

# MOSFET - Single N-Channel

## 100 V, 9.0 mΩ, 60 A

### NTBS9D0N10MC

#### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- Lowers Switching Noise/EMI
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Typical Applications

- Power Tools, Battery Operated Vacuums
- UAV/Drones, Material Handling
- BMS/Storage, Home Automation

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

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DSS}$	100	V	
Gate-to-Source Voltage		$V_{GS}$	$\pm 20$	V	
Continuous Drain Current $R_{\theta JC}$ (Note 2)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	60	A
Power Dissipation $R_{\theta JC}$ (Note 2)			$P_D$	68	W
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	14	A
Power Dissipation $R_{\theta JA}$ (Notes 1, 2)			$P_D$	3.8	W
Pulsed Drain Current	$T_C = 25^\circ\text{C}$ , $t_p = 100 \mu\text{s}$	$I_{DM}$	239	A	
Operating Junction and Storage Temperature Range		$T_J$ , $T_{stg}$	-55 to +175	°C	
Source Current (Body Diode)		$I_S$	57	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_L = 11 \text{ A}_{pk}$ , $L = 3 \text{ mH}$ )		$E_{AS}$	181.5	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	260	°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.

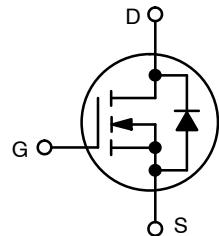
1. Surface-mounted on FR4 board using a 1 in<sup>2</sup>, 2 oz. Cu pad.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.



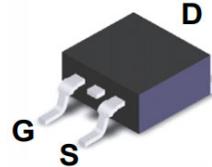
**ON Semiconductor®**

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

$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
100 V	9.0 mΩ @ 10 V	60 A



N-CHANNEL MOSFET



**MARKING DIAGRAM**  
D  
AYWWZZ  
NTBS9D0  
N10MC  
CASE 418AJ

A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Lot Traceability  
NTBS9D0N10MC = Specific Device Code

#### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTBS9D0N10MC	D <sup>2</sup> PAK (Pb-Free)	800 / 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 Specifications Brochure, BRD8011/D.

# NTBS9D0N10MC

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case – Steady State (Note 2)	$R_{\theta JC}$	2.2	°C/W
Junction-to-Ambient – Steady State (Notes 1, 2)	$R_{\theta JA}$	40	

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(\text{BR})\text{DSS}}$	$V_{\text{GS}} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$	100			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(\text{BR})\text{DSS}/T_J}$	$I_D = 250 \mu\text{A}$ , referenced to $25^\circ\text{C}$		56		$\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{\text{DSS}}$	$V_{\text{GS}} = 0 \text{ V}$ , $V_{\text{DS}} = 80 \text{ V}$	$T_J = 25^\circ\text{C}$		1	$\mu\text{A}$
			$T_J = 150^\circ\text{C}$		100	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{\text{GSS}}$	$V_{\text{GS}} = \pm 20 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$			$\pm 100$	nA

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{\text{GS}(\text{TH})}$	$V_{\text{GS}} = V_{\text{DS}}$ , $I_D = 131 \mu\text{A}$	2.0	3.0	4.0	V
Negative Threshold Temperature Coefficient	$V_{\text{GS}(\text{TH})/T_J}$	$I_D = 131 \mu\text{A}$ , referenced to $25^\circ\text{C}$		-9.6		$\text{mV}/^\circ\text{C}$
Drain-to-Source On Resistance	$R_{\text{DS}(\text{on})}$	$V_{\text{GS}} = 10 \text{ V}$ , $I_D = 23 \text{ A}$		7.8	9.0	$\text{m}\Omega$
		$V_{\text{GS}} = 6 \text{ V}$ , $I_D = 12 \text{ A}$		12	22.2	
Forward Transconductance	$g_{\text{FS}}$	$V_{\text{DS}} = 10 \text{ V}$ , $I_D = 23 \text{ A}$		59		S
Gate-Resistance	$R_G$	$T_A = 25^\circ\text{C}$		0.6		$\Omega$

## CHARGES & CAPACITANCES

Input Capacitance	$C_{\text{ISS}}$	$V_{\text{GS}} = 0 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{\text{DS}} = 50 \text{ V}$		1695		pF
Output Capacitance	$C_{\text{OSS}}$			935		
Reverse Transfer Capacitance	$C_{\text{RSS}}$			13		
Total Gate Charge	$Q_{\text{G}(\text{TOT})}$	$V_{\text{GS}} = 10 \text{ V}$ , $V_{\text{DS}} = 50 \text{ V}$ , $I_D = 23 \text{ A}$		23		nC
Threshold Gate Charge	$Q_{\text{G}(\text{TH})}$			5		
Gate-to-Source Charge	$Q_{\text{GS}}$			8		
Gate-to-Drain Charge	$Q_{\text{GD}}$			5		
Output Charge	$Q_{\text{OSS}}$		$V_{\text{DS}} = 50 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$	59		

## SWITCHING CHARACTERISTICS, $V_{\text{GS}} = 10 \text{ V}$ (Note 3)

Turn-On Delay Time	$t_{\text{d}(\text{ON})}$	$V_{\text{GS}} = 10 \text{ V}$ , $V_{\text{DS}} = 50 \text{ V}$ , $I_D = 23 \text{ A}$ , $R_G = 6 \Omega$		15		ns
Rise Time	$t_r$			6		
Turn-Off Delay Time	$t_{\text{d}(\text{OFF})}$			21		
Fall Time	$t_f$			7		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{\text{SD}}$	$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 23 \text{ A}$ , $T_J = 25^\circ\text{C}$		0.87	1.2	V
		$V_{\text{GS}} = 0 \text{ V}$ , $I_S = 23 \text{ A}$ , $T_J = 150^\circ\text{C}$		0.72		
Reverse Recovery Time	$t_{\text{RR}}$	$V_{\text{GS}} = 0 \text{ V}$ , $dI_S/dt = 300 \text{ A}/\mu\text{s}$ , $I_S = 12 \text{ A}$		29		ns
	$Q_{\text{RR}}$			61		
Reverse Recovery Time	$t_{\text{RR}}$	$V_{\text{GS}} = 0 \text{ V}$ , $dI_S/dt = 1000 \text{ A}/\mu\text{s}$ , $I_S = 12 \text{ A}$		23		ns
	$Q_{\text{RR}}$			147		

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.

3. Switching characteristics are independent of operating junction temperature

## TYPICAL CHARACTERISTICS

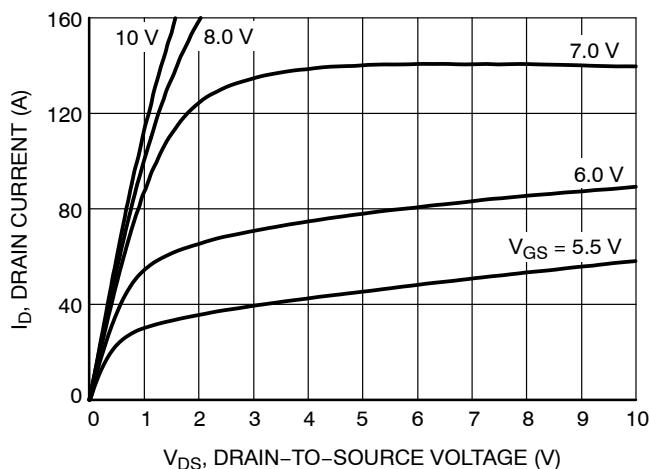


Figure 1. On-Region Characteristics

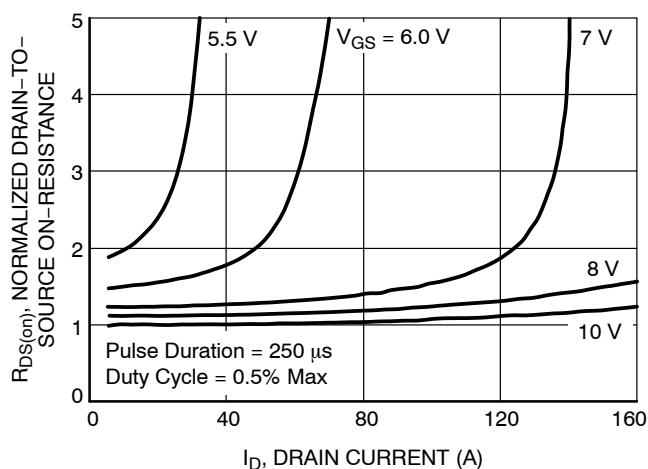


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

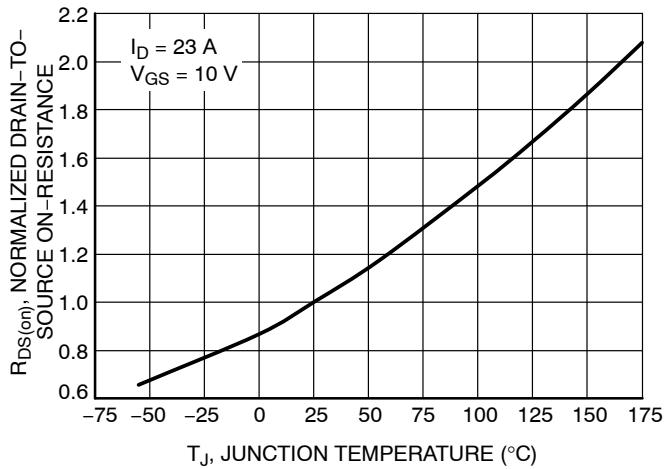


Figure 3. Normalized On-Resistance vs. Junction Temperature

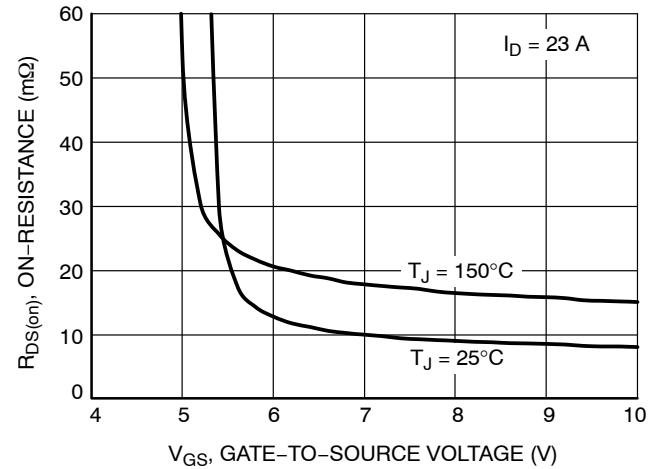


Figure 4. On-Resistance vs. Gate-to-Source Voltage

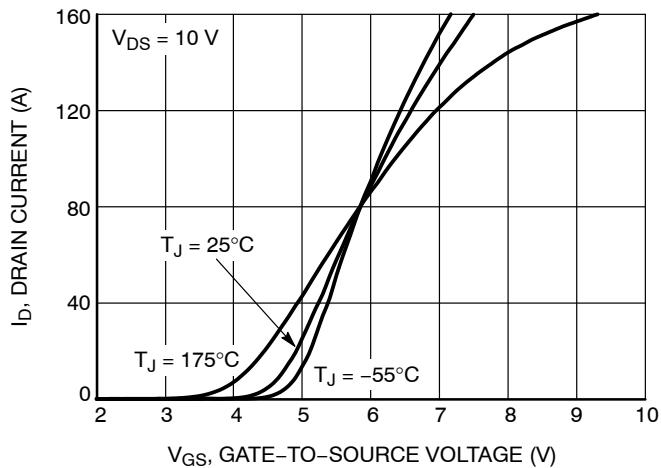


Figure 5. Transfer Characteristics

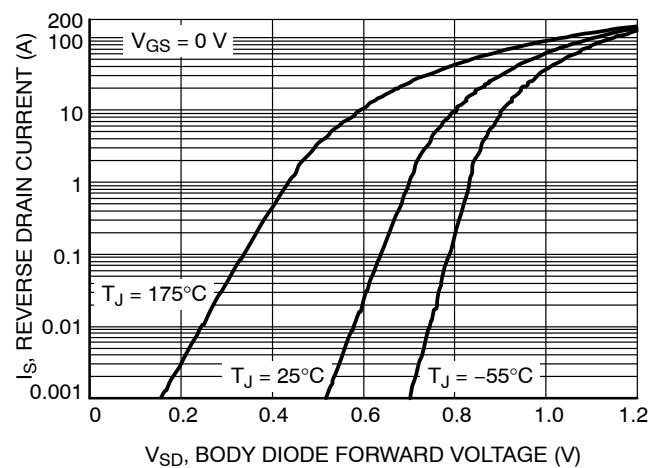
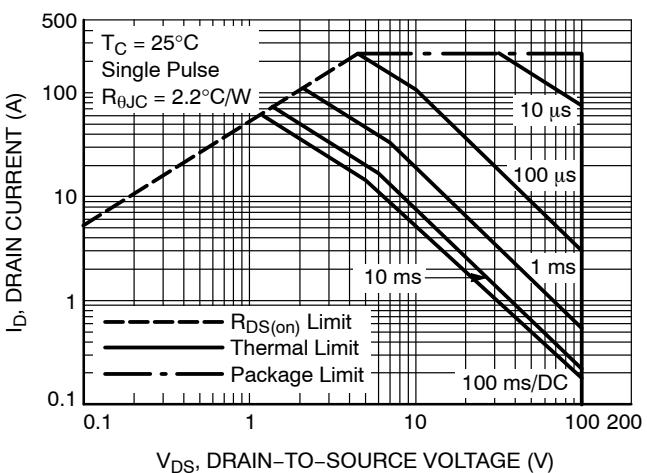
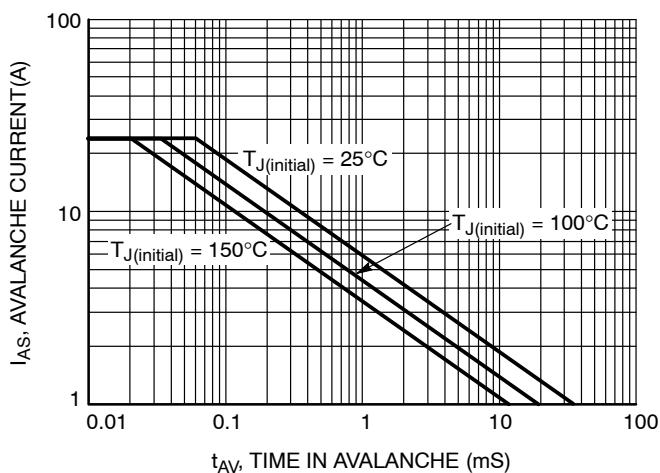
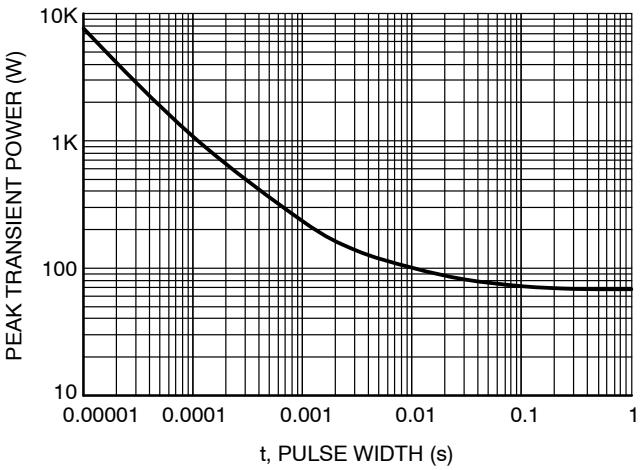
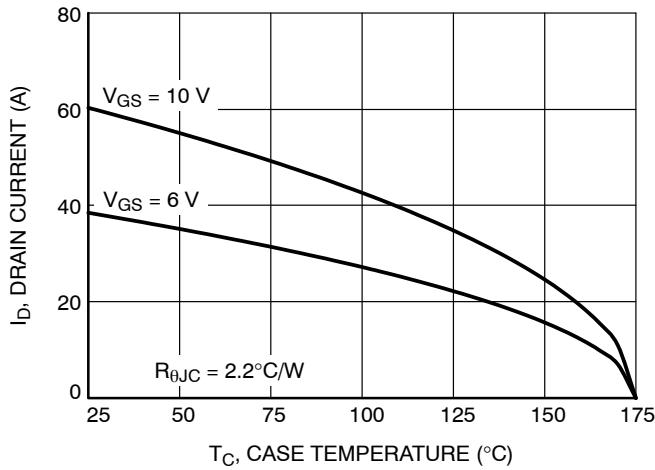
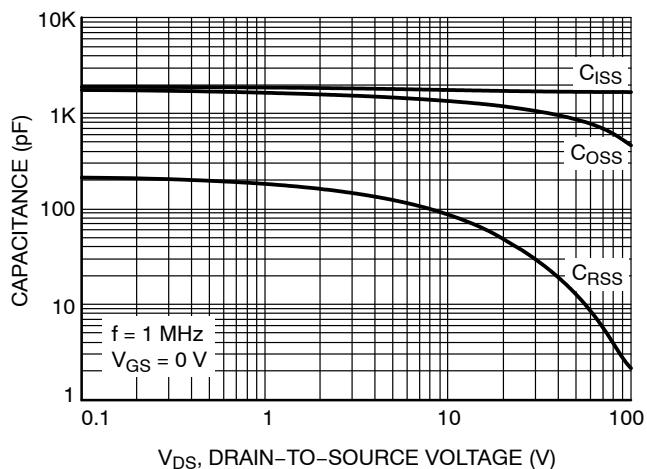
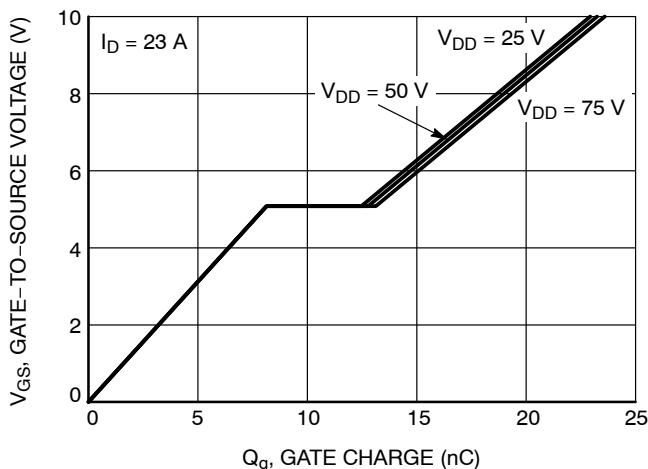


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

## TYPICAL CHARACTERISTICS



## TYPICAL CHARACTERISTICS

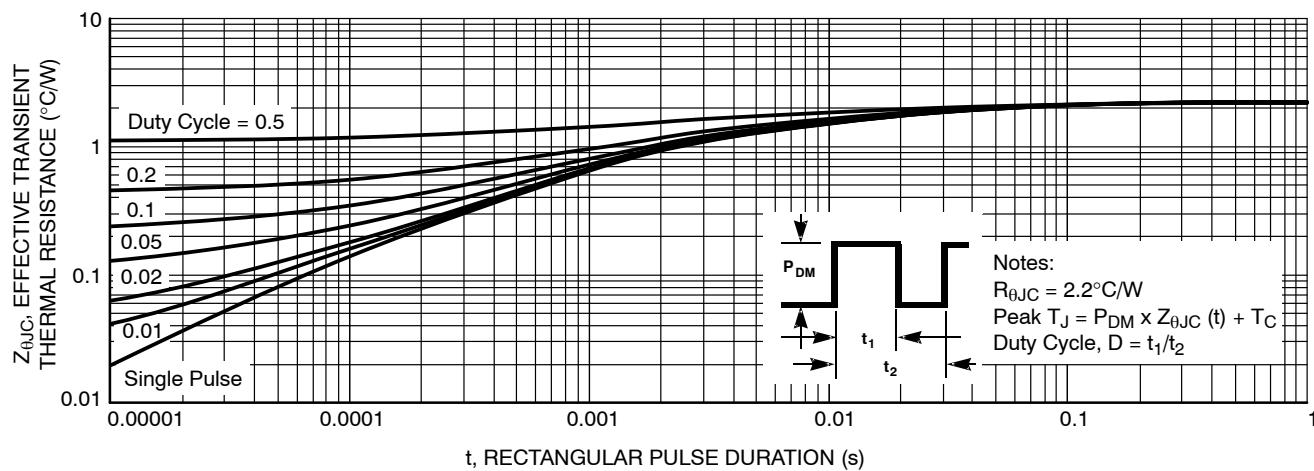


Figure 13. Transient Thermal Impedance



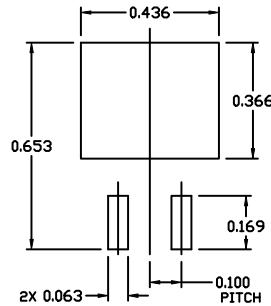
SCALE 1:1

D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)

CASE 418AJ

ISSUE F

DATE 11 MAR 2021



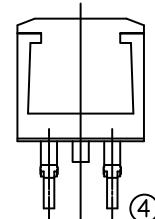
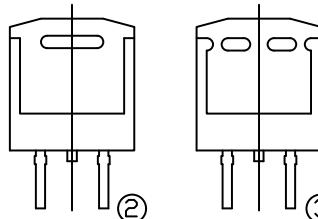
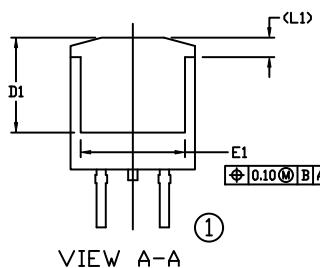
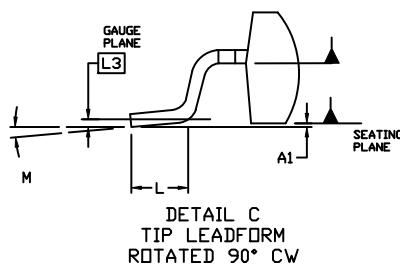
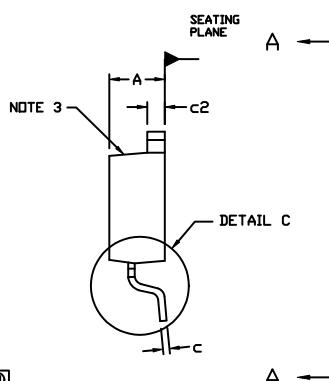
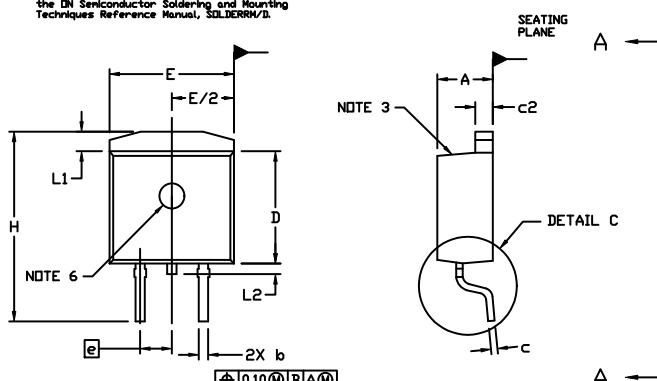
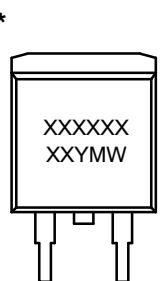
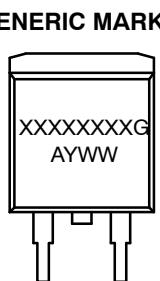
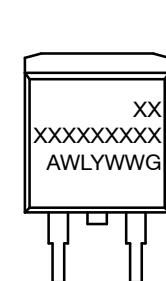
## RECOMMENDED MOUNTING FOOTPRINT

For additional information on our Pb-Free strategy and soldering details, please download the DN Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRAV2.

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
6. OPTIONAL MOLD FEATURE.
7. ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.160	0.190	4.06	4.83
A1	0.000	0.010	0.00	0.25
b	0.020	0.039	0.51	0.99
c	0.012	0.029	0.30	0.74
c2	0.045	0.065	1.14	1.65
D	0.330	0.380	8.38	9.65
D1	0.260	---	6.60	---
E	0.380	0.420	9.65	10.67
E1	0.245	---	6.22	---
e	0.100	BSC	2.54	BSC
H	0.575	0.625	14.60	15.88
L	0.070	0.110	1.78	2.79
L1	---	0.066	---	1.68
L2	---	0.070	---	1.78
L3	0.010	BSC	0.25	BSC
M	0°	8°	0°	8°

VIEW A-A  
OPTIONAL CONSTRUCTIONS

## GENERIC MARKING DIAGRAMS\*

XXXXXX = Specific Device Code

A = Assembly Location

WL = Wafer Lot

Y = Year

WW = Work Week

W = Week Code (SSG)

M = Month Code (SSG)

G = Pb-Free Package

AKA = Polarity Indicator

\*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.

DOCUMENT NUMBER:	98AON56370E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	D <sup>2</sup> PAK-3 (TO-263, 3-LEAD)	PAGE 1 OF 1

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

