

MOSFET – Power, Dual, N-Channel, Power Clip, Trench, Asymmetric 30 V



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NTMFD001N03P9

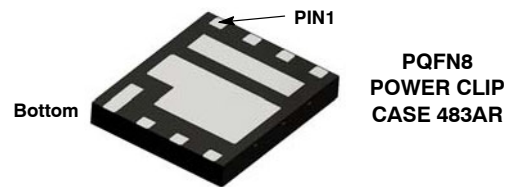
Features

- Small Footprint (5x6 mm) 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, Halogen Free/BFR Free and are RoHS Compliant

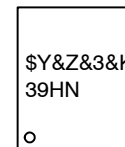
Typical Applications

- DC-DC Converters
- System Voltage Rails

FET	$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
Q1	30 V	5.0 m Ω @ 10 V	53 A
		6.5 m Ω @ 4.5 V	
Q2	30 V	1.0 m Ω @ 10 V	128 A
		1.2 m Ω @ 4.5 V	

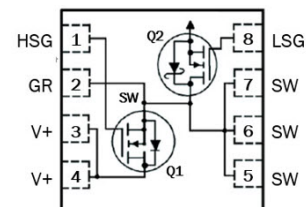
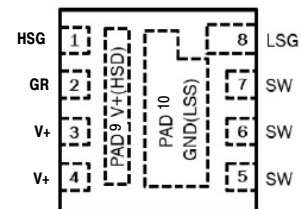


MARKING DIAGRAM



- \$Y = ON Semiconductor Logo
- &Z = Assembly Plant Code
- &3 = Numeric Date Code
- &K = Lot Code
- 39HN = Specific Device Code

ELECTRICAL CONNECTION



ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

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Table 1. MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Q1	Q2	Unit		
Drain-to-Source Voltage	V_{DSS}	30	30	V		
Gate-to-Source Voltage	V_{GS}	± 20	+16 V -12 V	V		
Continuous Drain Current $R_{\theta JC}$ (Note 3)	Steady State	$T_C = 25^\circ\text{C}$	I_D	53	128	A
		$T_C = 85^\circ\text{C}$		38	92	
Power Dissipation $R_{\theta JC}$ (Note 3)		$T_A = 25^\circ\text{C}$	P_D	22	25	W
Continuous Drain Current $R_{\theta JA}$ (Note 1, 3)	Steady State	$T_A = 25^\circ\text{C}$	I_D	16	38	A
		$T_A = 85^\circ\text{C}$		12	27	
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	11	25	A
		$T_A = 85^\circ\text{C}$		8	18	
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}	300	500	A
Single Pulse Drain-to-Source Avalanche Energy Q1: $I_L = 5.3 A_{pk}, L = 3 \text{ mH}$ (Note 4) Q2: $I_L = 8.35 A_{pk}, L = 3 \text{ mH}$ (Note 4)			E_{AS}	42	104	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.

Table 2. THERMAL RESISTANCE RATINGS

Parameter	Symbol	Q1 Max	Q2 Max	Units
Junction-to-Case – Steady State (Note 1, 3)	$R_{\theta JC}$	5.6	4.9	$^\circ\text{C}/\text{W}$
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	

- Surface-mounted on FR4 board using 1 in² pad size, 2 oz Cu pad.
- Surface-mounted on FR4 board using minimum pad size, 2 oz Cu pad.
- 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. $R_{\theta CA}$ is determined by the user's board design.
- Q1 100% UIS tested at $L = 0.1 \text{ mH}, I_{AS} = 20 \text{ A}$.
Q2 100% UIS tested at $L = 0.1 \text{ mH}, I_{AS} = 47 \text{ A}$.

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Table 3. 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	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	Q1	30			V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	Q2	30			
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS} / T_J$	$I_D = 250\ \mu\text{A}, \text{ ref to } 25^\circ\text{C}$	Q1		15		mV/ $^\circ\text{C}$
		$I_D = 50\text{ mA}, \text{ ref to } 25^\circ\text{C}$	Q2		16		
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$	$T_J = 25^\circ\text{C}$	Q1		1	μA
				Q2		500	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$	Q1			100	nA
		$V_{DS} = 0\text{ V}, V_{GS} = 16\text{ V}$	Q2			100	

ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	Q1	1.0		3.0	V
		$V_{GS} = V_{DS}, I_D = 1\text{ mA}$	Q2	1.0		3.0	
Threshold Temperature Coefficient	$V_{GS(TH)} / T_J$	$I_D = 250\ \mu\text{A}, \text{ ref to } 25^\circ\text{C}$	Q1		-5		mV/ $^\circ\text{C}$
		$I_D = 50\text{ mA}, \text{ ref to } 25^\circ\text{C}$	Q2		-3		
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 17\text{ A}$	Q1		4.5	5.0	m Ω
		$V_{GS} = 4.5\text{ V}, I_D = 14\text{ A}$			5.4	6.5	
		$V_{GS} = 10\text{ V}, I_D = 40\text{ A}$	Q2		0.75	1.0	
		$V_{GS} = 4.5\text{ V}, I_D = 37\text{ A}$			0.9	1.2	
Forward Transconductance	g_{FS}	$V_{DS} = 5\text{ V}, I_D = 14\text{ A}$	Q1		93		S
		$V_{DS} = 5\text{ V}, I_D = 37\text{ A}$	Q2		248		
Gate Resistance	R_G	$T_A = 25^\circ\text{C}$	Q1		1		Ω
			Q2		1		

CHARGES & CAPACITANCES

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, V_{DS} = 15\text{ V}, f = 1\text{ MHz}$	Q1		1224		pF	
			Q2		6575			
Output Capacitance	C_{OSS}		Q1		397		pF	
			Q2		2086			
Reverse Capacitance	C_{RSS}		Q1		42		pF	
			Q2		138			
Total Gate Charge	$Q_{G(TOT)}$		Q1: $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 14\text{ A}$ Q2: $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 37\text{ A}$	Q1		7.9		nC
				Q2		43		
Gate-to-Drain Charge	Q_{GD}	Q1			2.0		nC	
		Q2			9.5			
Gate-to-Source Charge	Q_{GS}	Q1			3.1		nC	
		Q2			15.8			
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 14\text{ A}$		Q1		17		nC
		$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 37\text{ A}$		Q2		93		

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

6. Switching characteristics are independent of operating junction temperatures

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Table 3. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Test Condition	FET	Min	Typ	Max	Unit	
SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 6)								
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}$ Q1: $I_D = 14\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$ Q2: $I_D = 37\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$	Q1		36		ns	
			Q2		12.6			
Rise Time	$t_{r(ON)}$		Q1		30.7		ns	
			Q2		21.5			
Turn-Off Delay Time	$t_{d(OFF)}$		Q1		64.7		ns	
			Q2		17.5			
Fall Time	t_f		Q1		23.5		ns	
			Q2		7.3			
SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 6)								
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}$ Q1: $I_D = 17\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$ Q2: $I_D = 40\text{ A}$, $V_{DD} = 15\text{ V}$, $R_G = 6\ \Omega$	Q1		8.0		ns	
			Q2		8.6			
Rise Time	$t_{r(ON)}$		Q1		2.0		ns	
			Q2		18.2			
Turn-Off Delay Time	$t_{d(OFF)}$		Q1		23.5		ns	
			Q2		4.5			
Fall Time	t_f		Q1		2.0		ns	
			Q2		4.5			
SOURCE-TO-DRAIN DIODE CHARACTERISTICS								
Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}$, $I_S = 14\text{ A}$	$T_J = 25^\circ\text{C}$	Q1		0.79	1.2	V
			$T_J = 125^\circ\text{C}$			0.66		
		$V_{GS} = 0\text{ V}$, $I_S = 37\text{ A}$	$T_J = 25^\circ\text{C}$	Q2		0.77	1.2	
			$T_J = 125^\circ\text{C}$			0.63		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}$ Q1: $I_S = 14\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ Q2: $I_S = 37\text{ A}$, $di/dt = 240\text{ A}/\mu\text{s}$	Q1		23		ns	
			Q2		4.6			
Reverse Recovery Charge	Q_{RR}		Q1		8.0		nC	
			Q2		68.3			

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

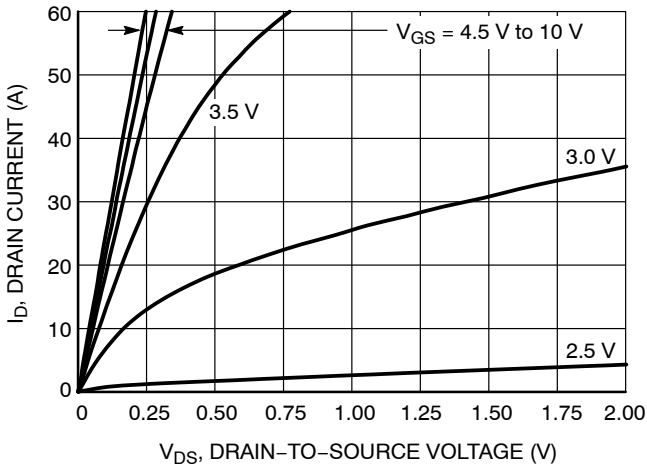


Figure 1. On-Region Characteristics

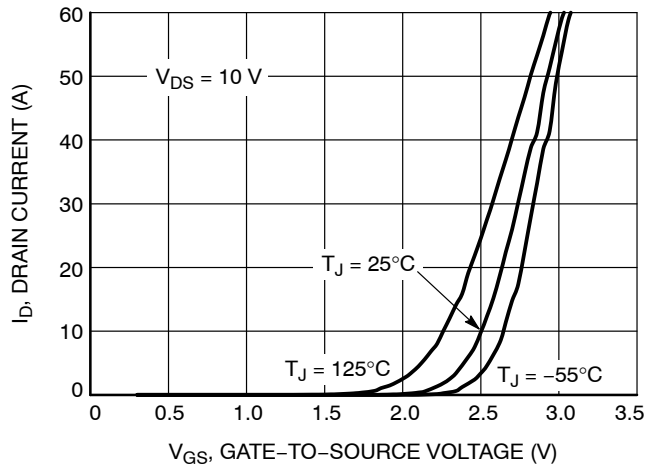


Figure 2. Transfer Characteristics

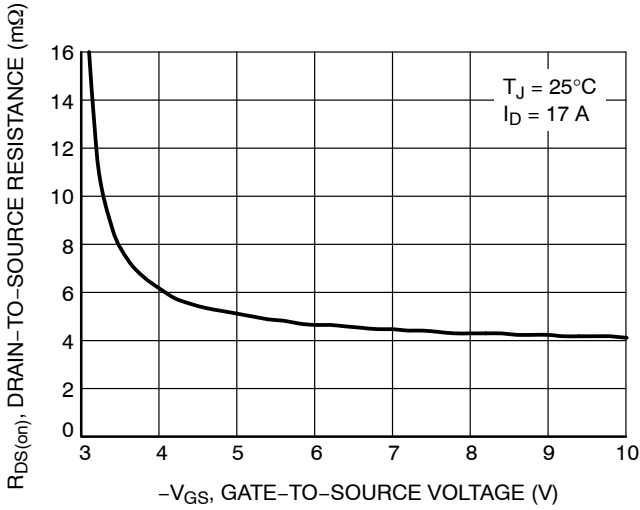


Figure 3. On-Resistance vs. Gate-to-Source Voltage

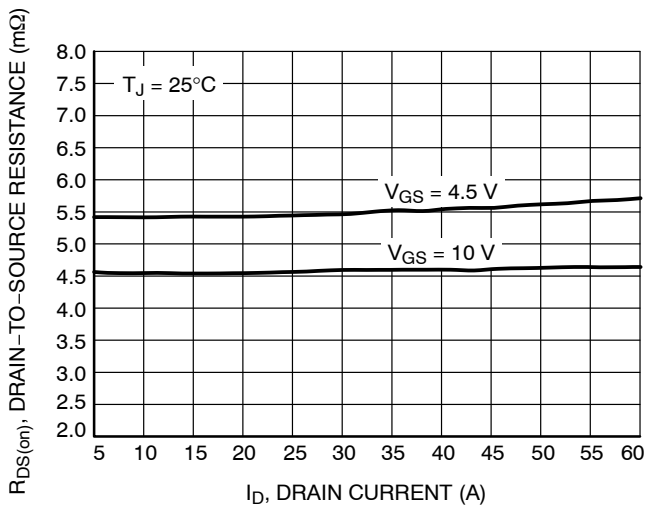


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

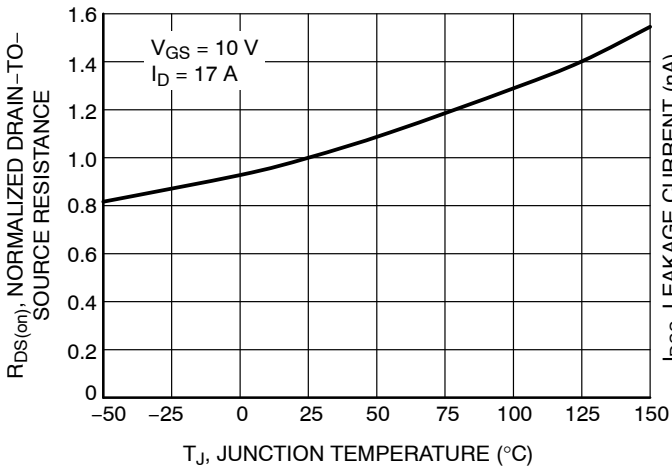


Figure 5. On-Resistance Variation with Temperature

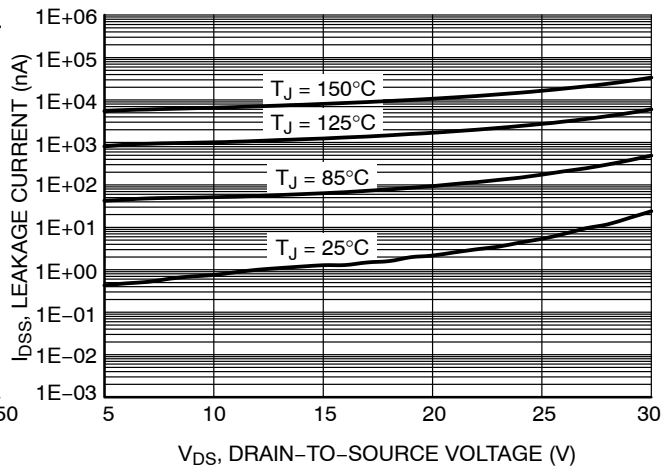


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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TYPICAL CHARACTERISTICS – Q1

