

## FR9214-VB Datasheet

### Power MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	- 250	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = -10\text{ V}$	1.0
$Q_g$ (Max.) (nC)	38	
$Q_{gs}$ (nC)	8.0	
$Q_{gd}$ (nC)	18	
Configuration	Single	

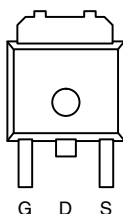
#### FEATURES

- Advanced Process Technology
- Dynamic  $dV/dt$  Rating
- 150 °C Operating Temperature
- Fast Switching
- P-Channel
- Fully Avalanche Rated
- Lead (Pb)-free Available



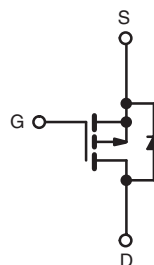
Available  
**RoHS\***  
 COMPLIANT

TO-252



Top View

Drain Connected to Tab



P-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	- 250	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current	$V_{GS}$ at - 10 V	$T_C = 25\text{ }^{\circ}\text{C}$	A
		$T_C = 100\text{ }^{\circ}\text{C}$	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	- 16	
Linear Derating Factor		0.28	W/ $^{\circ}\text{C}$
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	520	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	- 4.1	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	3.5	mJ
Maximum Power Dissipation	$P_D$	85	W
Peak Diode Recovery $dV/dt$ <sup>c</sup>	$dV/dt$	- 5.0	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^{\circ}\text{C}$
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>	
Mounting Torque	6-32 or M3 screw	10	lbf · in
		1.1	N · m

#### Notes


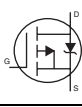
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 62\text{ mH}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = -4.1\text{ A}$  (see fig. 12).
- $I_{SD} \leq -4.1\text{ A}$ ,  $dI/dt \leq -640\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^{\circ}\text{C}$ .
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	65	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	3.6	

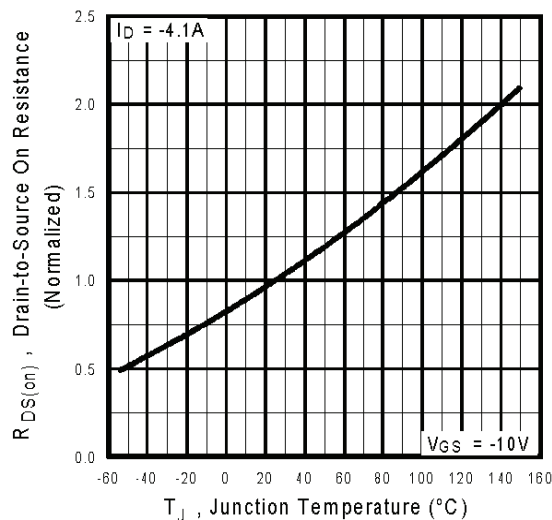
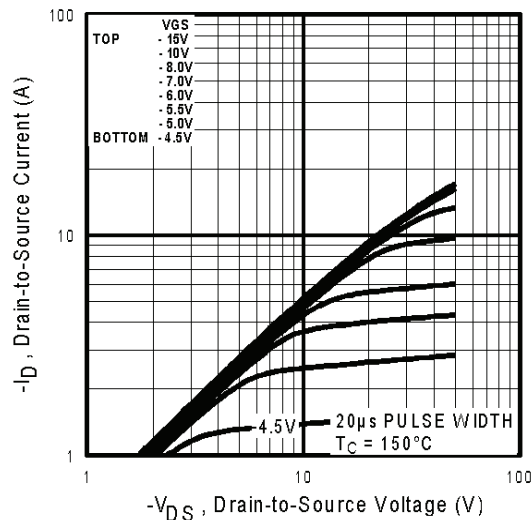
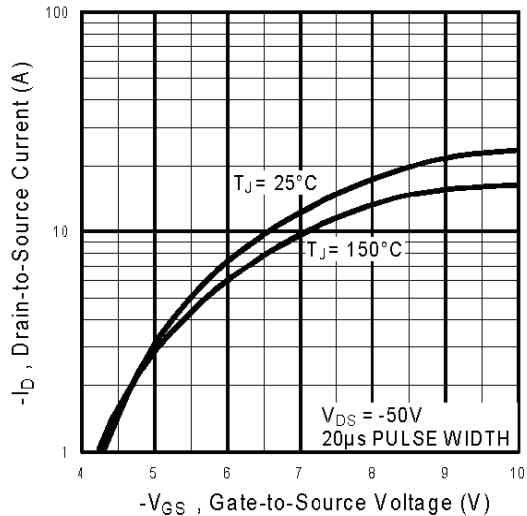
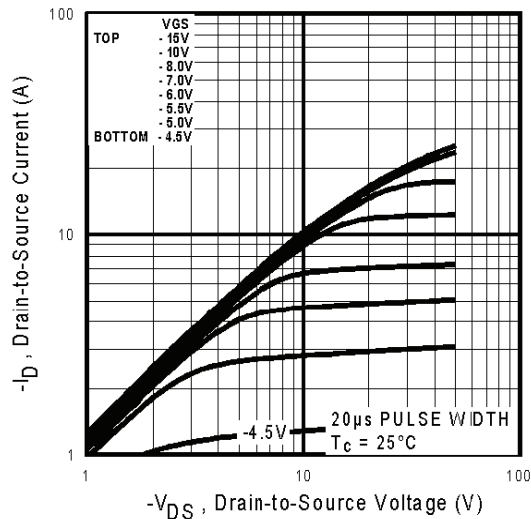
**SPECIFICATIONS**  $T_J = 25\text{ °C}$ , unless otherwise noted

