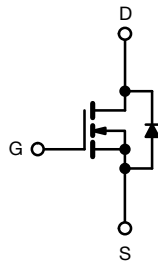
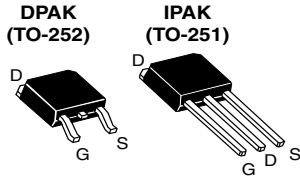


Power MOSFET



N-Channel MOSFET

FEATURES

- Dynamic dV/dt rating
- Surface-mount (IRFR014, SiHFR014)
- Straight lead (IRFU014, SiHFU014)
- Available in tape and reel
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
Available

PRODUCT SUMMARY	
V _{DS} (V)	60
R _{DS(on)} (Ω)	V _{GS} = 10 V 0.20
Q _g max. (nC)	11
Q _{gs} (nC)	3.1
Q _{gd} (nC)	5.8
Configuration	Single

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)	IPAK (TO-251)
Lead (Pb)-free and Halogen-free	SiHFR014-GE3	SiHFR014TRL-GE3	SiHFR014TR-GE3	SiHFU014-GE3
Lead (Pb)-free	IRFR014PbF	IRFR014TRLPbF ^a	IRFR014TRPbF ^a	IRFU014PbF
	IRFR014TRRPbF	-	-	-
Lead (Pb)-free and Halogen-free	IRFR014PbF-BE3 ^{ab}	IRFR014TRLPbF-BE3 ^{ab}	IRFR014TRPbF-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}	60	V
Gate-source voltage	V _{GS}	±20	
Continuous drain current	V _{GS} at 10 V	T _C = 25 °C	7.7
		T _C = 100 °C	4.9
Pulsed drain current ^a	I _{DM}	31	A
Linear derating factor		0.20	
Linear derating factor (PCB mount) ^e		0.020	W/°C
Single pulse avalanche energy ^b	E _{AS}	27.4	mJ
Maximum power dissipation	P _D	T _C = 25 °C	25
Maximum power dissipation (PCB mount) ^e		T _A = 25 °C	2.5
Peak diode recovery dV/dt ^c	dV/dt	4.5	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

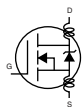
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- V_{DD} = 25 V, starting T_J = 25 °C, L = 924 μH, R_g = 25 Ω, I_{AS} = 7.7 A (see fig. 12)
- I_{SD} ≤ 10 A, dI/dt ≤ 90 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 150 °C
- 1.6 mm from case
- When mounted on 1" square PCB (FR-4 or 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}	-	-	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
Static							
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		60	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$		-	0.068	-	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}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	μA
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 4.6\text{ A}^b$	-	-	0.20	Ω
Forward transconductance	g_{fs}	$V_{DS} = 25\text{ V}, I_D = 4.6\text{ A}$		2.4	-	-	S
Dynamic							
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$		-	300	-	pF
Output capacitance	C_{oss}			-	160	-	
Reverse transfer capacitance	C_{rss}			-	29	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 10\text{ A}, V_{DS} = 48\text{ V}, \text{ see fig. 6 and 13}^b$	-	-	11	nC
Gate-source charge	Q_{gs}			-	-	3.1	
Gate-drain charge	Q_{gd}			-	-	5.8	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 10\text{ A}, R_g = 24\text{ }\Omega, R_D = 2.7\text{ }\Omega, \text{ see fig. 10}^b$		-	10	-	ns
Rise time	t_r			-	50	-	
Turn-off delay time	$t_{d(off)}$			-	13	-	
Fall time	t_f			-	19	-	
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 		-	-	7.7	A
Pulsed diode forward current ^a	I_{SM}			-	-	31	
Body diode voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 7.7\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	1.6	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 10\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$		-	70	140	ns
Body diode reverse recovery charge	Q_{rr}			-	0.20	0.40	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)

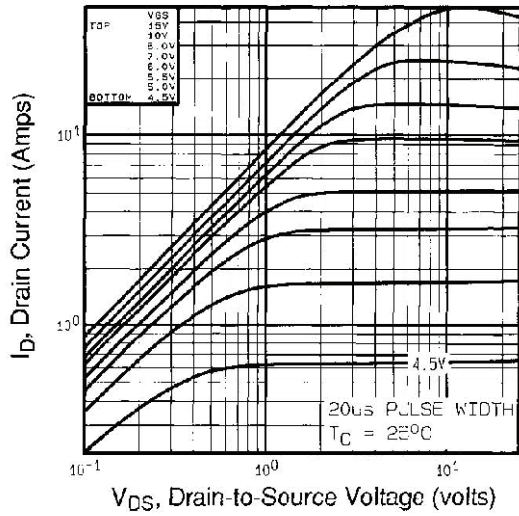


Fig. 1 - Typical Output Characteristics, $T_C = 25\text{ }^\circ\text{C}$

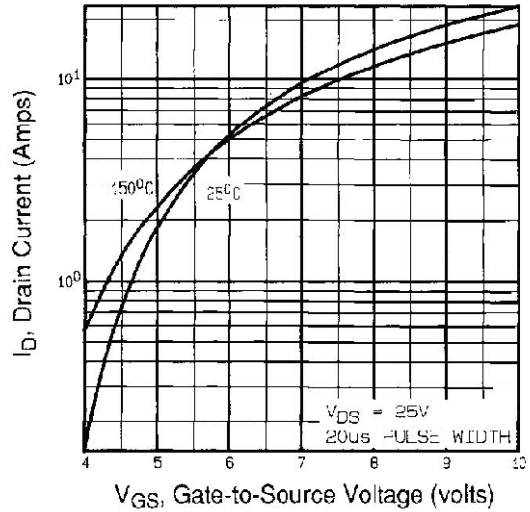


Fig. 3 - Typical Transfer Characteristics

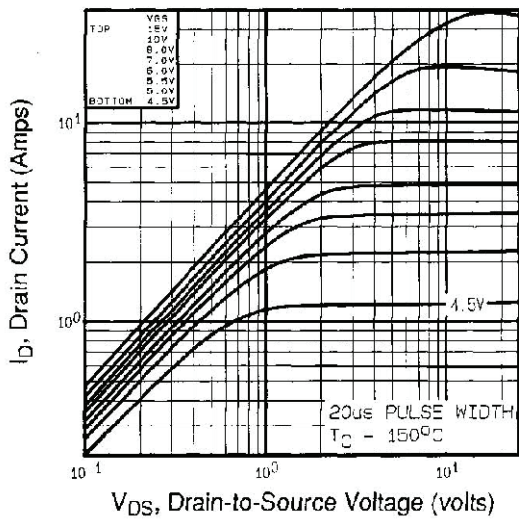


Fig. 2 - Typical Output Characteristics, $T_C = 150\text{ }^\circ\text{C}$

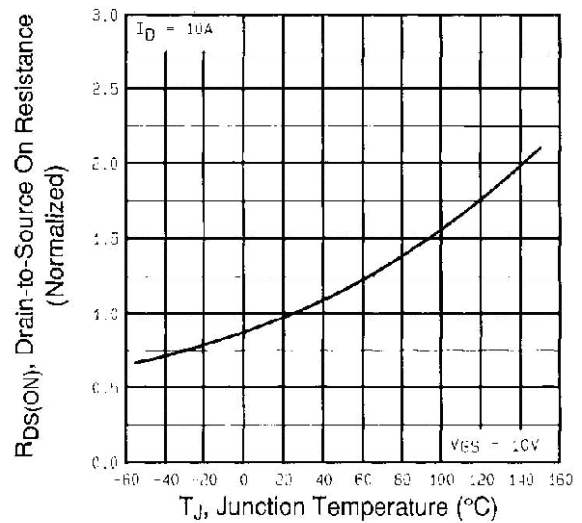


Fig. 4 - Normalized On-Resistance vs. Temperature

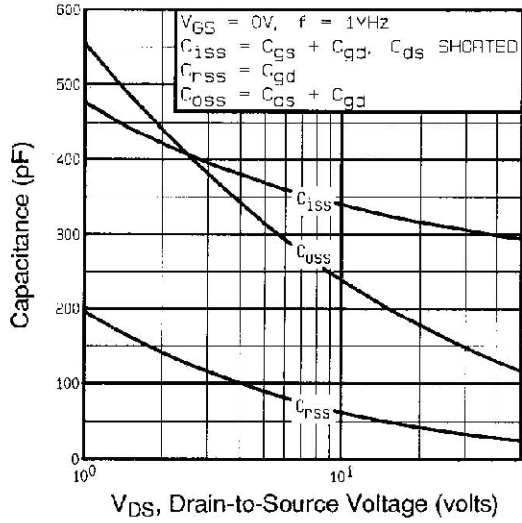


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

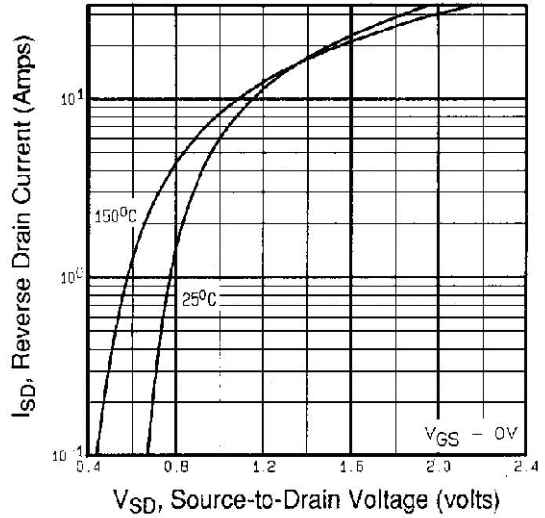


Fig. 7 - Typical Source-Drain Diode Forward Voltage

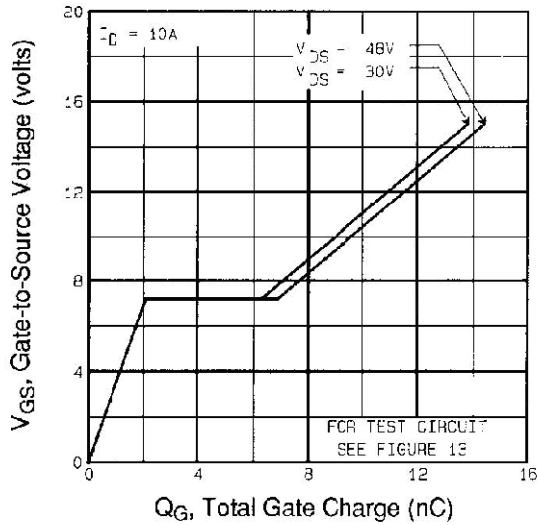


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

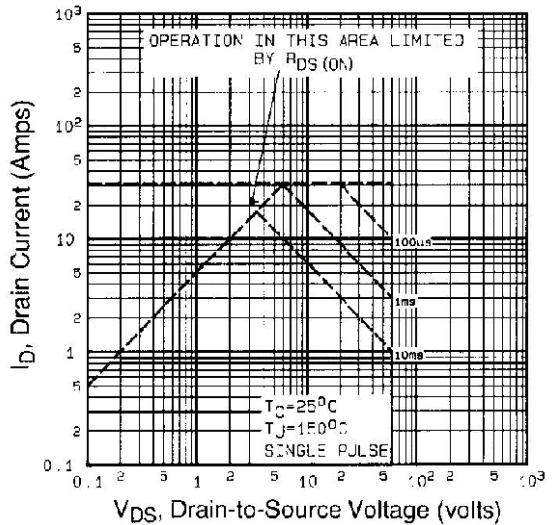


Fig. 8 - Maximum Safe Operating Area

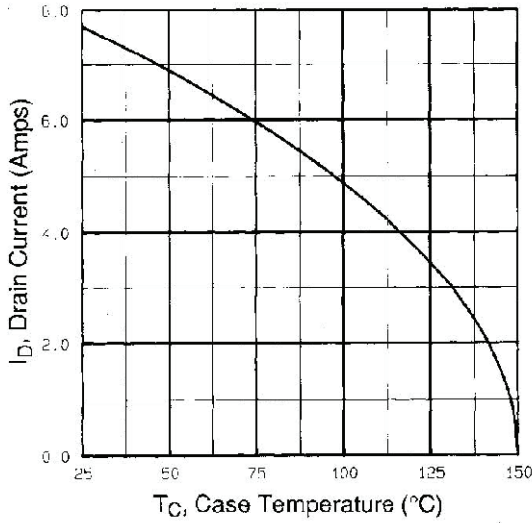


Fig. 9 - Maximum Drain Current vs. Case Temperature

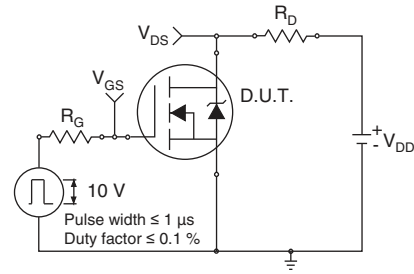


Fig. 10 - Switching Time Test Circuit



Fig. 11 - Switching Time Waveforms

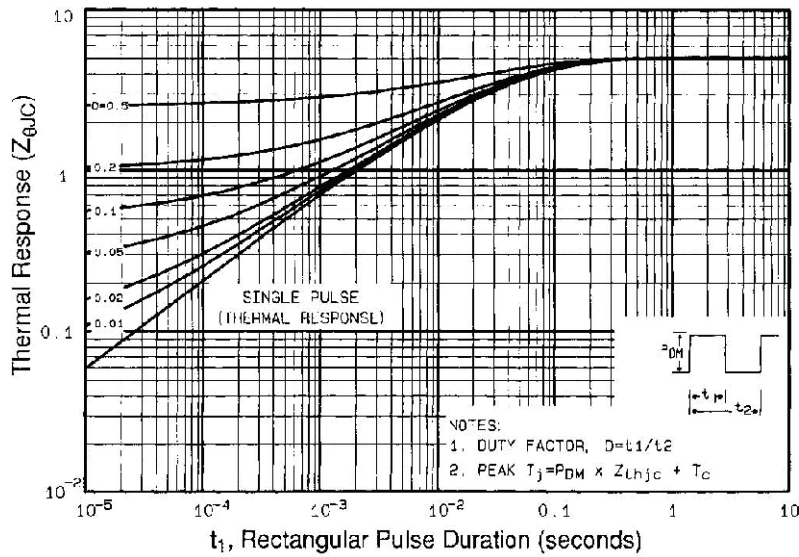


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

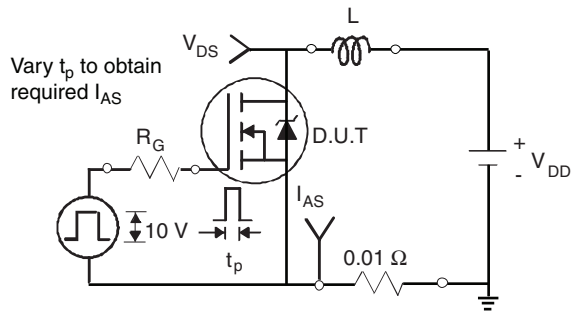


Fig. 13 - Unclamped Inductive Test Circuit



Fig. 14 - Unclamped Inductive Waveforms

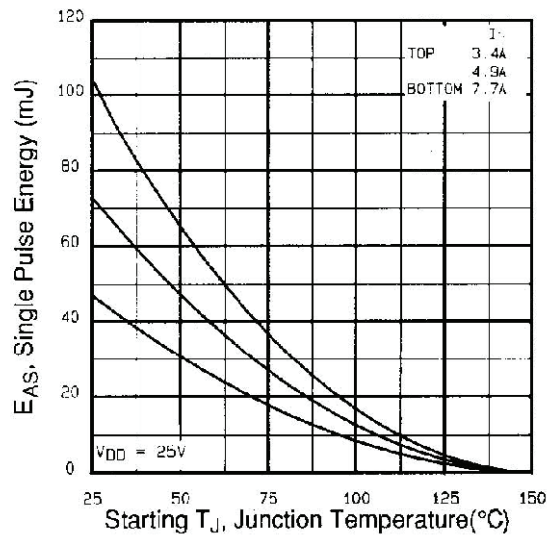


Fig. 15 - Maximum Avalanche Energy vs. Drain Current

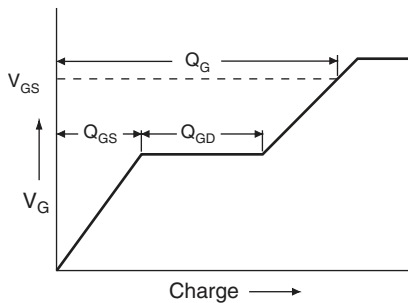


Fig. 16 - Basic Gate Charge Waveform

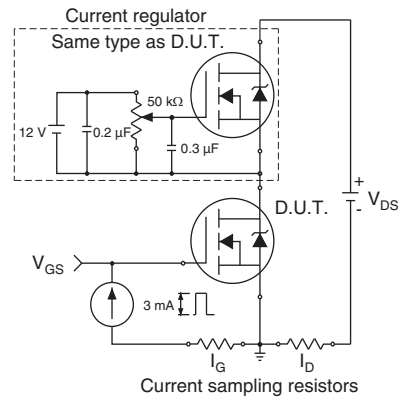
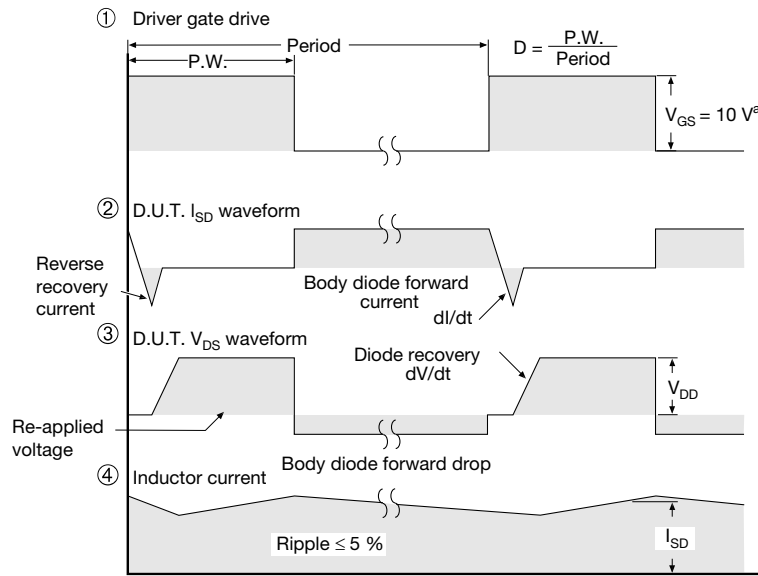
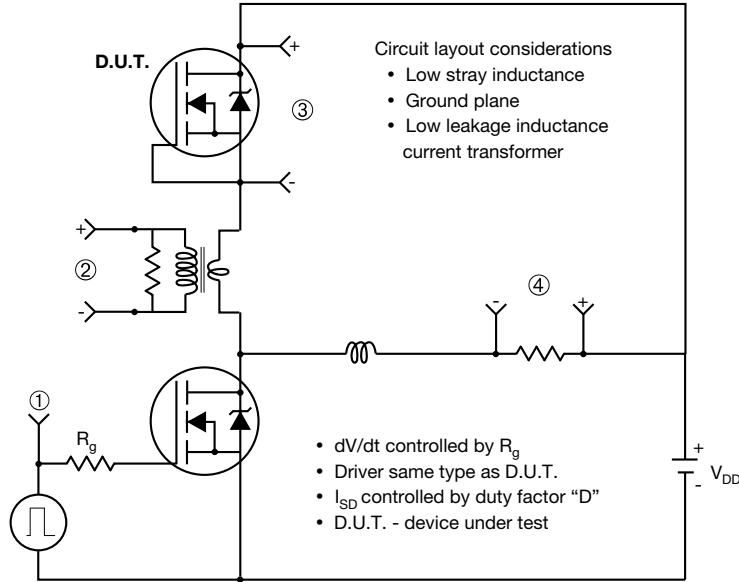


Fig. 17 - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note

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

Fig. 18 - 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?91263.



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



DIM.	MILLIMETERS	
	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

DIM.	MILLIMETERS	
	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

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
theta1	0'	15'	0'	15'
theta2	25'	35'	25'	35'

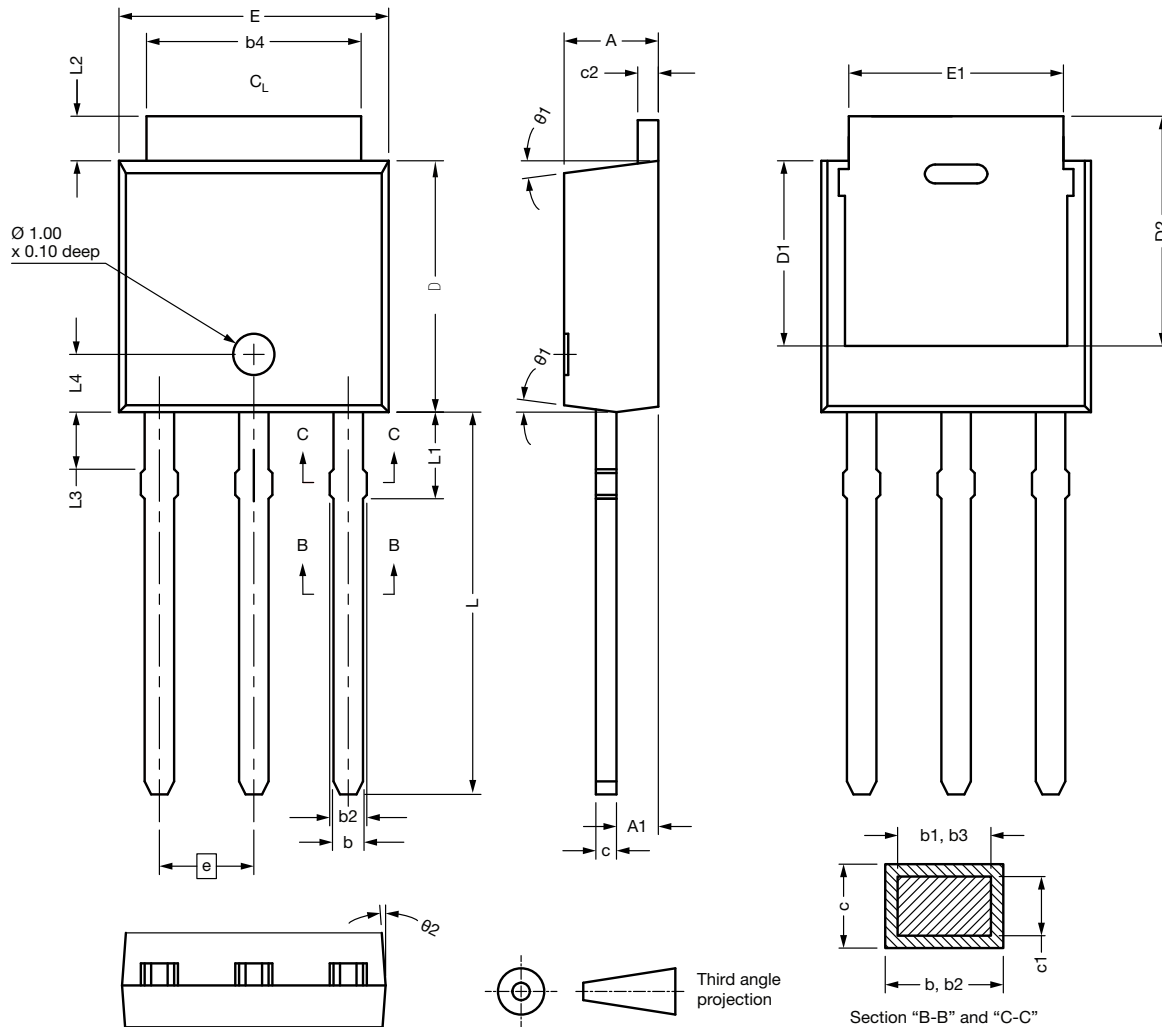
ECN: E21-0605-Rev. B, 25-Oct-2021
 DWG: 5968

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.	MAX.	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.	MAX.	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
θ1	0°	7.5°	15°
θ2	4°	-	-

ECN: E21-0605-Rev. B, 25-Oct-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)

[Return to Index](#)



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