

# NTF5P03, NVF5P03

## MOSFET – Power, P-Channel, SOT-223

**-5.2 A, -30 V**

### Features

- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Miniature SOT-223 Surface Mount Package
- Avalanche Energy Specified
- AEC-Q101 Qualified and PPAP Capable – NVF5P03T3G
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- DC-DC Converters
- Power Management
- Motor Controls
- Inductive Loads
- Replaces MMFT5P03HD

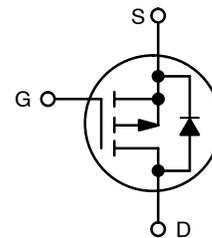


**ON Semiconductor®**

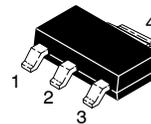
<http://onsemi.com>

**-5.2 AMPERES, -30 VOLTS**

**$R_{DS(on)} = 100 \text{ m}\Omega$**

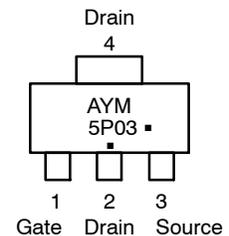


**P-Channel MOSFET**



**SOT-223  
CASE 318E  
STYLE 3**

### MARKING DIAGRAM & PIN ASSIGNMENT



- A = Assembly Location
- Y = Year
- M = Date Code
- 5P03 = Specific Device Code
- = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device     | Package              | Shipping†             |
|------------|----------------------|-----------------------|
| NTF5P03T3G | SOT-223<br>(Pb-Free) | 4000 / Tape &<br>Reel |
| NVF5P03T3G | SOT-223<br>(Pb-Free) | 4000 / Tape &<br>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.

## NTF5P03, NVF5P03

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

Negative sign for P-Channel devices omitted for clarity

| Rating  |   | Symbol         | Max         | Unit                       |
|---|---|----------------|-------------|----------------------------|
| Drain-to-Source Voltage   |   | $V_{DSS}$      | -30         | V                          |
| Drain-to-Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )   |   | $V_{DGR}$      | -30         | V                          |
| Gate-to-Source Voltage - Continuous   |   | $V_{GS}$       | $\pm 20$    | V                          |
| 1 sq in<br>FR-4 or G-10 PCB<br><br>10 seconds   | Thermal Resistance - Junction to Ambient              | $R_{THJA}$     | 40          | $^\circ\text{C}/\text{W}$  |
|   | Total Power Dissipation @ $T_A = 25^\circ\text{C}$    | $P_D$          | 3.13        | Watts                      |
|   | Linear Derating Factor                                |                | 25          | $\text{mW}/^\circ\text{C}$ |
|   | Drain Current - Continuous @ $T_A = 25^\circ\text{C}$ | $I_D$          | -5.2        | A                          |
| 10 seconds  | Continuous @ $T_A = 70^\circ\text{C}$                 | $I_D$          | -4.1        | A                          |
|   | Pulsed Drain Current (Note 1)                         | $I_{DM}$       | -26         | A                          |
|   | Thermal Resistance - Junction to Ambient              | $R_{THJA}$     | 80          | $^\circ\text{C}/\text{W}$  |
| Minimum<br>FR-4 or G-10 PCB<br><br>10 seconds   | Total Power Dissipation @ $T_A = 25^\circ\text{C}$    | $P_D$          | 1.56        | Watts                      |
|   | Linear Derating Factor                                |                | 12.5        | $\text{mW}/^\circ\text{C}$ |
|   | Drain Current - Continuous @ $T_A = 25^\circ\text{C}$ | $I_D$          | -3.7        | A                          |
|   | Continuous @ $T_A = 70^\circ\text{C}$                 | $I_D$          | -2.9        | A                          |
| 10 seconds  | Pulsed Drain Current (Note 1)                         | $I_{DM}$       | -19         | A                          |
|   | Operating and Storage Temperature Range               | $T_J, T_{stg}$ | - 55 to 150 | $^\circ\text{C}$           |
| Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$<br>( $V_{DD} = -30\text{ Vdc}$ , $V_{GS} = -10\text{ Vdc}$ , Peak $I_L = -12\text{ Apk}$ , $L = 3.5\text{ mH}$ , $R_G = 25\ \Omega$ ) |   | $E_{AS}$       | 250         | mJ                         |

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. Repetitive rating; pulse width limited by maximum junction temperature.

# NTF5P03, NVF5P03

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

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

### OFF CHARACTERISTICS

|   |                      |     |     |       |       |
|---|----------------------|-----|-----|-------|-------|
| Drain-to-Source Breakdown Voltage (Cpk ≥ 2.0) (Notes 2 and 4)<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = -250 μAdc)<br>Temperature Coefficient (Positive)            | V <sub>(BR)DSS</sub> | -30 | -   | -     | Vdc   |
|   |                      | -   | -28 | -     | mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = -24 Vdc, V <sub>GS</sub> = 0 Vdc)<br>(V <sub>DS</sub> = -24 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C) | I <sub>DSS</sub>     | -   | -   | -1.0  | μAdc  |
|   |                      | -   | -   | -25   |       |
| Gate-Body Leakage Current<br>(V <sub>GS</sub> = ± 20 Vdc, V <sub>DS</sub> = 0 Vdc)  | I <sub>GSS</sub>     | -   | -   | ± 100 | nAdc  |

### ON CHARACTERISTICS (Note 2)

|   |                     |      |       |      |       |
|---|---------------------|------|-------|------|-------|
| Gate Threshold Voltage (Cpk ≥ 2.0) (Notes 2 and 4)<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μAdc)<br>Threshold Temperature Coefficient (Negative)                | V <sub>GS(th)</sub> | -1.0 | -1.75 | -3.0 | Vdc   |
|   |                     | -    | 3.5   | -    | mV/°C |
| Static Drain-to-Source On-Resistance (Cpk ≥ 2.0) (Notes 2 and 4)<br>(V <sub>GS</sub> = -10 Vdc, I <sub>D</sub> = -5.2 Adc)<br>(V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -2.6 Adc) | R <sub>DS(on)</sub> | -    | 76    | 100  | mΩ    |
|   |                     |      | 107   | 150  |       |
| Forward Transconductance (Note 2)<br>(V <sub>DS</sub> = -15 Vdc, I <sub>D</sub> = -2.0 Adc)   | g <sub>fs</sub>     | 2.0  | 3.9   | -    | Mhos  |

### DYNAMIC CHARACTERISTICS

|                      |  |                  |   |     |     |    |
|----------------------|--|------------------|---|-----|-----|----|
| Input Capacitance    | (V <sub>DS</sub> = -25 Vdc, V <sub>GS</sub> = 0 V,<br>f = 1.0 MHz) | C <sub>iss</sub> | - | 500 | 950 | pF |
| Output Capacitance   |  | C <sub>oss</sub> | - | 153 | 440 |    |
| Transfer Capacitance |  | C <sub>rss</sub> | - | 58  | 140 |    |

### SWITCHING CHARACTERISTICS (Note 3)

|                     |  |                     |   |     |     |    |
|---------------------|--|---------------------|---|-----|-----|----|
| Turn-On Delay Time  | (V <sub>DD</sub> = -15 Vdc, I <sub>D</sub> = -4.0 Adc,<br>V <sub>GS</sub> = -10 Vdc,<br>R <sub>G</sub> = 6.0 Ω) (Note 2) | t <sub>d(on)</sub>  | - | 10  | 24  | ns |
| Rise Time           |  | t <sub>r</sub>      | - | 33  | 48  |    |
| Turn-Off Delay Time |  | t <sub>d(off)</sub> | - | 38  | 94  |    |
| Fall Time           |  | t <sub>f</sub>      | - | 20  | 92  |    |
| Turn-On Delay Time  | (V <sub>DD</sub> = -15 Vdc, I <sub>D</sub> = -2.0 Adc,<br>V <sub>GS</sub> = -10 Vdc,<br>R <sub>G</sub> = 6.0 Ω) (Note 2) | t <sub>d(on)</sub>  | - | 16  | 38  | ns |
| Rise Time           |  | t <sub>r</sub>      | - | 45  | 110 |    |
| Turn-Off Delay Time |  | t <sub>d(off)</sub> | - | 23  | 60  |    |
| Fall Time           |  | t <sub>f</sub>      | - | 24  | 80  |    |
| Gate Charge         | (V <sub>DS</sub> = -24 Vdc, I <sub>D</sub> = -4.0 Adc,<br>V <sub>GS</sub> = -10 Vdc) (Note 2)                            | Q <sub>T</sub>      | - | 15  | 38  | nC |
|                     |  | Q <sub>1</sub>      | - | 1.6 | -   |    |
|                     |  | Q <sub>2</sub>      | - | 3.5 | -   |    |
|                     |  | Q <sub>3</sub>      | - | 2.6 | -   |    |

### SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |  |                 |   |       |      |     |
|--------------------------------|--|-----------------|---|-------|------|-----|
| Forward On-Voltage             | (I <sub>S</sub> = -4.0 Adc, V <sub>GS</sub> = 0 Vdc)<br>(I <sub>S</sub> = -4.0 Adc, V <sub>GS</sub> = 0 Vdc,<br>T <sub>J</sub> = 125°C) (Note 2) | V <sub>SD</sub> | - | -1.1  | -1.5 | Vdc |
|                                |  |                 | - | -0.89 | -    |     |
| Reverse Recovery Time          | (I <sub>S</sub> = -4.0 Adc, V <sub>GS</sub> = 0 Vdc,<br>di <sub>S</sub> /dt = 100 A/μs) (Note 2)   | t <sub>rr</sub> | - | 34    | -    | ns  |
|                                |  | t <sub>a</sub>  | - | 20    | -    |     |
|                                |  | t <sub>b</sub>  | - | 14    | -    |     |
| Reverse Recovery Stored Charge |  | Q <sub>RR</sub> | - | 0.036 | -    | μC  |

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
3. Switching characteristics are independent of operating junction temperatures.
4. Reflects typical values.

$$C_{pk} = \left| \frac{\text{Max limit} - \text{Typ}}{3 \times \text{SIGMA}} \right|$$

TYPICAL ELECTRICAL CHARACTERISTICS

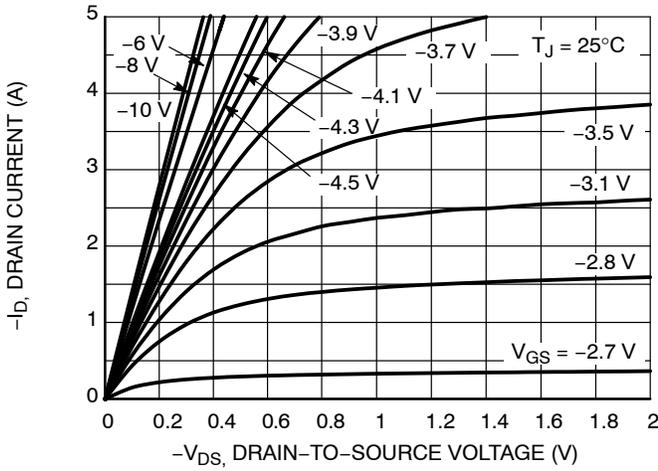


Figure 1. On-Region Characteristics

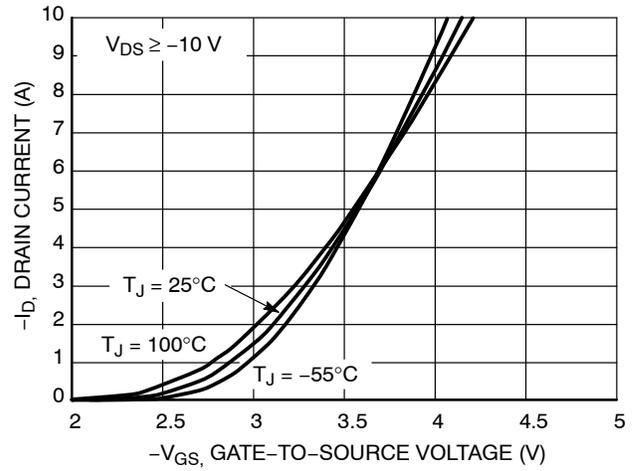


Figure 2. Transfer Characteristics

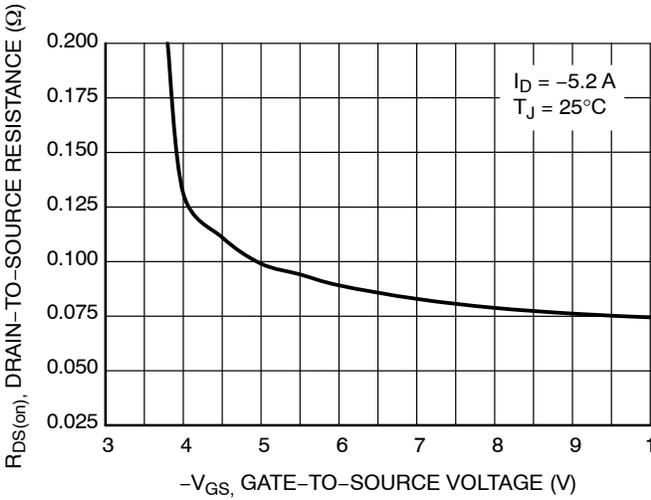


Figure 3. On-Resistance versus Gate-to-Source Voltage

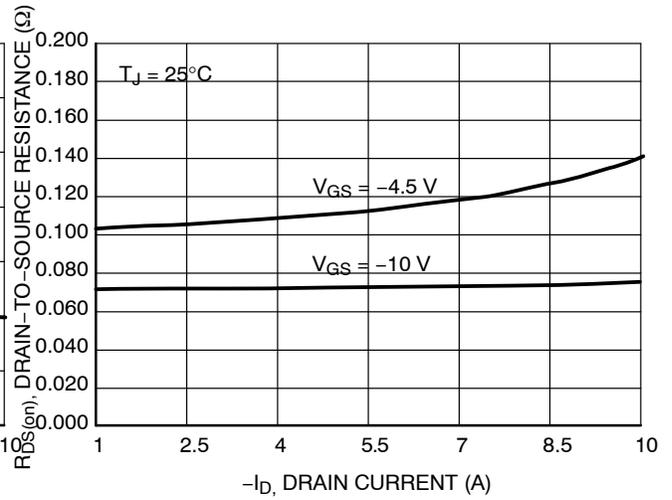


Figure 4. On-Resistance versus Drain Current and Gate Voltage

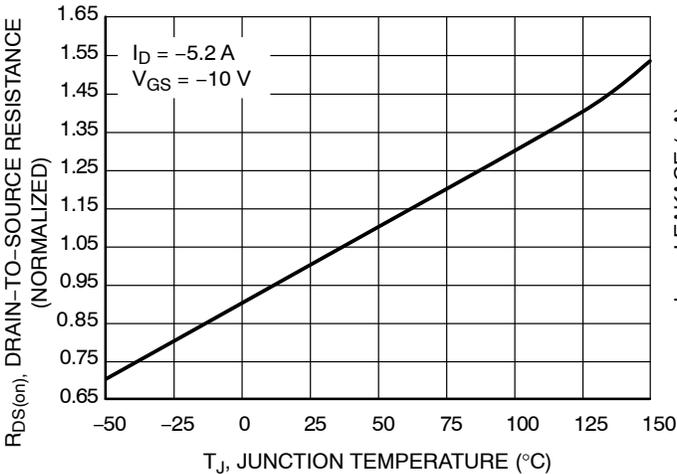


Figure 5. On-Resistance Variation with Temperature

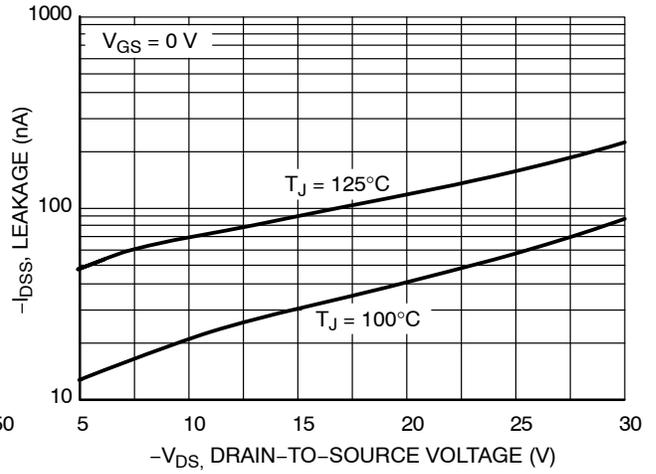


Figure 6. Drain-to-Source Leakage Current versus Voltage

# NTF5P03, NVF5P03

## TYPICAL ELECTRICAL CHARACTERISTICS

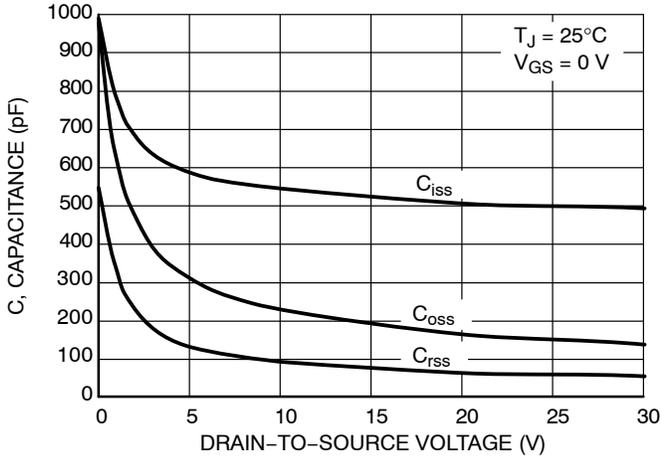


Figure 7. Capacitance Variation

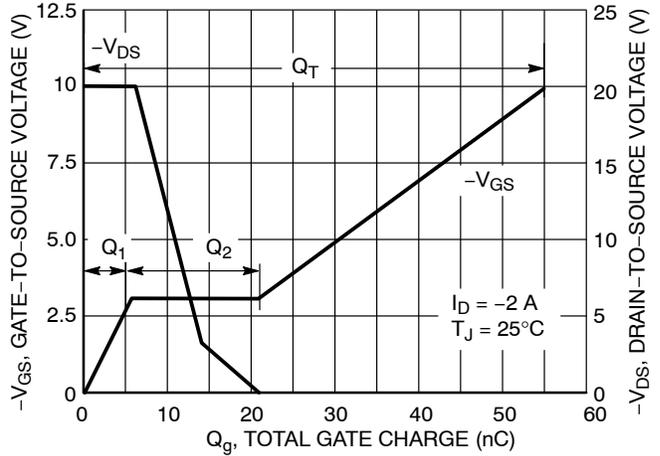


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

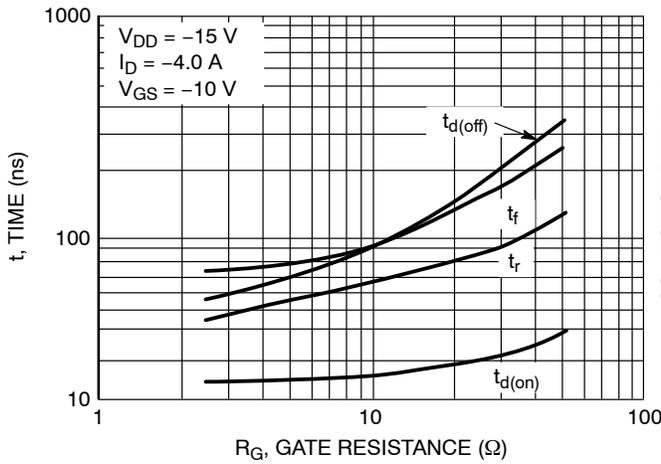


Figure 9. Resistive Switching Time Variation versus Gate Resistance

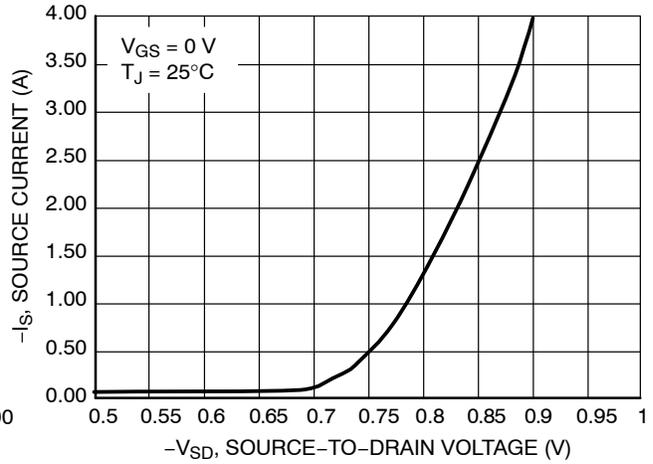
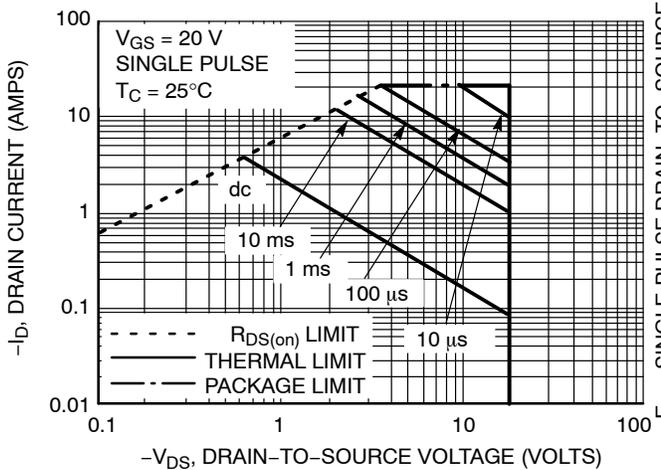


Figure 10. Diode Forward Voltage versus Current



Mounted on 2"sq. FR4 board (1"sq. 2 oz. Cu 0.06" thick single sided) with on die operating, 10 s max.

Figure 11. Maximum Rated Forward Biased Safe Operating Area

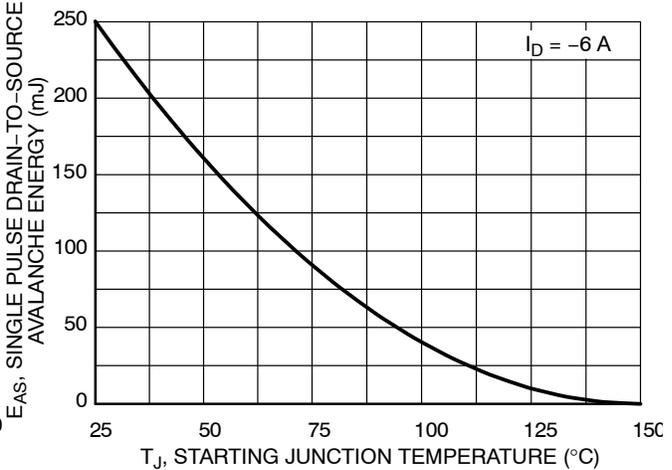


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

# NTF5P03, NVF5P03

## TYPICAL ELECTRICAL CHARACTERISTICS

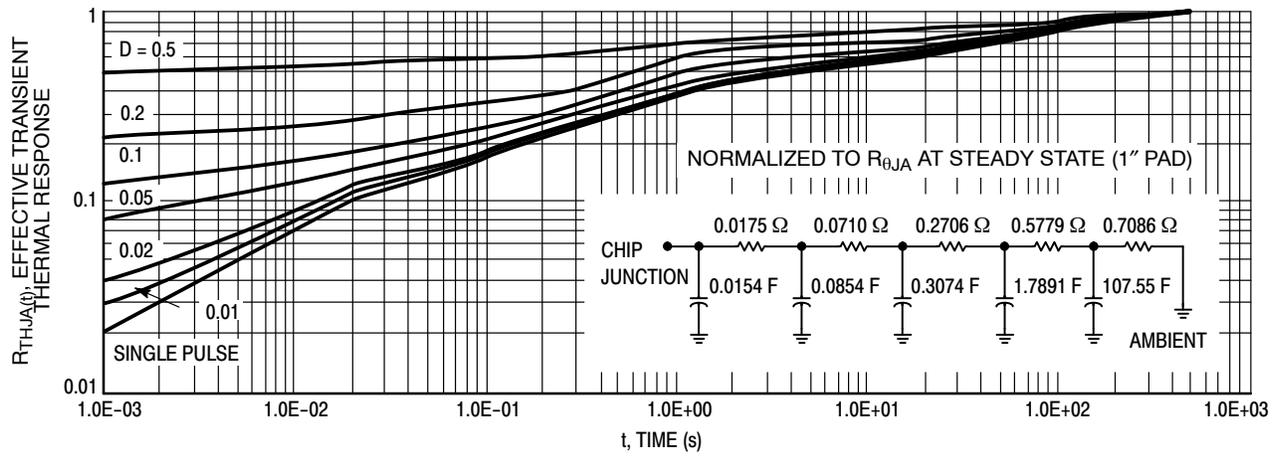


Figure 13. FET Thermal Response

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

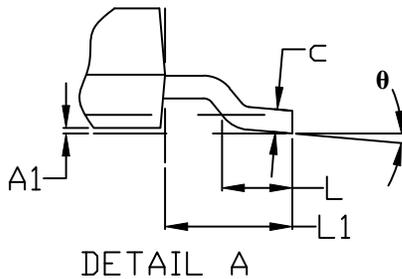
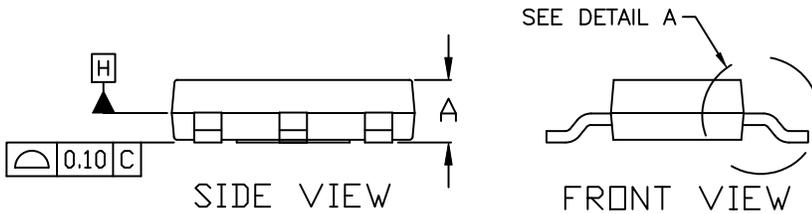
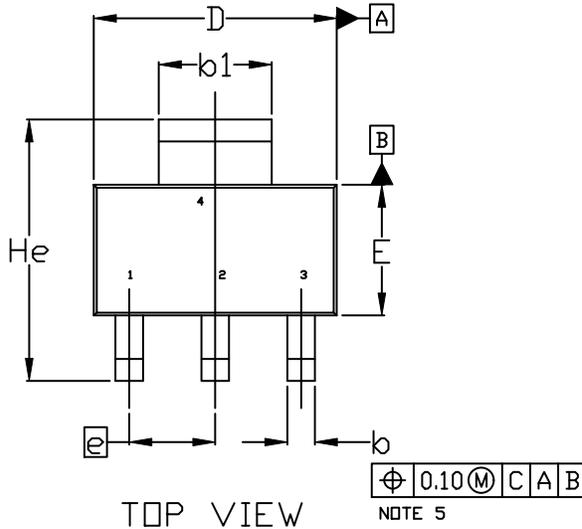
ON Semiconductor®



SCALE 1:1

SOT-223 (TO-261)  
CASE 318E-04  
ISSUE R

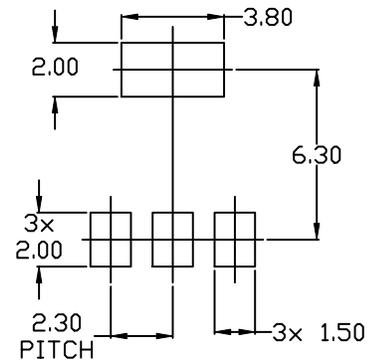
DATE 02 OCT 2018



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.200MM PER SIDE.
4. DATUMS A AND B ARE DETERMINED AT DATUM H.
5. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
6. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

| MILLIMETERS |          |      |      |
|-------------|----------|------|------|
| DIM         | MIN.     | NOM. | MAX. |
| A           | 1.50     | 1.63 | 1.75 |
| A1          | 0.02     | 0.06 | 0.10 |
| b           | 0.60     | 0.75 | 0.89 |
| b1          | 2.90     | 3.06 | 3.20 |
| c           | 0.24     | 0.29 | 0.35 |
| D           | 6.30     | 6.50 | 6.70 |
| E           | 3.30     | 3.50 | 3.70 |
| e           | 2.30 BSC |      |      |
| L           | 0.20     | ---  | ---  |
| L1          | 1.50     | 1.75 | 2.00 |
| He          | 6.70     | 7.00 | 7.30 |
| θ           | 0°       | ---  | 10°  |



|                  |                  |  |
|------------------|------------------|--|
| DOCUMENT NUMBER: | 98ASB42680B      | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | SOT-223 (TO-261) | PAGE 1 OF 2  |

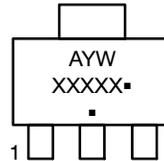
ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, 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.

**SOT-223 (TO-261)**  
**CASE 318E-04**  
**ISSUE R**

DATE 02 OCT 2018

- |  |   |   |   |   |
|--|---|---|---|---|
| <b>STYLE 1:</b><br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | <b>STYLE 2:</b><br>PIN 1. ANODE<br>2. CATHODE<br>3. NC<br>4. CATHODE        | <b>STYLE 3:</b><br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN           | <b>STYLE 4:</b><br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE<br>4. DRAIN   | <b>STYLE 5:</b><br>PIN 1. DRAIN<br>2. GATE<br>3. SOURCE<br>4. GATE    |
| <b>STYLE 6:</b><br>PIN 1. RETURN<br>2. INPUT<br>3. OUTPUT<br>4. INPUT        | <b>STYLE 7:</b><br>PIN 1. ANODE 1<br>2. CATHODE<br>3. ANODE 2<br>4. CATHODE | <b>STYLE 8:</b><br>CANCELLED  | <b>STYLE 9:</b><br>PIN 1. INPUT<br>2. GROUND<br>3. LOGIC<br>4. GROUND | <b>STYLE 10:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE<br>4. ANODE |
| <b>STYLE 11:</b><br>PIN 1. MT 1<br>2. MT 2<br>3. GATE<br>4. MT 2             | <b>STYLE 12:</b><br>PIN 1. INPUT<br>2. OUTPUT<br>3. NC<br>4. OUTPUT         | <b>STYLE 13:</b><br>PIN 1. GATE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR |   |   |

**GENERIC  
 MARKING DIAGRAM\***



- A = Assembly Location
- Y = Year
- W = Work Week
- XXXXX = Specific Device Code
- = Pb-Free Package

(Note: Microdot may be in either location)

\*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.

|                         |                         |   |
|-------------------------|-------------------------|---|
| <b>DOCUMENT NUMBER:</b> | <b>98ASB42680B</b>      | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>SOT-223 (TO-261)</b> | <b>PAGE 2 OF 2</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.

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 owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor'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). 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. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor 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 ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor 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 ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

### TECHNICAL SUPPORT

North American Technical Support:  
Voice Mail: 1 800-282-9855 Toll Free USA/Canada  
Phone: 011 421 33 790 2910

### Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative