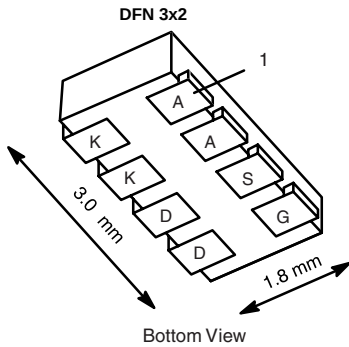


NTHD4P02FT1G-VB Datasheet

P-Channel 20 V (D-S) MOSFET with Schottky Diode

MOSFET PRODUCT SUMMARY			
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^a	Q_g (Typ.)
- 20	0.090 at $V_{GS} = - 4.5$ V	- 4.0	4.1 nC
	0.125 at $V_{GS} = - 2.5$ V	- 3.3	
	0.155 at $V_{GS} = - 1.8$ V	- 3.0	

SCHOTTKY PRODUCT SUMMARY		
V_{KA} (V)	V_f (V) Diode Forward Voltage	I_F (A) ^a
20	0.375 at 1 A	1



FEATURES

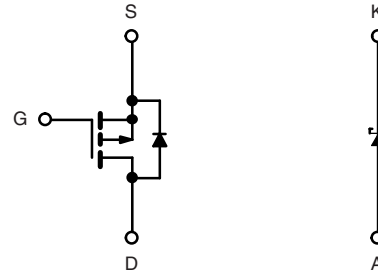
- Halogen-free According to IEC 61249-2-21 Definition
- LITTLE FOOT® Plus Power MOSFET
- Ultra Low V_F Schottky
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE
Available

APPLICATIONS

- Charging Switch for Portable Devices
- With Integrated Low V_F Trench Schottky Diode



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted				
Parameter		Symbol	Limit	Unit
Drain-Source Voltage (MOSFET)		V_{DS}	- 20	V
Reverse Voltage (Schottky)		V_{KA}	20	
Gate-Source Voltage (MOSFET)		V_{GS}	± 8	
Continuous Drain Current ($T_J = 150$ °C) (MOSFET)	$T_C = 25$ °C	I_D	- 4.0 ^a	A
	$T_C = 70$ °C		- 3.0	
	$T_A = 25$ °C		- 2.5 ^{b, c}	
	$T_A = 70$ °C		- 2.0 ^{b, c}	
Pulsed Drain Current (MOSFET)		I_{DM}	- 12	
Continuous Source Current (MOSFET Diode Conduction)	$T_C = 25$ °C	I_S	- 2.3 ^a	
	$T_A = 25$ °C		- 1.1 ^{b, c}	
Average Forward Current (Schottky)		I_F	1	W
Pulsed Forward Current (Schottky)		I_{FM}	7	
Maximum Power Dissipation (MOSFET)	$T_C = 25$ °C	P_D	2.8	
	$T_C = 70$ °C		1.8	
	$T_A = 25$ °C		1.3 ^{b, c}	
	$T_A = 70$ °C		0.8 ^{b, c}	
Maximum Power Dissipation (Schottky)	$T_C = 25$ °C		3.1	W
	$T_C = 70$ °C		2.0	
	$T_A = 25$ °C		1.9	
	$T_A = 70$ °C		1.2	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	- 55 to 150	°C
Soldering Recommendation (Peak Temperature) ^{d, e}			260	

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient (MOSFET) ^{b, c, f}	R_{thJA}	82	99	°C/W
Maximum Junction-to-Foot (Drain) (MOSFET)	R_{thJF}	35	45	
Maximum Junction-to-Ambient (Schottky) ^{b, c, g}	R_{thJA}	54	65	
Maximum Junction-to-Foot (Drain) (Schottky)	R_{thJF}	30	40	

Notes:

a. Based on $T_C = 25^\circ\text{C}$.

b. Surface mounted on FR4 board.

c. $t \leq 5$ s.

d. See Reliability Manual for profile. The DFN3X2 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 for MOSFETs is 130°C/W .

