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 Rg 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°C unless otherwise stated)

Parameter			Symbol	Q1	Q2	Unit
Drain−to−Source Voltage			V_{DSS}	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°C	I_D	77	180	A
		T_C = 85°C		56	130	
Power Dissipation $R_{\theta JC}$ (Note 3)		T_A = 25°C	P_D	29.2	37.4	W
Continuous Drain Current $R_{\theta JA}$ (Note 1, 3)	Steady State	T_A = 25°C	I_D	21	44	A
		T_A = 85°C		15	32	
Power Dissipation $R_{\theta JA}$ (Note 1, 3)		T_A = 25°C	P_D	2.1	2.3	W
Continuous Drain Current $R_{\theta JA}$ (Note 2, 3)	Steady State	T_A = 25°C	I_D	14	30	A
		T_A = 85°C		10	21	
Power Dissipation $R_{\theta JA}$ (Note 2, 3)		T_A = 25°C	P_D	0.96	1.04	W
Pulsed Drain Current	T_A = 25°C, t_p = 10 μs		I_{DM}	356	1023	A
Single Pulse Drain−to−Source Avalanche Energy Q1: I_L = 10 A_{pk}, L = 3 mH (Note 4) Q2: I_L = 20 A_{pk}, L = 3 mH (Note 4)			E_{AS}	150	600	mJ
Operating Junction and Storage Temperature			T_J, T_{stg}	−55 to 150		°C
Lead Temperature Soldering Reflow for Soldering Purposes (1/8″ from case for 10 s)			T_L	260		°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.

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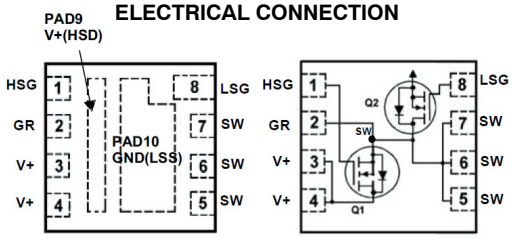
FET	$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
Q1	30 V	3.0 mΩ @ 10 V	77 A
		3.8 mΩ @ 4.5 V	
Q2	25 V	0.72 mΩ @ 10 V	180 A
		0.95 mΩ @ 4.5 V	

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.

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 in^2 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°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 V, I_D = 1 mA	Q1	30			V
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1 mA	Q2	25			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}$ / T_J	I_D = 1 mA, ref to 25°C	Q1		18		mV/°C
		I_D = 1 mA, ref to 25°C	Q2		16		
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 24 V, T_J = 25°C	Q1			10	μA
		V_{GS} = 0 V, V_{DS} = 20 V	Q2			10	
Gate−to−Source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} = +16 V / −12 V	Q1			±100	nA
		V_{DS} = 0 V, V_{GS} = +16 V / −12 V	Q2			±100	
ON CHARACTERISTICS (Note 5)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 340 μA	Q1	1.2	1.6	2.0	V
		V_{GS} = V_{DS}, I_D = 1 mA	Q2	1.2	1.5	2.0	
Threshold Temperature Coefficient	$V_{GS(TH)}$ / T_J	I_D = 340 μA, ref to 25°C	Q1		−4.4		mV/°C
		I_D = 1 mA, ref to 25°C	Q2		−5.1		
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 20 A	Q1		2.5	3.0	mΩ
		V_{GS} = 4.5 V, I_D = 18 A			3.0	3.8	
		V_{GS} = 10 V, I_D = 41 A	Q2		0.60	0.72	
		V_{GS} = 4.5 V, I_D = 37 A			0.75	0.95	
Forward Transconductance	g_{FS}	V_{DS} = 5 V, I_D = 20 A	Q1		147		
		V_{DS} = 5 V, I_D = 41 A	Q2		311		
Gate Resistance	R_G	T_A = 25°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 ≤ 300 μs, duty cycle ≤ 2%
6. Switching characteristics are independent of operating junction temperatures

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°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 A Q2: V_{GS} = 4.5V, V_{DS} = 13V, I_D = 41 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 V, V_{DS} = 15 V, I_D = 20 A		Q1		19		nC
		V_{GS} = 10 V, V_{DS} = 13 V, I_D = 41 A		Q2		67		
SWITCHING CHARACTERISTICS, VGS = 4.5 V (Note 6)								
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = 4.5 V Q1: I_D = 20 A, V_{DD} = 15 V, R_G = 6Ω Q2: I_D = 41 A, V_{DD} = 13 V, R_G = 6Ω		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 V, I_S = 20 A	T_J = 25°C	Q1		0.8	1.2	V
			T_J = 125°C			0.68		
		V_{GS} = 0 V, I_S = 41 A	T_J = 25°C	Q2		0.8	1.2	
			T_J = 125°C			0.64		
Reverse Recovery Time	t_{RR}	V_{GS} = 0 V, Q1: I_S = 20 A, dI/dt = 100 A/μs Q2: I_S = 41 A, dI/dt = 300 A/μs		Q1		26		ns
				Q2		48		
Reverse Recovery Charge	Q_{RR}			Q1		14		nC
				Q2		79		

5. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%
6. Switching characteristics are independent of operating junction temperatures

TYPICAL CHARACTERISTICS (Q1 N−Channel) T_J = 25°C unless otherwise noted.

