

## P4404ES-VB Datasheet

### P-Channel 40 V (D-S) MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	-40
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -10$ V	0.012
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = -4.5$ V	0.015
$I_D$ (A)	-60
Configuration	Single

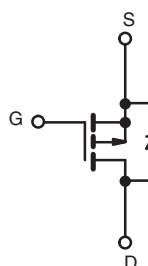
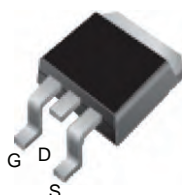
#### FEATURES

- Trench power MOSFET
- Package with low thermal resistance
- 100 %  $R_g$  and UIS tested



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

D<sup>2</sup>PAK (TO-263)



P-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		$V_{DS}$	-40	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	
Continuous Drain Current	$T_C = 25$ °C <sup>a</sup>	$I_D$	-60	A
	$T_C = 125$ °C		-45	
Continuous Source Current (Diode Conduction) <sup>a</sup>		$I_S$	-60	
Pulsed Drain Current <sup>b</sup>		$I_{DM}$	-230	
Single Pulse Avalanche Current	L = 0.1 mH	$I_{AS}$	-45	
Single Pulse Avalanche Energy		$E_{AS}$	80	mJ
Maximum Power Dissipation <sup>b</sup>	$T_A = 25$ °C	$P_D$	3.5	W
	$T_C = 25$ °C		166	
	$T_C = 125$ °C		65	
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	°C

#### THERMAL RESISTANCE RATINGS

PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-Ambient	PCB Mount <sup>c</sup>	$R_{thJA}$	50	°C/W
Junction-to-Case (Drain)		$R_{thJC}$	1.1	

#### Notes

- Package limited.
- Pulse test; pulse width  $\leq 300$   $\mu$ s, duty cycle  $\leq 2$  %.
- When mounted on 1" square PCB (FR4 material).
- Parametric verification ongoing.

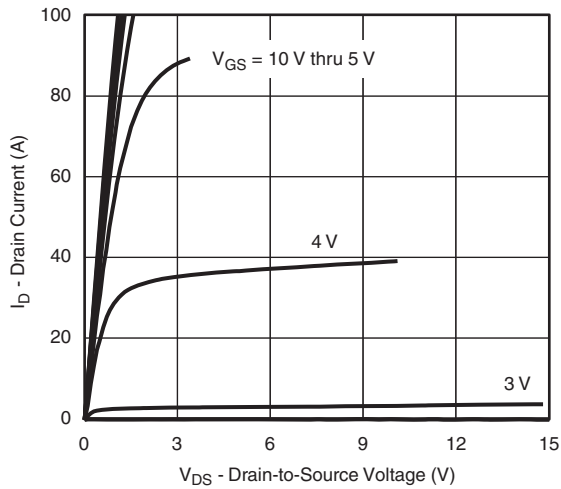
SPECIFICATIONS (T <sub>C</sub> = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA		-40	-	-	V
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA		-1.5	-	-2.5	
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -40 V	-	-	-1	μA
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -40 V, T <sub>J</sub> = 125 °C	-	-	-50	
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -40 V, T <sub>J</sub> = 175 °C	-	-	-150	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>GS</sub> = -10 V	V <sub>DS</sub> ≤ -5 V	-60	-	-	A
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10 V	I <sub>D</sub> = -17 A	-	0.012	-	Ω
		V <sub>GS</sub> = -10 V	I <sub>D</sub> = -50 A, T <sub>J</sub> = 125 °C	-	0.017	-	
		V <sub>GS</sub> = -10 V	I <sub>D</sub> = -50 A, T <sub>J</sub> = 175 °C	-	0.020	-	
		V <sub>GS</sub> = -4.5 V	I <sub>D</sub> = -14 A	-	0.015	-	
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = -15 V, I <sub>D</sub> = -17 A		-	61	-	S
Dynamic <sup>b</sup>							
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -25 V, f = 1 MHz	-	2872	3950	pF
Output Capacitance	C <sub>oss</sub>			-	508	635	
Reverse Transfer Capacitance	C <sub>rss</sub>			-	352	440	
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>GS</sub> = -10 V	V <sub>DS</sub> = -30 V, I <sub>D</sub> = -50 A	-	60	80	nC
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>			-	5.7	8.6	
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>			-	14.7	22	
Gate Resistance	R <sub>g</sub>	f = 1 MHz		1.5	3	4.5	Ω
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = -20 V, R <sub>L</sub> = 0.4 Ω I <sub>D</sub> ≅ -50 A, V <sub>GEN</sub> = -10 V, R <sub>g</sub> = 1 Ω		-	10	15	ns
Rise Time <sup>c</sup>	t <sub>r</sub>			-	12	18	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>			-	40	60	
Fall Time <sup>c</sup>	t <sub>f</sub>			-	16	24	
Source-Drain Diode Ratings and Characteristics <sup>b</sup>							
Pulsed Current <sup>a</sup>	I <sub>SM</sub>			-	-	-200	A
Forward Voltage	V <sub>SD</sub>	I <sub>F</sub> = -50 A, V <sub>GS</sub> = 0 V		-	-1	-1.5	V