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$		- 250	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	- 0.27	-	V/ $^\circ\text{C}$
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$		- 2.0	-	- 4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = - 250\text{ V}$ , $V_{GS} = 0\text{ V}$		-	-	- 25	$\mu\text{A}$
		$V_{DS} = - 200\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$		-	-	- 250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = - 10\text{ V}$	$I_D = - 2.5\text{ A}^b$	-	1.0	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = - 50\text{ V}$ , $I_D = - 4.1\text{ A}^b$		2.2	-	-	S
Dynamic							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = - 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5		-	680	-	pF
Output Capacitance	$C_{oss}$			-	170	-	
Reverse Transfer Capacitance	$C_{rss}$			-	40	-	
Drain to Sink Capacitance	$C$	$f = 1.0\text{ MHz}$		-	12	-	
Total Gate Charge	$Q_g$	$V_{GS} = - 10\text{ V}$	$I_D = - 4.1\text{ A}$ , $V_{DS} = - 200\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	38	nC
Gate-Source Charge	$Q_{gs}$			-	-	8.0	
Gate-Drain Charge	$Q_{gd}$			-	-	18	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = - 130\text{ V}$ , $I_D = - 4.1\text{ A}$ , $R_G = 12\text{ }\Omega$ , $R_D = 31\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	12	-	ns
Rise Time	$t_r$			-	23	-	
Turn-Off Delay Time	$t_{d(off)}$			-	34	-	
Fall Time	$t_f$			-	21	-	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact 		-	4.5	-	nH
Internal Source Inductance	$L_S$			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	- 4.1	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	- 16	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = - 4.1\text{ A}$ , $V_{GS} = 0\text{ V}^b$		-	-	- 6.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = - 4.1\text{ A}$ , $dI/dt = -100\text{ A}/\mu\text{s}^b$		-	190	290	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	1.5	2.2	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



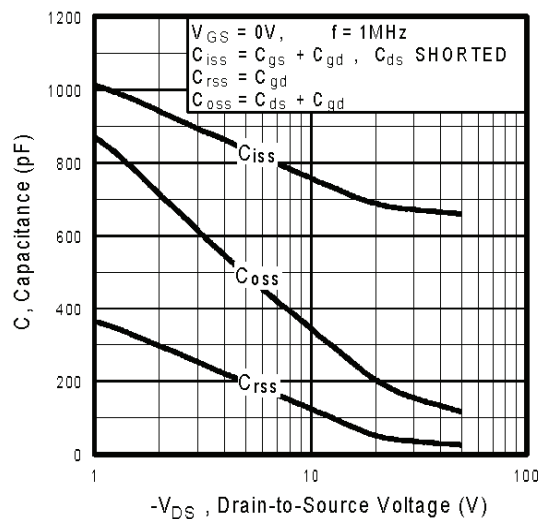


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

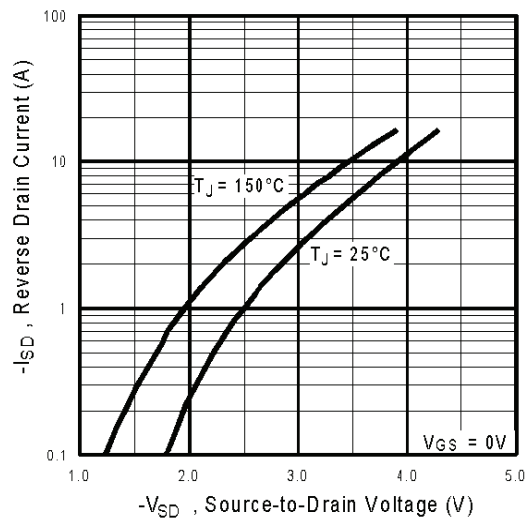


Fig. 7 - Typical Source-Drain Diode Forward Voltage

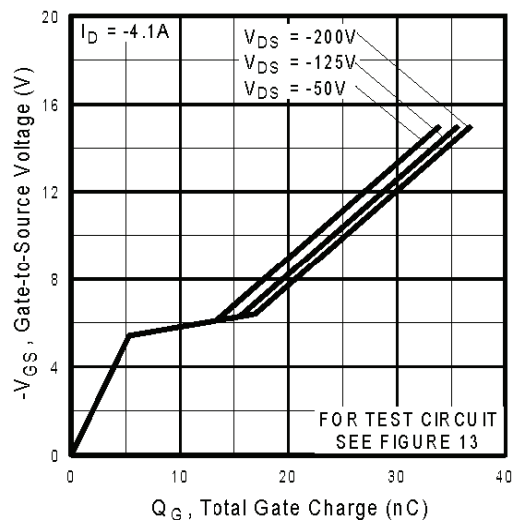


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

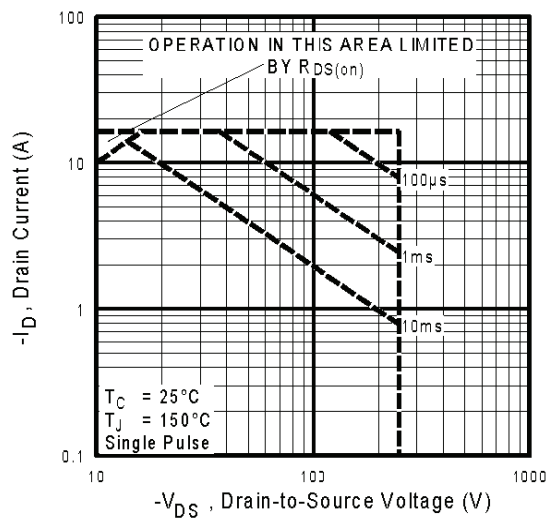


Fig. 8 - Maximum Safe Operating Area

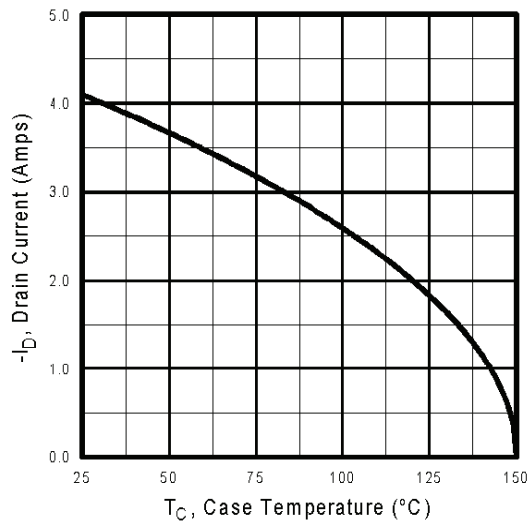


