



N- and P-Channel 12-V (D-S) MOSFET

PRODUCT SUMMARY

	V _{DS} (V)	R _{DS(on)} (Ω)	I _D (A)	Q _g (Typ.)
N-Channel	12	0.034 at V _{GS} = 4.5 V	4.5 ^a	5.6 nC
		0.040 at V _{GS} = 2.5 V	4.5 ^a	
		0.050 at V _{GS} = 1.8 V	4.5 ^a	
		0.070 at V _{GS} = 1.5 V	4.5 ^a	
P-Channel	- 12	0.059 at V _{GS} = - 4.5 V	- 4.5 ^a	7.8 nC
		0.081 at V _{GS} = - 2.5 V	- 4.5 ^a	
		0.115 at V _{GS} = - 1.8 V	- 4.5 ^a	
		0.215 at V _{GS} = - 1.5 V	- 1.5	

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFETs
- Typical ESD Protection: N-Channel 1500 V
P-Channel 1000 V
- 100 % R_g Tested
- Compliant to RoHS Directive 2002/95/EC

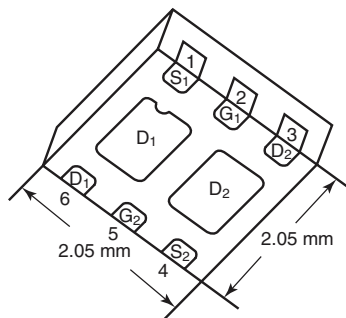


RoHS
COMPLIANT
HALOGEN
FREE

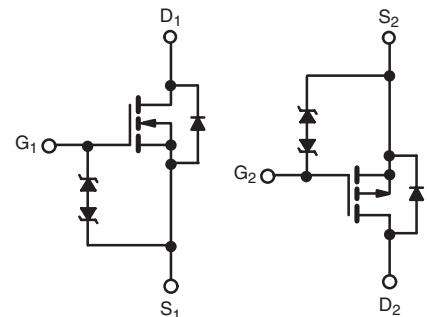
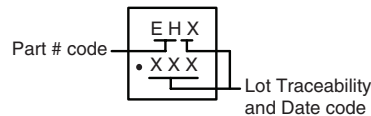
APPLICATIONS

- Load Switch for Portable Devices
- DC/DC Converters

PowerPAK® SC-70-6 Dual



Marking Code



N-Channel MOSFET

P-Channel MOSFET

Ordering Information: SiA533EDJ-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}	12	- 12	V
Gate-Source Voltage		V _{GS}	± 8		
Continuous Drain Current (T _J = 150 °C)	T _C = 25 °C	I _D	4.5 ^a	- 4.5 ^a	A
	T _C = 70 °C		4.5 ^a	- 4.5 ^a	
	T _A = 25 °C		4.5 ^{a, b, c}	- 4.5 ^{a, b, c}	
	T _A = 70 °C		4.5 ^{a, b, c}	- 3.7 ^{b, c}	
Pulsed Drain Current		I _{DM}	20	- 15	W
Source Drain Current Diode Current	T _C = 25 °C	I _S	4.5 ^a	- 4.5 ^a	
	T _A = 25 °C		1.6 ^{b, c}	- 1.6 ^{b, c}	
Maximum Power Dissipation	T _C = 25 °C	P _D	7.8	7.8	W
	T _C = 70 °C		5	5	
	T _A = 25 °C		1.9 ^{b, c}	1.9 ^{b, c}	
	T _A = 70 °C		1.2 ^{b, c}	1.2 ^{b, c}	
Operating Junction and Storage Temperature Range		T _J , T _{stg}	- 55 to 150		°C
Soldering Recommendations (Peak Temperature) ^{d, e}			260		

THERMAL RESISTANCE RATINGS

Parameter		Symbol	N-Channel		P-Channel		Unit
			Typ.	Max.	Typ.	Max.	
Maximum Junction-to-Ambient ^{b, f}	$t \leq 5 \text{ s}$	R_{thJA}	52	65	52	65	$^{\circ}\text{C/W}$
Maximum Junction-to-Case (Drain)	Steady State	R_{thJC}	12.5	16	12.5	16	

Notes:

a. Package limited.

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

c. $t = 5 \text{ s}$.d. See solder profile (www.vishay.com/ppg?73257). The PowerPAK SC-70 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

e. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components.

f. Maximum under steady state conditions is 110°C/W .SPECIFICATIONS $T_J = 25^{\circ}\text{C}$, unless otherwise noted

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$	N-Ch	12		V
		$V_{GS} = 0 \text{ V}, I_D = -250 \mu\text{A}$	P-Ch	-12		
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = 250 \mu\text{A}$	N-Ch		19	$\text{mV}/^{\circ}\text{C}$
		$I_D = -250 \mu\text{A}$	P-Ch		-5.7	
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	$I_D = 250 \mu\text{A}$	N-Ch		-2.7	$\text{mV}/^{\circ}\text{C}$
		$I_D = -250 \mu\text{A}$	P-Ch		1.7	
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$	N-Ch	0.4	1.0	V
		$V_{DS} = V_{GS}, I_D = -250 \mu\text{A}$	P-Ch	-0.4	-1.0	
Gate-Body Leakage	I_{GSS}	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 4.5 \text{ V}$	N-Ch		± 0.5	μA
			P-Ch		± 0.5	
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 8 \text{ V}$	N-Ch		± 5	
			P-Ch		± 5	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 12 \text{ V}, V_{GS} = 0 \text{ V}$	N-Ch		1	μA
		$V_{DS} = -12 \text{ V}, V_{GS} = 0 \text{ V}$	P-Ch		-1	
		$V_{DS} = 12 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 55^{\circ}\text{C}$	N-Ch		10	
		$V_{DS} = -12 \text{ V}, V_{GS} = 0 \text{ V}, T_J = 55^{\circ}\text{C}$	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	10		A
		$V_{DS} \leq -5 \text{ V}, V_{GS} = -4.5 \text{ V}$	P-Ch	-10		
Drain-Source On-State Resistance ^b	$R_{DS(on)}$	$V_{GS} = 4.5 \text{ V}, I_D = 4.6 \text{ A}$	N-Ch		0.028	Ω
		$V_{GS} = -4.5 \text{ V}, I_D = -3.6 \text{ A}$	P-Ch		0.048	
		$V_{GS} = 2.5 \text{ V}, I_D = 4.2 \text{ A}$	N-Ch		0.032	
		$V_{GS} = -2.5 \text{ V}, I_D = -3.1 \text{ A}$	P-Ch		0.066	
		$V_{GS} = 1.8 \text{ V}, I_D = 3.8 \text{ A}$	N-Ch		0.038	
		$V_{GS} = -1.8 \text{ V}, I_D = -2.6 \text{ A}$	P-Ch		0.093	
		$V_{GS} = 1.5 \text{ V}, I_D = 1.5 \text{ A}$	N-Ch		0.045	
		$V_{GS} = -1.5 \text{ V}, I_D = -0.5 \text{ A}$	P-Ch		0.120	
Forward Transconductance ^b	g_{fs}	$V_{DS} = 6 \text{ V}, I_D = 4.6 \text{ A}$	N-Ch		21	S
		$V_{DS} = -6 \text{ V}, I_D = -3.6 \text{ A}$	P-Ch		11	
Input Capacitance	C_{iss}	N-Channel $V_{DS} = 6 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ P-Channel $V_{DS} = -6 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	N-Ch		420	pF
			P-Ch		545	
Output Capacitance	C_{oss}		N-Ch		100	
			P-Ch		192	
Reverse Transfer Capacitance	C_{rss}		N-Ch		62	
			P-Ch		175	

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

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Dynamic ^a							
Total Gate Charge	Q _g	V _{DS} = 10 V, V _{GS} = 10 V, I _D = 5.9 A	N-Ch		10	15	nC
		V _{DS} = - 10 V, V _{GS} = - 10 V, I _D = - 4.7 A	P-Ch		13	20	
		N-Channel V _{DS} = 10 V, V _{GS} = 4.5 V, I _D = 5.9 A	N-Ch		5.6	8.5	
			P-Ch		7.8	12	
Gate-Source Charge	Q _{gs}	P-Channel V _{DS} = - 10 V, V _{GS} = - 4.5 V, I _D = - 4.7 A	N-Ch		0.7		
Gate-Drain Charge	Q _{gd}		P-Ch		1.3		
			N-Ch		0.85		
			P-Ch		2.3		
Gate Resistance	R _g	f = 1 MHz	N-Ch	0.7	3.5	7	Ω
			P-Ch	1.4	7	14	

Notes:

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

b. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.**SPECIFICATIONS** $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted

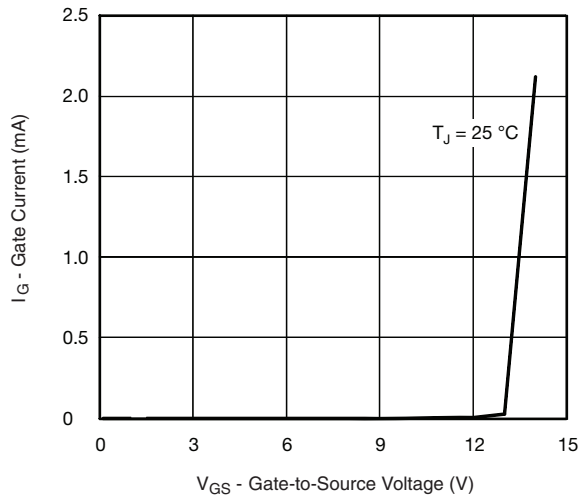
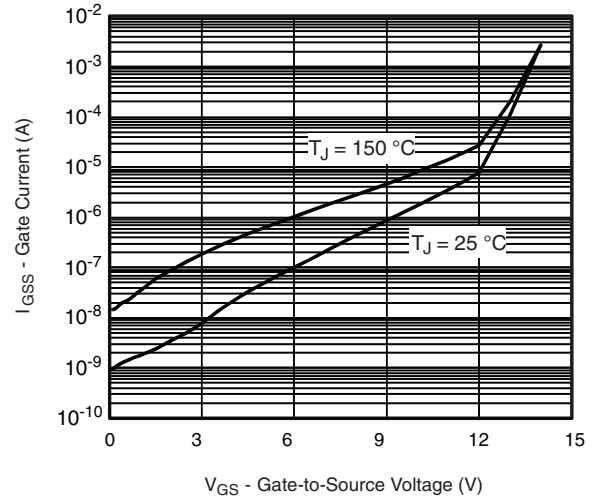
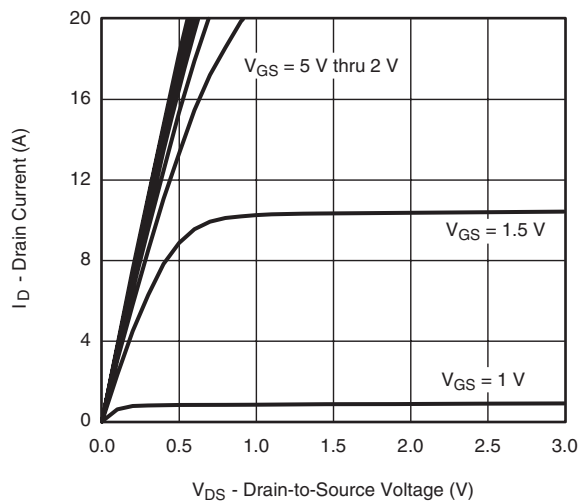
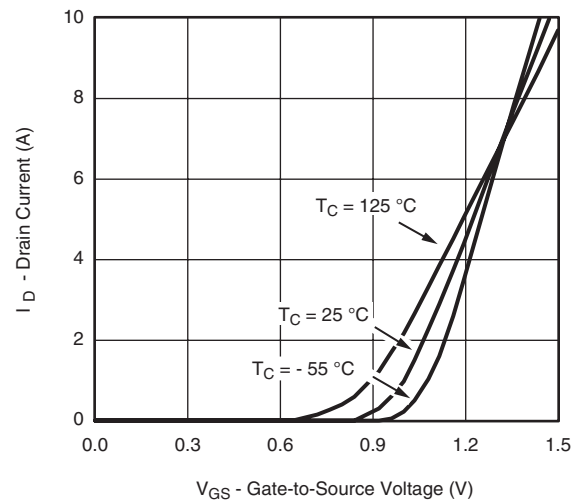
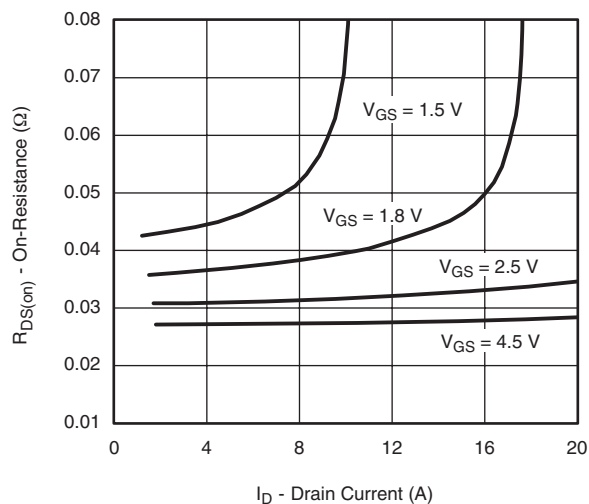
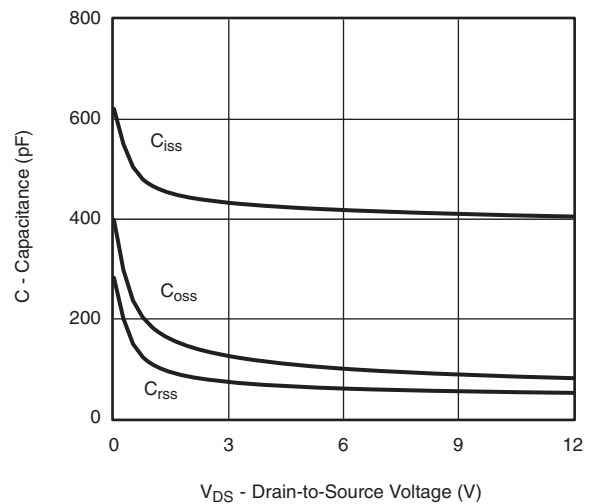
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Dynamic ^a							
Turn-On Delay Time	t _{d(on)}	N-Channel V _{DD} = 6 V, R _L = 1.3 Ω I _D ≅ 4.8 A, V _{GEN} = 4.5 V, R _g = 1 Ω	N-Ch		10	15	ns
Rise Time	t _r		P-Ch		15	25	
Turn-Off Delay Time	t _{d(off)}		N-Ch		10	15	
			P-Ch		15	25	
Fall Time	t _f	N-Ch		20	30		
		P-Ch		25	40		
Turn-On Delay Time	t _{d(on)}	N-Ch		10	15		
		P-Ch		10	15		
Turn-Off Delay Time	t _{d(off)}	N-Ch		5	10		
		P-Ch		5	10		
Fall Time	t _f	N-Ch		10	15		
		P-Ch		10	15		
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	T _C = 25 °C	N-Ch			4.5	A
			P-Ch			- 4.5	
Pulse Diode Forward Current ^a	I _{SM}		N-Ch			20	V
			P-Ch			- 15	
Body Diode Voltage	V _{SD}	I _S = 4.8 A, V _{GS} = 0 V	N-Ch		0.85	1.2	ns
		I _S = - 3.7 A, V _{GS} = 0 V	P-Ch		- 0.87	- 1.2	
Body Diode Reverse Recovery Time	t _{rr}	N-Channel I _F = 4.4 A, dI/dt = 100 A/μs, T _J = 25 °C	N-Ch		10	20	nC
			P-Ch		25	50	
Body Diode Reverse Recovery Charge	Q _{rr}		N-Ch		5	10	ns
			P-Ch		10	20	
Reverse Recovery Fall Time	t _a	P-Channel I _F = - 3.7 A, dI/dt = - 100 A/μs, T _J = 25 °C	N-Ch		5.5		ns
			P-Ch		17		
Reverse Recovery Rise Time	t _b		N-Ch		4.5		
			P-Ch		8		

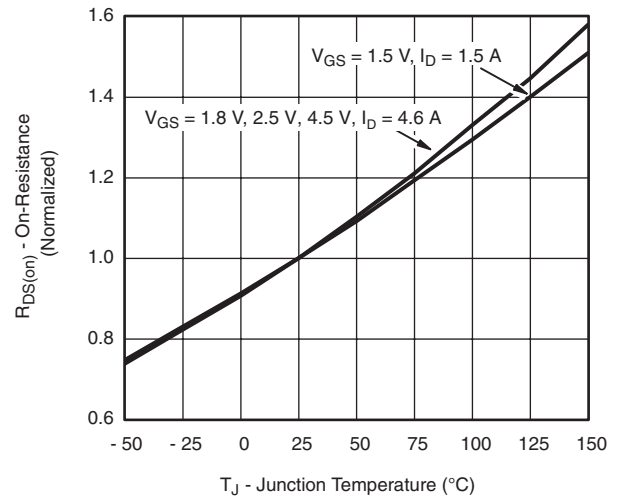
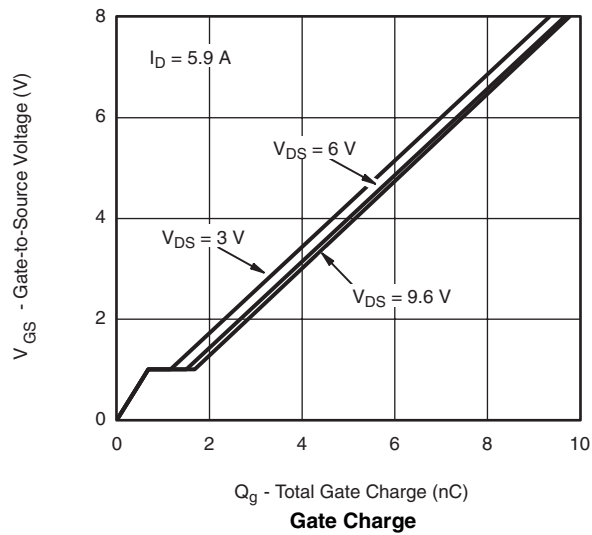
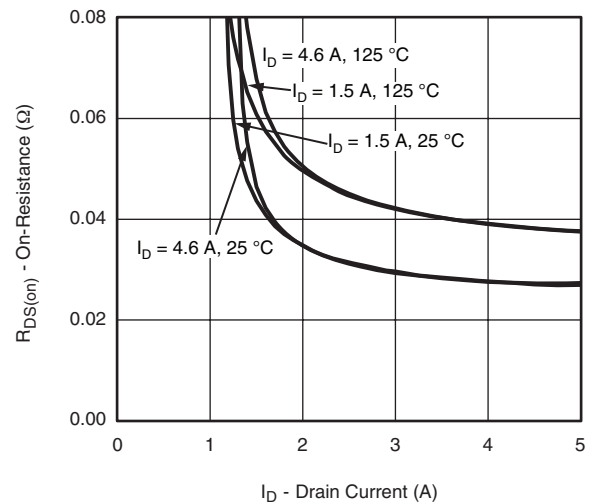
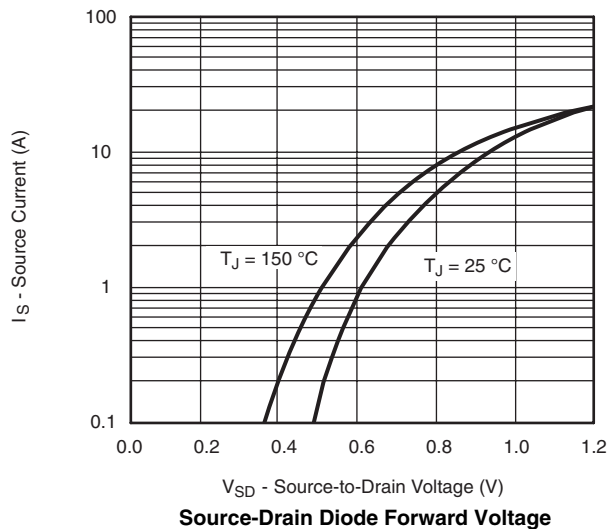
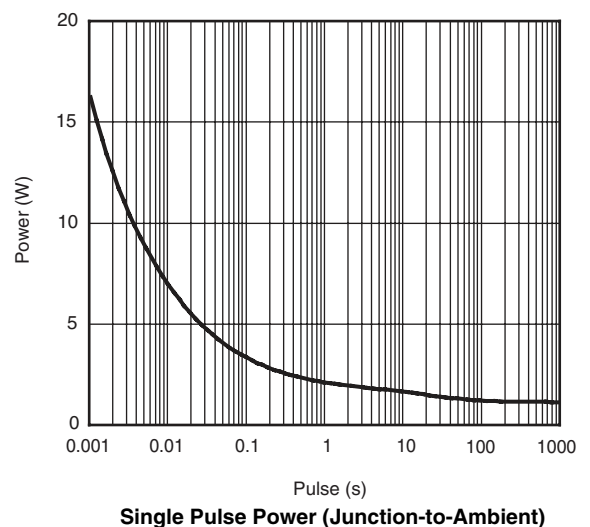
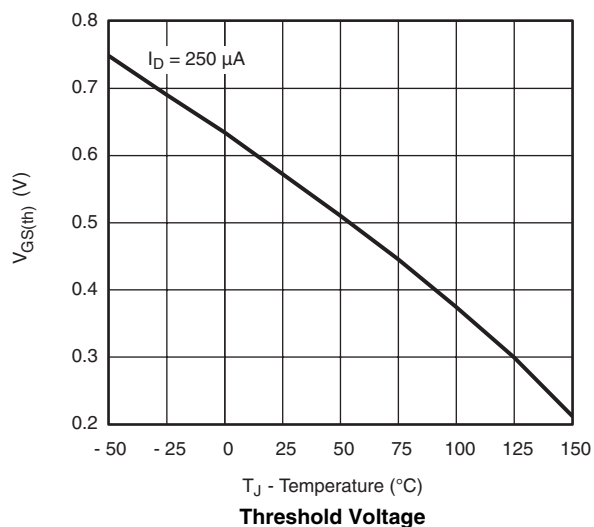
Notes:

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

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

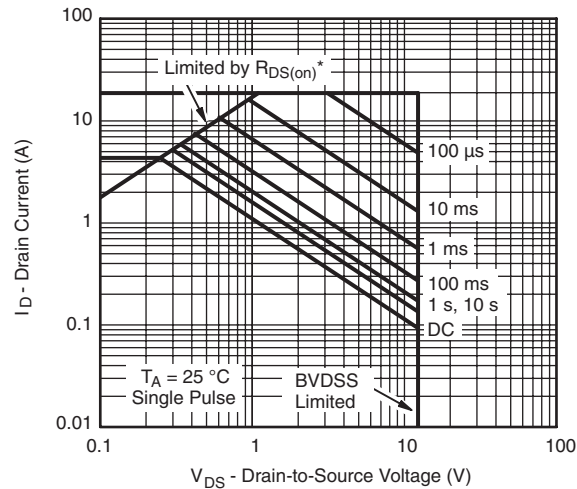
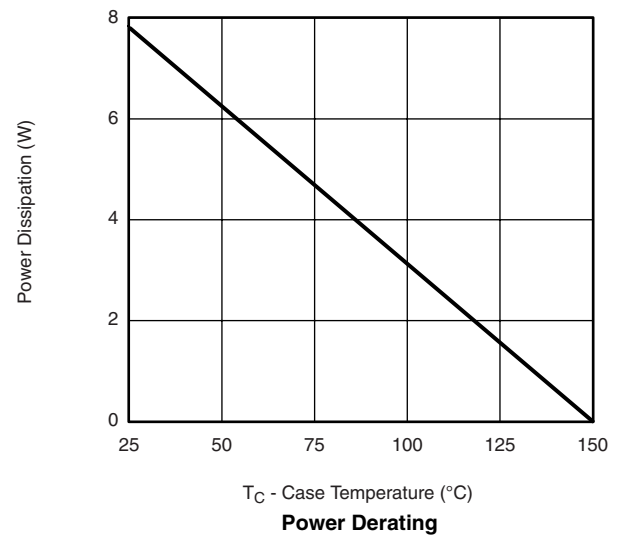
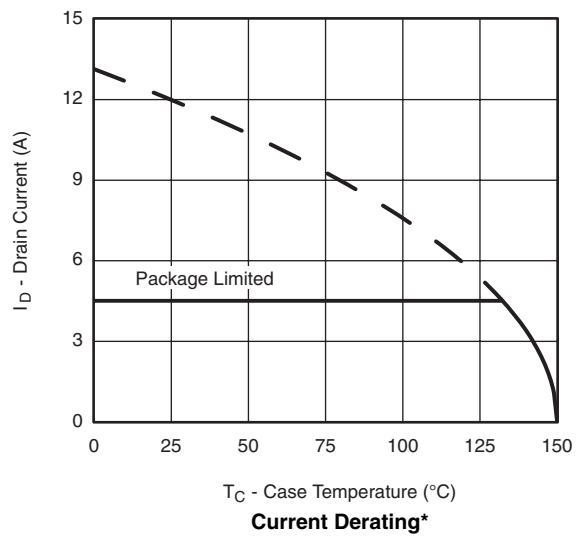
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted**Gate Current vs. Gate-Source Voltage****Gate Current vs. Gate-Source Voltage****Output Characteristics****Transfer Characteristics****On-Resistance vs. Drain Current and Gate Voltage****Capacitance**

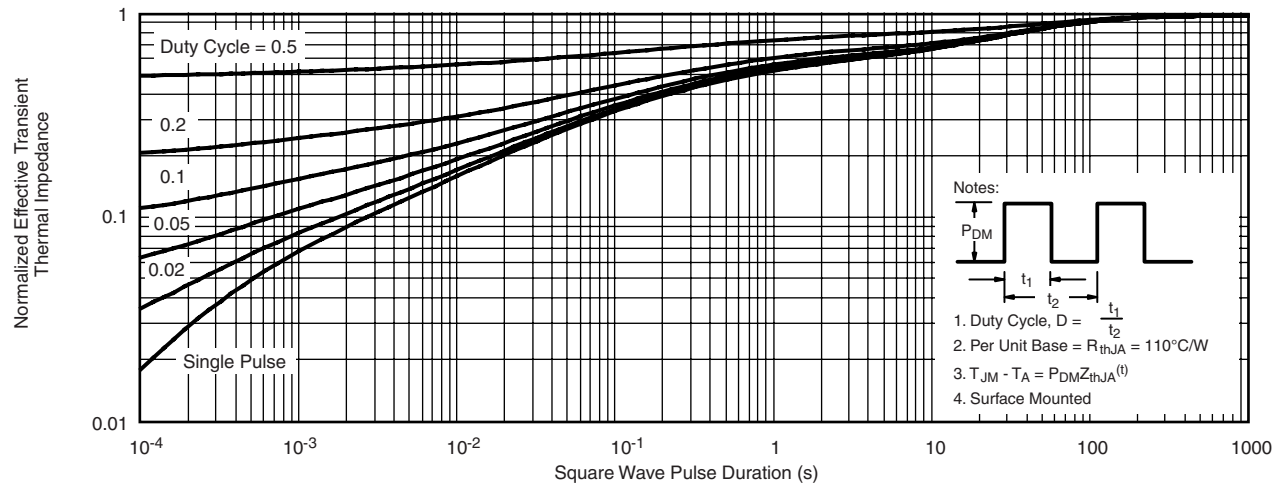
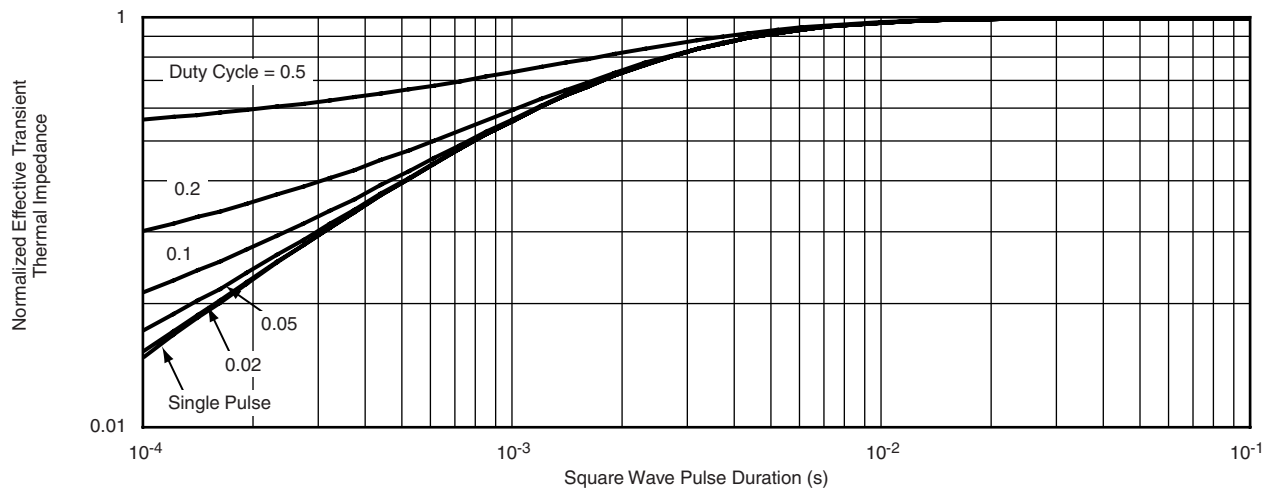

N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

On-Resistance vs. Junction Temperature

On-Resistance vs. Gate-to-Source Voltage


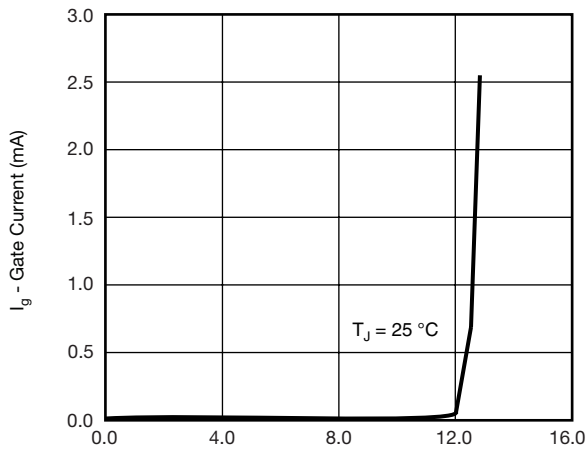
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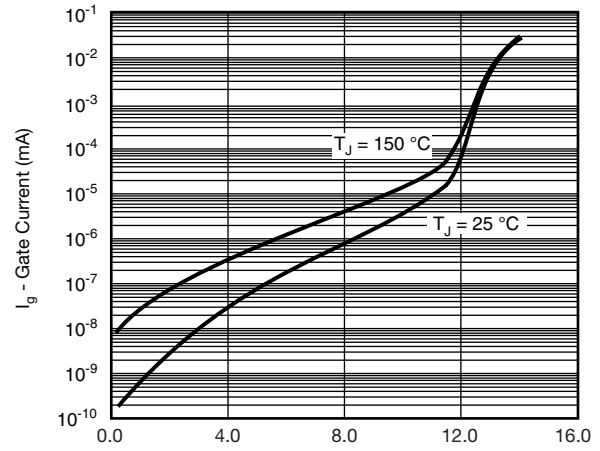
**N-CHANNEL TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified**Safe Operating Area, Junction-to-Ambient**

* The power dissipation P_D is based on $T_{J(max)} = 150\text{ }^{\circ}\text{C}$, 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.

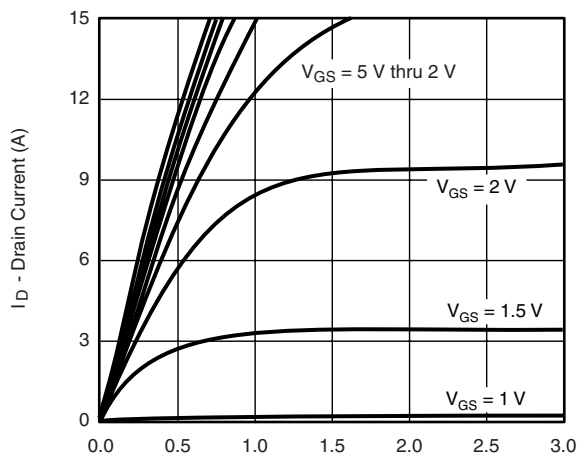

N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Normalized Thermal Transient Impedance, Junction-to-Ambient

Normalized Thermal Transient Impedance, Junction-to-Case

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

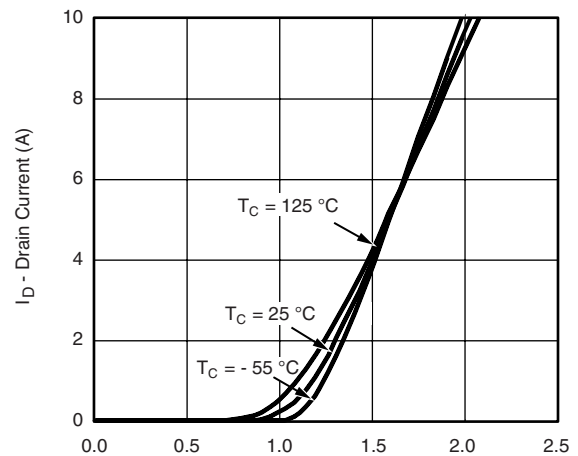
V_{GS} - Gate-to-Source Voltage (V)
Gate Current vs. Gate-Source Voltage



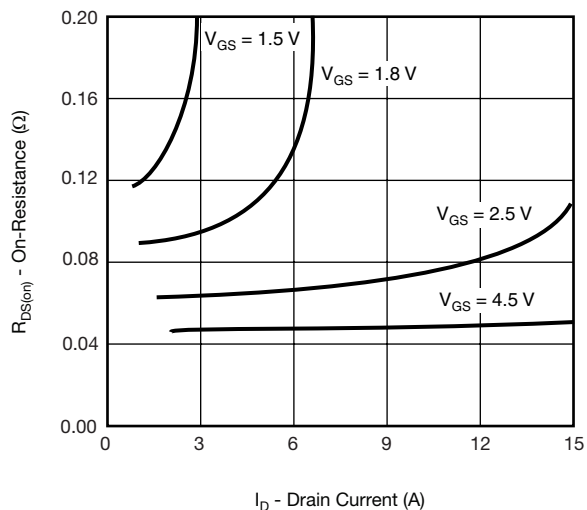
V_{GS} - Gate-to-Source Voltage (V)
Gate Current vs. Gate-Source Voltage



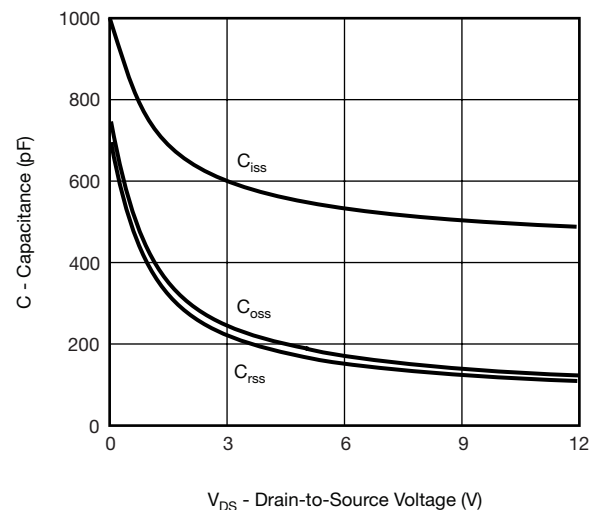
V_{DS} - Drain-to-Source Voltage (V)
Output Characteristics



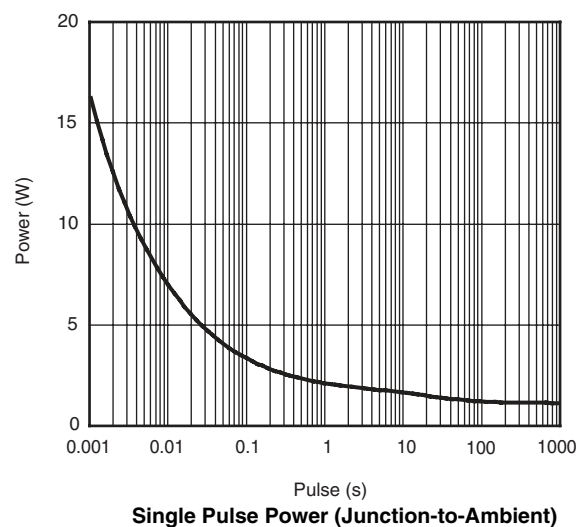
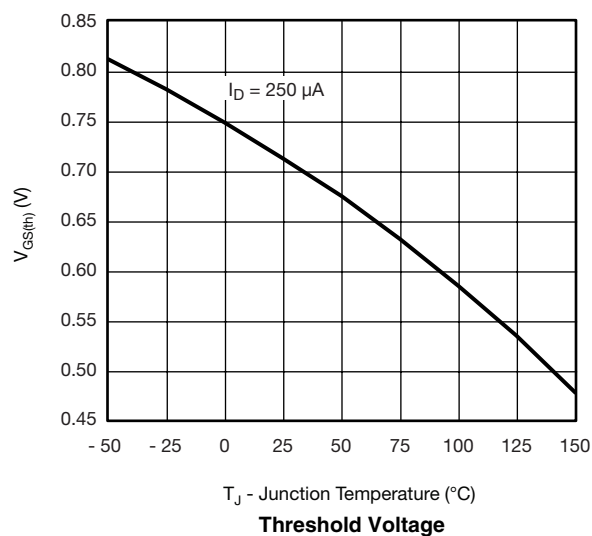
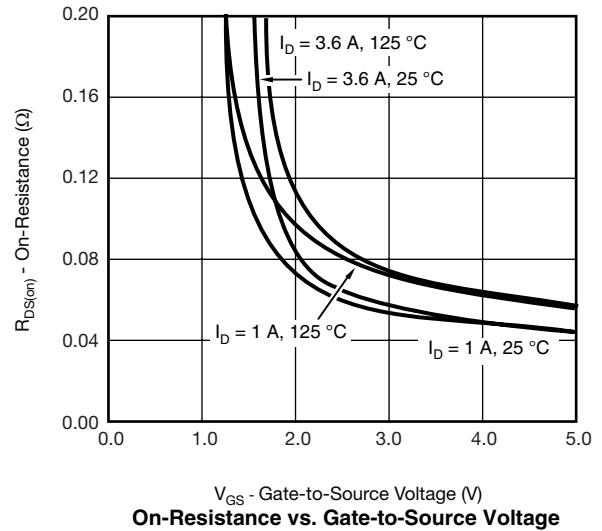
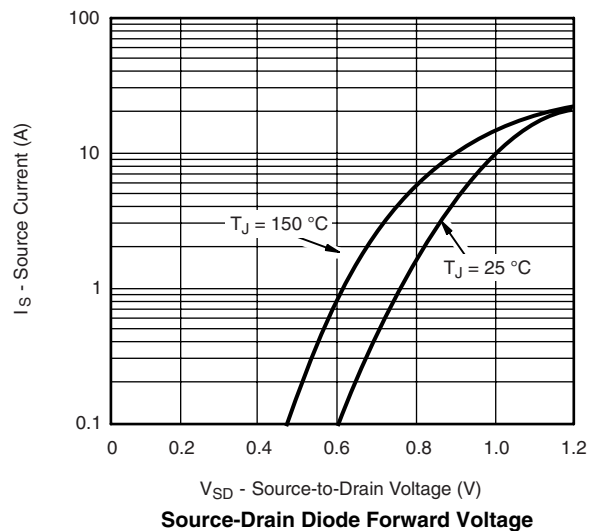
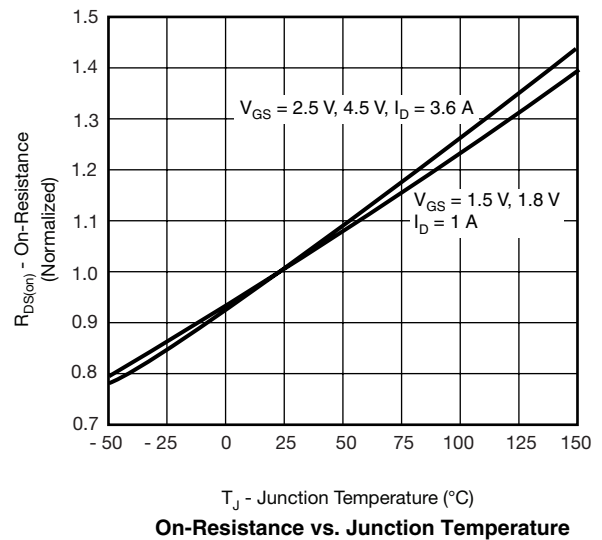
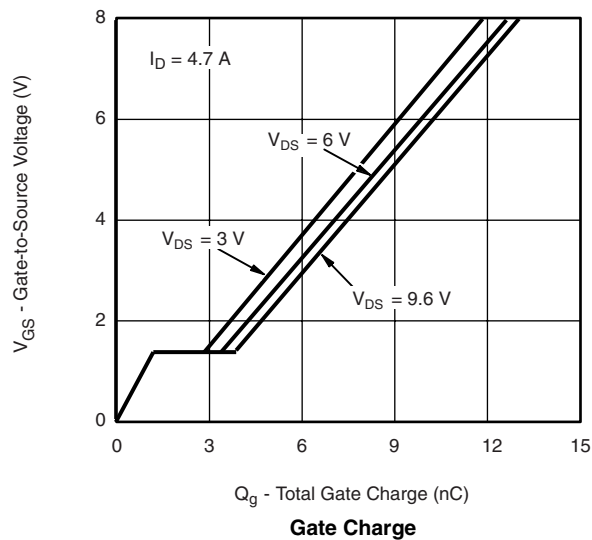
V_{GS} - Gate-to-Source Voltage (V)
Transfer Characteristics



I_D - Drain Current (A)
On-Resistance vs. Drain Current and Gate Voltage

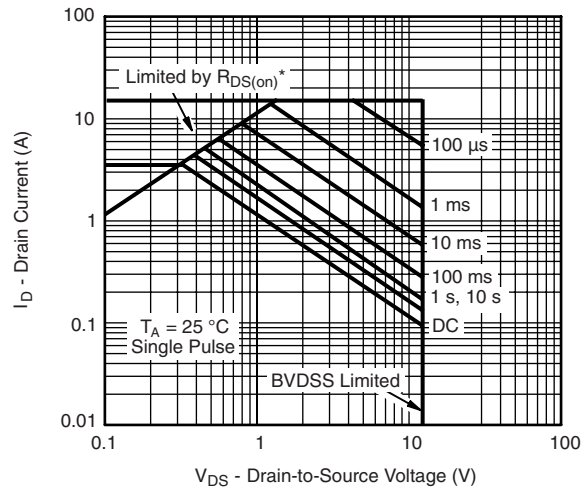
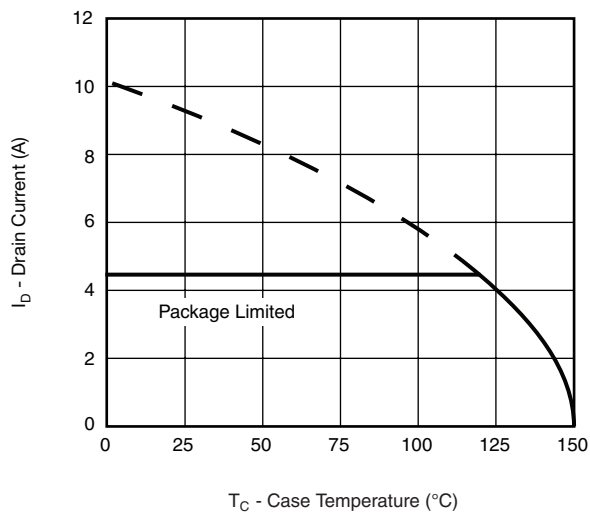
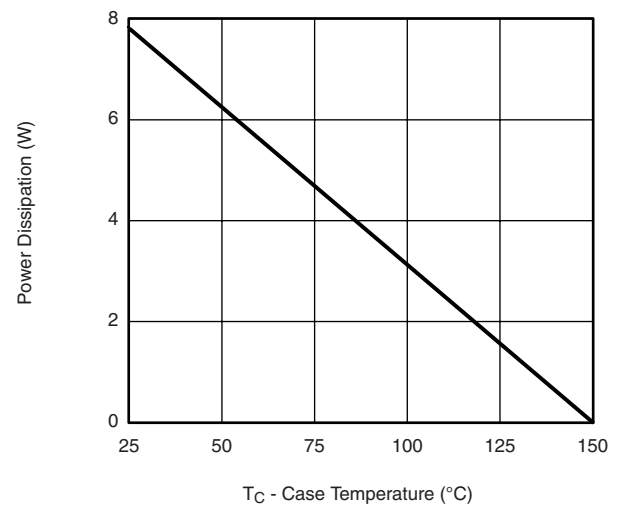


V_{DS} - Drain-to-Source Voltage (V)
Capacitance

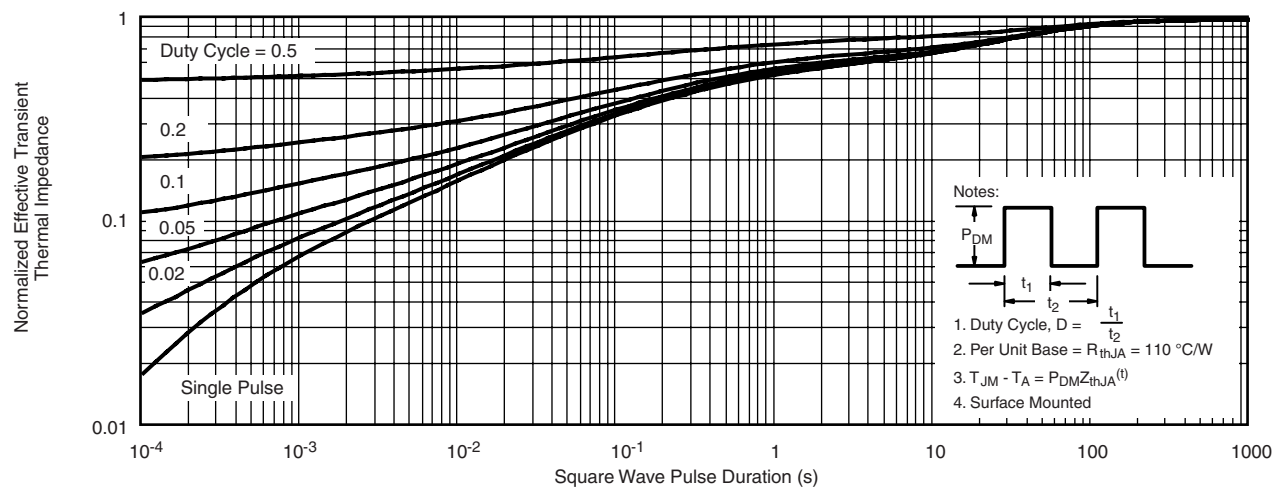

P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


SiA533EDJ

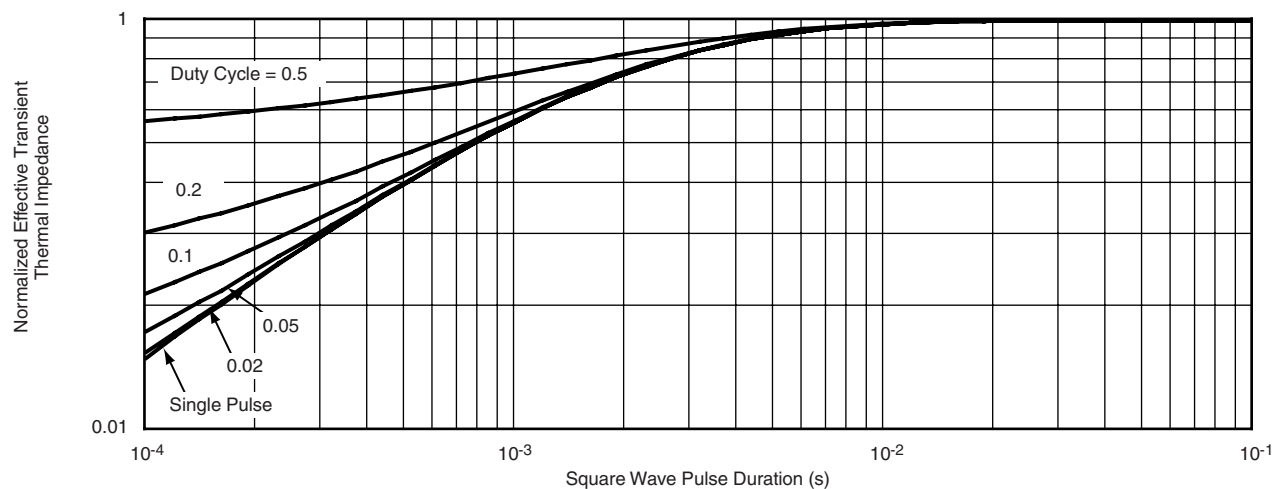
Vishay Siliconix

**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****Current Derating*****Power Derating**

* The power dissipation P_D is based on $T_{J(max)} = 150\text{ }^{\circ}\text{C}$, 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

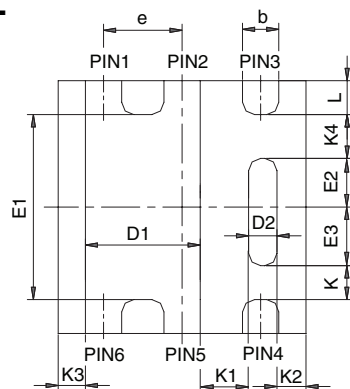


Normalized Thermal Transient Impedance, Junction-to-Case

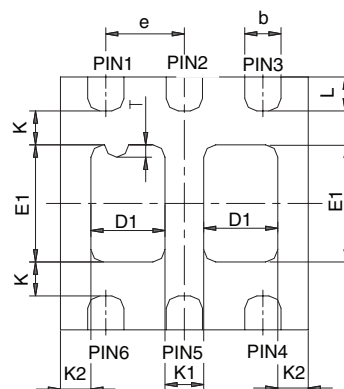
Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?65706.



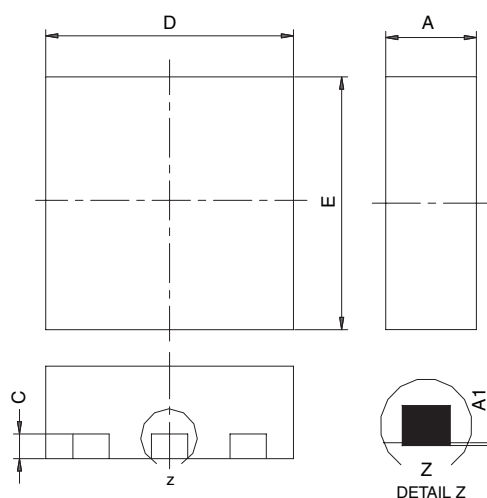
PowerPAK® SC70-6L



BACKSIDE VIEW OF SINGLE



BACKSIDE VIEW OF DUAL



- Notes:
1. All dimensions are in millimeters
 2. Package outline exclusive of mold flash and metal burr
 3. Package outline inclusive of plating

DIM	SINGLE PAD						DUAL PAD					
	MILLIMETERS			INCHES			MILLIMETERS			INCHES		
	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
A	0.675	0.75	0.80	0.027	0.030	0.032	0.675	0.75	0.80	0.027	0.030	0.032
A1	0	-	0.05	0	-	0.002	0	-	0.05	0	-	0.002
b	0.23	0.30	0.38	0.009	0.012	0.015	0.23	0.30	0.38	0.009	0.012	0.015
C	0.15	0.20	0.25	0.006	0.008	0.010	0.15	0.20	0.25	0.006	0.008	0.010
D	1.98	2.05	2.15	0.078	0.081	0.085	1.98	2.05	2.15	0.078	0.081	0.085
D1	0.85	0.95	1.05	0.033	0.037	0.041	0.513	0.613	0.713	0.020	0.024	0.028
D2	0.135	0.235	0.335	0.005	0.009	0.013						
E	1.98	2.05	2.15	0.078	0.081	0.085	1.98	2.05	2.15	0.078	0.081	0.085
E1	1.40	1.50	1.60	0.055	0.059	0.063	0.85	0.95	1.05	0.033	0.037	0.041
E2	0.345	0.395	0.445	0.014	0.016	0.018						
E3	0.425	0.475	0.525	0.017	0.019	0.021						
e	0.65 BSC			0.026 BSC			0.65 BSC			0.026 BSC		
K	0.275 TYP			0.011 TYP			0.275 TYP			0.011 TYP		
K1	0.400 TYP			0.016 TYP			0.320 TYP			0.013 TYP		
K2	0.240 TYP			0.009 TYP			0.252 TYP			0.010 TYP		
K3	0.225 TYP			0.009 TYP								
K4	0.355 TYP			0.014 TYP								
L	0.175	0.275	0.375	0.007	0.011	0.015	0.175	0.275	0.375	0.007	0.011	0.015
T							0.05	0.10	0.15	0.002	0.004	0.006
ECN: C-07431 – Rev. C, 06-Aug-07												
DWG: 5934												

RECOMMENDED PAD LAYOUT FOR PowerPAK® SC70-6L Dual



Dimensions in mm (inches)



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