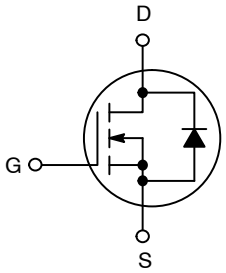
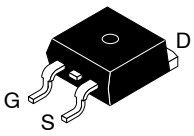
MOSFET - Power, Single N-Channel, D2PAK
650 V, 190 mΩ, 20 A

NVB190N65S3F

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
650 V	190 mΩ @ 10 V	20 A



N−CHANNEL MOSFET



D^2PAK−3
TO−263
CASE 418AJ

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.

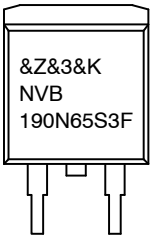
Features

- 700 V @ T_J = 150°C
- Typ. $R_{DS(on)}$ = 158 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 34 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 314 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

MARKING DIAGRAM



&Z	= Assembly Plant Code
&3	= Data Code (Year & Week)
&K	= Lot
NVB190N65S3F	= Specific Device Code

ORDERING INFORMATION

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

Table 1. ABSOLUTE MAXIMUM RATINGS (T_C = 25°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 Hz)	±30	
I_D	Drain Current	− Continuous (T_C = 25°C)	20	A
		− Continuous (T_C = 100°C)	12.7	
I_{DM}	Drain Current	− Pulsed (Note 1)	50	A
E_{AS}	Single Pulse Avalanche Energy (Note 2)		220	mJ
I_{AS}	Avalanche Current		2.8	A
E_{AR}	Repeated Avalanche Energy (Note 1)		1.62	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		50	
P_D	Power Dissipation	T_C = 25°C	162	W
		− Derate Above 25°C	1.3	W/°C
T_J, T_{stg}	Operating Junction and Storage Temperature		−55 to 150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8″ from Case for 5 Seconds		300	°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 = 2.8 A, RG = 25 Ω, starting T_J = 25°C.
3. ISD ≤ 10 A, di/dt ≤ 200 A/_s, V_{DD} ≤ 400 V, starting T_C = 25°C.

Table 2. THERMAL RESISTANCE RATINGS

Symbol	Parameter	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction−to−Case, Max.	0.77	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction−to−Ambient, Max.	40	

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
BV_{DSS}	Drain−to−Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA, T_J = 25°C	650	–	–	V
		V_{GS} = 0 V, I_D = 10 mA, T_J = 150°C	700	–	–	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 20 mA, Referenced to 25°C	–	0.61	–	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 650 V, V_{GS} = 0 V	–	–	10	μA
		V_{DS} = 520 V, T_C = 125°C	–	128	–	μA
I_{GSS}	Gate−to−Body Leakage Current	V_{DS} = 0 V, V_{GS} = ±30 V	–	–	±100	nA
ON CHARACTERISTICS						
$V_{GS(th)}$	Drain−to−Source Breakdown Voltage	V_{GS} = V_{DS}, I_D = 0.43 mA	3.0	–	5.0	V
$R_{DS(on)}$	Static Drain−to−Source On Resistance	V_{GS} = 10 V, I_D = 10 A	–	158	190	mΩ
g_{FS}	Forward Transconductance	V_{GS} = 20 V, I_D = 10 A	–	11	–	S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 400 V, V_{GS} = 0 V, f = 1 MHz	–	1605	–	pF
C_{oss}	Output Capacitance		–	32	–	pF
$C_{oss(eff.)}$	Effective Output Capacitance	V_{DS} = 0 to 400 V, V_{GS} = 0 V	–	314	–	pF
$C_{oss(er.)}$	Energy Related Output Capacitance	V_{DS} = 0 to 400 V, V_{GS} = 0 V	–	59	–	pF
$Q_{g(total)}$	Total Gate Charge at 10 V	V_{DS} = 400 V, I_D = 10 A, V_{GS} = 10 V (Note 4)	–	34	–	nC
Q_{gs}	Gate−to−Source Gate Charge		–	11	–	nC
Q_{gd}	Gate−to−Drain “Miller” Charge		–	13	–	nC
ESR	Equivalent Series Resistance	F = 1 MHz	–	2	–	Ω
SWITCHING CHARACTERISTICS, V_{GS} = 10 V						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400 V, I_D = 10 A, V_{GS} = 10 V, R_G = 4.7 Ω (Note 4)	–	19	–	ns
t_r	Rise Time		–	13	–	ns
$t_{d(off)}$	Turn-Off Delay Time		–	43	–	ns
t_f	Fall Time		–	3	–	ns
SOURCE−DRAIN DIODE CHARACTERISTICS						
I_S	Maximum Continuous Source−to−Drain Diode Forward Current		–	–	20	A
I_{SM}	Maximum Pulsed Source−to−Drain Diode Forward Current		–	–	50	A
V_{SD}	Source−to−Drain Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 10 A	–	–	1.3	V
t_{rr}	Reverse−Recovery Time	V_{GS} = 0 V, I_{SD} = 10 A, dI_F/dt = 100 A/μs	–	68	–	ns
Q_{rr}	Reverse−Recovery Charge		–	220	–	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

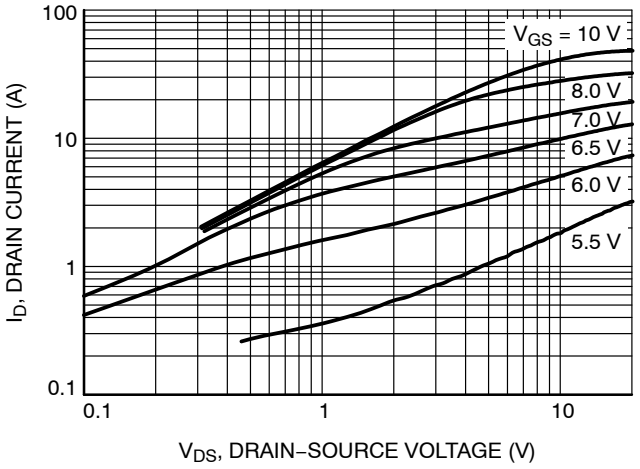


Figure 1. On−Region Characteristics 25°C

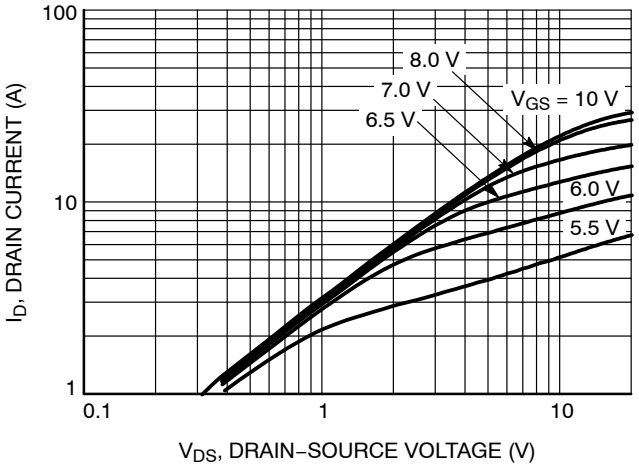


Figure 2. On−Region Characteristics 150°C

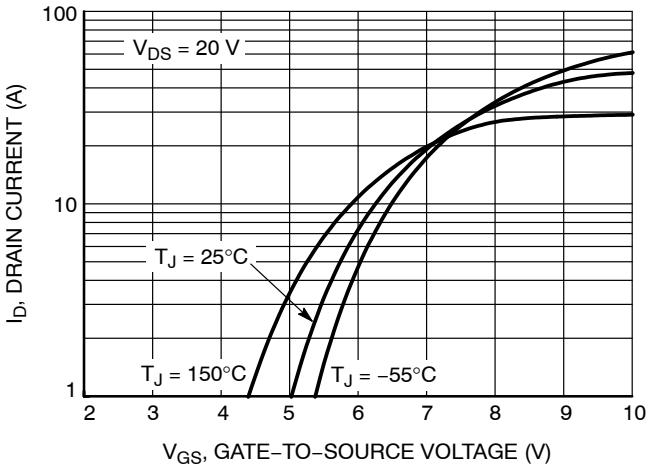


Figure 3. Transfer Characteristics

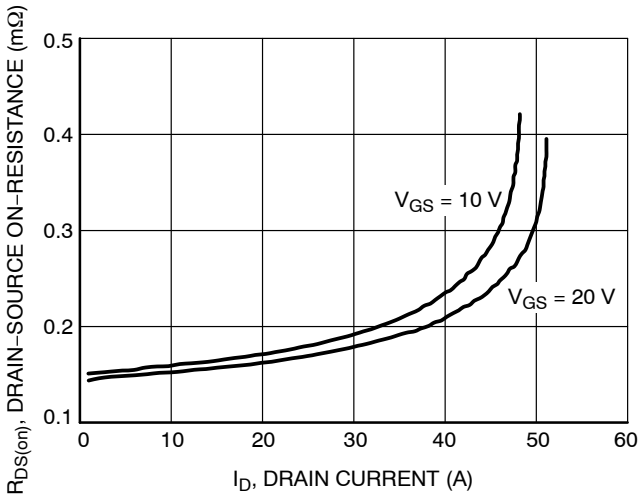


Figure 4. On−Resistance Variation vs. Drain Current and Gate Voltage

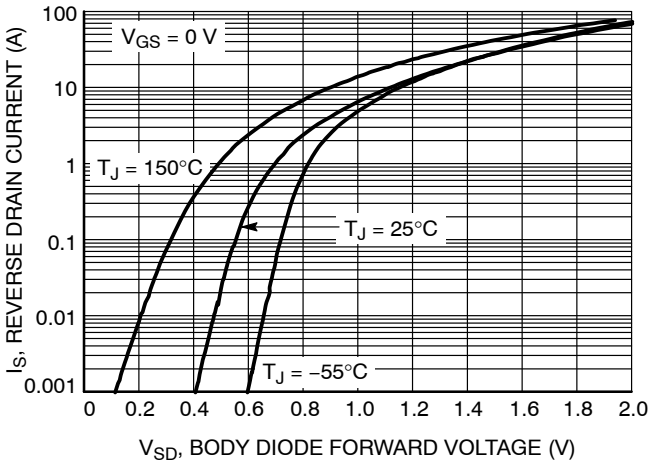


Figure 5. Body Diode Forward Voltage Variation vs. Source Current and Temperature

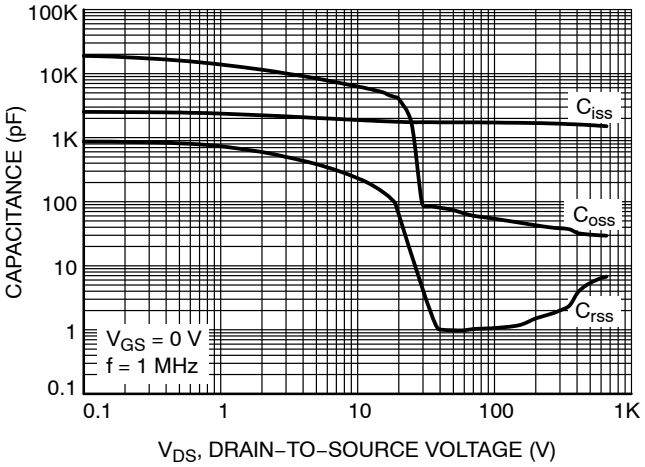


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS

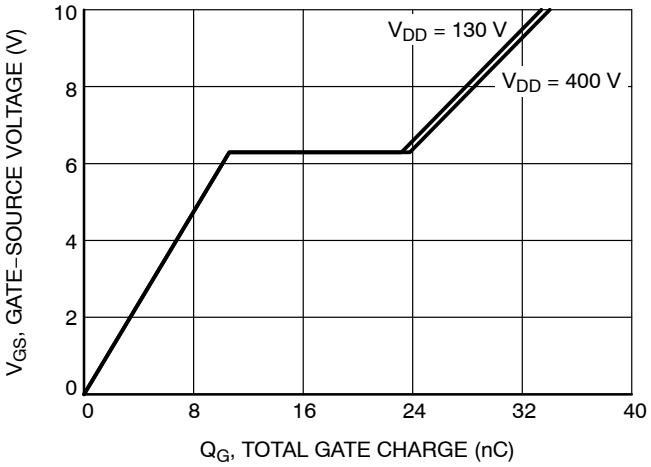


Figure 7. Gate Charge Characteristics

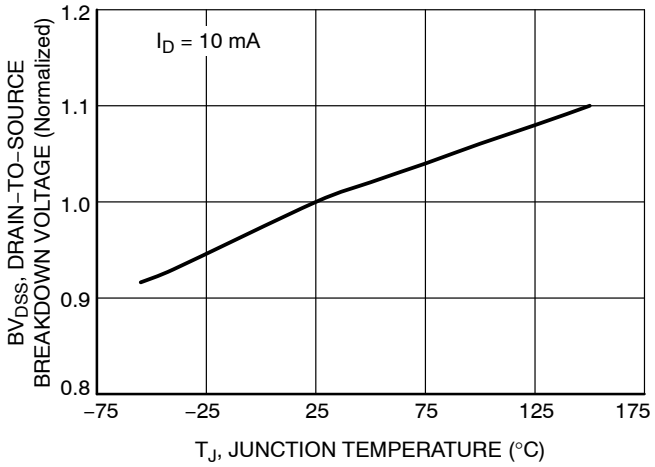


Figure 8. Breakdown Voltage Variation vs. Temperature

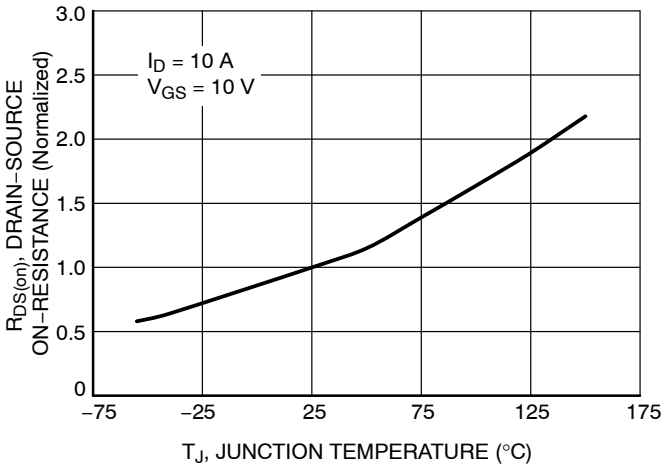


Figure 9. On−Resistance Variation vs. Temperature

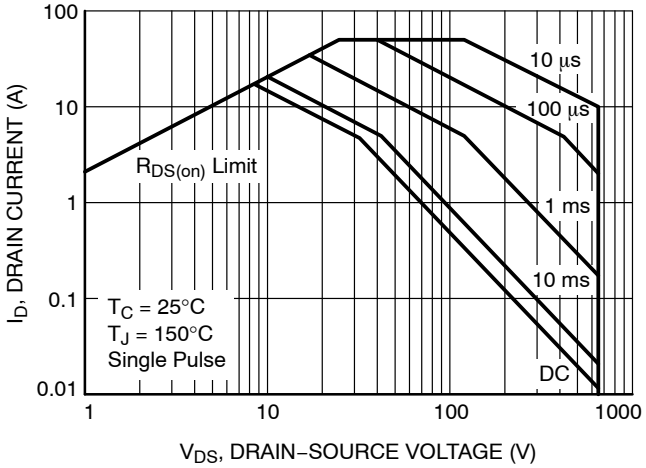


Figure 10. Maximum Safe Operating Area

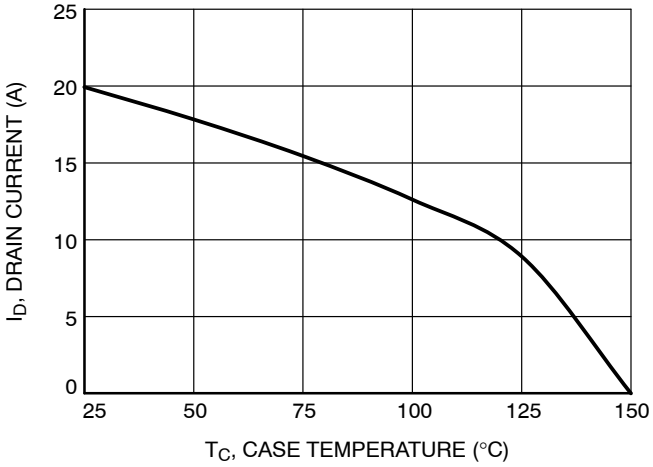


Figure 11. Maximum Drain Current vs. Case Temperature

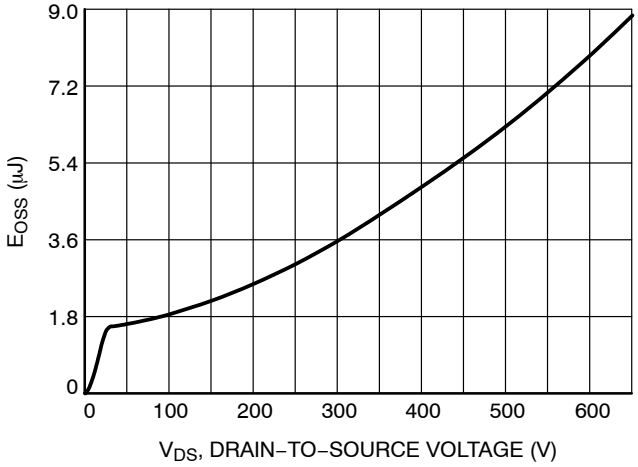


Figure 12. E_{OSS} vs. Drain−to−Source Voltage

TYPICAL CHARACTERISTICS

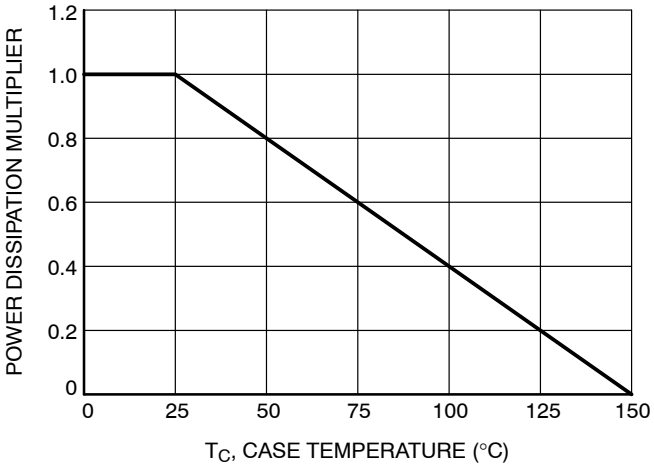


Figure 13. Normalized Power Dissipation vs. Case Temperature

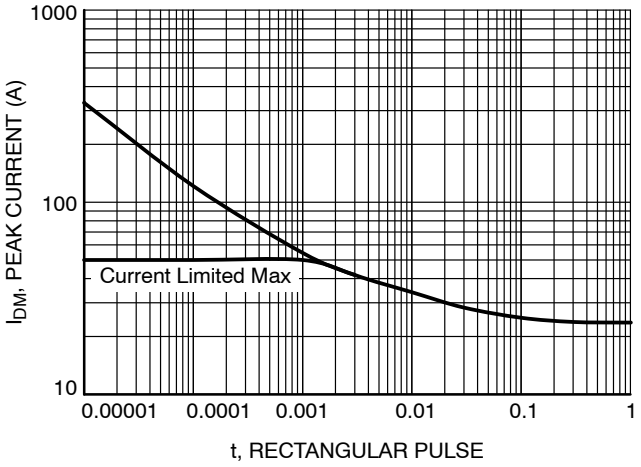


Figure 14. Peak Current Capability

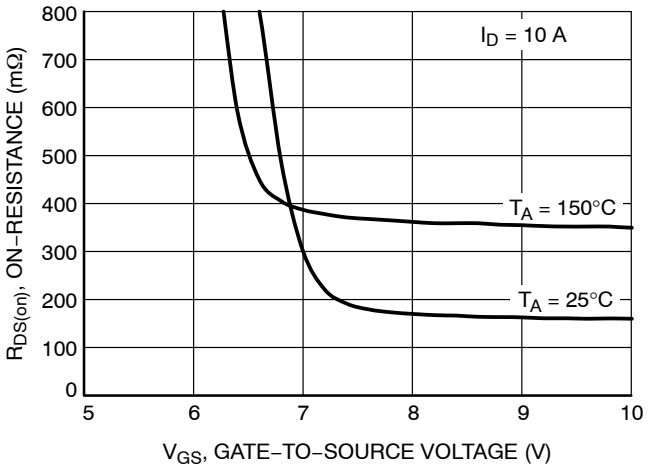


Figure 15. $R_{DS(on)}$ vs. Gate Voltage

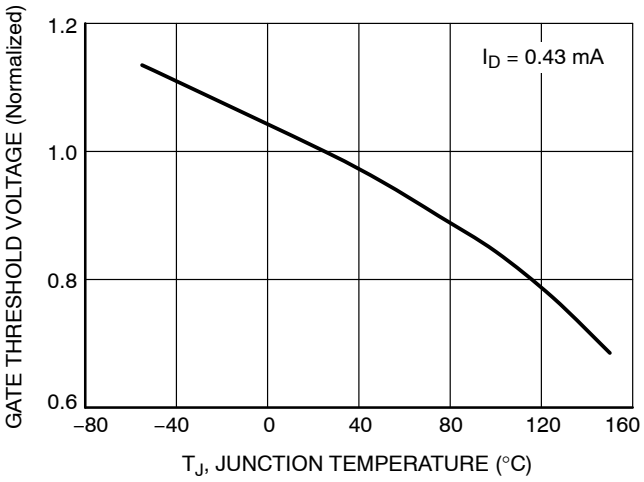


Figure 16. Normalized Gate Threshold Voltage vs. Temperature

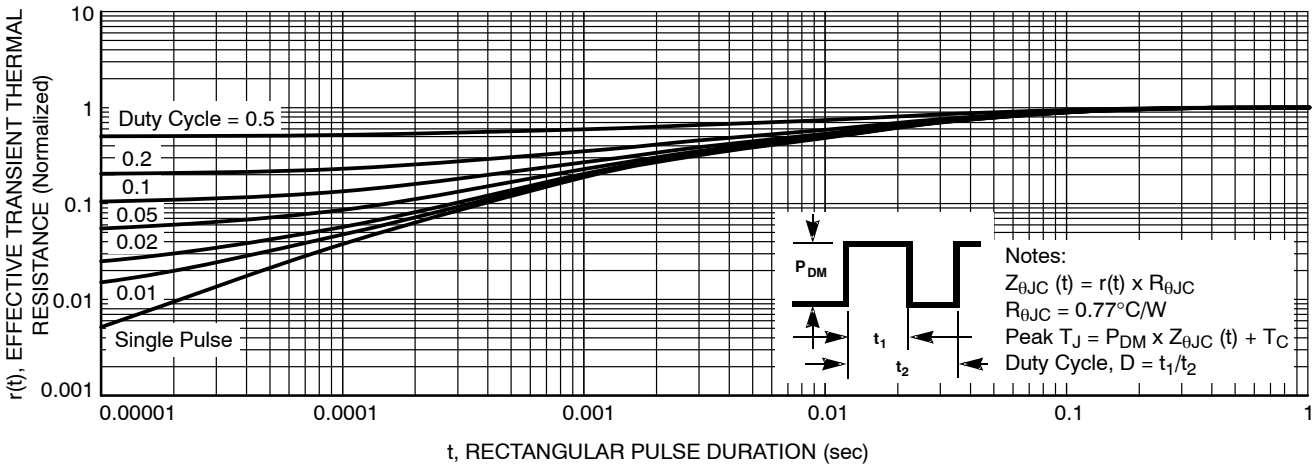
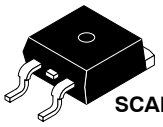


Figure 17. Transient Thermal Response

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NVB190N65S3F	NVB190N65S3F	D^2PAK	Tape & Reel†	330 mm	24 mm	800 Units

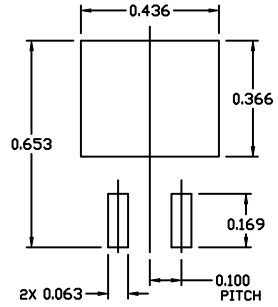
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



SCALE 1:1

D²PAK–3 (TO–263, 3–LEAD)
CASE 418AJ
ISSUE F

DATE 11 MAR 2021



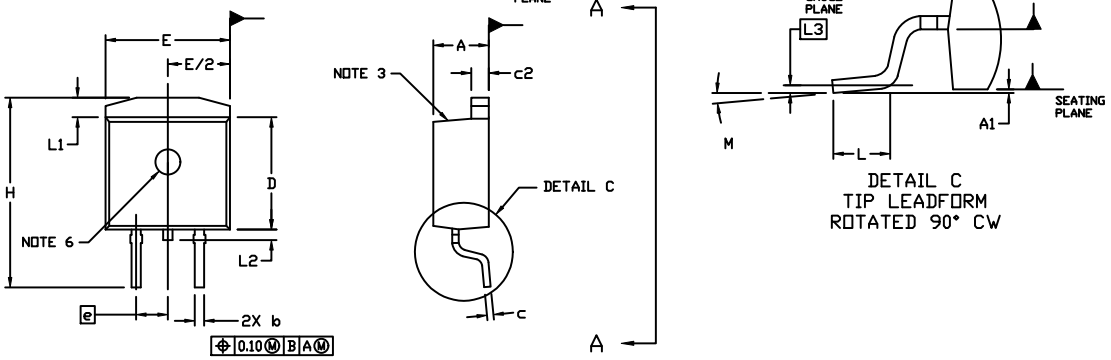
RECOMMENDED
MOUNTING FOOTPRINT

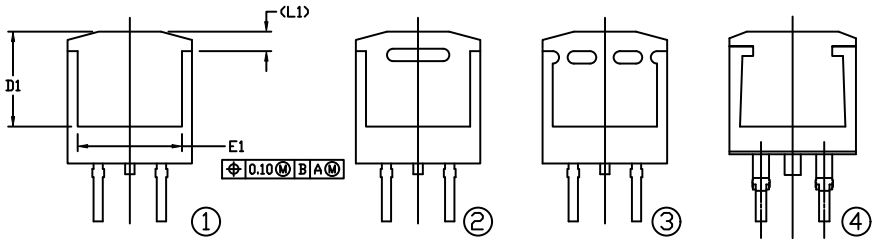
* For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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.

	INCHES		MILLIMETERS	
DIM	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°

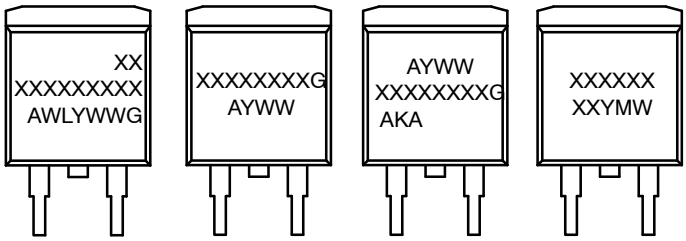




VIEW A–A

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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DESCRIPTION:	**D²PAK–3 (TO–263, 3–LEAD)**	**PAGE 1 OF 1**

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