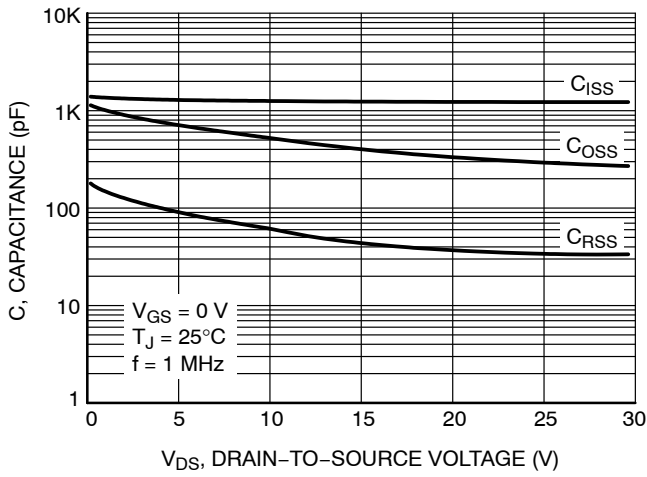


Figure 7. Capacitance Variation

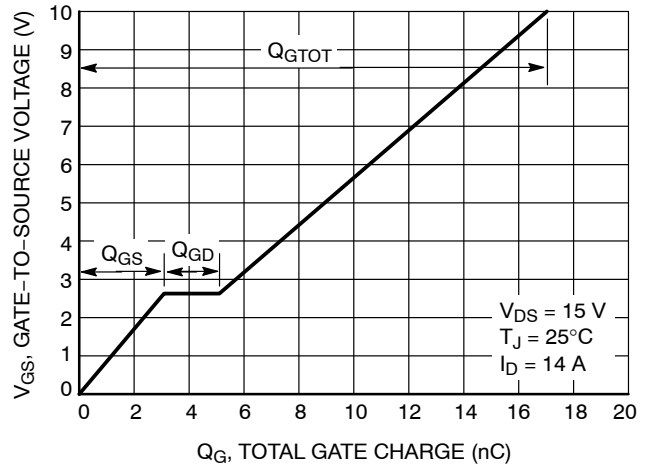


Figure 8. Gate-to-Source Voltage vs. Total Charge

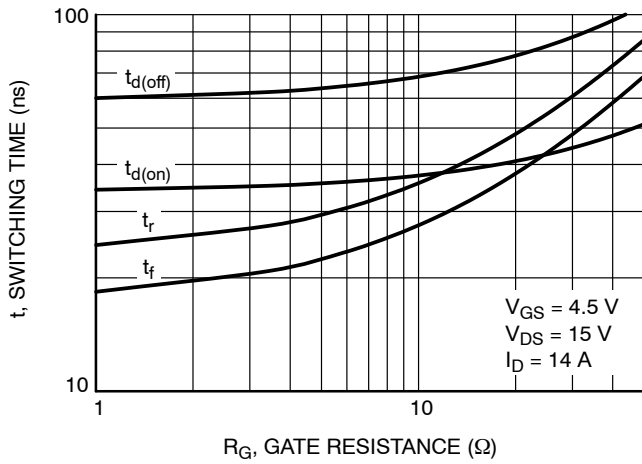


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

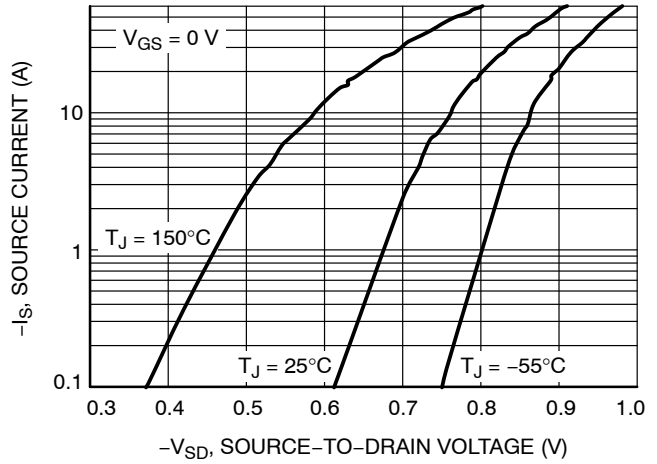


Figure 10. Diode Forward Voltage vs. Current

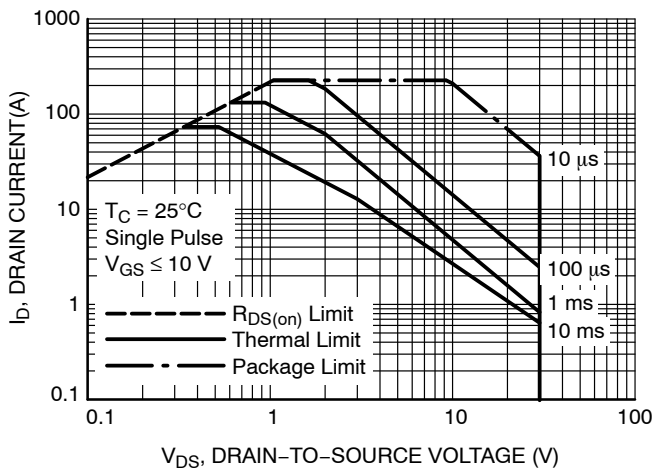


Figure 11. Maximum Rated Forward Biased Safe Operating Area

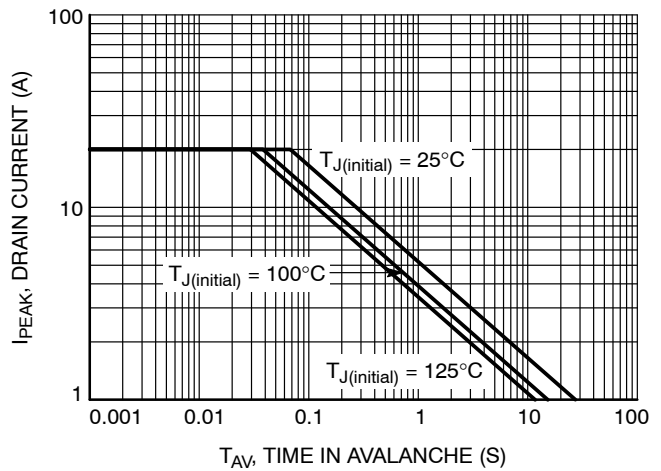


Figure 12. Maximum Drain Current vs. Time in Avalanche

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TYPICAL CHARACTERISTICS – Q1

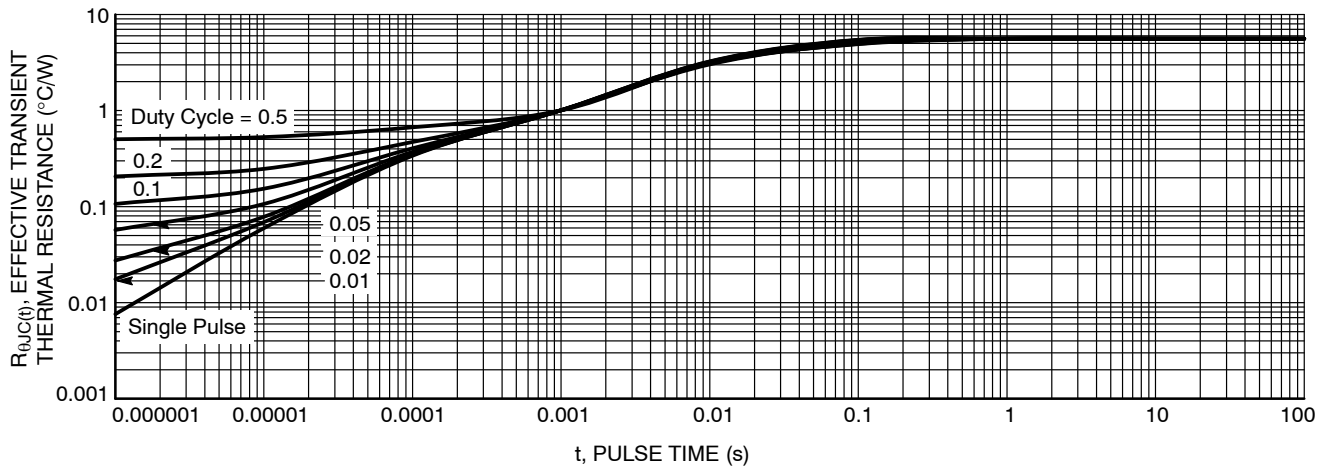


Figure 13. Thermal Response

TYPICAL CHARACTERISTICS – Q2

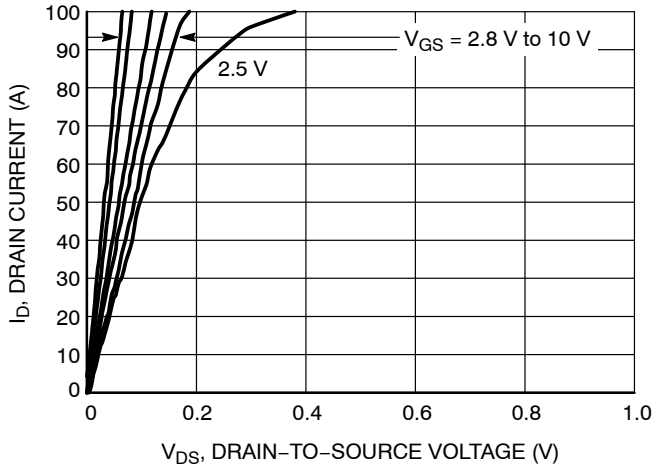


Figure 14. On-Region Characteristics

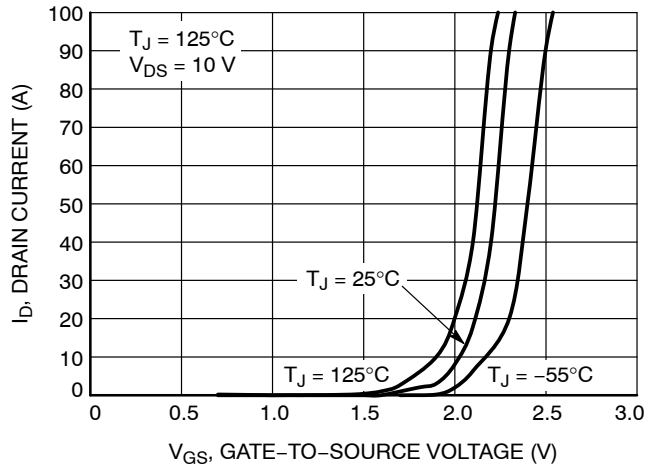


Figure 15. Transfer Characteristics

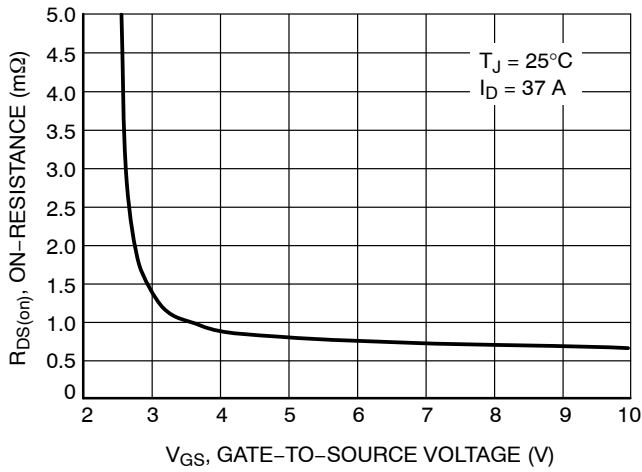


Figure 16. On-Resistance vs. Gate-to-Source Voltage

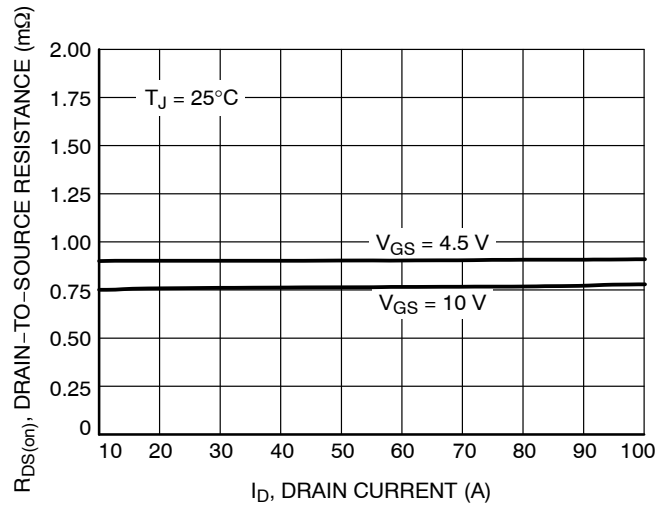


Figure 17. On-Resistance vs. Drain Current and Gate Voltage

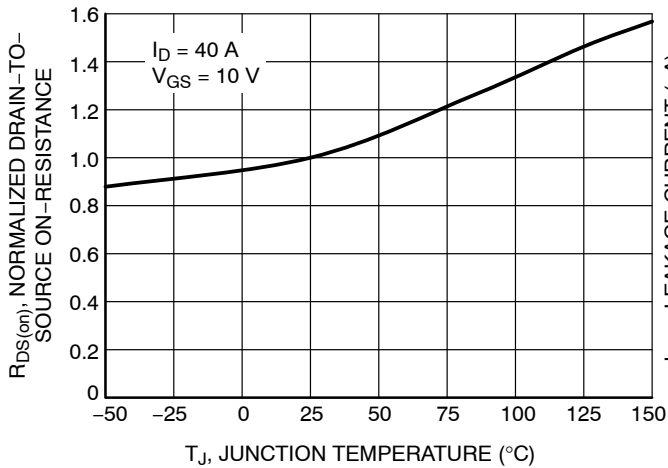


Figure 18. On-Resistance Variation with Temperature

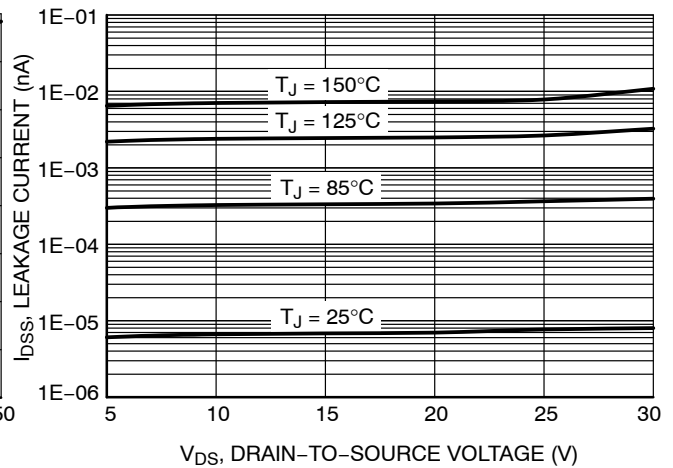


Figure 19. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS – Q2

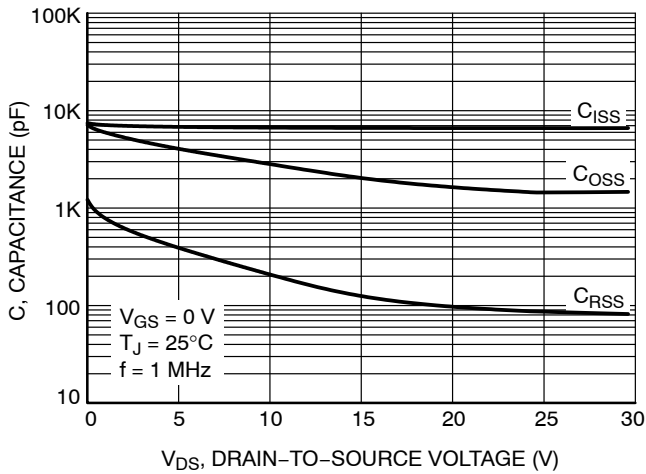


Figure 20. Capacitance Variation

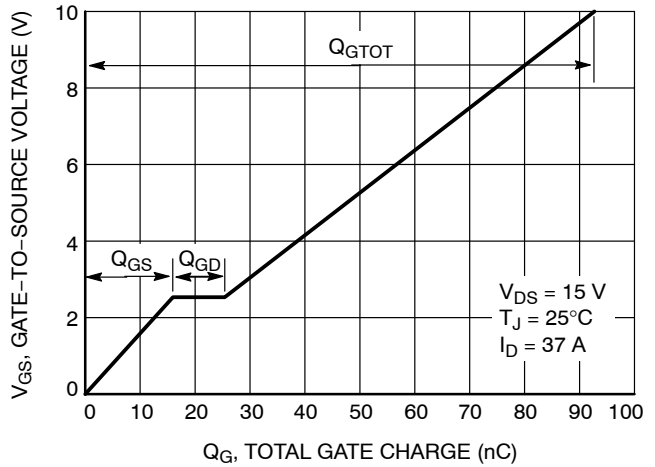


Figure 21. Gate-to-Source Voltage vs. Total Charge

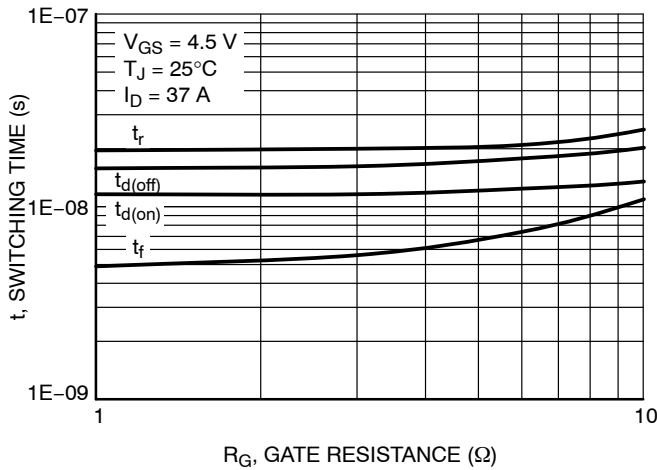


Figure 22. Resistive Switching Time Variation vs. Gate Resistance

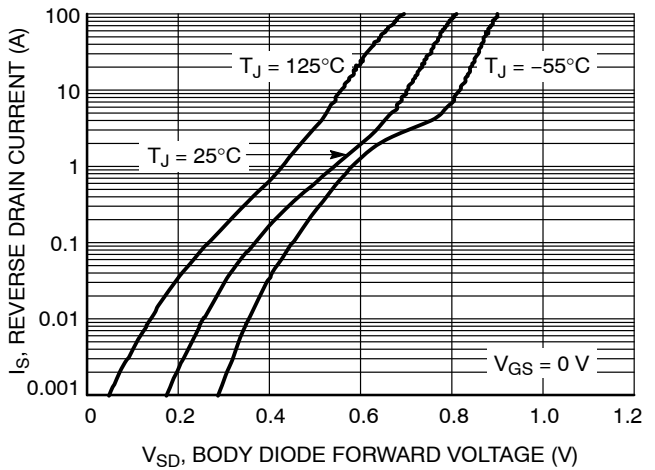


Figure 23. Diode Forward Voltage vs. Current

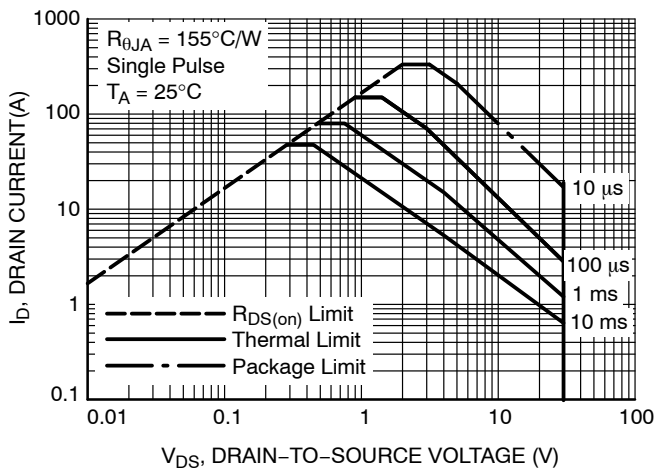


Figure 24. Maximum Rated Forward Biased Safe Operating Area

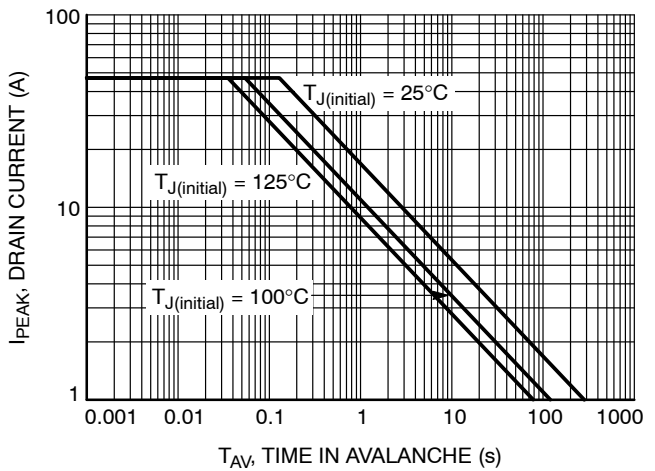


Figure 25. Maximum Drain Current vs. Time in Avalanche

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TYPICAL CHARACTERISTICS – Q2

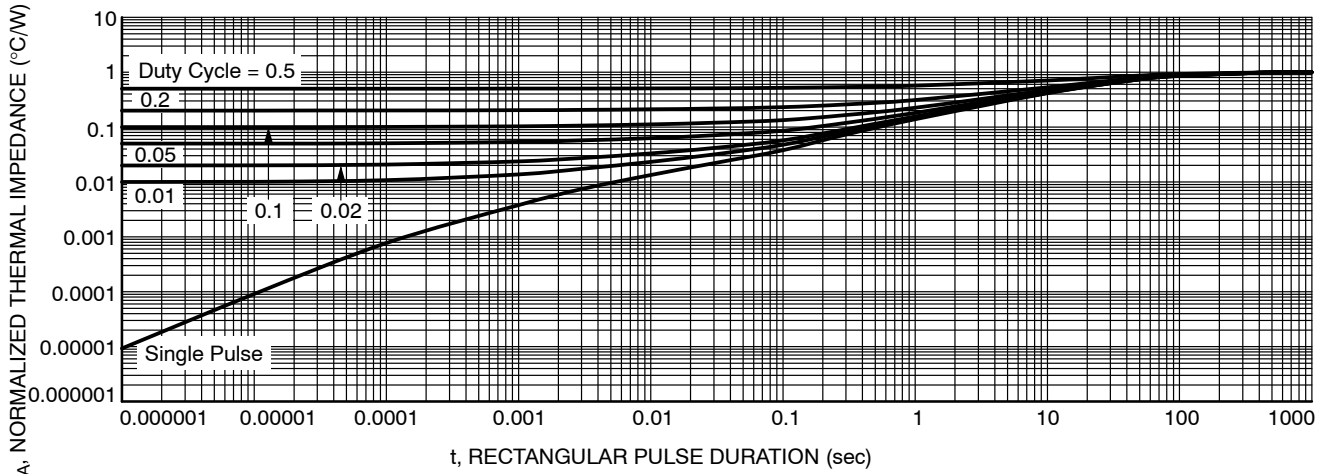


Figure 26. Transient Thermal Impedance

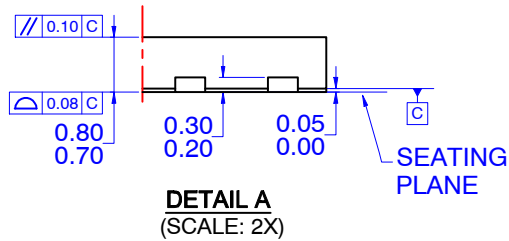
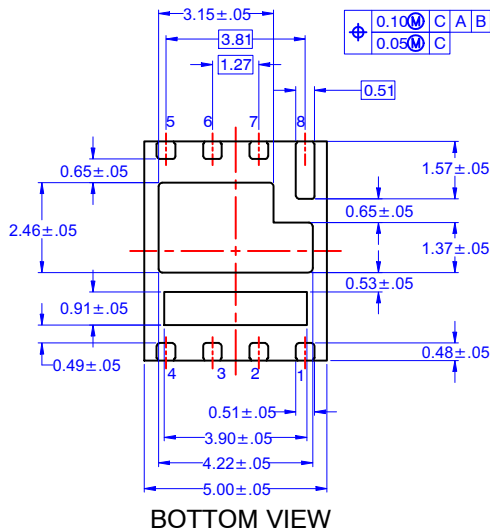
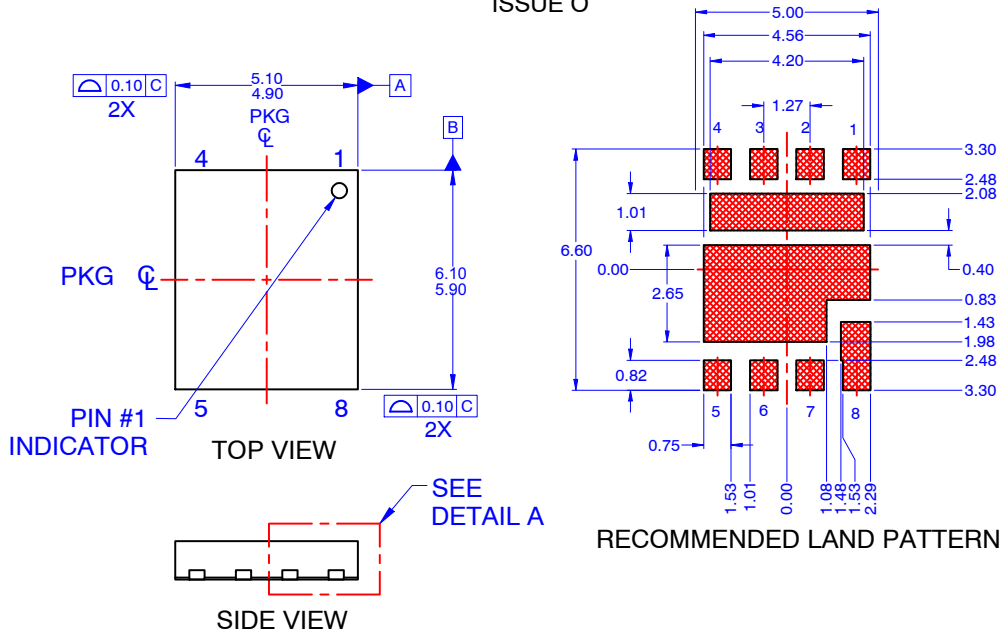
ORDERING INFORMATION

Device	Package	Shipping
NTMFD001N03P9	DFN8 (Pb-Free)	3000 / Tape & Reel

NTMFD001N03P9

PACKAGE DIMENSIONS


PQFN8 5X6, 1.27P
CASE 483AR
ISSUE O



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.

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