

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

PRODUCT SUMMARY				
	V_{DS} (V)	$R_{DS(on)}$ (Ω) Max.	I_D (A) ^a	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

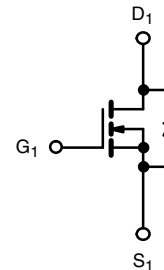
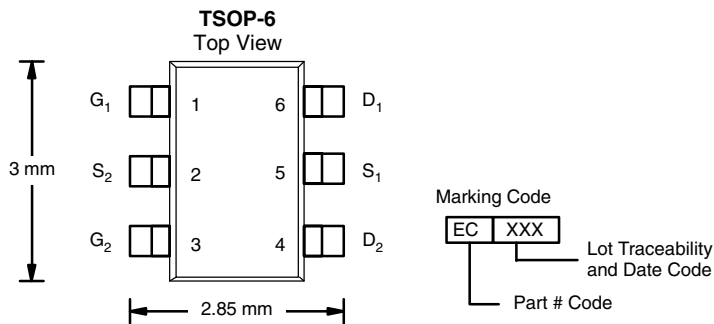
- TrenchFET[®] Power MOSFETs
- 100 % R_g Tested
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



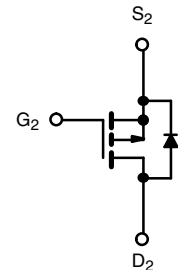
RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

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



N-Channel MOSFET



P-Channel MOSFET

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

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}	± 12		
Continuous Drain Current ($T_J = 150$ °C)	I_D	$T_C = 25$ °C	3.9	-2.1
		$T_C = 70$ °C	3.1	-1.7
		$T_A = 25$ °C	3.5 ^{b, c}	-1.9 ^{b, c}
		$T_A = 70$ °C	2.8 ^{b, c}	-1.5 ^{b, c}
Pulsed Drain Current ($t = 300$ μ s)	I_{DM}	12	-5	A
Source Drain Current Diode Current	I_S	$T_C = 25$ °C	1.2	
		$T_A = 25$ °C	0.9 ^{b, c}	-0.9 ^{b, c}
Maximum Power Dissipation	P_D	$T_C = 25$ °C	1.4	1.3
		$T_C = 70$ °C	0.9	0.8
		$T_A = 25$ °C	1.1 ^{b, c}	1.1 ^{b, c}
		$T_A = 70$ °C	0.7 ^{b, c}	0.7 ^{b, c}
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 ^{b, d}	$t \leq 5$ s	R_{thJA}	93	110	97	115	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R_{thJF}	75	90	78	95	

Notes:

- Based on $T_C = 25$ °C.
- Surface mounted on 1" x 1" FR4 board.
- $t = 5$ s.
- 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_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	N-Ch	20			V
		$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-20			
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		15		mV/°C
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		-16.2		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250\text{ }\mu\text{A}$	N-Ch		-2.8		
		$I_D = -250\text{ }\mu\text{A}$	P-Ch		2.5		
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	N-Ch	0.6		1.5	V
		$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	P-Ch	-0.6		-1.5	
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$	N-Ch			± 100	nA
			P-Ch			± 100	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$	N-Ch			1	μA
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$	P-Ch			-1	
		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	N-Ch			10	
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$	P-Ch			-10	
On-State Drain Current ^b	$I_{D(on)}$	$V_{DS} \geq 5\text{ V}, V_{GS} = 4.5\text{ V}$	N-Ch	12			A
		$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	P-Ch	-5			
Drain-Source On-State Resistance ^b	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 2.5\text{ A}$	N-Ch		0.048	0.058	Ω
		$V_{GS} = -4.5\text{ V}, I_D = -1.9\text{ A}$	P-Ch		0.162	0.195	
		$V_{GS} = 2.5\text{ V}, I_D = 1\text{ A}$	N-Ch		0.065	0.078	
		$V_{GS} = -2.5\text{ V}, I_D = -1\text{ A}$	P-Ch		0.263	0.316	
Forward Transconductance ^b	g_{fs}	$V_{DS} = 10\text{ V}, I_D = 35\text{ A}$	N-Ch		12		S
		$V_{DS} = -10\text{ V}, I_D = -1.9\text{ A}$	P-Ch		1		
Dynamic^a							
Input Capacitance	C_{iss}	N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch		150		pF
			P-Ch		210		
Output Capacitance	C_{oss}	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	N-Ch		53		
			P-Ch		50		
Reverse Transfer Capacitance	C_{rss}		N-Ch		22		
			P-Ch		35		
Total Gate Charge	Q_g	$V_{DS} = 10\text{ V}, V_{GS} = 10\text{ V}, I_D = 3.5\text{ A}$	N-Ch		3.2	4.8	nC
		$V_{DS} = -10\text{ V}, V_{GS} = -10\text{ V}, I_D = -1.9\text{ A}$	P-Ch		6	9	
Gate-Source Charge	Q_{gs}	N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 3.5\text{ A}$	N-Ch		1.6	2.4	
			P-Ch		2.9	4.3	
Gate-Drain Charge	Q_{gd}	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -1.9\text{ A}$	N-Ch		0.3		
			P-Ch		0.6		
Gate Resistance	R_g	$f = 1\text{ MHz}$	N-Ch	0.9	4.8	9.6	Ω
			P-Ch	1.2	6.2	12.4	



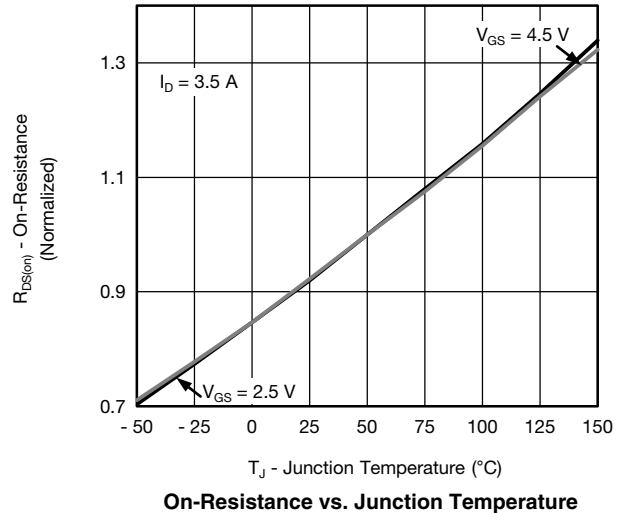
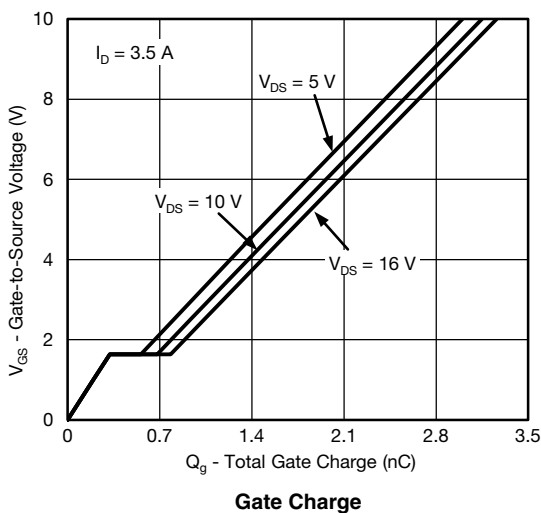
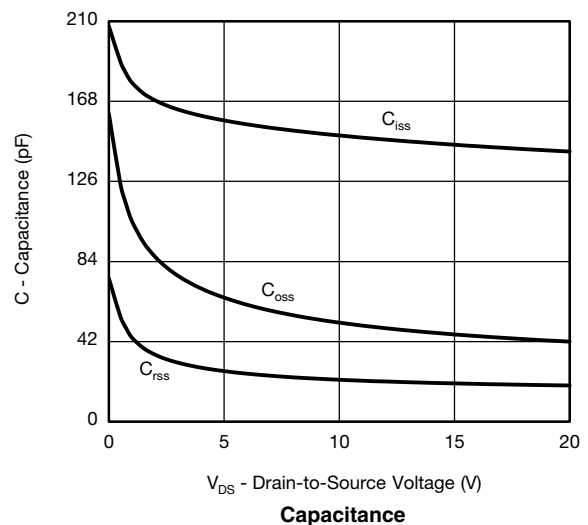
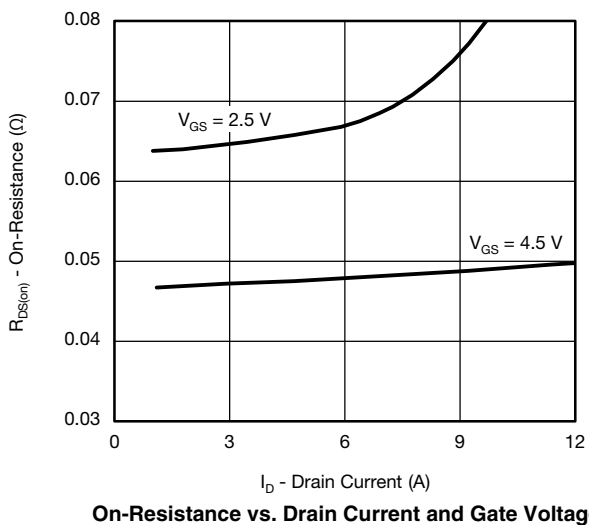
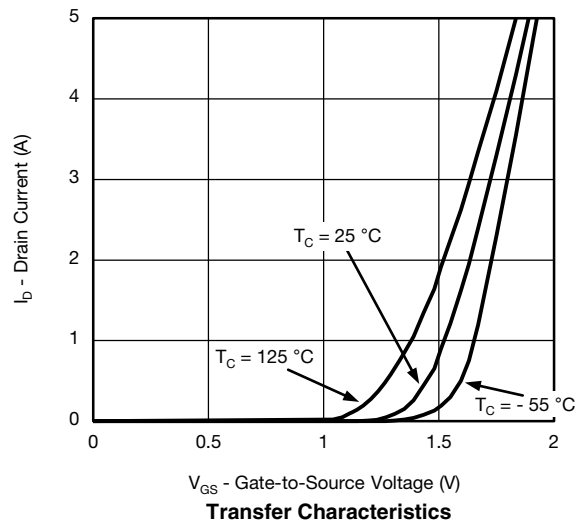
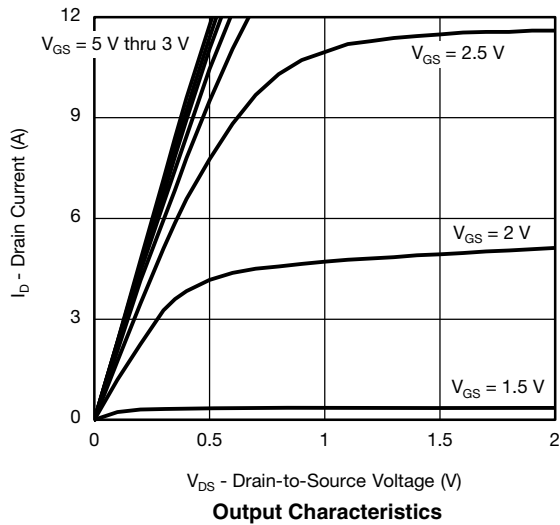
SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Dynamic^a							
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 10\text{ V}$, $R_L = 3.6\ \Omega$ $I_D \cong 2.8\text{ A}$, $V_{GEN} = 10\text{ V}$, $R_g = 1\ \Omega$	N-Ch		5	10	ns
			P-Ch		3	6	
Rise Time	t_r		N-Ch		20	30	
			P-Ch		10	20	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -10\text{ V}$, $R_L = 6.7\ \Omega$ $I_D \cong -1.5\text{ A}$, $V_{GEN} = -10\text{ V}$, $R_g = 1\ \Omega$	N-Ch		11	20	
			P-Ch		13	20	
Fall Time	t_f		N-Ch		8	16	
			P-Ch		7	14	
Turn-On Delay Time	$t_{d(on)}$	N-Channel $V_{DD} = 10\text{ V}$, $R_L = 3.6\ \Omega$ $I_D \cong 2.8\text{ A}$, $V_{GEN} = 4.5\text{ V}$, $R_g = 1\ \Omega$	N-Ch		15	23	
			P-Ch		16	25	
Rise Time	t_r		N-Ch		37	56	
			P-Ch		16	25	
Turn-Off Delay Time	$t_{d(off)}$	P-Channel $V_{DD} = -10\text{ V}$, $R_L = 6.7\ \Omega$ $I_D \cong -1.5\text{ A}$, $V_{GEN} = -4.5\text{ V}$, $R_g = 1\ \Omega$	N-Ch		25	38	
			P-Ch		13	20	
Fall Time	t_f		N-Ch		28	42	
			P-Ch		9	18	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^\circ\text{C}$	N-Ch			1.2	A
			P-Ch			-1.1	
Pulse Diode Forward Current ^a	I_{SM}		N-Ch			12	A
			P-Ch			-5	
Body Diode Voltage	V_{SD}	$I_S = 2.8\text{ A}$, $V_{GS} = 0\text{ V}$	N-Ch		0.8	1.2	V
		$I_S = -1.5\text{ A}$, $V_{GS} = 0\text{ V}$	P-Ch		-0.8	-1.2	
Body Diode Reverse Recovery Time	t_{rr}	N-Channel $I_F = 2.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 25\text{ }^\circ\text{C}$	N-Ch		8	16	ns
			P-Ch		21	32	
Body Diode Reverse Recovery Charge	Q_{rr}	P-Channel $I_F = -1.5\text{ A}$, $di/dt = -100\text{ A}/\mu\text{s}$, $T_J = 25\text{ }^\circ\text{C}$	N-Ch		2	4	nC
			P-Ch		11	20	
Reverse Recovery Fall Time	t_a		N-Ch		5		ns
			P-Ch		10		
Reverse Recovery Rise Time	t_b		N-Ch		3		
			P-Ch		11		

Notes:

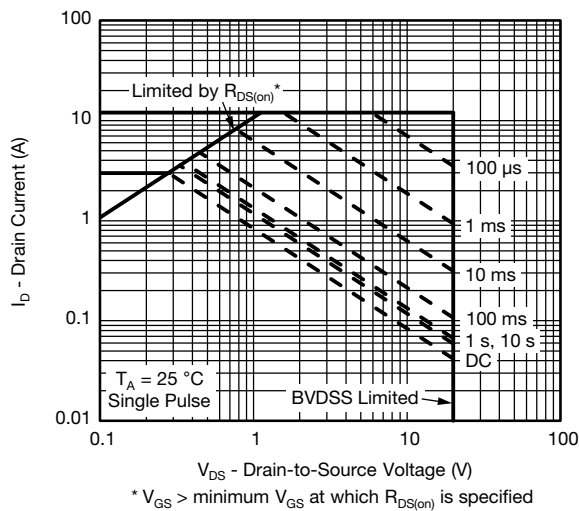
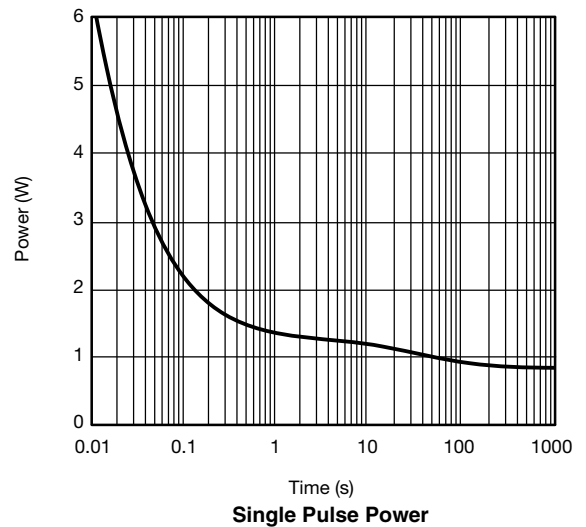
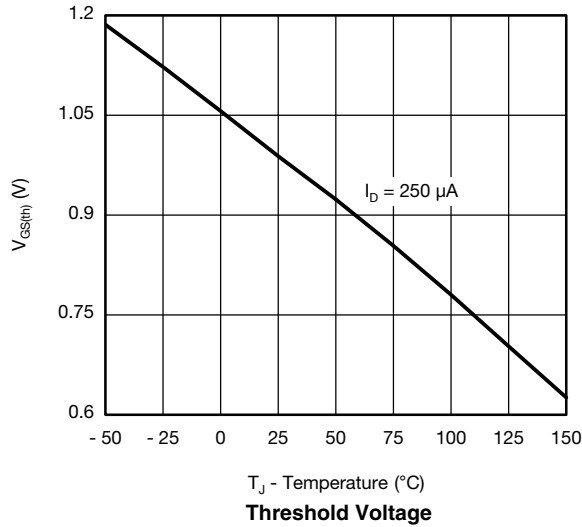
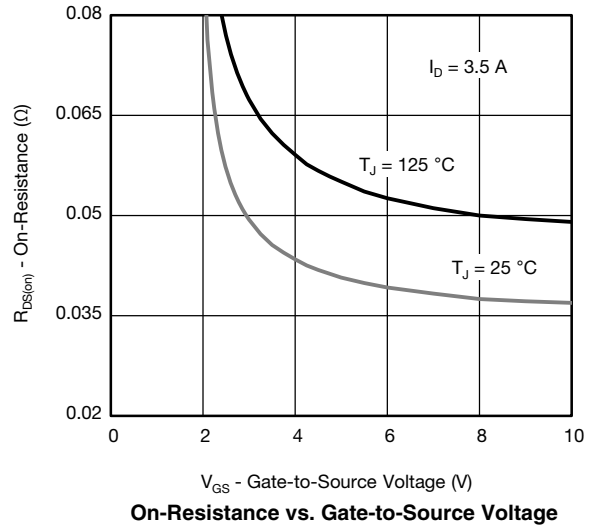
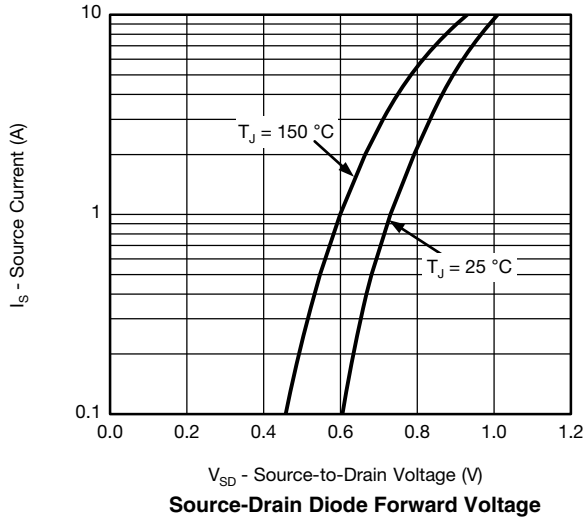
- a. Guaranteed by design, not subject to production testing.
- b. Pulse test; pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.

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.

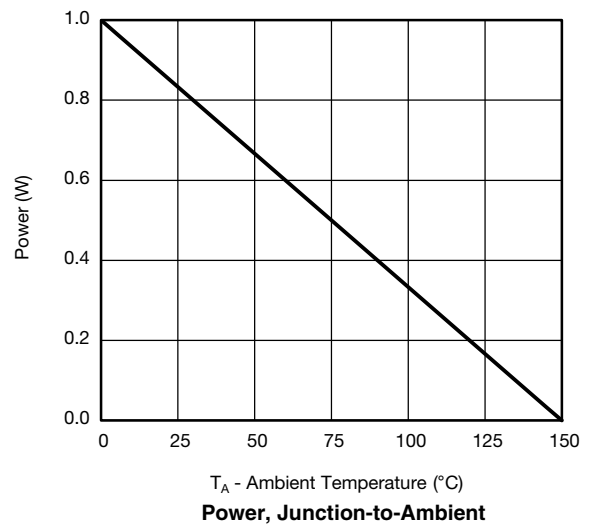
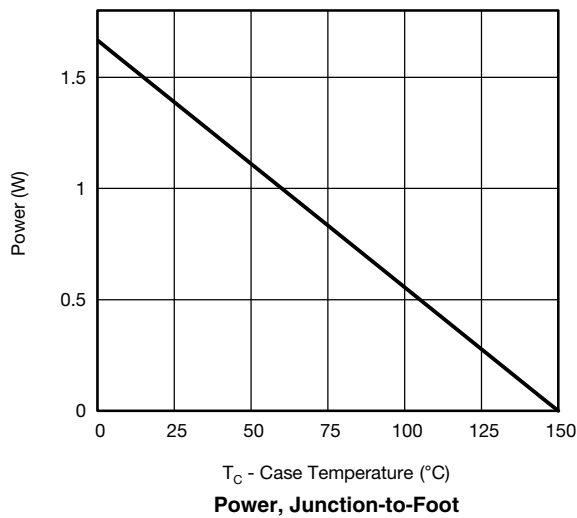
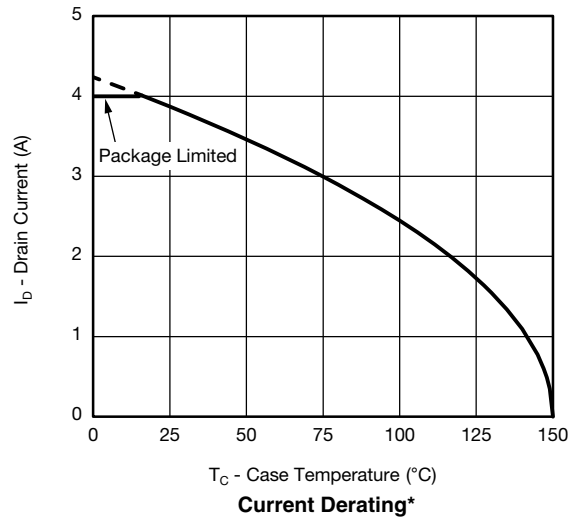
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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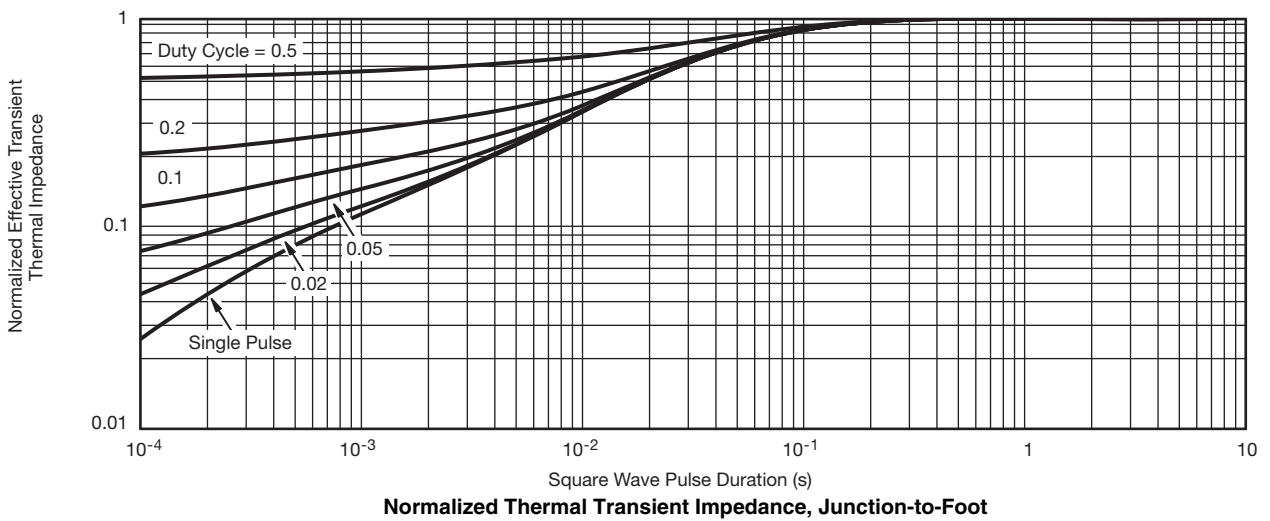
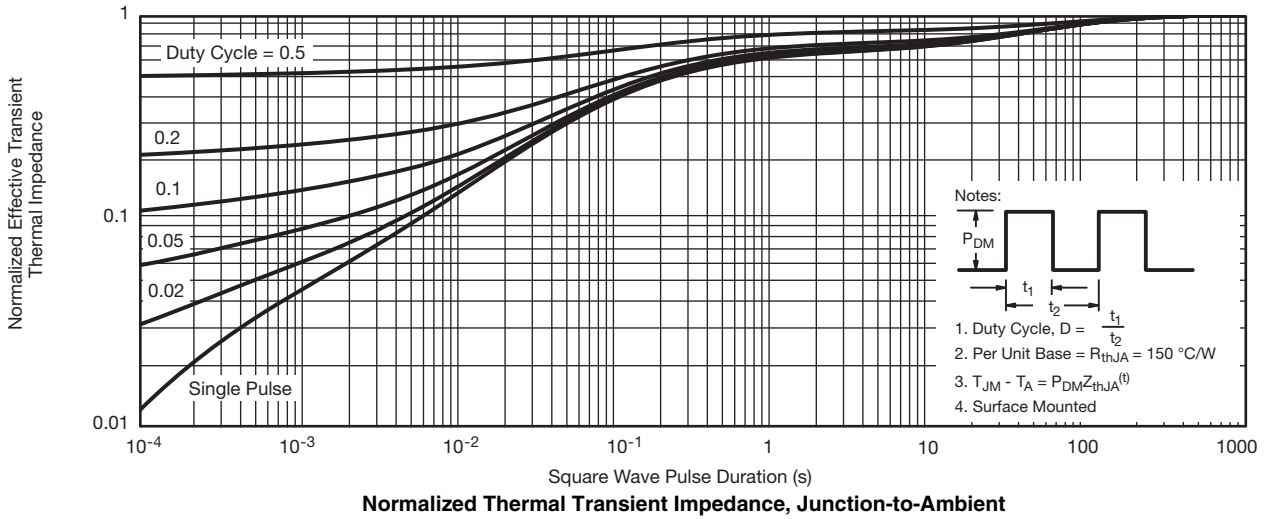


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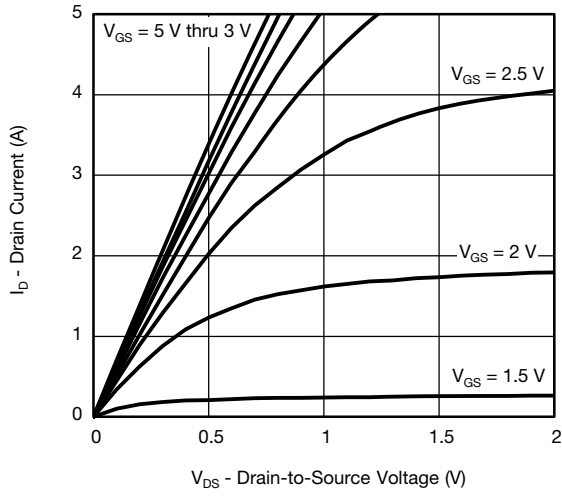


* The power dissipation P_D is based on $T_{J(max.)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

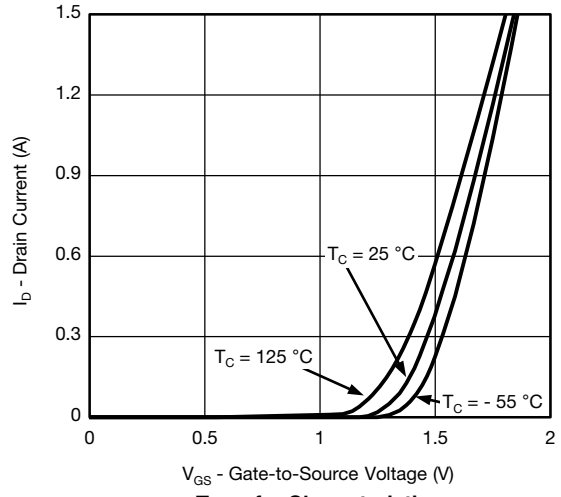
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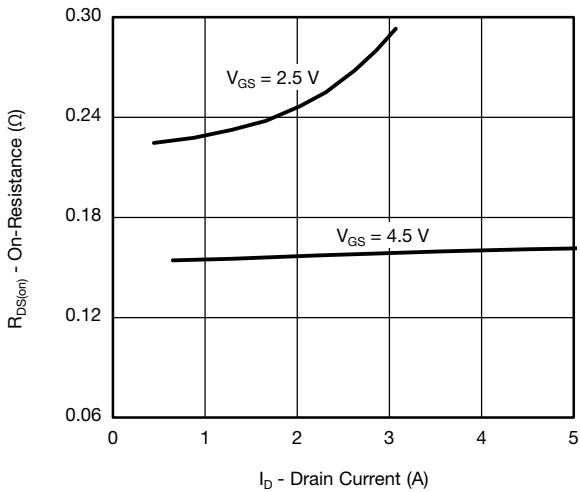
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



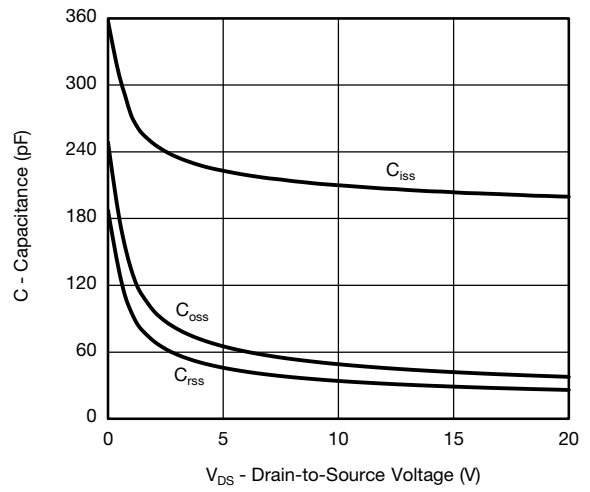
Output Characteristics



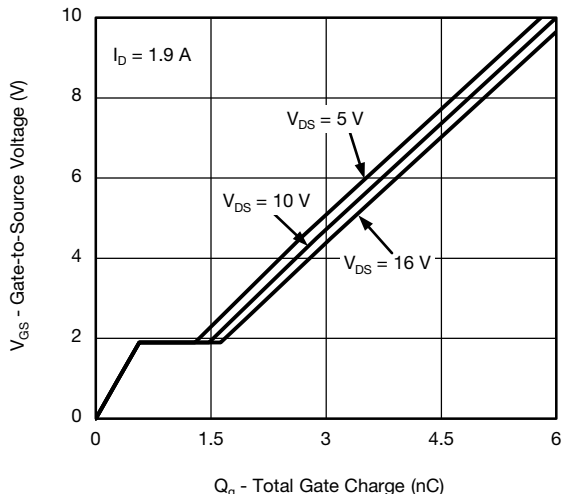
Transfer Characteristics



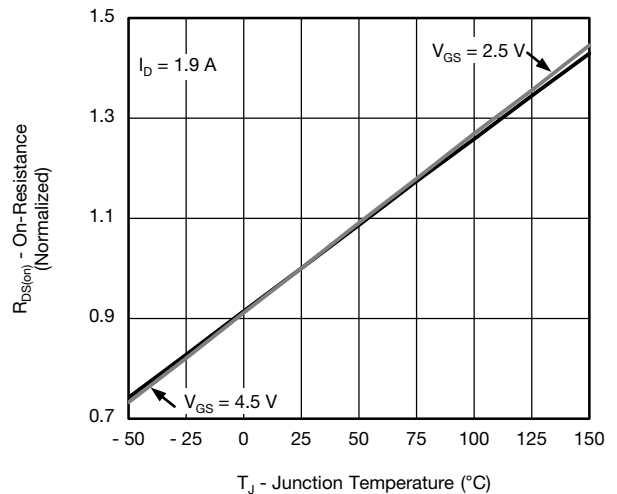
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

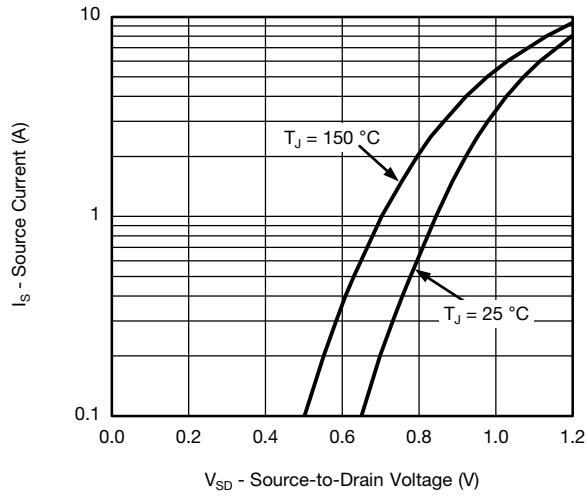


Gate Charge

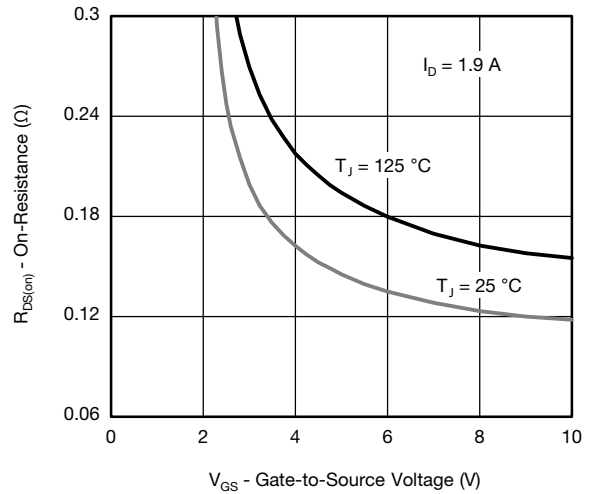


On-Resistance vs. Junction Temperature

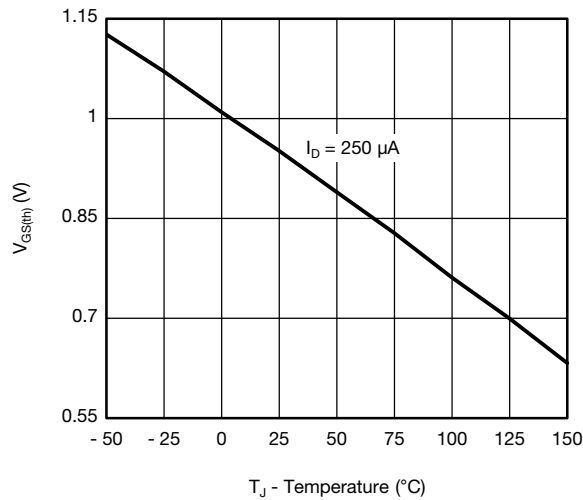
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



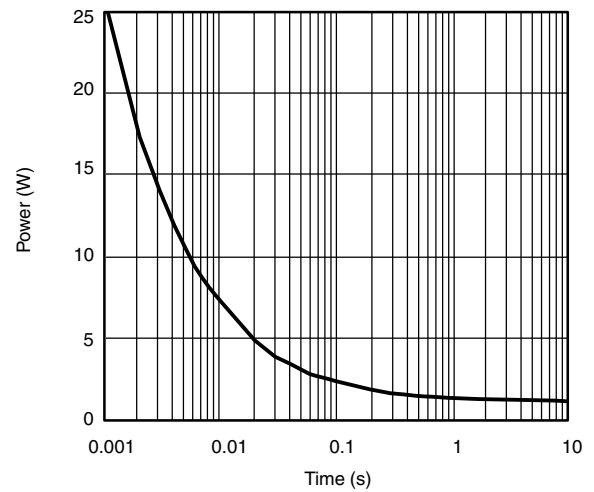
V_{SD} - Source-to-Drain Voltage (V)
Source-Drain Diode Forward Voltage



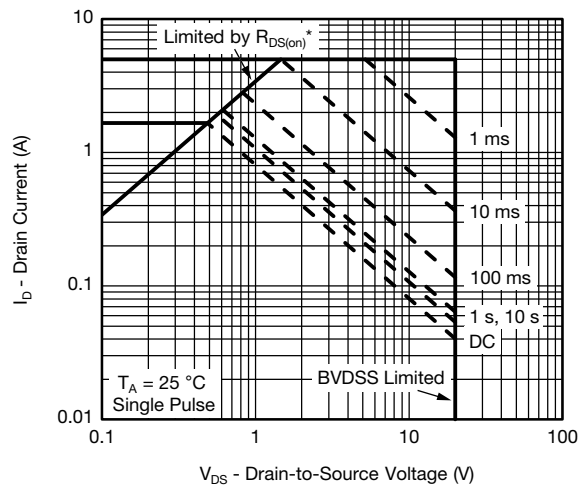
V_{GS} - Gate-to-Source Voltage (V)
On-Resistance vs. Gate-to-Source Voltage



T_J - Temperature ($^\circ\text{C}$)
Threshold Voltage



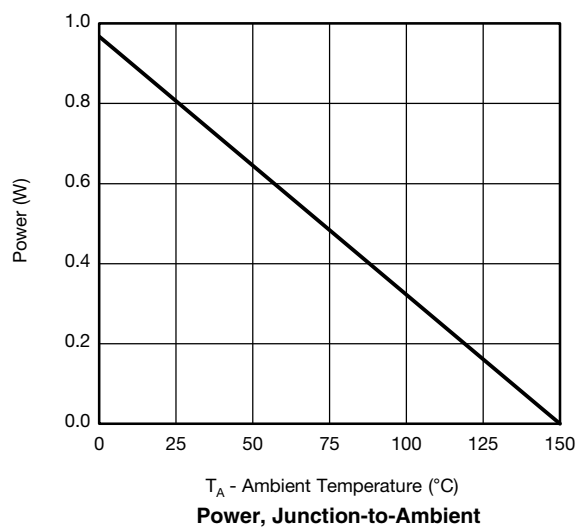
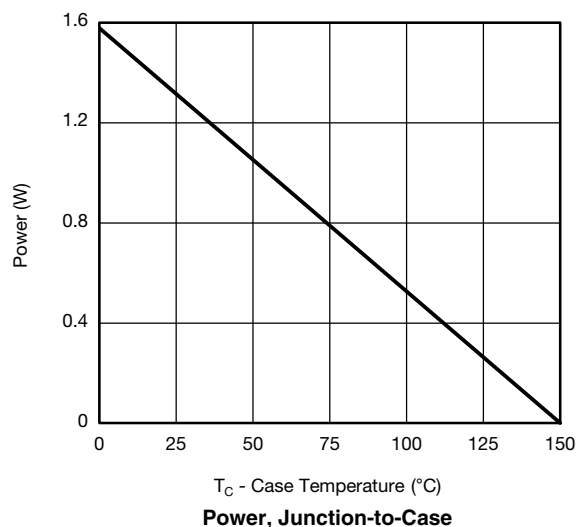
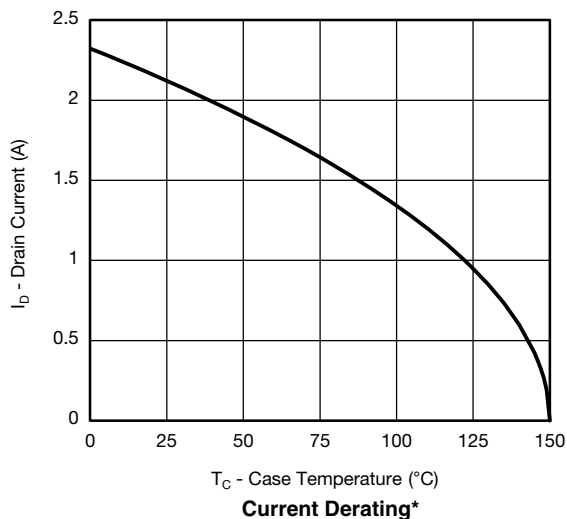
Single Pulse Power



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

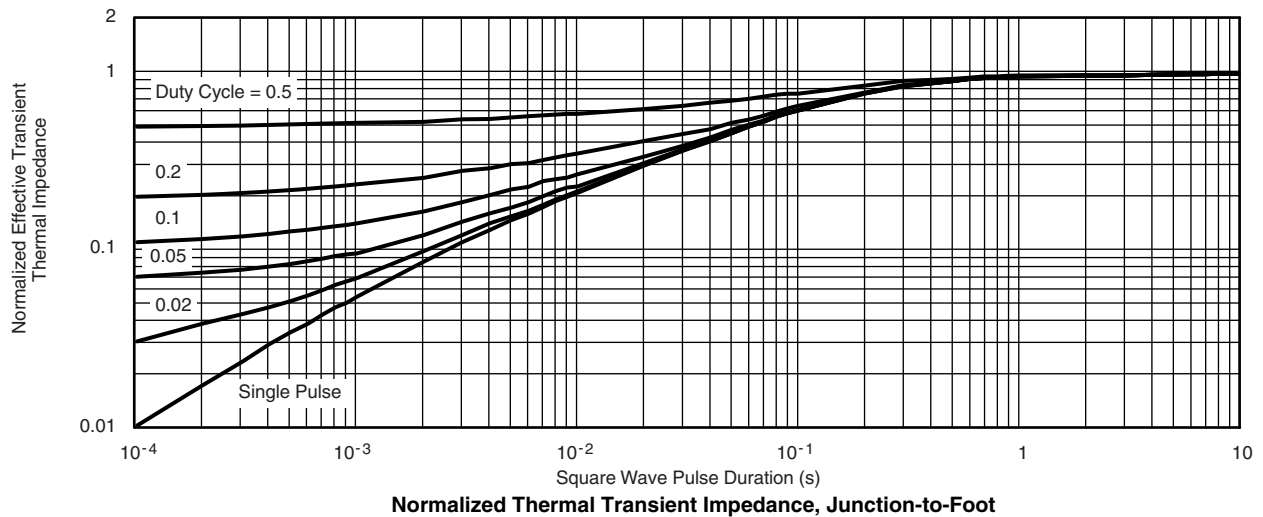
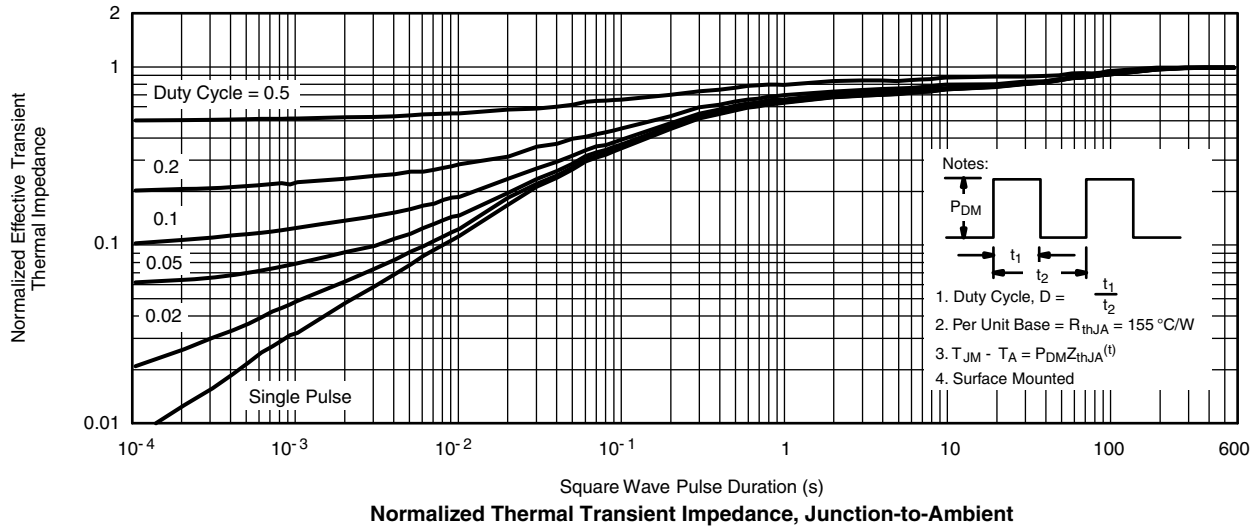
Safe Operating Area, Junction-to-Ambient

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



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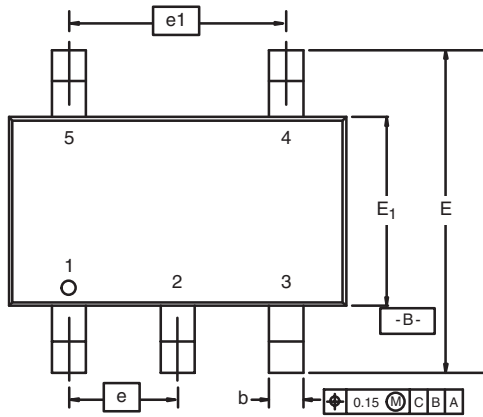
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



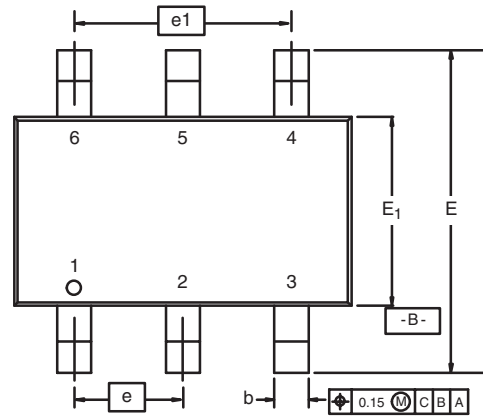
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TSOP: 5/6-LEAD

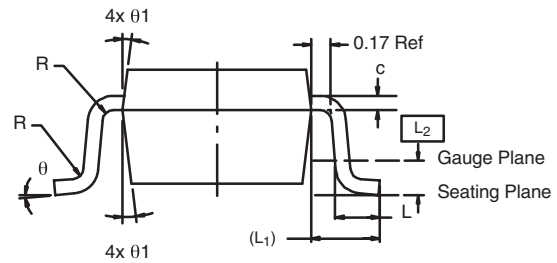
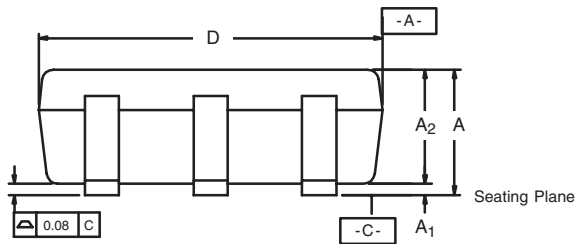
JEDEC Part Number: MO-193C



5-LEAD TSOP



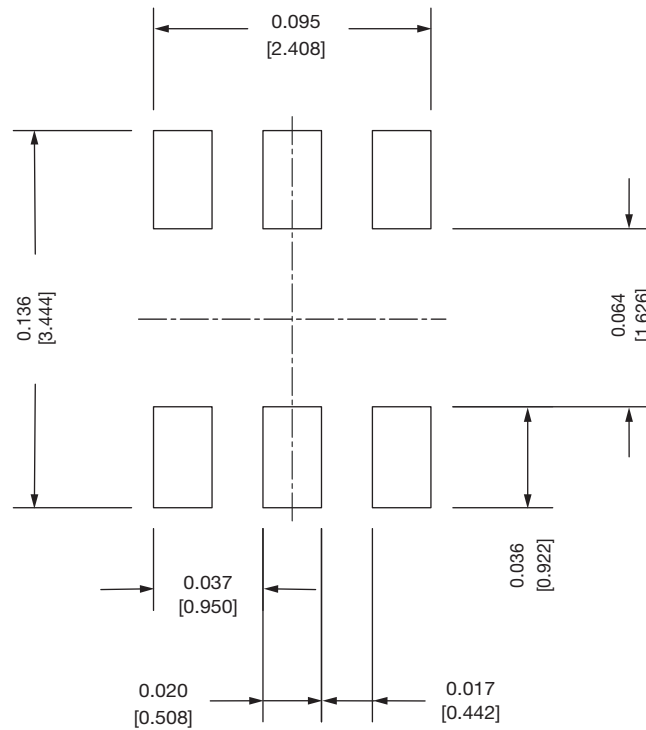
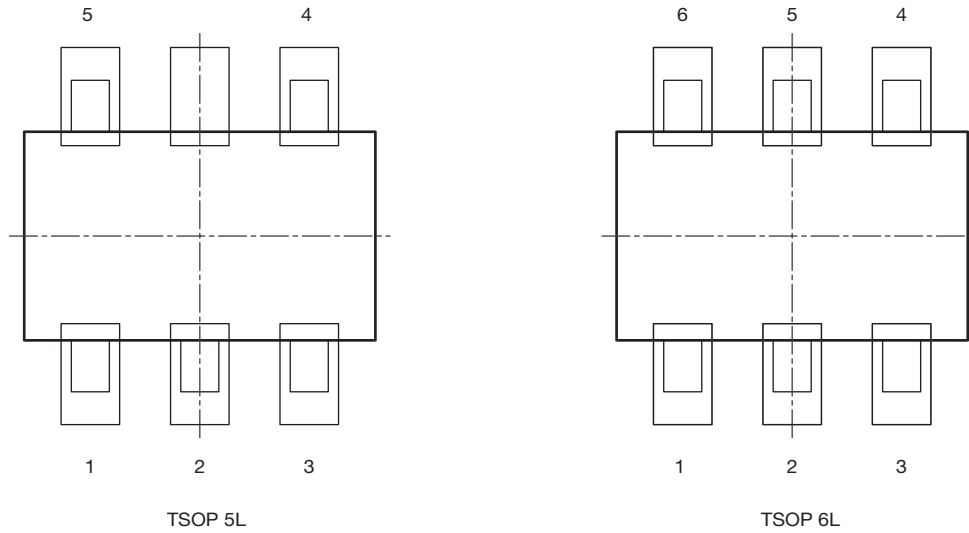
6-LEAD TSOP



Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.91	-	1.10	0.036	-	0.043
A₁	0.01	-	0.10	0.0004	-	0.004
A₂	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
E₁	1.55	1.65	1.70	0.061	0.065	0.067
e	0.95 BSC			0.0374 BSC		
e₁	1.80	1.90	2.00	0.071	0.075	0.079
L	0.32	-	0.50	0.012	-	0.020
L₁	0.60 Ref			0.024 Ref		
L₂	0.25 BSC			0.010 BSC		
R	0.10	-	-	0.004	-	-
θ	0°	4°	8°	0°	4°	8°
θ₁	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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