

# NTF6P02, NVF6P02

## MOSFET – Power, P-Channel, SOT-223

**-10 A, -20 V**

### Features

- Low  $R_{DS(on)}$
- Logic Level Gate Drive
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- NVF Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable\*
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

- Power Management in Portables and Battery-Powered Products, i.e.: Cellular and Cordless Telephones and PCMCIA Cards

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DS}$	-20	Vdc
Gate-to-Source Voltage	$V_{GS}$	$\pm 8.0$	Vdc
Drain Current (Note 1) <ul style="list-style-type: none"><li>- Continuous @ <math>T_A = 25^\circ\text{C}</math></li><li>- Continuous @ <math>T_A = 70^\circ\text{C}</math></li><li>- Single Pulse (<math>t_p = 10 \mu\text{s}</math>)</li></ul>	$I_D$ $I_D$ $I_{DM}$	-10 -8.4 -35	Adc Adc Apk
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	8.3	W
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = -20 \text{ Vdc}$ , $V_{GS} = -5.0 \text{ Vdc}$ , $I_{L(pk)} = -10 \text{ A}$ , $L = 3.0 \text{ mH}$ , $R_G = 25\Omega$ )	$E_{AS}$	150	mJ
Thermal Resistance <ul style="list-style-type: none"><li>- Junction to Lead (Note 1)</li><li>- Junction to Ambient (Note 2)</li><li>- Junction to Ambient (Note 3)</li></ul>	$R_{\theta JL}$ $R_{\theta JA}$ $R_{\theta JA}$	15 71.4 160	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

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.

1. Steady State.
2. When surface mounted to an FR4 board using 1" pad size, (Cu. Area 1.127 sq in), Steady State.
3. When surface mounted to an FR4 board using minimum recommended pad size, (Cu. Area 0.412 sq in), Steady State.



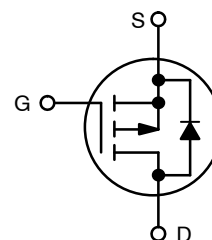
**ON Semiconductor®**

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

**-10 AMPERES**

**-20 VOLTS**

**$R_{DS(on)} = 44 \text{ m}\Omega$  (Typ.)**

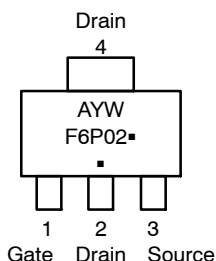


**P-Channel MOSFET**

### MARKING DIAGRAM & PIN ASSIGNMENT



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



A = Assembly Location  
Y = Year  
W = Work Week  
F6P02 = Specific Device Code  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

Device	Package	Shipping†
NTF6P02T3G	SOT-223 (Pb-Free)	4000 / Tape & Reel
NVF6P02T3G*	SOT-223 (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.

# NTF6P02, NVF6P02

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

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

### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 4) (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = -250 µAdc)	V <sub>(BR)DSS</sub>	-20	-25	-	Vdc
Temperature Coefficient (Positive)		-	-11	-	mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = -20 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = -20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	-	-	-1.0 -10	µAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ± 8.0 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	-	-	± 100	nAdc

### ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage (Note 4) (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 µAdc)	V <sub>GS(th)</sub>	-0.4	-0.7	-1.0	Vdc
Threshold Temperature Coefficient (Negative)		-	2.6	-	mV/°C
Static Drain-to-Source On-Resistance (Note 4) (V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -6.0 Adc) (V <sub>GS</sub> = -2.5 Vdc, I <sub>D</sub> = -4.0 Adc) (V <sub>GS</sub> = -2.5 Vdc, I <sub>D</sub> = -3.0 Adc)	R <sub>DS(on)</sub>	-	44 57 57	50 70 -	mΩ
Forward Transconductance (Note 4) (V <sub>DS</sub> = -10 Vdc, I <sub>D</sub> = -6.0 Adc)	g <sub>fs</sub>	-	12	-	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = -16 Vdc, V <sub>GS</sub> = 0 V, f = 1.0 MHz)	C <sub>iss</sub>	-	900	1200	pF
Output Capacitance		C <sub>oss</sub>	-	350	500	
Transfer Capacitance		C <sub>rss</sub>	-	90	150	
Input Capacitance	(V <sub>DS</sub> = -10 Vdc, V <sub>GS</sub> = 0 V, f = 1.0 MHz)	C <sub>iss</sub>	-	940	-	pF
Output Capacitance		C <sub>oss</sub>	-	410	-	
Transfer Capacitance		C <sub>rss</sub>	-	110	-	

### SWITCHING CHARACTERISTICS (Note 5)

Turn-On Delay Time	(V <sub>DD</sub> = -5.0 Vdc, I <sub>D</sub> = -1.0 Adc, V <sub>GS</sub> = -4.5 Vdc, R <sub>G</sub> = 6.0 Ω)	t <sub>d(on)</sub>	-	7.0	12	ns
Rise Time		t <sub>r</sub>	-	25	45	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	75	125	
Fall Time		t <sub>f</sub>	-	50	85	
Turn-On Delay Time	(V <sub>DD</sub> = -16 Vdc, I <sub>D</sub> = -6.0 Adc, V <sub>GS</sub> = -4.5 Vdc, R <sub>G</sub> = 2.5 Ω)	t <sub>d(on)</sub>	-	8.0	-	ns
Rise Time		t <sub>r</sub>	-	30	-	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	60	-	
Fall Time		t <sub>f</sub>	-	60	-	
Gate Charge	(V <sub>DS</sub> = -16 Vdc, I <sub>D</sub> = -6.0 Adc, V <sub>GS</sub> = -4.5 Vdc) (Note 4)	Q <sub>T</sub>	-	15	20	nC
		Q <sub>gs</sub>	-	1.7	-	
		Q <sub>gd</sub>	-	6.0	-	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	(I <sub>S</sub> = -3.0 Adc, V <sub>GS</sub> = 0 Vdc) (Note 4) (I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = -3.0 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	-	-0.82 -0.74 -0.68	-1.2 - -	Vdc
Reverse Recovery Time	(I <sub>S</sub> = -3.0 Adc, V <sub>GS</sub> = 0 Vdc, dI <sub>S</sub> /dt = 100 A/µs) (Note 4)	t <sub>rr</sub>	-	42	-	ns
		t <sub>a</sub>	-	17	-	
		t <sub>b</sub>	-	25	-	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	-	0.036	-	µC

4. Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

5. Switching characteristics are independent of operating junction temperatures.

TYPICAL ELECTRICAL CHARACTERISTICS

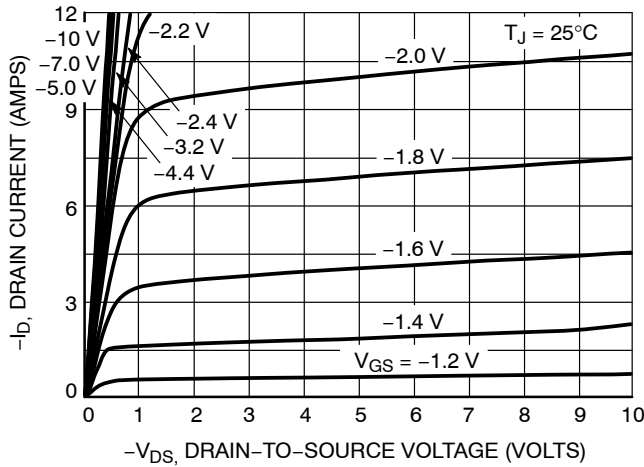


Figure 1. On-Region Characteristics

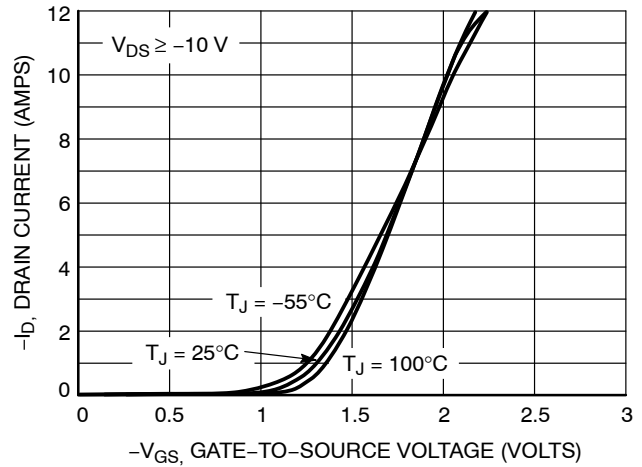


Figure 2. Transfer Characteristics

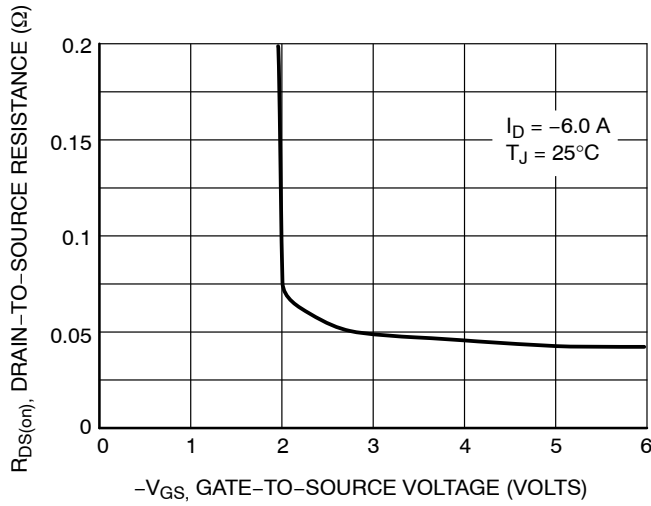


Figure 3. On-Resistance versus Gate-to-Source Voltage

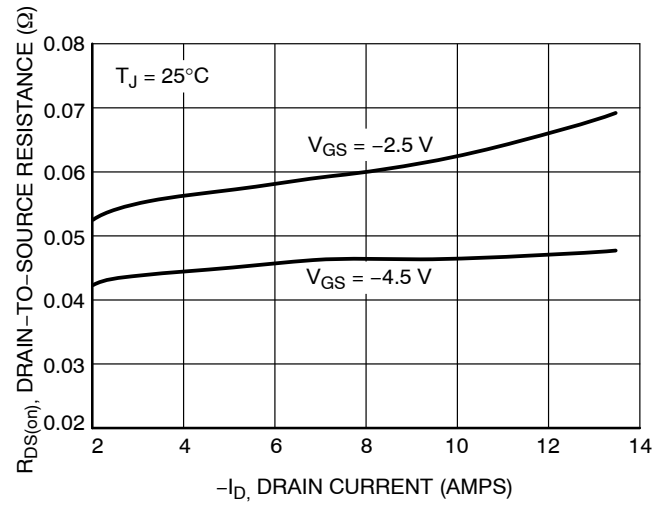


Figure 4. On-Resistance versus Drain Current and Gate Voltage

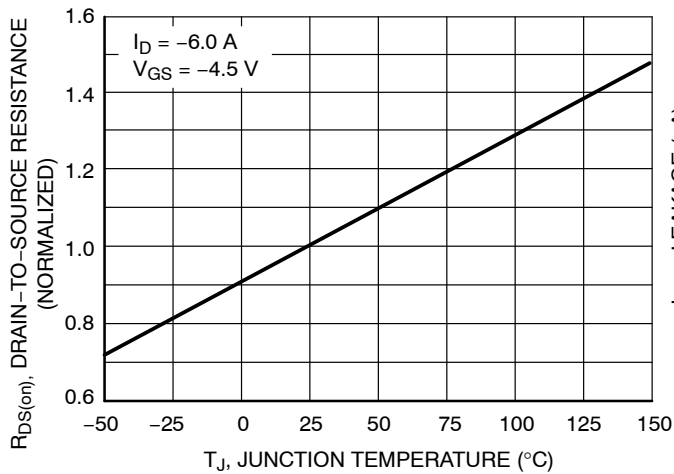


Figure 5. On-Resistance Variation with Temperature

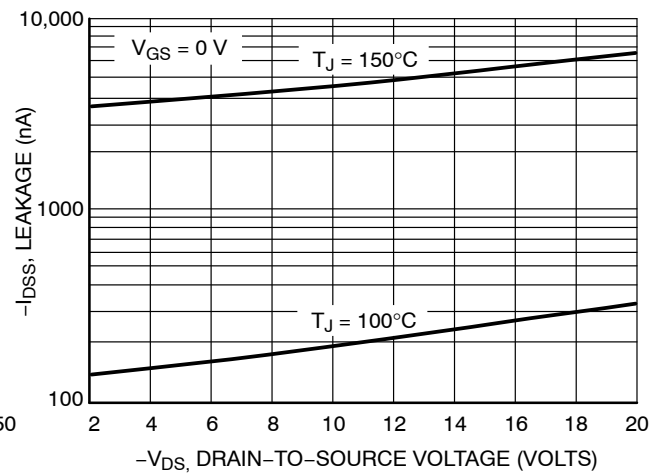


Figure 6. Drain-to-Source Leakage Current versus Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

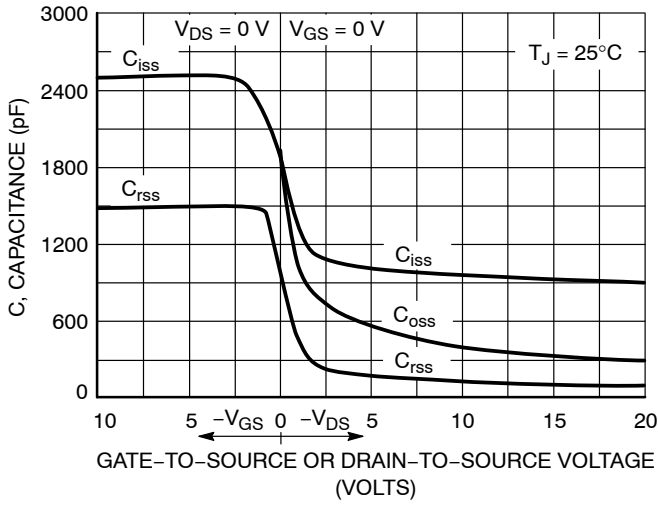


Figure 7. Capacitance Variation

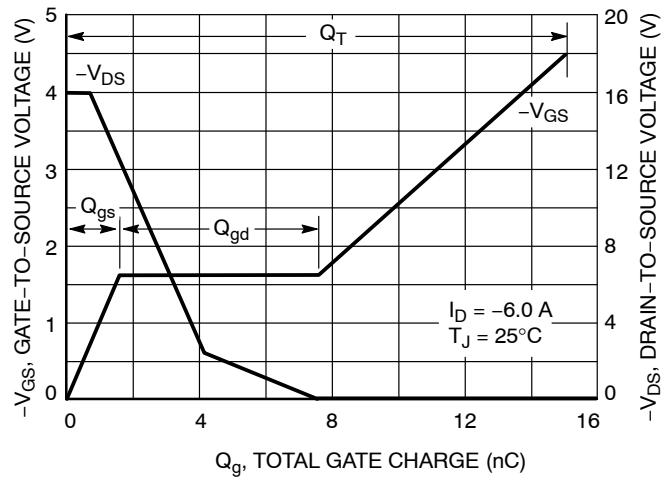


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

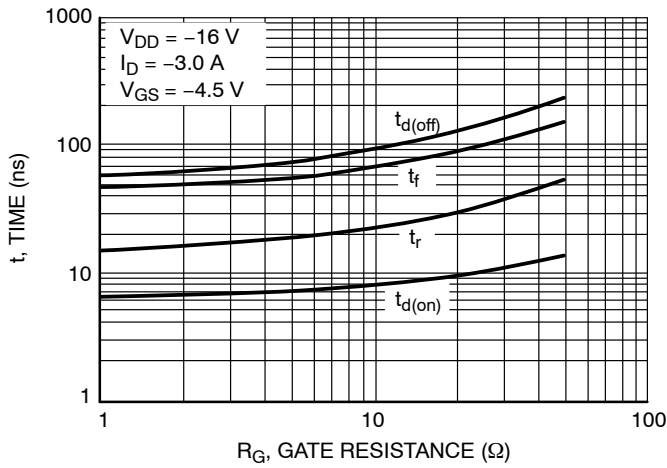


Figure 9. Resistive Switching Time Variation versus Gate Resistance

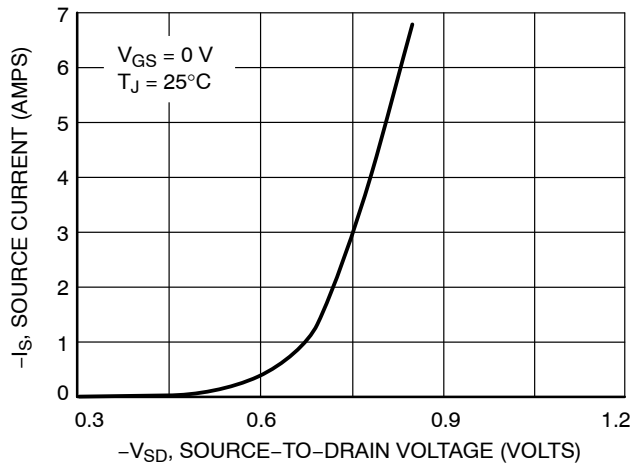


Figure 10. Diode Forward Voltage versus Current

# NTF6P02, NVF6P02

## TYPICAL ELECTRICAL CHARACTERISTICS

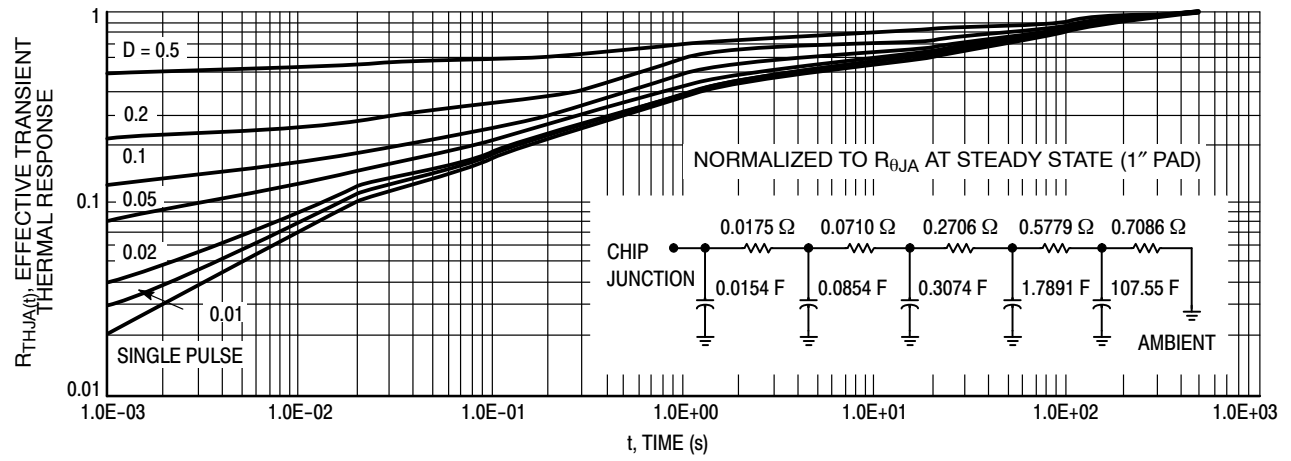


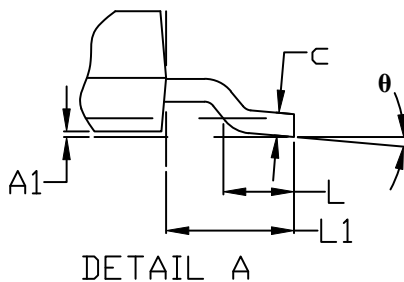
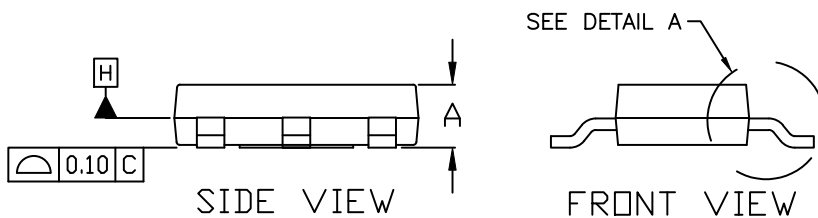
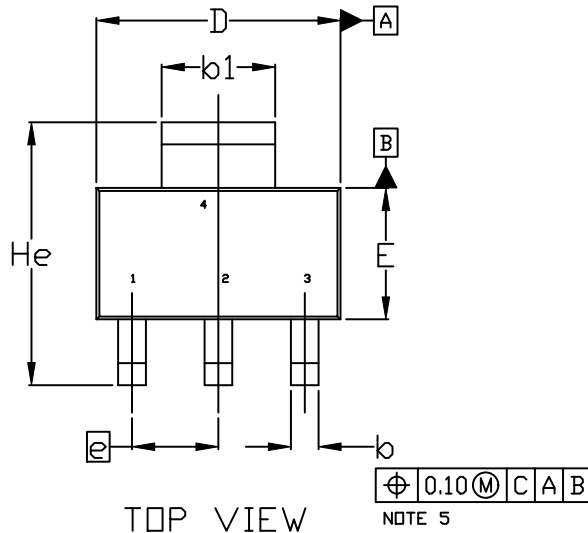
Figure 11. FET Thermal Response



SCALE 1:1

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

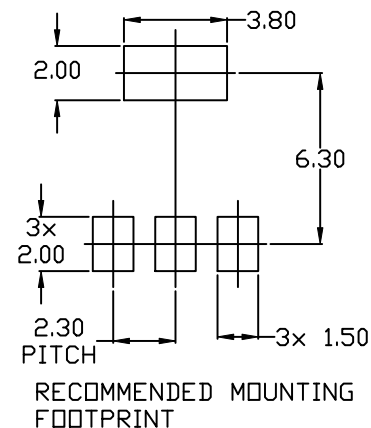
DATE 02 OCT 2018



**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°



<b>DOCUMENT NUMBER:</b>	<b>98ASB42680B</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>SOT-223 (TO-261)</b>	<b>PAGE 1 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.

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

DATE 02 OCT 2018

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

**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)