

NTTFD013N03P8

Dual N-Channel PowerTrench[®] MOSFET

Q1: 30 V, 11.6 mΩ; Q2: 30 V, 6.4 mΩ

General Description

This device includes two specialized N-Channel MOSFETs in a dual power33 (3 mm X 3 mm MLP) package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous MOSFET (Q2) have been designed to provide optimal power efficiency.

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 11.6 mΩ at $V_{GS} = 10$ V, $I_D = 10$ A
- Max $r_{DS(on)}$ = 13.3 mΩ at $V_{GS} = 4.5$ V, $I_D = 9$ A

Q2: N-Channel

- Max $r_{DS(on)}$ = 6.4 mΩ at $V_{GS} = 10$ V, $I_D = 16$ A
- Max $r_{DS(on)}$ = 7.0 mΩ at $V_{GS} = 4.5$ V, $I_D = 15$ A
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

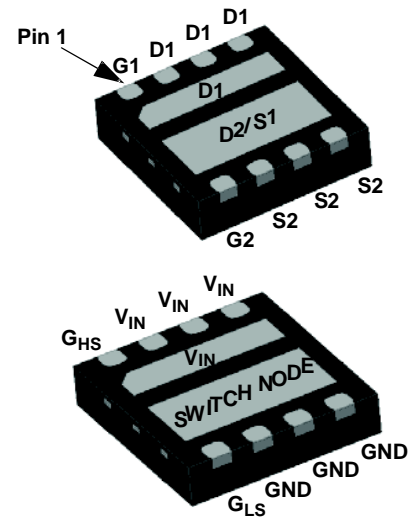
Applications

- Mobile Computing
- Mobile Internet Devices
- General Purpose Point of Load



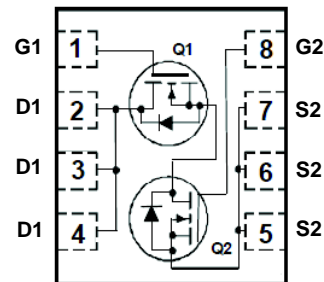
ON Semiconductor[®]

www.onsemi.com



(Bottom Views)

WDFN8
Power33
CASE 511DE



ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

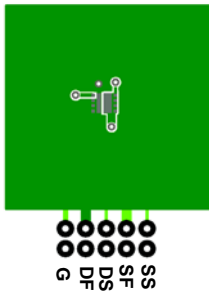
NTTFD013N03P8

Table 1. MOSFET MAXIMUM RATINGS $T_C = 25^\circ\text{C}$ unless otherwise noted.

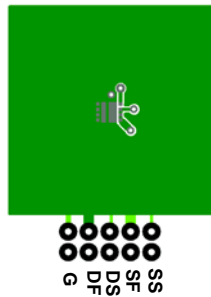
Symbol	Parameter	Q1	Q2	Units
V_{DS}	Drain to Source Voltage	30	30	V
V_{GS}	Gate to Source Voltage (Note 4)	± 12	± 12	V
I_D	Drain Current – Continuous $T_C = 25^\circ\text{C}$ (Note 9)	29	46	A
	– Continuous $T_C = 100^\circ\text{C}$ (Note 9)	18	29	
	– Continuous $T_A = 25^\circ\text{C}$	10 (Note 5)	16 (Note 6)	
	– Pulsed $T_A = 25^\circ\text{C}$ (Note 10)	113	302	
E_{AS}	Single Pulse Avalanche Energy (Note 3)	24	54	mJ
P_D	Power Dissipation for Single Operation $T_A = 25^\circ\text{C}$	1.9 (Note 5)	2.5 (Note 6)	W
	Power Dissipation for Single Operation $T_A = 25^\circ\text{C}$	0.7 (Note 7)	1.0 (Note 8)	
T_J, T_{STG}	Operating and Storage Junction Temperature Range	–55 to +150		$^\circ\text{C}$

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.

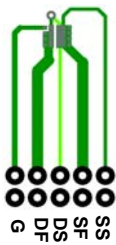
1. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.
2. Pulsed I_D please refer to Figure 11 and Figure 24 SOA graphs for more details.
3. Q1: E_{AS} of 24 mJ is based on starting $T_J = 25^\circ\text{C}$; $L = 3$ mH, $I_{AS} = 4$ A, $V_{DD} = 30$ V, $V_{GS} = 10$ V. 100% tested at $L = 0.1$ mH, $I_{AS} = 13$ A.
Q2: E_{AS} of 54 mJ is based on starting $T_J = 25^\circ\text{C}$; $L = 3$ mH, $I_{AS} = 6$ A, $V_{DD} = 30$ V, $V_{GS} = 10$ V. 100% tested at $L = 0.1$ mH, $I_{AS} = 22$ A.
4. As an N–ch device, the negative V_{GS} rating is for low duty cycle pulse occurrence only. No continuous rating is implied.



