

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

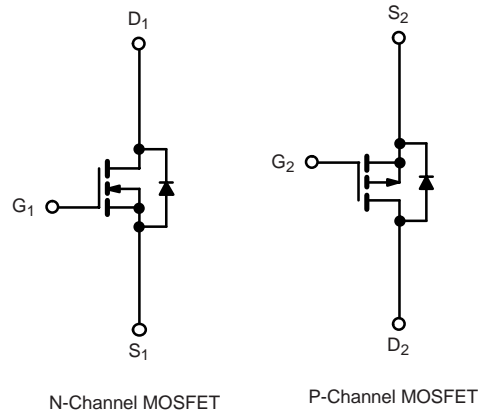
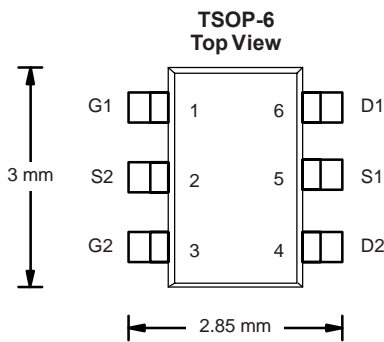
PRODUCT SUMMARY			
	V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)
N-Channel	20	0.022 at V <sub>GS</sub> = 10 V	5.5
		0.036 at V <sub>GS</sub> = 4.5 V	4.2
P-Channel	- 20	0.030 at V <sub>GS</sub> = - 10 V	- 3.4
		0.079 at V <sub>GS</sub> = - 4.5 V	- 2.5

### FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET
- 100 % R<sub>g</sub> Tested
- Compliant to RoHS Directive 2002/95/EC



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



ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted					
Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	V <sub>DS</sub>	20	- 20	V	
Gate-Source Voltage	V <sub>GS</sub>	± 20	± 20		
Continuous Drain Current (T <sub>J</sub> = 150 °C) <sup>a, b</sup>	I <sub>D</sub>	T <sub>A</sub> = 25 °C	5.5	A	
		T <sub>A</sub> = 70 °C	4.0		
Pulsed Drain Current	I <sub>DM</sub>	15	10		
Continuous Source Current (Diode Conduction) <sup>a, b</sup>	I <sub>S</sub>	1.05	- 1.05		
Maximum Power Dissipation <sup>a, b</sup>	P <sub>D</sub>	T <sub>A</sub> = 25 °C	1.15		W
		T <sub>A</sub> = 70 °C	0.73		
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150		°C	

THERMAL RESISTANCE RATINGS					
Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>a</sup>	t ≤ 5 s	R <sub>thJA</sub>	93	110	°C/W
	Steady State		130	150	
Maximum Junction-to-Lead	Steady State	R <sub>thJL</sub>	75	90	

Notes:

a. Surface Mounted on FR4 board.

b. t ≤ 5 s.

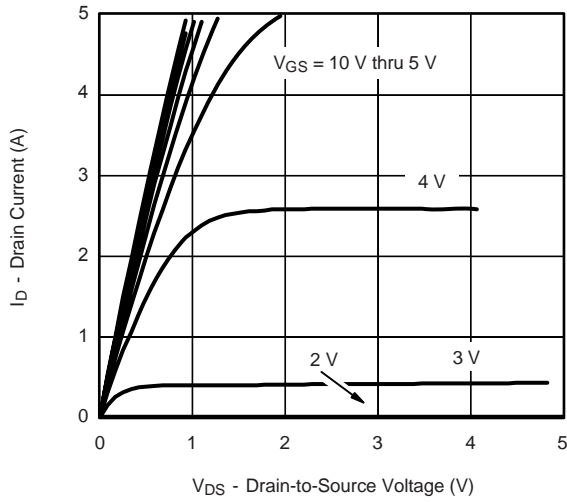
SPECIFICATIONS $T_J = 25^\circ\text{C}$ , unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
<b>Static</b>							
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	N-Ch	0.6			V
		$V_{DS} = V_{GS}, I_D = -250 \mu\text{A}$	P-Ch	-0.7			
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 20 \text{ V}$	N-Ch P-Ch			$\pm 100$ $\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 24 \text{ V}, V_{GS} = 0 \text{ V}$	N-Ch			1	$\mu\text{A}$
		$V_{DS} = -24 \text{ V}, V_{GS} = 0 \text{ V}$	P-Ch			-1	
		$V_{DS} = 24 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 55^\circ\text{C}$	N-Ch			5	
		$V_{DS} = -24 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 55^\circ\text{C}$	P-Ch			-5	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} = 5 \text{ V}, V_{GS} = 10 \text{ V}$	N-Ch	3.7			A
		$V_{DS} = -5 \text{ V}, V_{GS} = -10 \text{ V}$	P-Ch	-3			
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 10 \text{ V}, I_D = 2.5 \text{ A}$	N-Ch		0.022		$\Omega$
		$V_{GS} = -10 \text{ V}, I_D = -1.8 \text{ A}$	P-Ch		0.055		
		$V_{GS} = 4.5 \text{ V}, I_D = 2.0 \text{ A}$	N-Ch		0.030		
		$V_{GS} = -4.5 \text{ V}, I_D = -1.2 \text{ A}$	P-Ch		0.079		
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 10 \text{ V}, I_D = 2.5 \text{ A}$	N-Ch		4.3		S
		$V_{DS} = -15 \text{ V}, I_D = -1.8 \text{ A}$	P-Ch		2.4		
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$I_S = 1.05 \text{ A}, V_{GS} = 0 \text{ V}$	N-Ch		0.81	1.10	V
		$I_S = -1.05 \text{ A}, V_{GS} = 0 \text{ V}$	P-Ch		-0.83	-1.10	
<b>Dynamic<sup>b</sup></b>							
Total Gate Charge	$Q_g$	N-Channel $V_{DS} = 15 \text{ V}, V_{GS} = 5 \text{ V}, I_D = 1.8 \text{ A}$	N-Ch		2.1	3.2	nC
Gate-Source Charge	$Q_{gs}$		P-Ch		2.4	3.6	
Gate-Drain Charge	$Q_{gd}$	P-Channel $V_{DS} = -15 \text{ V}, V_{GS} = -5 \text{ V}, I_D = -1.8 \text{ A}$	N-Ch		0.7		
			P-Ch		0.9		
Gate Resistance	$R_g$		N-Ch	0.5		2.4	$\Omega$
			P-Ch	3		11	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 15 \text{ V}, R_L = 15 \Omega$ $I_D \cong 1 \text{ A}, V_{GEN} = 10 \text{ V}, R_g = 6 \Omega$	N-Ch		7	11	ns
Rise Time	$t_r$		P-Ch		8	12	
		N-Ch		9	14		
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -15 \text{ V}, R_L = 15 \Omega$ $I_D \cong -1 \text{ A}, V_{GEN} = -10 \text{ V}, R_g = 6 \Omega$	N-Ch		13	20	
			P-Ch		12	18	
Fall Time	$t_f$	N-Ch		5	8		
		P-Ch		7	11		
Source-Drain Reverse Recovery Time	$t_{rr}$	$I_F = 1.05 \text{ A}, dI/dt = 100 \text{ A}/\mu\text{s}$	N-Ch		35	60	
		$I_F = -1.05 \text{ A}, dI/dt = 100 \text{ A}/\mu\text{s}$	P-Ch		30	60	

Notes:

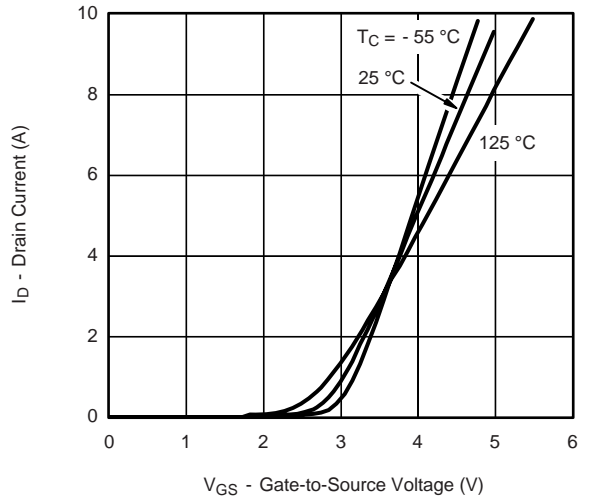
- a. Pulse test; pulse width  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.

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.

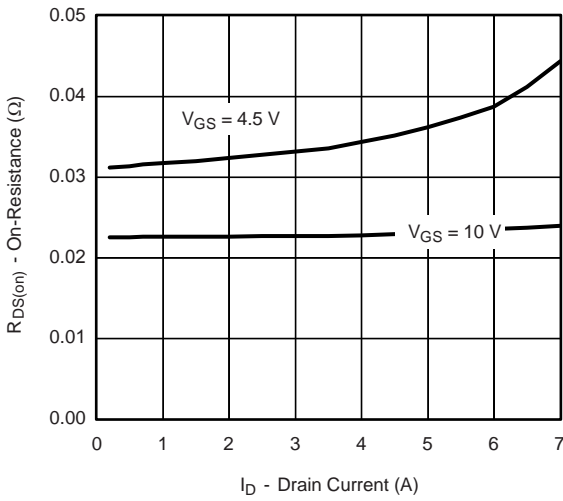
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



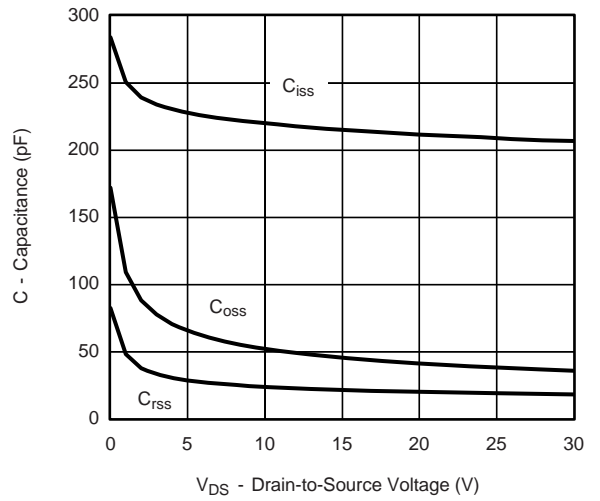
**Output Characteristics**



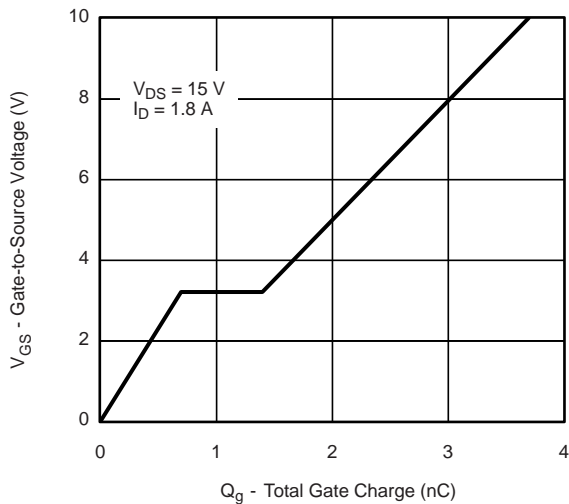
**Transfer Characteristics**



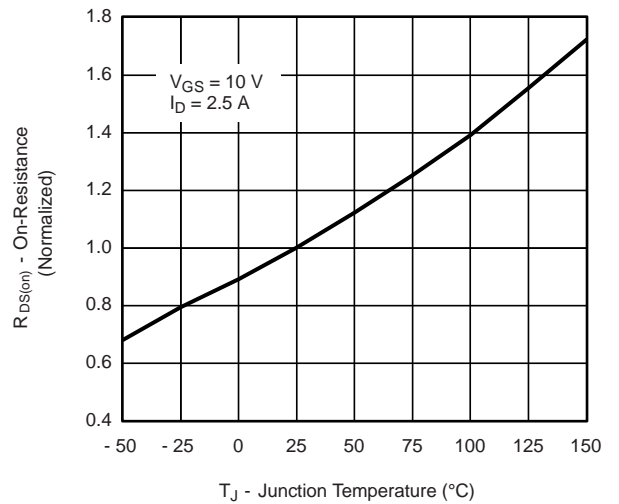
**On-Resistance vs. Drain Current**



**Capacitance**

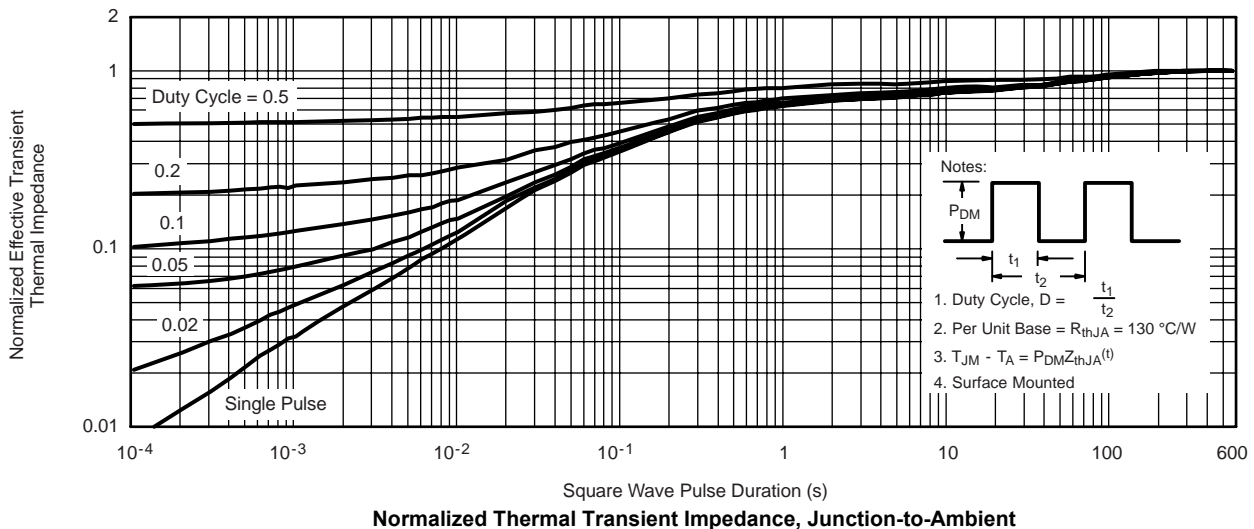
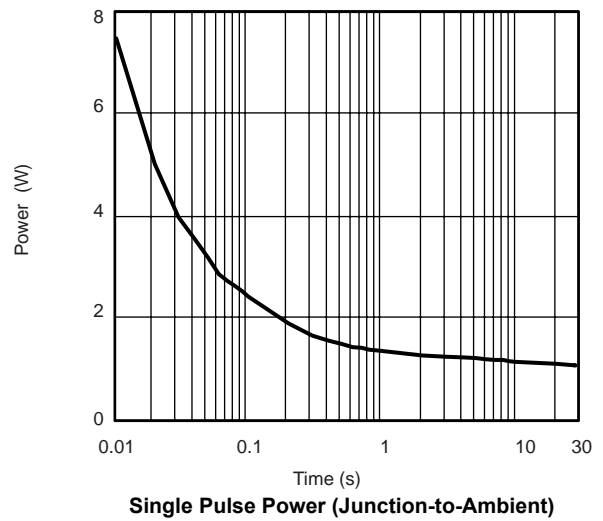
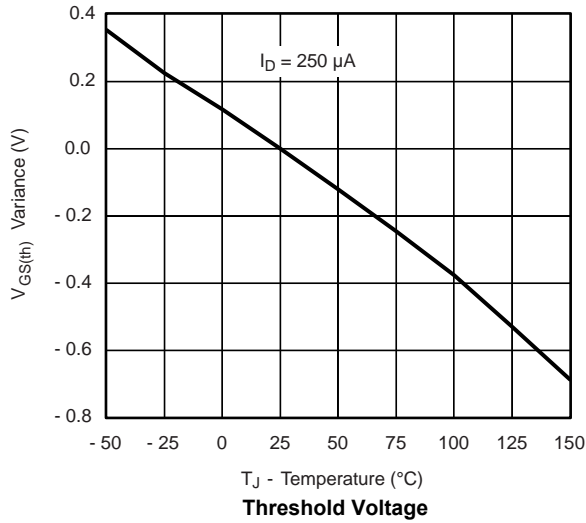
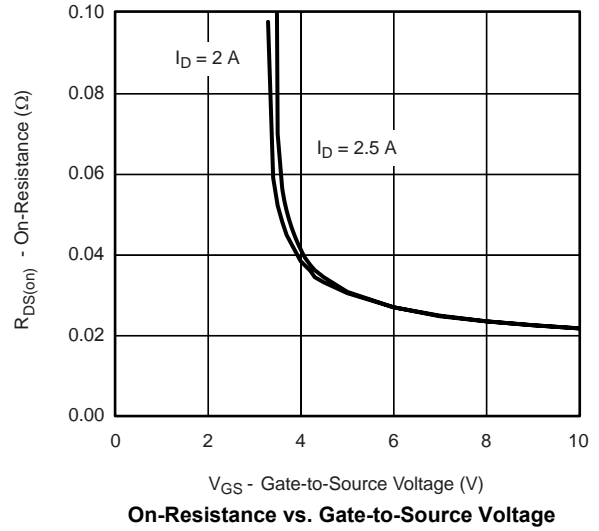
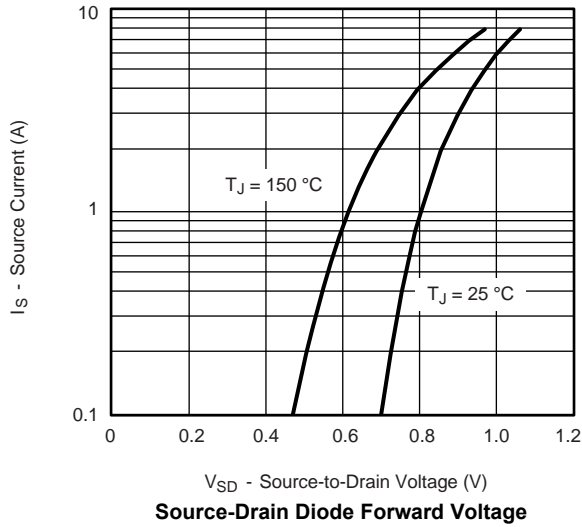


**Gate Charge**

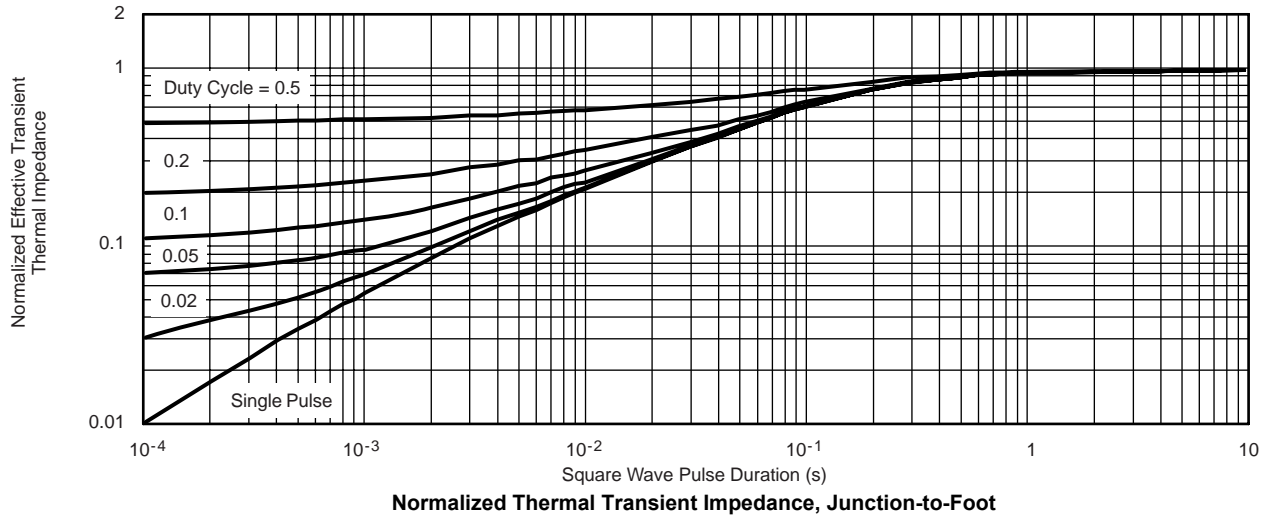


**On-Resistance vs. Junction Temperature**

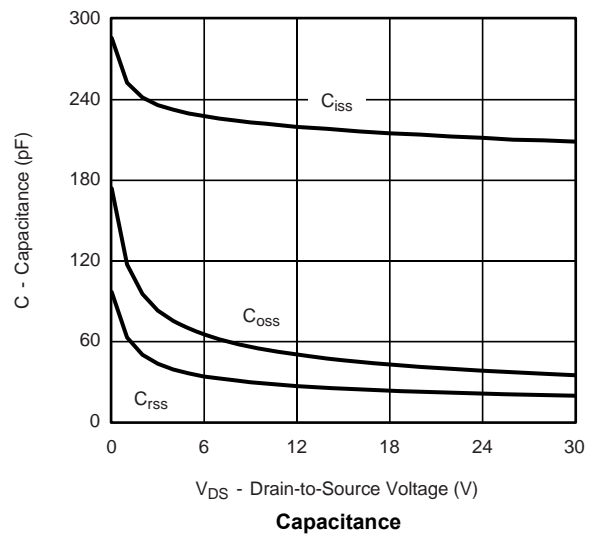
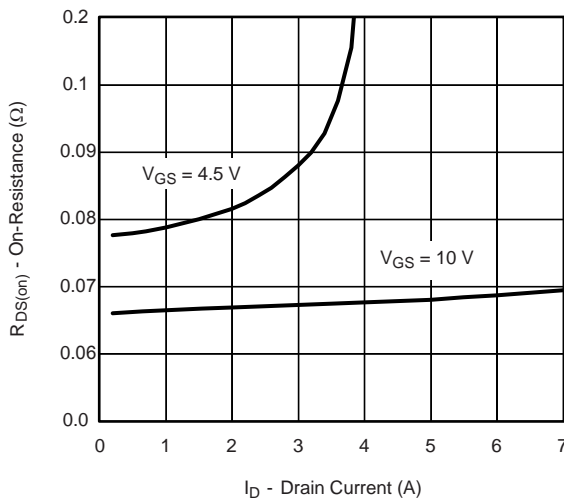
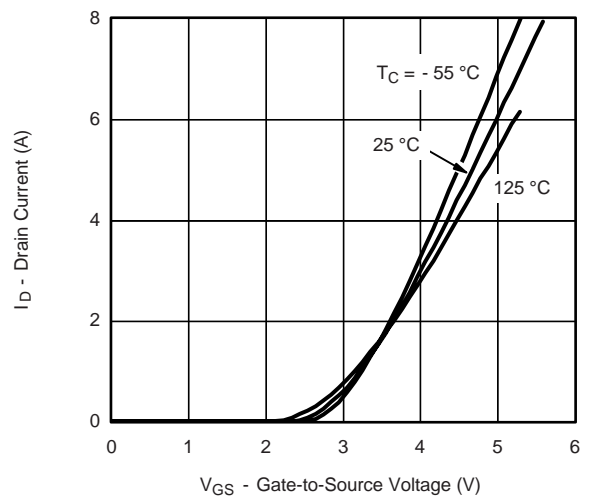
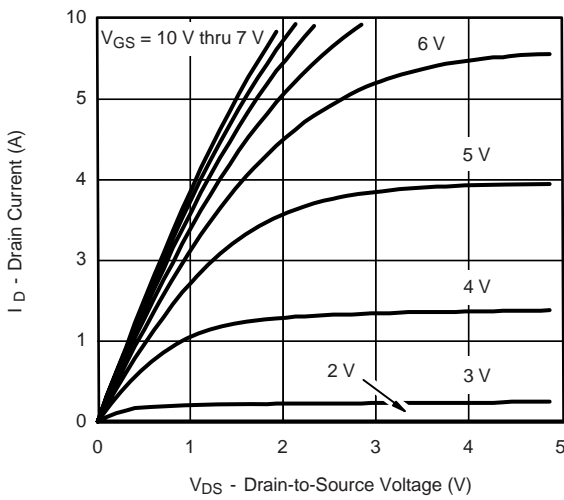
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



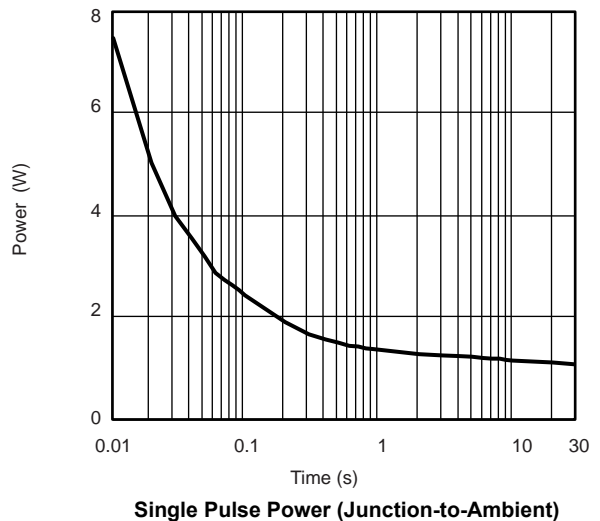
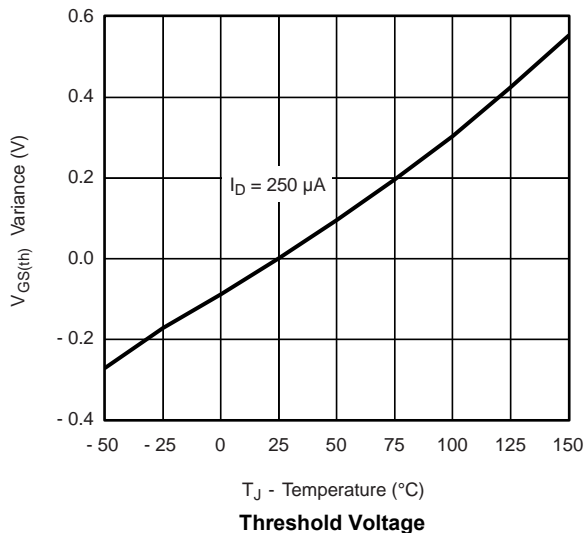
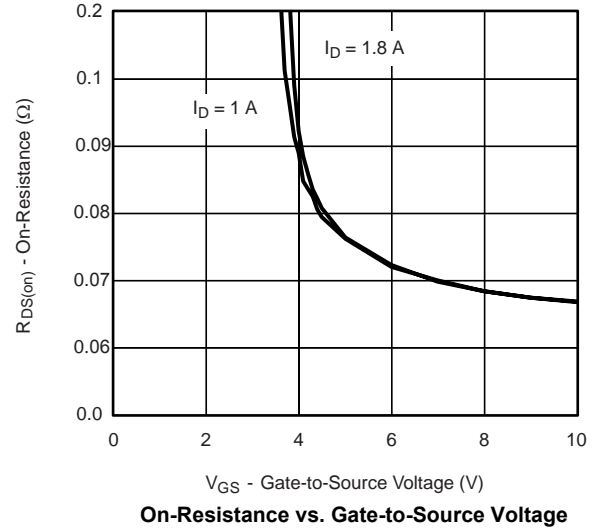
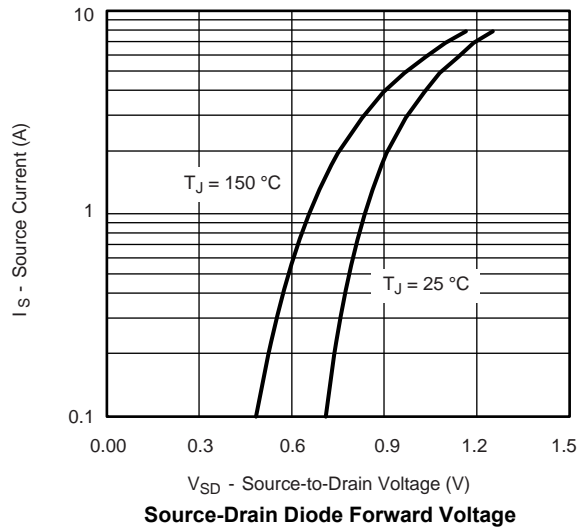
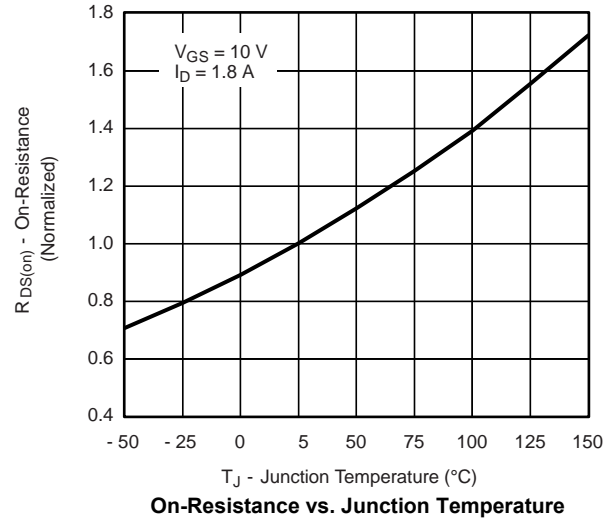
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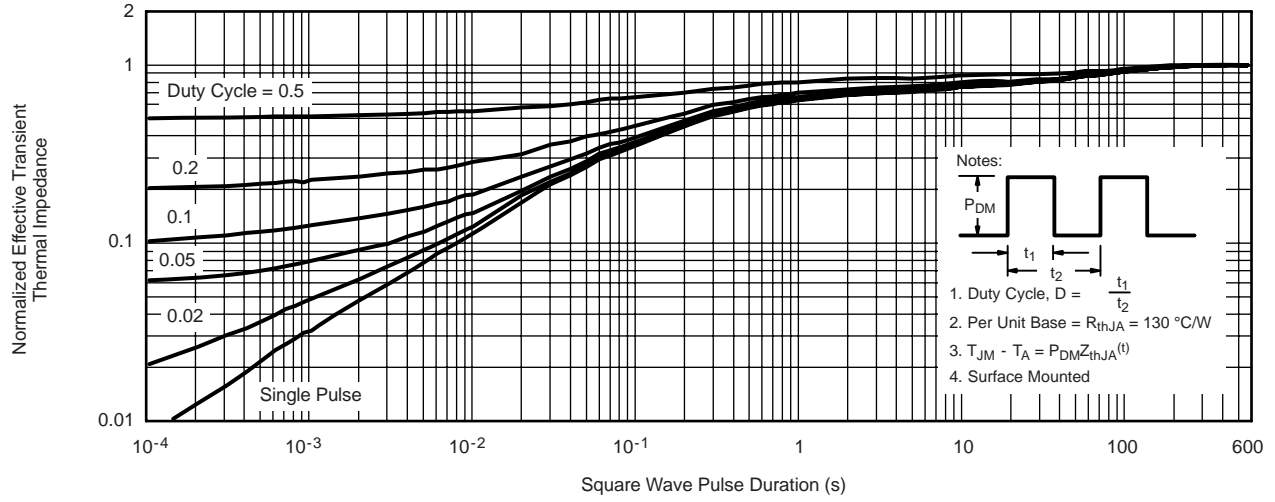
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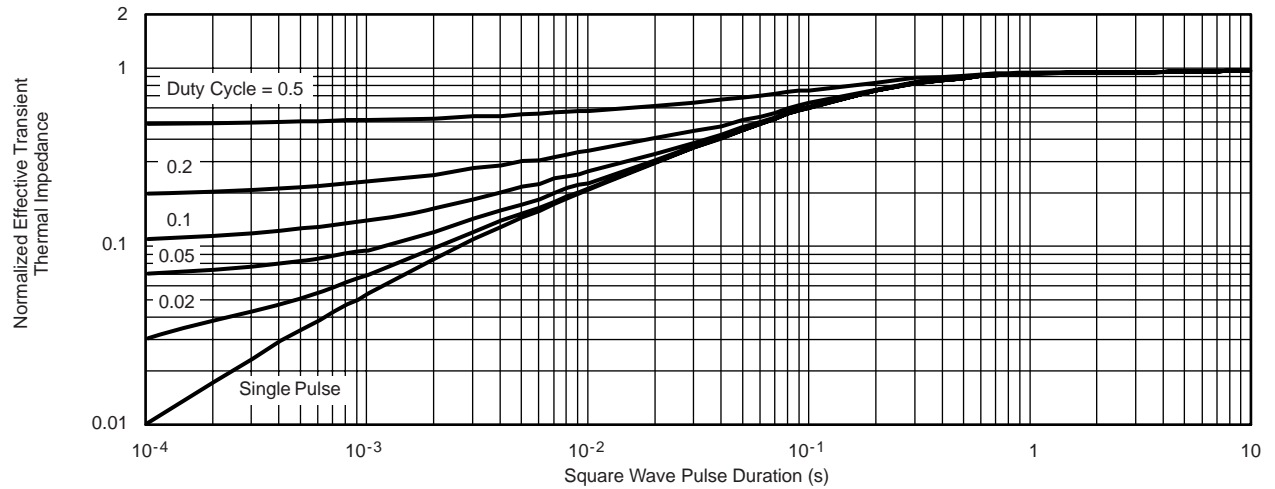
**P-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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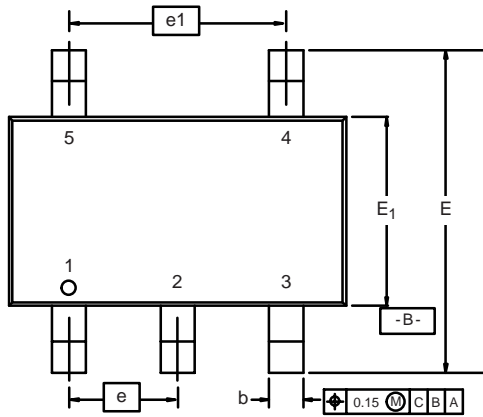


**Normalized Thermal Transient Impedance, Junction-to-Ambient**

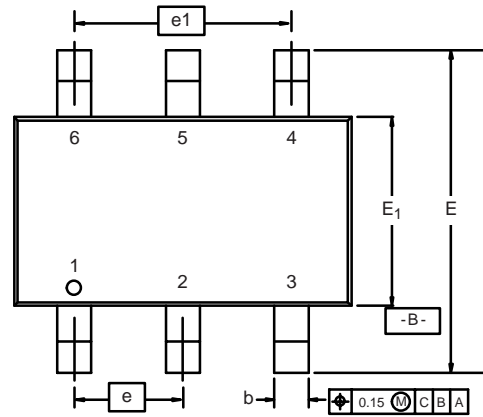


**Normalized Thermal Transient Impedance, Junction-to-Foot**

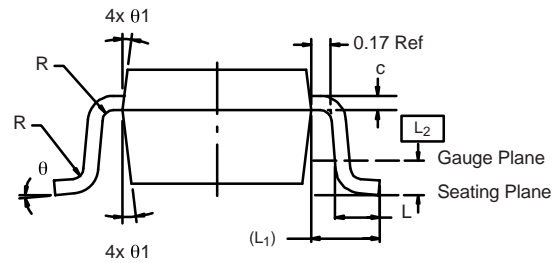
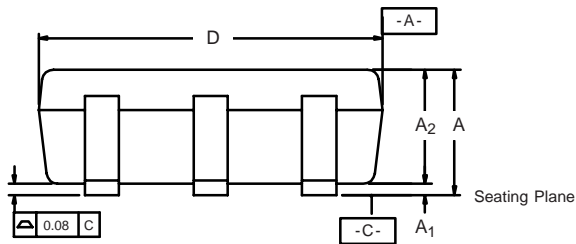
TSOP: 5/6-LEAD  
JEDEC Part Number: MO-193C



5-LEAD TSOP



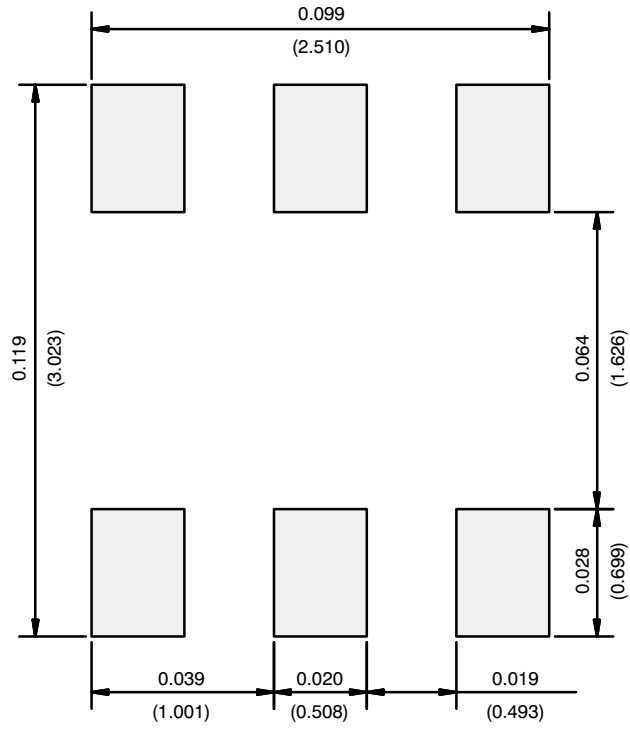
6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.91	-	1.10	0.036	-	0.043
A <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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