

# NTHD3101F

## MOSFET – Power, P-Channel, Schottky Diode, ChipFET, FETKY, Schottky Barrier Diode -20 V, -4.4 A, 4.1 A

### Features

- Leadless SMD Package Featuring a MOSFET and Schottky Diode
- 40% Smaller than TSOP-6 Package
- Leadless SMD Package Provides Great Thermal Characteristics
- Independent Pinout to each Device to Ease Circuit Design
- Trench P-Channel for Low On Resistance
- Ultra Low  $V_F$  Schottky
- Pb-Free Packages are Available

### Applications

- Li-Ion Battery Charging
- High Side DC-DC Conversion Circuits
- High Side Drive for Small Brushless DC Motors
- Power Management in Portable, Battery Powered Products

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

Parameter		Symbol	Value	Units
Drain-to-Source Voltage		$V_{DSS}$	-20	V
Gate-to-Source Voltage		$V_{GS}$	$\pm 8.0$	V
Continuous Drain Current (Note 1)	Steady State	$I_D$	-3.2	A
			-2.3	
	$t \leq 5 \text{ s}$		-4.4	
Power Dissipation (Note 1)	Steady State	$P_D$	1.1	W
	$t \leq 5 \text{ s}$		2.1	
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	$I_{DM}$	-13	A
Operating Junction and Storage Temperature		$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$
Source Current (Body Diode)		$I_S$	2.5	A
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	260	$^\circ\text{C}$

### SCHOTTKY DIODE MAXIMUM RATINGS

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

Parameter		Symbol	Value	Units
Peak Repetitive Reverse Voltage		$V_{RRM}$	20	V
DC Blocking Voltage		$V_R$	20	V



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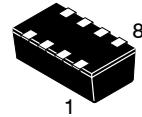
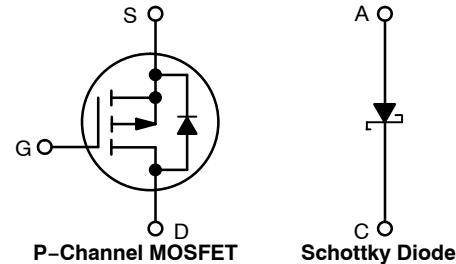
<http://onsemi.com>

### MOSFET

$V_{(BR)DSS}$	$R_{DS(on)} \text{ TYP}$	$I_D \text{ MAX}$
-20 V	64 m $\Omega$ @ -4.5 V	-4.4 A
	85 m $\Omega$ @ -2.5 V	

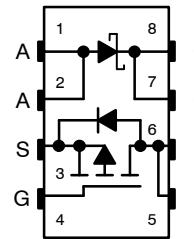
### SCHOTTKY DIODE

$V_R \text{ MAX}$	$V_F \text{ TYP}$	$I_F \text{ MAX}$
20 V	0.510 V	4.1 A

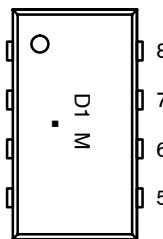


ChipFET  
CASE 1206A  
STYLE 3

### PIN CONNECTIONS



### MARKING DIAGRAM



D1 = 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.

## SCHOTTKY DIODE MAXIMUM RATINGS

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

Parameter		Symbol	Value	Units
Average Rectified Forward Current	Steady State	I <sub>F</sub>	2.2	V
	t ≤ 5 s		4.1	A

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).

## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Units
Junction-to-Ambient – Steady State (Note 2)	R <sub>θJA</sub>	113	°C/W
Junction-to-Ambient – t ≤ 10 s (Note 2)	R <sub>θJA</sub>	60	°C/W

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

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
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## OFF CHARACTERISTICS

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/T<sub>J</sub></sub>			-15		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = -16 V, V <sub>GS</sub> = 0 V	T <sub>J</sub> = 25°C		-1.0	μA
			T <sub>J</sub> = 125°C		-5.0	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±8.0 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	-0.45		-1.5	V
Gate Threshold Temperature Coefficient	V <sub>GS(TH)/T<sub>J</sub></sub>			2.7		mV/°C
Drain-to-Source On-Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -4.5, I <sub>D</sub> = -3.2 A		64	80	mΩ
		V <sub>GS</sub> = -2.5, I <sub>D</sub> = -2.2 A		85	110	
		V <sub>GS</sub> = -1.8, I <sub>D</sub> = -1.0 A		120	170	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -2.9 A		8.0		S

