

TDM2302AC-TTL-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

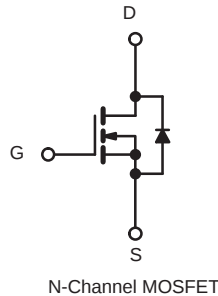
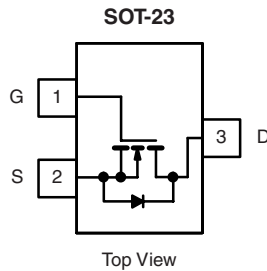
- Halogen-free According to IEC 61249-2-21 Definition
- Trench Power MOSFET
- 100 % R_g Tested
- Compliant to RoHS Directive 2002/95/EC



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)	I_D	$T_C = 25$ °C	A
		$T_C = 70$ °C	
		$T_A = 25$ °C	
		$T_A = 70$ °C	
Pulsed Drain Current	I_{DM}	20	A
Continuous Source-Drain Diode Current	I_S	$T_C = 25$ °C	
		$T_A = 25$ °C	
Maximum Power Dissipation	P_D	$T_C = 25$ °C	W
		$T_C = 70$ °C	
		$T_A = 25$ °C	
		$T_A = 70$ °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, dl/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		

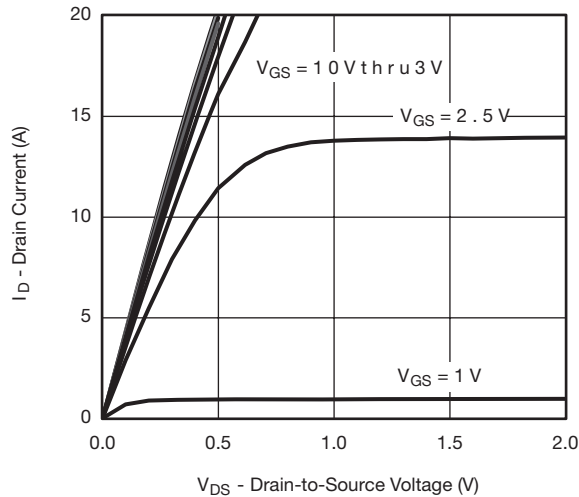
Notes:

a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$

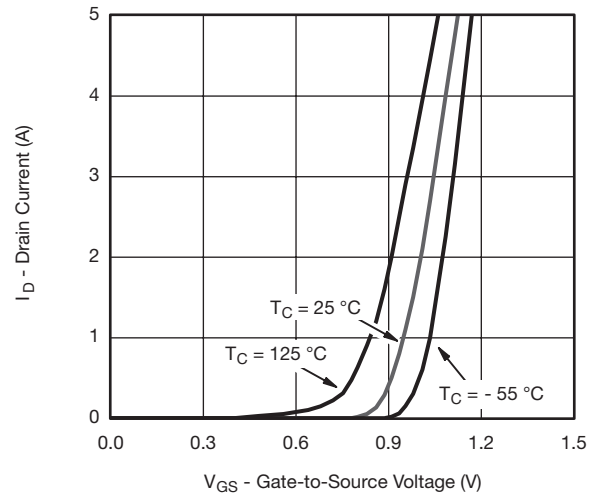
b. Guaranteed by design, not subject to production testing.

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.

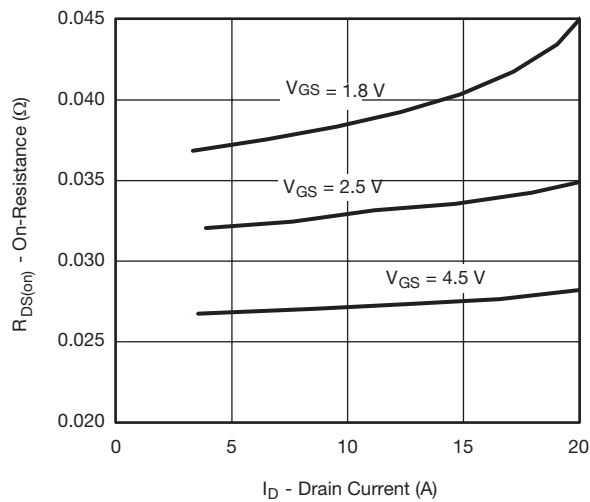
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



