

TSM2320CX-VB Datasheet

N-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^e	Q_g (Typ.)
20	0.022 at $V_{GS} = 4.5$ V	6 ^a	8.8 nC
	0.028 at $V_{GS} = 2.5$ V	6 ^a	
	0.039 at $V_{GS} = 1.8$ V	5.6	

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- Trench Power MOSFET
- 100 % R_g Tested
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- DC/DC Converters
- Load Switch for Portable Applications



ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	± 12	
Continuous Drain Current ($T_J = 150$ °C)	$T_C = 25$ °C	6 ^a	A
	$T_C = 70$ °C	5.1	
	$T_A = 25$ °C	5 ^{b, c}	
	$T_A = 70$ °C	4 ^{b, c}	
Pulsed Drain Current	I_{DM}	20	
Continuous Source-Drain Diode Current	$T_C = 25$ °C	1.75	
	$T_A = 25$ °C	1.04 ^{b, c}	
Maximum Power Dissipation	$T_C = 25$ °C	2.1	W
	$T_C = 70$ °C	1.3	
	$T_A = 25$ °C	1.25 ^{b, c}	
	$T_A = 70$ °C	0.8 ^{b, c}	
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	°C
Soldering Recommendations (Peak Temperature)		260	

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{b, d}	R_{thJA}	80	100	°C/W
Maximum Junction-to-Foot (Drain)	R_{thJF}	40	60	

Notes:

- Package limited
- Surface Mounted on 1" x 1" FR4 board.
- $t = 5$ s.
- Maximum under steady state conditions is 125 °C/W.
- Based on $T_C = 25$ °C.

SPECIFICATIONS T _J = 25 °C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	20			V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	I _D = 250 μA		25		mV/°C
V _{GS(th)} Temperature Coefficient	ΔV _{GS(th)} /T _J			- 2.6		
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	0.45		1.0	V
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 8 V			± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 20 V, V _{GS} = 0 V			1	μA
		V _{DS} = 20 V, V _{GS} = 0 V, T _J = 70 °C			10	
On-State Drain Current ^a	I _{D(on)}	V _{DS} ≤ 5 V, V _{GS} = 4.5 V	20			A
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = 4.5 V, I _D = 5.0 A		0.022		Ω
		V _{GS} = 2.5 V, I _D = 4.7 A		0.028		
		V _{GS} = 1.8 V, I _D = 4.3 A		0.039		
Forward Transconductance ^a	g _{fs}	V _{DS} = 10 V, I _D = 5.0 A		24		S
Dynamic ^b						
Input Capacitance	C _{iss}	V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz		865		pF
Output Capacitance	C _{oss}			105		
Reverse Transfer Capacitance	C _{rss}			55		
Total Gate Charge	Q _g	V _{DS} = 10 V, V _{GS} = 5 V, I _D = 5.0 A		12	18	nC
		V _{DS} = 10 V, V _{GS} = 4.5 V, I _D = 5.0 A		8.8	14	
Gate-Source Charge	Q _{gs}			1.1		
Gate-Drain Charge	Q _{gd}			0.7		
Gate Resistance	R _g	f = 1 MHz	0.5	2.4	4.8	Ω
Turn-On Delay Time	t _{d(on)}	V _{DD} = 10 V, R _L = 2.2 Ω I _D ≅ 4 A, V _{GEN} = 4.5 V, R _g = 1 Ω		8	16	ns
Rise Time	t _r			17	26	
Turn-Off Delay Time	t _{d(off)}			31	47	
Fall Time	t _f			8	16	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 10 V, R _L = 2.2 Ω I _D ≅ 4 A, V _{GEN} = 5 V, R _g = 1 Ω		5	10	
Rise Time	t _r			13	20	
Turn-Off Delay Time	t _{d(off)}			21	32	
Fall Time	t _f			6	12	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C			1.75	A
Pulse Diode Forward Current	I _{SM}				20	
Body Diode Voltage	V _{SD}	I _S = 4 A, V _{GS} = 0 V		0.75	1.2	V
Body Diode Reverse Recovery Time	t _{rr}	I _F = 4 A, dI/dt = 100 A/μs, T _J = 25 °C		12	20	ns
Body Diode Reverse Recovery Charge	Q _{rr}			5	10	nC
Reverse Recovery Fall Time	t _a			7		ns
Reverse Recovery Rise Time	t _b			5		

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



On-Resistance vs. Drain Current and Gate Voltage



Capacitance



Gate Charge



On-Resistance vs. Junction Temperature

Figure 10-10 is a graph showing the drain current (I_{DS}) versus the gate-to-source voltage (V_{GS}) for the 2N7000 MOSFET. The y-axis represents I_{DS} in Amperes (A) on a logarithmic scale from 0.1 to 100. The x-axis represents V_{GS} in Volts (V) from 0.0 to 1.2. Two curves are plotted for different temperatures: $T_J = 150\text{ }^{\circ}\text{C}$ and $T_J = 25\text{ }^{\circ}\text{C}$. The curve for $T_J = 150\text{ }^{\circ}\text{C}$ is shifted to the right of the curve for $T_J = 25\text{ }^{\circ}\text{C}$, indicating a higher threshold voltage at higher temperature.

