

# NTHD3100C

## MOSFET – Power, Complementary, ChipFET

20 V, +3.9 A /-4.4 A



ON Semiconductor®

<http://onsemi.com>

### Features

- Complementary N-Channel and P-Channel MOSFET
- Small Size, 40% Smaller than TSOP-6 Package
- Leadless SMD Package Provides Great Thermal Characteristics
- Trench P-Channel for Low On Resistance
- Low Gate Charge N-Channel for Test Switching
- Pb-Free Packages are Available

### Applications

- DC-DC Conversion Circuits
- Load Switch Applications Requiring Level Shift
- Drive Small Brushless DC Motors
- Ideal for Power Management Applications in Portable, Battery Powered Products

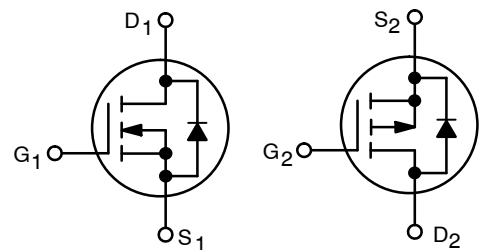
### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	V <sub>DSS</sub>	20	V	
Gate-to-Source Voltage	N-Ch	±12	V	
	P-Ch	±8.0	V	
N-Channel Continuous Drain Current (Note 1)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub> 2.9	A
		T <sub>A</sub> = 85°C	2.1	
	t ≤ 10 s	T <sub>A</sub> = 25°C	3.9	
P-Channel Continuous Drain Current (Note 1)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub> -3.2	A
		T <sub>A</sub> = 85°C	-2.3	
	t ≤ 10 s	T <sub>A</sub> = 25°C	-4.4	
Power Dissipation (Note 1)	Steady State	T <sub>A</sub> = 25°C	P <sub>D</sub> 1.1	W
		t ≤ 5 s	3.1	
Pulsed Drain Current (Note 1)	N-Ch	t = 10 μs	I <sub>DM</sub> 12	A
	P-Ch	t = 10 μs	-13	
Operating Junction and Storage Temperature	T <sub>J</sub> , T <sub>STG</sub>	-55 to 150	°C	
Source Current (Body Diode)	I <sub>S</sub>	2.5	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 seconds)	T <sub>L</sub>	260	°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.

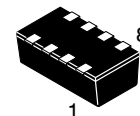
1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).

V <sub>(BR)DSS</sub>	R <sub>DS(on)</sub> Typ	I <sub>D</sub> MAX
N-Channel 20 V	58 mΩ @ 4.5 V	3.9 A
	77 mΩ @ 2.5 V	
P-Channel -20 V	64 mΩ @ -4.5 V	-4.4 A
	85 mΩ @ -2.5 V	



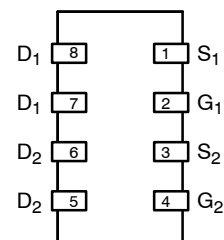
N-Channel MOSFET

P-Channel MOSFET

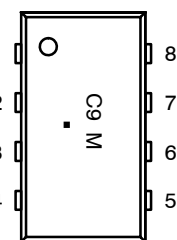


ChipFET  
CASE 1206A  
STYLE 2

### PIN CONNECTIONS



### MARKING DIAGRAM



- C9 = Specific Device Code
- M = Month Code
- = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# NTHD3100C

## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	113	$^{\circ}C/W$
Junction-to-Ambient – $t \leq 10$ s (Note 2)	$R_{\theta JA}$	60	$^{\circ}C/W$

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

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

Parameter	Symbol	N/P	Test Conditions	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS (Note 3)</b>							
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	N	$V_{GS} = 0$ V	$I_D = 250$ $\mu$ A	20		V
		P		$I_D = -250$ $\mu$ A	-20		
Zero Gate Voltage Drain Current	$I_{DSS}$	N	$V_{GS} = 0$ V, $V_{DS} = 16$ V	$T_J = 25^{\circ}C$		1.0	$\mu$ A
		P	$V_{GS} = 0$ V, $V_{DS} = -16$ V			-1.0	
		N	$V_{GS} = 0$ V, $V_{DS} = 16$ V	$T_J = 125^{\circ}C$		5.0	
		P	$V_{GS} = 0$ V, $V_{DS} = -16$ V			-5.0	
Gate-to-Source Leakage Current	$I_{GSS}$	N	$V_{DS} = 0$ V, $V_{GS} = \pm 12$ V			$\pm 100$	nA
		P	$V_{DS} = 0$ V, $V_{GS} = \pm 8.0$ V			$\pm 100$	

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	N	$V_{GS} = V_{DS}$	$I_D = 250$ $\mu$ A	0.6		1.2	V
		P		$I_D = -250$ $\mu$ A		-0.45		
Drain-to-Source On Resistance	$R_{DS(on)}$	N	$V_{GS} = 4.5$ V, $I_D = 2.9$ A			58	80	m $\Omega$
		P	$V_{GS} = -4.5$ V, $I_D = -3.2$ A			64	80	
		N	$V_{GS} = 2.5$ V, $I_D = 2.3$ A			77	115	
		P	$V_{GS} = -2.5$ V, $I_D = -2.2$ A			85	110	
Forward Transconductance	$g_{FS}$	N	$V_{DS} = 10$ V, $I_D = 2.9$ A			6.0		S
		P	$V_{DS} = -10$ V, $I_D = -3.2$ A			8.0		

## CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	N	$f = 1$ MHz, $V_{GS} = 0$ V	$V_{DS} = 10$ V		165		pF	
		P		$V_{DS} = -10$ V		680			
Output Capacitance	$C_{OSS}$	N		$V_{DS} = 10$ V		80			
		P		$V_{DS} = -10$ V		100			
Reverse Transfer Capacitance	$C_{RSS}$	N		$V_{DS} = 10$ V		25			
		P		$V_{DS} = -10$ V		70			
Total Gate Charge	$Q_{G(TOT)}$	N		$V_{GS} = 4.5$ V, $V_{DS} = 10$ V, $I_D = 2.9$ A		2.3			nC
		P		$V_{GS} = -4.5$ V, $V_{DS} = -10$ V, $I_D = -3.2$ A		7.4			
Threshold Gate Charge	$Q_{G(TH)}$	N		$V_{GS} = 4.5$ V, $V_{DS} = 10$ V, $I_D = 2.9$ A		0.2			
		P		$V_{GS} = -4.5$ V, $V_{DS} = -10$ V, $I_D = -3.2$ A		0.6			
Gate-to-Source Gate Charge	$Q_{GS}$	N	$V_{GS} = 4.5$ V, $V_{DS} = 10$ V, $I_D = 2.9$ A		0.4				
		P	$V_{GS} = -4.5$ V, $V_{DS} = -10$ V, $I_D = -3.2$ A		1.4				
Gate-to-Drain "Miller" Charge	$Q_{GD}$	N	$V_{GS} = 4.5$ V, $V_{DS} = 10$ V, $I_D = 2.9$ A		0.7				
		P	$V_{GS} = -4.5$ V, $V_{DS} = -10$ V, $I_D = -3.2$ A		2.5				

3. Pulse Test: pulse width  $\leq 250$   $\mu$ s, duty cycle  $\leq 2\%$ .

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

Parameter	Symbol	N/P	Test Conditions	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS</b> (Note 4)							
Turn-On Delay Time	$t_{d(ON)}$	N	$V_{GS} = 4.5\text{ V}, V_{DD} = 10\text{ V},$ $I_D = 2.9\text{ A}, R_G = 2.5\ \Omega$		6.3		ns
Rise Time	$t_r$				10.7		
Turn-Off Delay Time	$t_{d(OFF)}$				9.6		
Fall Time	$t_f$				1.5		
Turn-On Delay Time	$t_{d(ON)}$	P	$V_{GS} = -4.5\text{ V}, V_{DD} = -10\text{ V},$ $I_D = -3.2\text{ A}, R_G = 2.5\ \Omega$		5.8		
Rise Time	$t_r$				11.7		
Turn-Off Delay Time	$t_{d(OFF)}$				16		
Fall Time	$t_f$				12.4		

## DRAIN-SOURCE DIODE CHARACTERISTICS

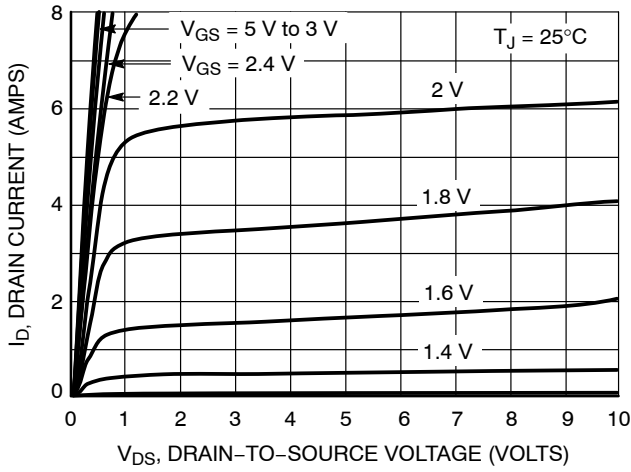
Forward Diode Voltage	$V_{SD}$	N	$V_{GS} = 0\text{ V}, T_J = 25\ ^\circ\text{C}$	$I_S = 2.5\text{ A}$		0.8	1.15	V
		P		$I_S = -2.5\text{ A}$		-0.8	-1.2	
Reverse Recovery Time	$t_{RR}$	N	$V_{GS} = 0\text{ V},$ $dI_S / dt = 100\text{ A}/\mu\text{s}$	$I_S = 1.5\text{ A}$		12.5		ns
		P		$I_S = -1.5\text{ A}$		13.5		
Charge Time	$t_a$	N		$I_S = 1.5\text{ A}$		9.0		
		P		$I_S = -1.5\text{ A}$		9.5		
Discharge Time	$t_b$	N		$I_S = 1.5\text{ A}$		3.5		
		P		$I_S = -1.5\text{ A}$		4.0		
Reverse Recovery Charge	$Q_{RR}$	N		$I_S = 1.5\text{ A}$		6.0		nC
		P		$I_S = -1.5\text{ A}$		6.5		

4. Switching characteristics are independent of operating junction temperatures.

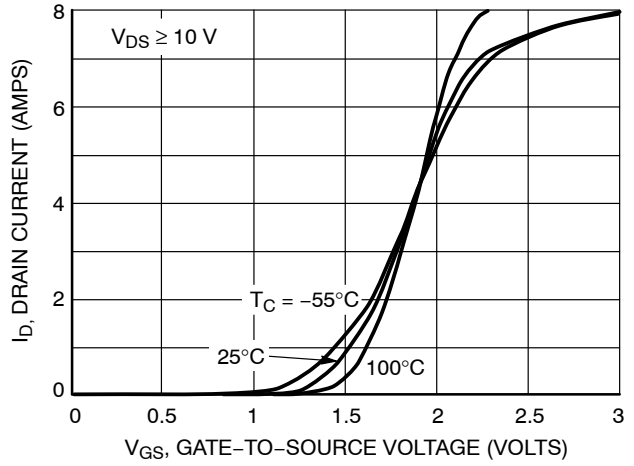
# NTHD3100C

## TYPICAL N-CHANNEL PERFORMANCE CURVES

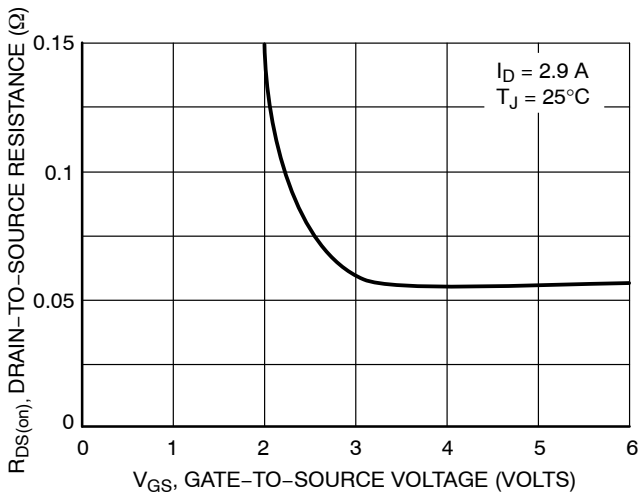
( $T_J = 25^\circ\text{C}$  unless otherwise noted)



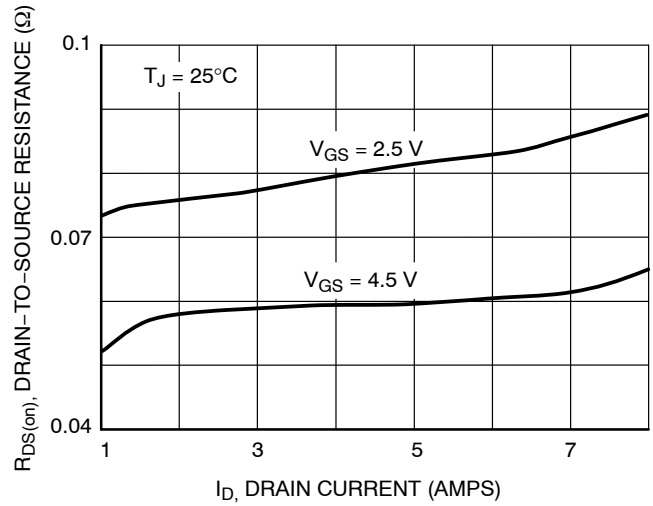
**Figure 1. On-Region Characteristics**



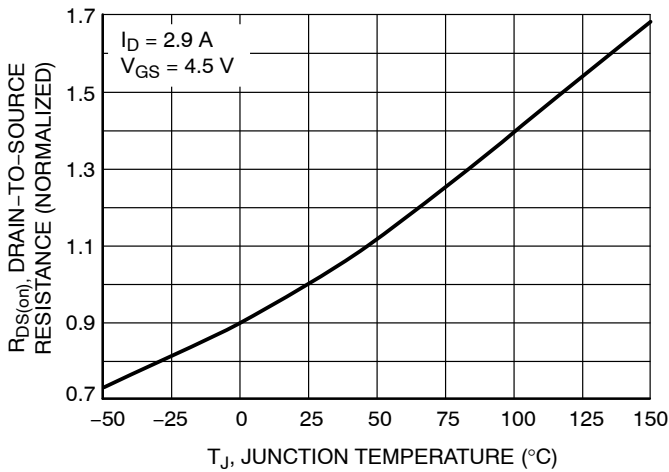
**Figure 2. Transfer Characteristics**



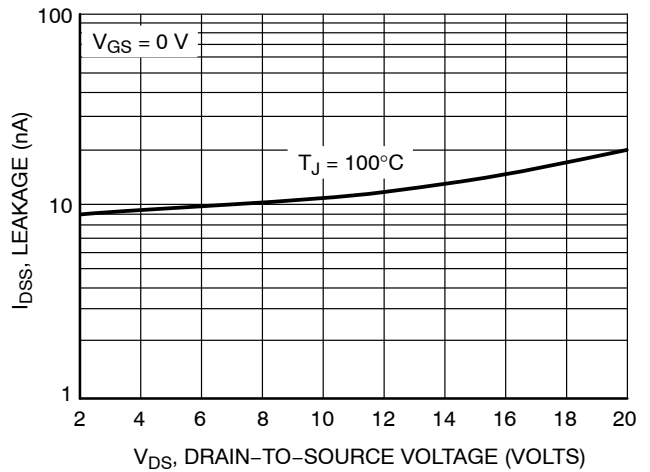
**Figure 3. On-Resistance vs. Gate-to-Source Voltage**



