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ON Semiconductor®

# FDD6N50TM-F085

## 500V N-Channel MOSFET

### Features

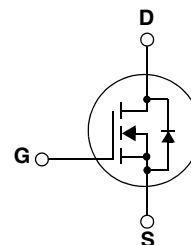
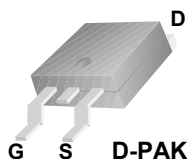
- 6A, 500V,  $R_{DS(on)} = 0.9\Omega$  @  $V_{GS} = 10V$
- Low gate charge ( typical 12.8 nC)
- Low  $C_{rss}$  ( typical 9 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- Qualified to AEC Q101
- RoHS Compliant



### Description

These N-Channel enhancement mode power field effect transistors are produced using ON Semiconductor's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficient switched mode power supplies and active power factor correction.



### Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
$V_{DSS}$	Drain-Source Voltage	500	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	6 3.8	A A
$I_{DM}$	Drain Current - Pulsed (Note 1)	24	A
$V_{GSS}$	Gate-Source voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	270	mJ
$I_{AR}$	Avalanche Current (Note 1)	6	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	8.9	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 $25^\circ\text{C}$	89 0.71	W 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 Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Min.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	1.4	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	83	$^\circ\text{C/W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD6N50	FDD6N50TM-F085	D-PAK	380mm	16mm	2500

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max	Units
Off Characteristics						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	500	--	--	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	--	0.5	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V V <sub>DS</sub> = 400V, T <sub>C</sub> = 125°C	-- --	-- --	1 10	μA μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V	--	--	-100	nA
On Characteristics						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	3.0	--	5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 3A	--	0.76	0.9	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40V, I <sub>D</sub> = 3A (Note 4)	--	2.5	--	S
Dynamic Characteristics						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	720	940	pF
C <sub>oss</sub>	Output Capacitance		--	95	190	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	9	13.5	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 250V, I <sub>D</sub> = 6A R <sub>G</sub> = 25Ω  (Note 4, 5)	--	6	20	ns
t <sub>r</sub>	Turn-On Rise Time		--	55	120	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	25	60	ns
t <sub>f</sub>	Turn-Off Fall Time		--	35	80	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 400V, I <sub>D</sub> = 6A V <sub>GS</sub> = 10V  (Note 4, 5)	--	12.8	16.6	nC
Q <sub>gs</sub>	Gate-Source Charge		--	3.7	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	5.8	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	6	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	24	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>S</sub> = 6A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>S</sub> = 6A dI <sub>F</sub> /dt = 100A/μs (Note 4)	--	275	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	1.7	--	μC

### NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 6A, V<sub>DD</sub> = 50V, L = 13.5mH, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 6A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

