

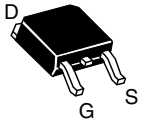


THE DATASHEET OF SIHFR220-GE3

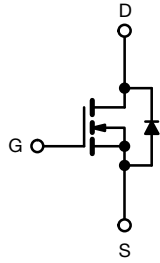
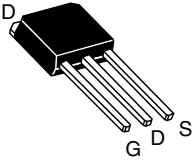


Power MOSFET

PAK (TO-252)



IPAK (TO-251)



N-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Repetitive avalanche rated
- Surface-mount (IRFR220, SiHFR220)
- Straight lead (IRFU220, SiHFU220)
- Available in tape and reel
- Fast switching
- Ease of paralleling
- 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 PAK 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.

PRODUCT SUMMARY	
V _{DS} (V)	200
R _{DS(on)} (Ω)	V _{GS} = 10 V 0.80
Q _g max. (nC)	14
Q _{gs} (nC)	3.0
Q _{gd} (nC)	7.9
Configuration	Single

ORDERING INFORMATION					
PACKAGE	PAK (TO-252)	PAK (TO-252)	PAK (TO-252)	PAK (TO-252)	IPAK (TO-251)
Lead (Pb)-free and halogen-free	SiHFR220-GE3	SiHFR220TRL-GE3	-	-	SiHFU220-GE3
Lead (Pb)-free	IRFR220PbF	IRFR220TRLPbF ^a	IRFR220TRPbF ^a	IRFR220TRRPbF ^a	IRFU220PbF
Lead (Pb)-free and halogen-free	IRFR220PbF-BE3 ^b	IRFR220TRLPbF-BE3 ^{ab}	IRFR220TRPbF-BE3 ^{ab}	-	-

Notes

- See device orientation
- “-BE3” denotes alternate manufacturing location

ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	V _{DS}	200	V
Gate-source voltage	V _{GS}	± 20	
Continuous drain current	V _{GS} at 10 V	T _C = 25 °C	A
		T _C = 100 °C	
Pulsed drain current ^a	I _{DM}	19	W/°C
Linear derating Factor		0.33	
Linear derating Factor (PCB Mount) ^e		0.020	
Single pulse avalanche energy ^b	E _{AS}	161	mJ
Repetitive avalanche current ^a	I _{AR}	4.8	A
Repetitive avalanche energy ^a	E _{AR}	4.2	mJ
Maximum power dissipation	P _D	T _C = 25 °C	W
Maximum power dissipation (PCB mount) ^e		T _A = 25 °C	
Peak diode recovery dV/dt ^c	dV/dt	5.0	V/ns
Operating junction and storage temperature range	T _J , T _{stg}	-55 to +150	°C
Soldering recommendations (peak temperature) ^d	for 10 s	260	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- V_{DD} = 50 V, starting T_J = 25 °C, L = 14 mH, R_g = 25 Ω, I_{AS} = 4.8 A (see fig. 12)
- I_{SD} ≤ 5.2 A, di/dt ≤ 95 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 150 °C
- 1.6 mm from case

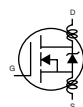



e. When mounted on 1" square PCB (FR-4 or G-10 material)

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}	-	-	3.0		

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	
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		200	-	- V	
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$		-	0.29	- $V/^\circ\text{C}$	
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}	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100\text{ nA}$	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$		-	-	25 μA	
		$V_{DS} = 160\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	250 μA	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 2.9\text{ A}^b$	-	-	0.80 Ω	
Forward Transconductance	g_{fs}	$V_{DS} = 50\text{ V}, I_D = 2.9\text{ A}^b$		1.7	-	- S	
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$		-	260	-	
Output Capacitance	C_{oss}			-	100	-	pF
Reverse Transfer Capacitance	C_{rss}			-	30	-	
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 4.8\text{ A}, V_{DS} = 160\text{ V}, \text{ see fig. 6 and 13}^b$	-	-	14	
Gate-Source Charge	Q_{gs}			-	-	3.0	nC
Gate-Drain Charge	Q_{gd}			-	-	7.9	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 100\text{ V}, I_D = 4.8\text{ A}, R_G = 18\text{ }\Omega, R_D = 20\text{ }\Omega, \text{ see fig. 10}^b$		-	7.2	-	
Rise Time	t_r			-	22	-	ns
Turn-Off Delay Time	$t_{d(off)}$			-	19	-	
Fall Time	t_f			-	13	-	
Internal Drain Inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact 		-	4.5	-	
Internal Source Inductance	L_S			-	7.5	-	nH
Drain-source body diode characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	4.8	
Pulsed Diode Forward Current ^a	I_{SM}			-	-	19	A
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 4.8\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	1.8 V	
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 4.8\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$		-	150	300 ns	
Body Diode Reverse Recovery Charge	Q_{rr}			-	0.91	1.8 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 $\leq 2\text{ }\%$



