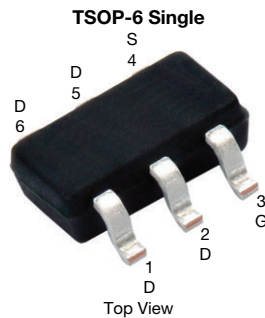


## P-Channel 20 V (D-S) MOSFET



Marking code: BQ

PRODUCT SUMMARY	
$V_{DS}$ (V)	-20
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -4.5$ V	0.0240
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -2.5$ V	0.0321
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = -1.8$ V	0.0511
$Q_g$ typ. (nC)	19.8
$I_D$ (A) <sup>a, d</sup>	-8
Configuration	Single

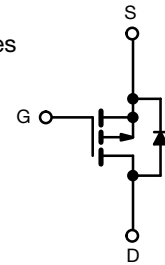
### FEATURES

- TrenchFET® Gen III p-channel power MOSFET
- $R_{DS(on)}$  rating at  $V_{GS} = -1.8$  V
- 100 %  $R_g$  and UIS tested
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


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

### APPLICATIONS

- Battery management in mobile devices
- Battery switch
- Load switch
- PA switch



P-Channel MOSFET

ORDERING INFORMATION	
Package	TSOP-6
Lead (Pb)-free and halogen-free	Si3493DDV-T1-GE3

ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		$V_{DS}$	-20	V
Gate-source voltage		$V_{GS}$	$\pm 8$	
Continuous drain current ( $T_J = 150$ °C)	$T_C = 25$ °C	$I_D$	-8 <sup>a</sup>	A
	$T_C = 70$ °C		-8	
	$T_A = 25$ °C		-7.5 <sup>b, c</sup>	
	$T_A = 70$ °C		-6 <sup>b, c</sup>	
Pulsed drain current ( $t = 100$ $\mu$ s)		$I_{DM}$	-32	A
Continuous source-drain diode current	$T_C = 25$ °C	$I_S$	-3	
	$T_A = 25$ °C		-1.67 <sup>b, c</sup>	
Single pulse avalanche current	L = 0.1 mH	$I_{AS}$	-10	mJ
Single pulse avalanche energy		$E_{AS}$	5	
Maximum power dissipation	$T_C = 25$ °C	$P_D$	3.6	W
	$T_C = 70$ °C		2.3	
	$T_A = 25$ °C		2 <sup>b, c</sup>	
	$T_A = 70$ °C		1.3 <sup>b, c</sup>	
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</sup>	$t \leq 5$ s	$R_{thJA}$	50	62.5	°C/W
Maximum junction-to-case (drain)	Steady state	$R_{thJC}$	28	35	

### Notes

- Package limited.
- Surface mounted on 1" x 1" FR4 board.
- $t = 5$  s.
- Maximum under steady state conditions is 110 °C/W.



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-source breakdown voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	-20	-	-	V
V <sub>DS</sub> temperature coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = -250 μA	-	-12	-	mV/°C
V <sub>GS(th)</sub> temperature coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>		-	2.5	-	
Gate-source threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	-0.4	-	-1	V
Gate-source leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 8 V	-	-	± 100	nA
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V	-	-	-1	μA
		V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 70 °C	-	-	-10	
On-state drain current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ -10 V, V <sub>GS</sub> = -4.5 V	-20	-	-	A
Drain-source on-state resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -7.5 A	-	0.0200	0.0240	Ω
		V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -6.4 A	-	0.0257	0.0321	
		V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -2 A	-	0.0378	0.0511	
Forward transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -7.5 A	-	30	-	S
<b>Dynamic <sup>b</sup></b>						
Input capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	1825	-	pF
Output capacitance	C <sub>OSS</sub>		-	210	-	
Reverse transfer capacitance	C <sub>RSS</sub>		-	200	-	
Total gate charge	Q <sub>g</sub>	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -8 V, I <sub>D</sub> = -7.5 A	-	34.8	52.2	nC
		V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -7.5 A	-	19.8	30	
Gate-source charge	Q <sub>gs</sub>		-	2.6	-	
Gate-drain charge	Q <sub>gd</sub>		-	3	-	
Gate resistance	R <sub>g</sub>	f = 1 MHz	2.12	10.6	21.2	Ω
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 1.67 Ω, I <sub>D</sub> ≅ -6 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	-	25	38	ns
Rise time	t <sub>r</sub>		-	30	45	
Turn-off delay time	t <sub>d(off)</sub>		-	95	145	
Fall time	t <sub>f</sub>		-	40	60	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 1.67 Ω, I <sub>D</sub> ≅ -6 A, V <sub>GEN</sub> = -8 V, R <sub>g</sub> = 1 Ω	-	8	16	
Rise time	t <sub>r</sub>		-	20	30	
Turn-off delay time	t <sub>d(off)</sub>		-	115	173	
Fall time	t <sub>f</sub>		-	40	60	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	-	-	-8	A
Pulse diode forward current	I <sub>SM</sub>		-	-	-32	
Body diode voltage	V <sub>SD</sub>	I <sub>S</sub> = -6 A, V <sub>GS</sub> = 0 V	-	-0.8	-1.2	V
Body diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = -6 A, di/dt = 100 A/μs, T <sub>J</sub> = 25 °C	-	21	32	ns
Body diode reverse recovery charge	Q <sub>rr</sub>		-	9	18	nC
Reverse recovery fall time	t <sub>a</sub>		-	9	-	ns
Reverse recovery rise time	t <sub>b</sub>		-	12	-	

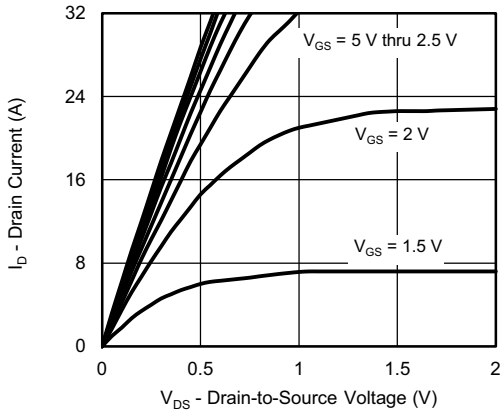
**Notes**

- a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
- b. Guaranteed by design, not subject to production testing.

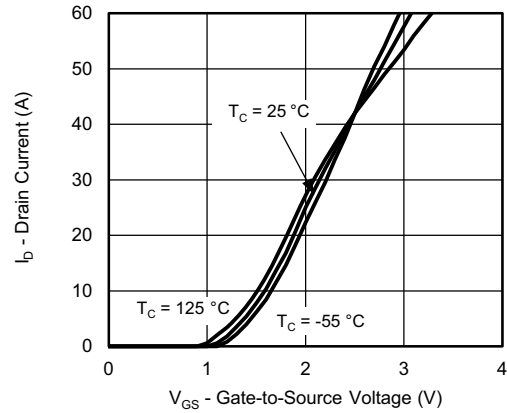
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



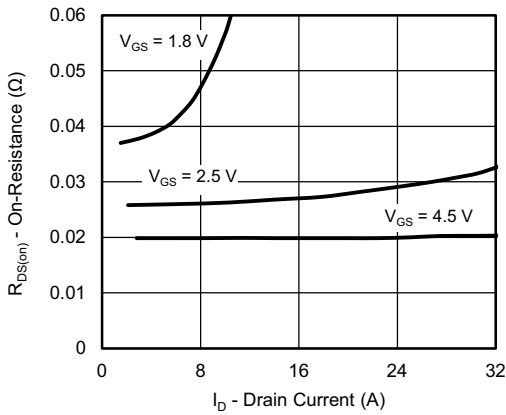
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



