

MOSFET - Single, N-Channel

100 V, 25 mΩ, 24 A

NTTFD022N10C

General Description

This device includes two specialized N-Channel MOSFETs in a dual package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q2) and synchronous (Q1) have been designed to provide optimal power efficiency.

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 25 mΩ at $V_{GS} = 10$ V, $I_D = 7.8$ A
- Max $r_{DS(on)}$ = 61 mΩ at $V_{GS} = 6$, $I_D = 3.9$ A

Q2: N-Channel

- Max $r_{DS(on)}$ = 25 mΩ at $V_{GS} = 10$ V, $I_D = 7.8$ A
- Max $r_{DS(on)}$ = 61 mΩ at $V_{GS} = 6$, $I_D = 3.9$ A
- Low Inductance Packaging Shortens Rise/Fall Times, Resulting in Lower Switching Losses
- RoHS Compliant

Applications

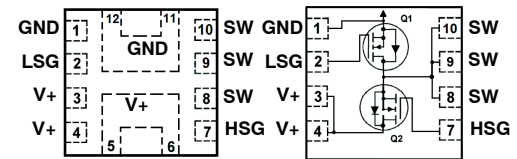
- Computing
- Communications
- General Purpose Point of Load

PIN DESCRIPTION

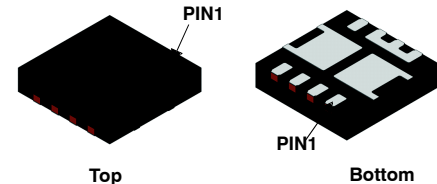
Pin	Name	Description
1, 11, 12	GND (LSS)	Low Side Source
2	LSG	Low Side Gate
3, 4, 5, 6	V + (HSD)	High Side Drain
7	HSG	High Side Gate
8, 9, 10	SW	Switching Node, Low Side Drain

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
100 V	25 mΩ @ 10 V	24 A
	61 mΩ @ 6 V	

ELECTRICAL CONNECTION

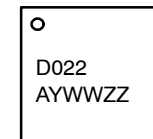


Dual N-Channel MOSFET



Power Clip 33 Symmetric
(WQFN12)
CASE 510CJ

MARKING DIAGRAM



D022 = Specific Device Code
A = Assembly Plant Code
Y = Numeric Year Code
WW = Work Week Code
ZZ = Assembly Lot Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

NTTFD022N10C

ORDERING INFORMATION AND PACKAGE MARKING

Device	Marking	Package	Shipping [†]
NTTFD022N10C	D022	WQFN12 (Pb-Free)	3000 Units/ 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.

MOSFET MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, Unless otherwise specified)

Symbol	Parameter	Q1	Q2	Units
V_{DS}	Drain-to-Source Voltage	100	100	V
V_{GS}	Gate-to-Source Voltage	± 20	± 20	V
I_D	Drain Current – Continuous $T_C = 25^\circ\text{C}$ (Note 4)	24	24	A
	– Continuous $T_C = 100^\circ\text{C}$ (Note 4)	14	14	
	– Continuous $T_A = 25^\circ\text{C}$	6 (Note 1a)	6 (Note 1b)	
	– Pulsed $T_A = 25^\circ\text{C}$	349	349	
E_{AS}	Single Pulse Avalanche Energy ($L = 3\text{ mH}$, $I_{L(pk)} = 5.1\text{ A}$) (Note 3)	39	39	mJ
P_D	Power Dissipation for Single Operation $T_C = 25^\circ\text{C}$	26	26	W
	Power Dissipation for Single Operation $T_A = 25^\circ\text{C}$	1.7 (Note 1a)	1.7 (Note 1b)	
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to $+150$		$^\circ\text{C}$
T_L	Lead Temperature for Soldering Purposes ($1/8''$ from case for 10 s)	260	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.

THERMAL CHARACTERISTICS

Symbol	Parameter	Q1	Q2	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	4.8	4.8	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	70 (Note 1a)	70 (Note 1b)	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	135 (Note 1c)	135 (Note 1c)	

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

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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OFF CHARACTERISTICS

BV_{DSS}	Drain-to-Source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0\text{ V}$	Q1	100			V
		$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0\text{ V}$	Q2	100			
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$, referenced to 25°C	Q1		80		$\text{mV}/^\circ\text{C}$
		$I_D = 250\text{ }\mu\text{A}$, referenced to 25°C	Q2		80		
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 80\text{ V}$, $V_{GS} = 0\text{ V}$	Q1			1	μA
		$V_{DS} = 80\text{ V}$, $V_{GS} = 0\text{ V}$	Q2			1	
I_{GSS}	Gate-to-Source Leakage Current, Forward	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$	Q1			± 100	nA
		$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$	Q2			± 100	

NTTFD022N10C

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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ON CHARACTERISTICS

V _{GS(th)}	Gate-to-Source Threshold Voltage	V _{GS} = V _{DS} , I _D = 44 μA	Q1	2	2.9	4	V
		V _{GS} = V _{DS} , I _D = 44 μA	Q2	2	2.9	4	
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate-to-Source Threshold Voltage Temperature Coefficient	I _D = 44 μA, referenced to 25°C	Q1		-9.2		mV/°C
		I _D = 44 μA, referenced to 25°C	Q2		-9.2		
r _{DS(on)}	Drain-to-Source On Resistance	V _{GS} = 10 V, I _D = 7.8 A	Q1		18.7	25	mΩ
		V _{GS} = 6 V, I _D = 3.9 A			28	61	
		V _{GS} = 10 V, I _D = 7.8 A, T _J = 125°C			32.6		
r _{DS(on)}	Drain-to-Source On Resistance	V _{GS} = 10 V, I _D = 7.8 A	Q2		18.7	25	mΩ
		V _{GS} = 6 V, I _D = 3.9 A			28	61	
		V _{GS} = 10 V, I _D = 7.8 A, T _J = 125°C			32.6		
g _{FS}	Forward Transconductance	V _{DS} = 5 V, I _D = 7.8 A	Q1		191		S
		V _{DS} = 5 V, I _D = 7.8 A	Q2		191		

DYNAMIC CHARACTERISTICS

C _{ISS}	Input Capacitance	Q1: V _{DS} = 50 V, V _{GS} = 0 V, f = 1 Mhz	Q1		585		pF
			Q2		585		
C _{OSS}	Output Capacitance	Q2: V _{DS} = 50 V, V _{GS} = 0 V, f = 1 MHz	Q1		354		pF
			Q2		354		
C _{RSS}	Reverse Transfer Capacitance		Q1		8		pF
			Q2		8		
R _G	Gate Resistance	T _A = 25°C	Q1		1.5		Ω
			Q2		1.5		

SWITCHING CHARACTERISTICS

td(ON)	Turn-On Delay Time	Q1: V _{DD} = 50 V, I _D = 7.8 A, R _{GEN} = 6 Ω Q2: V _{DD} = 50 V, I _D = 7.8 A, R _{GEN} = 6 Ω	Q1		8.5		ns	
			Q2		8.5			
t _r	Rise Time			Q1		3.2		ns
				Q2		3.2		
t _{D(OFF)}	Turn-Off Delay Time		Q1		13.3		ns	
			Q2		13.3			
t _f	Fall Time		Q1		4.1		ns	
			Q2		4.1			
Q _g	Total Gate Charge	V _{GS} = 0 V to 10 V Q1: V _{DD} = 50 V, I _D = 7.8 A Q2: V _{DD} = 50 V, I _D = 7.8 A	Q1		9.0		nC	
			Q2		9.0			
Q _g	Total Gate Charge			Q1		5.89		nC
				Q2		5.89		
Q _{gs}	Gate-to-Source Gate Charge			Q1		2.67		nC
				Q2		2.67		
Q _{gd}	Gate-to-Drain “Miller” Charge			Q1		2.0		nC
				Q2		2.0		

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

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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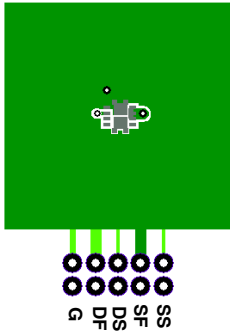
DRAIN-SOURCE DIODE CHARACTERISTICS

V_{SD}	Source-to-Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$, $I_S = 7.8\text{ A}$ (Note 2)	Q1		0.82	1.5	V
		$V_{GS} = 0\text{ V}$, $I_S = 7.8\text{ A}$ (Note 2)	Q2		0.82	1.5	
t_{rr}	Reverse Recovery Time	Q1: $I_F = 7.8\text{ A}$, $di/dt = 300\text{ A}/\mu\text{s}$ Q2: $I_F = 7.8\text{ A}$, $di/dt = 300\text{ A}/\mu\text{s}$	Q1		33		ns
			Q2		33		
Q_{rr}	Reverse Recovery Charge	$I_F = 7.8\text{ A}$, $di/dt = 300\text{ A}/\mu\text{s}$	Q1		35		nC
			Q2		35		
t_{rr}	Reverse Recovery Time	Q1: $I_F = 7.8\text{ A}$, $di/dt = 1000\text{ A}/\mu\text{s}$ Q2: $I_F = 7.8\text{ A}$, $di/dt = 1000\text{ A}/\mu\text{s}$	Q1		14		ns
			Q2		14		
Q_{rr}	Reverse Recovery Charge	$I_F = 7.8\text{ A}$, $di/dt = 1000\text{ A}/\mu\text{s}$	Q1		91		nC
			Q2		91		

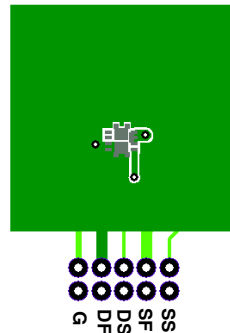
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

NOTES:

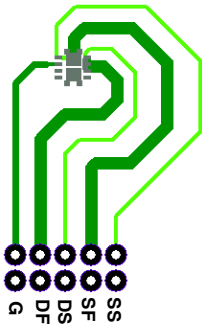
1. $R_{\theta JA}$ is determined with the device mounted on a 1 in² pad 2 oz copper pad on a 1.5 × 1.5 in. board of FR-4 material. $R_{\theta CA}$ is determined by the user's board design.



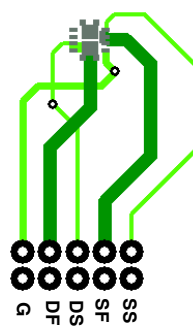
a) $70^\circ\text{C}/\text{W}$ when mounted on a 1 in² pad of 2 oz copper.



b) $70^\circ\text{C}/\text{W}$ when mounted on a 1 in² pad of 2 oz copper.



c) $135^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper.



d) $135^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper.

2. Pulse Test: Pulse Width < 300 μs , Duty cycle < 2.0%.
3. Q1: E_{AS} of 39 mJ is based on starting $T_J = 25^\circ\text{C}$; N-ch: $L = 3\text{ mH}$, $I_{AS} = 5.1\text{ A}$, $V_{DD} = 80\text{ V}$, $V_{GS} = 10\text{ V}$. 100% test at $L = 3\text{ mH}$, $I_{AS} = 5.3\text{ A}$.
Q2: E_{AS} of 39 mJ is based on starting $T_J = 25^\circ\text{C}$; N-ch: $L = 3\text{ mH}$, $I_{AS} = 5.1\text{ A}$, $V_{DD} = 80\text{ V}$, $V_{GS} = 10\text{ V}$. 100% test at $L = 3\text{ mH}$, $I_{AS} = 5.3\text{ A}$.
4. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

TYPICAL CHARACTERISTICS

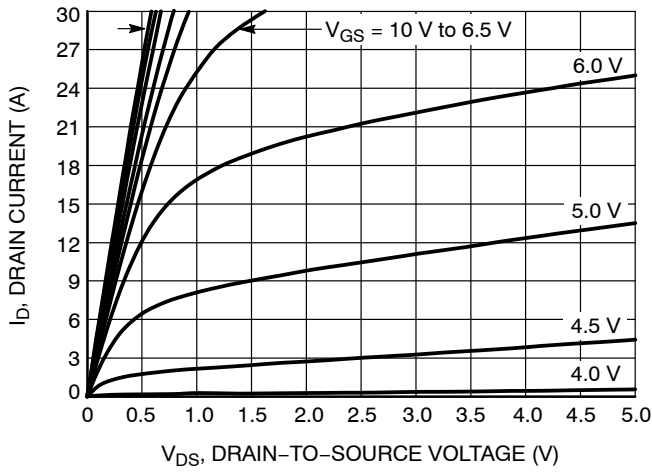


Figure 1. On-Region Characteristics

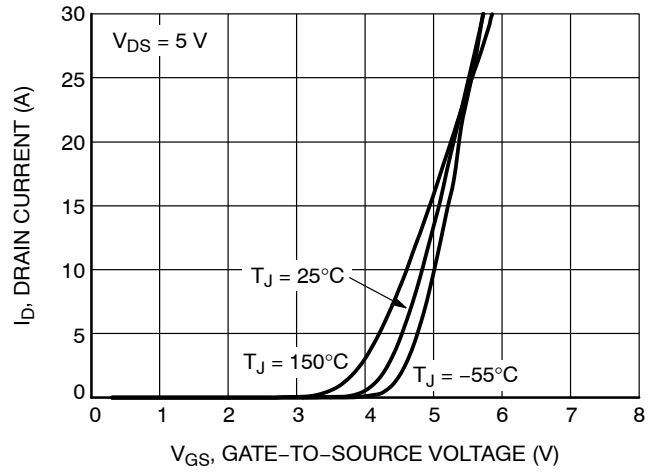


Figure 2. Transfer Characteristics

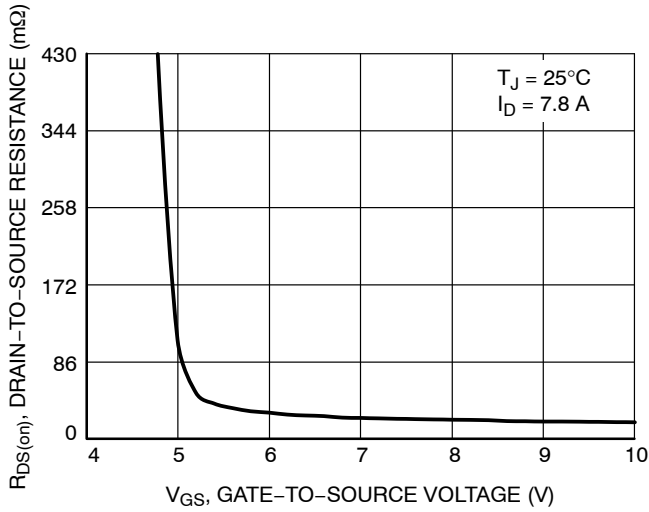


Figure 3. On-Resistance vs. Gate-to-Source Voltage

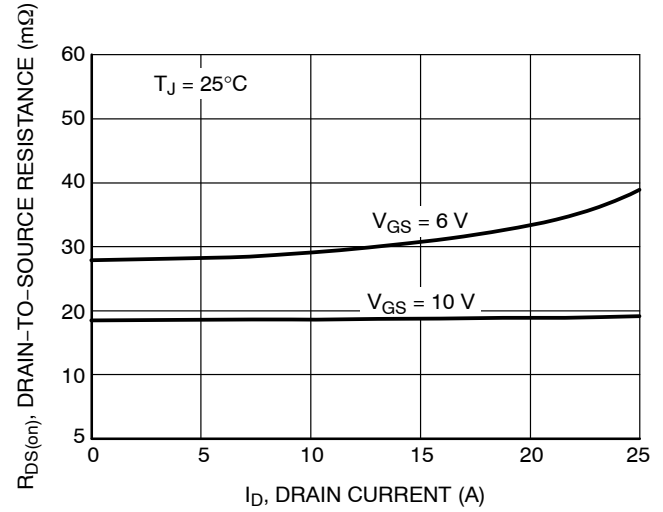


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

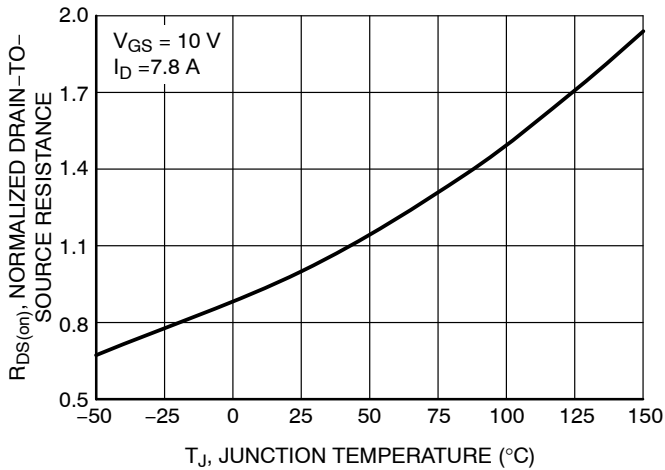


Figure 5. On-Resistance Variation with Temperature

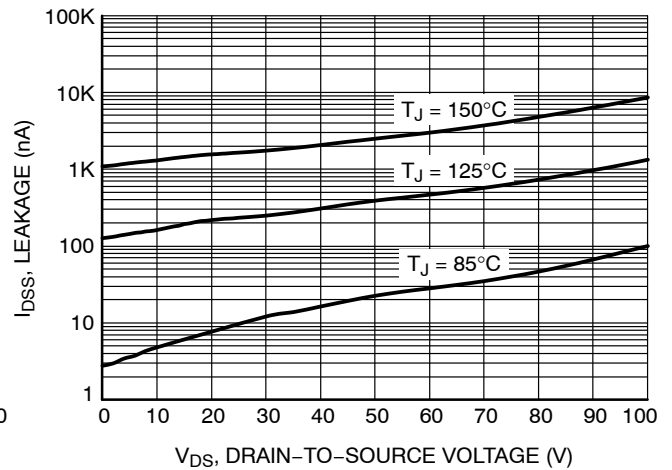


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

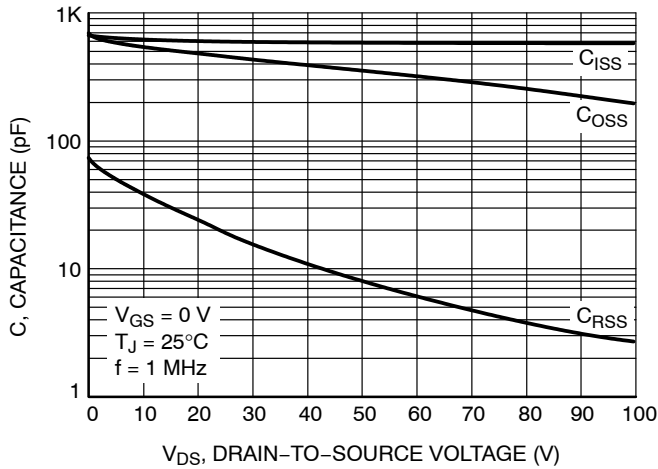


Figure 7. Capacitance Variation

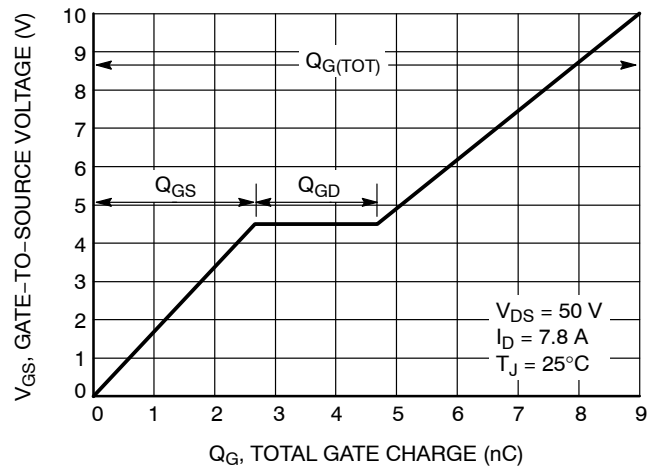


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

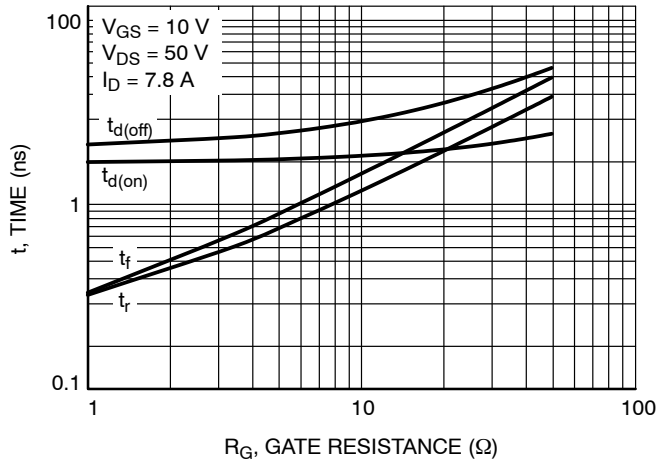


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

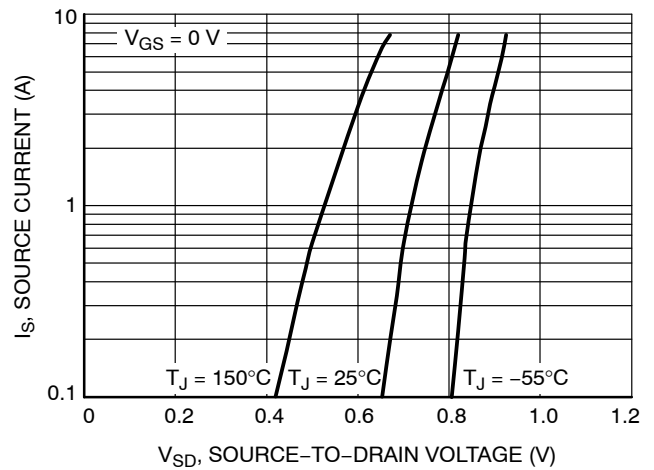


Figure 10. Diode Forward Voltage vs. Current

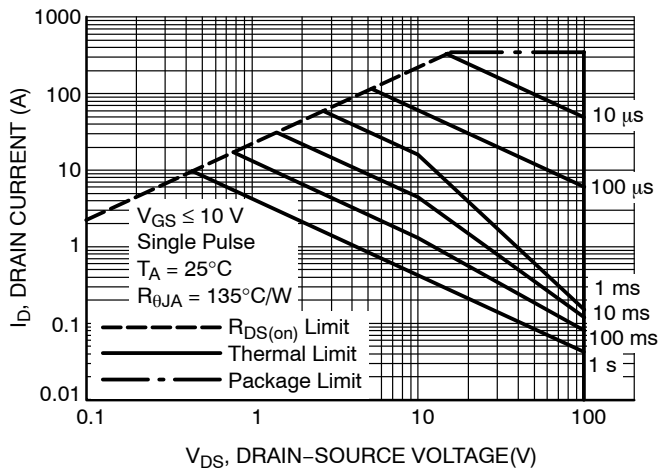


Figure 11. Safe Operating Area

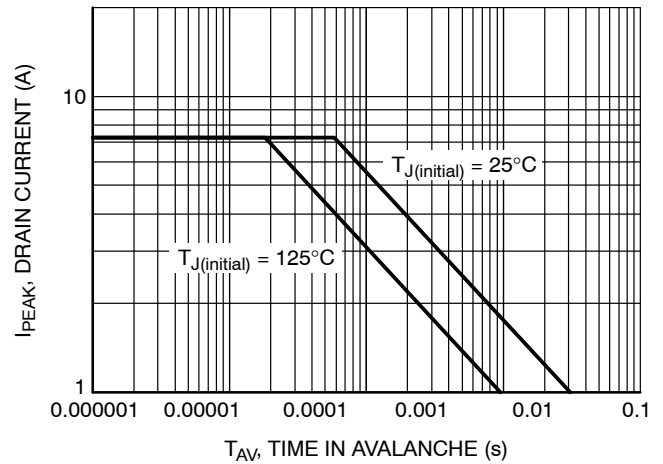


Figure 12. I_{PEAK} vs. Time in Avalanche

NTTFD022N10C

TYPICAL CHARACTERISTICS

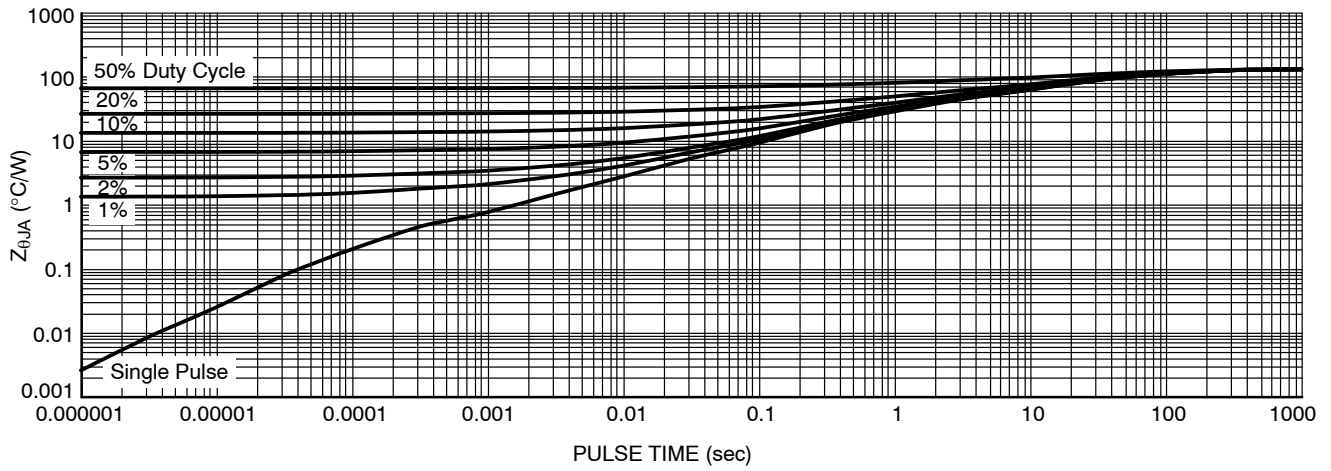
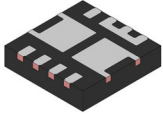
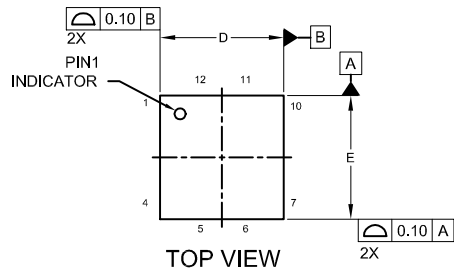


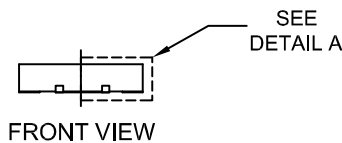
Figure 13. Thermal Characteristics


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

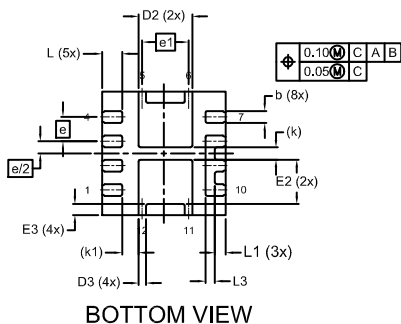
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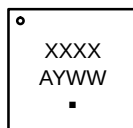
TOP VIEW



FRONT VIEW



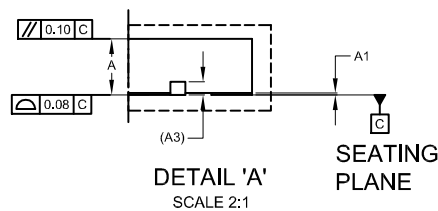
BOTTOM VIEW

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.

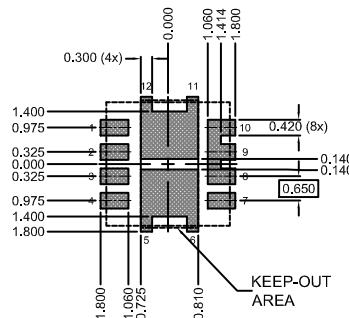
NOTES:

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


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, SOLDERM/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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