5. $65^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper



6. $50^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper



7. $180^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper



8. $125^\circ\text{C}/\text{W}$ when mounted on a minimum pad of 2 oz copper

NTTFD013N03P8

Table 2. PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
D13N03	NTTFD013N03P8	Power 33	13"	12 mm	3000 units

Table 3. THERMAL CHARACTERISTICS

Parameter	Description	Q1	Q2	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	8.2	6.1	$^{\circ}C/W$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	65 (Note 9)	50 (Note 9)	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	180 (Note 9)	125 (Note 9)	

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

Table 4. ELECTRICAL CHARACTERISTICS $T_J = 25^{\circ}C$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
--------	-----------	-----------------	------	-----	-----	-----	-------

OFF CHARACTERISTICS

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250 \mu A, V_{GS} = 0 V$	Q1 Q2	30 30			V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu A$, referenced to $25^{\circ}C$	Q1 Q2		15 16		mV/ $^{\circ}C$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24 V, V_{GS} = 0 V$	Q1 Q2			1 1	μA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 12 V, V_{DS} = 0 V$	Q1 Q2			± 100 ± 100	nA nA

ON CHARACTERISTICS

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250 \mu A$	Q1 Q2	1.0 1.0	1.3 1.8	3.0 3.0	V
$\Delta V_{GS(th)} / \Delta T_J$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250 \mu A$, referenced to $25^{\circ}C$	Q1 Q2		-4 -4		mV/ $^{\circ}C$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10 V, I_D = 10 A$ $V_{GS} = 4.5 V, I_D = 9 A$ $V_{GS} = 10 V, I_D = 10 A, T_J = 125^{\circ}C$	Q1		7.7 8.9 10.8	11.5 13.3 16.3	m Ω
		$V_{GS} = 10 V, I_D = 16 A$ $V_{GS} = 4.5 V, I_D = 15 A$ $V_{GS} = 10 V, I_D = 16 A, T_J = 125^{\circ}C$	Q2		4.4 5.4 6.2	6.3 7.0 9.0	
g_{FS}	Forward Transconductance	$V_{DD} = 5 V, I_D = 10 A$ $V_{DD} = 5 V, I_D = 16 A$	Q1 Q2		46 70		S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHz$	Q1 Q2		792 1685	1100 2300	pF
C_{oss}	Output Capacitance		Q1 Q2		230 467	320 650	pF
C_{riss}	Reverse Transfer Capacitance		Q1 Q2		20 36	30 50	pF
R_g	Gate Resistance		Q1 Q2	0.1 0.1	2.0 1.2	4.0 2.4	Ω

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	Q1: $V_{DD} = 15 V, I_D = 10 A,$ $V_{GS} = 10 V, R_{GEN} = 6 \Omega$	Q1 Q2		7 10	14 20	ns
t_r	Rise Time		Q1 Q2		2 3	10 10	ns
$t_{d(off)}$	Turn-Off Delay Time	Q2: $V_{DD} = 15 V, I_D = 16 A,$ $V_{GS} = 10 V, R_{GEN} = 6 \Omega$	Q1 Q2		19 24	33 39	ns
t_f	Fall Time		Q1 Q2		2 3	10 10	ns

NTTFD013N03P8

Table 4. ELECTRICAL CHARACTERISTICS $T_J = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units	
SWITCHING CHARACTERISTICS								
$Q_{g(\text{tot})}$	Total Gate Charge	$V_{GS} = 0\text{ V to }10\text{ V}$	Q1 $V_{DD} = 15\text{ V},$ $I_D = 10\text{ A}$ Q2 $V_{DD} = 15\text{ V},$ $I_D = 16\text{ A}$	Q1		12	17	nC
$Q_{g(\text{tot})}$	Total Gate Charge	$V_{GS} = 0\text{ V to }4.5\text{ V}$		Q2		24	34	nC
Q_{gs}	Gate to Source Charge			Q1		5.5	7.7	nC
Q_{gd}	Gate to Drain "Miller" Charge			Q2		11	16	nC
				Q1		1.7		nC
				Q2		4.4		nC
				Q1		1.3		nC
				Q2		2.7		nC

DRAIN-SOURCE DIODE CHARACTERISTICS

V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 10\text{ A}$ (Note 10) $V_{GS} = 0\text{ V}, I_S = 1.5\text{ A}$ (Note 10) $V_{GS} = 0\text{ V}, I_S = 16\text{ A}$ (Note 10) $V_{GS} = 0\text{ V}, I_S = 2\text{ A}$ (Note 10)	Q1		0.85	1.2	V
			Q1		0.75	1.2	
			Q2		0.83	1.2	
			Q2		0.73	1.2	
t_{rr}	Reverse Recovery Time	Q1 $I_F = 10\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	Q1		17	31	ns
			Q2		27	42	
Q_{rr}	Reverse Recovery Charge	Q2 $I_F = 16\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	Q1		5	10	nC
			Q2		10	20	

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.
10. Pulse Test: Pulse Width < 300 μs , Duty Cycle < 2.0%.

