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

PRODUCT SUMMARY				
	V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)[a]	Q_g (Typ.)
N-Channel	20	0.028 at V_{GS} = 4.5 V	6.5	9.5
		0.036 at V_{GS} = 2.5 V	5.0	
P-Channel	- 20	0.072 at V_{GS} = - 4.5 V	- 3.8	8.8
		0.099 at V_{GS} = - 2.5 V	- 3.0	

FEATURES

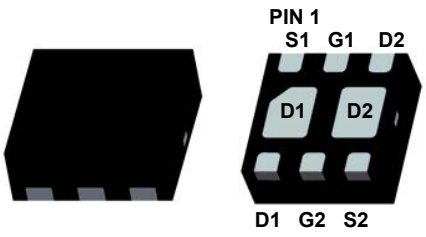
- DT-Trench Power MOSFET
- Compliant to RoHS Directive 2002/95/EC

Pb-free
RoHS COMPLIANT

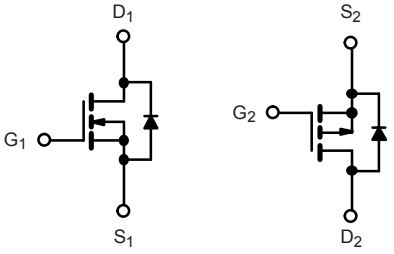
APPLICATIONS

- 1-2 Cell Battery Protection Circuitry
- DC/DC 'Switching' MOSFET in cellular handset and other ultra-portable applications

DFN 2x2-6L-U



Top View Bottom View



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}	± 12		
Continuous Drain Current (T_J = 150 °C)	T_C = 25 °C	I_D	6.5	- 3.8	A
	T_C = 70 °C		5.0	- 2.5	
	T_A = 25 °C		5.2[b, c]	- 2.6[b, c]	
	T_A = 70 °C		4.0[b, c]	- 1.5[b, c]	
Pulsed Drain Current		I_{DM}	25	- 15	
Source-Drain Current Diode Current	T_C = 25 °C	I_S	2.5	- 2.5	
	T_A = 25 °C		1.6[b, c]	- 1.6[b, c]	
Pulsed Source-Drain Current		I_{SM}	20	- 12	
Single Pulse Avalanche Current	L = 0 1 mH	I_{AS}	6.5	-3.8	
Single Pulse Avalanche Energy		E_{AS}	2.45	1.5	mJ
Maximum Power Dissipation	T_C = 25 °C	P_D	1.9	1.4	W
	T_C = 70 °C		0.9	0.7	
	T_A = 25 °C		1.1[b, c]	0.8[b, c]	
	T_A = 70 °C		0.65[b, c]	0.45[b, c]	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to 150		°C

THERMAL RESISTANCE RATINGS							
			N-Channel		P-Channel		
Parameter		Symbol	Typ.	Max.	Typ.	Max.	Unit
Maximum Junction-to-Ambient[b, d]	t ≤ 10 s	R_{thJA}	70	84	110	160	°C/W
Maximum Junction-to-Foot (Drain)	Steady State	R_{thJF}	53	70	90	140	

Notes:
a. Based on T_C = 25 °C.
b. Surface Mounted on 1" x 1" FR4 board.
c. t = 10 s.
d. Maximum under Steady State conditions is 120 °C/W.