## CHARGES AND CAPACITANCES

Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = -10 V		680		pF
Output Capacitance	C <sub>OSS</sub>			100		
Reverse Transfer Capacitance	C <sub>RSS</sub>			70		
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> = -3.2 A		7.4		nC
	Q <sub>G(TH)</sub>			0.6		
	Q <sub>GS</sub>			1.4		
	Q <sub>GD</sub>			2.5		

## SWITCHING CHARACTERISTICS (Note 4)

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> = -3.2 A, R <sub>G</sub> = 2.4 Ω		5.8		ns
Rise Time	t <sub>r</sub>			11.7		
Turn-Off Delay Time	t <sub>d(OFF)</sub>			16		
Fall Time	t <sub>f</sub>			12.4		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = -2.5 A	T <sub>J</sub> = 25°C		-0.8	-1.2	V
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# NTHD3101F

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0 \text{ V}$ , $I_S = -1.0 \text{ A}$ , $dI_S/dt = 100 \text{ A}/\mu\text{s}$		13.5		ns
Charge Time	$t_a$			9.5		
Discharge Time	$t_b$			4.0		
Reverse Recovery Charge	$Q_{RR}$			6.5		nC

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

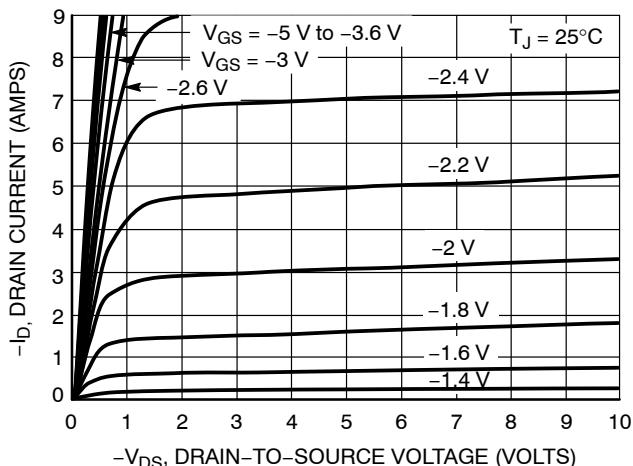
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Maximum Instantaneous Forward Voltage	$V_F$	$I_F = 0.1 \text{ A}$		0.425		V
		$I_F = 1.0 \text{ A}$		0.510	0.575	
Maximum Instantaneous Reverse Current	$I_R$	$V_R = 10 \text{ V}$			1.0	$\mu\text{A}$
		$V_R = 20 \text{ V}$			5.0	

3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

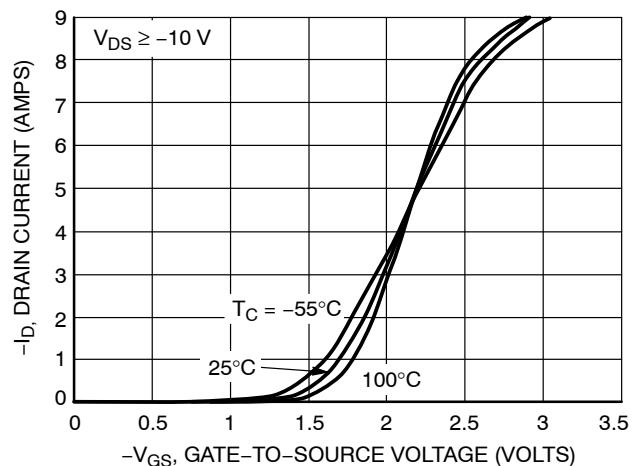
4. Switching characteristics are independent of operating junction temperatures.

**TYPICAL P-CHANNEL PERFORMANCE CURVES**

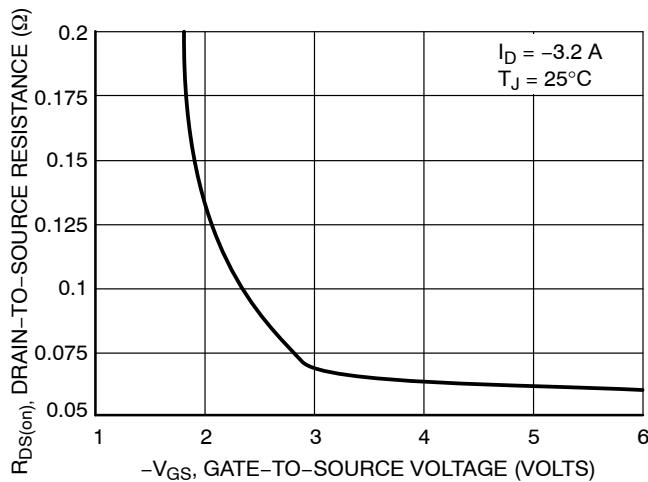
( $T_J = 25^\circ\text{C}$  unless otherwise noted)



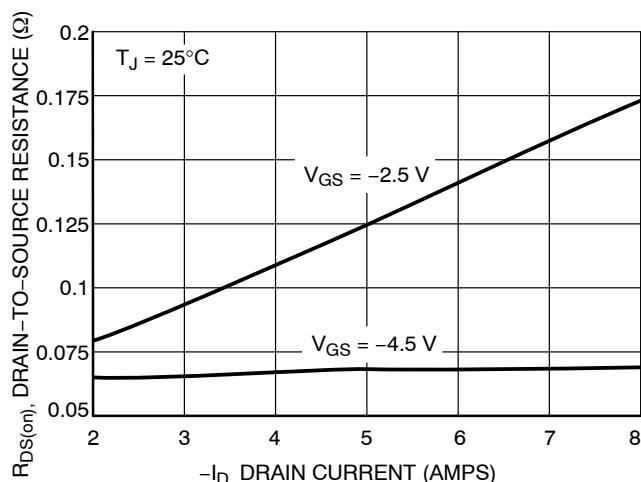
**Figure 1. On-Region Characteristics**



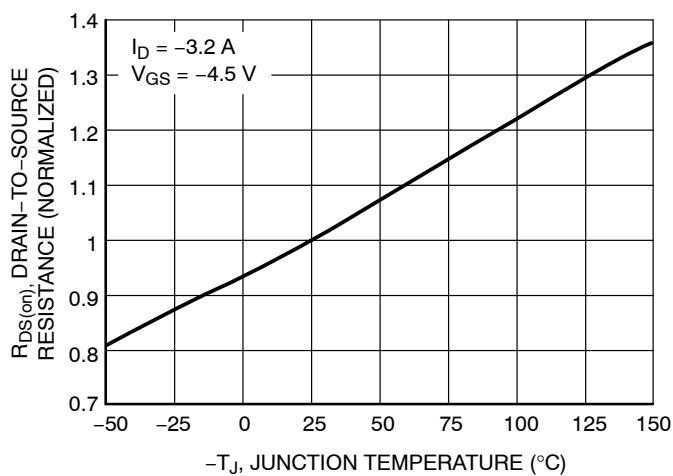
**Figure 2. Transfer Characteristics**



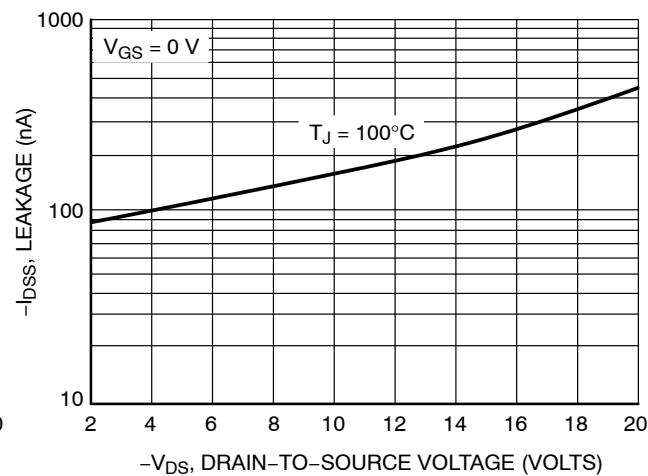
**Figure 3. On-Resistance vs. Gate-to-Source Voltage**



