

## HM2302D-VB Datasheet

# N-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY						
V <sub>DS</sub> (V)	$R_{DS(on)}\left(\Omega\right)$	$R_{DS(on)}(\Omega)$ $I_{D}(A)^{e}$				
	0.028 at V <sub>GS</sub> = 4.5 V	6 <sup>a</sup>				
20	0.042 at V <sub>GS</sub> = 2.5 V	6 <sup>a</sup>	8.8 nC			
	0.050 at V <sub>GS</sub> = 1.8 V	5.6				

# FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- 100 % R<sub>g</sub> Tested
- Compliant to RoHS Directive 2002/95/EC



ROHS COMPLIANT HALOGEN FREE

#### **APPLICATIONS**

- DC/DC Converters
- Load Switch for Portable Applications

	SOT-23		
G 1 S 2		3	D
	Top View		

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted					
Parameter		Symbol	Limit	Unit	
Drain-Source Voltage		$V_{DS}$	20	V	
Gate-Source Voltage		$V_{GS}$	± 12	v	
	T <sub>C</sub> = 25 °C		6 <sup>a</sup>		
Continuous Drain Current (T - 150 °C)	T <sub>C</sub> = 70 °C	I <sub>D</sub>	5.1		
Continuous Drain Current (T <sub>J</sub> = 150 °C)	T <sub>A</sub> = 25 °C		5 <sup>b, c</sup>		
	T <sub>A</sub> = 70 °C		4 <sup>b, c</sup>	Α	
Pulsed Drain Current	•	I <sub>DM</sub>	20		
Continuous Source-Drain Diode Current	T <sub>C</sub> = 25 °C	1	1.75		
Continuous Source-Drain Diode Current	T <sub>A</sub> = 25 °C	l <sub>S</sub>	1.04 <sup>b, c</sup>		
	T <sub>C</sub> = 25 °C		2.1		
Maximum Power Dissipation	T <sub>C</sub> = 70 °C	P <sub>D</sub>	1.3	w	
Maximum Fower Dissipation	T <sub>A</sub> = 25 °C		1.25 <sup>b, c</sup>	VV	
	T <sub>A</sub> = 70 °C	]	0.8 <sup>b, c</sup>		
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150	°C	
Soldering Recommendations (Peak Tempera	ature)		260		

THERMAL RESISTANCE RATINGS						
Parameter		Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>b, d</sup>	t ≤ 5 s	R <sub>thJA</sub>	80	100	°C/W	
Maximum Junction-to-Foot (Drain)	Steady State	R <sub>thJF</sub>	40	60	O/ VV	

#### Notes:

- a. Package limited
- b. Surface Mounted on 1" x 1" FR4 board.
- c. t = 5 s.
- d. Maximum under steady state conditions is 125  $^{\circ}\text{C/W}.$
- e. Based on  $T_C = 25$  °C.



<b>SPECIFICATIONS</b> T <sub>J</sub> = 25 °C, unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Unit	
Static							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0 \text{ V, } I_D = 250 \mu\text{A}$	20			V	
V <sub>DS</sub> Temperature Coefficient	$\Delta V_{DS}/T_{J}$	I <sub>D</sub> = 250 μA		25		mV/°C	
V <sub>GS(th)</sub> Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			- 2.6			
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	$V_{DS} = V_{GS}$ , $I_{D} = 250 \mu A$	0.45		1.0	V	
Gate-Source Leakage	I <sub>GSS</sub>	$V_{DS} = 0 V, V_{GS} = \pm 8 V$			± 100	nA	
	lace	$V_{DS} = 20 \text{ V}, V_{GS} = 0 \text{ V}$			1	μΑ	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	$V_{DS} = 20 \text{ V}, V_{GS} = 0 \text{ V}, T_{J} = 70 ^{\circ}\text{C}$			10		
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	$V_{DS} \le 5 \text{ V}, V_{GS} = 4.5 \text{ V}$	20			Α	
		$V_{GS} = 4.5 \text{ V}, I_D = 5.0 \text{ A}$		0.028		Ω	
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	$V_{GS} = 2.5 \text{ V}, I_D = 4.7 \text{ A}$		0.042			
		$V_{GS} = 1.8 \text{ V}, I_D = 4.3 \text{ A}$		0.050			
Forward Transconductance <sup>a</sup>	9 <sub>fs</sub>	$V_{DS} = 10 \text{ V}, I_D = 5.0 \text{ A}$		24		S	
Dynamic <sup>b</sup>							
Input Capacitance	C <sub>iss</sub>			865			
Output Capacitance	C <sub>oss</sub>	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		105		pF	
Reverse Transfer Capacitance	C <sub>rss</sub>			55			
<u> </u>		$V_{DS} = 10 \text{ V}, V_{GS} = 5 \text{ V}, I_{D} = 5.0 \text{ A}$		12	18	1	
Total Gate Charge	$Q_g$	20 7 60 7 5		8.8	14	nC	
Gate-Source Charge	Q <sub>gs</sub>	$V_{DS} = 10 \text{ V}, V_{GS} = 4.5 \text{ V}, I_{D} = 5.0 \text{ A}$		1.1			
Gate-Drain Charge	Q <sub>gd</sub>	50 4 40 4 5		0.7			
Gate Resistance	$R_{g}$	f = 1 MHz	0.5	2.4	4.8	Ω	
Turn-On Delay Time	t <sub>d(on)</sub>			8	16		
Rise Time	t <sub>r</sub>	$V_{DD}$ = 10 V, $R_L$ = 2.2 $\Omega$		17	26	1	
Turn-Off Delay Time	t <sub>d(off)</sub>	$I_D \cong 4 \text{ A}, V_{GEN} = 4.5 \text{ V}, R_g = 1 \Omega$		31	47		
Fall Time	t <sub>f</sub>			8	16	1	
Turn-On Delay Time	t <sub>d(on)</sub>			5	10	ns	
Rise Time	t <sub>r</sub>	$V_{DD}$ = 10 V, $R_L$ = 2.2 $\Omega$		13	20	1	
Turn-Off Delay Time	t <sub>d(off)</sub>	$I_D\cong 4$ A, $V_{GEN}=5$ V, $R_g=1$ $\Omega$		21	32		
Fall Time	t <sub>f</sub>			6	12		
<b>Drain-Source Body Diode Characteristic</b>	cs		<u> </u>	I.			
Continuous Source-Drain Diode Current	Is	T <sub>C</sub> = 25 °C			1.75		
Pulse Diode Forward Current	I <sub>SM</sub>				20	A	
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = 4 A, V <sub>GS</sub> = 0 V		0.75	1.2	V	
Body Diode Reverse Recovery Time	t <sub>rr</sub>			12	20	ns	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			5	10	nC	
Reverse Recovery Fall Time	t <sub>a</sub>	$I_F = 4$ A, $dI/dt = 100$ A/ $\mu$ s, $T_J = 25$ °C		7			
Reverse Recovery Rise Time	t <sub>b</sub>	<del>- </del>		5		ns	

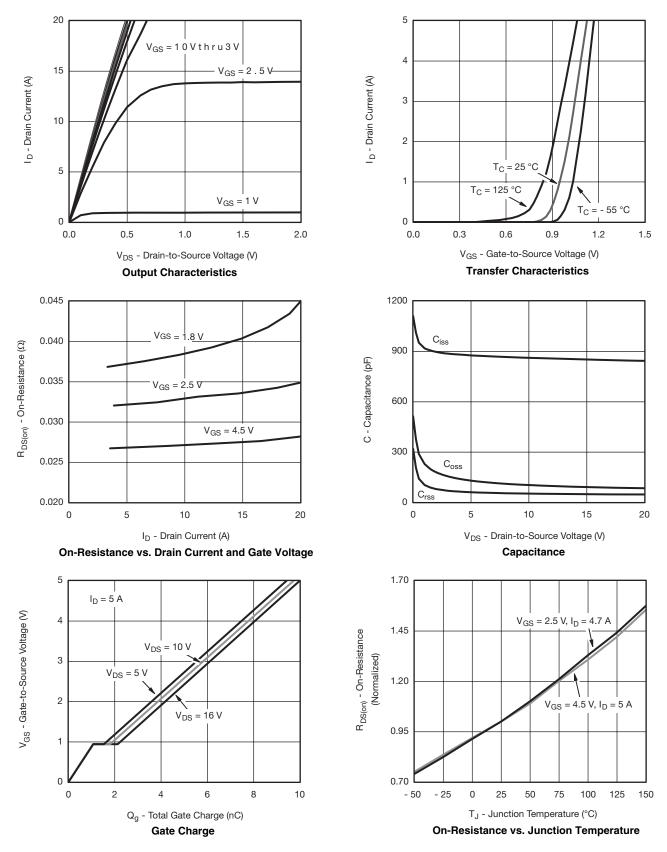
### Notes:

- a. Pulse test; pulse width  $\leq$  300  $\mu s,$  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.

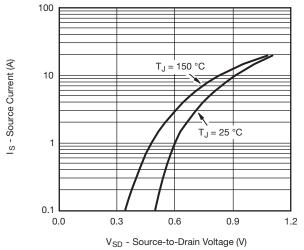


## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

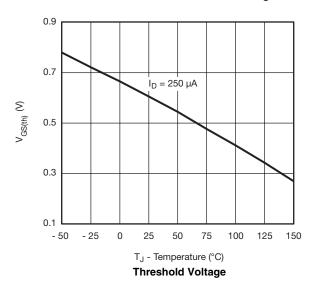


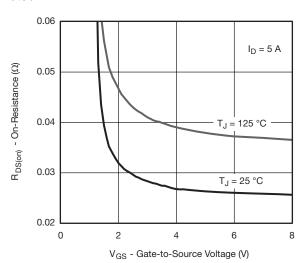


## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

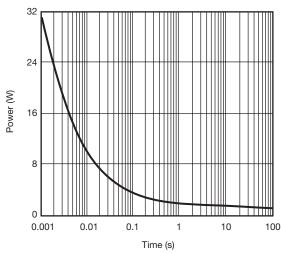


#### Source-Drain Diode Forward Voltage

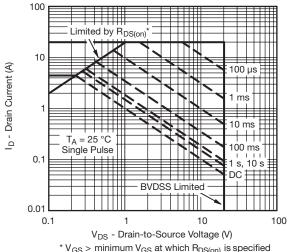




On-Resistance vs. Gate-to-Source Voltage



Single Pulse Power (Junction-to-Ambient)

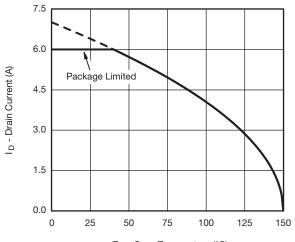


 $^{\star}$   $V_{GS}$  > minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area, Junction-to-Ambient

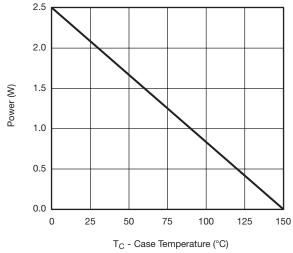


## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

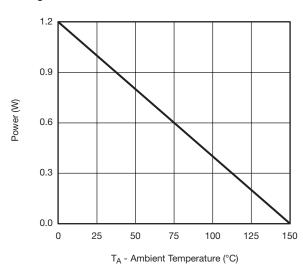


T<sub>C</sub> - Case Temperature (°C)

#### **Current Derating\***







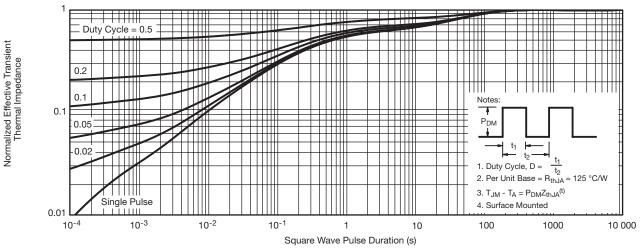
Power Derating, Junction-to-Ambient

<sup>\*</sup> The power dissipation  $P_D$  is based on  $T_{J(max.)}$  = 150 °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.

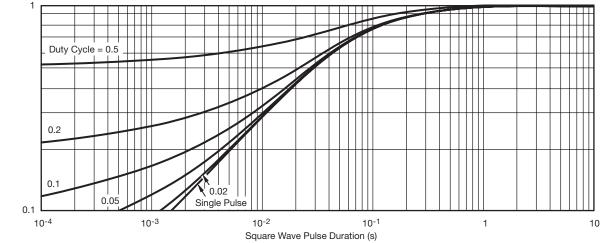
Normalized Effective Transient Thermal Impedance



## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



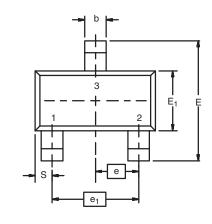
Normalized Thermal Transient Impedance, Junction-to-Ambient

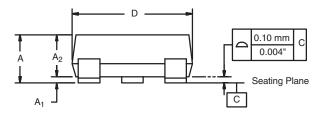


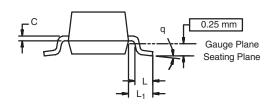
Normalized Thermal Transient Impedance, Junction-to-Foot



## SOT-23 (TO-236): 3-LEAD







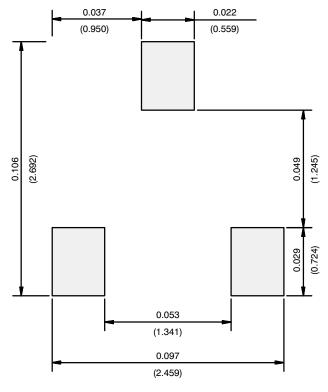
Dim	MILLI	METERS	INCHES		
	Min	Max	Min	Max	
Α	0.89	1.12	0.035	0.044	
A <sub>1</sub>	0.01	0.10	0.0004	0.004	
A <sub>2</sub>	0.88	1.02	0.0346	0.040	
b	0.35	0.50	0.014	0.020	
С	0.085	0.18	0.003	0.007	
D	2.80	3.04	0.110	0.120	
E	2.10	2.64	0.083	0.104	
E <sub>1</sub>	1.20	1.40	0.047	0.055	
е	0.95 BSC		0.0374 Ref		
e <sub>1</sub>	1.90 BSC 0.0748 Re		8 Ref		
L	0.40	0.60	0.016	0.024	
L <sub>1</sub>	0.64 Ref		0.025 Ref		
S	0.50 Ref		0.020 Ref		
q	3°	8°	3°	8°	
FCN: S-03946-Rev K 09-	Jul-01	•			

ECN: S-03946-Rev. K, 09-Jul-01

DWG: 5479



## **RECOMMENDED MINIMUM PADS FOR SOT-23**



Recommended Minimum Pads Dimensions in Inches/(mm)



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