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

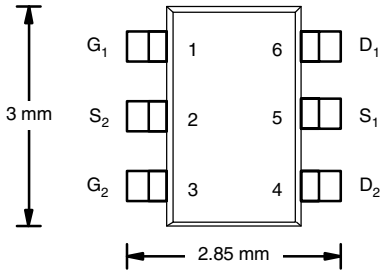
- TrenchFET® Power MOSFETs
- 100 % R_g Tested
- Material categorization:
  For definitions of compliance please see
  www.vishay.com/doc?99912

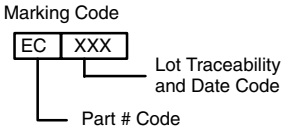
Pb-free
RoHS COMPLIANT
HALOGEN FREE

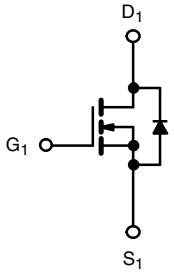
APPLICATIONS

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

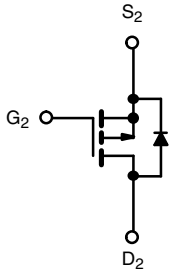
TSOP-6
Top View







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)	T_C = 25 °C	I_D	3.9	- 2.1	A
	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 µs)		I_{DM}	12	- 5	
Source Drain Current Diode Current	T_C = 25 °C	I_S	1.2	- 1.1	
	T_A = 25 °C		0.9[b, c]	- 0.9[b, c]	
Maximum Power Dissipation	T_C = 25 °C	P_D	1.4	1.3	W
	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 ≤ 5 s	R_{thJA}	93	110	97	115	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R_{thJF}	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 °C, unless otherwise noted)							
Parameter	**Symbol**	**Test Conditions**		**Min.**	**Typ.**	**Max.**	**Unit**
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA	N-Ch	20			V
		V_{GS} = 0 V, I_D = - 250 µA	P-Ch	- 20			
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	I_D = 250 µA	N-Ch		15		mV/°C
		I_D = - 250 µA	P-Ch		- 16.2		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	I_D = 250 µA	N-Ch		- 2.8		
		I_D = - 250 µA	P-Ch		2.5		
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	N-Ch	0.6		1.5	V
		V_{DS} = V_{GS}, I_D = - 250 µA	P-Ch	- 0.6		- 1.5	
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 12 V	N-Ch			± 100	nA
			P-Ch			± 100	
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	N-Ch			1	µA
		V_{DS} = - 20 V, V_{GS} = 0 V	P-Ch			- 1	
		V_{DS} = 20 V, V_{GS} = 0 V, T_J = 55 °C	N-Ch			10	
		V_{DS} = - 20 V, V_{GS} = 0 V, T_J = 55 °C	P-Ch			- 10	
On-State Drain Current[b]	$I_{D(on)}$	$V_{DS} \geq$ 5 V, V_{GS} = 4.5 V	N-Ch	12			A
		$V_{DS} \leq$ - 5 V, V_{GS} = - 4.5 V	P-Ch	- 5			
Drain-Source On-State Resistance[b]	$R_{DS(on)}$	V_{GS} = 4.5 V, I_D = 2.5 A	N-Ch		0.048	0.058	Ω
		V_{GS} = - 4.5 V, I_D = - 1.9 A	P-Ch		0.162	0.195	
		V_{GS} = 2.5 V, I_D = 1 A	N-Ch		0.065	0.078	
		V_{GS} = - 2.5 V, I_D = - 1 A	P-Ch		0.263	0.316	
Forward Transconductance[b]	g_{fs}	V_{DS} = 10 V, I_D = 35 A	N-Ch		12		S
		V_{DS} = - 10 V, I_D = - 1.9 A	P-Ch		1		
Dynamic[a]							
Input Capacitance	C_{iss}	N-Channel V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz P-Channel V_{DS} = - 10 V, V_{GS} = 0 V, f = 1 MHz	N-Ch		150		pF
			P-Ch		210		
Output Capacitance	C_{oss}		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 V, V_{GS} = 10 V, I_D = 3.5 A	N-Ch		3.2	4.8	nC
		V_{DS} = - 10 V, V_{GS} = - 10 V, I_D = - 1.9 A	P-Ch		6	9	
		N-Channel V_{DS} = 10 V, V_{GS} = 4.5 V, I_D = 3.5 A P-Channel V_{DS} = - 10 V, V_{GS} = - 4.5 V, I_D = - 1.9 A	N-Ch		1.6	2.4	
			P-Ch		2.9	4.3	
Gate-Source Charge	Q_{gs}		N-Ch		0.3		
			P-Ch		0.6		
Gate-Drain Charge	Q_{gd}		N-Ch		0.4		
			P-Ch		0.9		
Gate Resistance	R_g	f = 1 MHz	N-Ch	0.9	4.8	9.6	Ω
			P-Ch	1.2	6.2	12.4	

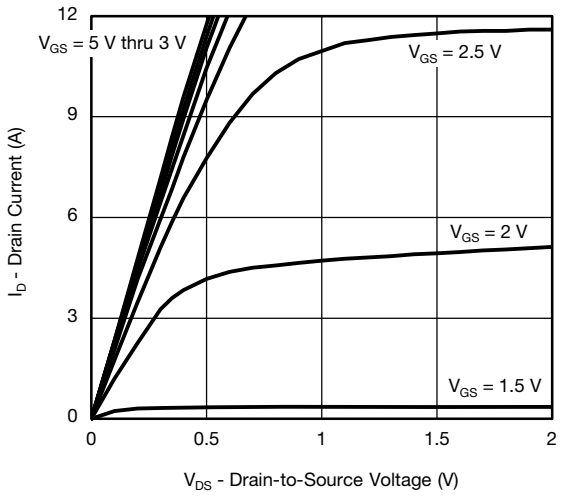
For technical questions, contact: pmostechsupport@vishay.com
Document Number: 67470
S13-1562-Rev. C, 15-Jul-13

SPECIFICATIONS (T_J = 25 °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 V, R_L = 3.6 Ω $I_D \cong$ 2.8 A, V_{GEN} = 10 V, R_g = 1 Ω	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 V, R_L = 6.7 Ω $I_D \cong$ - 1.5 A, V_{GEN} = - 10 V, R_g = 1 Ω	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 V, R_L = 3.6 Ω $I_D \cong$ 2.8 A, V_{GEN} = 4.5 V, R_g = 1 Ω	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 V, R_L = 6.7 Ω $I_D \cong$ - 1.5 A, V_{GEN} = - 4.5 V, R_g = 1 Ω	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 °C	N-Ch			1.2	A
			P-Ch			- 1.1	
Pulse Diode Forward Current[a]	I_{SM}		N-Ch			12	
			P-Ch			- 5	
Body Diode Voltage	V_{SD}	I_S = 2.8 A, V_{GS} = 0 V	N-Ch		0.8	1.2	V
		I_S = - 1.5 A, V_{GS} = 0 V	P-Ch		- 0.8	- 1.2	
Body Diode Reverse Recovery Time	t_{rr}	N-Channel I_F = 2.8 A, dI/dt = 100 A/µs, T_J = 25 °C P-Channel I_F = - 1.5 A, dI/dt = - 100 A/µs, T_J = 25 °C	N-Ch		8	16	ns
			P-Ch		21	32	
Body Diode Reverse Recovery Charge	Q_{rr}		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		

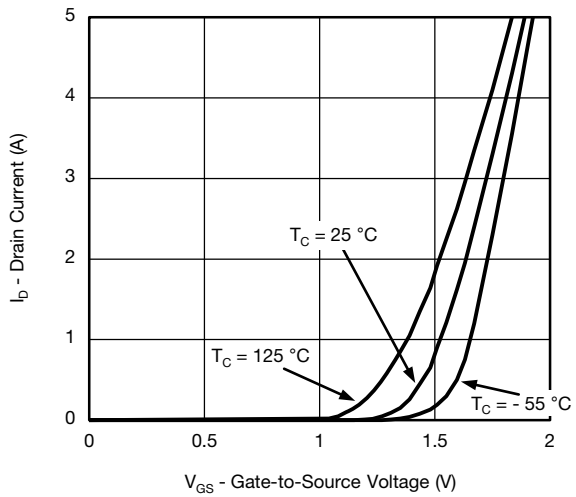
Notes:
a. Guaranteed by design, not subject to production testing.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.

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.

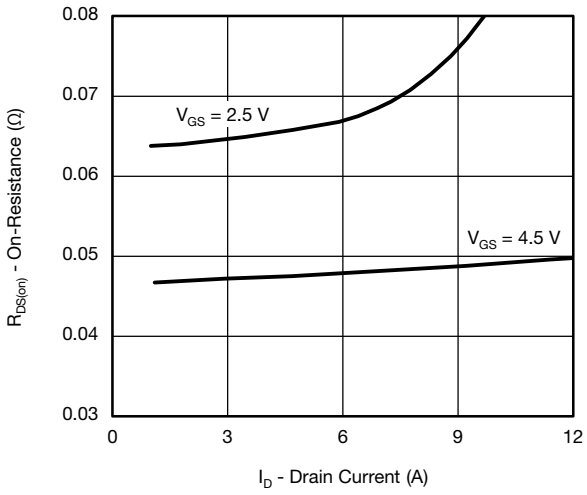
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



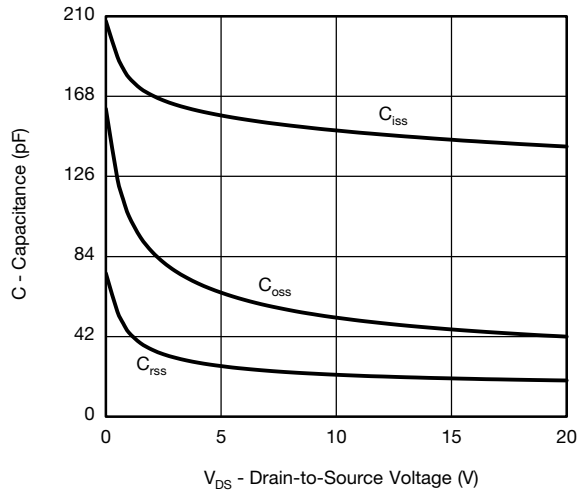
Output Characteristics



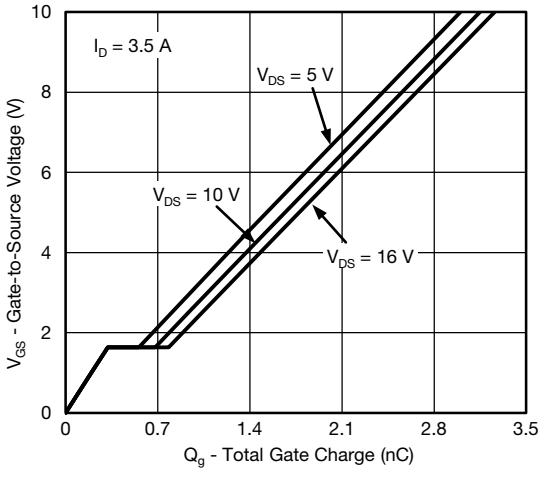
Transfer Characteristics



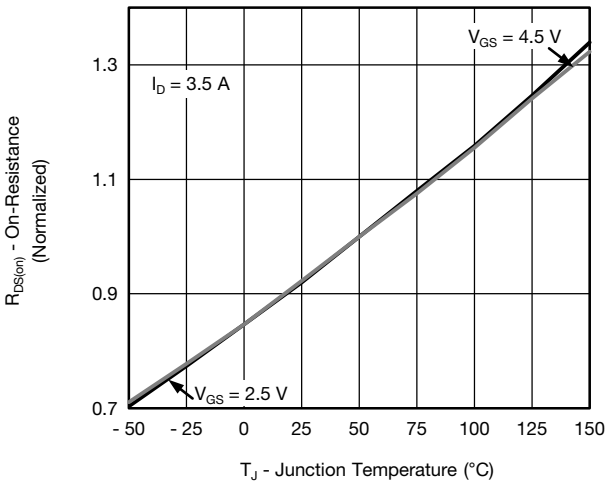
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



Gate Charge



On-Resistance vs. Junction Temperature

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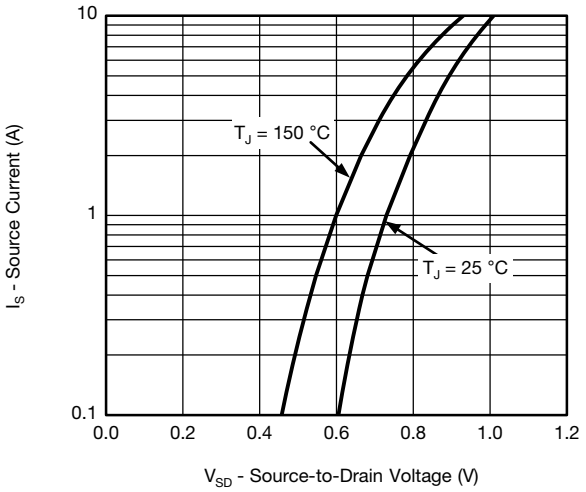
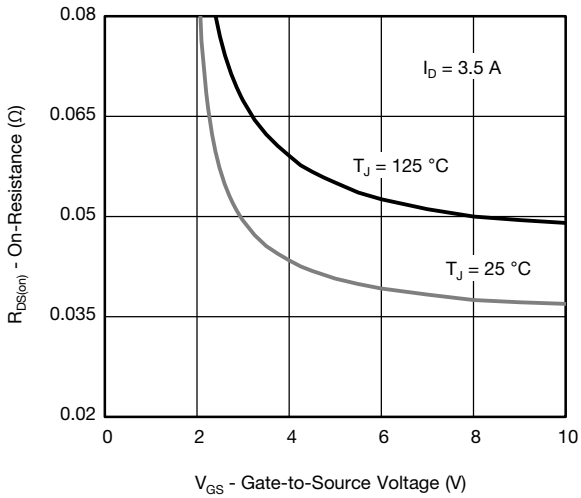
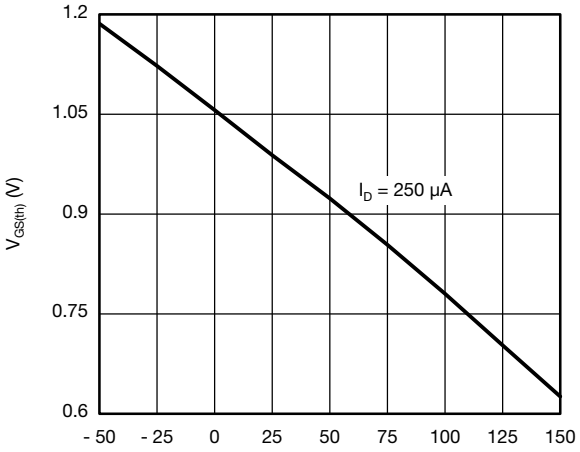
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



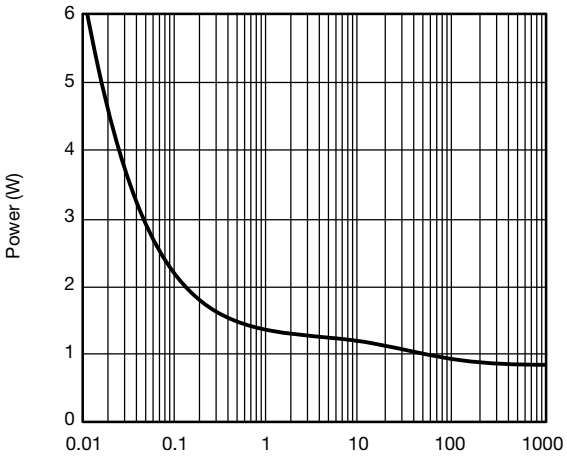
Source-Drain Diode Forward Voltage



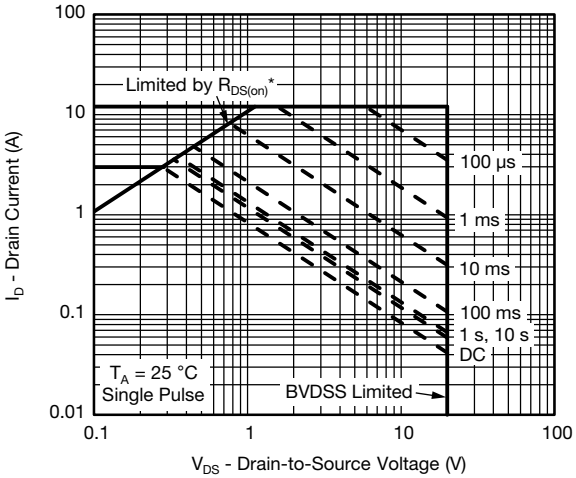
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



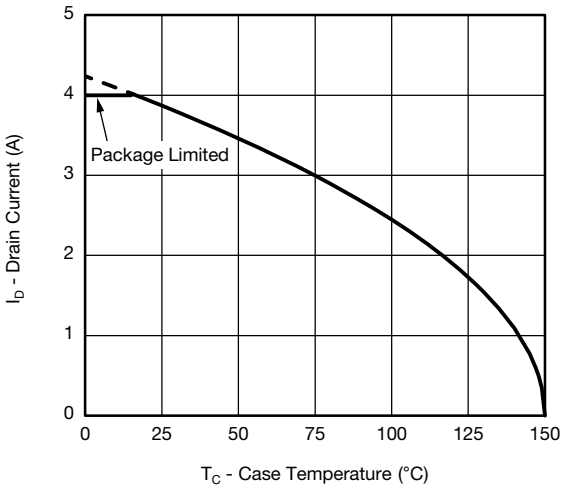
Single Pulse Power



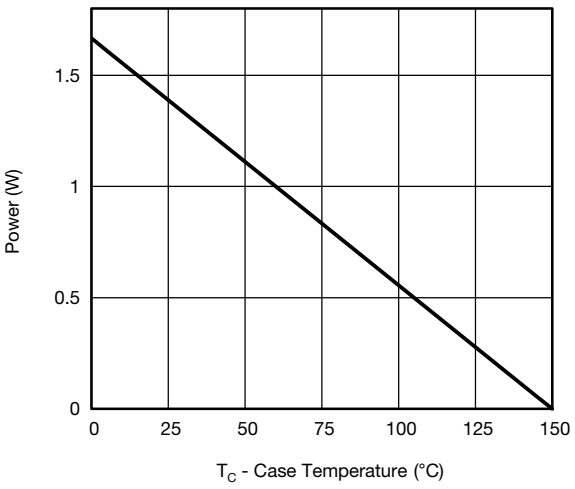
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

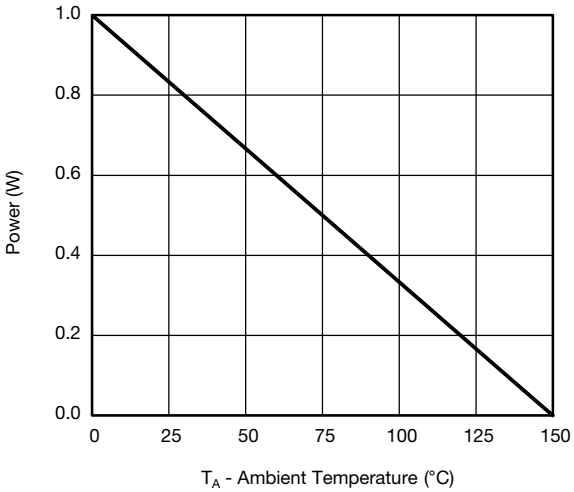
N-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*



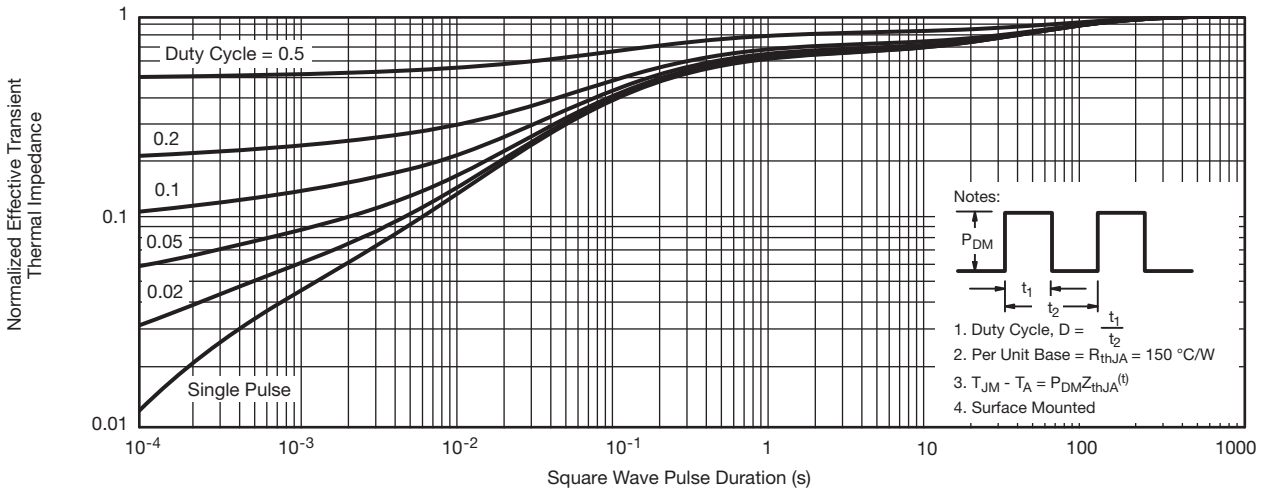
Power, Junction-to-Foot



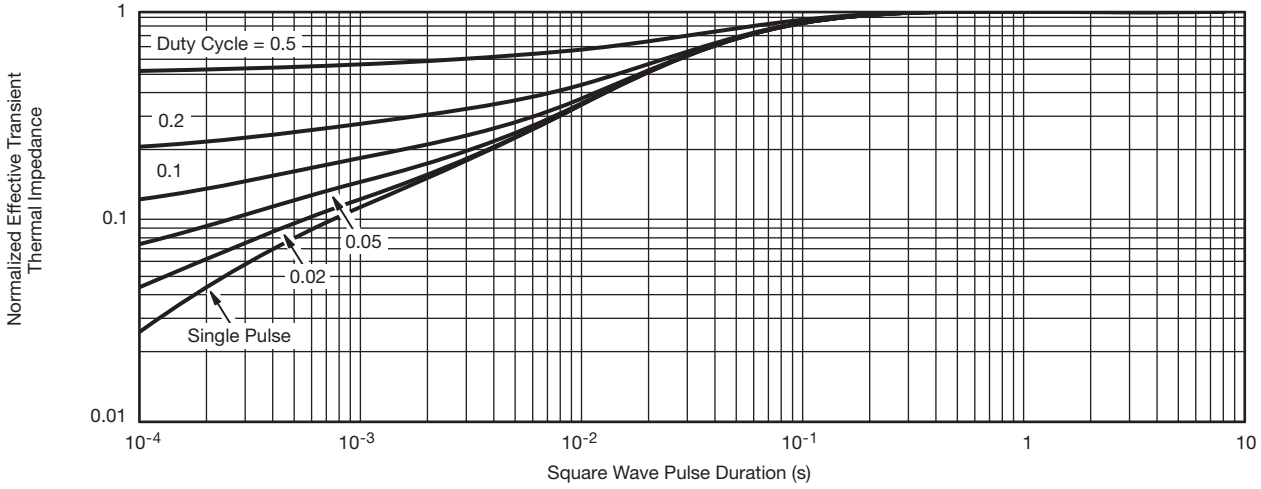
Power, Junction-to-Ambient

* 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)

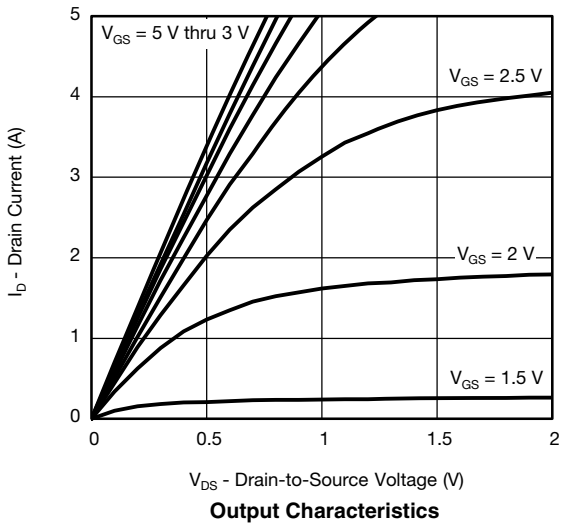


Normalized Thermal Transient Impedance, Junction-to-Ambient

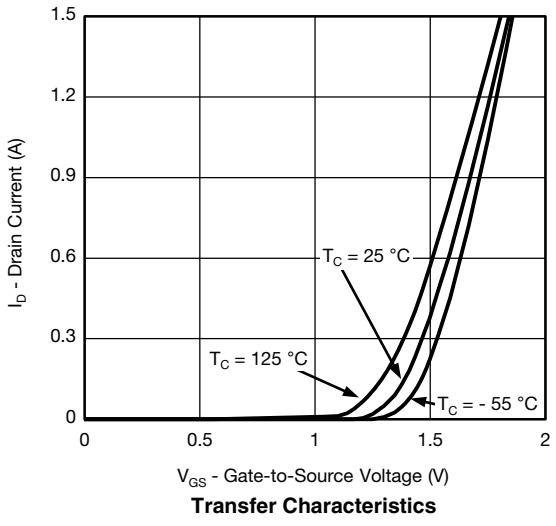


Normalized Thermal Transient Impedance, Junction-to-Foot

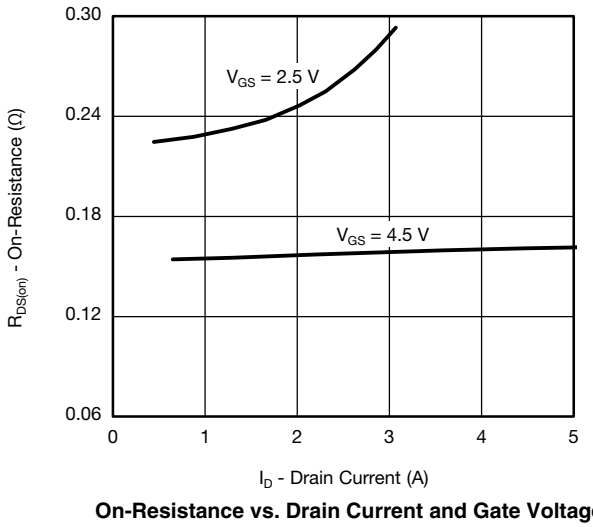
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



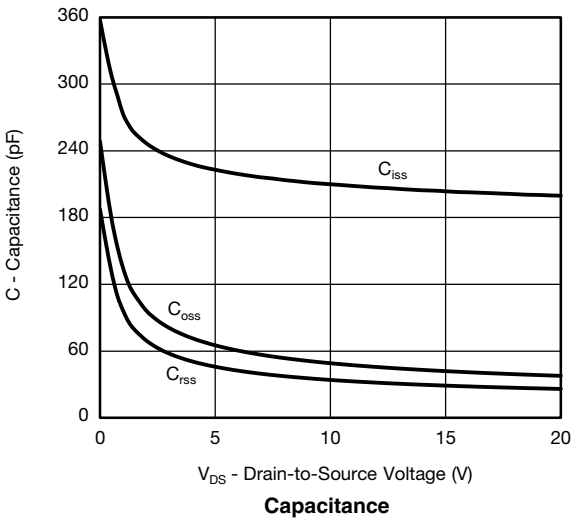
Output Characteristics



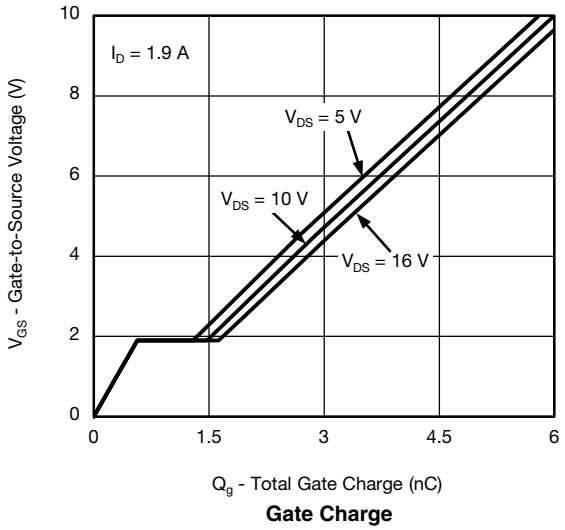
Transfer Characteristics



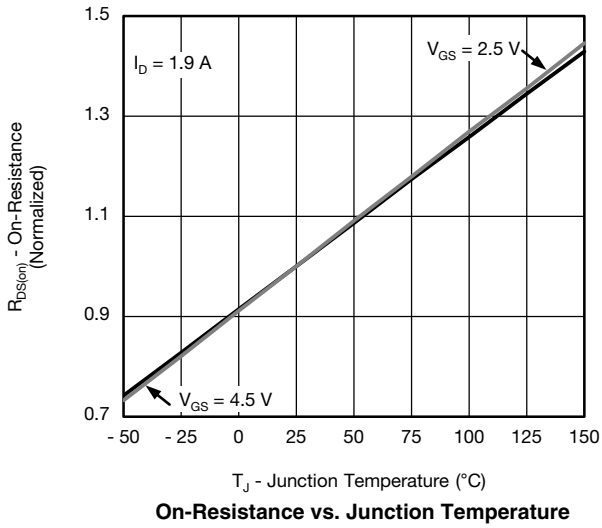
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



Gate Charge



On-Resistance vs. Junction Temperature

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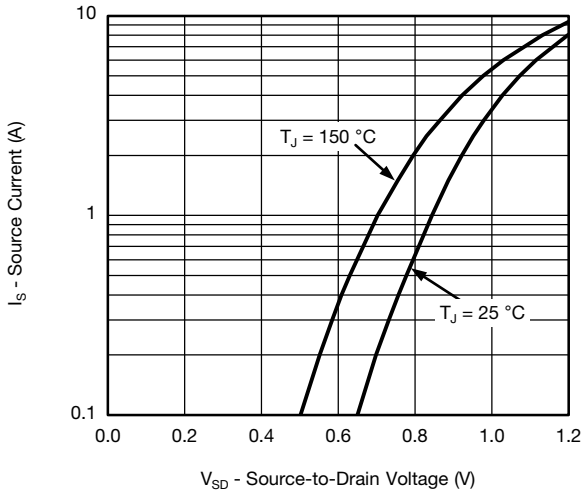
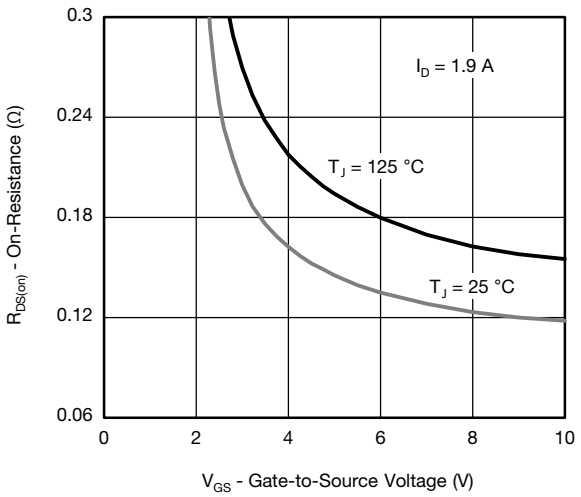
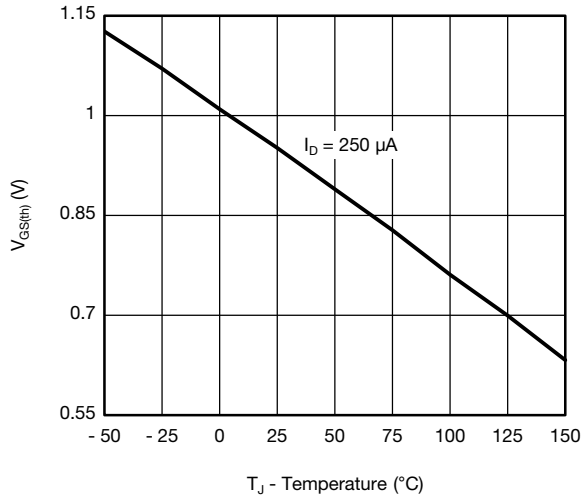
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



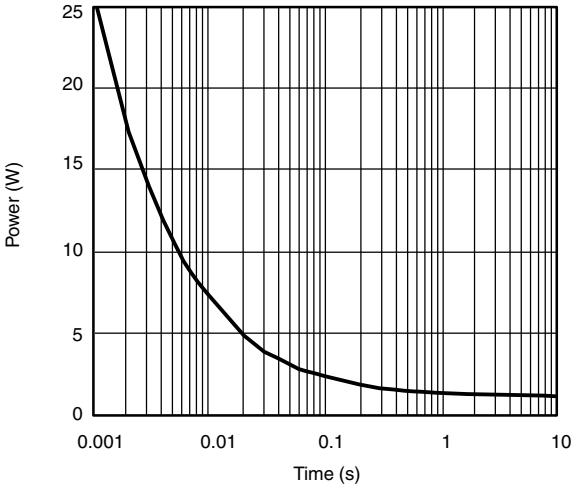
Source-Drain Diode Forward Voltage



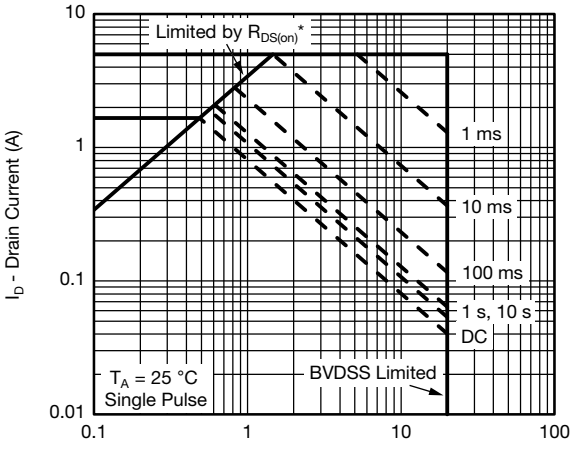
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



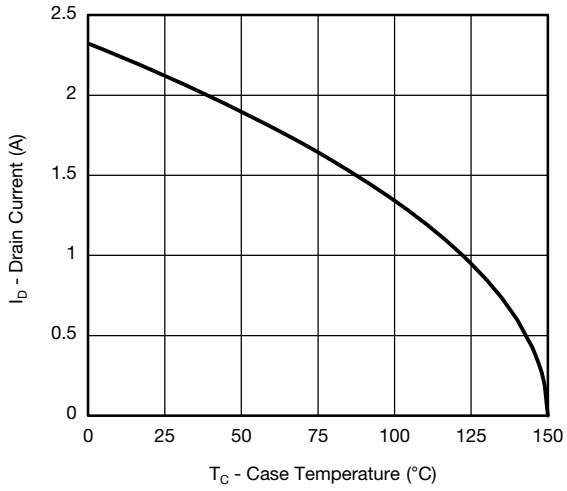
Single Pulse Power



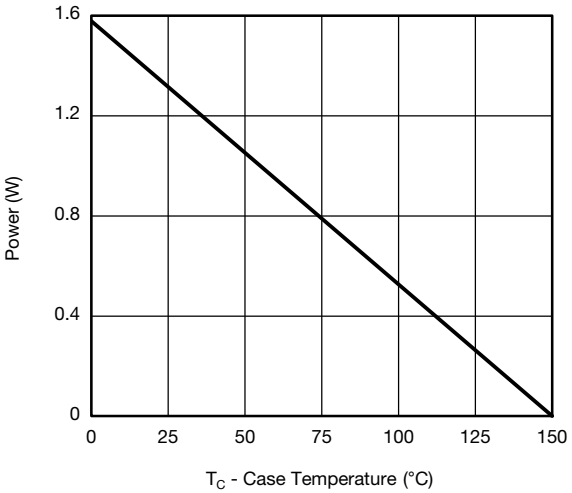
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

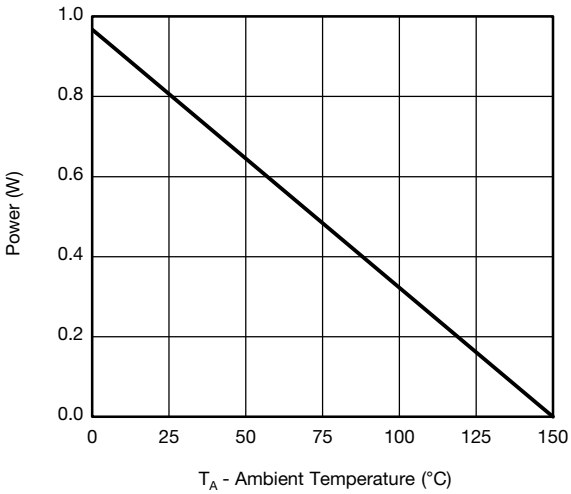
P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating*



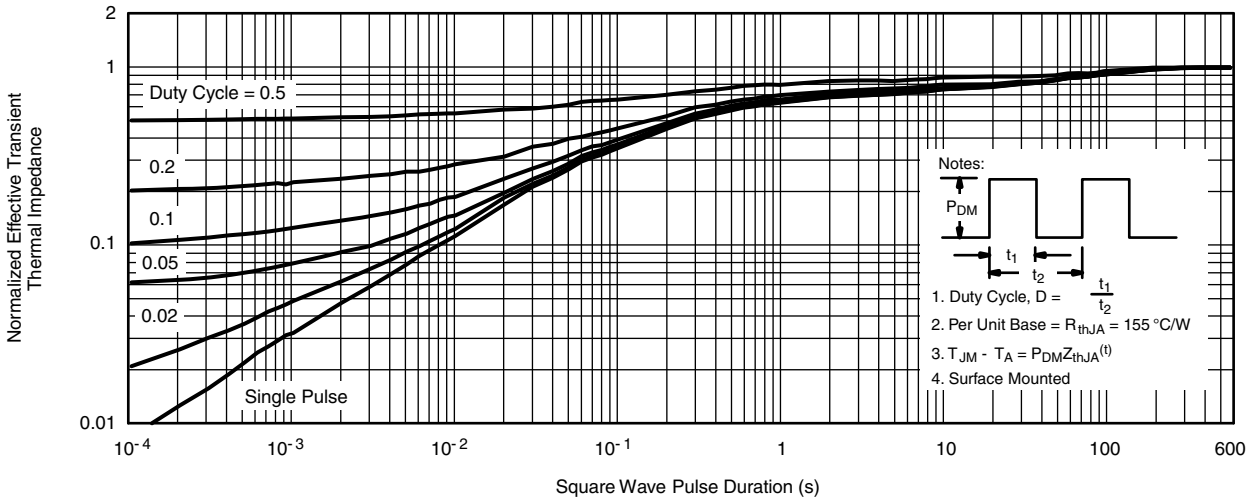
Power, Junction-to-Case



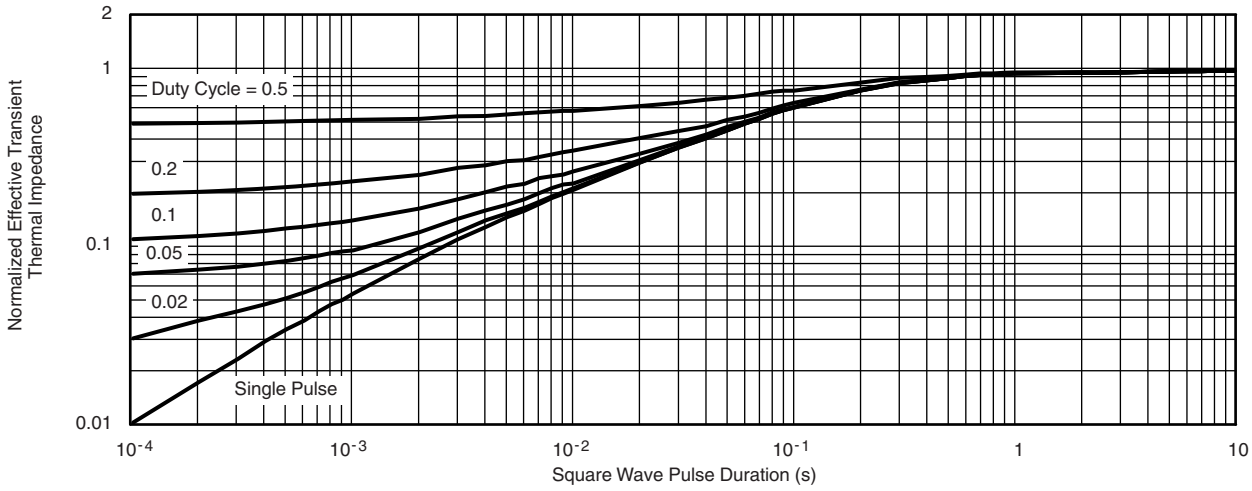
Power, Junction-to-Ambient

* 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)



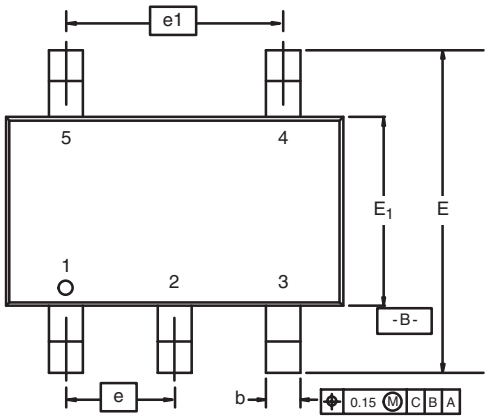
Normalized Thermal Transient Impedance, Junction-to-Ambient



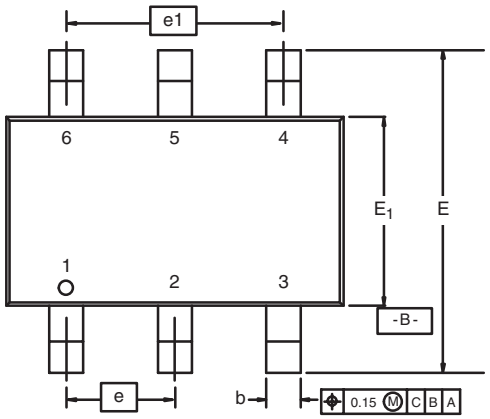
Normalized Thermal Transient Impedance, Junction-to-Foot

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?67470.

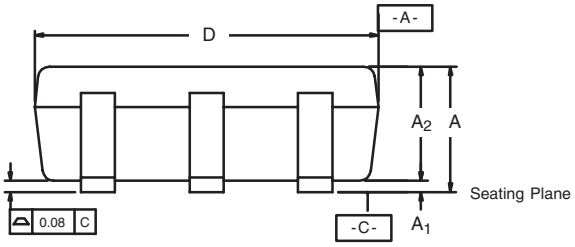
TSOP: 5/6–LEAD
JEDEC Part Number: MO-193C

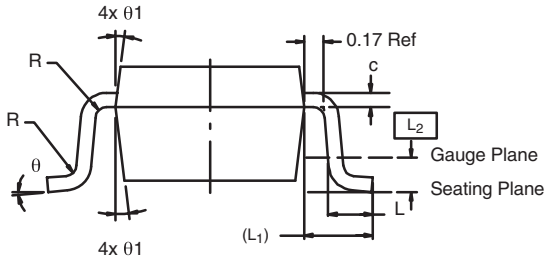


5-LEAD TSOP



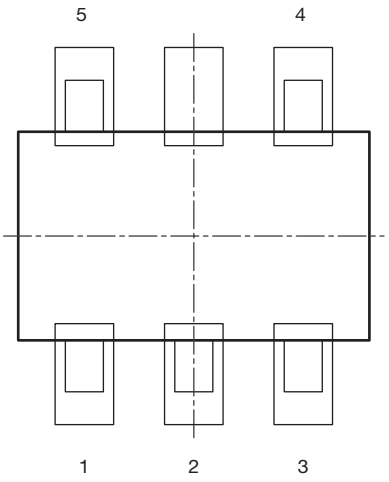
6-LEAD TSOP



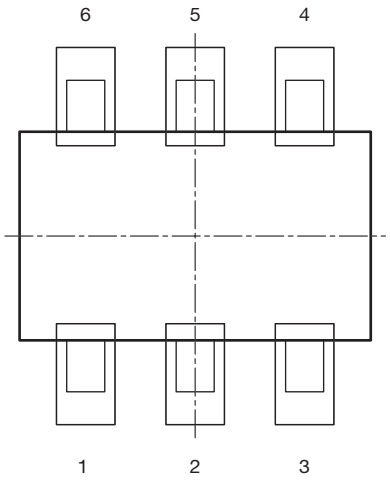


Dim	MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max
A	0.91	-	1.10	0.036	-	0.043
A_1	0.01	-	0.10	0.0004	-	0.004
A_2	0.90	-	1.00	0.035	0.038	0.039
b	0.30	0.32	0.45	0.012	0.013	0.018
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.95	3.05	3.10	0.116	0.120	0.122
E	2.70	2.85	2.98	0.106	0.112	0.117
E_1	1.55	1.65	1.70	0.061	0.065	0.067
e	0.95 BSC			0.0374 BSC		
e_1	1.80	1.90	2.00	0.071	0.075	0.079
L	0.32	-	0.50	0.012	-	0.020
L_1	0.60 Ref			0.024 Ref		
L_2	0.25 BSC			0.010 BSC		
R	0.10	-	-	0.004	-	-
θ	0°	4°	8°	0°	4°	8°
θ_1	7° Nom			7° Nom		
ECN: C-06593-Rev. I, 18-Dec-06 DWG: 5540						

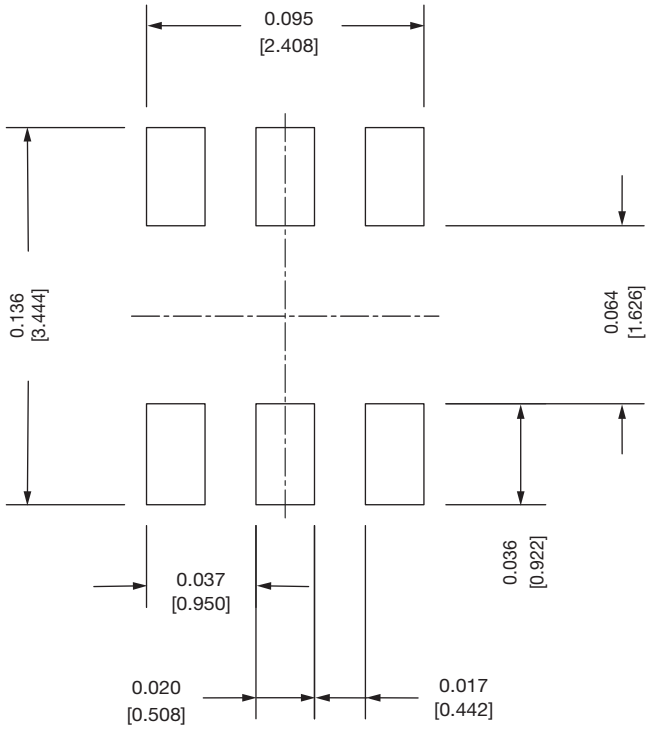
Recommended Land Pattern For TSOP-5L / TSOP-6L



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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