

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

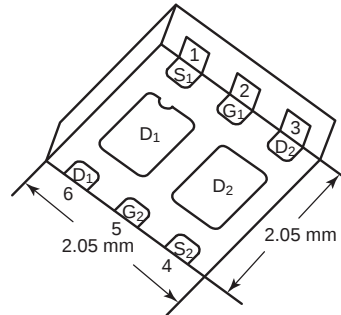
Features:

- 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

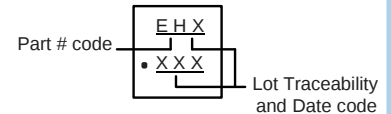
Applications:

- Load Switch for Portable Devices
- DC/DC Converters

PowerPAK® SC-70-6 Dual

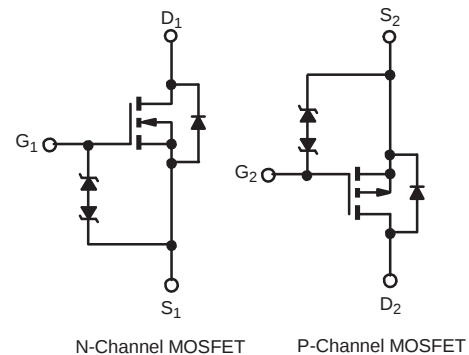


Marking Code



Ordering Information: SiA533EDJ-T1-GE3 (Lead (Pb)-free and Halogen-free)

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	



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	
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	°C/W
Maximum Junction-to-Case (Drain)	Steady State	R_{thJC}	12.5	16	12.5	16	

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	$\frac{\partial V_{DS}}{\partial T_J}$	$I_D = 250 \mu\text{A}$	N-Ch		19	mV/°C
		$I_D = -250 \mu\text{A}$	P-Ch		-5.7	
$V_{GS(th)}$ Temperature Coefficient	$\frac{\partial V_{GS(th)}}{\partial T_J}$	$I_D = 250 \mu\text{A}$	N-Ch		-2.7	mV/°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 $V_{DS} = 6 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	N-Ch		420	pF
			P-Ch		545	
Output Capacitance	C_{oss}	P-Channel $V_{DS} = -6 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	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	$V_{DS} = 10\text{ V}, V_{GS} = 10\text{ V}, I_D = 5.9\text{ A}$	N-Ch		10	15
		$V_{DS} = -10\text{ V}, V_{GS} = -10\text{ V}, I_D = -4.7\text{ A}$	P-Ch		13	20
		N-Channel $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 5.9\text{ A}$	N-Ch		5.6	8.5
			P-Ch		7.8	12
Gate-Source Charge	Q_{gs}	P-Channel $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -4.7\text{ A}$	N-Ch		0.7	
			P-Ch		1.3	
Gate-Drain Charge	Q_{gd}		N-Ch		0.85	
			P-Ch		2.3	
Gate Resistance	R_g	$f = 1\text{ MHz}$	N-Ch	0.7	3.5	7
			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

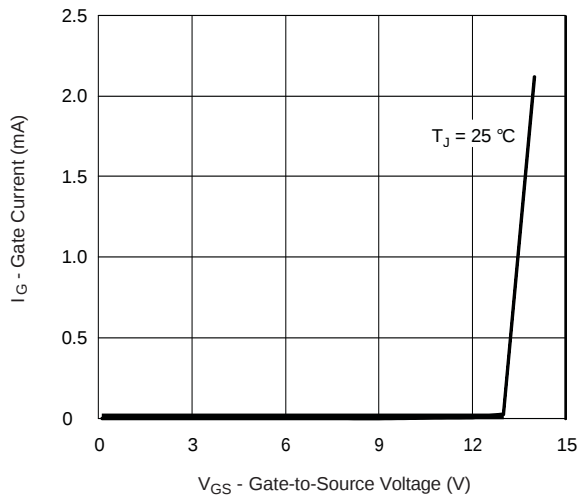
Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Unit
Dynamic ^a							
Turn-On Delay Time	t _{d(on)}	N-Channel V _{DD} = 6 V, R _L = 1.3 $\wedge$ I _D ≅ 4.8 A, V _{GEN} = 4.5 V, R _g = 1 $\wedge$	N-Ch		10	15	ns
Rise Time	t _r		P-Ch		15	25	
			N-Ch		10	15	
Turn-Off Delay Time	t _{d(off)}		P-Ch		15	25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

Notes:

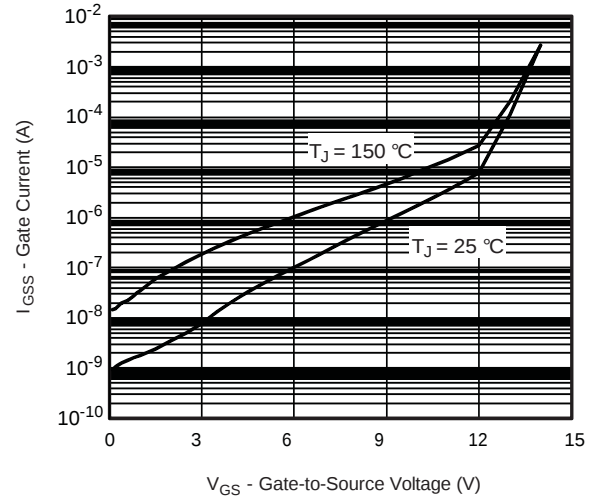
a. Guaranteed by design, not subject to production testing.

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

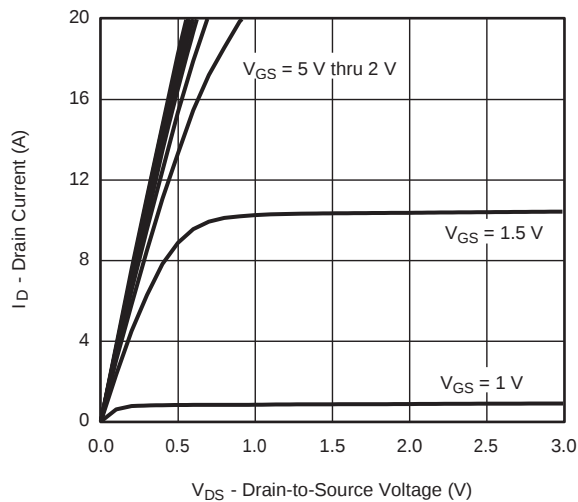
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



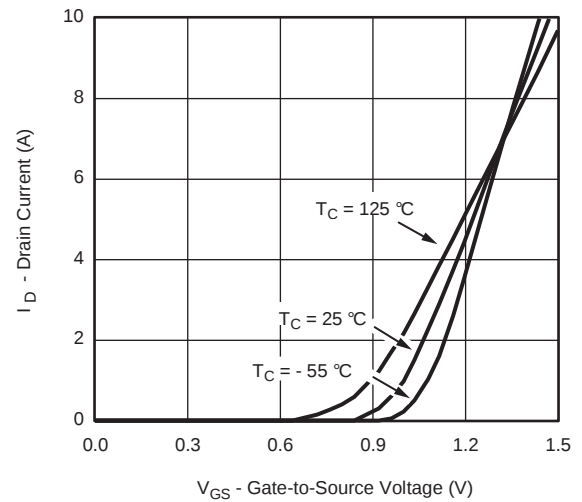
Gate Current vs. Gate-Source Voltage



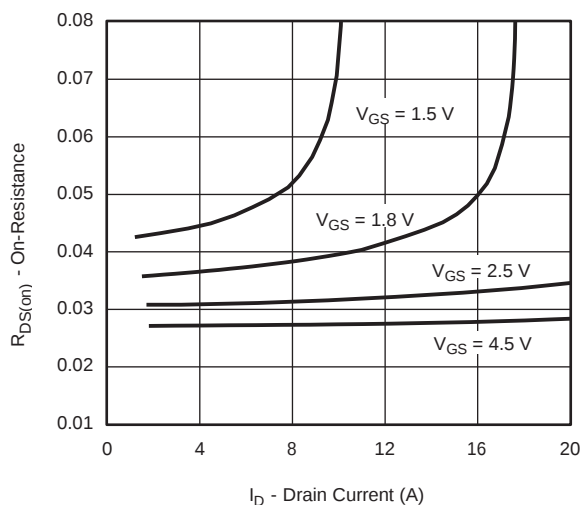
Gate Current vs. Gate-Source Voltage



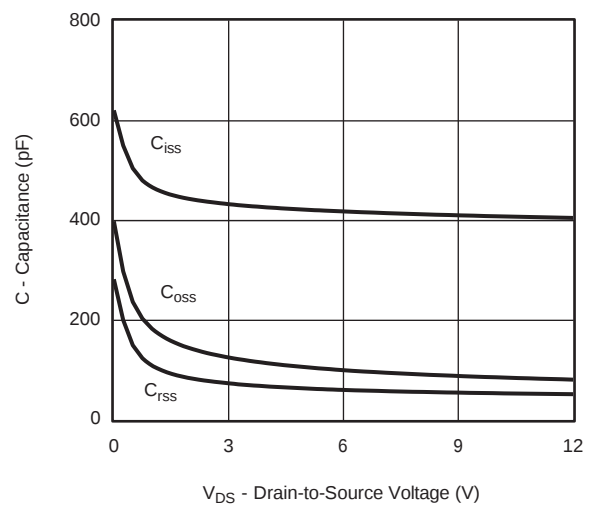
Output Characteristics



Transfer Characteristics

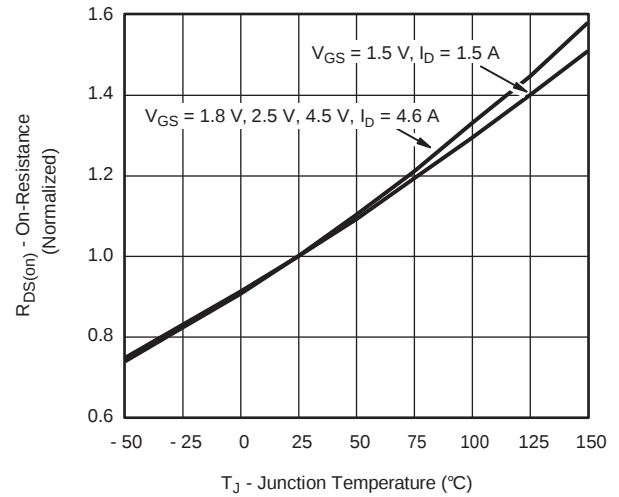
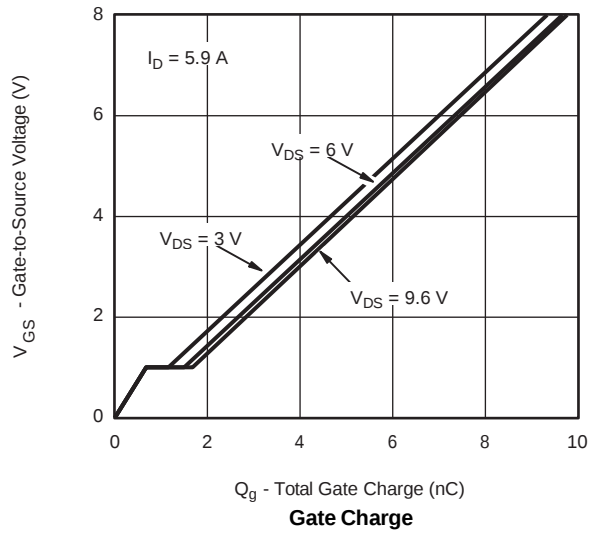