**Notes**

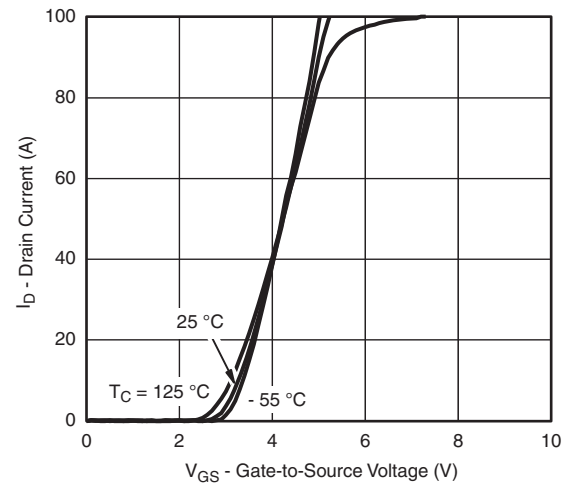
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.  
 c. Independent of operating temperature.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

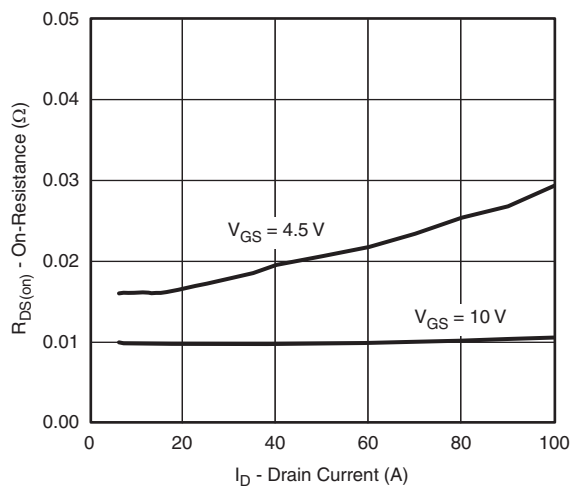
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