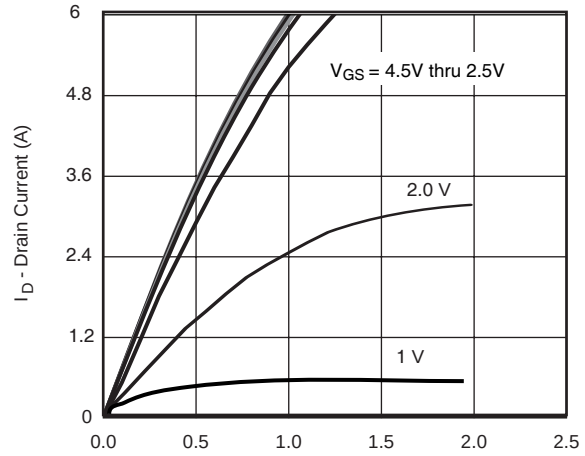
SPECIFICATIONS T_J = 25 °C, unless otherwise noted							
Parameter	**Symbol**	**Test Conditions**		**Min.**	**Typ.[a]**	**Max.**	**Unit**
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA	N-Ch	20			V
		V_{GS} = 0 V, I_D = - 250 µA	P-Ch	- 20			
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	I_D = 250 µA	N-Ch		15		mV/°C
		I_D = - 250 µA	P-Ch		- 12		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	I_D = 250 µA	N-Ch		4		
		I_D = - 250 µA	P-Ch		-4.6		
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-Body Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 12 V	N-Ch			10	nA
			P-Ch			- 10	
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 16 V, V_{GS} = 0 V	N-Ch			1	µA
		V_{DS} = - 16 V, V_{GS} = 0 V	P-Ch			- 1	
		V_{DS} = 16 V, V_{GS} = 0 V, T_J = 55 °C	N-Ch			10	
		V_{DS} = - 16 V, V_{GS} = 0 V, T_J = 55 °C	P-Ch			- 10	
On-State Drain Current[b]	$I_{D(on)}$	V_{DS} = 5 V, V_{GS} = 10 V	N-Ch	25			A
		V_{DS} = - 5 V, V_{GS} = - 10 V	P-Ch	- 15			
Drain-Source On-State Resistance[b]	$R_{DS(on)}$	V_{GS} = 4.5 V, I_D = 3 .5A	N-Ch		0.028	0.035	Ω
		V_{GS} = - 4.5 V, I_D = - 3 A	P-Ch		0.072	0.080	
		V_{GS} = 2.5 V, I_D = 2.5 A	N-Ch		0.036	0.040	
		V_{GS} = - 2.5 V, I_D = - 2 A	P-Ch		0.099	0.110	
Forward Transconductance[b]	g_{fs}	V_{DS} = 16 V, I_D = 3.5A	N-Ch		18		S
		V_{DS} = - 16 V, I_D = - 3 A	P-Ch		12		
Dynamic[a]							
Input Capacitance	C_{iss}	N-Channel V_{DS} = 16 V, V_{GS} = 0 V, f = 1 MHz P-Channel V_{DS} = - 16 V, V_{GS} = 0 V, f = 1 MHz	N-Ch		1040		pF
			P-Ch		830		
Output Capacitance	C_{oss}		N-Ch		240		
			P-Ch		120		
Reverse Transfer Capacitance	C_{rss}		N-Ch		200		
			P-Ch		95		
Total Gate Charge	Q_g	V_{DS} = 16 V, V_{GS} = 4.5 V, I_D = 3.5 A	N-Ch		10		nC
		V_{DS} = - 16 V, V_{GS} = - 4.5 V, I_D = - 3 A	P-Ch		15		
		N-Channel V_{DS} = 16 V, V_{GS} = 2.5 V I_D = 2 A P-Channel V_{DS} = - 16 V, V_{GS} = - 2.5 V, I_D = - 2 A	N-Ch		5.3		
			P-Ch		11.8		
Gate-Source Charge	Q_{gs}		N-Ch		1.9		
			P-Ch		3.0		
Gate-Drain Charge	Q_{gd}		N-Ch		1.7		
			P-Ch		5.2		
Gate Resistance	R_g	f = 1 MHz	N-Ch		2.2		Ω
			P-Ch		5.5		

