

## VS6640AL-VB Datasheet

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

#### PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (A) <sup>a</sup>	$Q_g$ (Typ.)
60	0.030 at $V_{GS} = 10$ V	5.5	2.3 nC
	0.033 at $V_{GS} = 4.5$ V	4.5	

#### FEATURES

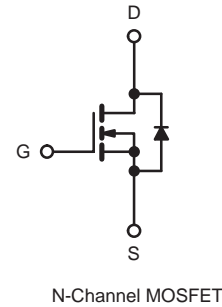
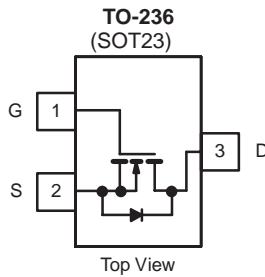
- Halogen-free According to IEC 61249-2-21 Available
- Trench Power MOSFET
- 100 %  $R_g$  Tested
- 100 % UIS Tested

#### APPLICATIONS

- Battery Switch
- DC/DC Converter



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available



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

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
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	
Continuous Source-Drain Diode Current	$I_S$	$T_C = 25$ °C	A
		$T_A = 25$ °C	
Avalanche Current	$I_{AS}$	6	mJ
Single-Pulse Avalanche Energy	$E_{AS}$	1.8	
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

#### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>b, d</sup>	$R_{thJA}$	90	115	°C/W
Maximum Junction-to-Foot (Drain)	$R_{thJF}$	60	75	

Notes:

- a. Based on  $T_C = 25$  °C.  
 b. Surface Mounted on 1" x 1" FR4 board.  
 c.  $t = 5$  s.  
 d. Maximum under Steady State conditions is 130 °C/W.

