

# NTQD6866R2

## Power MOSFET 6.9 Amps, 20 Volts N-Channel TSSOP-8

### Features

- New Low Profile TSSOP-8 Package
- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- $I_{DSS}$  and  $V_{DS(on)}$  Specified at Elevated Temperatures
- Pb-Free Package is Available

### Applications

- Power Management in Portable and Battery-Powered Products, i.e.: Computers, Printers, PCMCIA Cards, Cellular and Cordless Phones
- Battery Applications
- NoteBook PC

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	20	Vdc
Drain-to-Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )	$V_{DGR}$	20	Vdc
Gate-to-Source Voltage - Continuous	$V_{GS}$	$\pm 12$	Vdc
Thermal Resistance - Single Die Junction-to-Ambient (Note 1)	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	2.0	W
Continuous Drain Current @ $T_A = 25^\circ\text{C}$	$I_D$	6.9	Adc
Pulsed Drain Current (Note 4)	$I_{DM}$	24	Adc
Thermal Resistance - Single Die Junction-to-Ambient (Note 2)	$R_{\theta JA}$	88	$^\circ\text{C}/\text{W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	1.42	W
Continuous Drain Current @ $T_A = 25^\circ\text{C}$	$I_D$	5.8	Adc
Continuous Drain Current @ $T_A = 70^\circ\text{C}$	$I_D$	4.6	Adc
Pulsed Drain Current (Note 4)	$I_{DM}$	20	Adc
Thermal Resistance - Single Die Junction-to-Ambient (Note 3)	$R_{\theta JA}$	132	$^\circ\text{C}/\text{W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	0.94	W
Continuous Drain Current @ $T_A = 25^\circ\text{C}$	$I_D$	4.7	Adc
Continuous Drain Current @ $T_A = 70^\circ\text{C}$	$I_D$	3.8	Adc
Pulsed Drain Current (Note 4)	$I_{DM}$	14	Adc
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 20\text{ Vdc}$ , $V_{GS} = 5.0\text{ Vdc}$ , Peak $I_L = 5.5\text{ Apk}$ , $L = 10\text{ mH}$ , $R_G = 25\ \Omega$ )	$E_{AS}$	150	mJ
Maximum Lead Temperature for Soldering Purposes for 10 seconds	$T_L$	260	$^\circ\text{C}$

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.

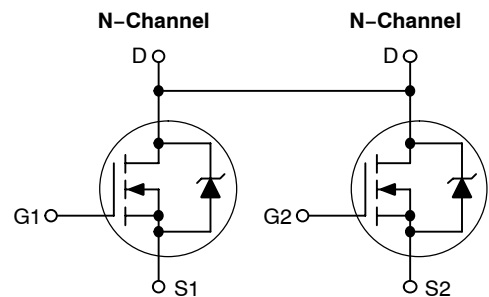
1. Mounted onto a 2" square FR-4 board  
(1 in sq, 2 oz Cu 0.06" thick single-sided),  $t < 10$  seconds.
2. Mounted onto a 2" square FR-4 board  
(1 in sq, 2 oz Cu 0.06" thick single-sided),  $t = ss$ .
3. Minimum FR-4 or G-10 PCB,  $t = \text{steady state}$ .
4. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.



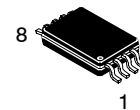
ON Semiconductor®

<http://onsemi.com>

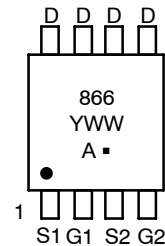
**6.9 AMPERES  
20 VOLTS  
30 m $\Omega$  @  $V_{GS} = 4.5\text{ V}$**



### MARKING DIAGRAM & PIN ASSIGNMENT



**TSSOP-8  
CASE 948S  
PLASTIC**



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

### ORDERING INFORMATION

Device	Package	Shipping†
NTQD6866R2	TSSOP-8	4000/Tape & Reel
NTQD6866R2G	TSSOP-8 (Pb-Free)	4000/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

# NTQD6866R2

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

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	20 -	- 18.5	- -	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = 20 Vdc, T <sub>J</sub> = 25°C) (V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = 20 Vdc, T <sub>J</sub> = 100°C)	I <sub>DSS</sub>	- -	- -	1.0 10	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ±12 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	-	-	±100	nAdc

### ON CHARACTERISTICS

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	0.6 -	0.9 -2.7	1.2 -	Vdc mV/°C
Static Drain-to-Source On-State Resistance (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 6.9 Adc) (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 5.8 Adc) (V <sub>GS</sub> = 2.5 Vdc, I <sub>D</sub> = 3.5 Adc) (V <sub>GS</sub> = 2.5 Vdc, I <sub>D</sub> = 2.9 Adc)	R <sub>DS(on)</sub>	- - - -	0.026 0.025 0.030 0.030	0.032 0.030 0.038 0.038	Ω
Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 5.8 Adc)	g <sub>FS</sub>	-	14	-	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 16 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>iss</sub>	-	875	1400	pF
Output Capacitance		C <sub>oss</sub>	-	325	550	
Reverse Transfer Capacitance		C <sub>rss</sub>	-	100	175	

### SWITCHING CHARACTERISTICS (Note 5)

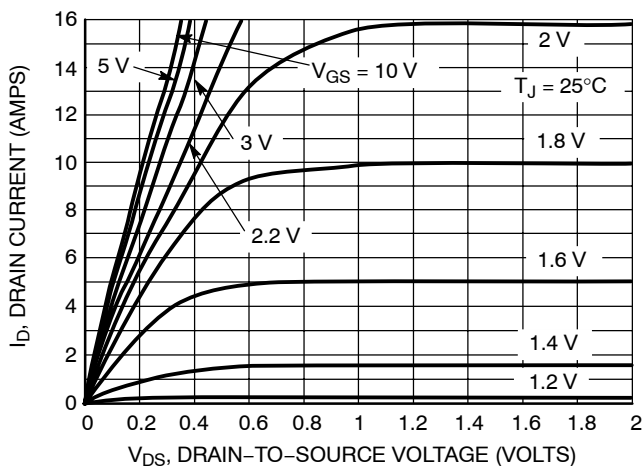
Turn-On Delay Time	(V <sub>DD</sub> = 16 Vdc, I <sub>D</sub> = 5.8 Adc, V <sub>GS</sub> = 4.5 Vdc, R <sub>G</sub> = 6.0 Ω)	t <sub>d(on)</sub>	-	10	18	ns
Rise Time		t <sub>r</sub>	-	45	80	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	40	75	
Fall Time		t <sub>f</sub>	-	90	150	
Turn-On Delay Time	(V <sub>DD</sub> = 16 Vdc, I <sub>D</sub> = 5.8 Adc, V <sub>GS</sub> = 4.5 Vdc, R <sub>G</sub> = 3.0 Ω)	t <sub>d(on)</sub>	-	8.0	-	
Rise Time		t <sub>r</sub>	-	45	-	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	35	-	
Fall Time		t <sub>f</sub>	-	75	-	
Gate Charge	(V <sub>DS</sub> = 16 Vdc, V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 5.8 Adc)	Q <sub>tot</sub>	-	13	22	nC
		Q <sub>gs</sub>	-	1.8	-	
		Q <sub>gd</sub>	-	4.5	-	

### BODY-DRAIN DIODE RATINGS

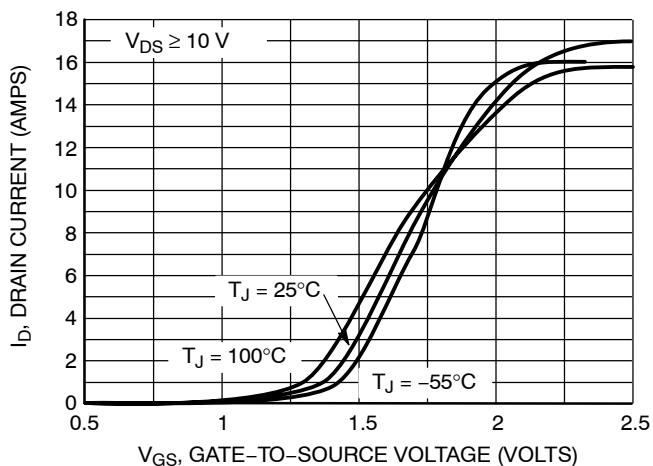
Forward On-Voltage	(I <sub>S</sub> = 5.8 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = 5.8 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 100°C)	V <sub>SD</sub>	- -	0.85 0.75	1.0 -	Vdc
Reverse Recovery Time	(I <sub>S</sub> = 5.8 Adc, V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = 20 Vdc dI <sub>S</sub> /dt = 100 A/μs)	t <sub>rr</sub>	-	23	-	ns
		t <sub>b</sub>	-	11	-	
		t <sub>a</sub>	-	12	-	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	-	0.013	-	μC

5. Switching characteristics are independent of operating junction temperature.

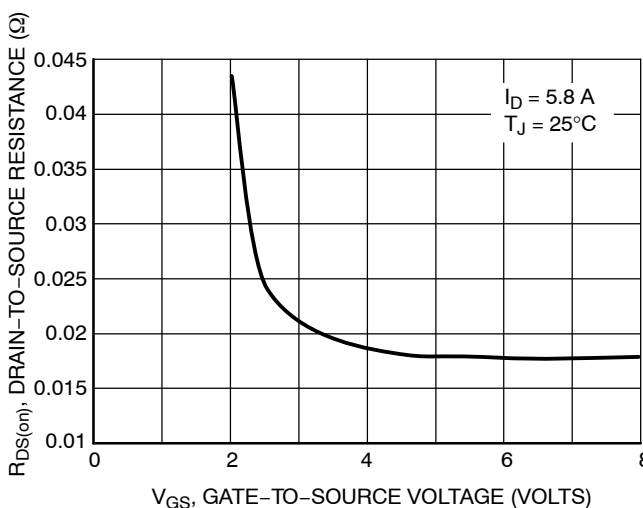
# NTQD6866R2



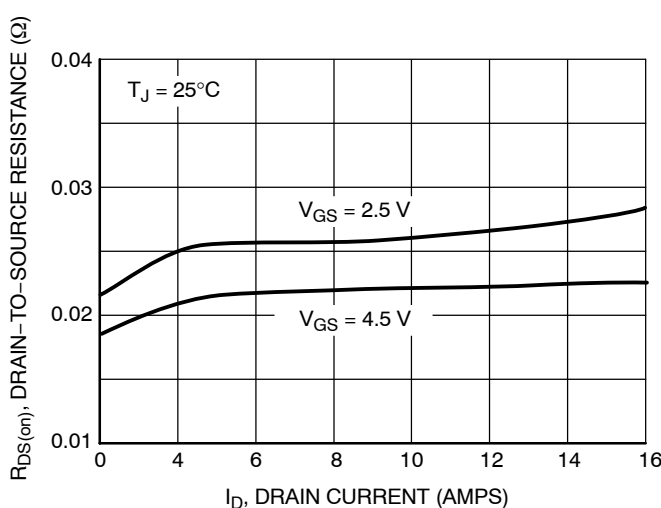
**Figure 1. On-Region Characteristics**



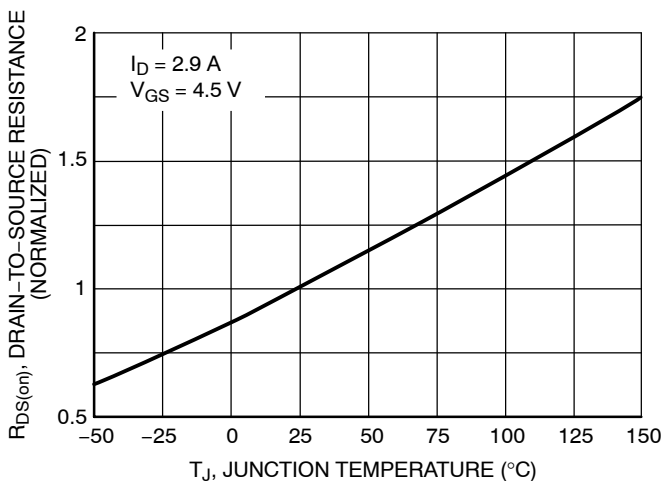
**Figure 2. Transfer Characteristics**



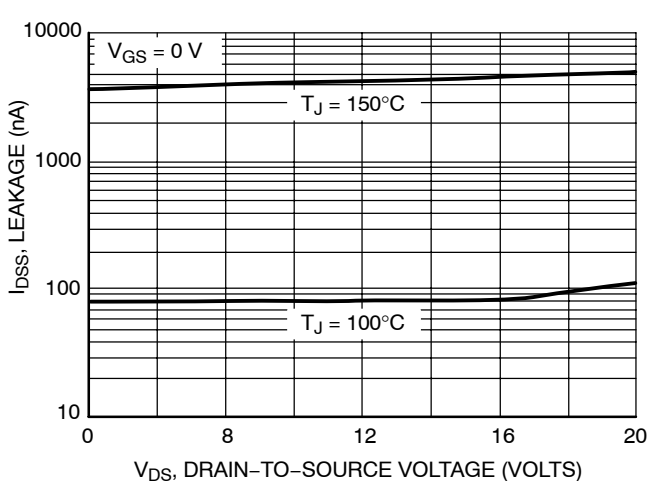
**Figure 3. On-Resistance versus Gate-to-Source Voltage**



**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**

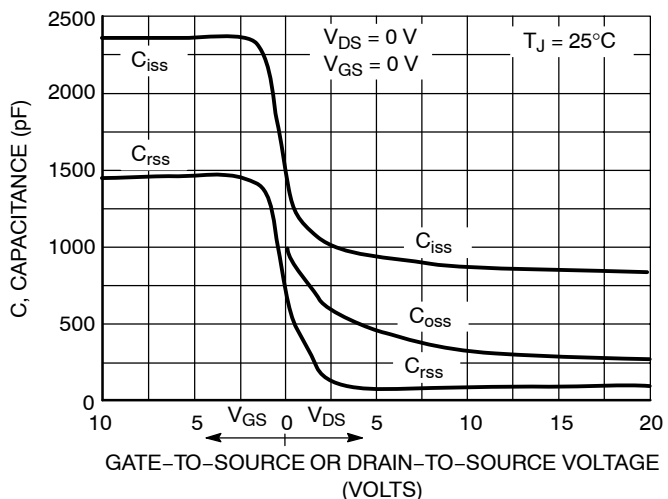


Figure 7. Capacitance Variation

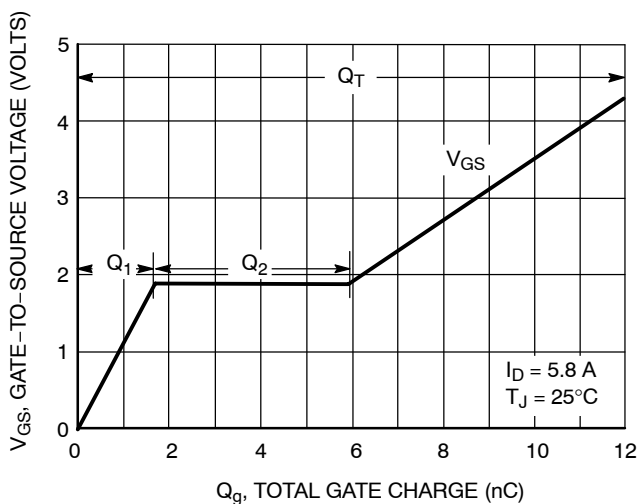


Figure 8. Gate-to-Source Voltage versus Total Charge

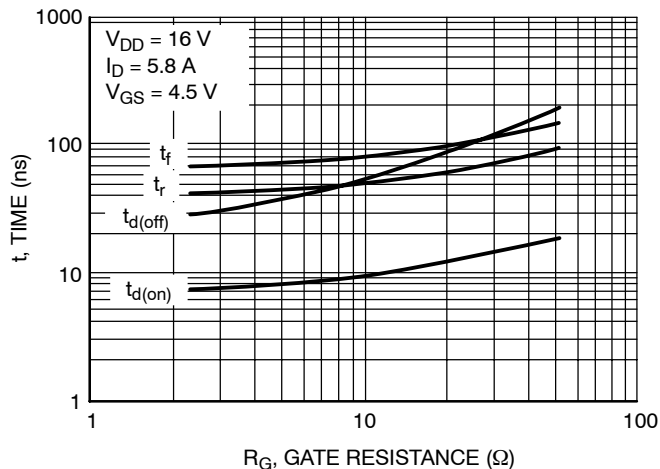


Figure 9. Resistive Switching Time Variation versus Gate Resistance

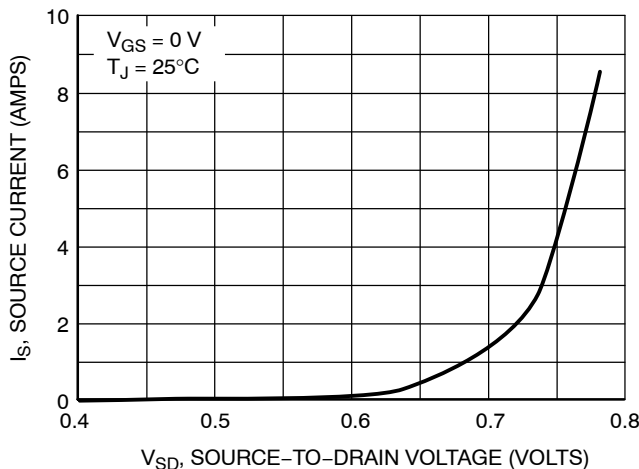


Figure 10. Diode Forward Voltage versus Current

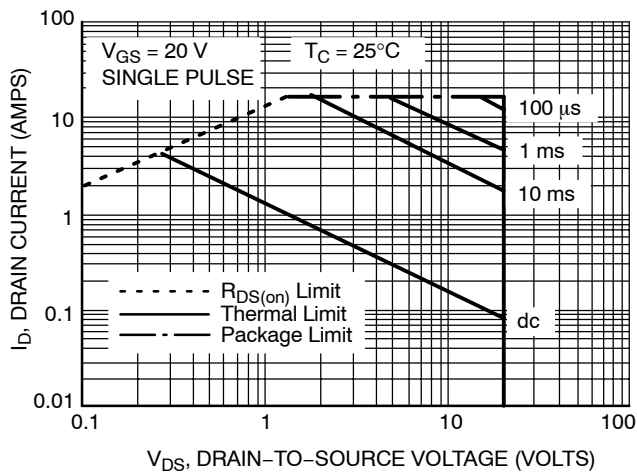


Figure 11. Maximum Rated Forward Biased Safe Operating Area

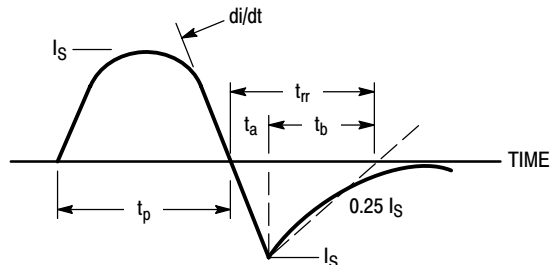


Figure 12. Diode Reverse Recovery Waveform

# NTQD6866R2

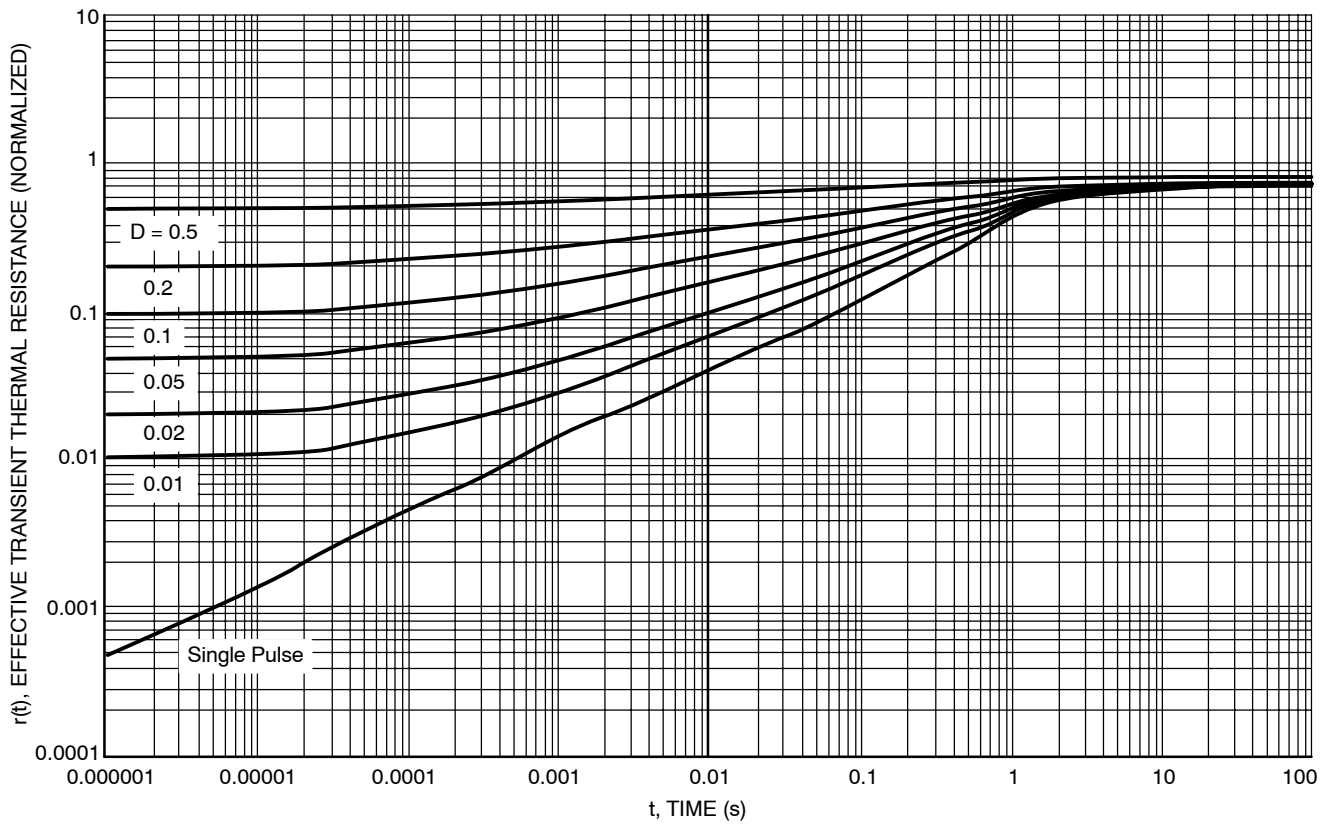
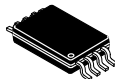


Figure 13. Thermal Response

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

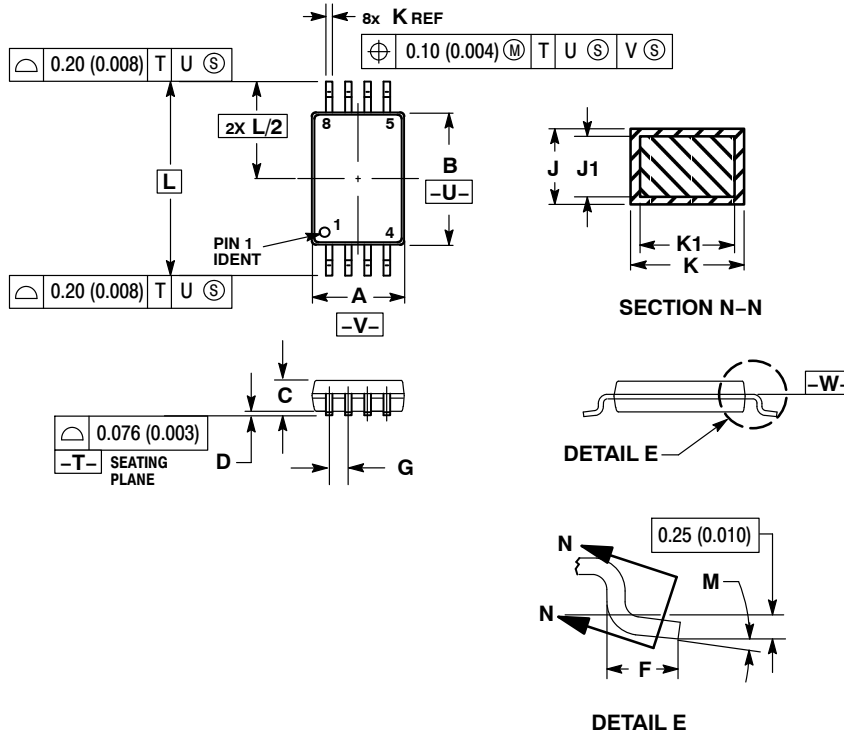
ON Semiconductor®



SCALE 2:1

TSSOP-8  
CASE 948S-01  
ISSUE C

DATE 20 JUN 2008

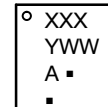


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	4.30	4.50	0.169	0.177
C	---	1.10	---	0.043
D	0.05	0.15	0.002	0.006
F	0.50	0.70	0.020	0.028
G	0.65 BSC		0.026 BSC	
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

GENERIC  
MARKING DIAGRAM\*



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

\*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.

DOCUMENT NUMBER:	98AON00697D	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
STATUS:	ON SEMICONDUCTOR STANDARD	
NEW STANDARD:		
DESCRIPTION:	TSSOP-8	PAGE 1 OF 2



<b>ISSUE</b>	<b>REVISION</b>	<b>DATE</b>
O	RELEASED FOR PRODUCTION.	18 APR 2000
A	ADDED MARKING DIAGRAM INFORMATION. REQ. BY V. BASS.	13 JAN 2006
B	CORRECTED MARKING DIAGRAM PIN 1 LOCATION AND MARKING. REQ. BY C. REBELLO.	13 MAR 2006
C	REMOVED EXPOSED PAD VIEW AND DIMENSIONS P AND P1. CORRECTED MARKING INFORMATION. REQ. BY C. REBELLO.	20 JUN 2008

ON Semiconductor and ON are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC 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. "Typical" parameters which may be provided in SCILLC 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. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC 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 SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

**onsemi**, **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](http://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](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)