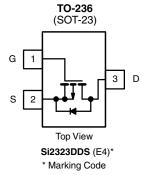




P-Channel 20-V (D-S) MOSFET

PRODUCT SUMMARY					
V _{DS} (V)	$R_{DS(on)}\left(\Omega\right)$ Max.	I _D (A) ^d	Q _g (Typ.)		
	0.039 at V _{GS} = - 4.5 V	- 5.3			
- 20	0.050 at V _{GS} = - 2.5 V	- 4.7	13.6 nC		
	0.075 at V _{GS} = - 1.8 V	- 3.8			



Ordering Information:

Si2323DDS-T1-GE3 (Lead (Pb)-free and Halogen-free)

FEATURES

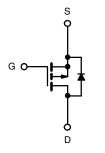
- TrenchFET® Power MOSFET
- 100 % R_a Tested
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912



HALOGEN FREE

APPLICATIONS

- Load Switch
- PA Switch
- DC/DC Converters
- **Power Management**



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS	$T_A = 25 ^{\circ}C$, unle	ess otherwise r	noted)		
Parameter	Symbol	Limit	Unit		
Drain-Source Voltage	V_{DS}	- 20	V		
Gate-Source Voltage	V_{GS}	± 8	¬		
	T _C = 25 °C		- 5.3		
Continuous Drain Current /T 150 °C)	T _C = 70 °C	,	- 4.3		
Continuous Drain Current (T _J = 150 °C)	T _A = 25 °C	I _D	- 4.1 ^{a,b}		
	T _A = 70 °C		- 3.2 ^{a,b}	Α	
Pulsed Drain Current (t = 300 μs)		I _{DM}	- 20		
Continuous Course Drain Diade Current	T _C = 25 °C	I _S	- 1.4		
Continuous Source-Drain Diode Current	T _A = 25 °C		- 0.8 ^{a,b}		
	T _C = 25 °C		1.7	W	
Mariana Barra Birata atian	T _C = 70 °C	Б	1.1		
Maximum Power Dissipation	T _A = 25 °C	P_{D}	0.96 ^{a,b}		
	T _A = 70 °C		0.62 ^{a,b}		
Operating Junction and Storage Temperature Ra	T_J, T_stg	- 55 to 150	°C		

THERMAL RESISTANCE RATINGS					
Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{a, c}	t ≤ 5 s	R_{thJA}	100	130	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R _{thJF}	60	75	C/VV

Notes:

- a. Surface mounted on 1" x 1" FR4 board.
- b. t = 5 s.
- c. Maximum under steady state conditions is 175 $^{\circ}\text{C/W}.$
- d. $T_C = 25$ °C.

Document Number: 64004 S13-1165-Rev. A, 13-May-13 For technical questions, contact: pmostechsupport@vishav.com

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Si2323DDS

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Parameter Symbol Test Conditions Min. Typ. Max. Unit Static	SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)							
Drain-Source Breakdown Voltage V _{DS} V _{GS} = 0 V, I _D = -250 μA -20 V V _{DS} Pemperature Coefficient Δ/V _{DS} (T _J I _D = -250 μA -2.8 mV/°C MV _{CS} (m) Temperature Coefficient Λ/V _{DS} (m) Temperature Coefficient Λ/V _{DS} (m) Temperature Coefficient Λ/D _{SS} (m) V _{DS} = V _{GS} , I _D = -250 μA -0.4 -1.1 V MV/°C MV _{DS} = 0 V V _{DS} = 0 V V _{DS} = 250 μA -0.4 -1.1 V V _{DS} = 0	Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Unit	
Vos Temperature Coefficient AV _{DS} /T _J V _{DS} Temperature Coefficient AV _{DS} /T _J V _{DS} Temperature Coefficient AV _{DS} (Hy)	Static							
Vos(m) Temperature Coefficient AV _{GS(m)}	Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}, I_D = -250 \mu\text{A}$	- 20			V	
V _{GS(m)} Temperature Coefficient ΔV _{GS(m)} /T _s V _{DS} = V _{GS} , I _D = -250 μA - 0.4 - 1 V Gate-Source Threshold Voltage I _{GSS} V _{DS} = V _{GS} , I _D = -250 μA - 0.4 ± 100 nA Zero Gate Voltage Drain Current I _{GSS} V _{DS} = -20 V, V _{GS} = 8 V ± 100 nA On-State Drain Current ^a I _{D(m)} V _{DS} = -20 V, V _{GS} = 0 V, T _J = 55 °C - 10 A On-State Drain Current ^a I _{D(m)} V _{DS} = -20 V, V _{GS} = 0 V, T _J = 55 °C - 10 A On-State Drain Current ^a I _{D(m)} V _{DS} = -5 V, V _{GS} = -4 S V - 15 A On-State Drain Current ^a I _{D(m)} V _{DS} = -5 V, V _{GS} = -4 S V - 15 A On-State Drain Current ^a I _{D(m)} V _{DS} = -10 V, V _{GS} = -4 S V - 15 A On-State Drain Current ^a I _{D(m)} V _{DS} = -10 V,	V _{DS} Temperature Coefficient	$\Delta V_{DS}/T_{J}$	I 250 uA		- 13		m\//°C	
Sate-Source Leakage	V _{GS(th)} Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	1Β = - 250 μΑ		- 2.8		IIIV/ C	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Gate-Source Threshold Voltage	V _{GS(th)}	$V_{DS} = V_{GS}, I_{D} = -250 \mu A$	- 0.4		- 1	V	
Description	Gate-Source Leakage	I _{GSS}	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 8 \text{ V}$			± 100	nA	
On-State Drain Current ^a	Zoro Coto Voltago Drain Current	1	$V_{DS} = -20 \text{ V}, V_{GS} = 0 \text{ V}$			- 1	μΑ	
Drain-Source On-State Resistance Pasient Properties Pasient Prope	Zero Gate Voltage Drain Current	'DSS	$V_{DS} = -20 \text{ V}, V_{GS} = 0 \text{ V}, T_{J} = 55 \text{ °C}$			- 10		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	On-State Drain Current ^a	I _{D(on)}	$V_{DS} \le -5 \text{ V}, V_{GS} = -4.5 \text{ V}$	- 15			Α	
V _{GS} = -1.8 V, I _D = -1.4 0.058 0.075			V _{GS} = - 4.5 V, I _D = - 4.1 A		0.032	0.039		
Forward Transconductance ^a g_{fs} $V_{DS} = \cdot 10 \text{ V, } I_{D} = \cdot 4.1 \text{ A}$ 18 S Dynamic ^b Input Capacitance C_{iss} $V_{DS} = \cdot 10 \text{ V, } V_{GS} = 0 \text{ V, } f = 1 \text{ MHz}$ 1160 pF Output Capacitance C_{oss} $V_{DS} = \cdot 10 \text{ V, } V_{GS} = 0 \text{ V, } f = 1 \text{ MHz}$ 135 pF Total Gate Charge Q_g $V_{DS} = \cdot 10 \text{ V, } V_{GS} = \cdot 8 \text{ V, } I_{D} = \cdot 4.1 \text{ A}$ 24 36 Total Gate Charge Q_g $V_{DS} = \cdot 10 \text{ V, } V_{GS} = \cdot 4.5 \text{ V, } I_{D} = \cdot 4.1 \text{ A}$ 2 13.6 21 Gate-Source Charge Q_{gs} $V_{DS} = \cdot 10 \text{ V, } V_{GS} = \cdot 4.5 \text{ V, } I_{D} = \cdot 4.1 \text{ A}$ 2 2 Gate-Drain Charge Q_{gs} $V_{DS} = \cdot 10 \text{ V, } V_{GS} = \cdot 4.5 \text{ V, } I_{D} = \cdot 4.1 \text{ A}$ 2 2 Gate Resistance R_g $f = 1 \text{ MHz}$ 2 10 20 Ω Turn-On Delay Time $t_{d(on)}$ $V_{DD} = \cdot 10 \text{ V, } R_L = 3.1 \Omega$ 22 40 Turn-Off Delay Time t_f $V_{DD} = \cdot 10 \text{ V, } R_L = 3.1 \Omega$ 9 18 Time $V_{DD} $	Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = - 2.5 V, I _D = - 2 A		0.041	0.050	Ω	
Input Capacitance			V _{GS} = - 1.8 V, I _D = - 1 A		0.058	0.075		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Forward Transconductance ^a	9 _{fs}	V _{DS} = - 10 V, I _D = - 4.1 A		18		S	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Dynamic ^b	•			•	I.	I.	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		C _{iss}			1160			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Output Capacitance	C _{oss}	V _{DS} = - 10 V, V _{GS} = 0 V, f = 1 MHz		135		pF	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Reverse Transfer Capacitance				120			
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Total Gate Charge		V _{DS} = - 10 V, V _{GS} = - 8 V, I _D = - 4.1 A		24	36		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Total Gate Charge				13.6	21		
$ \begin{array}{ c c c c c c c c } \hline \text{Gate-Drain Charge} & Q_{gd} & & 2.2 & & \\ \hline \text{Gate Resistance} & R_g & f = 1 \text{MHz} & 2 & 10 & 20 & \Omega \\ \hline \text{Turn-On Delay Time} & t_{d(on)} & & 24 & 36 & \\ \hline \text{Rise Time} & t_r & & 22 & 40 & \\ \hline \text{Turn-Off Delay Time} & t_{d(off)} & & & 22 & 40 \\ \hline \text{Turn-Off Delay Time} & t_{d(off)} & & & 52 & 78 \\ \hline \text{Fall Time} & & t_f & & & 11 & 20 \\ \hline \text{Turn-On Delay Time} & t_{d(on)} & & & & & & & & & & & \\ \hline \text{Rise Time} & & t_r & & & & & & & & & & & & \\ \hline \text{Turn-On Delay Time} & & t_{d(off)} & & & & & & & & & & & & & \\ \hline \text{Rise Time} & & t_r & & & & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & & & \\ \hline \text{Fall Time} & & & t_r & & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{d(off)} & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{f} & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{f} & & & & & & & & & \\ \hline \text{Rise Time} & & & t_{g} & & & & & & & & & & \\ \hline \text{Turn-Off Delay Time} & & t_{f} & & & & & & & & & \\ \hline \text{Pulse Diode Forward Current} & & I_{S} & & & & & & & & & & \\ \hline \text{Drain-Source Body Diode Characteristics} & & & & & & & & & & \\ \hline \text{Continuous Source-Drain Diode Current} & & I_{S} & & & & & & & & & & \\ \hline \text{Pulse Diode Forward Current} & & I_{S} & & & & & & & & & & \\ \hline \text{Body Diode Reverse Recovery Time} & & t_{rr} & & & & & & & & & & \\ \hline \text{Body Diode Reverse Recovery Charge} & Q_{rr} & & & & & & & & & & \\ \hline \text{Reverse Recovery Fall Time} & & t_{a} & & & & & & & & & \\ \hline \text{Reverse Recovery Fall Time} & & t_{a} & & & & & & & & \\ \hline \end{array}$	Gate-Source Charge		V _{DS} = - 10 V, V _{GS} = - 4.5 V, I _D = - 4.1 A		2		nC	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Gate-Drain Charge	Q _{gd}			2.2			
Turn-On Delay Time $t_{d(on)}$ $V_{DD} = -10 \text{ V}, R_L = 3.1 \Omega$ 24 36 Rise Time t_r $V_{DD} = -10 \text{ V}, R_L = 3.1 \Omega$ 22 40 Turn-Off Delay Time t_f 11 20 Turn-On Delay Time $t_d(on)$ 8 16 Rise Time t_r $V_{DD} = -10 \text{ V}, R_L = 3.1 \Omega$ 9 18 Turn-Off Delay Time $t_d(off)$ $t_{D} = -3.2 \text{ A}, V_{GEN} = -8 \text{ V}, R_g = 1 \Omega$ 58 87 Fall Time t_f 9 18 Drain-Source Body Diode Characteristics 9 18 Continuous Source-Drain Diode Current t_g t_g t_g t_g Pulse Diode Forward Current t_g t_g t_g t_g t_g t_g Body Diode Voltage t_g </td <td>Gate Resistance</td> <td></td> <td>f = 1 MHz</td> <td>2</td> <td>10</td> <td>20</td> <td>Ω</td>	Gate Resistance		f = 1 MHz	2	10	20	Ω	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-On Delay Time	t _{d(on)}			24	36		
	Rise Time		$V_{DD} = -10 \text{ V}, R_{L} = 3.1 \Omega$		22	40		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-Off Delay Time	t _{d(off)}	$I_D \cong -3.2 \text{ A}, V_{GEN} = -4.5 \text{ V}, R_g = 1 \Omega$		52	78		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Fall Time				11	20		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-On Delay Time	t _{d(on)}			8	16	ns	
Fall Time t_f 9 18 Drain-Source Body Diode Characteristics Continuous Source-Drain Diode Current t_S $t_C = 25 ^{\circ}\text{C}$ -1.4 Pulse Diode Forward Current t_S $t_S = -3.2 ^{\circ}\text{A}$, $t_S = 0 ^{\circ}\text{C}$ -0.79 -1.2 V Body Diode Reverse Recovery Time t_T Body Diode Reverse Recovery Charge t_S $t_S = -3.2 ^{\circ}\text{A}$, $t_S = -3.2 ^{\circ}\text{A}$	Rise Time	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			9	18		
	Turn-Off Delay Time	t _{d(off)}	$I_D \cong -3.2 \text{ A}, V_{GEN} = -8 \text{ V}, R_g = 1 \Omega$		58	87		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Fall Time				9	18		
Pulse Diode Forward Current I_{SM} -20 Body Diode Voltage V_{SD} $I_S = -3.2 \text{ A}, V_{GS} = 0 \text{ V}$ -0.79 -1.2 V Body Diode Reverse Recovery Time t_{rr} Body Diode Reverse Recovery Charge Q_{rr} Reverse Recovery Fall Time t_a $I_F = -3.2 \text{ A}, dI/dt = 100 \text{ A/µs}, T_J = 25 ^{\circ}\text{C}$ 8								
Pulse Diode Forward Current I_{SM} -20 Body Diode Voltage V_{SD} $I_S = -3.2 \text{ A}, V_{GS} = 0 \text{ V}$ -0.79 -1.2 V_{SD} Body Diode Reverse Recovery Time V_{rr} -0.79 -1.2 V_{SD} Body Diode Reverse Recovery Charge V_{rr} -0.79 -1.2 -0.79 -0.79 -0.79 -0.79 -0.79 -0.79 -0.79 -0.79 -0.79 -0	Continuous Source-Drain Diode Current	I _S	T _C = 25 °C			- 1.4		
Body Diode Reverse Recovery Time t_{rr} Body Diode Reverse Recovery Charge Q_{rr} Reverse Recovery Fall Time t_a $I_F = -3.2 \text{ A, dl/dt} = 100 \text{ A/µs, T}_J = 25 \text{ °C}$ 8 Inside the second of the secon	Pulse Diode Forward Current	I _{SM}				- 20	A	
Body Diode Reverse Recovery Charge Q_{rr} $I_F = -3.2 \text{ A}, \text{ dI/dt} = 100 \text{ A/}\mu\text{s}, T_J = 25 °C$ 6 12 nC Reverse Recovery Fall Time t_a	Body Diode Voltage	V_{SD}	I _S = - 3.2 A, V _{GS} = 0 V		- 0.79	- 1.2	V	
Body Diode Reverse Recovery Charge Q_{rr}	Body Diode Reverse Recovery Time				14	25	ns	
Reverse Recovery Fall Time t _a 8	Body Diode Reverse Recovery Charge		_ 22 A dl/dt = 100 A/v = T		6	12	nC	
ns	Reverse Recovery Fall Time	t _a	$ 1_F = -3.2 \text{ A}, \text{ al/at} = 100 \text{ A/} \mu \text{s}, 1_J = 25 ^{\circ} \text{C}$		8			
	Reverse Recovery Rise Time				6		ns	

Notes:

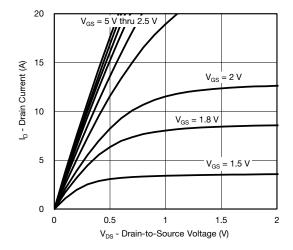
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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

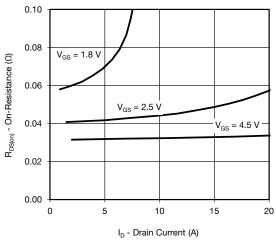
b. Guaranteed by design, not subject to production testing.



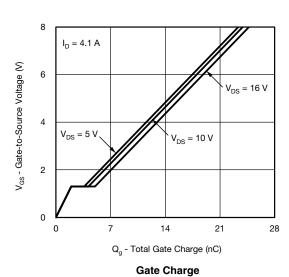
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

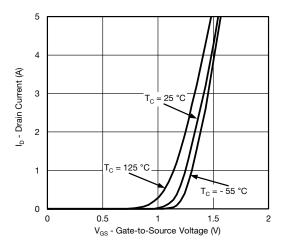


Output Characteristics

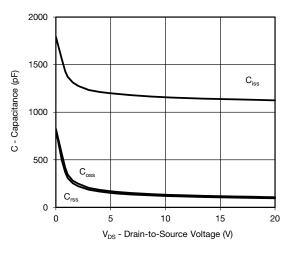


On-Resistance vs. Drain Current and Gate Voltage

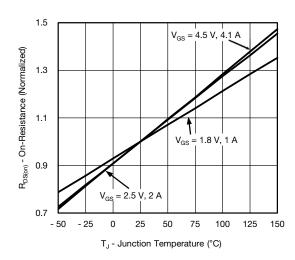




Transfer Characteristics



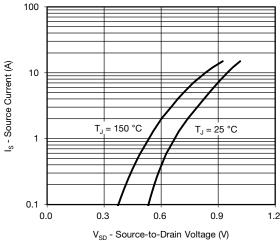
Capacitance



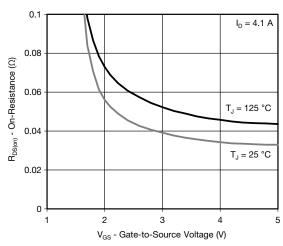
On-Resistance vs. Junction Temperature

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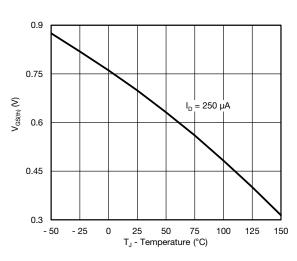
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



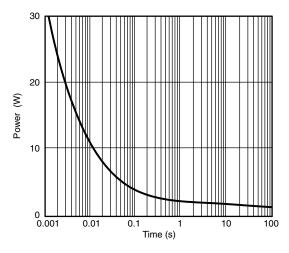
Source-Drain Diode Forward Voltage



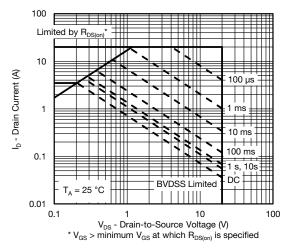
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



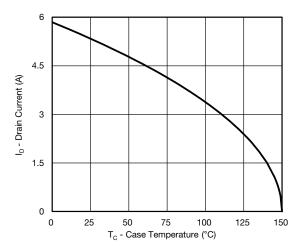
Single Pulse Power, Junction-to-Ambient

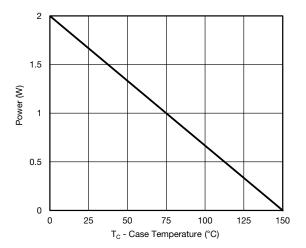


Safe Operating Area, Junction-to-Ambient



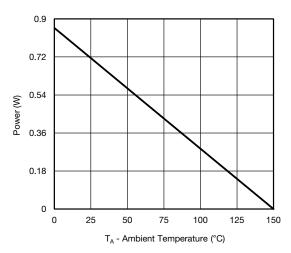
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)





Current Derating*

Power Derating, Junction-to-Foot



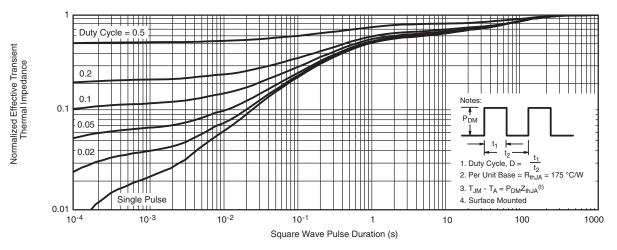
Power, Junction-to-Ambient

^{*} 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.

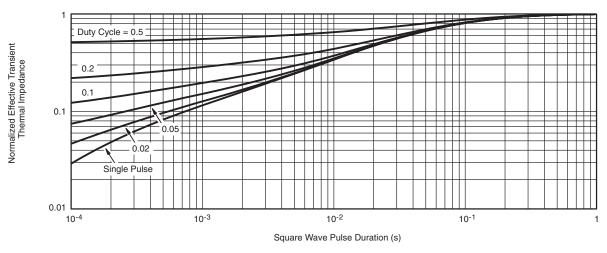
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TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient

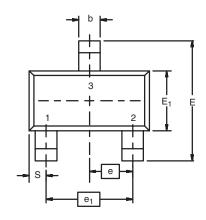


Normalized Thermal Transient Impedance, Junction-to-Foot

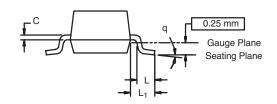
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SOT-23 (TO-236): 3-LEAD







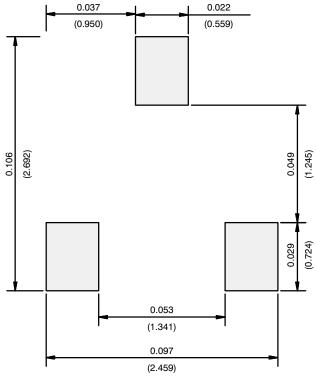
Dim	MILLIMETERS		INCHES			
	Min	Max	Min	Max		
Α	0.89	1.12	0.035	0.044		
A ₁	0.01	0.10	0.0004	0.004		
A ₂	0.88	1.02	0.0346	0.040		
b	0.35	0.50	0.014	0.020		
С	0.085	0.18	0.003	0.007		
D	2.80	3.04	0.110	0.120		
E	2.10	2.64	0.083	0.104		
E ₁	1.20	1.40	0.047	0.055		
е	0.95 BSC		0.0374 Ref			
e ₁	1.90 BSC		0.0748 Ref			
L	0.40	0.60	0.016	0.024		
L ₁	0.64 Ref		0.025	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

Document Number: 71196 www.vishay.com 09-Jul-01



RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads Dimensions in Inches/(mm)

Return to Index

APPLICATION NOTE

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