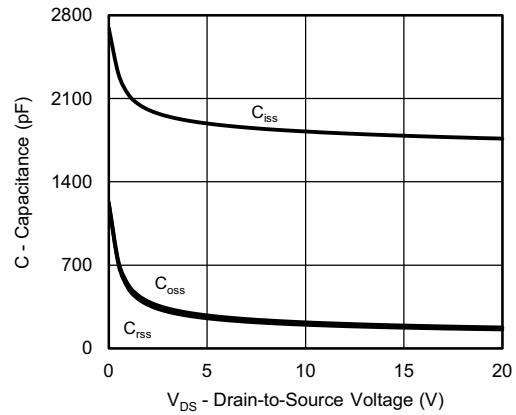
Output Characteristics



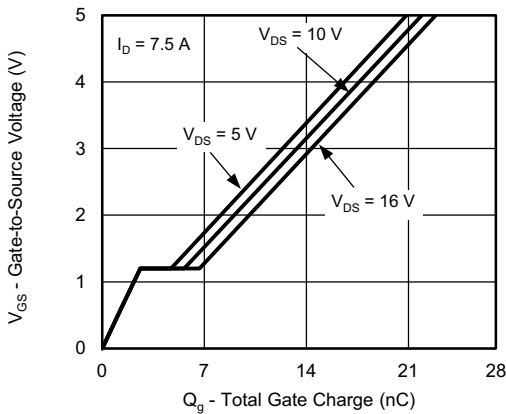
Transfer Characteristics



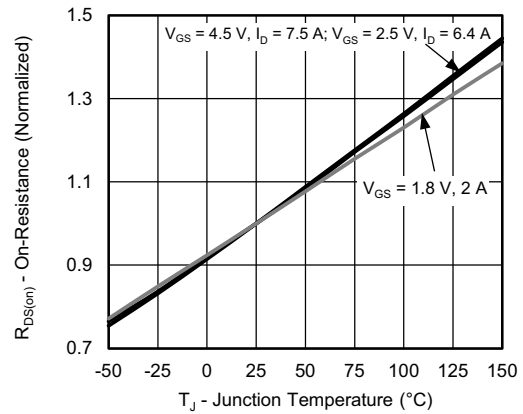
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



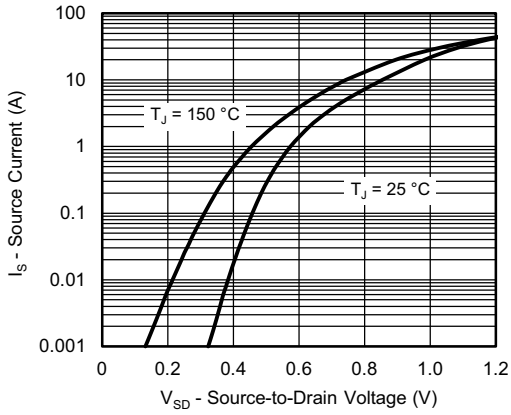
Gate Charge



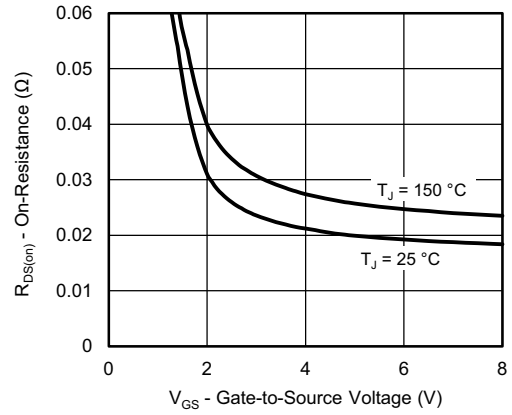
On-Resistance vs. Junction Temperature



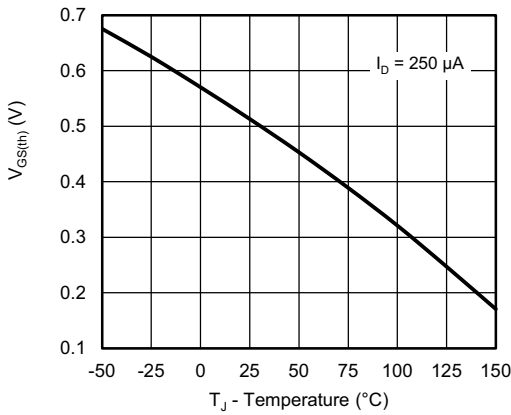
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