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



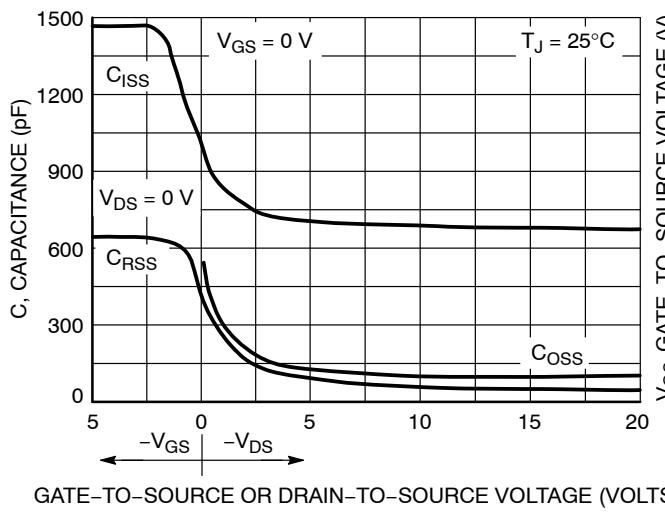
**Figure 5. On-Resistance Variation with Temperature**



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

TYPICAL P-CHANNEL PERFORMANCE CURVES

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



GATE-TO-SOURCE OR DRAIN-TO-SOURCE VOLTAGE (VOLTS)

Figure 7. Capacitance Variation

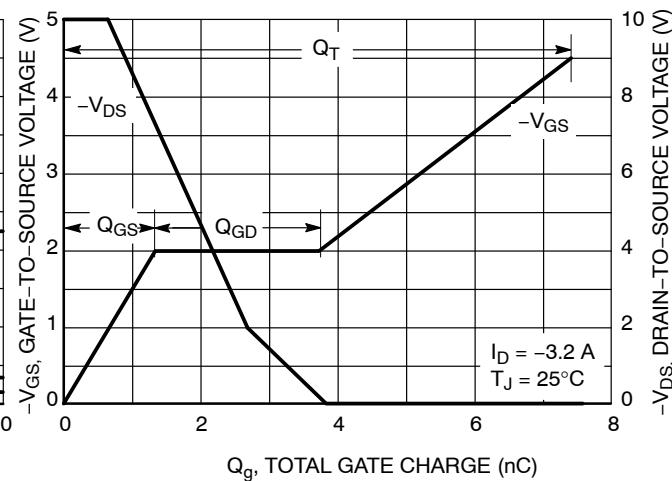


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

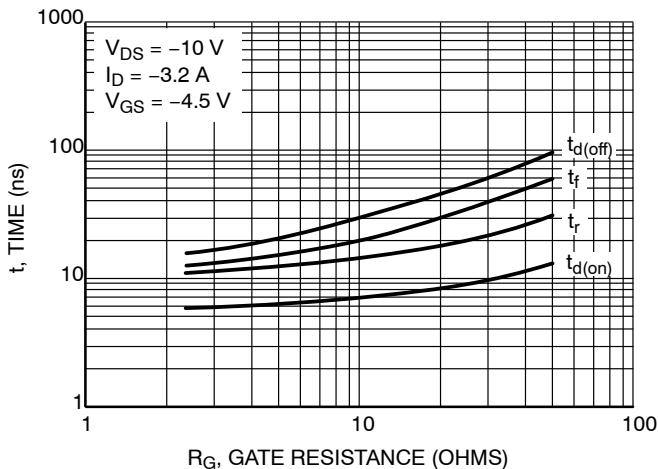


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

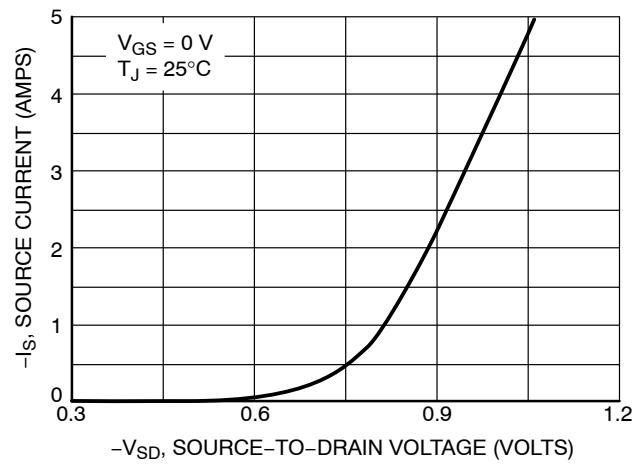


Figure 10. Diode Forward Voltage vs. Current

## TYPICAL SCHOTTKY PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

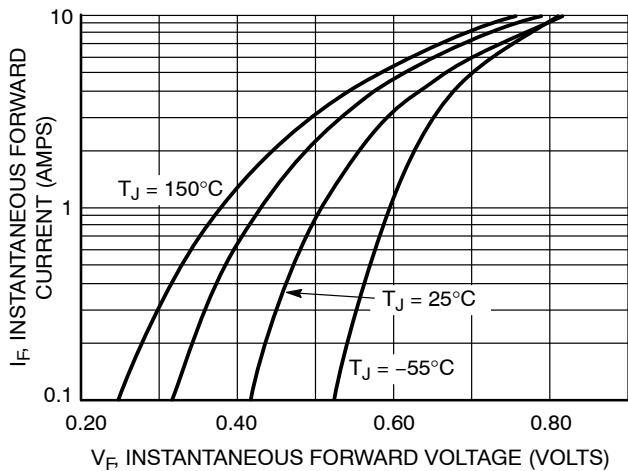


Figure 11. Typical Forward Voltage

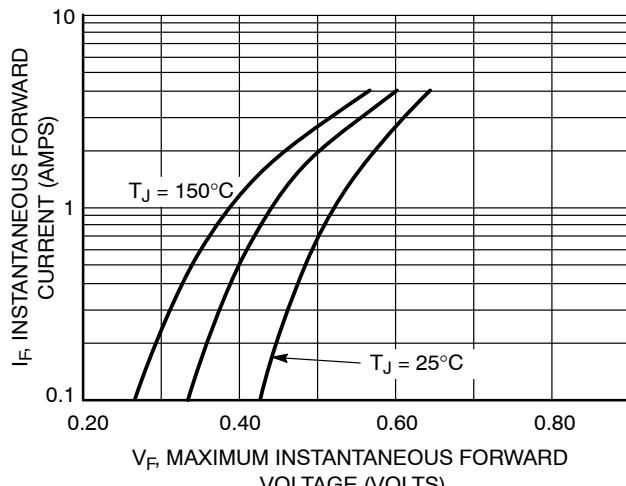


Figure 12. Maximum Forward Voltage

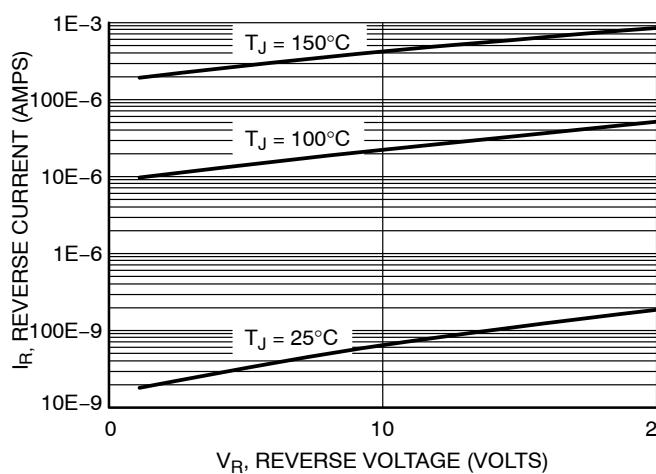


Figure 13. Typical Reverse Current

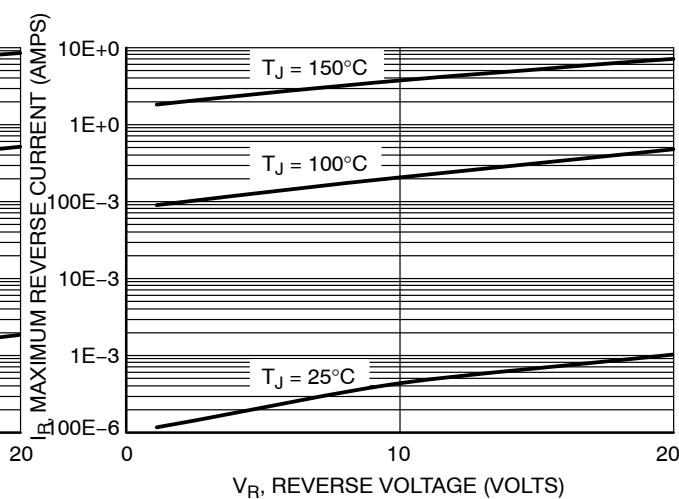


Figure 14. Maximum Reverse Current

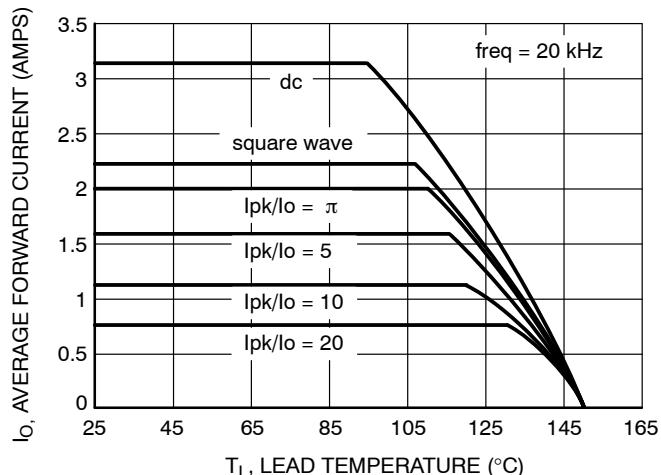