SPECIFICATIONS T_J = 25 °C, unless otherwise noted							
Parameter	**Symbol**	**Test Conditions**		**Min.**	**Typ.[a]**	**Max.**	**Unit**
Dynamic[a]							
Turn-On Delay Time	$t_{d(on)}$	N-Channel V_{DD} = 16 V, R_L = 4 Ω, $I_D \cong$ 3.5 A, V_{GEN} = 4.5 V, R_g = 1 Ω P-Channel V_{DD} = - 16 V, R_L = 4 Ω, $I_D \cong$ - 3 A, V_{GEN} = - 4.5 V, R_g = 1 Ω	N-Ch		7	14	ns
			P-Ch		7	14	
Rise Time	t_r		N-Ch		10	20	
			P-Ch		12	24	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		15	30	
			P-Ch		35	65	
Fall Time	t_f		N-Ch		10	18	
			P-Ch		10	18	
Turn-On Delay Time	$t_{d(on)}$	N-Channel V_{DD} = 16 V, R_L = 4 Ω, $I_D \cong$ 3.5 A, V_{GEN} = 4.5 V, R_g = 1 Ω P-Channel V_{DD} = - 16 V, R_L = 4 Ω, $I_D \cong$ - 3 A, V_{GEN} = - 4.5 V, R_g = 1 Ω	N-Ch		16	30	
			P-Ch		44	80	
Rise Time	t_r		N-Ch		17	30	
			P-Ch		33	50	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		16	30	
			P-Ch		28	60	
Fall Time	t_f		N-Ch		10	20	
			P-Ch		13	25	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	T_C = 25 °C	N-Ch			2.5	A
			P-Ch			- 2.5	
Pulse Diode Forward Current[a]	I_{SM}		N-Ch			20	
			P-Ch			- 12	
Body Diode Voltage	V_{SD}	I_S = 1.6 A	N-Ch		0.7	1.2	V
		I_S = - 1.6 A	P-Ch		- 0.7	- 1.2	
Body Diode Reverse Recovery Time	t_{rr}	N-Channel I_F = 2 A, dI/dt = 100 A/µs, T_J = 25 °C P-Channel I_F = - 2 A, dI/dt = - 100 A/µs, T_J = 25 °C	N-Ch		20	30	ns
			P-Ch		26	55	
Body Diode Reverse Recovery Charge	Q_{rr}		N-Ch		14	25	nC
			P-Ch		18.5	35	
Reverse Recovery Fall Time	t_a		N-Ch		13		ns
			P-Ch		12.5		
Reverse Recovery Rise Time	t_b		N-Ch		6		
			P-Ch		13.5		

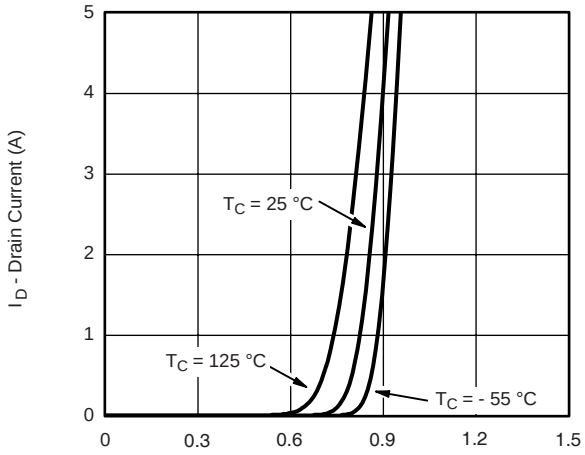
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.

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.

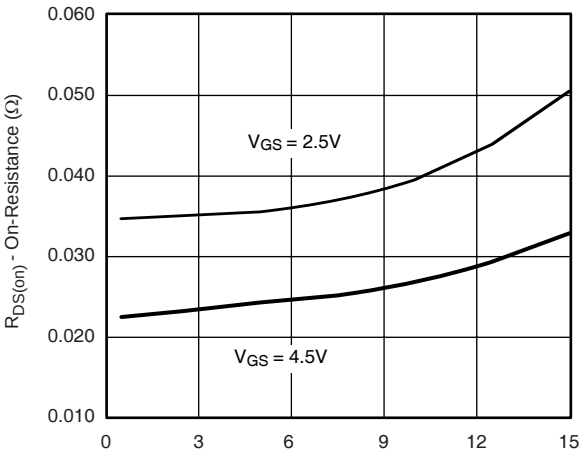
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



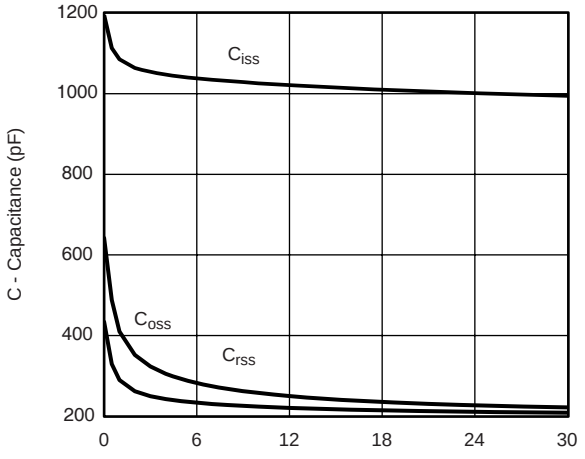
Output Characteristics



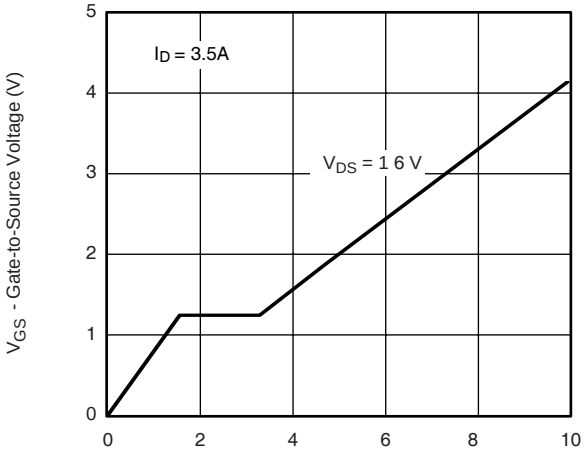
Transfer Characteristics



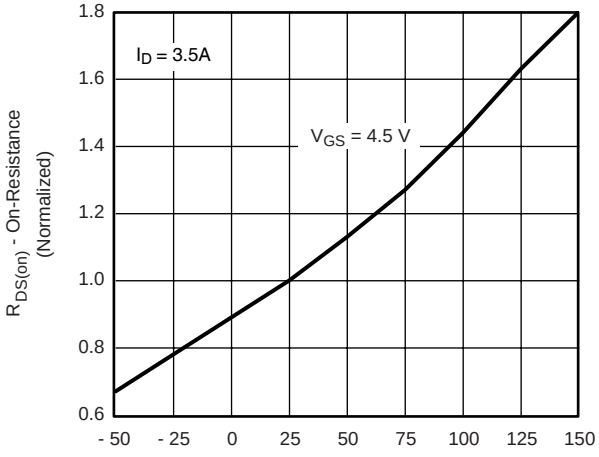
On-Resistance vs. Drain Current



Capacitance

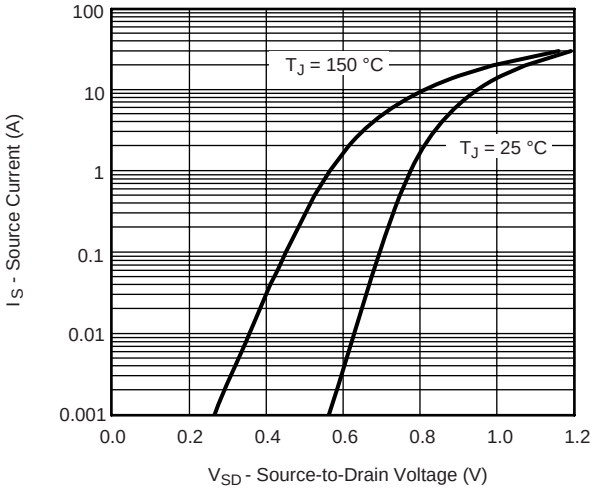


Gate Charge

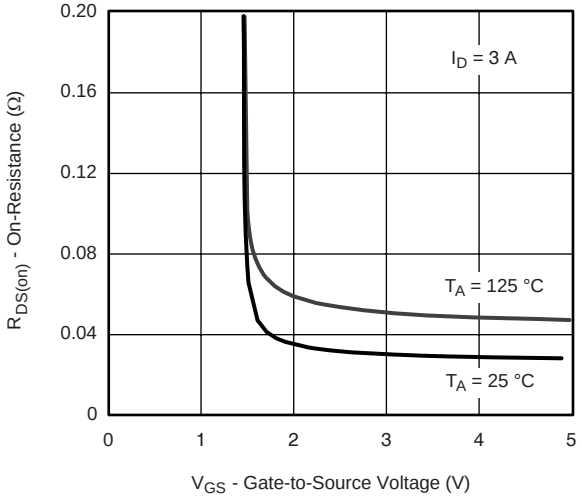


On-Resistance vs. Junction Temperature

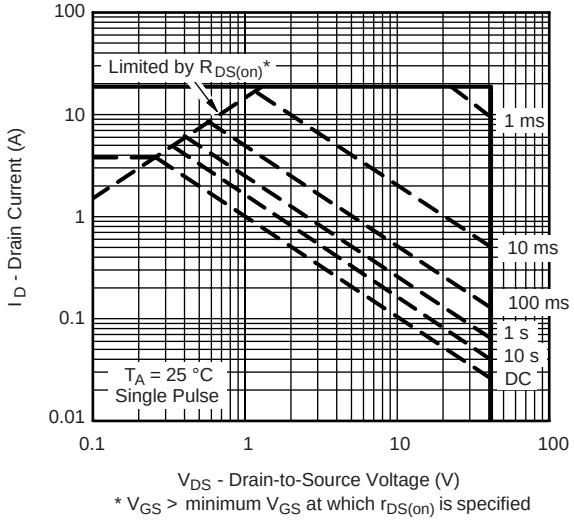
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Source-Drain Diode Forward Voltage

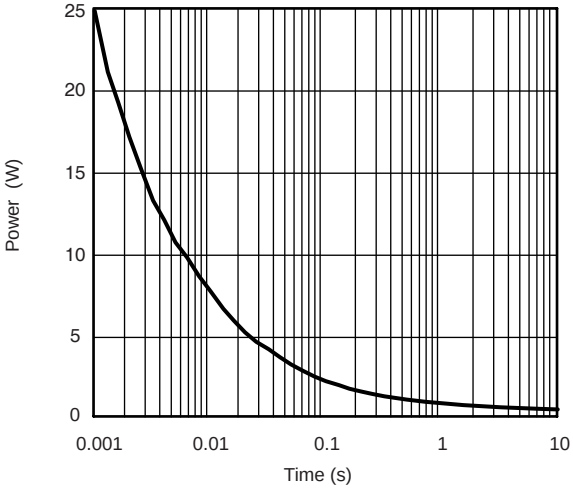


On-Resistance vs. Gate-to-Source Voltage



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

Safe Operating Area, Junction-to-Ambient



Single Pulse Power, Junction-to-Ambient

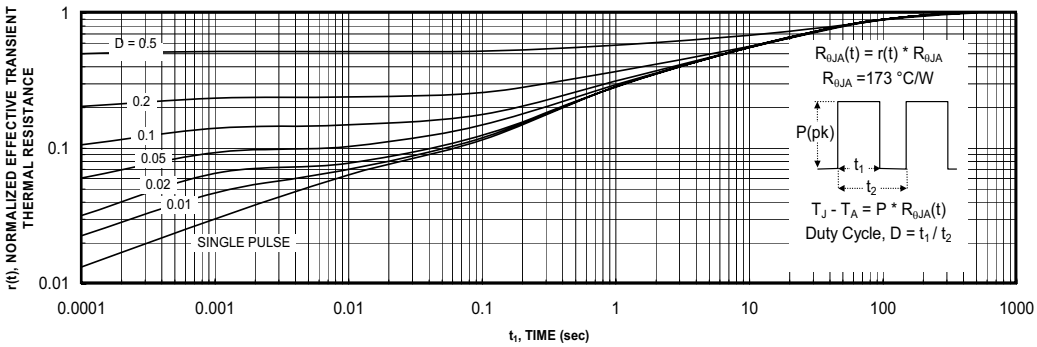
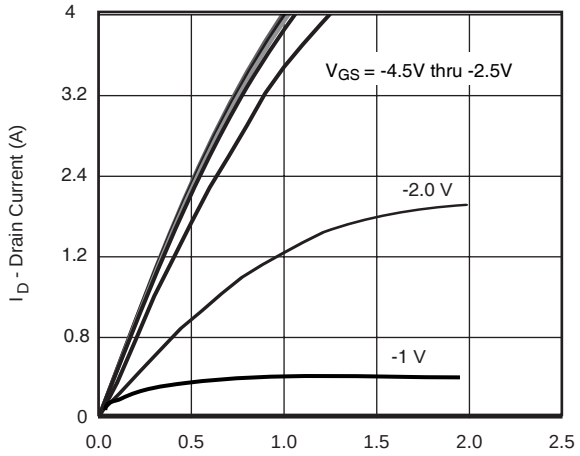


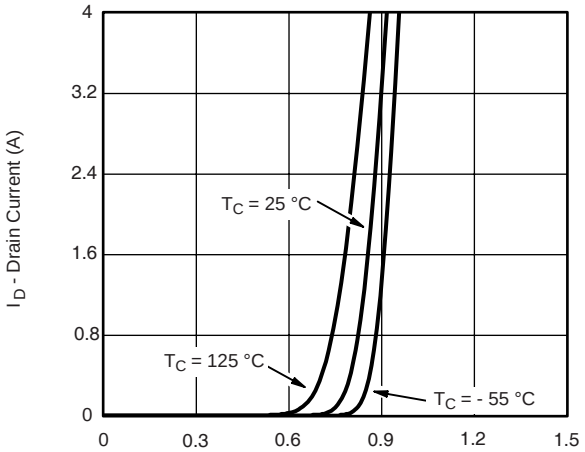
Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1b.
Transient thermal response will change depending on the circuit board design.

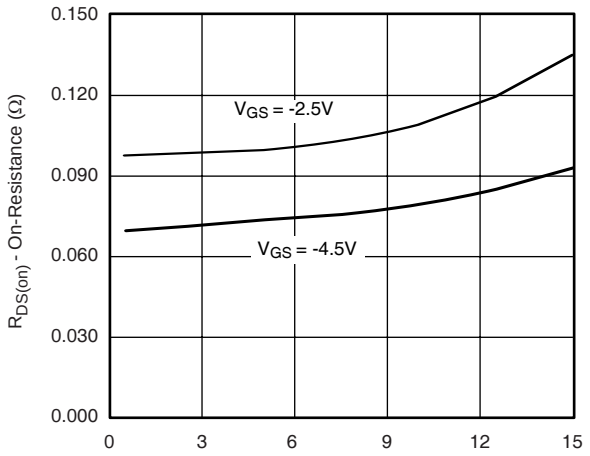
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



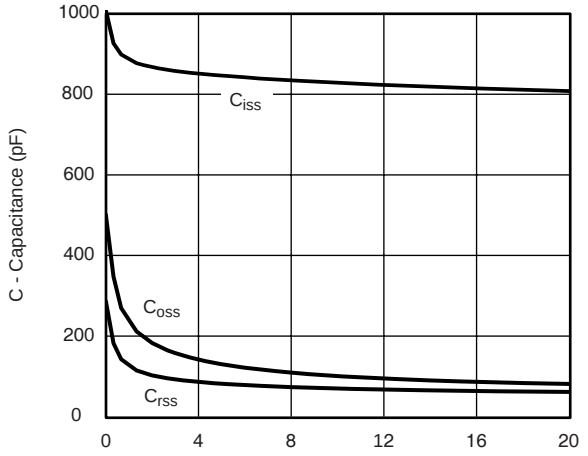
Output Characteristics



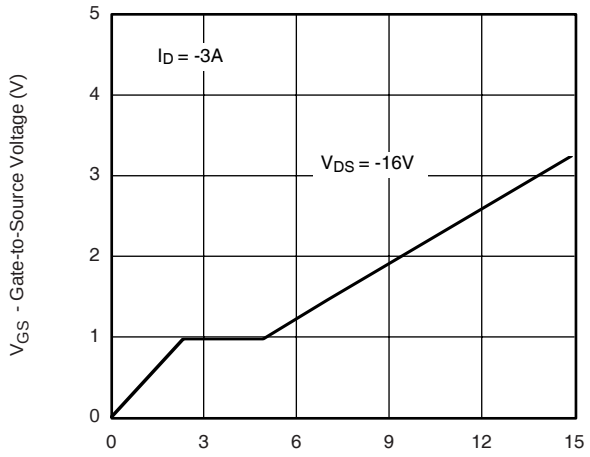
Transfer Characteristics



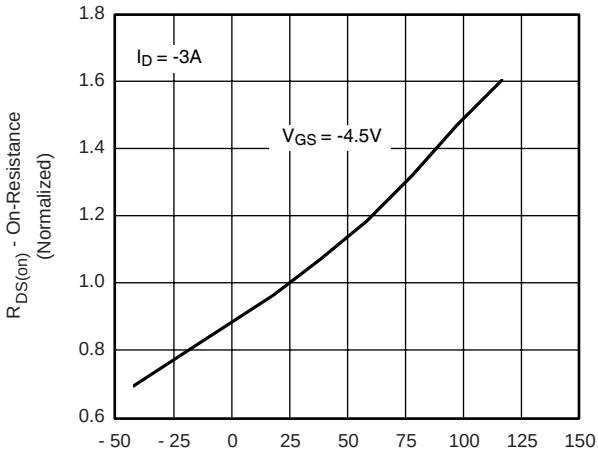
On-Resistance vs. Drain Current



Capacitance

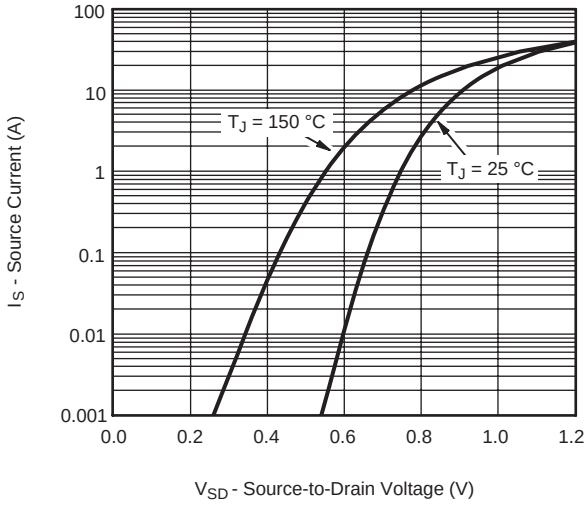


Gate Charge

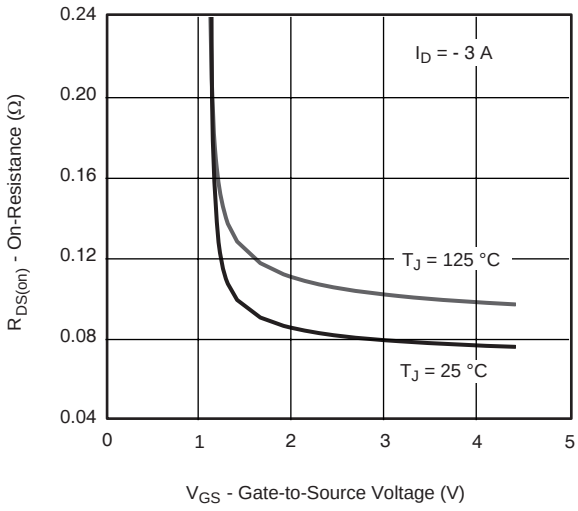


On-Resistance vs. Junction Temperature

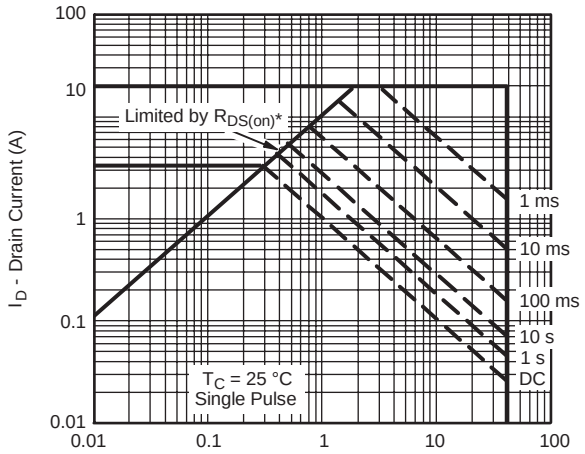
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Source-Drain Diode Forward Voltage

