

## P-Channel 60 V (D-S) MOSFET

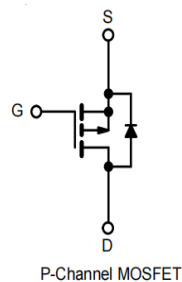
PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω) MAX.	I <sub>D</sub> (A)	Q <sub>g</sub> (TYP.)
-60	0.007 at V <sub>GS</sub> = -10 V	-120	60nC

### FEATURES

- VBmos® Trench Cell
- 100 % R<sub>g</sub> and UIS tested
- Maximum 150°C junction temperature



**RoHS**  
 COMPLIANT  
 HALOGEN  
 FREE



### APPLICATIONS

- Power supplies:
  - Uninterruptible power supplies
  - AC/DC switch-mode power supplies
  - Lighting
- Synchronous rectification
- DC/DC converter
- Motor drive switch
- DC/AC inverter
- Solar micro inverter
- Class D audio amplifier

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		V <sub>DS</sub>	-60	V
Gate-Source Voltage		V <sub>GS</sub>	± 20	
Continuous Drain Current (T <sub>J</sub> = 150 °C)	T <sub>C</sub> = 25 °C	I <sub>D</sub>	-80	A
	T <sub>C</sub> = 70 °C		-65	
Pulsed Drain Current (t = 100 μs)		I <sub>DM</sub>	-320	
Avalanche Current	L = 0.5 mH	I <sub>AS</sub>	-70	
Single Avalanche Energy <sup>a</sup>		E <sub>AS</sub>	-730	mJ
Maximum Power Dissipation <sup>a</sup>	T <sub>C</sub> = 25 °C	P <sub>D</sub>	300 <sup>b</sup>	W
	T <sub>C</sub> = 100 °C		150 <sup>b</sup>	
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C

THERMAL RESISTANCE RATINGS				
PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-Ambient (PCB Mount) <sup>c</sup>		R <sub>thJA</sub>	40	°C/W
Junction-to-Case (Drain)		R <sub>thJC</sub>	0.5	

#### Notes

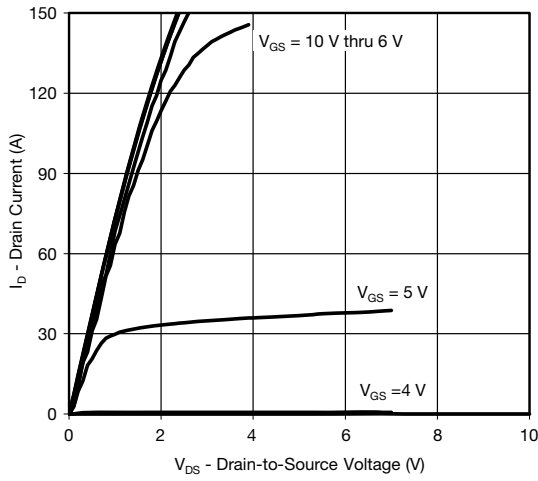
- Duty cycle ≤ 1 %.
- See SOA curve for voltage derating.
- When mounted on 1" square PCB (FR4 material).

<b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	-60	-	-	V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	-2.5	-	-4.5	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$	-	-	$\pm 250$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}$	-	-	-1	$\mu\text{A}$
		$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	-150	
		$V_{DS} = -60\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	-	-5	mA
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 10\text{ V}, V_{GS} = -10\text{ V}$	-90	-	-	A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = -30\text{ A}$	-	0.007	-	$\Omega$
		$V_{GS} = 7.5\text{ V}, I_D = -30\text{ A}$	-	0.009	-	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = -30\text{ A}$	-	75	-	S
<b>Dynamic <sup>b</sup></b>						
Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, V_{DS} = -48\text{ V}, f = 1\text{ MHz}$	-	8000	-	pF
Output Capacitance	$C_{OSS}$		-	246	-	
Reverse Transfer Capacitance	$C_{RSS}$		-	21	-	
Total Gate Charge <sup>c</sup>	$Q_g$	$V_{DS} = -48\text{ V}, V_{GS} = -10\text{ V}, I_D = -40\text{ A}$	-	60	96	nC
Gate-Source Charge <sup>c</sup>	$Q_{gs}$		-	16.7	-	
Gate-Drain Charge <sup>c</sup>	$Q_{gd}$		-	16.9	-	
Gate Resistance	$R_g$	$f = 1\text{ MHz}$	1.5	3	6	$\Omega$
Turn-On Delay Time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -48\text{ V}, R_L = 1.66\text{ }\Omega$ $I_D \cong 40\text{ A}, V_{GEN} = -10\text{ V}, R_g = 1\text{ }\Omega$	-	19	21	ns
Rise Time <sup>c</sup>	$t_r$		-	100	202	
Turn-Off Delay Time <sup>c</sup>	$t_{d(off)}$		-	33	75	
Fall Time <sup>c</sup>	$t_f$		-	82	148	
<b>Drain-Source Body Diode Ratings and Characteristics <sup>b</sup></b> ( $T_C = 25\text{ }^\circ\text{C}$ )						
Pulsed Current ( $t = 100\text{ }\mu\text{s}$ )	$I_{SM}$		-	-	-320	A
Forward Voltage <sup>a</sup>	$V_{SD}$	$I_F = -40\text{ A}, V_{GS} = 0\text{ V}$	-	-0.8	-1.2	V
Reverse Recovery Time	$t_{rr}$	$I_F = -40\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	-	25	-	ns
Peak Reverse Recovery Charge	$I_{RM(REC)}$		-	11	20	A
Reverse Recovery Charge	$Q_{rr}$		-	0.9	1.8	$\mu\text{C}$

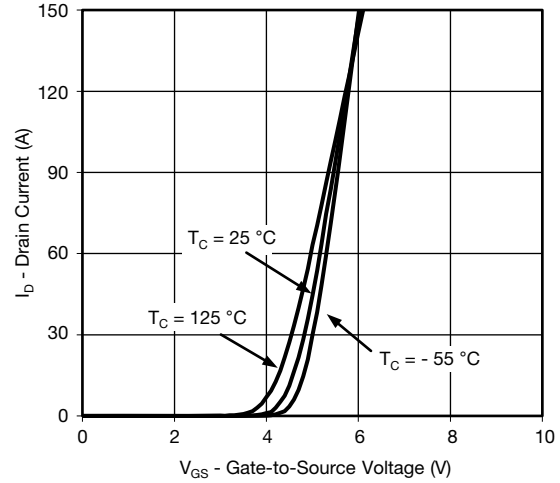
**Notes**

- 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.

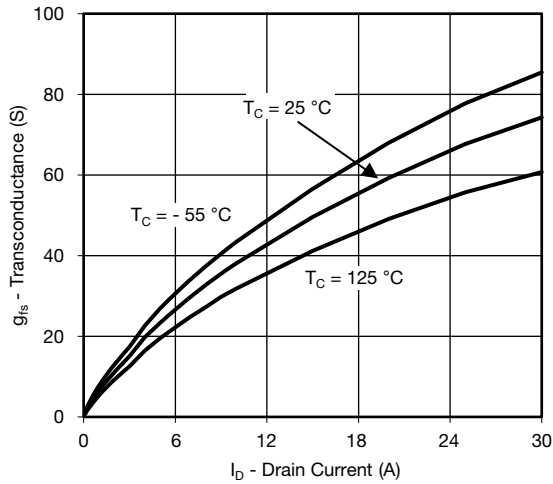
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



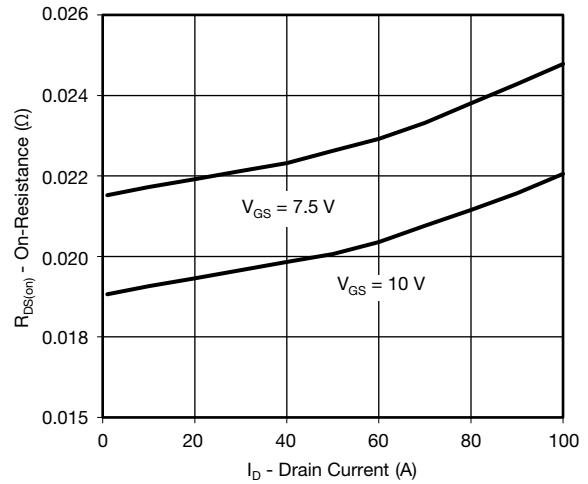
**Output Characteristics**



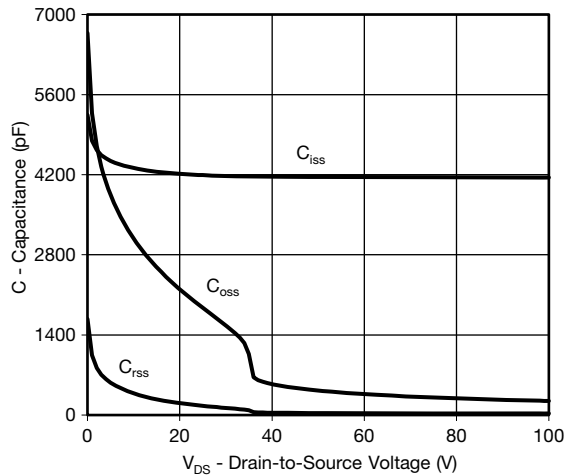
**Transfer Characteristics**



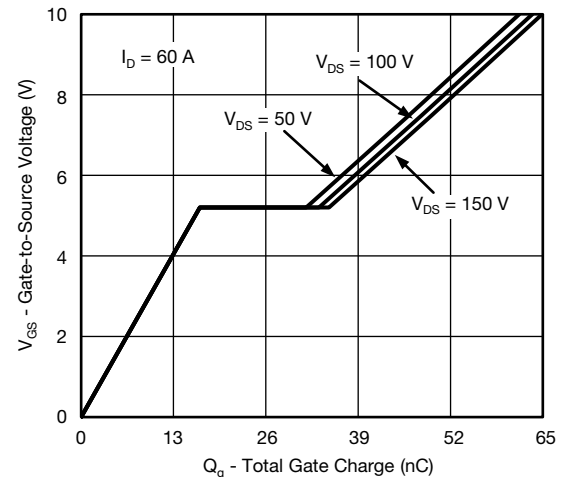
**Transconductance**



**On-Resistance vs. Drain Current**

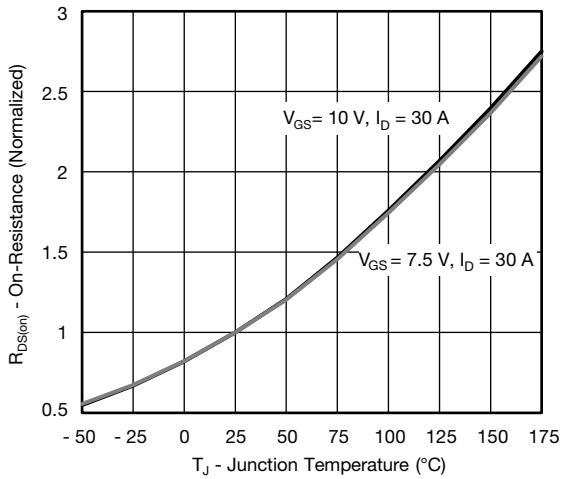


**Capacitance**

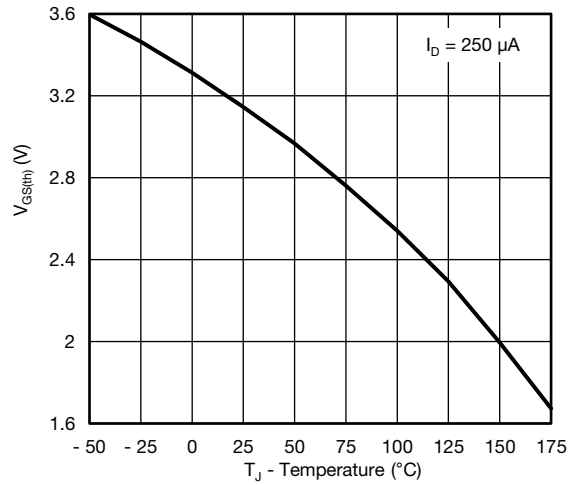


**Gate Charge**

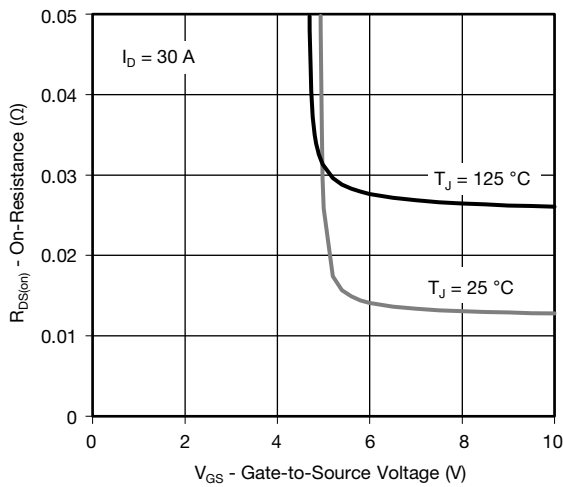
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



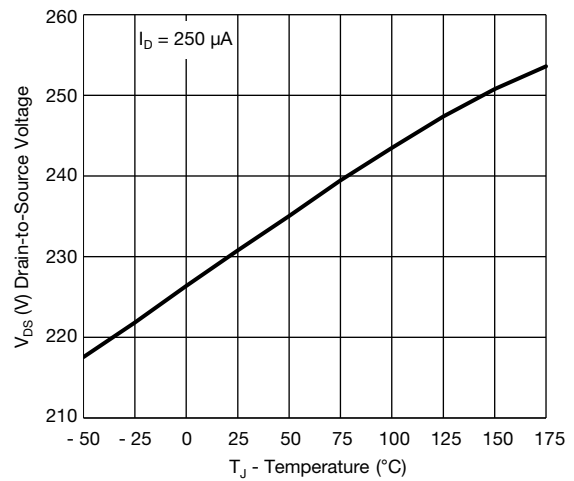
**On-Resistance vs. Junction Temperature**



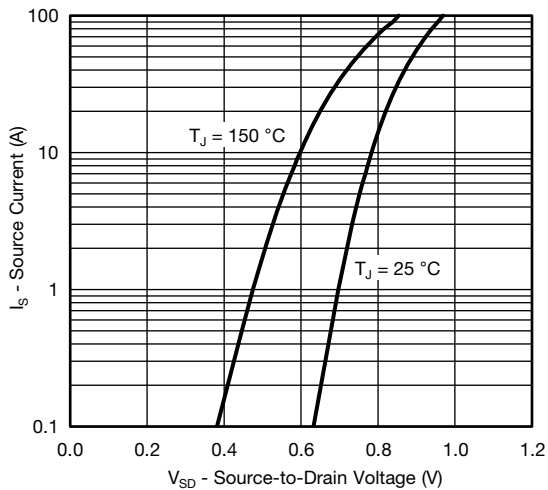
**Threshold Voltage**



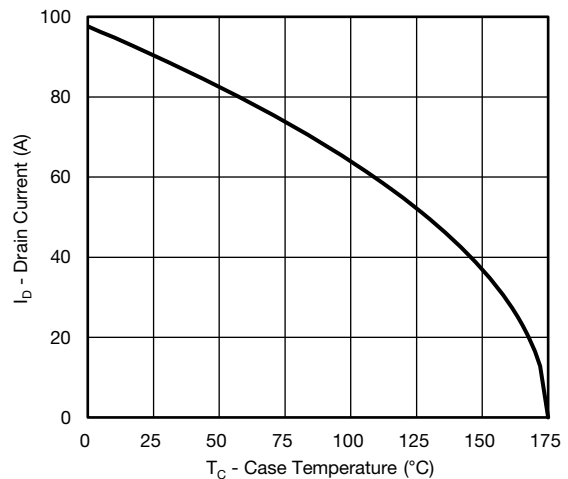
**On-Resistance vs. Gate-to-Source Voltage**



**Drain Source Breakdown vs. Junction Temperature**

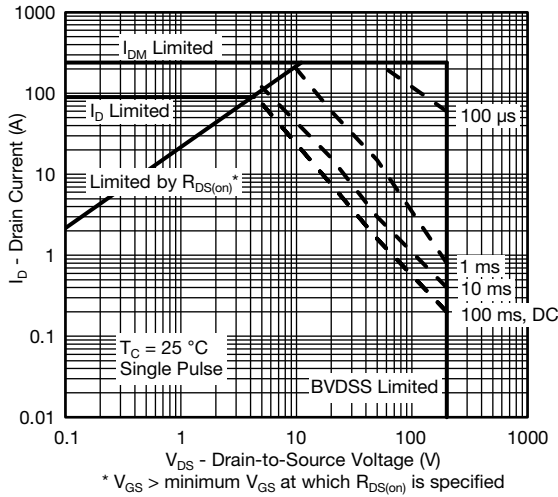


**Source Drain Diode Forward Voltage**

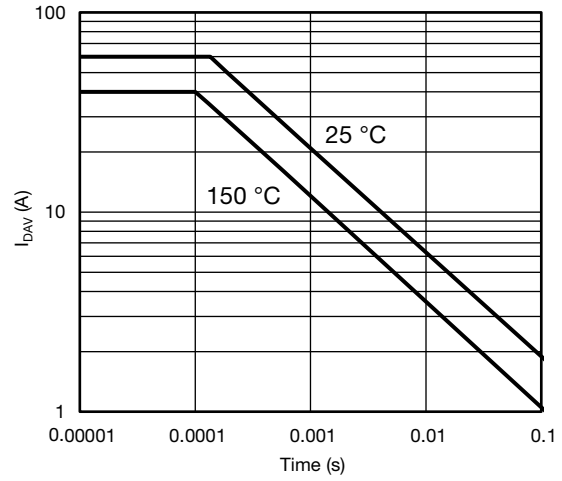


**Current De-rating**

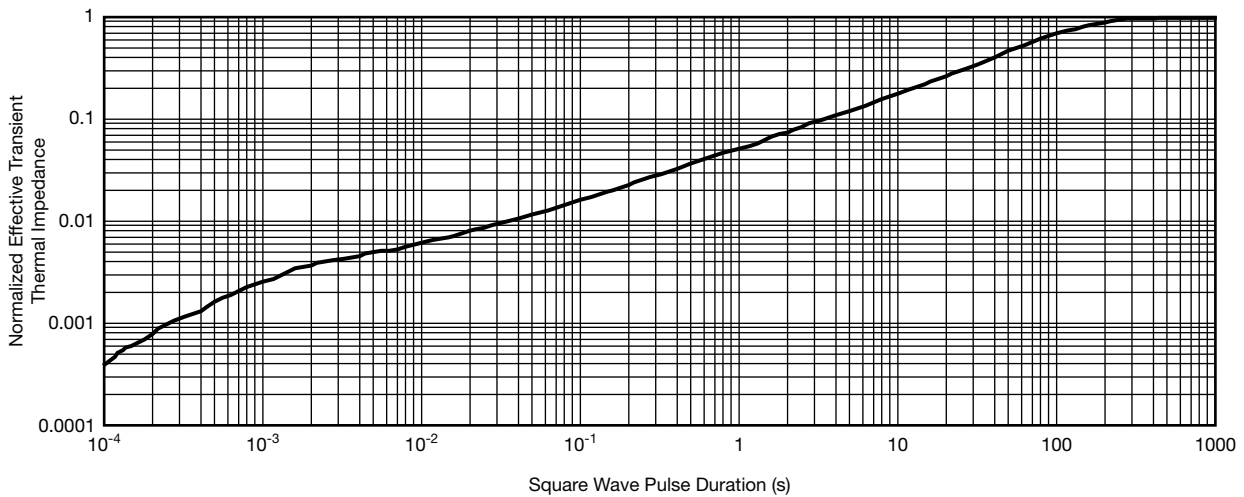
**THERMAL RATINGS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



**Safe Operating Area**

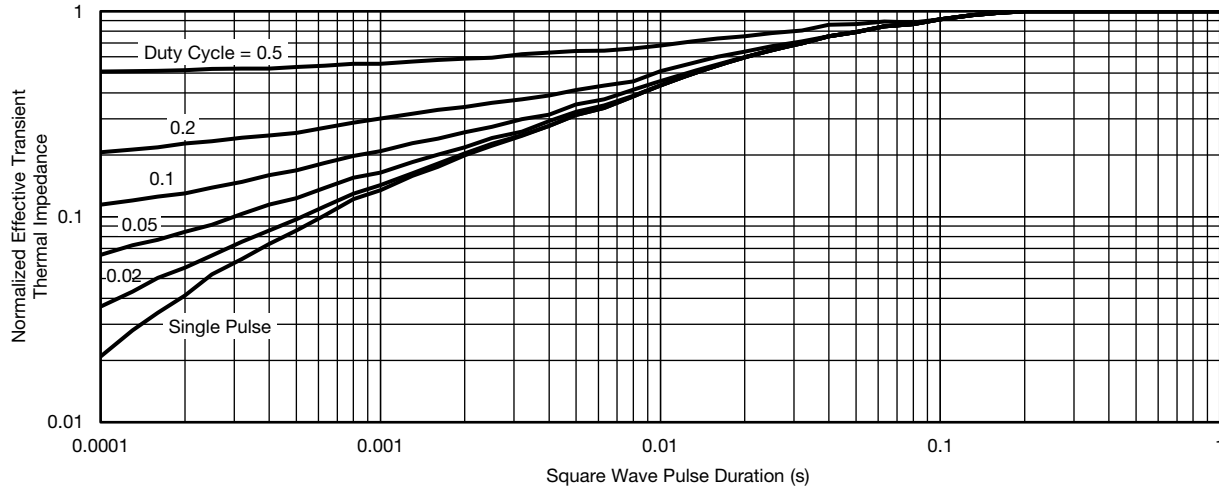


**Single Pulse Avalanche Current Capability vs. Time**



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

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

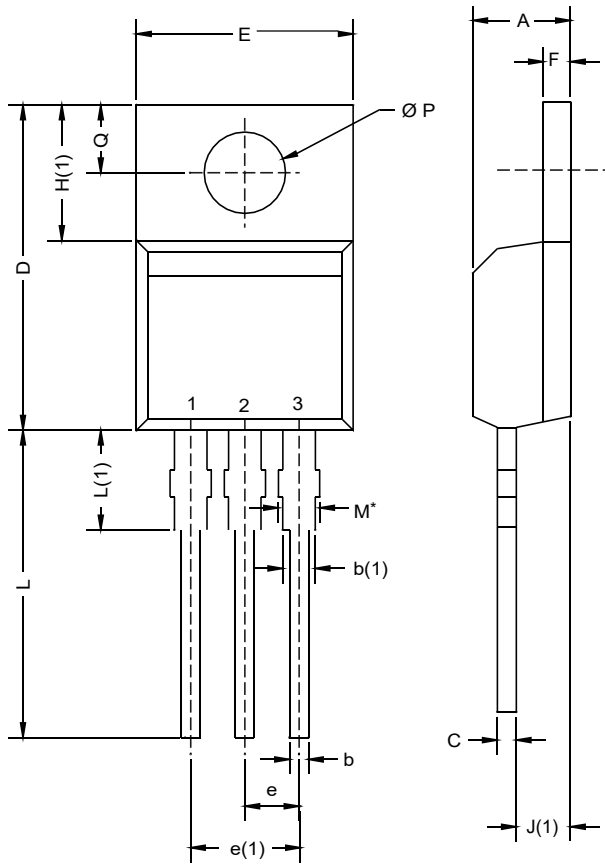


**Normalized Thermal Transient Impedance, Junction-to-Case**

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction to Ambient ( $25\text{ }^\circ\text{C}$ )
  - Normalized Transient Thermal Impedance Junction to Case ( $25\text{ }^\circ\text{C}$ )
 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-220AB



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.25	4.65	0.167	0.183
b	0.69	1.01	0.027	0.040
b(1)	1.20	1.73	0.047	0.068
c	0.36	0.61	0.014	0.024
D	14.85	15.49	0.585	0.610
E	10.04	10.51	0.395	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.09	6.48	0.240	0.255
J(1)	2.41	2.92	0.095	0.115
L	13.35	14.02	0.526	0.552
L(1)	3.32	3.82	0.131	0.150
$\varnothing P$	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118

**Notes**

\* M = 1.32 mm to 1.62 mm (dimension including protrusion)  
Heatsink hole for HVM

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