

NTMFD0D9N02P1E

MOSFET – Power, Dual, N-Channel, Power Trench, Power Clip, Asymmetric

30 V / 25 V

Features

- Small Footprint (5x6mm) for Compact Design
- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low Q_G and Capacitance to Minimize Driver Losses
- Designed with Low R_g for Fast Switching Applications
- These are Pb-free, Halogen Free / BFR Free and are RoHS Compliant

Typical Applications

- DC-DC Converters
- System Voltage Rails
- General Purpose Point of Load

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

Parameter			Sym- bol	Q1	Q2	Unit
Drain-to-Source Voltage			V_{DS}	30	25	V
Gate-to-Source Voltage			V_{GS}	+16V -12V	+16V -12V	V
Continuous Drain Current $R_{\theta JC}$ (Note 3)	Steady State	$T_C = 25^\circ\text{C}$	I_D	77	180	A
		$T_C = 85^\circ\text{C}$		56	130	
Power Dissipation $R_{\theta JC}$ (Note 3)		$T_A = 25^\circ\text{C}$	P_D	29.2	37.4	W
Continuous Drain Current $R_{\theta JA}$ (Note 1, 3)	Steady State	$T_A = 25^\circ\text{C}$	I_D	21	44	A
		$T_A = 85^\circ\text{C}$		15	32	
Power Dissipation $R_{\theta JA}$ (Note 1, 3)		$T_A = 25^\circ\text{C}$	P_D	2.1	2.3	W
Continuous Drain Current $R_{\theta JA}$ (Note 2, 3)	Steady State	$T_A = 25^\circ\text{C}$	I_D	14	30	A
		$T_A = 85^\circ\text{C}$		10	21	
Power Dissipation $R_{\theta JA}$ (Note 2, 3)		$T_A = 25^\circ\text{C}$	P_D	0.96	1.04	W
Pulsed Drain Current	$T_A = 25^\circ\text{C}$, $t_p = 10 \mu\text{s}$		I_{DM}	356	1023	A
Single Pulse Drain-to-Source Avalanche Energy Q1: $I_L = 10 A_{pk}$, $L = 3 \text{ mH}$ (Note 4) Q2: $I_L = 20 A_{pk}$, $L = 3 \text{ mH}$ (Note 4)			E_{AS}	150	600	mJ
Operating Junction and Storage Temperature			T_J , T_{stg}	-55 to 150		$^\circ\text{C}$
Lead Temperature Soldering Reflow 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.



ON Semiconductor®

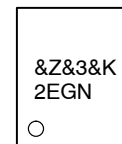
www.onsemi.com

FET	$V_{(BR)DS}$	$R_{DS(on)}$ MAX	I_D MAX
Q1	30 V	3.0 m Ω @ 10 V	77 A
		3.8 m Ω @ 4.5 V	
Q2	25 V	0.72 m Ω @ 10 V	180 A
		0.95 m Ω @ 4.5 V	



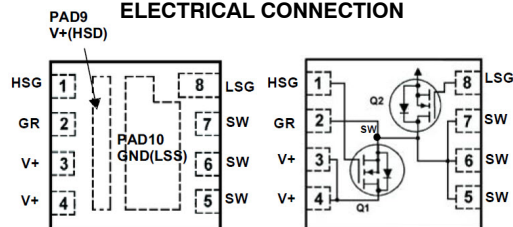
PQFN8
POWER CLIP
CASE 483AR

MARKING DIAGRAM



&Z = Assembly Plant Code
&3 = Numeric Date Code
&K = Lot Code
2EGN = Specific Device Code

ELECTRICAL CONNECTION



ORDERING INFORMATION

Device	Package	Shipping†
NTMFD0D9N02P1E	PQFN8 (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 Specification Brochure, BRD8011/D.

NTMFD0D9N02P1E

Table 1. THERMAL RESISTANCE RATINGS

Parameter	Symbol	Q1 Max	Q2 Max	Units
Junction-to-Case – Steady State (Note 1, 3)	$R_{\theta JC}$	4.3	3.3	°C/W
Junction-to-Ambient – Steady State (Note 1, 3)	$R_{\theta JA}$	60	55	
Junction-to-Ambient – Steady State (Note 2, 3)	$R_{\theta JA}$	130	120	

1. Surface-mounted on FR4 board using 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. RQCA is determined by the user's board design.
4. Q1 100% UIS tested at L = 0.1 mH, $I_{AS} = 21$ A.
Q2 100% UIS tested at L = 0.1 mH, $I_{AS} = 45$ A.

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Test Condition	FET	Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	Q1	30			V
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	Q2	25			V
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		18		mV/°C
		$I_D = 1\text{ mA}, \text{ref to } 25^\circ\text{C}$	Q2		16		
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$	Q1			10	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$	Q2			10	
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 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 340\text{ }\mu\text{A}$	Q1	1.2	1.6	2.0	V
		$V_{GS} = V_{DS}, I_D = 1\text{ mA}$	Q2	1.2	1.5	2.0	
Threshold Temperature Coefficient	$V_{GS(TH)} / T_J$	$I_D = 340\text{ }\mu\text{A}, \text{ref to } 25^\circ\text{C}$	Q1		-4.4		mV/°C
		$I_D = 1\text{ mA}, \text{ref to } 25^\circ\text{C}$	Q2		-5.1		
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$	Q1		2.5	3.0	m Ω
		$V_{GS} = 4.5\text{ V}, I_D = 18\text{ A}$			3.0	3.8	
		$V_{GS} = 10\text{ V}, I_D = 41\text{ A}$	Q2		0.60	0.72	
		$V_{GS} = 4.5\text{ V}, I_D = 37\text{ A}$			0.75	0.95	
Forward Transconductance	g_{FS}	$V_{DS} = 5\text{ V}, I_D = 20\text{ A}$	Q1		147		
		$V_{DS} = 5\text{ V}, I_D = 41\text{ A}$	Q2		311		
Gate Resistance	R_G	$T_A = 25^\circ\text{C}$	Q1		0.4		Ω
			Q2		0.4		