On-Resistance vs. Drain Current and Gate Voltage

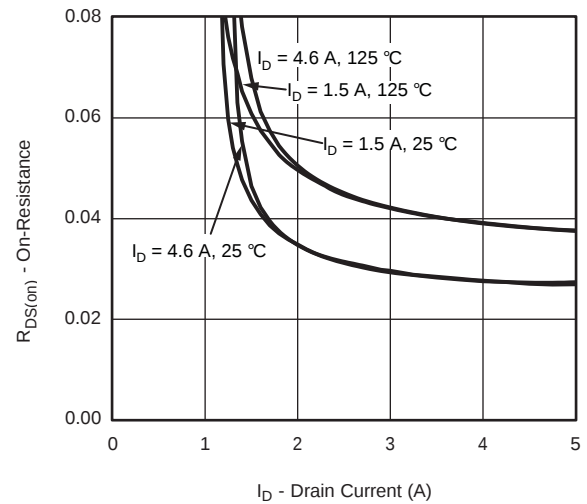
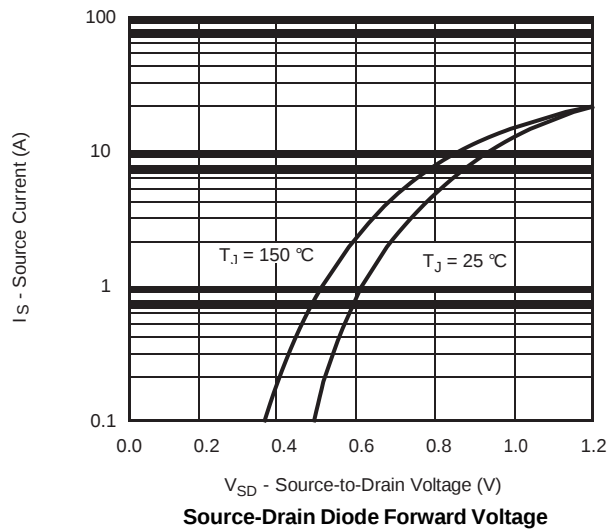


Capacitance

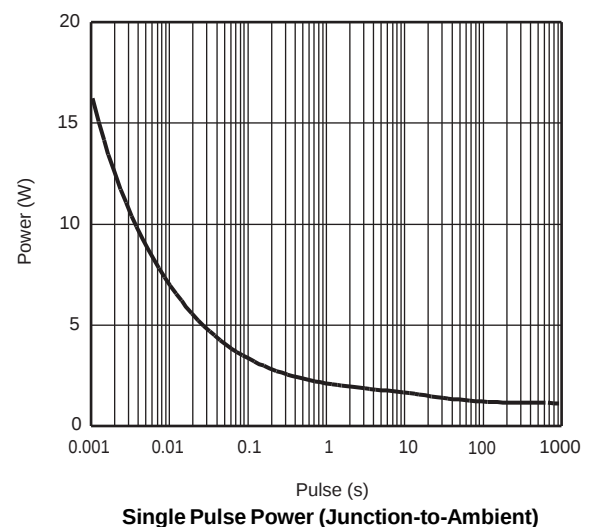
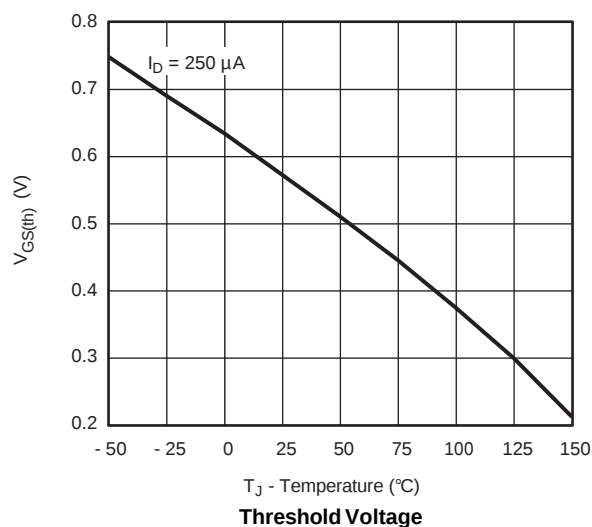
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



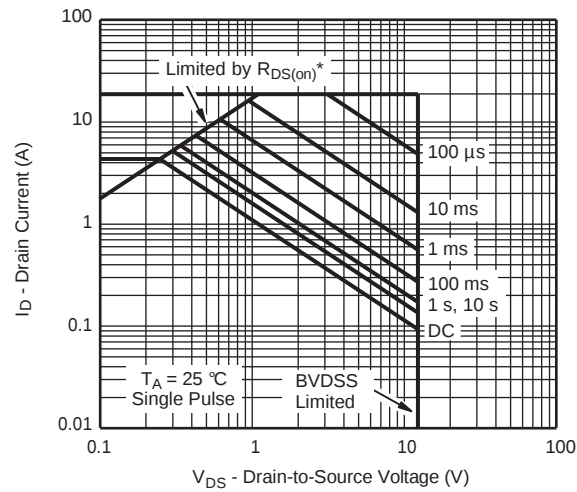
On-Resistance vs. Junction Temperature



On-Resistance vs. Gate-to-Source Voltage

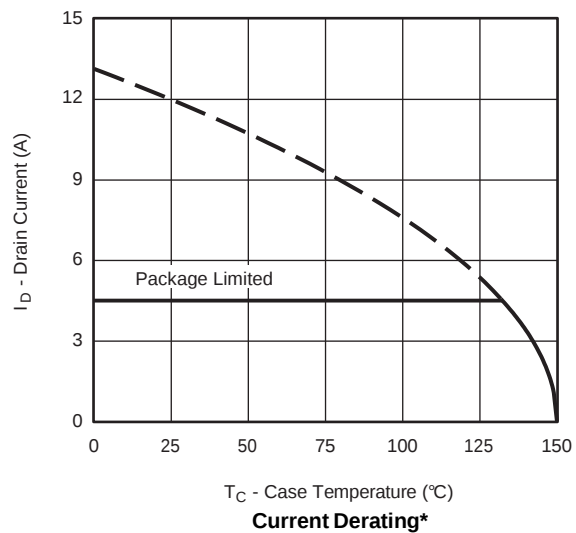


N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

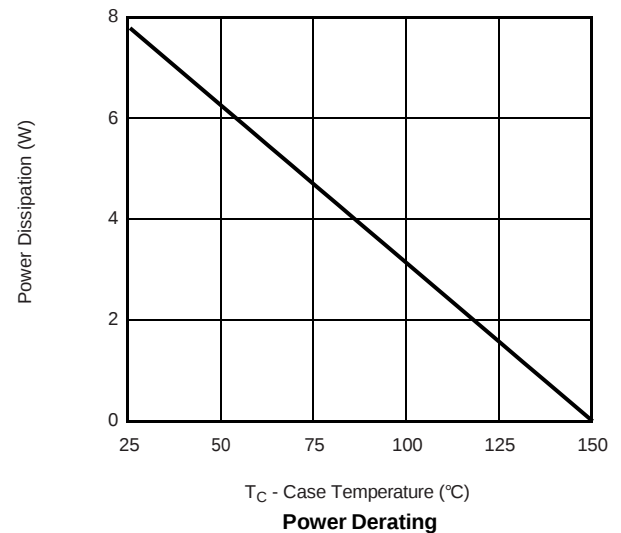


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

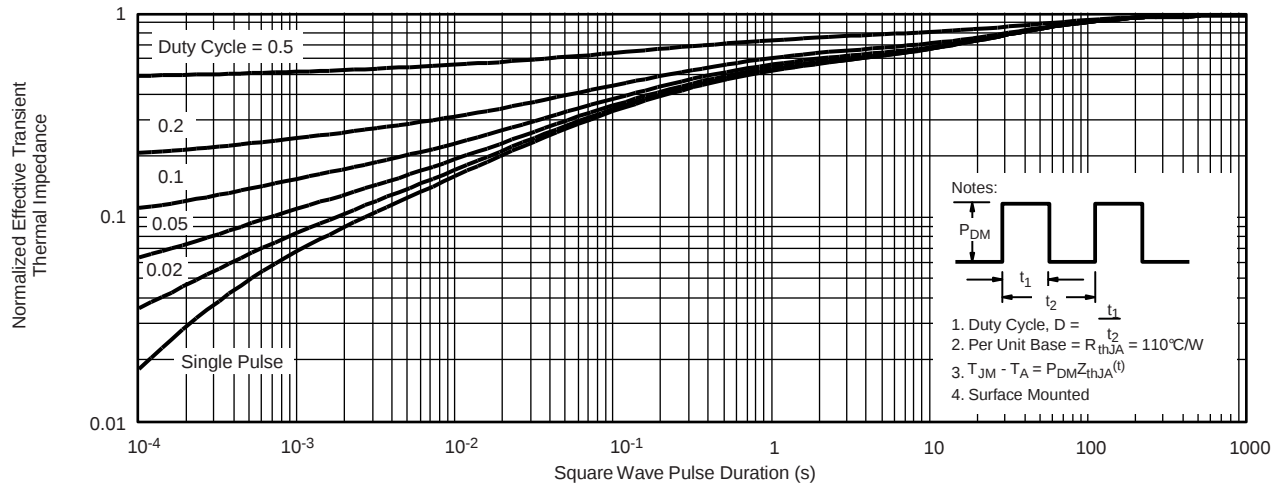


Current Derating*

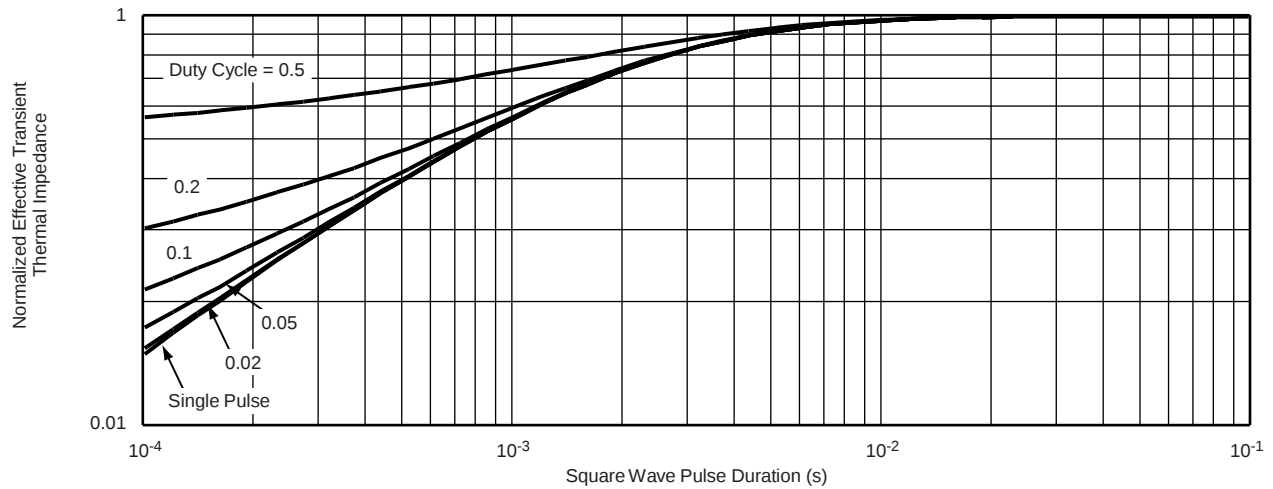


Power Derating

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

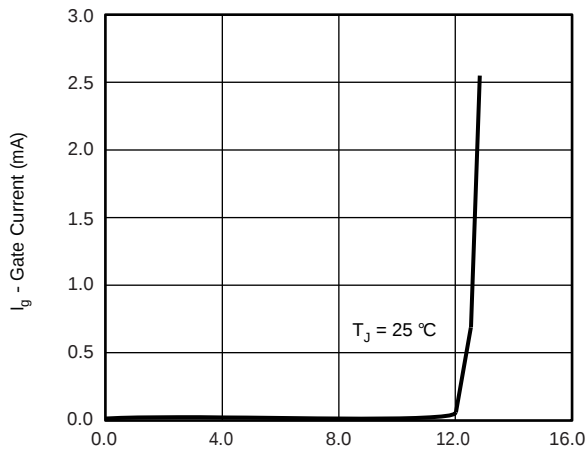


Normalized Thermal Transient Impedance, Junction-to-Ambient

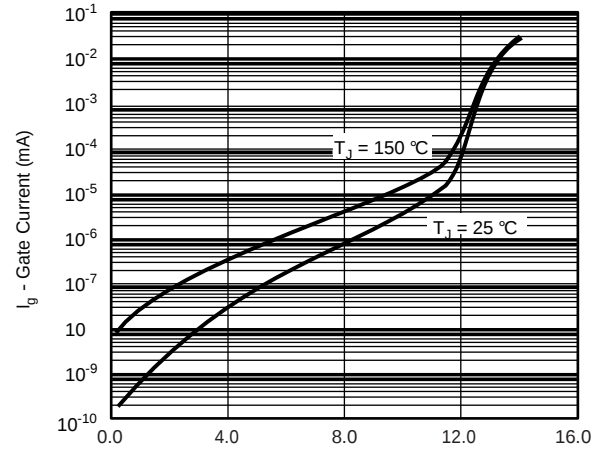


Normalized Thermal Transient Impedance, Junction-to-Case

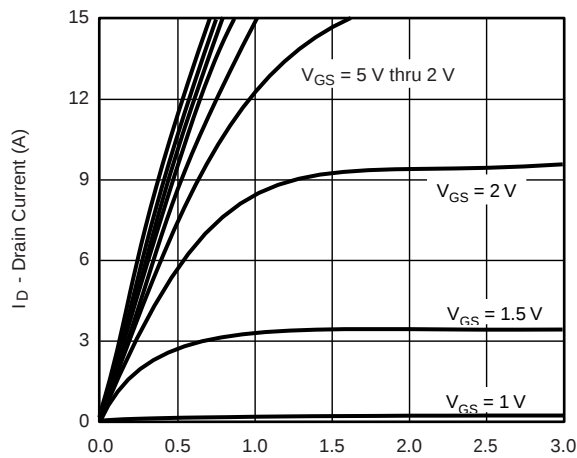
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



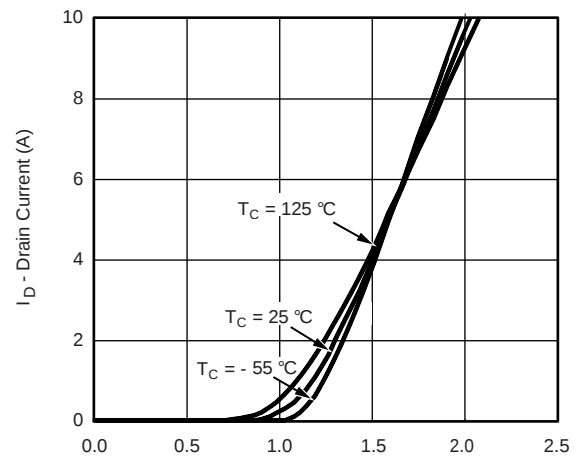
V_{GS} - Gate-to-Source Voltage (V)
Gate Current vs. Gate-Source Voltage



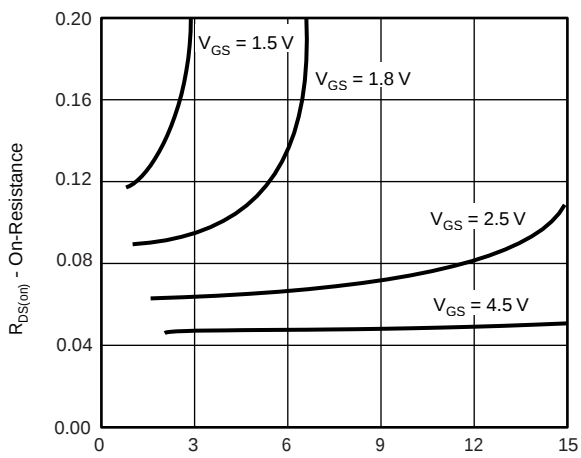
V_{GS} - Gate-to-Source Voltage (V)
Gate Current vs. Gate-Source Voltage



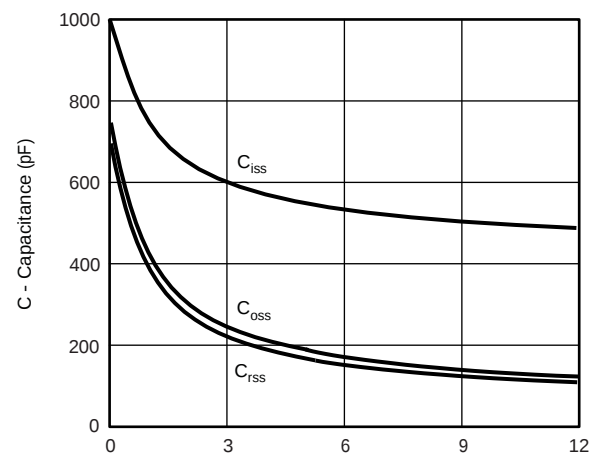
V_{DS} - Drain-to-Source Voltage (V)
Output Characteristics



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

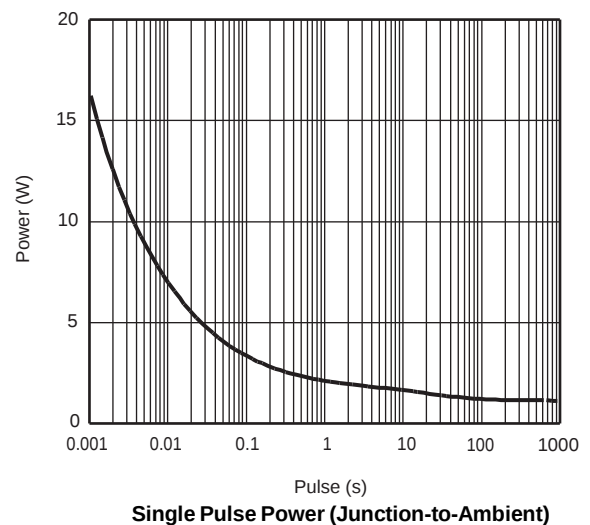
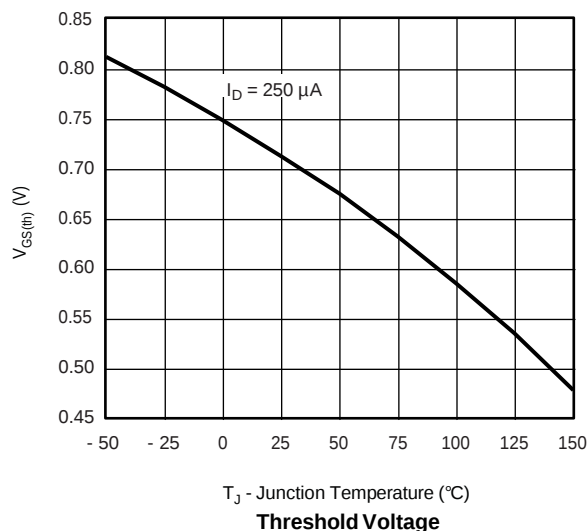
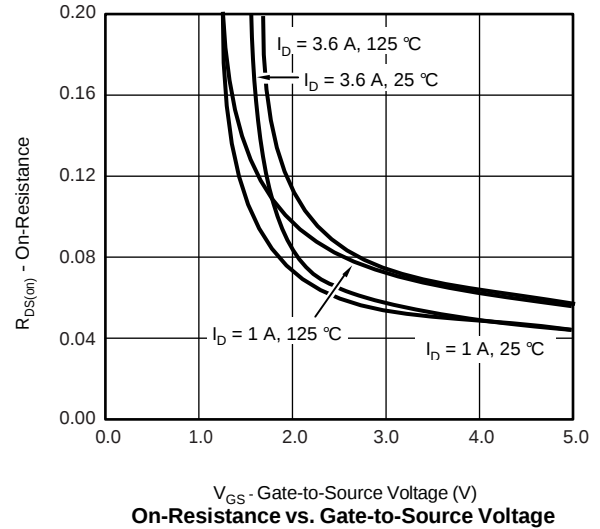
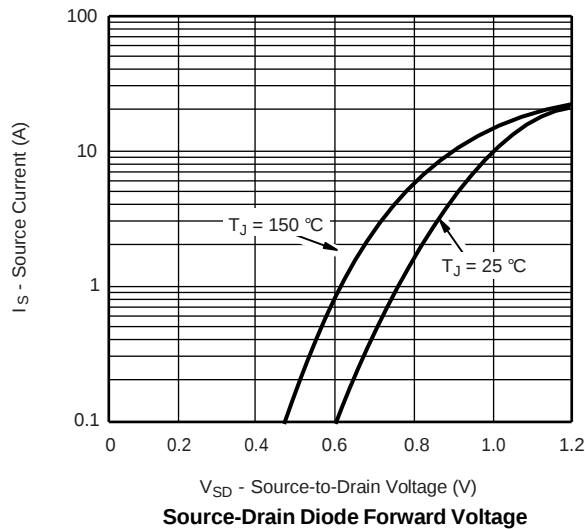
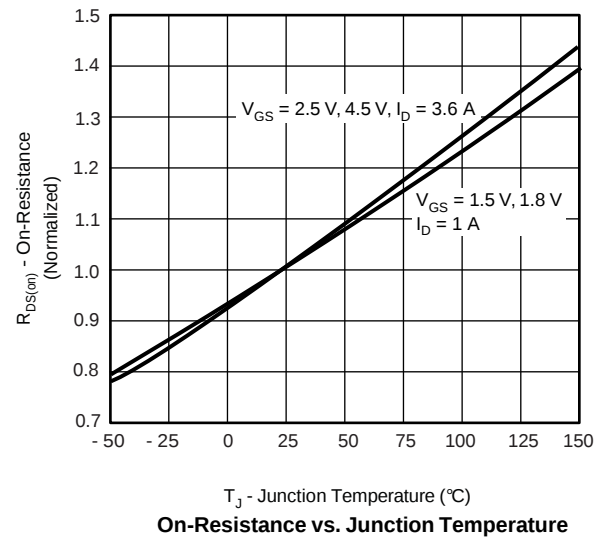
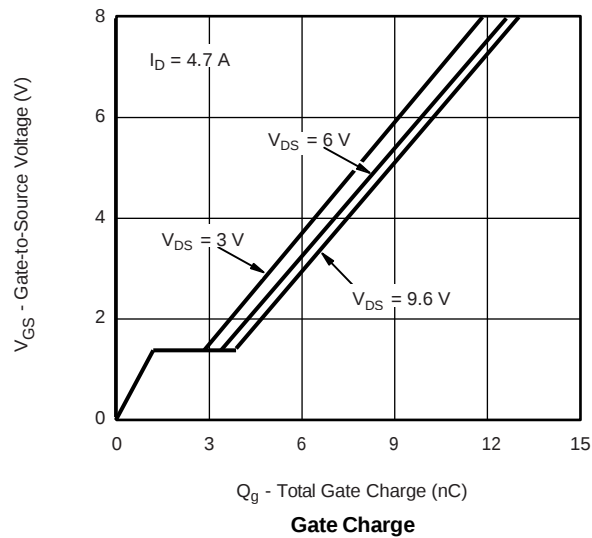


I_D - Drain Current (A)
On-Resistance vs. Drain Current and Gate Voltage

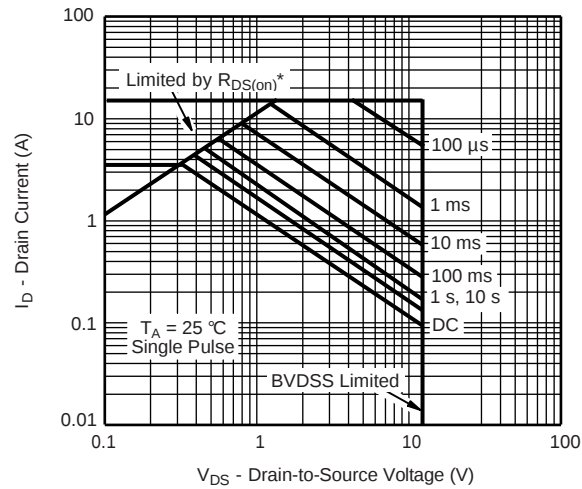


V_{DS} - Drain-to-Source Voltage (V)
Capacitance

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

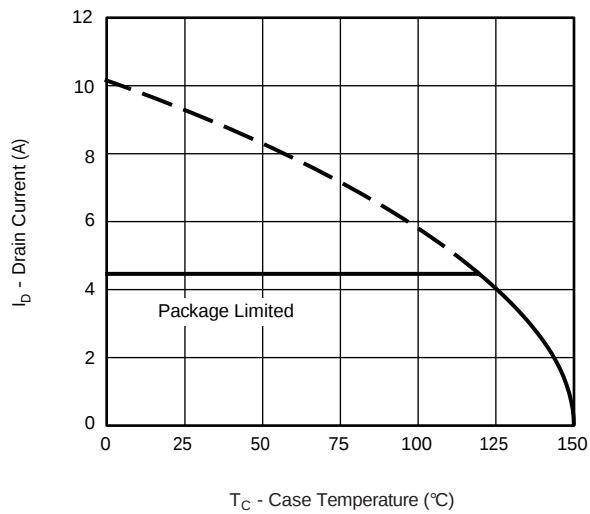


P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

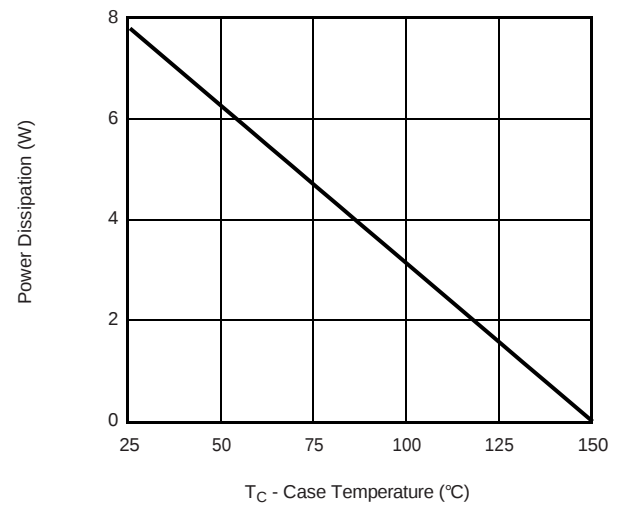


* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

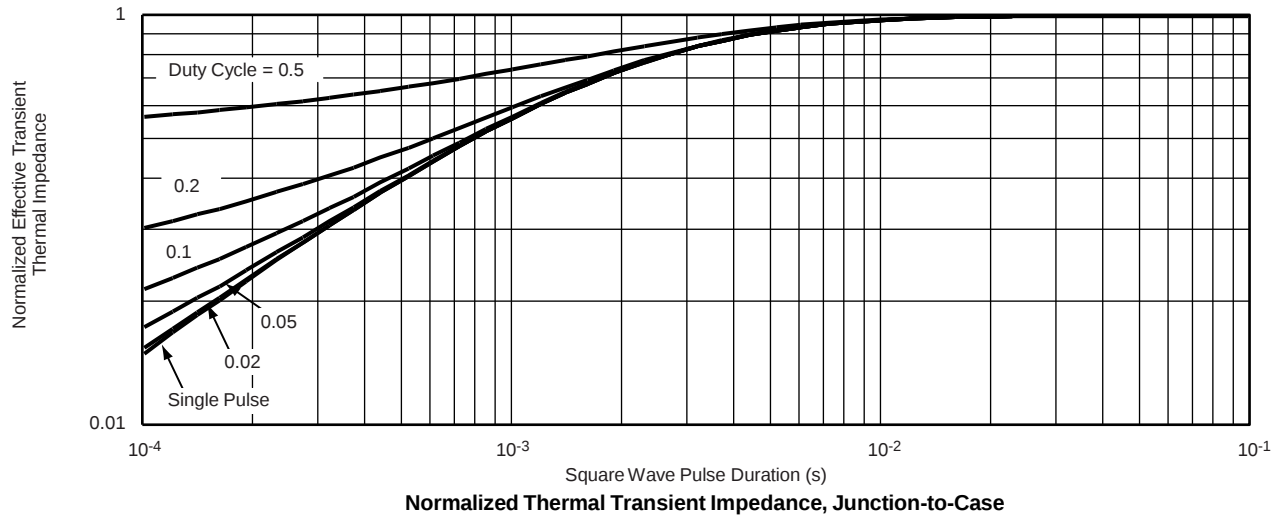