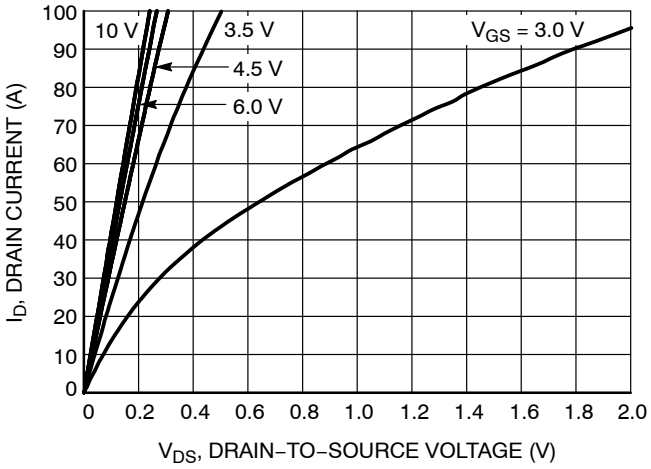


Figure 1. On−Region Characteristics

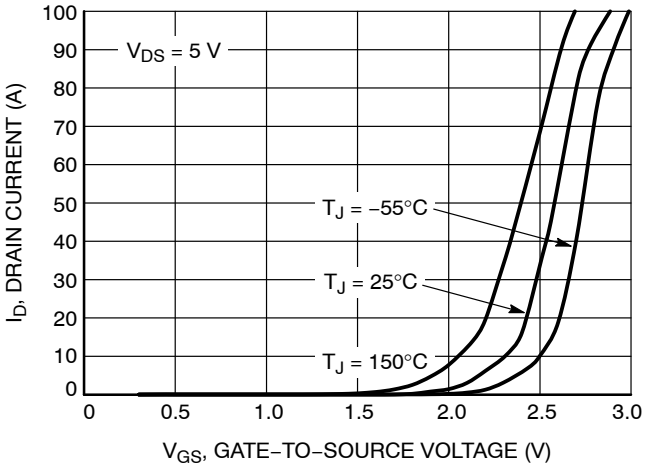


Figure 2. Transfer Characteristics

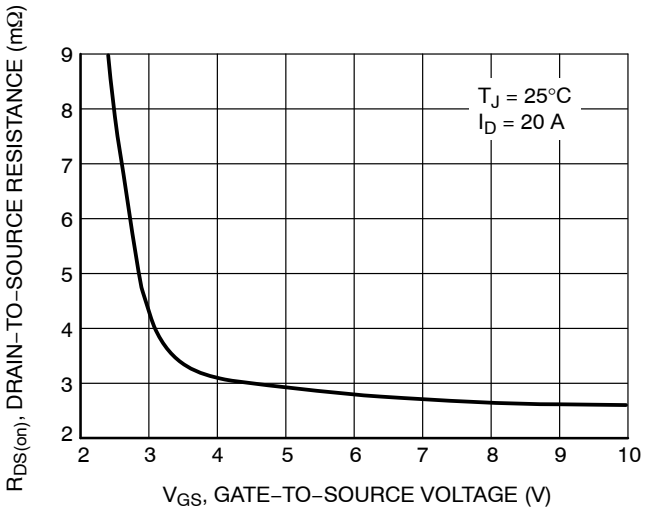


Figure 3. On−Resistance vs. Gate−to−Source Voltage

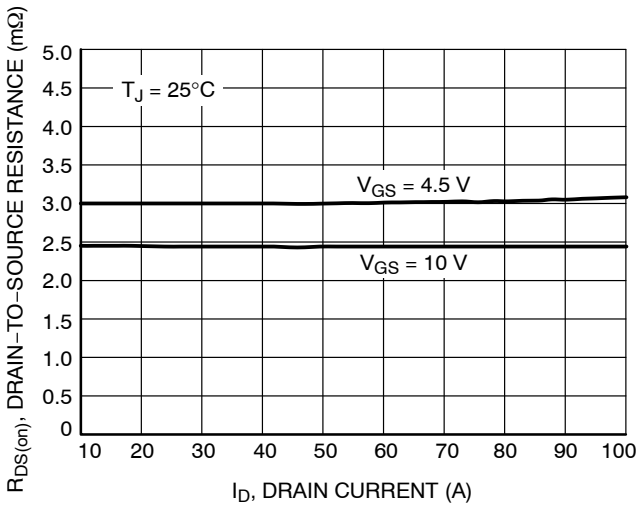


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

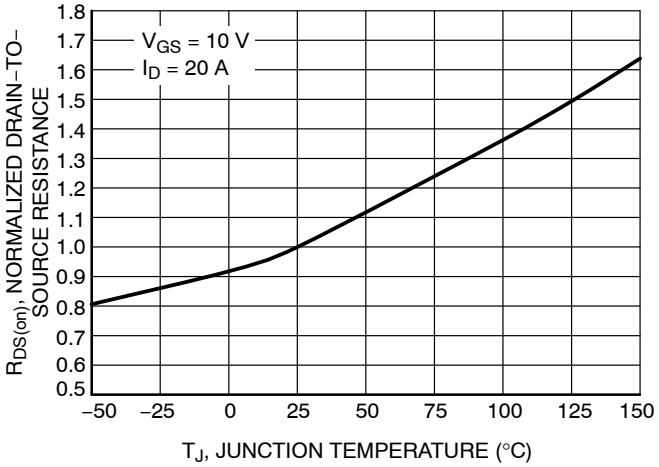


Figure 5. On−Resistance Variation with Temperature

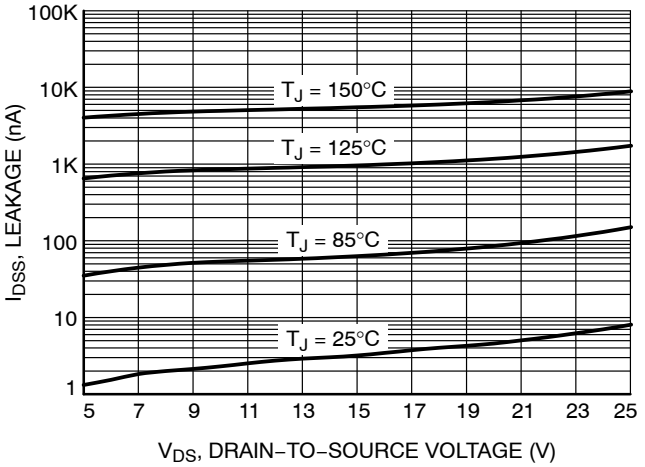


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (Q1 N−Channel) T_J = 25°C unless otherwise noted.

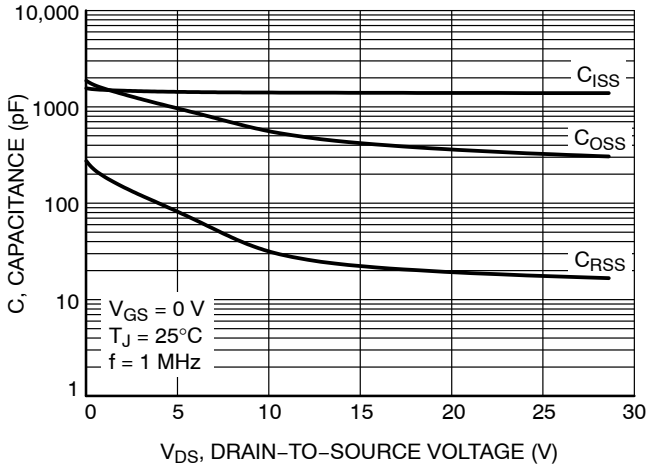


Figure 7. Capacitance Variation

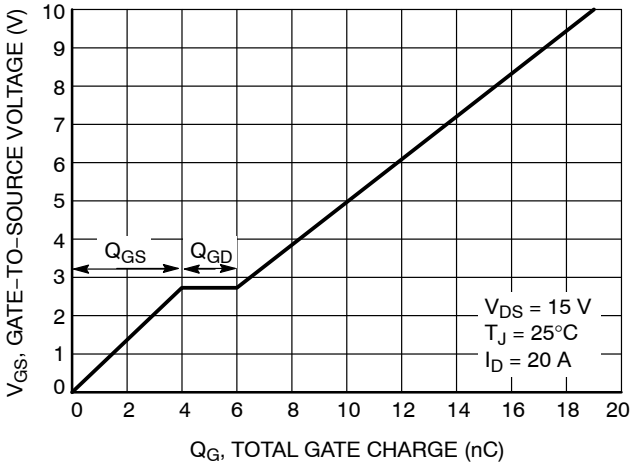


Figure 8. Gate−to−Source Voltage vs. Total Charge

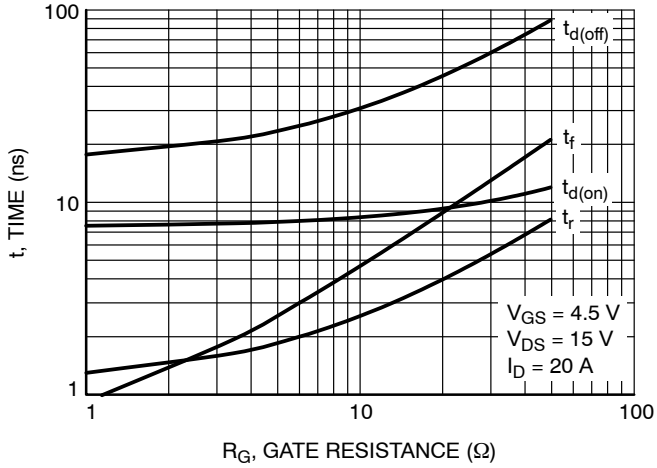


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

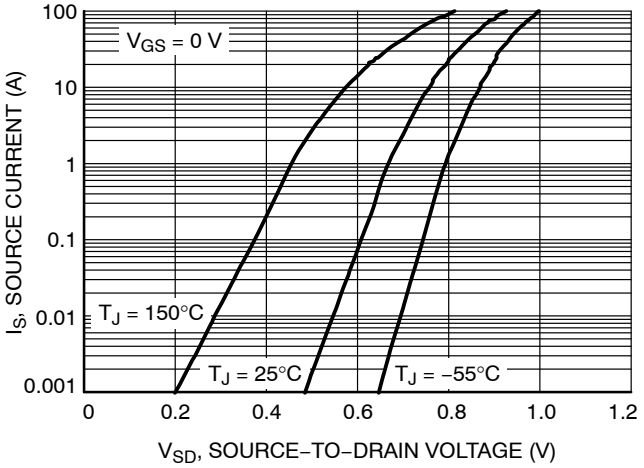


Figure 10. Diode Forward Voltage vs. Current

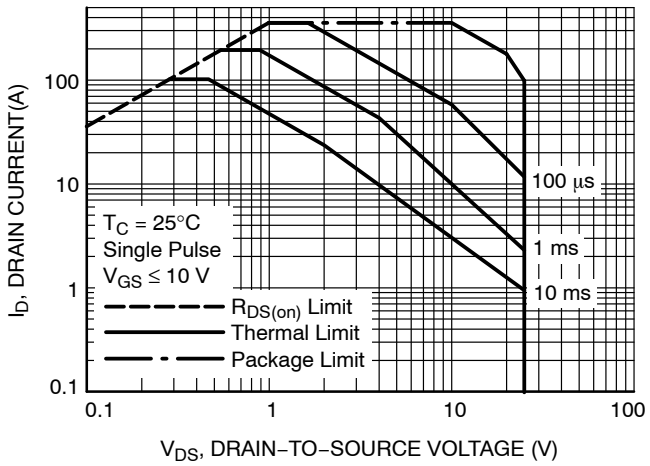


Figure 11. Maximum Rated Forward Biased Safe Operating Area

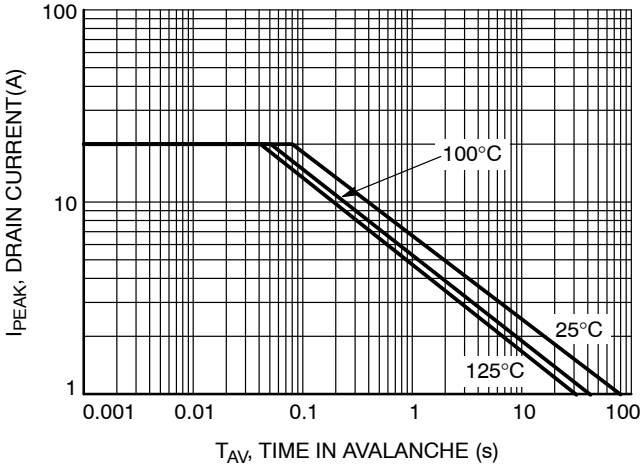


Figure 12. Maximum Drain Current vs. Time in Avalanche

TYPICAL CHARACTERISTICS (Q1 N−Channel) T_J = 25°C unless otherwise noted.

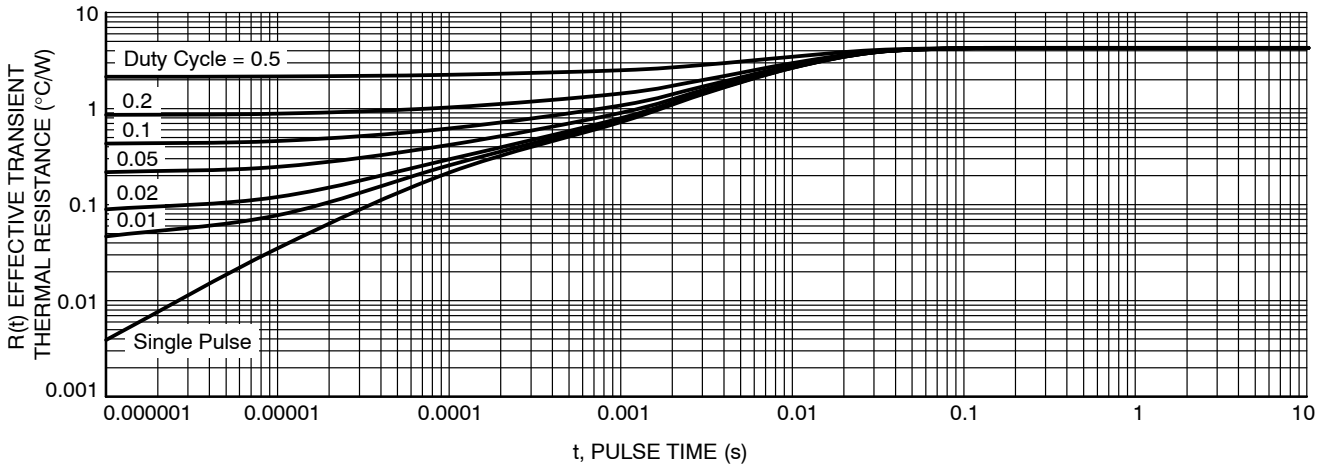


Figure 13. Thermal Response

TYPICAL CHARACTERISTICS (Q2 N−Channel) T_J = 25°C unless otherwise noted.

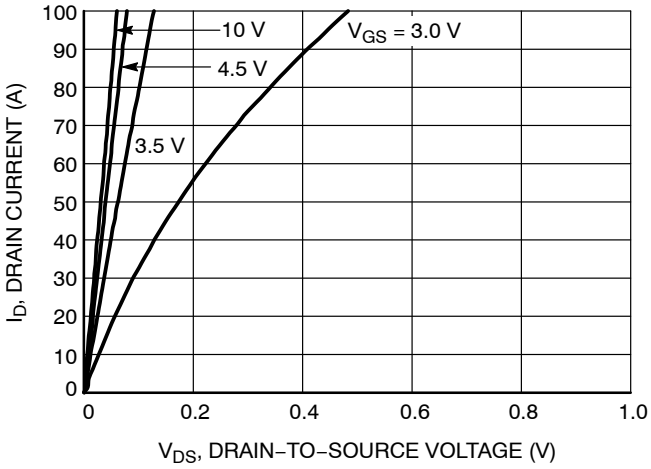


Figure 14. On−Region Characteristics

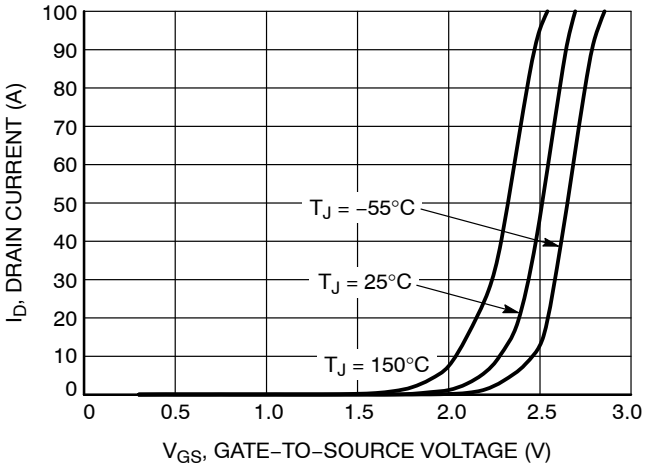


Figure 15. Transfer Characteristics

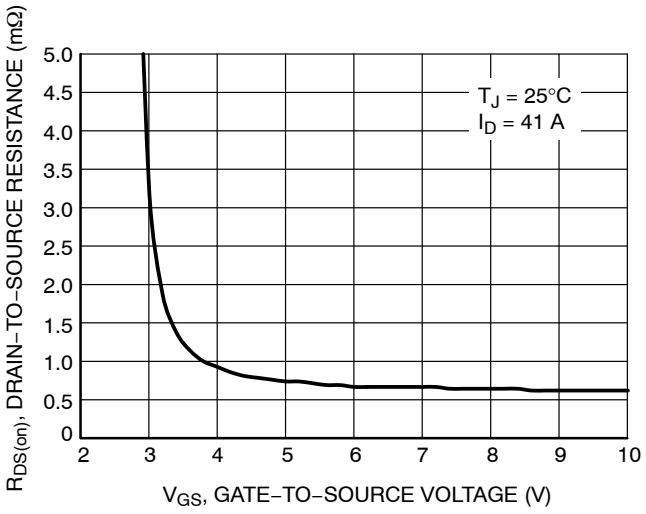


Figure 16. On−Resistance vs. Gate−to−Source Voltage

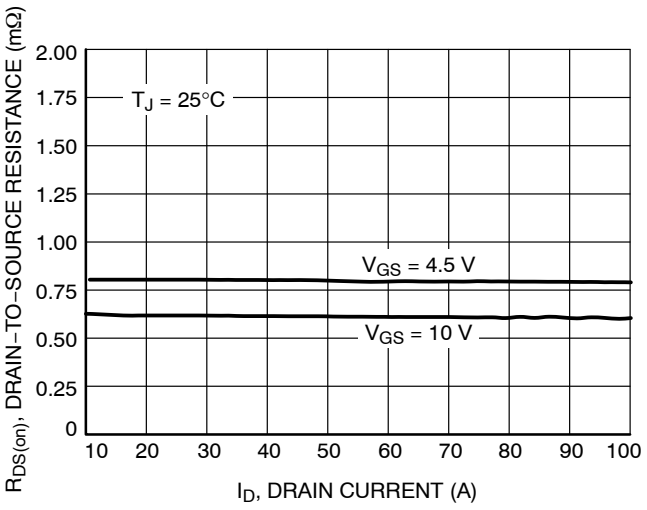


Figure 17. On−Resistance vs. Drain Current and Gate Voltage

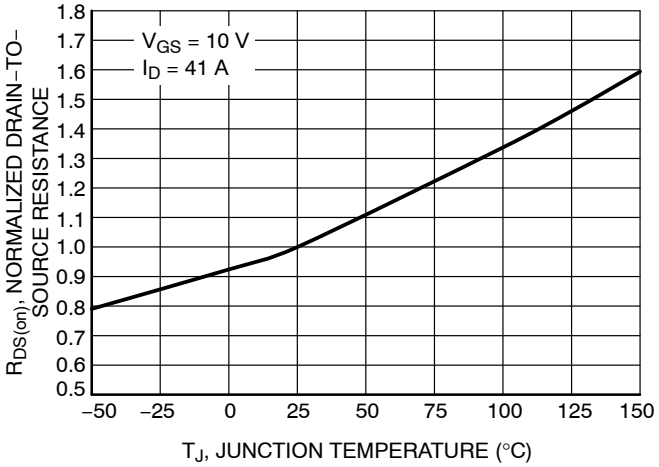


Figure 18. On−Resistance Variation with Temperature

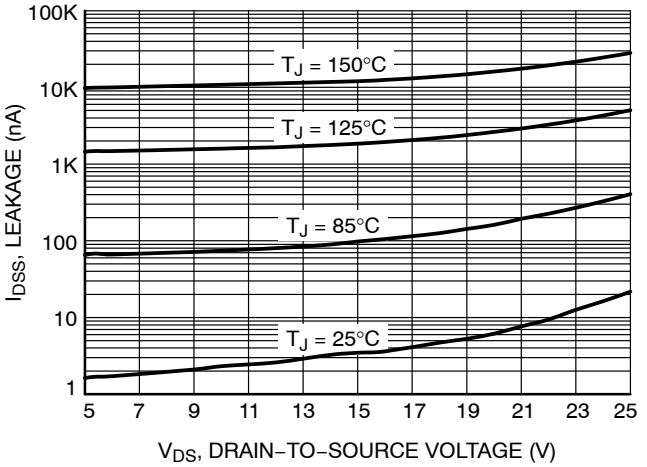


Figure 19. Drain−to−Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (Q2 N−Channel) T_J = 25°C unless otherwise noted.

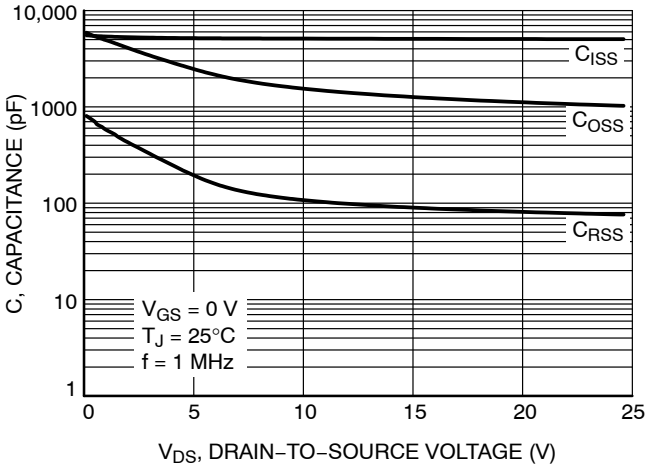


Figure 20. Capacitance Variation

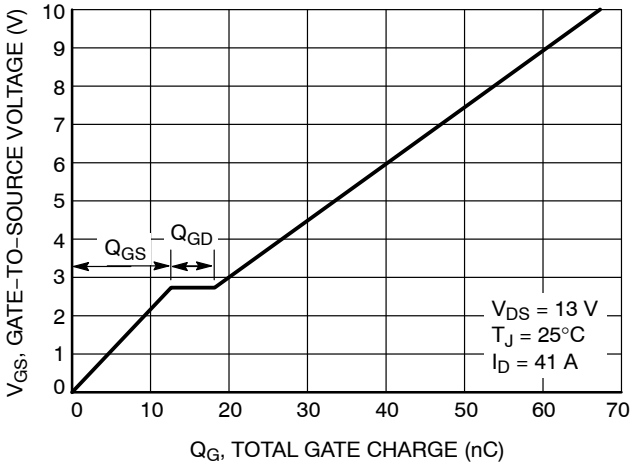


Figure 21. Gate−to−Source Voltage vs. Total Charge

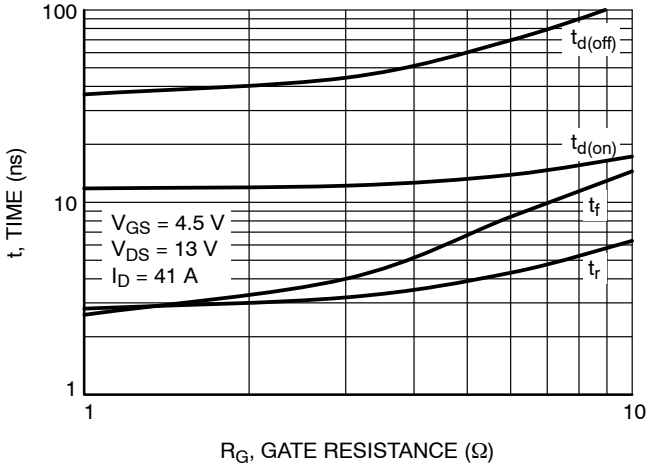


Figure 22. Resistive Switching Time Variation vs. Gate Resistance

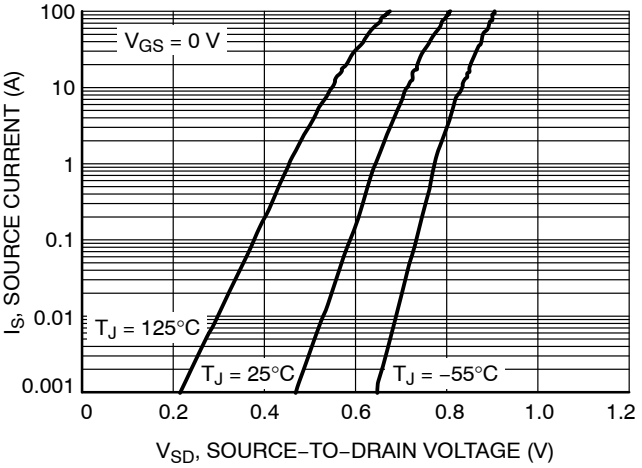


Figure 23. Diode Forward Voltage vs. Current

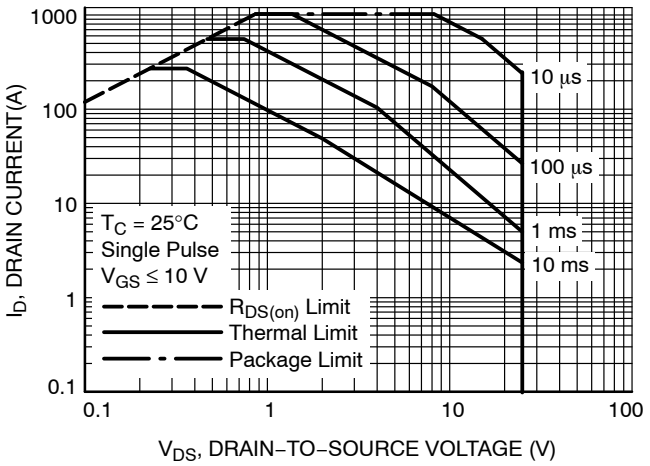


Figure 24. Maximum Rated Forward Biased Safe Operating Area

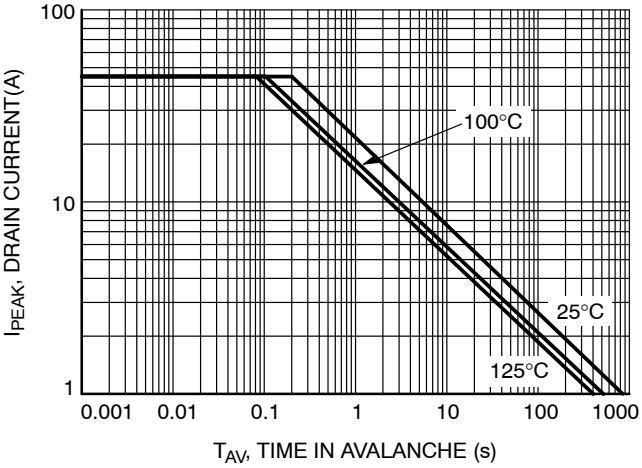


Figure 25. Maximum Drain Current vs. Time in Avalanche

TYPICAL CHARACTERISTICS (Q2 N−Channel) T_J = 25°C unless otherwise noted.