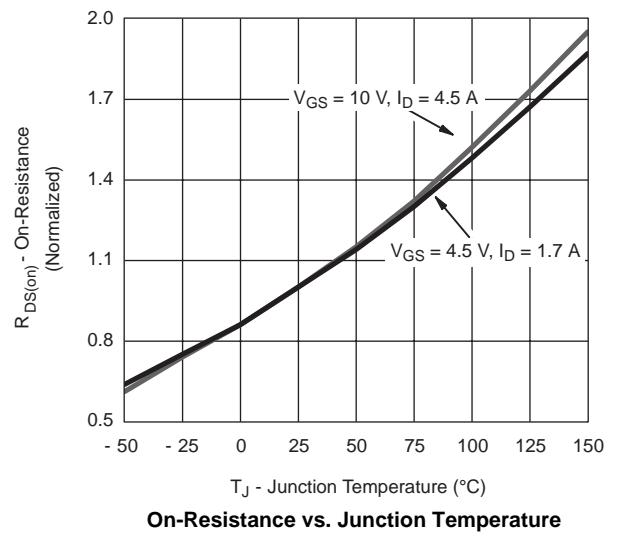
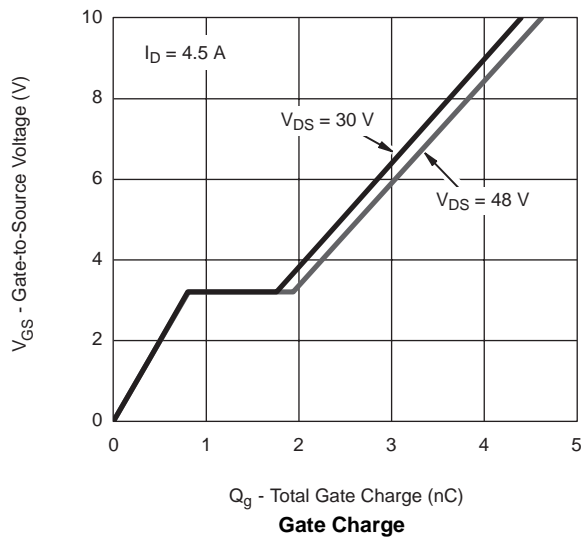
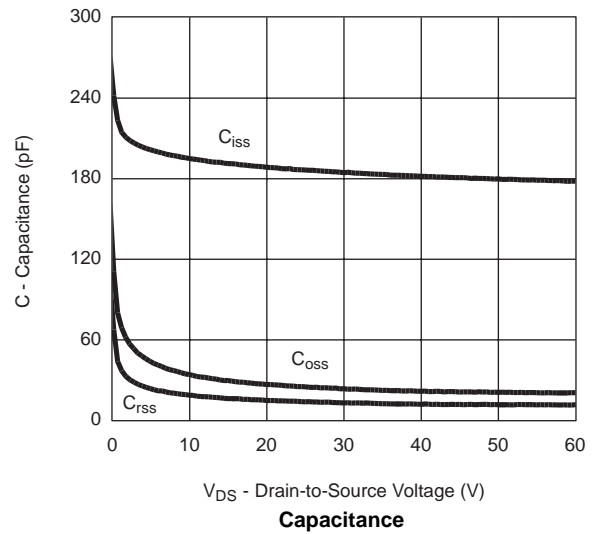
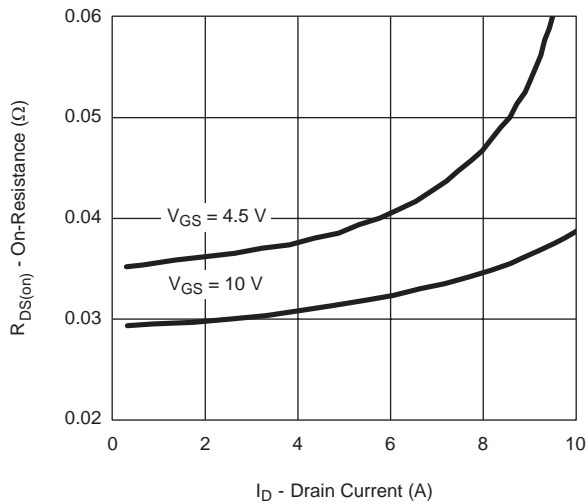
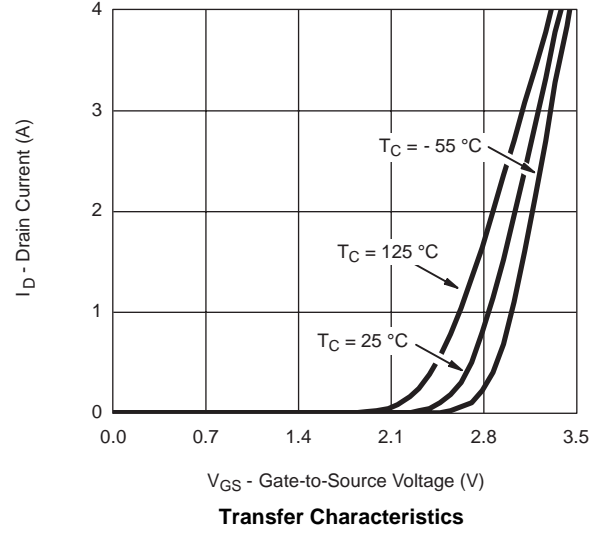
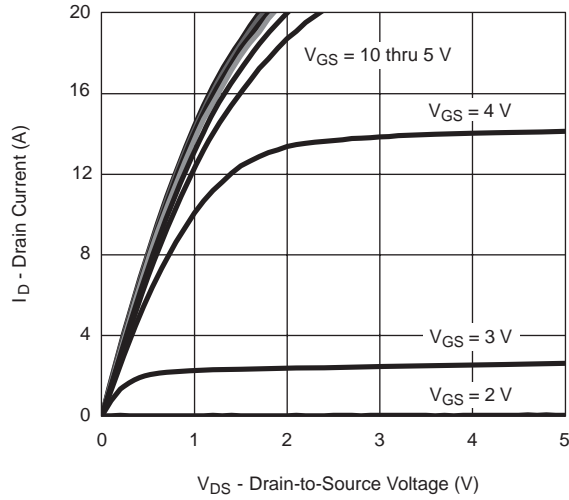
MOSFET SPECIFICATIONS T <sub>J</sub> = 25 °C, unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Static							
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>DS</sub> = 0 V, I <sub>D</sub> = 250 μA	60			V	
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA		55		mV/°C	
V <sub>GS(th)</sub> Temperature Coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>			- 5			
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	1		3	V	
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			± 100	nA	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V			1	μA	
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C			10		
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 5 V, V <sub>GS</sub> = 10 V	8			A	
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.9 A		0.030		Ω	
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 1.7 A		0.033			
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15V, I <sub>D</sub> = 1.9 A		5		S	
Dynamic <sup>b</sup>							
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V, f = 1 MHz		190		pF	
Output Capacitance	C <sub>oss</sub>			26			
Reverse Transfer Capacitance	C <sub>rss</sub>			15			
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 1.9 A		4.5	6.8	nC	
Gate-Source Charge	Q <sub>gs</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 1.9 A		2.3	3.5		
Gate-Drain Charge	Q <sub>gd</sub>			0.8			
Gate Resistance	R <sub>g</sub>			1			
Turn-On Delay Time	t <sub>d(on)</sub>	f = 1 MHz	0.6	2.8	5.6	Ω	
Rise Time	t <sub>r</sub>		V <sub>DD</sub> = 30 V, R <sub>L</sub> = 20 Ω I <sub>D</sub> ≅ 1.5 A, V <sub>GEN</sub> = 10 V, R <sub>G</sub> = 1 Ω		4	6	ns
Turn-Off Delay Time	t <sub>d(off)</sub>				10	15	
Fall Time	t <sub>f</sub>				10	15	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, R <sub>L</sub> = 20 Ω I <sub>D</sub> = 1.5 A, V <sub>GEN</sub> = 4.5 V, R <sub>G</sub> = 1 Ω			7	10.5	
Rise Time	t <sub>r</sub>			15	23		
Turn-Off Delay Time	t <sub>d(off)</sub>			16	24		
Fall Time	t <sub>f</sub>			11	17		
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C			2.39	A	
Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>				8		
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = 1.5 A		0.8	1.2	V	
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 1.5 A, dI/dt = 100 A/μs, T <sub>J</sub> = 25 °C		15	23	ns	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>			10	15	nC	
Reverse Recovery Fall Time	t <sub>a</sub>			12		ns	
Reverse Recovery Rise Time	t <sub>b</sub>			3			