CHARGES & CAPACITANCES

Input Capacitance	C _{ISS}	Q1: V _{GS} = 0 V, V _{DS} = 15 V, f = 1 MHz Q2: V _{GS} = 0 V, V _{DS} = 13 V, f = 1 MHz	Q1		1400		pF
			Q2		5050		
Output Capacitance	C _{OSS}		Q1		421		pF
			Q2		1355		
Reverse Capacitance	C _{RSS}		Q1		22		pF
			Q2		94		

5. Pulse Test: pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$
6. Switching characteristics are independent of operating junction temperatures

NTMFD0D9N02P1E

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Test Condition	FET	Min	Typ	Max	Unit	
CHARGES & CAPACITANCES								
Total Gate Charge	$Q_{G(TOT)}$	Q1: $V_{GS} = 4.5V$, $V_{DS} = 15V$, $I_D = 20\text{ A}$ Q2: $V_{GS} = 4.5V$, $V_{DS} = 13V$, $I_D = 41\text{ A}$	Q1		9		nC	
			Q2		30			
Gate-to-Drain Charge	Q_{GD}		Q1		2		nC	
			Q2		6			
Gate-to-Source Charge	Q_{GS}		Q1		4		nC	
			Q2		13			
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}$, $V_{DS} = 15\text{ V}$, $I_D = 20\text{ A}$	Q1		19		nC	
		$V_{GS} = 10\text{ V}$, $V_{DS} = 13\text{ V}$, $I_D = 41\text{ A}$	Q2		67			
SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 6)								
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}$ Q1: $I_D = 20\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\Omega$ Q2: $I_D = 41\text{ A}$, $V_{DD} = 13\text{ V}$, $R_G = 6\Omega$	Q1		8		ns	
			Q2		15			
Rise Time	$t_{r(ON)}$		Q1		2		ns	
			Q2		4			
Turn-Off Delay Time	$t_{d(OFF)}$		Q1		25		ns	
			Q2		70			
Fall Time	t_f		Q1		3		ns	
			Q2		10			
SOURCE-TO-DRAIN DIODE CHARACTERISTICS								
Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}$, $I_S = 20\text{ A}$	$T_J = 25^{\circ}C$	Q1		0.8	1.2	V
			$T_J = 125^{\circ}C$			0.68		
		$V_{GS} = 0\text{ V}$, $I_S = 41\text{ A}$	$T_J = 25^{\circ}C$	Q2		0.8	1.2	
			$T_J = 125^{\circ}C$			0.64		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}$, Q1: $I_S = 20\text{ A}$, $dI/dt = 100\text{ A}/\mu s$ Q2: $I_S = 41\text{ A}$, $dI/dt = 300\text{ A}/\mu s$	Q1		26		ns	
			Q2		48			
Reverse Recovery Charge	Q_{RR}		Q1		14		nC	
			Q2		79			

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

6. Switching characteristics are independent of operating junction temperatures

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

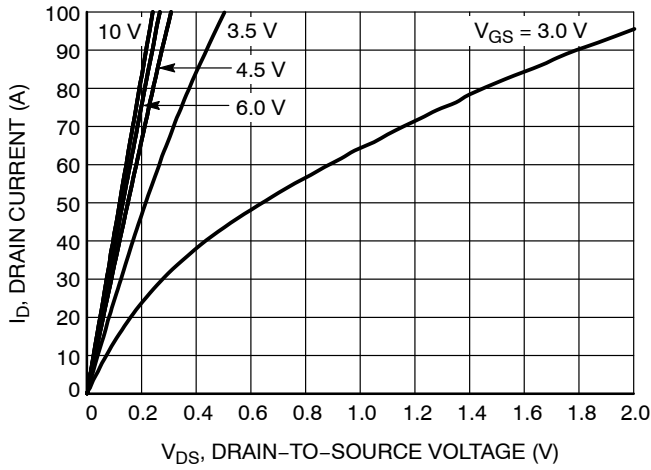


Figure 1. On-Region Characteristics

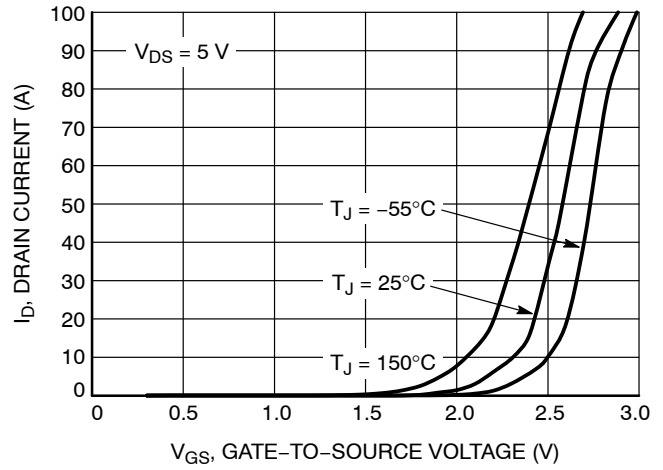


Figure 2. Transfer Characteristics

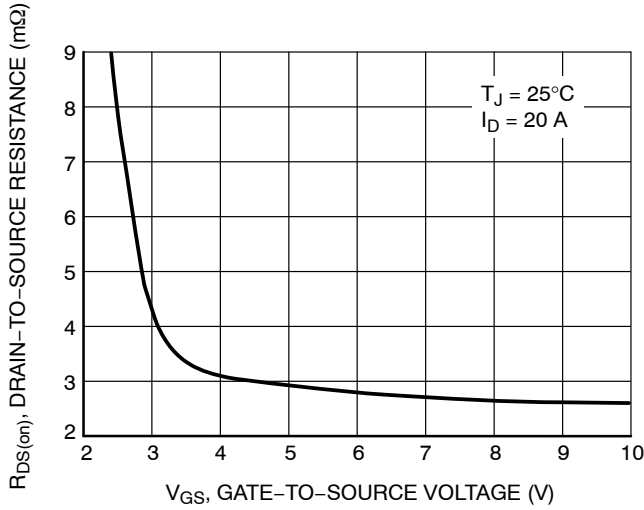


Figure 3. On-Resistance vs. Gate-to-Source Voltage

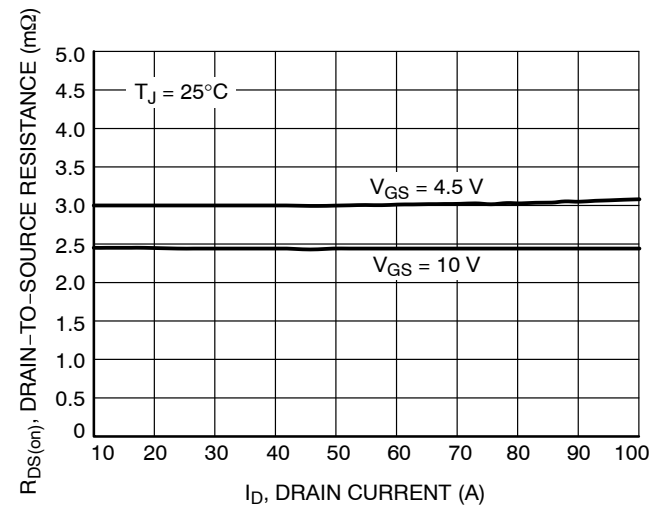


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

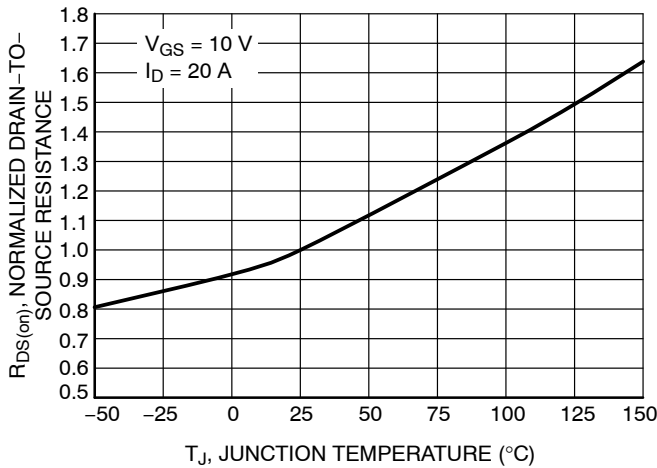


Figure 5. On-Resistance Variation with Temperature

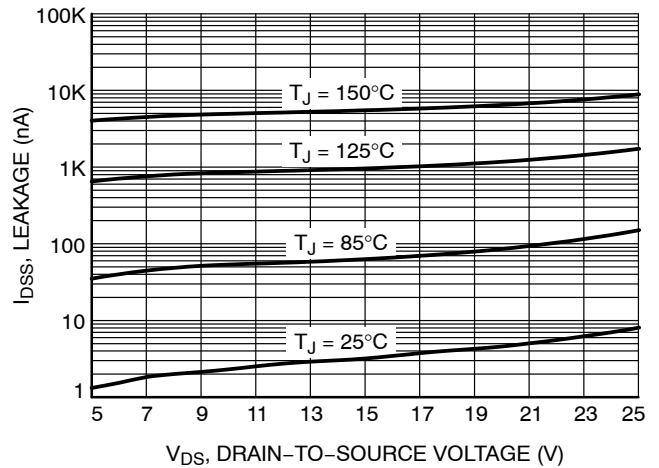


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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

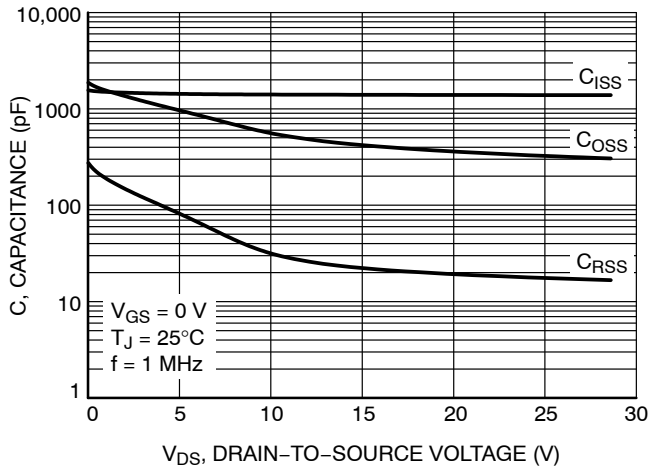


Figure 7. Capacitance Variation

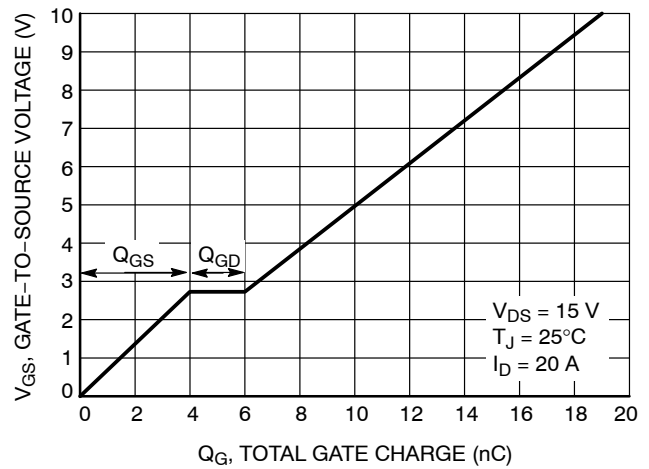


Figure 8. Gate-to-Source Voltage vs. Total Charge

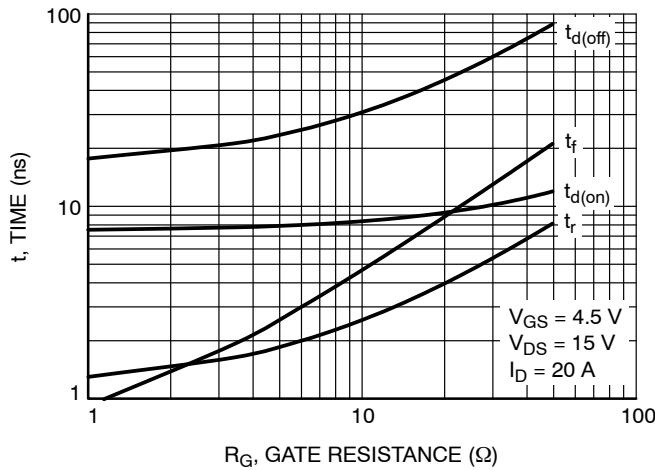


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

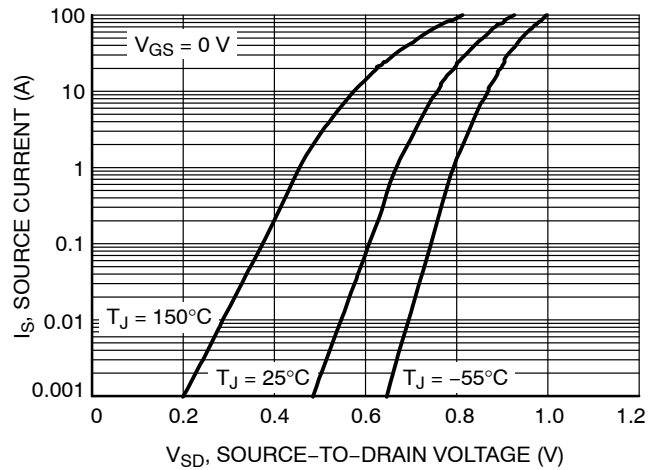


Figure 10. Diode Forward Voltage vs. Current

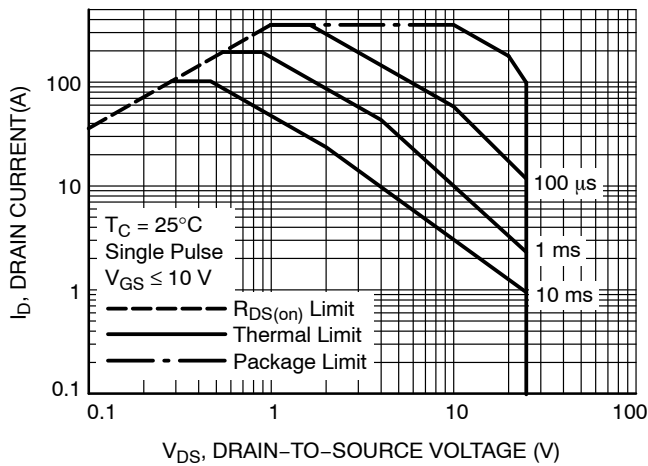


Figure 11. Maximum Rated Forward Biased Safe Operating Area

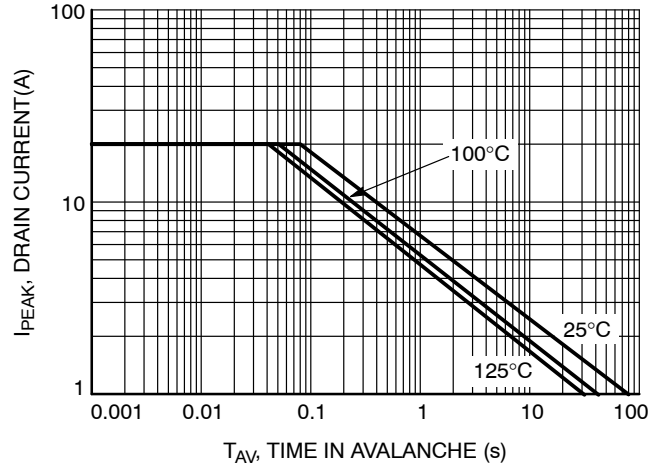


Figure 12. Maximum Drain Current vs. Time in Avalanche

NTMFD0D9N02P1E

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

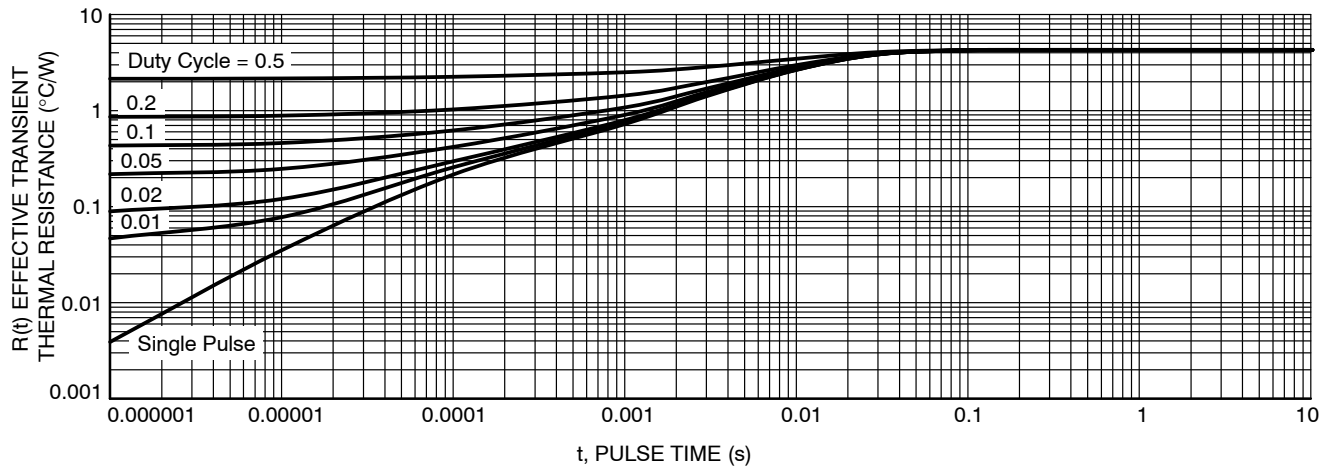


Figure 13. Thermal Response

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

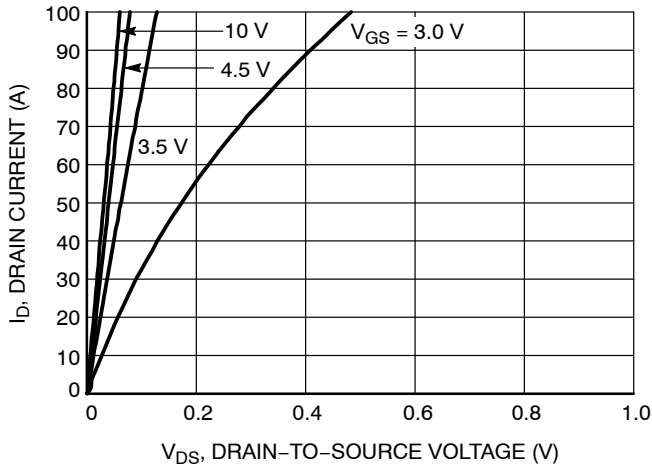


Figure 14. On-Region Characteristics

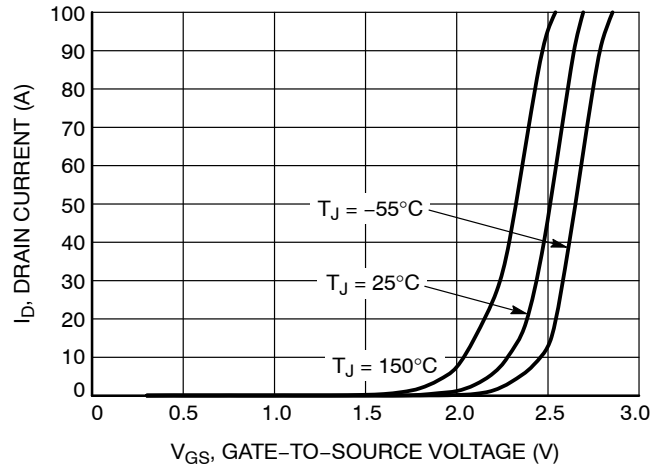


Figure 15. Transfer Characteristics

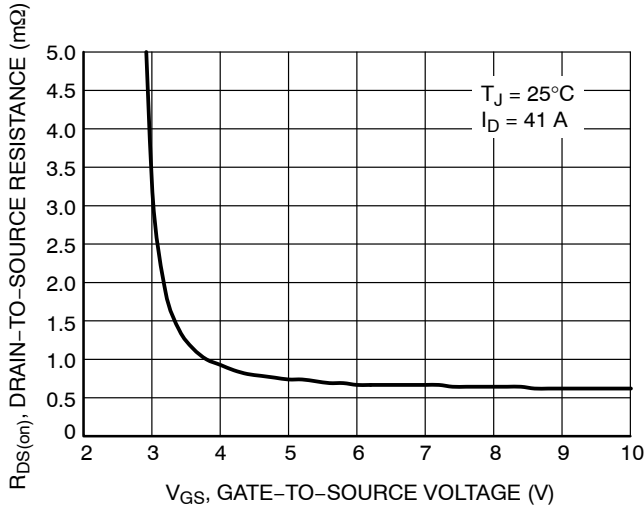


Figure 16. On-Resistance vs. Gate-to-Source Voltage

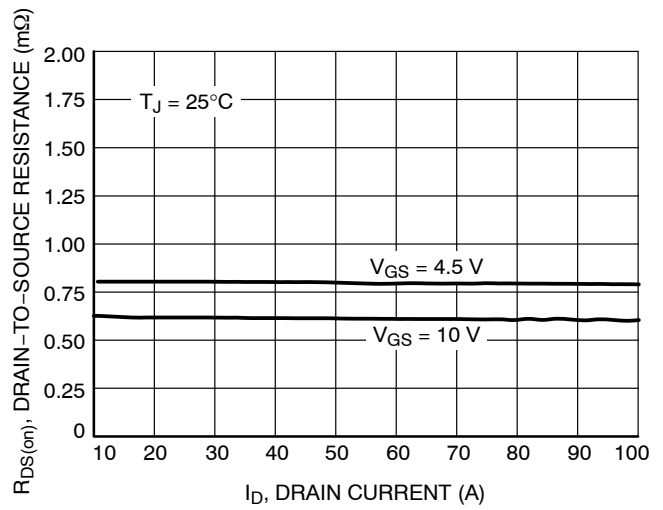


Figure 17. On-Resistance vs. Drain Current and Gate Voltage

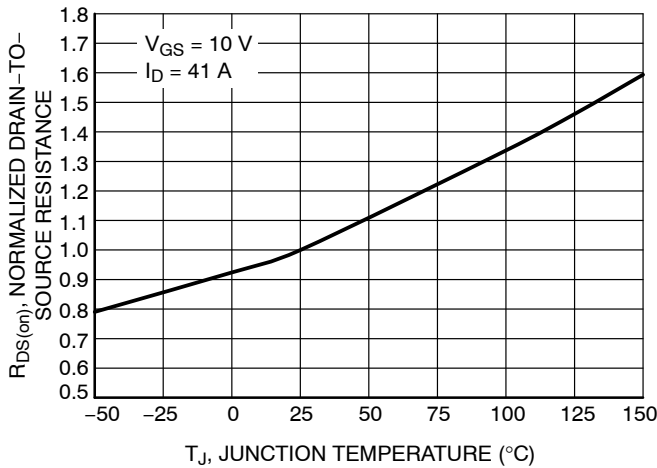


Figure 18. On-Resistance Variation with Temperature

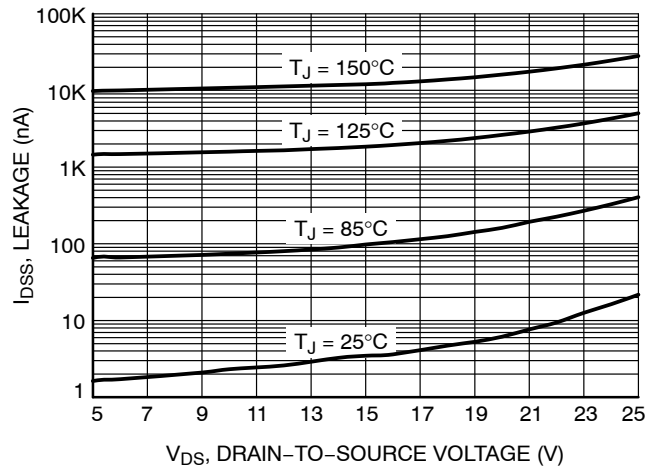


Figure 19. Drain-to-Source Leakage Current vs. Voltage

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

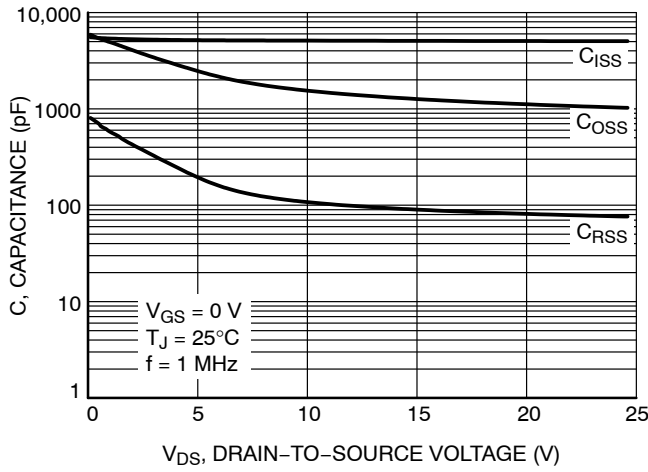


Figure 20. Capacitance Variation

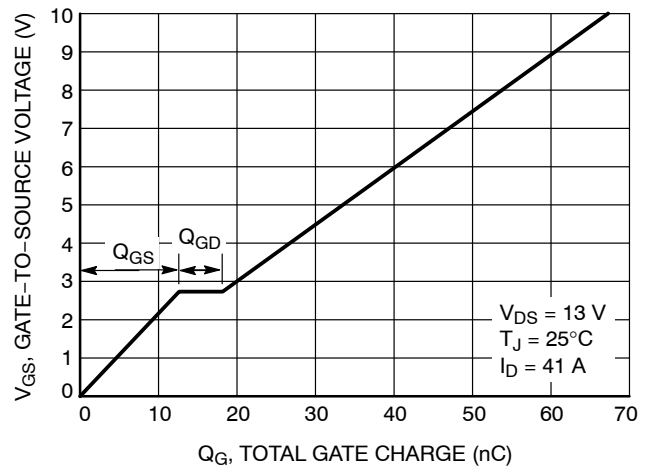


Figure 21. Gate-to-Source Voltage vs. Total Charge

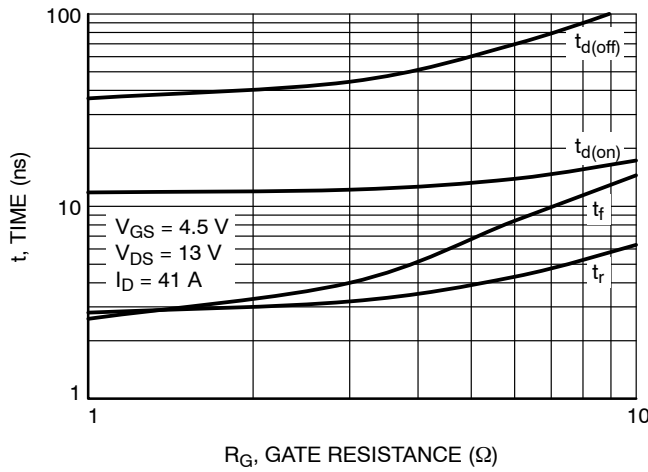


Figure 22. Resistive Switching Time Variation vs. Gate Resistance

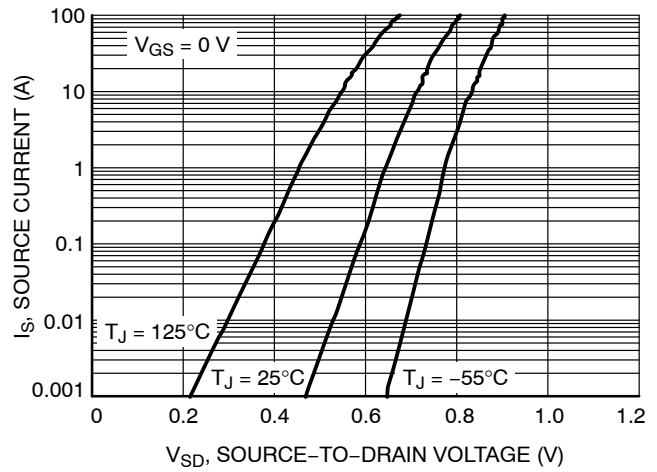


Figure 23. Diode Forward Voltage vs. Current

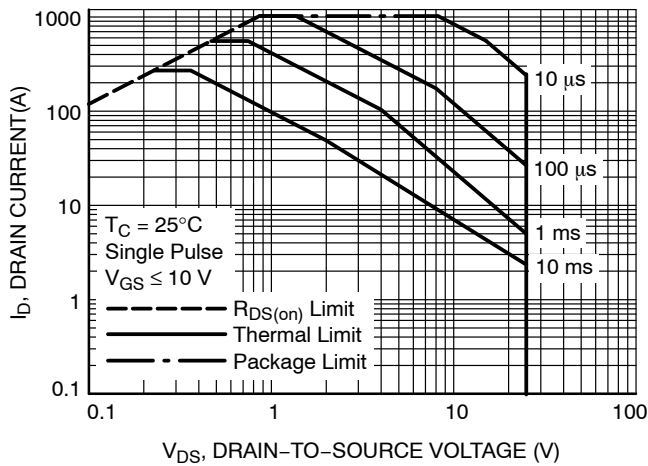


Figure 24. Maximum Rated Forward Biased Safe Operating Area

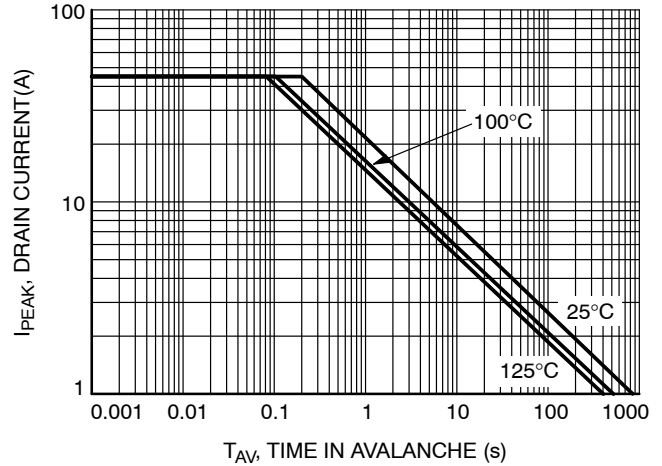


Figure 25. Maximum Drain Current vs. Time in Avalanche

NTMFD0D9N02P1E

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

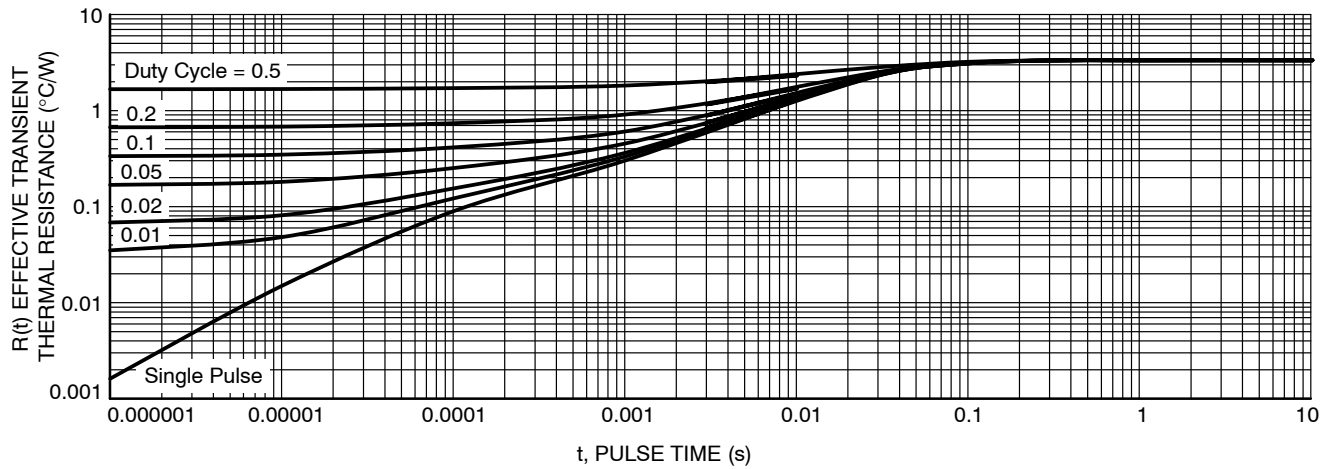
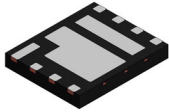
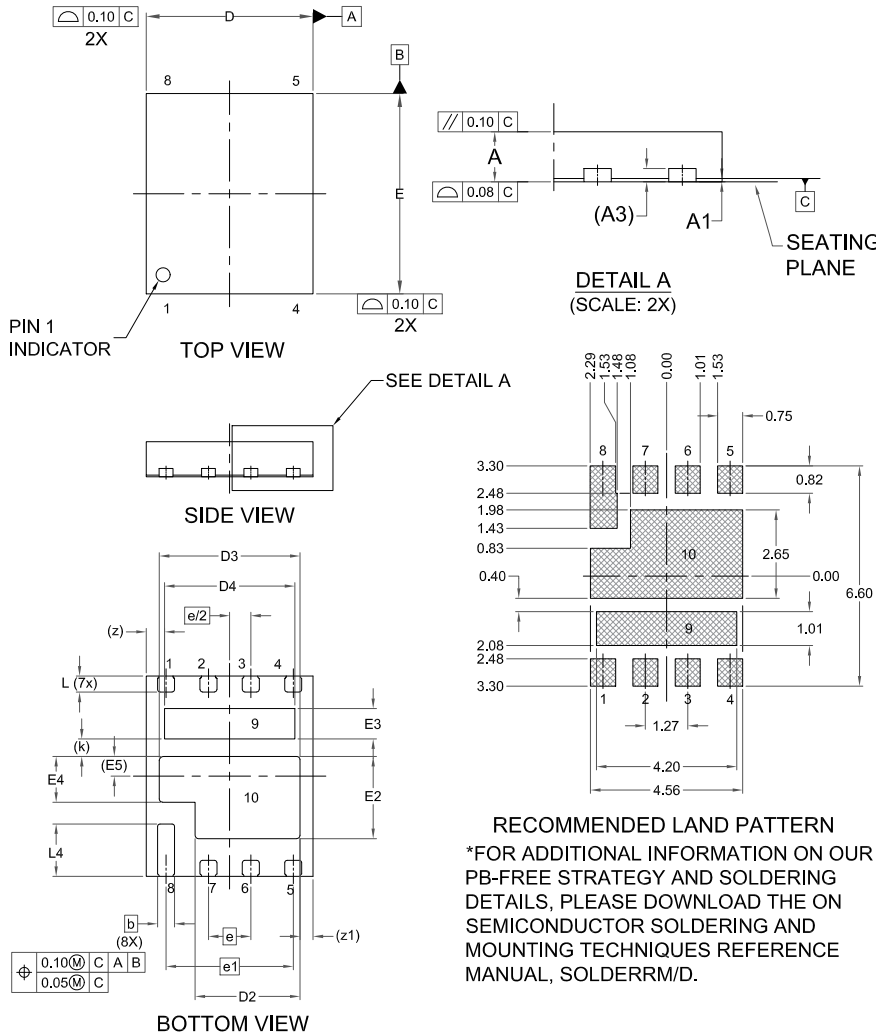


Figure 26. Thermal Response



PQFN8 5.00x6.00x0.75, 1.27P
CASE 483AR
ISSUE D

DATE 06 NOV 2023



NOTES: UNLESS OTHERWISE SPECIFIED

- A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION, MO-229, DATED 11/2001.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
- D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.00	-	0.05
A3	0.20 REF		
b	0.51 BSC		
D	4.90	5.00	5.10
D2	3.05	3.15	3.25
D3	4.12	4.22	4.32
D4	3.80	3.90	4.00
E	5.90	6.00	6.10
E2	2.36	2.46	2.56
E3	0.81	0.91	1.01
E4	1.27	1.37	1.47
E5	0.59 REF		
e	1.27 BSC		
e/2	0.635 BSC		
e1	3.81 BSC		
k	0.52 REF		
L	0.38	0.48	0.58
L4	1.47	1.57	1.67
z	0.55 REF		
z1	0.39 REF		

DOCUMENT NUMBER: 98AON13666G

Electronic versions are uncontrolled except when accessed directly from the Document Repository.
Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.

DESCRIPTION: PQFN8 5.00x6.00x0.75, 1.27P

PAGE 1 OF 1

onsemi and Onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi 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. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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 **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** 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 **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales