

P-Channel 500 V (D-S) Power MOSFET

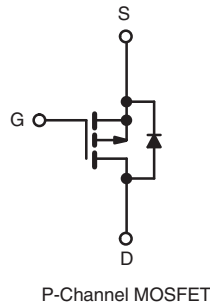
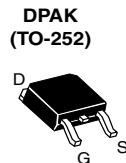
PRODUCT SUMMARY		
V_{DS} (V)	- 500	
$R_{DS(on)}$ (Ω)	$V_{GS} = -10$ V	2.0
Q_g (Max.) (nC)	13	
Q_{gs} (nC)	3.2	
Q_{gd} (nC)	5.0	
Configuration	Single	

FEATURES

- P-Channel
- Surface Mount (IRFR9310, SiHFR9310)
- Straight Lead (IRFU9310, SiHFU9310)
- Advanced Process Technology
- Fast Switching
- Fully Avalanche Rated



RoHS
COMPLIANT
HALOGEN
FREE
Available



ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)					
PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	- 500	V
Gate-Source Voltage			V _{GS}	± 20	
Continuous Drain Current	V _{GS} at - 10 V	T _C = 25 °C	I _D	- 4.0	A
		T _C = 100 °C		- 3.1	
Pulsed Drain Current ^a			I _{DM}	-15	
Linear Derating Factor				0.40	W/°C
Single Pulse Avalanche Energy ^b			E _{AS}	92	mJ
Repetitive Avalanche Current ^a			I _{AR}	- 4	A
Repetitive Avalanche Energy ^a			E _{AR}	15.0	mJ
Maximum Power Dissipation	T _C = 25 °C		P _D	80	W
Peak Diode Recovery dV/dt ^c			dV/dt	- 24	V/ns
Operating Junction and Storage Temperature Range			T _J , T _{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature) ^d	for 10 s			300	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting $T_J = 25^\circ\text{C}$, $L = 57$ mH, $R_g = 25\ \Omega$, $I_{AS} = -1.8$ A (see fig. 12).
- $I_{SD} \leq -1.1$ A, $dI/dt \leq 450$ A/ μs , $V_{DD} \leq V_{DS}$, $T_J \leq 150^\circ\text{C}$.
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	-	110	°C/W
Maximum Junction-to-Ambient (PCB Mount) ^a	R_{thJA}	-	-	50	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	-	2.5	

Note

a. When mounted on 1" square PCB (FR-4 or G-10 material).

