

# NTR3161N

## Power MOSFET

20 V, 3.3 A, Single N-Channel, SOT-23

### Features

- Low  $R_{DS(on)}$
- Low Gate Charge
- Low Threshold Voltage
- Halide-Free
- This is a Pb-Free Device

### Applications

- DC-DC Conversion
- Battery Management
- Load/Power Switch

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

Parameter		Symbol	Value	Unit
Drain-to-Source Voltage		$V_{DS}$	20	V
Gate-to-Source Voltage		$V_{GS}$	$\pm 8$	V
Continuous Drain Current (Note 1)	$t \leq 30$ s	$I_D$	$T_A = 25^\circ\text{C}$ 3.3	A
			$T_A = 85^\circ\text{C}$ 2.3	
	$t \leq 10$ s		$T_A = 25^\circ\text{C}$ 4.0	
Power Dissipation (Note 1)	Steady State	$P_D$	$T_A = 25^\circ\text{C}$ 0.82	W
	$t \leq 10$ s		1.25	
Pulsed Drain Current	$t_p = 10$ $\mu\text{s}$	$I_{DM}$	6.4	A
Operating Junction and Storage Temperature		$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$
Source Current (Body Diode)		$I_S$	0.65	A
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	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.

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	260	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – $t \leq 30$ s	$R_{\theta JA}$	153	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – $t < 10$ s (Note 1)	$R_{\theta JA}$	100	$^\circ\text{C}/\text{W}$

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).

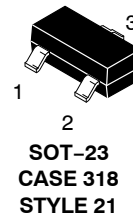
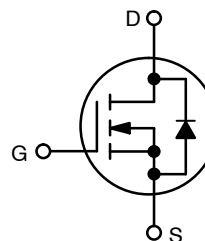


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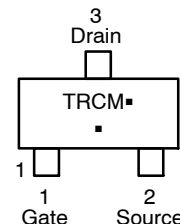
$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
20 V	50 m $\Omega$ @ 4.5 V	3.3 A
	63 m $\Omega$ @ 2.5 V	3.0 A
	87 m $\Omega$ @ 1.8 V	2.5 A

### SIMPLIFIED SCHEMATIC – N-CHANNEL



SOT-23  
CASE 318  
STYLE 21

### MARKING DIAGRAM/ PIN ASSIGNMENT



TRC = Specific Device Code  
M = Date Code  
■ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

Device	Package	Shipping†
NTR3161NT1G	SOT-23 (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.

# NTR3161N

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	20			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> / T <sub>J</sub>	I <sub>D</sub> = 250 μA, Reference to 25°C		16.2		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 16 V, T <sub>J</sub> = 25°C V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 16 V, T <sub>J</sub> = 125°C			1.0 10	μA
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 8 V			100	nA

## ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	0.4	0.6	1.0	V
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> / T <sub>J</sub>			2.4		mV/°C
Drain-to-Source On-Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 3.3 A		38	50	mΩ
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 3.0 A		44	63	
		V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 2.5 A		52	87	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 5.0 V, I <sub>D</sub> = 3.3 A		10.5		S

## CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = 10 V		540		pF
Output Capacitance	C <sub>oss</sub>			80		
Reverse Transfer Capacitance	C <sub>rss</sub>			62		
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 10 V, I <sub>D</sub> = 3.3 A		7.3		nC
Threshold Gate Charge	Q <sub>G(TH)</sub>			0.4		
Gate-to-Source Charge	Q <sub>GS</sub>			0.8		
Gate-to-Drain Charge	Q <sub>GD</sub>			1.6		
Gate Resistance	R <sub>G</sub>			2.4		Ω

## SWITCHING CHARACTERISTICS (Note 3)

Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DD</sub> = 10 V, I <sub>D</sub> = 3.3 A, R <sub>G</sub> = 6 Ω		6.7		ns
Rise Time	t <sub>r</sub>			11.6		
Turn-Off Delay Time	t <sub>d(off)</sub>			18.6		
Fall Time	t <sub>f</sub>			23.2		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 1.0 A, T <sub>J</sub> = 25°C		0.65	1.0	V
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 1.0 A, dI <sub>SD</sub> /dt = 100 A/μs		14.7		ns
Charge Time	t <sub>a</sub>			5.2		
Discharge Time	t <sub>b</sub>			9.5		
Reverse Recovery Charge	Q <sub>RR</sub>			3.3		nC