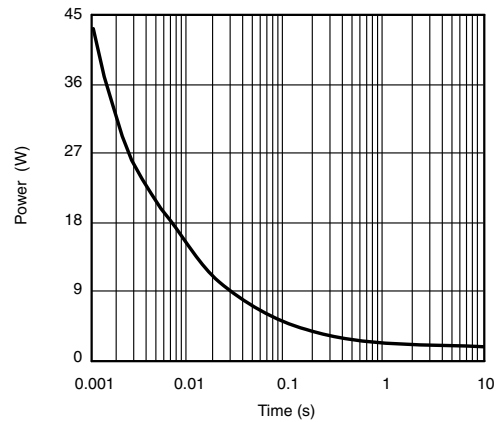
**Source-Drain Diode Forward Voltage**



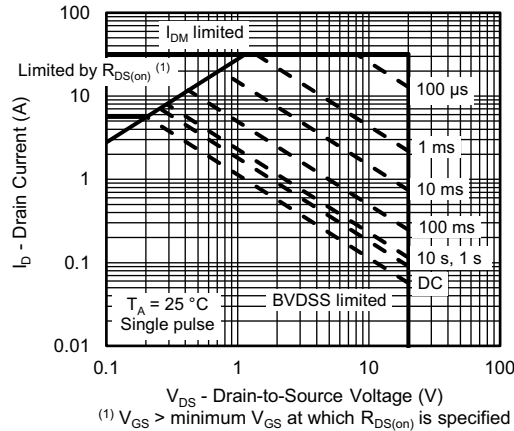
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



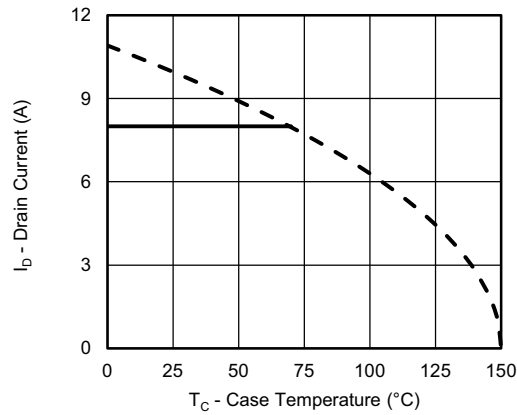
**Single Pulse Power, Junction-to-Ambient**



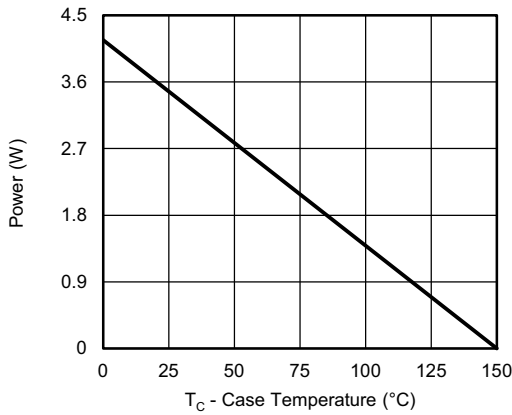
**Safe Operating Area, Junction-to-Ambient**



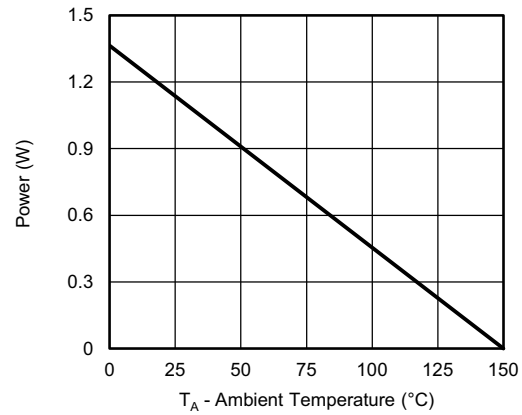
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Current Derating <sup>a</sup>**



**Power, Junction-to-Case**



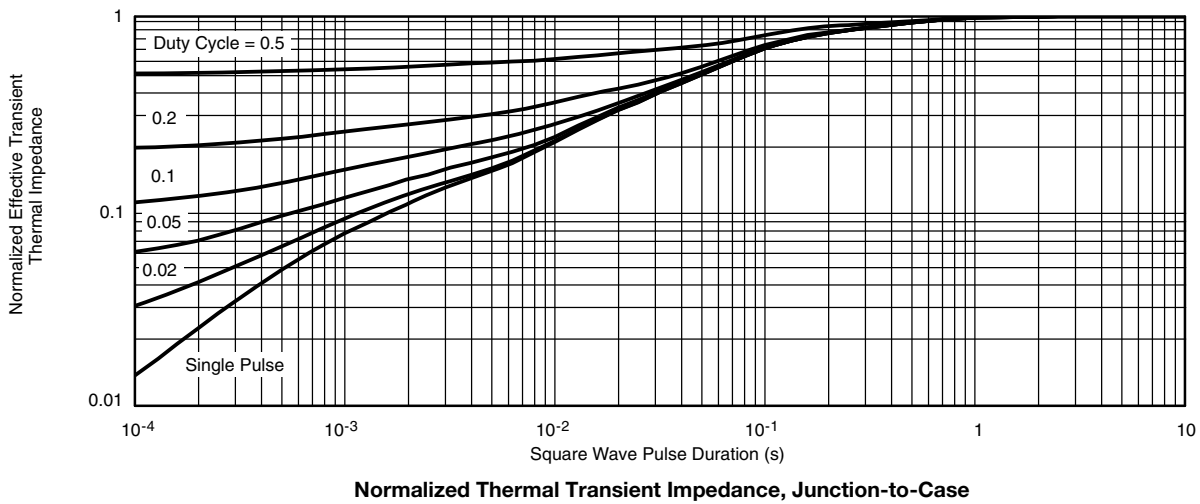
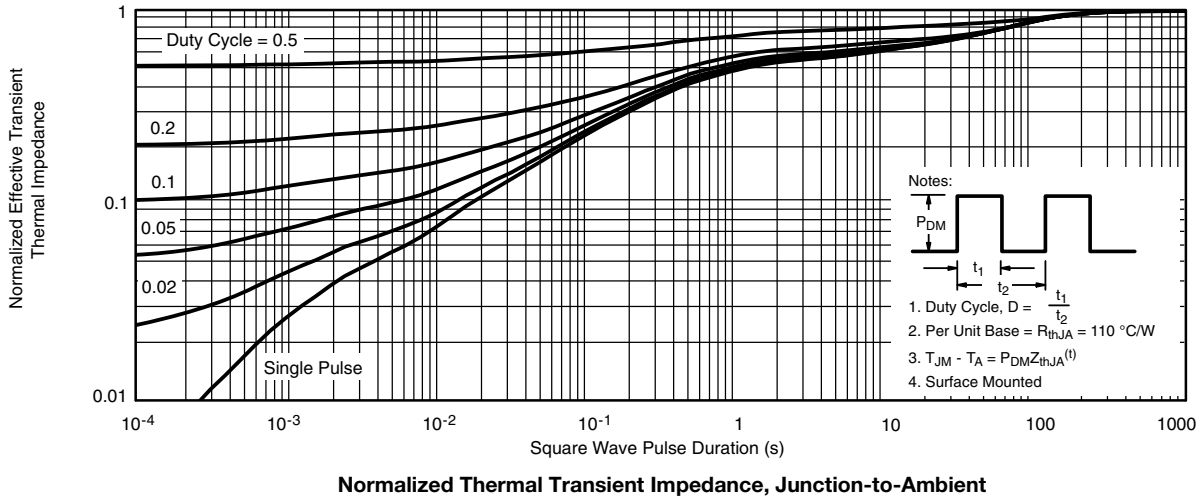
**Power, Junction-to-Ambient**

**Note**

- a. 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)



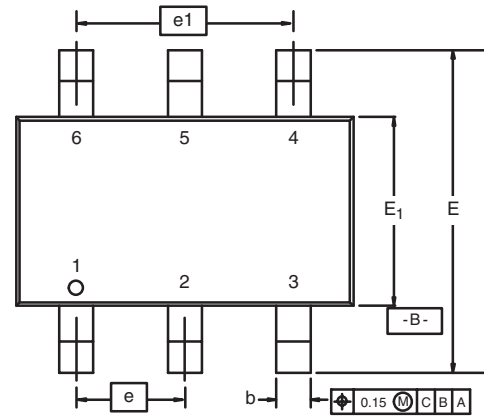
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## TSOP: 5/6-LEAD

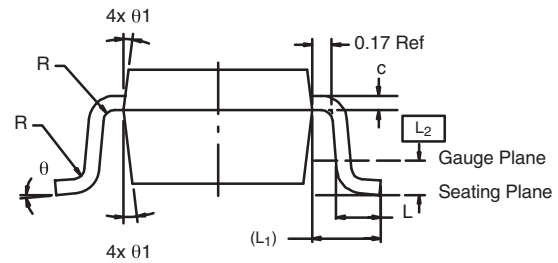
JEDEC Part Number: MO-193C



5-LEAD TSOP

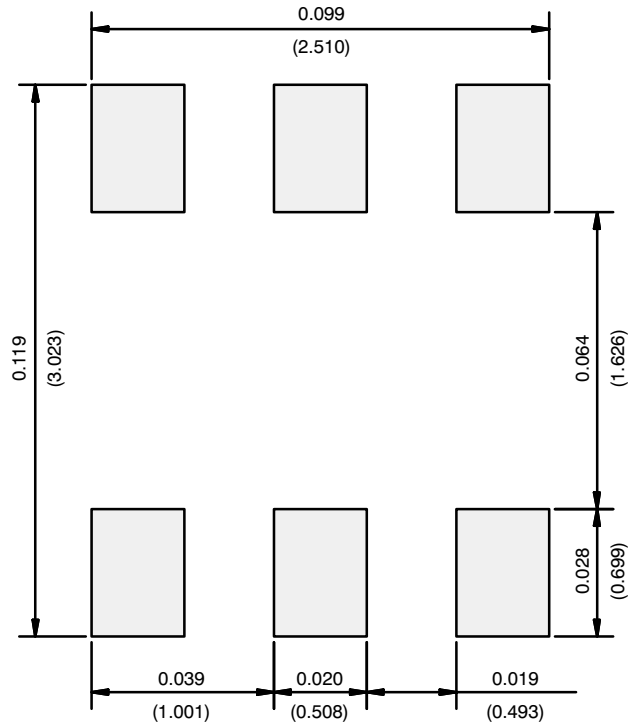


6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<b>A</b>	0.91	-	1.10	0.036	-	0.043
<b>A<sub>1</sub></b>	0.01	-	0.10	0.0004	-	0.004
<b>A<sub>2</sub></b>	0.90	-	1.00	0.035	0.038	0.039
<b>b</b>	0.30	0.32	0.45	0.012	0.013	0.018
<b>c</b>	0.10	0.15	0.20	0.004	0.006	0.008
<b>D</b>	2.95	3.05	3.10	0.116	0.120	0.122
<b>E</b>	2.70	2.85	2.98	0.106	0.112	0.117
<b>E<sub>1</sub></b>	1.55	1.65	1.70	0.061	0.065	0.067
<b>e</b>	0.95 BSC			0.0374 BSC		
<b>e<sub>1</sub></b>	1.80	1.90	2.00	0.071	0.075	0.079
<b>L</b>	0.32	-	0.50	0.012	-	0.020
<b>L<sub>1</sub></b>	0.60 Ref			0.024 Ref		
<b>L<sub>2</sub></b>	0.25 BSC			0.010 BSC		
<b>R</b>	0.10	-	-	0.004	-	-
<b>θ</b>	0°	4°	8°	0°	4°	8°
<b>θ<sub>1</sub></b>	7° Nom			7° Nom		
ECN: C-06593-Rev. I, 18-Dec-06						
DWG: 5540						

## RECOMMENDED MINIMUM PADS FOR TSOP-6



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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