

# NTLJF4156N

## MOSFET – Power, N-Channel with Schottky Barrier Diode, Schottky Diode, $\mu$ Cool, WDFN 2X2 mm

**30 V, 4.6 A, 2.0 A**

### Features

- WDFN Package Provides Exposed Drain Pad for Excellent Thermal Conduction
- Co-Packaged MOSFET and Schottky For Easy Circuit Layout
- $R_{DS(on)}$  Rated at Low  $V_{GS(on)}$  Levels,  $V_{GS} = 1.5$  V
- Low Profile (< 0.8 mm) for Easy Fit in Thin Environments
- Low  $V_F$  Schottky
- This is a Pb-Free Device

### Applications

- DC-DC Converters
- Li-Ion Battery Applications in Cell Phones, PDA's, Media Players
- Color Display and Camera Flash Regulators

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

Parameter		Symbol	Value	Unit
Drain-to-Source Voltage		$V_{DSS}$	30	V
Gate-to-Source Voltage		$V_{GS}$	$\pm 8.0$	V
Continuous Drain Current (Note 1)	Steady State	$T_J = 25^\circ\text{C}$	3.7	A
		$T_J = 85^\circ\text{C}$	2.7	
	$t \leq 5$ s	$T_J = 25^\circ\text{C}$	4.6	
Power Dissipation (Note 1)	Steady State	$T_J = 25^\circ\text{C}$	1.5	W
		$t \leq 5$ s	2.3	
Continuous Drain Current (Note 2)	Steady State	$T_J = 25^\circ\text{C}$	2.5	A
		$T_J = 85^\circ\text{C}$	1.8	
Power Dissipation (Note 2)	Steady State	$T_J = 25^\circ\text{C}$	0.71	W
Pulsed Drain Current	$t_p = 10$ $\mu$ s	$I_{DM}$	20	A
Operating Junction and Storage Temperature		$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$
Source Current (Body Diode) (Note 2)		$I_S$	2.4	A
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	260	$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.



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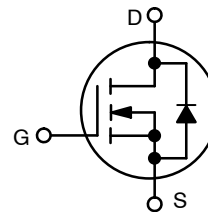
<http://onsemi.com>

### MOSFET

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX (Note 1)
30 V	70 m $\Omega$ @ 4.5 V	4.6 A
	90 m $\Omega$ @ 2.5 V	
	125 m $\Omega$ @ 1.8 V	
	250 m $\Omega$ @ 1.5 V	

### SCHOTTKY DIODE

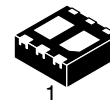
$V_R$ MAX	$V_F$ TYP	$I_F$ MAX
30 V	0.47 V	2.0 A



N-CHANNEL MOSFET



SCHOTTKY DIODE



WDFN6  
CASE 506AN

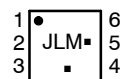
JL = Specific Device Code

M = Date Code

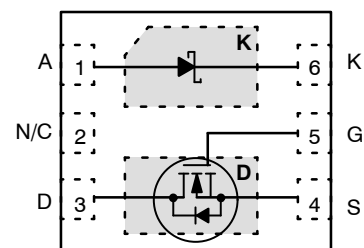
■ = Pb-Free Package

(Note: Microdot may be in either location)

### MARKING DIAGRAM



### PIN CONNECTIONS



(Top View)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

## **NTLJF4156N**

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 of 30 mm<sup>2</sup>, 2 oz. Cu.

# NTLJF4156N

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

Parameter	Symbol	Value	Unit
Peak Repetitive Reverse Voltage	$V_{RRM}$	30	V
DC Blocking Voltage	$V_R$	30	V
Average Rectified Forward Current	$I_F$	2.0	A

## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	83	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – $t \leq 5$ s (Note 3)	$R_{\theta JA}$	54	
Junction-to-Ambient – Steady State Min Pad (Note 4)	$R_{\theta JA}$	180	

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

4. Surface Mounted on FR4 Board using the minimum recommended pad size of 30 mm<sup>2</sup>, 2 oz. Cu.

## 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, $I_D = 250$ $\mu\text{A}$	30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 250$ $\mu\text{A}$ , Ref to $25^\circ\text{C}$		18.1		$\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 24$ V, $V_{GS} = 0$ V	$T_J = 25^\circ\text{C}$		1.0	$\mu\text{A}$
			$T_J = 85^\circ\text{C}$		10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0$ V, $V_{GS} = \pm 8.0$ V			100	nA

### ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$ , $I_D = 250$ $\mu\text{A}$	0.4	0.7	1.0	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, $I_D = 2.0$ A		47	70	$\text{m}\Omega$
		$V_{GS} = 2.5$ V, $I_D = 2.0$ A		56	90	
		$V_{GS} = 1.8$ V, $I_D = 1.8$ A		88	125	
		$V_{GS} = 1.5$ V, $I_D = 1.5$ A		133	250	
Forward Transconductance	$g_{FS}$	$V_{DS} = 10$ V, $I_D = 2.0$ A		4.5		S

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0$ V, $f = 1.0$ MHz, $V_{DS} = 15$ V		427		$\text{pF}$
Output Capacitance	$C_{OSS}$			51		
Reverse Transfer Capacitance	$C_{RSS}$			32		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5$ V, $V_{DS} = 15$ V, $I_D = 2.0$ A		5.4	6.5	$\text{nC}$
Threshold Gate Charge	$Q_{G(TH)}$			0.5		
Gate-to-Source Charge	$Q_{GS}$			0.8		
Gate-to-Drain Charge	$Q_{GD}$			1.24		
Gate Resistance	$R_G$			3.7		$\Omega$

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

6. Switching characteristics are independent of operating junction temperatures.

# NTLJF4156N

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS</b> (Note 6)						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DD} = 15\text{ V},$ $I_D = 2.0\text{ A}, R_G = 2.0\ \Omega$		4.8		ns
Rise Time	$t_r$			9.2		
Turn-Off Delay Time	$t_{d(OFF)}$			14.2		
Fall Time	$t_f$			1.7		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Recovery Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 2.0\text{ A}$	$T_J = 25^\circ\text{C}$		0.78	1.2	V
			$T_J = 125^\circ\text{C}$		0.62		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, d_{ISD}/d_t = 100\text{ A}/\mu\text{s},$ $I_S = 2.0\text{ A}$			10.5		ns
Charge Time	$t_a$				7.6		
Discharge Time	$t_b$				2.9		
Reverse Recovery Time	$Q_{RR}$				5.0		

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

6. Switching characteristics are independent of operating junction temperatures.

## 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	$V_F$	$I_F = 0.1\text{ A}$		0.34	0.39	V
		$I_F = 1.0\text{ A}$		0.47	0.53	
Maximum Instantaneous Reverse Current	$I_R$	$V_R = 30\text{ V}$		17	20	$\mu\text{A}$
		$V_R = 20\text{ V}$		3.0	8.0	
		$V_R = 10\text{ A}$		2.0	4.5	

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 85^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Maximum Instantaneous Forward Voltage	$V_F$	$I_F = 0.1\text{ A}$		0.22	0.35	V
		$I_F = 1.0\text{ A}$		0.40	0.50	
Maximum Instantaneous Reverse Current	$I_R$	$V_R = 30\text{ V}$		0.22	2.5	mA
		$V_R = 20\text{ V}$		0.11	1.6	
		$V_R = 10\text{ V}$		0.06	1.2	

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 125^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Maximum Instantaneous Forward Voltage	$V_F$	$I_F = 0.1\text{ A}$		0.2	0.29	V
		$I_F = 1.0\text{ A}$		0.4	0.47	
Maximum Instantaneous Reverse Current	$I_R$	$V_R = 30\text{ V}$		2.0	20	mA
		$V_R = 20\text{ V}$		1.1	10.9	
		$V_R = 10\text{ V}$		0.63	8.4	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Capacitance	C	$V_R = 5.0\text{ V}, f = 1.0\text{ MHz}$		38		pF

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

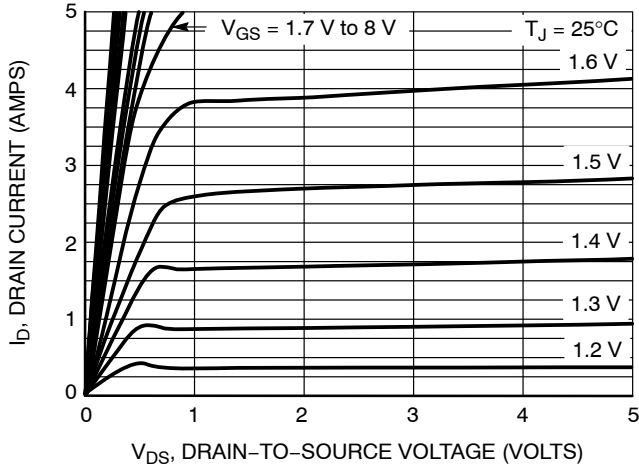
8. Surface-mounted on FR4 board using the minimum recommended pad size of 30 mm<sup>2</sup>, 2 oz cu.

9. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

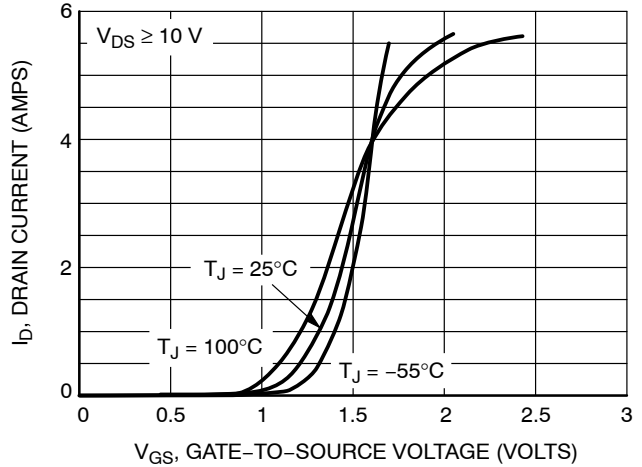
10. Switching characteristics are independent of operating junction temperatures.

# NTLJF4156N

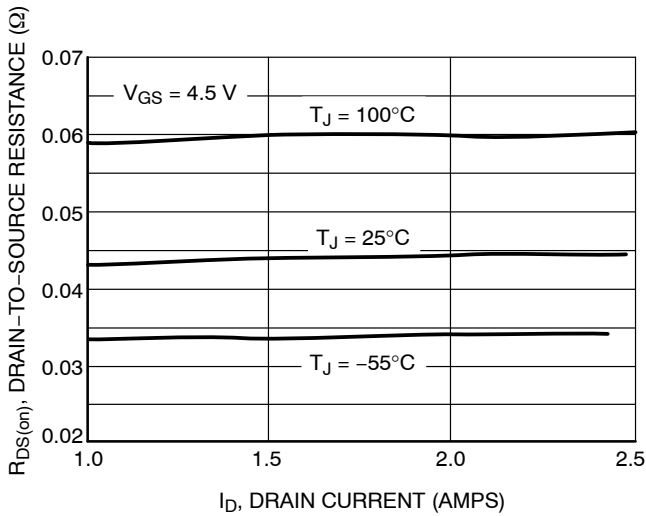
## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)



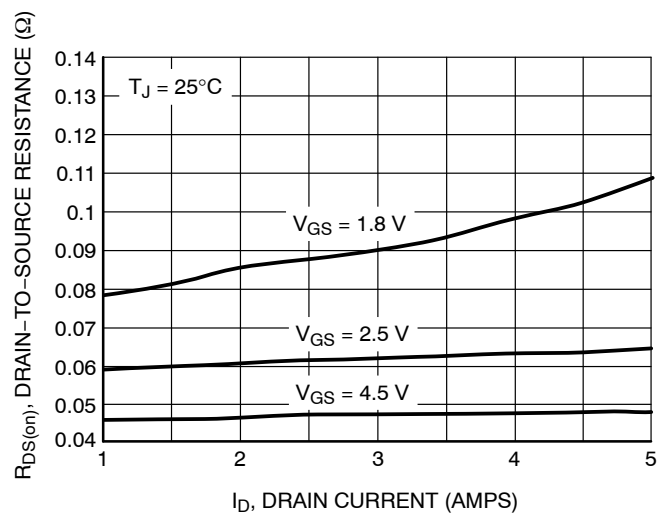
**Figure 1. On-Region Characteristics**



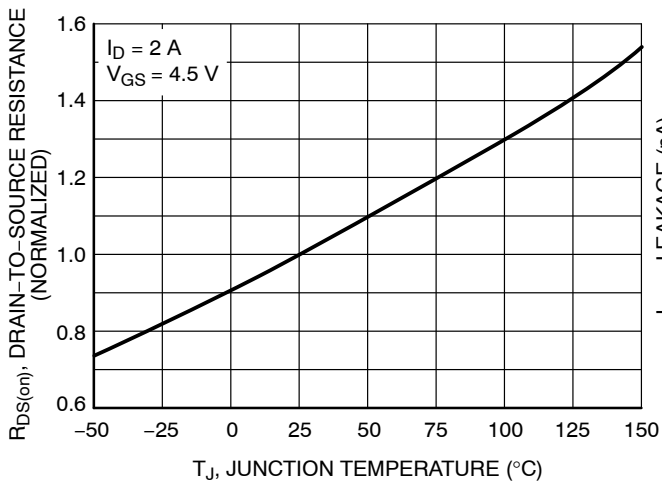
**Figure 2. Transfer Characteristics**



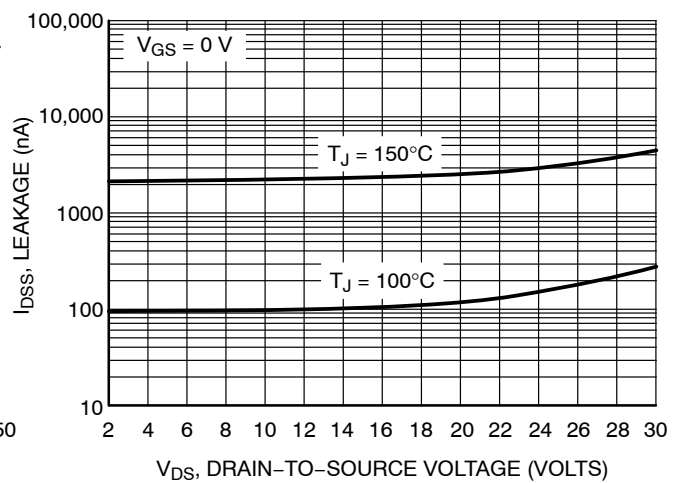
**Figure 3. On-Resistance versus Drain Current**



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



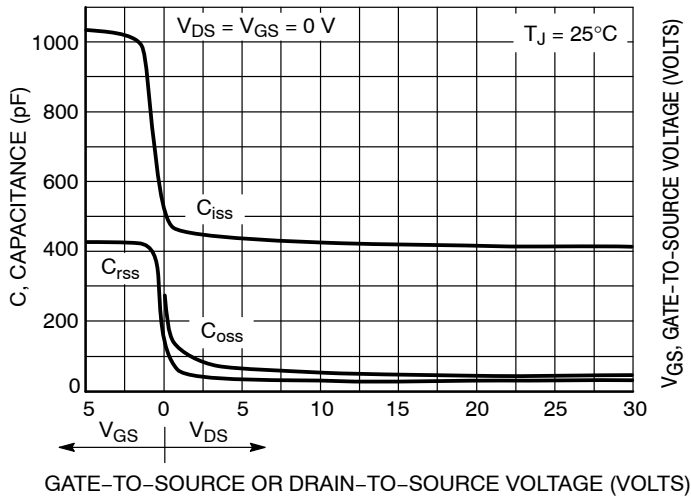
**Figure 5. On-Resistance Variation with Temperature**



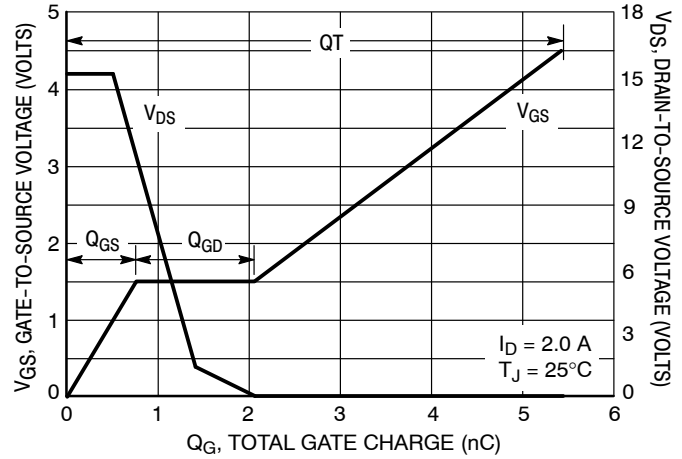
**Figure 6. Drain-to-Source Leakage Current versus Voltage**

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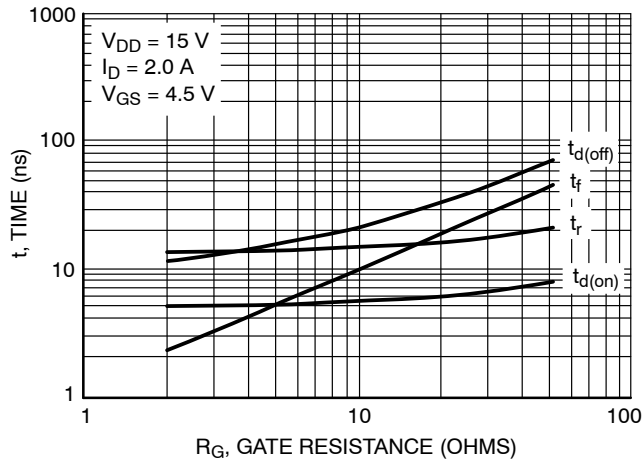
## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)



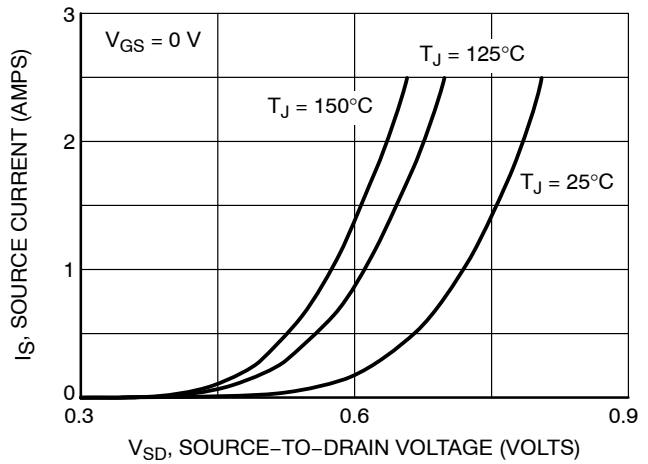
**Figure 7. Capacitance Variation**



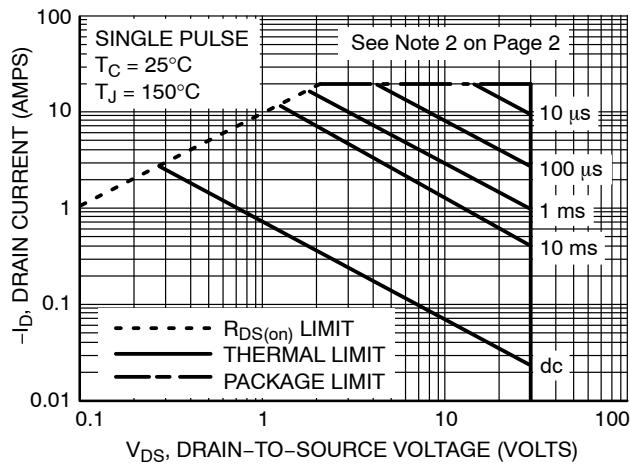
**Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge**



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



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



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

# NTLJF4156N

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

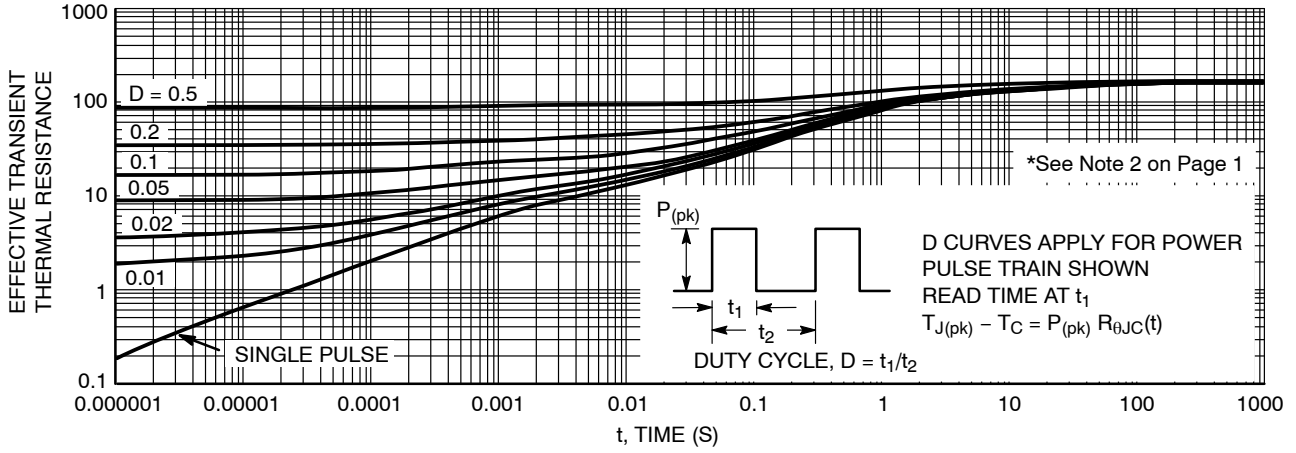


Figure 12. Thermal Response

# NTLJF4156N

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

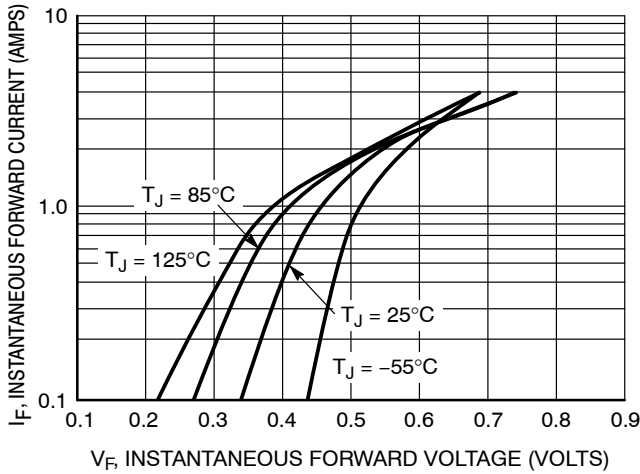


Figure 13. Typical Forward Voltage

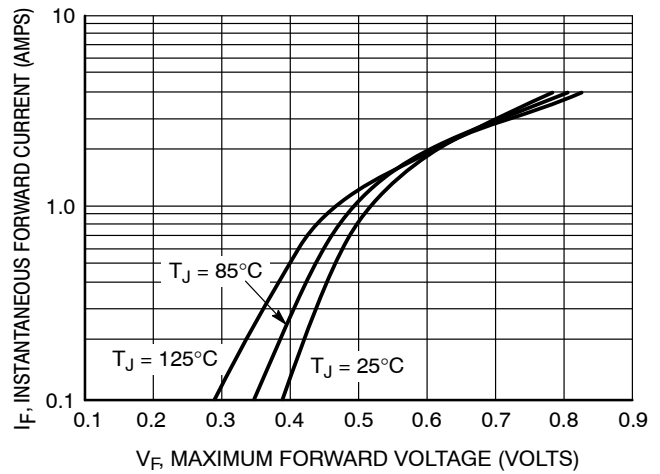


Figure 14. Maximum Forward Voltage

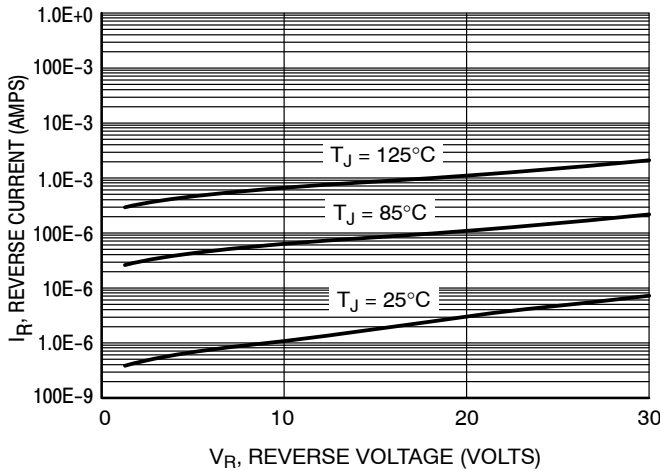


Figure 15. Typical Reverse Current

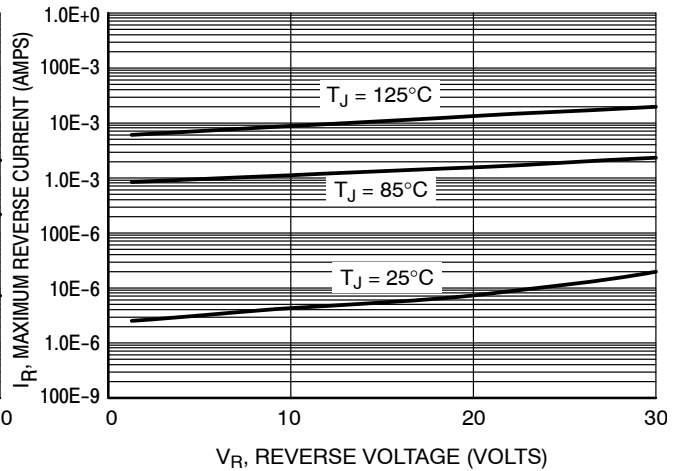


Figure 16. Maximum Reverse Current

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTLJF4156NT1G	WDFN6 (Pb-Free)	3000 / Tape & Reel
NTLJF4156NTAG	WDFN6 (Pb-Free)	3000 / 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.

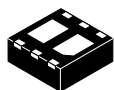
$\mu$ Cool is a trademark of Semiconductor Components Industries, LLC (SCILLC).



# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

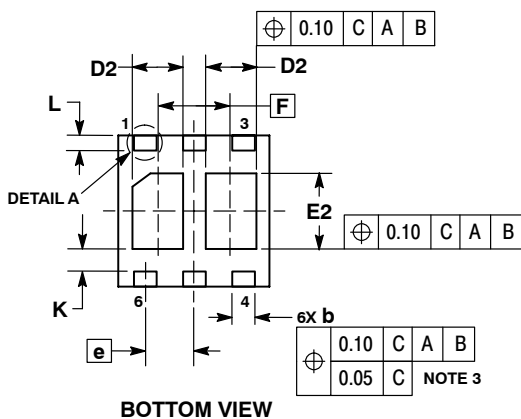
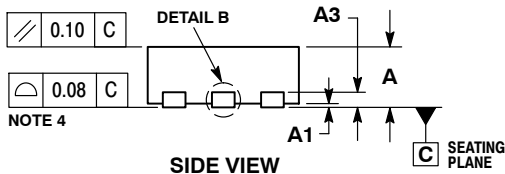
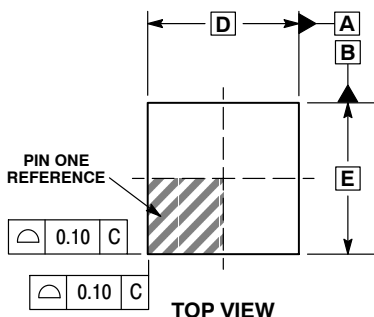
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SCALE 4:1

WDFN6 2x2, 0.65P  
CASE 506AN  
ISSUE G

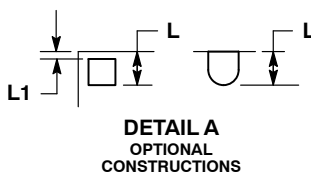
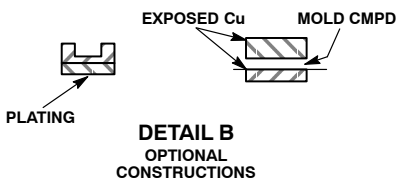
DATE 22 AUG 2013



STYLE 1:  
PIN 1. SOURCE 1  
2. GATE 1  
3. DRAIN 2  
4. SOURCE 2  
5. GATE 2  
6. DRAIN 1

STYLE 2:  
PIN 1. ANODE  
2. N/C  
3. DRAIN  
4. SOURCE  
5. GATE  
6. CATHODE

STYLE 3:  
PIN 1. SOURCE 1  
2. GATE 1  
3. SOURCE 2  
4. DRAIN 2  
5. GATE 2  
6. DRAIN 1

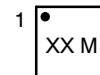


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.25	0.35
D	2.00 BSC	
D2	0.57	0.77
E	2.00 BSC	
E2	0.90	1.10
e	0.65 BSC	
F	0.95 BSC	
K	0.25 REF	
L	0.20	0.30
L1	---	0.10

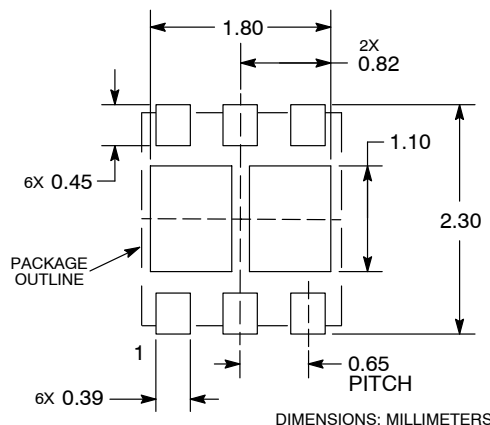
### GENERIC MARKING DIAGRAM\*



XX = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "μ", may or may not be present.

### SOLDERMASK DEFINED MOUNTING FOOTPRINT



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DESCRIPTION:	WDFN6 2X2, 0.65P	PAGE 1 OF 1

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