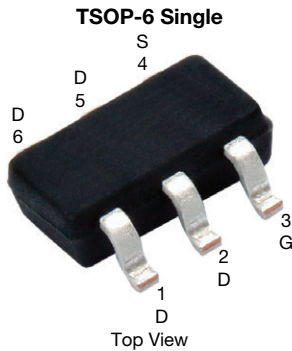


## Automotive P-Channel 20 V (D-S) 175 °C MOSFET



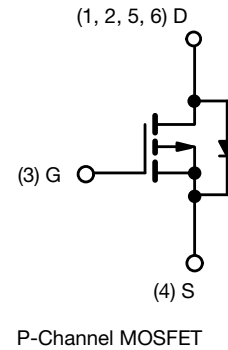
Marking Code: 9D

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

### FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified <sup>c</sup>
- 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)

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		$V_{GS}$	$\pm 12$	
Continuous drain current	$T_C = 25$ °C	$I_D$	-8	A
	$T_C = 125$ °C		-7	
Continuous source current (diode conduction)		$I_S$	-4.5	
Pulsed drain current <sup>a</sup>		$I_{DM}$	-32	
Single pulse avalanche current	L = 0.1 mH	$I_{AS}$	-17	
Single pulse avalanche energy		$E_{AS}$	14.4	
Maximum power dissipation <sup>a</sup>	$T_C = 25$ °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 <sup>b</sup>	$R_{thJA}$	110	°C/W
Junction-to-foot (drain)		$R_{thJF}$	30	

### Notes

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



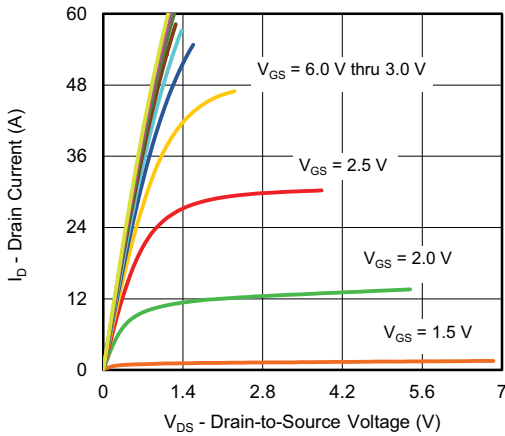
<b>SPECIFICATIONS</b> ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0, I_D = -250\text{ }\mu\text{A}$		-20	-	-	V
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$		-0.6	-1	-1.4	
Gate-source leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$		-	-	$\pm 100$	nA
Zero gate voltage drain current	$I_{DSS}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -20\text{ V}$	-	-	-1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$	$V_{DS} = -20\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	-50	
		$V_{GS} = 0\text{ V}$	$V_{DS} = -20\text{ V}, T_J = 175\text{ }^\circ\text{C}$	-	-	-150	
On-state drain current <sup>a</sup>	$I_{D(on)}$	$V_{GS} = -4.5\text{ V}$	$V_{DS} \leq -5\text{ V}$	-15	-	-	A
Drain-source on-state resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}$	$I_D = -5\text{ A}$	-	0.016	0.021	$\Omega$
		$V_{GS} = -4.5\text{ V}$	$I_D = -5\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	-	0.034	
		$V_{GS} = -4.5\text{ V}$	$I_D = -5\text{ A}, T_J = 175\text{ }^\circ\text{C}$	-	-	0.034	
		$V_{GS} = -2.5\text{ V}$	$I_D = -4\text{ A}$	-	0.026	0.032	
Forward transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = -10\text{ V}, I_D = -5.6\text{ A}$		-	24	-	S
<b>Dynamic <sup>b</sup></b>							
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$	$V_{DS} = -10\text{ V}, f = 1\text{ MHz}$	-	2354	3300	$\mu\text{F}$
Output capacitance	$C_{oss}$			-	298	420	
Reverse transfer capacitance	$C_{rss}$			-	290	405	
Total gate charge <sup>c</sup>	$Q_g$	$V_{GS} = -4.5\text{ V}$	$V_{DS} = -10\text{ V}, I_D = -7.9\text{ A}$	-	22.7	34	nC
Gate-source charge <sup>c</sup>	$Q_{gs}$			-	4.5	-	
Gate-drain charge <sup>c</sup>	$Q_{gd}$			-	6.4	-	
Gate resistance	$R_g$	f = 1 MHz		2.3	5.9	9.4	$\Omega$
Turn-on delay time <sup>c</sup>	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 1.27\text{ }\Omega$ $I_D \cong -7.9\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		-	18	25	ns
Rise time <sup>c</sup>	$t_r$			-	41	58	
Turn-off delay time <sup>c</sup>	$t_{d(off)}$			-	54	76	
Fall time <sup>c</sup>	$t_f$			-	51	71	
<b>Source-Drain Diode Ratings and Characteristics <sup>b</sup></b>							
Pulsed current <sup>a</sup>	$I_{SM}$			-	-	-32	A
Forward voltage	$V_{SD}$	$I_F = -5\text{ A}, V_{GS} = 0\text{ V}$		-	-0.8	-1.2	V