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

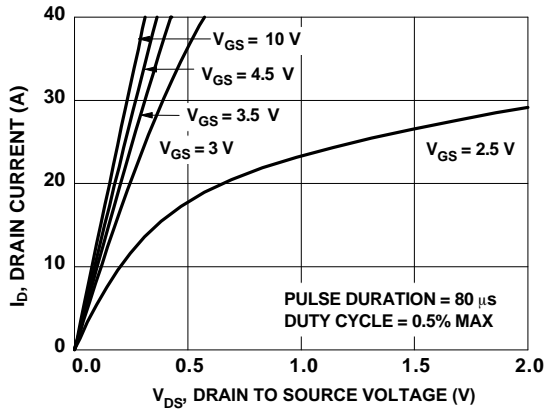


Figure 1. On Region Characteristics

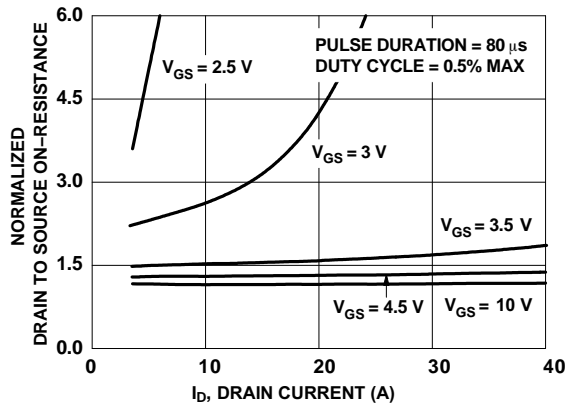


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

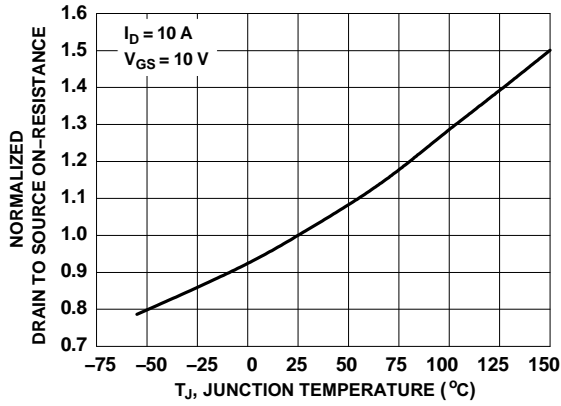


Figure 3. Normalized On-Resistance vs. Junction Temperature

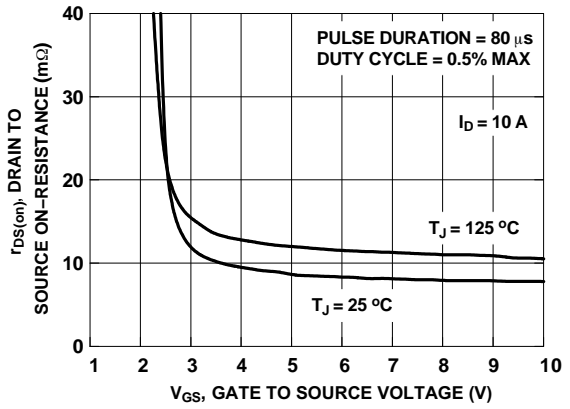


Figure 4. On-Resistance vs. Gate to Source Voltage

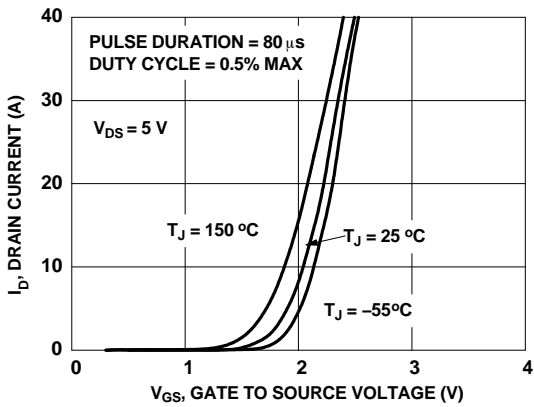


Figure 5. Transfer Characteristics

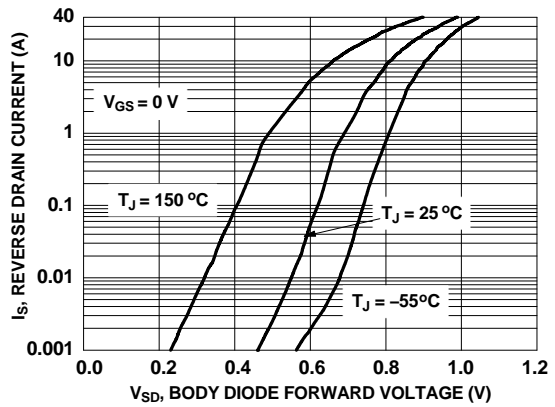


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

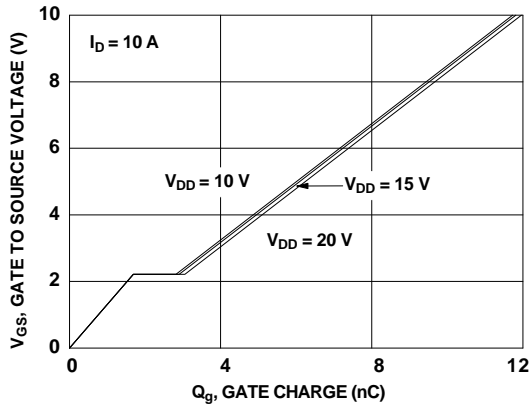


Figure 7. Gate Charge Characteristics

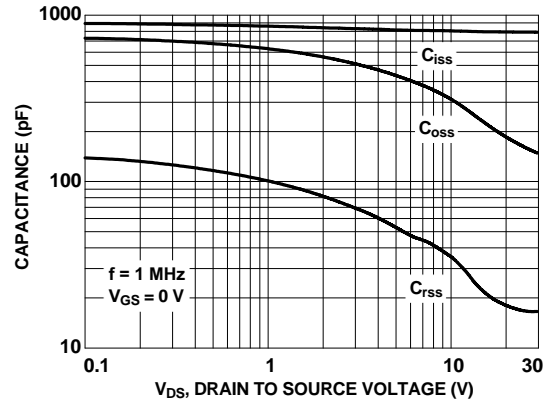


Figure 8. Capacitance vs. Drain to Source Voltage

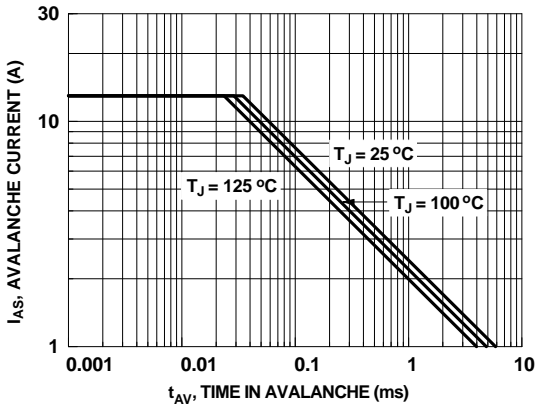


Figure 9. Unclamped Inductive Switching Capability

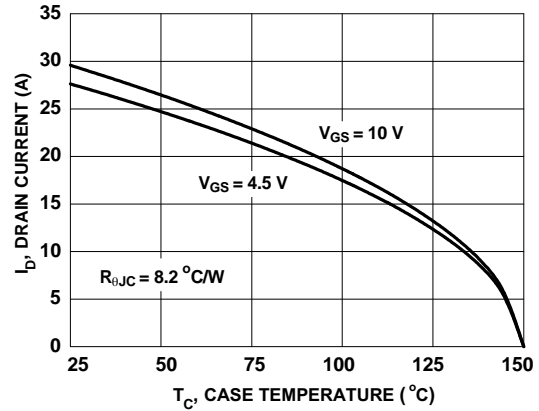


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

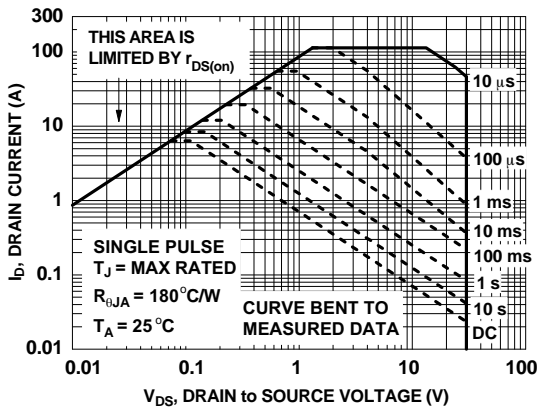


Figure 11. Forward Bias Safe Operating Area

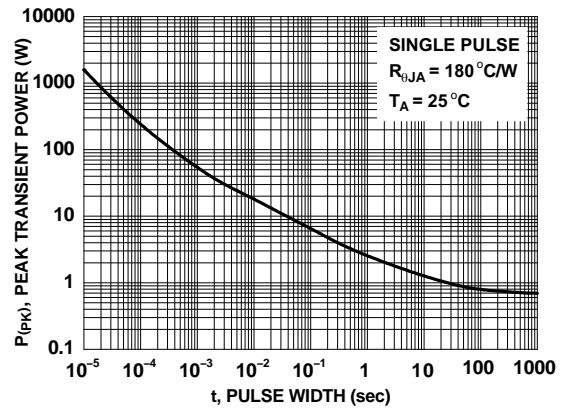


Figure 12. Single Pulse Maximum Power Dissipation

NTTFD013N03P8

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

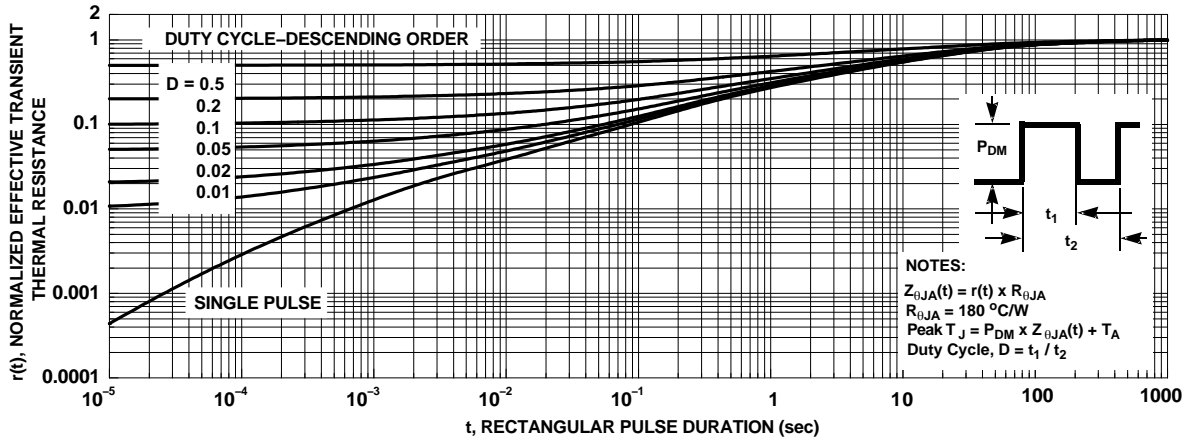


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

Typical Characteristics (Q2 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

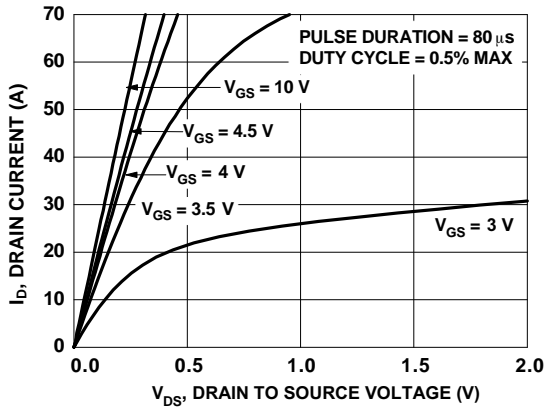


Figure 14. On Region Characteristics

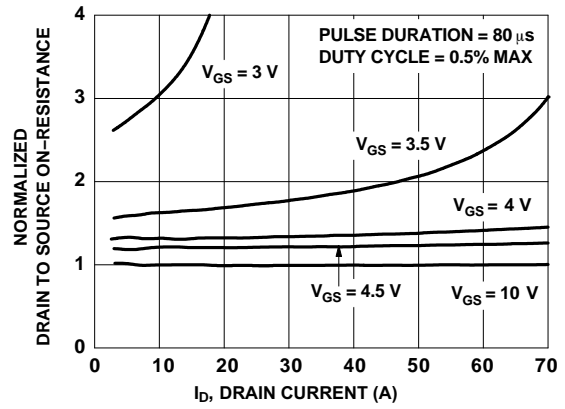


Figure 15. Normalized On-Resistance vs. Drain Current and Gate Voltage

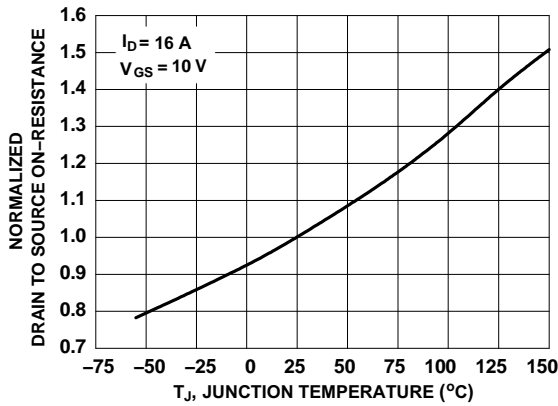


Figure 16. Normalized On-Resistance vs. Junction Temperature

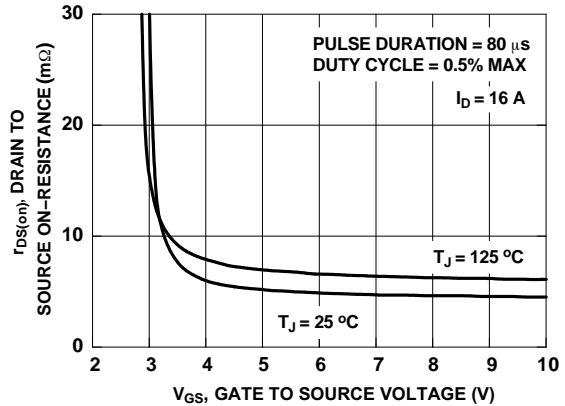


Figure 17. On-Resistance vs. Gate to Source Voltage

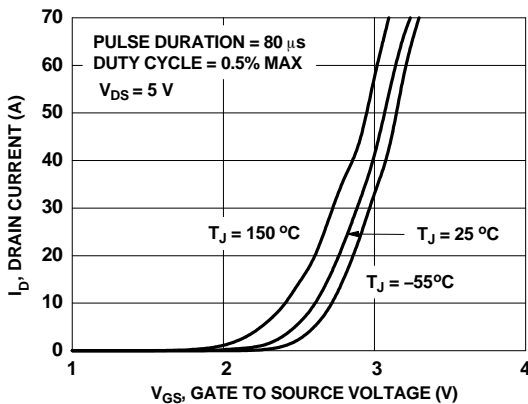


Figure 18. Transfer Characteristics

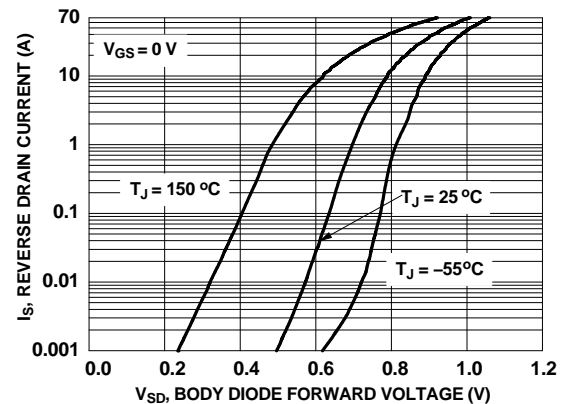


Figure 19. Source to Drain Diode Forward Voltage vs. Source Current

Typical Characteristics (Q2 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

