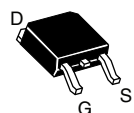
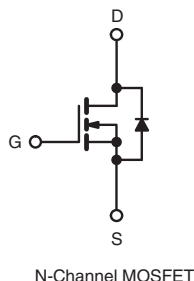
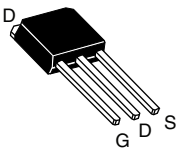




Power MOSFET

PRODUCT SUMMARY

V_{DS} (V)	400	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10$ V	3.6
Q_g (Max.) (nC)	12	
Q_{gs} (nC)	1.9	
Q_{gd} (nC)	6.5	
Configuration	Single	

DPAK
(TO-252)IPAK
(TO-251)

FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Surface Mount (IRFR310, SiHFR310)
- Straight Lead (IRFU310, SiHFU310)
- Available in Tape and Reel
- Fast Switching
- Fully Avalanche Rated
- Material categorization: For definitions of compliance please see 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. The straight lead version (IRFU, SiHFU series) is for through-hole mounting applications. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

ORDERING INFORMATION

Package	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	DPAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free and Halogen-free	SiHFR310-GE3	SiHFR310TRL-GE3	SiHFR310TR-GE3	SiHFR310TRR-GE3	SiHFU310-GE3
Lead (Pb)-free	IRFR310PbF	IRFR310TRLPbF ^a	IRFR310TRPbF ^a	IRFR310TRRPbF ^a	IRFU310PbF
	SiHFR310-E3	SiHFR310TL-E3 ^a	SiHFR310T-E3 ^a	SiHFR310TR-E3 ^a	SiHFU310-E3

Note

a. See device orientation.

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

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V_{DS}	400	V
Gate-Source Voltage	V_{GS}	± 20	
Continuous Drain Current	V_{GS} at 10 V	$T_C = 25^\circ\text{C}$	A
		$T_C = 100^\circ\text{C}$	
Pulsed Drain Current ^a	I_{DM}	6.0	W/ $^\circ\text{C}$
Linear Derating Factor		0.20	
Linear Derating Factor (PCB Mount) ^e		0.020	
Single Pulse Avalanche Energy ^b	E_{AS}	86	mJ
Repetitive Avalanche Current ^a	I_{AR}	1.7	A
Repetitive Avalanche Energy ^a	E_{AR}	2.5	mJ
Maximum Power Dissipation	P_D	$T_C = 25^\circ\text{C}$	W
Maximum Power Dissipation (PCB Mount) ^e		$T_A = 25^\circ\text{C}$	
Peak Diode Recovery dV/dt ^c	dV/dt	4.0	V/ns
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 150	$^\circ\text{C}$
Soldering Recommendations (Peak Temperature) ^d	for 10 s	260	

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. $V_{DD} = 50$ V, starting $T_J = 25^\circ\text{C}$, $L = 52$ mH, $R_g = 25\ \Omega$, $I_{AS} = 1.7$ A (see fig. 12).
c. $I_{SD} \leq 1.7$ A, $dI/dt \leq 40$ A/ μs , $V_{DD} \leq V_{DS}$, $T_J \leq 150^\circ\text{C}$.
d. 1.6 mm from case.
e. When mounted on 1" square PCB (FR-4 or G-10 material).

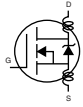
**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient (PCB Mounted, steady-state) ^a	R_{thJA}	-	50	°C/W
Maximum Junction-to-Ambient	R_{thJA}	-	110	
Maximum Junction-to-Case	R_{thJC}	-	5.0	

Note

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

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

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT		
Static									
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$		400	-	-	V		
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.47	-	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}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA		
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 400\text{ V}$, $V_{GS} = 0\text{ V}$		-	-	25	μA		
		$V_{DS} = 320\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$		-	-	250			
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 1.0\text{ A}^b$	-	-	3.6	Ω		
Forward Transconductance	g_{fs}	$V_{DS} = 50\text{ V}$, $I_D = 1.0\text{ A}^b$		0.97	-	-	S		
Dynamic									
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5 ^c		-	170	-	pF		
Output Capacitance	C_{oss}			-	34	-			
Reverse Transfer Capacitance	C_{rss}			-	6.3	-			
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 2.0\text{ A}$, $V_{DS} = 320\text{ V}$, see fig. 6 and 13 ^{b, c}	-	-	12	nC		
Gate-Source Charge	Q_{gs}			-	-	1.9			
Gate-Drain Charge	Q_{gd}			-	-	6.5			
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 200\text{ V}$, $I_D = 2.0\text{ A}$, $R_g = 24\text{ }\Omega$, $R_D = 95\text{ }\Omega$, see fig. 10 ^{b, c}		-	7.9	-	ns		
Rise Time	t_r			-	9.9	-			
Turn-Off Delay Time	$t_{d(off)}$			-	21	-			
Fall Time	t_f			-	11	-			
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				-	-	1.7	A
Pulsed Diode Forward Current ^a	I_{SM}					-	-	6.0	
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}$, $I_S = 1.7\text{ A}$, $V_{GS} = 0\text{ V}^b$		-	-	1.6	V		
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}$, $I_F = 2.0\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$		-	240	540	ns		
Body Diode Reverse Recovery Charge	Q_{rr}			-	0.85	1.6	μC		
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)

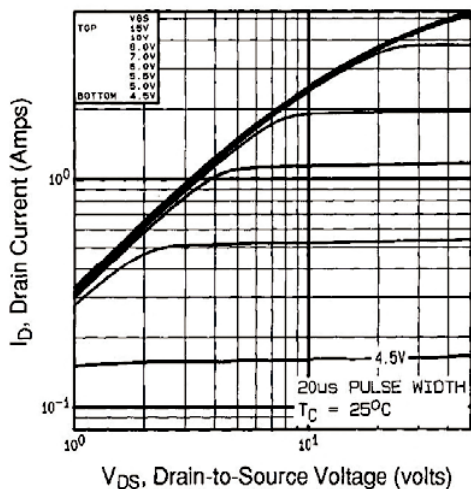


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

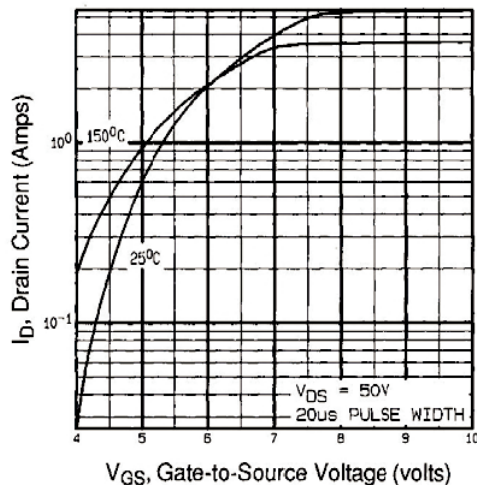


Fig. 3 - Typical Transfer Characteristics

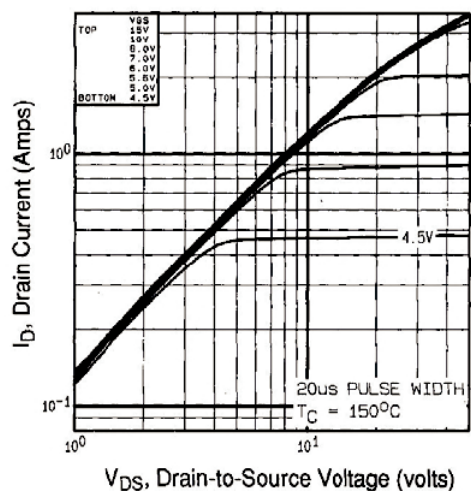


Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

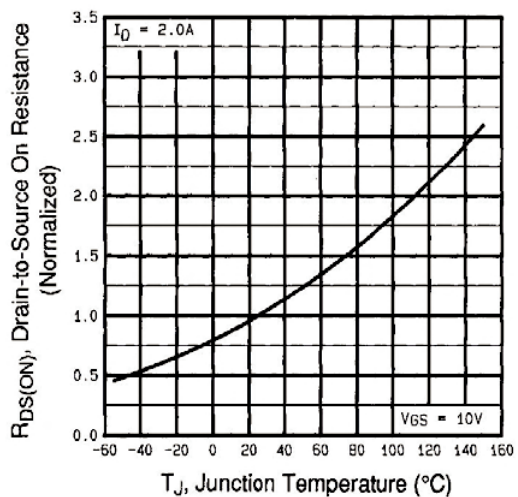


Fig. 4 - Normalized On-Resistance vs. Temperature

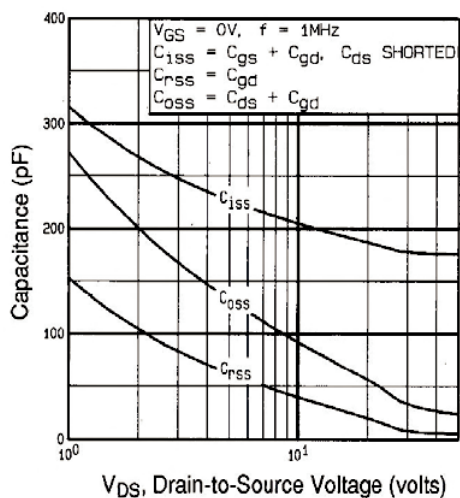


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

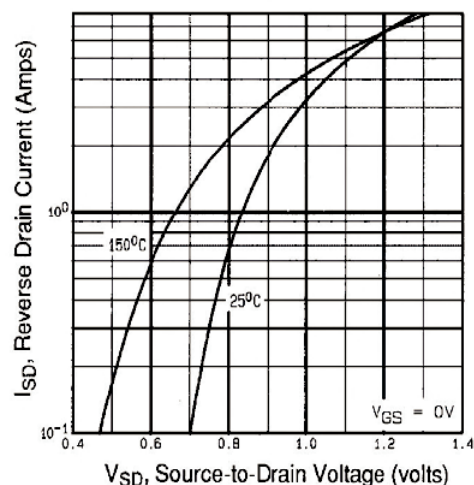


Fig. 7 - Typical Source-Drain Diode Forward Voltage

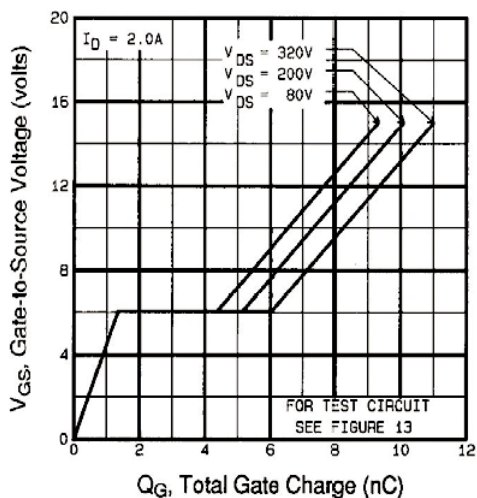


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

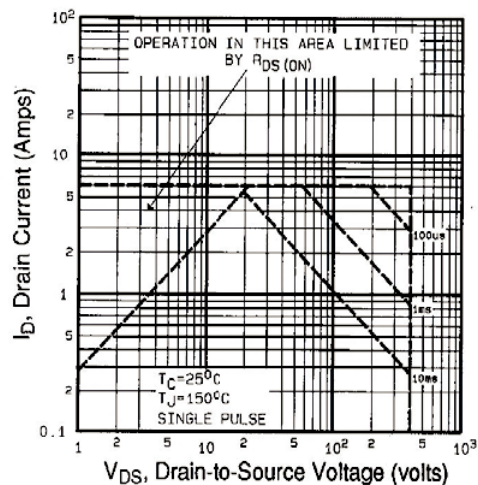


Fig. 8 - Maximum Safe Operating Area

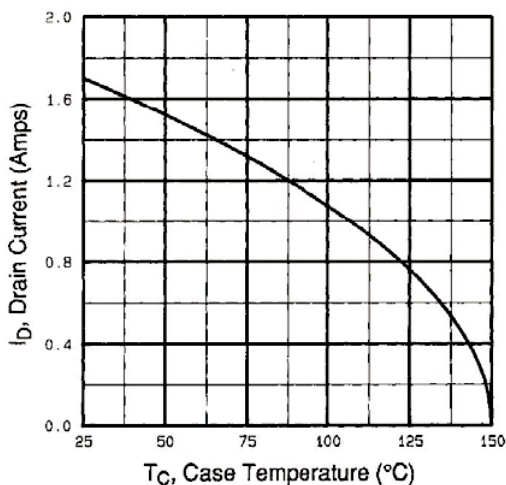


Fig. 9 - Maximum Drain Current vs. Case Temperature

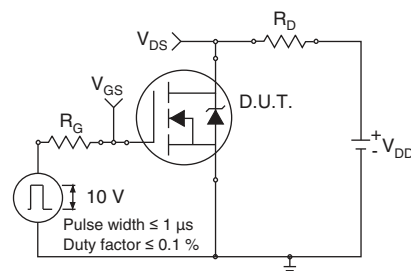


Fig. 10a - Switching Time Test Circuit

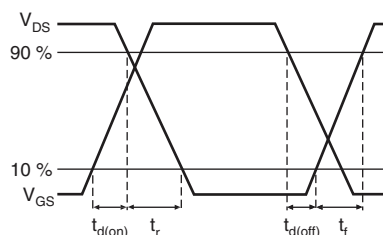


Fig. 10b - Switching Time Waveforms

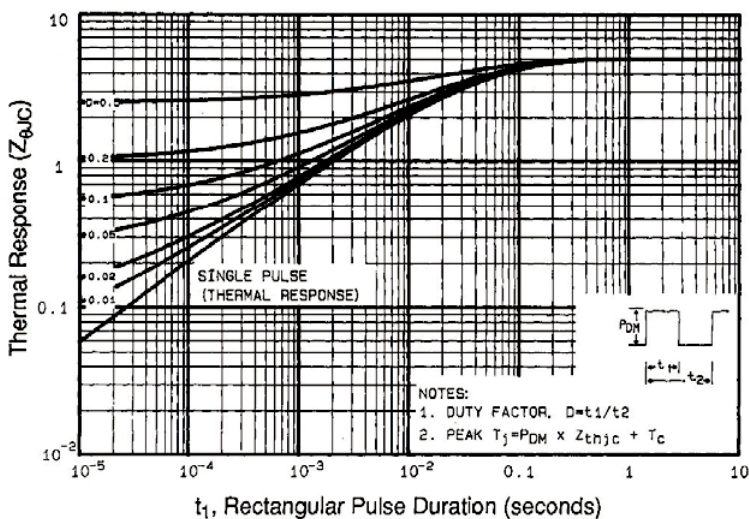


