

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

## PRODUCT SUMMARY

	$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ ) Max.	$I_D$ (A) <sup>a</sup>	$Q_g$ (Typ.)
N-Channel	20	0.058 at $V_{GS} = 4.5$ V	3.9	2.9 nC
		0.078 at $V_{GS} = 2.5$ V	3.3	
P-Channel	- 20	0.195 at $V_{GS} = - 4.5$ V	- 2.1	1.6 nC
		0.316 at $V_{GS} = - 2.5$ V	- 1.7	

## FEATURES

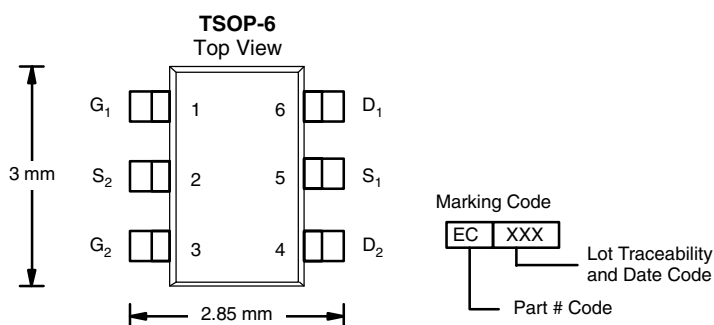
- TrenchFET<sup>®</sup> Power MOSFETs
- 100 %  $R_g$  Tested
- Material categorization:  
For definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



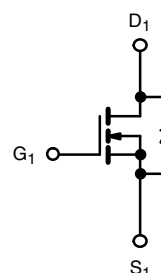
**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## APPLICATIONS

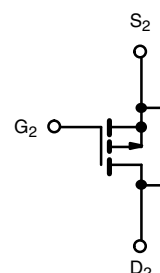
- Load Switch for Portable Devices
- DC/DC Converters
- Drivers: Motor, Solenoid, Relay



**Ordering Information:** Si3585CDV-T1-GE3 (Lead (Pb)-free and Halogen-free)



N-Channel MOSFET



P-Channel MOSFET

## 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	$V_{GS}$	$\pm 12$		
Continuous Drain Current ( $T_J = 150$ °C)	$T_C = 25$ °C	3.9	- 2.1	A
	$T_C = 70$ °C	3.1	- 1.7	
	$T_A = 25$ °C	3.5 <sup>b, c</sup>	- 1.9 <sup>b, c</sup>	
	$T_A = 70$ °C	2.8 <sup>b, c</sup>	- 1.5 <sup>b, c</sup>	
Pulsed Drain Current ( $t = 300$ $\mu$ s)	$I_{DM}$	12	- 5	
Source Drain Current Diode Current	$T_C = 25$ °C	1.2	- 1.1	
	$T_A = 25$ °C	0.9 <sup>b, c</sup>	- 0.9 <sup>b, c</sup>	
Maximum Power Dissipation	$T_C = 25$ °C	1.4	1.3	W
	$T_C = 70$ °C	0.9	0.8	
	$T_A = 25$ °C	1.1 <sup>b, c</sup>	1.1 <sup>b, c</sup>	
	$T_A = 70$ °C	0.7 <sup>b, c</sup>	0.7 <sup>b, c</sup>	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150		°C

## THERMAL RESISTANCE RATINGS

Parameter		Symbol	N-Channel		P-Channel		Unit
			Typ.	Max.	Typ.	Max.	
Maximum Junction-to-Ambient <sup>b, d</sup>	t ≤ 5 s	R <sub>thJA</sub>	93	110	97	115	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R <sub>thJF</sub>	75	90	78	95	

Notes:

a. Based on  $T_C = 25$  °C.

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

c.  $t = 5$  s.

d. Maximum under steady state conditions is 150 °C/W for n-channel and 155 °C/W for p-channel.

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Unit		
Static									
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	N-Ch	20			V		
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = - 250 μA	P-Ch	- 20					
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	N-Ch		15		mV/°C		
		I <sub>D</sub> = - 250 μA	P-Ch		- 16.2				
V <sub>GS(th)</sub> Temperature Coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA	N-Ch		- 2.8				
		I <sub>D</sub> = - 250 μA	P-Ch		2.5				
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-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 12 V	N-Ch P-Ch	 		± 100 ± 100	nA		
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V	N-Ch			1	μA		
		V <sub>DS</sub> = - 20 V, V <sub>GS</sub> = 0 V	P-Ch			- 1			
		V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C	N-Ch			10			
		V <sub>DS</sub> = - 20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 55 °C	P-Ch			- 10			
On-State Drain Current <sup>b</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 5 V, V <sub>GS</sub> = 4.5 V	N-Ch	12			A		
		V <sub>DS</sub> ≤ - 5 V, V <sub>GS</sub> = - 4.5 V	P-Ch	- 5					
Drain-Source On-State Resistance <sup>b</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 2.5 A	N-Ch		0.048	0.058	Ω		
		V <sub>GS</sub> = - 4.5 V, I <sub>D</sub> = - 1.9 A	P-Ch		0.162	0.195			
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 1 A	N-Ch		0.065	0.078			
		V <sub>GS</sub> = - 2.5 V, I <sub>D</sub> = - 1 A	P-Ch		0.263	0.316			
Forward Transconductance <sup>b</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 35 A	N-Ch		12		S		
		V <sub>DS</sub> = - 10 V, I <sub>D</sub> = - 1.9 A	P-Ch		1				
Dynamic <sup>a</sup>									
Input Capacitance	C <sub>iss</sub>	N-Channel V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	N-Ch P-Ch	 	150 210		pF		
Output Capacitance	C <sub>oss</sub>		N-Ch P-Ch	 	53 50				
Reverse Transfer Capacitance	C <sub>rss</sub>	P-Channel V <sub>DS</sub> = - 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	N-Ch P-Ch	 	22 35			nC	
			Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3.5 A	N-Ch			
V <sub>DS</sub> = - 10 V, V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 1.9 A	P-Ch				6	9			
Gate-Source Charge	Q <sub>gs</sub>	N-Channel V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 3.5 A		N-Ch P-Ch	 	1.6 2.9	2.4 4.3		
				Gate-Drain Charge	Q <sub>gd</sub>	P-Channel V <sub>DS</sub> = - 10 V, V <sub>GS</sub> = - 4.5 V, I <sub>D</sub> = - 1.9 A	N-Ch P-Ch		 
Gate Resistance	R <sub>g</sub>	f = 1 MHz	N-Ch P-Ch				 		0.9 1.2



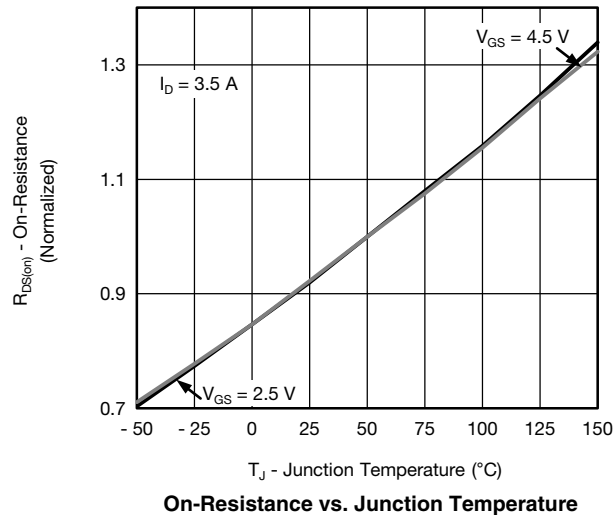
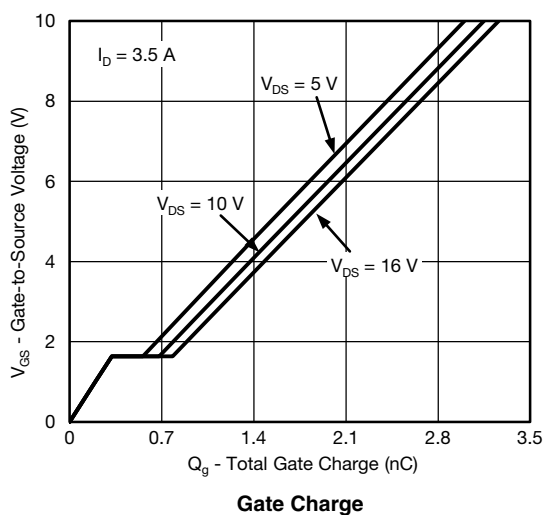
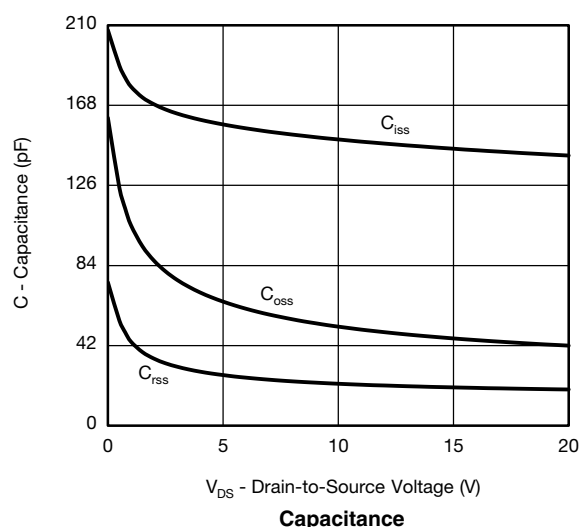
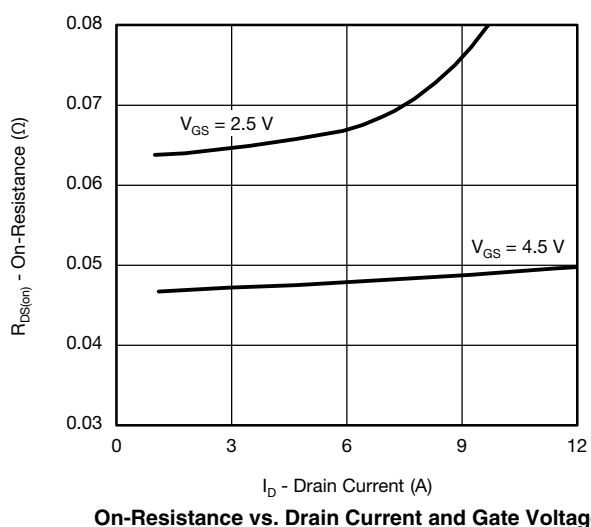
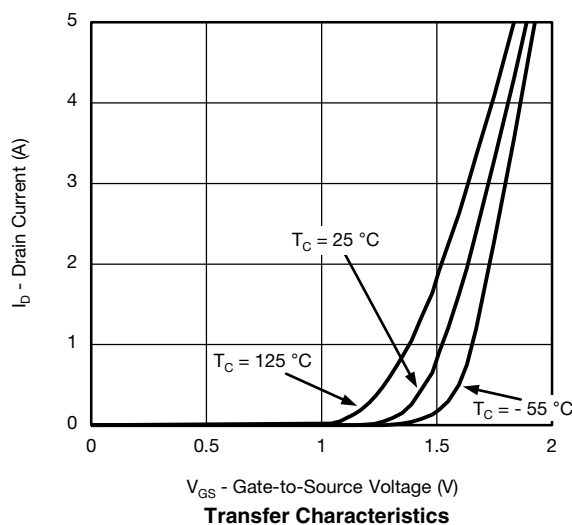
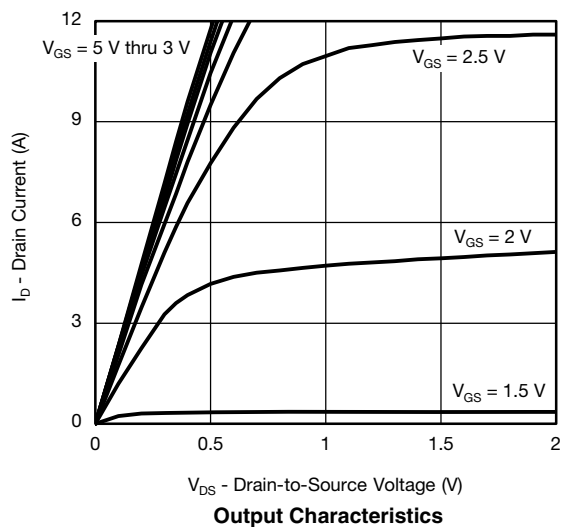
SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Dynamic <sup>a</sup>							
Turn-On Delay Time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 3.6 Ω I <sub>D</sub> ≅ 2.8 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω	N-Ch		5	10	ns
			P-Ch		3	6	
Rise Time	t <sub>r</sub>		N-Ch		20	30	
			P-Ch		10	20	
Turn-Off Delay Time	t <sub>d(off)</sub>	P-Channel V <sub>DD</sub> = - 10 V, R <sub>L</sub> = 6.7 Ω I <sub>D</sub> ≅ - 1.5 A, V <sub>GEN</sub> = - 10 V, R <sub>g</sub> = 1 Ω	N-Ch		11	20	
			P-Ch		13	20	
Fall Time	t <sub>f</sub>		N-Ch		8	16	
			P-Ch		7	14	
Turn-On Delay Time	t <sub>d(on)</sub>	N-Channel V <sub>DD</sub> = 10 V, R <sub>L</sub> = 3.6 Ω I <sub>D</sub> ≅ 2.8 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω	N-Ch		15	23	
			P-Ch		16	25	
Rise Time	t <sub>r</sub>		N-Ch		37	56	
			P-Ch		16	25	
Turn-Off Delay Time	t <sub>d(off)</sub>	P-Channel V <sub>DD</sub> = - 10 V, R <sub>L</sub> = 6.7 Ω I <sub>D</sub> ≅ - 1.5 A, V <sub>GEN</sub> = - 4.5 V, R <sub>g</sub> = 1 Ω	N-Ch		25	38	
			P-Ch		13	20	
Fall Time	t <sub>f</sub>		N-Ch		28	42	
			P-Ch		9	18	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	N-Ch			1.2	A
			P-Ch			- 1.1	
Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>		N-Ch			12	
			P-Ch			- 5	
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = 2.8 A, V <sub>GS</sub> = 0 V	N-Ch		0.8	1.2	V
		I <sub>S</sub> = - 1.5 A, V <sub>GS</sub> = 0 V	P-Ch		- 0.8	- 1.2	
Body Diode Reverse Recovery Time	t <sub>rr</sub>	N-Channel I <sub>F</sub> = 2.8 A, dI/dt = 100 A/μs, T <sub>J</sub> = 25 °C	N-Ch		8	16	ns
			P-Ch		21	32	
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>		N-Ch		2	4	nC
			P-Ch		11	20	
Reverse Recovery Fall Time	t <sub>a</sub>	P-Channel I <sub>F</sub> = - 1.5 A, dI/dt = - 100 A/μs, T <sub>J</sub> = 25 °C	N-Ch		5		ns
			P-Ch		10		
Reverse Recovery Rise Time	t <sub>b</sub>		N-Ch		3		
			P-Ch		11		

Notes:

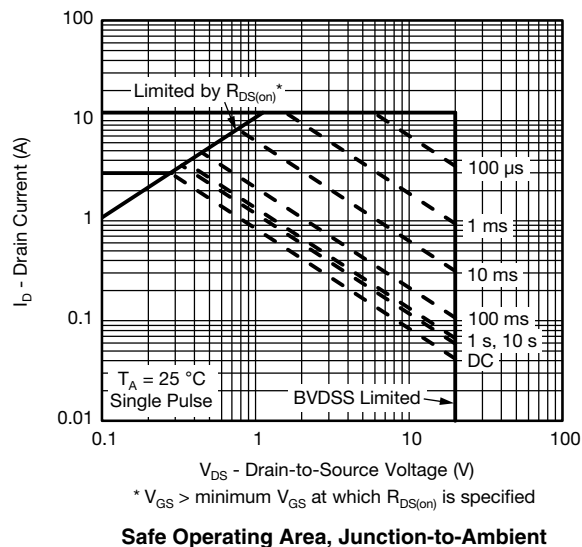
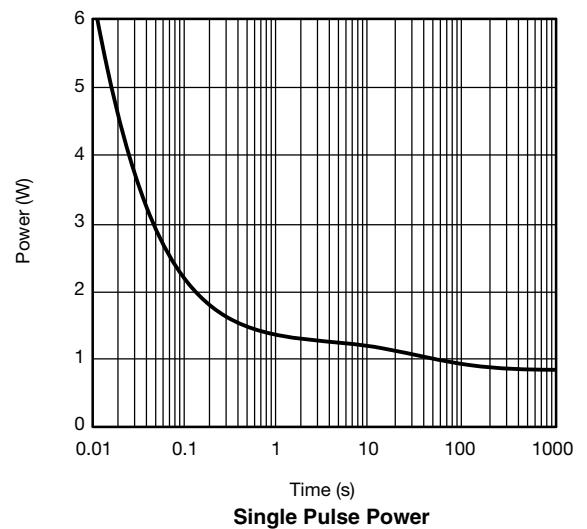
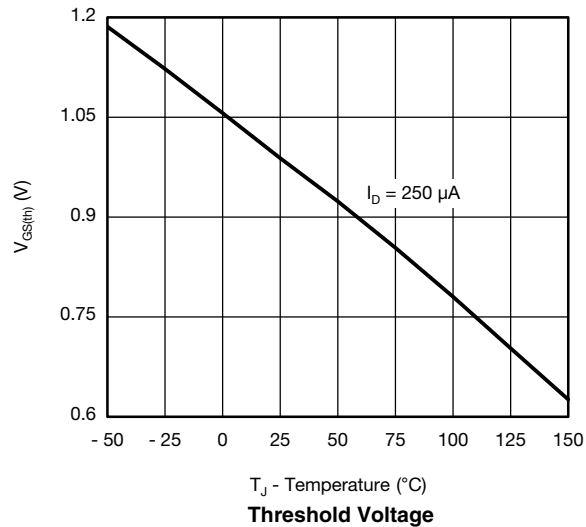
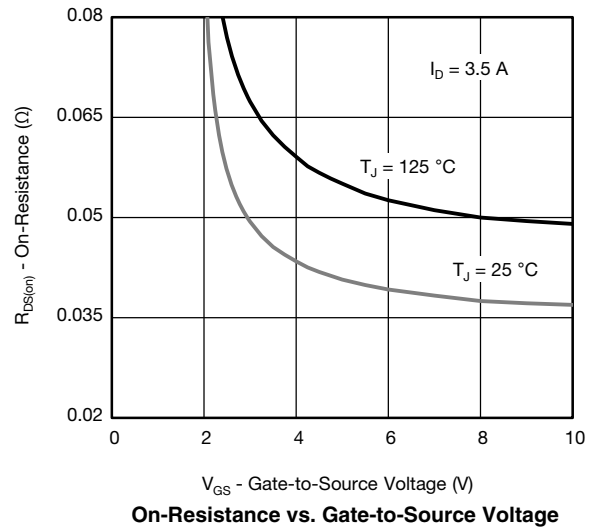
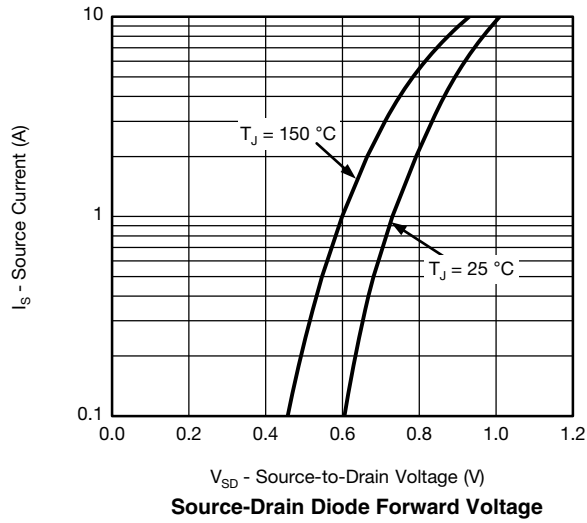
a. Guaranteed by design, not subject to production testing.

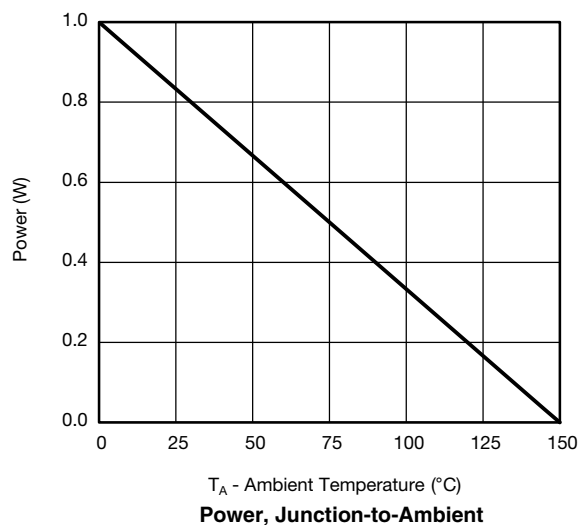
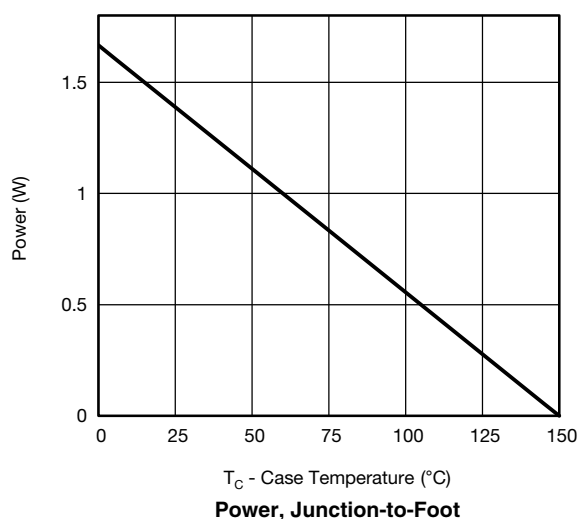
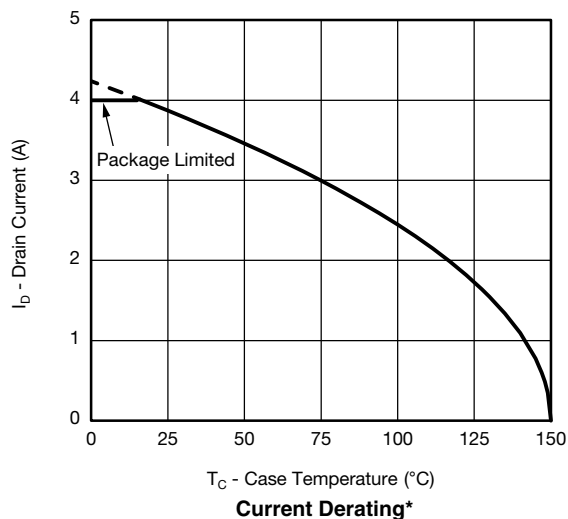
b. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

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)

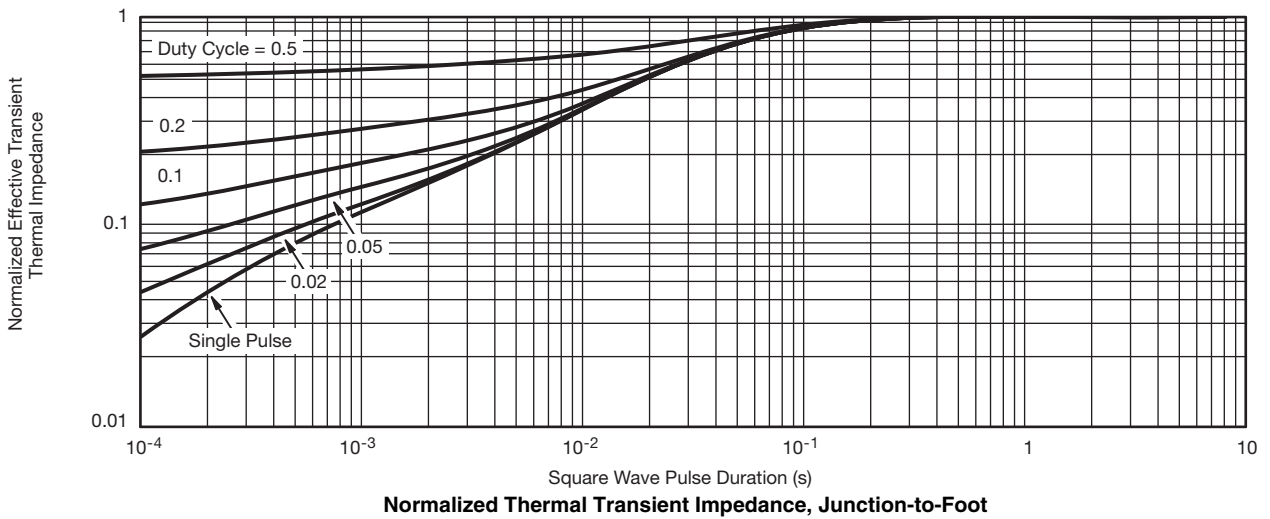
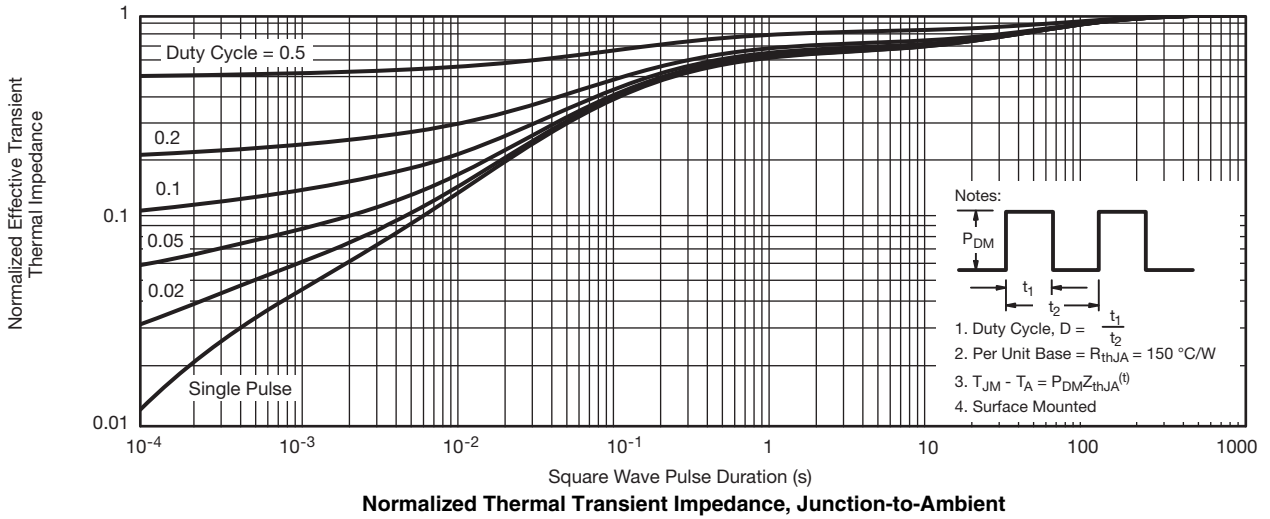
## N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

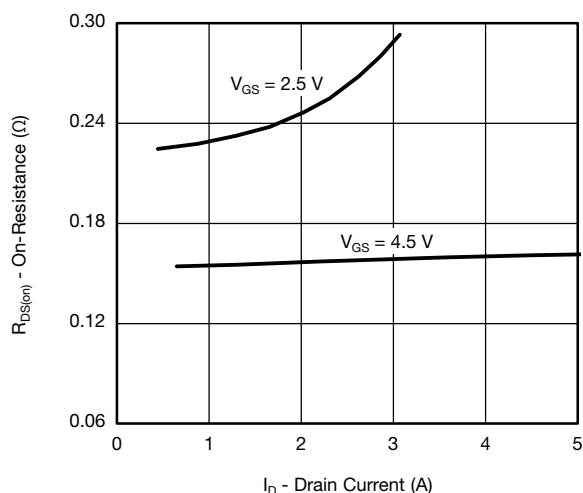
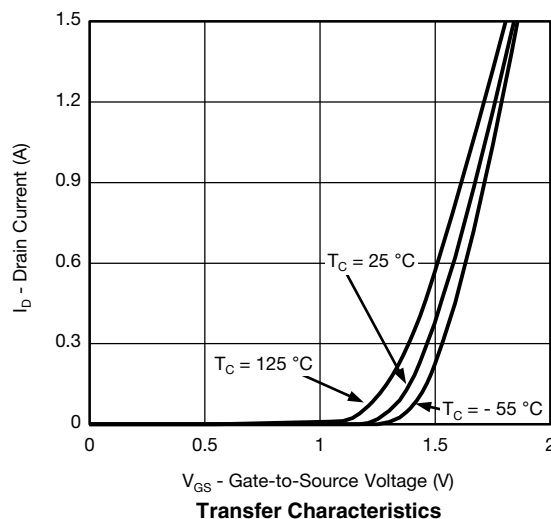
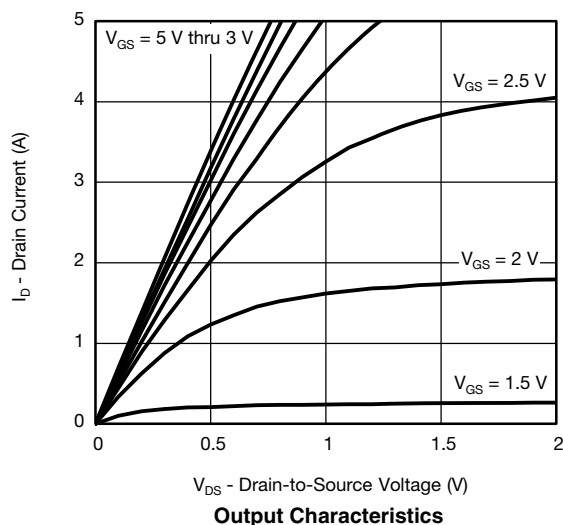
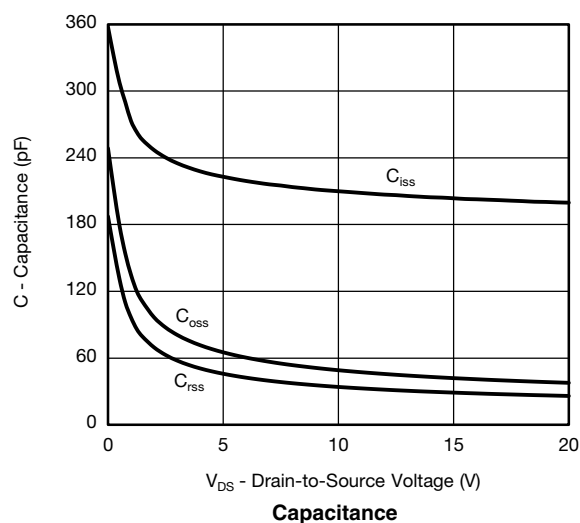
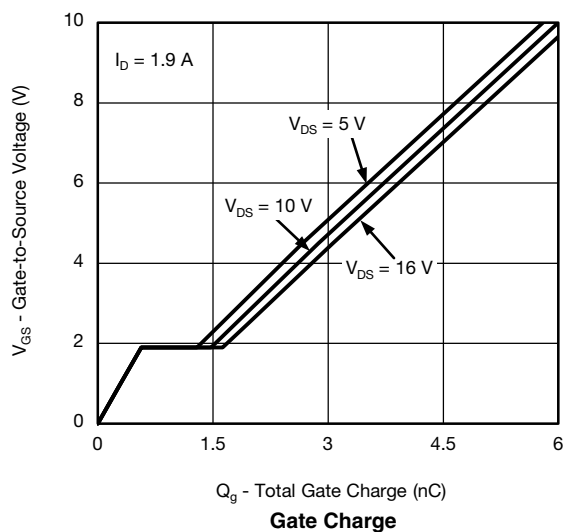
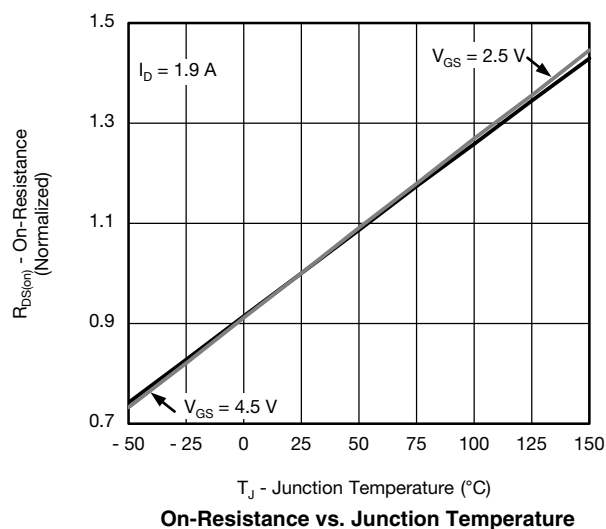


**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

\* 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.

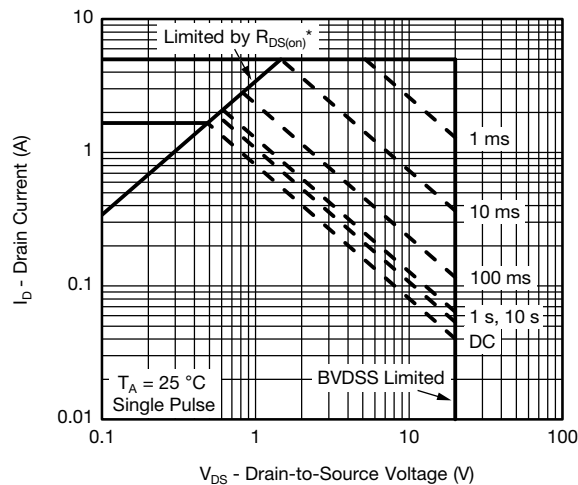
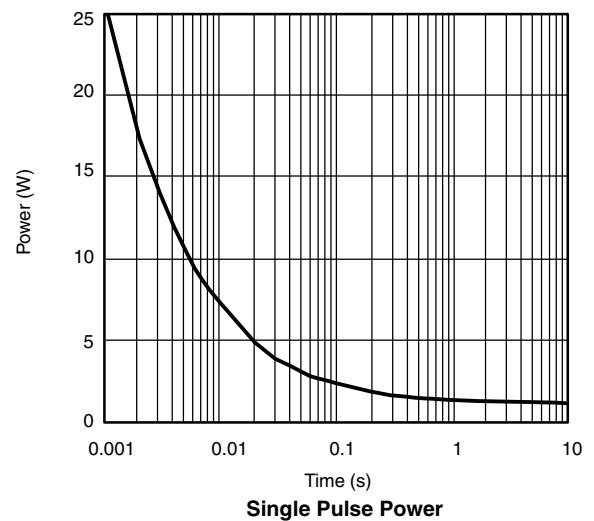
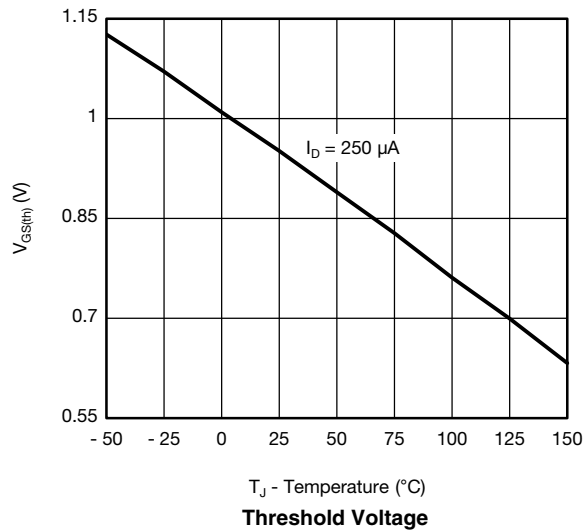
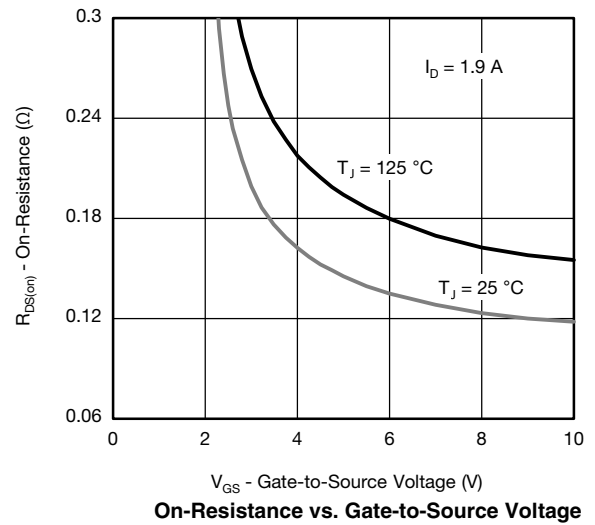
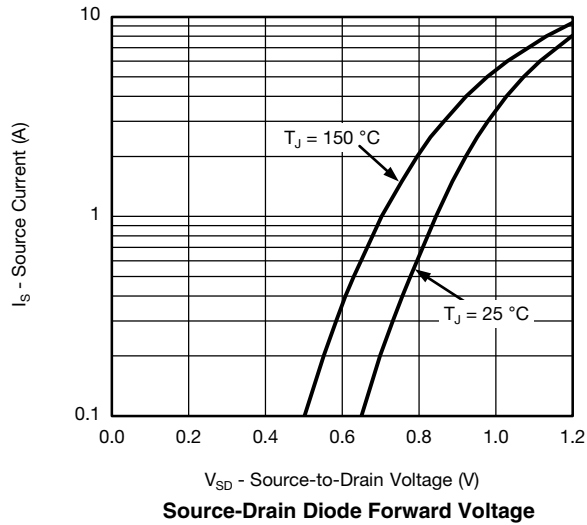
**N-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)**On-Resistance vs. Drain Current and Gate Voltage****Capacitance****Gate Charge****On-Resistance vs. Junction Temperature**

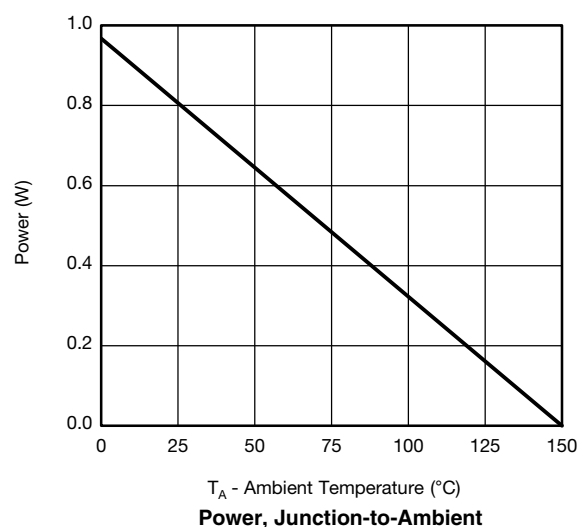
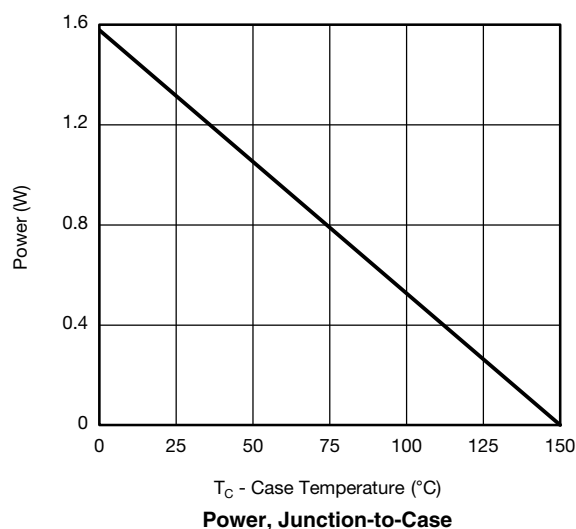
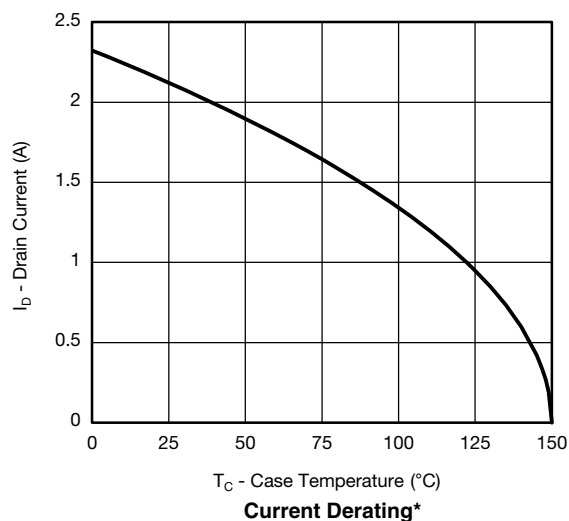


## P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



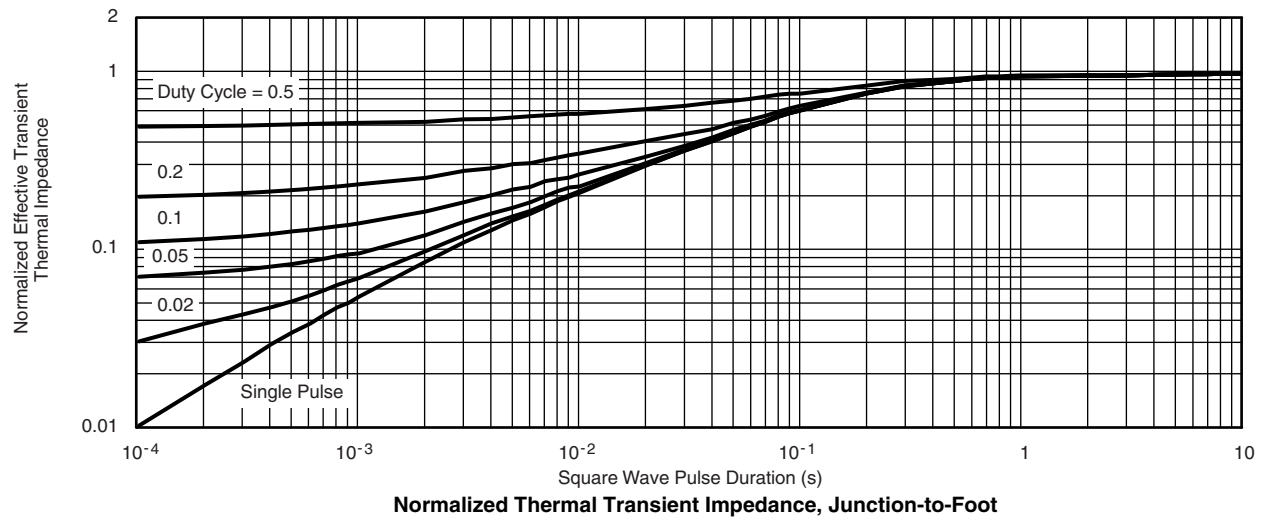
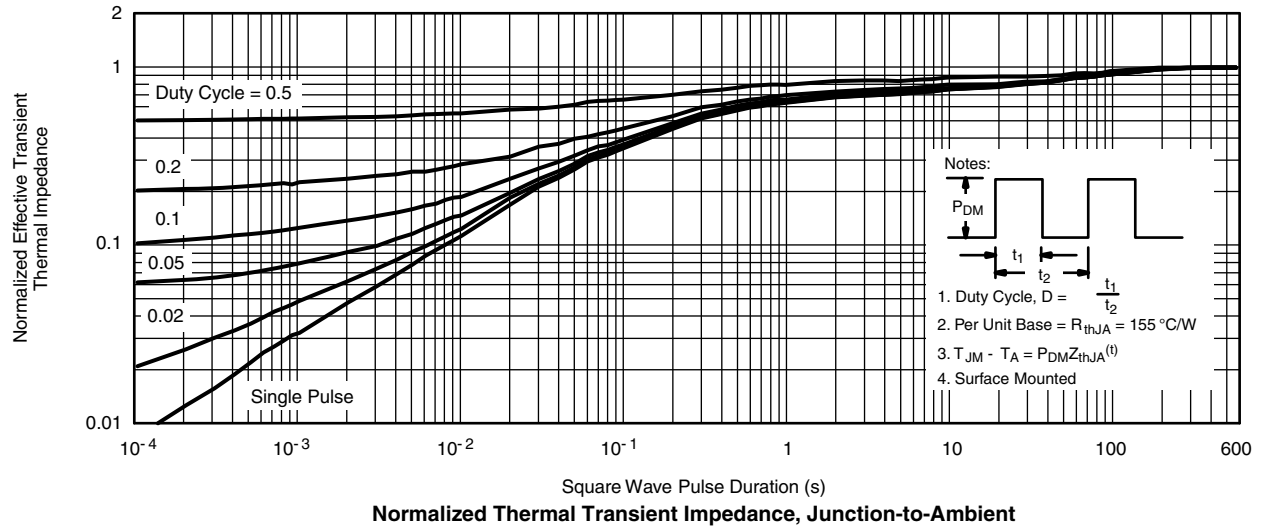
\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

Safe Operating Area, Junction-to-Ambient

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


\* 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.

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

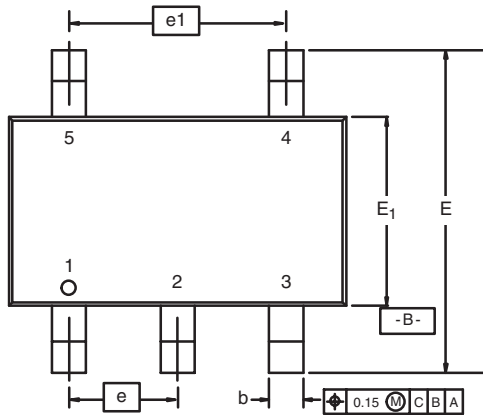


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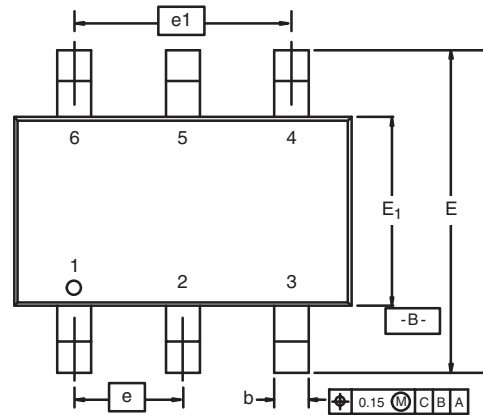


## TSOP: 5/6-LEAD

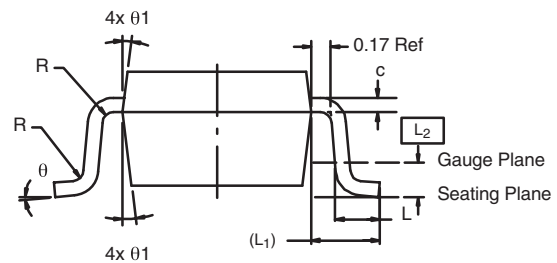
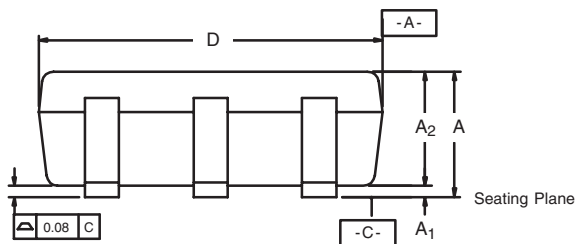
JEDEC Part Number: MO-193C



5-LEAD TSOP

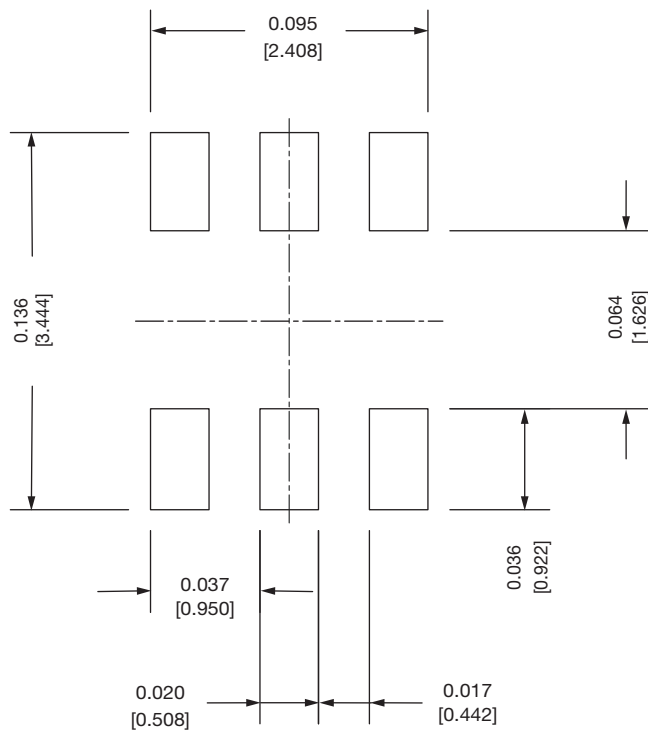
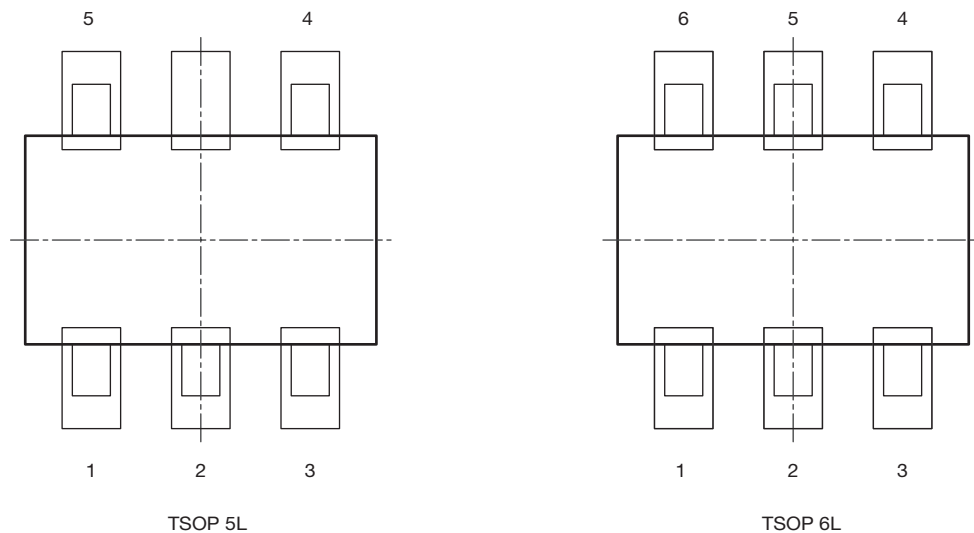


6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
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 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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