g. Maximum under steady state conditions for Schottky is 115°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}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	- 20			V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		- 19		mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			2		
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	- 0.45		- 1	V
Gate-Body Leakage	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			± 100	ns
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}$			- 1	μA
		$V_{DS} = -20\text{ V}, V_{GS} = 0\text{ V}, T_J = 55^\circ\text{C}$			- 10	
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$	- 10			A
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -2.5\text{ A}$		0.090		Ω
		$V_{GS} = -2.5\text{ V}, I_D = -2.2\text{ A}$		0.125		
		$V_{GS} = -1.8\text{ V}, I_D = -2.0\text{ A}$		0.155		
Forward Transconductance ^a	g_{fs}	$V_{DS} = -10\text{ V}, I_D = -2.5\text{ A}$		18		S
Dynamic^b						
Input Capacitance	C_{iss}	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		276		pF
Output Capacitance	C_{oss}			60		
Reverse Transfer Capacitance	C_{rss}			43		
Total Gate Charge	Q_g	$V_{DS} = -10\text{ V}, V_{GS} = -5\text{ V}, I_D = -2.5\text{ A}$		4.5	6.8	nC
Gate-Source Charge	Q_{gs}	$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -2.5\text{ A}$		4.1	6.2	
Gate-Drain Charge	Q_{gd}			0.6		
Gate Resistance	R_g			1.0		
Turn-On Delay Time	$t_{d(on)}$	$f = 1\text{ MHz}$	1.1	5.5	11	Ω
Rise Time	t_r					
Turn-Off Delay Time	$t_{d(off)}$					
Fall Time	t_f					
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 5\text{ }\Omega$ $I_D \cong -2\text{ A}, V_{GEN} = -4.5\text{ V}, R_g = 1\text{ }\Omega$		11	17	ns
Rise Time	t_r			34	51	
Turn-Off Delay Time	$t_{d(off)}$			22	33	
Fall Time	t_f			8	16	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10\text{ V}, R_L = 5\text{ }\Omega$ $I_D \cong -2\text{ A}, V_{GEN} = -5\text{ V}, R_g = 1\text{ }\Omega$		5	10	
Rise Time	t_r			14	21	
Turn-Off Delay Time	$t_{d(off)}$			17	26	
Fall Time	t_f			8	16	

SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^{\circ}\text{C}$			- 2.3	A
Pulse Diode Forward Current	I_{SM}				- 10	
Body Diode Voltage	V_{SD}	$I_S = -2\text{ A}$, $V_{GS} = 0\text{ V}$		- 0.8	- 1.2	V
Body Diode Reverse Recovery Time	t_{rr}	$I_F = -2\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $T_J = 25\text{ }^{\circ}\text{C}$		23	35	ns
Body Diode Reverse Recovery Charge	Q_{rr}			13	20	nC
Reverse Recovery Fall Time	t_a			10		ns
Reverse Recovery Rise Time	t_b			13		

Notes:

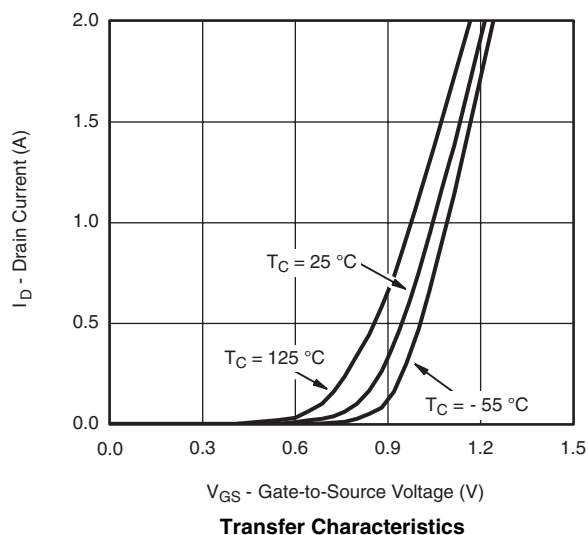
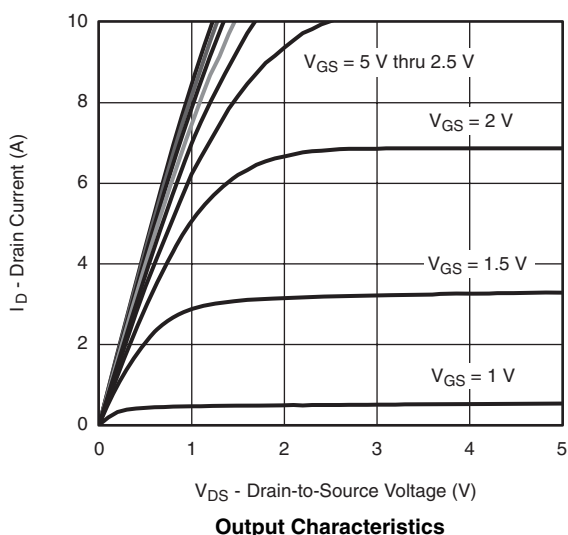
a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

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

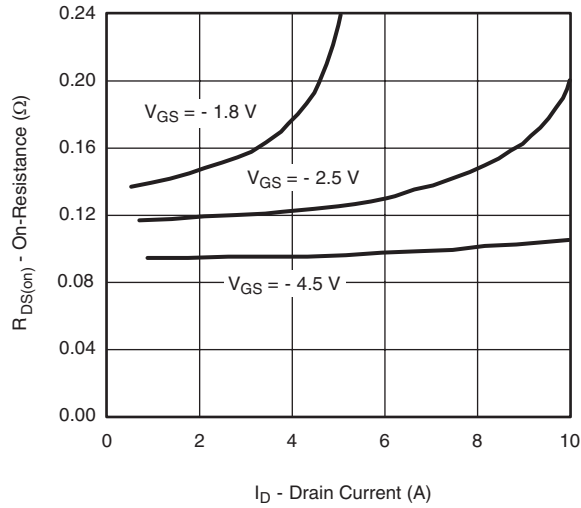
SCHOTTKY SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Forward Voltage Drop	V_F	$I_F = 1\text{ A}$		0.34	0.375	V
		$I_F = 1\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		0.255	0.290	
Maximum Reverse Leakage Current	I_{rm}	$V_r = 20\text{ V}$		0.05	0.500	mA
		$V_r = 20\text{ V}$, $T_J = 85\text{ }^{\circ}\text{C}$		2	20	
		$V_r = 20\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$		10	100	
Junction Capacitance	C_T	$V_r = 10\text{ V}$		90		pF

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.

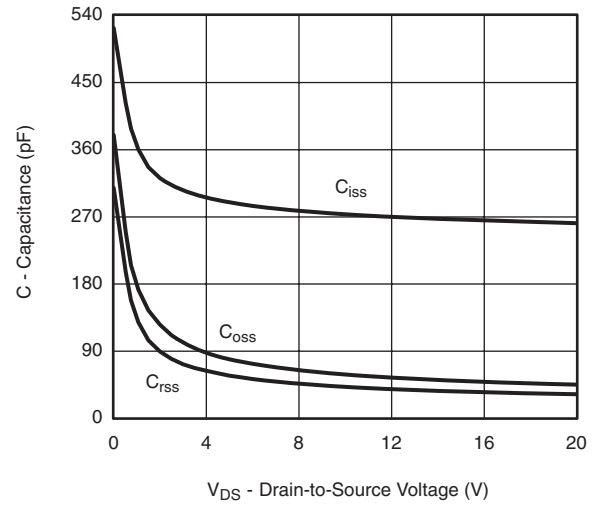
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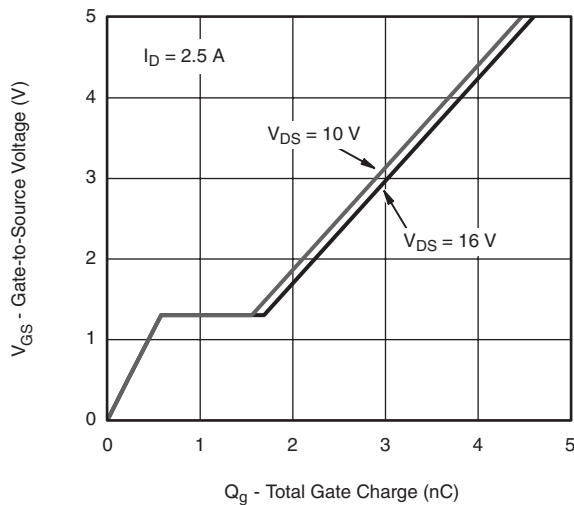
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