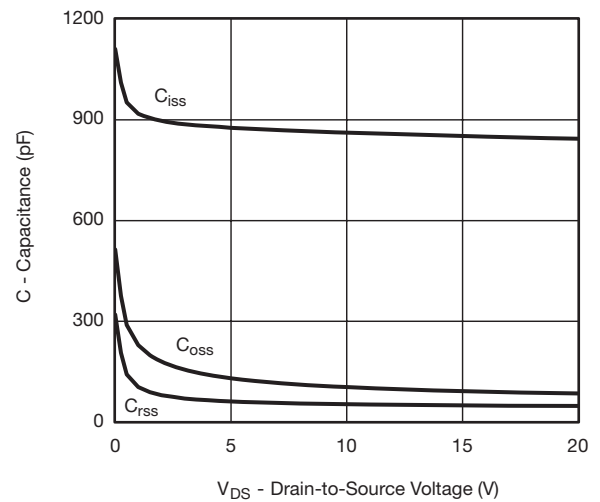
Output Characteristics



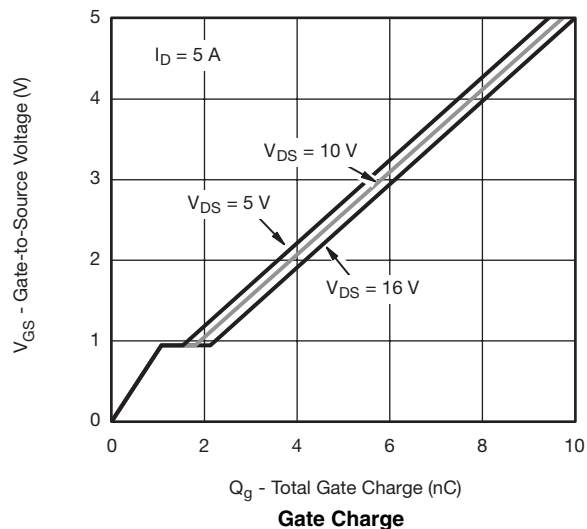
Transfer Characteristics



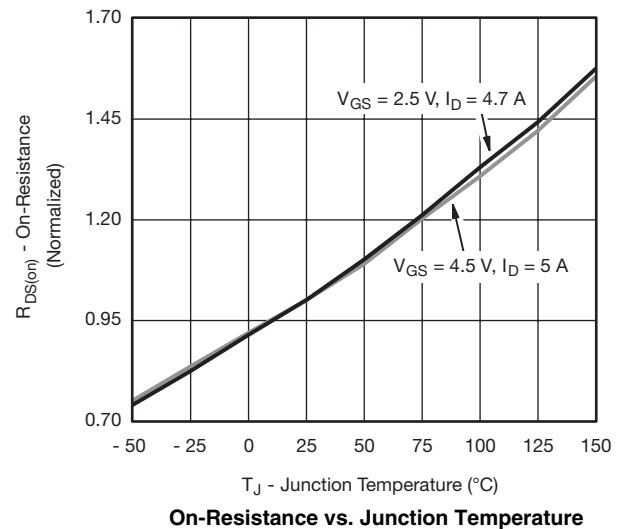
On-Resistance vs. Drain Current and Gate Voltage



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, ranging from 0.1 to 100. The x-axis represents V_{GS} in Volts (V) on a linear scale, ranging from 0.0 to 1.2. Two curves are plotted, corresponding to different junction temperatures (T_J):

- The upper curve is labeled $T_J = 150\text{ }^{\circ}\text{C}$.
- The lower curve is labeled $T_J = 25\text{ }^{\circ}\text{C}$.

The graph illustrates that the drain current increases with both gate-to-source voltage and junction temperature. For a given gate-to-source voltage, the drain current is higher at $150\text{ }^{\circ}\text{C}$ than at $25\text{ }^{\circ}\text{C}$.

Figure 10 is a line graph showing the relationship between On-Resistance ($R_{DS(on)}$) and Gate-to-Source Voltage (V_{GS}) for a MOSFET at a constant drain current $I_D = 5\text{ A}$. The y-axis represents $R_{DS(on)}$ in Ohms (Ω), ranging from 0.02 to 0.06. The x-axis represents V_{GS} in Volts (V), ranging from 0 to 8. Two curves are plotted for different temperatures: $T_J = 125\text{ }^{\circ}\text{C}$ (upper curve) and $T_J = 25\text{ }^{\circ}\text{C}$ (lower curve). Both curves show a sharp decrease in on-resistance as V_{GS} increases from 1 V to 2 V, followed by a more gradual decrease. The on-resistance is higher at $125\text{ }^{\circ}\text{C}$ than at $25\text{ }^{\circ}\text{C}$ for any given 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

Graph of $V_{GS(th)}$ (V) vs. Temperature ($^{\circ}C$) for $I_D = 250 \mu A$. The curve shows a linear decrease in threshold voltage with increasing temperature.

Temperature ($^{\circ}C$)	$V_{GS(th)}$ (V)
-50	0.78
-25	0.72
0	0.66
25	0.60
50	0.54
75	0.48
100	0.42
125	0.36
150	0.30

A line graph showing the power consumption of a 100 W incandescent lamp over time. The y-axis is labeled 'Power (W)' and ranges from 0 to 32 with major grid lines every 8 units. The x-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 approximately 32 W at 0.001 s and decreases rapidly, reaching about 1 W at 100 s.

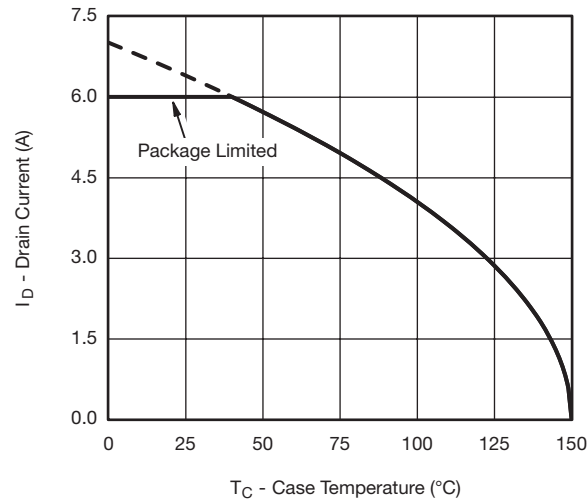
Time (s)	Power (W)
0.001	32
0.002	20
0.005	12
0.01	8
0.02	5
0.05	3
0.1	2
0.2	1.5
0.5	1.2
1	1.1
10	1.0
100	1.0

Figure 10 is a Power Dissipation Characteristics graph. The y-axis represents Drain Current (I_D) in Amperes (A) on a logarithmic scale from 0.01 to 100. The x-axis represents Drain-to-Source Voltage (V_{DS}) in Volts (V) on a logarithmic scale from 0.1 to 100. The graph shows the relationship between I_D and V_{DS} for different pulse widths at $T_A = 25^\circ\text{C}$ for a Single Pulse. The solid line represents the power limit, labeled "Limited by $R_{DS(on)}^*$ ". The dashed line represents the thermal limit, labeled "BVDSS Limited". The pulse widths indicated on the right are 100 μs , 1 ms, 10 ms, 100 ms, 1 s, 10 s, and DC.

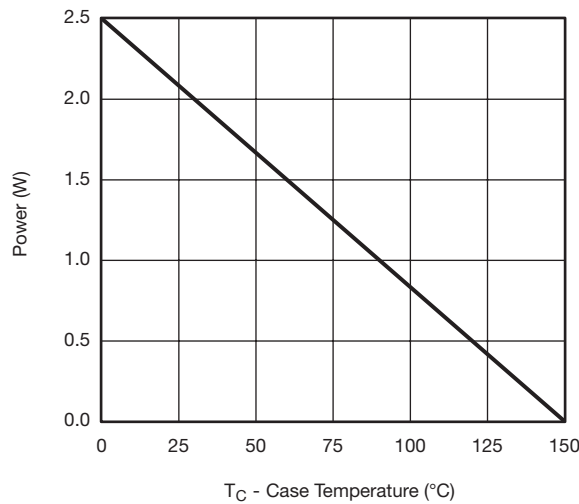
* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

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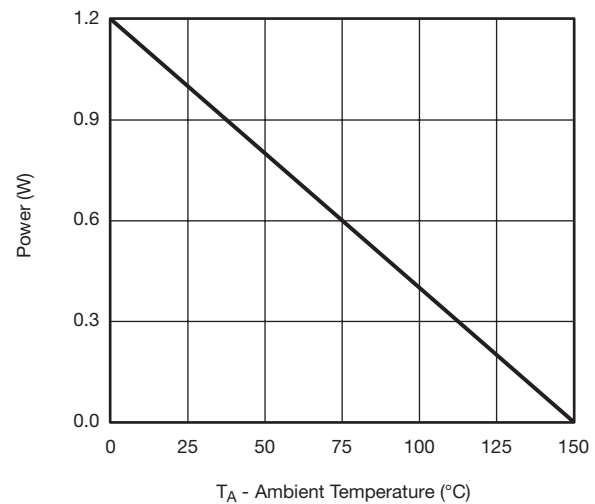
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating*



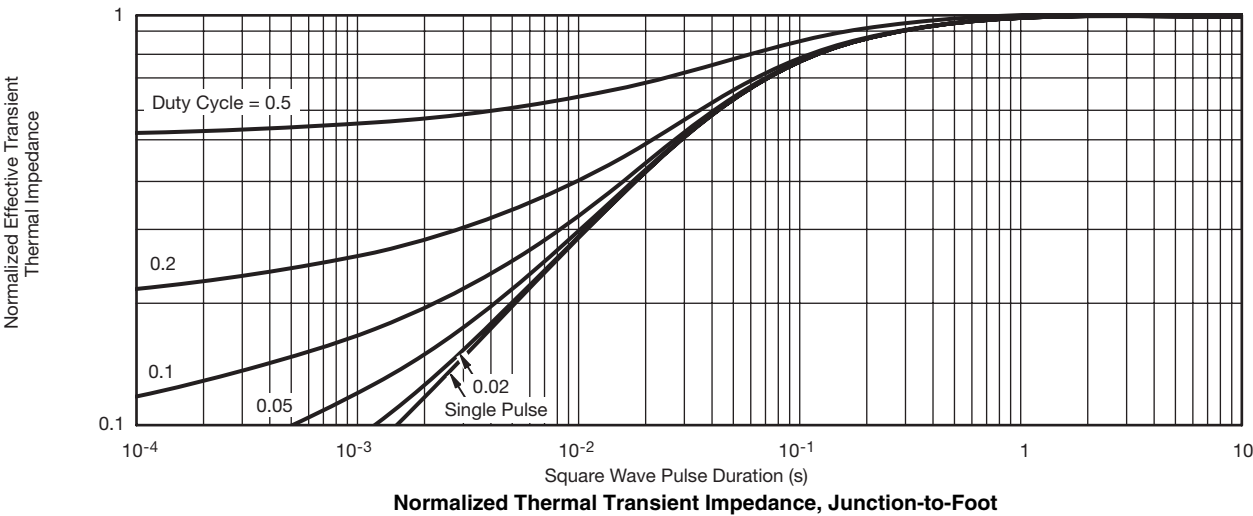
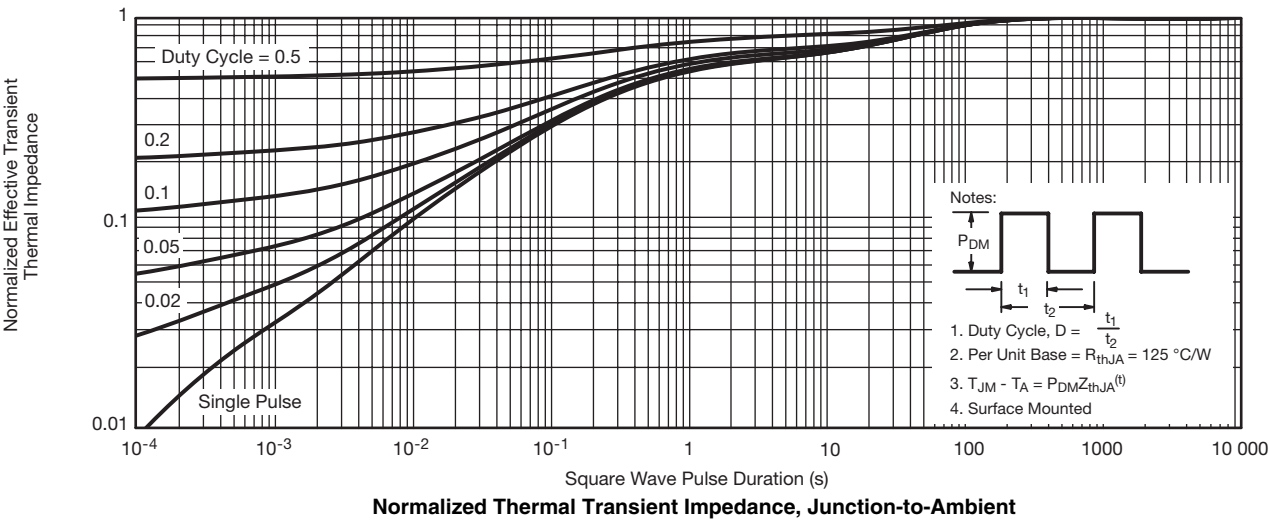
Power Derating, Junction-to-Foot

