

## VS4604AT-VB Datasheet

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

PRODUCT SUMMARY		
$V_{DS}$	40	V
$R_{DS(on)}$ $V_{GS} = 10$ V	2	m $\Omega$
$I_D$	180	A
Configuration	Single	

#### FEATURES

- TrenchFET<sup>®</sup> Power MOSFET
- 100 %  $R_g$  and UIS Tested

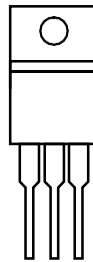


**RoHS**  
COMPLIANT

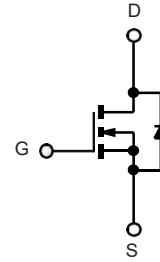
#### APPLICATIONS

- Synchronous Rectification
- Power Supplies

TO-220AB



G D S  
Top View



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °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 ( $T_J = 175$ °C)	$I_D$	$T_C = 25$ °C	180 <sup>a, c</sup>	
		$T_C = 70$ °C	150 <sup>c</sup>	
		$T_A = 25$ °C	29 <sup>b</sup>	
		$T_A = 70$ °C	23 <sup>b</sup>	
Pulsed Drain Current	$I_{DM}$	350	A	
Avalanche Current Pulse	$I_{AS}$	80		
Single Pulse Avalanche Energy	$E_{AS}$	320	mJ	
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25$ °C	110 <sup>a, c</sup>	
		$T_A = 25$ °C	2.6 <sup>b</sup>	
Maximum Power Dissipation	$P_D$	$T_C = 25$ °C	312 <sup>a</sup>	
		$T_C = 70$ °C	200	
		$T_A = 25$ °C	3.13 <sup>b</sup>	
		$T_A = 70$ °C	2.0 <sup>b</sup>	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C	

THERMAL RESISTANCE RATINGS					
Parameter	Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>b</sup>	$R_{thJA}$	32	40	°C/W	
Maximum Junction-to-Case					

Notes:

- Based on  $T_C = 25$  °C.
- Surface Mounted on 1" x 1" FR4 board.
- Calculated based on maximum junction temperature. Package limitation current is 110 A.

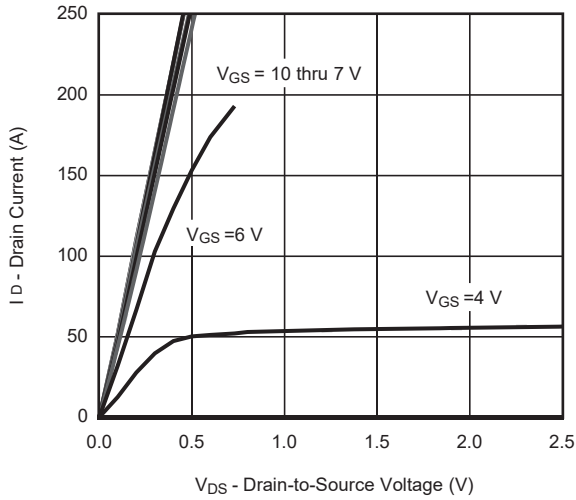
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	40			V	
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$		41		mV/ $^\circ\text{C}$	
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			- 8			
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	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$	
		$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$			10		
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 10\text{ V}$	120			A	
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 30\text{ A}$		2		m $\Omega$	
		$V_{GS} = 4.5\text{ V}, I_D = 20\text{ A}$		15			
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		180		S	
<b>Dynamic<sup>b</sup></b>							
Input Capacitance	$C_{iss}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		9000		pF	
Output Capacitance	$C_{oss}$			650			
Reverse Transfer Capacitance	$C_{rss}$			450			
Total Gate Charge	$Q_g$	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_D = 20\text{ A}$		120		nC	
Gate-Source Charge	$Q_{gs}$			30			
Gate-Drain Charge	$Q_{gd}$			16			
Gate Resistance	$R_g$	$f = 1\text{ MHz}$		0.85	1.3	$\Omega$	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 20\text{ V}, R_L = 1.0\text{ }\Omega$ $I_D \cong 20\text{ A}, V_{GEN} = 10\text{ V}, R_g = 1\text{ }\Omega$		20	30	ns	
Rise Time	$t_r$			11	17		
Turn-Off Delay Time	$t_{d(off)}$			77	115		
Fall Time	$t_f$			10	15		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 20\text{ V}, R_L = 1.0\text{ }\Omega$ $I_D \cong 20\text{ A}, V_{GEN} = 4.5\text{ V}, R_g = 1\text{ }\Omega$		102	155		
Rise Time	$t_r$			62	95		
Turn-Off Delay Time	$t_{d(off)}$			180	270		
Fall Time	$t_f$			60	90		
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25\text{ }^\circ\text{C}$			110	A	
Pulse Diode Forward Current <sup>a</sup>	$I_{SM}$				200		
Body Diode Voltage	$V_{SD}$	$I_S = 20\text{ A}$		0.8	1.2	V	
Body Diode Reverse Recovery Time	$t_{rr}$	$I_F = 20\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, T_J = 25\text{ }^\circ\text{C}$		50	75	ns	
Body Diode Reverse Recovery Charge	$Q_{rr}$				70	105	nC
Reverse Recovery Fall Time	$t_a$				30		ns
Reverse Recovery Rise Time	$t_b$				20		

Notes:

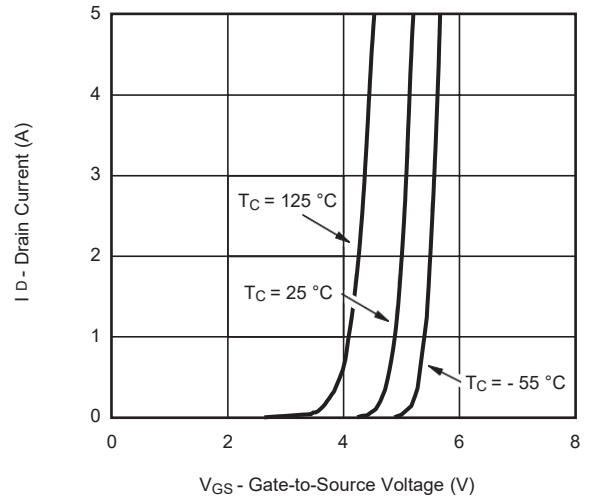
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- b. Guaranteed by design, not subject to production testing.

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.

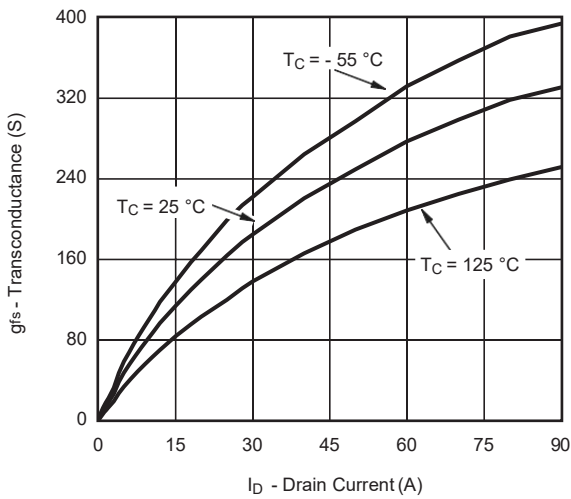
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