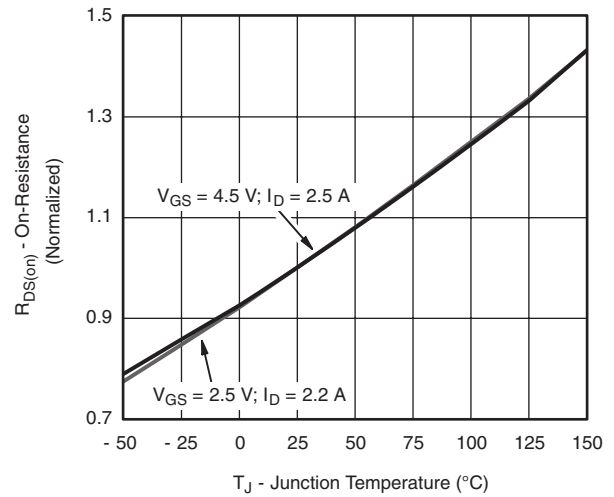
On Resistance vs. Drain Current



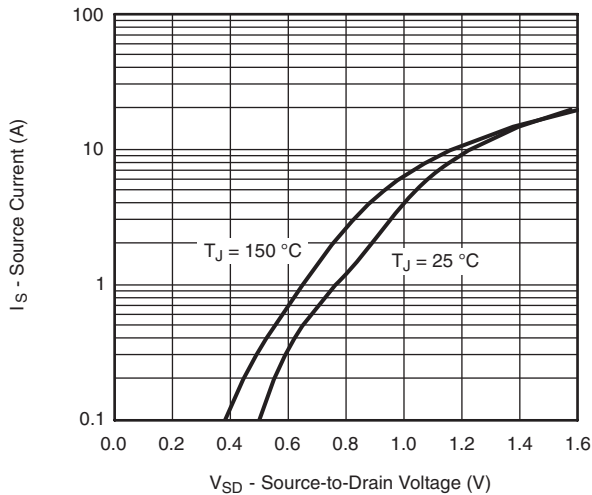
Capacitance



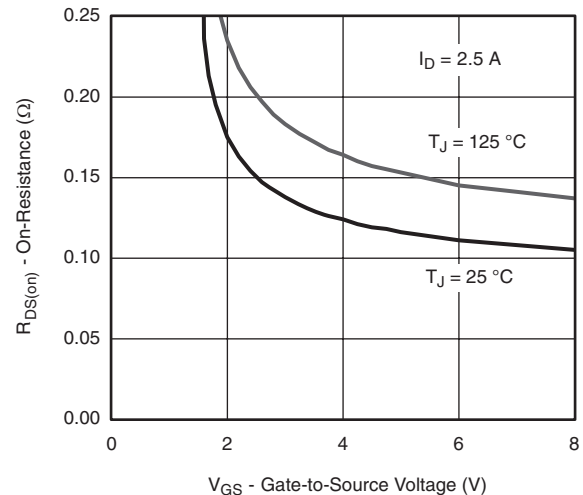
Gate Charge



On-Resistance vs. Junction Temperature

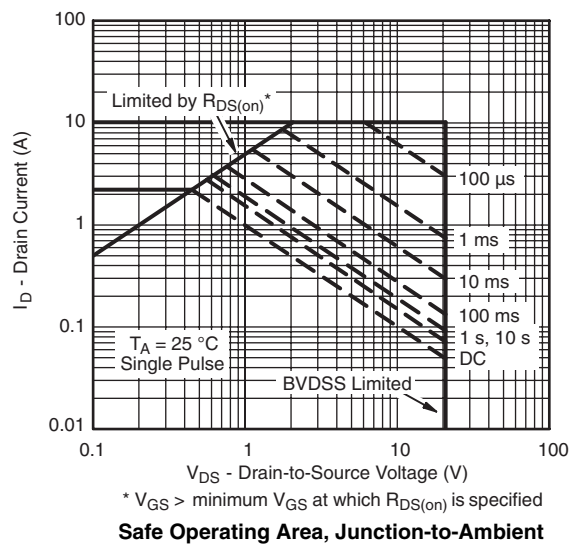
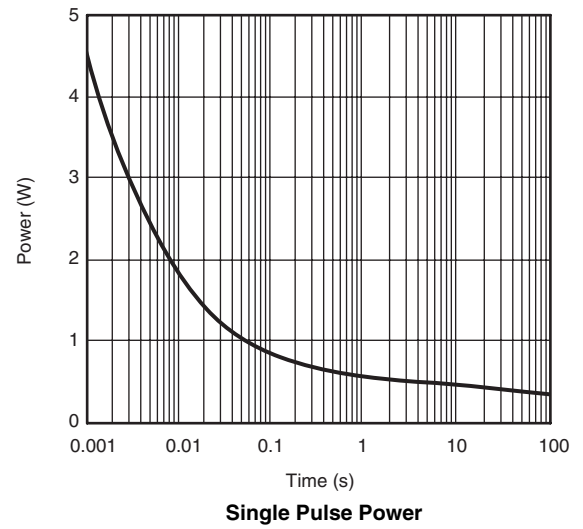
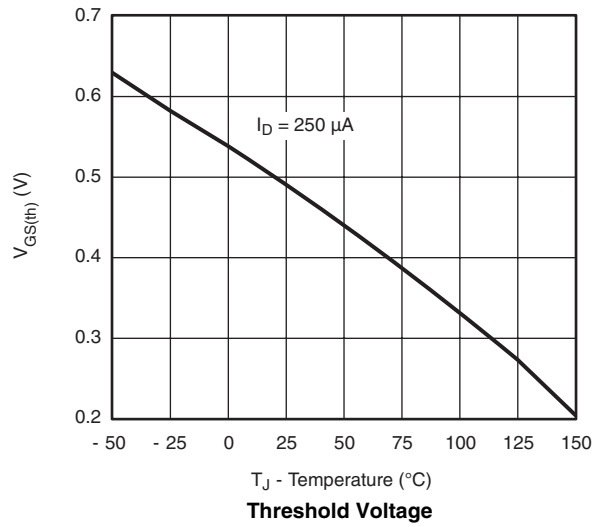


Forward Diode Voltage vs. Temp.

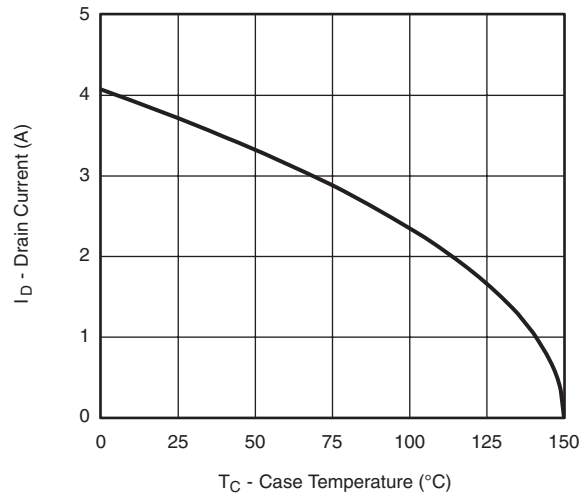


On-Resistance vs. Gate-to-Source Voltage

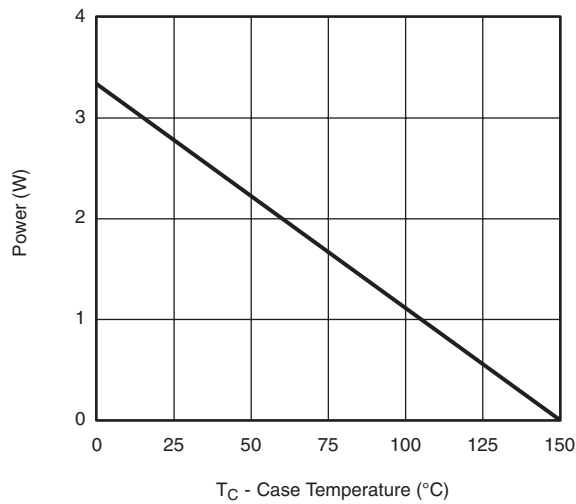
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



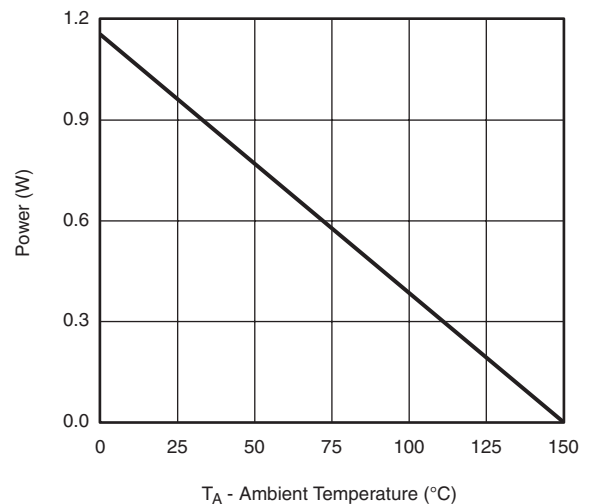
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Current Derating*