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

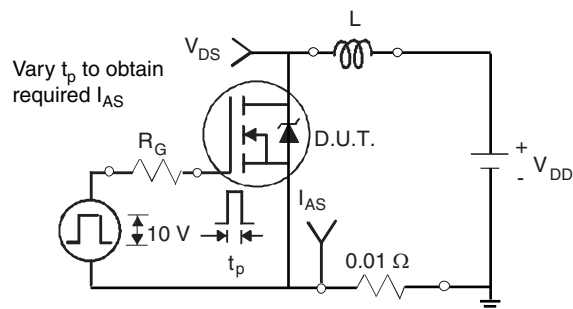


Fig. 12a - Unclamped Inductive Test Circuit

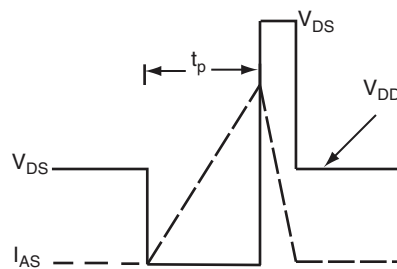


Fig. 12b - Unclamped Inductive Waveforms

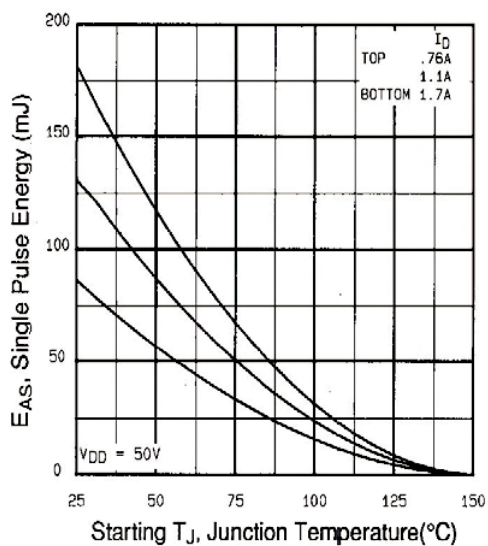


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

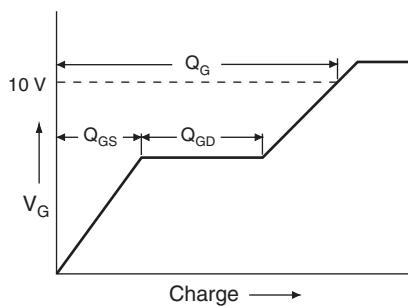


Fig. 13a - Basic Gate Charge Waveform

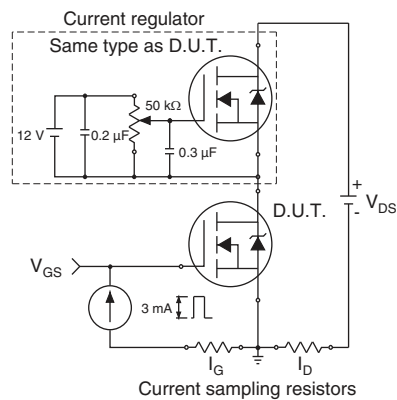
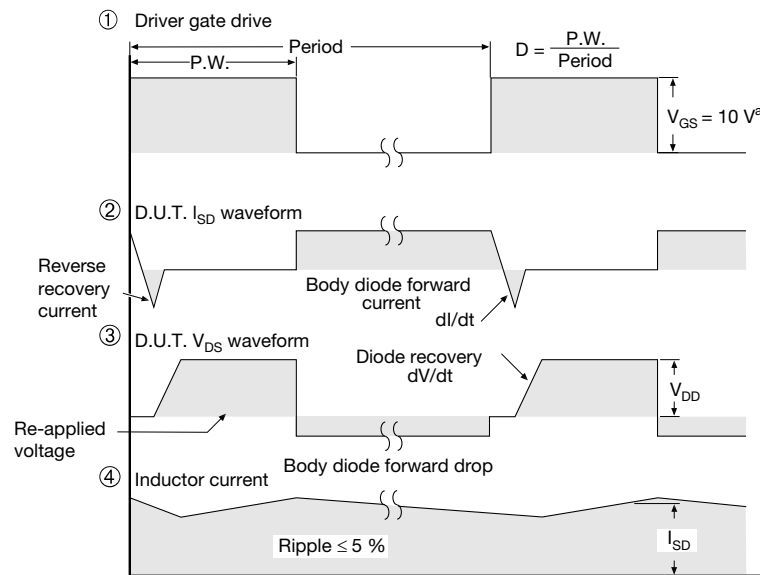
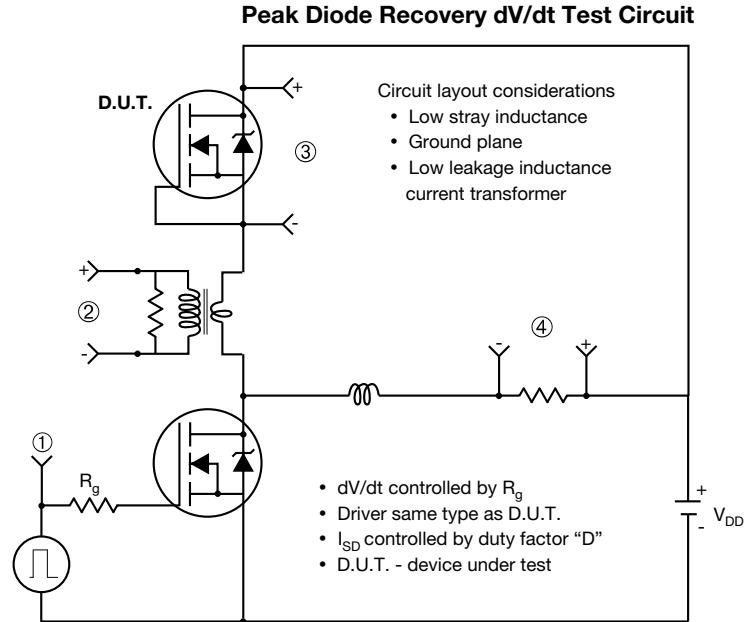


Fig. 13b - Gate Charge Test Circuit



Note

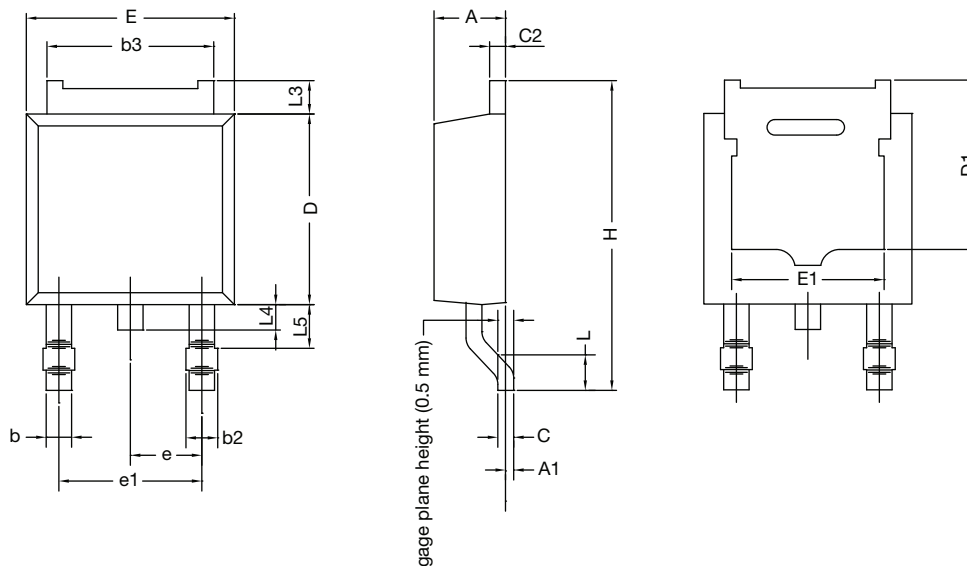
a. V_{GS} = 5 V for logic level devices

Fig. 14 - For N-Channel

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?91272.

TO-252AA Case Outline

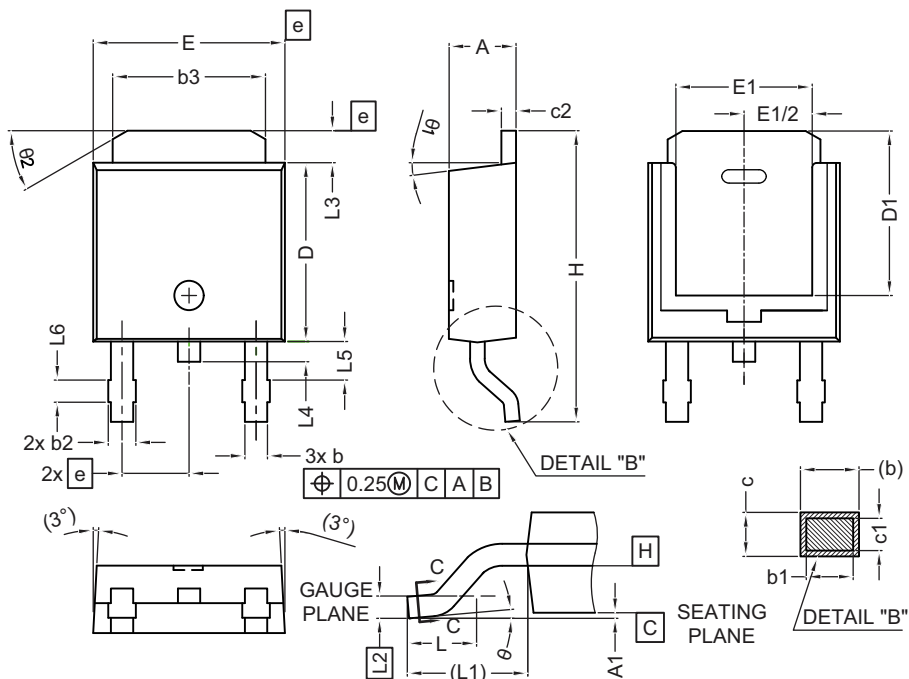
VERSION 1: FACILITY CODE = Y



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

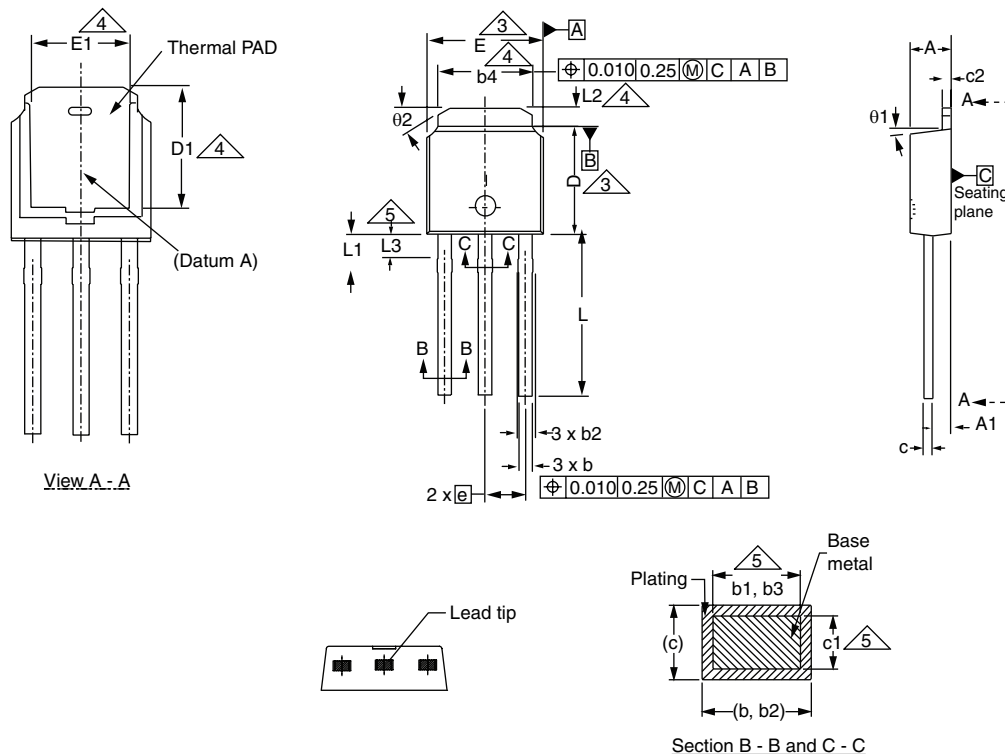
	MILLIMETERS	
DIM.	MIN.	MAX.
L	1.50	1.78
L1	2.74 ref.	
L2	0.51 BSC	
L3	0.89	1.27
L4	-	1.02
L5	1.14	1.49
L6	0.65	0.85
theta	0°	10°
theta1	0°	15°
theta2	25°	35°

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

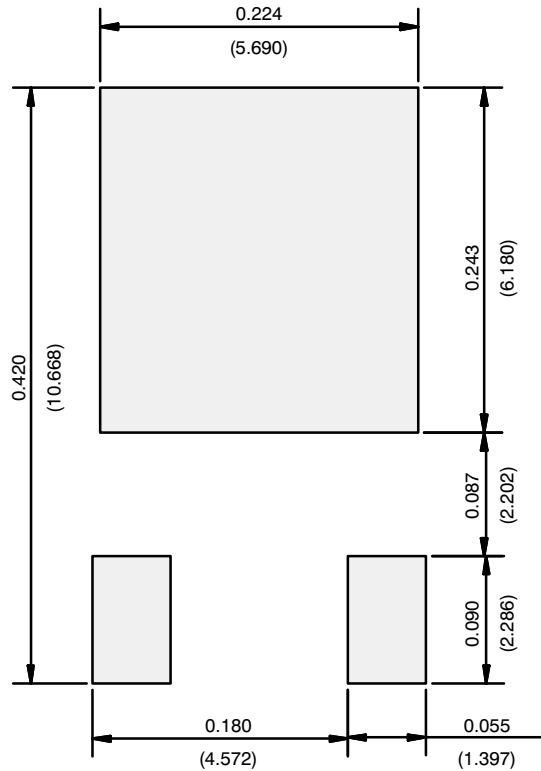
DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	5.21	-	0.205	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
e	2.29 BSC		2.29 BSC	
L	8.89	9.65	0.350	0.380
L1	1.91	2.29	0.075	0.090
L2	0.89	1.27	0.035	0.050
L3	1.14	1.52	0.045	0.060
Ø1	0'	15'	0'	15'
Ø2	25'	35'	25'	35'

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)

[Return to Index](#)



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