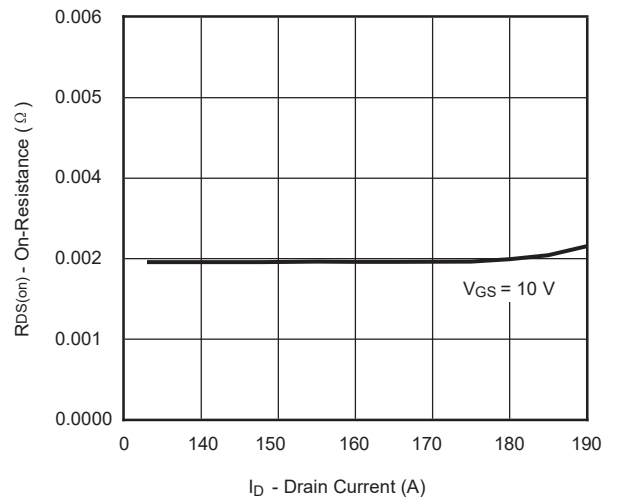
Output Characteristics



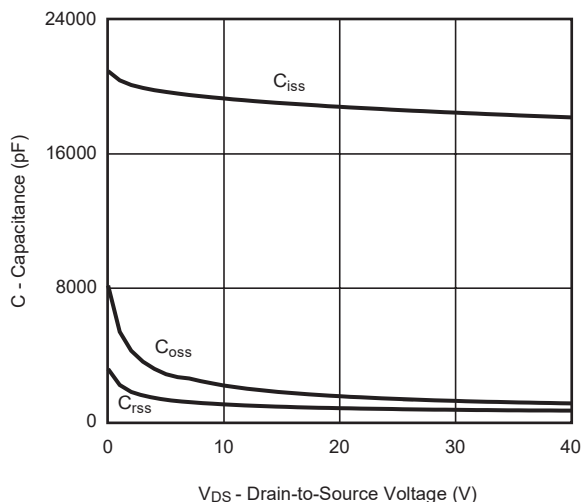
Transfer Characteristics



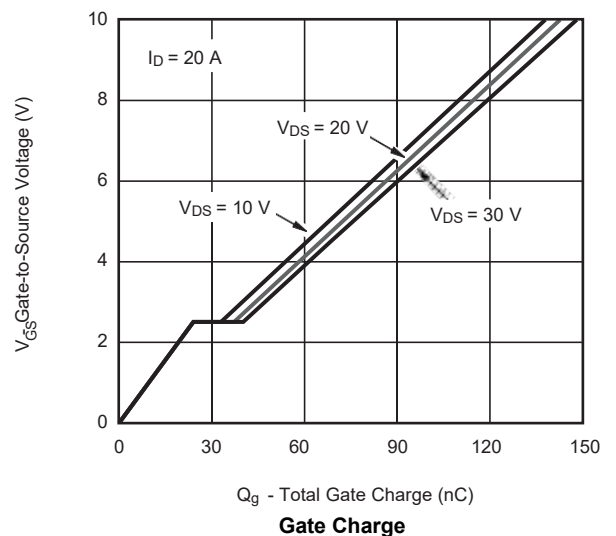
Transconductance



On-Resistance vs. Drain Current

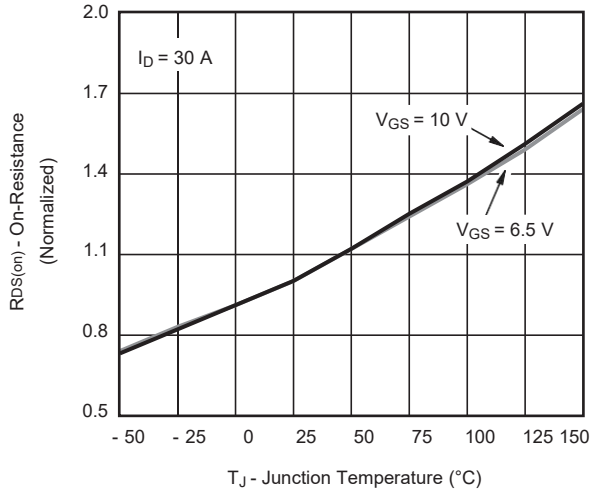


Capacitance

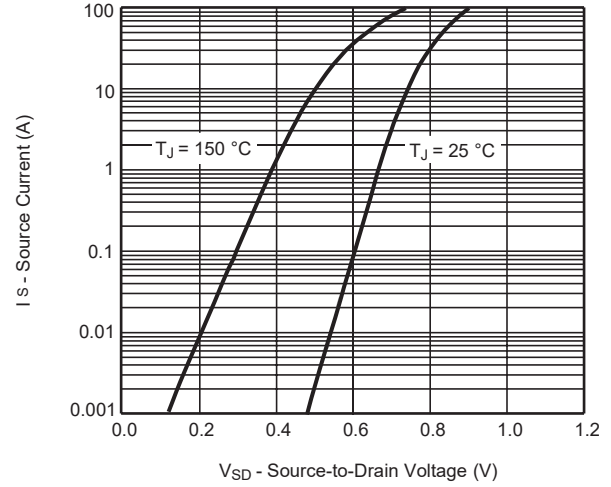


Gate Charge

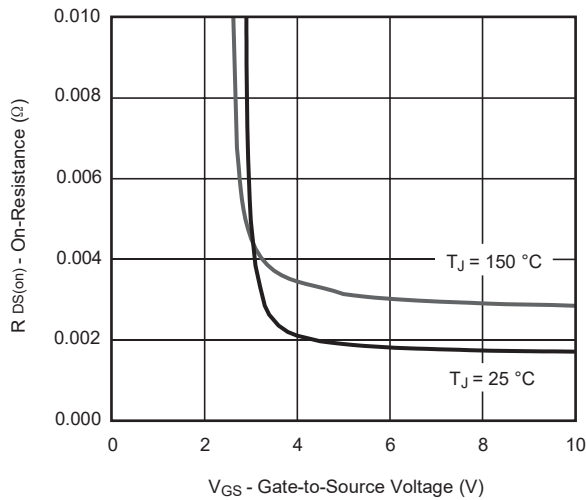
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



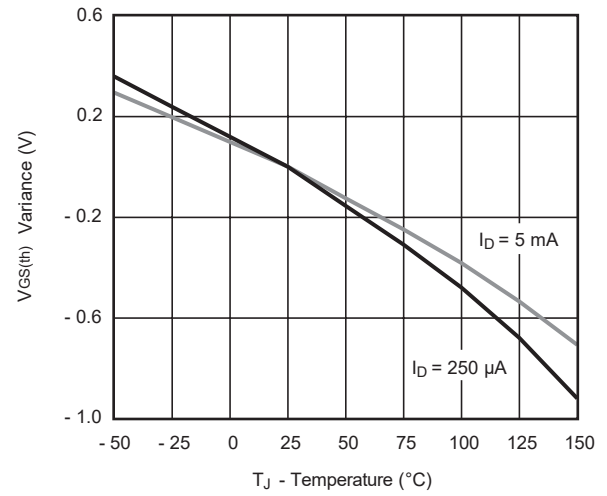
On-Resistance vs. Junction Temperature



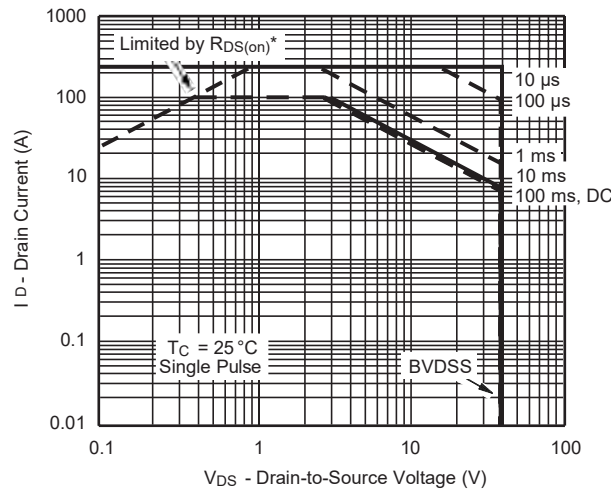
Forward Diode Voltage vs. Temperature



On-Resistance vs. Gate-to-Source Voltage



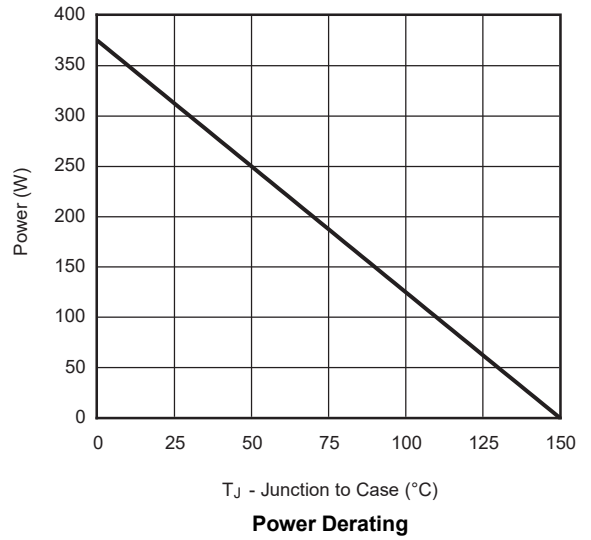
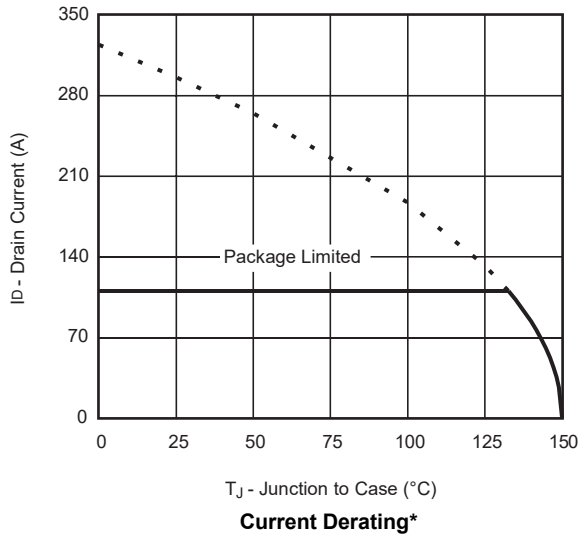
Threshold Voltage



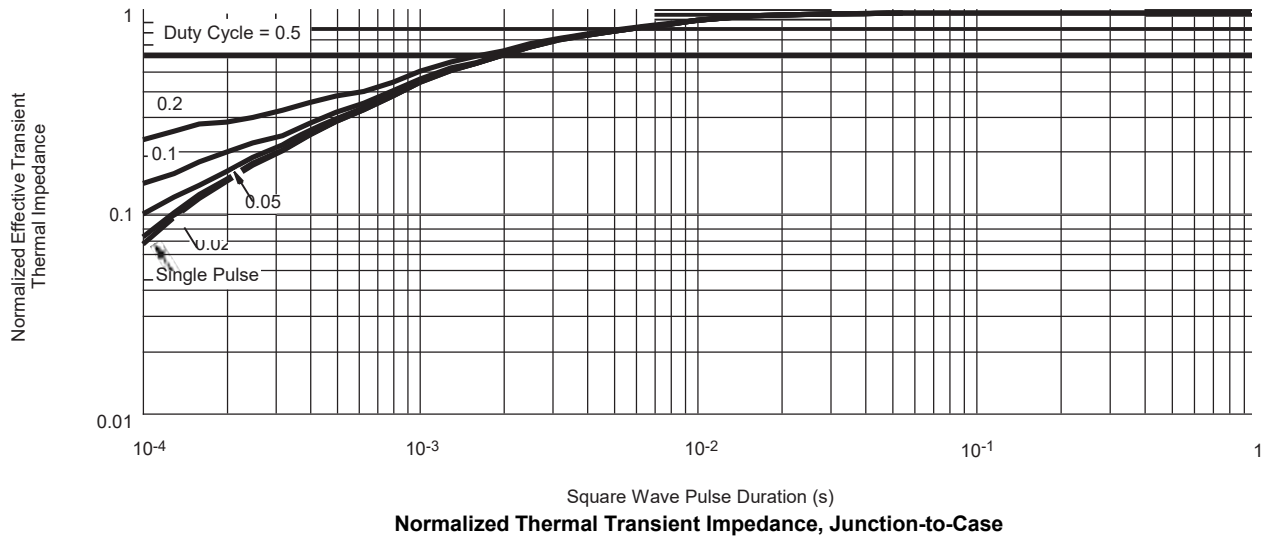
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area, Junction-to-Ambient

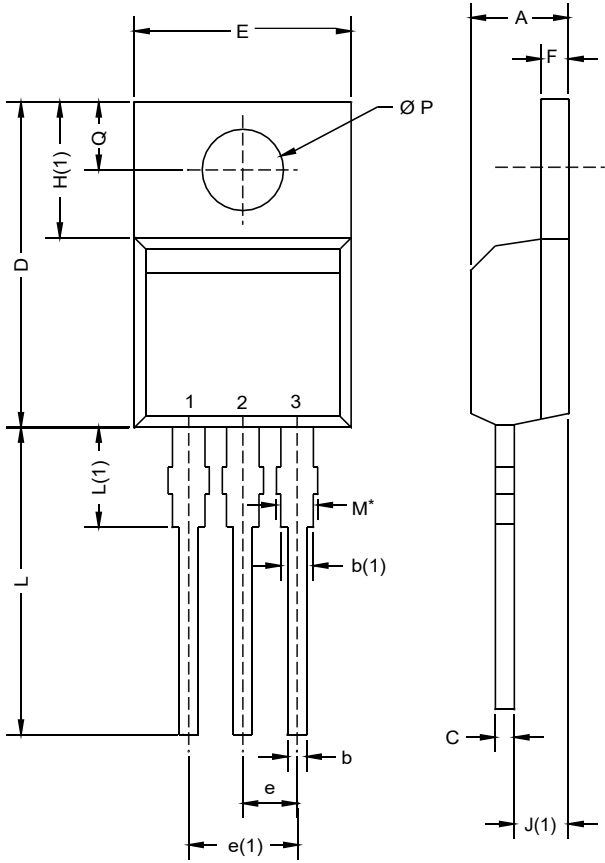
**TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted**



\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 150\text{ °C}$ , using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.



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
Ø P	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118

ECN: X12-0208-Rev. N, 08-Oct-12  
DWG: 5471

Notes

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

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