Notes:

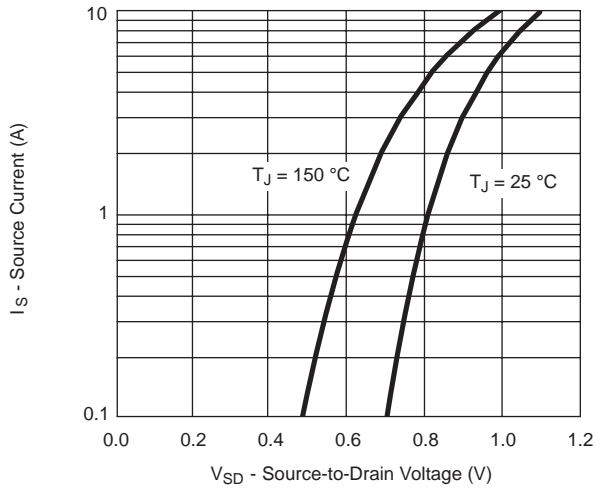
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

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.

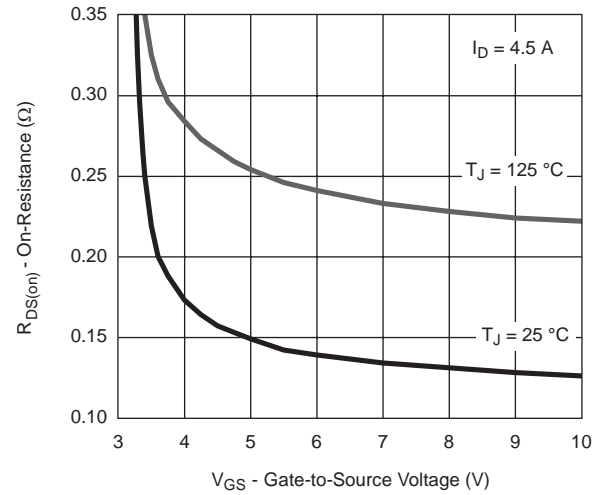
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