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

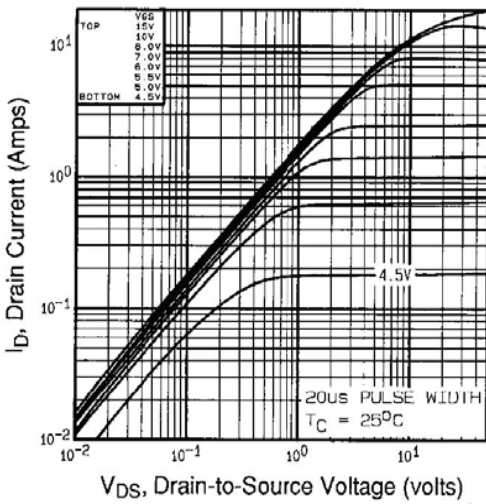


Fig. 1 - Typical Output Characteristics, $T_C = 25\text{ }^\circ\text{C}$

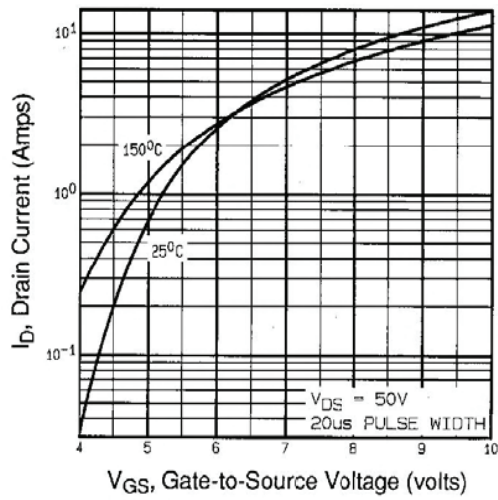


Fig. 3 - Typical Transfer Characteristics

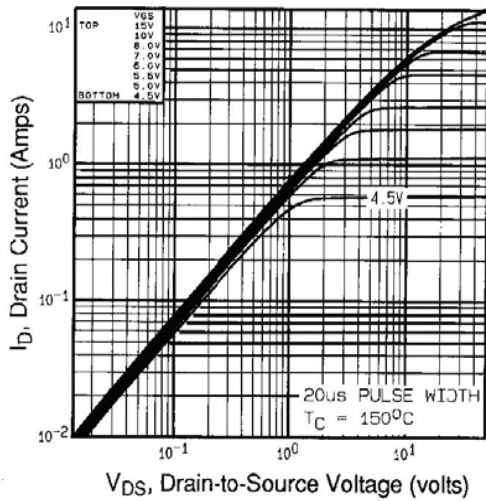


Fig. 2 - Typical Output Characteristics, $T_C = 150\text{ }^\circ\text{C}$

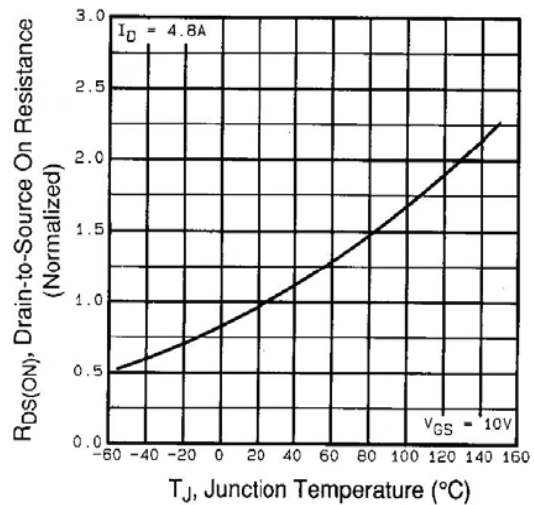


Fig. 4 - Normalized On-Resistance vs. Temperature

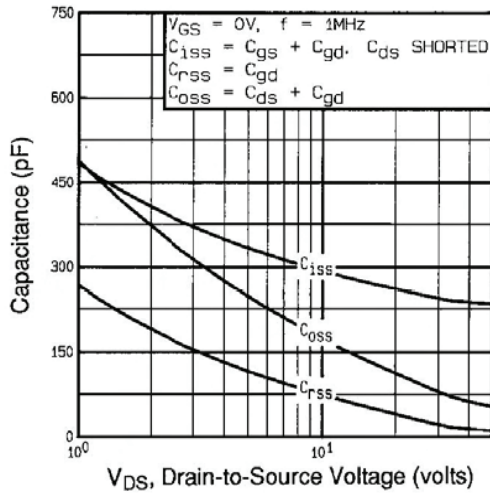


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

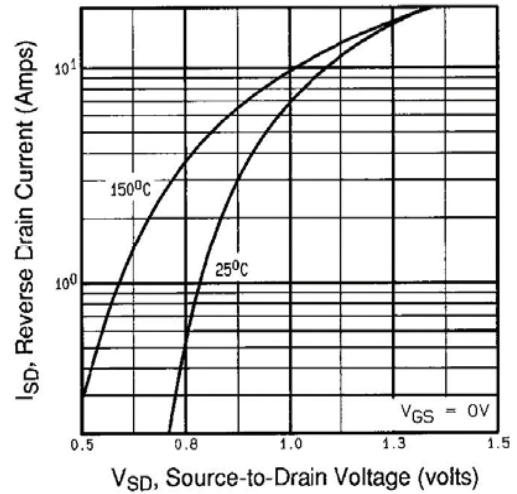


Fig. 7 - Typical Source-Drain Diode Forward Voltage

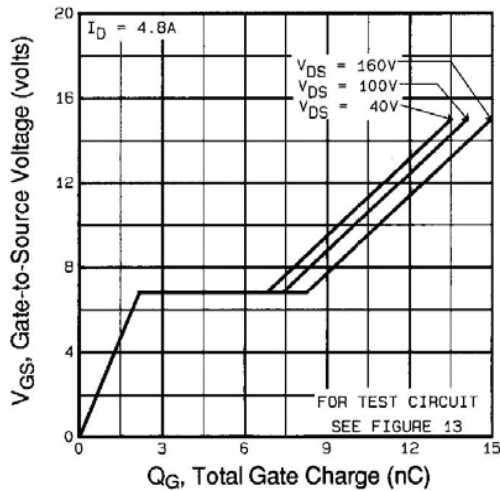


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

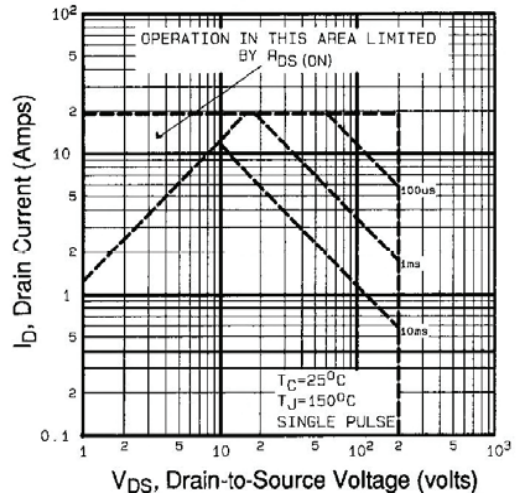


Fig. 8 - Maximum Safe Operating Area

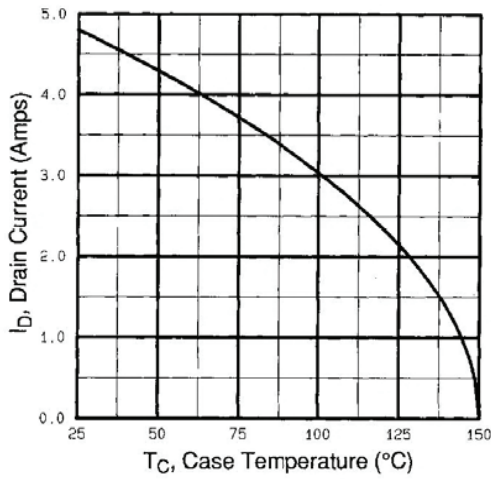


Fig. 9 - Maximum Drain Current vs. Case Temperature

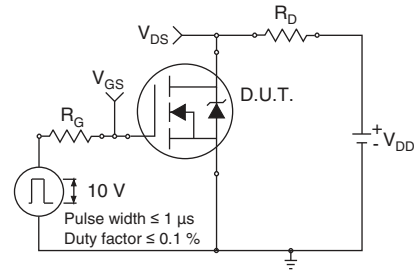


Fig. 10a - Switching Time Test Circuit

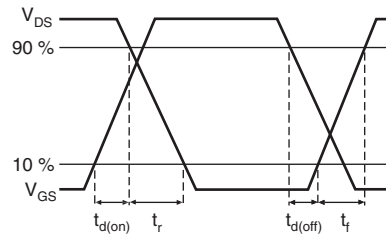


Fig. 10b - Switching Time Waveforms

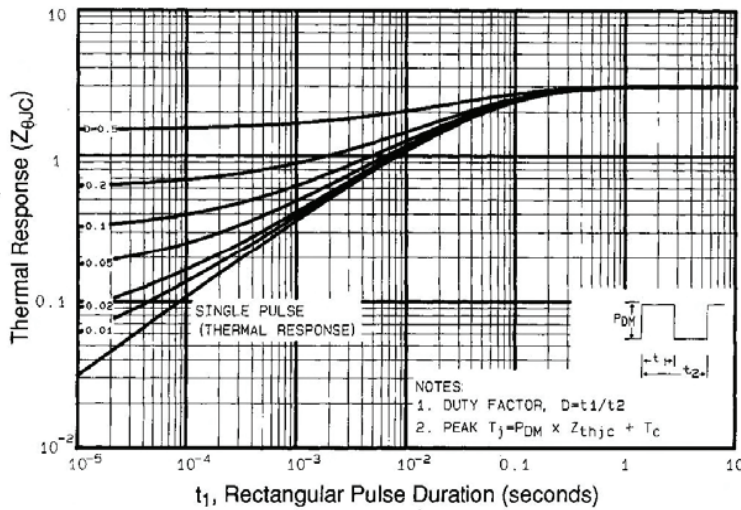


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

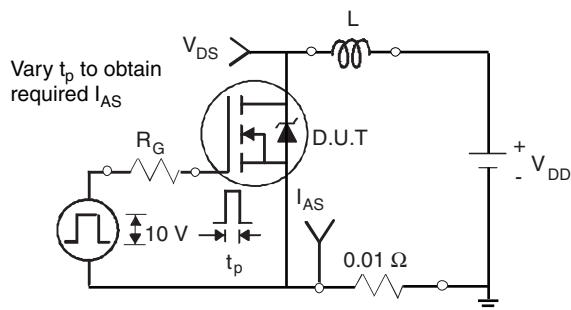


Fig. 12a - Unclamped Inductive Test Circuit

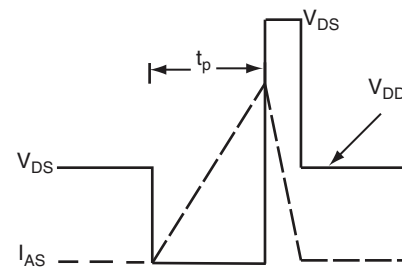


Fig. 12b - Unclamped Inductive Waveforms

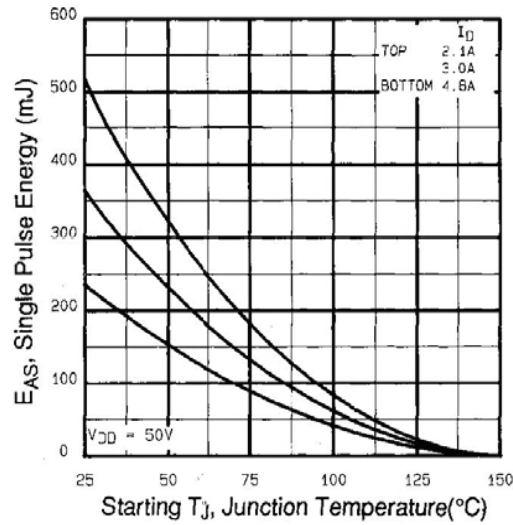


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

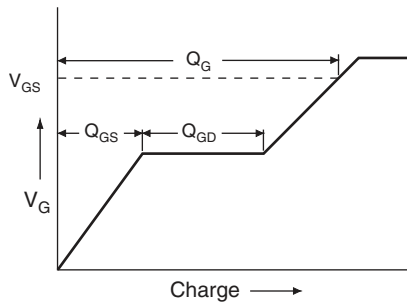


Fig. 13a - Basic Gate Charge Waveform

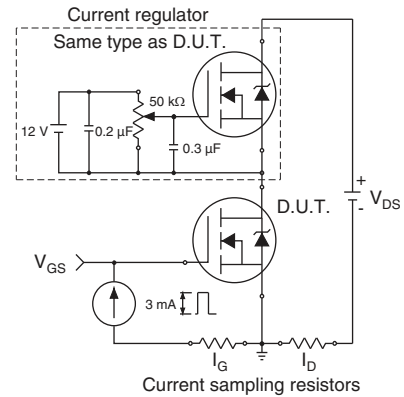
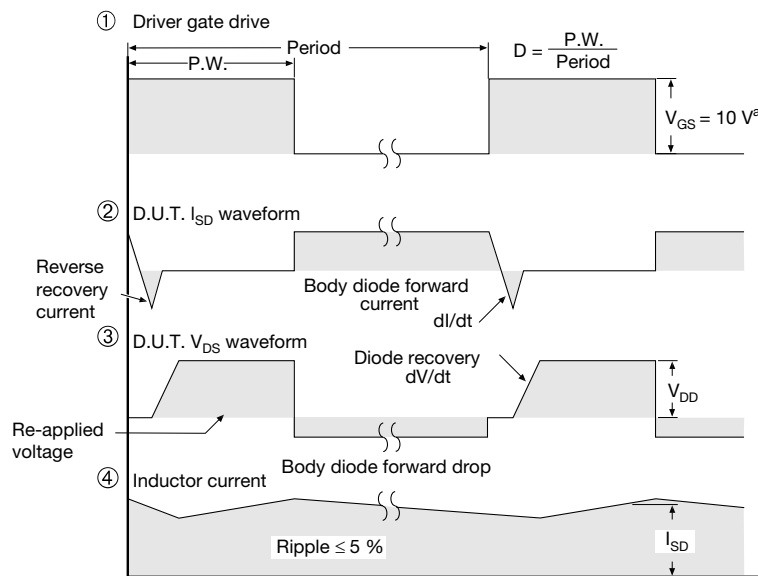
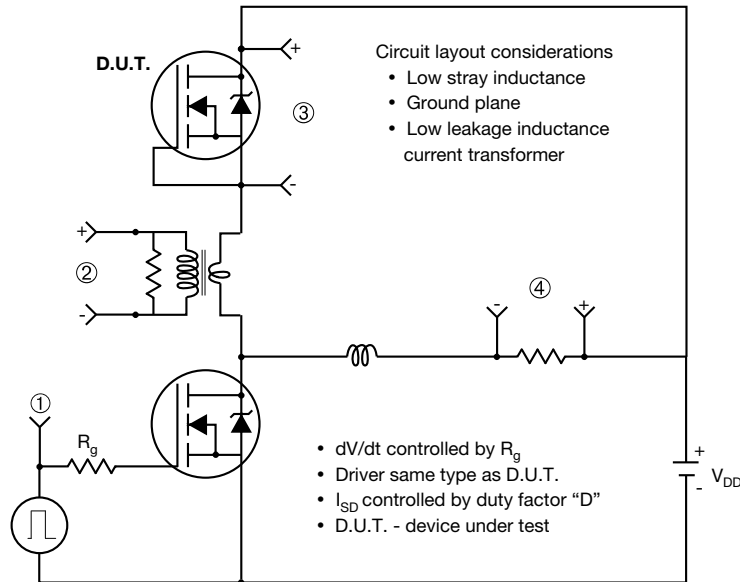


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

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

Fig. 14 - For N-Channel

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TO-252AA Case Outline

VERSION 1: FACILITY CODE = Y



DIM.	MILLIMETERS	
	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: E22-0399-Rev. R, 03-Oct-2022
 DWG: 5347

Case Outline for TO-251AA (High Voltage)

OPTION 1:


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
θ1	0°	15°	0°	15°
θ2	25°	35°	25°	35°

 ECN: E21-0682-Rev. C, 27-Dec-2021
 DWG: 5968

Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Dimension are shown in inches and millimeters
- 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
- Thermal pad contour optional with dimensions b4, L2, E1 and D1
- Lead dimension uncontrolled in L3
- Dimension b1, b3 and c1 apply to base metal only
- Outline conforms to JEDEC® outline TO-251AA



OPTION 2: FACILITY CODE = N



DIM.	MIN.	NOM.	MAX.
A	2.180	2.285	2.390
A1	0.890	1.015	1.140
b	0.640	0.765	0.890
b1	0.640	0.715	0.790
b2	0.760	0.950	1.140
b3	0.760	0.900	1.040
b4	4.950	5.205	5.460
c	0.460	-	0.610
c1	0.410	-	0.560
c2	0.460	-	0.610
D	5.970	6.095	6.220
D1	4.300	-	-

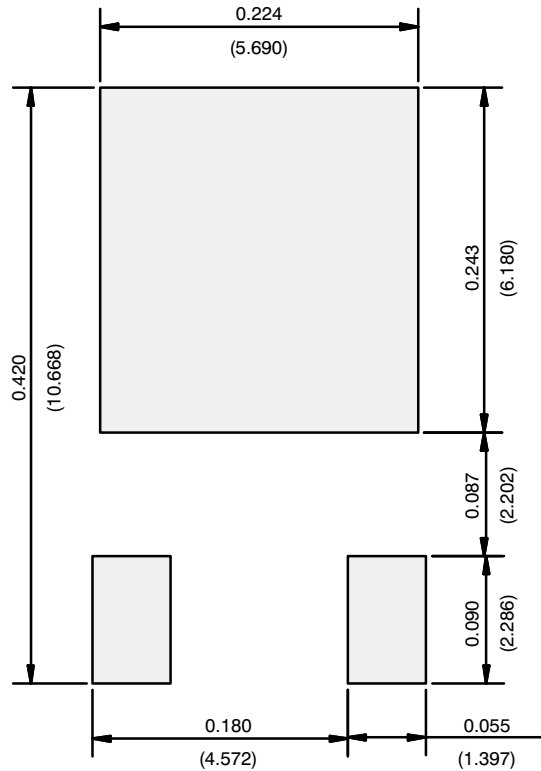
DIM.	MIN.	NOM.	MAX.
D2	5.380	-	-
E	6.350	6.540	6.730
E1	4.32	-	-
e	2.29 BSC		
L	8.890	9.270	9.650
L1	1.910	2.100	2.290
L2	0.890	1.080	1.270
L3	1.140	1.330	1.520
L4	1.300	1.400	1.500
θ_1	0°	7.5°	15°
θ_2	4°	-	-

ECN: E21-0682-Rev. C, 27-Dec-2021
DWG: 5968

Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- All dimension are in millimeters, angles are in degrees
- Heat sink side flash is max. 0.8 mm

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads
Dimensions in Inches/(mm)

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