Figure 10 is a line graph showing the On-Resistance ($R_{DS(on)}$) in Ohms (Ω) versus the Gate-to-Source Voltage (V_{GS}) in Volts (V) for the 2N7000 MOSFET. The graph is plotted for a drain current $I_D = 5\text{ A}$. Two curves are shown for different temperatures: $T_J = 125\text{ }^{\circ}\text{C}$ (upper curve) and $T_J = 25\text{ }^{\circ}\text{C}$ (lower curve). The on-resistance decreases sharply as V_{GS} increases from 1 V to 2 V, and then more gradually as V_{GS} increases further. The on-resistance is higher at $125\text{ }^{\circ}\text{C}$ than at $25\text{ }^{\circ}\text{C}$ for the same V_{GS} .

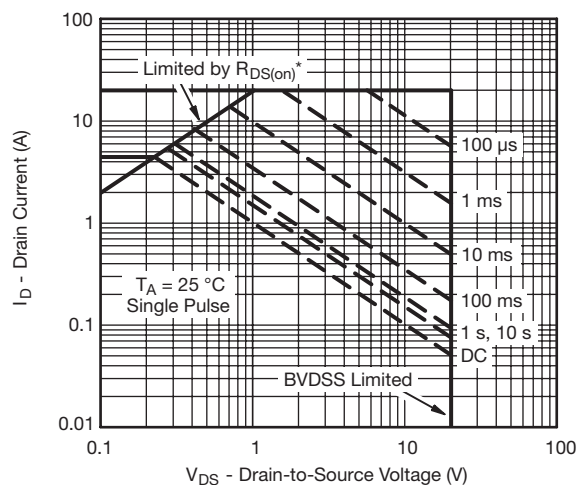
V_{GS} (V)	$R_{DS(on)}$ (Ω) at $T_J = 125\text{ }^{\circ}\text{C}$	$R_{DS(on)}$ (Ω) at $T_J = 25\text{ }^{\circ}\text{C}$
1.5	> 0.06	> 0.06
2.0	0.048	0.032
3.0	0.042	0.028
4.0	0.039	0.027
6.0	0.037	0.026
8.0	0.036	0.025

T_J (°C)	$V_{GS(th)}$ (V)
-50	0.78
0	0.68
50	0.58
100	0.48
150	0.28

A line graph showing the power dissipation of a 100 W incandescent lamp over time. The vertical axis is labeled 'Power (W)' and ranges from 0 to 32 with major grid lines every 8 units. The horizontal axis is labeled 'Time (s)' and is on a logarithmic scale with major ticks at 0.001, 0.01, 0.1, 1, 10, and 100. The curve starts at 32 W at 0.001 s and decays exponentially, reaching approximately 1 W at 10 s and continuing to approach 0 W as time increases.

Time (s)	Power (W)
0.001	32
0.002	20
0.005	12
0.01	8
0.02	5
0.05	3
0.1	2
0.2	1.5
0.5	1
1	0.8
10	0.4
100	0.2

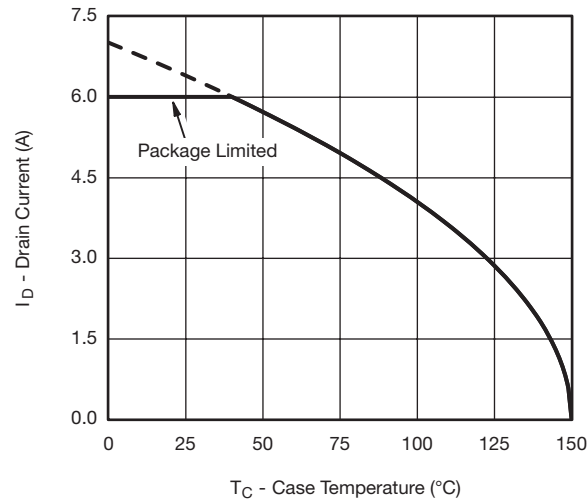
Single Pulse Power (Junction-to-Ambient)



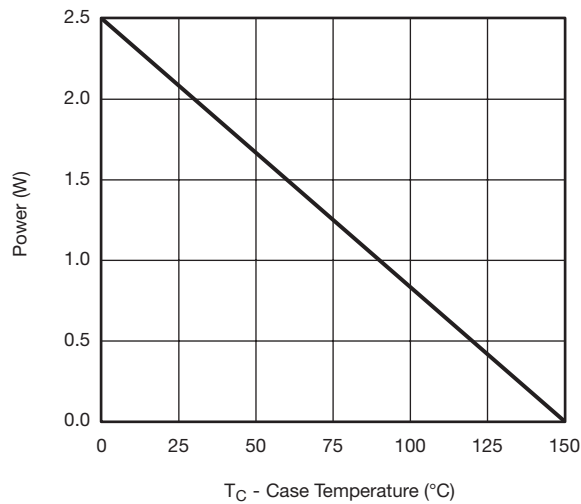
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

4

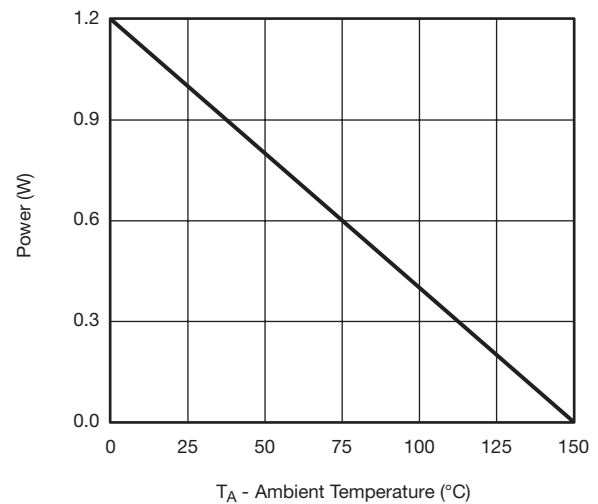
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating*



