

# NTQD6968N

## Power MOSFET

7.0 A, 20 V, Common Drain,  
Dual N-Channel, TSSOP-8

### Features

- Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- 3 mm Wide TSSOP-8 Surface Mount Package
- High Speed, Soft Recovery Diode
- TSSOP-8 Mounting Information Provided
- Pb-Free Package is Available

### Applications

- Battery Protection Circuits

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

| Rating                                                                                                                                                                                                              | Symbol                     | Value            | Unit               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------|--------------------|
| Drain-to-Source Voltage                                                                                                                                                                                             | $V_{DS}$                   | 20               | Vdc                |
| Gate-to-Source Voltage – Continuous                                                                                                                                                                                 | $V_{GS}$                   | $\pm 12$         | Vdc                |
| Drain Current <ul style="list-style-type: none"><li>– Continuous @ <math>T_A 25^\circ\text{C}</math> (Note 1)</li><li>– Continuous @ <math>T_A 70^\circ\text{C}</math> (Note 1)</li><li>– Pulsed (Note 3)</li></ul> | $I_D$<br>$I_D$<br>$I_{DM}$ | 7.0<br>5.6<br>20 | Adc                |
| Total Power Dissipation @ $T_A 25^\circ\text{C}$ (Note 1)                                                                                                                                                           | $P_D$                      | 1.81             | W                  |
| Drain Current <ul style="list-style-type: none"><li>– Continuous @ <math>T_A 25^\circ\text{C}</math> (Note 2)</li><li>– Continuous @ <math>T_A 70^\circ\text{C}</math> (Note 2)</li><li>– Pulsed (Note 3)</li></ul> | $I_D$<br>$I_D$<br>$I_{DM}$ | 6.2<br>4.9<br>18 | Adc                |
| Total Power Dissipation @ $T_A 25^\circ\text{C}$ (Note 2)                                                                                                                                                           | $P_D$                      | 1.39             | W                  |
| Operating and Storage Temperature Range                                                                                                                                                                             | $T_J, T_{stg}$             | $-55$ to $+150$  | $^\circ\text{C}$   |
| Thermal Resistance –<br>Junction-to-Ambient (Note 1)<br>Junction-to-Ambient (Note 2)                                                                                                                                | $R_{\theta JA}$            | 69<br>90         | $^\circ\text{C/W}$ |
| Maximum Lead Temperature for Soldering Purposes for 10 seconds                                                                                                                                                      | TL                         | 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.

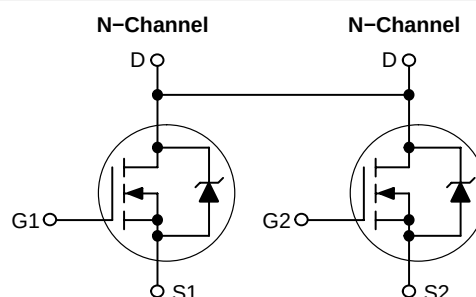
1. Mounted onto a 2" square FR-4 Board  
(1 in sq, 2 oz. Cu 0.06" thick single sided),  $t \leq 10$  sec.
2. Mounted onto a 2" square FR-4 Board  
(1 in sq, 2 oz. Cu 0.06" thick single sided), Steady State.
3. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.



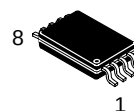
ON Semiconductor®

<http://onsemi.com>

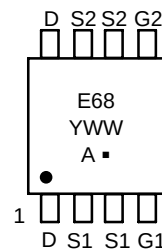
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP      | $I_D$ MAX |
|---------------|-----------------------|-----------|
| 20 V          | 17 m $\Omega$ @ 4.5 V | 7.0 A     |



### MARKING DIAGRAM & PIN ASSIGNMENT



TSSOP-8  
CASE 948S  
PLASTIC



E68 = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

### ORDERING INFORMATION

| Device       | Package              | Shipping†        |
|--------------|----------------------|------------------|
| NTQD6968N    | TSSOP-8              | 100 Units / Rail |
| NTQD6968NR2  | TSSOP-8              | 4000/Tape & Reel |
| NTQD6968NR2G | TSSOP-8<br>(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.

# NTQD6968N

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

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

### OFF CHARACTERISTICS

|                                                                                                                                                                                                                |               |    |    |           |                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----|----|-----------|----------------------|
| Drain-to-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 250\text{ }\mu\text{Adc}$ )                                                                                                            | $V_{(BR)DSS}$ | 20 | –  | –         | Vdc                  |
| Temperature Coefficient (Positive)                                                                                                                                                                             |               | –  | 16 | –         | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Collector Current<br>( $V_{DS} = 16\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 25^\circ\text{C}$ )<br>( $V_{DS} = 16\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ ) | $I_{DSS}$     | –  | –  | 1.0<br>10 | $\mu\text{Adc}$      |
| Gate-Body Leakage Current<br>( $V_{GS} = \pm 12\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )                                                                                                                        | $I_{GSS}$     | –  | –  | $\pm 100$ | nAdc                 |

### ON CHARACTERISTICS

|                                                                                                                                                                                                                          |              |     |                         |                         |                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----|-------------------------|-------------------------|----------------------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{Adc}$ )                                                                                                                                       | $V_{GS(th)}$ | 0.6 | 0.75                    | 1.2                     | Vdc                  |
| Temperature Coefficient (Negative)                                                                                                                                                                                       |              | –   | 3.0                     | –                       | mV/ $^\circ\text{C}$ |
| Static Drain-to-Source On-State Resistance<br>( $V_{GS} = 4.5\text{ Vdc}$ , $I_D = 7.0\text{ Adc}$ )<br>( $V_{GS} = 2.5\text{ Vdc}$ , $I_D = 7.0\text{ Adc}$ )<br>( $V_{GS} = 2.5\text{ Vdc}$ , $I_D = 3.5\text{ Adc}$ ) | $R_{DS(on)}$ | –   | 0.017<br>0.022<br>0.022 | 0.022<br>0.030<br>0.030 | $\Omega$             |
| Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 7.0\text{ Adc}$ )                                                                                                                                           | $g_{FS}$     | –   | 19.2                    | –                       | Mhos                 |

### DYNAMIC CHARACTERISTICS

|                      |                                                                                 |           |   |     |   |    |
|----------------------|---------------------------------------------------------------------------------|-----------|---|-----|---|----|
| Input Capacitance    | $(V_{DS} = 16\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$f = 1.0\text{ MHz}$ ) | $C_{iss}$ | – | 630 | – | pF |
| Output Capacitance   |                                                                                 | $C_{oss}$ | – | 260 | – |    |
| Transfer Capacitance |                                                                                 | $C_{rss}$ | – | 95  | – |    |

### SWITCHING CHARACTERISTICS (Notes 4 and 5)

|                     |                                                                                                                 |              |   |      |    |    |
|---------------------|-----------------------------------------------------------------------------------------------------------------|--------------|---|------|----|----|
| Turn-On Delay Time  | $(V_{DD} = 16\text{ Vdc}$ , $I_D = 7.0\text{ Adc}$ ,<br>$V_{GS} = 4.5\text{ Vdc}$ , $R_G = 6.0\text{ }\Omega$ ) | $t_{d(on)}$  | – | 8.0  | –  | ns |
| Rise Time           |                                                                                                                 | $t_r$        | – | 25   | –  |    |
| Turn-Off Delay Time |                                                                                                                 | $t_{d(off)}$ | – | 60   | –  |    |
| Fall Time           |                                                                                                                 | $t_f$        | – | 65   | –  |    |
| Gate Charge         | $(V_{DS} = 16\text{ Vdc}$ ,<br>$V_{GS} = 4.5\text{ Vdc}$ ,<br>$I_D = 7.0\text{ Adc}$ )                          | $Q_{tot}$    | – | 12.5 | 17 | nC |
|                     |                                                                                                                 | $Q_{gs}$     | – | 1.0  | –  |    |
|                     |                                                                                                                 | $Q_{gd}$     | – | 5.0  | –  |    |

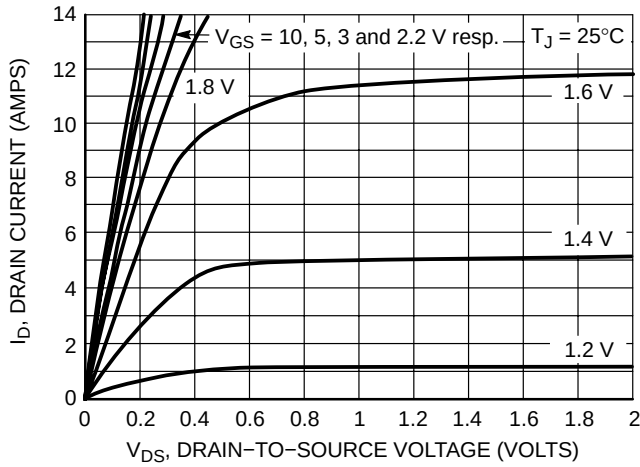
### BODY-DRAIN DIODE RATINGS (Note 4)

|                                |                                                                                               |          |   |      |     |               |
|--------------------------------|-----------------------------------------------------------------------------------------------|----------|---|------|-----|---------------|
| Forward On-Voltage             | $(I_S = 7.0\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ )                                           | $V_{SD}$ | – | 0.82 | 1.2 | Vdc           |
| Reverse Recovery Time          | $(I_S = 7.0\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$di_S/dt = 100\text{ A}/\mu\text{s}$ ) | $t_{rr}$ | – | 35   | –   | ns            |
|                                |                                                                                               | $t_a$    | – | 15   | –   |               |
|                                |                                                                                               | $t_b$    | – | 20   | –   |               |
| Reverse Recovery Stored Charge |                                                                                               | $Q_{RR}$ | – | 0.02 | –   | $\mu\text{C}$ |

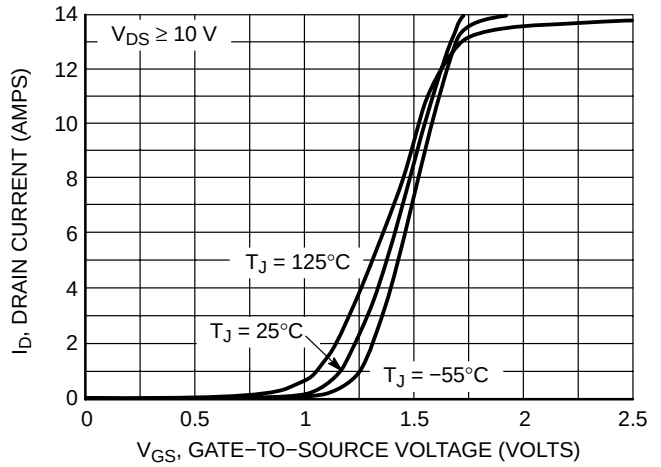
4. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.

5. Switching characteristics are independent of operating junction temperature.

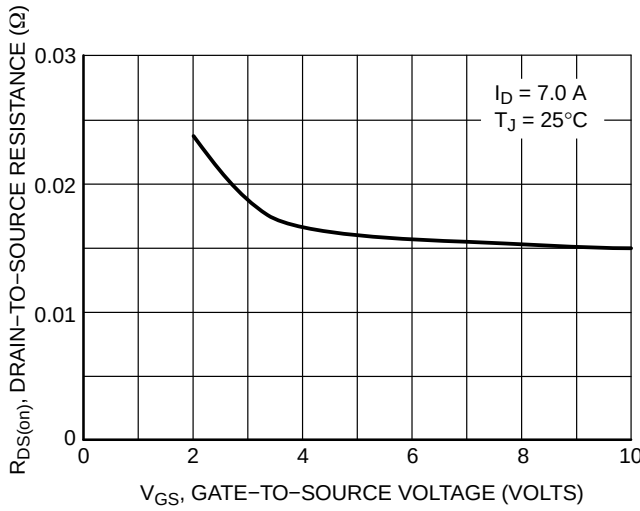
# NTQD6968N



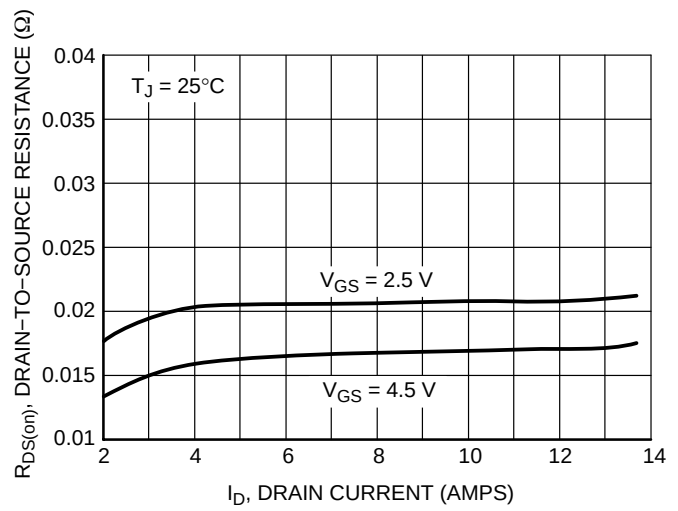
**Figure 1. On-Region Characteristics**



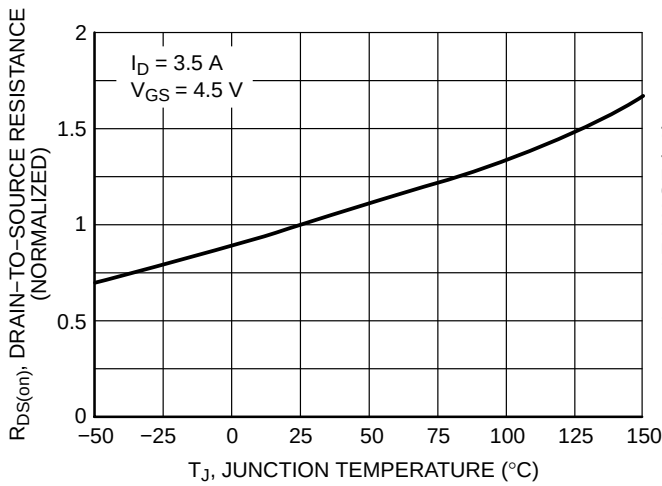
**Figure 2. Transfer Characteristics**



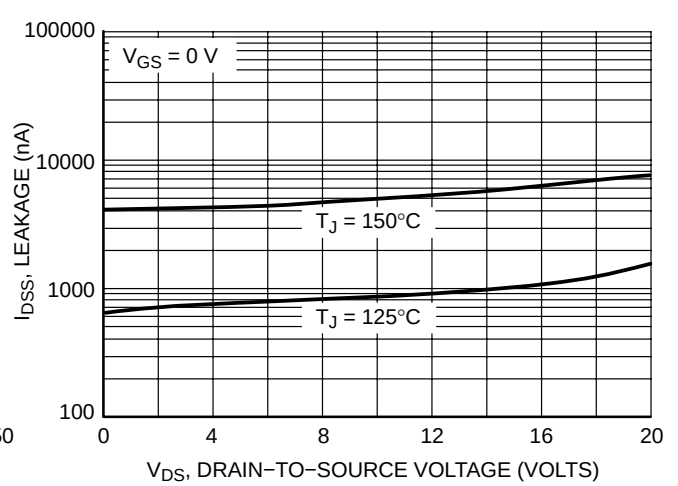
**Figure 3. On-Resistance versus Gate-to-Source Voltage**



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

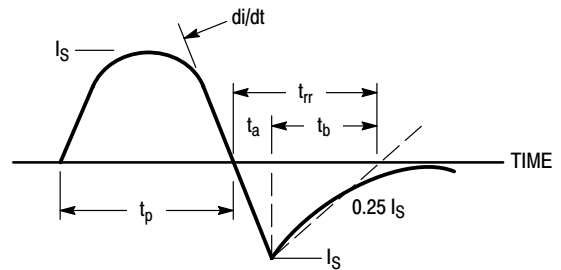
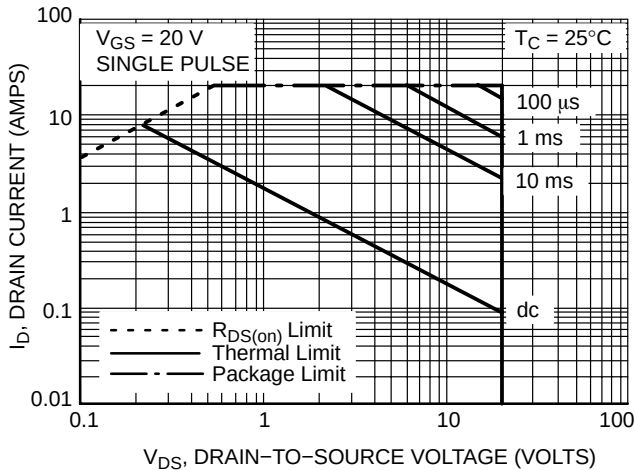
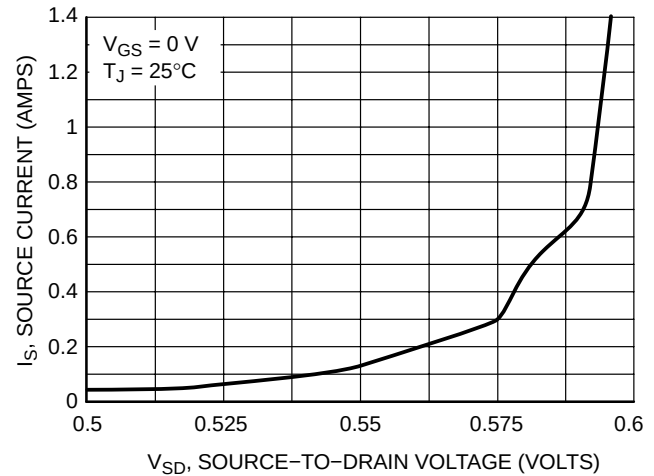
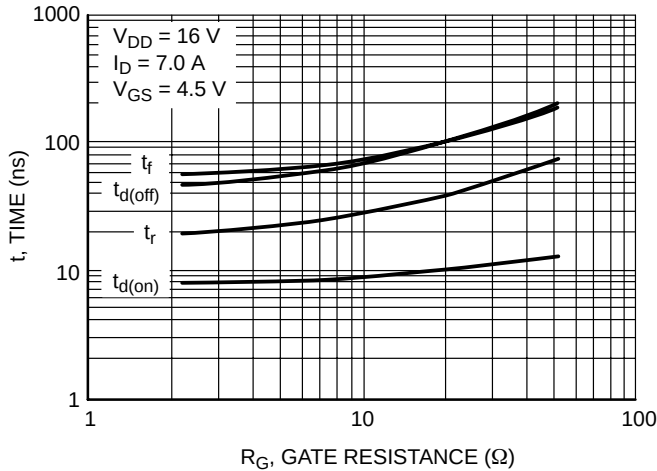
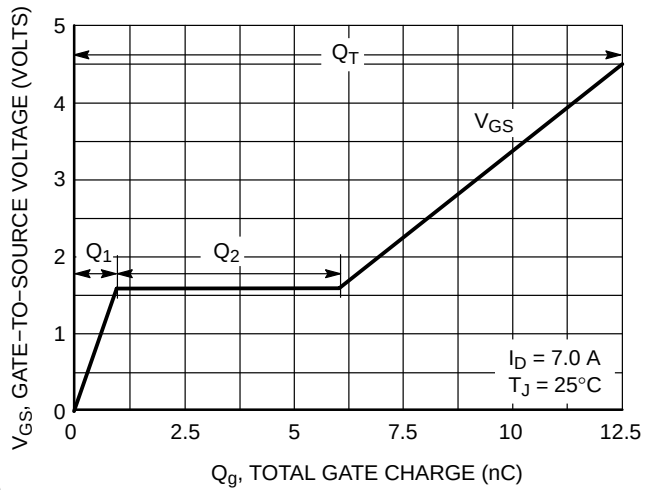
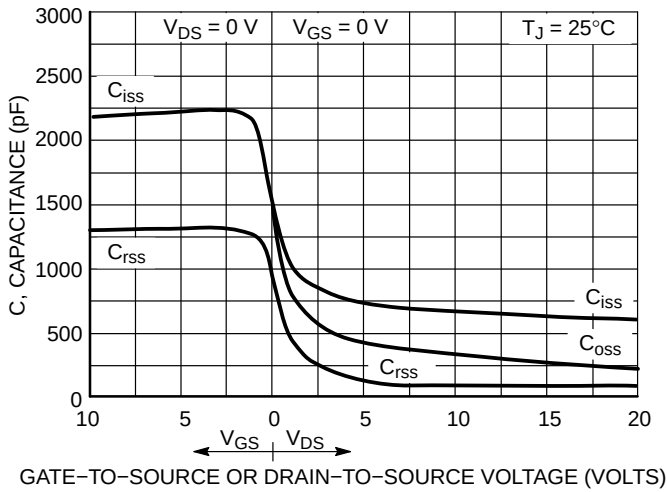


**Figure 5. On-Resistance Variation with Temperature**



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

# NTQD6968N



# NTQD6968N

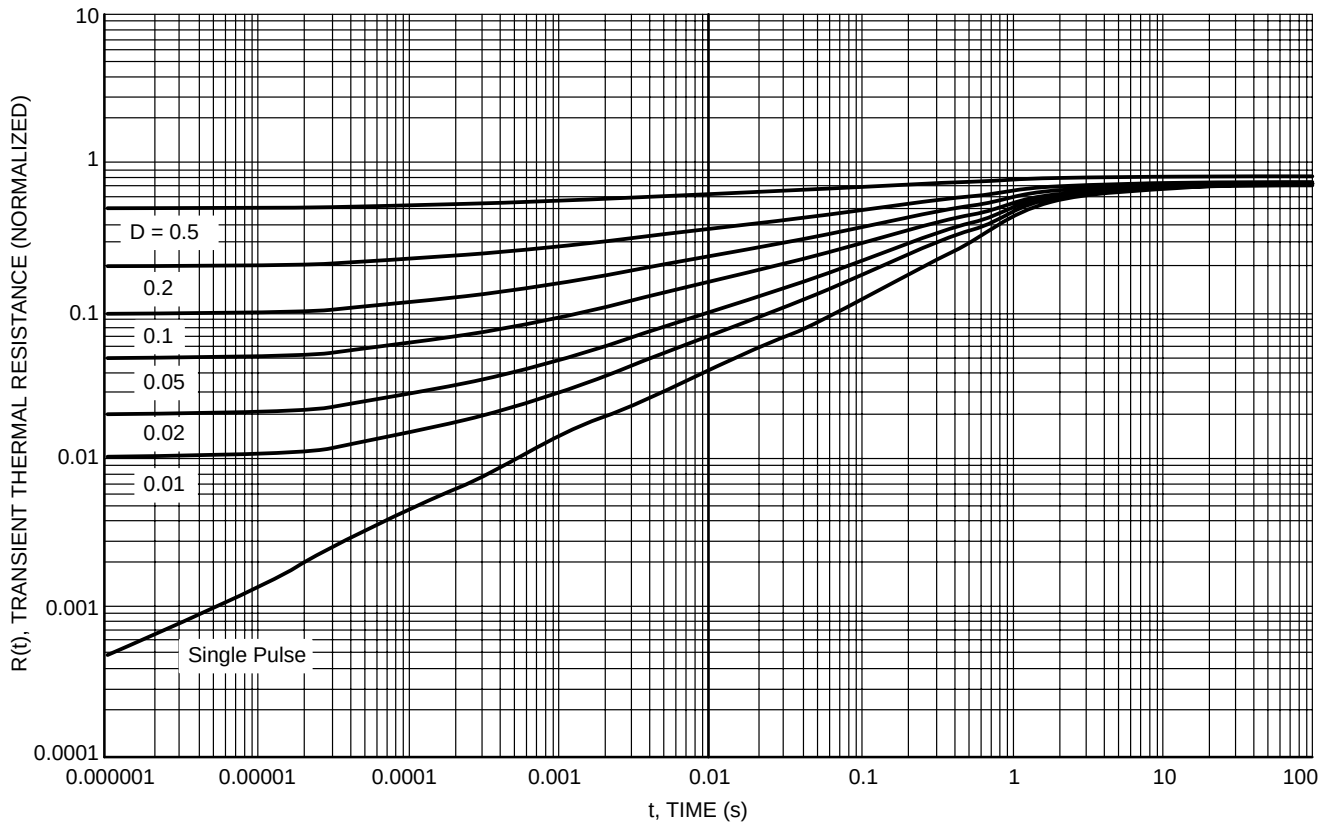
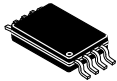


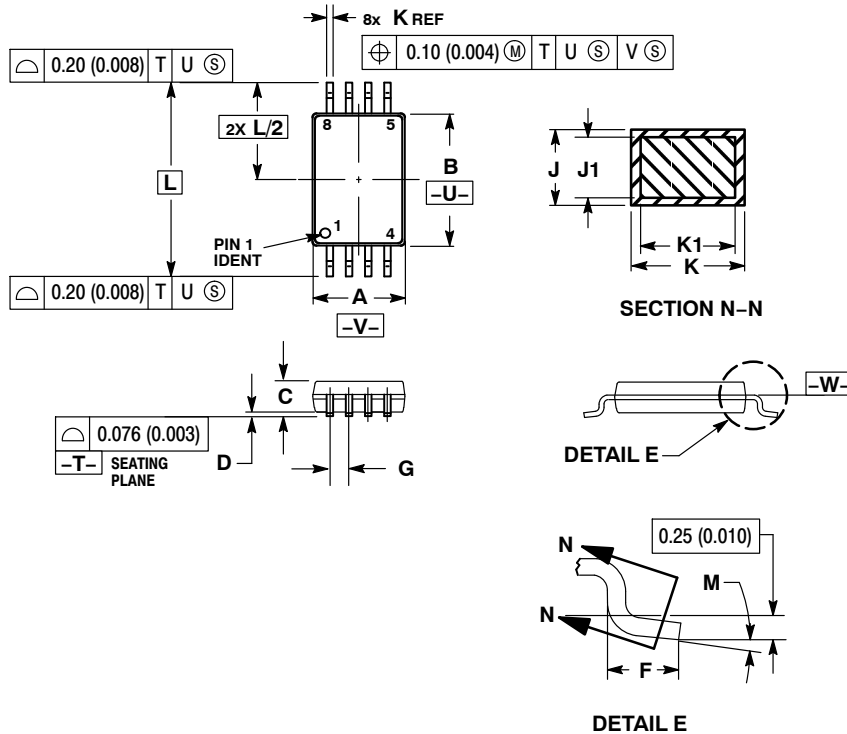
Figure 13. Thermal Response



SCALE 2:1

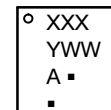
**TSSOP-8 3.0x4.4x1.1**  
**CASE 948S**  
**ISSUE C**

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. Some products may not follow the Generic Marking.

|                         |                            |                                                                                                                                                                                     |
|-------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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