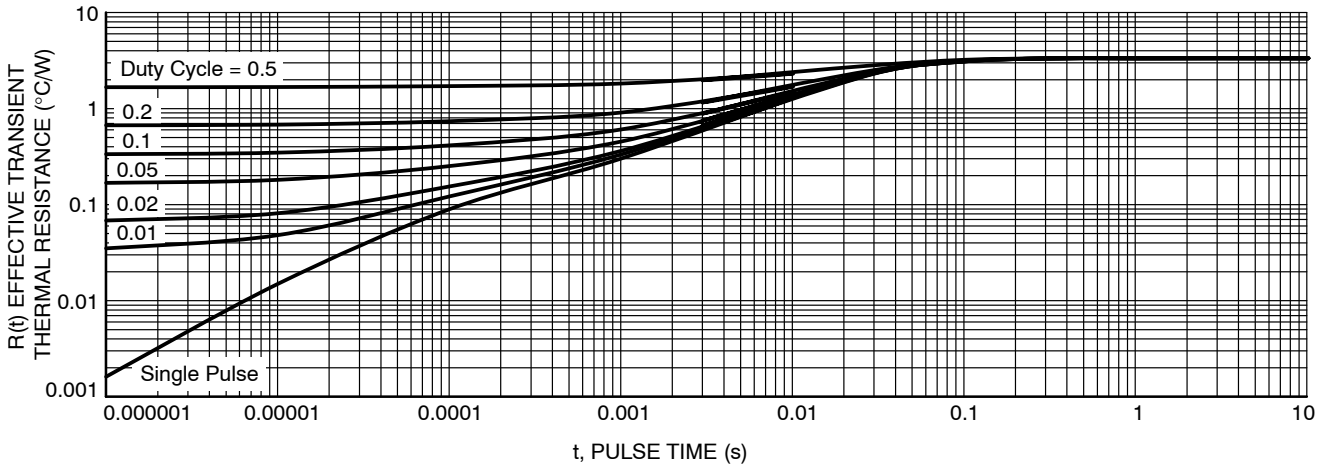
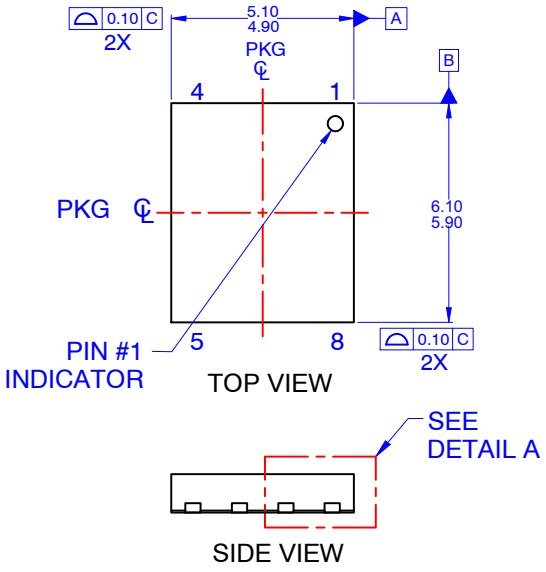
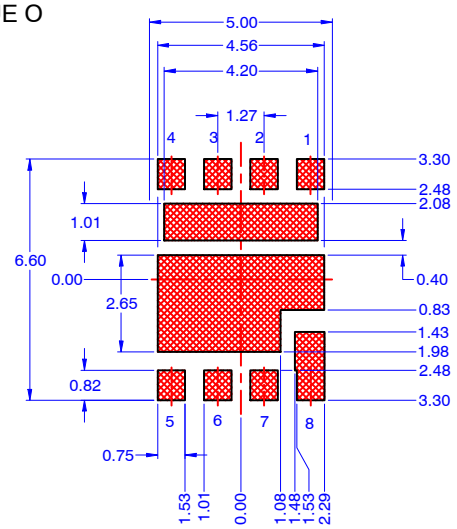


Figure 26. Thermal Response

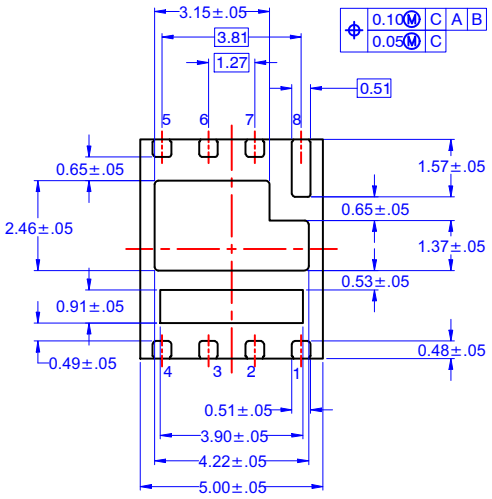
PACKAGE DIMENSIONS

PQFN8 5X6, 1.27P
CASE 483AR
ISSUE O





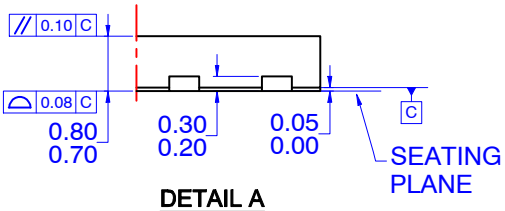
RECOMMENDED LAND PATTERN



BOTTOM VIEW

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.



DETAIL A
(SCALE: 2X)

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