

## Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V)	100
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$ 0.54
$Q_g$ (Max.) (nC)	8.3
$Q_{gs}$ (nC)	2.3
$Q_{gd}$ (nC)	3.8
Configuration	Single

### FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR110, SiHFR110)
- Available in Tape and Reel
- Fast Switching
- Ease of Paralleling
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



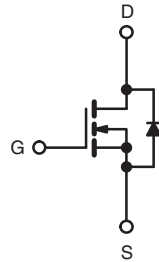
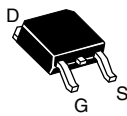
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available

### DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The DPAK is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

**DPAK**  
(TO-252)



N-Channel MOSFET

ORDERING INFORMATION				
Package	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)
Lead (Pb)-free and Halogen-free	SiHFR110-GE3	SiHFR110TRL-GE3	SiHFR110TR-GE3	SiHFR110TRR-GE3
Lead (Pb)-free	IRFR110PbF	IRFR110TRLPbF <sup>a</sup>	IRFR110TRPbF <sup>a</sup>	IRFR110TRRPbF <sup>a</sup>
	SiHFR110-E3	SiHFR110TL-E3 <sup>a</sup>	SiHFR110T-E3 <sup>a</sup>	SiHFR110TR-E3 <sup>a</sup>

#### Note

- a. See device orientation.

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$		100	V
Gate-Source Voltage	$V_{GS}$		$\pm 20$	
Continuous Drain Current	$V_{GS}$ at 10 V	$T_C = 25\text{ }^\circ\text{C}$	4.3	A
		$T_C = 100\text{ }^\circ\text{C}$	2.7	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$		17	W/ $^\circ\text{C}$
Linear Derating Factor			0.20	
Linear Derating Factor (PCB Mount) <sup>e</sup>			0.020	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$		75	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$		4.3	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$		2.5	mJ
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$		25	W
Maximum Power Dissipation (PCB Mount) <sup>e</sup>	$T_A = 25\text{ }^\circ\text{C}$		2.5	
Peak Diode Recovery dV/dt <sup>c</sup>	$dV/dt$		5.5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$		- 55 to + 150	$^\circ\text{C}$
Soldering Recommendations (Peak Temperature) <sup>d</sup>	for 10 s		260	

#### Notes

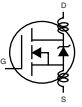
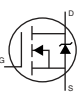
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b.  $V_{DD} = 25\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 8.1\text{ mH}$ ,  $R_g = 25\text{ }^\circ\Omega$ ,  $I_{AS} = 4.3\text{ A}$  (see fig. 12).  
 c.  $I_{SD} \leq 5.6\text{ A}$ ,  $dI/dt \leq 75\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .  
 d. 1.6 mm from case.  
 e. When mounted on 1" square PCB (FR-4 or G-10 material).



THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	110	°C/W
Maximum Junction-to-Ambient (PCB Mount) <sup>a</sup>	$R_{thJA}$	-	50	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	5.0	

**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
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		100	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.13	-	V/°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	$I_{DSS}$	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	$\mu\text{A}$
		$V_{DS} = 80\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 2.6\text{ A}^b$	-	-	0.54	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 2.6\text{ A}$		1.6	-	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}$ , see fig. 5		-	180	-	$\mu\text{F}$
Output Capacitance	$C_{oss}$			-	80	-	
Reverse Transfer Capacitance	$C_{rss}$			-	15	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 5.6\text{ A}, V_{DS} = 80\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	8.3	nC
Gate-Source Charge	$Q_{gs}$			-	-	2.3	
Gate-Drain Charge	$Q_{gd}$			-	-	3.8	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 50\text{ V}, I_D = 5.6\text{ A}, R_g = 24\text{ }\Omega, R_D = 8.4\text{ }\Omega$ , see fig. 10 <sup>b</sup>		-	6.9	-	ns
Rise Time	$t_r$			-	16	-	
Turn-Off Delay Time	$t_{d(off)}$			-	15	-	
Fall Time	$t_f$			-	9.4	-	
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	-	
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	4.3	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$			-	-	17	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 4.3\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	2.5	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 5.6\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	100	200	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	0.44	0.88	$\mu\text{C}$
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)

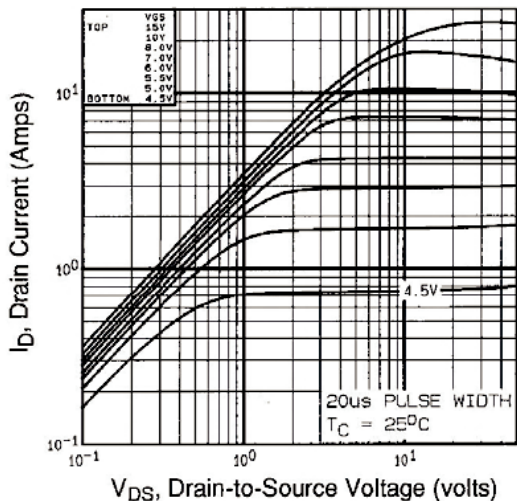


Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$

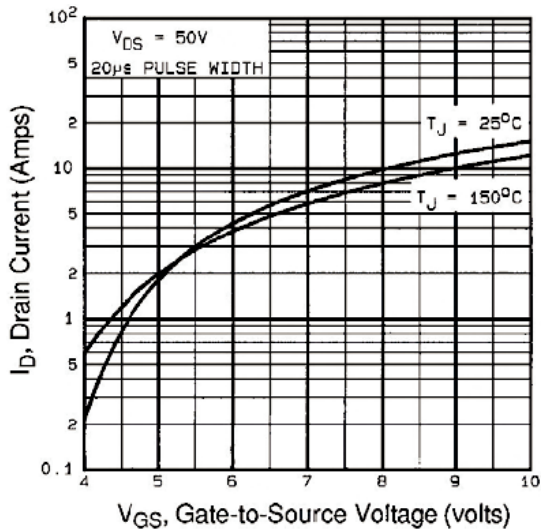


Fig. 3 - Typical Transfer Characteristics

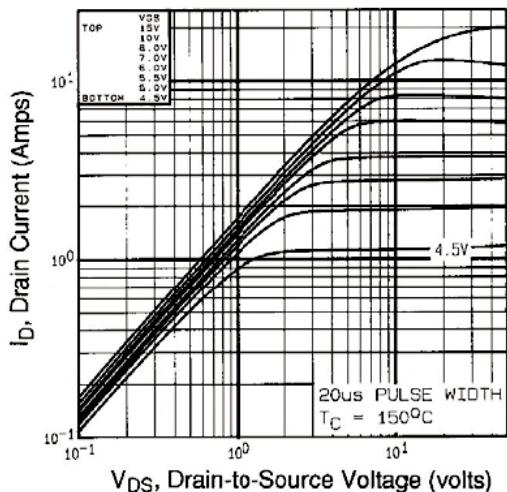


Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^\circ\text{C}$

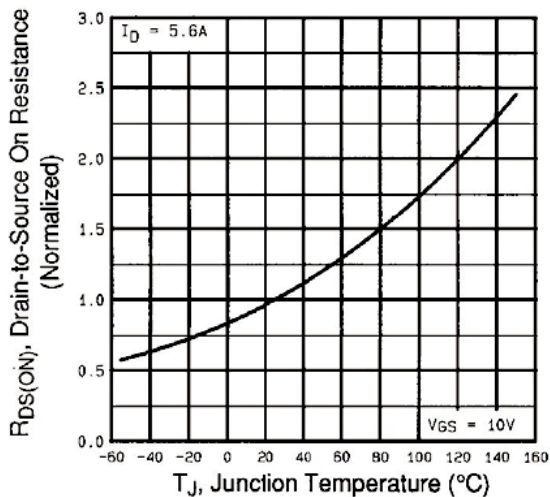


Fig. 4 - Normalized On-Resistance vs. Temperature

