

# MOSFET - Power, Single N-Channel, Source-Down TDFN9

60 V, 1.3 mΩ, 243 A

## NTMFSS1D3N06CL

### 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
- Power Load Switch
- Notebook Battery Management
- Synchronous Rectifier

### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V <sub>DSS</sub>	60	V	
Gate-to-Source Voltage		V <sub>GS</sub>	±20	V	
Continuous Drain Current R <sub>θJC</sub>	Steady State	T <sub>C</sub> = 25°C	I <sub>D</sub>	243	A
		T <sub>C</sub> = 100°C		153	
Power Dissipation R <sub>θJC</sub>	Steady State	T <sub>C</sub> = 25°C	P <sub>D</sub>	153	W
		T <sub>C</sub> = 100°C		61	
Continuous Drain Current R <sub>θJA</sub> (Notes 1, 2)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub>	31	A
		T <sub>C</sub> = 100°C		19	
Power Dissipation R <sub>θJA</sub> (Notes 1, 2)	Steady State	T <sub>A</sub> = 25°C	P <sub>D</sub>	2.5	W
		T <sub>C</sub> = 100°C		1	
Pulsed Drain Current	T <sub>A</sub> = 25°C, t <sub>p</sub> = 10 μs	I <sub>DM</sub>	1758	A	
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C	
Single Pulse Drain-to-Source Avalanche Energy (I <sub>L(pk)</sub> = 79 A)		E <sub>AS</sub>	234	mJ	
Lead Temperature Soldering Reflow for Soldering Purposes (1/8" from case for 10 s)		T <sub>L</sub>	260	°C	

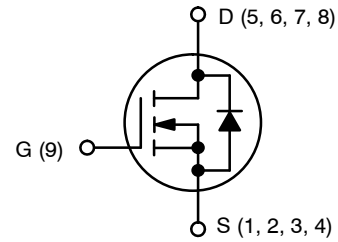
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE MAXIMUM RATINGS

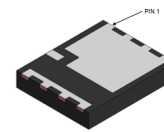
Parameter	Symbol	Value	Unit
Junction-to-Case - Steady State	R <sub>θJC</sub>	0.81	°C/W
Junction-to-Ambient - Steady State (Note 2)	R <sub>θJA</sub>	50	

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Surface-mounted on FR4 board using a 1 in<sup>2</sup> pad size, 2 oz. Cu pad.

V <sub>(BR)DSS</sub>	R <sub>DS(ON) MAX</sub>	I <sub>D MAX</sub>
60 V	1.3 mΩ @ 10 V	243 A
	2.0 mΩ @ 4.5 V	

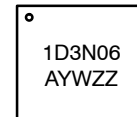


N-CHANNEL MOSFET



TDFN9 5x6  
CASE 520AE

### MARKING DIAGRAM



XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Wafer Lot

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTMFSS1D3N06CL	TDFN9 (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>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.

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## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA, ref to 25°C		24		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 60 V, T <sub>J</sub> = 25°C			10	μA
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = 20 V			100	nA

### ON CHARACTERISTICS

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	1.2		2.0	V
Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>	I <sub>D</sub> = 250 μA, ref to 25°C		-5.9		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 50 A		1.0	1.3	mΩ
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 50 A		1.3	2.0	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 50 A		180		S
Gate Resistance	R <sub>G</sub>	T <sub>A</sub> = 25°C		0.6		Ω

### CHARGES & CAPACITANCES

Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>DS</sub> = 30 V		8190		pF	
Output Capacitance	C <sub>OSS</sub>			3950			
Reverse Capacitance	C <sub>RSS</sub>			25			
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 30 V, I <sub>D</sub> = 50 A		117		nC	
Total Gate Charge	Q <sub>G(TOT)</sub>		V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 30 V, I <sub>D</sub> = 50 A		53		
Gate-to-Drain Charge	Q <sub>GD</sub>				10		
Gate-to-Source Charge	Q <sub>GS</sub>				22.4		
Plateau Voltage	V <sub>GP</sub>				2.8		

### SWITCHING CHARACTERISTICS (Note 3)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DD</sub> = 30 V, I <sub>D</sub> = 50 A, R <sub>G</sub> = 2.5 Ω		19.6		ns
Rise Time	t <sub>r</sub>			9.2		
Turn-Off Delay Time	t <sub>d(OFF)</sub>			55		
Fall Time	t <sub>f</sub>			14		

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 50 A	T <sub>J</sub> = 25°C		0.79	1.2	V
			T <sub>J</sub> = 125°C		0.65		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, di/dt = 100 A/μs, I <sub>S</sub> = 50 A		84		ns	
Charge Time	t <sub>a</sub>			43			
Discharge Time	t <sub>b</sub>			41			
Reverse Recovery Charge	Q <sub>RR</sub>			153			nC

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.

3. Switching characteristics are independent of operating junction temperatures.

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## TYPICAL CHARACTERISTICS

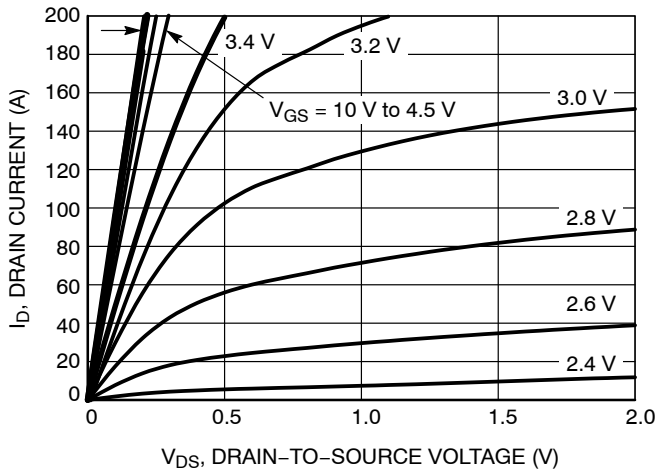


Figure 1. On-Region Characteristics

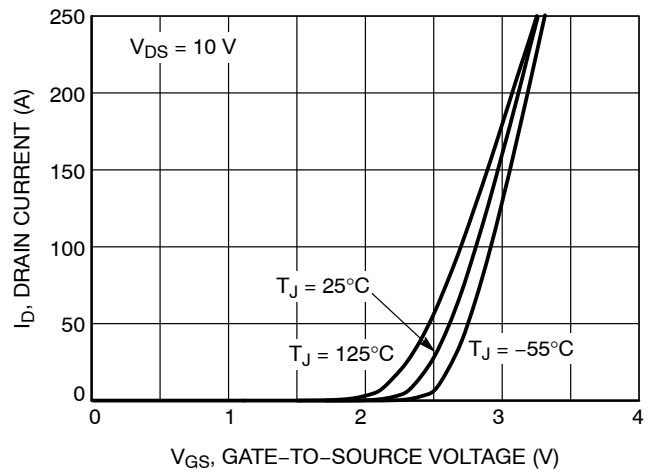


Figure 2. Transfer Characteristics

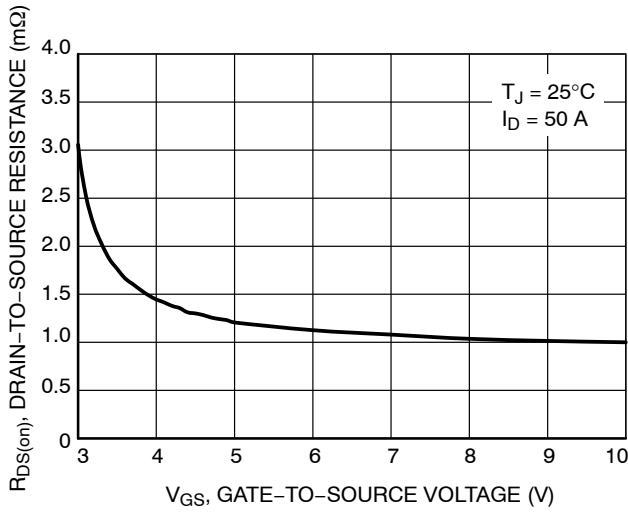


Figure 3. On-Resistance vs. Gate-to-Source Voltage

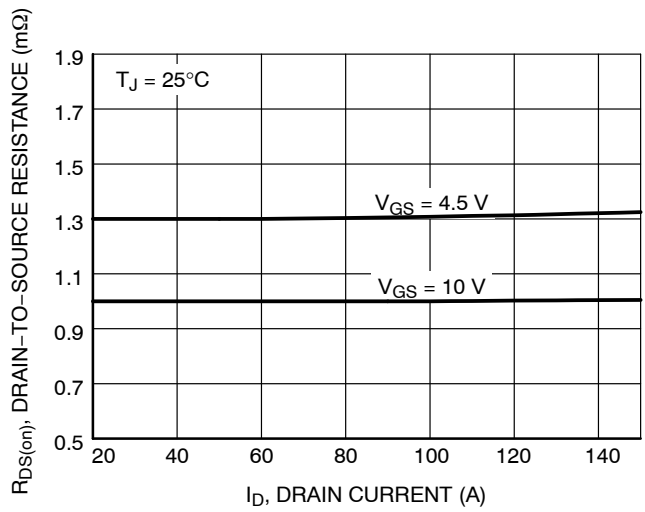


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

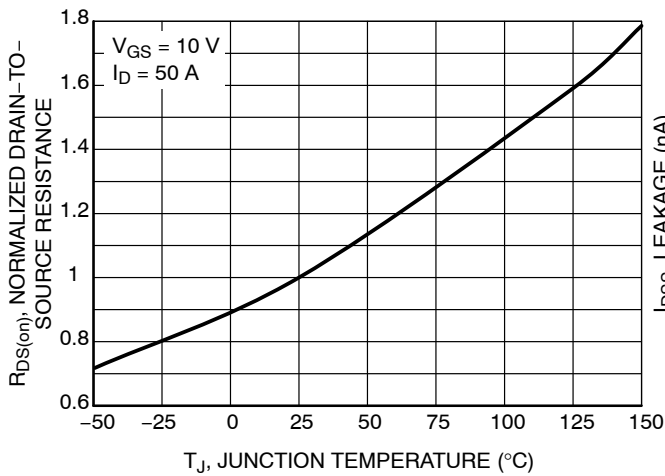


Figure 5. On-Resistance Variation with Temperature

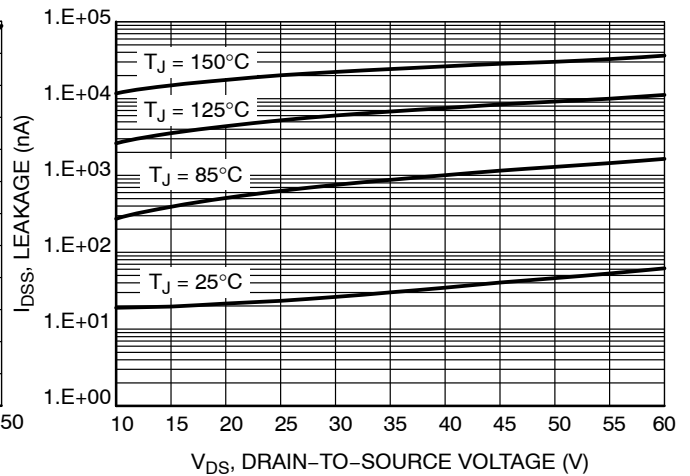


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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## TYPICAL CHARACTERISTICS

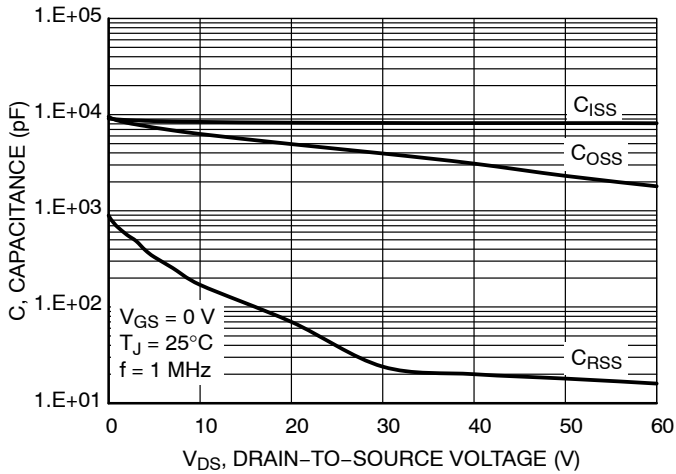


Figure 7. Capacitance Variation

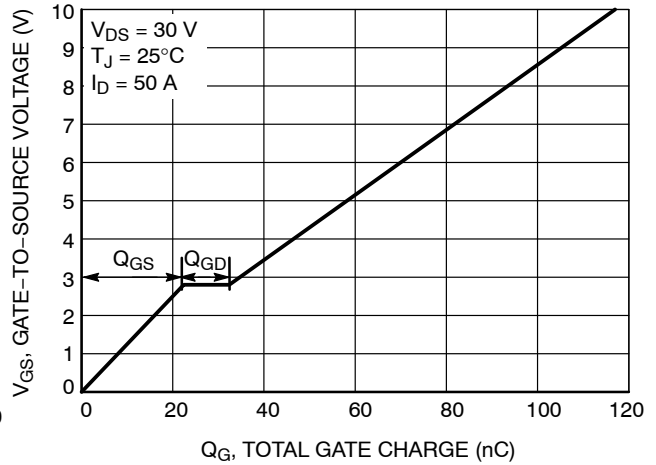


Figure 8. Gate-to-Source vs. Total Charge

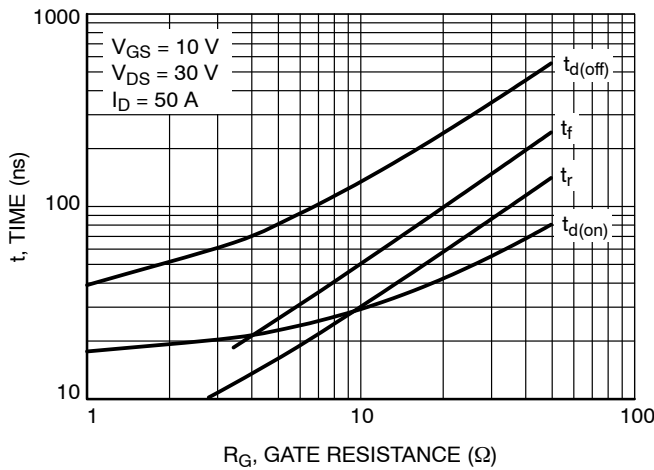


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

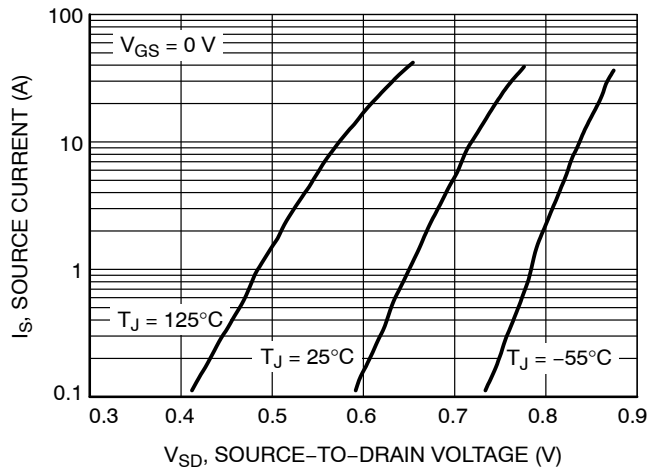


Figure 10. Diode Forward Voltage vs. Current

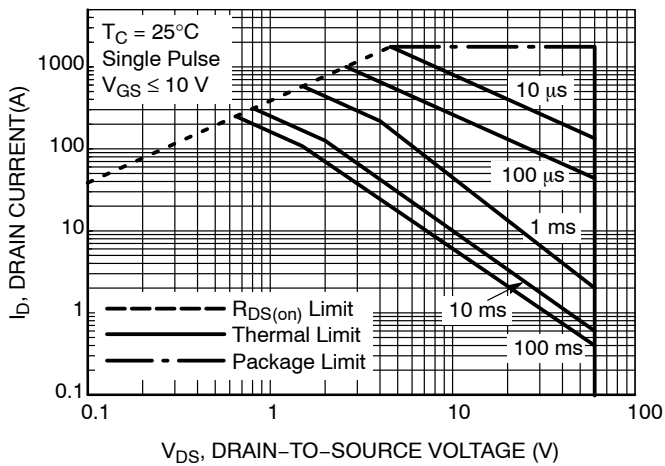


Figure 11. Safe Operating Area

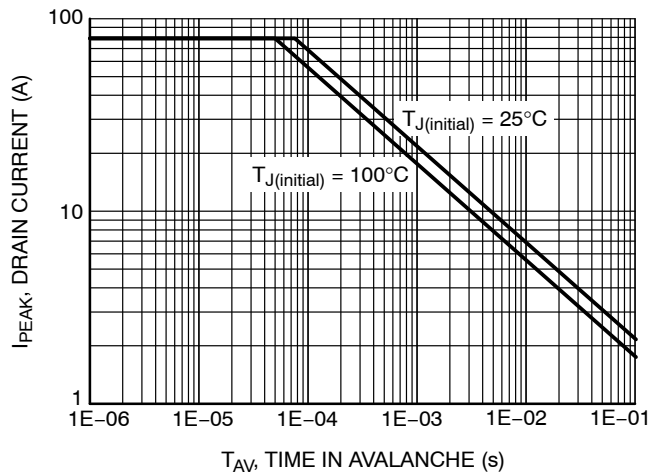


Figure 12.  $I_{PEAK}$  vs. Time in Avalanche

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## TYPICAL CHARACTERISTICS

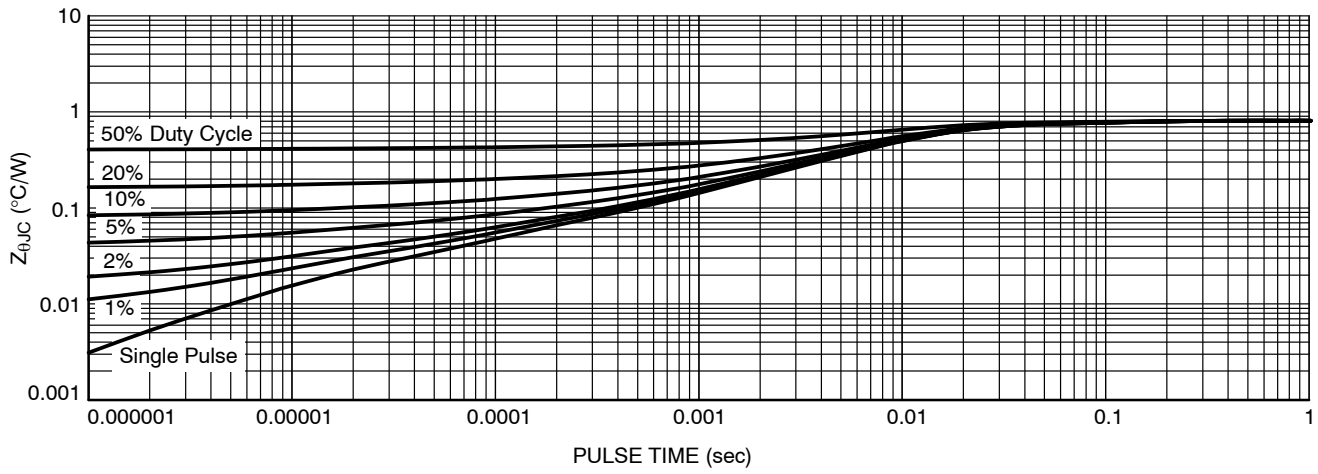


Figure 13. Thermal Characteristics



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