

# NTMD5836NL

## Power MOSFET

40 V, Dual N-Channel, SOIC-8

### Features

- Asymmetrical N Channels
- Low  $R_{DS(on)}$
- Low Capacitance
- Optimized Gate Charge
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

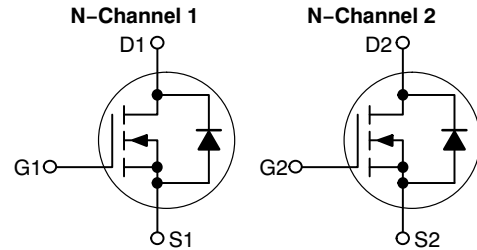
	$V_{(BR)DSS}$	$R_{DS(on)}$ Max	$I_D$ Max (Notes 1 and 2)
Channel 1	40 V	12 m $\Omega$ @ 10 V	11 A
		16 m $\Omega$ @ 4.5 V	
Channel 2	40 V	20 m $\Omega$ @ 10 V	6.5 A
		36.5 m $\Omega$ @ 4.5 V	

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces)
2. Only selected channel is been powered  
1W applied on channel 1:  $T_J = 1 W * 85^{\circ}C/W + 25^{\circ}C = 110^{\circ}C$

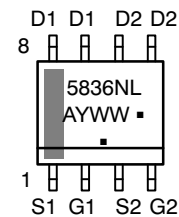


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### MARKING DIAGRAM\* AND PIN ASSIGNMENT



- A = Assembly Location
- Y = Year
- WW = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

Device	Package	Shipping†
NTMD5836NLR2G	SOIC-8 (Pb-Free)	2500 / Tape & Reel

†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

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

Parameter	Symbol	Ch 1	Ch 2	Unit		
Drain-to-Source Voltage	$V_{DSS}$	40	40	V		
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V		
Continuous Drain Current $R_{\theta JA}$ (Notes 3 and 4)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	9.0	5.7	A
		$T_A = 70^\circ\text{C}$		7.2	4.6	
Power Dissipation $R_{\theta JA}$ (Notes 3 and 4)		$T_A = 25^\circ\text{C}$	$P_D$	1.5	1.5	W
		$T_A = 70^\circ\text{C}$		0.9	0.9	
Continuous Drain Current $R_{\theta JA}$ (Notes 3 and 4)	$t \leq 10\text{s}$	$T_A = 25^\circ\text{C}$	$I_D$	11	6.5	A
		$T_A = 70^\circ\text{C}$		8.6	4.6	
Power Dissipation $R_{\theta JA}$ (Notes 3 and 4)		$T_A = 25^\circ\text{C}$	$P_D$	2.1	1.9	W
		$T_A = 70^\circ\text{C}$		1.3	1.2	
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	$I_{DM}$	43	26	A	
Operating Junction and Storage Temperature	$T_J, T_{STG}$	-55 to +150		$^\circ\text{C}$		
Source Current (Body Diode)	$I_S$	10	7.0	A		
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 40\text{V}$ , $V_{GS} = 10\text{V}$ , $L = 0.1\text{mH}$ )	$E_{AS}$	76	22	mJ		
	$I_{AS}$	39	21	A		
Lead Temperature for Soldering Purposes (1/8" from case for 10s)	$T_L$	260		$^\circ\text{C}$		

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

- Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces)
- Only selected channel is been powered  
1W applied on channel 1:  $T_J = 1\text{W} * 85^\circ\text{C}/\text{W} + 25^\circ\text{C} = 110^\circ\text{C}$

## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Ch 1	Ch 2	Unit
Junction-to-Ambient Steady State (Notes 5 and 7)	$R_{\theta JA}$	85	86	$^\circ\text{C}/\text{W}$
Junction-to-Ambient - $t \leq 10\text{s}$ (Notes 5 and 7)	$R_{\theta JA}$	60	65	
Junction-to-Ambient Steady State (Notes 5 and 8)	$R_{\theta JA}$	59		
Junction-to-Ambient Steady State (Notes 6 and 7)	$R_{\theta JA}$	136	136	

- Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces)
- Surface-mounted on FR4 board using 0.155 in sq (100 mm<sup>2</sup>) pad size
- Only selected channel is been powered  
1W applied on channel 1:  $T_J = 1\text{W} * 85^\circ\text{C}/\text{W} + 25^\circ\text{C} = 110^\circ\text{C}$
- Both channels receive equivalent power dissipation  
1 W applied on each channel:  $T_J = 2\text{W} * 59^\circ\text{C}/\text{W} + 25^\circ\text{C} = 143^\circ\text{C}$

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

Parameter	Symbol	Test Condition	Ch	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>							
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	Ch 1	40			V
			Ch 2				
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS} / T_J$		Ch 1		146		mV/ $^\circ\text{C}$
			Ch 2		25		
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 40\text{ V}$	$T_J = 25^\circ\text{C}$				$\mu\text{A}$
			Ch 1	1.0			
			Ch 2				
			$T_J = 125^\circ\text{C}$				
Ch 1							
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$	Ch 1			$\pm 100$	nA
			Ch 2				

## ON CHARACTERISTICS (Note 9)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	Ch 1	1.0	1.8	3.0	V
			Ch 2	1.0	1.8	3.0	
Negative Threshold Temperature Coefficient	$V_{GS(TH)} / T_J$		Ch 1		6.0		mV/ $^\circ\text{C}$
			Ch 2		6.0		
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	Ch 1		9.5	12	m $\Omega$
			Ch 2		16.2	20	
			Ch 1	$V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$	13	16	m $\Omega$
					Ch 2	25.0	
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 10\text{ A}$	Ch 1		10.5		S
			Ch 2		6.0		

## CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 20\text{ V}$	Ch 1		2120		pF
			Ch 2		730		
Output Capacitance	$C_{OSS}$		Ch 1		315		
			Ch 2		123		
Reverse Transfer Capacitance	$C_{RSS}$		Ch 1		225		
			Ch 2		84		

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

10. Switching characteristics are independent of operating junction temperatures

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

Parameter	Symbol	Test Condition	Ch	Min	Typ	Max	Unit
<b>CHARGES, CAPACITANCES &amp; GATE RESISTANCE</b>							
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 10V, V <sub>DS</sub> = 20V, I <sub>D</sub> = 10A	Ch 1		36	50	nC
		V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 20 V, I <sub>D</sub> = 7 A	Ch 2		16		
Threshold Gate Charge	Q <sub>G(TH)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 20 V, CH1: I <sub>D</sub> = 10 A, CH2: I <sub>D</sub> = 7 A	Ch 1		15	23	V
			Ch 2		8.5	11	
Gate-to-Source Charge	Q <sub>GS</sub>		Ch 1		2.4		
			Ch 2		1.0		
Gate-to-Drain Charge	Q <sub>GD</sub>		Ch 1		6.9		
			Ch 2		2.8		
Plateau Voltage	V <sub>GP</sub>		Ch 1		7.2		
			Ch 2		4.0		
Gate Resistance	R <sub>G</sub>	Ch 1		3.2			
		Ch 2		3.3			
Gate Resistance	R <sub>G</sub>	Ch 1		1.2		Ω	
		Ch 2		2.1			

## SWITCHING CHARACTERISTICS (Note 10)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DD</sub> = 20 V, CH1: I <sub>D</sub> = 10 A, CH2: I <sub>D</sub> = 7 A, R <sub>G</sub> = 2.5 Ω	Ch 1		16		ns
			Ch 2		11.5		
Rise Time	t <sub>r</sub>		Ch 1		22		
			Ch 2		14		
Turn-Off Delay Time	t <sub>d(OFF)</sub>		Ch 1		26		
			Ch 2		15.5		
Fall Time	t <sub>f</sub>		Ch 1		8.5		
			Ch 2		3.5		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, CH1: I <sub>D</sub> = 10 A, CH2: I <sub>D</sub> = 7 A	T <sub>J</sub> = 25°C	Ch 1		0.9	1.2	V
				Ch 2		0.85	1.2	
			T <sub>J</sub> = 125°C	Ch 1		0.65		
				Ch 2		0.73		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, dI <sub>SD</sub> /dt = 100 A/μs, CH1: I <sub>D</sub> = 10 A, CH2: I <sub>D</sub> = 7 A	Ch 1		27		ns	
Charge Time	T <sub>a</sub>		Ch 2		17			
			Ch 1		14			
Ch 2			11					
Discharge Time	T <sub>b</sub>		Ch 1		13			
			Ch 2		6.0			
Reverse Recovery Charge	Q <sub>RR</sub>		Ch 1		19		nC	
			Ch 2		9.0			

9. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%

10. Switching characteristics are independent of operating junction temperatures

TYPICAL PERFORMANCE CURVES

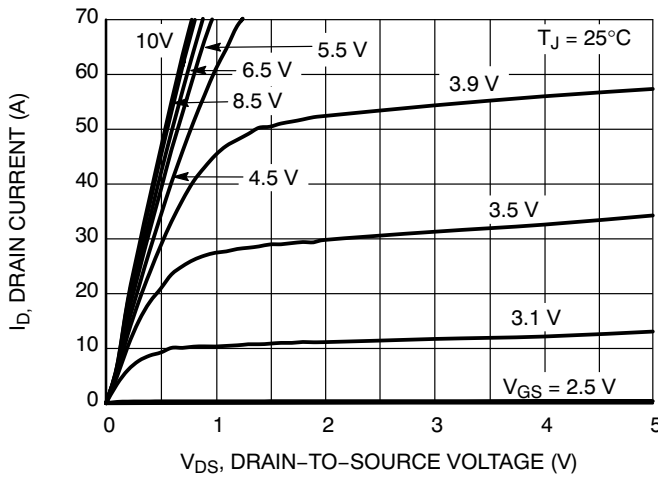


Figure 1. On-Region Characteristics - Channel 1

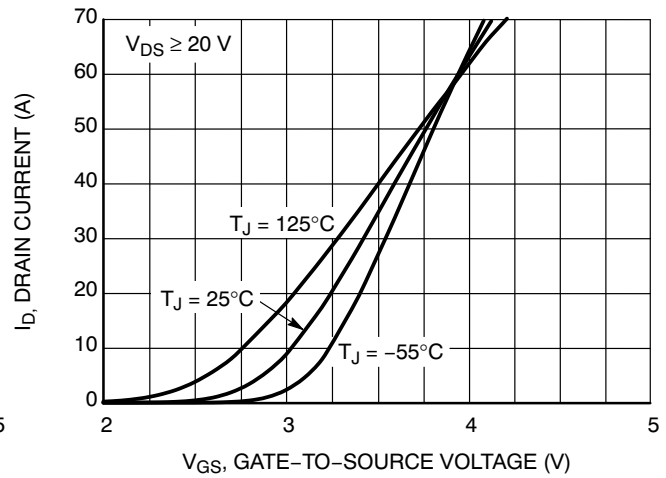


Figure 2. Transfer Characteristics - Channel 1

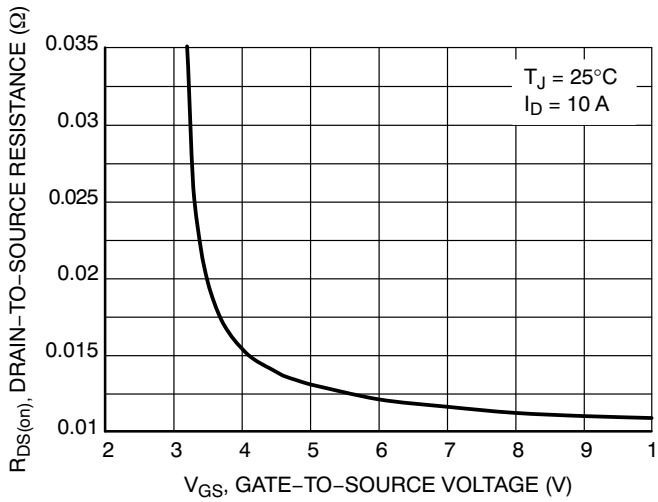


Figure 3. On-Resistance vs. Gate-to-Source Voltage - Channel 1

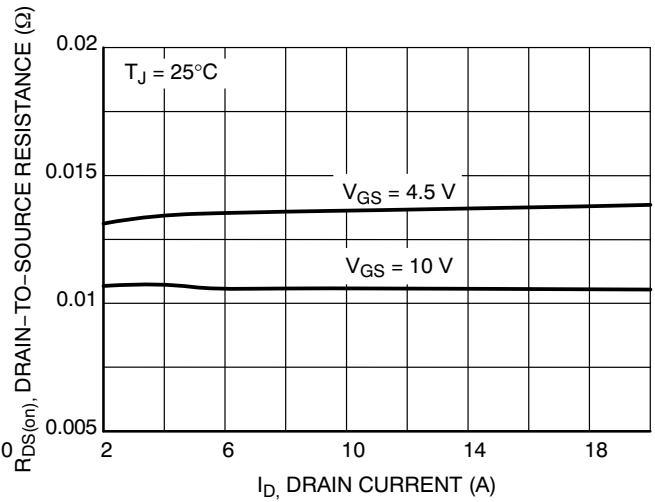


Figure 4. On-Resistance vs. Drain Current and Gate Voltage - Channel 1

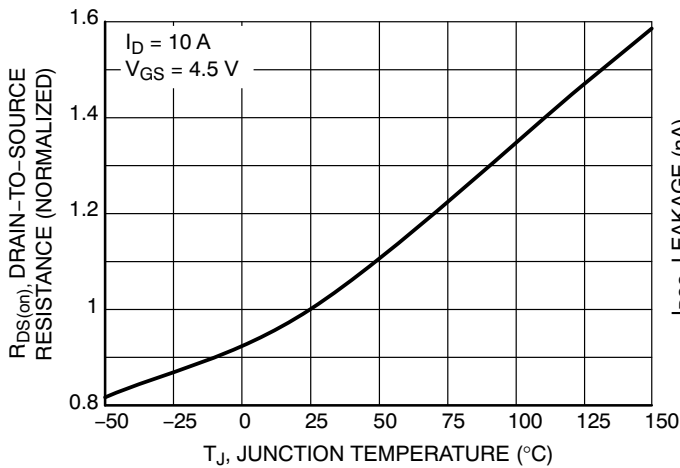


Figure 5. On-Resistance Variation with Temperature - Channel 1

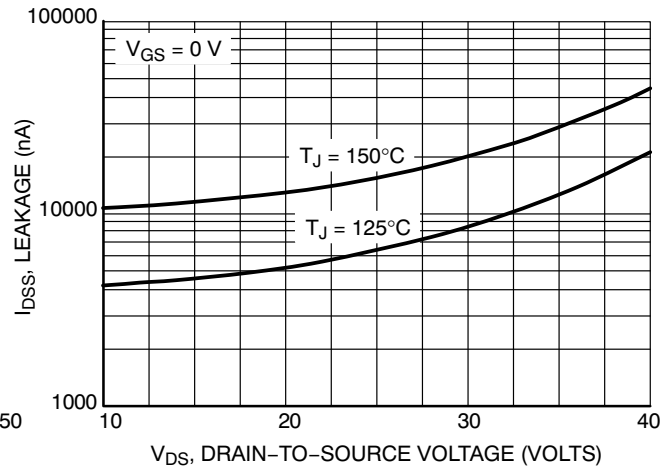


Figure 6. Drain-to-Source Leakage Current vs. Voltage - Channel 1

TYPICAL PERFORMANCE CURVES

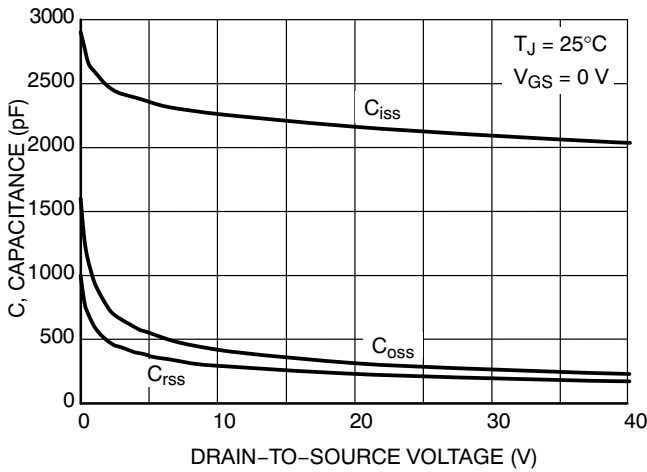


Figure 7. Capacitance Variation - Channel 1

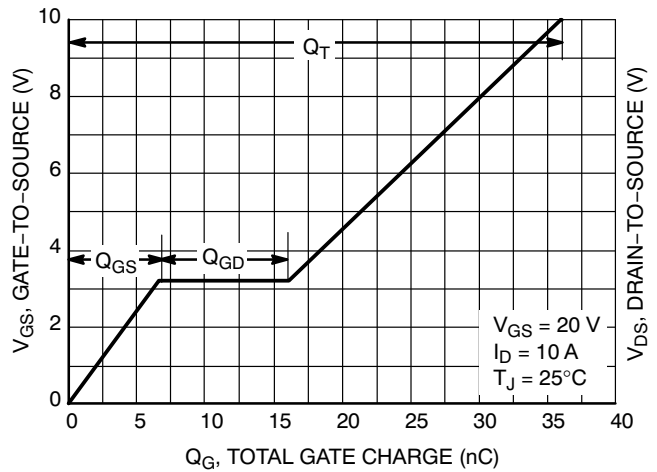


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge - Channel 1

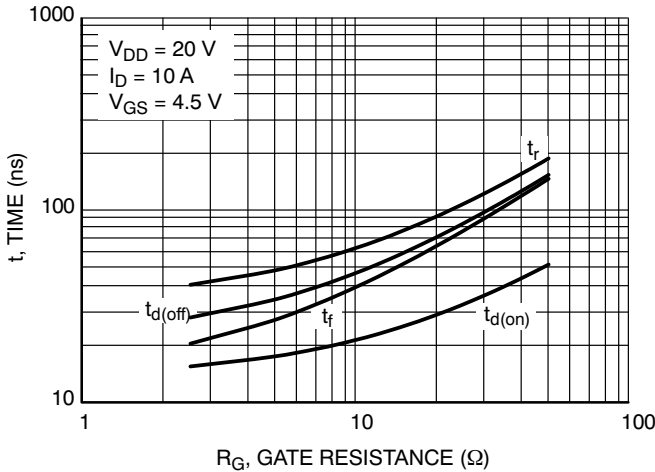


Figure 9. Resistive Switching Time Variation vs. Gate Resistance - Channel 1

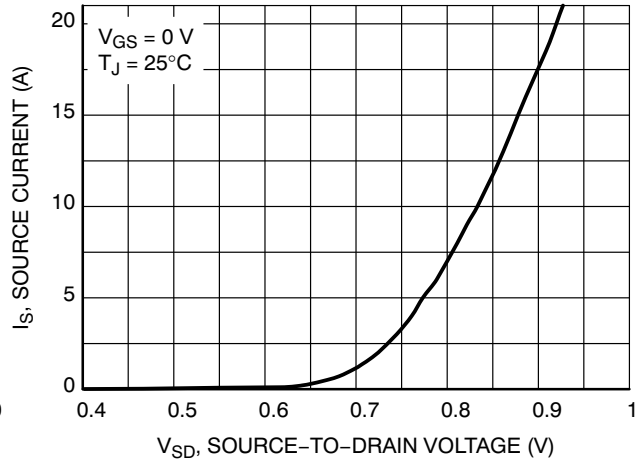


Figure 10. Diode Forward Voltage vs. Current - Channel 1

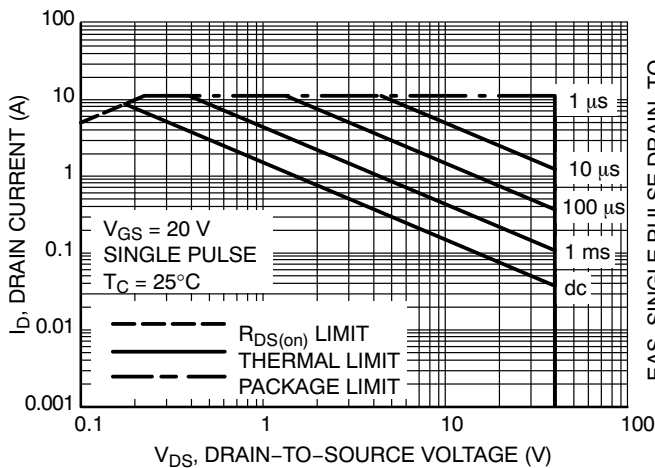


Figure 11. Maximum Rated Forward Biased Safe Operating Area - Channel 1

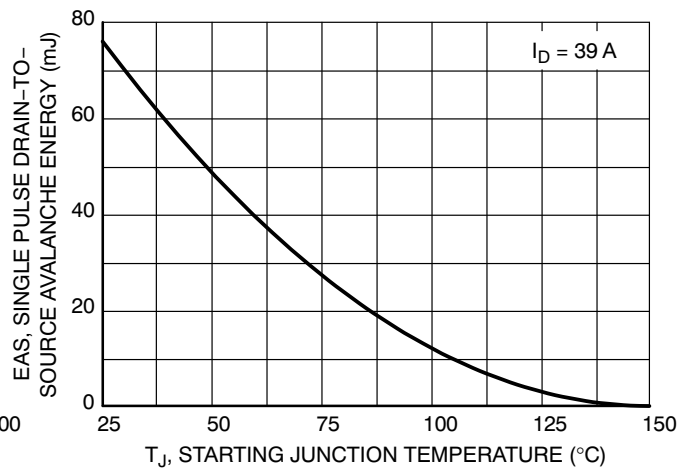
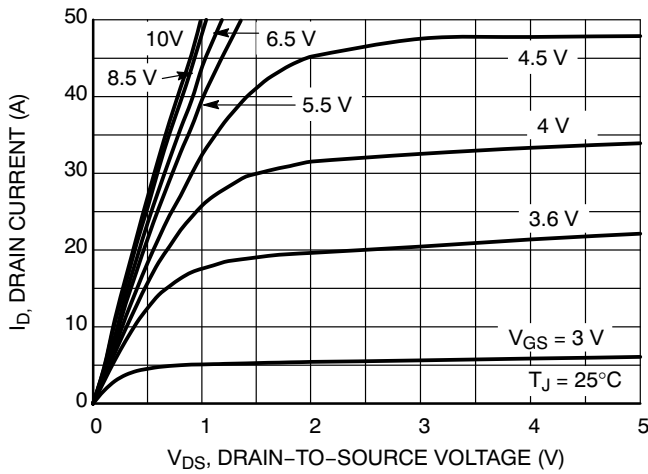


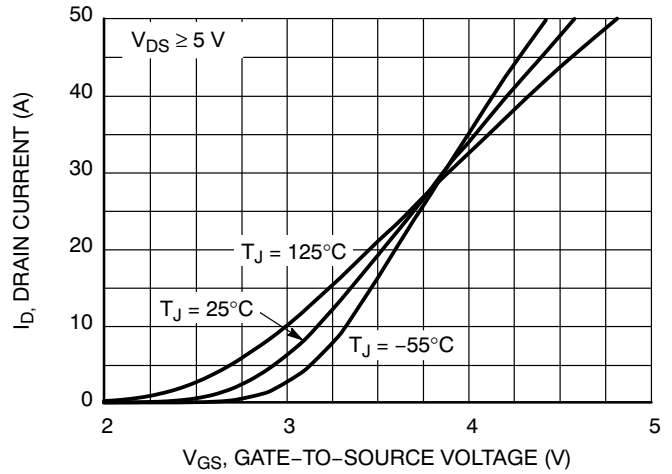
Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature - Channel 1

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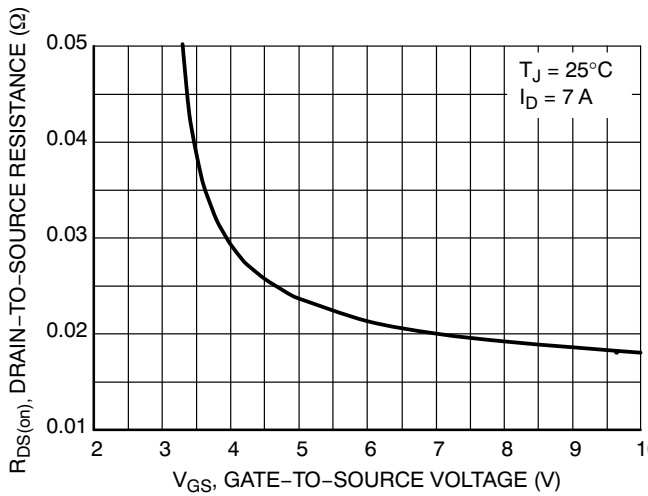
## TYPICAL PERFORMANCE CURVES



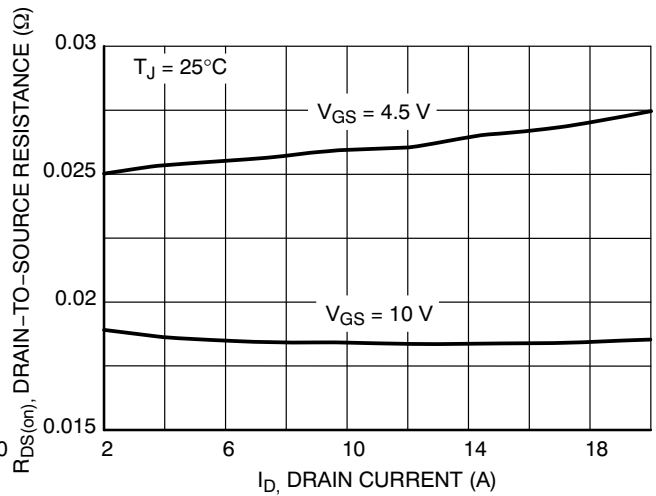
**Figure 1. On-Region Characteristics - Channel 2**



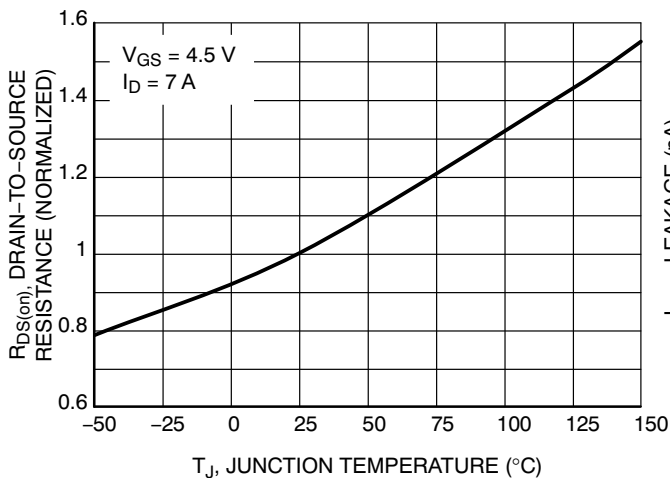
**Figure 2. Transfer Characteristics - Channel 2**



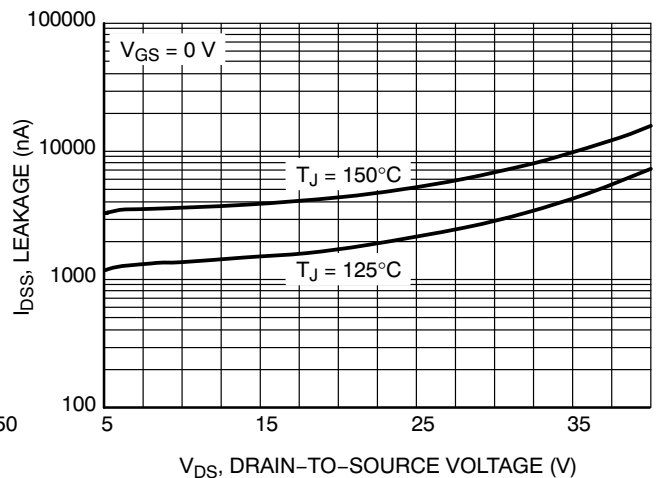
**Figure 3. On-Resistance vs. Gate-to-Source Voltage - Channel 2**



**Figure 4. On-Resistance vs. Drain Current and Gate Voltage - Channel 2**



**Figure 5. On-Resistance Variation with Temperature - Channel 2**



**Figure 6. Drain-to-Source Leakage Current vs. Voltage - Channel 2**

TYPICAL PERFORMANCE CURVES

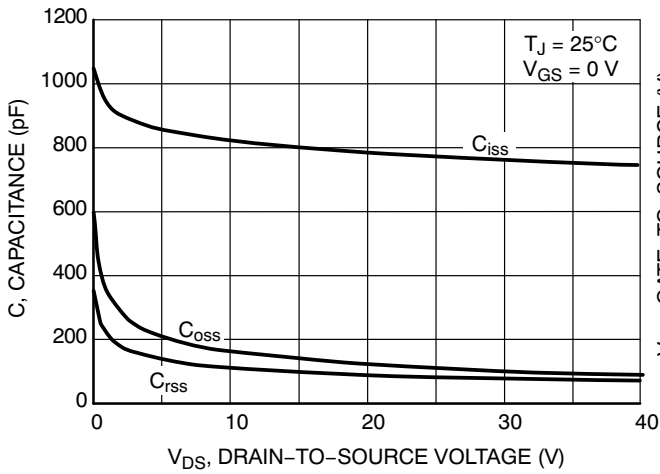


Figure 7. Capacitance Variation - Channel 2

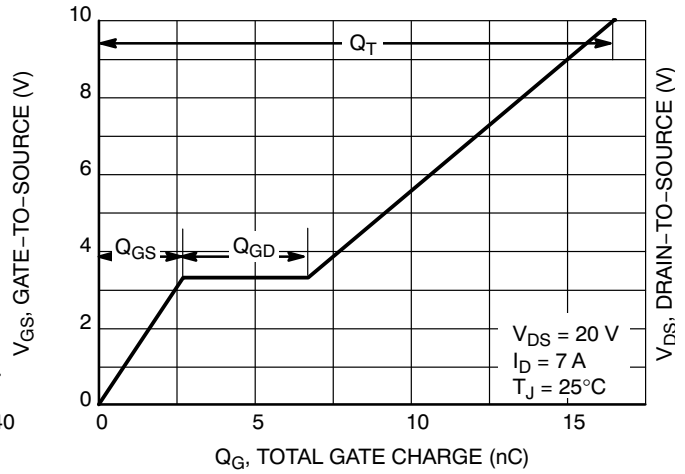


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

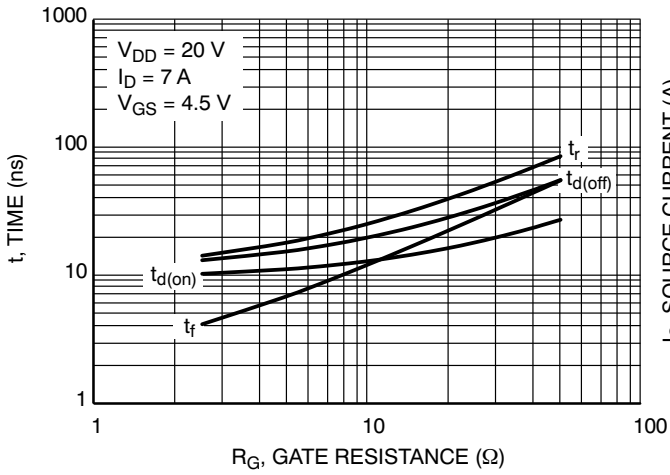


Figure 9. Resistive Switching Time Variation vs. Gate Resistance - Channel 2

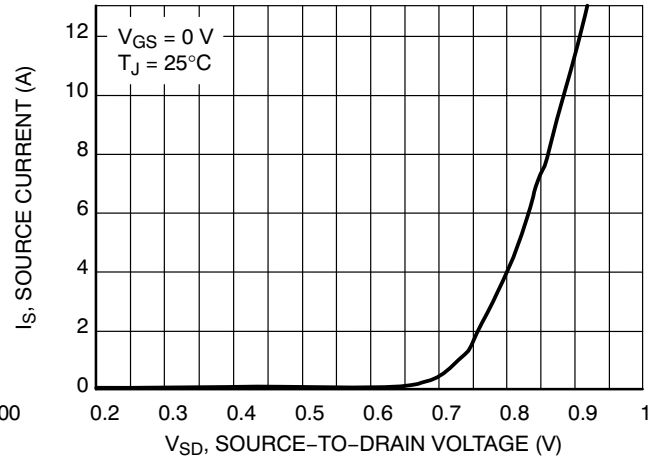


Figure 10. Diode Forward Voltage vs. Current - Channel 2

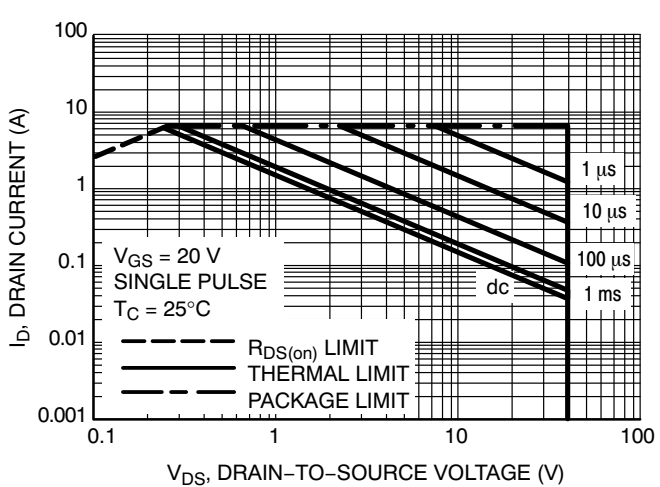


Figure 11. Maximum Rated Forward Biased Safe Operating Area - Channel 2

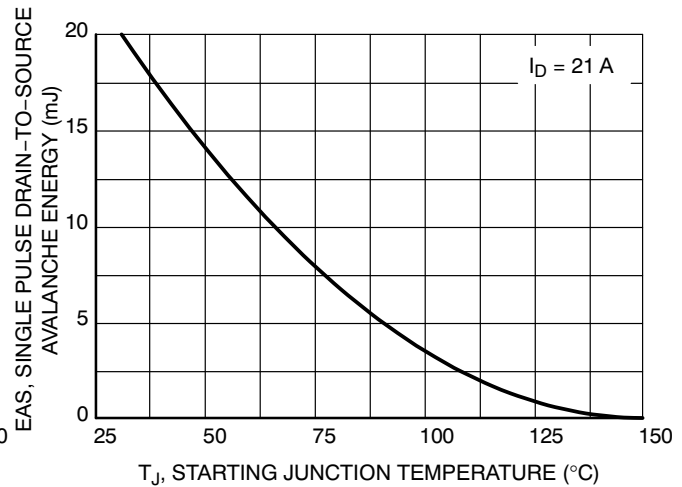


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature



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## TYPICAL PERFORMANCE CURVES

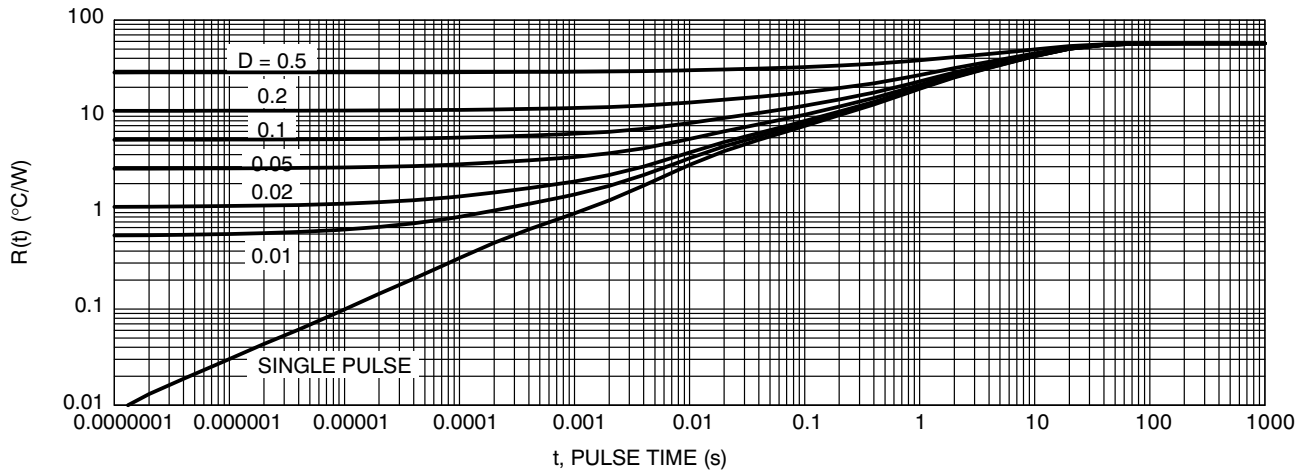
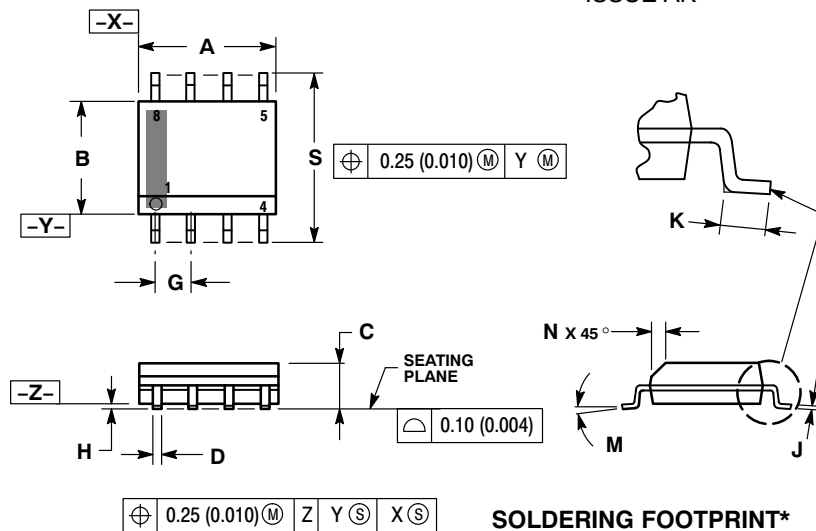


Figure 13. Thermal Response

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## PACKAGE DIMENSIONS

### SOIC-8 NB CASE 751-07 ISSUE AK

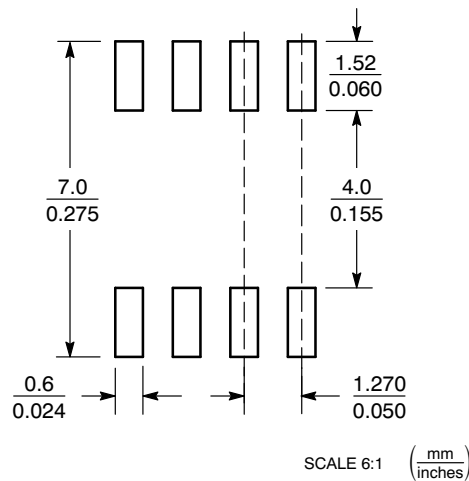


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

#### SOLDERING FOOTPRINT\*



\*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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