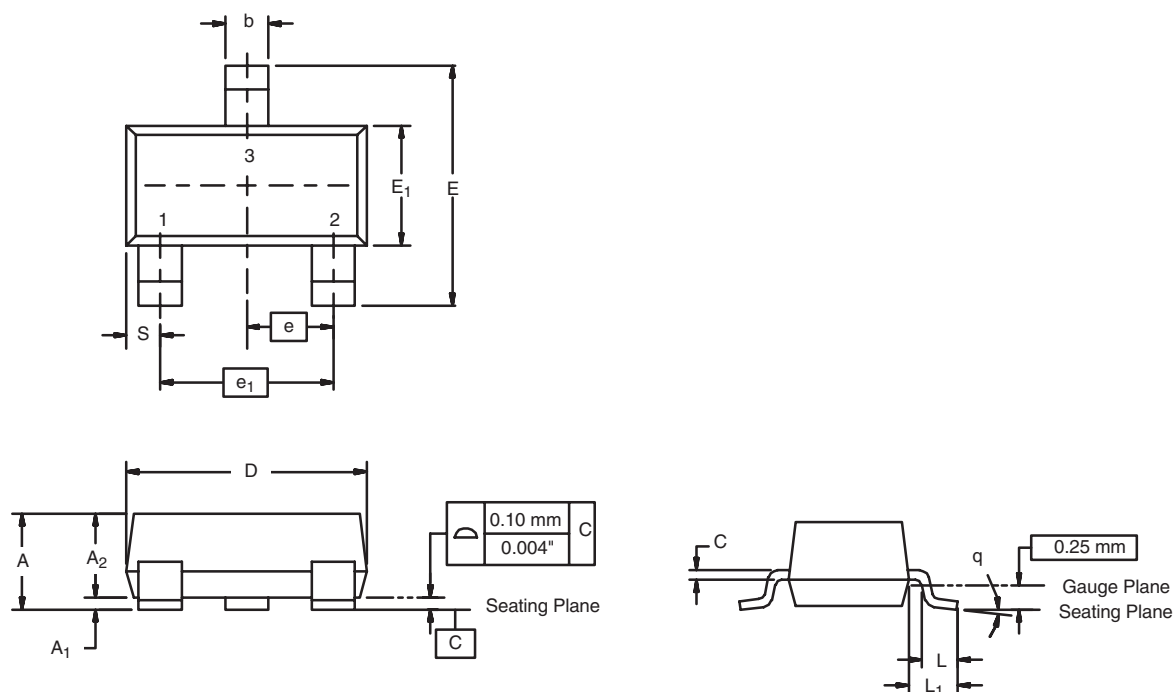


Power Derating, Junction-to-Ambient

* 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)

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