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

3. Switching characteristics are independent of operating junction temperatures.

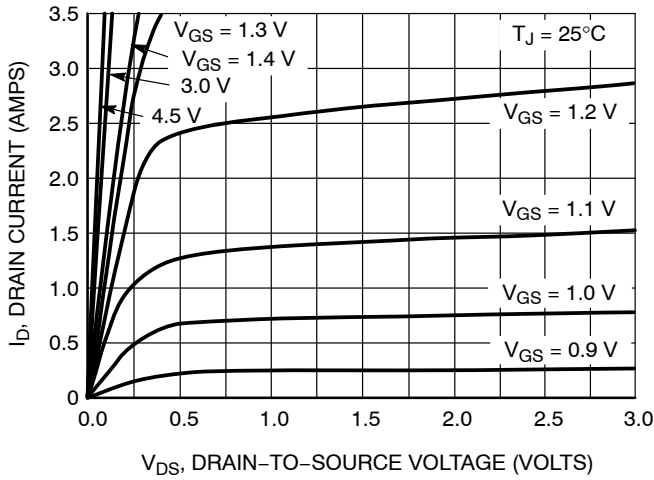


Figure 1. On-Region Characteristics

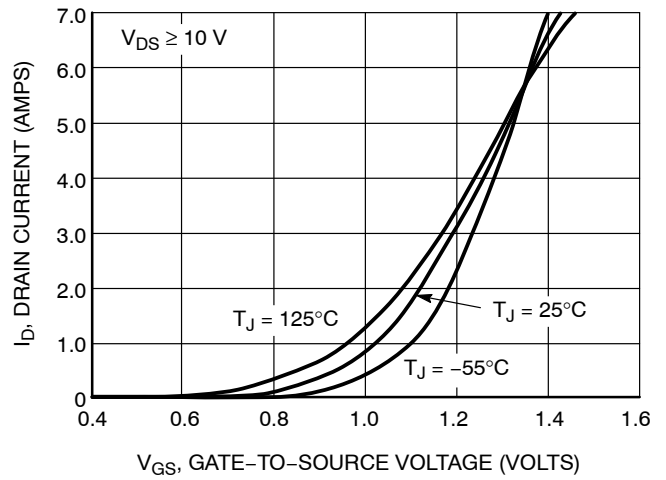


Figure 2. Transfer Characteristics

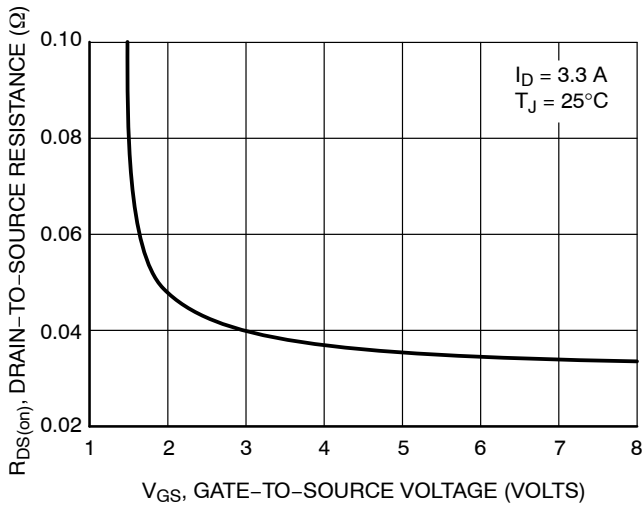


Figure 3. On-Resistance versus Gate-to-Source Voltage

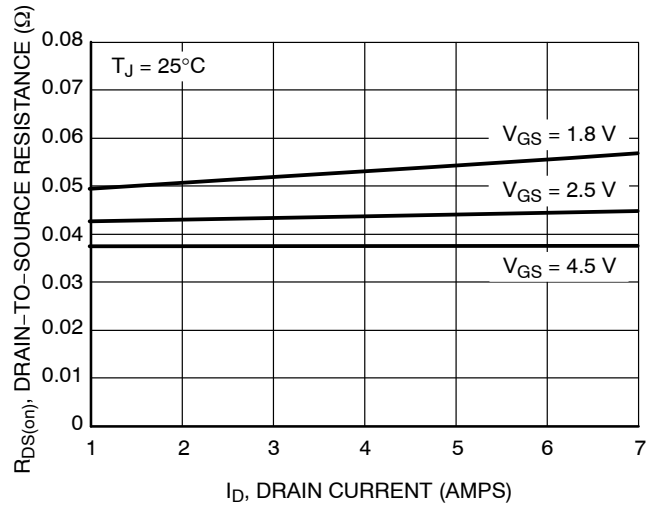


Figure 4. On-Resistance versus Drain Current and Gate Voltage

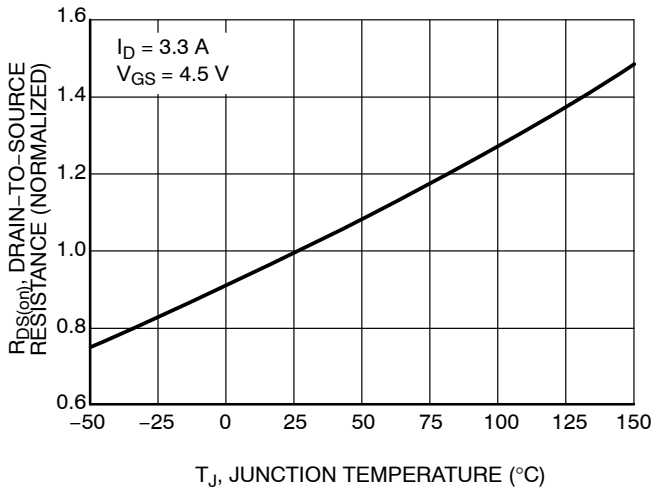


Figure 5. On-Resistance Variation with Temperature

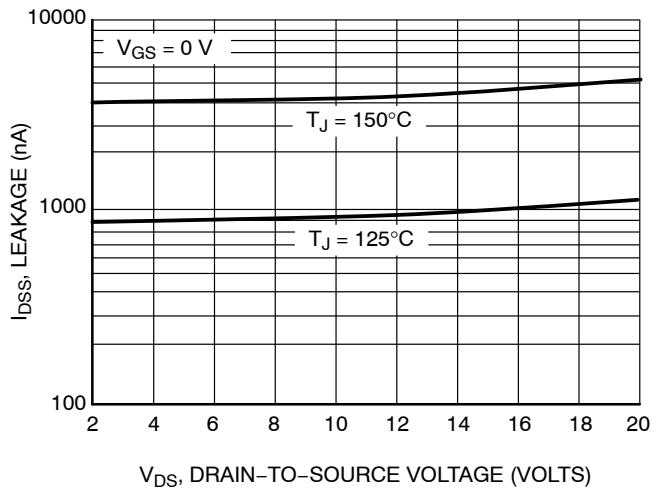


Figure 6. Drain-to-Source Leakage Current versus Voltage

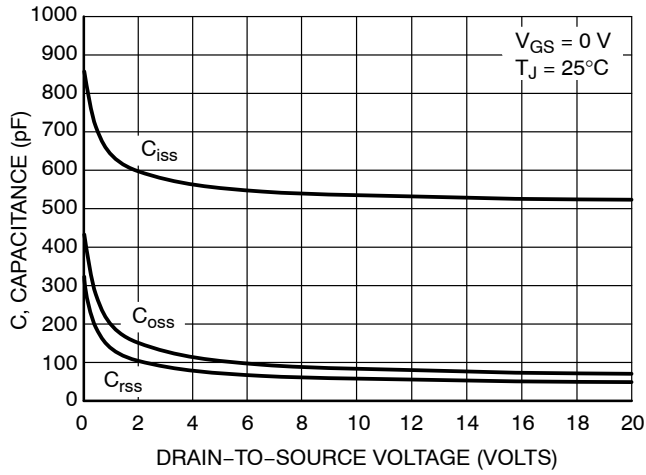


Figure 7. Capacitance Variation

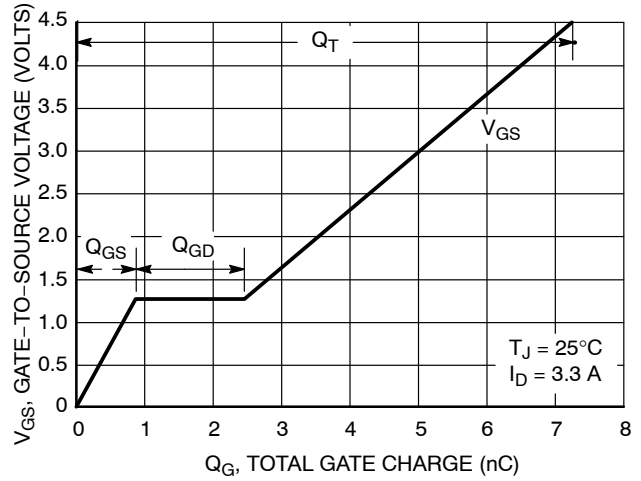


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

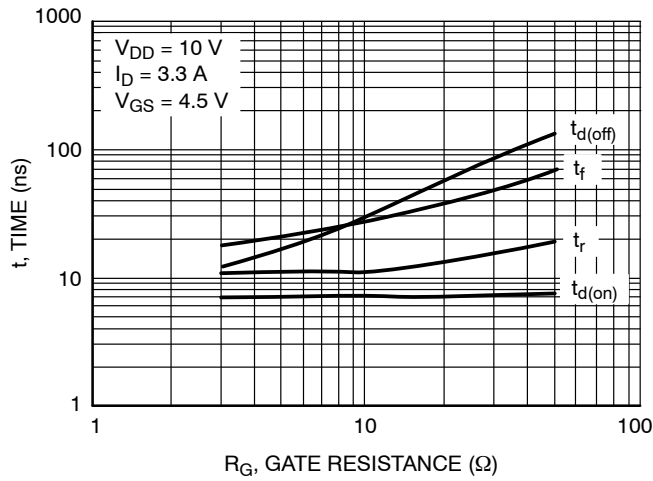


Figure 9. Resistive Switching Time Variation versus Gate Resistance

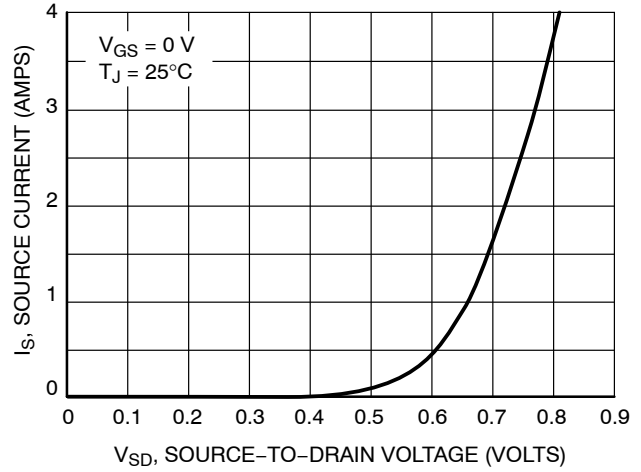
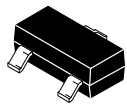


Figure 10. Diode Forward Voltage versus Current

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

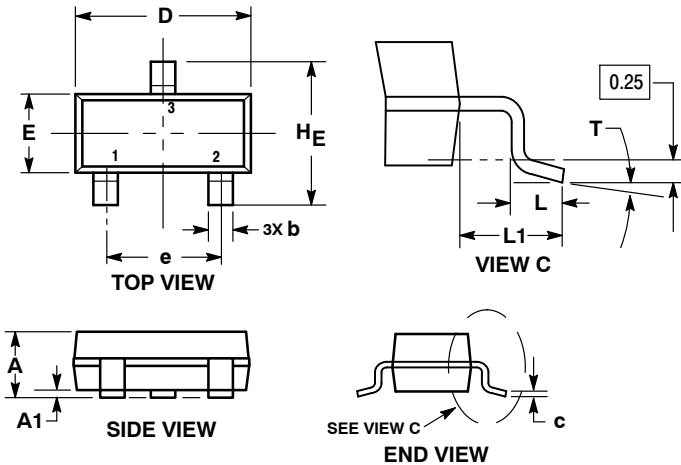
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### SOT-23 (TO-236) CASE 318-08 ISSUE AS

DATE 30 JAN 2018

SCALE 4:1

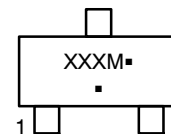


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
HE	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

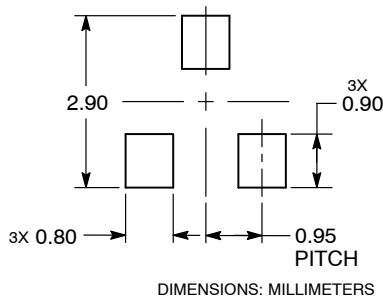
#### GENERIC MARKING DIAGRAM\*



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*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.

#### RECOMMENDED SOLDERING FOOTPRINT



STYLE 1 THRU 5:  
CANCELLED

STYLE 6:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

STYLE 7:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 8:  
PIN 1. ANODE  
2. NO CONNECTION  
3. CATHODE

STYLE 9:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 10:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

STYLE 11:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 12:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 13:  
PIN 1. SOURCE  
2. DRAIN  
3. GATE

STYLE 14:  
PIN 1. CATHODE  
2. GATE  
3. ANODE

STYLE 15:  
PIN 1. GATE  
2. CATHODE  
3. ANODE

STYLE 16:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE

STYLE 17:  
PIN 1. NO CONNECTION  
2. ANODE  
3. CATHODE

STYLE 18:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. ANODE

STYLE 19:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE-ANODE

STYLE 20:  
PIN 1. CATHODE  
2. ANODE  
3. GATE

STYLE 21:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN

STYLE 22:  
PIN 1. RETURN  
2. OUTPUT  
3. INPUT

STYLE 23:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 24:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

STYLE 25:  
PIN 1. ANODE  
2. CATHODE  
3. GATE

STYLE 26:  
PIN 1. CATHODE  
2. ANODE  
3. NO CONNECTION

STYLE 27:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

STYLE 28:  
PIN 1. ANODE  
2. ANODE  
3. ANODE

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