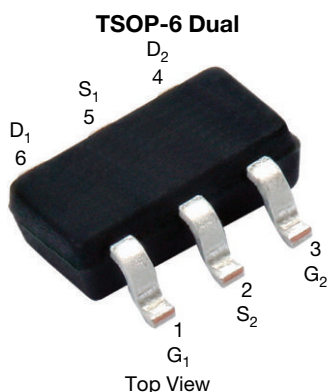


# Automotive N- and P-Channel 20 V (D-S) MOSFET



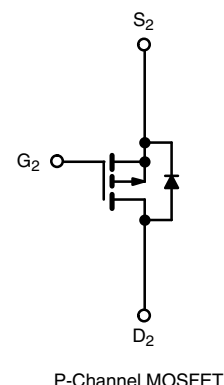
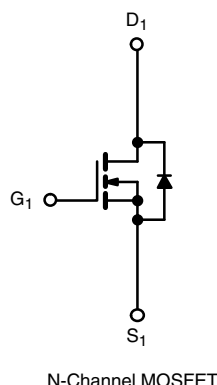
## FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified
- 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**

PRODUCT SUMMARY		
	N-CHANNEL	P-CHANNEL
$V_{DS}$ (V)	20	-20
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = 4.5$ V	0.077	0.166
$R_{DS(on)}$ ( $\Omega$ ) at $V_{GS} = \pm 2.5$ V	0.120	0.318
$I_D$ (A)	3.57	-2.5
Configuration	Dual	
Package	TSOP-6	



ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted)					
PARAMETER	SYMBOL	N-CHANNEL	P-CHANNEL	UNIT	
Drain-Source Voltage	$V_{DS}$	20	-20	V	
Gate-Source Voltage	$V_{GS}$	$\pm 12$	$\pm 12$		
Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>	$I_D$	$T_C = 25$ °C	-2.5	A	
		$T_C = 125$ °C	-1.45		
Pulsed Drain Current	$I_{DM}$	12	-10		
Continuous Source Current (Diode Conduction) <sup>a</sup>	$I_S$	2.1	-2.1	W	
Maximum Power Dissipation <sup>a</sup>	$P_D$	$T_C = 25$ °C	1.67		
		$T_C = 125$ °C	0.56		
Unclamped Inductive Surge UIS	$I_{AV}$	3.3	3	A	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175		°C	

THERMAL RESISTANCE RATINGS					
PARAMETER	SYMBOL		N-CHANNEL	P-CHANNEL	UNIT
			MAX.	MAX.	
Maximum Junction-to-Ambient <sup>a</sup>	Steady State	$R_{thJA}$	150	150	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	$R_{thJF}$	90	90	

## Note

a. Surface mounted on 1" x 1" FR4 board.

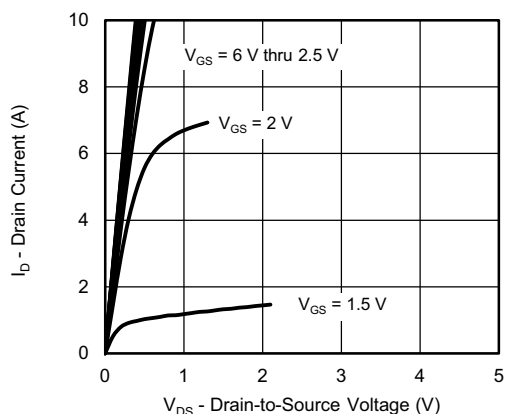
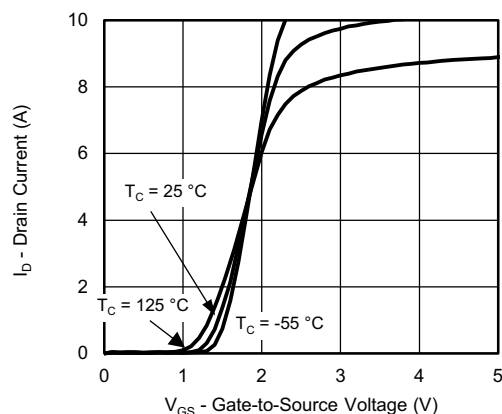
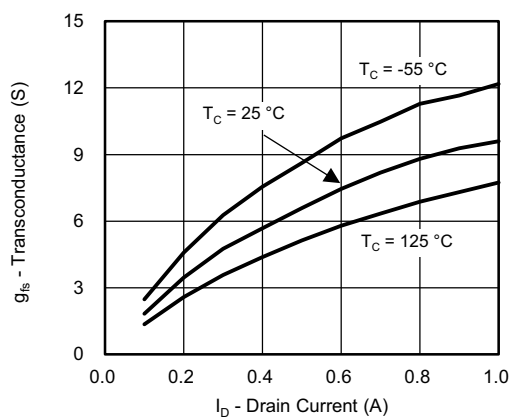
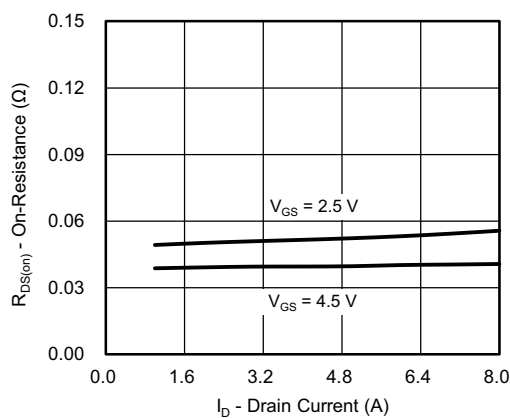
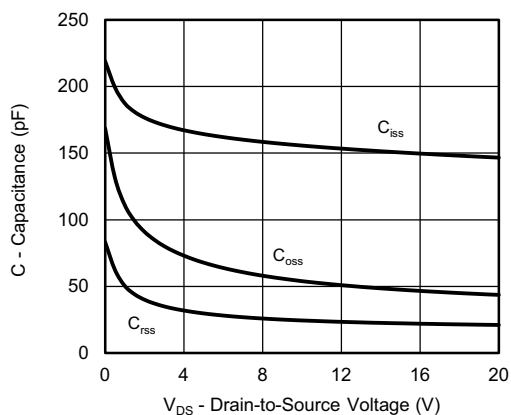
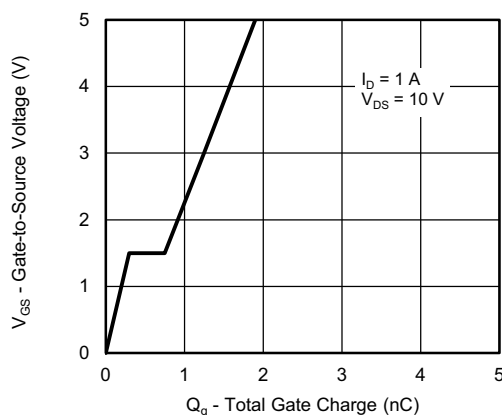


SPECIFICATIONS (T <sub>J</sub> = 25°C, unless otherwise noted)										
PARAMETER	SYMBOL	TEST CONDITIONS			MIN.	TYP.	MAX.	UNIT		
Static										
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA		N-Ch	0.6	-	1.5	V		
		V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA		P-Ch	-0.6	-	-1.5			
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 12 V		N-Ch	-	-	± 100	nA		
				P-Ch	-	-	± 100			
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 30 V	N-Ch	-	-	1	μA		
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -30 V	P-Ch	-	-	-1			
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = 30 V, T <sub>J</sub> = 55 °C	N-Ch	-	-	5			
		V <sub>GS</sub> = 0 V	V <sub>DS</sub> = -30 V, T <sub>J</sub> = 55 °C	P-Ch	-	-	-5			
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>GS</sub> = 4.5 V	V <sub>DS</sub> ≥ 5 V	N-Ch	5	-	-	A		
		V <sub>GS</sub> = -4.5 V	V <sub>DS</sub> ≤ -5 V	P-Ch	-5	-	-			
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 4.5 V	I <sub>D</sub> = 1 A	N-Ch	-	0.049	0.077	Ω		
		V <sub>GS</sub> = -4.5 V	I <sub>D</sub> = -1 A	P-Ch	-	0.140	0.166			
		V <sub>GS</sub> = 2.5 V	I <sub>D</sub> = 1 A	N-Ch	-	0.066	0.120			
		V <sub>GS</sub> = -2.5 V	I <sub>D</sub> = -1 A	P-Ch	-	0.265	0.318			
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 1 A		N-Ch	-	10	-	S		
		V <sub>DS</sub> = -5 V, I <sub>D</sub> = -1 A		P-Ch	-	3	-			
Diode Forward Voltage <sup>a</sup>	V <sub>SD</sub>	I <sub>S</sub> = 1.05 A, V <sub>GS</sub> = 0 V		N-Ch	-	0.80	1.10	V		
		I <sub>S</sub> = -1.05 A, V <sub>GS</sub> = 0 V		P-Ch	-	-0.83	-1.10			
Dynamic <sup>b</sup>										
Total Gate Charge	Q <sub>g</sub>	V <sub>GS</sub> = 4.5 V	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 A	N-Ch	-	1.8	2.5	nC		
		V <sub>GS</sub> = -4.5 V	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 A	P-Ch	-	2.4	3.5			
Gate-Source Charge	Q <sub>gs</sub>	V <sub>GS</sub> = 4.5 V	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 A	N-Ch	-	0.3	-			
		V <sub>GS</sub> = -4.5 V	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 A	P-Ch	-	0.4	-			
Gate-Drain Charge	Q <sub>gd</sub>	V <sub>GS</sub> = 4.5 V	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 A	N-Ch	-	0.4	-			
		V <sub>GS</sub> = -4.5 V	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 A	P-Ch	-	0.7	-			
Gate Resistance	R <sub>g</sub>	f = 1 MHz		N-Ch	3.4	-	9.1	Ω		
				P-Ch	3.4	-	9.1			
Turn-On Delay Time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 10 Ω I <sub>D</sub> ≅ 1 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 kΩ		N-Ch	-	9	12	ns		
Rise Time	t <sub>r</sub>			P-Ch	-	7	11			
				N-Ch	-	15	19			
				P-Ch	-	16	22			
Turn-Off Delay Time	t <sub>d(off)</sub>			P-Channel V <sub>DD</sub> = -10 V, R <sub>L</sub> = 10 Ω I <sub>D</sub> ≅ -1 A, V <sub>GEN</sub> = -10 V, R <sub>g</sub> = 1 kΩ		N-Ch	-		22	28
						P-Ch	-		29	40
Fall Time	t <sub>f</sub>			N-Ch	-	8	12			
				P-Ch	-	14	24			

**Notes**

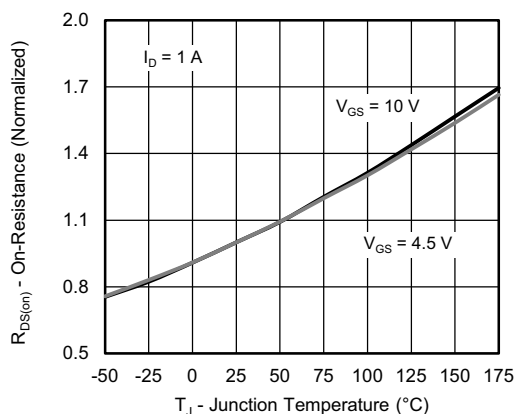
- a. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\ \%$ .  
b. Guaranteed by design, not subject to production testing.

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.

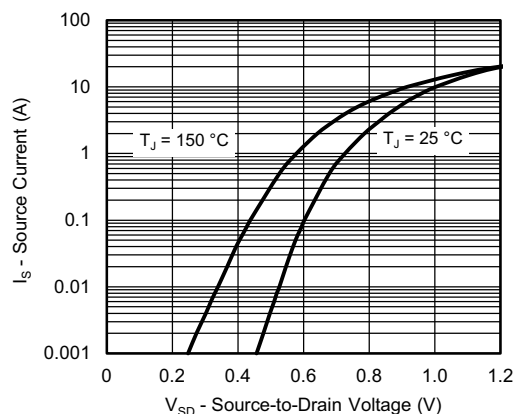
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C unless otherwise noted)

**Output Characteristics**

**Transfer Characteristics**

**Transconductance**

**On-Resistance vs. Drain Current**

**Capacitance**

**Gate Charge**



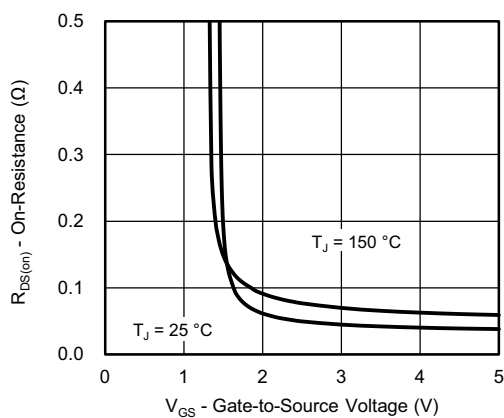
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C unless otherwise noted)



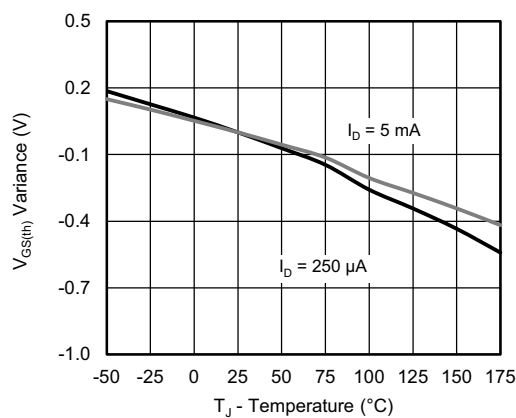
**On-Resistance vs. Junction Temperature**



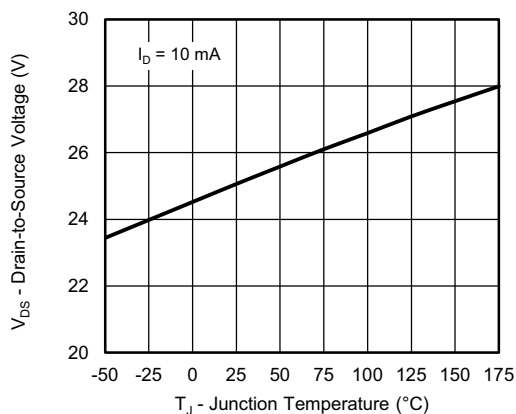
**Source-Drain Diode Forward Voltage**



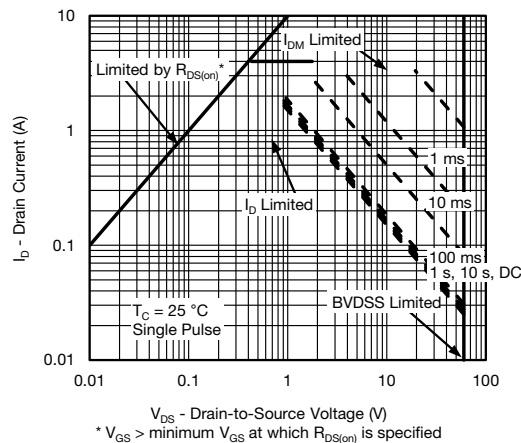
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



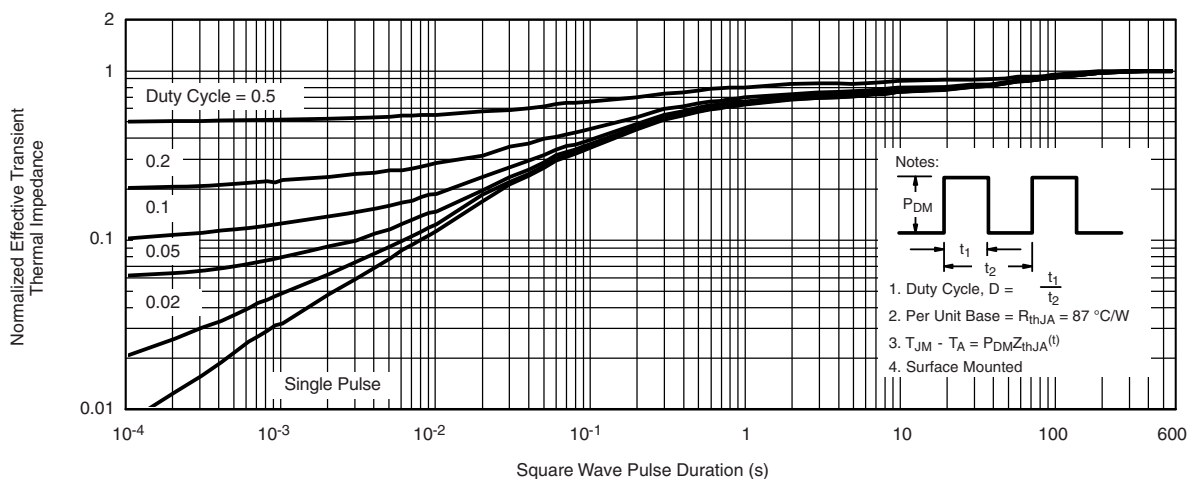
**Drain Source Breakdown vs. Junction Temperature**



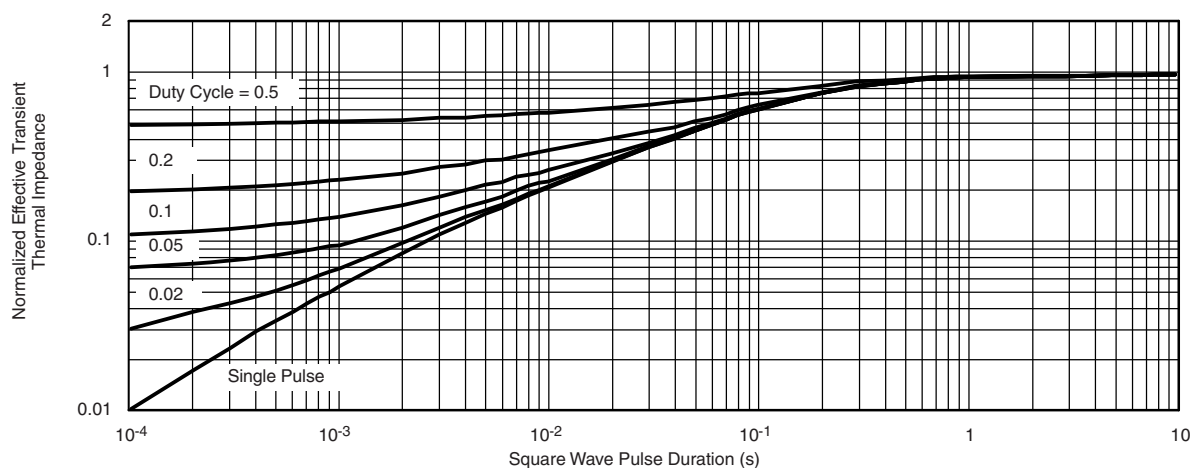
**Safe Operating Area, Junction-to-Case**



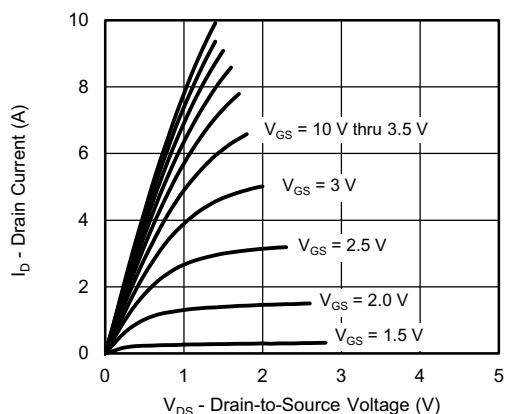
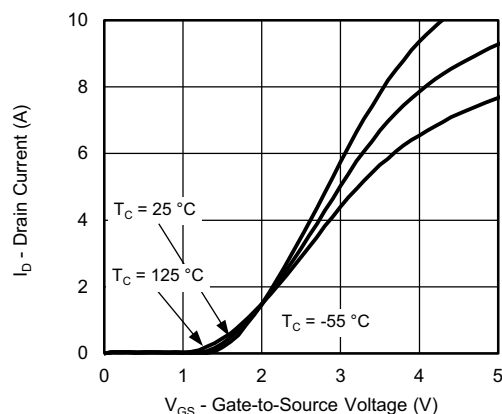
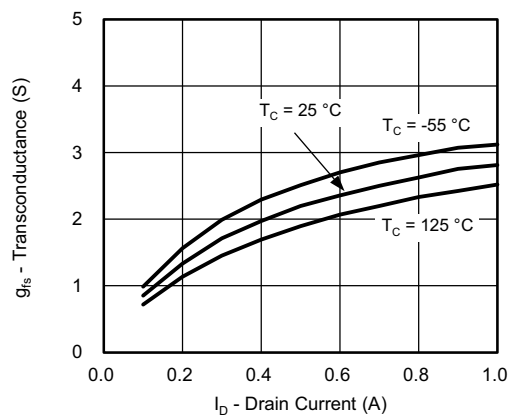
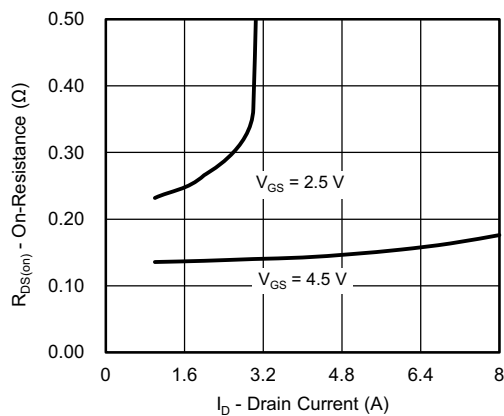
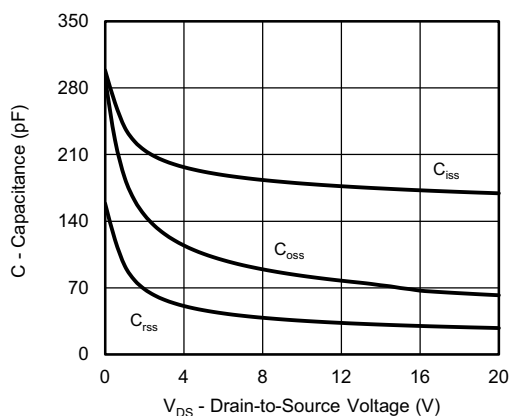
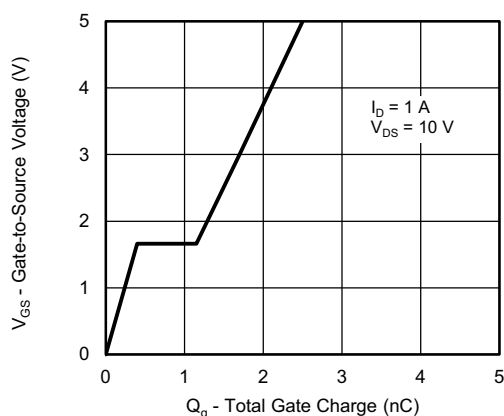
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C unless otherwise noted)

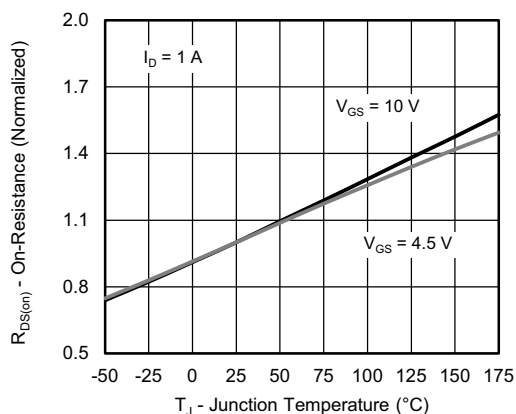
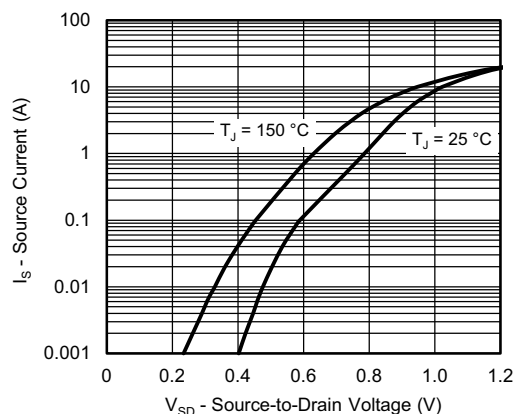
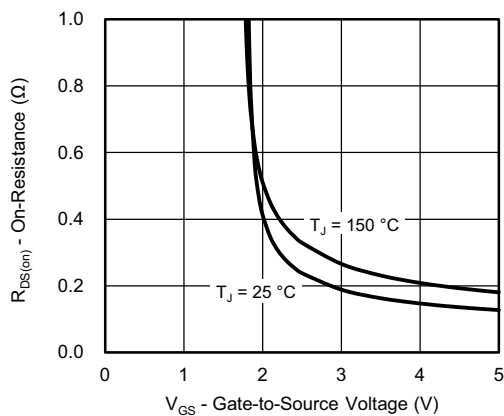
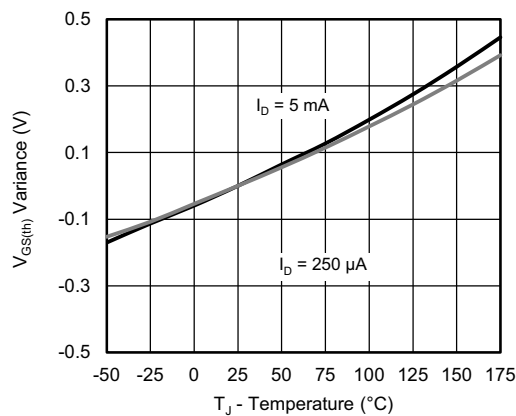
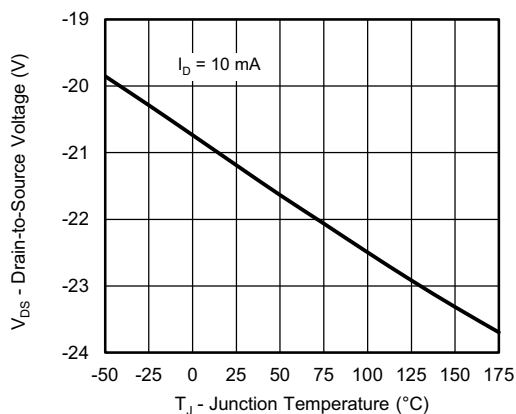
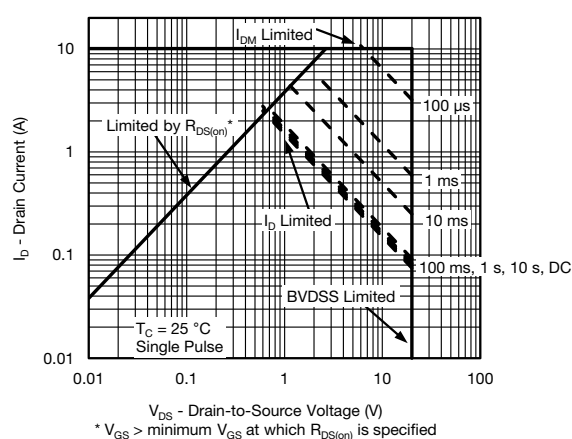


**Normalized Thermal Transient Impedance, Junction-to-Ambient**



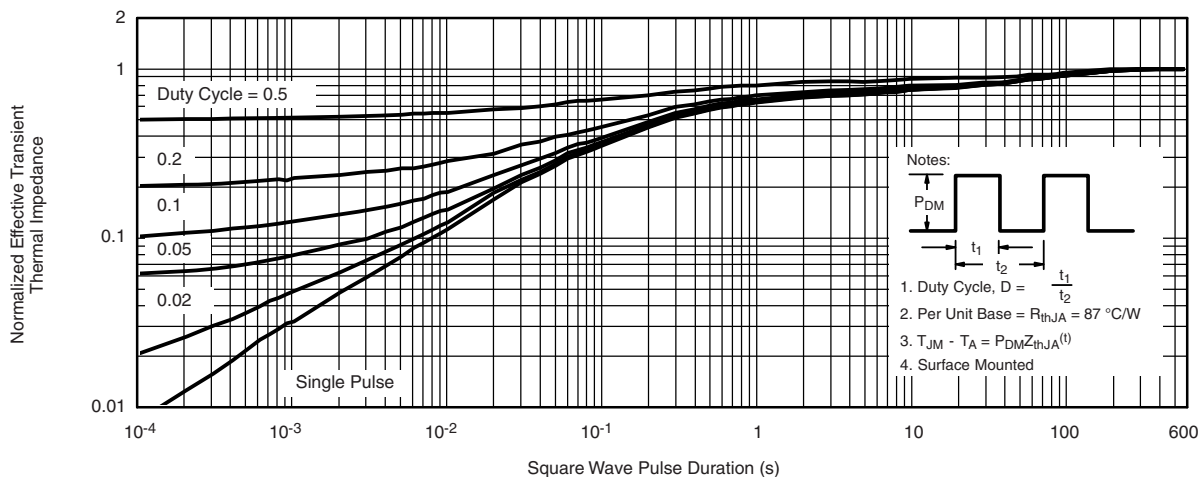
**Normalized Thermal Transient Impedance, Junction-to-Foot**

**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C unless otherwise noted)

**Output Characteristics**

**Transfer Characteristics**

**Transconductance**

**On-Resistance vs. Drain Current**

**Capacitance**

**Gate Charge**

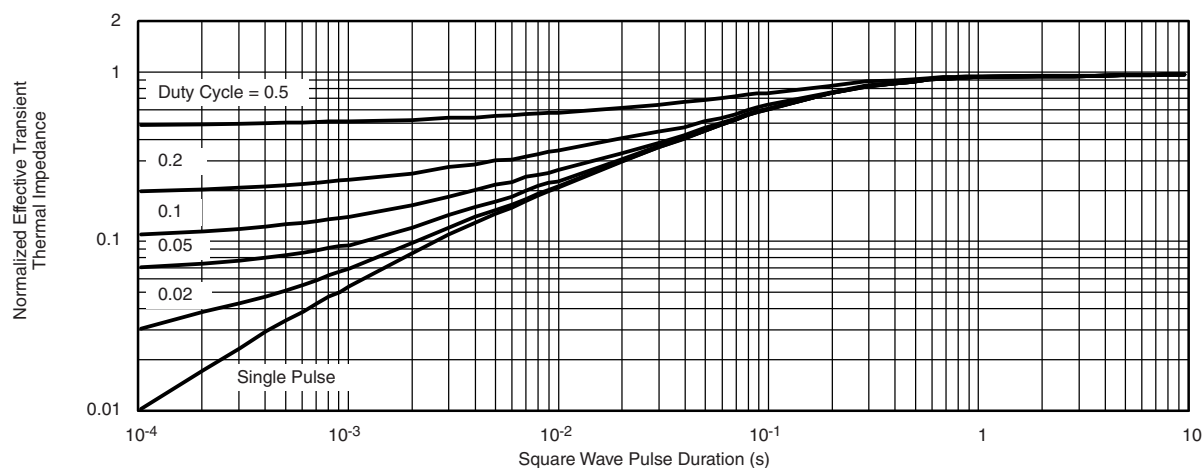
**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C unless otherwise noted)

**On-Resistance vs. Junction Temperature**

**Source-Drain Diode Forward Voltage**

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

**Threshold Voltage**

**Drain Source Breakdown vs. Junction Temperature**

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



**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C unless otherwise noted)



**Normalized Thermal Transient Impedance, Junction-to-Ambient**



**Normalized Thermal Transient Impedance, Junction-to-Foot**

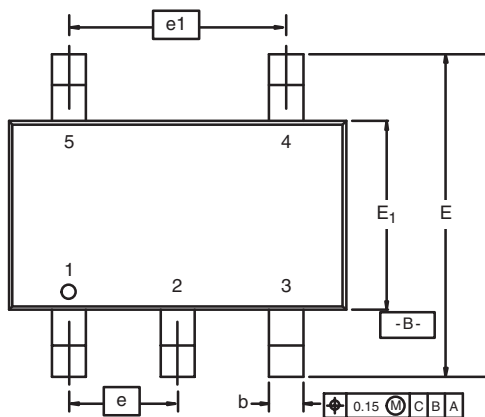
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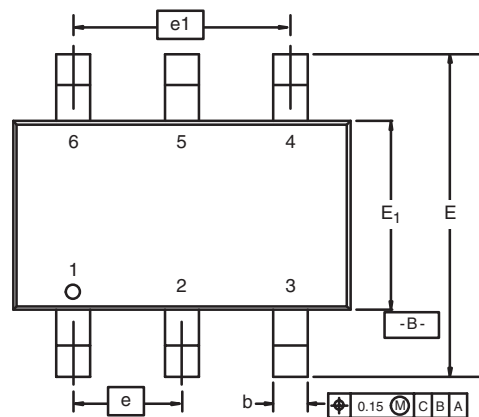


## TSOP: 5/6-LEAD

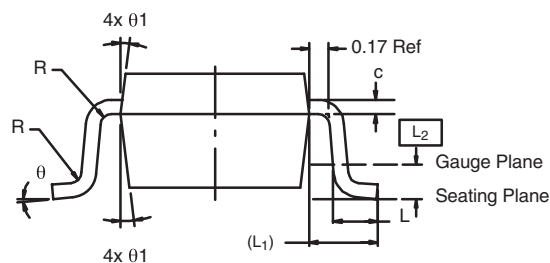
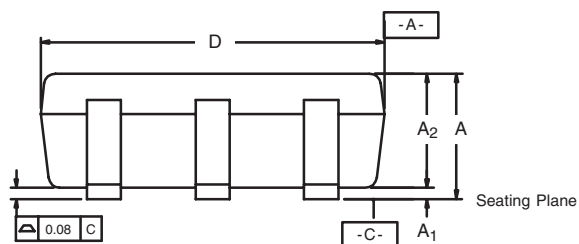
JEDEC Part Number: MO-193C



5-LEAD TSOP



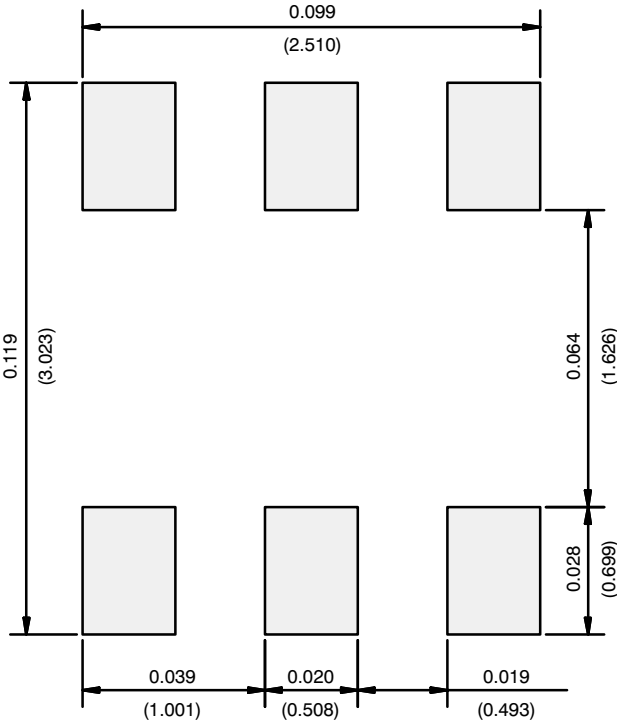
6-LEAD TSOP



	MILLIMETERS			INCHES		
Dim	Min	Nom	Max	Min	Nom	Max
A	0.91	-	1.10	0.036	-	0.043
A <sub>1</sub>	0.01	-	0.10	0.0004	-	0.004
A <sub>2</sub>	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 <sub>1</sub>	1.55	1.65	1.70	0.061	0.065	0.067
e	0.95 BSC			0.0374 BSC		
e <sub>1</sub>	1.80	1.90	2.00	0.071	0.075	0.079
L	0.32	-	0.50	0.012	-	0.020
L <sub>1</sub>	0.60 Ref			0.024 Ref		
L <sub>2</sub>	0.25 BSC			0.010 BSC		
R	0.10	-	-	0.004	-	-
θ	0°	4°	8°	0°	4°	8°
θ <sub>1</sub>	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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