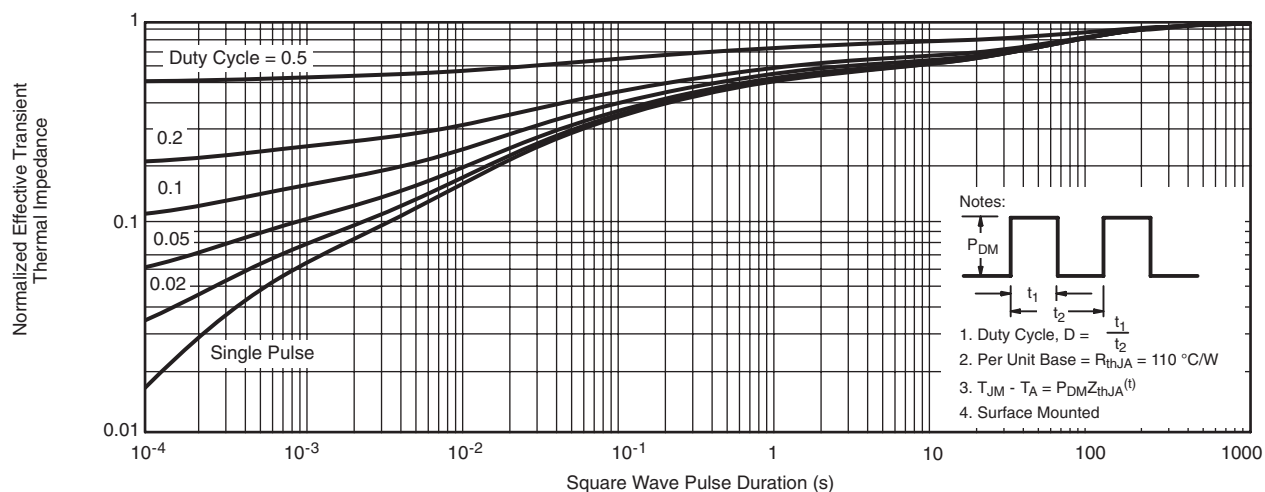
Power, Junction-to-Foot



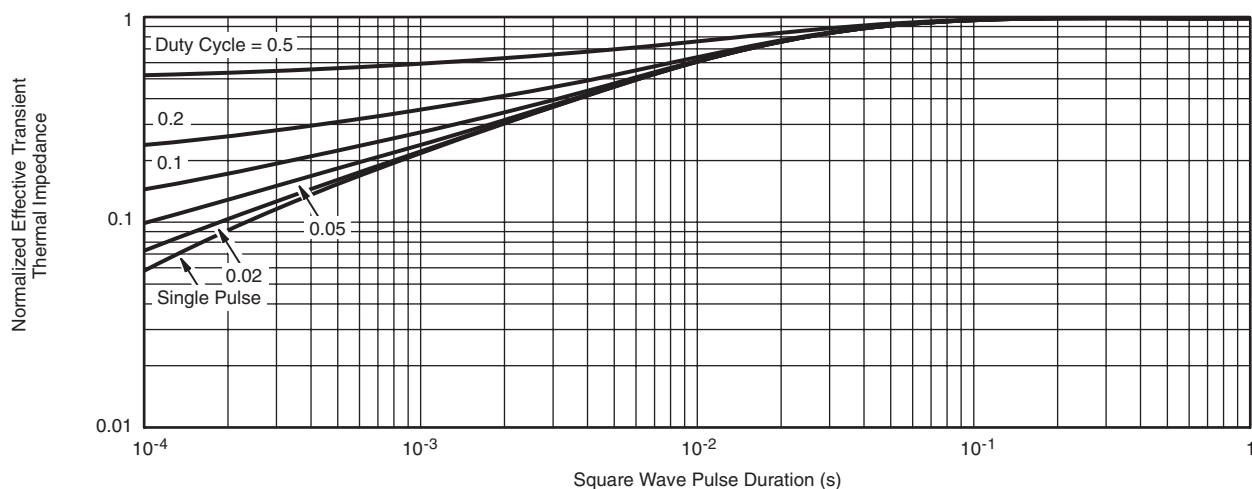
Power, Junction-to-Ambient

* 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.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

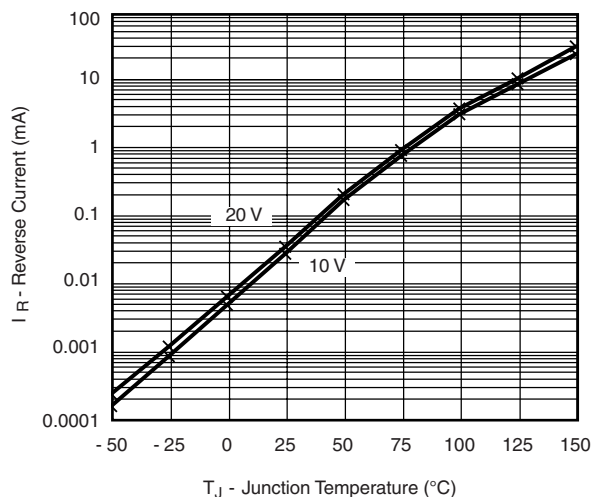


Normalized Thermal Transient Impedance, Junction-to-Ambient

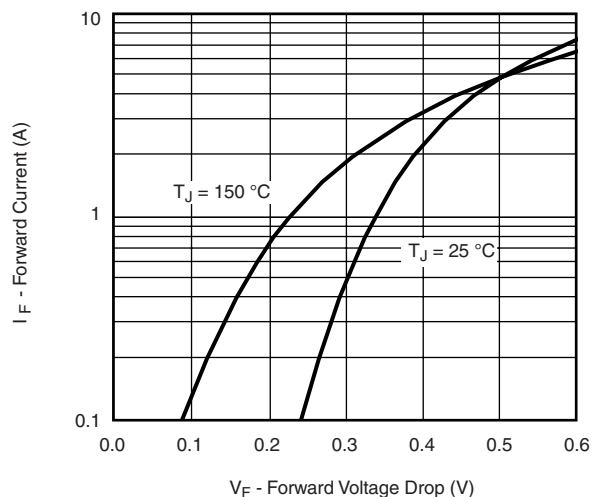


Normalized Thermal Transient Impedance, Junction-to-Foot

SCHOTTKY TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

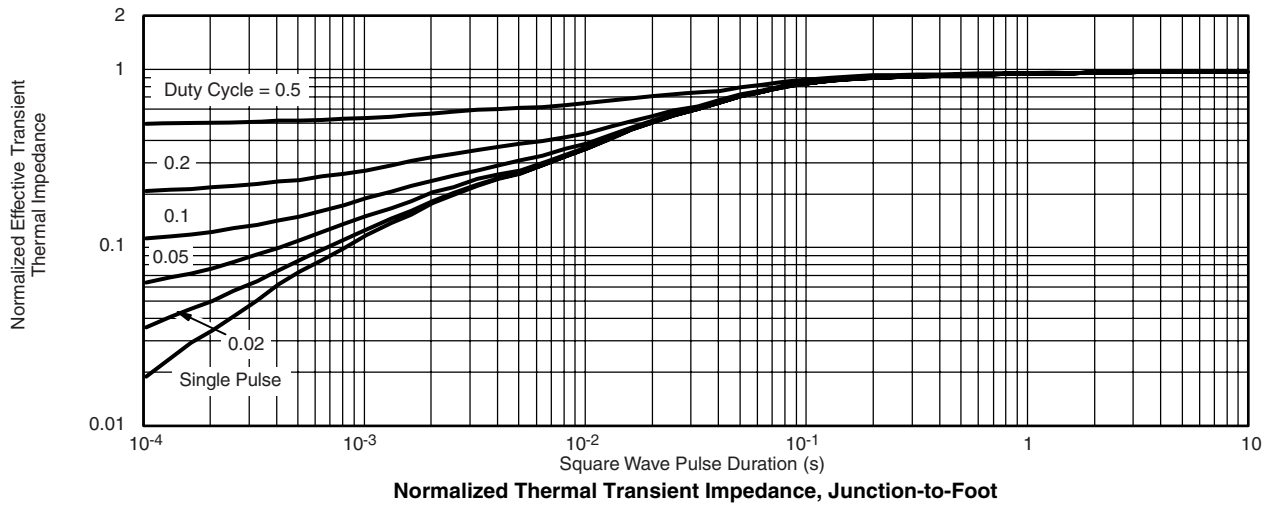
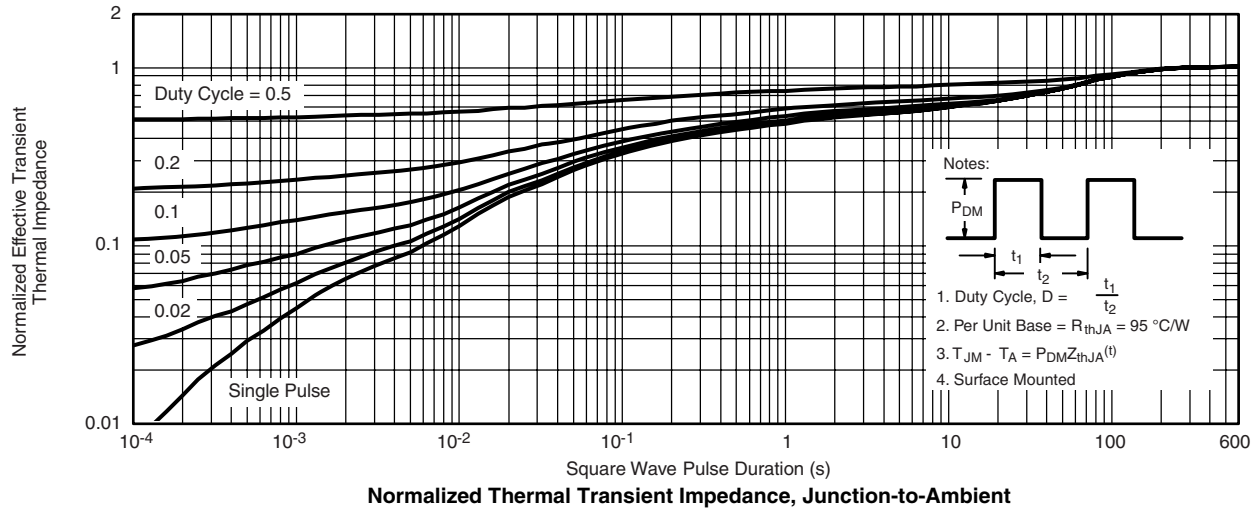
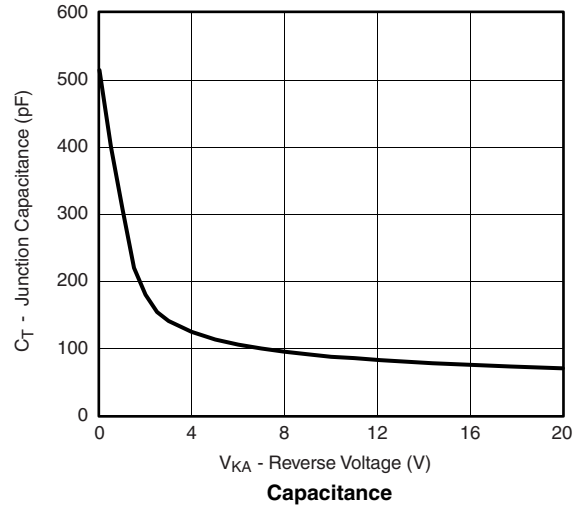


