

# NTR4170N

## Power MOSFET

30 V, 3.1 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

- Power Converters for Portables
- Battery Management
- Load/Power Switch

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

Parameter	Symbol	Value	Unit		
Drain-to-Source Voltage	$V_{DS}$	30	V		
Gate-to-Source Voltage	$V_{GS}$	$\pm 12$	V		
Continuous Drain Current (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	2.4	A	
			$t \leq 30$ s		3.1
			$t \leq 10$ s		3.9
	Steady State	$T_A = 85^\circ\text{C}$	1.7		
			$t \leq 30$ s		2.3
			$t \leq 10$ s		2.8
Power Dissipation (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$	0.48	W
			$t \leq 30$ s	0.82	
			$t \leq 10$ s	$P_D$	
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	$I_{DM}$	8.0	A	
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$		
Source Current (Body Diode)	$I_S$	0.82	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	
Junction-to-Ambient - $t < 10$ s (Note 1)	$R_{\theta JA}$	100	

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

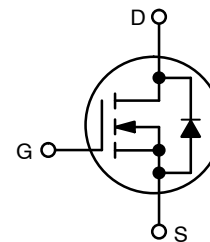


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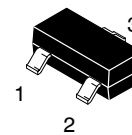
<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
30 V	55 m $\Omega$ @ 10 V	3.1 A
	70 m $\Omega$ @ 4.5 V	2.8 A
	110 m $\Omega$ @ 2.5 V	2.0 A

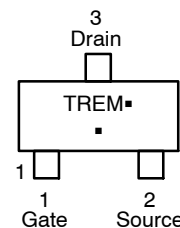
### SIMPLIFIED SCHEMATIC - N-CHANNEL



### MARKING DIAGRAM/ PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



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

### ORDERING INFORMATION

Device	Package	Shipping†
NTR4170NT1G	SOT-23 (Pb-Free)	3000/Tape & Reel
NTR4170NT3G	SOT-23 (Pb-Free)	10000/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.

# NTR4170N

## 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	30			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		26.4		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 24 V, T <sub>J</sub> = 25°C V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 24 V, T <sub>J</sub> = 125°C			1.0 5.0	μA
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±12 V			±100	nA

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	0.6	1.0	1.4	V
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> / T <sub>J</sub>			3.3		mV/°C
Drain-to-Source On-Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3.2 A		45	55	mΩ
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 2.8 A		50	70	
		V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 2.0 A		64	110	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 5.0 V, I <sub>D</sub> = 3.2 A		8.0		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> = 15 V		432		pF
Output Capacitance	C <sub>oss</sub>			53.6		
Reverse Transfer Capacitance	C <sub>rss</sub>			37.1		
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 15 V, I <sub>D</sub> = 3.2 A		4.76		nC
Threshold Gate Charge	Q <sub>G(TH)</sub>			0.3		
Gate-to-Source Charge	Q <sub>GS</sub>			1.0		
Gate-to-Drain Charge	Q <sub>GD</sub>			1.4		
Gate Resistance	R <sub>G</sub>			3.8		Ω

## SWITCHING CHARACTERISTICS, V<sub>GS</sub> = 4.5 V (Note 4)

Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DD</sub> = 15 V, I <sub>D</sub> = 3.2 A, R <sub>G</sub> = 6.2 Ω		6.4		ns
Rise Time	t <sub>r</sub>			9.9		
Turn-Off Delay Time	t <sub>d(off)</sub>			15.1		
Fall Time	t <sub>f</sub>			3.5		

## 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		0.75	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		8.0		ns
Charge Time	t <sub>a</sub>			5.1		
Discharge Time	t <sub>b</sub>			2.9		
Reverse Recovery Charge	Q <sub>RR</sub>			2.9		nC

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

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

4. Switching characteristics are independent of operating junction temperatures.

# NTR4170N

## TYPICAL CHARACTERISTICS

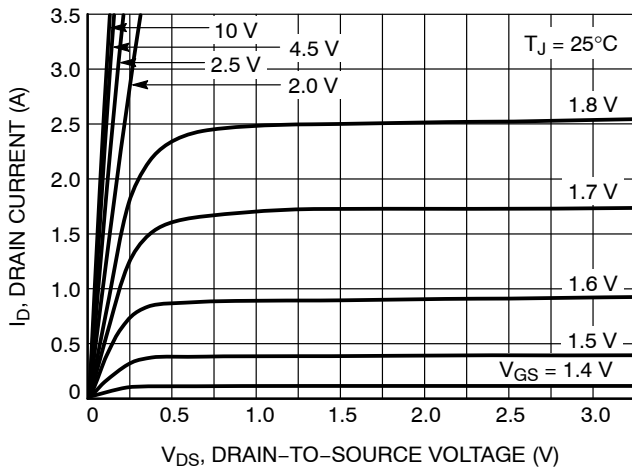


Figure 1. On-Region Characteristics

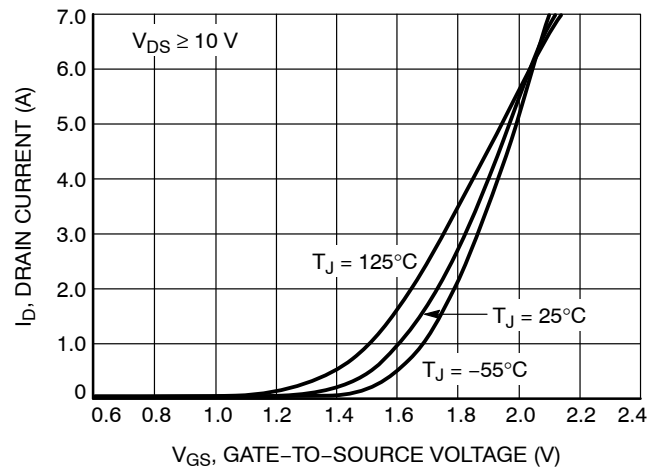


Figure 2. Transfer Characteristics

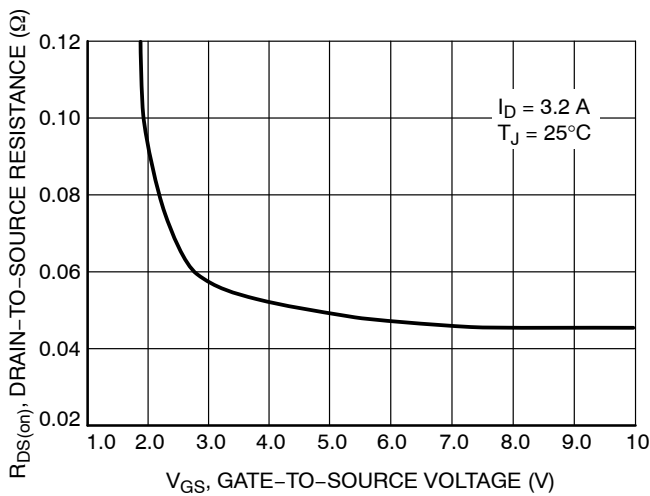


Figure 3. On-Resistance vs. Gate Voltage

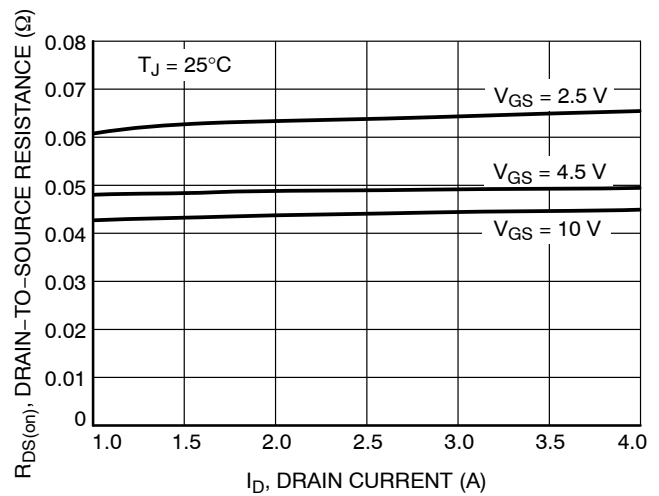


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

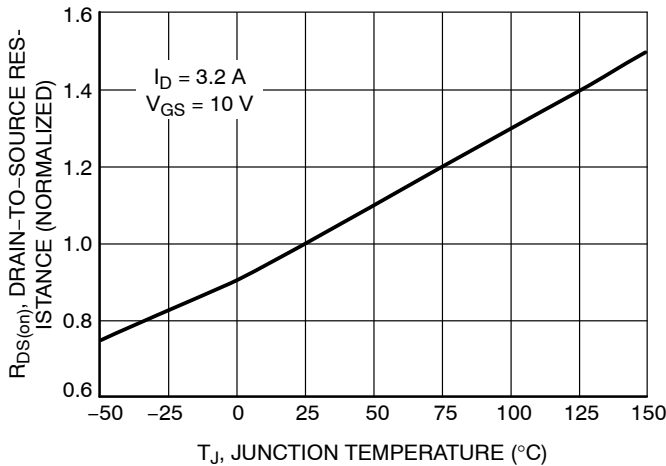


Figure 5. On-Resistance Variation with Temperature

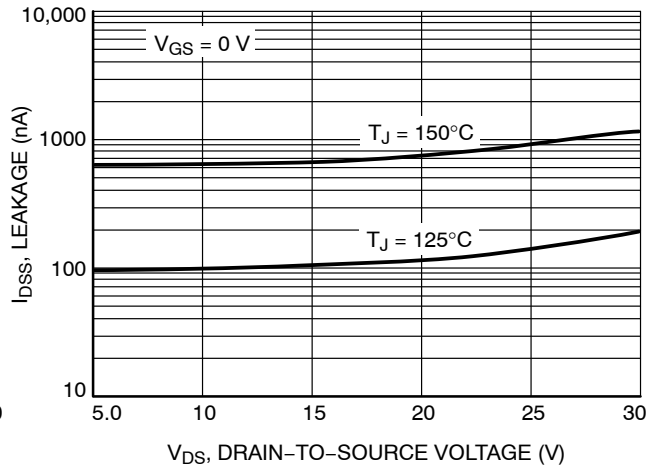
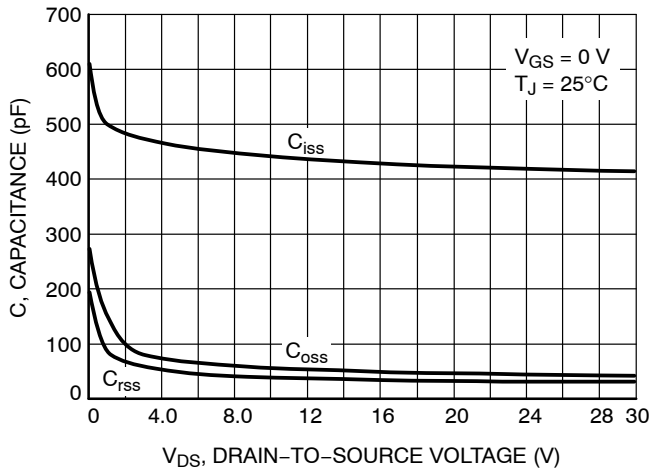


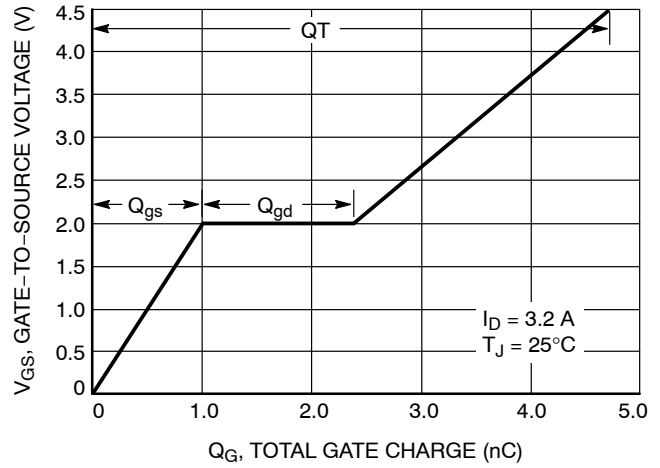
Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTR4170N

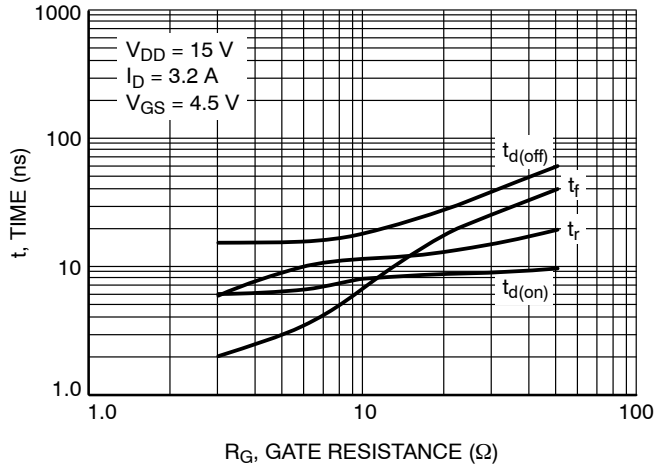
## TYPICAL CHARACTERISTICS



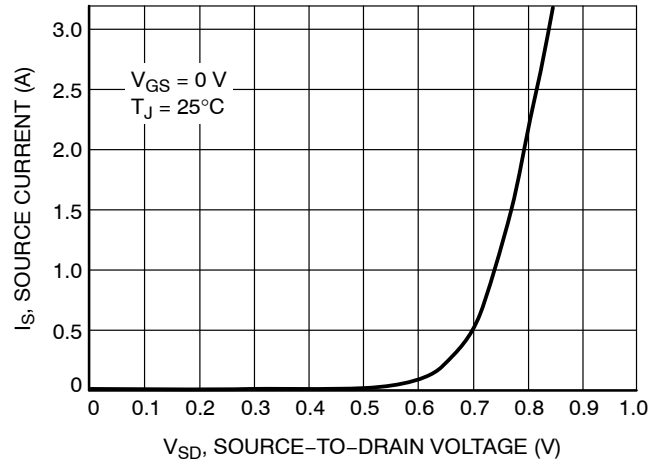
**Figure 7. Capacitance Variation**



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



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

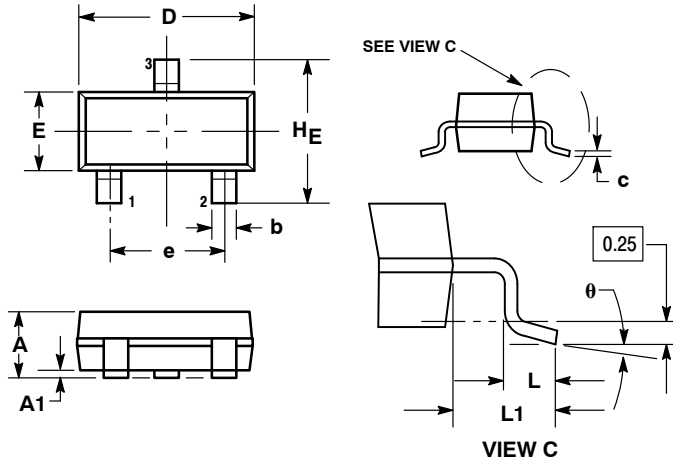


**Figure 10. Diode Forward Voltage vs. Current**

# NTR4170N

## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AP

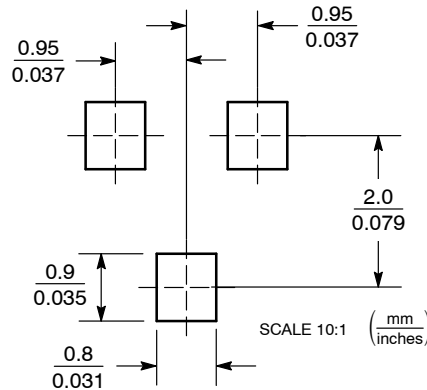


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.


DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.040	0.044
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.37	0.44	0.50	0.015	0.018	0.020
c	0.09	0.13	0.18	0.003	0.005	0.007
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	0.081
L	0.10	0.20	0.30	0.004	0.008	0.012
L1	0.35	0.54	0.69	0.014	0.021	0.029
HE	2.10	2.40	2.64	0.083	0.094	0.104
θ	0°	---	10°	0°	---	10°

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

### 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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