Fig. 9 - Maximum Drain Current vs. Case Temperature

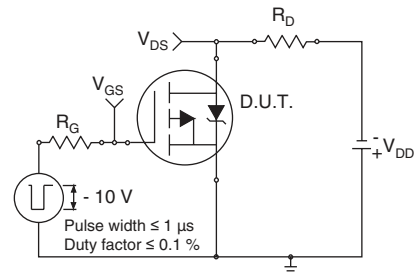


Fig. 10a - Switching Time Test Circuit

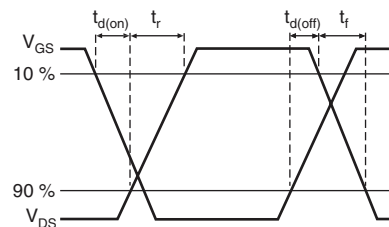


Fig. 10b - Switching Time Waveforms

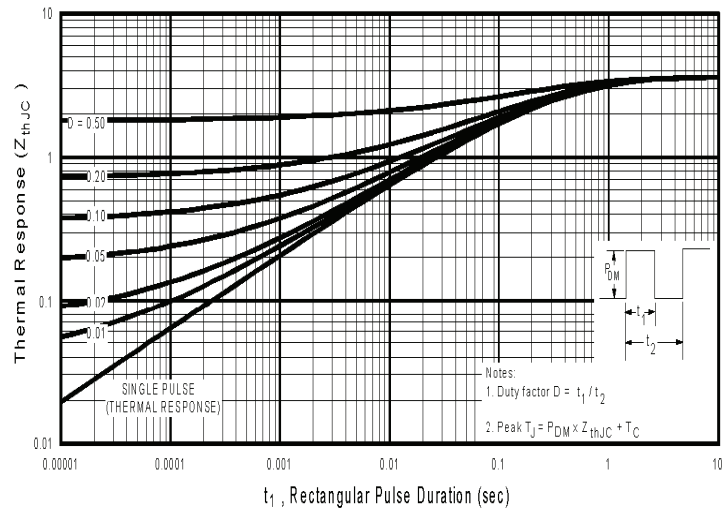


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

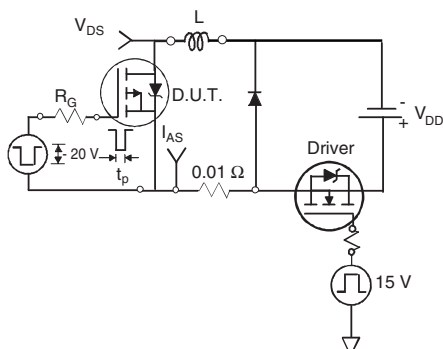


Fig. 12a - Unclamped Inductive Test Circuit

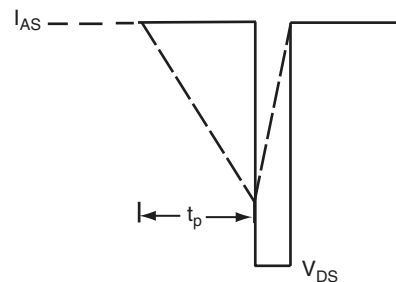


Fig. 12b - Unclamped Inductive Waveforms

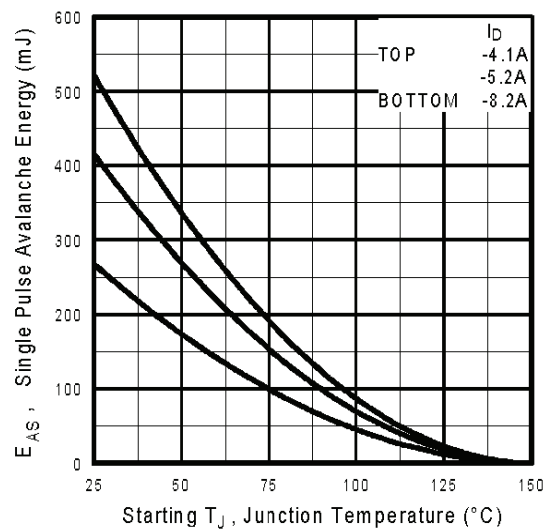


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

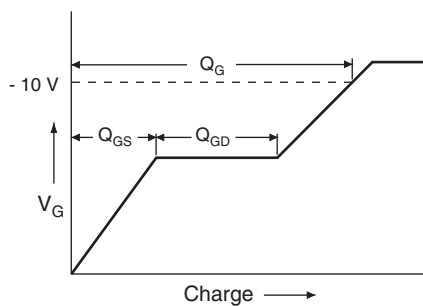


Fig. 13a - Basic Gate Charge Waveform

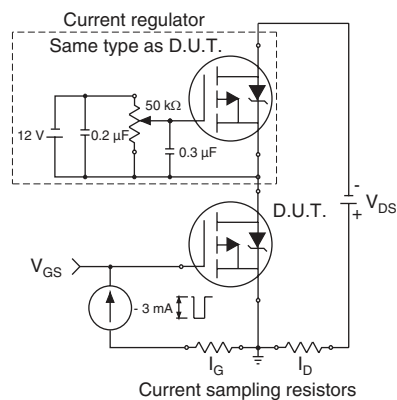
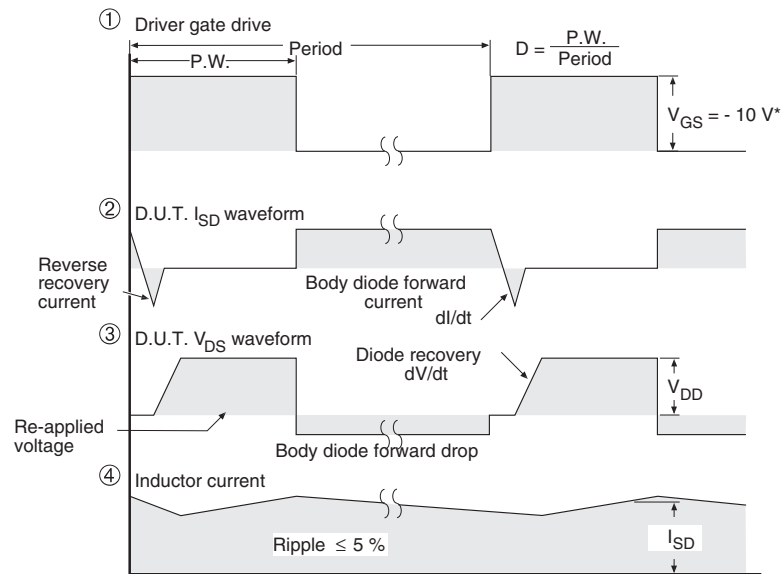
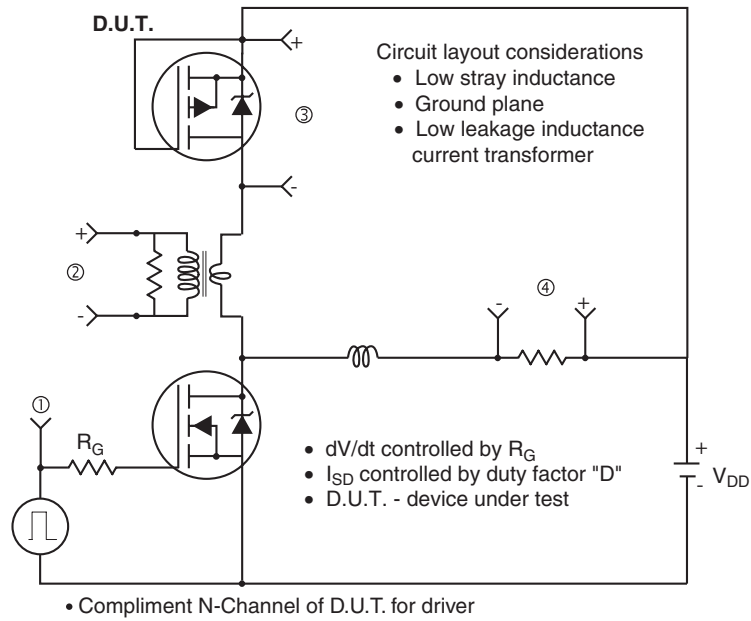


Fig. 13b - Gate Charge Test Circuit

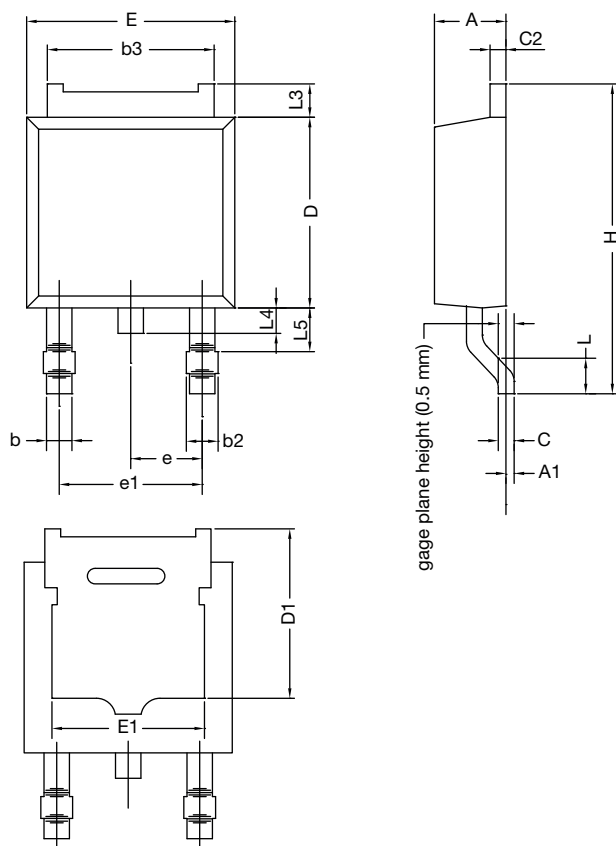
### Peak Diode Recovery $dV/dt$ Test Circuit



\*  $V_{GS} = -5V$  for logic level and  $-3V$  drive devices

**Fig. 14 - For P-Channel**

## TO-252AA CASE OUTLINE



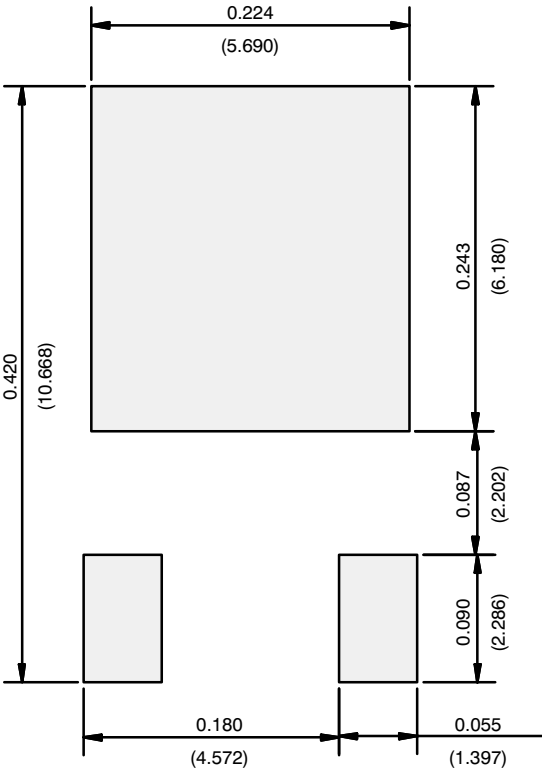
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.38	0.086	0.094
A1	-	0.127	-	0.005
b	0.64	0.88	0.025	0.035
b2	0.76	1.14	0.030	0.045
b3	4.95	5.46	0.195	0.215
C	0.46	0.61	0.018	0.024
C2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	5.21	-	0.205	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
H	9.40	10.41	0.370	0.410
e	2.28 BSC		0.090 BSC	
e1	4.56 BSC		0.180 BSC	
L	1.40	1.78	0.055	0.070
L3	0.89	1.27	0.035	0.050
L4	-	1.02	-	0.040
L5	1.14	1.52	0.045	0.060
ECN: X12-0247-Rev. M, 24-Dec-12				
DWG: 5347				

### Note

- Dimension L3 is for reference only.



RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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