Reverse Current vs. Junction Temperature

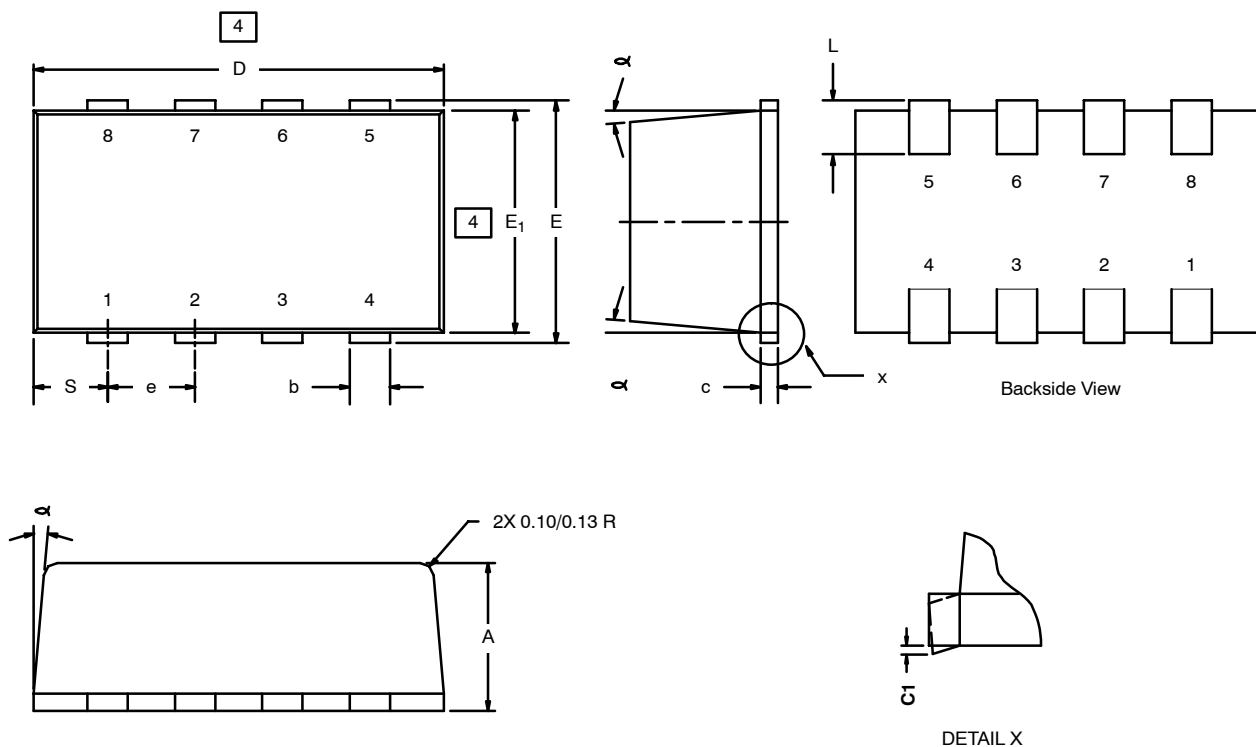


Forward Voltage Drop

SCHOTTKY TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



DFN 3x2

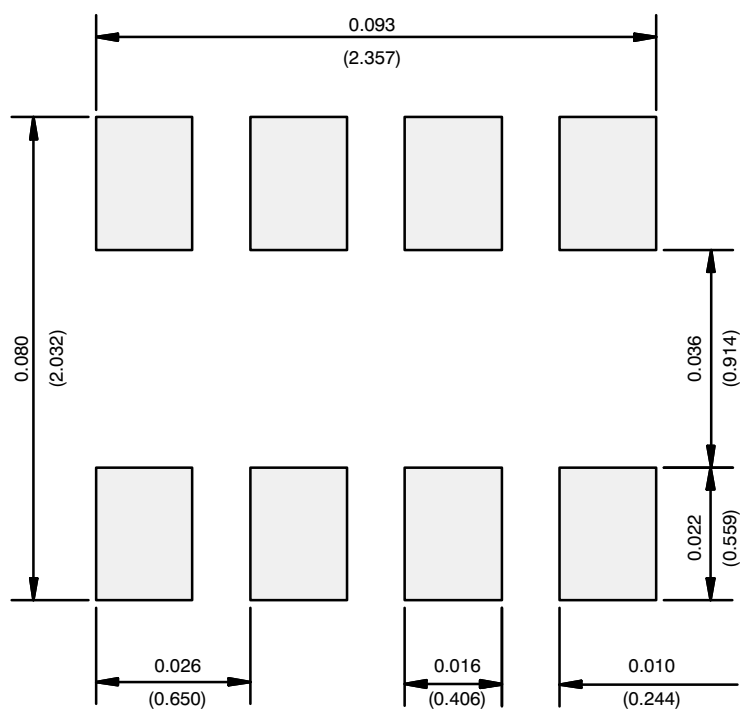


NOTES:

1. All dimensions are in millimeters.
2. Mold gate burrs shall not exceed 0.13 mm per side.
3. Leadframe to molded body offset is horizontal and vertical shall not exceed 0.08 mm.
4. Dimensions exclusive of mold gate burrs.
5. No mold flash allowed on the top and bottom lead surface.

	MILLIMETERS			INCHES		
Dim	Min	Nom	Max	Min	Nom	Max
A	1.00	–	1.10	0.039	–	0.043
b	0.25	0.30	0.35	0.010	0.012	0.014
c	0.1	0.15	0.20	0.004	0.006	0.008
c1	0	–	0.038	0	–	0.0015
D	2.95	3.05	3.10	0.116	0.120	0.122
E	1.825	1.90	1.975	0.072	0.075	0.078
E ₁	1.55	1.65	1.70	0.061	0.065	0.067
e	0.65 BSC			0.0256 BSC		
L	0.28	–	0.42	0.011	–	0.017
S	0.55 BSC			0.022 BSC		
α	5°Nom			5°Nom		
ECN: C-03528—Rev. F, 19-Jan-04 DWG: 5547						

RECOMMENDED MINIMUM PADS FOR DFN 3x2



Recommended Minimum Pads
Dimensions in Inches/(mm)

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