

# MOSFET - Power, Single N-Channel, D<sup>2</sup>PAK 650 V, 150 mΩ, 24 A

## NVB150N65S3F

### Description

SUPERFET<sup>®</sup> III MOSFET is onsemi'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<sup>®</sup> MOSFET's optimized reverse recovery performance of body diode can remove additional component and improve system reliability.

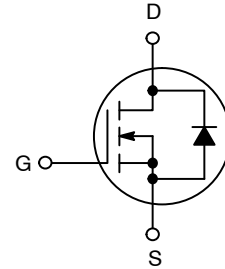
### Features

- 700 V @ T<sub>J</sub> = 150°C
- Typ. R<sub>DS(on)</sub> = 114 mΩ
- Ultra Low Gate Charge (Typ. Q<sub>g</sub> = 43 nC)
- Low Effective Output Capacitance (Typ. C<sub>oss(eff.)</sub> = 385 pF)
- 100% Avalanche Tested
- Qualified with AEC-Q101
- These Devices are Pb-Free and are RoHS Compliant

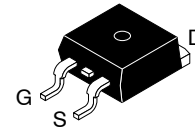
### Typical Applications

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

V <sub>(BR)DSS</sub>	R <sub>DS(ON)</sub> MAX	I <sub>D</sub> MAX
650 V	150 mΩ @ 10 V	24 A

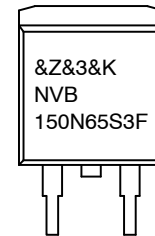


N-CHANNEL MOSFET



D<sup>2</sup>PAK-3  
 TO-263  
 CASE 418AJ

### MARKING DIAGRAM



- &Z = Assembly Plant Code
- &3 = Data Code (Year & Week)
- &K = Lot
- NVB150N65S3F = Specific Device Code

### ORDERING INFORMATION

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

# NVB150N65S3F

**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	$\pm 30$
		- AC ( $f > 1$ Hz)	$\pm 30$
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	24
		- Continuous ( $T_C = 100^\circ\text{C}$ )	15.2
$I_{DM}$	Drain Current	- Pulsed (Note 1)	60
$E_{AS}$	Single Pulse Avalanche Energy (Note 2)	275	mJ
$I_{AS}$	Avalanche Current	3.2	A
$E_{AR}$	Repeated Avalanche Energy (Note 1)	1.92	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt (Note 3)	50	
$P_D$	Power Dissipation	$T_C = 25^\circ\text{C}$	192
		- Derate Above $25^\circ\text{C}$	1.54
$T_J, T_{stg}$	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.  $I_{AS} = 3.2$  A,  $R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $ISD \leq 12$  A,  $di/dt \leq 200$  A/\_s,  $V_{DD} \leq 400$  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.	0.65	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	40	

# NVB150N65S3F

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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### 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
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 20\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.61	-	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$	-	128	-	$\mu\text{A}$
$I_{GSS}$	Gate-to-Body Leakage Current	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	-	-	$\pm 100$	nA

### ON CHARACTERISTICS

$V_{GS(th)}$	Drain-to-Source Breakdown Voltage	$V_{GS} = V_{DS}, I_D = 0.54\text{ mA}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain-to-Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 12\text{ A}$	-	114	150	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{GS} = 20\text{ V}, I_D = 12\text{ A}$	-	14	-	S

### DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	1999	-	pF
$C_{oss}$	Output Capacitance		-	40.1	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ to }400\text{ V}, V_{GS} = 0\text{ V}$	-	385	-	pF
$C_{oss(er.)}$	Energy Related Output Capacitance	$V_{DS} = 0\text{ to }400\text{ V}, V_{GS} = 0\text{ V}$	-	72	-	pF
$Q_{g(total)}$	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 12\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 4)	-	43	-	nC
$Q_{gs}$	Gate-to-Source Gate Charge		-	13	-	nC
$Q_{gd}$	Gate-to-Drain "Miller" Charge		-	17	-	nC
ESR	Equivalent Series Resistance	$F = 1\text{ MHz}$	-	5	-	$\Omega$

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

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 12\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 4.7\text{ }\Omega$ (Note 4)	-	21	-	ns
$t_r$	Rise Time		-	13	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	53	-	ns
$t_f$	Fall Time		-	3	-	ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

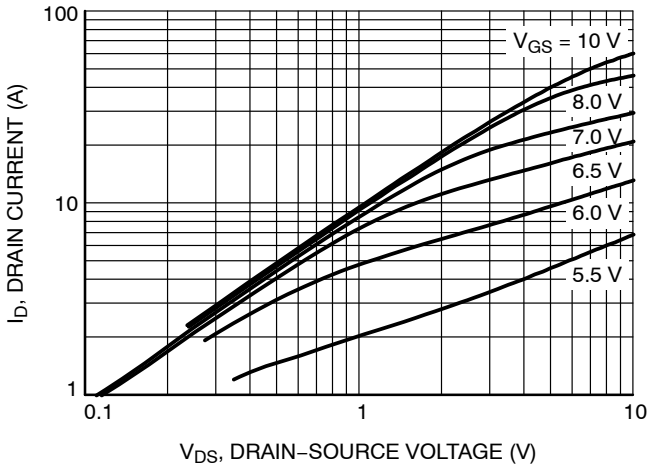
$I_S$	Maximum Continuous Source-to-Drain Diode Forward Current	-	-	24	A	
$I_{SM}$	Maximum Pulsed Source-to-Drain Diode Forward Current	-	-	60	A	
$V_{SD}$	Source-to-Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 12\text{ A}$	-	-	1.3	V
$t_{rr}$	Reverse-Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 12\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$	-	88	-	ns
$Q_{rr}$	Reverse-Recovery Charge		-	300	-	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.

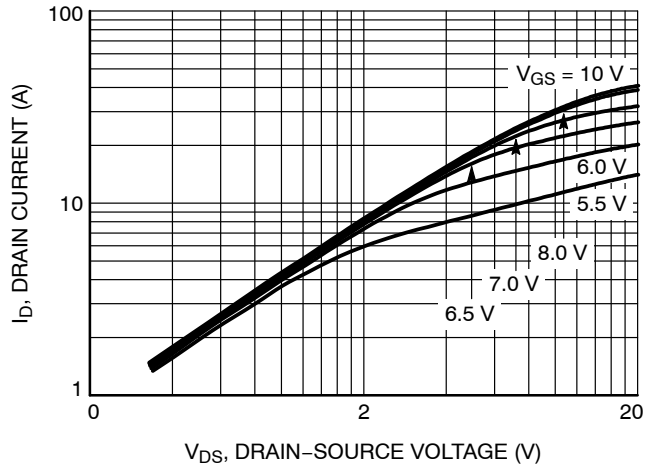
4. Essentially independent of operating temperature typical characteristics.

# NVB150N65S3F

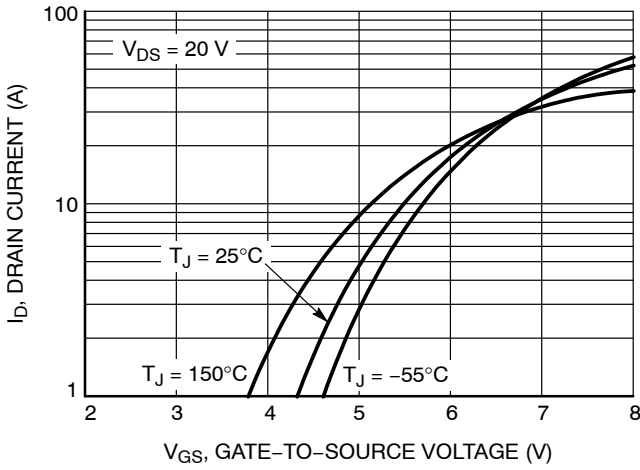
## TYPICAL CHARACTERISTICS



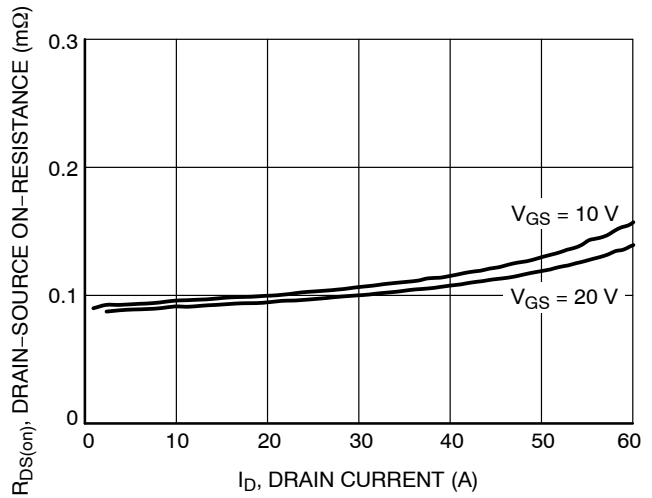
**Figure 1. On-Region Characteristics  
25°C**



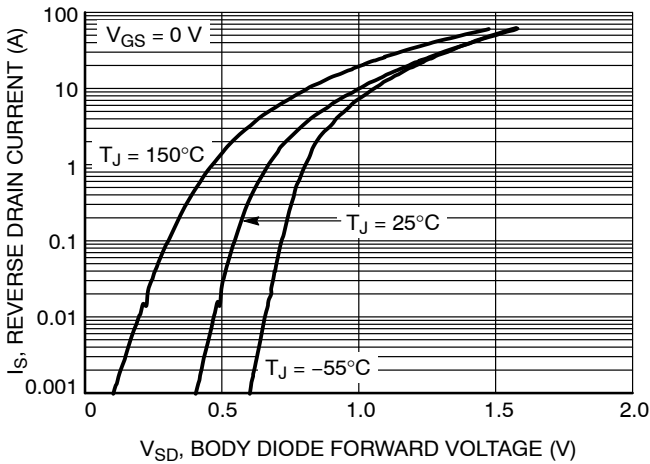
**Figure 2. On-Region Characteristics  
150°C**



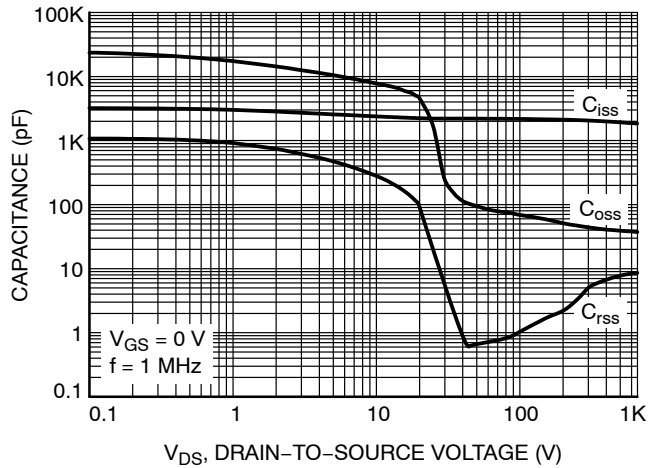
**Figure 3. Transfer Characteristics**



**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

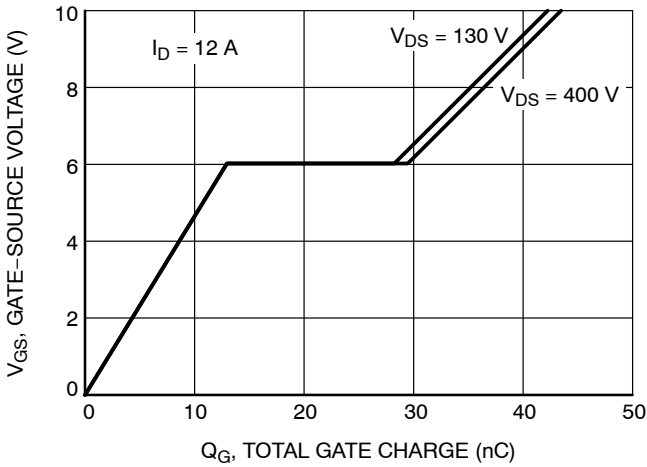


Figure 7. Gate Charge Characteristics

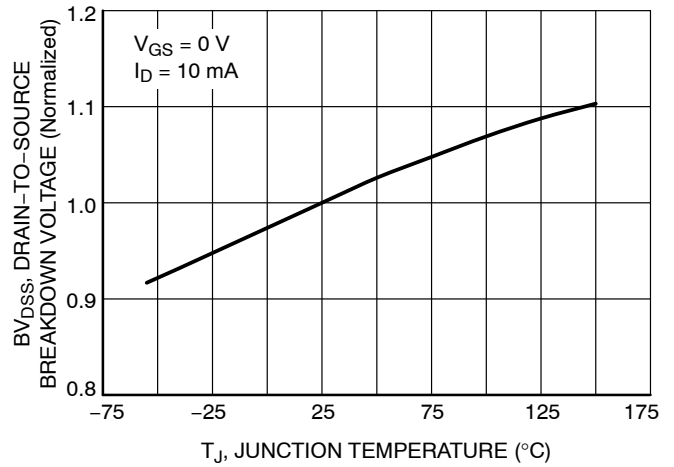


Figure 8. Breakdown Voltage Variation vs. Temperature

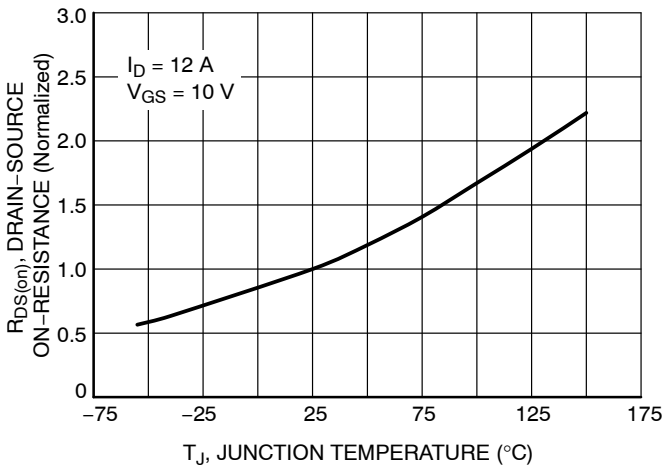


Figure 9. On-Resistance Variation vs. Temperature

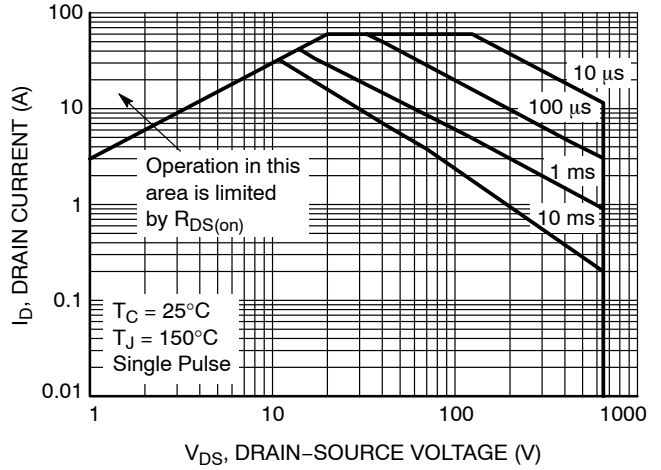


Figure 10. Maximum Safe Operating Area

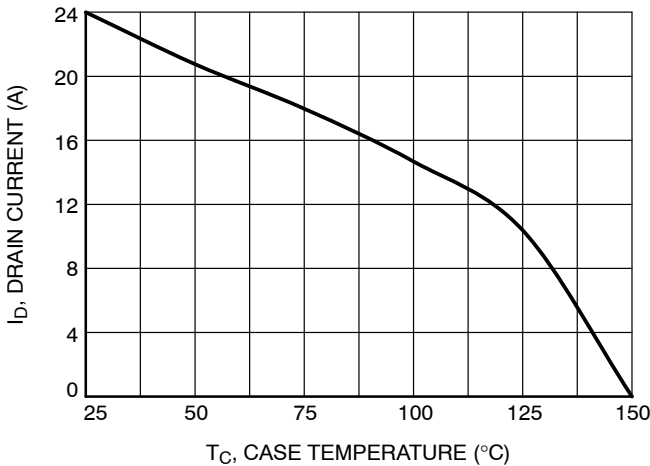


Figure 11. Maximum Drain Current vs. Case Temperature

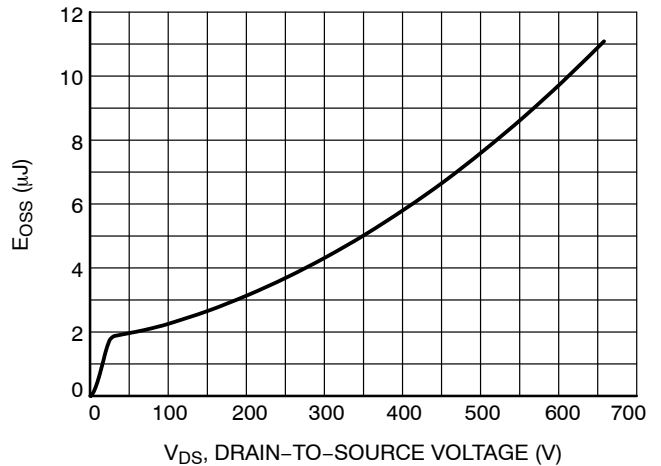
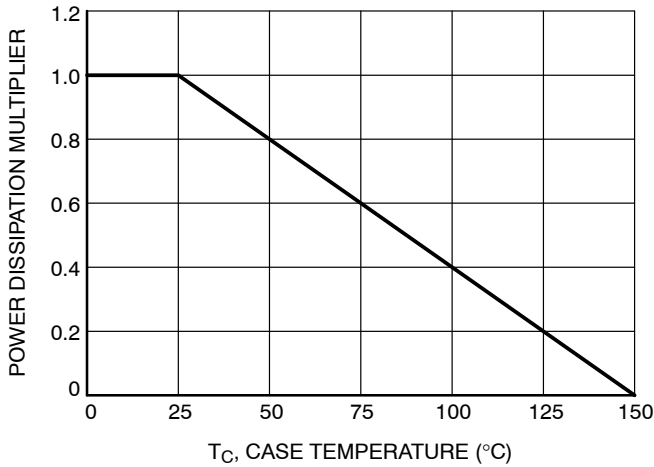


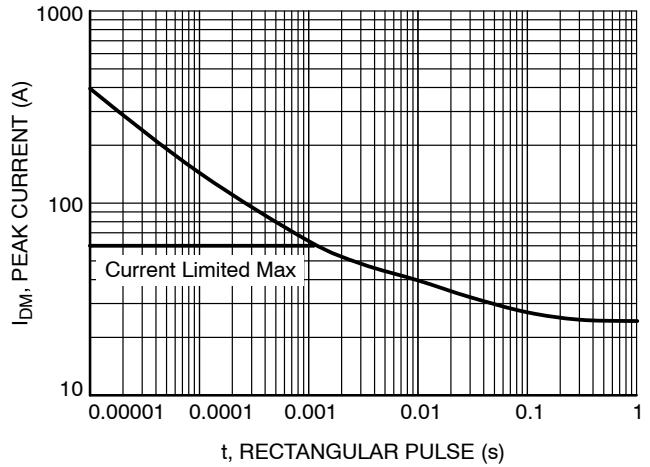
Figure 12.  $E_{OSS}$  vs. Drain-to-Source Voltage

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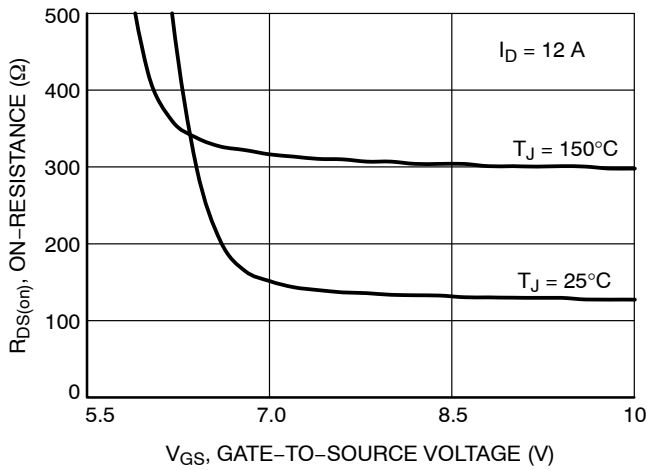
## TYPICAL CHARACTERISTICS



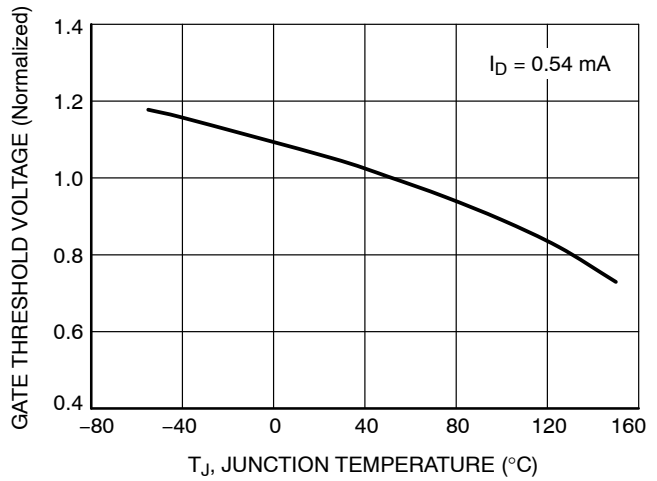
**Figure 13. Normalized Power Dissipation vs. Case Temperature**



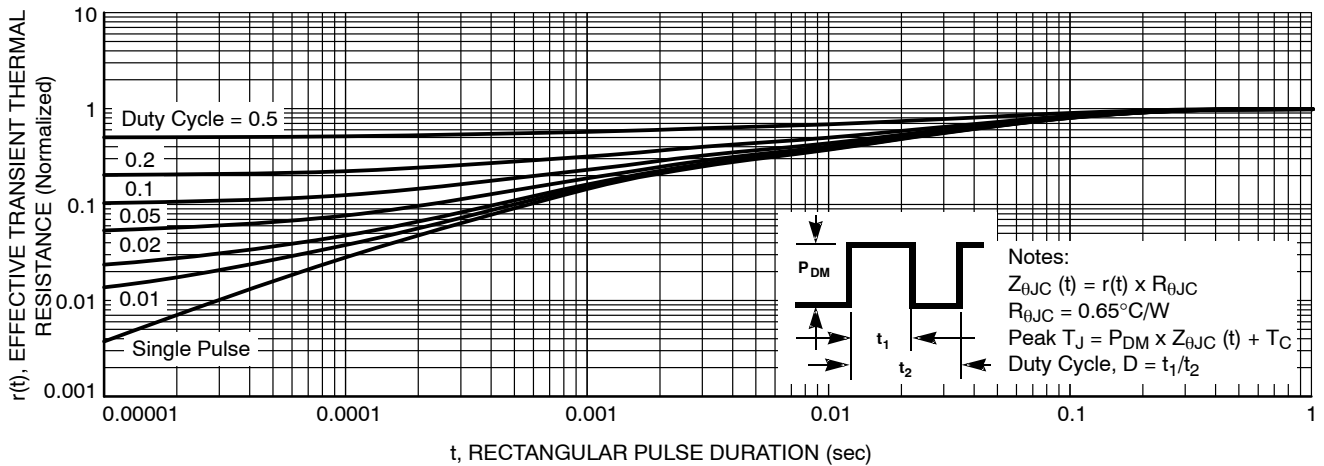
**Figure 14. Peak Current Capability**



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



**Figure 16. Normalized Gate Threshold Voltage vs. Temperature**



**Figure 17. Transient Thermal Response**

# NVB150N65S3F

## PACKAGE MARKING AND ORDERING INFORMATION

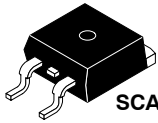
Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NVB150N65S3F	NVB150N65S3F	D <sup>2</sup> PAK	Tape & Reel†	330 mm	24 mm	800 Units

†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](#).

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



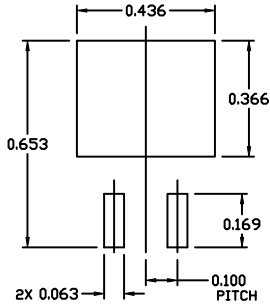
SCALE 1:1

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

#### CASE 418AJ

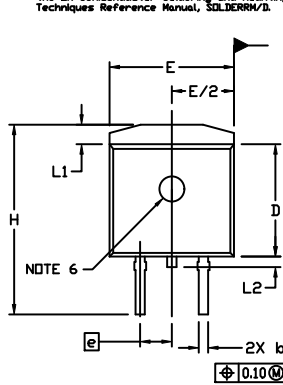
#### ISSUE F

DATE 11 MAR 2021



#### RECOMMENDED MOUNTING FOOTPRINT

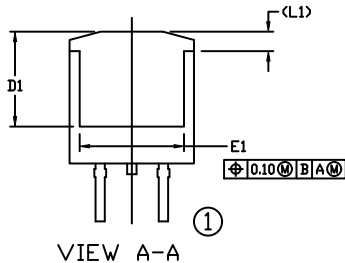
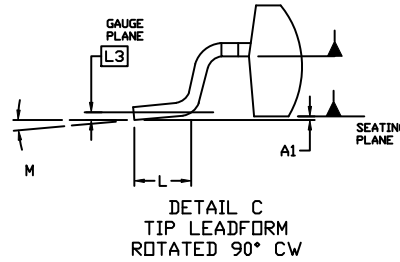
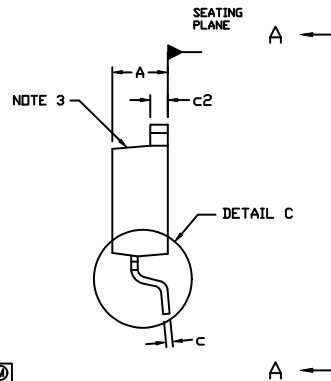
For additional information on our Pb-free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



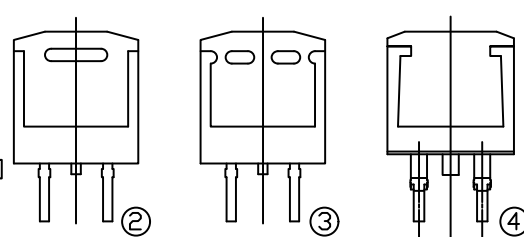
#### NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- CONTROLLING DIMENSION: INCHES
- CHAMFER OPTIONAL.
- 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.
- THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
- OPTIONAL MOLD FEATURE.
- 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*

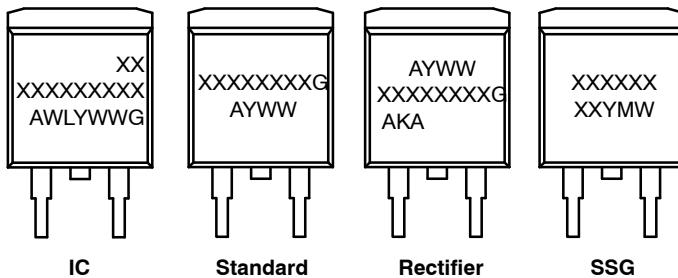


VIEW A-A



VIEW A-A  
OPTIONAL CONSTRUCTIONS

#### GENERIC MARKING DIAGRAMS\*



IC

Standard

Rectifier

SSG

- 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.

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<b>DESCRIPTION:</b>	<b>D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)</b>	<b>PAGE 1 OF 1</b>

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