

# MOSFET – Power, Single N-Channel, TOLL

**40 V, 300 A, 0.57 mΩ**

## NVBL50D5N04C

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- AEC-Q101 Qualified and PPAP Capable
- Small Footprint (TOLL) for Compact Design
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

Symbol	Parameter			Value	Unit
V <sub>DSS</sub>	Drain-to-Source Voltage			40	V
V <sub>GS</sub>	Gate-to-Source Voltage			+20/-16	V
I <sub>D</sub>	Continuous Drain Current R <sub>θJC</sub> (Notes 1, 3)	Steady State	T <sub>C</sub> = 25°C	300	A
			T <sub>C</sub> = 100°C	300	
P <sub>D</sub>	Power Dissipation R <sub>θJC</sub> (Note 1)			T <sub>C</sub> = 25°C	198.4
			T <sub>C</sub> = 100°C	97.4	
I <sub>D</sub>	Continuous Drain Current R <sub>θJA</sub> (Notes 1, 2, 3)	Steady State	T <sub>A</sub> = 25°C	65	A
				T <sub>A</sub> = 100°C	
P <sub>D</sub>	Power Dissipation R <sub>θJA</sub> (Notes 1, 2)			T <sub>A</sub> = 25°C	4.3
			T <sub>A</sub> = 100°C	2.1	
I <sub>DM</sub>	Pulsed Drain Current	T <sub>A</sub> = 25°C, t <sub>p</sub> = 10 μs		4700	A
T <sub>J</sub> , T <sub>stg</sub>	Operating Junction and Storage Temperature Range			-55 to +175	°C
I <sub>S</sub>	Source Current (Body Diode)			170	A
E <sub>AS</sub>	Single Pulse Drain-to-Source Avalanche Energy (I <sub>L(pk)</sub> = 55 A, L = 1 mH)			1512	mJ
T <sub>L</sub>	Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			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.

### THERMAL RESISTANCE MAXIMUM RATINGS

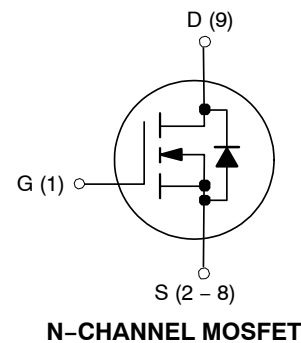
Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Junction-to-Case – Steady State	0.77	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient – Steady State (Note 2)	35	

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted. Current is limited by bondwire configuration.
2. Surface-mounted on FR4 board using a 650 mm<sup>2</sup>, 2 oz. Cu pad.
3. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

$V_{(BR)DSS}$	$R_{DS(on)} \text{ MAX}$	$I_D \text{ MAX}$
40 V	0.57 mΩ @ 10 V	300 A



H-PSOF8L  
CASE 100CU



### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NVBL50D5N04CTXG	H-PSOF8L (Pb-Free)	2000 / 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](http://BRD8011/D).

# NVBLS0D5N04C

**Table 1. ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
--------	-----------	-----------------	-----	-----	-----	-------

## OFF CHARACTERISTICS

$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0\ \text{V}$	40			V
$V_{(BR)DSS}/T_J$	Drain-to-Source Breakdown Voltage Temperature Coefficient			21.3		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 40\ \text{V}$ , $V_{GS} = 0\ \text{V}$	$T_J = 25^\circ\text{C}$		1	$\mu\text{A}$
			$T_J = 175^\circ\text{C}$		1	mA
$I_{GSS}$	Gate-to-Source Leakage Current	$V_{DS} = 0\ \text{V}$ , $V_{GS} = +20/-16\ \text{V}$			$\pm 100$	nA

## ON CHARACTERISTICS (Note 4)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 475\ \mu\text{A}$	2	2.8	4	V
$V_{GS(th)}/T_J$	Threshold Temperature Coefficient			-7.4		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 10\ \text{V}$ , $I_D = 50\ \text{A}$		0.5	0.57	m $\Omega$

## CHARGES, CAPACITANCES & GATE RESISTANCE

$C_{iss}$	Input Capacitance	$V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$		12600		pF
$C_{oss}$	Output Capacitance			6705		pF
$C_{rss}$	Reverse Transfer Capacitance			227		pF
$R_g$	Gate Resistance	$V_{GS} = 0.5\ \text{V}$ , $f = 1\ \text{MHz}$		1.8		$\Omega$
$Q_{G(tot)}$	Total Gate Charge	$V_{GS} = 10\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $I_D = 50\ \text{A}$		185		nC
$Q_{G(th)}$	Threshold Gate Charge	$V_{GS} = 0\ \text{to}\ 2\ \text{V}$		22		nC
$Q_{gs}$	Gate-to-Source Gate Charge	$V_{DD} = 32\ \text{V}$ , $I_D = 50\ \text{A}$		48		nC
$Q_{gd}$	Gate-to-Drain "Miller" Charge			38		nC
$V_{GP}$	Plateau Voltage			4.2		V

## SWITCHING CHARACTERISTICS (Note 5)

$t_{d(on)}$	Turn-On Delay Time	$V_{GS} = 10\ \text{V}$ , $V_{DD} = 20\ \text{V}$ , $I_D = 50\ \text{A}$ , $R_{GEN} = 6\ \Omega$		40		ns
$t_r$	Turn-On Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			164		ns
$t_f$	Turn-Off Fall Time			81		ns

## DRAIN-SOURCE DIODE CHARACTERISTICS

$V_{SD}$	Source-to-Drain Diode Voltage	$I_{SD} = 50\ \text{A}$ , $V_{GS} = 0\ \text{V}$		0.76	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\ \text{V}$ , $dI_S/dt = 100\ \text{A}/\mu\text{s}$ , $I_S = 50\ \text{A}$		108		ns
$t_a$	Charge Time			62		ns
$t_b$	Discharge Time			46		ns
$Q_{rr}$	Reverse Recovery Charge			288		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.

4. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

5. Switching characteristics are independent of operating junction temperatures

TYPICAL CHARACTERISTICS

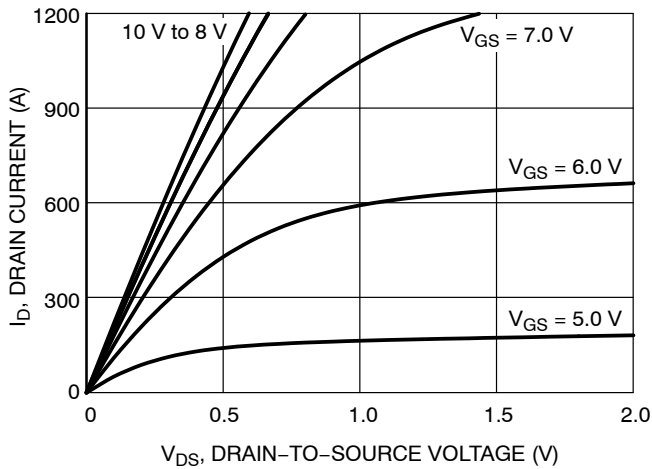


Figure 1. On-Region Characteristics

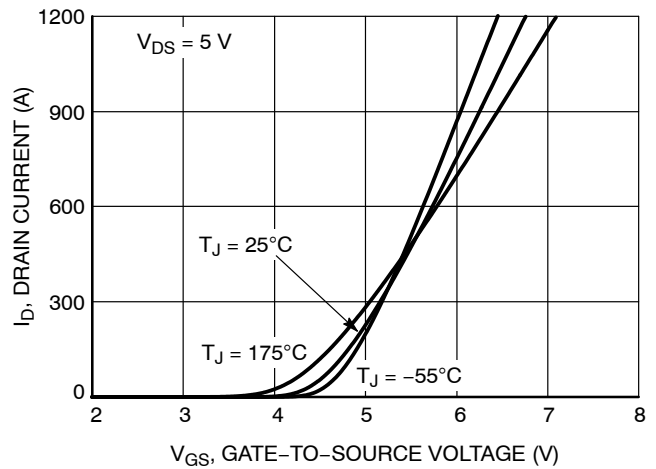


Figure 2. Transfer Characteristics

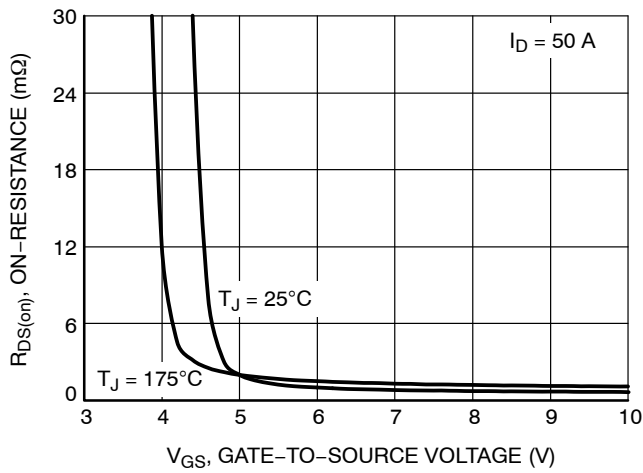


Figure 3. On-Resistance vs. Gate-to-Source Voltage

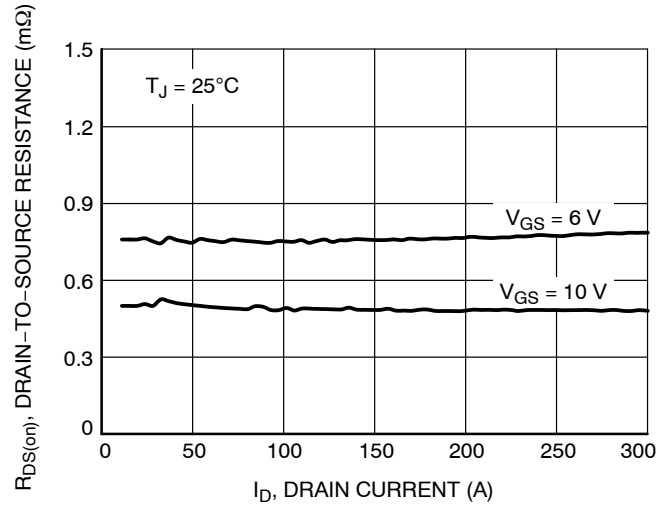


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

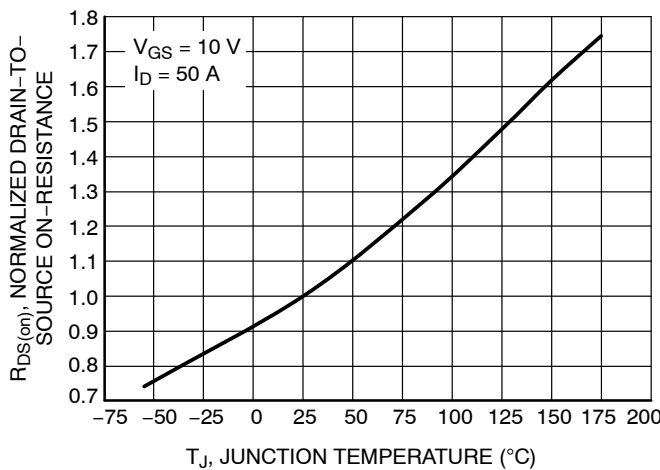


Figure 5. On-Resistance Variation with Temperature

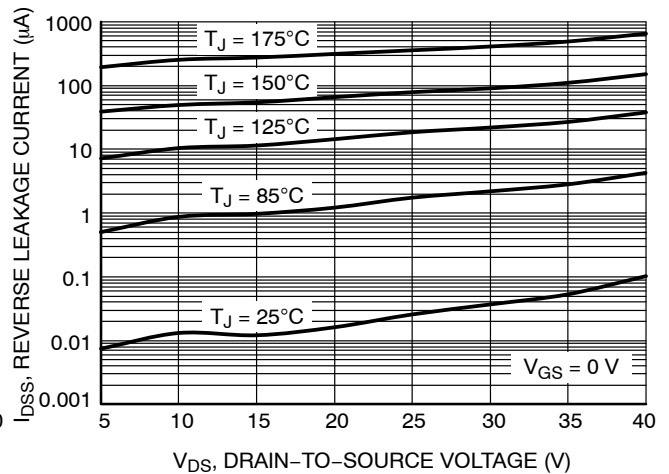


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS (continued)

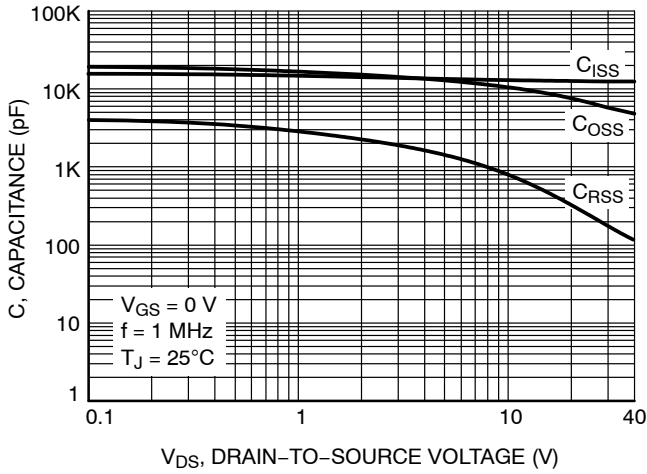


Figure 7. Capacitance Variation

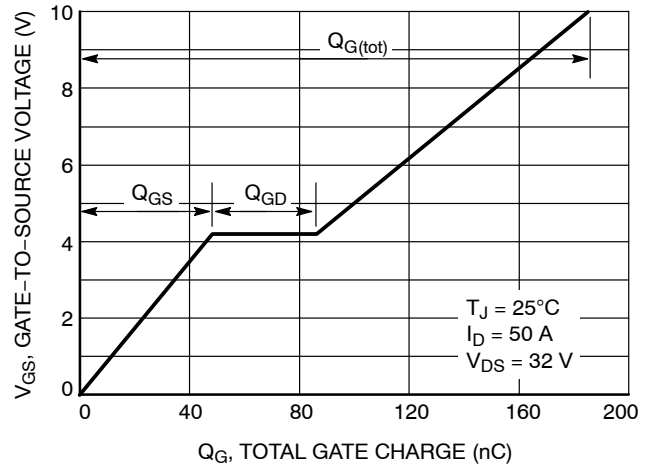


Figure 8. Gate-to-Source Voltage vs. Total Charge

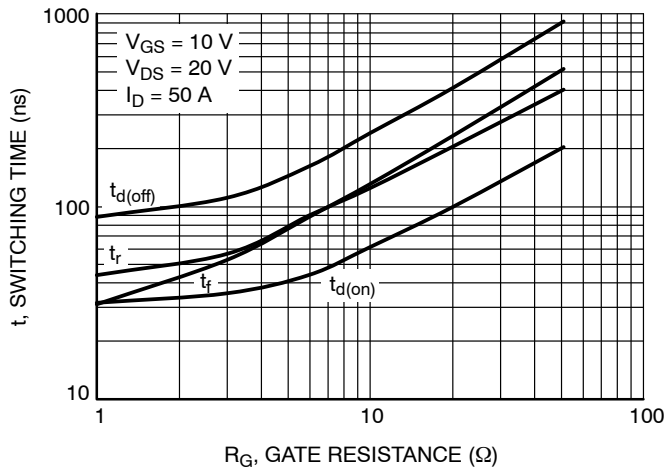


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

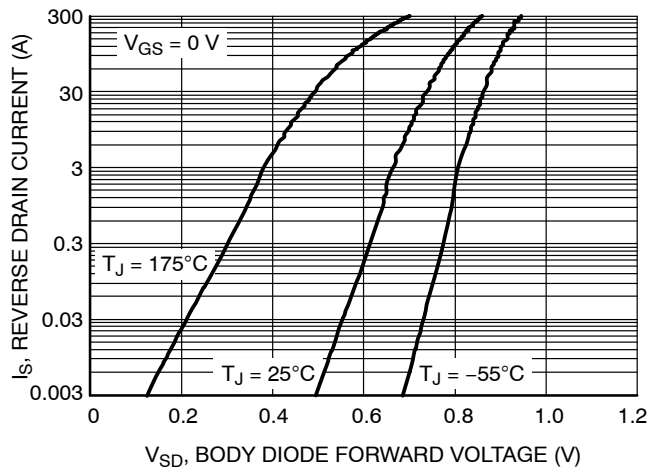


Figure 10. Diode Forward Voltage vs. Current

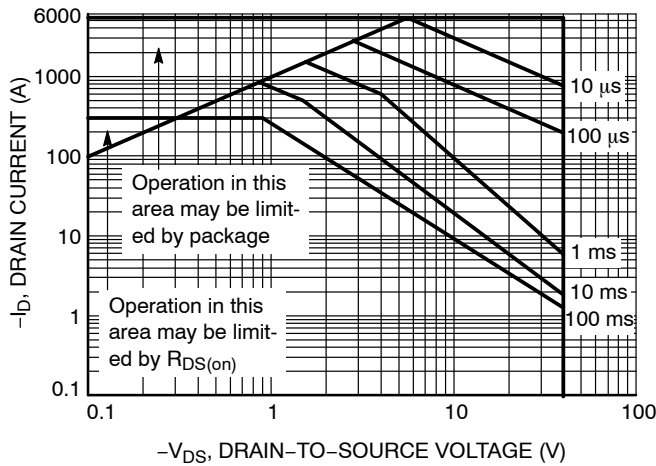


Figure 11. Forward Biased Safe Operating Area

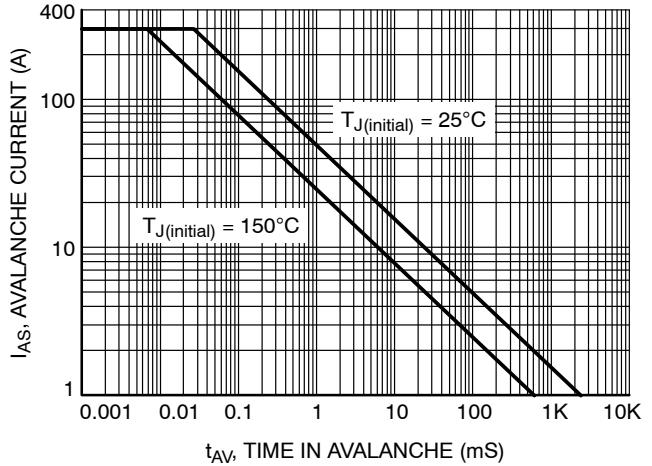


Figure 12. Maximum Drain Current vs. Time in Avalanche

TYPICAL CHARACTERISTICS (continued)

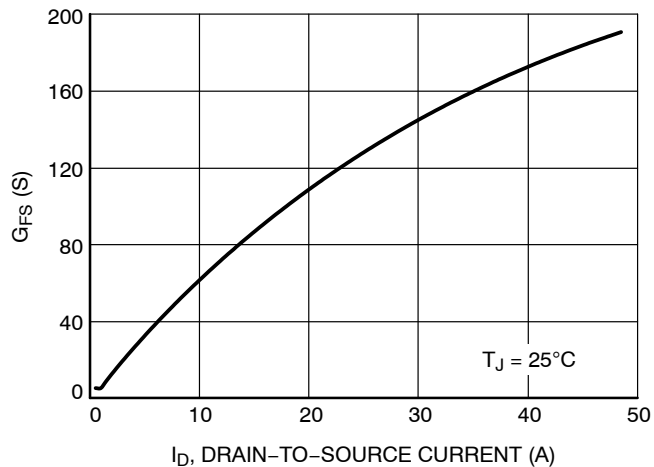


Figure 13.  $G_{FS}$  vs.  $I_D$

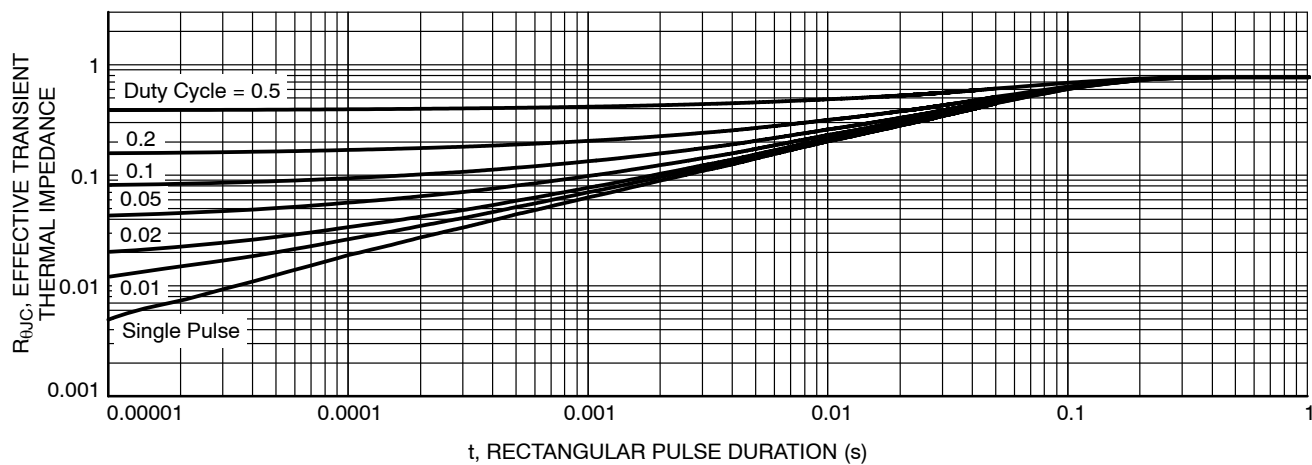


Figure 14. Transient Thermal Impedance



H-PSOF8L 11.68x9.80x2.30, 1.20P  
CASE 100CU  
ISSUE F

DATE 30 JUL 2024

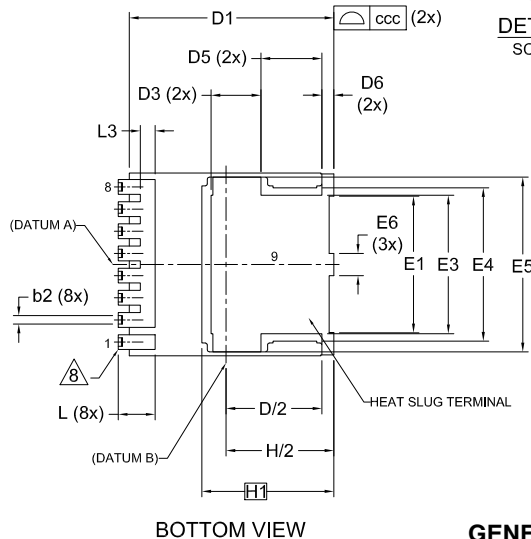


\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.



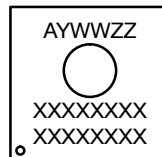
NOTES:

1. PACKAGE STANDARD REFERENCE: JEDEC MO-299, ISSUE B.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
3. "e" REPRESENTS THE TERMINAL PITCH.
4. THIS DIMENSION INCLUDES ENCAPSULATION THICKNESS "A1", AND PACKAGE BODY THICKNESS, BUT DOES NOT INCLUDE ATTACHED FEATURES, e.g., EXTERNAL OR CHIP CAPACITORS. AN INTEGRAL HEATSLUG IS NOT CONSIDERED AS ATTACHED FEATURE.
5. A VISUAL INDEX FEATURE MUST BE LOCATED WITHIN THE HATCHED AREA.
6. DIMENSIONS b1, L1, L2 APPLY TO PLATED TERMINALS.
7. THE LOCATION AND SIZE OF EJECTOR MARKS ARE OPTIONAL.
8. THE LOCATION AND NUMBER OF FUSED LEADS ARE OPTIONAL.



GENERIC  
MARKING DIAGRAM\*

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



\*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.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	2.20	2.30	2.40
A1	1.70	1.80	1.90
b	0.70	0.80	0.90
b1	9.70	9.80	9.90
b2	0.35	0.45	0.55
c	0.40	0.50	0.60
D	10.28	10.38	10.48
D/2	5.09	5.19	5.29
D1	10.98	11.08	11.18
D2	3.20	3.30	3.40
D3	2.60	2.70	2.80
D4	4.45	4.55	4.65
D5	3.20	3.30	3.40
D6	0.55	0.65	0.75
E	9.80	9.90	10.00
E1	7.30	7.40	7.50
E2	0.30	0.40	0.50
E3	7.40	7.50	7.60
E4	8.20	8.30	8.40

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
E5	9.36	9.46	9.56
E6	1.10	1.20	1.30
E7	0.15	0.18	0.21
e	1.20 BSC		
e/2	0.60 BSC		
H	11.58	11.68	11.78
H/2	5.74	5.84	5.94
H1	7.15 BSC		
L	1.90	2.00	2.10
L1	0.60	0.70	0.80
L2	0.50	0.60	0.70
L3	0.70	0.80	0.90
Θ	10° REF		
Θ1	10° REF		
aaa	0.20		
bbb	0.25		
ccc	0.20		
ddd	0.20		
eee	0.10		

DOCUMENT NUMBER: 98AON13813G

Electronic versions are uncontrolled except when accessed directly from the Document Repository.  
Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.

DESCRIPTION: H-PSOF8L 11.68x9.80x2.30, 1.20P

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)