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



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

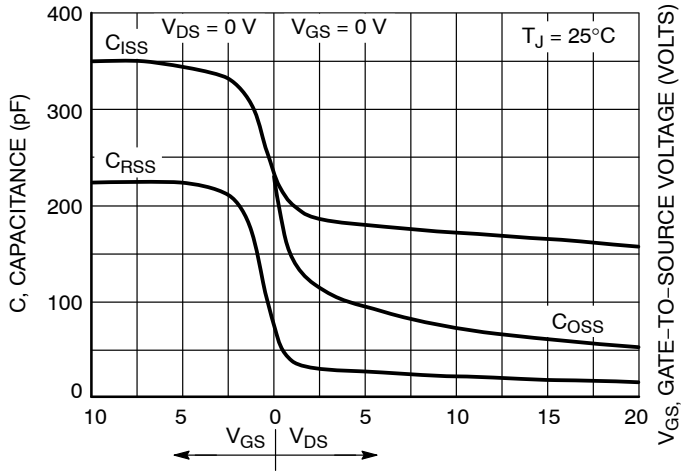


**Figure 6. Drain-to-Source Leakage Current vs. Voltage**

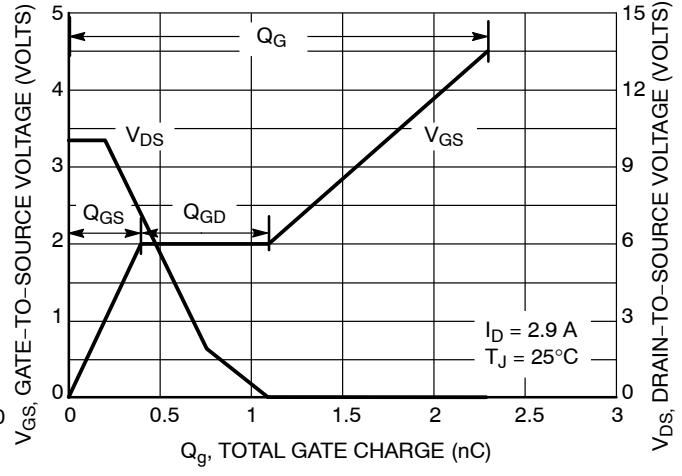
# NTHD3100C

## TYPICAL N-CHANNEL PERFORMANCE CURVES

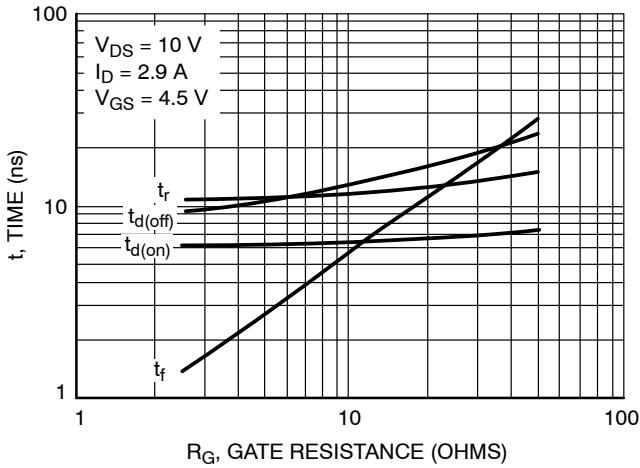
( $T_J = 25^\circ\text{C}$  unless otherwise noted)



