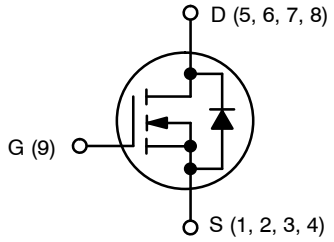
MOSFET - Power, Single N-Channel, Source-Down TDFN9
60 V, 1.5 mΩ, 235 A

NTMFSS1D5N06CL

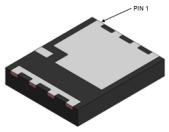
$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
60 V	1.5 mΩ @ 10 V	235 A
	2.3 mΩ @ 4.5 V	

Features
- Small Footprint (5x6 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

Typical Applications
- DC−DC Converters
- Power Load Switch
- Notebook Battery Management



N−CHANNEL MOSFET



TDFN9 5x6
CASE 520AE

MARKING DIAGRAM

1D5N06 = Specific Device Code
A = Assembly Location
Y = Year
W = Work Week
ZZ = Wafer Lot

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	60	V
Gate−to−Source Voltage			V_{GS}	±20	V
Continuous Drain Current $R_{\theta JC}$	Steady State	T_C = 25°C	I_D	237	A
		T_C = 100°C		149	
Power Dissipation $R_{\theta JC}$	Steady State	T_C = 25°C	P_D	144	W
		T_C = 100°C		57	
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2)	Steady State	T_A = 25°C	I_D	31	A
		T_A = 100°C		19	
Power Dissipation $R_{\theta JA}$ (Notes 1, 2)	Steady State	T_A = 25°C	P_D	2.5	W
		T_A = 100°C		1	
Pulsed Drain Current	T_A = 25°C, t_p = 10 μs		I_{DM}	1698	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +150	°C
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 75 A)			E_{AS}	207	mJ
Lead Temperature Soldering Reflow for Soldering Purposes (1/8″ from case for 10 s)			T_L	260	°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

Parameter	Symbol	Value	Unit
Junction−to−Case − Steady State	$R_{\theta JC}$	0.86	°C/W
Junction−to−Ambient − Steady State (Note 2)	$R_{\theta JA}$	50	

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. Surface−mounted on FR4 board using a 1 in^2 pad size, 2 oz. Cu pad.

ORDERING INFORMATION

Device	Package	Shipping†
NTMFSS1D5N06CL	TDFN9 (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 Specification Brochure, BRD8011/D.

© Semiconductor Components Industries, LLC, 2018

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 250 μA		60			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = 250 μA, ref to 25°C			23.2		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 60 V	T_J = 25°C			10	μA
Gate−to−Source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} = 20 V				100	nA
ON CHARACTERISTICS (Note 3)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 250 μA		1.2		2.0	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	I_D = 250 μA, ref to 25°C			−5.76		mV/°C
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 50 A			1.05	1.5	mΩ
		V_{GS} = 4.5 V, I_D = 50 A			1.42	2.3	
Forward Transconductance	g_{FS}	V_{DS} = 15 V, I_D = 50 A			151		S
Gate Resistance	R_G	T_A = 25°C			1		Ω
CHARGES & CAPACITANCES							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 30 V			7526		pF
Output Capacitance	C_{OSS}				3462		
Reverse Capacitance	C_{RSS}				42		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = 10 V, V_{DS} = 30 V, I_D = 50 A			102.6		nC
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = 4.5 V, V_{DS} = 30 V, I_D = 50 A			46.1		
Gate−to−Drain Charge	Q_{GD}				8.4		
Gate−to−Source Charge	Q_{GS}				21		
Plateau Voltage	V_{GP}				2.9		V
SWITCHING CHARACTERISTICS (Note 3)							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = 4.5 V, V_{DD} = 30 V, I_D = 50 A, R_G = 1.0 Ω			16		ns
Rise Time	t_r				7.1		
Turn−Off Delay Time	$t_{d(OFF)}$				41.3		
Fall Time	t_f				5.4		
SOURCE−TO−DRAIN DIODE CHARACTERISTICS							
Forward Diode Voltage	V_{SD}	V_{GS} = 0 V, I_S = 50 A	T_J = 25°C		0.78	1.2	V
			T_J = 125°C		0.66		
Reverse Recovery Time	t_{RR}	V_{GS} = 0 V, dI/dt = 100 A/μs, I_S = 50 A			83		ns
Charge Time	t_a				39.9		
Discharge Time	t_b				43.2		
Reverse Recovery Charge	Q_{RR}				142		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.

3. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

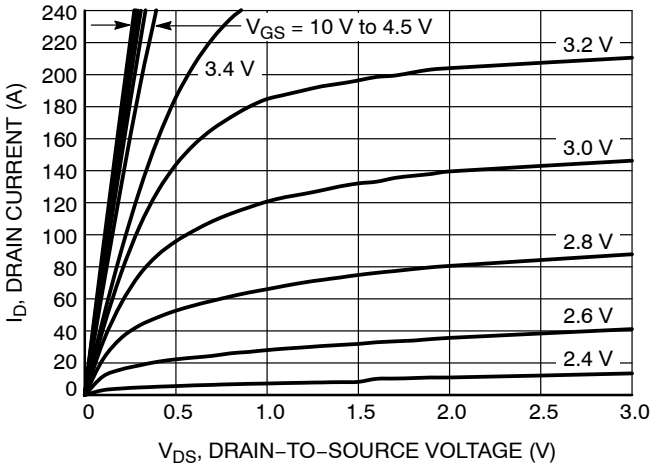


Figure 1. On−Region Characteristics

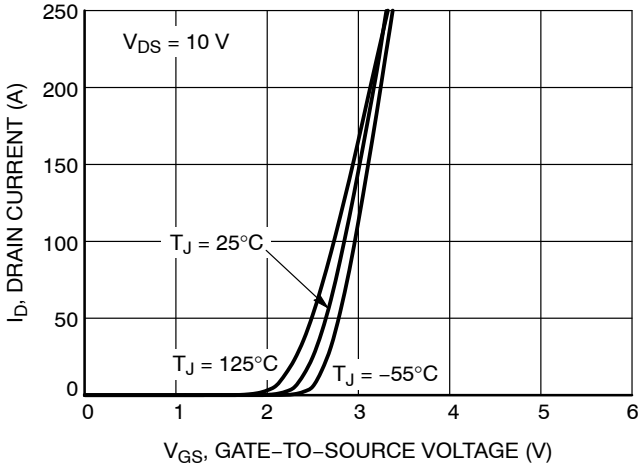


Figure 2. Transfer Characteristics

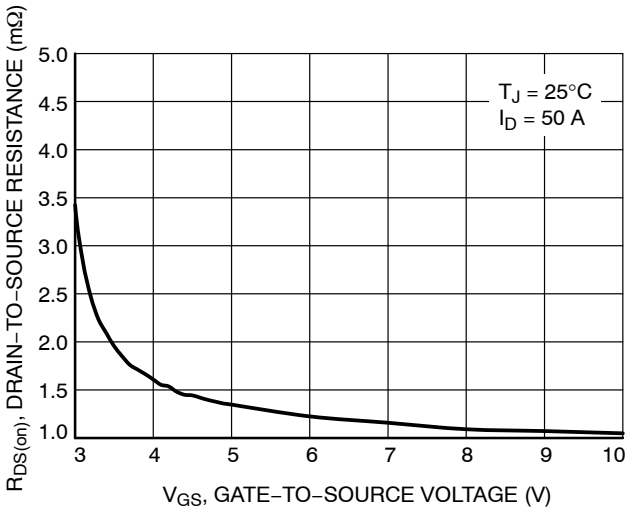


Figure 3. On−Resistance vs. Gate−to−Source Voltage

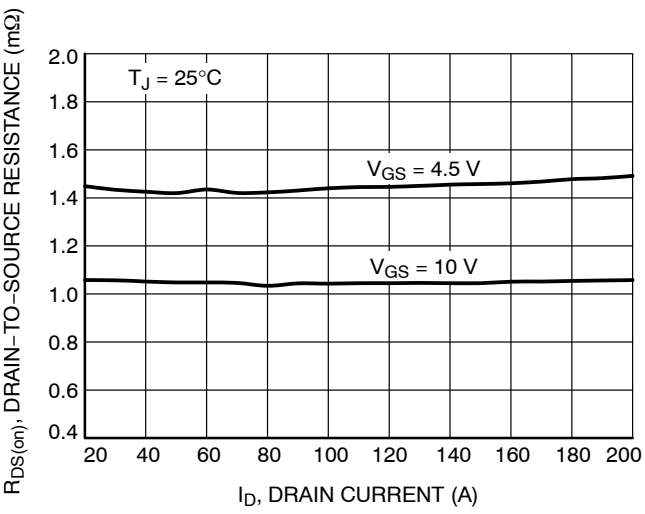


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

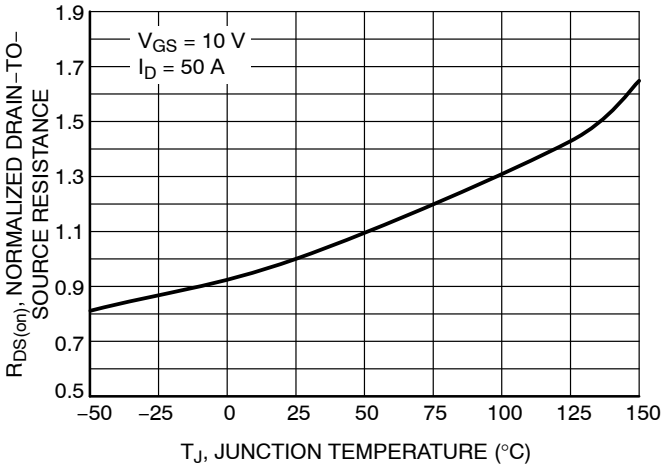


Figure 5. On−Resistance Variation with Temperature

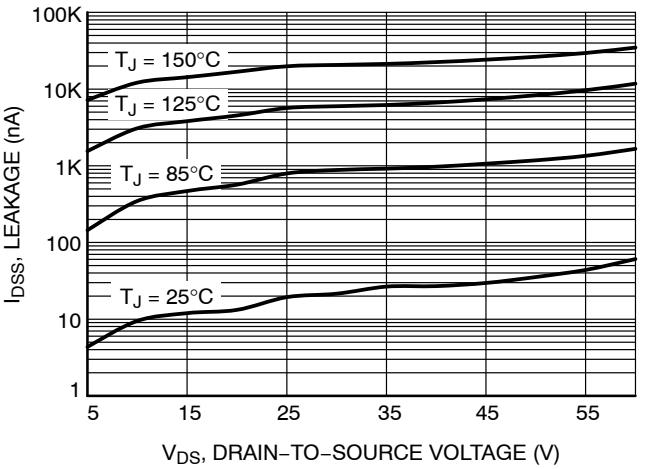


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

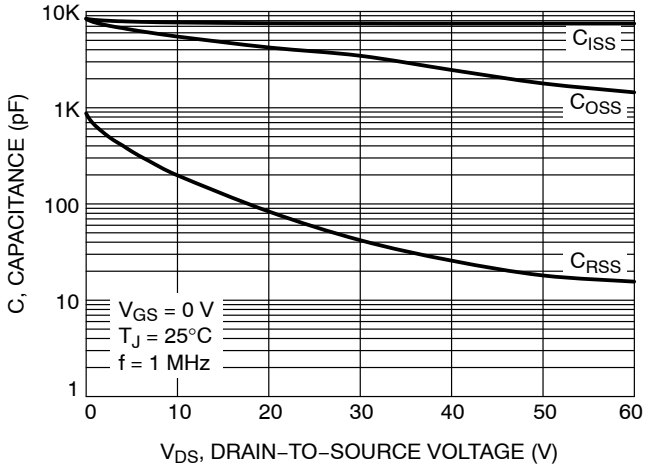


Figure 7. Capacitance Variation

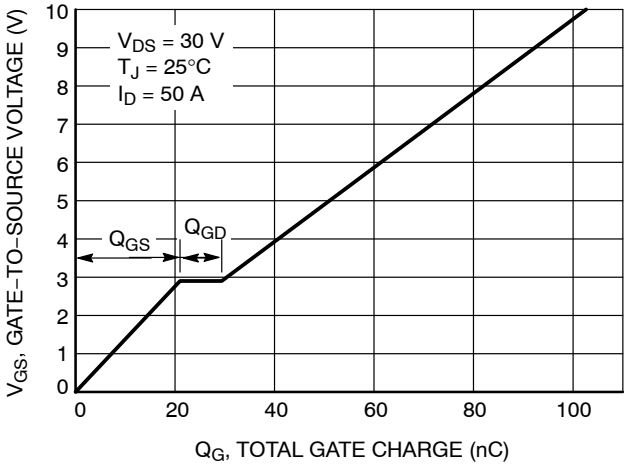


Figure 8. Gate−to−Source vs. Total Charge

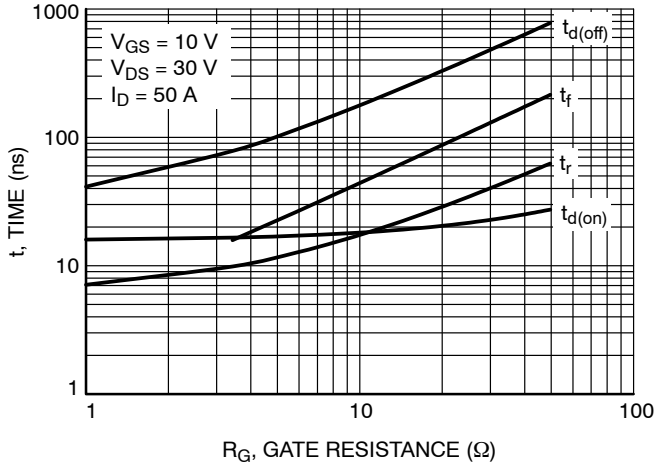


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

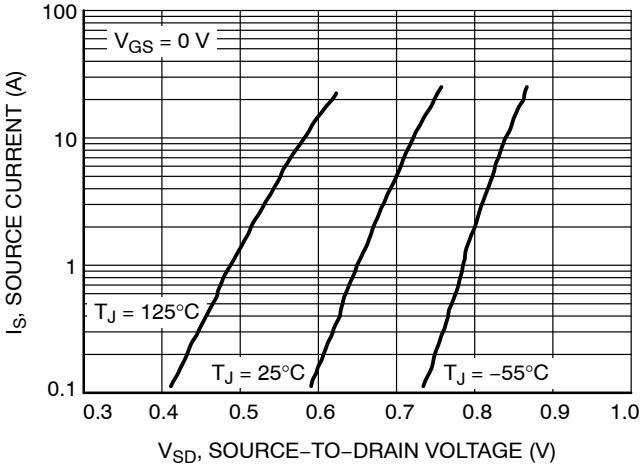


Figure 10. Diode Forward Voltage vs. Current

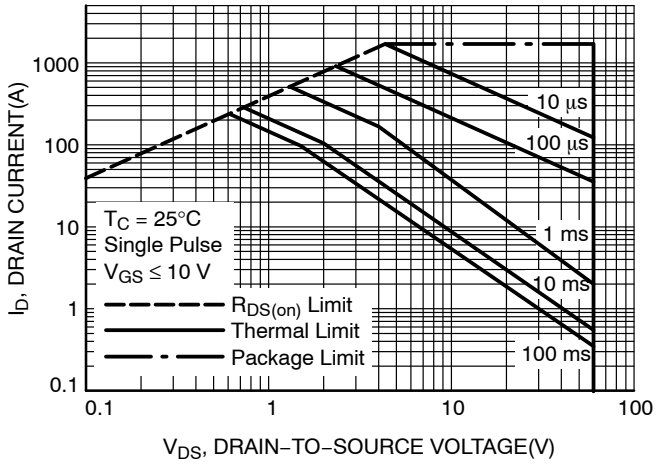


Figure 11. Safe Operating Area

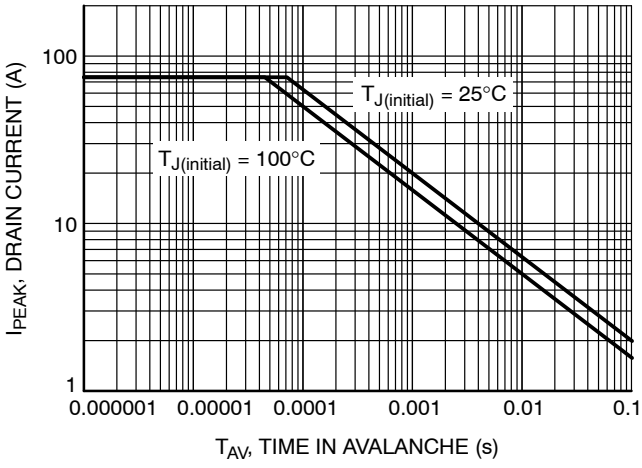


Figure 12. I_{PEAK} vs. Time in Avalanche

TYPICAL CHARACTERISTICS

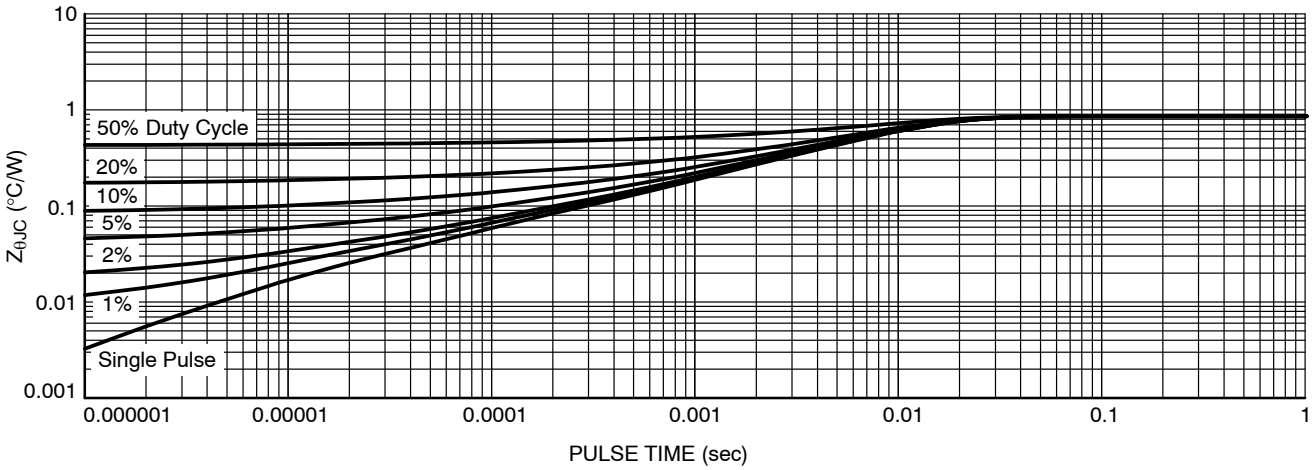
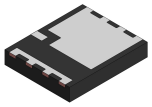
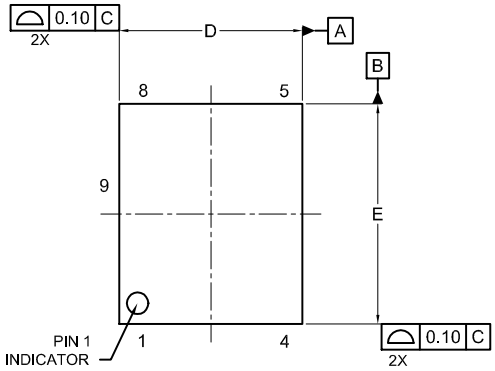


Figure 13. Thermal Characteristics

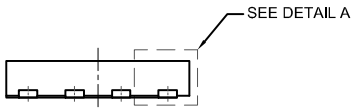


TDFN9 5x6, 1.27P
CASE 520AE
ISSUE B

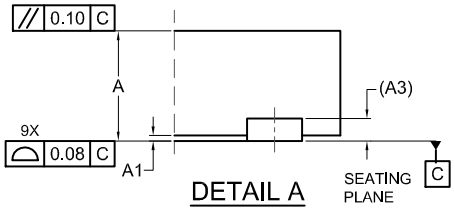
DATE 24 NOV 2022



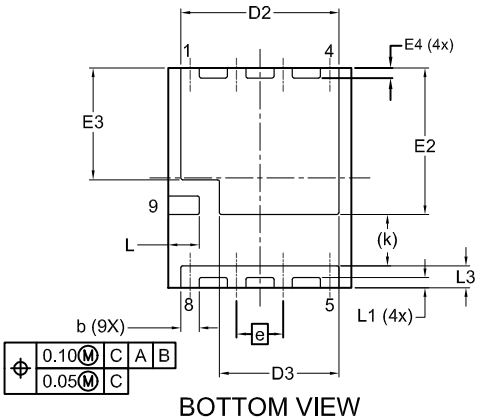
TOP VIEW



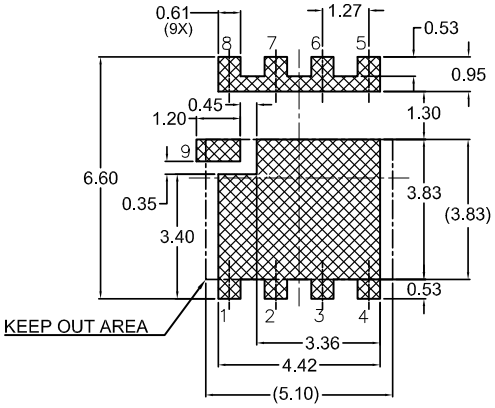
FRONT VIEW



DETAIL A
SCALE: 3:1



BOTTOM VIEW



LAND PATTERN
RECOMMENDATION

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D1, D2, E1 AND E2 DO NOT INCLUDE MOLD FLASH.
5. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.95	1.00	1.05
A1	0.00	0.02	0.05
A3		0.20 REF	
b	0.45	0.50	0.55
D	4.90	5.00	5.10
D2	4.10	4.30	4.50
D3	3.16	3.26	3.36
E	5.90	6.00	6.10
E2	3.90	4.00	4.10
E3	2.95	3.05	3.15
E4	0.18	0.28	0.38
e		1.27 BSC	
k		1.40 REF	
L	0.75	0.85	0.95
L1	0.18	0.28	0.38
L3	0.50	0.60	0.70

GENERIC MARKING DIAGRAM*

XXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year Code
WW = Work Week Code

*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.

DOCUMENT NUMBER:	**98AON99041G**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	**TDFN9 5x6, 1.27P**		**PAGE 1 OF 1**

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

onsemi, , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales