

MOSFET - Power, N-Channel, PowerTrench® Power Clip, Symmetric Dual 30 V NTTFD2D8N03P1E

Features

- Small Footprint (3.3mm x 3.3mm) for Compact Design
- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low Q_G and Capacitance to Minimize Driver Losses
- These Devices are Pb-Free and are RoHS Compliant

Typical Applications

- DC-DC Converters
- System Voltage Rails

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

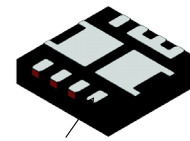
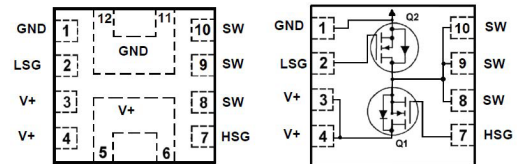
Parameter		Symbol	Q1	Q2	Unit
Drain-to-Source Voltage		V_{DSS}	30	30	V
Gate-to-Source Voltage		V_{GS}	+16 -12	+16 -12	V
Continuous Drain Current $R_{\theta JC}$ (Note 3)	Steady State	$T_C = 25^\circ\text{C}$	I_D	80	A
		$T_C = 85^\circ\text{C}$		58	58
Power Dissipation $R_{\theta JC}$ (Note 3)		$T_A = 25^\circ\text{C}$	P_D	26	W
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 3)	Steady State	$T_A = 25^\circ\text{C}$	I_D	21.1	A
		$T_A = 85^\circ\text{C}$		15.2	15.2
Power Dissipation $R_{\theta JA}$ (Notes 1, 3)		$T_A = 25^\circ\text{C}$	P_D	1.79	W
Continuous Drain Current $R_{\theta JA}$ (Notes 2, 3)	Steady State	$T_A = 25^\circ\text{C}$	I_D	16.1	A
		$T_A = 85^\circ\text{C}$		11.6	11.6
Power Dissipation $R_{\theta JA}$ (Notes 2, 3)		$T_A = 25^\circ\text{C}$	P_D	1.04	W
Pulsed Drain Current	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	I_{DM}	327	356	A
Single Pulse Drain-to-Source Avalanche Energy Q1: $I_L = 33.3 \text{ A}_{pk}, L = 0.1 \text{ mH}$ (Note 4) Q2: $I_L = 34.3 \text{ A}_{pk}, L = 0.1 \text{ mH}$ (Note 4)		E_{AS}	55.4	58.8	mJ
Operating Junction and Storage Temperature		T_J, T_{stg}	-55 to + 150		$^\circ\text{C}$
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		T_L	260		$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface-mounted on FR4 board using a 1 in² pad size, 2 oz. Cu pad.
2. Surface-mounted on FR4 board using minimum pad size, 2 oz. Cu pad.
3. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted. Actual continuous current will be limited by thermal & electro-mechanical application board design. $R_{\theta JC}$ is determined by the user's board design.
4. Q1 100% UIS tested at $L = 0.1 \text{ mH}$, $I_{AS} = 21.1 \text{ A}$.
Q2 100% UIS tested at $L = 0.1 \text{ mH}$, $I_{AS} = 21.1 \text{ A}$.
5. This device is Class 1B ESD HBM Rating.

FET	$V_{(BR)DSS}$	$R_{DS(ON) MAX}$	$I_D MAX$
Q1	30 V	2.5 m Ω @ 10 V	80 A
		3.0 m Ω @ 4.5 V	
Q2	30 V	2.5 m Ω @ 10 V	80 A
		3.0 m Ω @ 4.5 V	

ELECTRICAL CONNECTION



PIN1

WQFN12
3.3X3.3, 0.65P
CASE 510CJ

MARKING DIAGRAM



3ESN = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Assembly Lot Code

ORDERING INFORMATION

Device	Package	Shipping†
NTTFD2D8N03P1E	WQFN12 (Pb-Free)	3000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Q1 Max	Q2 Max	Unit
Junction-to-Case – Steady State (Notes 1, 3)	$R_{\theta JC}$	4.8	4.8	°C/W
Junction-to-Ambient – Steady State (Notes 1, 3)	$R_{\theta JA}$	70	70	
Junction-to-Ambient – Steady State (Notes 2, 3)	$R_{\theta JA}$	120	120	

ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	FET	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$		Q1	30		V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$		Q2	30		
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1\text{ mA}, \text{ ref to } 25^\circ\text{C}$		Q1		17.9	mV/°C
		$I_D = 1\text{ mA}, \text{ ref to } 25^\circ\text{C}$		Q2		17.2	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$	$T_J = 25^\circ\text{C}$	Q1		1.0	μA
				Q2		1.0	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = +16\text{ V} / -12\text{ V}$		Q1		± 100	nA
		$V_{DS} = 0\text{ V}, V_{GS} = +16\text{ V} / -12\text{ V}$		Q2		± 100	

