

# NTLGF3501N

## Power MOSFET and Schottky Diode

20 V, 4.6 A FETKY®, N-Channel,  
2.0 A Schottky Barrier Diode, DFN6

### Features

- Flat Lead 6 Terminal Package 3x3x1 mm
- Reduced Gate Charge to Improve Switching Response
- Enhanced Thermal Characteristics
- This is a Pb-Free Device

### Applications

- Buck Converter, Inverting Buck/Boost
- High Side DC-DC Conversion Circuits
- Power Management in Portable, HDD and Computing

### MOSFET 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		V <sub>GS</sub>	±12	V	
Continuous Drain Current (Note 1)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub>	3.4	A
		T <sub>A</sub> = 85°C		2.5	
	t ≤ 10 s	T <sub>A</sub> = 25°C		4.6	
Power Dissipation (Note 1)	Steady State	T <sub>A</sub> = 25°C	P <sub>D</sub>	1.74	W
		t ≤ 10 s		3.13	
Continuous Drain Current (Note 2)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub>	2.8	A
		T <sub>A</sub> = 85°C		2.0	
		T <sub>A</sub> = 25°C	P <sub>D</sub>	1.14	W
Pulsed Drain Current	t <sub>p</sub> = 10 μs	I <sub>DM</sub>	13.8	A	
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>	1.7	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		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).
2. Surface Mounted on FR4 Board using the minimum recommended pad size (Cu area = 0.5 in sq).



ON Semiconductor®

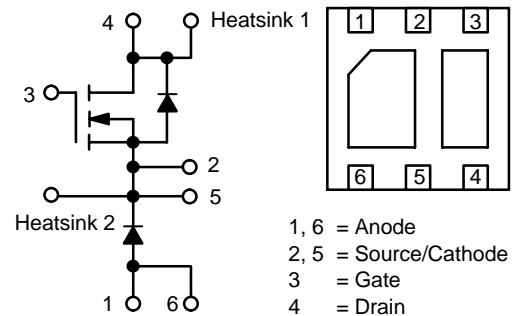
<http://onsemi.com>

### MOSFET

V <sub>(BR)DSS</sub>	R <sub>DS(on)</sub> TYP	I <sub>D</sub> TYP
20 V	70 mΩ @ 4.5 V	4.6 A

### SCHOTTKY DIODE

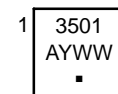
V <sub>R</sub> MAX	V <sub>F</sub> TYP	I <sub>F</sub> MAX
20 V	0.36 V	2.0 A



### MARKING DIAGRAMS



DFN6  
CASE 506AG



3501 = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
NTLGF3501NT1G	DFN6 (Pb-free)	3000 / Tape & Reel
NTLGF3501NT2G	DFN6 (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 Specifications Brochure, BRD8011/D.

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

Parameter	Symbol	Max	Unit
Peak Repetitive Reverse Voltage	$V_{RRM}$	20	V
DC Blocking Voltage	$V_R$	20	V
Average Rectified Forward Current	$I_F$	2.0	A

## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	110	$^\circ\text{C/W}$
Junction-to-Ambient – $t \leq 10$ s (Note 2)	$R_{\theta JA}$	56	$^\circ\text{C/W}$
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	72	$^\circ\text{C/W}$
Junction-to-Ambient – $t \leq 10$ s (Note 3)	$R_{\theta JA}$	40	$^\circ\text{C/W}$

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

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0$ V, $I_D = 250$ $\mu\text{A}$	20			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			22		$\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 16$ V, $V_{GS} = 0$ V	$T_J = 25^\circ\text{C}$		1.0	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0$ V, $V_{GS} = \pm 12$ V			100	nA

### ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$ , $I_D = 250$ $\mu\text{A}$	0.6		2.0	V
Gate Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-2.8		$\text{mV}/^\circ\text{C}$
Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 4.5$ V, $I_D = 3.4$ A		70	90	$\text{m}\Omega$
		$V_{GS} = 2.5$ V, $I_D = 1.7$ A		95	120	
Forward Transconductance	$g_{FS}$	$V_{DS} = 10$ V, $I_D = 3.4$ A		6.7		S

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0$ V, $f = 1.0$ MHz, $V_{DS} = 10$ V		144	275	$\text{pF}$
Output Capacitance	$C_{OSS}$			67	125	
Reverse Transfer Capacitance	$C_{RSS}$			22	40	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5$ V, $V_{DS} = 10$ V, $I_D = 3.4$ A		2.1	10	$\text{nC}$
Threshold Gate Charge	$Q_{G(TH)}$			0.11		
Gate-to-Source Charge	$Q_{GS}$			0.42		
Gate-to-Drain Charge	$Q_{GD}$			0.7		

### SWITCHING CHARACTERISTICS (Note 5)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5$ V, $V_{DD} = 16$ V, $I_D = 3.4$ A, $R_G = 2.5$ $\Omega$		4.8	10	$\text{ns}$
Rise Time	$t_r$			13.6	25	
Turn-Off Delay Time	$t_{d(OFF)}$			9.0	20	
Fall Time	$t_f$			1.9	5.0	

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

5. Switching characteristics are independent of operating junction temperatures.

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 1.7\text{ A}$	$T_J = 25^\circ\text{C}$		0.8	1.15	V
			$T_J = 150^\circ\text{C}$		0.63		V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, I_S = 1.0\text{ A},$ $di_S/dt = 100\text{ A}/\mu\text{s}$			12		ns
Charge Time	$t_a$				8.0		
Discharge Time	$t_b$				4.0		
Reverse Recovery Charge	$Q_{RR}$				5.0		

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Maximum Instantaneous Forward Voltage	$V_F$	$I_F = 0.1\text{ A}$		0.32	0.34	V
		$I_F = 1.0\text{ A}$		0.36	0.39	
Maximum Instantaneous Reverse Current	$I_R$	$V_R = 5.0\text{ V}$			100	$\mu\text{A}$
		$V_R = 5\text{ V}, T_J = 100^\circ\text{C}$			12	mA
		$V_R = 10\text{ V}$			70	$\mu\text{A}$
		$V_R = 20\text{ V}$			255	

6. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .  
 7. Switching characteristics are independent of operating junction temperatures.

# NTLGF3501N

## TYPICAL N-CHANNEL PERFORMANCE CURVES

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

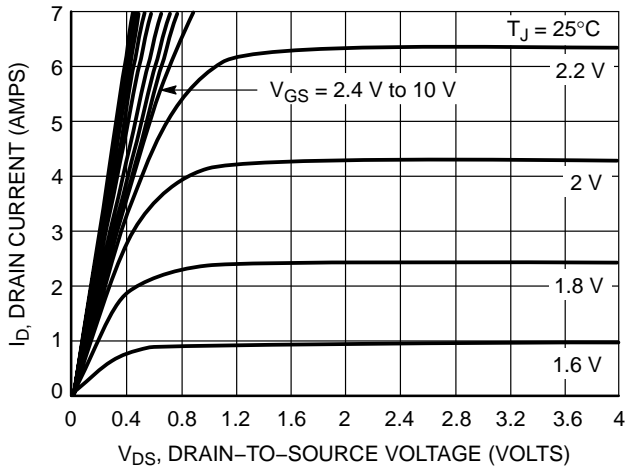


Figure 1. On-Region Characteristics

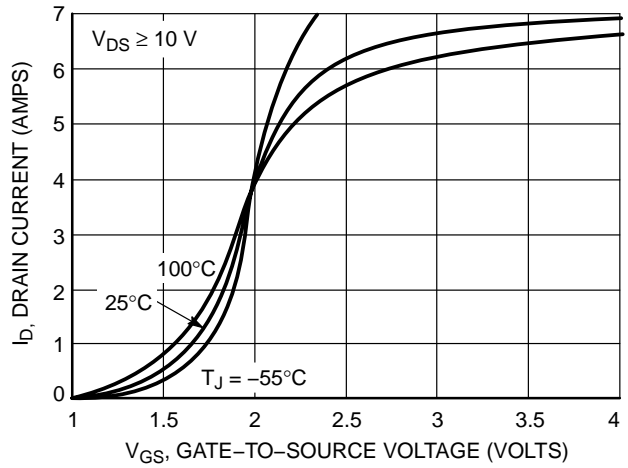


Figure 2. Transfer Characteristics

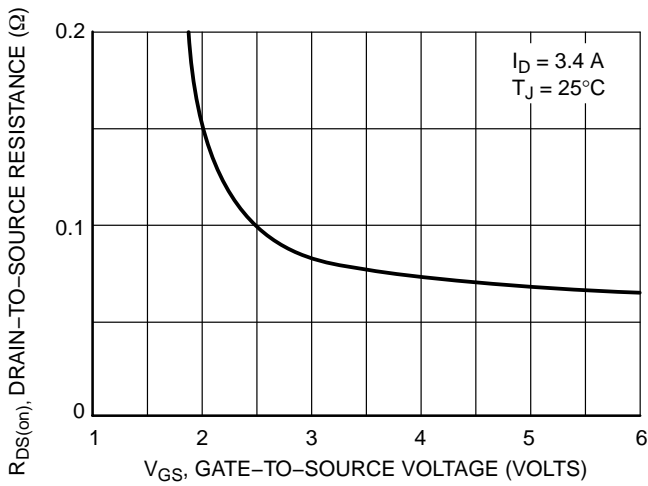


Figure 3. On-Resistance vs. Gate-to-Source Voltage

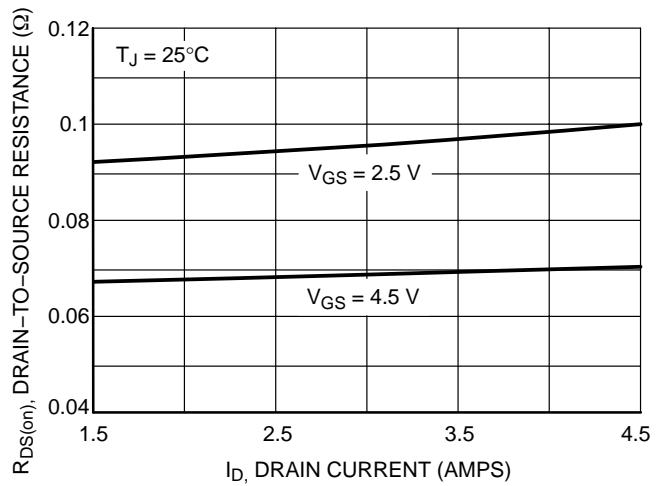


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

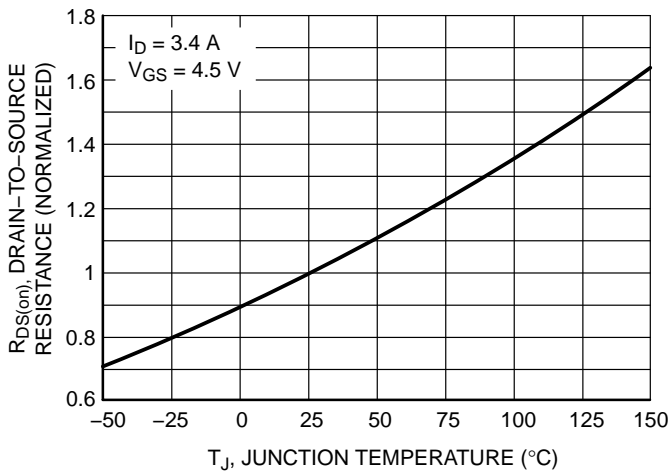


Figure 5. On-Resistance Variation with Temperature

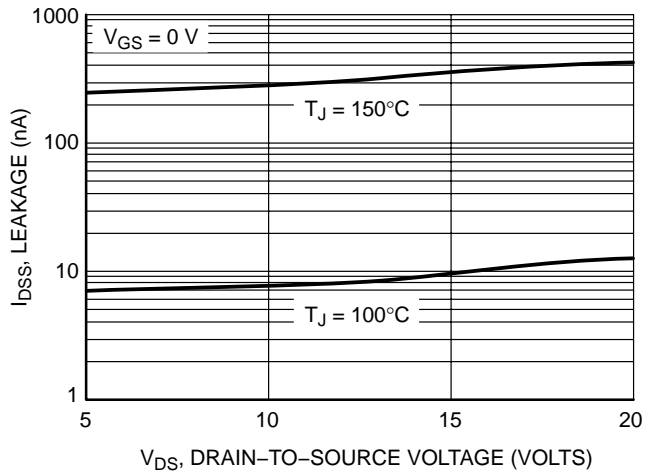
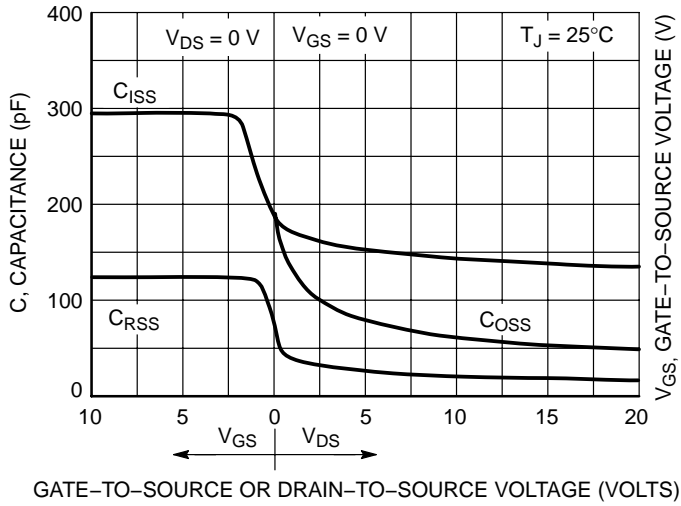


Figure 6. Drain-to-Source Leakage Current vs. Voltage

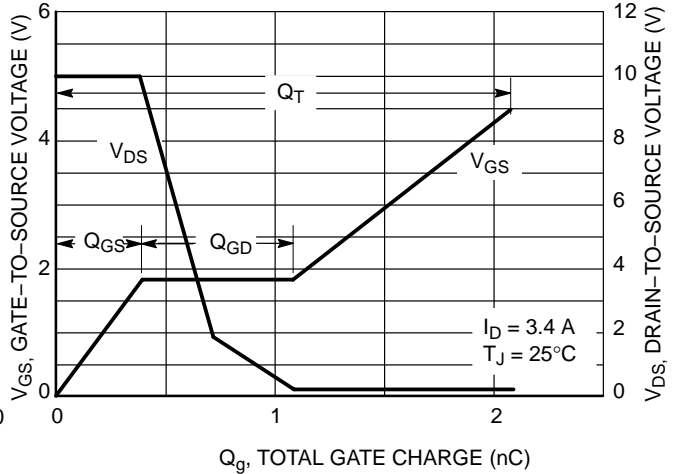
# NTLGF3501N

## TYPICAL N-CHANNEL PERFORMANCE CURVES

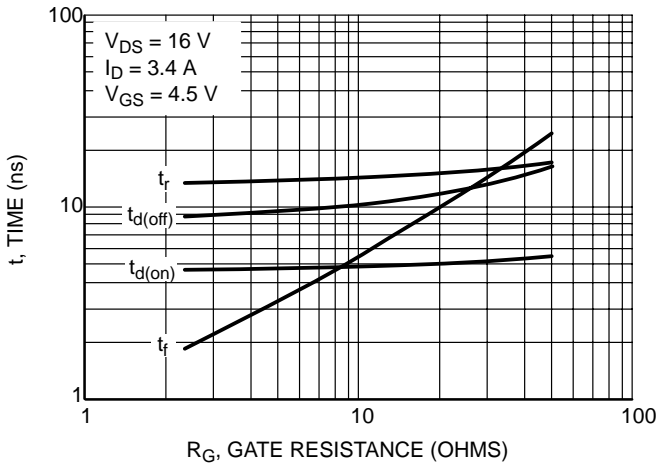
( $T_J = 25^\circ\text{C}$  unless otherwise noted)



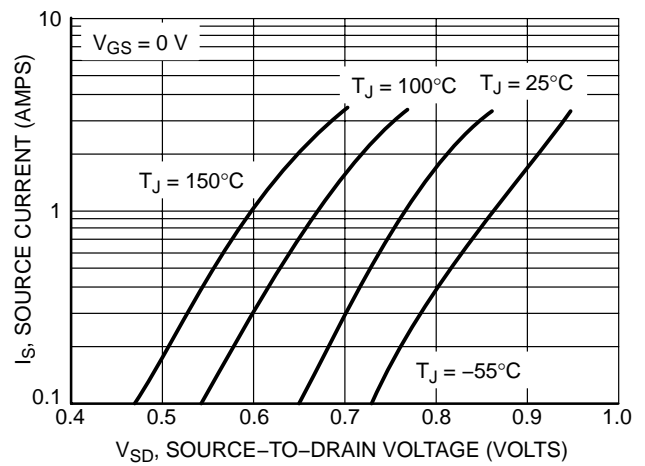
**Figure 7. Capacitance Variation**



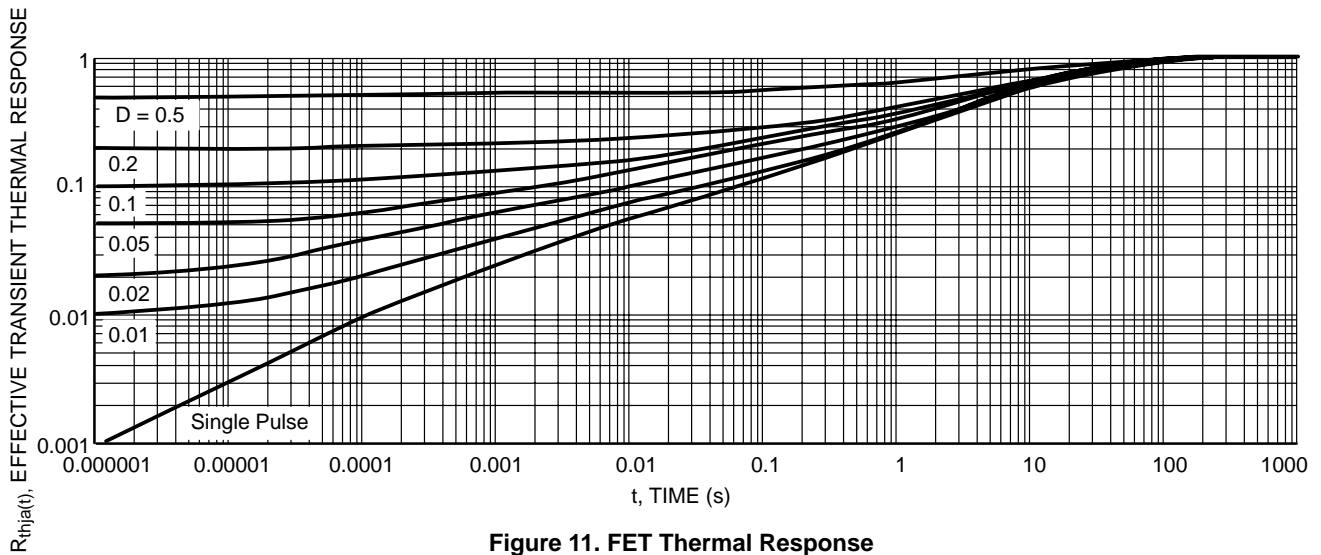
**Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



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



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



**Figure 11. FET Thermal Response**

# NTLGF3501N

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

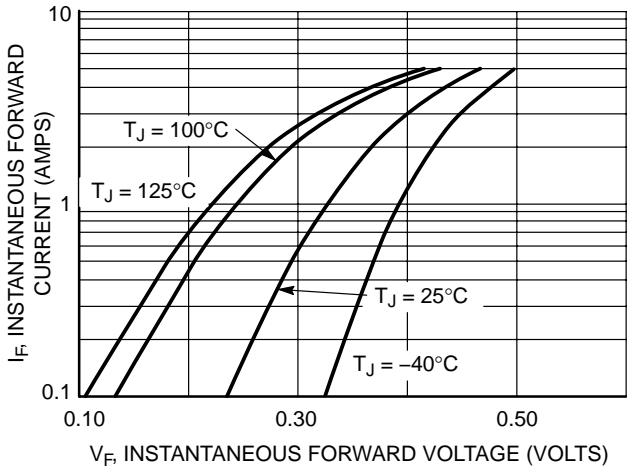


Figure 12. Typical Forward Voltage

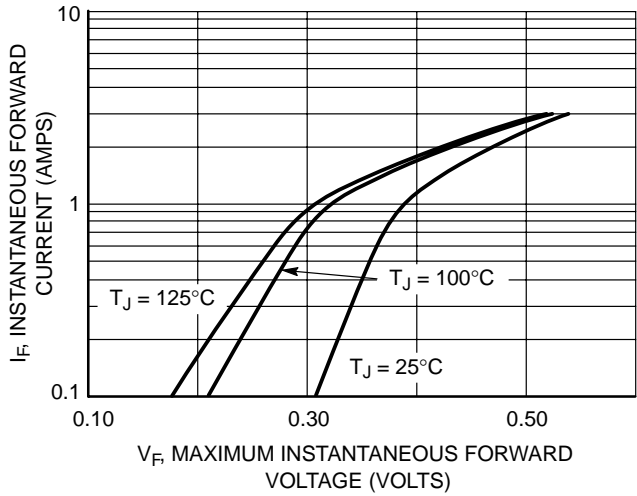


Figure 13. Maximum Forward Voltage

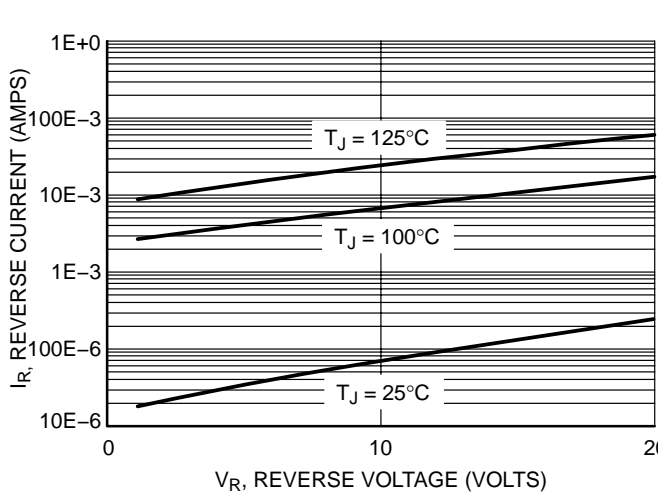


Figure 14. Typical Reverse Current

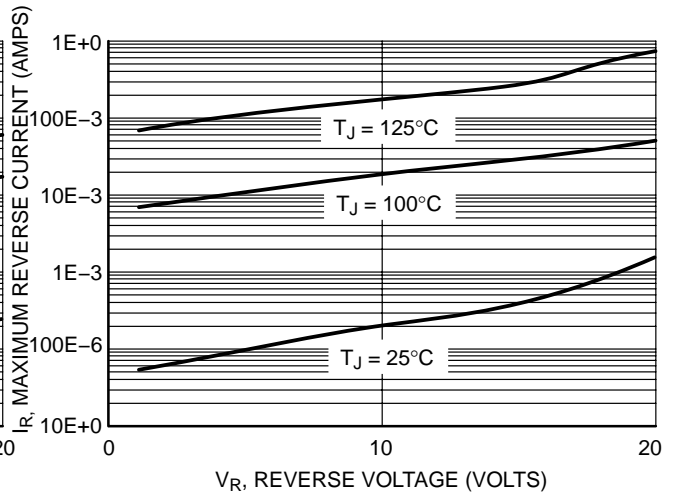


Figure 15. Maximum Reverse Current

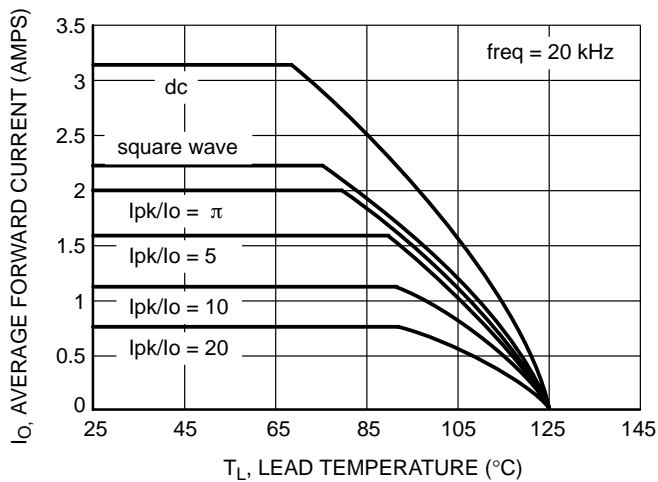


Figure 16. Current Derating

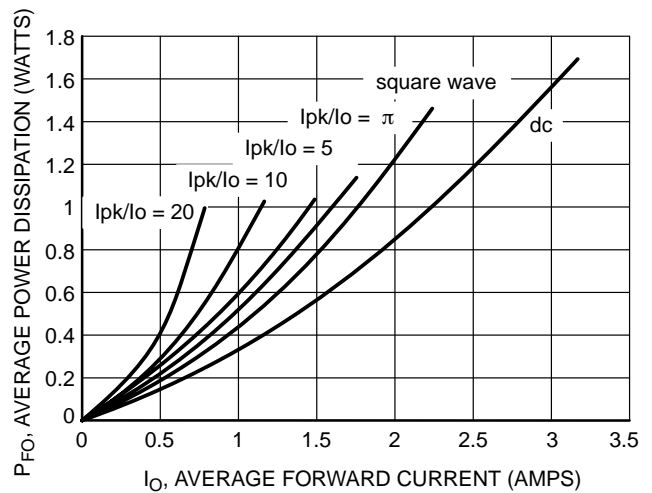


Figure 17. Forward Power Dissipation

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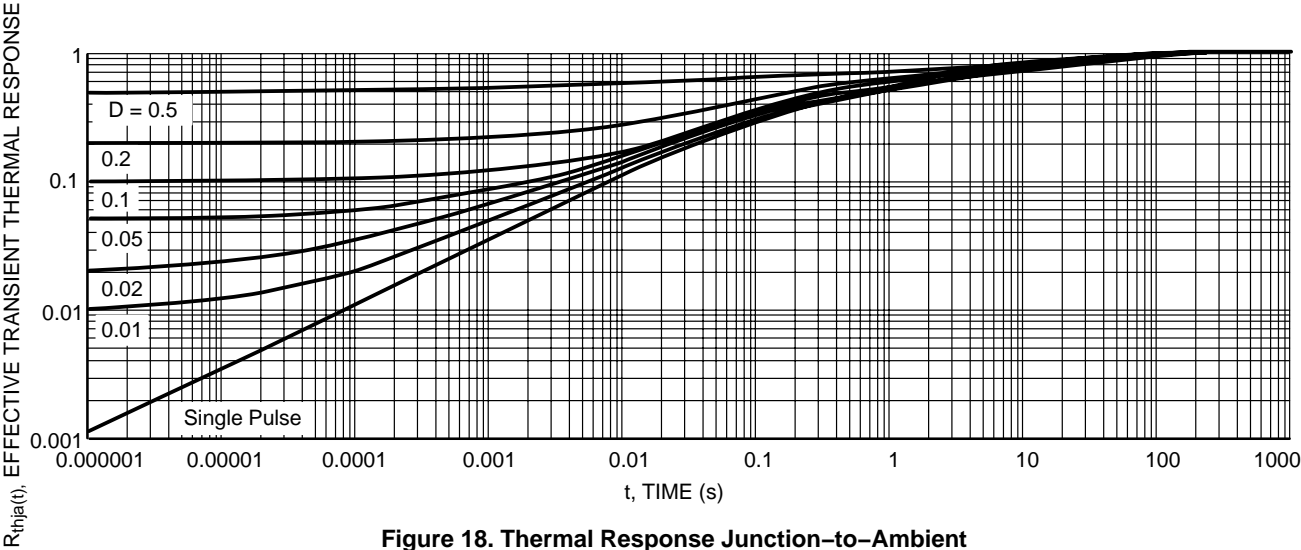
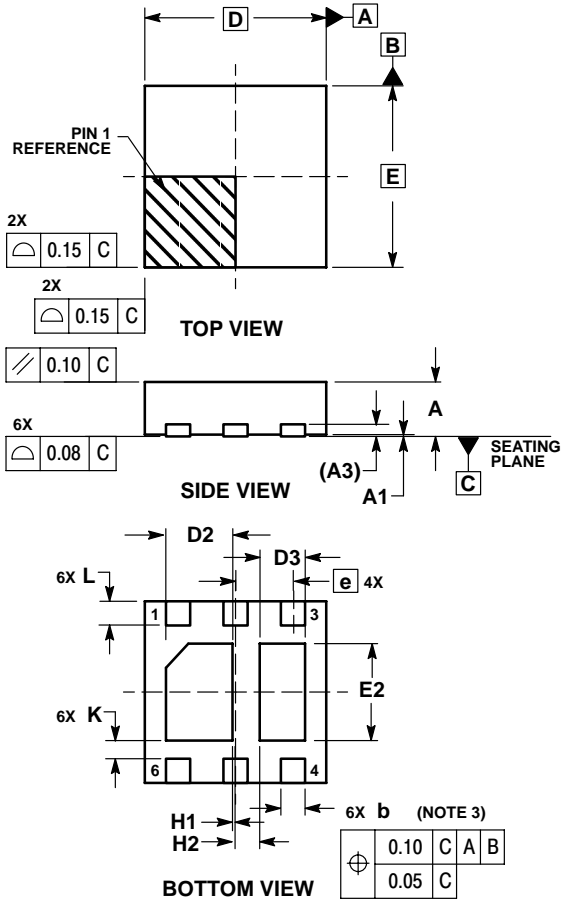


Figure 18. Thermal Response Junction-to-Ambient

# NTLGF3501N

## PACKAGE DIMENSIONS

DFN6 3\*3 MM, 0.95 PITCH  
CASE 506AG-01  
ISSUE 0

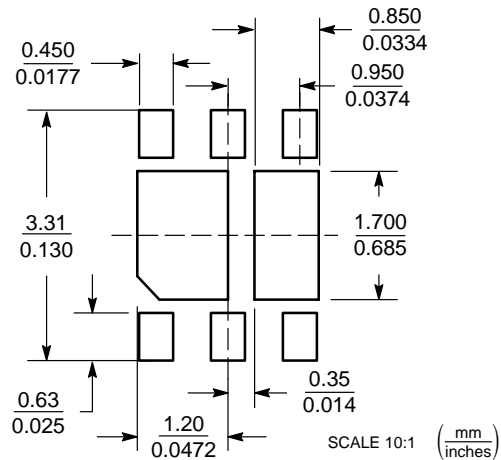


**NOTES:**

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3	0.20 REF		
b	0.35	0.40	0.45
D	3.00 BSC		
D2	1.00	1.10	1.20
D3	0.65	0.75	0.85
E	3.00 BSC		
E2	1.50	1.60	1.70
e	0.95 BSC		
K	0.21	---	---
L	0.30	0.40	0.50
H1	0.05 REF		
H2	0.40 REF		

### 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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