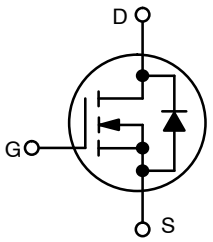
NTB190N65S3HF

Power MOSFET, N-Channel, SUPERFET® III, FRFET®, 650 V, 20 A, 190 mΩ

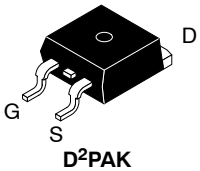
ON Semiconductor®

www.onsemi.com

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



N−CHANNEL MOSFET



D²PAK
(TO−263 3−Lead)
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 systems 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. $R_{DS(on)}$ = 161 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 34 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 316 pF)
- 100% Avalanche Tested
- These Devices are Pb−Free and are RoHS Compliant

Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- EV Charger
- UPS / Solar

MARKING DIAGRAM

$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Data Code (Year & Week)
&K	= Lot
NTB190N65S3HF	= Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise noted)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GSS}	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 Pulsed Avalanche Energy (Note 2)		220	mJ
I_{AS}	Avalanche Current (Note 2)		3.7	A
E_{AR}	Repetitive 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 and Storage Temperature Range		–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. I_{AS} = 3.7 A, R_G = 25 Ω, starting T_J = 25°C.
3. $I_{SD} \le$ 10 A, di/dt ≤ 200 A/μs, $V_{DD} \le$ 400 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.77	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max. (Note 4)	40	

4. Device on 1 in^2 2−oz copper pad on 1.5 x 1.5 in. board of FR−4 material.

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Reel Size	Tape Width	Shipping†
NTB190N65S3HF	NTB190N65S3HF	D^2PAK	330 mm	24 mm	800 / Tape & Reel

†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.

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 = 1 mA, T_J = 150°C	700			V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 10 mA, Referenced to 25°C		0.65		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		65		
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±30 V, V_{DS} = 0 V			±100	nA
ON CHARACTERISTICS						
$V_{GS(th)}$	Gate Threshold 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		161	190	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 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		1610		pF
C_{oss}	Output Capacitance			30		pF
$C_{oss(eff.)}$	Effective Output Capacitance	V_{DS} = 0 V to 400 V, V_{GS} = 0 V		316		pF
$C_{oss(er.)}$	Energy Related Output Capacitance	V_{DS} = 0 V to 400 V, V_{GS} = 0 V		59		pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	V_{DS} = 400 V, I_D = 10 A, V_{GS} = 10 V (Note 5)		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		6.8		Ω
SWITCHING CHARACTERISTICS						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400 V, I_D = 10 A, V_{GS} = 10 V, R_g = 4.7 Ω (Note 5)		19		ns
t_r	Turn-On Rise Time			19		ns
$t_{d(off)}$	Turn-Off Delay Time			58		ns
t_f	Turn-Off Fall Time			14		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		80		ns
Q_{rr}	Reverse Recovery Charge			264		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.

5. Essentially independent of operating temperature typical characteristics.

TYPICAL CHARACTERISTICS

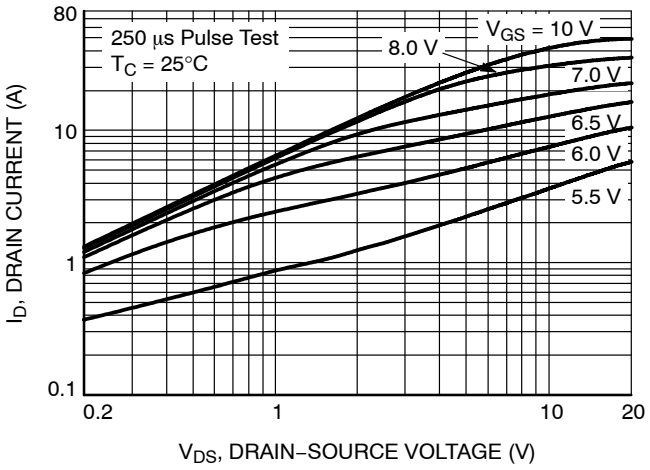


Figure 1. On−Region Characteristics

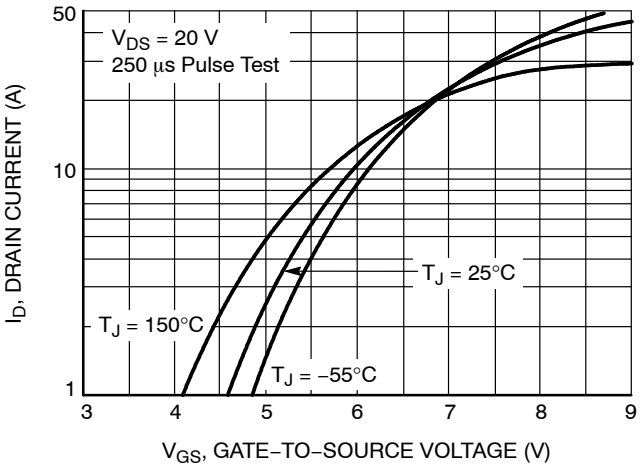


Figure 2. Transfer Characteristics

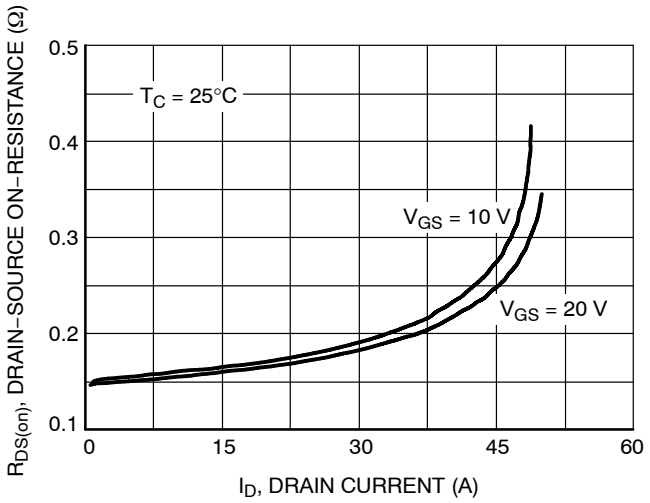


Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage

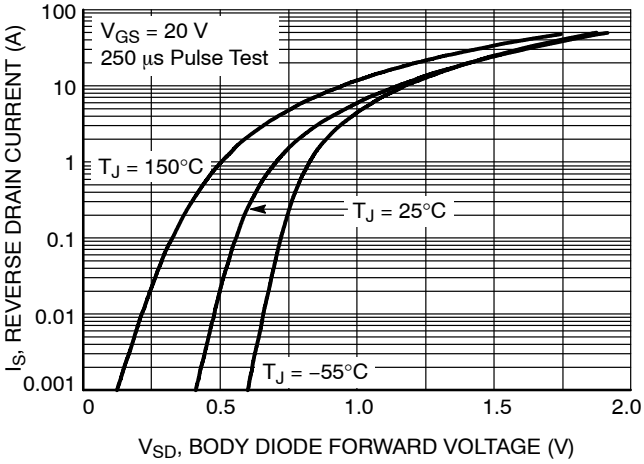


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

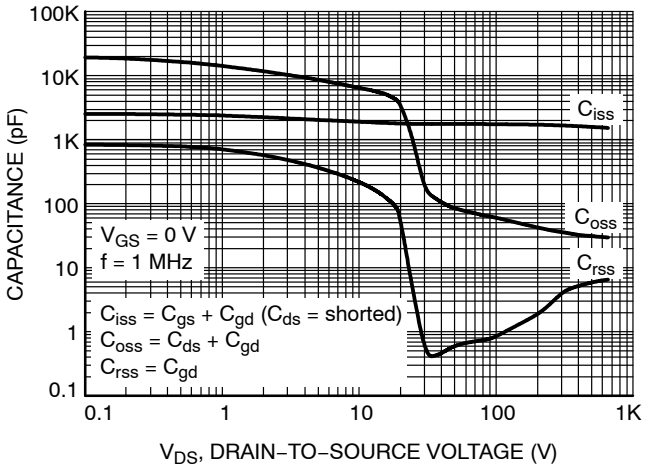


Figure 5. Capacitance Characteristics

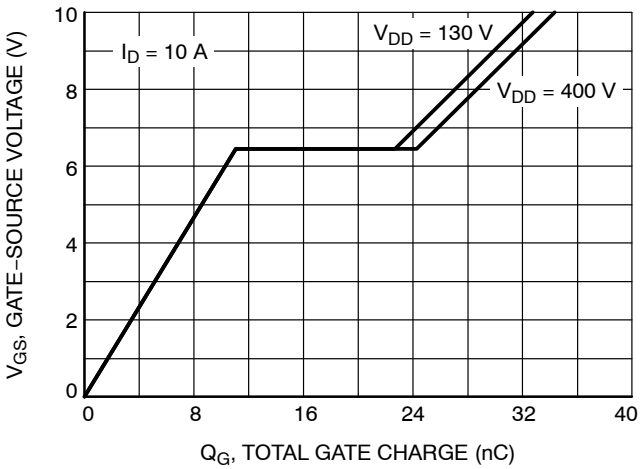


Figure 6. Gate Charge Characteristics

TYPICAL CHARACTERISTICS

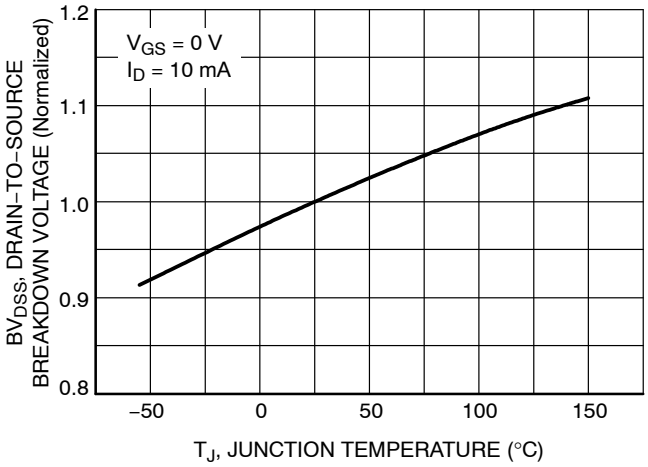


Figure 7. Breakdown Voltage Variation vs. Temperature

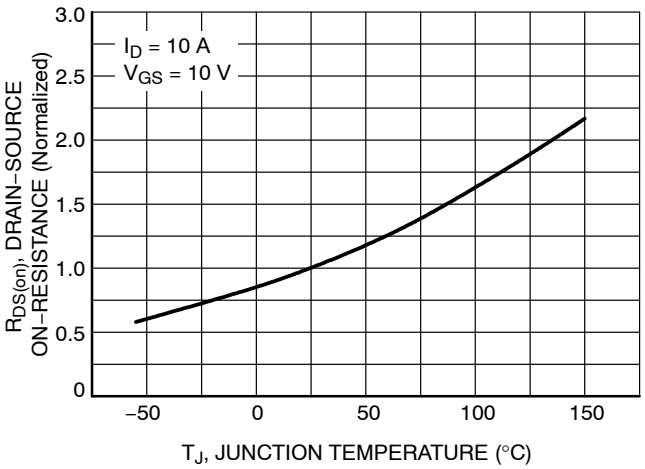


Figure 8. On−Resistance Variation vs. Temperature

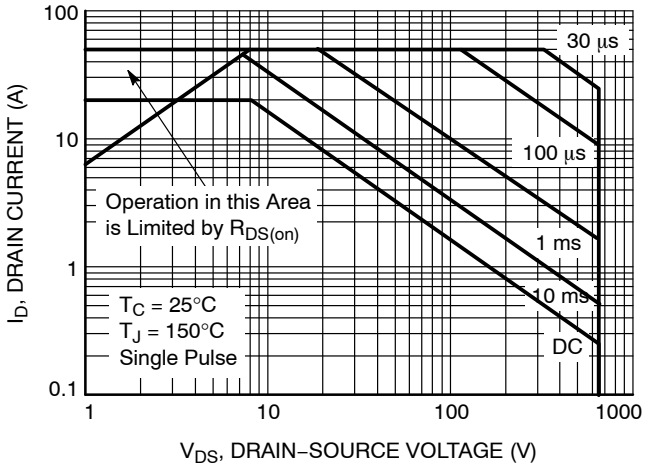


Figure 9. Maximum Safe Operating Area

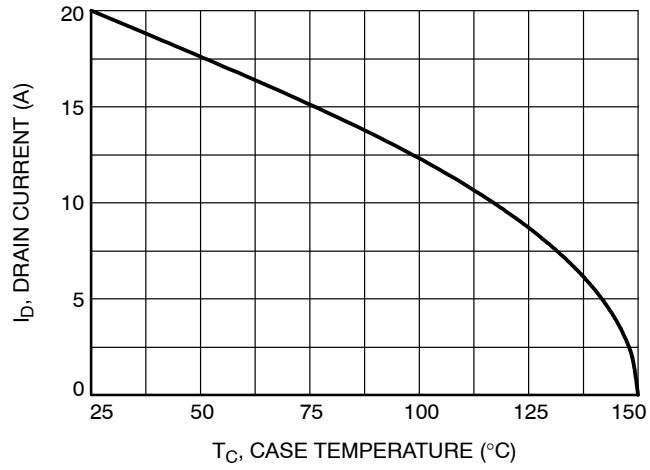


Figure 10. Maximum Drain Current vs. Case Temperature

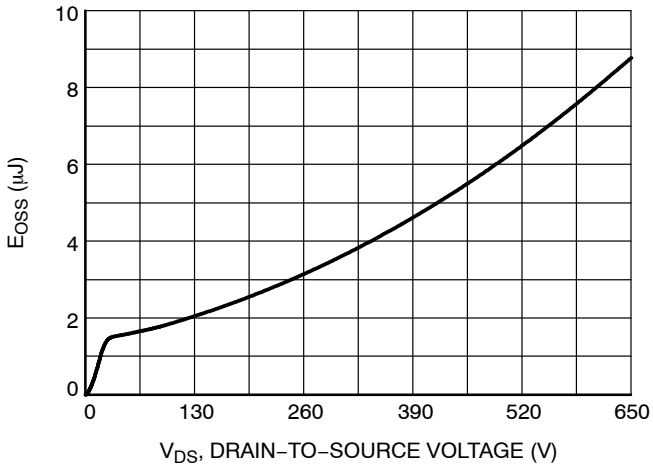


Figure 11. E_{OSS} vs. Drain−to−Source Voltage

TYPICAL CHARACTERISTICS

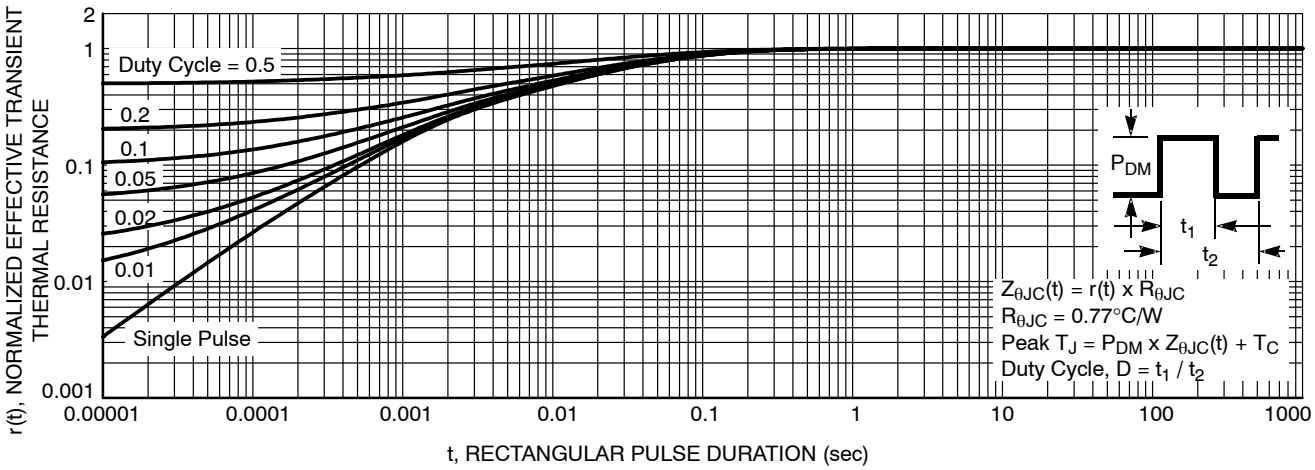


Figure 12. Transient Thermal Response Curve

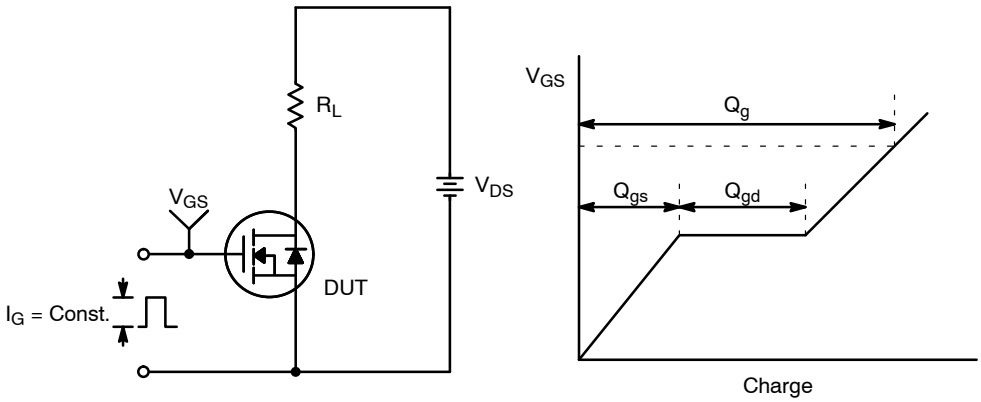


Figure 13. Gate Charge Test Circuit & Waveform

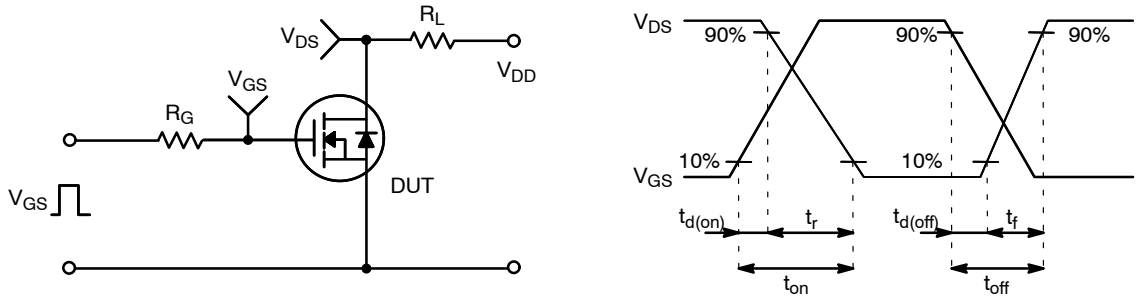


Figure 14. Resistive Switching Test Circuit & Waveforms

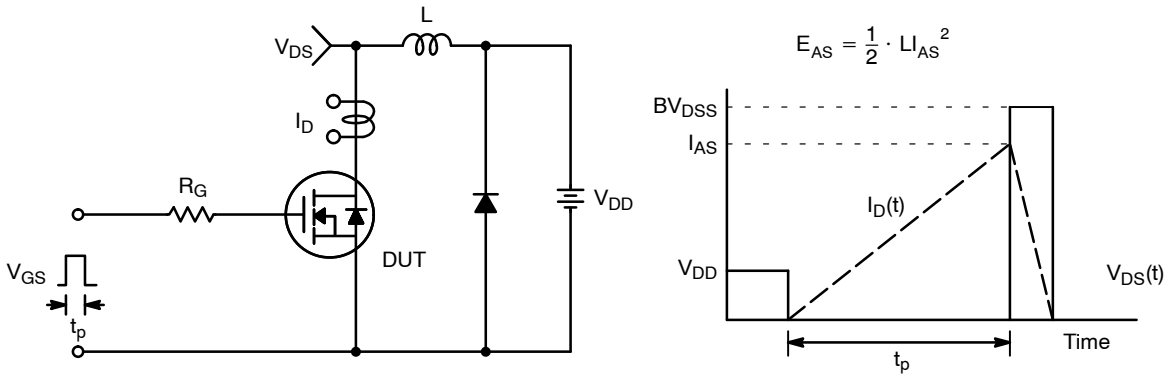


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

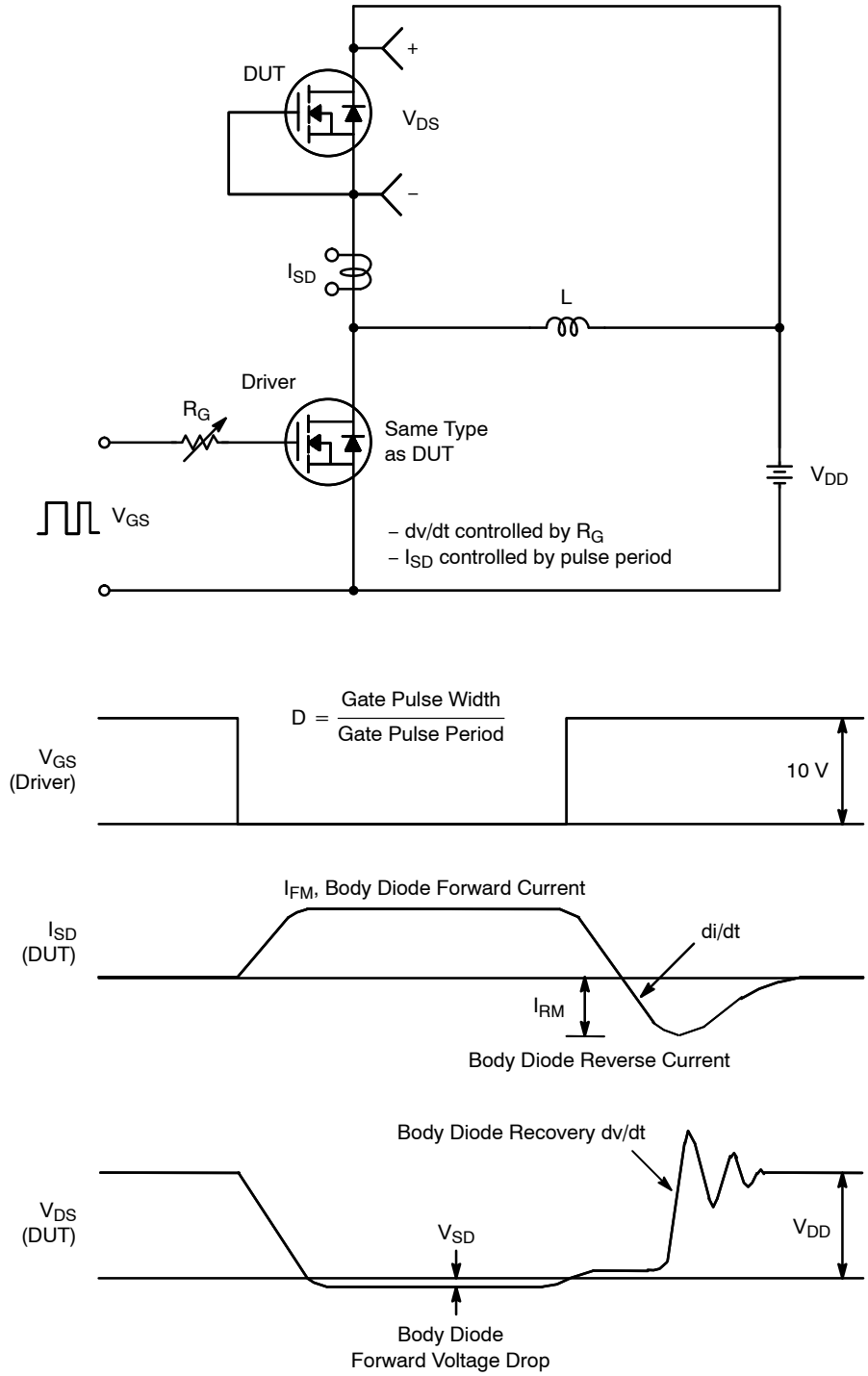


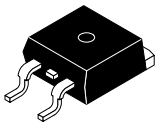
Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

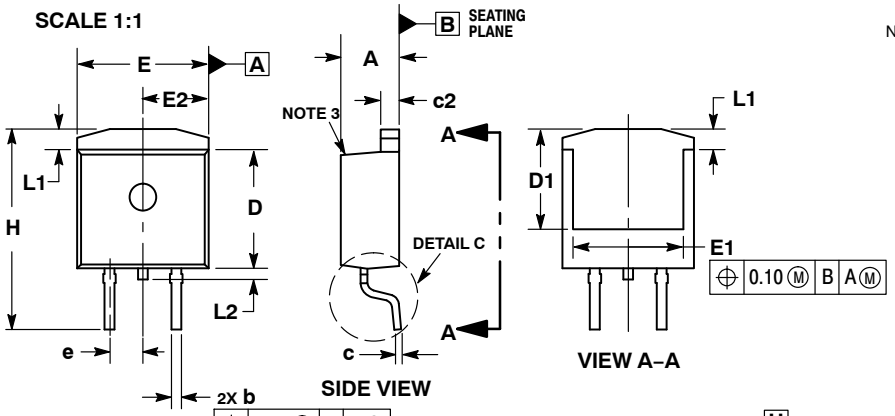
ON Semiconductor®

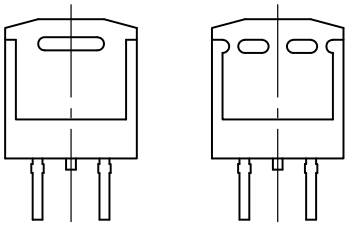
D²PAK–3 (TO–263, 3–LEAD)
CASE 418AJ
ISSUE C

DATE 03 OCT 2018

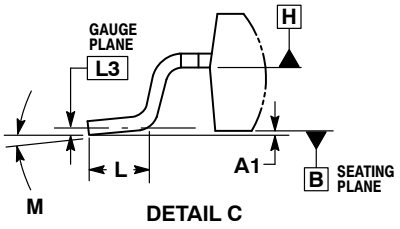


SCALE 1:1





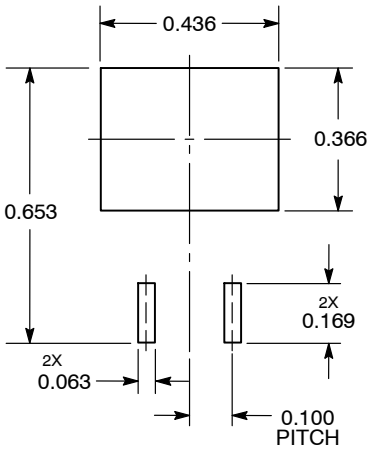
VIEW A–A
OPTIONAL CONSTRUCTIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
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.

	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	–8°	8°	–8°	8°

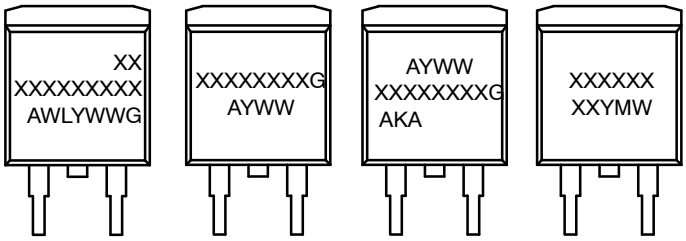
RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: INCHES

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

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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