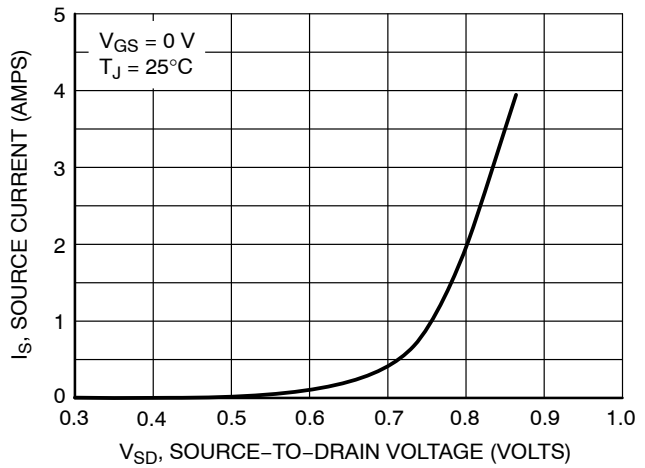
**Figure 7. Capacitance Variation**



**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**

# NTHD3100C

## TYPICAL P-CHANNEL PERFORMANCE CURVES

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

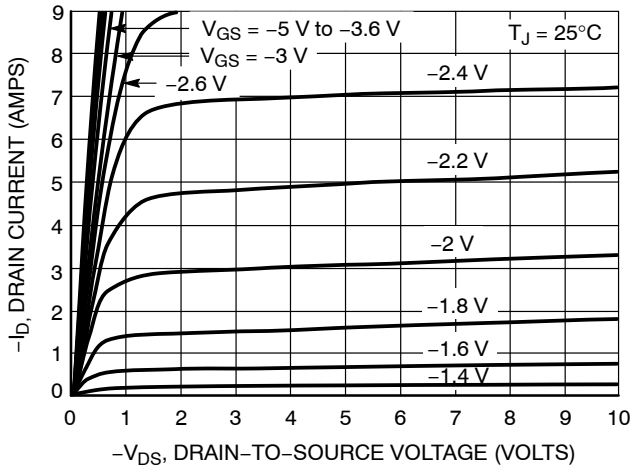


Figure 11. On-Region Characteristics

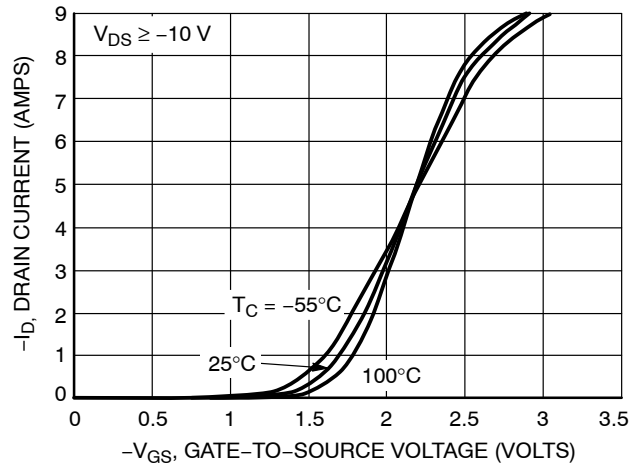


Figure 12. Transfer Characteristics

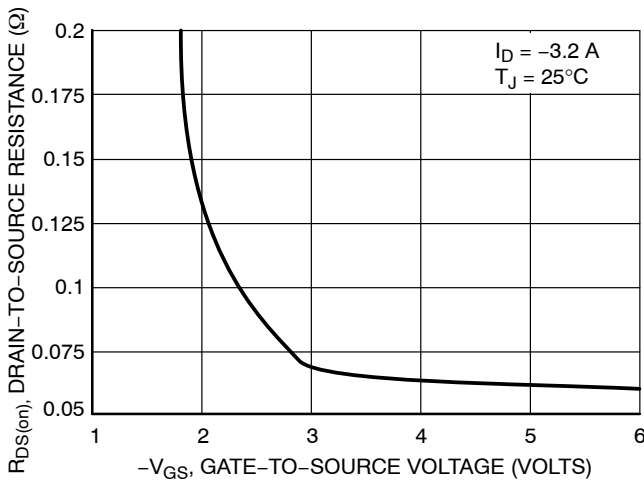


Figure 13. On-Resistance vs. Gate-to-Source Voltage

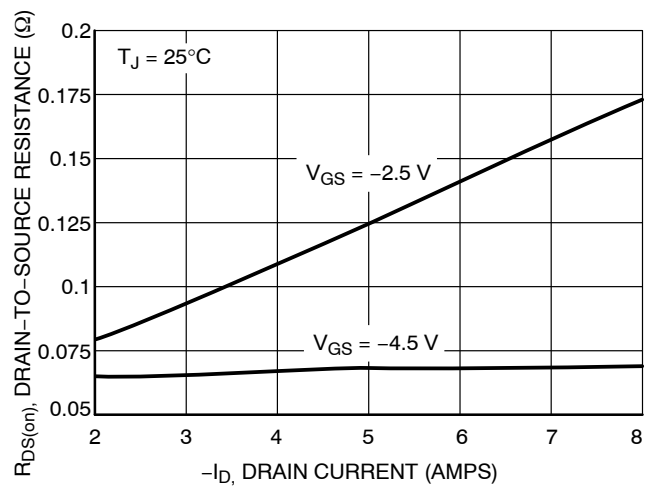


Figure 14. On-Resistance vs. Drain Current and Gate Voltage

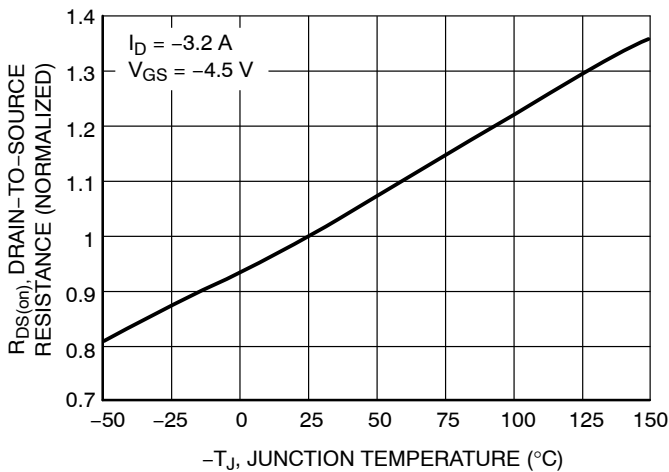


Figure 15. On-Resistance Variation with Temperature

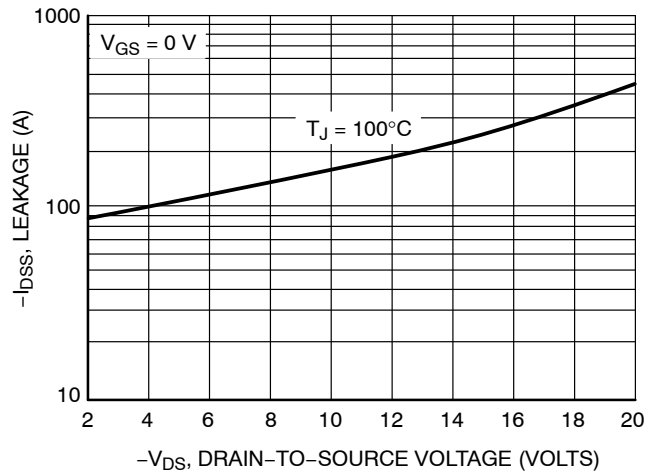
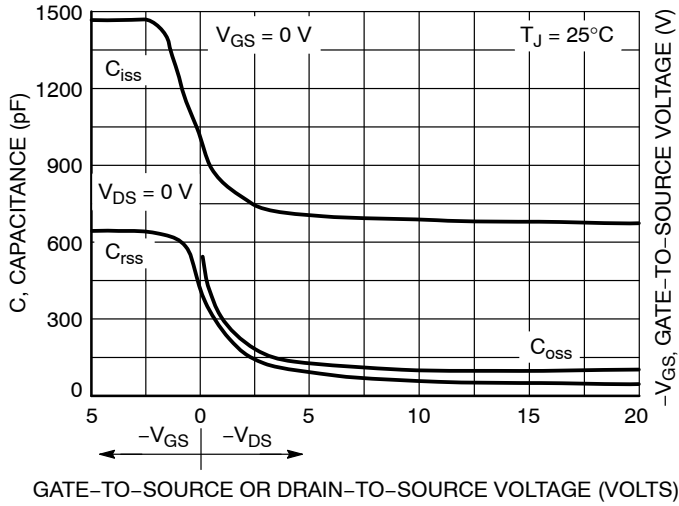


Figure 16. Drain-to-Source Leakage Current vs. Voltage

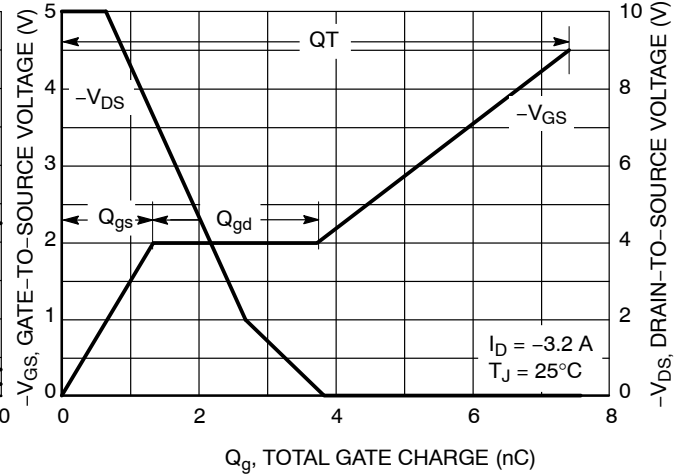
# NTHD3100C

## TYPICAL P-CHANNEL PERFORMANCE CURVES

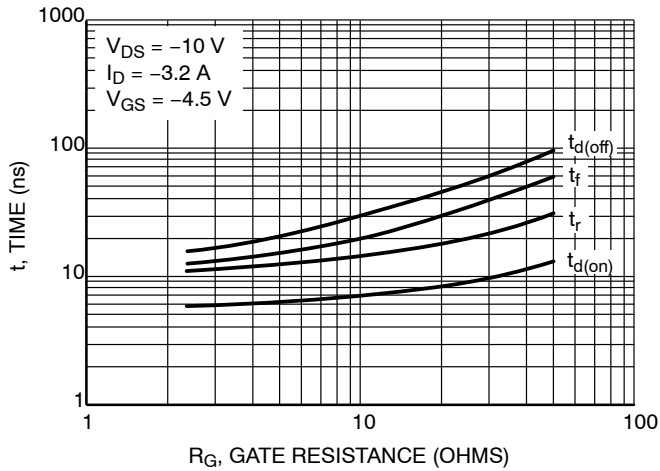
( $T_J = 25^\circ\text{C}$  unless otherwise noted)