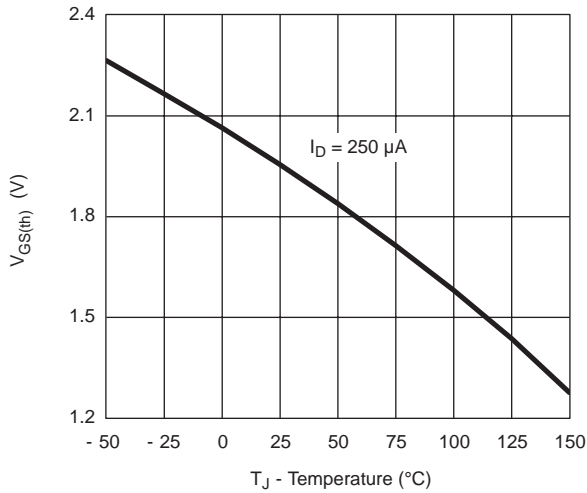
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



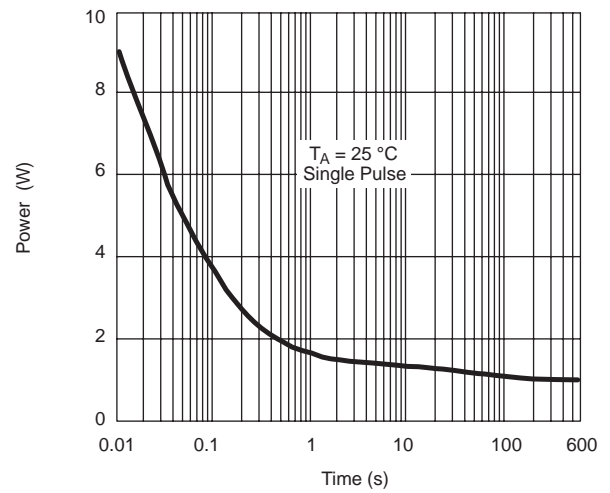
Source-Drain Diode Forward Voltage



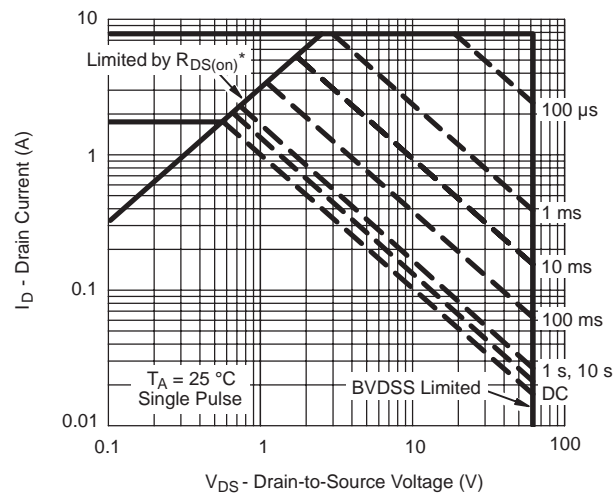
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage

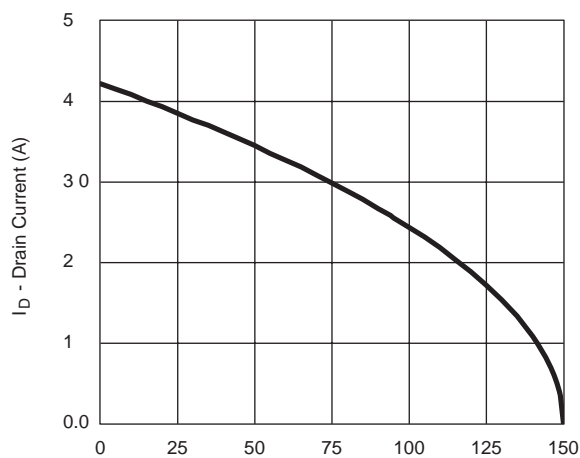


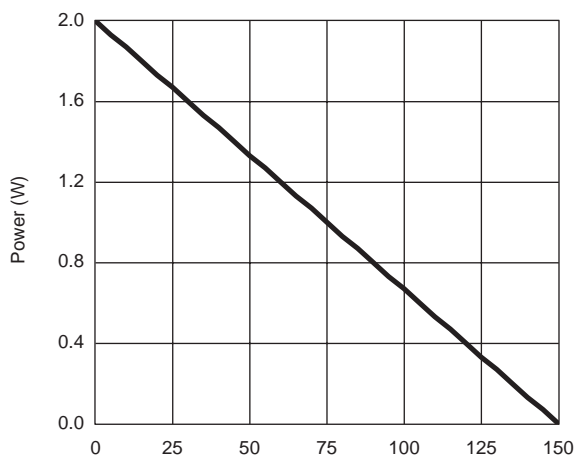
Single Pulse Power

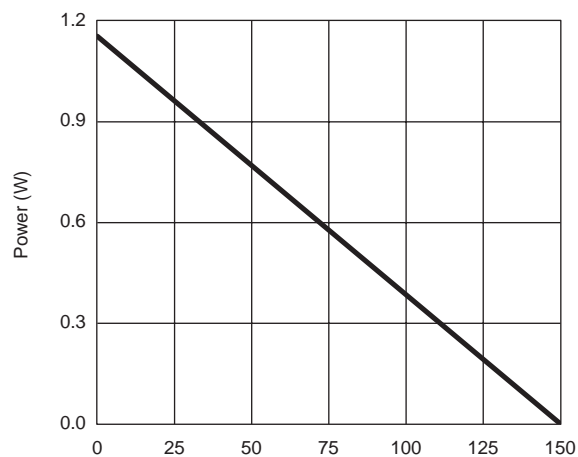


\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area

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

 $T_C$  - Case Temperature (°C)

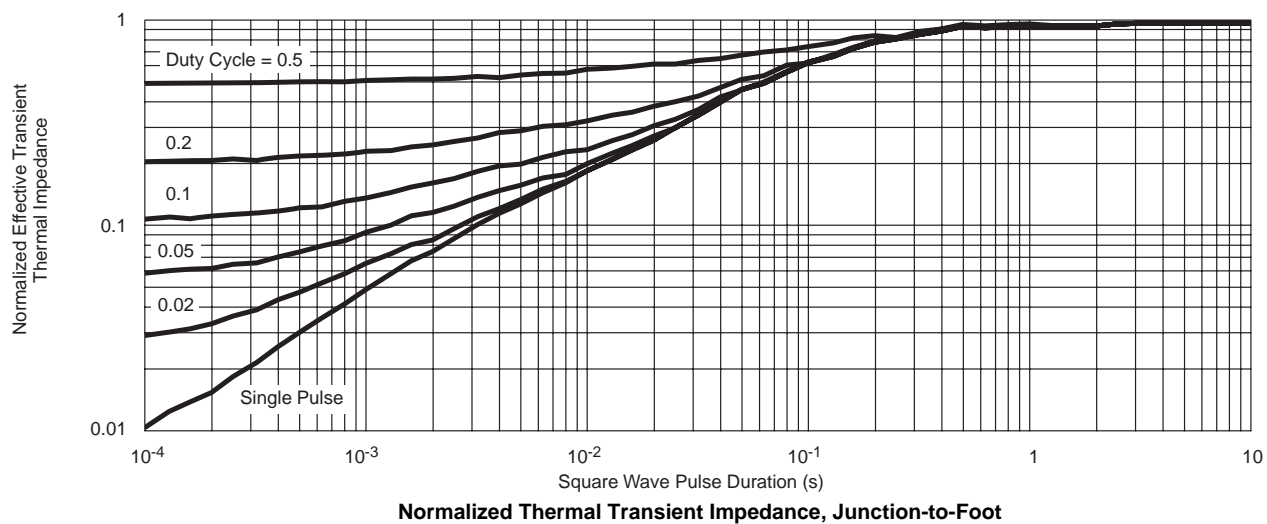
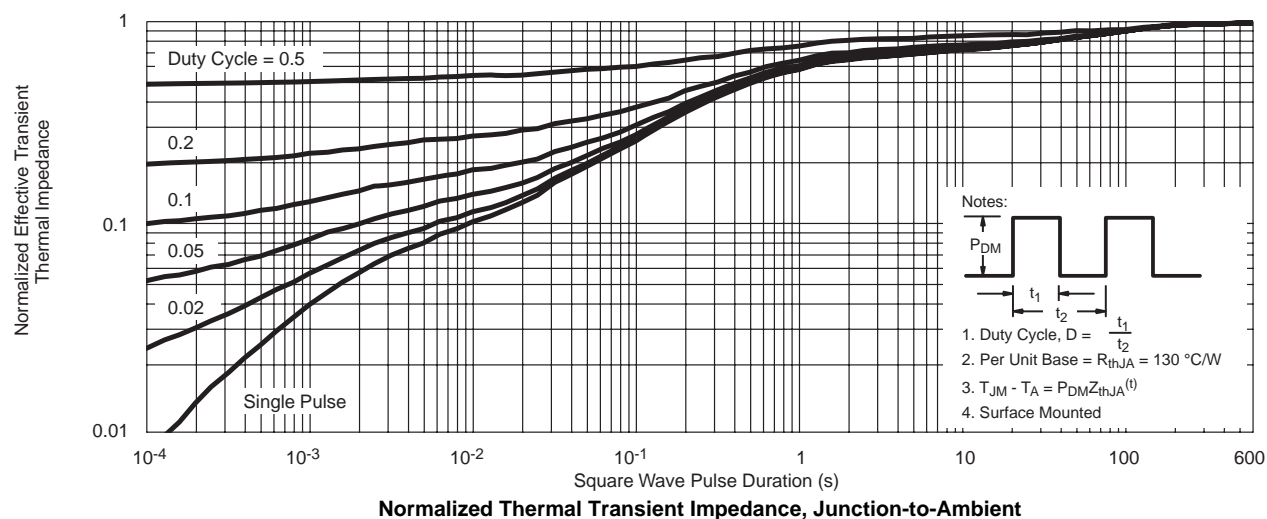
**Current Derating\***

