50	W
		0.4	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	FQD3N60CTM_WS	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	2.5	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	110	$^\circ\text{C/W}$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQD3N60CS	FQD3N60CTM-WS	D-PAK	330 mm	16 mm	2500 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
V_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	600	--	--	V
$\Delta V_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$, Referenced to 25°C	--	0.6	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	--	--	1	μA
		$V_{DS} = 480V, T_C = 125^\circ C$	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30V, V_{DS} = 0V$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30V, V_{DS} = 0V$	600	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 1.2A$	--	2.8	3.4	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40V, I_D = 1.2A$	--	3.5	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0MHz$	--	435	565	pF
C_{oss}	Output Capacitance		--	45	60	pF
C_{rss}	Reverse Transfer Capacitance		--	5	8	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300V, I_D = 3A,$ $R_G = 25\Omega$ (Note 4)	--	12	34	ns
t_r	Turn-On Rise Time		--	30	70	ns
$t_{d(off)}$	Turn-Off Delay Time		--	35	80	ns
t_f	Turn-Off Fall Time		--	35	80	ns
Q_g	Total Gate Charge	$V_{DS} = 480V, I_D = 3A,$ $V_{GS} = 10V$ (Note 4)	--	10.5	14	nC
Q_{gs}	Gate-Source Charge		--	2.1	--	nC
Q_{gd}	Gate-Drain Charge		--	4.5	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	3	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	12	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_S = 2.4A$	--	--	1.4	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0V, I_S = 3A$ $dI_F/dt = 100A/\mu s$	--	260	--	ns
Q_{rr}	Reverse Recovery Charge		--	1.6	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. $I_{AS} = 2.4A, V_{DD} = 50V, L = 47mH, R_G = 25\Omega$, starting $T_J = 25^\circ\text{C}$.
3. $I_{SD} \leq 3A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.
4. Essentially independent of operating temperature.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

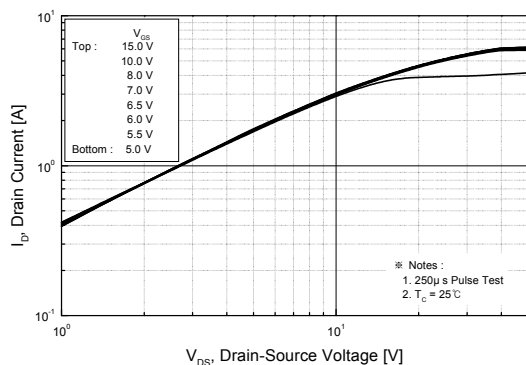


Figure 2. Transfer Characteristics

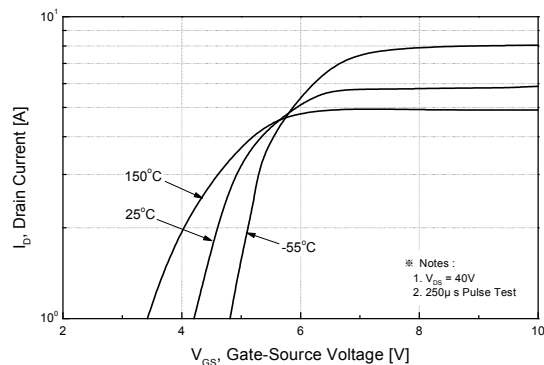


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

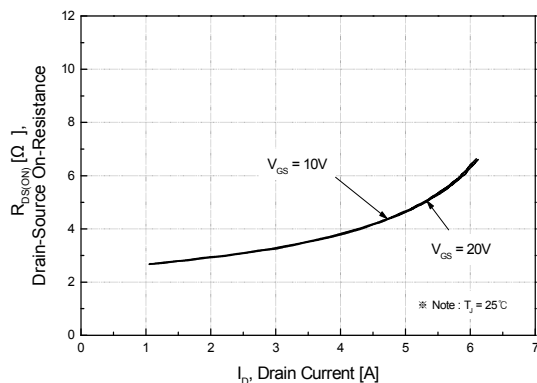


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

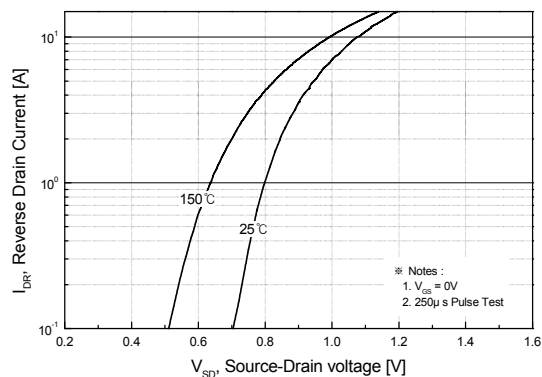


Figure 5. Capacitance Characteristics

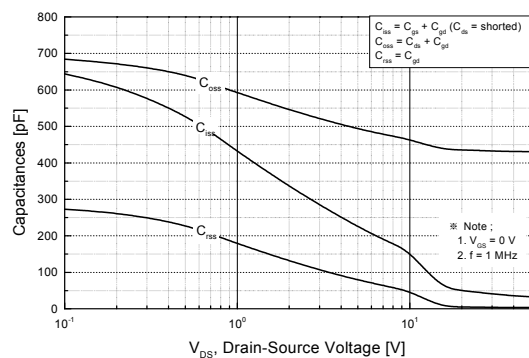
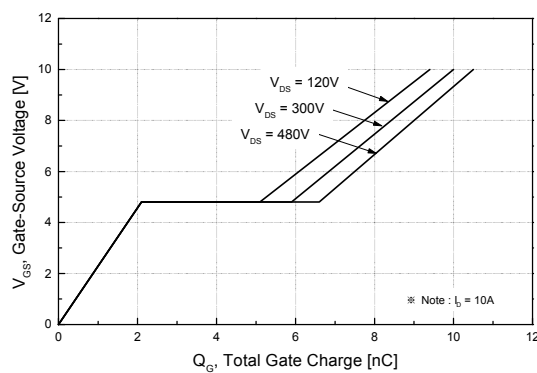


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

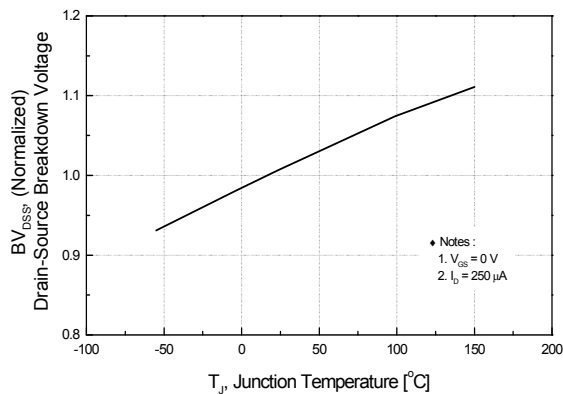


Figure 8. On-Resistance Variation vs. Temperature

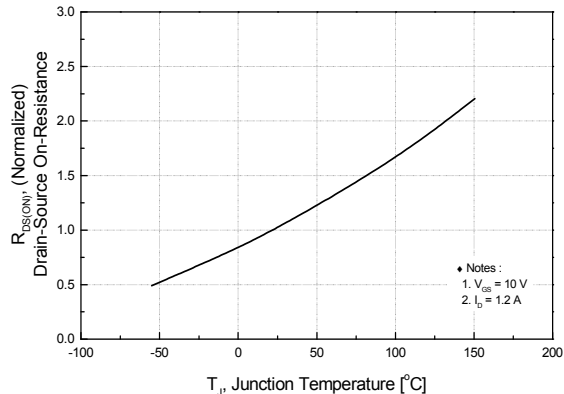


Figure 9. Maximum Safe Operating Area

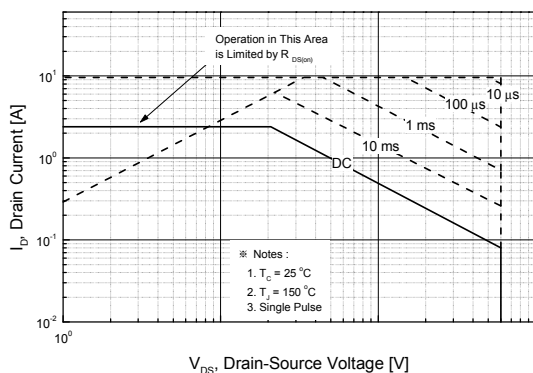


Figure 10. Maximum Drain Current vs. Case Temperature

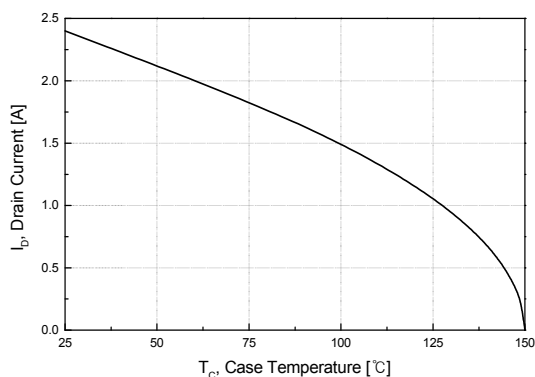


Figure 11. Transient Thermal Response Curve

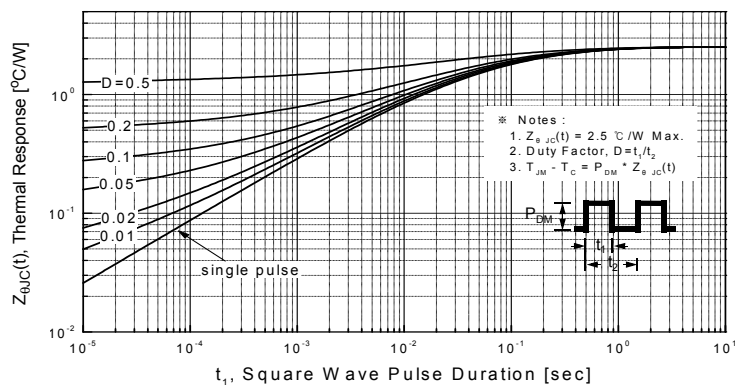


Figure 12. Gate Charge Test Circuit & Waveform

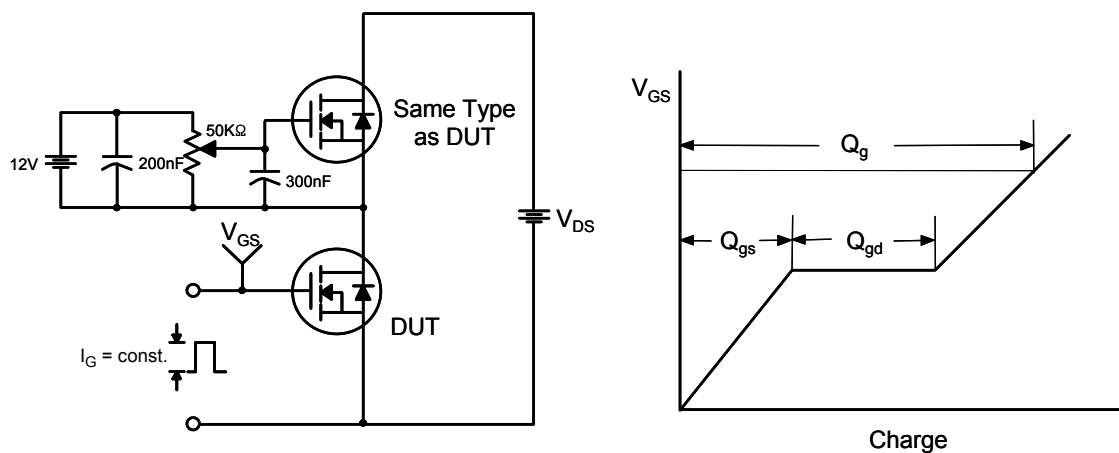


Figure 13. Resistive Switching Test Circuit & Waveforms

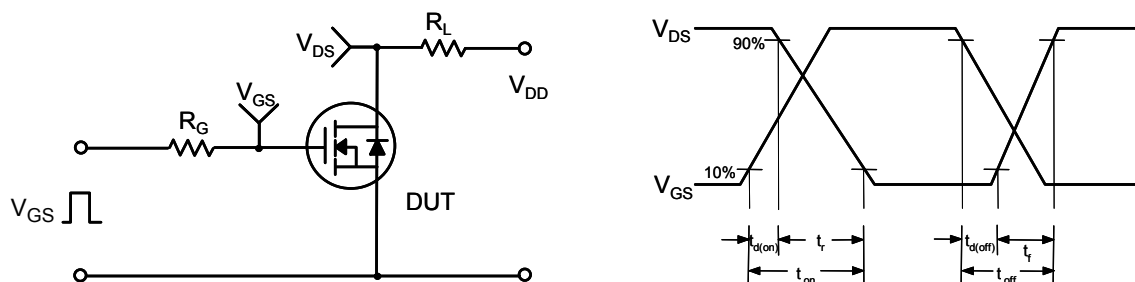


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

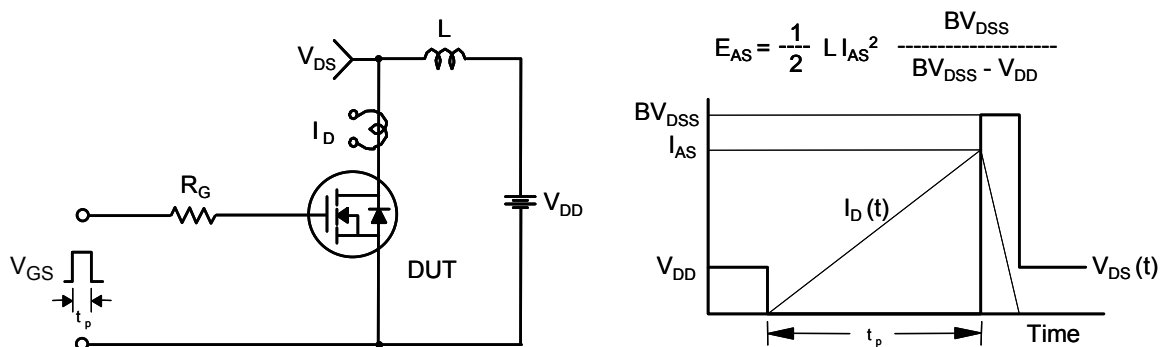
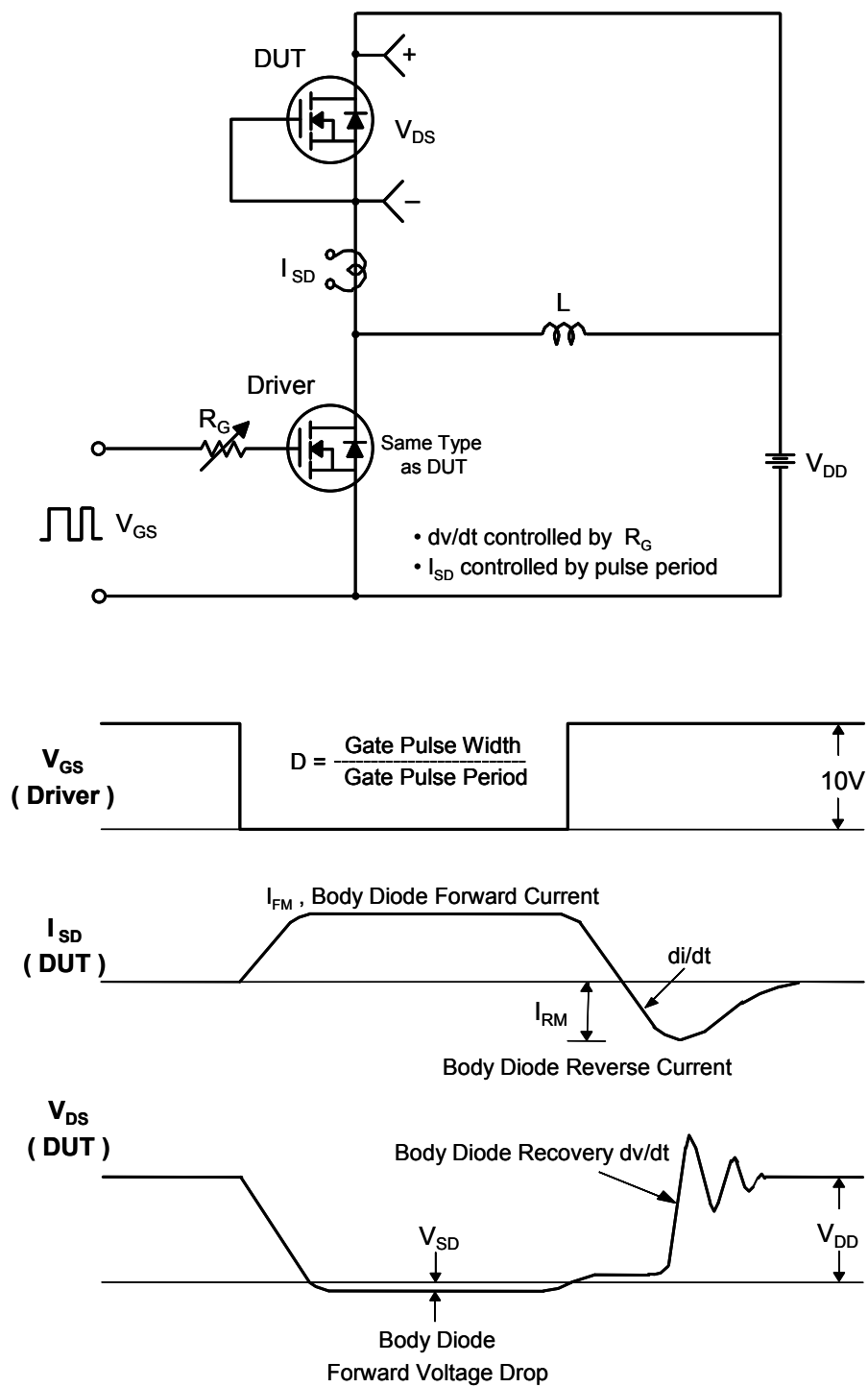
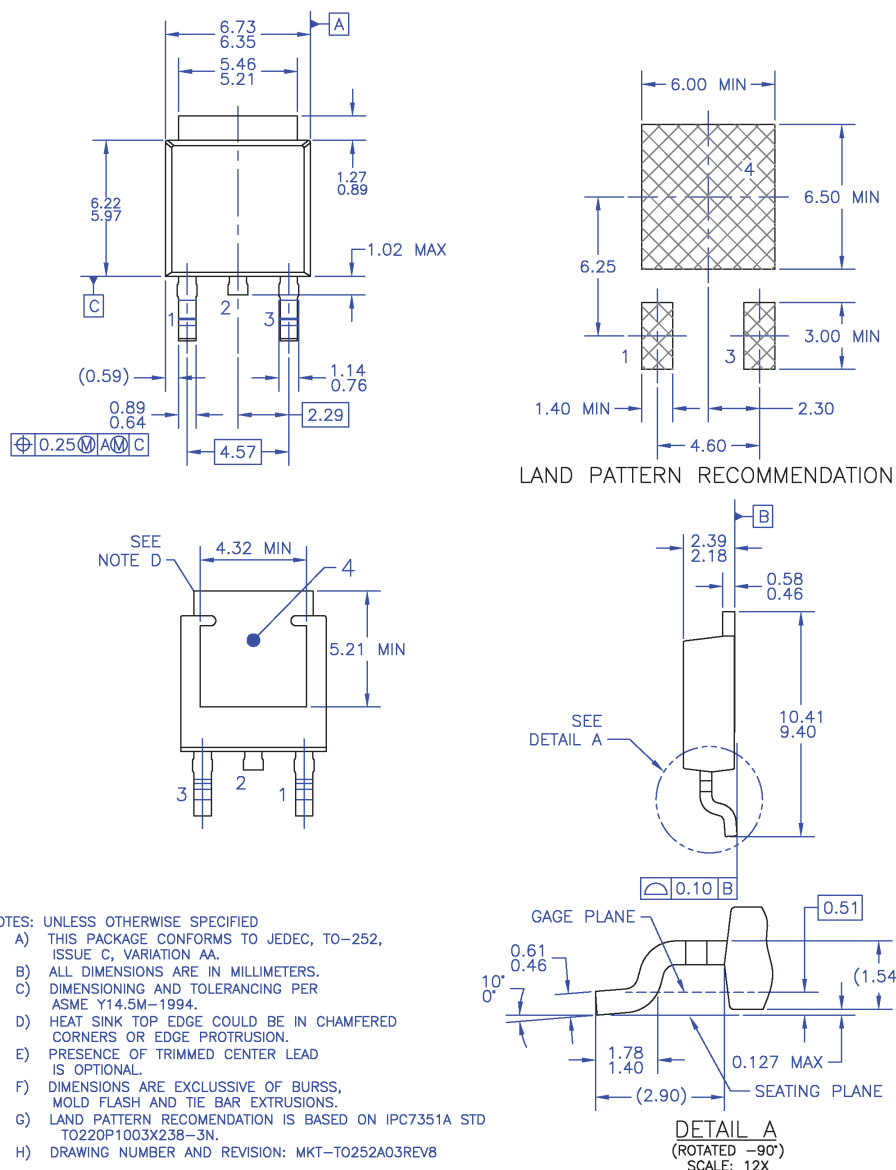


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-252 3L (DPAK)



- NOTES: UNLESS OTHERWISE SPECIFIED
- THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
 - ALL DIMENSIONS ARE IN MILLIMETERS.
 - DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
 - HEAT SINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.
 - PRESENCE OF TRIMMED CENTER LEAD IS OPTIONAL.
 - DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
 - LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO220P1003X238-3N.
 - DRAWING NUMBER AND REVISION: MKT-TO252A03REV8

Figure 16. TO252 (D-PAK), Molded, 3 Lead, Option AA&AB

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Dimension in Millimeters

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