

# MOSFET – Power, Single, N-Channel

## 40 V, 0.67 mΩ, 370 A

### NTMFS5C404NL

#### 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

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			$V_{DSS}$	40	V
Gate-to-Source Voltage			$V_{GS}$	$\pm 20$	V
Continuous Drain Current $R_{\theta JC}$ (Notes 1, 3)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	370	A
		$T_C = 100^\circ\text{C}$		260	
Power Dissipation $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	$P_D$	167	W
		$T_C = 100^\circ\text{C}$		67	
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	52	A
		$T_A = 100^\circ\text{C}$		37	
Power Dissipation $R_{\theta JA}$ (Notes 1 & 2)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$	3.2	W
		$T_A = 100^\circ\text{C}$		1.3	
Pulsed Drain Current	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	$I_{DM}$	900	A	
Operating Junction and Storage Temperature			$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$
Source Current (Body Diode)			$I_S$	184	A
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 38 \text{ A}$ )			$E_{AS}$	907	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			$T_L$	260	$^\circ\text{C}$

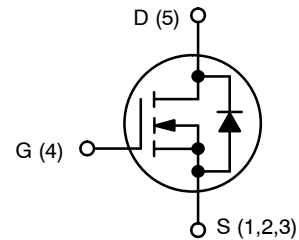
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

#### THERMAL RESISTANCE MAXIMUM RATINGS

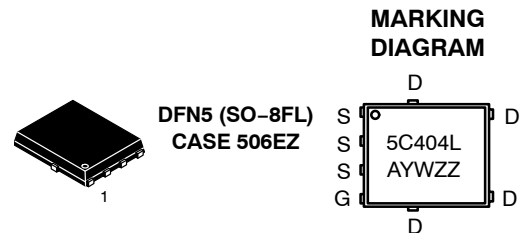
Parameter	Symbol	Value	Unit
Junction-to-Case – Steady State	$R_{\theta JC}$	0.75	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	39	

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 650 mm<sup>2</sup>, 2 oz. Cu pad.
3. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

$V_{(BR)DSS}$	$R_{DS(ON) MAX}$	$I_D MAX$
40 V	0.67 mΩ @ 10 V	370 A
	1.0 mΩ @ 4.5 V	



N-CHANNEL MOSFET



5C404L = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Lot Traceability

#### ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 5 of this data sheet.

# NTMFS5C40NL

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			21.6		mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 40\text{ V}$	$T_J = 25\ ^\circ\text{C}$		10	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		250	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$			100	nA

## ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.2		2.0	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-6.2		mV/ $^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 50\text{ A}$		0.52	0.67	m $\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 50\text{ A}$		0.75	1.0	
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 50\text{ A}$		270		S

## CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 25\text{ V}$		12168		pF
Output Capacitance	$C_{OSS}$			4538		
Reverse Transfer Capacitance	$C_{RSS}$			79.8		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}; I_D = 50\text{ A}$		81		nC
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 20\text{ V}; I_D = 50\text{ A}$		181		
Threshold Gate Charge	$Q_{G(TH)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}; I_D = 50\text{ A}$		8.5		
Gate-to-Source Charge	$Q_{GS}$			27.8		
Gate-to-Drain Charge	$Q_{GD}$			23.8		
Plateau Voltage	$V_{GP}$			2.7		V

## SWITCHING CHARACTERISTICS (Note 5)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}, I_D = 50\text{ A}, R_G = 1.0\ \Omega$		24		ns
Rise Time	$t_r$			135		
Turn-Off Delay Time	$t_{d(OFF)}$			87		
Fall Time	$t_f$			157		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 50\text{ A}$	$T_J = 25^\circ\text{C}$		0.7	1.2	V
			$T_J = 125^\circ\text{C}$		0.61		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 50\text{ A}$		97.4		ns	
Charge Time	$t_a$			46.5			
Discharge Time	$t_b$			50.9			
Reverse Recovery Charge	$Q_{RR}$			190			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.

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

5. Switching characteristics are independent of operating junction temperatures.

# NTMFS5C404NL

## TYPICAL CHARACTERISTICS

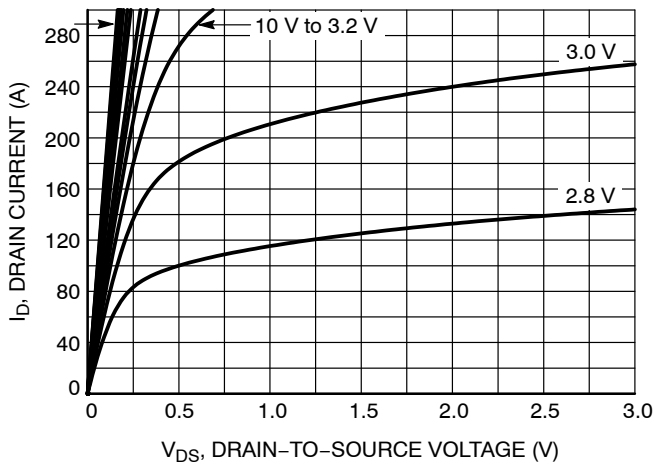


Figure 1. On-Region Characteristics

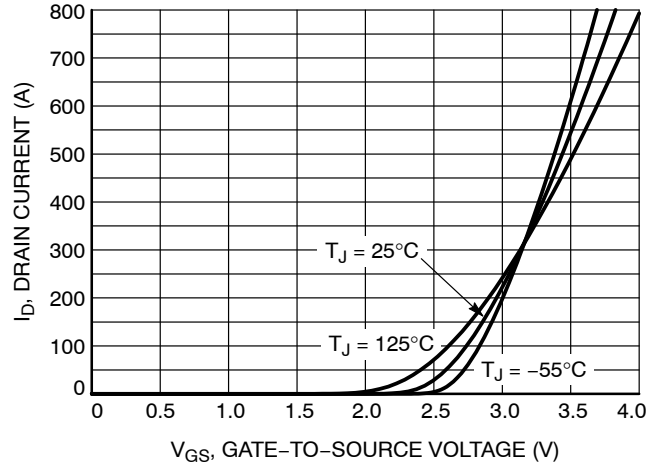


Figure 2. Transfer Characteristics

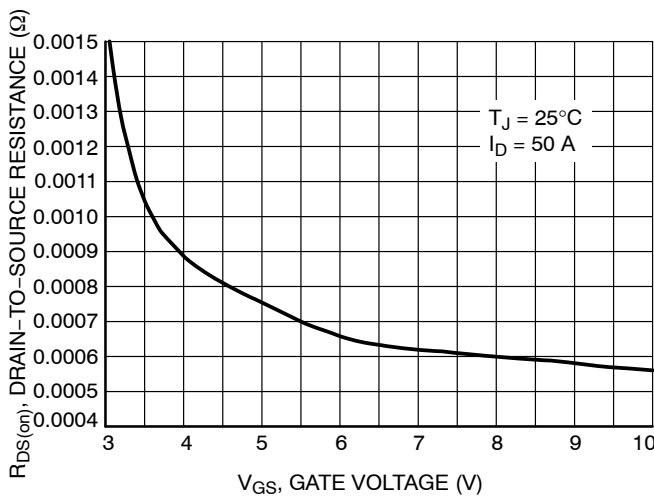


Figure 3. On-Resistance vs. Gate-to-Source Voltage

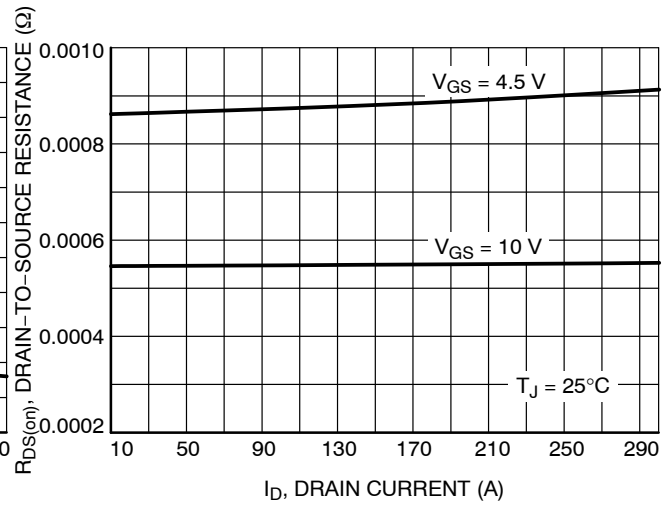


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

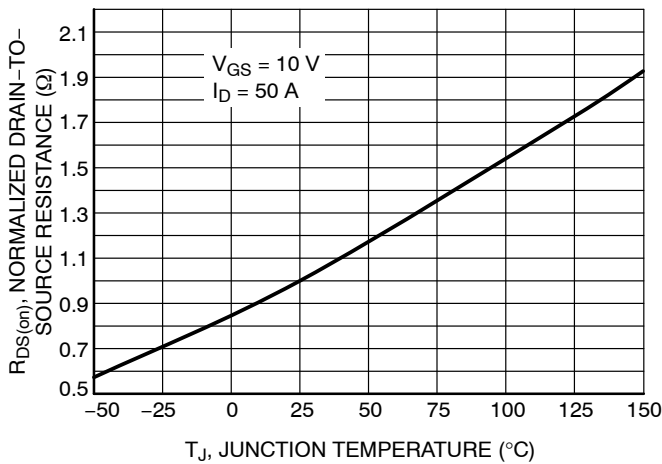


Figure 5. On-Resistance Variation with Temperature

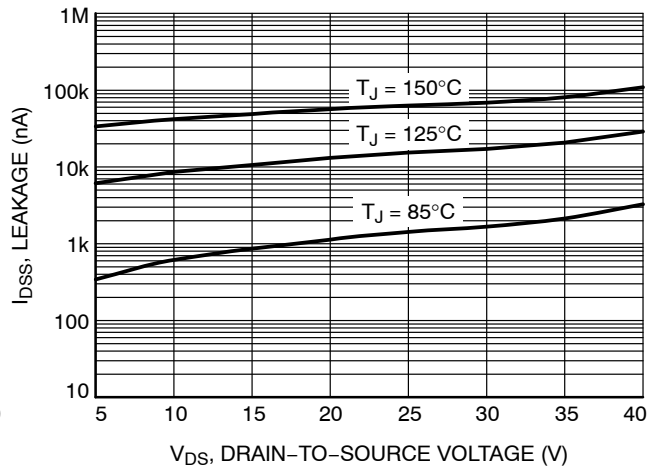


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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## TYPICAL CHARACTERISTICS



Figure 7. Capacitance Variation



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

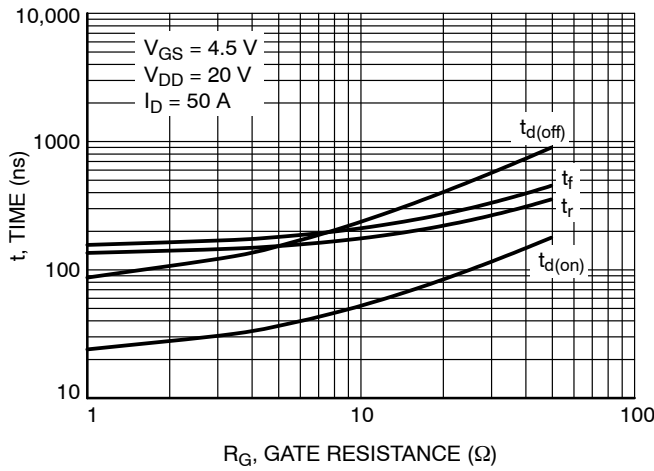


Figure 9. Resistive Switching Time Variation vs. Gate Resistance



Figure 10. Diode Forward Voltage vs. Current

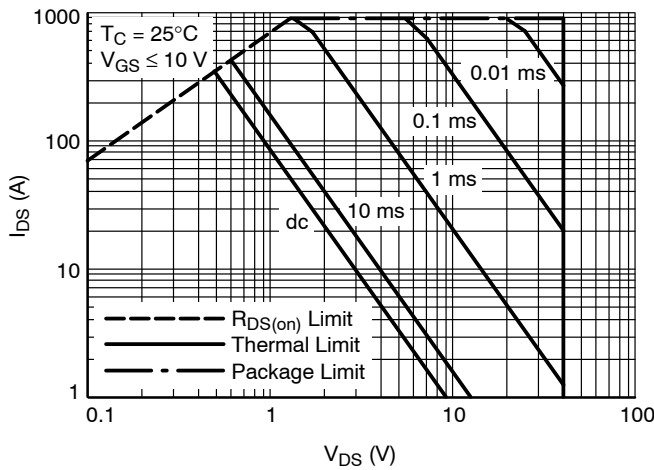
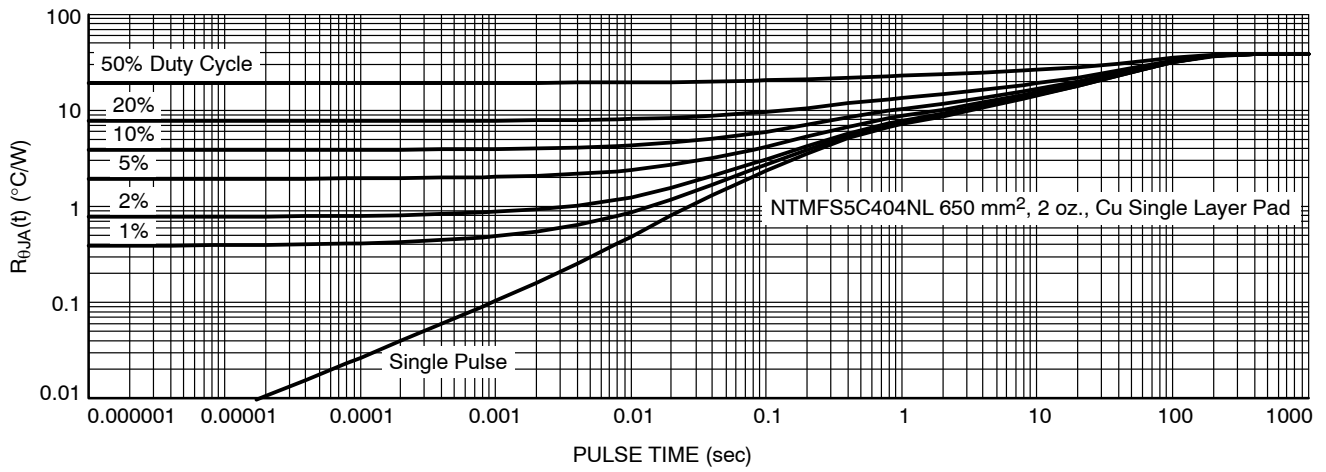


Figure 11. Safe Operating Area



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

# NTMFS5C404NL



**Figure 13. Thermal Characteristics**

## DEVICE ORDERING INFORMATION

Device	Marking	Package	Shipping <sup>†</sup>
NTMFS5C404NLT1G	5C404L	DFN5 (Pb-Free)	1500 / Tape & Reel
NTMFS5C404NLT3G	5C404L	DFN5 (Pb-Free)	5000 / 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

ON Semiconductor®



1  
SCALE 2:1

DFN5 5x6, 1.27P (SO-8FL)  
CASE 506EZ  
ISSUE A

DATE 25 AUG 2021



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
  2. CONTROLLING DIMENSION: MILLIMETERS
  3. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

MILLIMETERS			
DIM	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	3.80	3.85
e	1.27 BSC		
G	0.51	0.575	0.71
k	1.10	1.20	1.40
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.

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

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