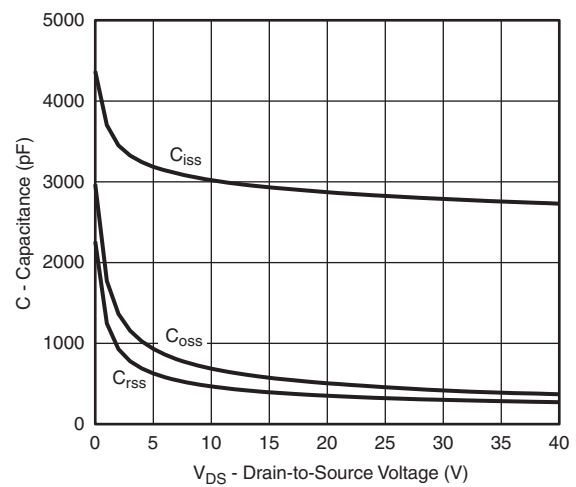
**Output Characteristics**



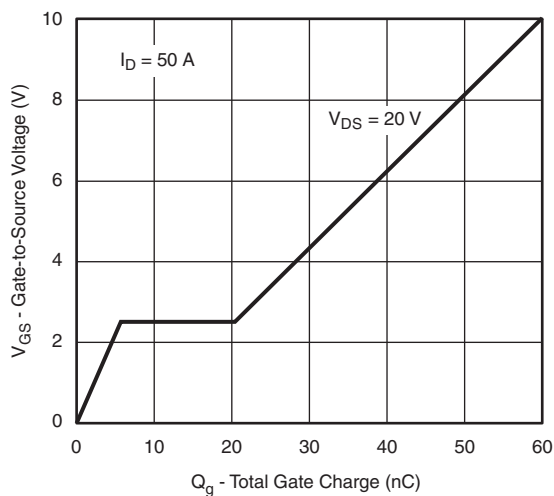
**Transfer Characteristics**



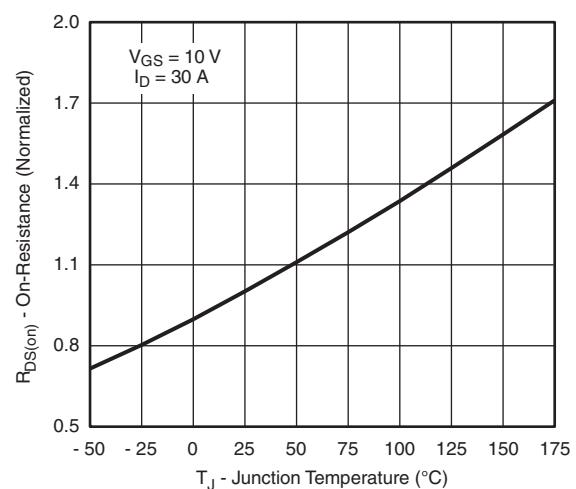
**On-Resistance vs. Drain Current**



**Capacitance**

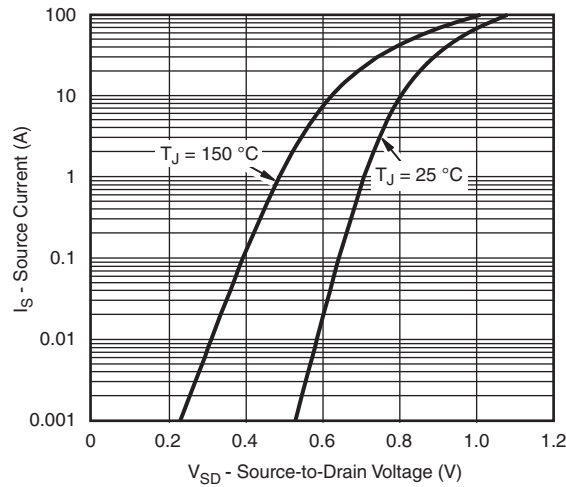


**Gate Charge**

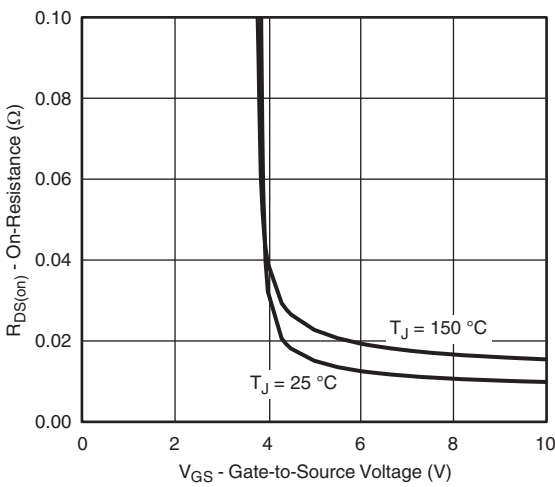


**On-Resistance vs. Junction Temperature**

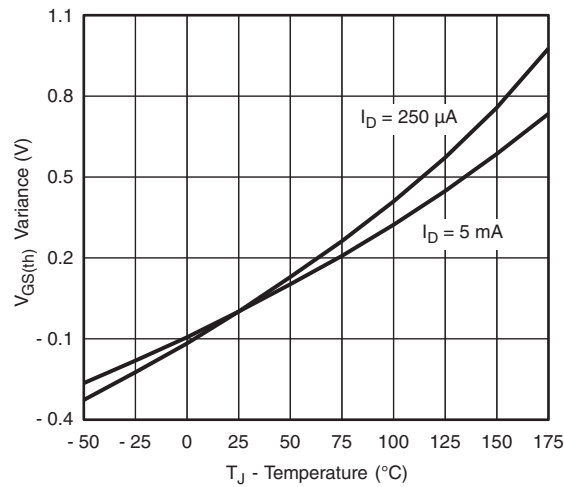
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



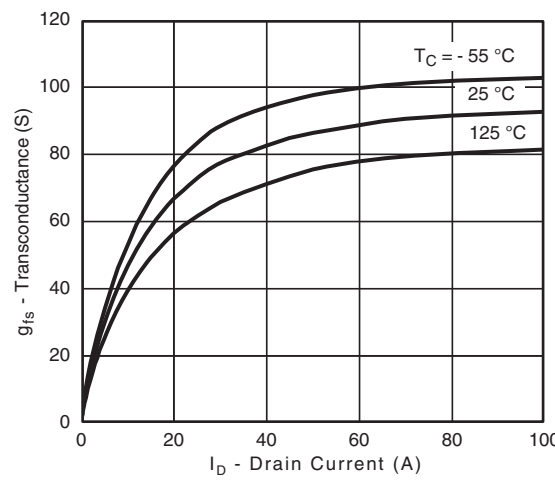
Source Drain Diode Forward Voltage



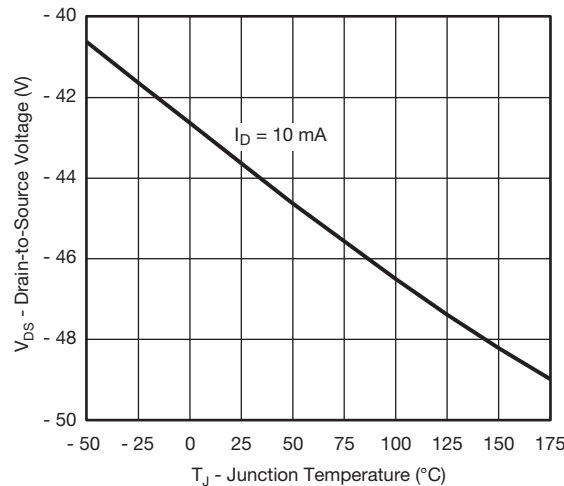
On-Resistance vs. Gate-to Source Voltage



Threshold Voltage

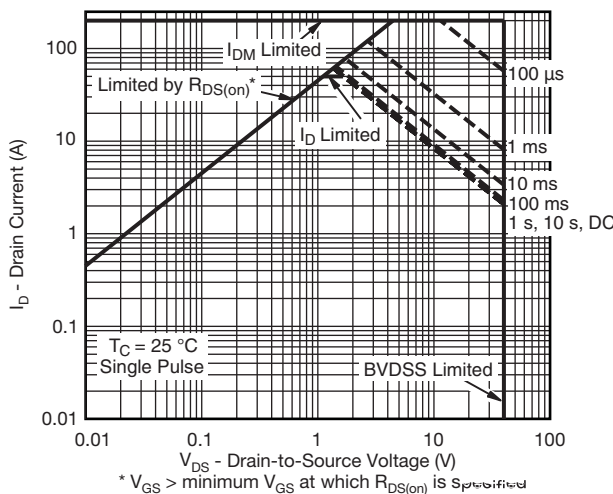


Transconductance

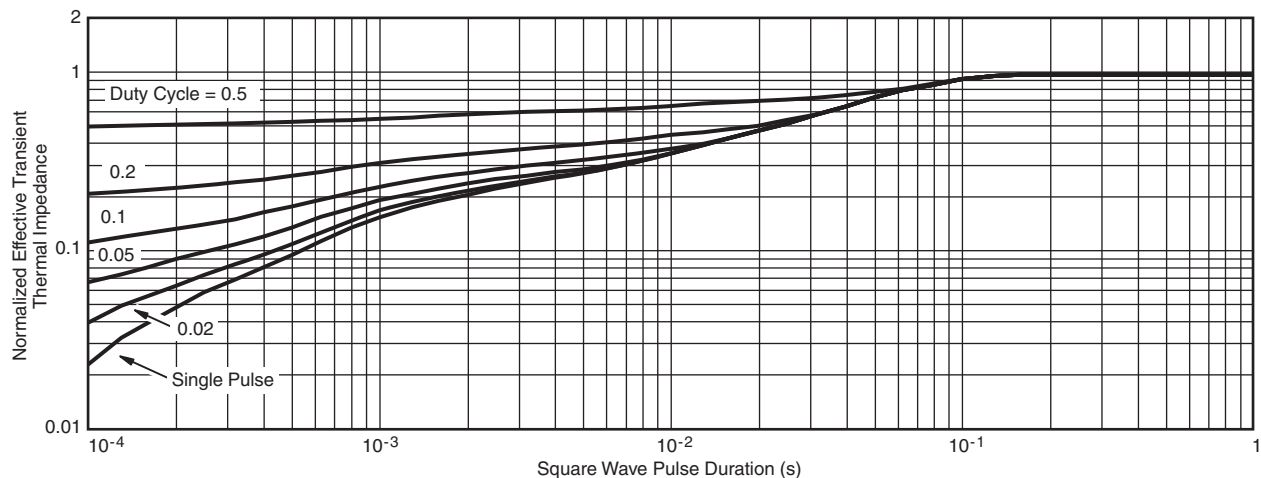


Drain Source Breakdown vs. Junction Temperature

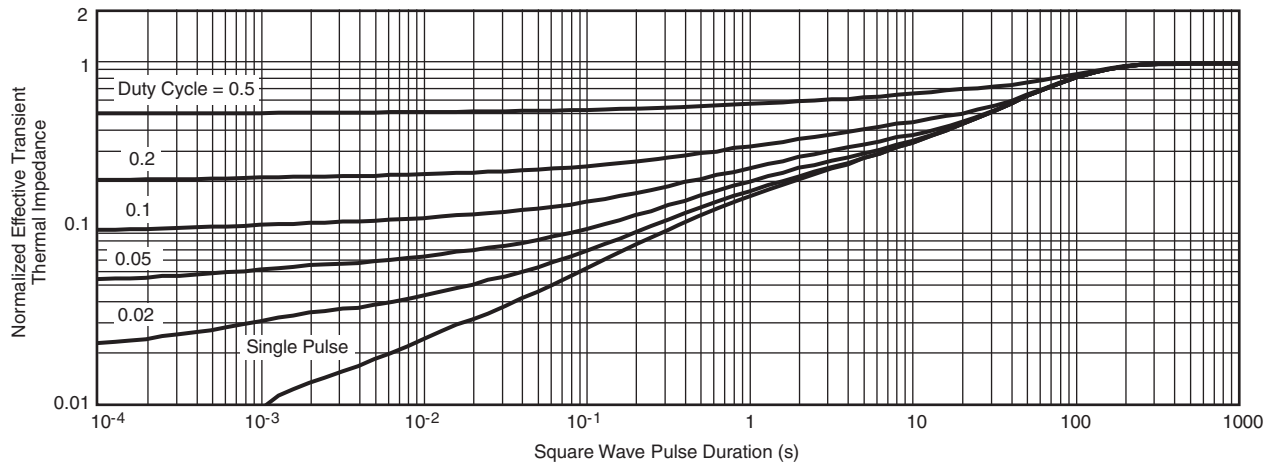
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



**Safe Operating Area**



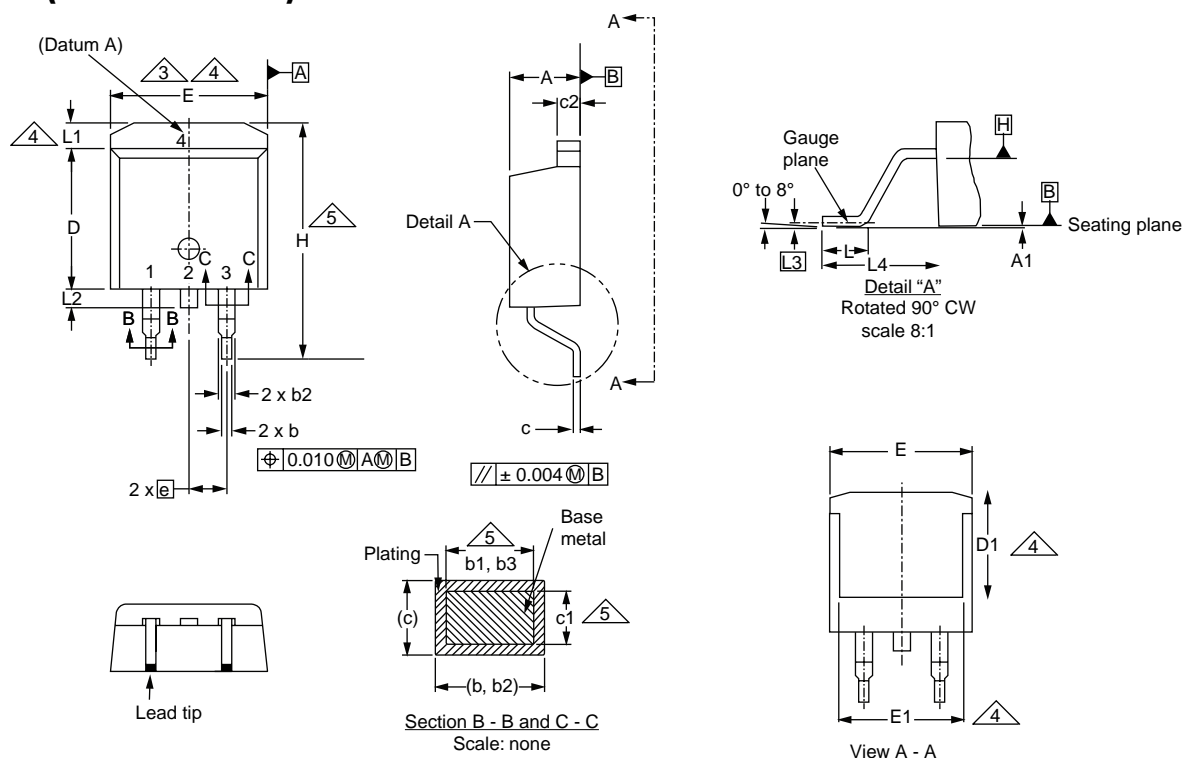
**Normalized Thermal Transient Impedance, Junction-to-Case**



**Normalized Thermal Transient Impedance, Junction-to-Ambient**

**Note**

- The characteristics shown in the two graphs
    - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
    - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)
- are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

**TO-263AB (HIGH VOLTAGE)**

	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
A	4.06	4.83	0.160	0.190
A1	0.00	0.25	0.000	0.010
b	0.51	0.99	0.020	0.039
b1	0.51	0.89	0.020	0.035
b2	1.14	1.78	0.045	0.070
b3	1.14	1.73	0.045	0.068
c	0.38	0.74	0.015	0.029
c1	0.38	0.58	0.015	0.023
c2	1.14	1.65	0.045	0.065
D	8.38	9.65	0.330	0.380

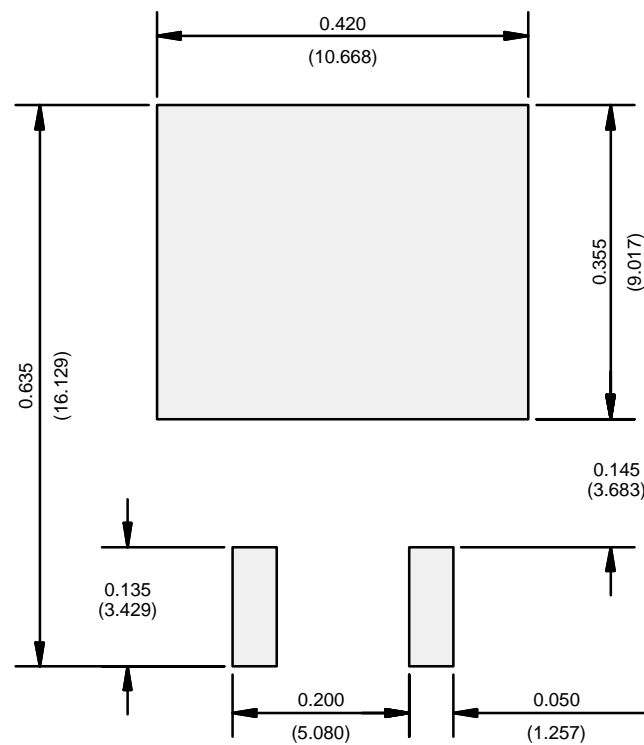
	MILLIMETERS		INCHES	
DIM.	MIN.	MAX.	MIN.	MAX.
D1	6.86	-	0.270	-
E	9.65	10.67	0.380	0.420
E1	6.22	-	0.245	-
e	2.54 BSC		0.100 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	-	1.65	-	0.066
L2	-	1.78	-	0.070
L3	0.25 BSC		0.010 BSC	
L4	4.78	5.28	0.188	0.208

ECN: S-82110-Rev. A, 15-Sep-08  
 DWG: 5970

**Notes**

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body at datum A.
4. Thermal PAD contour optional within dimension E, L1, D1 and E1.
5. Dimension b1 and c1 apply to base metal only.
6. Datum A and B to be determined at datum plane H.
7. Outline conforms to JEDEC outline to TO-263AB.

**RECOMMENDED MINIMUM PADS FOR D<sup>2</sup>PAK: 3-Lead**



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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