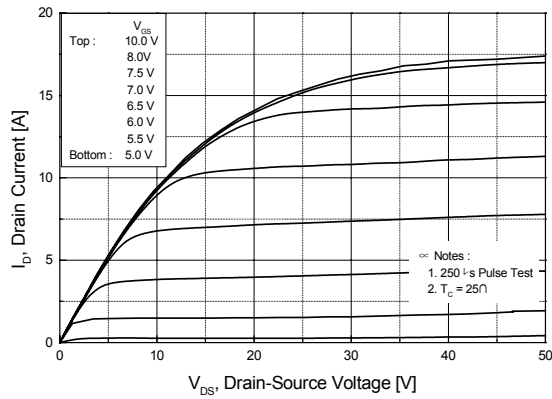


Figure 2. Transfer Characteristics

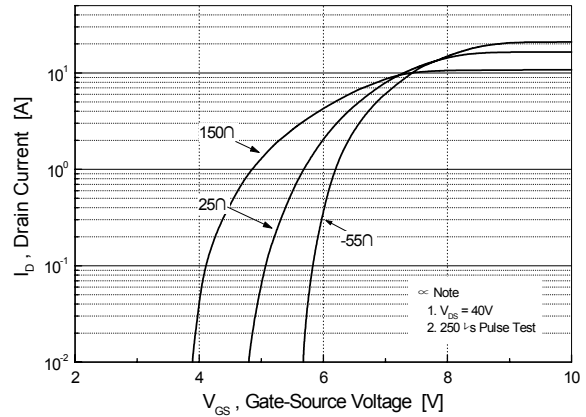


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

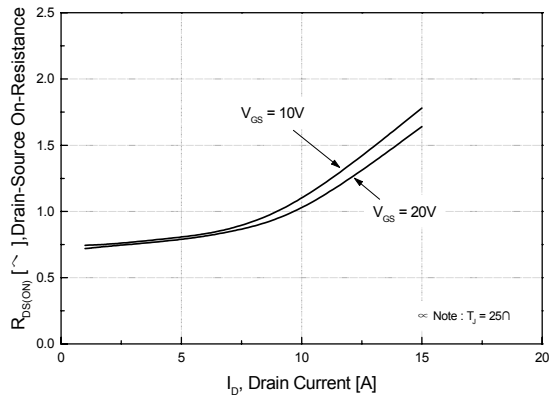


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

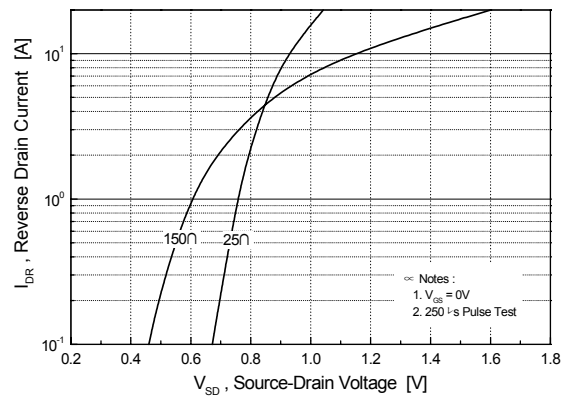


Figure 5. Capacitance Characteristics

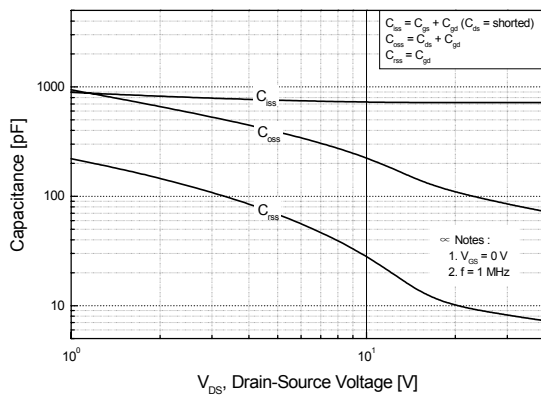
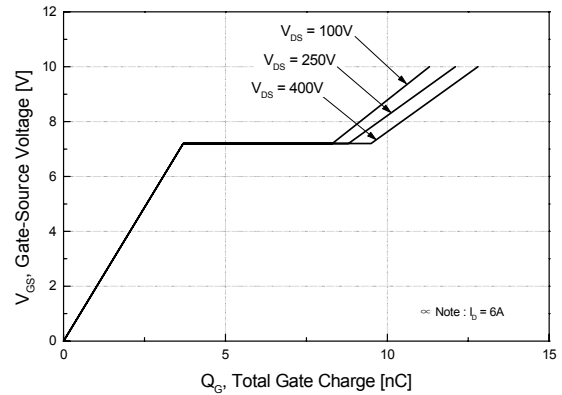
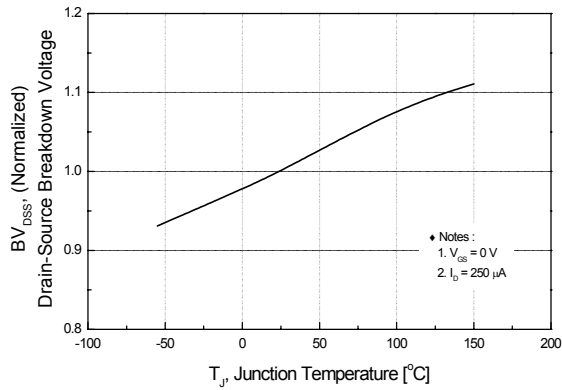


