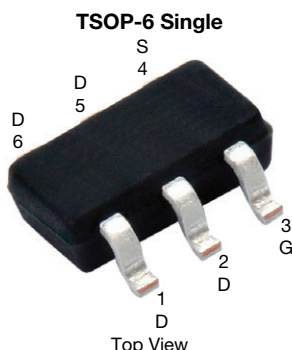


Automotive P-Channel 20 V (D-S) 175 °C MOSFET

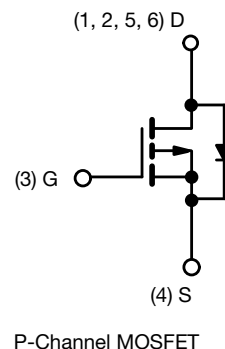

Marking Code: 9D

PRODUCT SUMMARY	
V_{DS} (V)	-20
$R_{DS(on)}$ (Ω) at $V_{GS} = -4.5$ V	0.021
$R_{DS(on)}$ (Ω) at $V_{GS} = -2.5$ V	0.032
I_D (A)	-8
Configuration	Single
Package	TSOP-6

FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified ^c
- 100 % R_g and UIS tested
- Material categorization:
for definitions of compliance please see
www.vishay.com/doc?99912

AUTOMOTIVE
GRADE

RoHS
COMPLIANT
HALOGEN
FREE


ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		V_{DS}	-20	V
Gate-source voltage		V_{GS}	± 12	
Continuous drain current	$T_C = 25$ °C	I_D	-8	
	$T_C = 125$ °C		-7	A
Continuous source current (diode conduction)		I_S	-4.5	
Pulsed drain current ^a		I_{DM}	-32	
Single pulse avalanche current		I_{AS}	-17	
Single pulse avalanche energy		E_{AS}	14.4	mJ
Maximum power dissipation ^a	$T_C = 25$ °C	P_D	5	W
	$T_C = 125$ °C		1.67	
Operating junction and storage temperature range		T_J, T_{stg}	-55 to +175	°C

THERMAL RESISTANCE RATINGS				
PARAMETER		SYMBOL	LIMIT	UNIT
Junction-to-ambient	PCB mount ^b	R_{thJA}	110	°C/W
Junction-to-foot (drain)		R_{thJF}	30	

Notes

- Pulse test; pulse width ≤ 300 μ s, duty cycle ≤ 2 %
- When mounted on 1" square PCB (FR4 material)
- Parametric verification ongoing



SPECIFICATIONS (T _C = 25 °C, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	V _{DS}	V _{GS} = 0, I _D = -250 μA		-20	-	-	V
Gate-source threshold voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = -250 μA		-0.6	-1	-1.4	
Gate-source leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 12 V		-	-	± 100	nA
Zero gate voltage drain current	I _{DSS}	V _{GS} = 0 V	V _{DS} = -20 V	-	-	-1	μA
		V _{GS} = 0 V	V _{DS} = -20 V, T _J = 125 °C	-	-	-50	
		V _{GS} = 0 V	V _{DS} = -20 V, T _J = 175 °C	-	-	-150	
On-state drain current ^a	I _{D(on)}	V _{GS} = -4.5 V	V _{DS} ≤ -5 V	-15	-	-	A
Drain-source on-state resistance ^a	R _{DS(on)}	V _{GS} = -4.5 V	I _D = -5 A	-	0.016	0.021	Ω
		V _{GS} = -4.5 V	I _D = -5 A, T _J = 125 °C	-	-	0.034	
		V _{GS} = -4.5 V	I _D = -5 A, T _J = 175 °C	-	-	0.034	
		V _{GS} = -2.5 V	I _D = -4 A	-	0.026	0.032	
Forward transconductance ^a	g _{fs}	V _{DS} = -10 V, I _D = -5.6 A		-	24	-	S
Dynamic ^b							
Input capacitance	C _{iss}	V _{GS} = 0 V	V _{DS} = -10 V, f = 1 MHz	-	2354	3300	pF
Output capacitance	C _{oss}			-	298	420	
Reverse transfer capacitance	C _{rss}			-	290	405	
Total gate charge ^c	Q _g	V _{GS} = -4.5 V	V _{DS} = -10 V, I _D = -7.9 A	-	22.7	34	nC
Gate-source charge ^c	Q _{gs}			-	4.5	-	
Gate-drain charge ^c	Q _{gd}			-	6.4	-	
Gate resistance	R _g	f = 1 MHz		2.3	5.9	9.4	Ω
Turn-on delay time ^c	t _{d(on)}	V _{DD} = -10 V, R _L = 1.27 Ω I _D ≅ -7.9 A, V _{GEN} = -4.5 V, R _g = 1 Ω		-	18	25	ns
Rise time ^c	t _r			-	41	58	
Turn-off delay time ^c	t _{d(off)}			-	54	76	
Fall time ^c	t _f			-	51	71	
Source-Drain Diode Ratings and Characteristics ^b							
Pulsed current ^a	I _{SM}			-	-	-32	A
Forward voltage	V _{SD}	I _F = -5 A, V _{GS} = 0 V		-	-0.8	-1.2	V

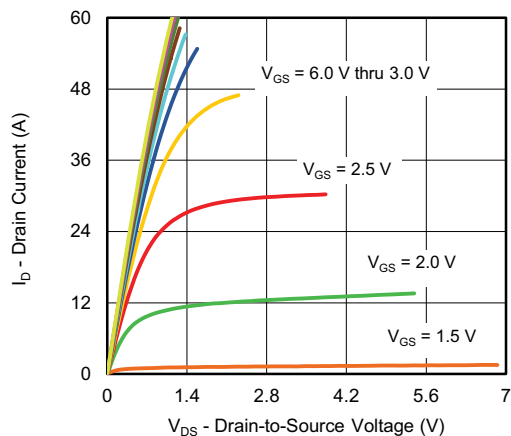
Notes

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

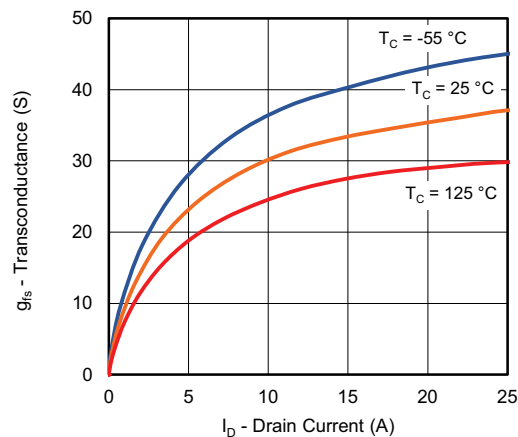
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



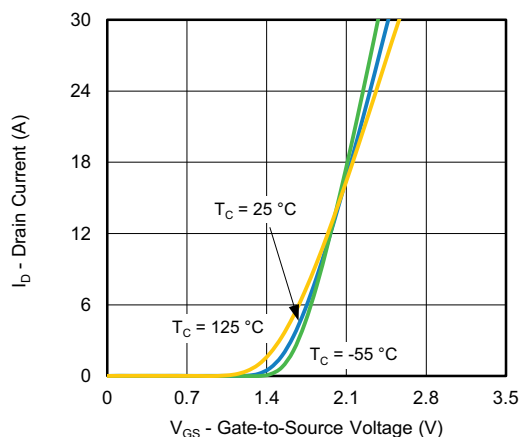
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)



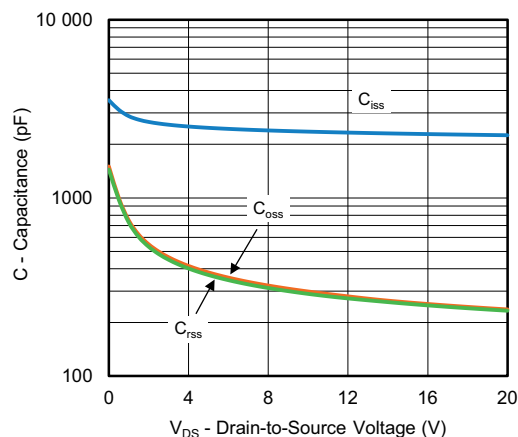
Output Characteristics



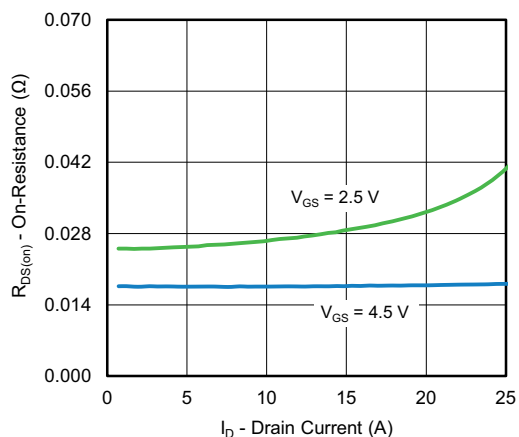
Transconductance



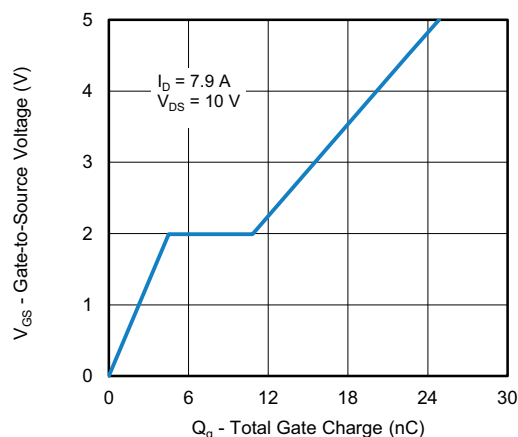
Transfer Characteristics



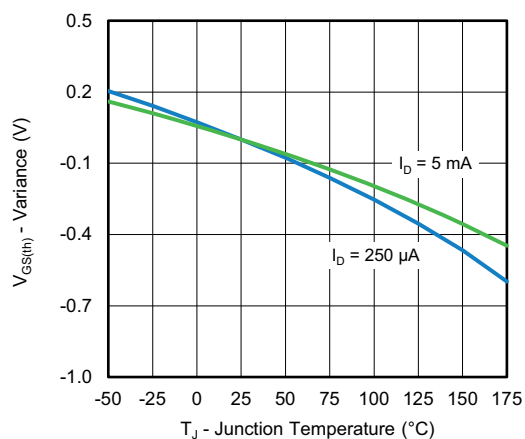
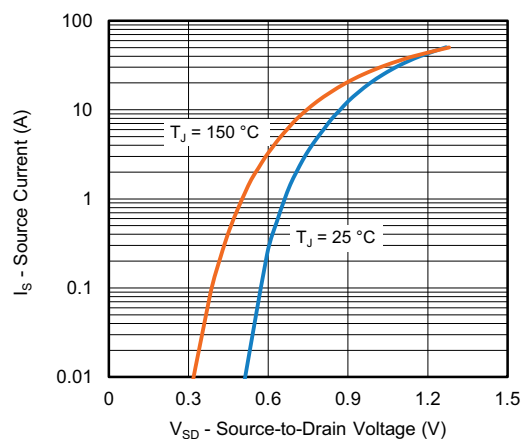
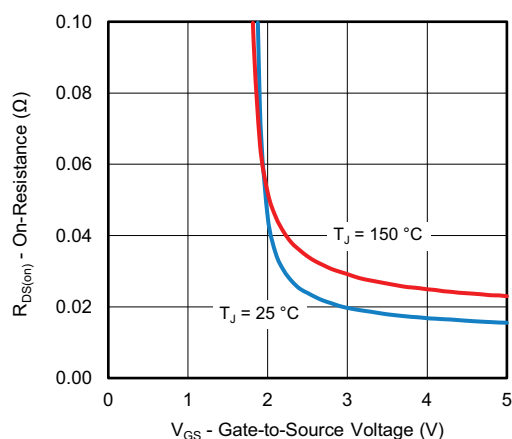
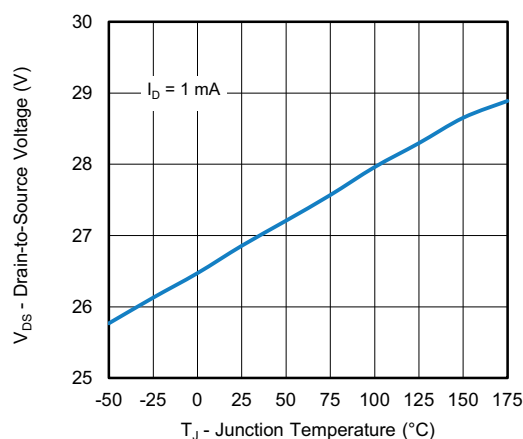
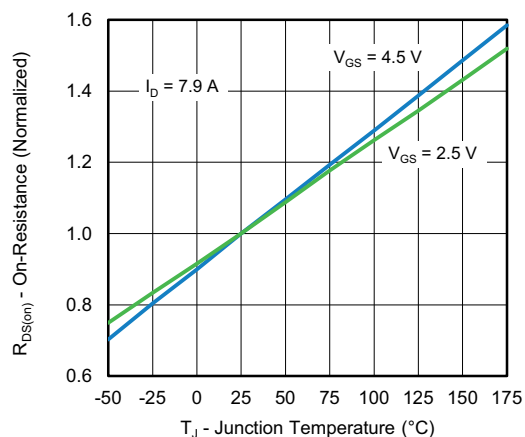
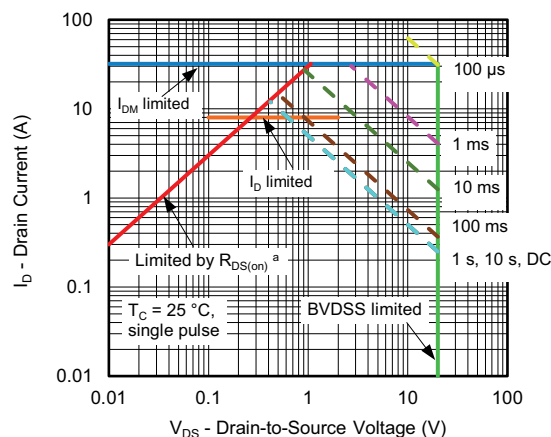
Capacitance



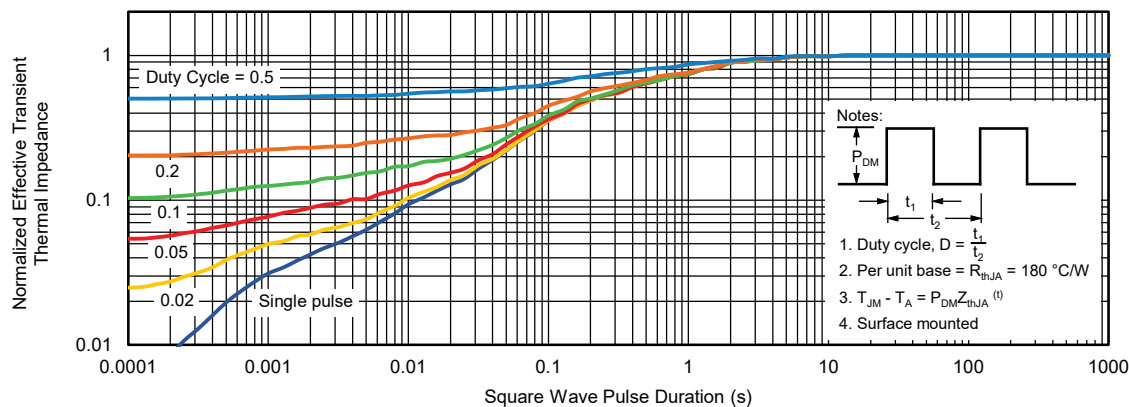
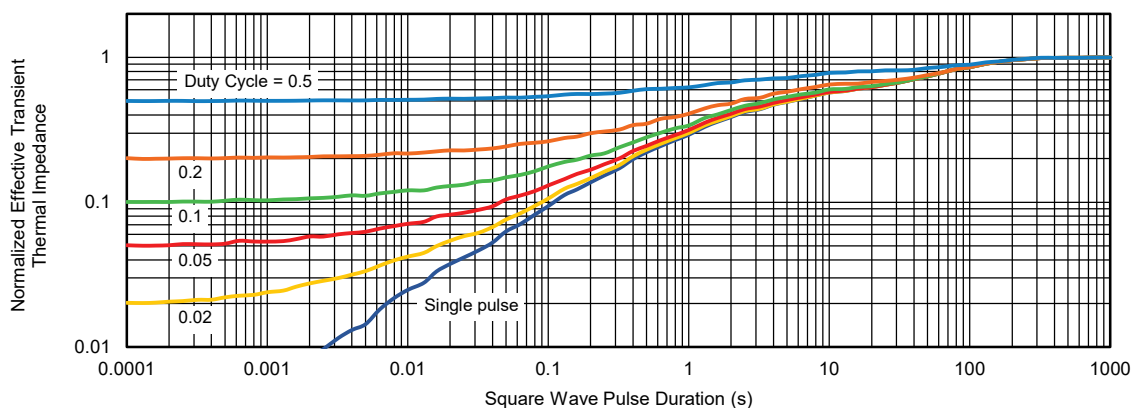
On-Resistance vs. Drain Current



Gate Charge

TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Threshold Voltage

Source Drain Diode Forward Voltage

On-Resistance vs. Gate-to-Source Voltage

Drain Source Breakdown vs. Junction Temperature

On-Resistance vs. Junction Temperature

Safe Operating Area
Note

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

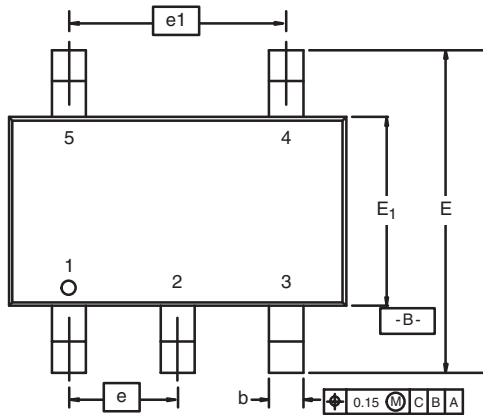
THERMAL RATINGS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Normalized Thermal Transient Impedance, Junction-to-Ambient

Normalized Thermal Transient Impedance, Junction-to-Foot
Note

- The characteristics shown in the two graphs
 - Normalized Transient Thermal Impedance Junction-to-Ambient ($25\text{ }^{\circ}\text{C}$)
 - Normalized Transient Thermal Impedance Junction-to-Case ($25\text{ }^{\circ}\text{C}$)
 are given for general guidelines only to enable the user to get a "ball park" indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions

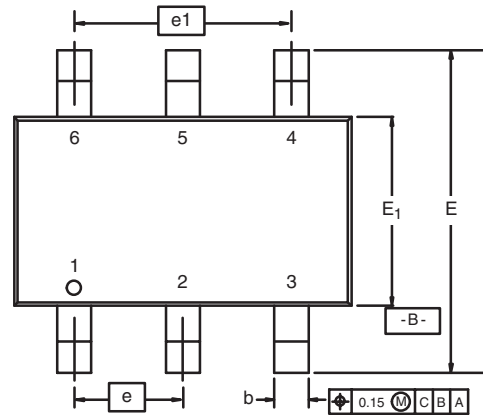
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TSOP: 5/6-LEAD

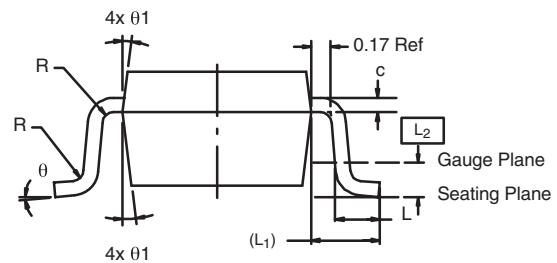
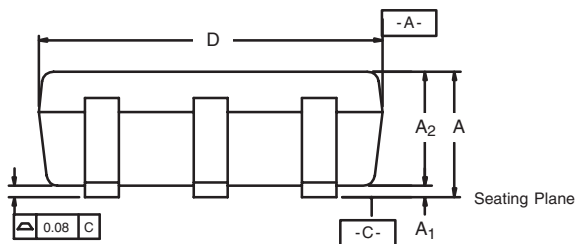
JEDEC Part Number: MO-193C



5-LEAD TSOP

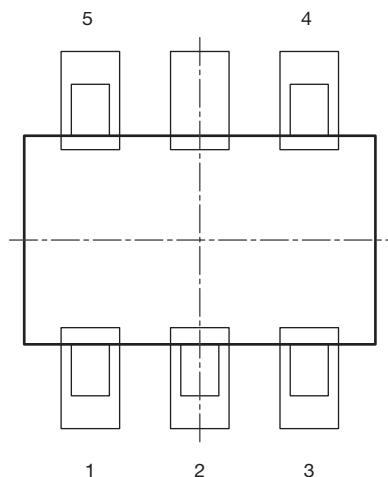


6-LEAD TSOP

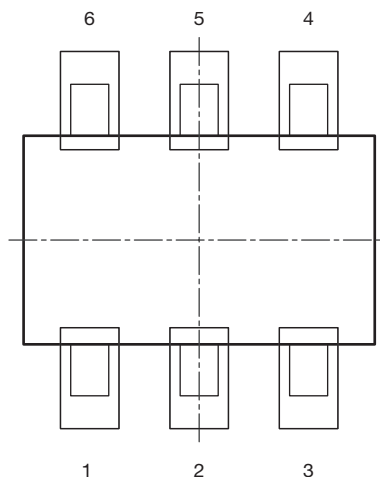


Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.91	-	1.10	0.036	-	0.043
A ₁	0.01	-	0.10	0.0004	-	0.004
A ₂	0.90	-	1.00	0.035	0.038	0.039
b	0.30	0.32	0.45	0.012	0.013	0.018
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.95	3.05	3.10	0.116	0.120	0.122
E	2.70	2.85	2.98	0.106	0.112	0.117
E ₁	1.55	1.65	1.70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

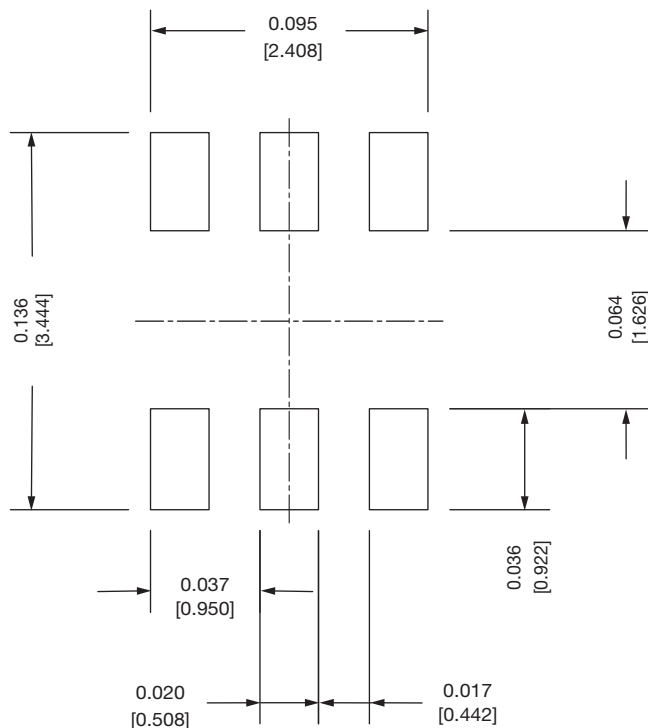
Recommended Land Pattern For TSOP-5L / TSOP-6L



TSOP 5L



TSOP 6L


Note

- All dimensions are in inches (millimeter)

ECN: C22-0860-Rev. B, 24-Oct-2022
DWG: 3010



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