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

PRODUCT SUMMARY

	V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)	Q_g (Typ.)
N-Channel	20	0.020 at V_{GS} = 4.5 V	5^a	6.7 nC
		0.032 at V_{GS} = 2.5 V	5^a	
P-Channel	- 20	0.024 at V_{GS} = - 4.5 V	- 5 ^{a}	17 nC
		0.040 at V_{GS} = - 2.5 V	- 5 ^{a}	

FEATURES

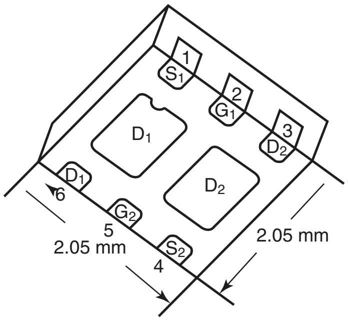
- **Halogen-free**
- Trench Power MOSFETs

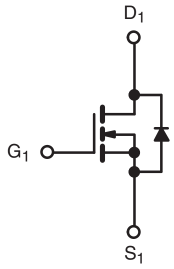
APPLICATIONS

- Load Switch
- DC/DC Converter

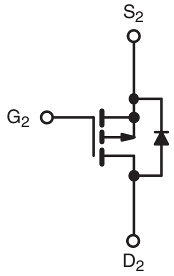
Pb
Pb-free
RoHS
COMPLIANT

DFN 2x2





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	± 12	
Continuous Drain Current (T_J = 150 °C)	T_C = 25 °C	I_D	5.0	- 5 .0	A
	T_C = 70 °C		3.5	- 3 .0	
	T_A = 25 °C		$4.0^{b, c}$	$- 3 .5^{b, c}$	
	T_A = 70 °C		$2.5^{b, c}$	$- 2 .0^{b, c}$	
Pulsed Drain Current		I_{DM}	20	- 2 0	
Source Drain Current Diode Current	T_C = 25 °C	I_S	1.3	- 1.4	
	T_A = 25 °C		$0.9^{b, c}$	$- 1.0^{b, c}$	
Maximum Power Dissipation	T_C = 25 °C	P_D	2.7	2.9	W
	T_C = 70 °C		1.78	1.86	
	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	- 55 to 150	°C

THERMAL RESISTANCE RATINGS

			N-Channel		P-Channel		
Parameter		Symbol	Typ.	Max.	Typ.	Max.	Unit
Maximum Junction-to-Case$^{b, d}$	t ≤ 10 s	R_{thJC}	25	45	25	43	°C/W
Maximum Junction-to-Ambient	Steady State	R_{thJA}	66	-	66	-	

Notes:
a. T_C = 25 °C.
b. Surface Mounted on 1" x 1" FR4 board.
c. t = 10 s.
d. Maximum under Steady State conditions is 145 °C/W.

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		22		mV/°C
		I_D = - 250 µA	P-Ch		- 21		
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	I_D = 250 µA	N-Ch		- 3.5		
		I_D = - 250 µA	P-Ch		3.5		
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	N-Ch		0.7		V
		V_{DS} = V_{GS}, I_D = - 250 µA	P-Ch		-0.6		
Gate-Body 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	20			A
		$V_{DS} \leq -5$ V, V_{GS} = - 4.5 V	P-Ch	- 2 0			
Drain-Source On-State Resistance[b]	$R_{DS(on)}$	V_{GS} = 4.5 V, I_D = 2.5 A	N-Ch		0.020		Ω
		V_{GS} = - 4.5 V, I_D = - 2.0 A	P-Ch		0.032		
		V_{GS} = 2.5 V, I_D = 2.0 A	N-Ch		0.024		
		V_{GS} = - 2.5 V, I_D = - 1.8 A	P-Ch		0.040		
Forward Transconductance[b]	g_{fs}	V_{DS} = 10 V, I_D = 2.5 A	N-Ch		17		S
		V_{DS} = - 10 V, I_D = -2.5 A	P-Ch		22		
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		600		pF
			P-Ch		700		
Output Capacitance	C_{oss}		N-Ch		150		
			P-Ch		260		
Reverse Transfer Capacitance	C_{rss}		N-Ch		70		
			P-Ch		45		
Total Gate Charge	Q_g	V_{DS} = 10 V, V_{GS} = 10 V, I_D = 2.5 A	N-Ch		15	23	nC
		V_{DS} = - 10 V, V_{GS} = - 10 V, I_D = - 2.5 A	P-Ch		34	51	
		N-Channel V_{DS} = 10 V, V_{GS} = 4.5 V, I_D = 2.5 A P-Channel V_{DS} = - 10 V, V_{GS} = - 4.5 V, I_D = - 2.5 A	N-Ch		6.7	11	
			P-Ch		17	30	
Gate-Source Charge	Q_{gs}		N-Ch		1.8		
			P-Ch		3		
Gate-Drain Charge	Q_{gd}		N-Ch		0.9		
			P-Ch		5.5		
Gate Resistance	R_g	f = 1 MHz	N-Ch		2		Ω
			P-Ch		6		

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

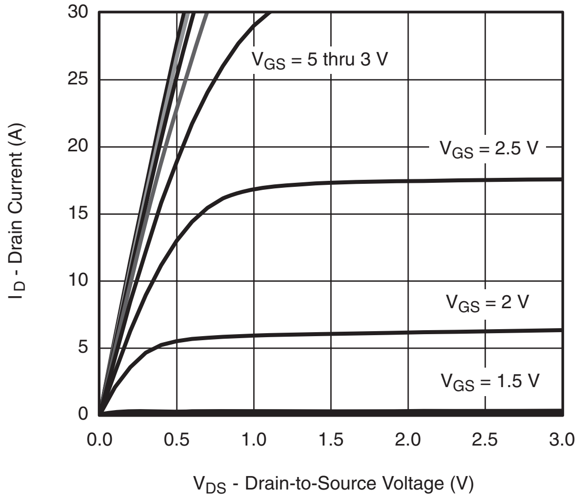
SPECIFICATIONS T_J = 25 °C, unless otherwise noted

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 = 2.2 Ω I_D ≅ 2.5A, V_{GEN} = 4.5 V, R_g = 1 Ω P-Channel V_{DD} = - 10 V, R_L = 2.4 Ω I_D ≅ - 2.5 A, V_{GEN} = - 4.5 V, R_g = 1 Ω	N-Ch		12	20	ns
			P-Ch		30	45	
Rise Time	t_r		N-Ch		10	15	
			P-Ch		25	40	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		25	40	
			P-Ch		45	70	
Fall Time	t_f		N-Ch		10	15	
			P-Ch		15	25	
Turn-On Delay Time	$t_{d(on)}$	N-Channel V_{DD} = 10 V, R_L = 2.2 Ω I_D ≅ 2.5 A, V_{GEN} = 10 V, R_g = 1 Ω P-Channel V_{DD} = - 10 V, R_L = 2.4 Ω I_D ≅ - 2.5 A, V_{GEN} = - 10 V, R_g = 1 Ω	N-Ch		10	15	ns
			P-Ch		10	15	
Rise Time	t_r		N-Ch		10	15	
			P-Ch		10	15	
Turn-Off Delay Time	$t_{d(off)}$		N-Ch		20	30	
			P-Ch		45	70	
Fall Time	t_f		N-Ch		8	15	
			P-Ch		15	25	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	T_C = 25 °C	N-Ch			1.3	A
			P-Ch			- 1.4	
Pulse Diode Forward Current[a]	I_{SM}		N-Ch			30	
			P-Ch			- 30	
Body Diode Voltage	V_{SD}	I_S = 1.2 A, V_{GS} = 0 V	N-Ch		0.8	1.2	V
		I_S = - 1.1 A, V_{GS} = 0 V	P-Ch		- 0.8	- 1.2	
Body Diode Reverse Recovery Time	t_{rr}	N-Channel I_F = 4.5 A, dI/dt = 100 A/µs, T_J = 25 °C P-Channel I_F = - 4.1 A, dI/dt = - 100 A/µs, T_J = 25 °C	N-Ch		15	30	ns
			P-Ch		35	55	
Body Diode Reverse Recovery Charge	Q_{rr}		N-Ch		6	12	nC
			P-Ch		21	35	
Reverse Recovery Fall Time	t_a		N-Ch		7.6		ns
			P-Ch		18		
Reverse Recovery Rise Time	t_b		N-Ch		7.4		
			P-Ch		17		

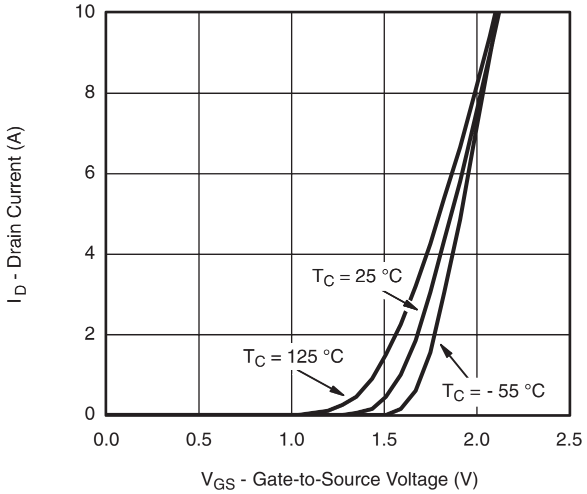
Notes:
a. Guaranteed by design, not subject to production testing.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.

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.

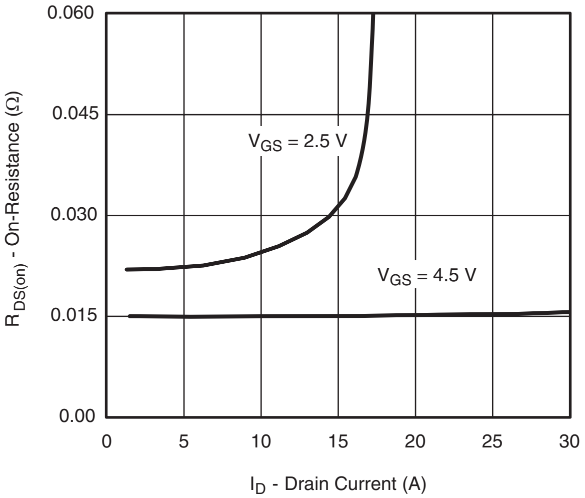
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



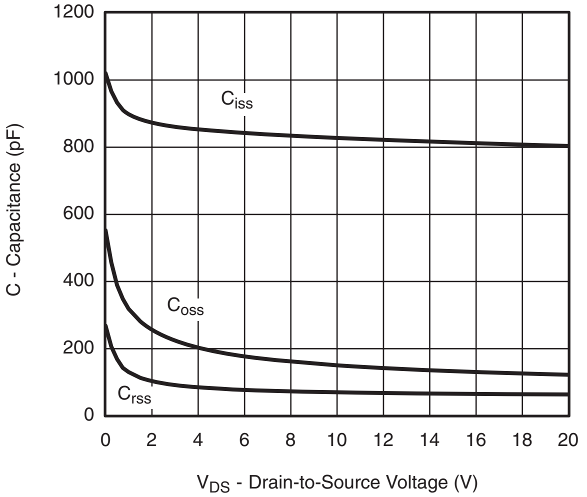
Output Characteristics



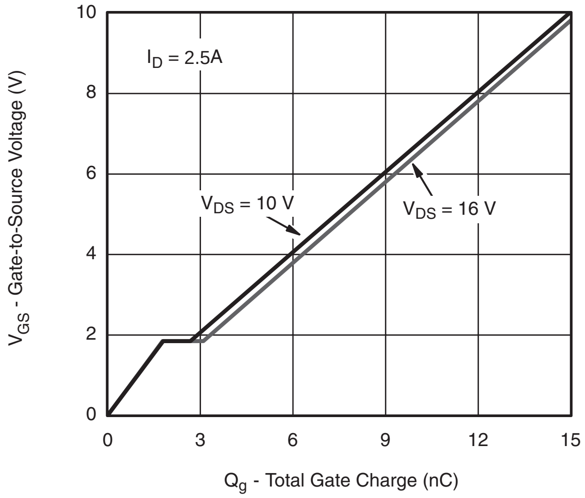
Transfer Characteristics



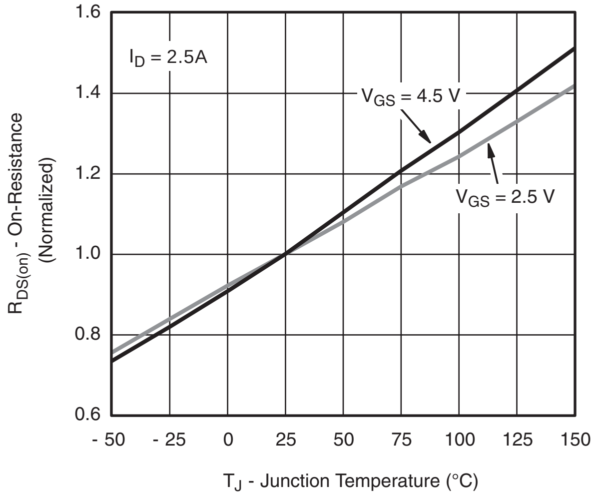
On-Resistance vs. Drain Current



Capacitance

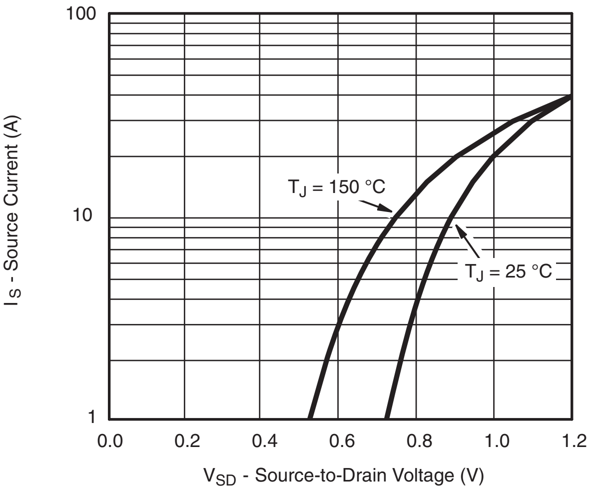


Gate Charge

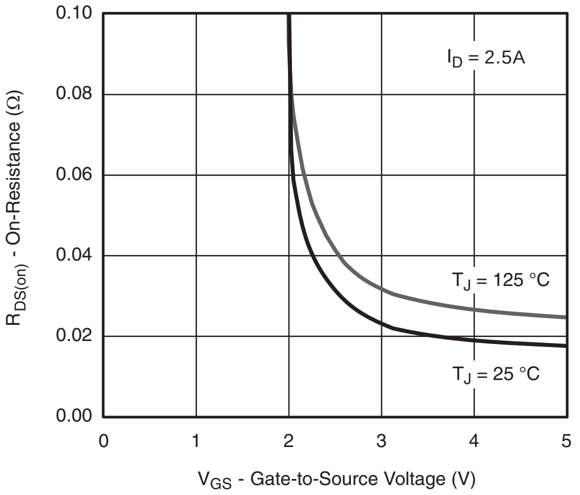


On-Resistance vs. Junction Temperature

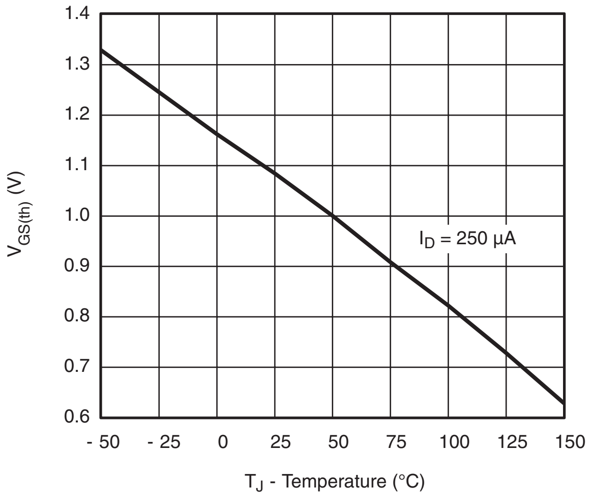
N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



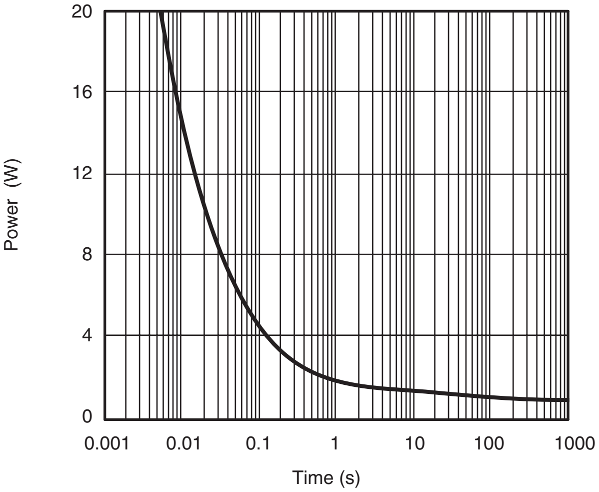
Source-Drain Diode Forward Voltage



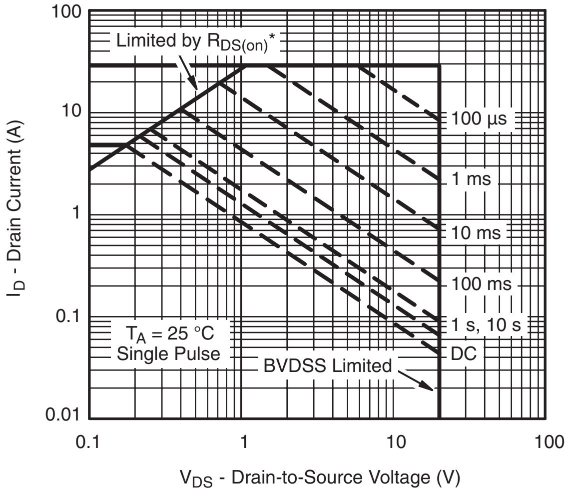
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



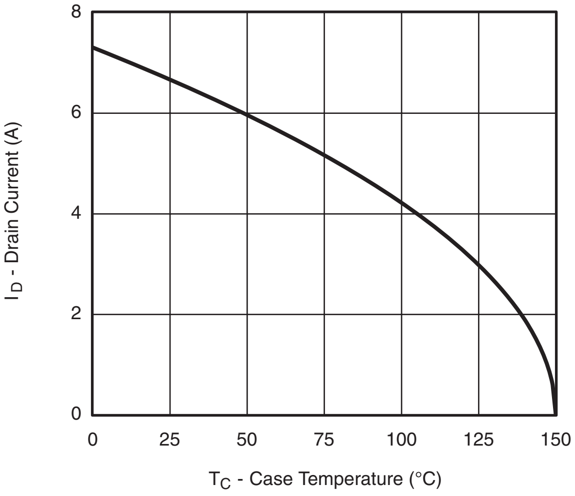
Single Pulse Power



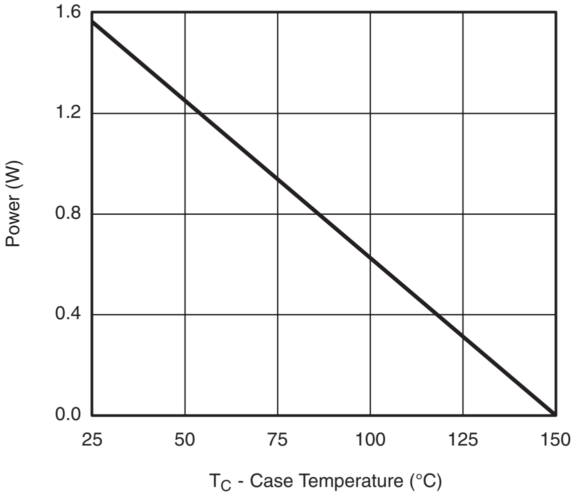
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

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



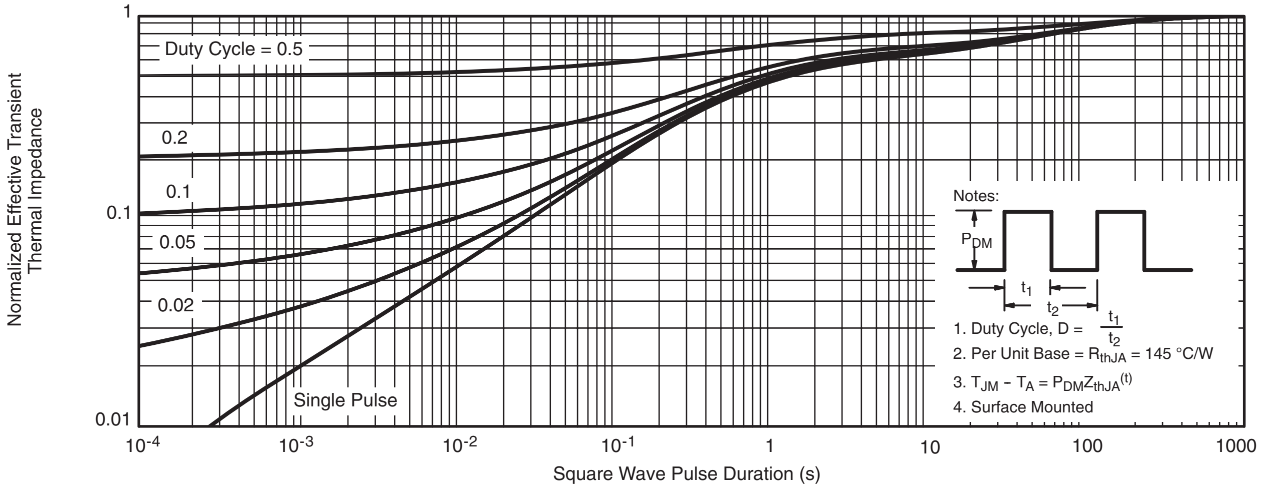
Current Derating*



Power Derating

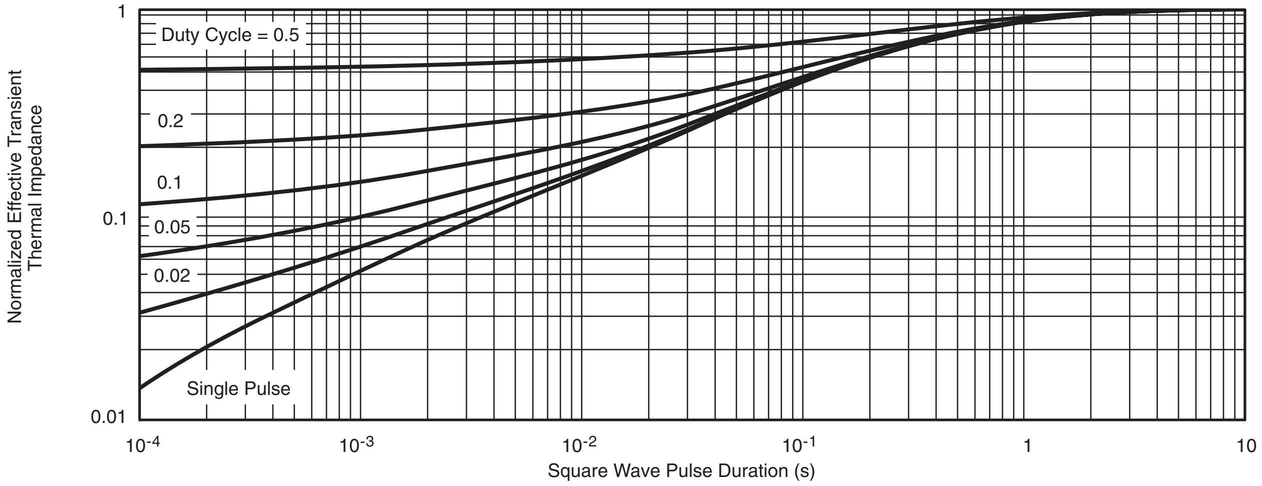
* The power dissipation P_D is based on $T_{J(max)}$ = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

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



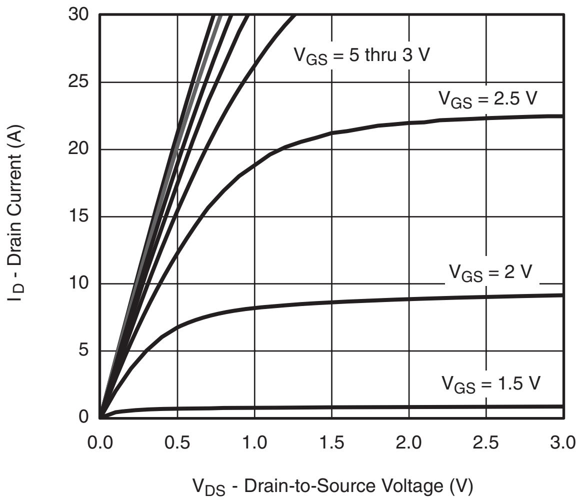
1. Duty Cycle, D = $\frac{t_1}{t_2}$
2. Per Unit Base = R_{thJA} = 145 °C/W
3. $T_{JM} - T_A = P_{DM}Z_{thJA}^{(t)}$
4. Surface Mounted

Normalized Thermal Transient Impedance, Junction-to-Case

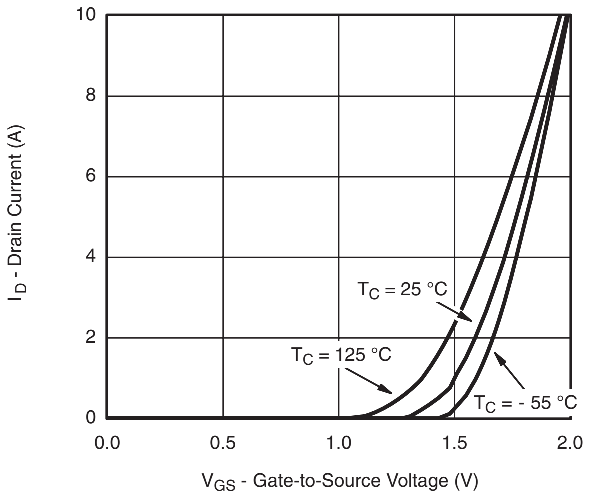


Normalized Thermal Transient Impedance, Junction-to-Ambient

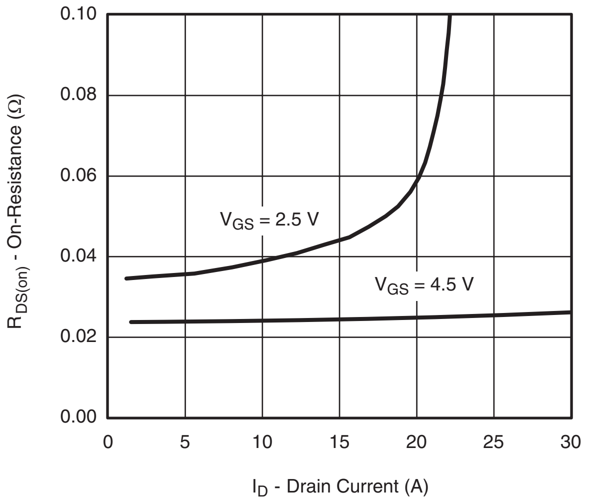
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



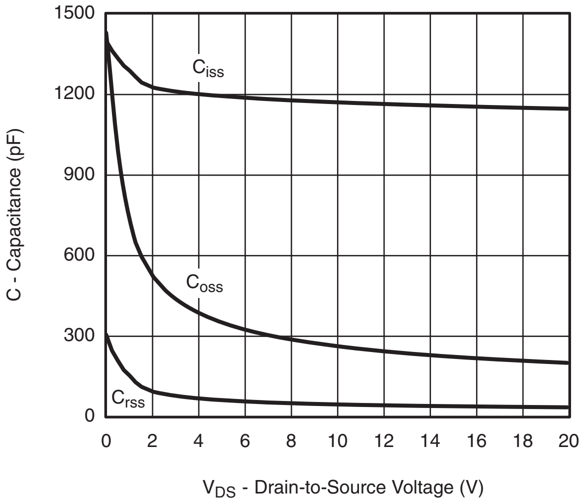
Output Characteristics



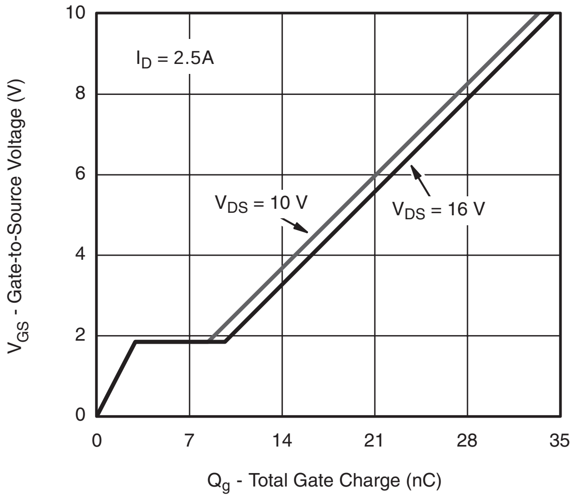
Transfer Characteristics



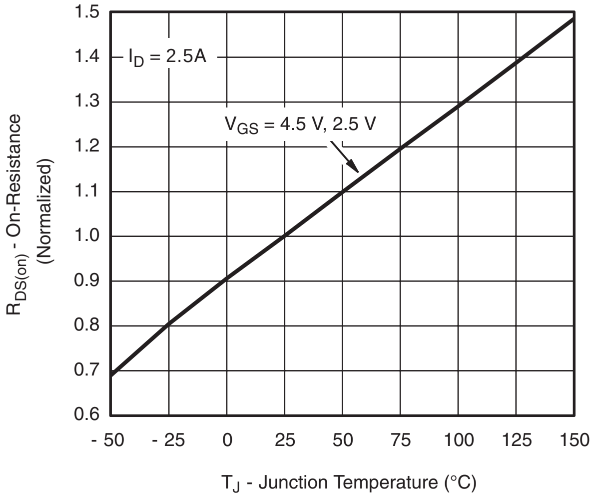
On-Resistance vs. Drain Current



Capacitance

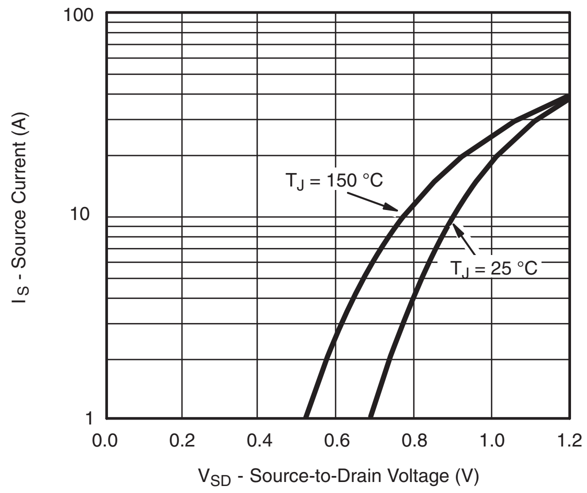


Gate Charge

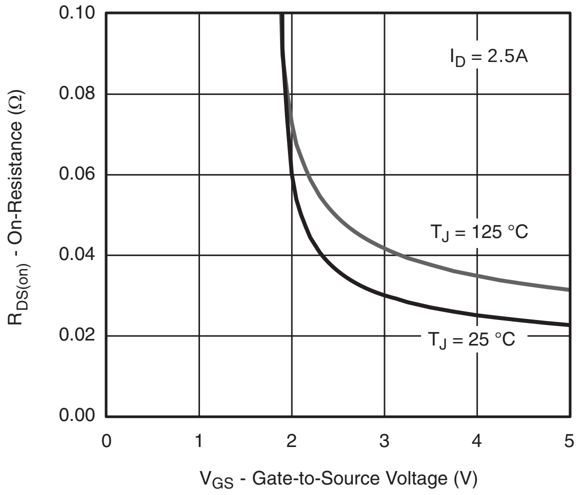


On-Resistance vs. Junction Temperature

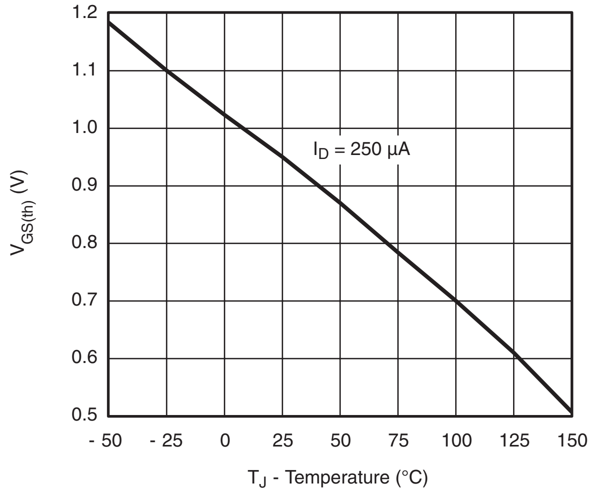
P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



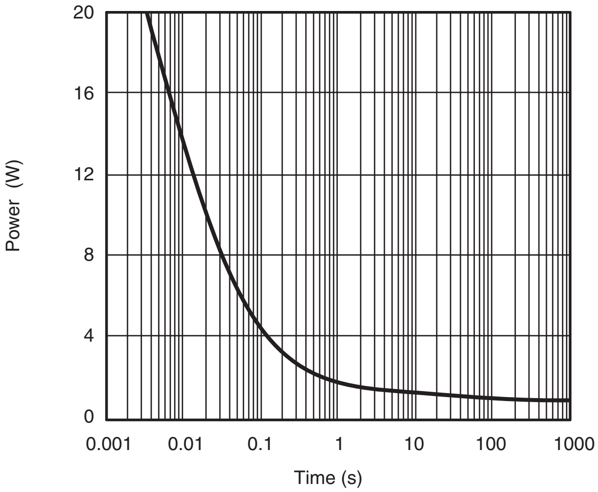
Source-Drain Diode Forward Voltage



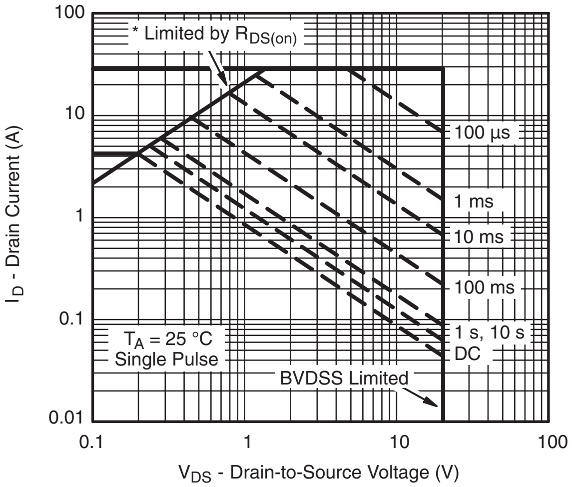
On-Resistance vs. Gate-to-Source



Threshold Voltage



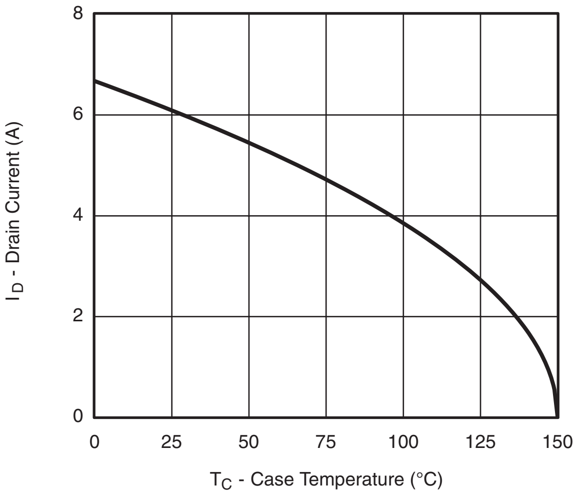
Single Pulse Power



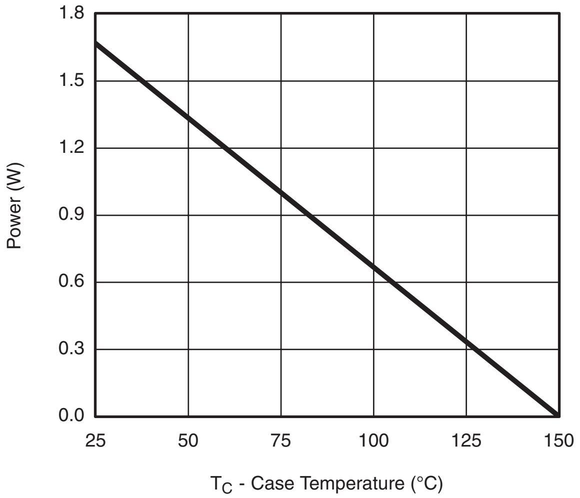
* V_{GS} > minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area, Junction-to-Ambient

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



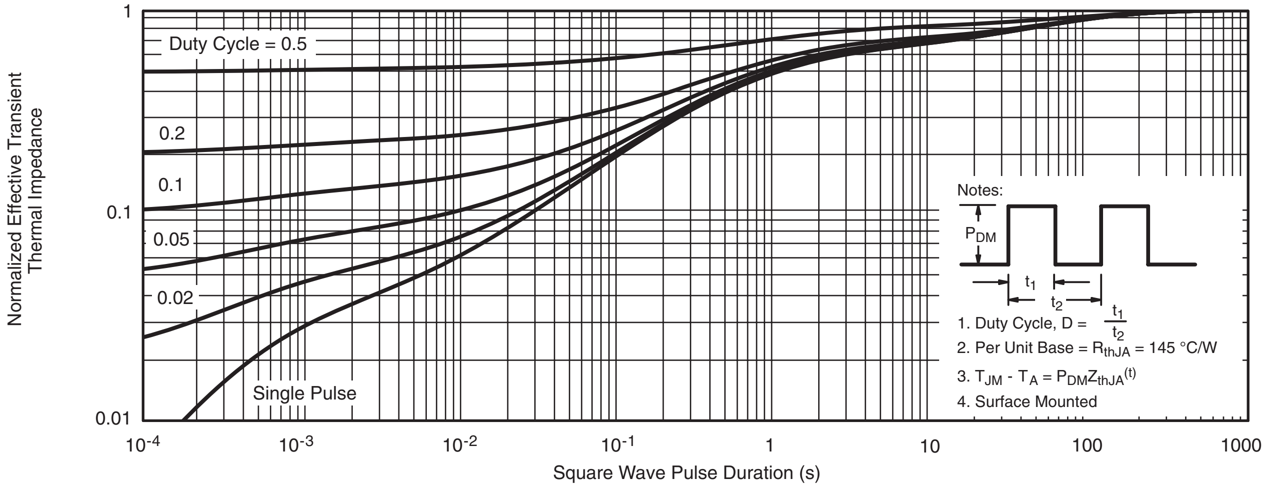
Current Derating*



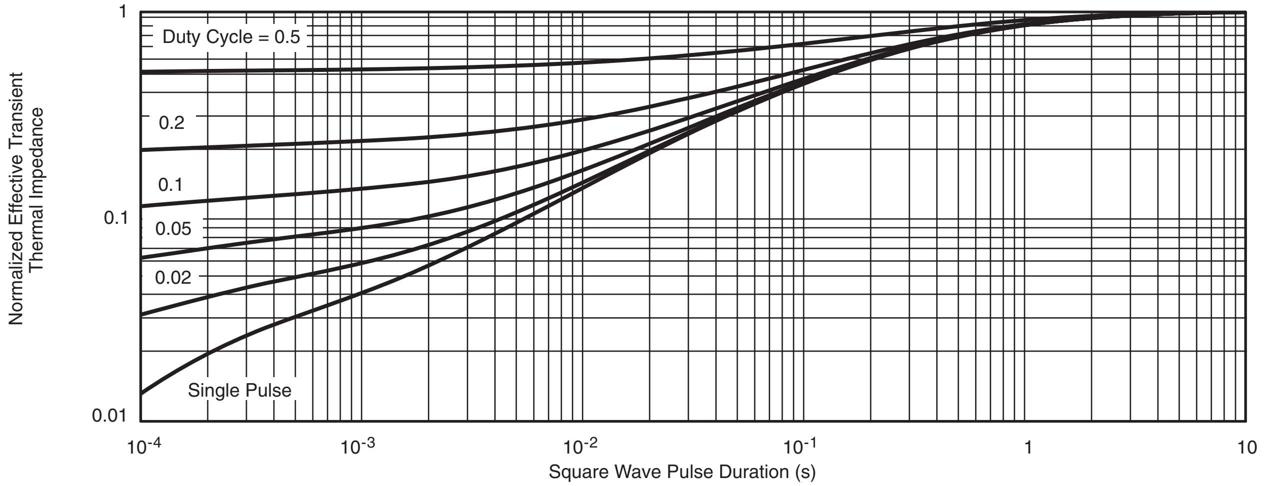
Power Derating

* 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

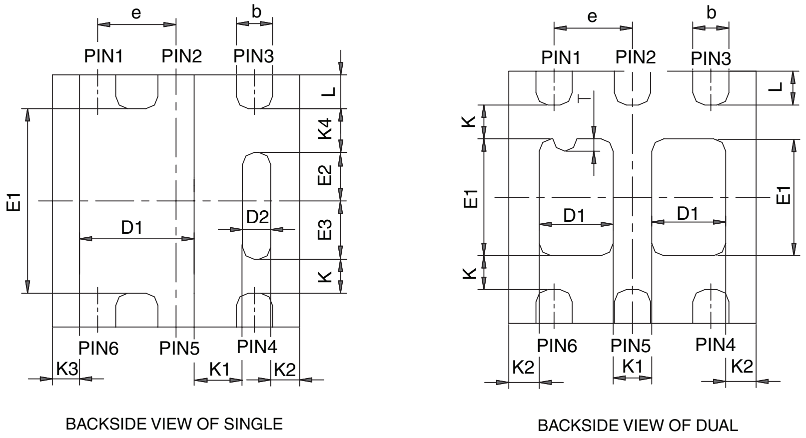


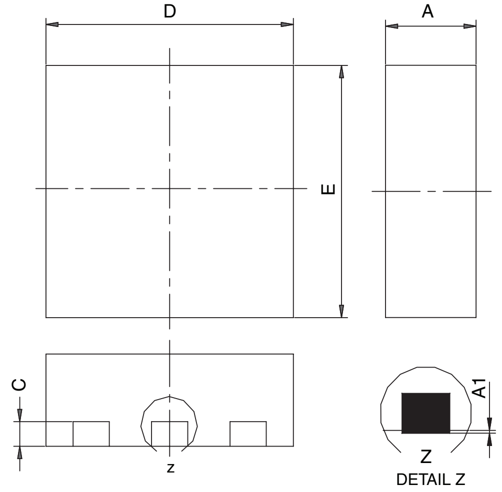
Normalized Thermal Transient Impedance, Junction-to-Case



Normalized Thermal Transient Impedance, Junction-to-Ambient

DFN2x2

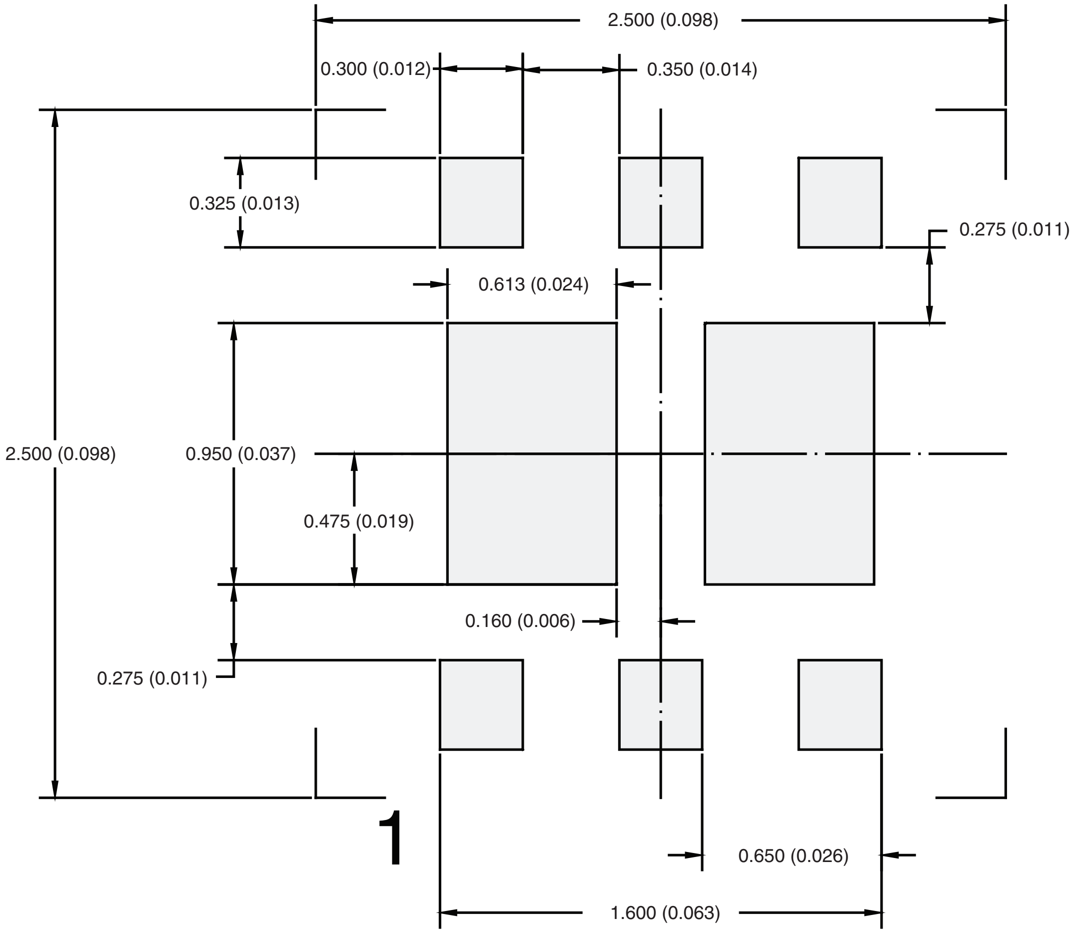




Notes:
1. All dimensions are in millimeters
2. Package outline exclusive of mold flash and metal burr
3. Package outline inclusive of plating

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

XRECOMMENDED PAD LAYOUT FOR DFN2x2



Dimensions in mm (inches)

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