Figure 15. Current Derating

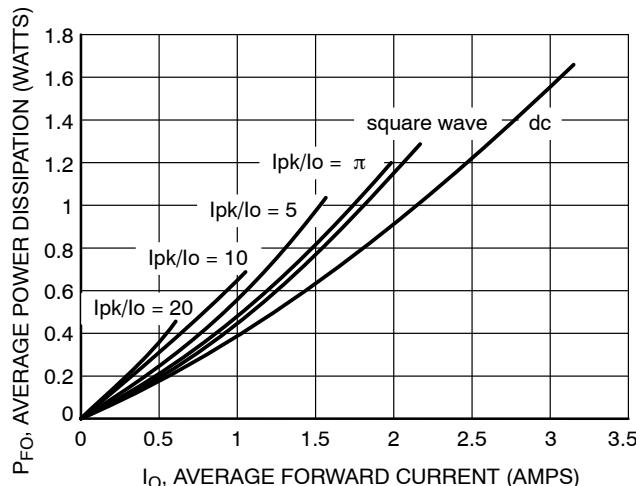


Figure 16. Forward Power Dissipation

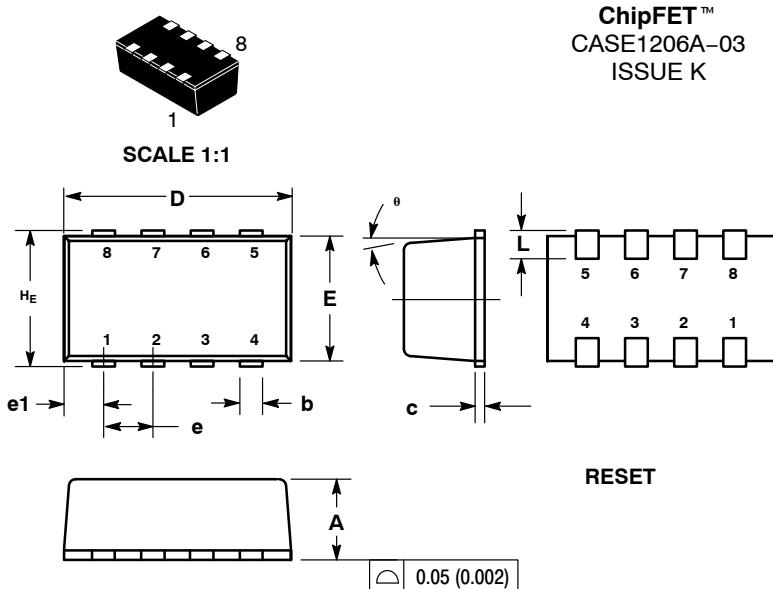
# NTHD3101F

## DEVICE ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTHD3101FT1	ChipFET	3000 / Tape & Reel
NTHD3101FT1G	ChipFET (Pb-Free)	3000 / Tape & Reel
NTHD3101FT3	ChipFET	10000 / Tape & Reel
NTHD3101FT3G	ChipFET (Pb-Free)	10000 / 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.

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FETKY is a registered trademark of International Rectifier Corporation.



ChipFET™  
CASE1206A-03  
ISSUE K

DATE 19 MAY 2009

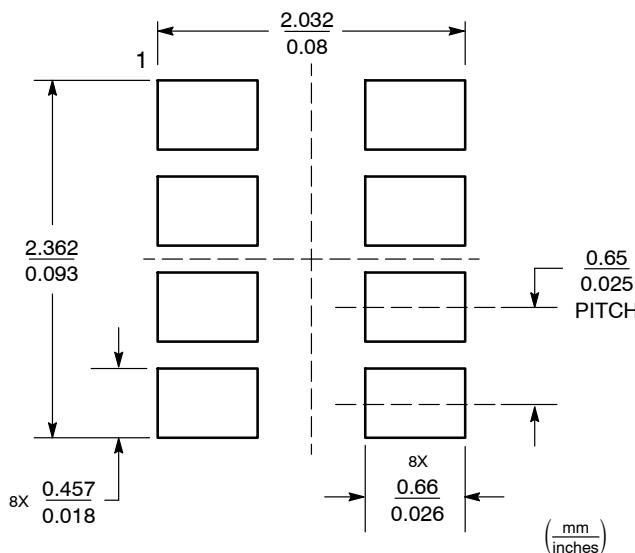
NOTES:

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
H <sub>E</sub>	1.80	1.90	2.00	0.071	0.075	0.079
θ	5° NOM			5° NOM		

STYLE 1:	STYLE 2:	STYLE 3:	STYLE 4:	STYLE 5:	STYLE 6:
PIN 1. DRAIN	PIN 1. SOURCE 1	PIN 1. ANODE	PIN 1. COLLECTOR	PIN 1. ANODE	PIN 1. ANODE
2. DRAIN	2. GATE 1	2. ANODE	2. COLLECTOR	2. ANODE	2. DRAIN
3. DRAIN	3. SOURCE 2	3. SOURCE	3. COLLECTOR	3. DRAIN	3. DRAIN
4. GATE	4. GATE 2	4. GATE	4. BASE	4. DRAIN	4. GATE
5. SOURCE	5. DRAIN 2	5. DRAIN	5. Emitter	5. SOURCE	5. SOURCE
6. DRAIN	6. DRAIN 2	6. DRAIN	6. COLLECTOR	6. GATE	6. DRAIN
7. DRAIN	7. DRAIN 1	7. CATHODE	7. COLLECTOR	7. CATHODE	7. DRAIN
8. DRAIN	8. DRAIN 1	8. CATHODE	8. COLLECTOR	8. CATHODE	8. CATHODE / DRAIN

SOLDERING FOOTPRINT



GENERIC  
MARKING DIAGRAM\*



XXX = Specific Device Code

M = Month Code

■ = Pb-Free Package

(Note: Microdot may be in either location)

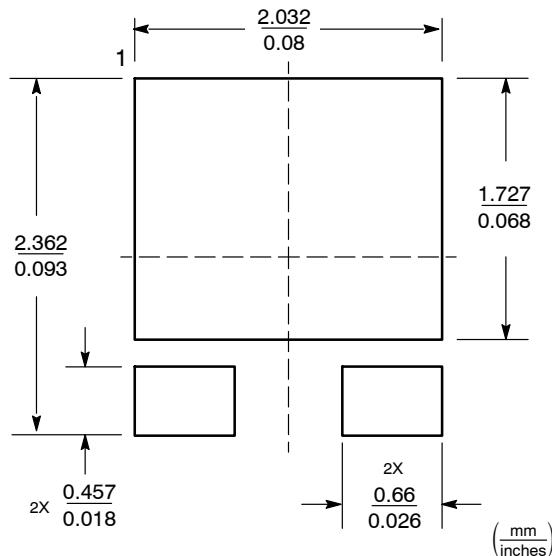
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

OPTIONAL SOLDERING FOOTPRINTS ON PAGE 2

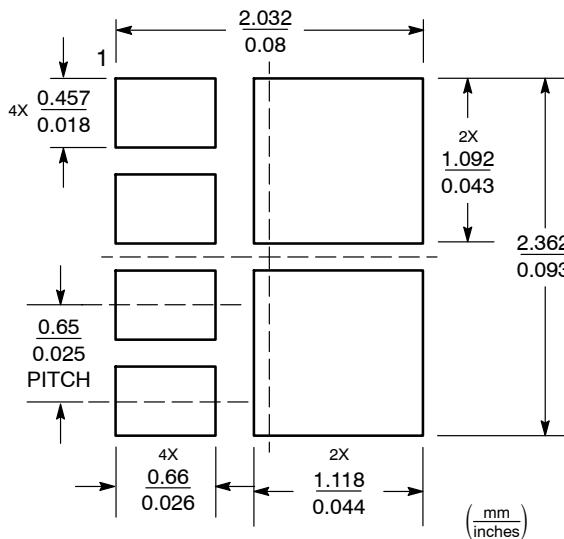
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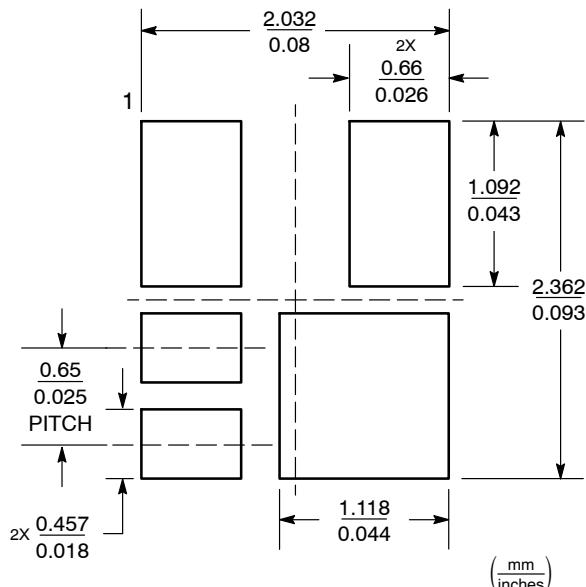
ADDITIONAL SOLDERING FOOTPRINTS\*



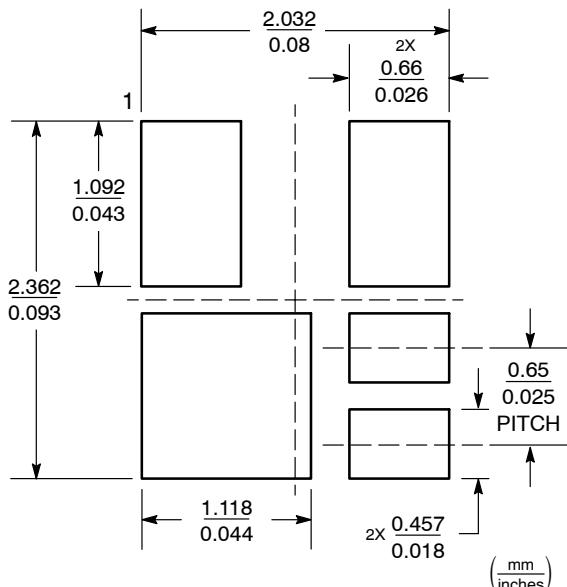
Styles 1 and 4



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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