ON CHARACTERISTICS (Note 6)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 400\ \mu\text{A}$		Q1	1.2	2.2	V	
		$V_{GS} = V_{DS}, I_D = 400\ \mu\text{A}$		Q2	1.2	2.2		
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	$I_D = 400\ \mu\text{A}, \text{ ref to } 25^\circ\text{C}$		Q1		-4.3	mV/°C	
		$I_D = 400\ \mu\text{A}, \text{ ref to } 25^\circ\text{C}$		Q2		-4.5		
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 18\text{ A}$		Q1		2.0	m Ω	
		$V_{GS} = 4.5\text{ V}, I_D = 16\text{ A}$				2.6		3.0
		$V_{GS} = 10\text{ V}, I_D = 18\text{ A}$		Q2		1.8		2.5
		$V_{GS} = 4.5\text{ V}, I_D = 16\text{ A}$				2.4		3.0
Forward Transconductance	g_{FS}	$V_{DS} = 5\text{ V}, I_D = 18\text{ A}$		Q1		129	S	
		$V_{DS} = 5\text{ V}, I_D = 18\text{ A}$		Q2		141		
Gate-Resistance	R_G	$T_A = 25^\circ\text{C}$		Q1		0.68	Ω	
				Q2		0.75		

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, V_{DS} = 15\text{ V}, f = 1\text{ MHz}$	Q1		1500	pF
			Q2		1521	
Output Capacitance	C_{OSS}		Q1		483	pF
			Q2		498	
Reverse Transfer Capacitance	C_{RSS}		Q1		29	pF
			Q2		22	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

6. Pulse Test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.

7. Switching characteristics are independent of operating junction temperatures.

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ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Condition	FET	Min	Typ	Max	Unit
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CHARGES, CAPACITANCES & GATE RESISTANCE

Total Gate Charge	$Q_{G(TOT)}$	Q1: $V_{GS} = 4.5\text{ V}$, $V_{DS} = 15\text{ V}$; $I_D = 18\text{ A}$ Q2: $V_{GS} = 4.5\text{ V}$, $V_{DS} = 15\text{ V}$; $I_D = 18\text{ A}$	Q1		9.5		nC
			Q2		9.3		
Gate-to-Drain Charge	Q_{GD}		Q1		2.0		nC
			Q2		1.6		
Gate-to-Source Charge	Q_{GS}		Q1		3.7		nC
			Q2		3.7		
Total Gate Charge	$Q_{G(TOT)}$	Q1: $V_{GS} = 10\text{ V}$, $V_{DS} = 15\text{ V}$; $I_D = 18\text{ A}$	Q1		20.8		nC
		Q2: $V_{GS} = 10\text{ V}$, $V_{DS} = 15\text{ V}$; $I_D = 18\text{ A}$	Q2		20.5		

SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 7)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}$ Q1: $I_D = 18\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$ Q2: $I_D = 18\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$	Q1		13		ns
			Q2		13.3		
Rise Time	t_r		Q1		5.5		ns
			Q2		5.8		
Turn-Off Delay Time	$t_{d(OFF)}$		Q1		18.9		ns
			Q2		19		
Fall Time	t_f	Q1		5.5		ns	
		Q2		5.5			

SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 7)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}$ Q1: $I_D = 18\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$ Q2: $I_D = 18\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$	Q1		8.4		ns
			Q2		8.7		
Rise Time	t_r		Q1		2		ns
			Q2		2		
Turn-Off Delay Time	$t_{d(OFF)}$		Q1		26.3		ns
			Q2		26.3		
Fall Time	t_f	Q1		3.8		ns	
		Q2		3.6			

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}$, $I_S = 18\text{ A}$	$T_J = 25^\circ\text{C}$	Q1		0.8	1.2	V
			$T_J = 125^\circ\text{C}$			0.67		
		$V_{GS} = 0\text{ V}$, $I_S = 18\text{ A}$	$T_J = 25^\circ\text{C}$	Q2		0.8	1.2	
			$T_J = 125^\circ\text{C}$			0.66		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}$, $V_{DD} = 15\text{ V}$ Q1: $I_S = 18\text{ A}$, $dI_S/dt = 100\text{ A}/\mu\text{s}$ Q2: $I_S = 18\text{ A}$, $dI_S/dt = 100\text{ A}/\mu\text{s}$	Q1		30		ns	
			Q2		29			
Reverse Recovery Charge	Q_{RR}		Q1		13		nC	
			Q2		12.5			

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

6. Pulse Test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.

7. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS – Q1

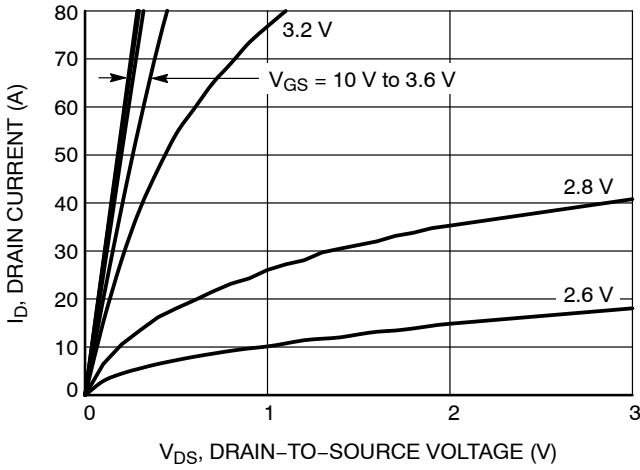


Figure 1. On-Region Characteristics

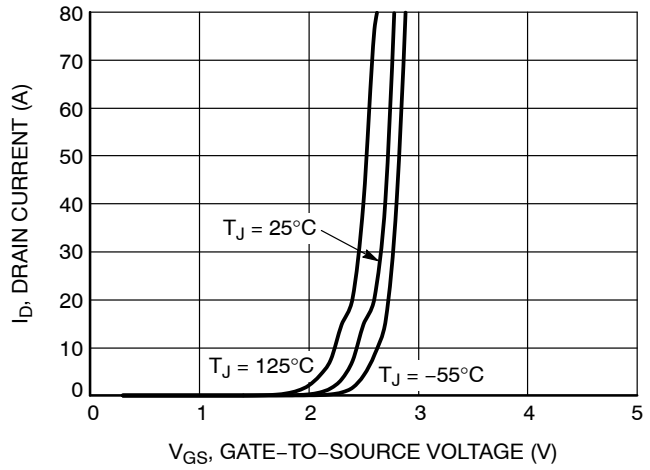


Figure 2. Transfer Characteristics

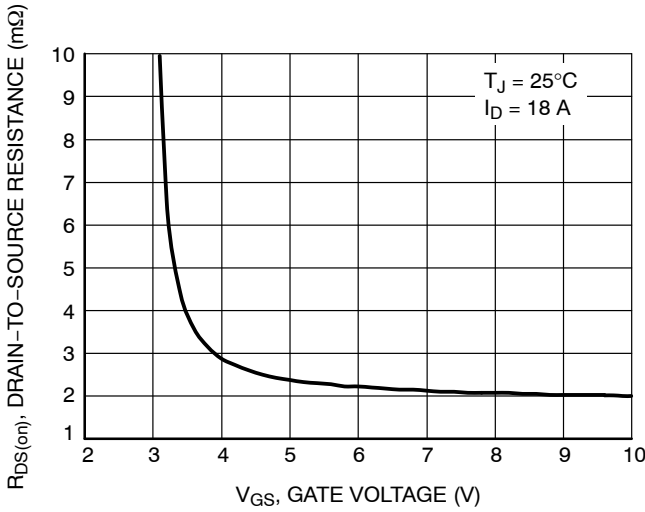


Figure 3. On-Resistance vs. Gate-to-Source Voltage

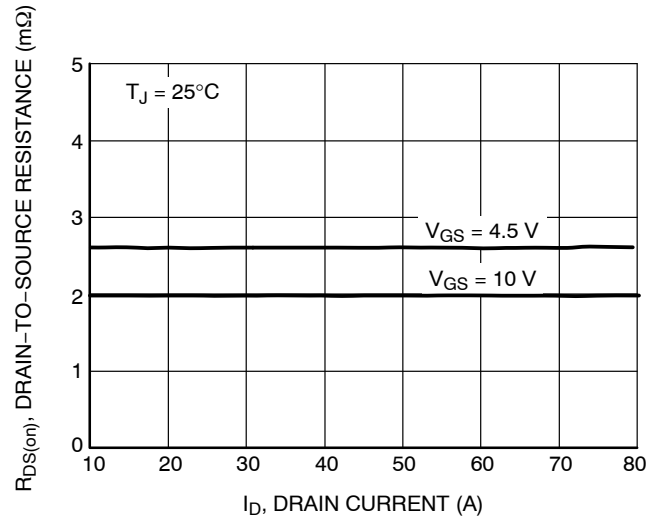


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

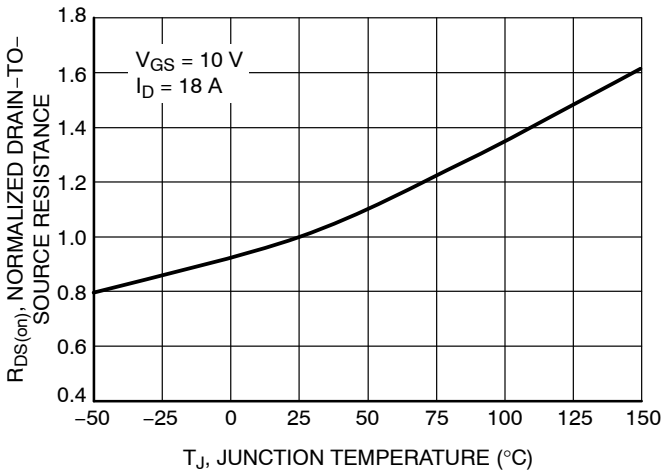


Figure 5. On-Resistance Variation with Temperature

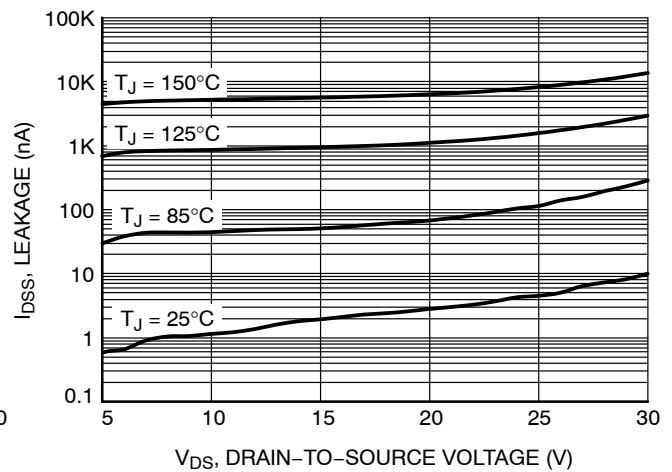


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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TYPICAL CHARACTERISTICS – Q1

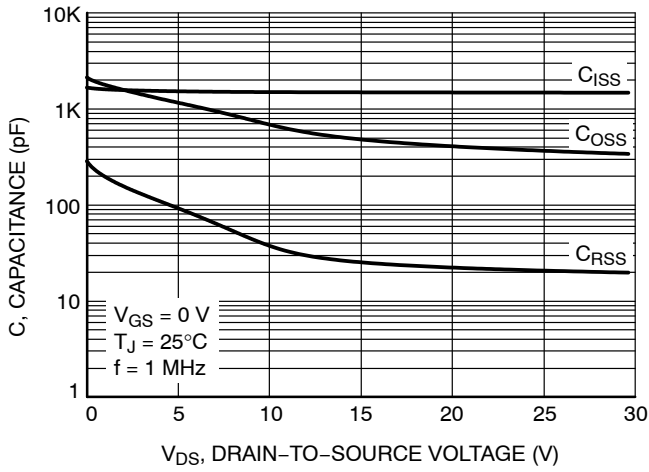


Figure 7. Capacitance Variation

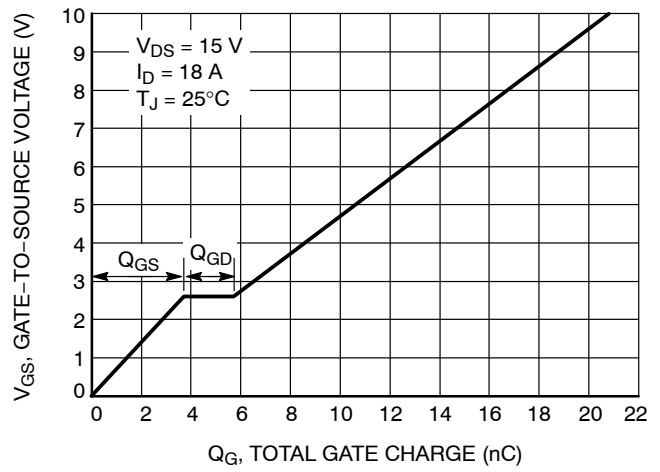


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

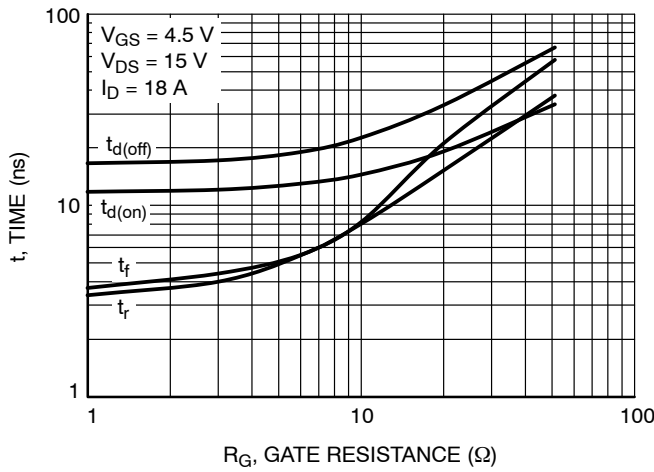


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

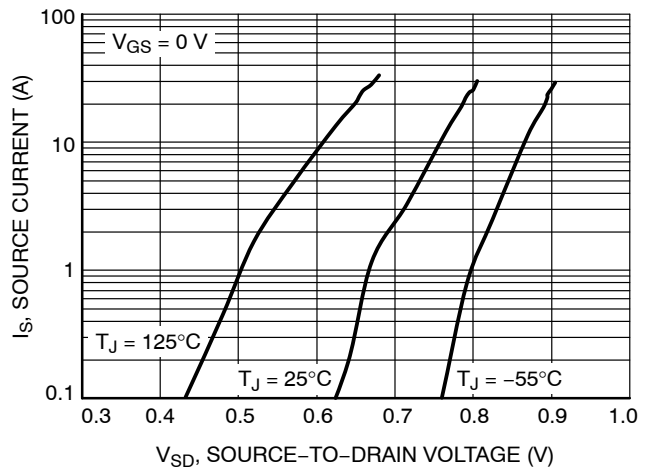


Figure 10. Diode Forward Voltage vs. Current

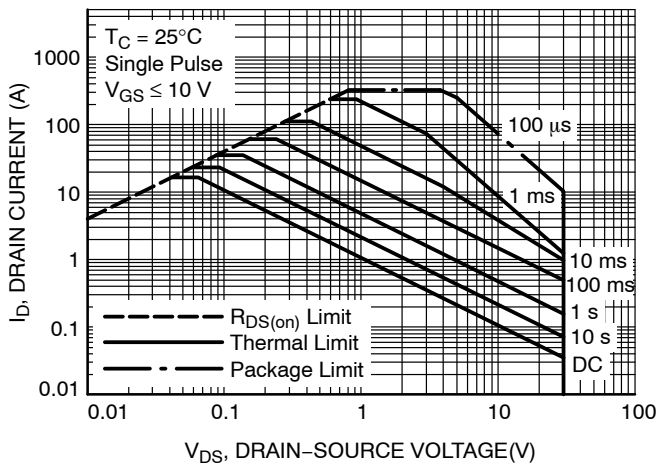


Figure 11. Safe Operating Area

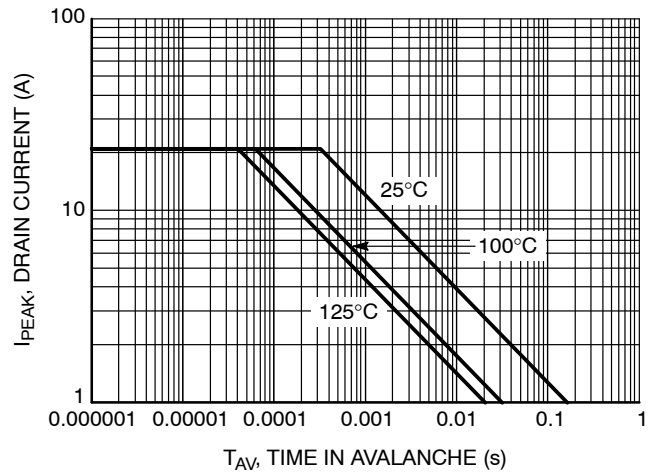


Figure 12. I_{PEAK} vs. Time in Avalanche

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TYPICAL CHARACTERISTICS – Q1

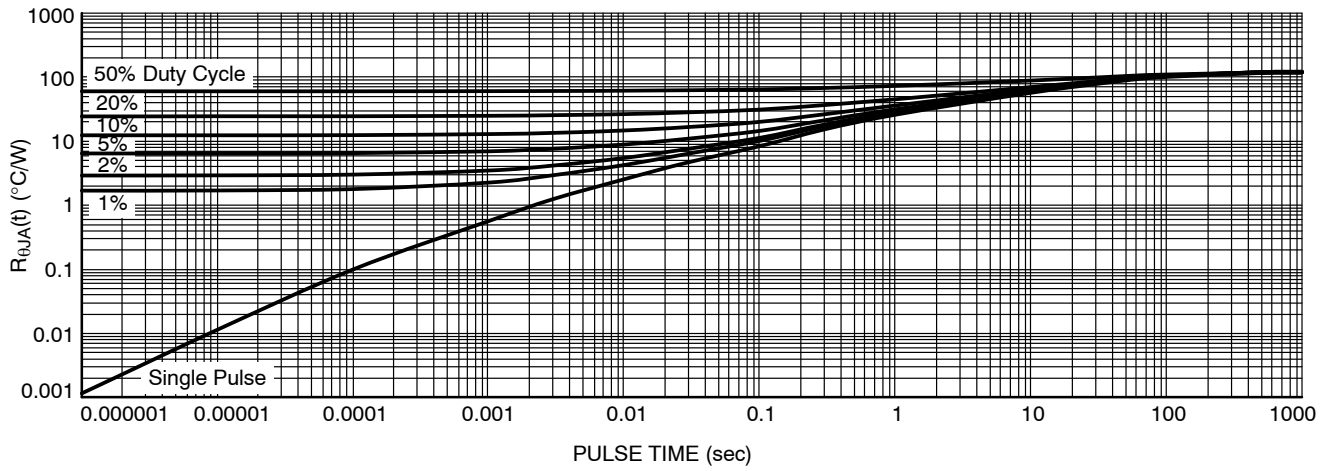


Figure 13. Thermal Characteristics

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TYPICAL CHARACTERISTICS – Q2

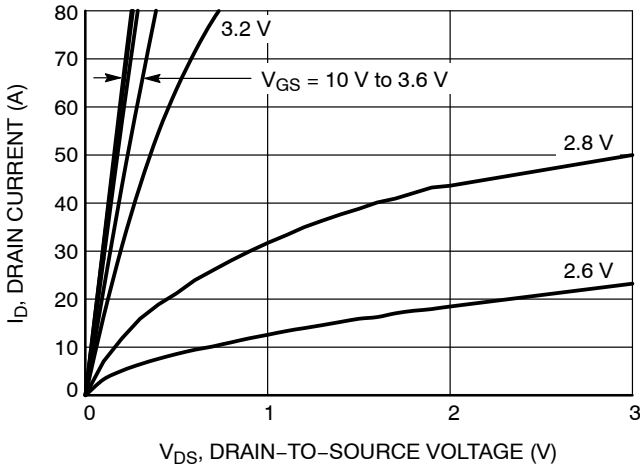


Figure 14. On-Region Characteristics

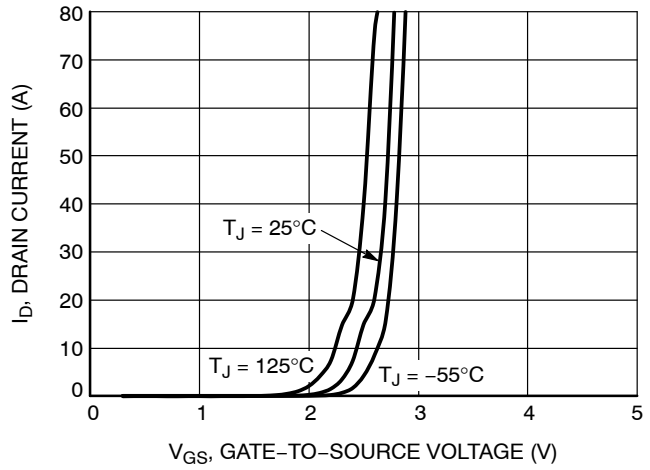


Figure 15. Transfer Characteristics

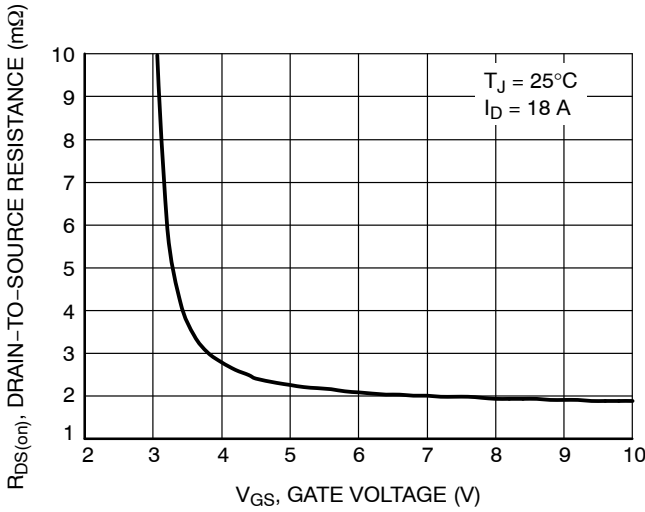


Figure 16. On-Resistance vs. Gate-to-Source Voltage

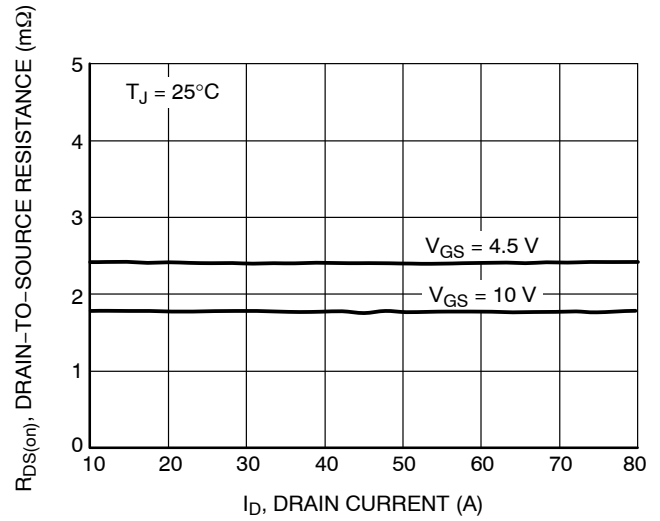


Figure 17. On-Resistance vs. Drain Current and Gate Voltage

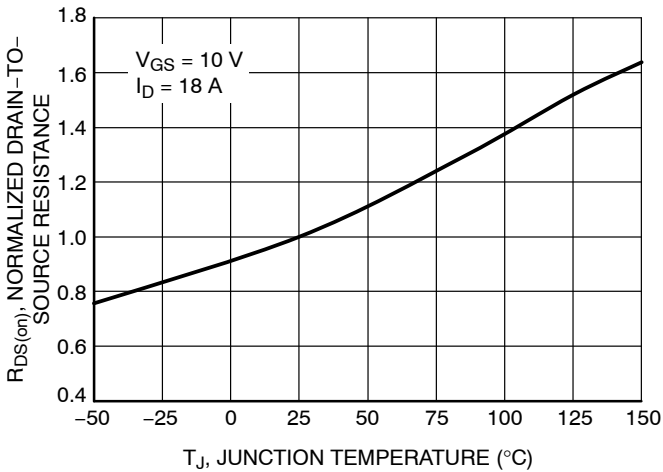


Figure 18. On-Resistance Variation with Temperature

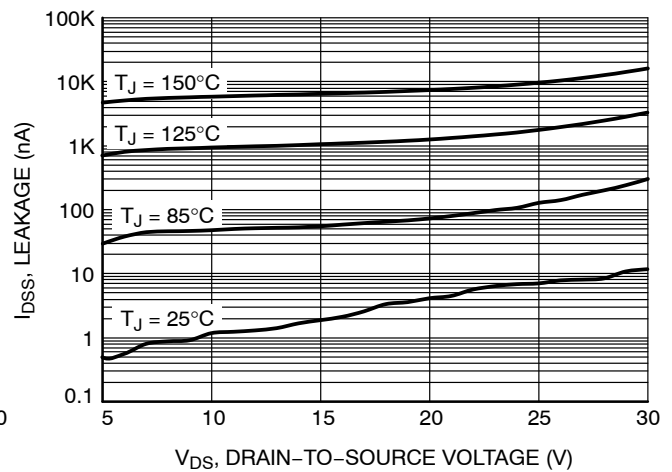


Figure 19. Drain-to-Source Leakage Current vs. Voltage

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TYPICAL CHARACTERISTICS – Q2

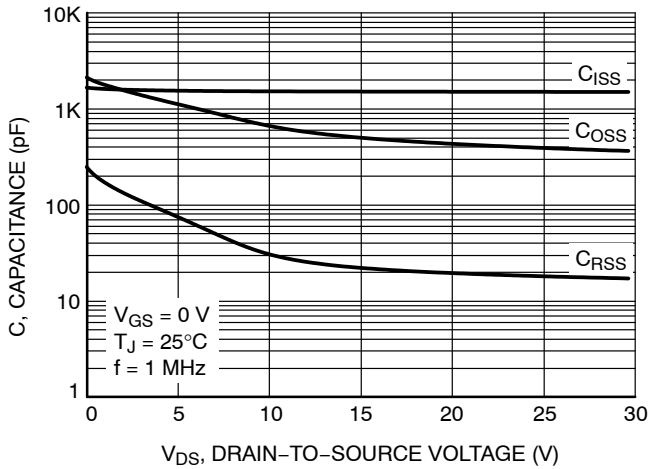


Figure 20. Capacitance Variation

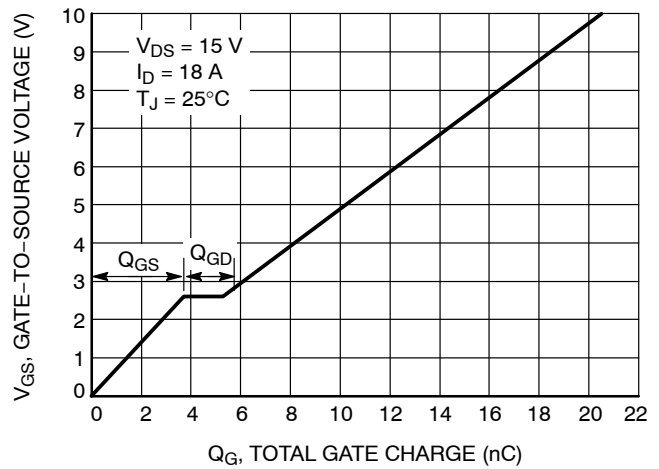


Figure 21. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

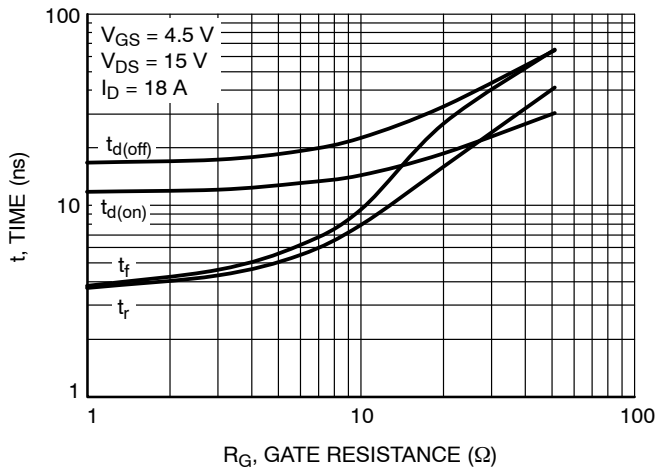


Figure 22. Resistive Switching Time Variation vs. Gate Resistance

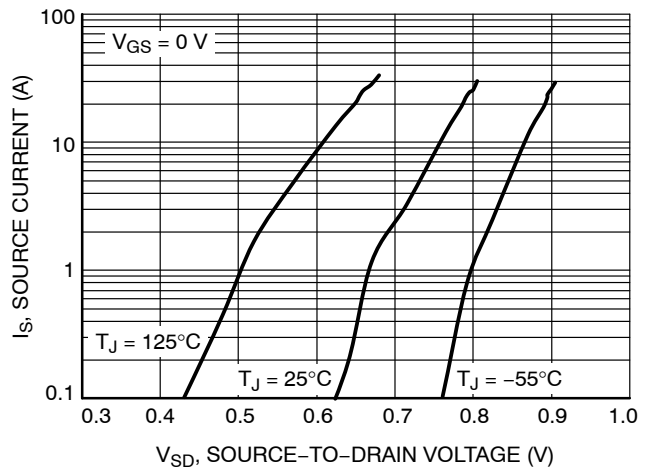


Figure 23. Diode Forward Voltage vs. Current

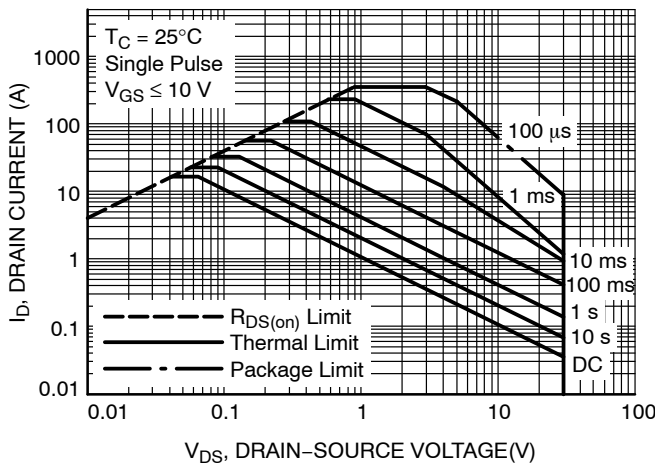


Figure 24. Safe Operating Area

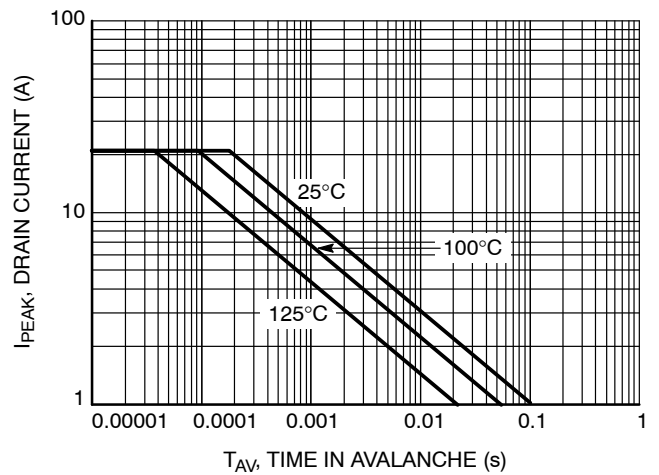


Figure 25. IPEAK vs. Time in Avalanche

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TYPICAL CHARACTERISTICS – Q2