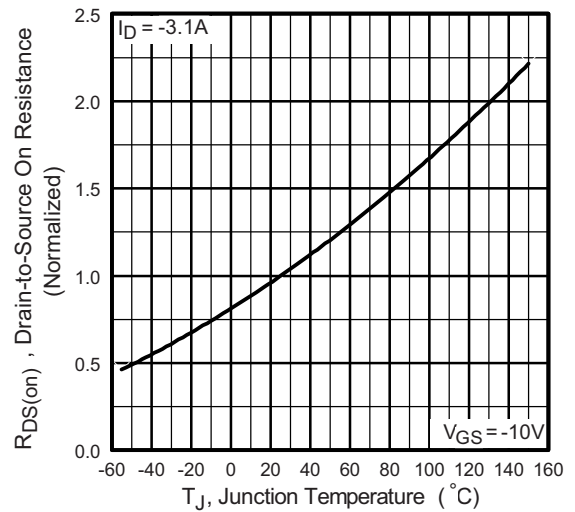
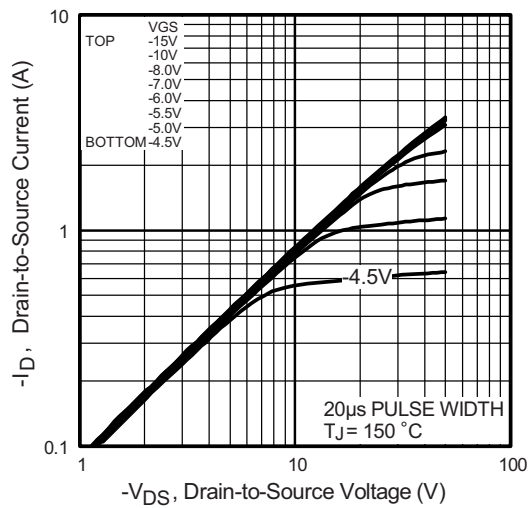
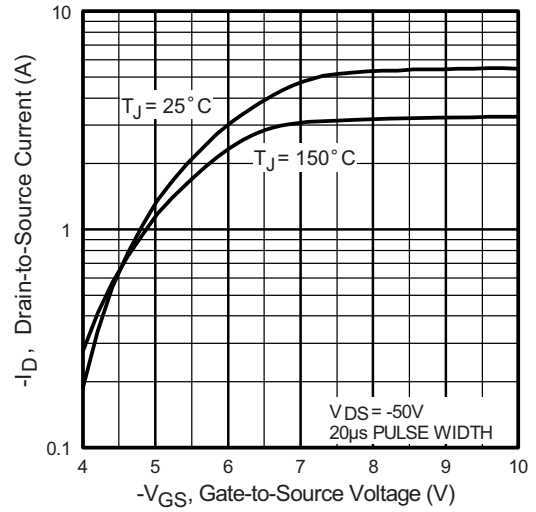
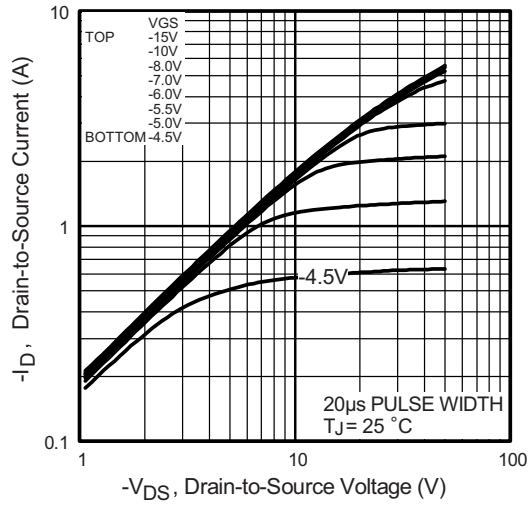
SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = - 250 μA		- 500	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = - 1 mA		-	- 0.41	-	V/°C
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = - 250 μA		- 2.0	-	- 4.0	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = - 500 V, V _{GS} = 0 V		-	-	- 100	μA
		V _{DS} = - 400 V, V _{GS} = 0 V, T _J = 125 °C		-	-	- 500	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = - 10 V	I _D = - 3.1 A ^b	-	2	-	Ω
Forward Transconductance	g _{fs}	V _{DS} = - 50 V, I _D = - 3.1 A		0.91	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = - 25 V, f = 1.0 MHz, see fig. 5		-	270	-	pF
Output Capacitance	C _{oss}			-	50	-	
Reverse Transfer Capacitance	C _{rss}			-	8.0	-	
Total Gate Charge	Q _g	V _{GS} = - 10 V	I _D = - 1.1 A, V _{DS} = - 320 V, see fig. 6 and 13 ^b	-	-	13	nC
Gate-Source Charge	Q _{gs}			-	-	3.2	
Gate-Drain Charge	Q _{gd}			-	-	5.0	
Turn-On Delay Time	t _{d(on)}	V _{DD} = - 200 V, I _D = - 1.1 A, R _g = 21 Ω, R _D = 180 Ω, see fig. 10 ^b		-	11	-	ns
Rise Time	t _r			-	10	-	
Turn-Off Delay Time	t _{d(off)}			-	25	-	
Fall Time	t _f			-	24	-	
Internal Drain Inductance	L _D	Between lead, 6 mm (0.25") from package and center of die contact ^c 		-	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 		-	-	- 1.9	A
Pulsed Diode Forward Current ^a	I _{SM}			-	-	- 7.6	
Body Diode Voltage	V _{SD}	T _J = 25 °C, I _S = - 1.1 A, V _{GS} = 0 V ^b		-	-	- 4.0	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = -1.1 A, dI/dt = 100 A/μs ^b		-	170	260	ns
Body Diode Reverse Recovery Charge	Q _{rr}			-	640	960	nC
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 $\leq 2\%$.
 c. This is applied for IPAK, L_S of DPAK is measured between lead and center of die contact.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



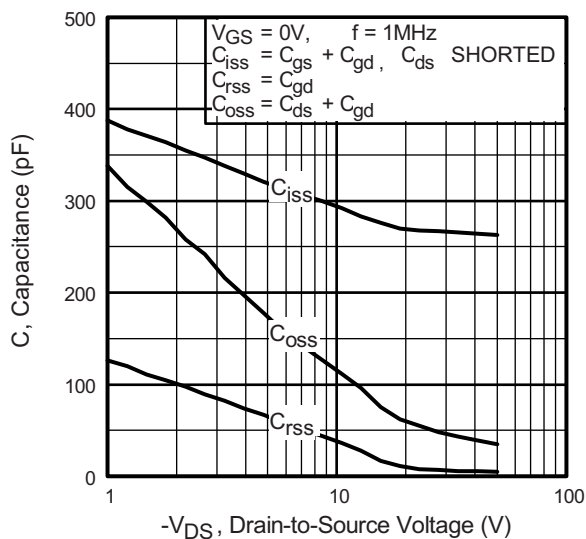


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

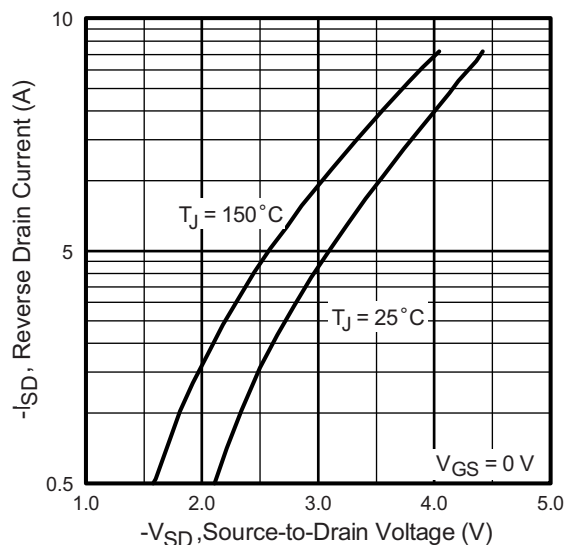


Fig. 7 - Typical Source-Drain Diode Forward Voltage

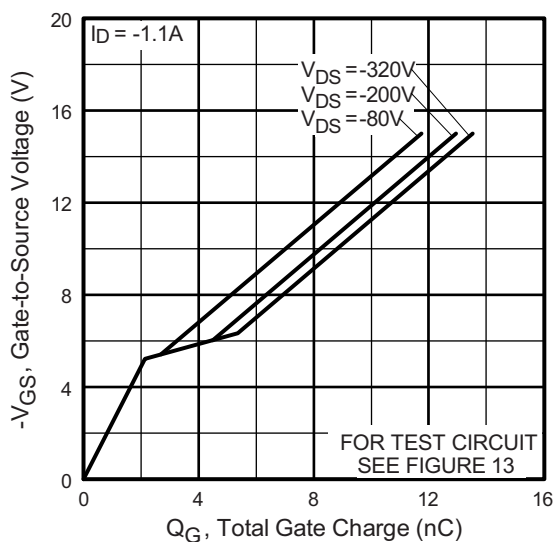


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

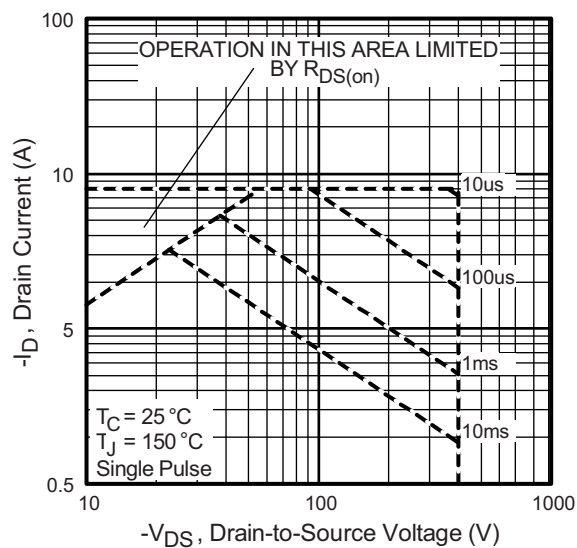


Fig. 8 - Maximum Safe Operating Area

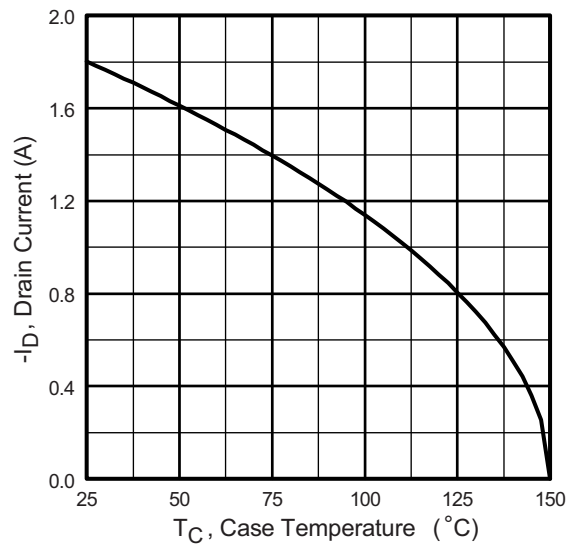


Fig. 9 - Maximum Drain Current vs. Case Temperature

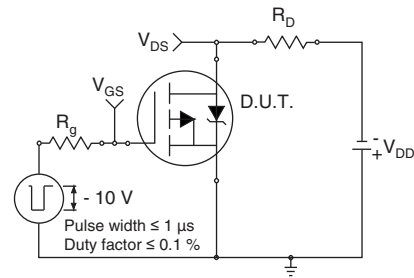


Fig. 10a - Switching Time Test Circuit

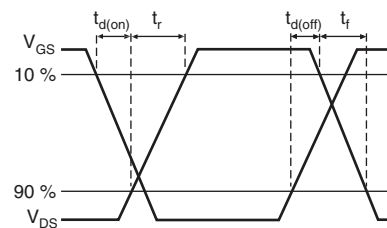


Fig. 10b - Switching Time Waveforms

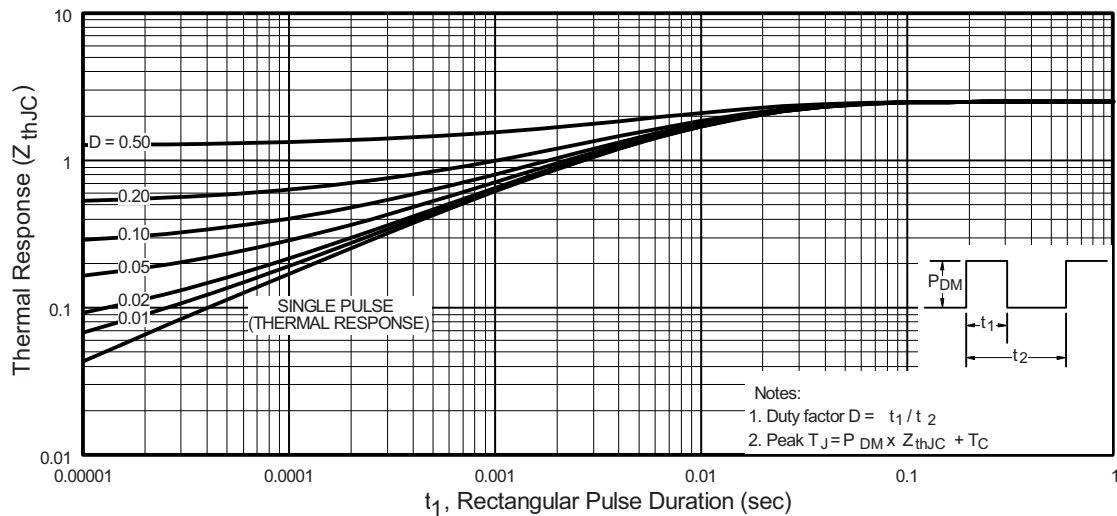


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

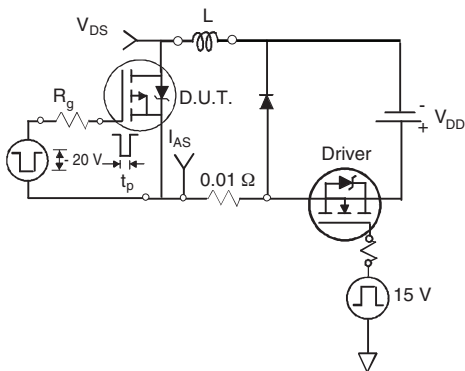


Fig. 12a - Unclamped Inductive Test Circuit

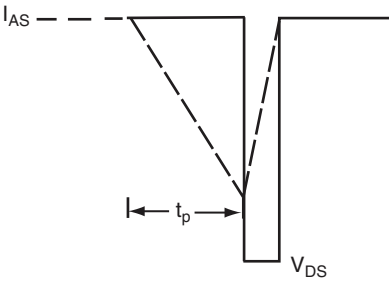


Fig. 12b - Unclamped Inductive Waveforms

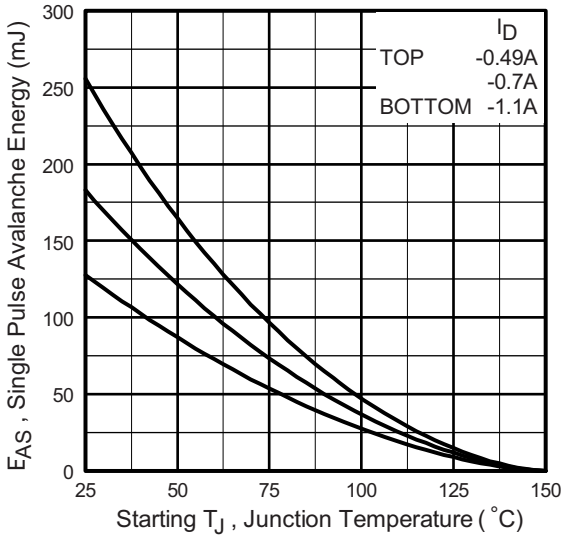


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

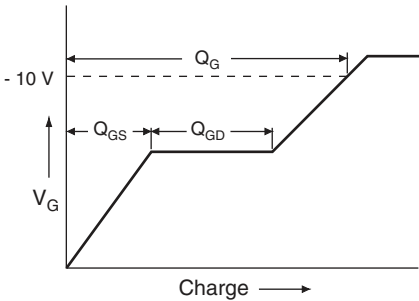


Fig. 13a - Basic Gate Charge Waveform

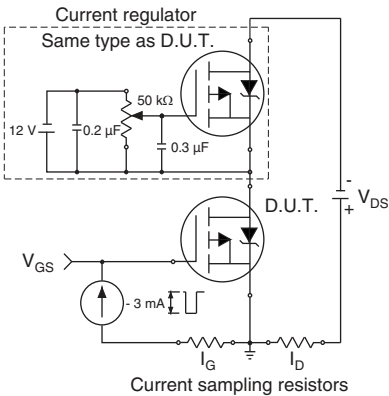
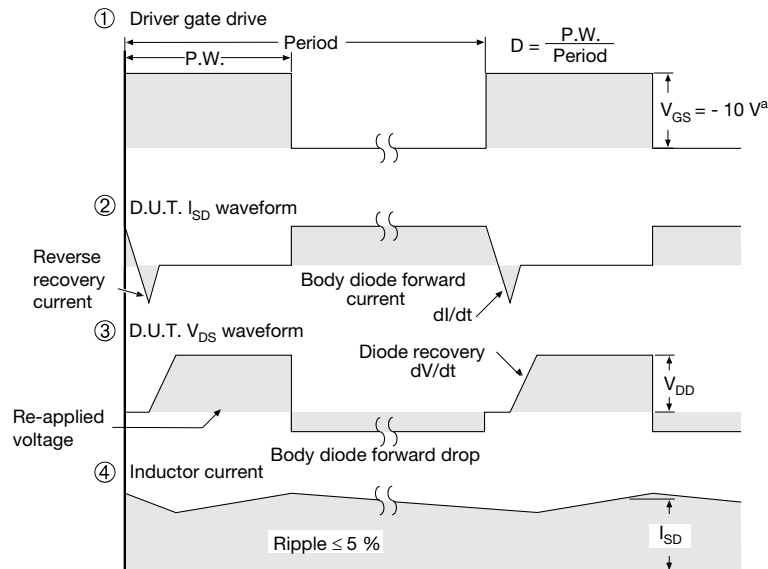
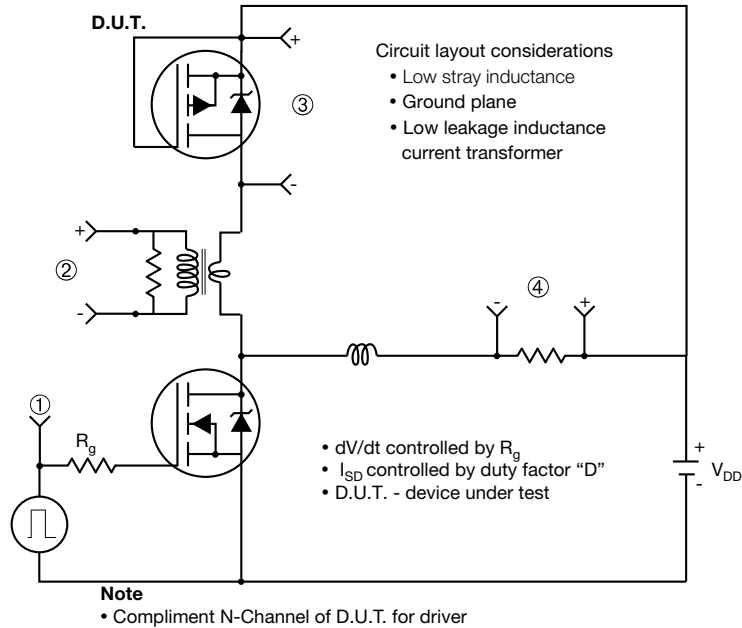


Fig. 13b - Gate Charge Test Circuit

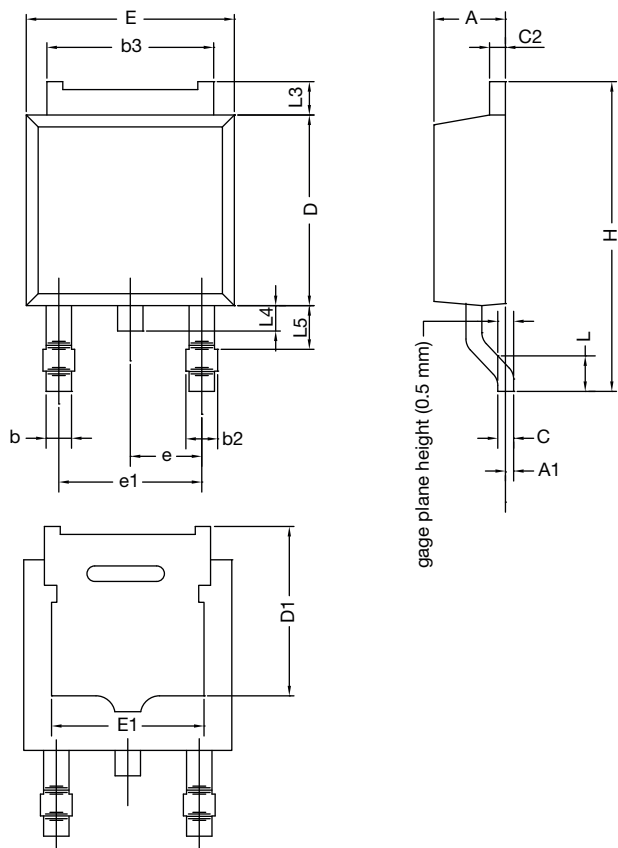
Peak Diode Recovery dV/dt Test Circuit



Note
a. $V_{GS} = -5V$ for logic level and $-3V$ drive devices

Fig. 14 - For P-Channel

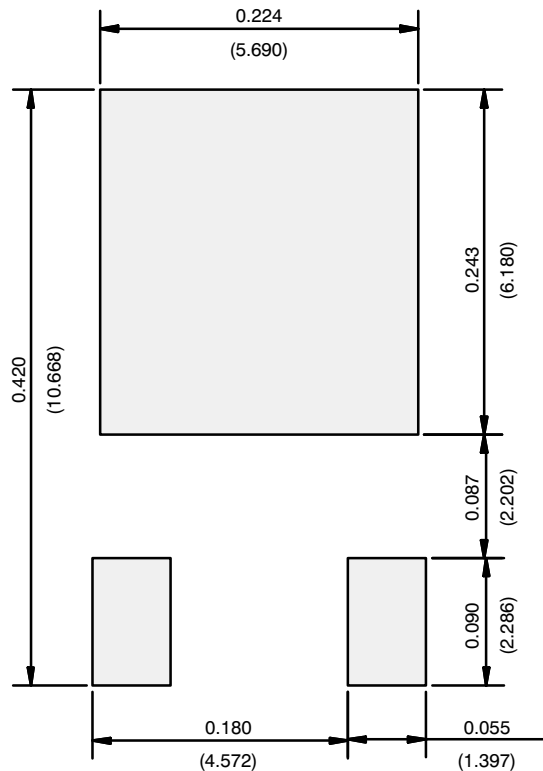
TO-252AA Case Outline



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	4.10	-	0.161	-
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	1.01	1.52	0.040	0.060
ECN: T16-0236-Rev. P, 16-May-16 DWG: 5347				

- Notes
- Dimension L3 is for reference only.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

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