Figure 6. Gate Charge Characteristics

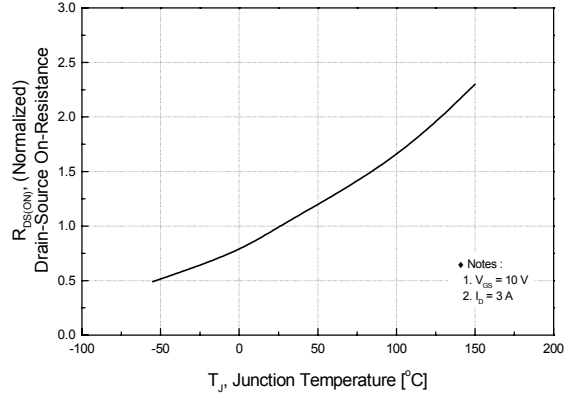


## Typical Performance Characteristics (Continued)

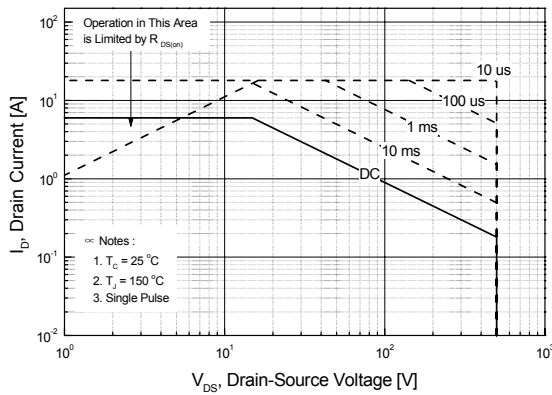
**Figure 7. Breakdown Voltage Variation vs. Temperature**



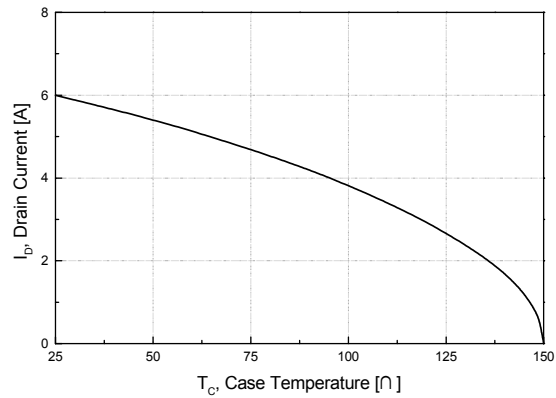
**Figure 8. On-Resistance Variation vs. Temperature**



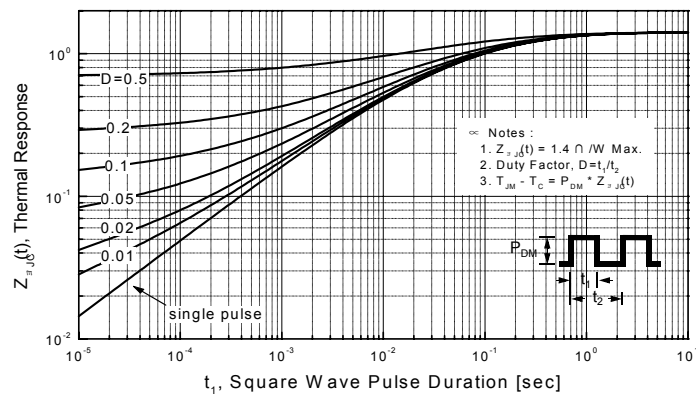
**Figure 9. Maximum Safe Operating Area**



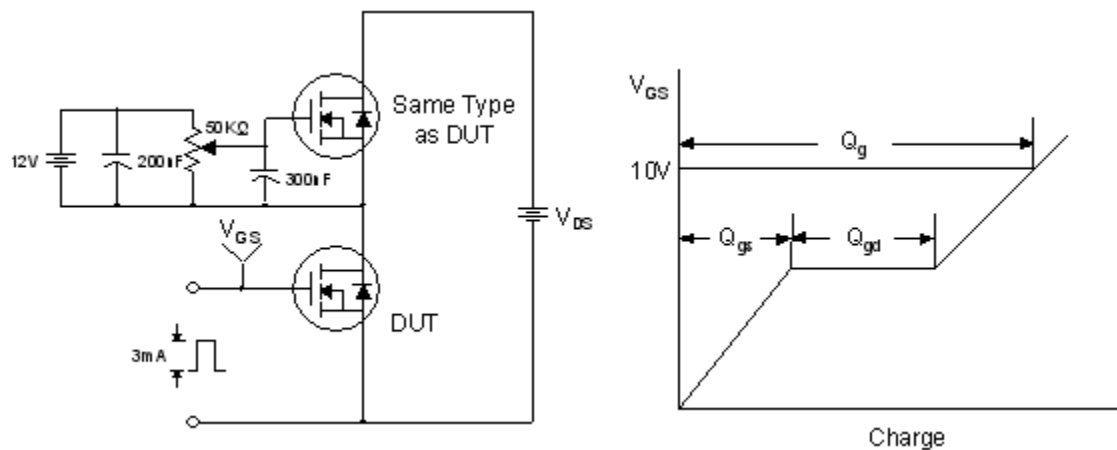
**Figure 10. Maximum Drain Current vs. Case Temperature**



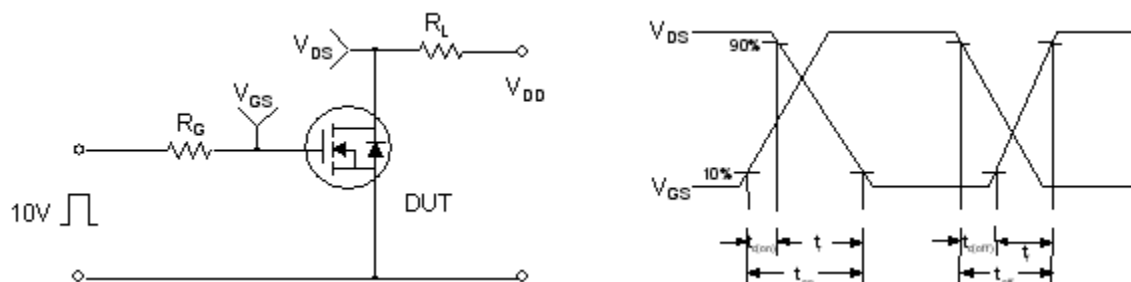
**Figure 11. Transient Thermal Response Curve**



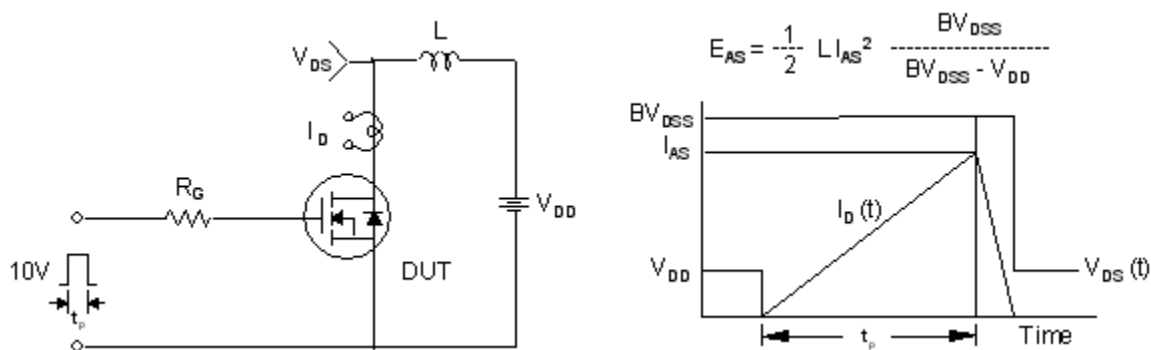
### Gate Charge Test Circuit & Waveform



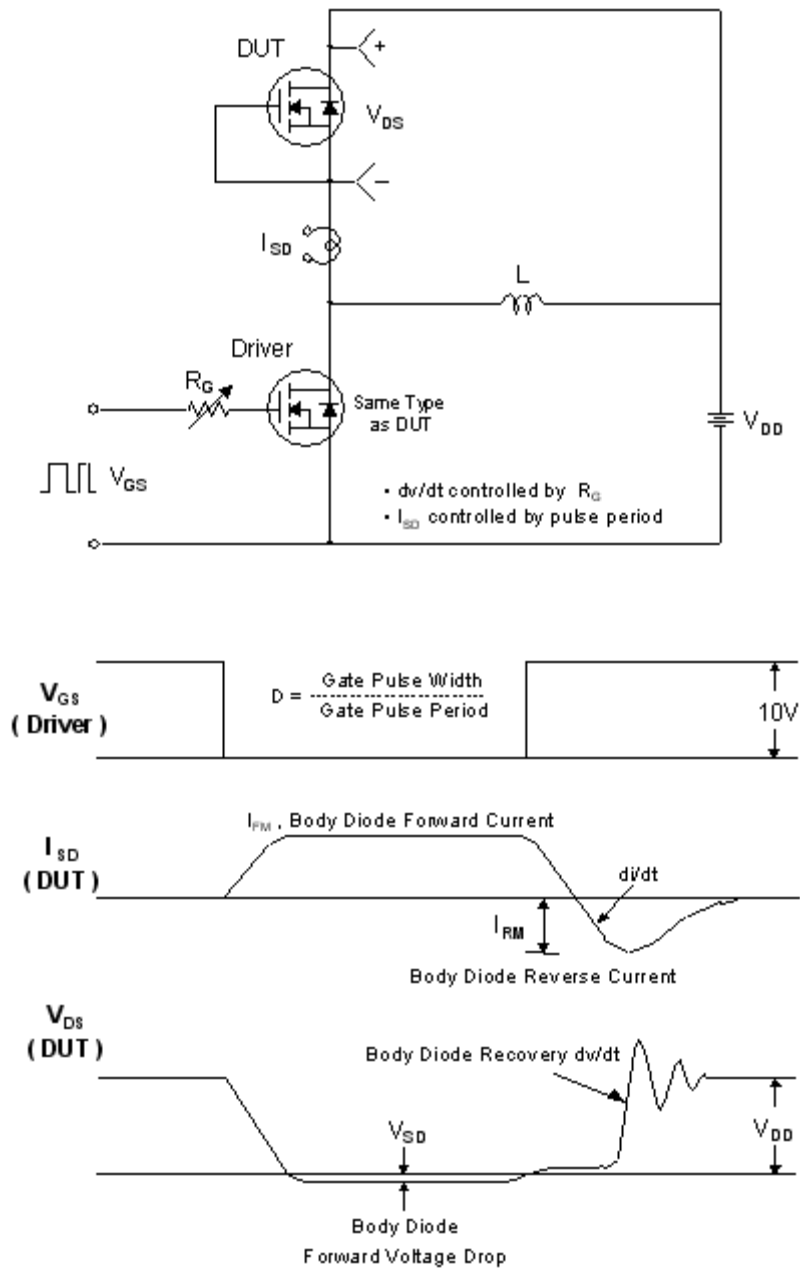
### Resistive Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms

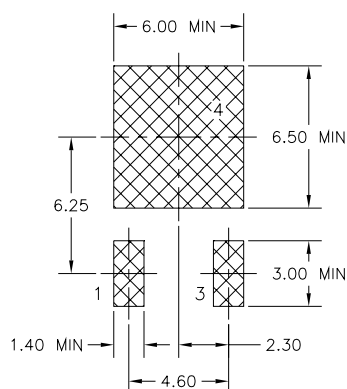
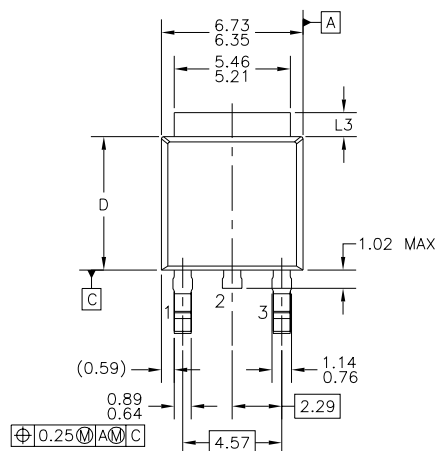


# Peak Diode Recovery dv/dt Test Circuit & Waveforms

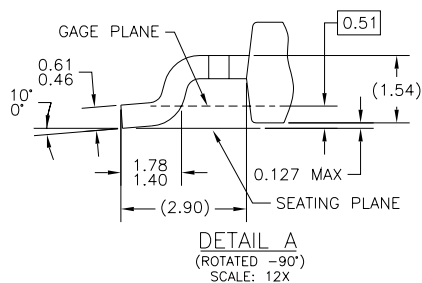
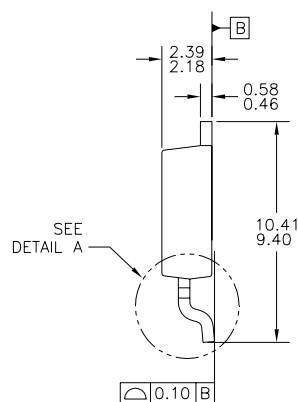
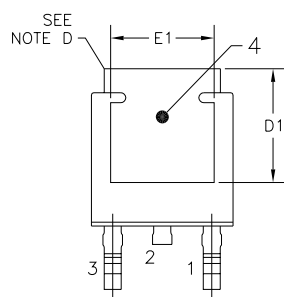


## Mechanical Dimensions

## D-PAK



LAND PATTERN RECOMMENDATION



NOTES: UNLESS OTHERWISE SPECIFIED


- UNLESS OTHERWISE SPECIFIED
- A) ALL DIMENSIONS ARE IN MILLIMETERS.
  - B) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA & AB, DATED NOV. 1999.
  - C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
  - D) HEAT SINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.
  - E) DIMENSIONS L3,D,E1&D1 TABLE:

E) DIMENSIONS L3,D,E1&D1 TABLE:

	OPTION AA	OPTION AB
L3	0.89–1.27	1.52–2.03
D	5.97–6.22	5.33–5.59
E1	4.32 MIN	3.81 MIN
D1	5.21 MIN	4.57 MIN

- F) PRESENCE OF TRIMMED CENTER LEAD IS OPTIONAL.

### Dimensions in Millimeters

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