

# NTTFS5C670NL

## Power MOSFET

60 V, 6.5 mΩ, 70 A, Single N-Channel

### Features

- Small Footprint (3.3 x 3.3 mm) for Compact Design
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DS}$	60	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current $R_{\theta JC}$ (Notes 1, 2, 3, 4)	Steady State	$T_C = 25^\circ\text{C}$	70	A
		$T_C = 100^\circ\text{C}$	49	
Power Dissipation $R_{\theta JC}$ (Notes 1, 2, 3)	Steady State	$T_C = 25^\circ\text{C}$	63	W
		$T_C = 100^\circ\text{C}$	31	
Continuous Drain Current $R_{\theta JA}$ (Notes 1 & 3, 4)	Steady State	$T_A = 25^\circ\text{C}$	16	A
		$T_A = 100^\circ\text{C}$	11	
Power Dissipation $R_{\theta JA}$ (Notes 1, 3)	Steady State	$T_A = 25^\circ\text{C}$	3.2	W
		$T_A = 100^\circ\text{C}$	1.6	
Pulsed Drain Current	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	$I_{DM}$	440	A
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	68	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 3.6 \text{ A}$ )	$E_{AS}$	166	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE MAXIMUM RATINGS (Note 1)

Parameter	Symbol	Value	Unit
Junction-to-Case – Steady State (Note 3)	$R_{\theta JC}$	2.4	$^\circ\text{C/W}$
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	47	

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Psi ( $\Psi$ ) is used as required per JESD51-12 for packages in which substantially less than 100% of the heat flows to single case surface.
3. Surface-mounted on FR4 board using a 650 mm<sup>2</sup>, 2 oz. Cu pad.
4. Continuous DC current rating. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

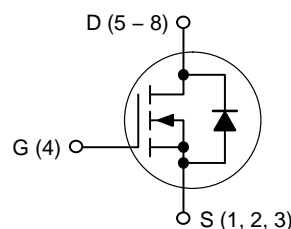


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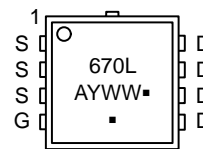
$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
60 V	6.5 mΩ @ 10 V	70 A
	9.1 mΩ @ 4.5 V	

### N-Channel



WDFN8  
(μ8FL)  
CASE 511AB

### MARKING DIAGRAM



670L = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ■ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 5 of this data sheet.

# NTTFS5C670NL

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			27		mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 60\text{ V}$	$T_J = 25^\circ\text{C}$		10	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		250	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$			100	nA

## ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.2		2.0	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-4.7		mV/ $^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 35\text{ A}$		5.4	6.5	m $\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 35\text{ A}$		7.3	9.1	
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 35\text{ A}$		82		S

## CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 25\text{ V}$		1400		pF
Output Capacitance	$C_{OSS}$			690		
Reverse Transfer Capacitance	$C_{RSS}$			15		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 30\text{ V}; I_D = 35\text{ A}$		9.0		nC
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 30\text{ V}; I_D = 35\text{ A}$		20		nC
Threshold Gate Charge	$Q_{G(TH)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 30\text{ V}; I_D = 35\text{ A}$		2.5		nC
Gate-to-Source Charge	$Q_{GS}$			4.5		
Gate-to-Drain Charge	$Q_{GD}$			2.0		
Plateau Voltage	$V_{GP}$			3.1		

## SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 30\text{ V}, I_D = 35\text{ A}, R_G = 2.5\ \Omega$		11		ns
Rise Time	$t_r$			60		
Turn-Off Delay Time	$t_{d(OFF)}$			15		
Fall Time	$t_f$			4		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 35\text{ A}$	$T_J = 25^\circ\text{C}$		0.9	1.2	V
			$T_J = 125^\circ\text{C}$		0.8		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, di_S/dt = 100\text{ A}/\mu\text{s}, I_S = 35\text{ A}$		34		ns	
Charge Time	$t_a$			17			
Discharge Time	$t_b$			17			
Reverse Recovery Charge	$Q_{RR}$			19			nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

6. Switching characteristics are independent of operating junction temperatures.

# NTTFS5C670NL

## TYPICAL CHARACTERISTICS

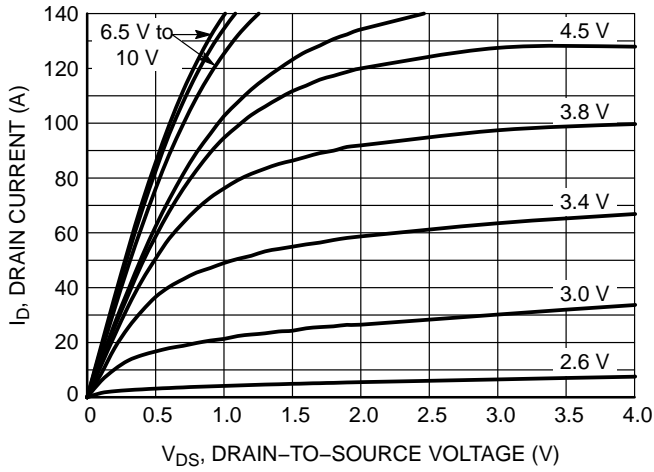


Figure 1. On-Region Characteristics

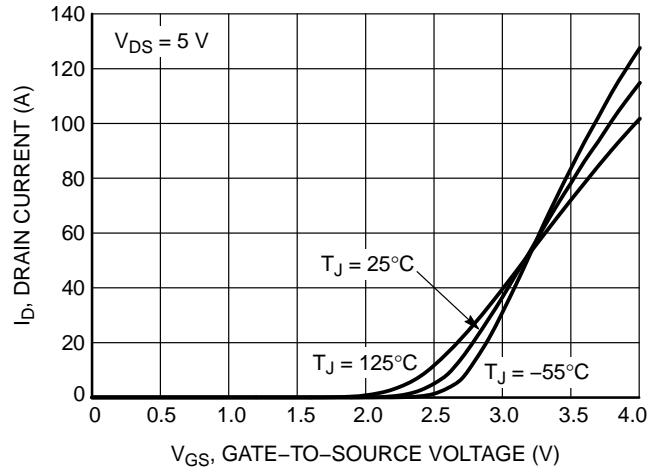


Figure 2. Transfer Characteristics

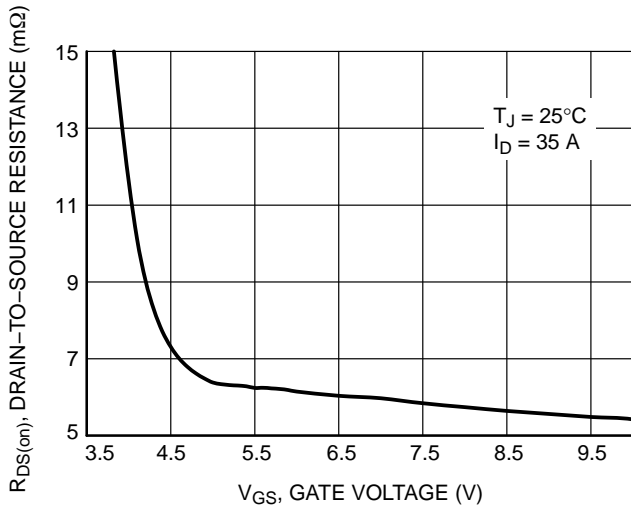


Figure 3. On-Resistance vs. Gate-to-Source Voltage

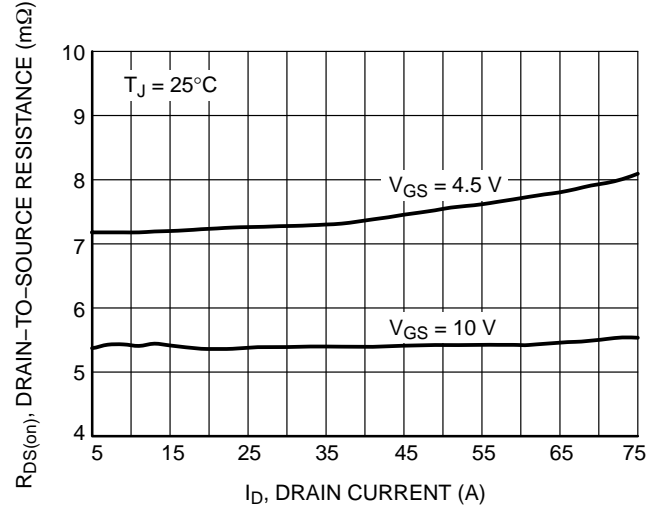


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

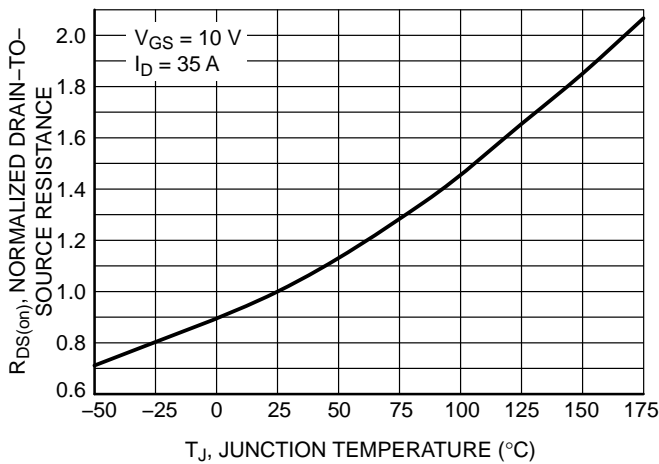


Figure 5. On-Resistance Variation with Temperature

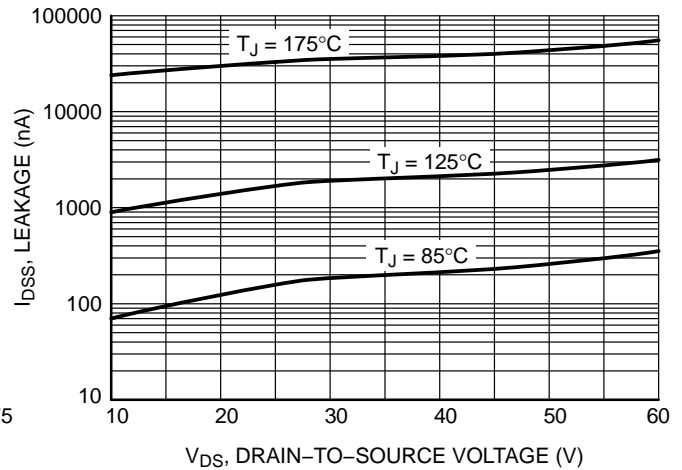


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTTFS5C670NL

## TYPICAL CHARACTERISTICS

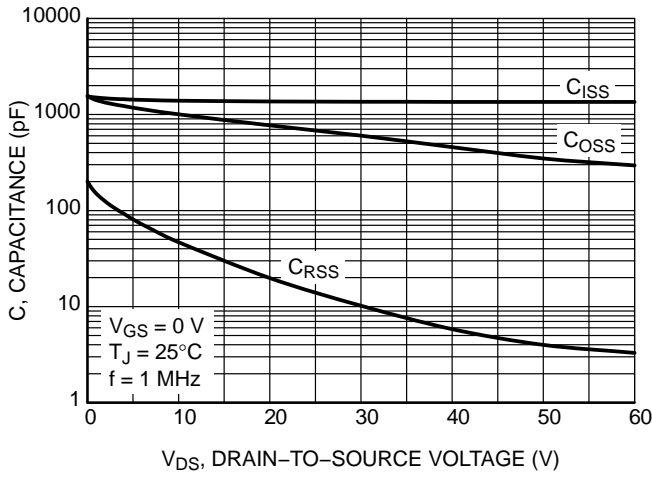


Figure 7. Capacitance Variation

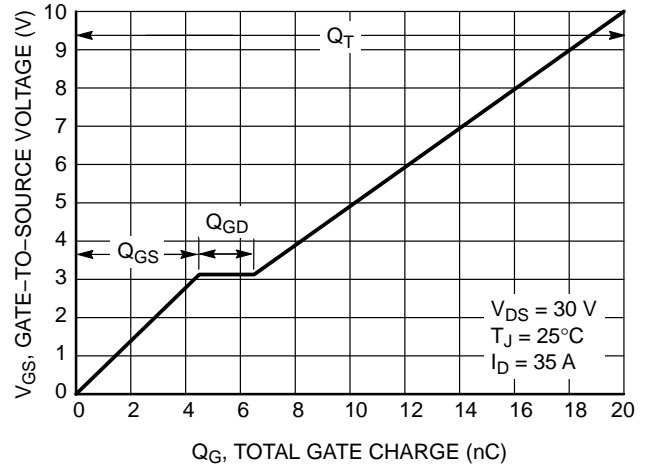


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

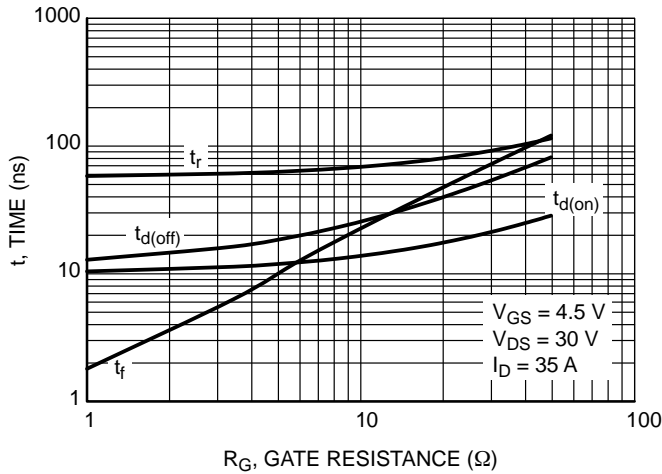


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

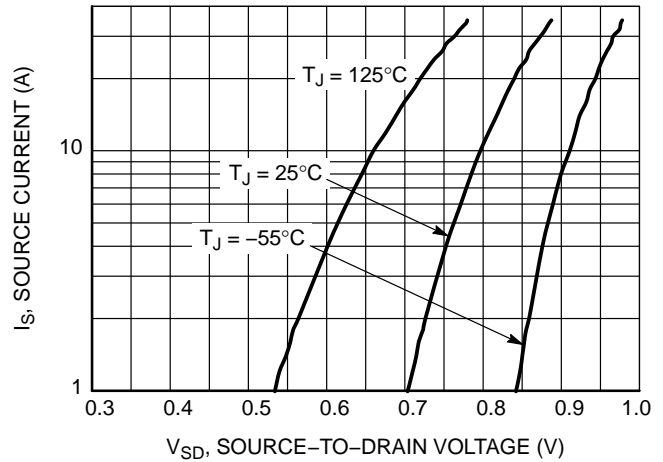


Figure 10. Diode Forward Voltage vs. Current

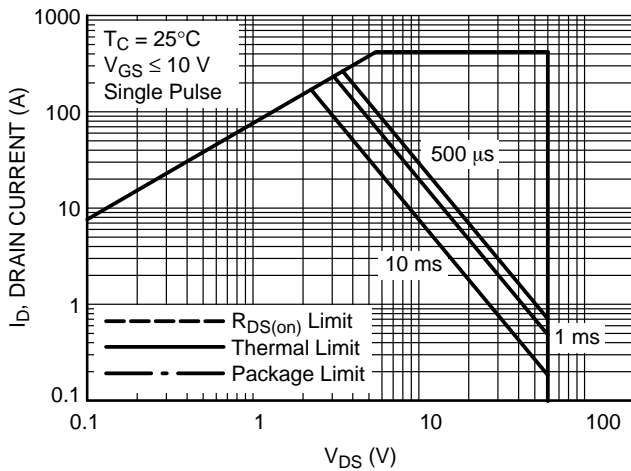


Figure 11. Maximum Rated Forward Biased Safe Operating Area

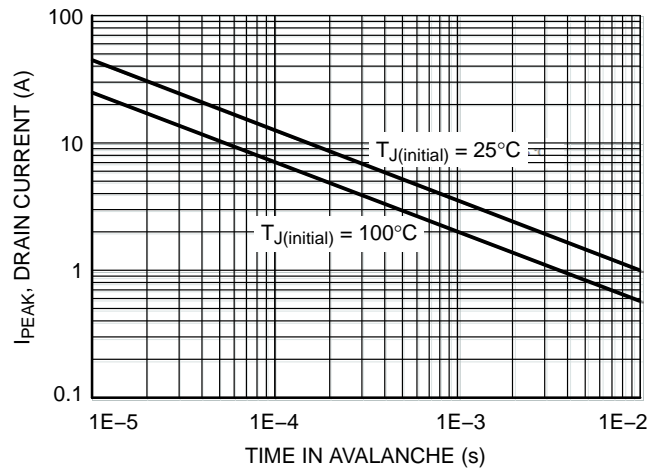
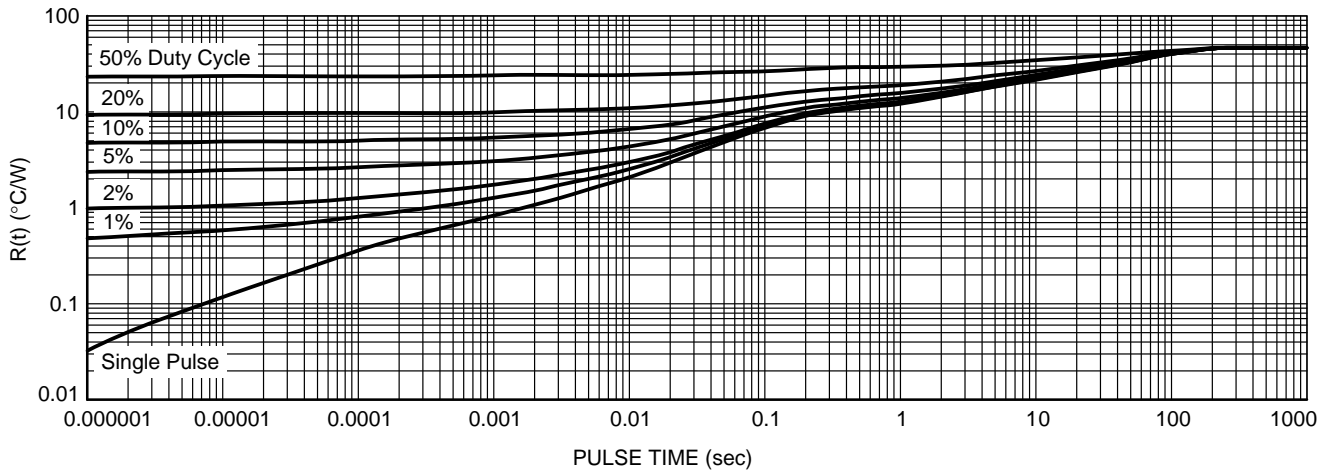


Figure 12. Maximum Drain Current vs. Time in Avalanche

# NTTFS5C670NL



**Figure 13. Thermal Characteristics**

## DEVICE ORDERING INFORMATION

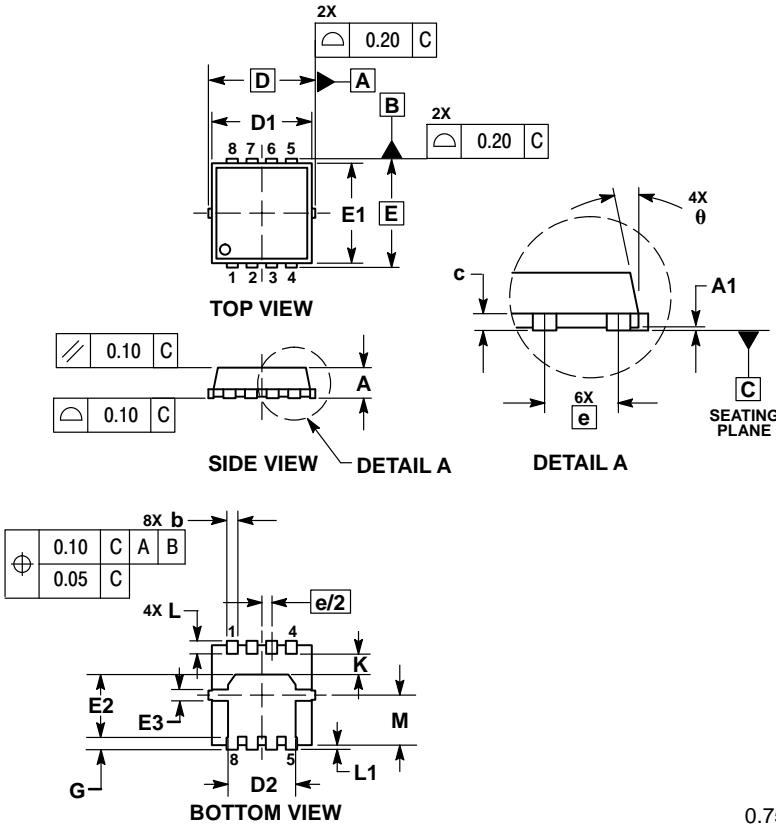
Device	Marking	Package	Shipping <sup>†</sup>
NTTFS5C670NLTAG	670L	WDFN8 (Pb-Free)	1500 / Tape & Reel
NTTFS5C670NLTWG	670L	WDFN8 (Pb-Free)	5000 / Tape & Reel

<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.

# NTTFS5C670NL

## PACKAGE DIMENSIONS

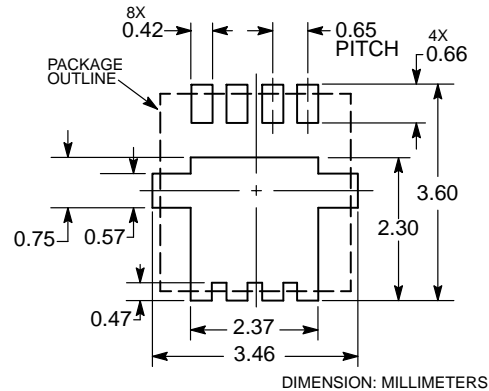
WDFN8 3.3x3.3, 0.65P  
CASE 511AB  
ISSUE D



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	0.00	—	0.05	0.000	—	0.002
b	0.23	0.30	0.40	0.009	0.012	0.016
c	0.15	0.20	0.25	0.006	0.008	0.010
D	3.30 BSC			0.130 BSC		
D1	2.95	3.05	3.15	0.116	0.120	0.124
D2	1.98	2.11	2.24	0.078	0.083	0.088
E	3.30 BSC			0.130 BSC		
E1	2.95	3.05	3.15	0.116	0.120	0.124
E2	1.47	1.60	1.73	0.058	0.063	0.068
E3	0.23	0.30	0.40	0.009	0.012	0.016
e	0.65 BSC			0.026 BSC		
G	0.30	0.41	0.51	0.012	0.016	0.020
K	0.65	0.80	0.95	0.026	0.032	0.037
L	0.30	0.43	0.56	0.012	0.017	0.022
L1	0.06	0.13	0.20	0.002	0.005	0.008
M	1.40	1.50	1.60	0.055	0.059	0.063
θ	0°	—	12°	0°	—	12°

### 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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