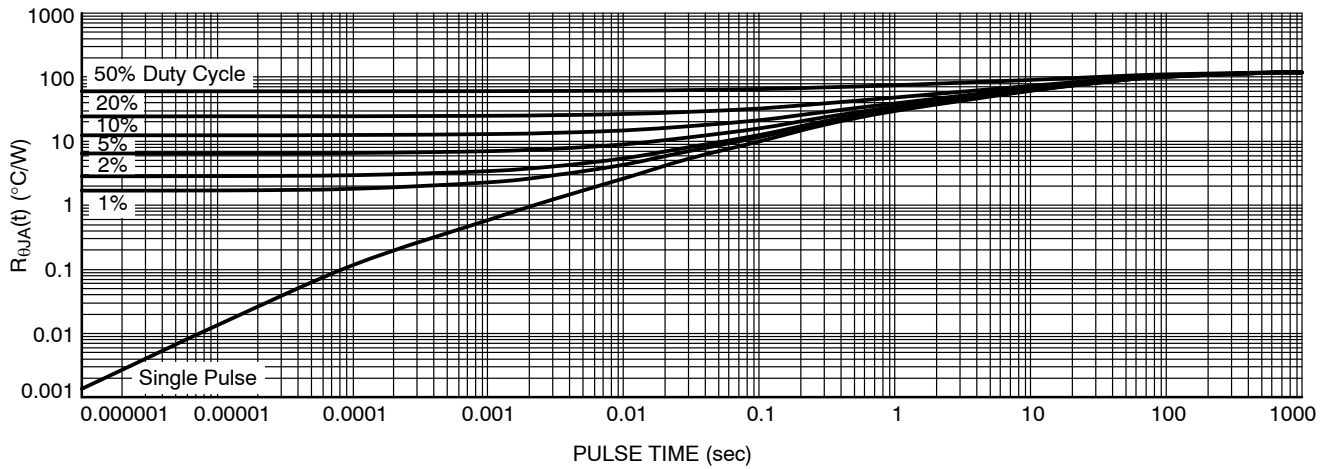
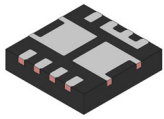


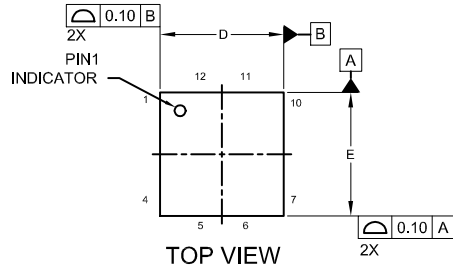
Figure 26. Thermal Characteristics

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

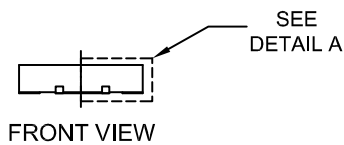


WQFN12 3.3X3.3, 0.65P CASE 510CJ ISSUE A

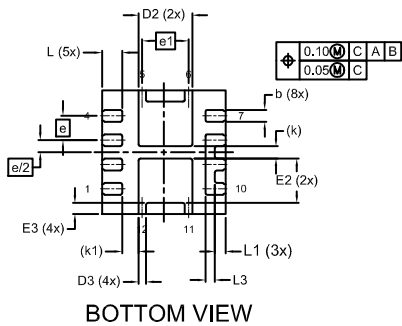
DATE 08 AUG 2022



TOP VIEW

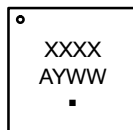


FRONT VIEW



BOTTOM VIEW

GENERIC MARKING DIAGRAM*

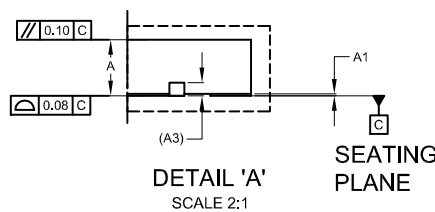


- XXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

NOTES:

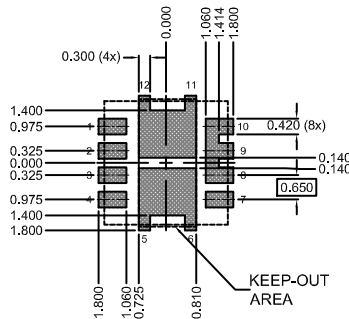
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. COPLANARITY APPLIES TO THE EXPOSED
4. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.
5. IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.



DETAIL 'A'

SCALE 2:1

SEATING PLANE



LAND PATTERN RECOMMENDATION

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	--	0.05
A3	0.20 REF		
b	0.27	0.32	0.37
D	3.20	3.30	3.40
D2	1.34	1.44	1.54
D3	0.10	0.20	0.30
E	3.20	3.30	3.40
E2	1.09	1.19	1.29
E3	0.20	0.30	0.40
e	0.65 BSC		
e/2	0.325 BSC		
e1	1.24 BSC		
k	0.33 REF		
k1	0.43 REF		
L	0.44	0.54	0.64
L1	0.19	0.29	0.39
L3	0.15	0.25	0.35

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DESCRIPTION:	WQFN12 3.3X3.3, 0.65P	PAGE 1 OF 1

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