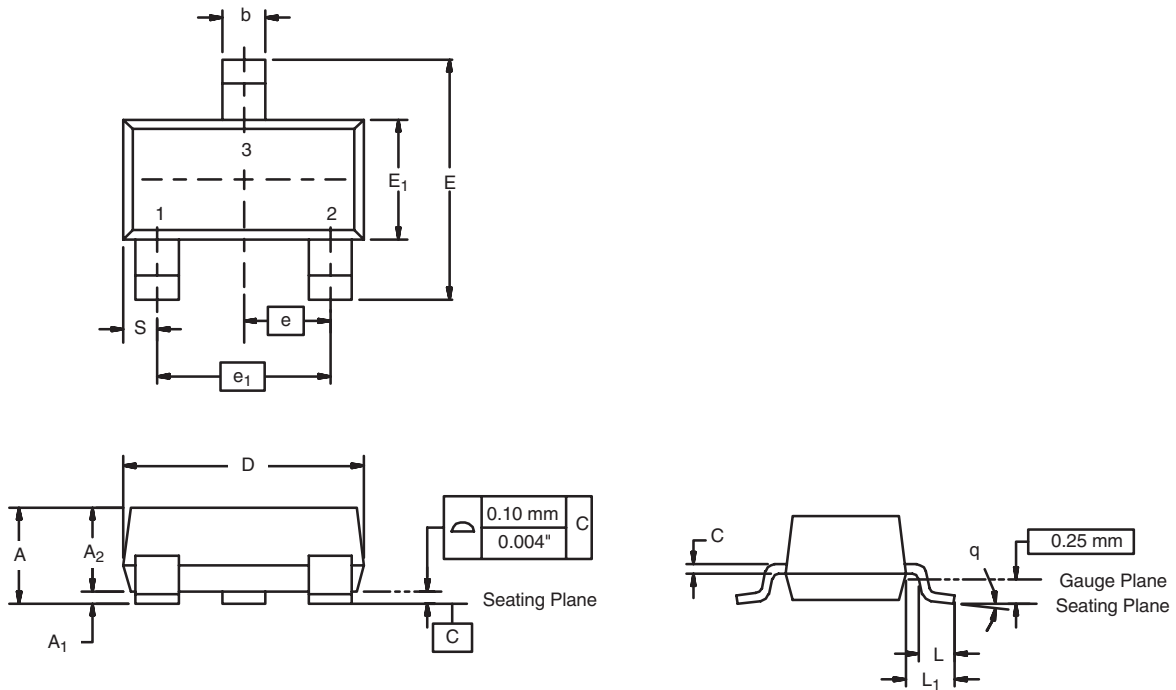
Power Derating, Junction-to-Foot



Power Derating, Junction-to-Ambient

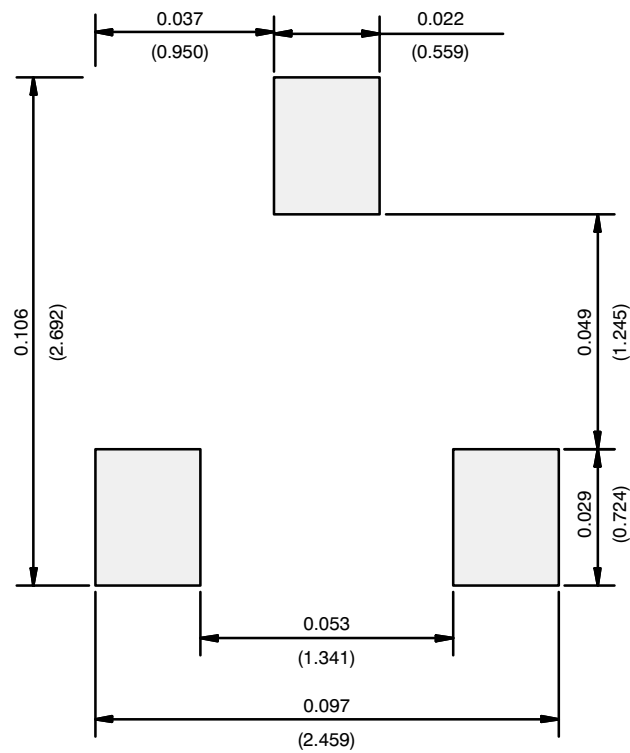
* The power dissipation P_D is based on $T_{J(max.)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


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

Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	0.89	1.12	0.035	0.044
A ₁	0.01	0.10	0.0004	0.004
A ₂	0.88	1.02	0.0346	0.040
b	0.35	0.50	0.014	0.020
c	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 ₁	1.20	1.40	0.047	0.055
e	0.95 BSC		0.0374 Ref	
e ₁	1.90 BSC		0.0748 Ref	
L	0.40	0.60	0.016	0.024
L ₁	0.64 Ref		0.025 Ref	
S	0.50 Ref		0.020 Ref	
q	3°	8°	3°	8°
ECN: S-03946-Rev. K, 09-Jul-01				
DWG: 5479				

RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads
Dimensions in Inches/(mm)

Disclaimer

All products due to improve reliability, function or design or for other reasons, product specifications and data are subject to change without notice.

Taiwan VBsemi Electronics Co., Ltd., branches, agents, employees, and all persons acting on its or their representatives (collectively, the "Taiwan VBsemi"), assumes no responsibility for any errors, inaccuracies or incomplete data contained in the table or any other any disclosure of any information related to the product.(www.VBsemi.com)

Taiwan VBsemi makes no guarantee, representation or warranty on the product for any particular purpose of any goods or continuous production. To the maximum extent permitted by applicable law on Taiwan VBsemi relinquished: (1) any application and all liability arising out of or use of any products; (2) any and all liability, including but not limited to special, consequential damages or incidental ; (3) any and all implied warranties, including a particular purpose, non-infringement and merchantability guarantee.

Statement on certain types of applications are based on knowledge of the product is often used in a typical application of the general product VBsemi Taiwan demand that the Taiwan VBsemi of. Statement on whether the product is suitable for a particular application is non-binding. It is the customer's responsibility to verify specific product features in the products described in the specification is appropriate for use in a particular application. Parameter data sheets and technical specifications can be provided may vary depending on the application and performance over time. All operating parameters, including typical parameters must be made by customer's technical experts validated for each customer application. Product specifications do not expand or modify Taiwan VBsemi purchasing terms and conditions, including but not limited to warranty herein.

Unless expressly stated in writing, Taiwan VBsemi products are not intended for use in medical, life saving, or life sustaining applications or any other application. Wherein VBsemi product failure could lead to personal injury or death, use or sale of products used in Taiwan VBsemi such applications using client did not express their own risk. Contact your authorized Taiwan VBsemi people who are related to product design applications and other terms and conditions in writing.

The information provided in this document and the company's products without a license, express or implied, by estoppel or otherwise, to any intellectual property rights granted to the VBsemi act or document. Product names and trademarks referred to herein are trademarks of their respective representatives will be all.

Material Category Policy

Taiwan VBsemi Electronics Co., Ltd., hereby certify that all of the products are determined to be RoHS compliant and meets the definition of restrictions under Directive of the European Parliament 2011/65 / EU, 2011 Nian. 6. 8 Ri Yue restrict the use of certain hazardous substances in electrical and electronic equipment (EEE) - modification, unless otherwise specified as inconsistent.(www.VBsemi.com)

Please note that some documents may still refer to Taiwan VBsemi RoHS Directive 2002/95 / EC. We confirm that all products identified as consistent with the Directive 2002/95 / EC European Directive 2011/65 / .

Taiwan VBsemi Electronics Co., Ltd. hereby certify that all of its products comply identified as halogen-free halogen-free standards required by the JEDEC JS709A. Please note that some Taiwanese VBsemi documents still refer to the definition of IEC 61249-2-21, and we are sure that all products conform to confirm compliance with IEC 61249-2-21 standard level JS709A.