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# FQD5P20 / FQU5P20

## P-Channel QFET® MOSFET

### -200 V, -3.7 A, 1.4 Ω

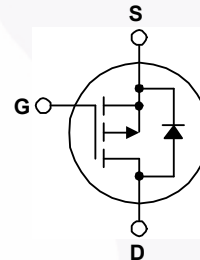
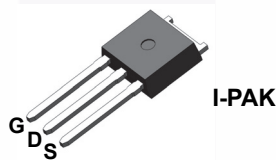
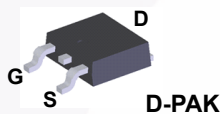


#### Description

This P-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

- -3.7 A, -200 V,  $R_{DS(on)} = 1.4 \Omega$  (Max.) @  $V_{GS} = -10$  V,  $I_D = -1.85$  A
- Low Gate Charge (Typ. 10 nC)
- Low Crss (Typ. 12 pF)
- 100% Avalanche Tested
- RoHS Compliant



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

Symbol	Parameter	FQD5P20TM / FQU5P20TU	Unit
$V_{DSS}$	Drain-Source Voltage	-200	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )	-3.7	A
	Drain Current - Continuous ( $T_C = 100^\circ\text{C}$ )	-2.34	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	-14.8	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	330	mJ
$I_{AR}$	Avalanche Current (Note 1)	-3.7	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	4.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	-5.5	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ\text{C}$ ) *	2.5	W
	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	45	W
	- Derate above $25^\circ\text{C}$	0.36	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	FQD5P20TM / FQU5P20TU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.78	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (minimum pad of 2 oz copper), Max.	110	
	Thermal Resistance, Junction to Ambient (* 1 in <sup>2</sup> pad of 2 oz copper), Max.	50	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQD5P20	FQD5P20TM	DPAK	330 mm	16 mm	2500
FQU5P20	FQU5P20TU	IPAK	-	-	70

## 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-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-200	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	-0.17	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -200\text{ V}, V_{GS} = 0\text{ V}$	--	--	-1	$\mu\text{A}$
		$V_{DS} = -160\text{ V}, T_C = 125^\circ\text{C}$	--	--	-10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-3.0	--	-5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{ V}, I_D = -1.85\text{ A}$	--	1.1	1.4	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = -40\text{ V}, I_D = -1.85\text{ A}$	--	2.2	--	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	330	430	pF
$C_{oss}$	Output Capacitance		--	75	98	pF
$C_{rss}$	Reverse Transfer Capacitance		--	12	15	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -100\text{ V}, I_D = -4.8\text{ A},$ $R_G = 25\ \Omega$	--	9	28	ns
$t_r$	Turn-On Rise Time		--	70	150	ns
$t_{d(off)}$	Turn-Off Delay Time		--	12	35	ns
$t_f$	Turn-Off Fall Time		(Note 4)	--	25	60
$Q_g$	Total Gate Charge	$V_{DS} = -160\text{ V}, I_D = -4.8\text{ A},$ $V_{GS} = -10\text{ V}$	--	10	13	nC
$Q_{gs}$	Gate-Source Charge		--	2.8	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4)	--	5.2	--

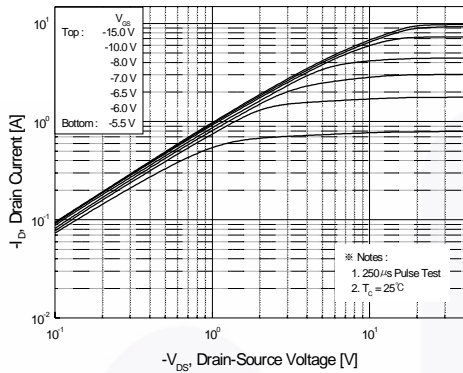
### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	-3.7	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	-14.8	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -3.7\text{ A}$	--	--	-5.0	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = -4.8\text{ A},$ $di_F / dt = 100\text{ A}/\mu\text{s}$	--	175	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	1.07	--	$\mu\text{C}$

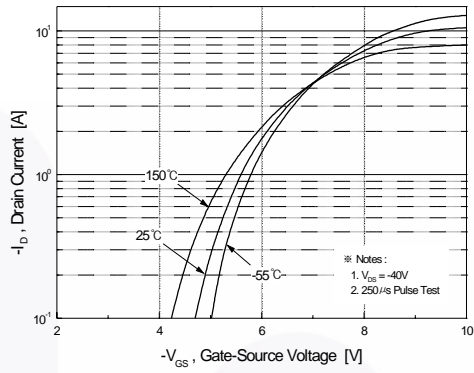
#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 36.2\text{ mH}, I_{AS} = -3.7\text{ A}, V_{DD} = -50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq -4.8\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially independent of operating temperature

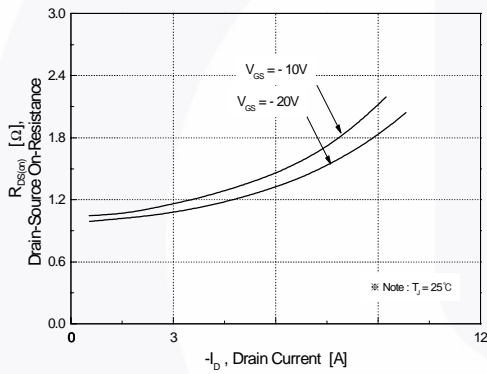
## Typical Characteristics



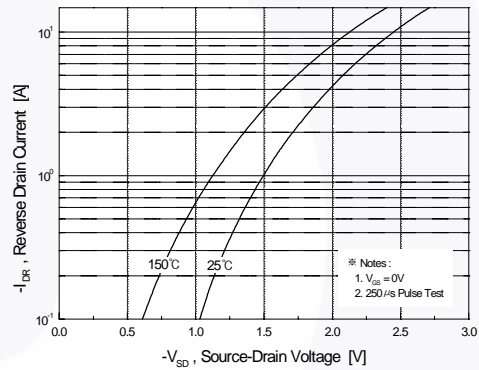
**Figure 1. On-Region Characteristics**



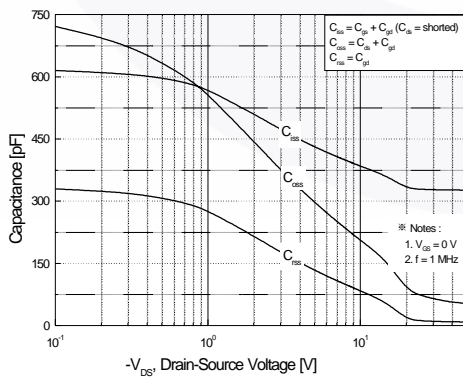
**Figure 2. Transfer Characteristics**



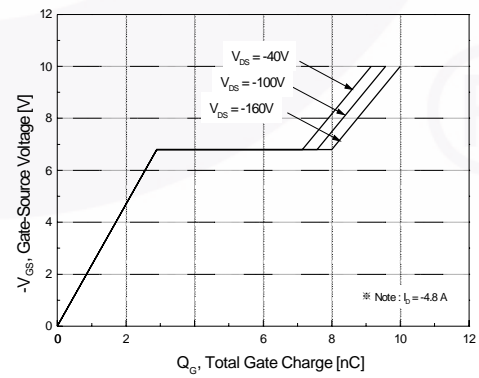
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



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

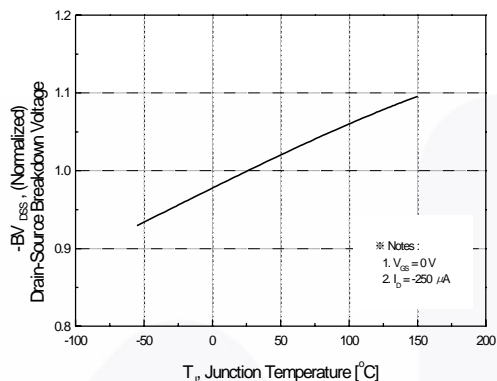


**Figure 5. Capacitance Characteristics**

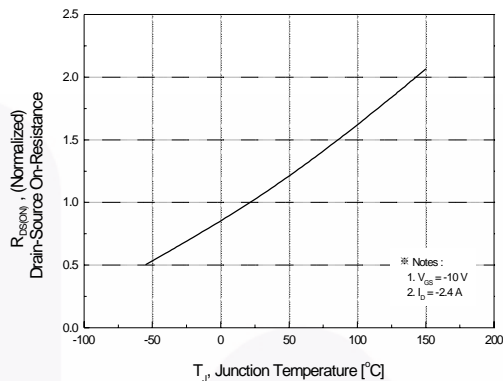


**Figure 6. Gate Charge Characteristics**

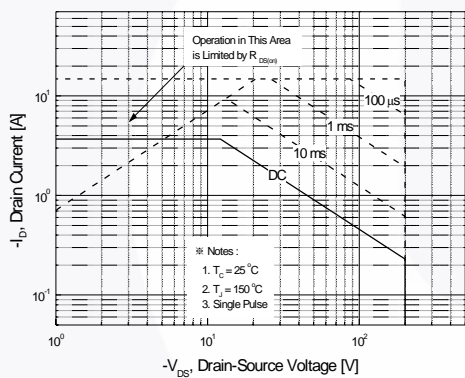
## Typical Characteristics (Continued)



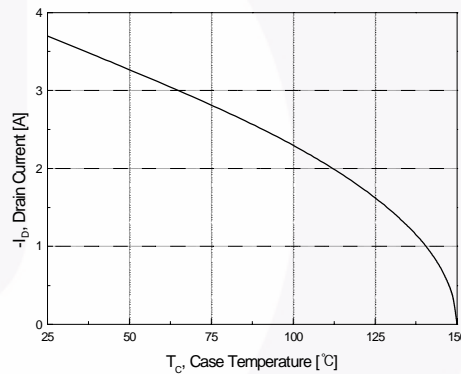
**Figure 7. Breakdown Voltage Variation vs. Temperature**



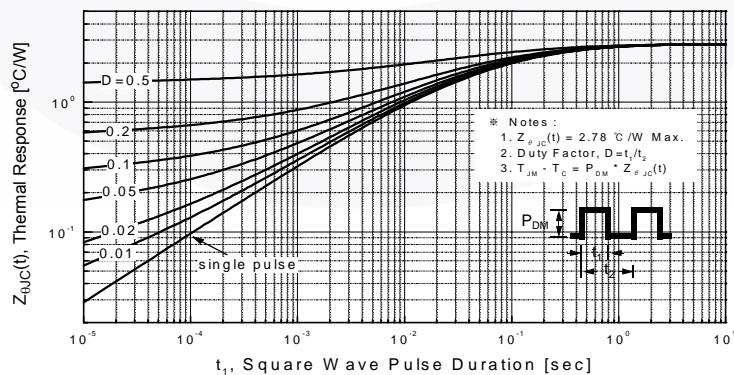
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

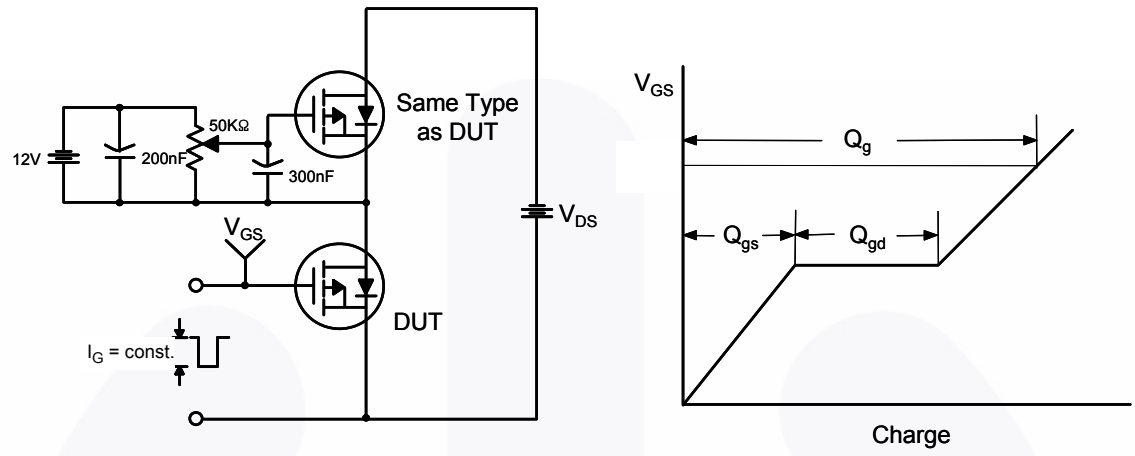


**Figure 10. Maximum Drain Current vs. Case Temperature**

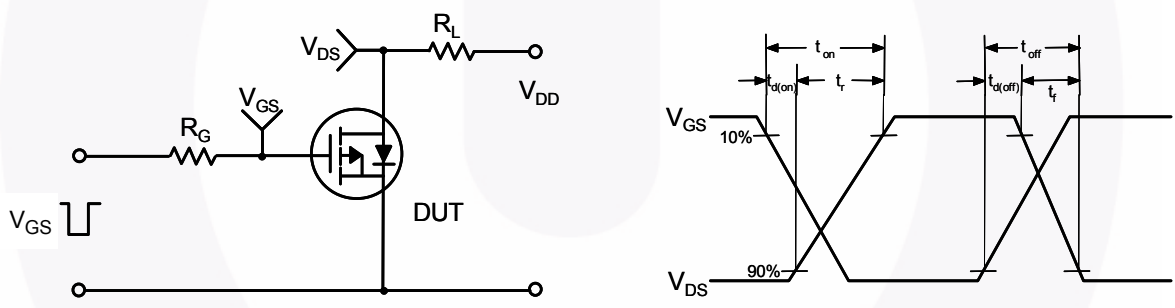


**Figure 11. Transient Thermal Response Curve**

**Figure 12. Gate Charge Test Circuit & Waveform**



**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

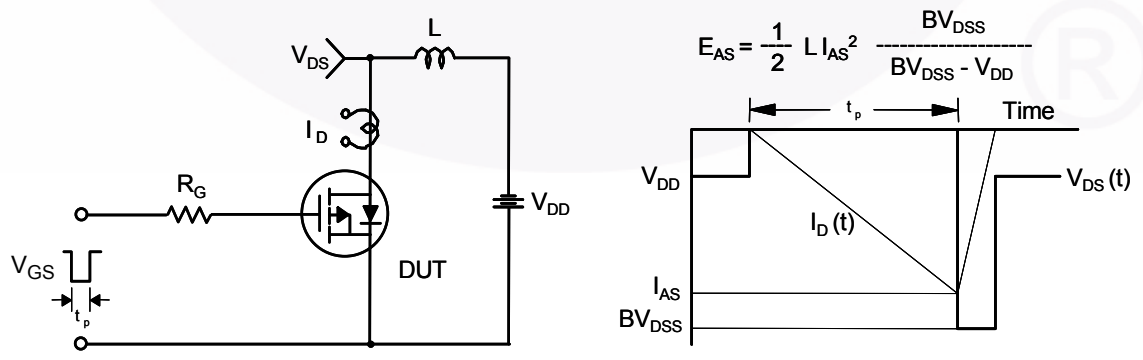
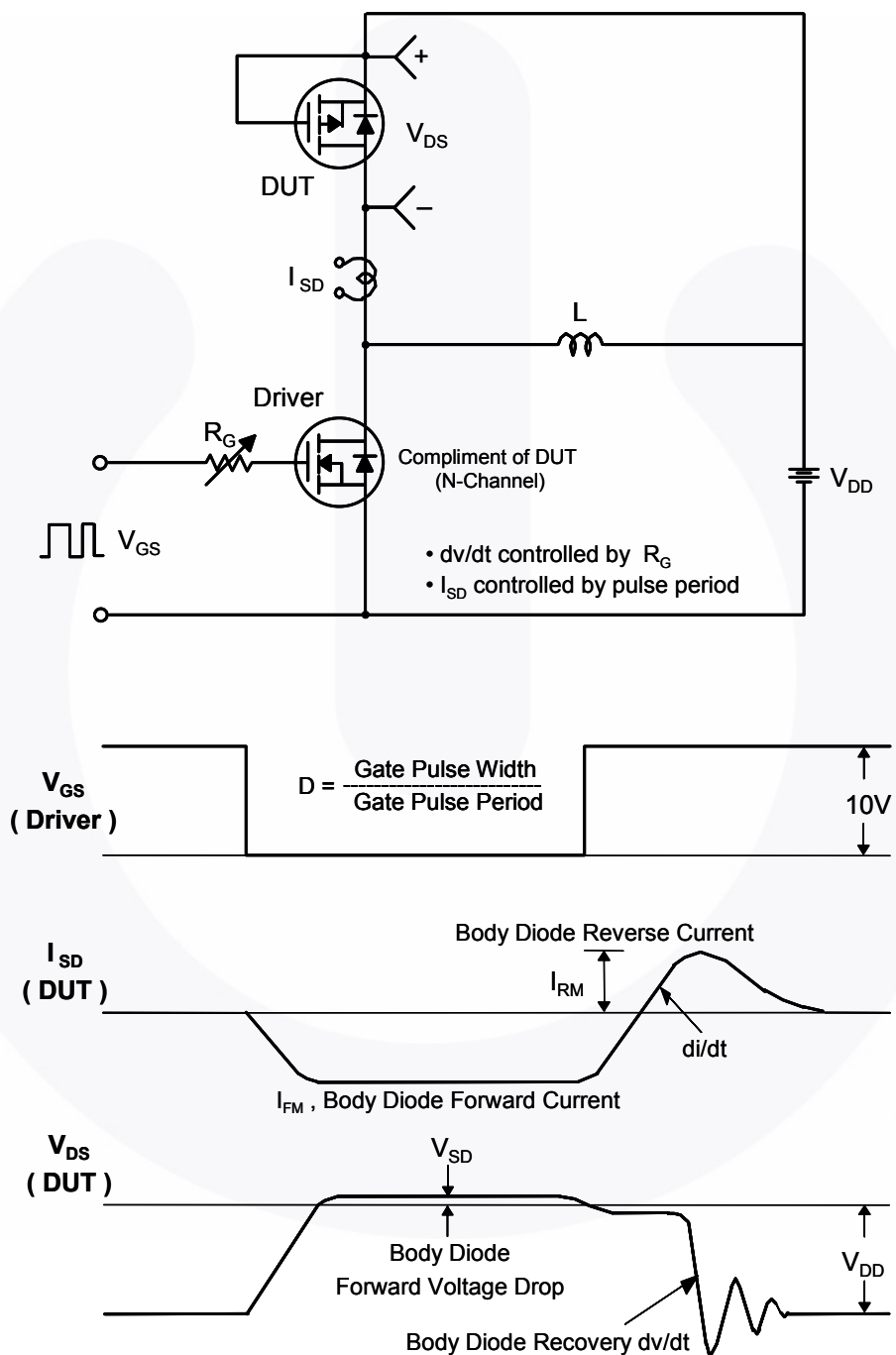
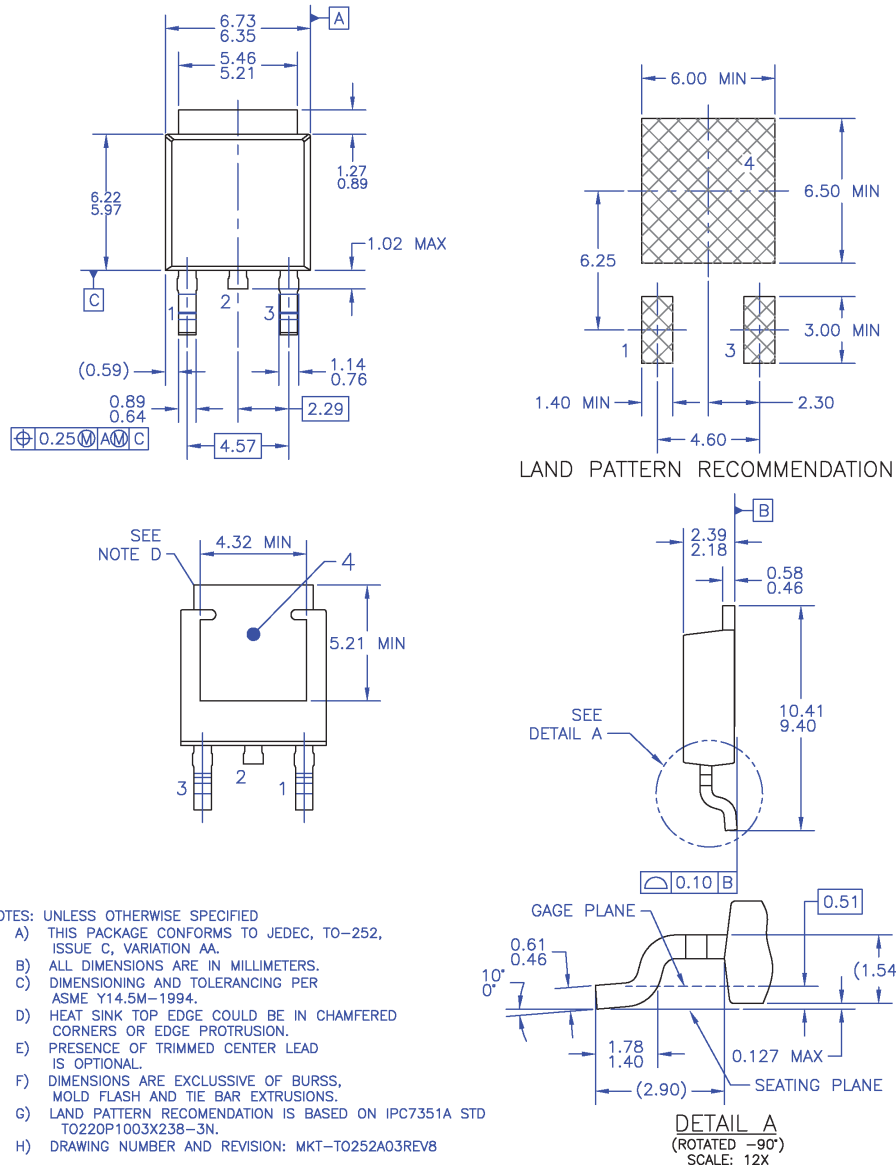


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Mechanical Dimensions

### TO-252 3L (DPAK)



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

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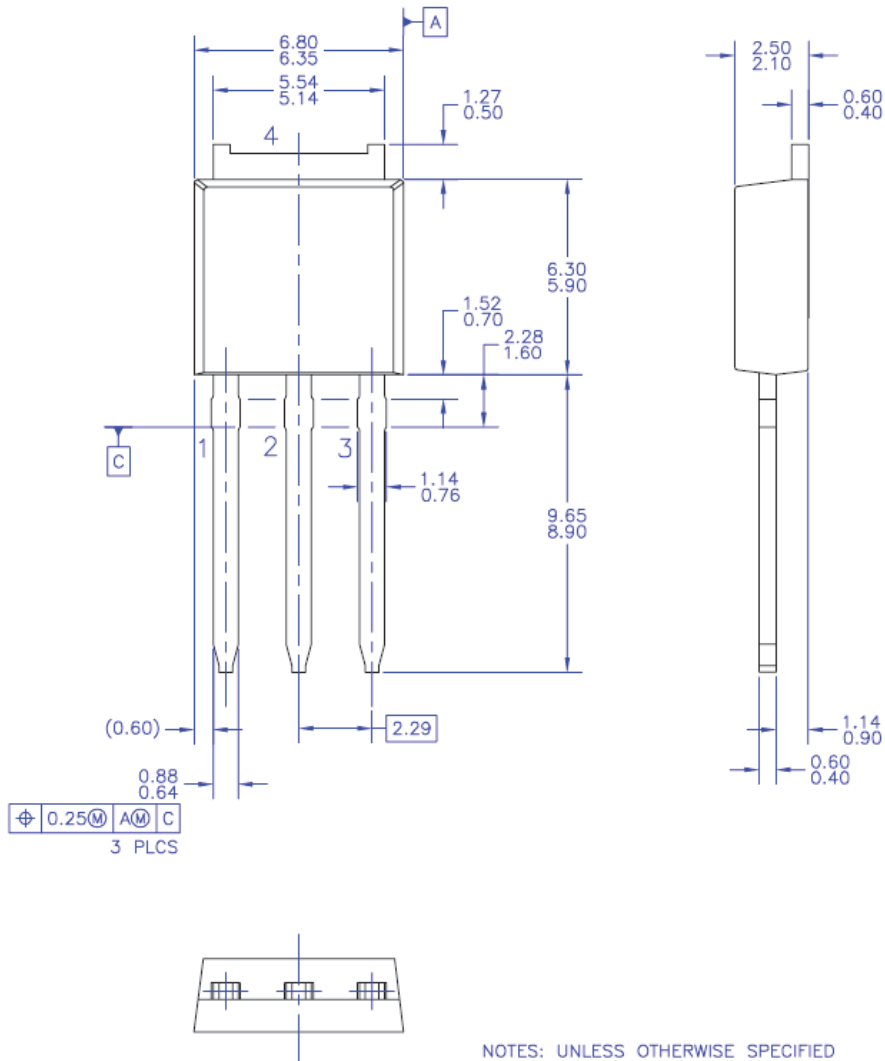
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Dimension in Millimeters



## Mechanical Dimensions

### TO-251 3L (IPAK)



NOTES: UNLESS OTHERWISE SPECIFIED

- A) ALL DIMENSIONS ARE IN MILLIMETERS.
- B) THIS PACKAGE CONFORMS TO JEDEC, TO-251, ISSUE C, VARIATION AA, DATED SEP 1988.
- C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

**Figure 17. TO251 (IPAK) Molded 3 Lead**

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Dimension in Millimeters



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