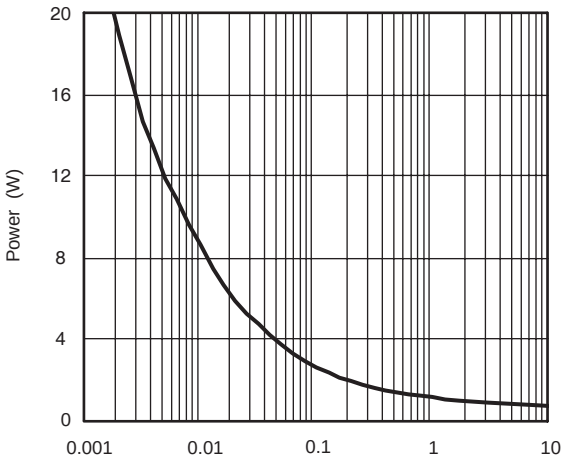


On-Resistance vs. Gate-to-Source Voltage



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

Safe Operating Area, Junction-to-Ambient



Single Pulse Power, Junction-to-Ambient

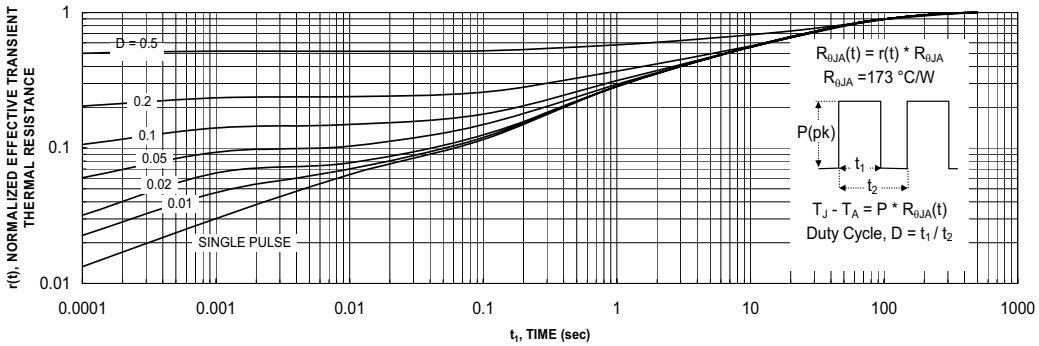
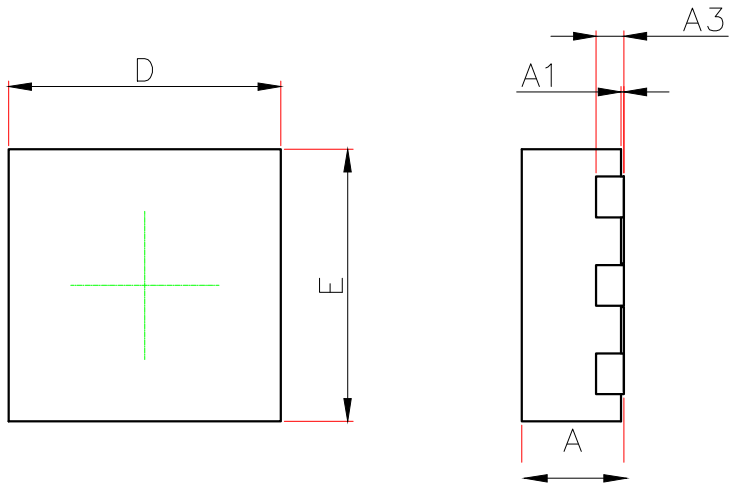


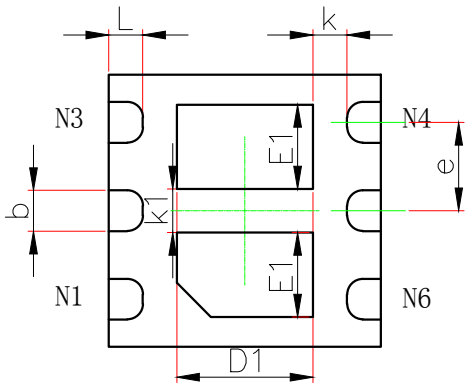
Figure 22. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1c.
Transient thermal response will change depending on the circuit board design.



TOP VIEW

SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN.	MAX.	MIN.	MAX.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D1	0.900	1.100	0.035	0.043
E1	0.520	0.720	0.020	0.028
b	0.250	0.350	0.010	0.014
e	0.650TYP.		0.026TYP.	
k	0.200MIN.		0.008MIN.	
k1	0.320REF		0.013REF.	
L	0.200	0.300	0.008	0.012

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