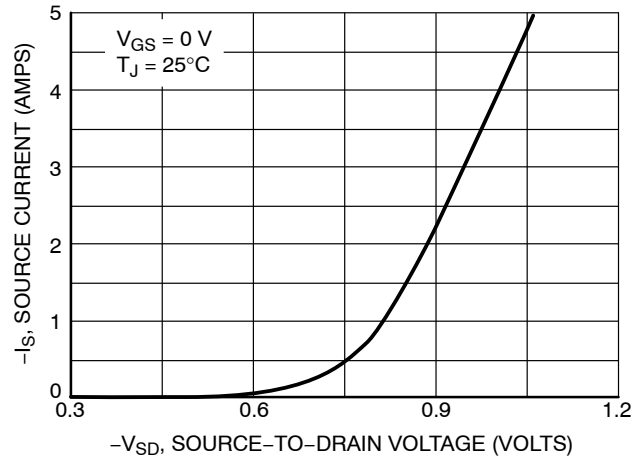
**Figure 17. Capacitance Variation**



**Figure 18. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



**Figure 19. Resistive Switching Time Variation vs. Gate Resistance**

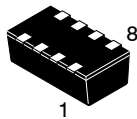


**Figure 20. Diode Forward Voltage vs. Current**

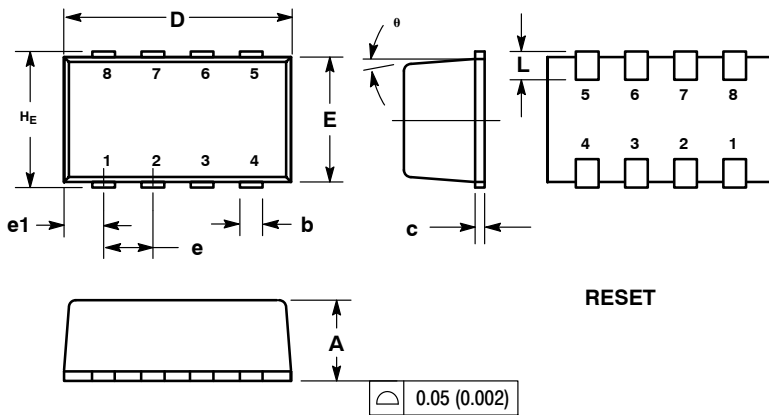
### DEVICE ORDERING INFORMATION

Device	Package	Shipping†
NTHD3100CT1	ChipFET	3000 / Tape & Reel
NTHD3100CT1G	ChipFET (Pb-Free)	3000 / Tape & Reel
NTHD3100CT3	ChipFET	10000 / Tape & Reel
NTHD3100CT3G	ChipFET (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 Specifications Brochure, BRD8011/D.



SCALE 1:1



ChipFET™  
CASE1206A-03  
ISSUE K

DATE 19 MAY 2009

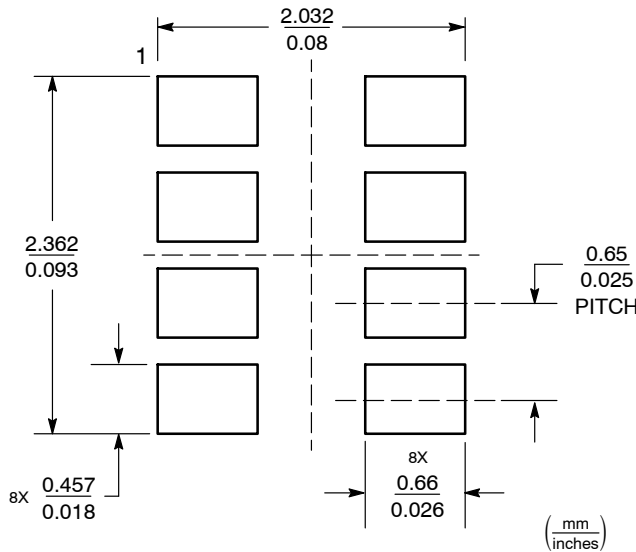
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MOLD GATE BURRS SHALL NOT EXCEED 0.13 MM PER SIDE.
4. LEADFRAME TO MOLDED BODY OFFSET IN HORIZONTAL AND VERTICAL SHALL NOT EXCEED 0.08 MM.
5. DIMENSIONS A AND B EXCLUSIVE OF MOLD GATE BURRS.
6. NO MOLD FLASH ALLOWED ON THE TOP AND BOTTOM LEAD SURFACE.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.05	1.10	0.039	0.041	0.043
b	0.25	0.30	0.35	0.010	0.012	0.014
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.95	3.05	3.10	0.116	0.120	0.122
E	1.55	1.65	1.70	0.061	0.065	0.067
e	0.65 BSC			0.025 BSC		
e1	0.55 BSC			0.022 BSC		
L	0.28	0.35	0.42	0.011	0.014	0.017
HE	1.80	1.90	2.00	0.071	0.075	0.079
θ	5° NOM			5° NOM		

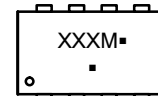
- |   |   |   |  |   |   |
|---|---|---|--|---|---|
| <p>STYLE 1:<br/>PIN 1. DRAIN<br/>2. DRAIN<br/>3. DRAIN<br/>4. GATE<br/>5. SOURCE<br/>6. DRAIN<br/>7. DRAIN<br/>8. DRAIN</p> | <p>STYLE 2:<br/>PIN 1. SOURCE 1<br/>2. GATE 1<br/>3. SOURCE 2<br/>4. GATE 2<br/>5. DRAIN 2<br/>6. DRAIN 2<br/>7. DRAIN 1<br/>8. DRAIN 1</p> | <p>STYLE 3:<br/>PIN 1. ANODE<br/>2. ANODE<br/>3. SOURCE<br/>4. GATE<br/>5. DRAIN<br/>6. DRAIN<br/>7. CATHODE<br/>8. CATHODE</p> | <p>STYLE 4:<br/>PIN 1. COLLECTOR<br/>2. COLLECTOR<br/>3. COLLECTOR<br/>4. BASE<br/>5. EMITTER<br/>6. COLLECTOR<br/>7. COLLECTOR<br/>8. COLLECTOR</p> | <p>STYLE 5:<br/>PIN 1. ANODE<br/>2. ANODE<br/>3. DRAIN<br/>4. DRAIN<br/>5. SOURCE<br/>6. GATE<br/>7. CATHODE<br/>8. CATHODE</p> | <p>STYLE 6:<br/>PIN 1. ANODE<br/>2. DRAIN<br/>3. DRAIN<br/>4. GATE<br/>5. SOURCE<br/>6. DRAIN<br/>7. DRAIN<br/>8. CATHODE / DRAIN</p> |
|---|---|---|--|---|---|

SOLDERING FOOTPRINT



Basic Style

GENERIC MARKING DIAGRAM\*



- XXX = Specific Device Code
  - M = Month Code
  - = Pb-Free Package
- (Note: Microdot may be in either location)

\*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.

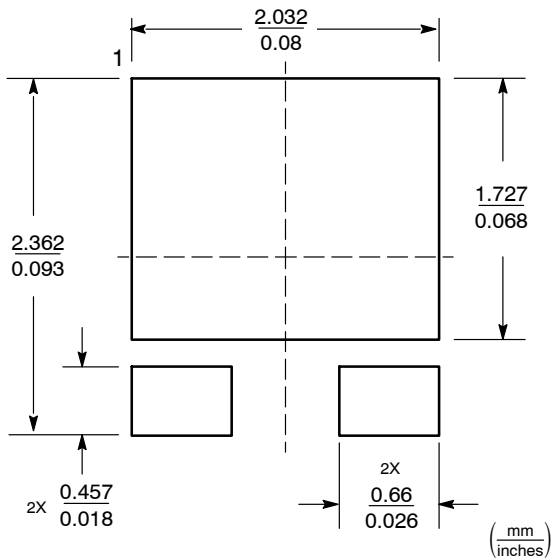
OPTIONAL SOLDERING FOOTPRINTS ON PAGE 2

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DESCRIPTION:	ChipFET	PAGE 1 OF 2

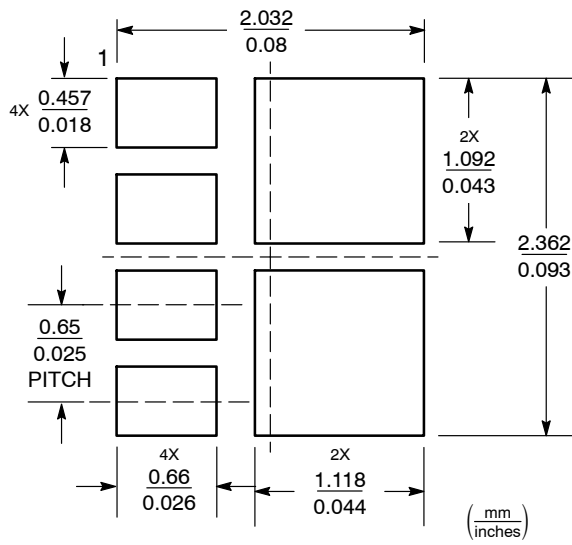
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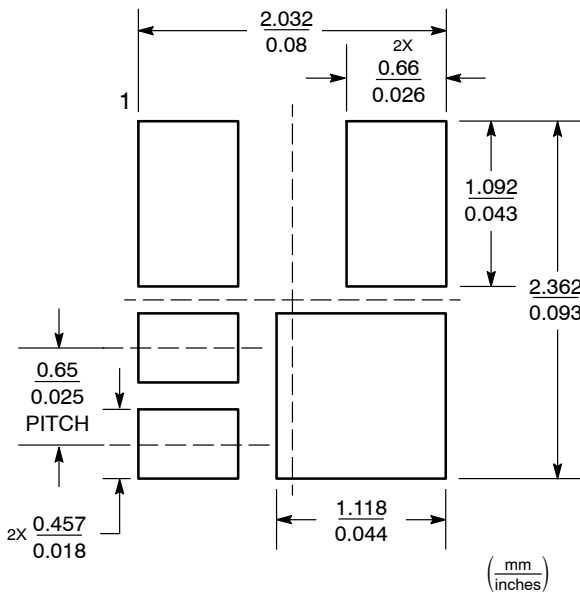
ADDITIONAL SOLDERING FOOTPRINTS\*



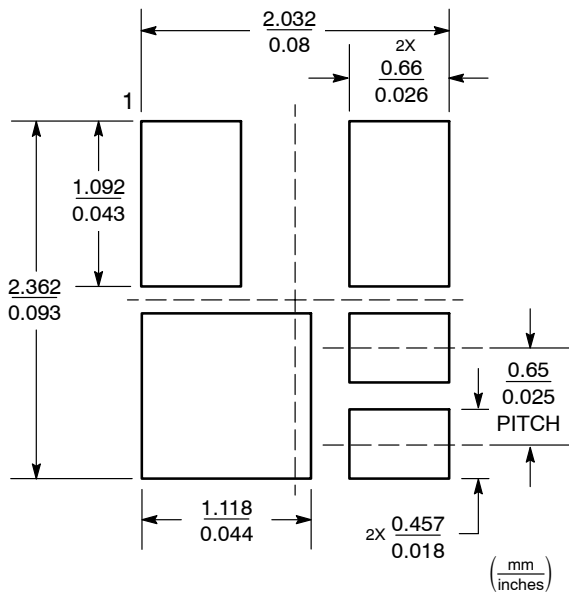
Styles 1 and 4



Style 2



Style 3



Style 5

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

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<b>DESCRIPTION:</b>	<b>ChipFET</b>	<b>PAGE 2 OF 2</b>

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