

# MOSFET, N-Channel, POWERTRENCH®

40 V, 18.6 A, 4.5 mΩ

## FDS8840NZ

### General Description

The FDS8840NZ has been designed to minimize losses in power conversion application. Advancements in both silicon and package technologies have been combined to offer the lowest  $r_{DS(on)}$  while maintaining excellent switching performance.

### Features

- Max  $r_{DS(on)}$  = 4.5 mΩ at  $V_{GS} = 10\text{ V}$ ,  $I_D = 18.6\text{ A}$
- Max  $r_{DS(on)}$  = 6.0 mΩ at  $V_{GS} = 4.5\text{ V}$ ,  $I_D = 14.9\text{ A}$
- HBM ESD Protection Level of 6 kV Typical (Note 3)
- High Performance Trench Technology for Extremely Low  $r_{DS(on)}$  and Fast Switching
- High Power and Current Handling Capability
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

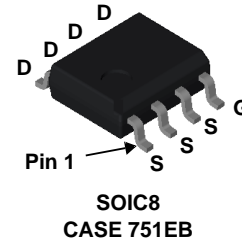
### Applications

- Synchronous Buck for Vcore and Server
- Notebook Battery Pack
- Load Switch

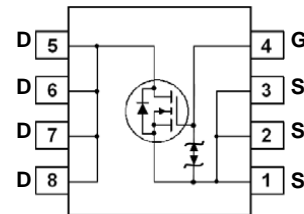


ON Semiconductor®

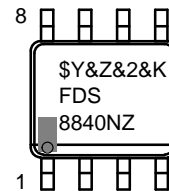
[www.onsemi.com](http://www.onsemi.com)



### PIN ASSIGNMENT



### MARKING DIAGRAM



|           |                         |
|-----------|-------------------------|
| \$Y       | = ON Semiconductor Logo |
| &Z        | = Assembly Plant Code   |
| &2        | = Numeric Date Code     |
| &K        | = Lot Code              |
| FDS8840NZ | = Specific Device Code  |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FDS8840NZ

## ORDERING INFORMATION

| Part Number | Device Marking | Package                           | Shipping <sup>†</sup>    |
|-------------|----------------|-----------------------------------|--------------------------|
| FDS8840NZ   | FDS8840NZ      | SOIC8<br>(Pb-Free / Halogen Free) | 2500 Units / 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 Specification Brochure, BRD8011/D.

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                            | Parameter  | Value      | Unit |
|-----------------------------------|--|------------|------|
| V <sub>DS</sub>                   | Drain to Source Voltage                            | 40         | V    |
| V <sub>GS</sub>                   | Gate to Source Voltage                             | ±20        | V    |
| I <sub>D</sub>                    | Drain Current Continuous                           | 18.6       | A    |
|                                   | Drain Current Pulsed                               | 63         |      |
| E <sub>AS</sub>                   | Single Pulse Avalanche Energy (Note 4)             | 600        | mJ   |
| P <sub>D</sub>                    | Power Dissipation, T <sub>A</sub> = 25°C (Note 1a) | 2.5        | W    |
|                                   | Power Dissipation, T <sub>A</sub> = 25°C (Note 1b) | 1.0        |      |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Junction Temperature Range   | -55 to 150 | °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 CHARACTERISTICS

| Symbol           | Parameter   | Value | Unit |
|------------------|---|-------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case (Note 1)     | 25    | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Note 1a) | 50    | °C/W |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

### Off Characteristics

|                                      |   |  |    |    |     |       |
|--------------------------------------|---|--|----|----|-----|-------|
| BV <sub>DSS</sub>                    | Drain to Source Breakdown Voltage         | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V | 40 |    |     | V     |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, referenced to 25°C    |    | 31 |     | mV/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 32 V, V <sub>GS</sub> = 0 V  |    |    | 1   | μA    |
| I <sub>GSS</sub>                     | Gate to Source Leakage Current            | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V |    |    | ±10 | μA    |

### On Characteristics

|  |  |   |     |     |     |       |
|--|--|---|-----|-----|-----|-------|
| V <sub>GS(th)</sub>                    | Gate to Source Threshold Voltage                         | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA             | 1.0 | 1.8 | 3.0 | V     |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, referenced to 25°C                             |     | -6  |     | mV/°C |
| r <sub>DS(on)</sub>                    | Static Drain to Source On Resistance                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 18.6 A                         |     | 3.9 | 4.5 | mΩ    |
|  |  | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 14.9 A                        |     | 4.6 | 6.0 |       |
|  |  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 18.6 A, T <sub>J</sub> = 125°C |     | 5.9 | 7.0 |       |
| g <sub>FS</sub>                        | Forward Transconductance                                 | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 18.6 A                          |     | 83  |     | S     |

### Dynamic Characteristics

|                  |                              |  |  |      |      |    |
|------------------|------------------------------|--|--|------|------|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V, f = 1 MHz |  | 5665 | 7535 | pF |
| C <sub>oss</sub> | Output Capacitance           |  |  | 650  | 865  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |  |  | 445  | 670  | pF |
| R <sub>g</sub>   | Gate Resistance              |  |  | 1.2  |      | Ω  |

# FDS8840NZ

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

| Symbol                           | Parameter                     | Test Conditions  | Min   | Typ | Max | Unit |
|----------------------------------|-------------------------------|--|---|-----|-----|------|
| <b>Switching Characteristics</b> |                               |  |   |     |     |      |
| $t_{d(on)}$                      | Turn-On Delay Time            | $V_{DD} = 20\text{ V}$ , $I_D = 18.6\text{ A}$ , $V_{GS} = 10\text{ V}$ ,<br>$R_{GEN} = 6\ \Omega$ |   | 18  | 32  | ns   |
| $t_r$                            | Rise Time                     |  |   | 13  | 23  | ns   |
| $t_{d(off)}$                     | Turn-Off Delay Time           |  |   | 57  | 103 | ns   |
| $t_f$                            | Fall Time                     |  |   | 11  | 20  | ns   |
| $Q_g$                            | Total Gate Charge             | $V_{GS} = 0\text{ V to }10\text{ V}$   | $V_{DD} = 20\text{ V}$ ,<br>$I_D = 18.6\text{ A}$ | 103 | 144 | nC   |
| $Q_g$                            | Total Gate Charge             | $V_{GS} = 0\text{ V to }5\text{ V}$  |   | 54  | 76  | nC   |
| $Q_{gs}$                         | Gate to Source Charge         |  |   | 16  |     | nC   |
| $Q_{gd}$                         | Gate to Drain "Miller" Charge |  |   | 19  |     | nC   |

### Drain-Source Diode Characteristics

|          |                                       |  |  |     |     |    |
|----------|---------------------------------------|--|--|-----|-----|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}$ , $I_S = 18.6\text{ A}$              |  | 0.8 | 1.2 | V  |
|          |                                       | $V_{GS} = 0\text{ V}$ , $I_S = 2.1\text{ A}$               |  | 0.7 | 1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = 18.6\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ |  | 33  | 53  | ns |
| $Q_{rr}$ | Reverse Recovery Charge               |  |  | 21  | 34  | 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.

#### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a.) 50°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b.) 125°C/W when mounted on a minimum pad

- Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty cycle < 2.0%.
- The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.
- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{ mH}$ ,  $I_{AS} = 20\text{ A}$ ,  $V_{DD} = 40\text{ V}$ ,  $V_{GS} = 10\text{ V}$ .

TYPICAL CHARACTERISTICS

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

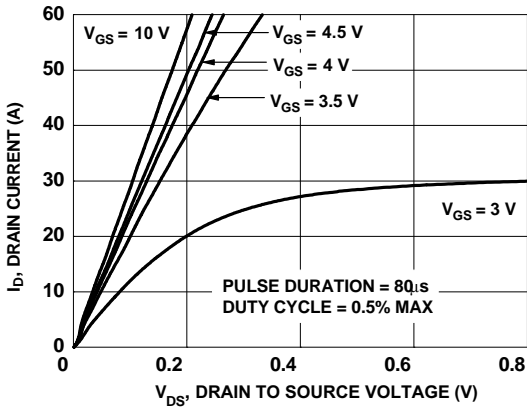


Figure 1. On-Region Characteristics

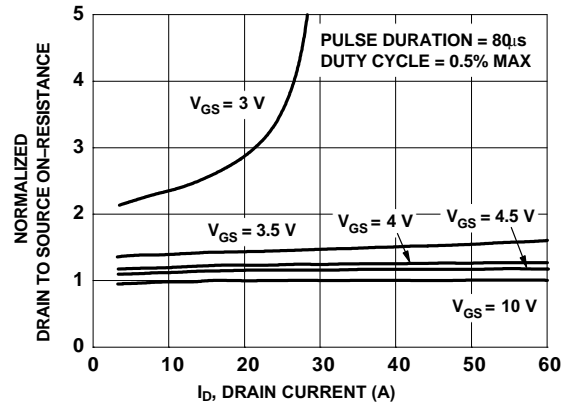


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

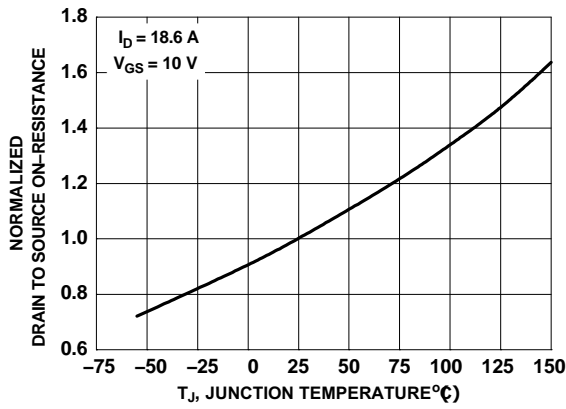


Figure 3. Normalized On-Resistance vs Junction Temperature

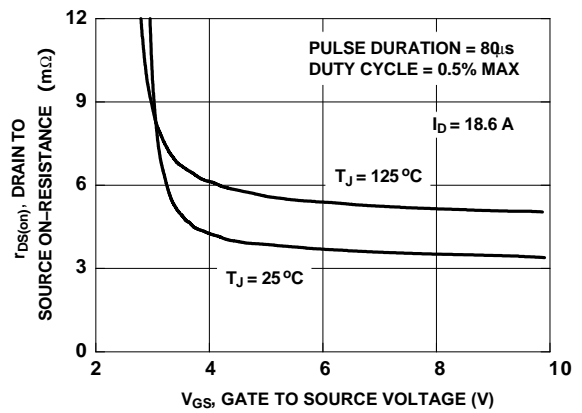


Figure 4. On-Resistance vs Gate to Source Voltage

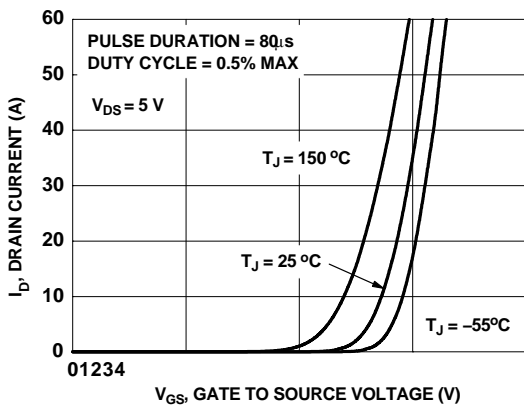


Figure 5. Transfer Characteristics

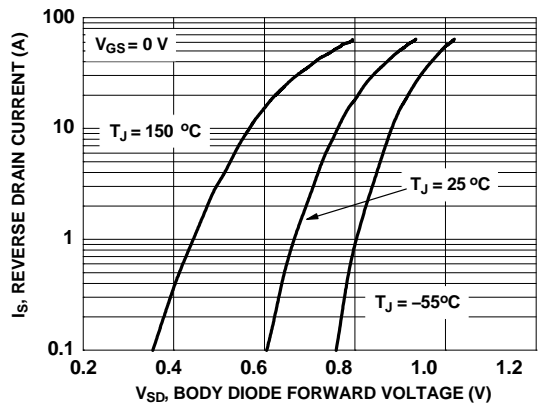


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

# FDS8840NZ

## TYPICAL CHARACTERISTICS

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

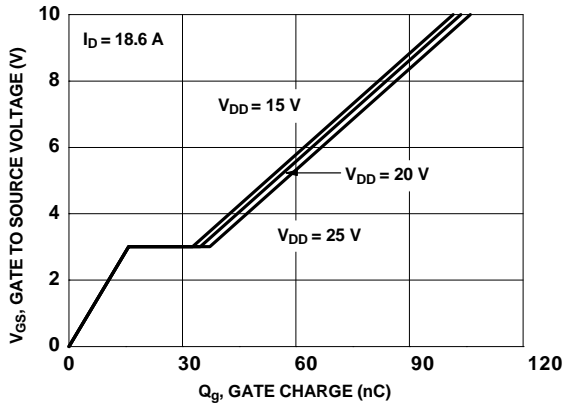


Figure 7. Gate Charge Characteristics

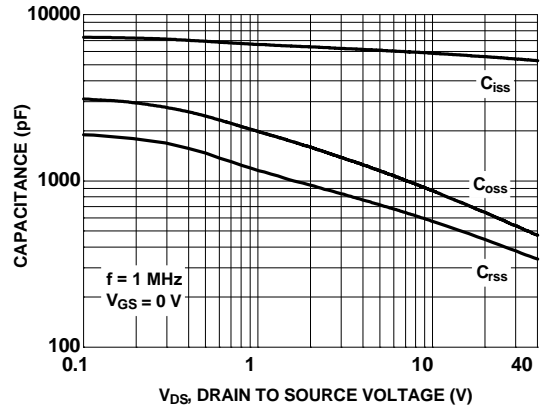


Figure 8. Capacitance vs Drain to Source Voltage

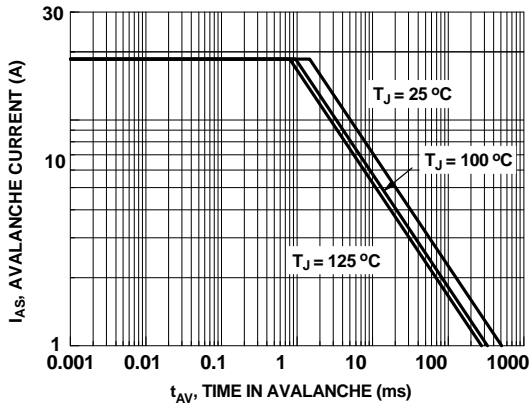


Figure 9. Unclamped Inductive Switching Capability

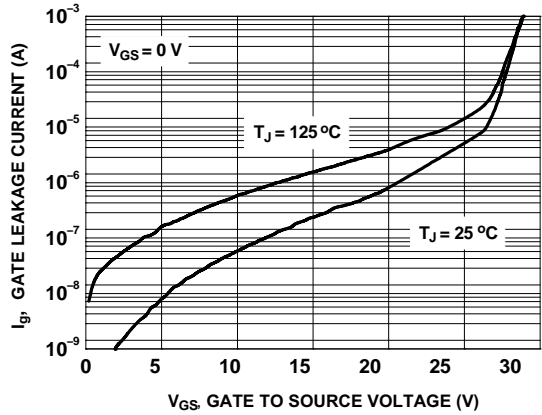


Figure 10.  $I_{GSS}$  vs  $V_{GS}$

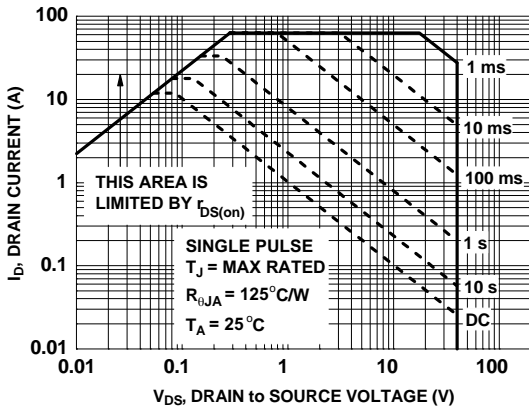


Figure 11. Forward Bias Safe Operating Area

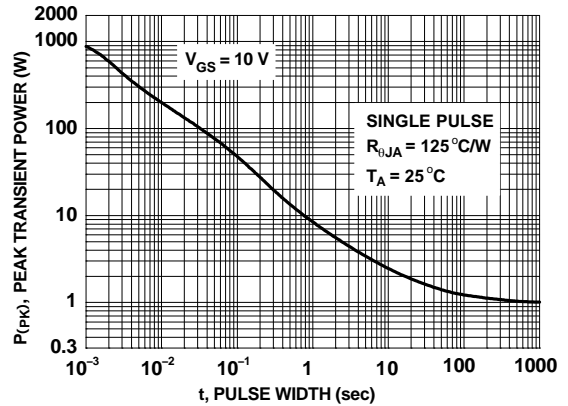


Figure 12. Single Pulse Maximum Power Dissipation

# FDS8840NZ

## TYPICAL CHARACTERISTICS

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

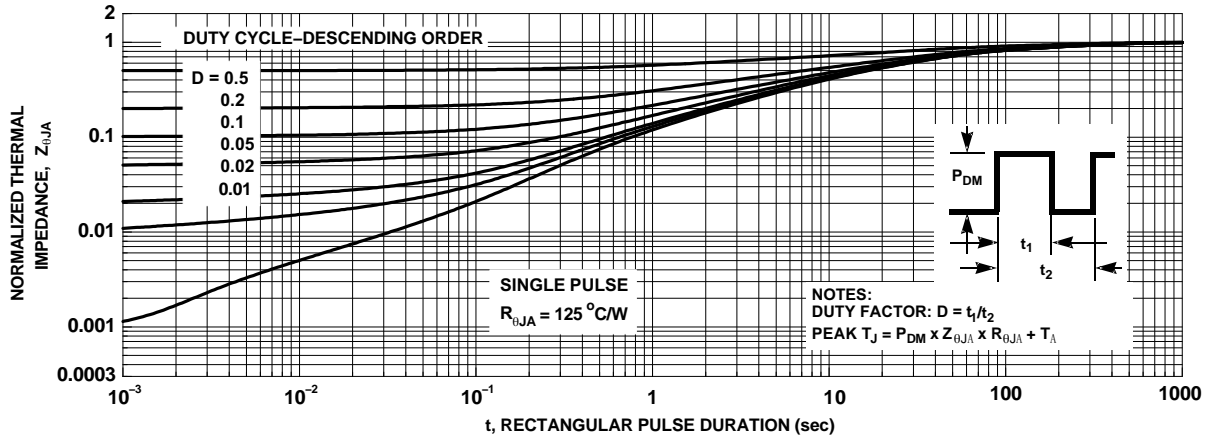


Figure 13. Transient Thermal Response Curve

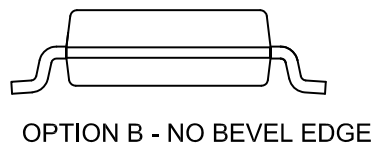
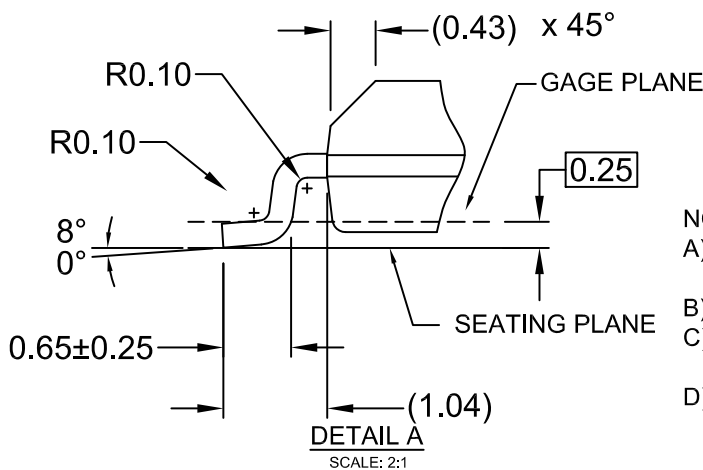
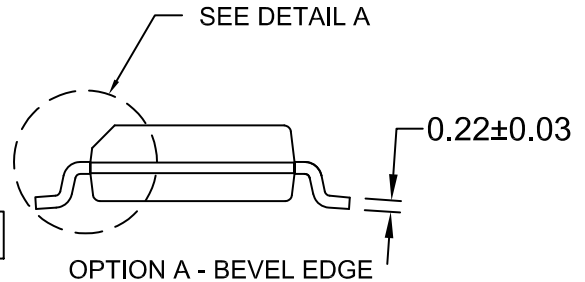
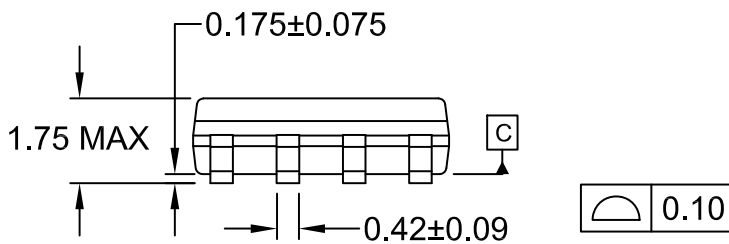
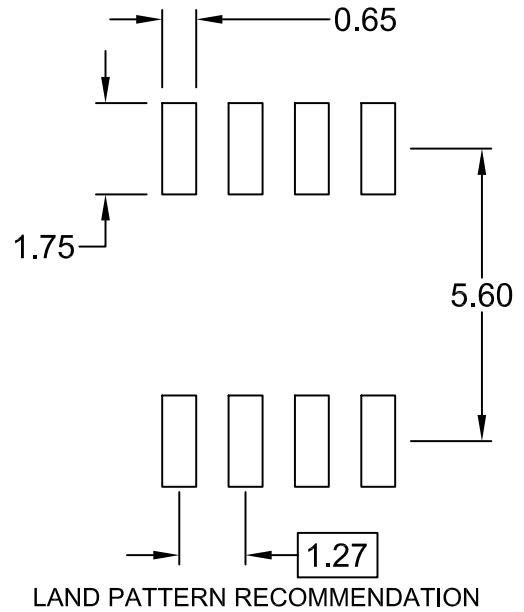
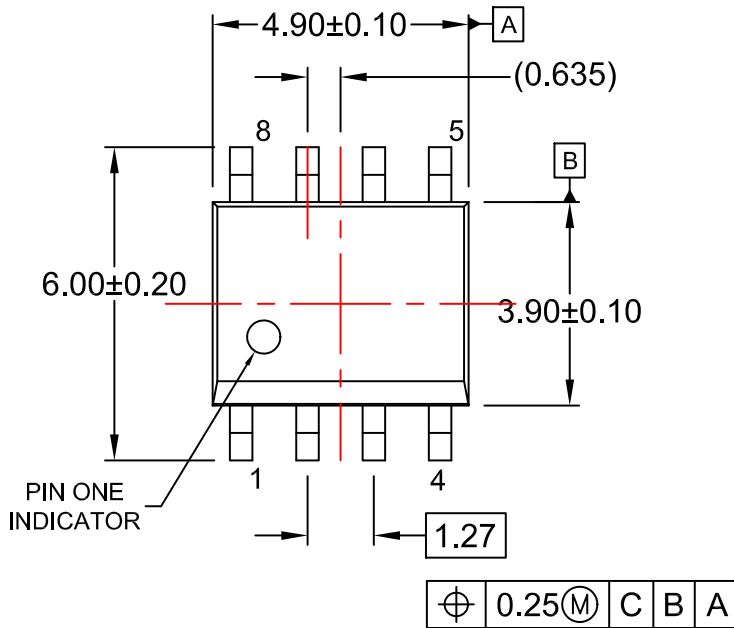
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

ON Semiconductor®



**SOIC8**  
**CASE 751EB**  
**ISSUE A**

DATE 24 AUG 2017



- NOTES:  
 A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AA.  
 B) ALL DIMENSIONS ARE IN MILLIMETERS.  
 C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.  
 D) LANDPATTERN STANDARD: SOIC127P600X175-8M

|                         |                    |  |
|-------------------------|--------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13735G</b> | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>SOIC8</b>       | <b>PAGE 1 OF 1</b>   |

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

**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)