 $T_C$  - Case Temperature (°C)

**Power Derating, Junction-to-Case**

 $T_A$  - Ambient Temperature (°C)

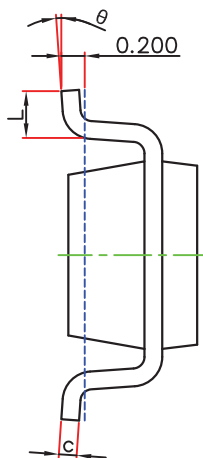
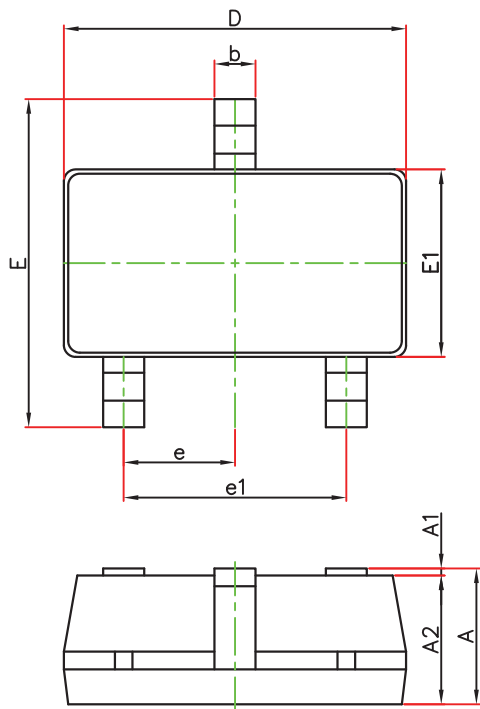
**Power Derating, Junction-to-Ambient**

\* 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.

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

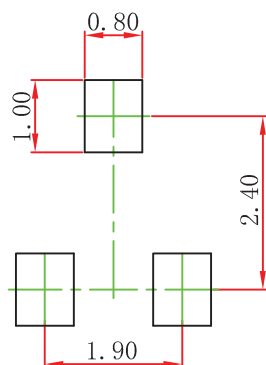


SOT-23-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

## RECOMMENDED MINIMUM PADS FOR SOT-23-3L



### Note:

1. Controlling dimension: in millimeters.
2. General tolerance:  $\pm 0.05\text{mm}$ .
3. The pad layout is for reference purposes only.



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