

MOSFET – Power, Single N-Channel, D2PAK 650 V, 110 mΩ, 30 A

NVB110N65S3F

Description

SUPERFET® III MOSFET is ON Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III MOSFET is very suitable for the various power system for miniaturization and higher efficiency. SUPERFET III FRFET® MOSFET's optimized reverse recovery performance of body diode can remove additional component and improve system reliability.

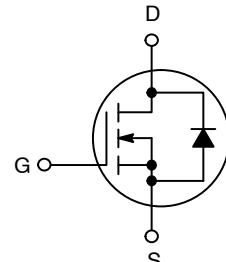
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(\text{on})} = 93 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 58 \text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(\text{eff.})} = 533 \text{ pF}$)
- 100% Avalanche Tested
- Qualified with AEC-Q101
- These Devices are Pb-Free and are RoHS Compliant

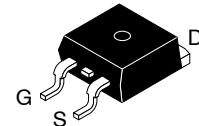
Typical Applications

- Automotive On Board Charger
- Automotive DC/DC Converter for HEV

$V_{(\text{BR})\text{DSS}}$	$R_{DS(\text{ON}) \text{ MAX}}$	$I_D \text{ MAX}$
650 V	110 mΩ @ 10 V	30 A

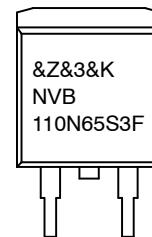


N-CHANNEL MOSFET



D²PAK-3
TO-263
CASE 418AJ

MARKING DIAGRAM



&Z = Assembly Plant Code
 &3 = Data Code (Year & Week)
 &K = Lot
 NVB110N65S3F = Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

NVB110N65S3F

Table 1. ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise stated)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain-to-Source Voltage		650	V
V_{GS}	Gate-to-Source Voltage	– DC	± 30	V
		– AC ($f > 1 \text{ Hz}$)	± 30	
I_D	Drain Current	– Continuous ($T_C = 25^\circ\text{C}$)	30	A
		– Continuous ($T_C = 100^\circ\text{C}$)	19.5	
I_{DM}	Drain Current	– Pulsed (Note 1)	69	A
E_{AS}	Single Pulse Avalanche Energy (Note 2)		380	mJ
I_{AS}	Avalanche Current		3.5	A
E_{AR}	Repeated Avalanche Energy (Note 1)		2.4	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$	240	W
		– Derate Above 25°C	1.92	$\text{W}/^\circ\text{C}$
T_J, T_{stg}	Operating Junction and Storage Temperature		–55 to 150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300	$^\circ\text{C}$

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. Repetitive rating: pulse – width limited by maximum junction temperature.
2. IAS = 3.5 A, RG = 25 Ω , starting $T_J = 25^\circ\text{C}$.
3. ISD \leq 15 A, $di/dt \leq 200 \text{ A}/\text{s}$, $V_{DD} \leq 400 \text{ V}$, starting $T_C = 25^\circ\text{C}$.

Table 2. THERMAL RESISTANCE RATINGS

Symbol	Parameter	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.52	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	40	

NVB110N65S3F

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

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

OFF CHARACTERISTICS

BV _{DSS}	Drain-to-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}, T_J = 25^\circ\text{C}$	650	–	–	V
		$V_{GS} = 0 \text{ V}, I_D = 10 \text{ mA}, T_J = 150^\circ\text{C}$	700	–	–	V
$\Delta V_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 20 \text{ mA}$, Referenced to 25°C	–	0.61	–	$^\circ\text{C}$
I _{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650 \text{ V}, V_{GS} = 0 \text{ V}$	–	–	10	μA
		$V_{DS} = 520 \text{ V}, T_C = 125^\circ\text{C}$	–	128	–	μA
I _{GSS}	Gate-to-Body Leakage Current	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 30 \text{ V}$	–	–	± 100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 0.74 \text{ mA}$	3.0	–	5.0	V
R _{DS(on)}	Static Drain-to-Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 15 \text{ A}$	–	93	110	$\text{m}\Omega$
g _{FS}	Forward Transconductance	$V_{GS} = 20 \text{ V}, I_D = 15 \text{ A}$	–	17	–	S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	–	2560	–	pF
C _{oss}	Output Capacitance		–	50	–	pF
C _{oss(eff.)}	Effective Output Capacitance	$V_{DS} = 0 \text{ to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	–	553	–	pF
C _{oss(er.)}	Energy Related Output Capacitance	$V_{DS} = 0 \text{ to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	–	83	–	pF
Q _{g(total)}	Total Gate Charge at 10 V	$V_{DS} = 400 \text{ V}, I_D = 15 \text{ A}, V_{GS} = 10 \text{ V}$ (Note 4)	–	58	–	nC
Q _{gs}	Gate-to-Source Gate Charge		–	19	–	nC
Q _{gd}	Gate-to-Drain "Miller" Charge		–	23	–	nC
ESR	Equivalent Series Resistance	$f = 1 \text{ MHz}$	–	2	–	Ω

SWITCHING CHARACTERISTICS, $V_{GS} = 10 \text{ V}$

t _{d(on)}	Turn-On Delay Time	$V_{DD} = 400 \text{ V}, I_D = 15 \text{ A}, V_{GS} = 10 \text{ V}, R_G = 4.7 \Omega$ (Note 4)	–	29	–	ns
t _r	Rise Time		–	32	–	ns
t _{d(off)}	Turn-Off Delay Time		–	61	–	ns
t _f	Fall Time		–	16	–	ns

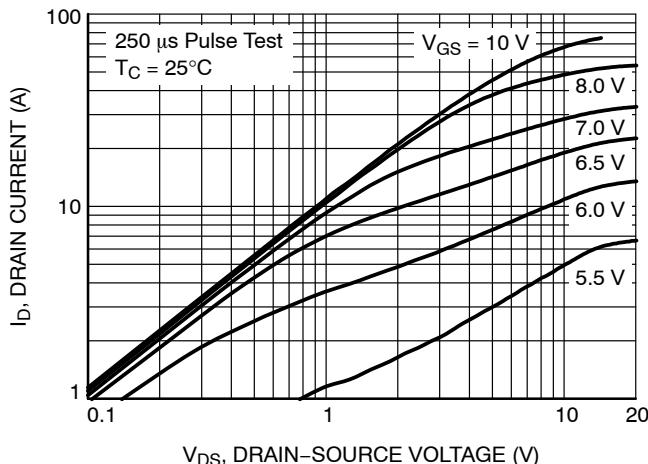
SOURCE-DRAIN DIODE CHARACTERISTICS

I _S	Maximum Continuous Source-to-Drain Diode Forward Current	–	–	30	A	
I _{SM}	Maximum Pulsed Source-to-Drain Diode Forward Current	–	–	69	A	
V _{SD}	Source-to-Drain Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 15 \text{ A}$	–	–	1.3	V
t _{rr}	Reverse-Recovery Time	$V_{GS} = 0 \text{ V}, I_{SD} = 15 \text{ A}, dI/dt = 100 \text{ A}/\mu\text{s}$	–	94	–	ns
Q _{rr}	Reverse-Recovery Charge		–	343	–	nC

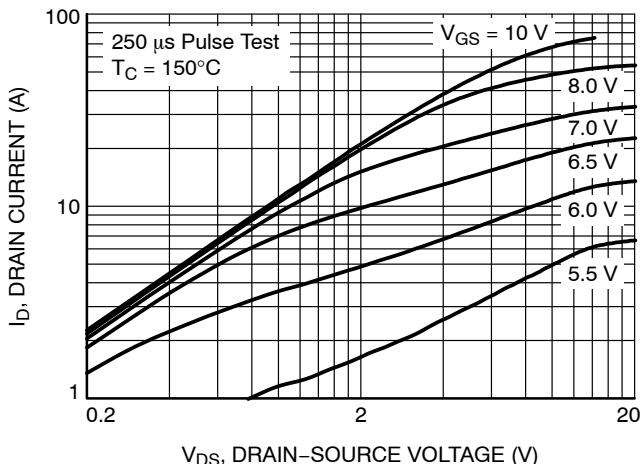
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Essentially independent of operating temperature typical characteristics.

TYPICAL CHARACTERISTICS



**Figure 1. On-Region Characteristics
25°C**



**Figure 2. On-Region Characteristics
150°C**

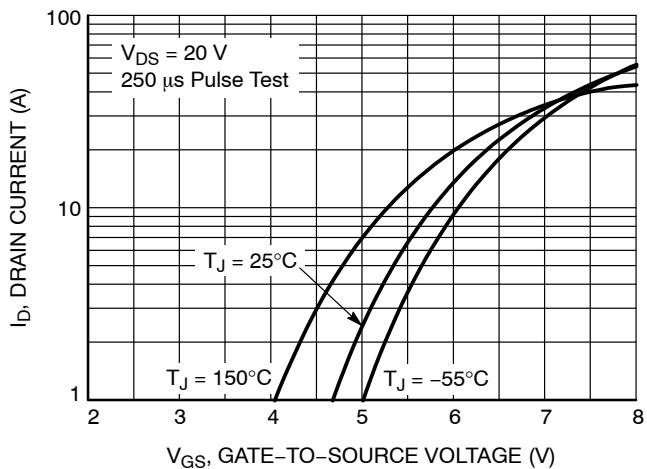


Figure 3. Transfer Characteristics

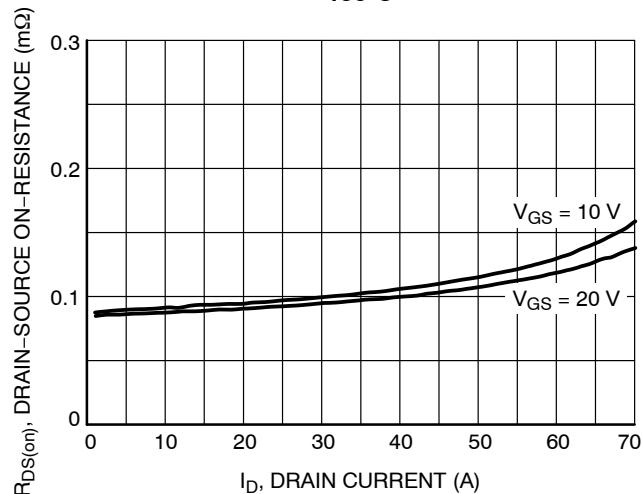


Figure 4. On-Resistance Variation vs. Drain Current and Gate Voltage

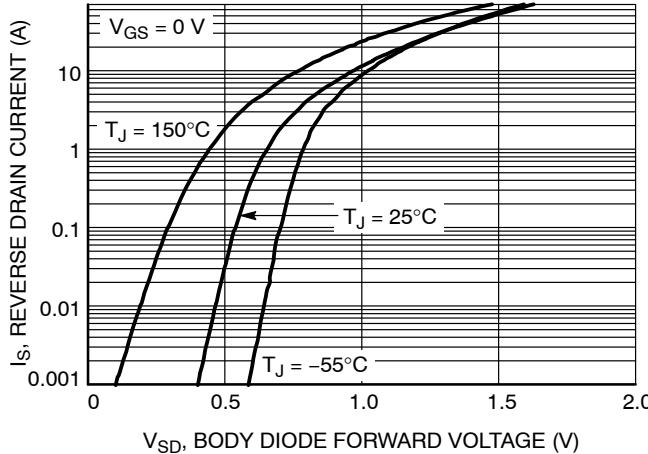


Figure 5. Body Diode Forward Voltage Variation vs. Source Current and Temperature

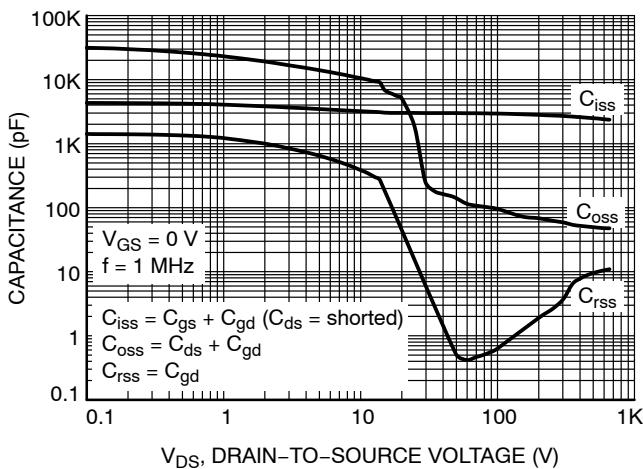
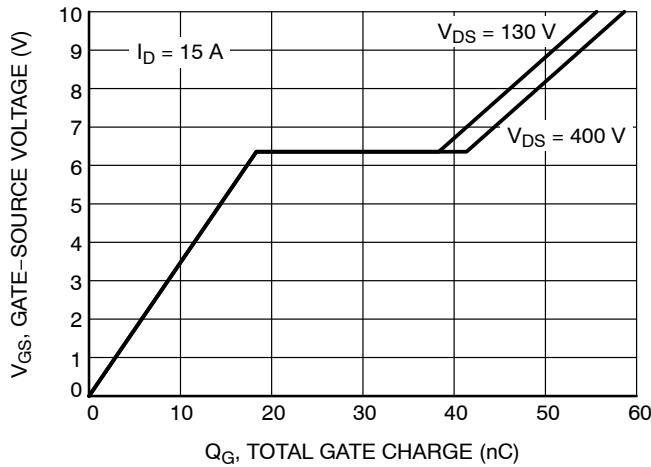
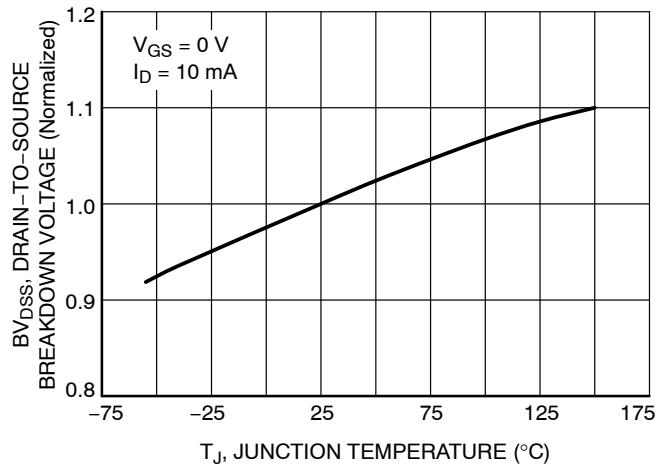
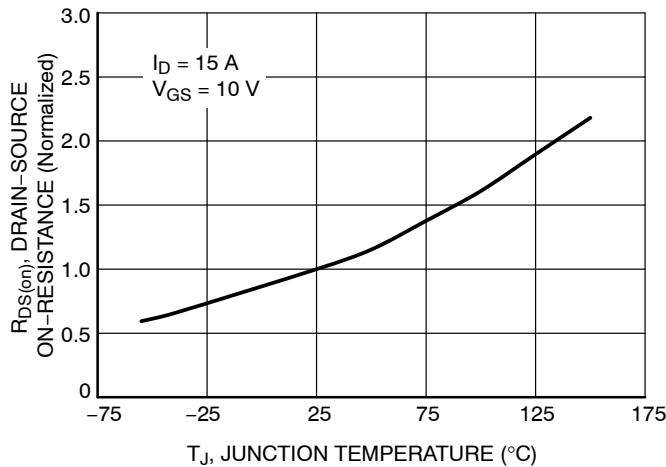
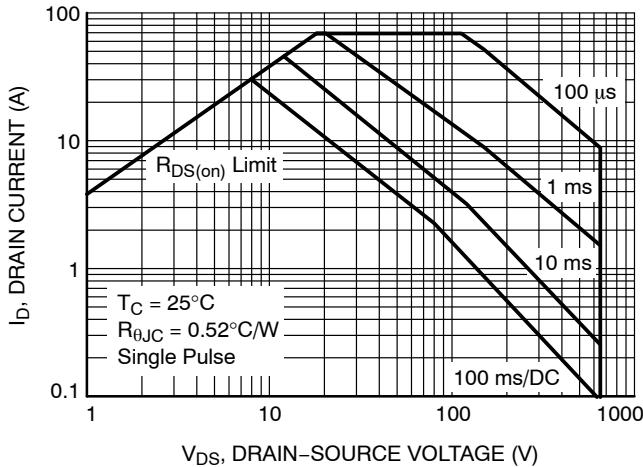
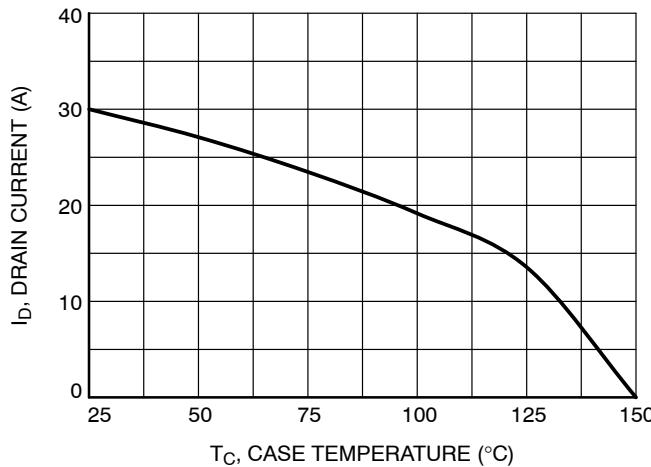
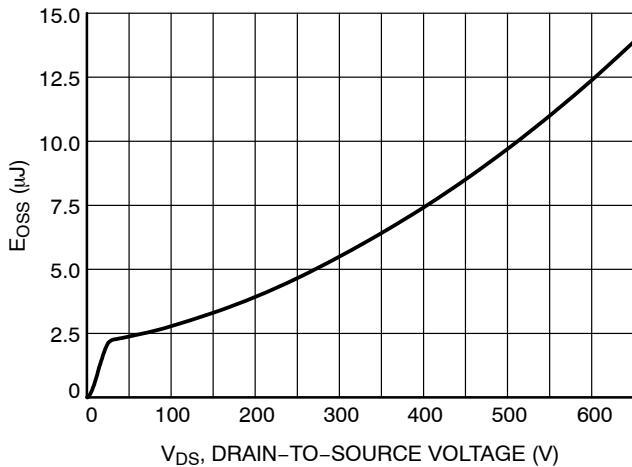


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS

Figure 7. Gate Charge Characteristics

Figure 8. Breakdown Voltage Variation vs. Temperature

Figure 9. On-Resistance Variation vs. Temperature

Figure 10. Maximum Safe Operating Area

Figure 11. Maximum Drain Current vs. Case Temperature

Figure 12. E_{OSS} vs. Drain-to-Source Voltage

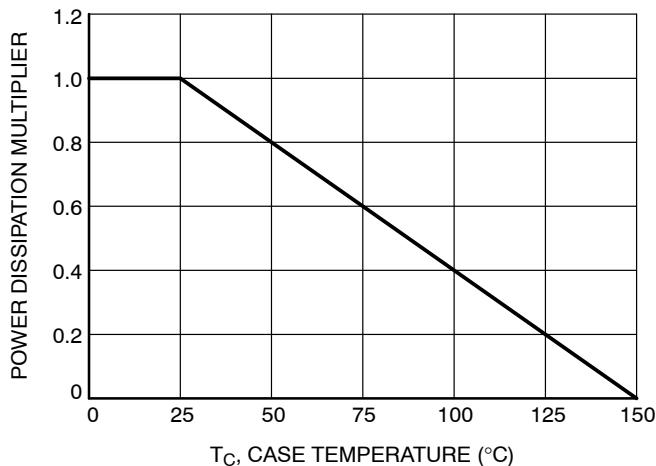
TYPICAL CHARACTERISTICS


Figure 13. Normalized Power Dissipation vs. Case Temperature

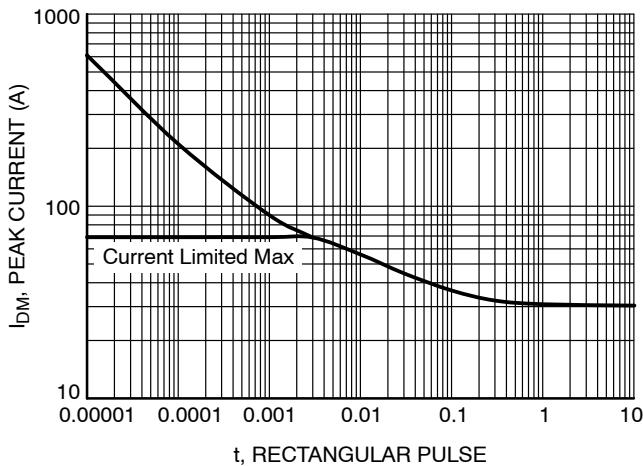


Figure 14. Peak Current Capability

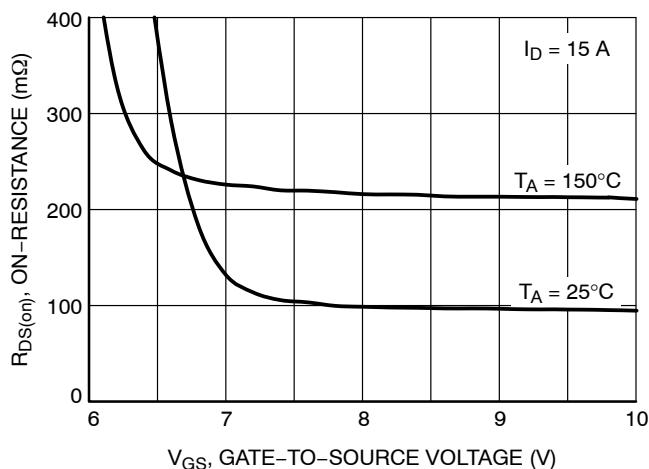


Figure 15. R_{DS(on)} vs. Gate Voltage

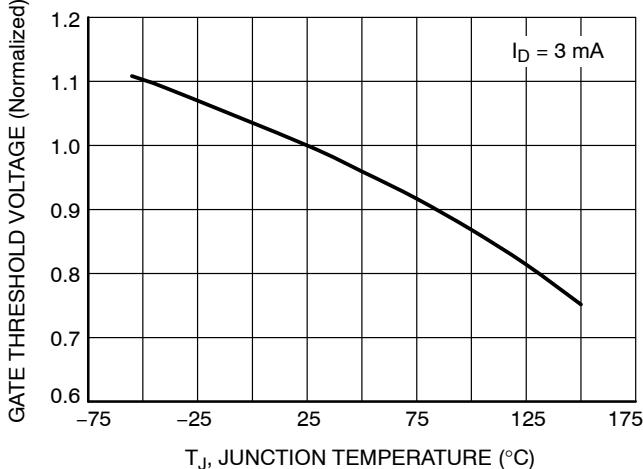


Figure 16. Normalized Gate Threshold Voltage vs. Temperature

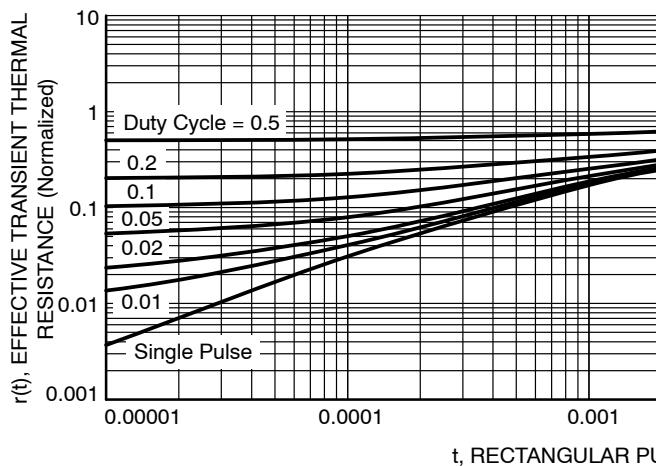


Figure 17. Transient Thermal Response

Notes:
 $Z_{\theta JC}(t) = r(t) \times R_{\theta JC}$
 $R_{\theta JC} = 0.4^{\circ}\text{C}/\text{W}$
 $\text{Peak } T_J = P_{DM} \times Z_{\theta JC}(t) + T_C$
 $\text{Duty Cycle, } D = t_1/t_2$

NVB110N65S3F

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NVB110N65S3F	NVB110N65S3F	D ² PAK	Tape & Reel [†]	330 mm	24 mm	800 Units

[†]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](#).

SUPERFET and FRFET are registered trademarks of Semiconductor Components Industries, LLC.



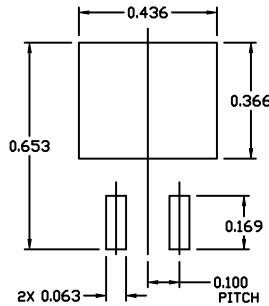
SCALE 1:1

D²PAK-3 (TO-263, 3-LEAD)

CASE 418AJ

ISSUE F

DATE 11 MAR 2021



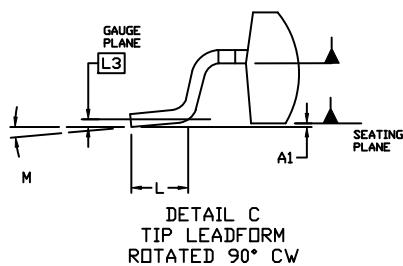
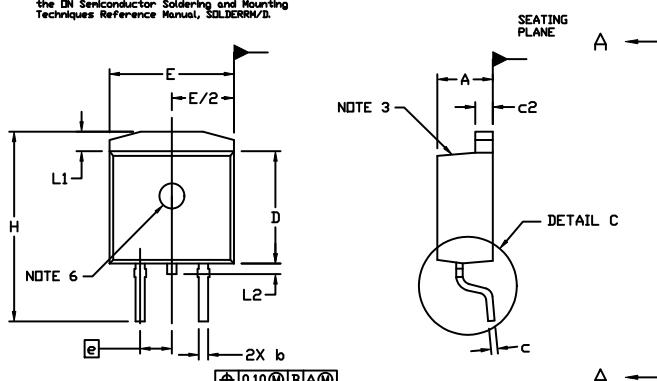
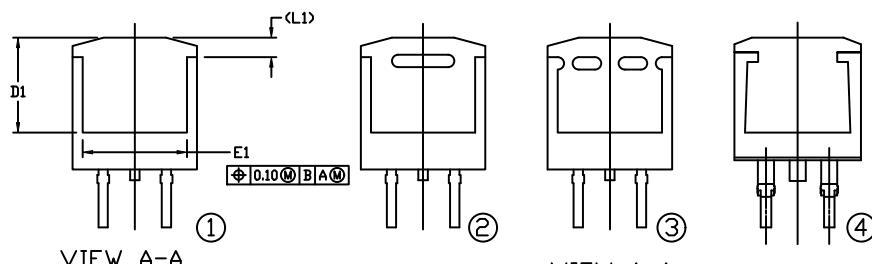
RECOMMENDED MOUNTING FOOTPRINT

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

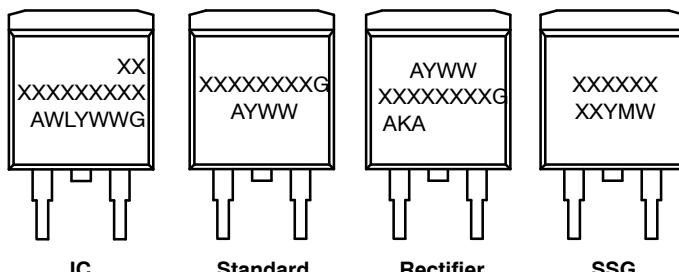
NOTES:

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°

DETAIL C
TIP LEADFORM
ROTATED 90° CWVIEW A-A
OPTIONAL CONSTRUCTIONS

GENERAL 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 ² 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. **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
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales

