

# MOSFET - Power, Single N-Channel, SO8FL

## 40 V, 1.05 mΩ, 233 A

### NTMFS1D1N04XM

#### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Small Footprint (5 x 6 mm) with Compact Design
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Applications

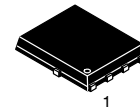
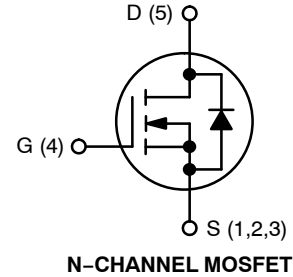
- Motor Drive
- Battery Protection
- ORing

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

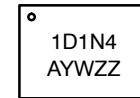
Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	40	V
Gate-to-Source Voltage	DC $V_{GS}$	$\pm 20$	V
Continuous Drain Current	$I_D$	$T_C = 25^\circ\text{C}$	233
		$T_C = 100^\circ\text{C}$	165
Power Dissipation	$P_D$	104	W
Continuous Drain Current $R_{\theta JA}$	$I_{DA}$	$T_A = 25^\circ\text{C}$	44
		$T_A = 100^\circ\text{C}$	31
Pulsed Drain Current	$I_{DM}$	1448	A
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to +175	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	88	A
Single Pulse Avalanche Energy ( $I_{PK} = 14.3\text{ A}$ )	$E_{AS}$	395	mJ
Lead Temperature 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.

$V_{(BR)DSS}$	$R_{DS(ON)}\text{ MAX}$	$I_D\text{ MAX}$
40 V	1.05 mΩ @ 10 V	233 A



SO-8FL  
CASE 488AA  
(DFN5)



1D1N4 = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Assembly Lot Code

#### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 5 of this data sheet.

# NTMFS1D1N04XM

## THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Note 2)	$R_{\theta JC}$	1.43	°C/W
Thermal Resistance, Junction-to-Ambient (Notes 1, 2)	$R_{\theta JA}$	39.8	

1. Surface-mounted on FR4 board using 650 mm<sup>2</sup>, 2 oz Cu pad.

2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$\Delta V_{(BR)DSS} / \Delta T_J$	$I_D = 1\text{ mA}$ . Referenced to $25^\circ\text{C}$		15		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 40\text{ V}, T_J = 25^\circ\text{C}$			10	μA
		$V_{DS} = 40\text{ V}, T_J = 125^\circ\text{C}$			100	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$			100	nA

### ON CHARACTERISTICS

Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 30\text{ A}, T_J = 25^\circ\text{C}$		0.9	1.05	mΩ
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 120\text{ }\mu\text{A}, T_J = 25^\circ\text{C}$	2.5	3.0	3.5	V
Gate Threshold Voltage Temperature Coefficient	$\Delta V_{GS(TH)} / \Delta T_J$	$V_{GS} = V_{DS}, I_D = 120\text{ }\mu\text{A}$		-7.25		mV/°C
Forward Transconductance	$g_{FS}$	$V_{DS} = 5\text{ V}, I_D = 30\text{ A}$		152		S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}, f = 1\text{ MHz}$		3155		pF
Output Capacitance	$C_{OSS}$			2250		
Reverse Transfer Capacitance	$C_{RSS}$			47.3		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DD} = 20\text{ V}; I_D = 50\text{ A}$		49.1		nC
Threshold Gate Charge	$Q_{G(TH)}$			2.34		
Gate-to-Source Charge	$Q_{GS}$			14.3		
Gate-to-Drain Charge	$Q_{GD}$			9.04		
Gate Resistance	$R_G$	$f = 1\text{ MHz}$		0.99		Ω

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	Resistive Load, $V_{GS} = 0/10\text{ V}, V_{DD} = 20\text{ V},$ $I_D = 50\text{ A}, R_G = 0\text{ }\Omega$		22.2		ns
Rise Time	$t_r$			7.09		
Turn-Off Delay Time	$t_{d(OFF)}$			32.8		
Fall Time	$t_f$			6.07		

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 30\text{ A}, T_J = 25^\circ\text{C}$		0.79	1.2	V
		$V_{GS} = 0\text{ V}, I_S = 30\text{ A}, T_J = 125^\circ\text{C}$		0.64		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, di/dt = 100\text{ A}/\mu\text{s},$ $I_S = 50\text{ A}, V_{DD} = 20\text{ V}$		54.3		ns
Charge Time	$t_a$			25.4		
Discharge Time	$t_b$			28.9		
Reverse Recovery Charge	$Q_{RR}$			76.7		

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.

# NTMFS1D1N04XM

## TYPICAL CHARACTERISTICS

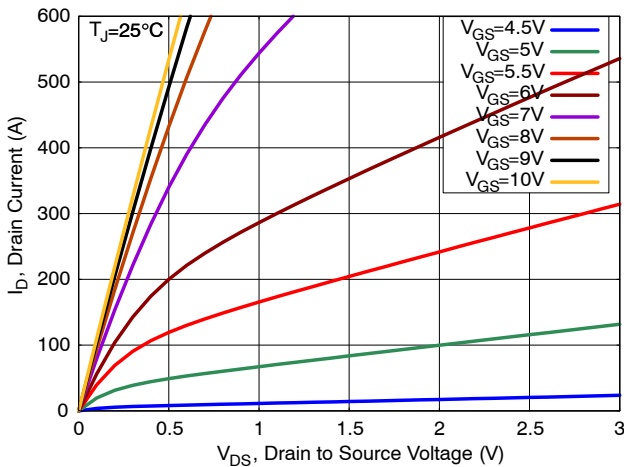


Figure 1. On-Region Characteristics

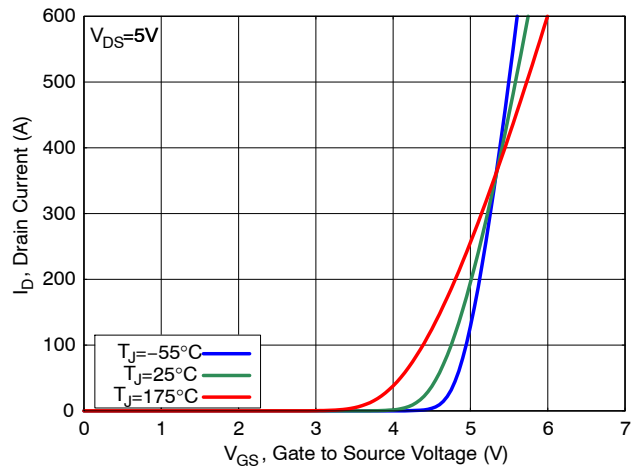


Figure 2. Transfer Characteristics

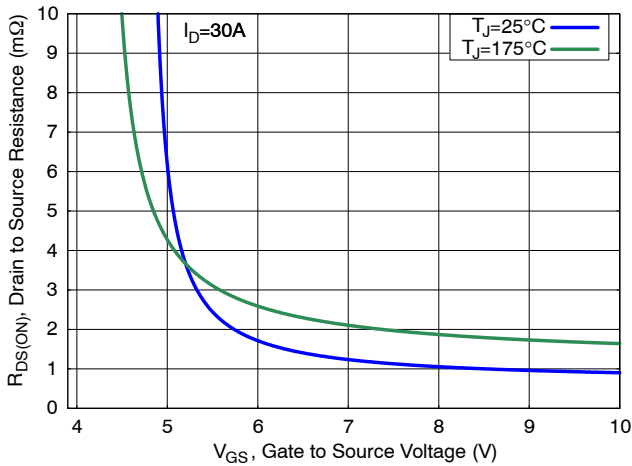


Figure 3. On-Resistance vs. Gate Voltage

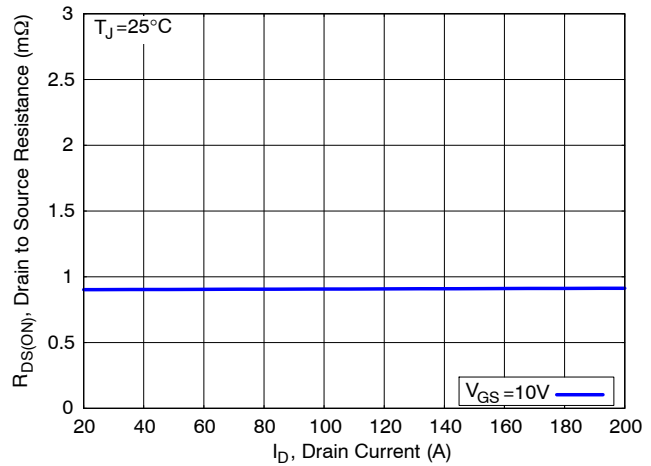


Figure 4. On-Resistance vs. Drain Current

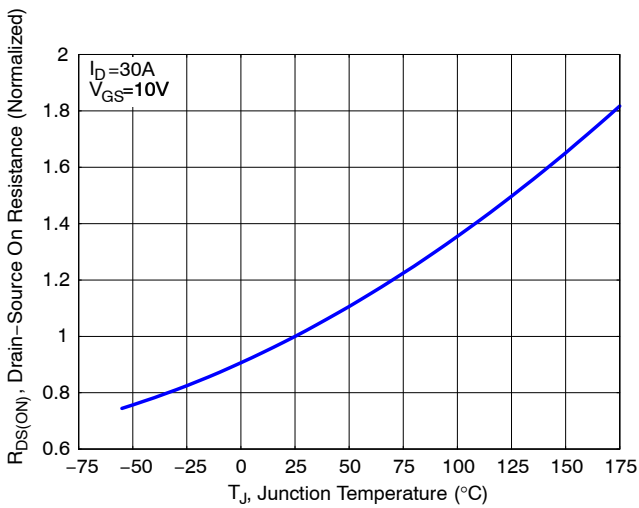


Figure 5. Normalized ON Resistance vs. Junction Temperature

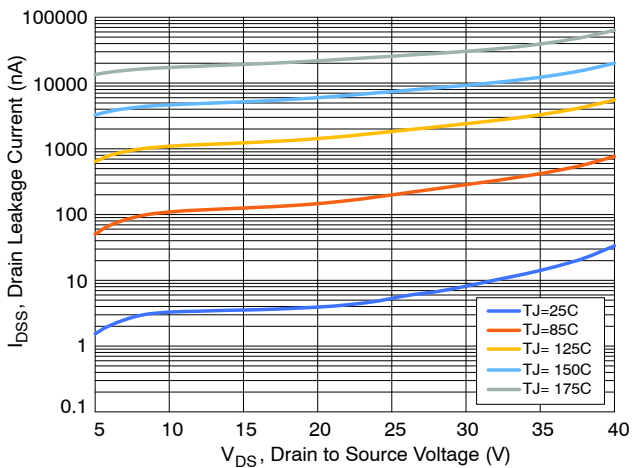


Figure 6. Drain Leakage Current vs. Drain Voltage

# NTMFS1D1N04XM

## TYPICAL CHARACTERISTICS (continued)

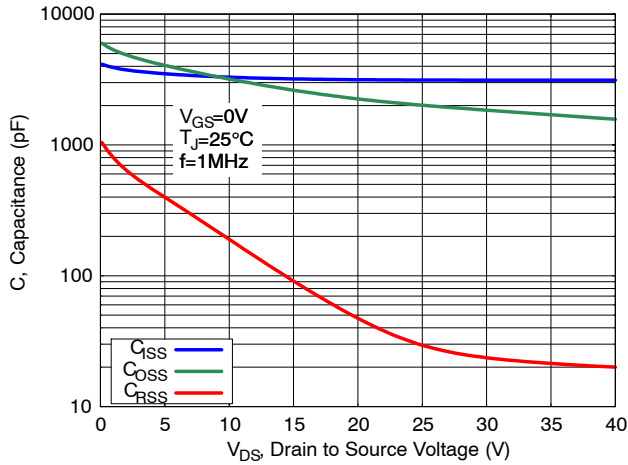


Figure 7. Capacitance Characteristics

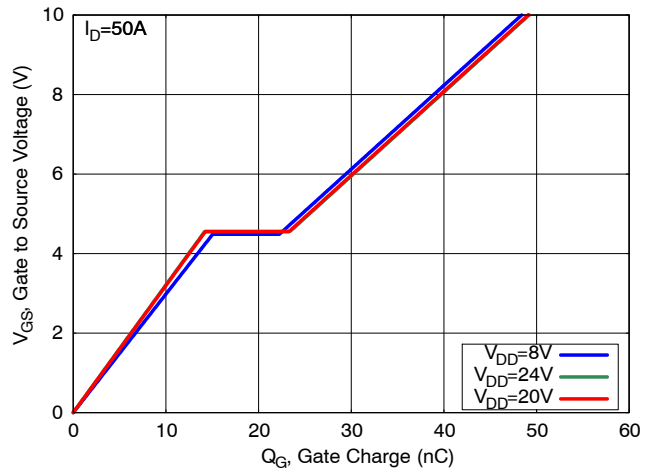


Figure 8. Gate Charge Characteristics

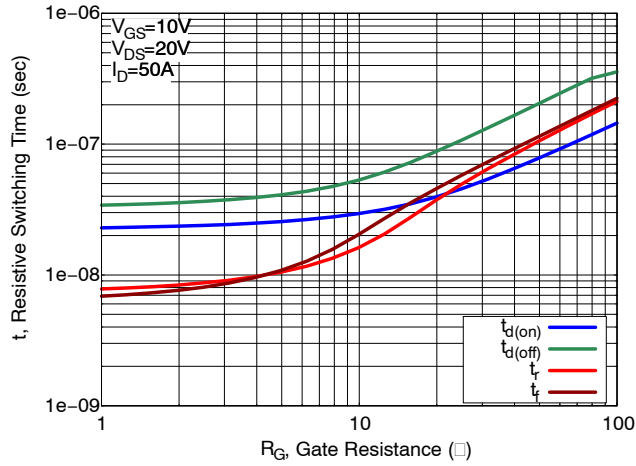


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

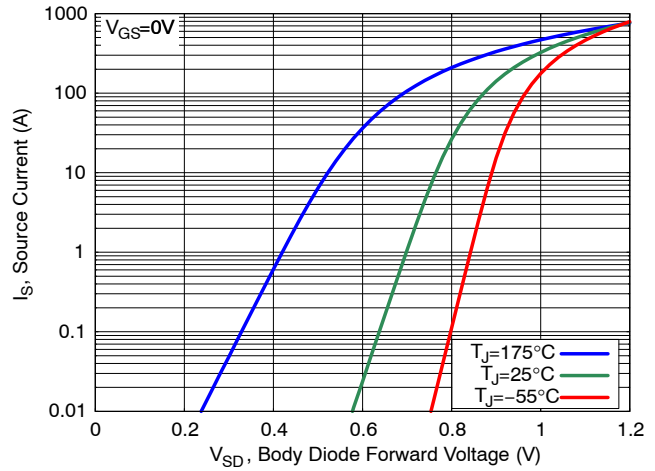


Figure 10. Diode Forward Characteristics

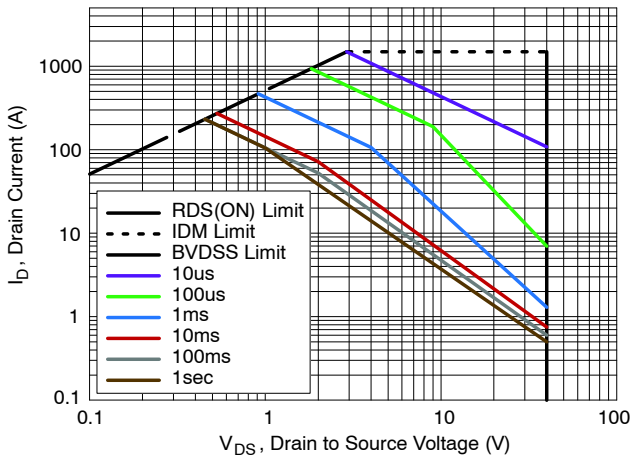


Figure 11. Safe Operating Area (SOA)

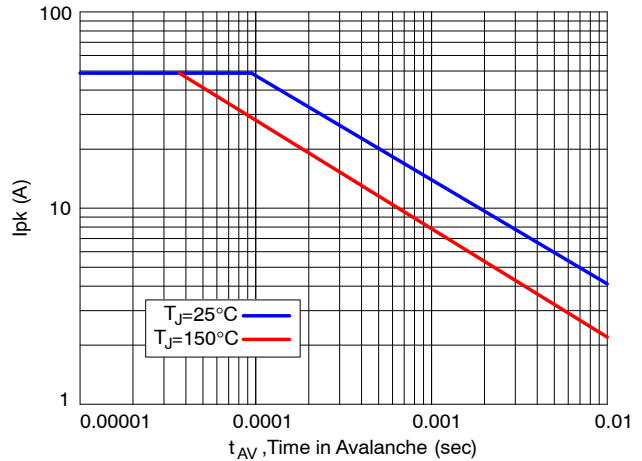
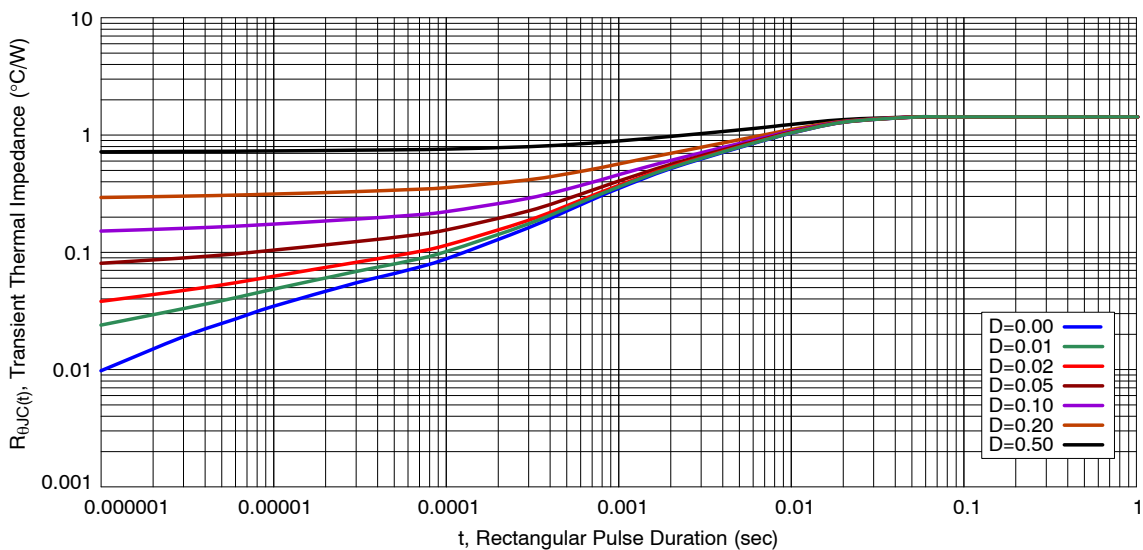


Figure 12.  $I_{peak}$  vs. Time in Avalanche (UIS)

# NTMFS1D1N04XM

## TYPICAL CHARACTERISTICS (continued)



**Figure 13. Thermal Characteristics**

### DEVICE ORDERING INFORMATION

Device	Marking	Package	Shipping <sup>†</sup>
NTMFS1D1N04XMT1G	1D1N4	SO-8FL (DFN5) (Pb-Free)	1500 / 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 Specifications Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



1  
SCALE 2:1

DFN5 5x6, 1.27P  
(SO-8FL)  
CASE 488AA  
ISSUE N

DATE 25 JUN 2018



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.90	1.00	1.10
A1	0.00	---	0.05
b	0.33	0.41	0.51
c	0.23	0.28	0.33
D	5.00	5.15	5.30
D1	4.70	4.90	5.10
D2	3.80	4.00	4.20
E	6.00	6.15	6.30
E1	5.70	5.90	6.10
E2	3.45	3.65	3.85
e	1.27 BSC		
G	0.51	0.575	0.71
K	1.20	1.35	1.50
L	0.51	0.575	0.71
L1	0.125 REF		
M	3.00	3.40	3.80
θ	0°	---	12°

### GENERIC MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.



STYLE 1:  
PIN 1. SOURCE  
2. SOURCE  
3. SOURCE  
4. GATE  
5. DRAIN

STYLE 2:  
PIN 1. ANODE  
2. ANODE  
3. ANODE  
4. NO CONNECT  
5. CATHODE

DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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DESCRIPTION:	DFN5 5x6, 1.27P (SO-8FL)	PAGE 1 OF 1

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