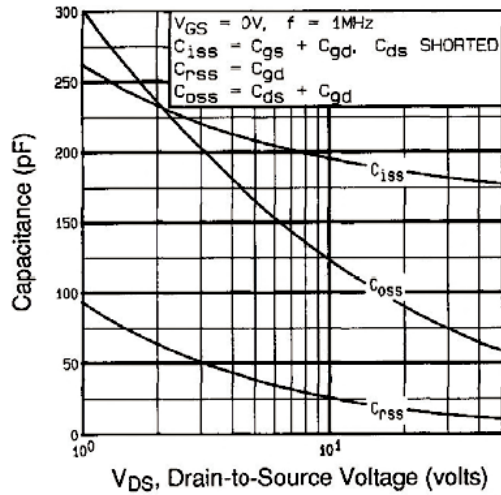


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

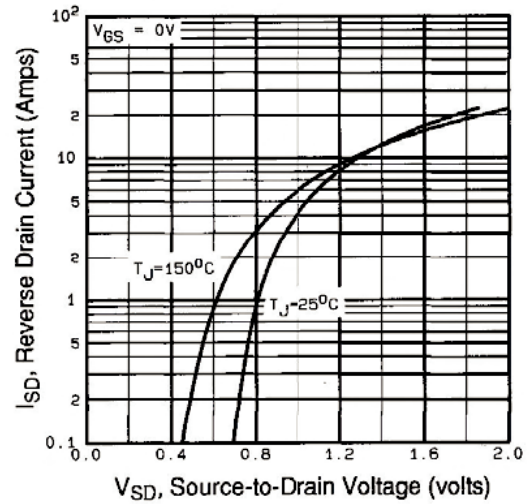


Fig. 7 - Typical Source-Drain Diode Forward Voltage

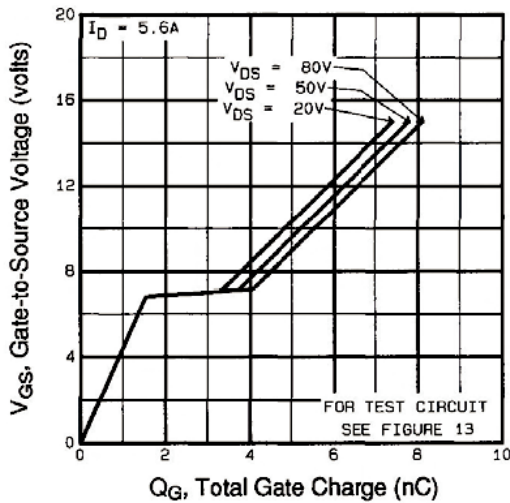


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

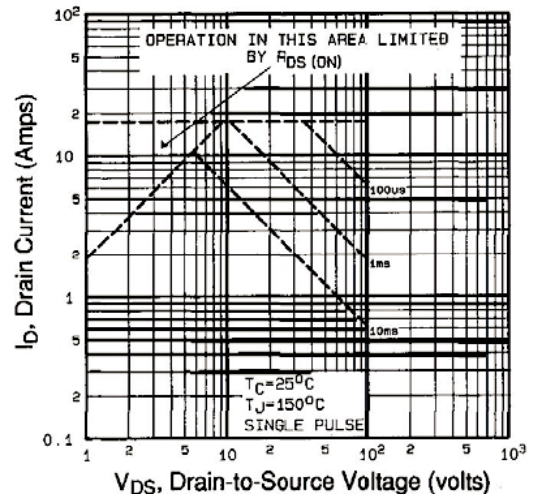


Fig. 8 - Maximum Safe Operating Area

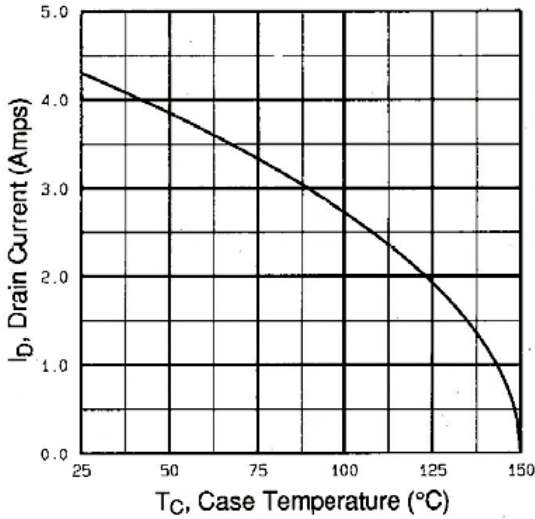


Fig. 9 - Maximum Drain Current vs. Case Temperature

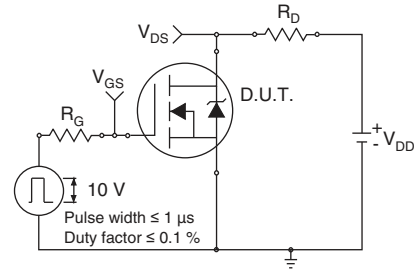


Fig. 10a - Switching Time Test Circuit

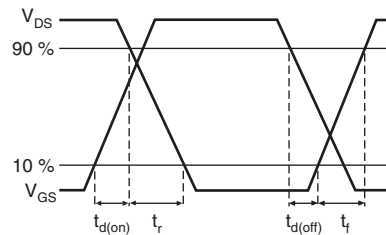


Fig. 10b - Switching Time Waveforms

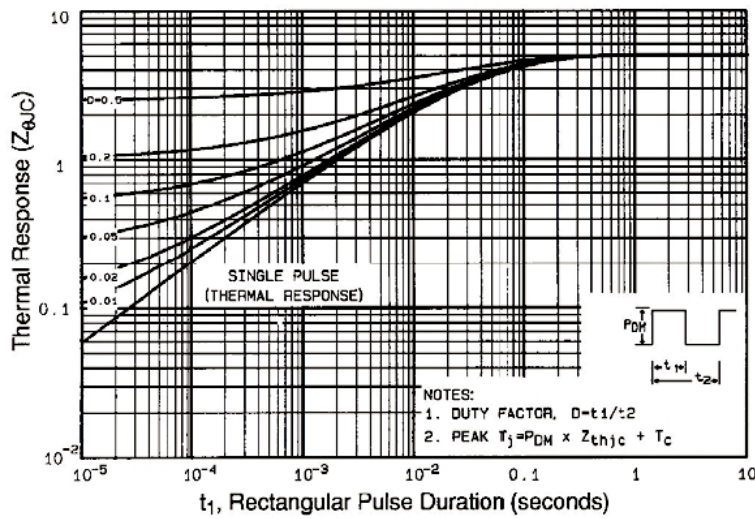


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

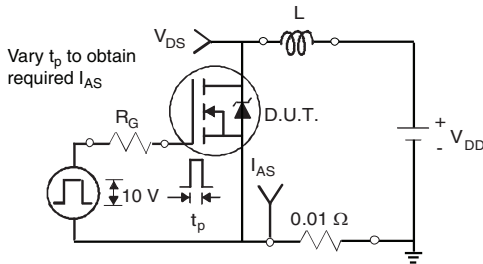


Fig. 12a - Unclamped Inductive Test Circuit

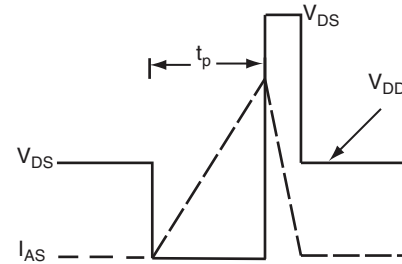


Fig. 12b - Unclamped Inductive Waveforms

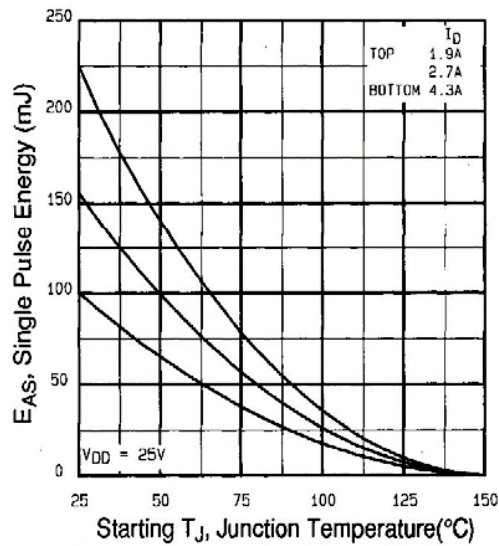


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

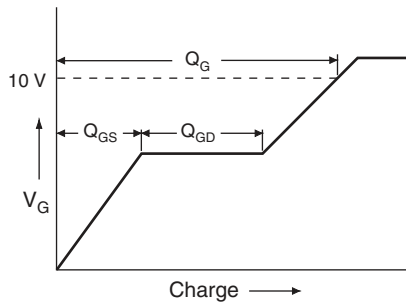


Fig. 13a - Basic Gate Charge Waveform

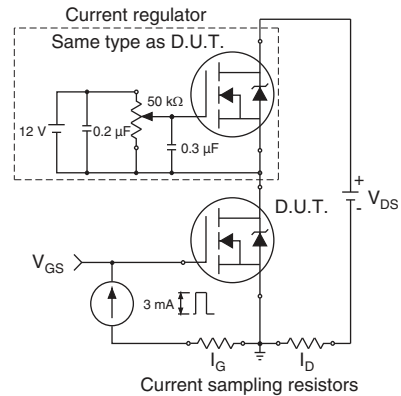
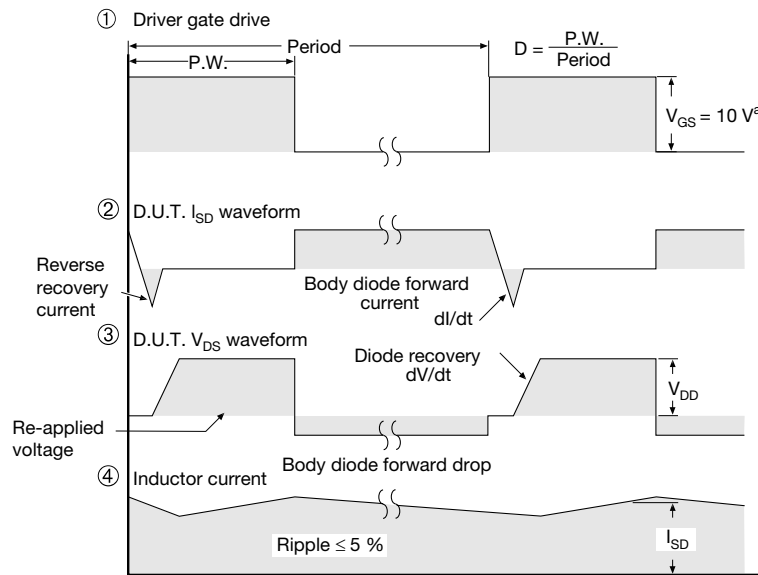
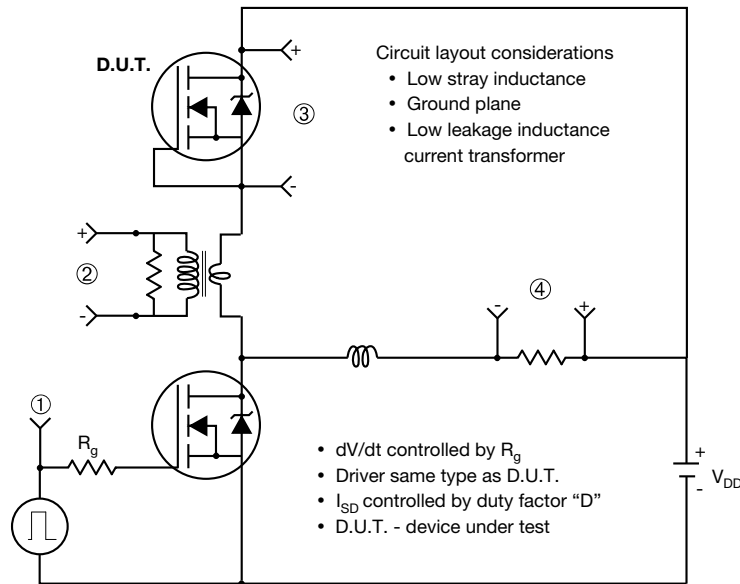


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

a.  $V_{GS} = 5\text{ V}$  for logic level devices

Fig. 14 - For N-Channel

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# TO-252AA Case Outline

## VERSION 1: FACILITY CODE = Y



MILLIMETERS		
DIM.	MIN.	MAX.
A	2.18	2.38
A1	-	0.127
b	0.64	0.88
b2	0.76	1.14
b3	4.95	5.46
C	0.46	0.61
C2	0.46	0.89
D	5.97	6.22
D1	4.10	-
E	6.35	6.73
E1	4.32	-
H	9.40	10.41
e	2.28 BSC	
e1	4.56 BSC	
L	1.40	1.78
L3	0.89	1.27
L4	-	1.02
L5	1.01	1.52

### Note

- Dimension L3 is for reference only





VERSION 2: FACILITY CODE = N



MILLIMETERS		
DIM.	MIN.	MAX.
A	2.18	2.39
A1	-	0.13
b	0.65	0.89
b1	0.64	0.79
b2	0.76	1.13
b3	4.95	5.46
c	0.46	0.61
c1	0.41	0.56
c2	0.46	0.60
D	5.97	6.22
D1	5.21	-
E	6.35	6.73
E1	4.32	-
e	2.29 BSC	
H	9.94	10.34

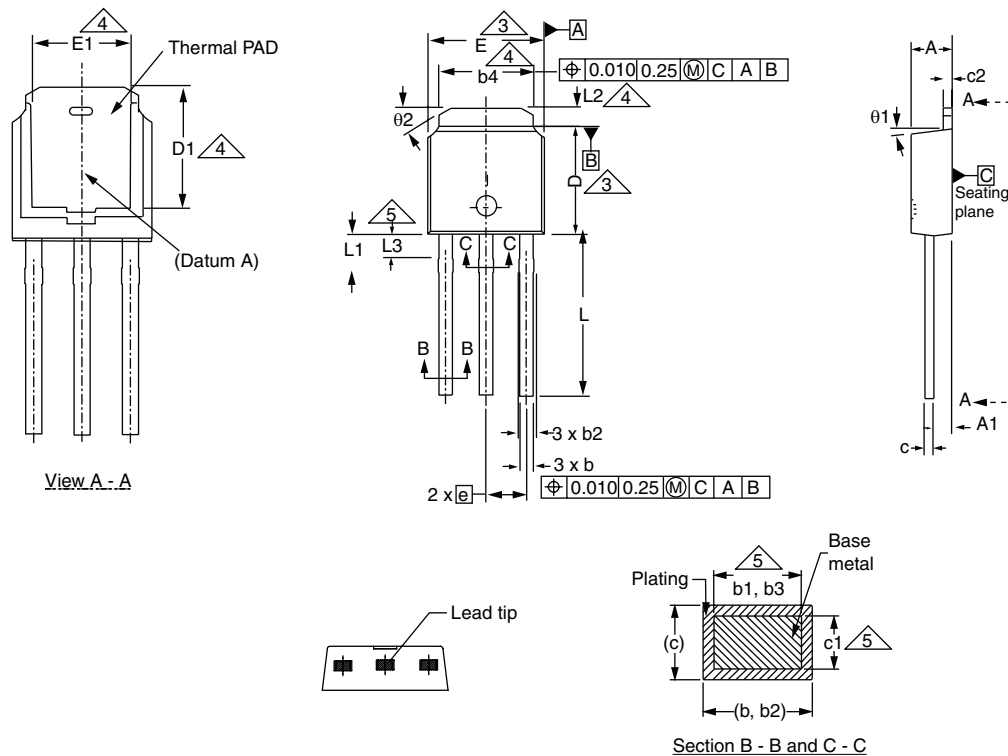
MILLIMETERS		
DIM.	MIN.	MAX.
L	1.50	1.78
L1	2.74 ref.	
L2	0.51 BSC	
L3	0.89	1.27
L4	-	1.02
L5	1.14	1.49
L6	0.65	0.85
θ	0°	10°
θ1	0°	15°
θ2	25°	35°

Notes

- Dimensioning and tolerance confirm to ASME Y14.5M-1994
- All dimensions are in millimeters. Angles are in degrees
- Heat sink side flash is max. 0.8 mm
- Radius on terminal is optional

ECN: E19-0649-Rev. Q, 16-Dec-2019  
 DWG: 5347

### TO-251AA (HIGH VOLTAGE)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1	0.89	1.14	0.035	0.045
b	0.64	0.89	0.025	0.035
b1	0.65	0.79	0.026	0.031
b2	0.76	1.14	0.030	0.045
b3	0.76	1.04	0.030	0.041
b4	4.95	5.46	0.195	0.215
c	0.46	0.61	0.018	0.024
c1	0.41	0.56	0.016	0.022
c2	0.46	0.86	0.018	0.034
D	5.97	6.22	0.235	0.245

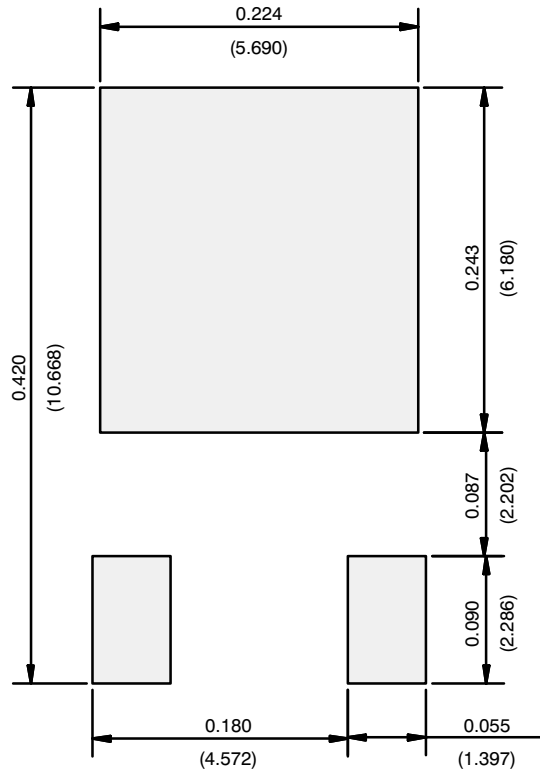
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	5.21	-	0.205	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
e	2.29 BSC		2.29 BSC	
L	8.89	9.65	0.350	0.380
L1	1.91	2.29	0.075	0.090
L2	0.89	1.27	0.035	0.050
L3	1.14	1.52	0.045	0.060
theta1	0'	15'	0'	15'
theta2	25'	35'	25'	35'

ECN: S-82111-Rev. A, 15-Sep-08  
 DWG: 5968

#### Notes

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimension are shown in inches and millimeters.
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.13 mm (0.005") per side. These dimensions are measured at the outermost extremes of the plastic body.
4. Thermal pad contour optional with dimensions b4, L2, E1 and D1.
5. Lead dimension uncontrolled in L3.
6. Dimension b1, b3 and c1 apply to base metal only.
7. Outline conforms to JEDEC outline TO-251AA.

## RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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