**Notes**

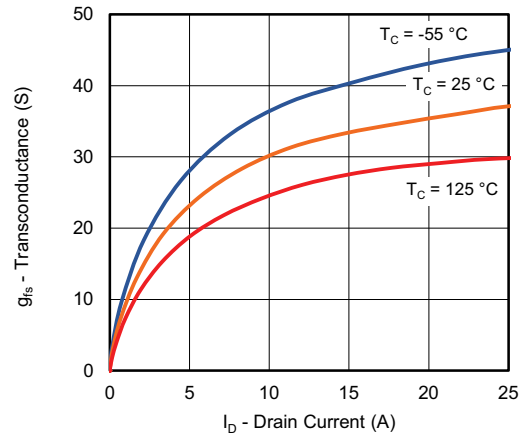
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$
- b. Guaranteed by design, not subject to production testing
- c. Independent of operating temperature

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.

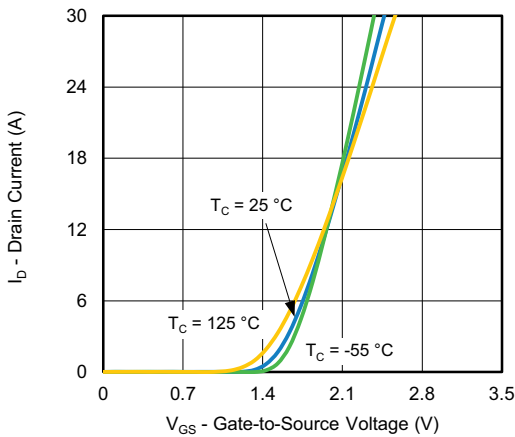
**TYPICAL CHARACTERISTICS** ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted)



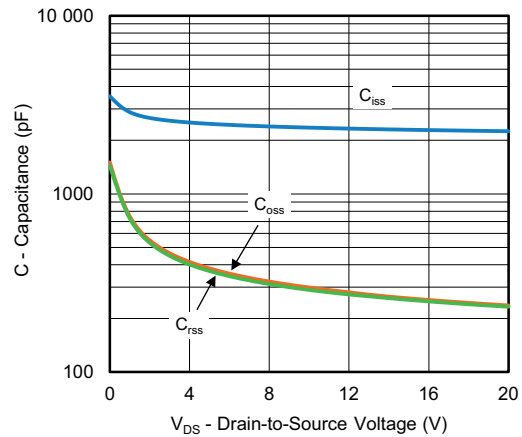
**Output Characteristics**



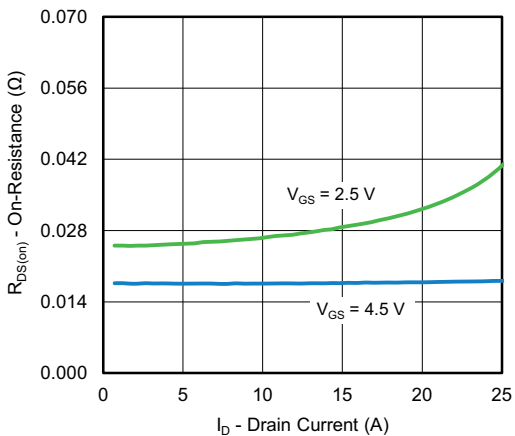
**Transconductance**



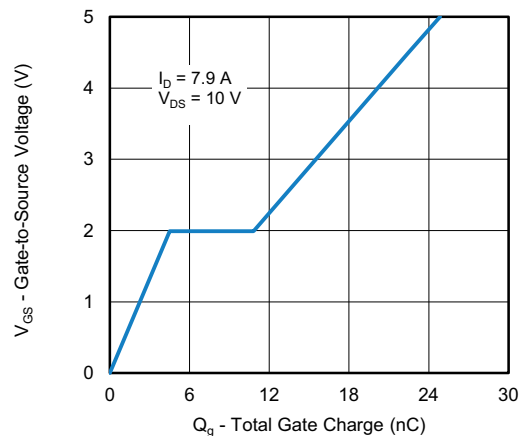
**Transfer Characteristics**



**Capacitance**



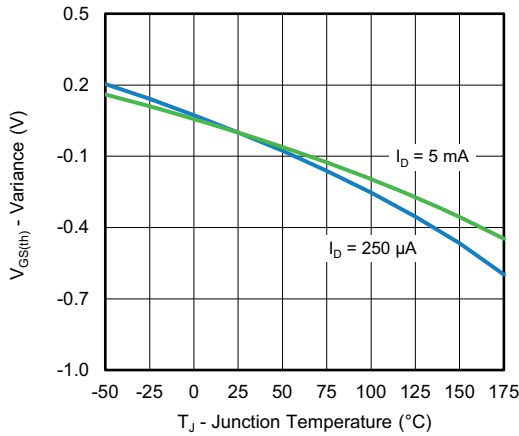
**On-Resistance vs. Drain Current**



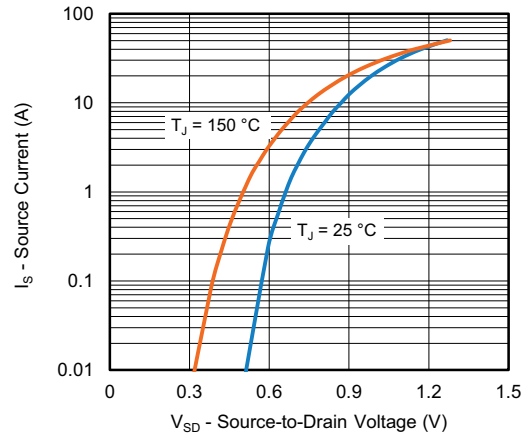
**Gate Charge**



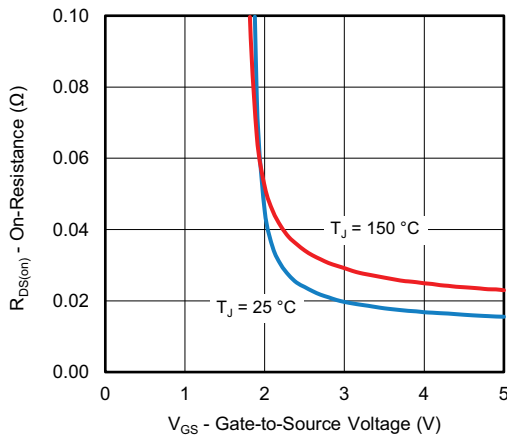
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



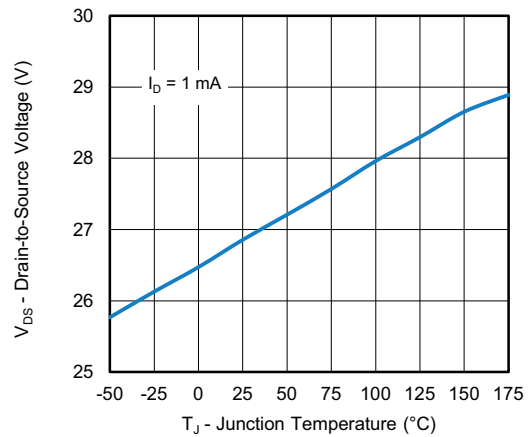
Threshold Voltage



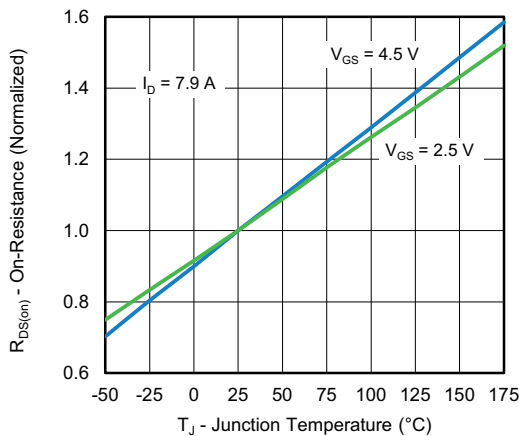
Source Drain Diode Forward Voltage



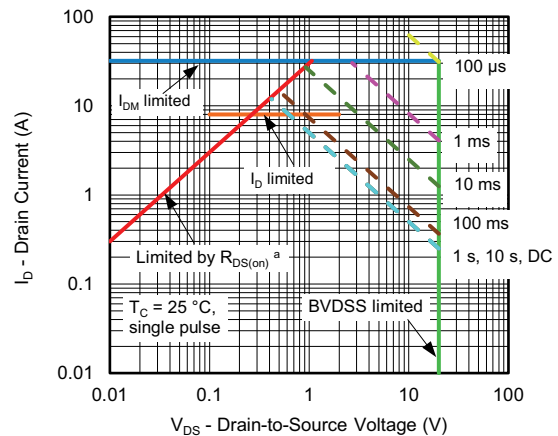
On-Resistance vs. Gate-to-Source Voltage



Drain Source Breakdown vs. Junction Temperature



On-Resistance vs. Junction Temperature

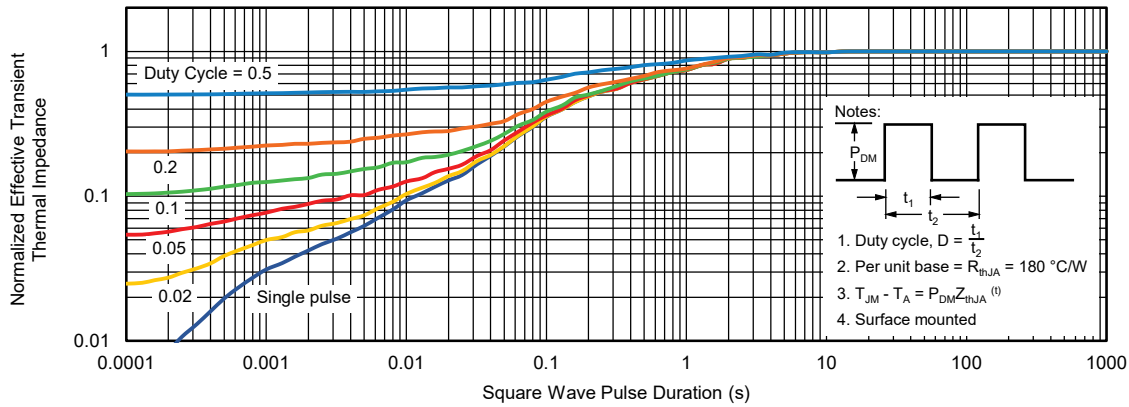


Safe Operating Area

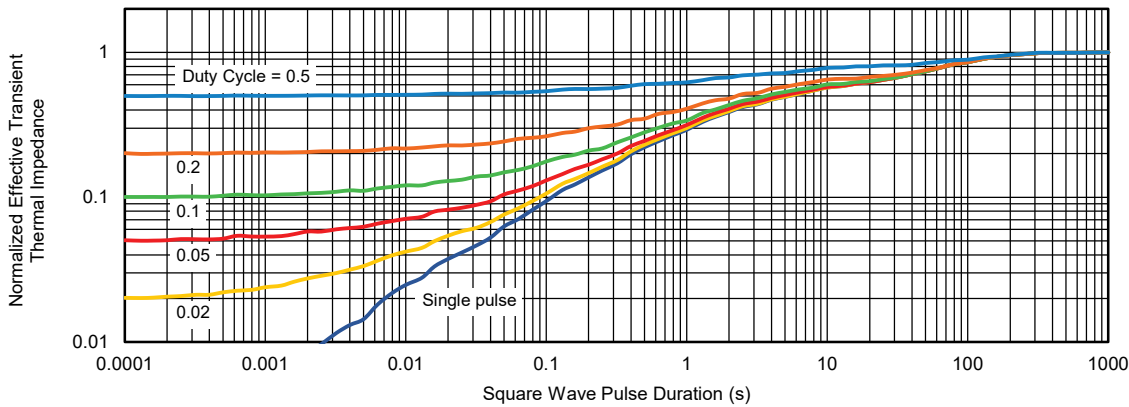
Note

a. V<sub>GS</sub> > minimum V<sub>GS</sub> at which R<sub>DS(on)</sub> 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**



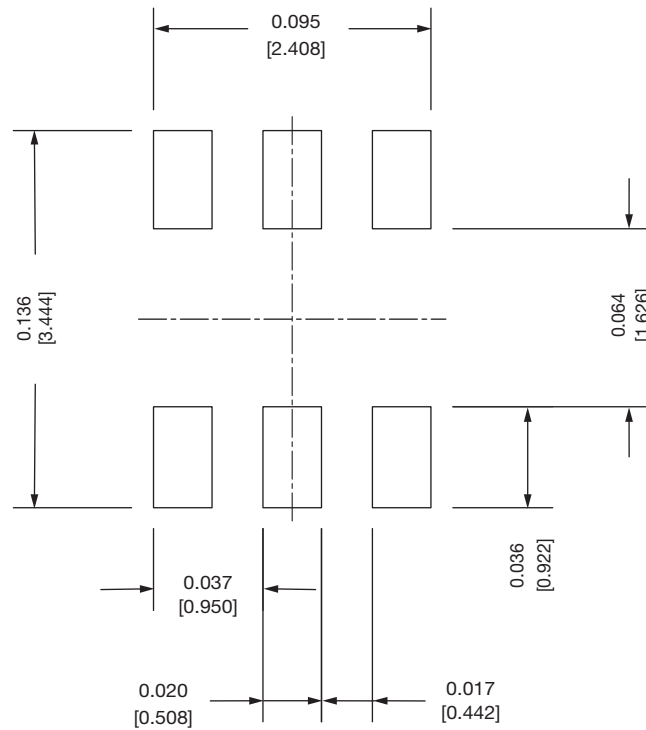
**6-LEAD TSOP**



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
<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 Land Pattern For 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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