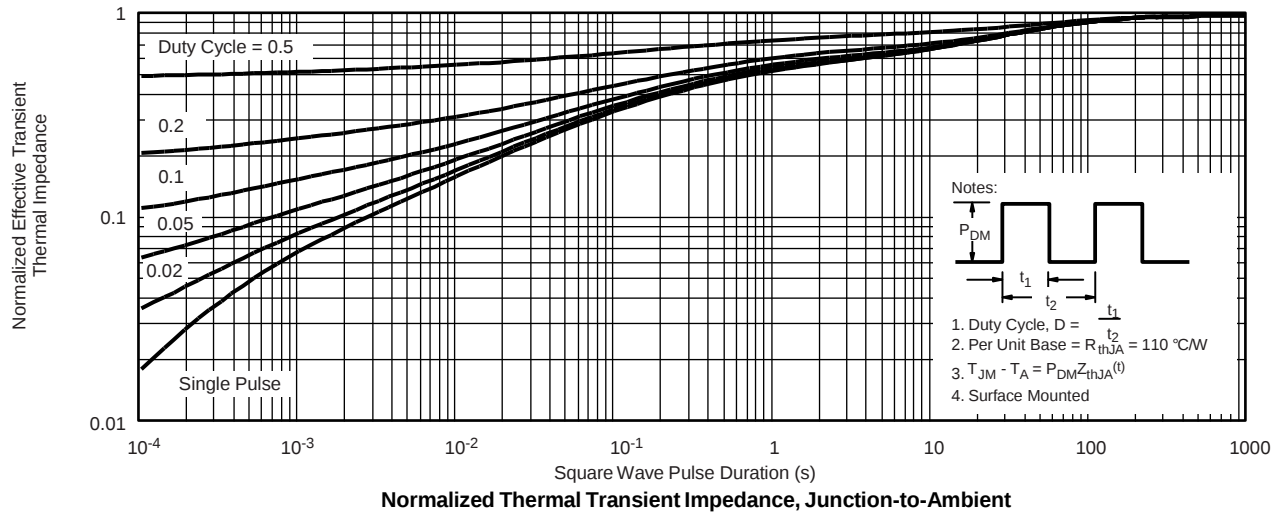


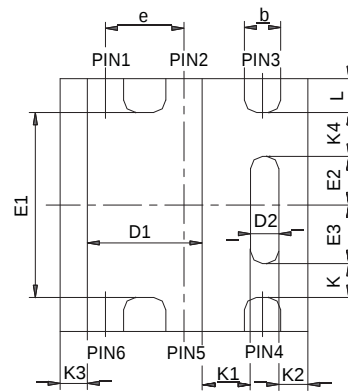
Current Derating*



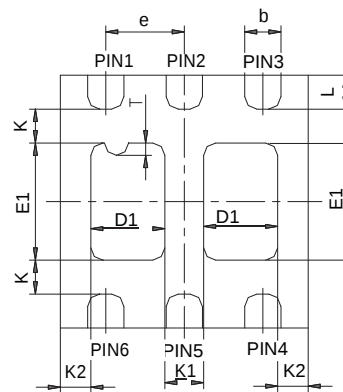
Power Derating

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

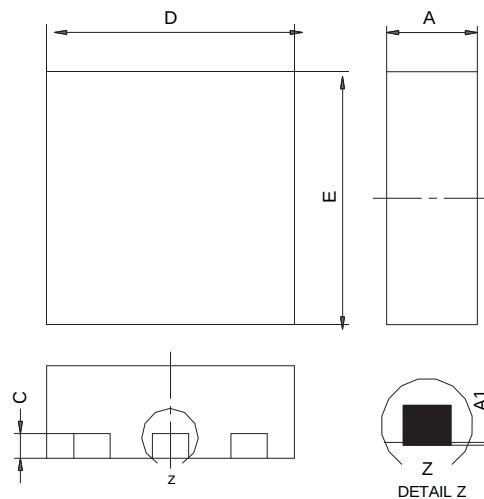




BACKSIDE VIEW OF SINGLE



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

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RECOMMENDED PAD LAYOUT FOR PowerPAK® SC70-6L Dual