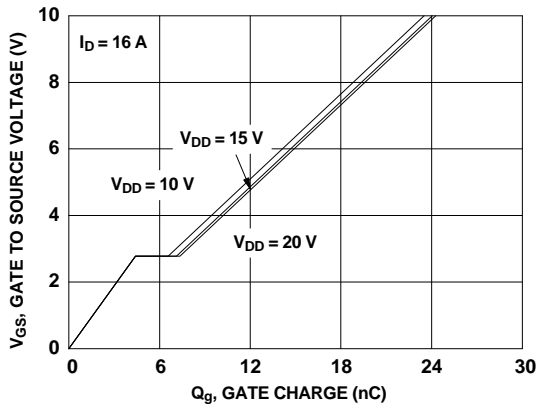


Figure 20. Gate Charge Characteristics

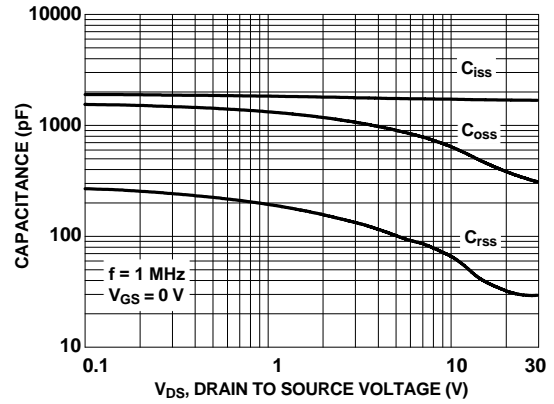


Figure 21. Capacitance vs. Drain to Source Voltage

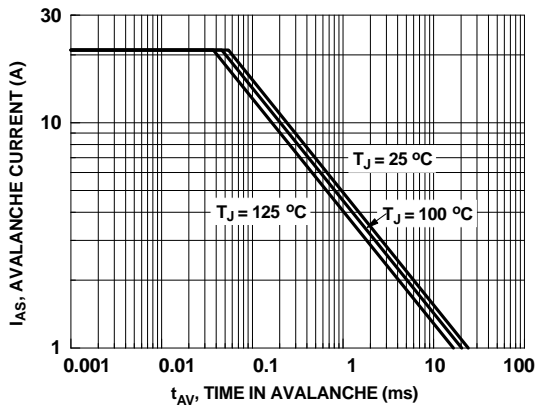


Figure 22. Unclamped Inductive Switching Capability

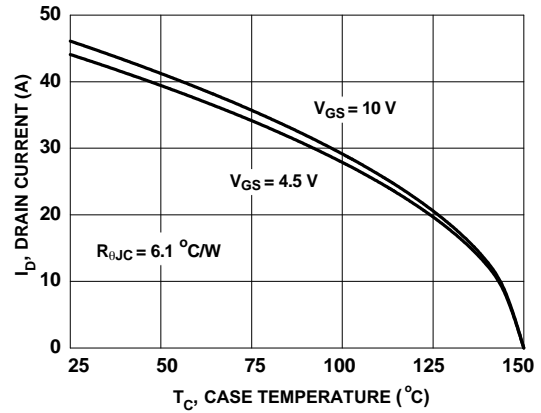


Figure 23. Maximum Continuous Drain Current vs. Case Temperature

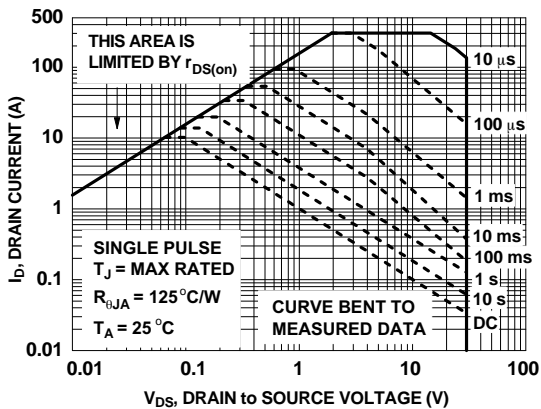


Figure 24. Forward Bias Safe Operating Area

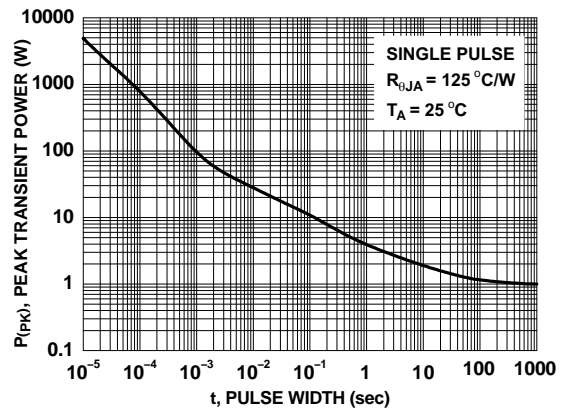


Figure 25. Single Pulse Maximum Power Dissipation

NTTFD013N03P8

Typical Characteristics (Q2 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

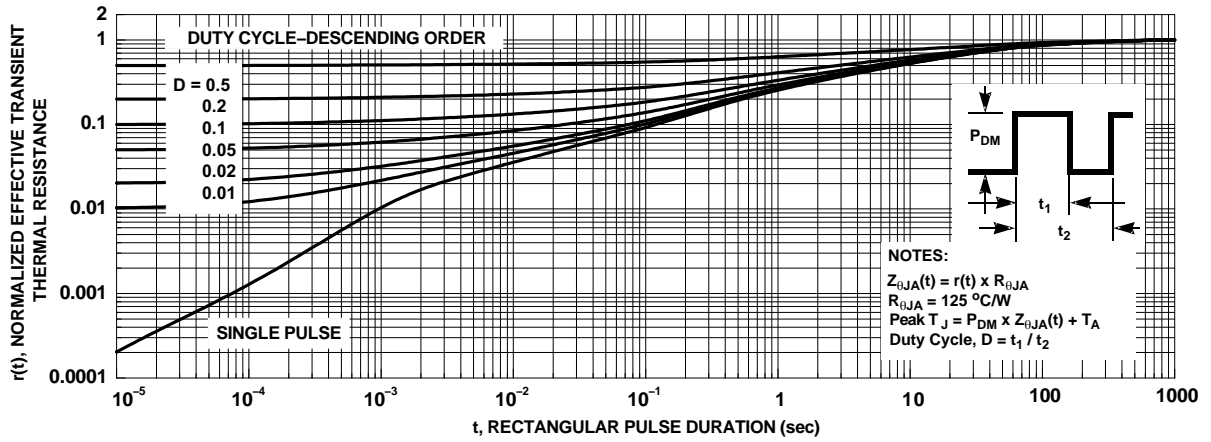
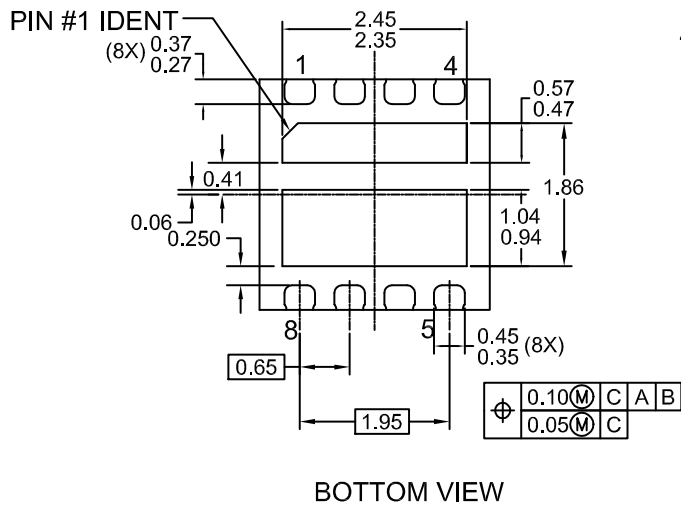
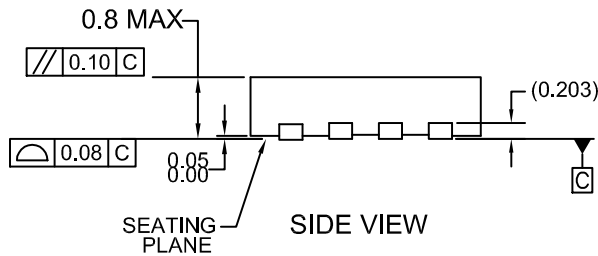
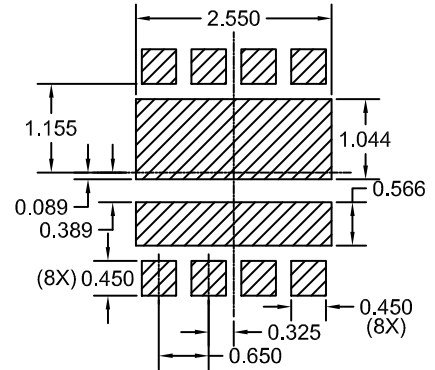
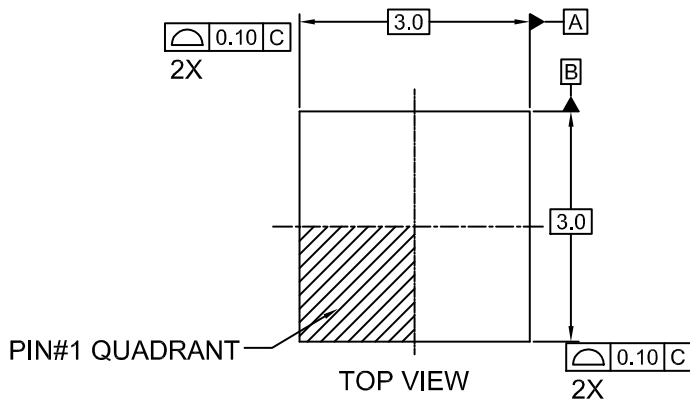


Figure 26. Junction-to-Ambient Transient Thermal Response Curve

NTTFD013N03P8

PACKAGE DIMENSIONS


WDFN8 3x3, 0.65P
CASE 511DE
ISSUE O



NOTES:

- A. DOES NOT CONFORM TO JEDEC REGISTRATION MO-229
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

PowerTrench is a registered trademark of Semiconductor Components Industries, LLC.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative