

MOSFET – Power, N-Channel, SUPERFET III, FRFET

650 V, 36 A, 95 mΩ



ON Semiconductor®

www.onsemi.com

NVB095N65S3F

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.

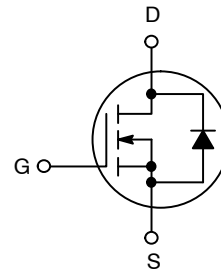
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 78\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 65\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 597\text{ pF}$)
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen-Free/BFR-Free and are RoHS Compliant

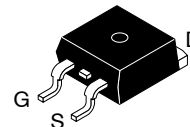
Applications

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

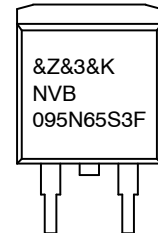
V_{DSS}	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	95 mΩ @ 10 V	36 A



MARKING DIAGRAM



D²PAK-3
TO-263
CASE 418AJ



&Z = Assembly Plant Code
&3 = Data Code (Year & Week)
&K = Lot
NVB095N65S3F = Specific Device Code

ORDERING INFORMATION

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

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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
		- AC (f > 1 Hz)	±30
I _D	Drain Current	- Continuous (T _C = 25°C)	36
		- Continuous (T _C = 100°C)	22.8
I _{DM}	Drain Current	- Pulsed (Note 1)	90
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	440	mJ
I _{AS}	Avalanche Current (Note 2)	4.6	A
E _{AR}	Repetitive Avalanche Energy (Note 1)	2.72	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)	272
		- Derate Above 25°C	2.176
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} = 4.6 A, R_G = 25 Ω, starting T_J = 25°C.
3. I_{SD} ≤ 18 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R _{θJC}	Thermal Resistance, Junction to Case, Max.	0.46	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max.	40	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Reel Size	Tape Width	Shipping [†]
NVB095N65S3F	NVB095N65S3F	D ² PAK	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](#).

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

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
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OFF CHARACTERISTICS

Drain to Source Breakdown Voltage	BV _{DSS}	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
Breakdown Voltage Temperature Coefficient	ΔBV _{DSS} /ΔT _J	I _D = 15 mA, Referenced to 25°C		640		mV/°C
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 650 V, V _{GS} = 0 V			10	μA
		V _{DS} = 520 V, T _C = 125°C		12		
Gate to Body Leakage Current	I _{GSS}	V _{GS} = ±30 V, V _{DS} = 0 V			±100	nA

ON CHARACTERISTICS

Gate Threshold Voltage	V _{GS(th)}	V _{GS} = V _{DS} , I _D = 0.86 mA	3.0		5.0	V
Threshold Temperature Coefficient	ΔV _{GS(th)} /ΔT _J	V _{GS} = V _{DS} , I _D = 0.86 mA		-7		mV/°C
Static Drain to Source On Resistance	R _{DS(on)}	V _{GS} = 10 V, I _D = 18 A		78	95	mΩ
Forward Transconductance	g _{FS}	V _{DS} = 20 V, I _D = 18 A		19		S

DYNAMIC CHARACTERISTICS

Input Capacitance	C _{iss}	V _{DS} = 400 V, V _{GS} = 0 V, f = 1 MHz		3020		pF
Output Capacitance	C _{oss}			61		
Reverse Transfer Capacitance	C _{rss}			7.0		
Effective Output Capacitance	C _{oss(eff.)}	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		597		pF
Energy Related Output Capacitance	C _{oss(er.)}	V _{DS} = 0 V to 400 V, V _{GS} = 0 V		107		pF
Total Gate Charge at 10V	Q _{g(tot)}	V _{GS} = 10 V, V _{DS} = 400 V, I _D = 18 A (Note 4)		66		nC
Threshold Gate Charge	Q _{g(th)}			13		
Gate to Source Gate Charge	Q _{gs}			22		
Gate to Drain "Miller" Charge	Q _{gd}			26		
Equivalent Series Resistance	ESR	f = 1 MHz		2.4		Ω

SWITCHING CHARACTERISTICS

Turn-On Delay Time	t _{d(on)}	V _{GS} = 10 V, V _{DD} = 400 V, I _D = 18 A, R _g = 2.2 Ω (Note 4)		26		ns
Turn-On Rise Time	t _r			26		ns
Turn-Off Delay Time	t _{d(off)}			62		ns
Turn-Off Fall Time	t _f			4.0		ns

SOURCE-DRAIN DIODE CHARACTERISTICS

Maximum Continuous Source to Drain Diode Forward Current	I _S	V _{GS} = 0 V			36	A
Maximum Pulsed Source to Drain Diode Forward Current	I _{SM}	V _{GS} = 0 V			90	A
Source to Drain Diode Forward Voltage	V _{SD}	V _{GS} = 0 V, I _{SD} = 18 A			1.3	V
Reverse Recovery Time	t _{rr}	V _{GS} = 0 V, dI _F /dt = 100 A/μs, I _{SD} = 18 A		97		ns
Charge Time	t _a			78		
Discharge Time	t _b			19		
Reverse Recovery Charge	Q _{rr}			349		

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

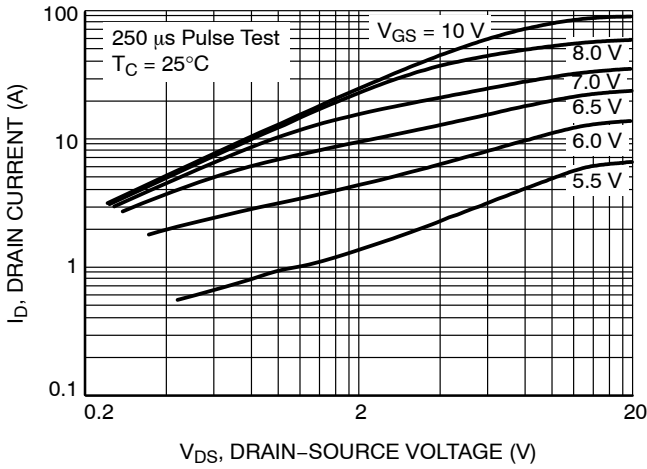


Figure 1. On-Region Characteristics
25°C

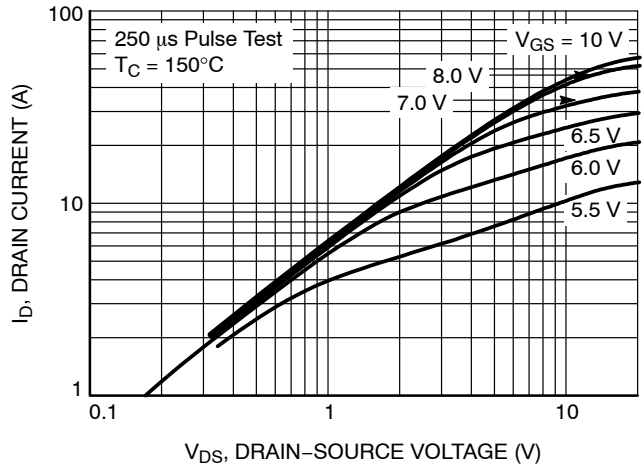


Figure 2. On-Region Characteristics
150°C

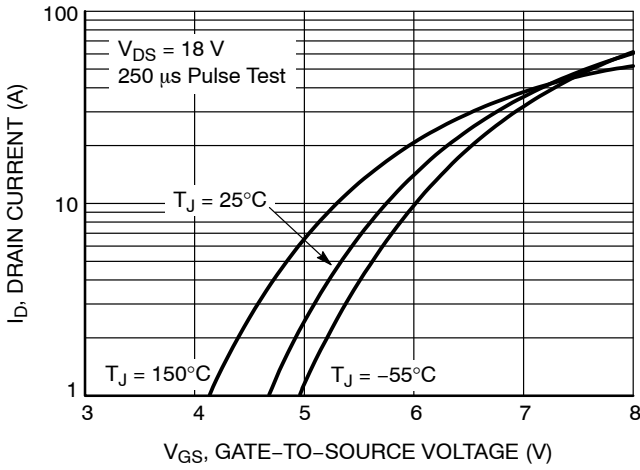


Figure 3. Transfer Characteristics

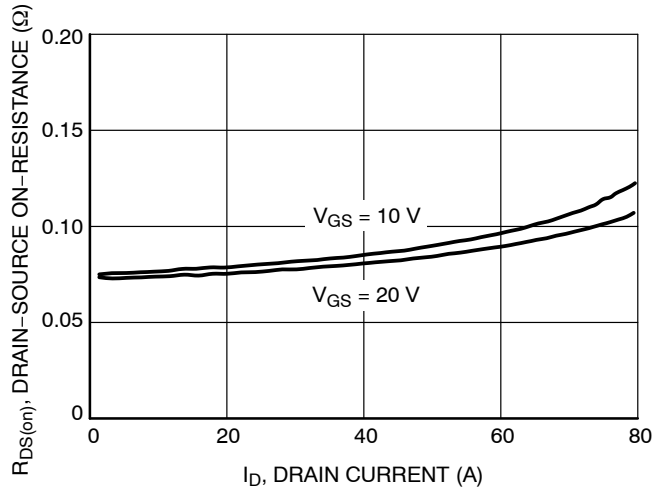


Figure 4. On-Resistance Variation vs. Drain Current and Gate Voltage

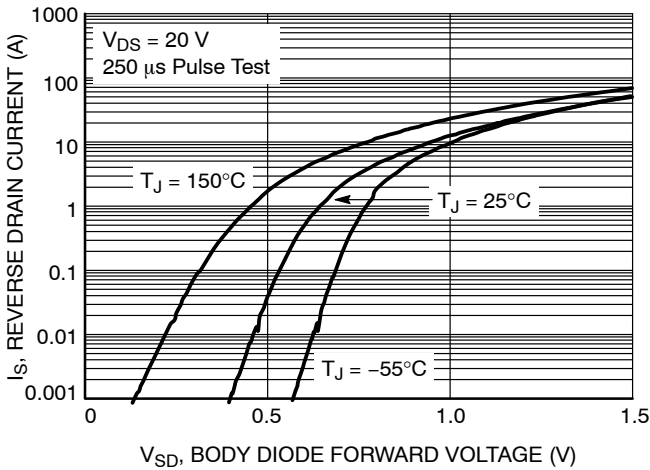


Figure 5. Body Diode Forward Voltage Variation vs. Source Current and Temperature

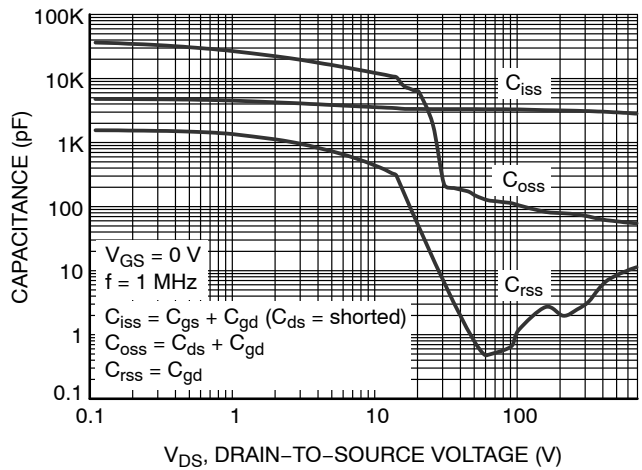


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS

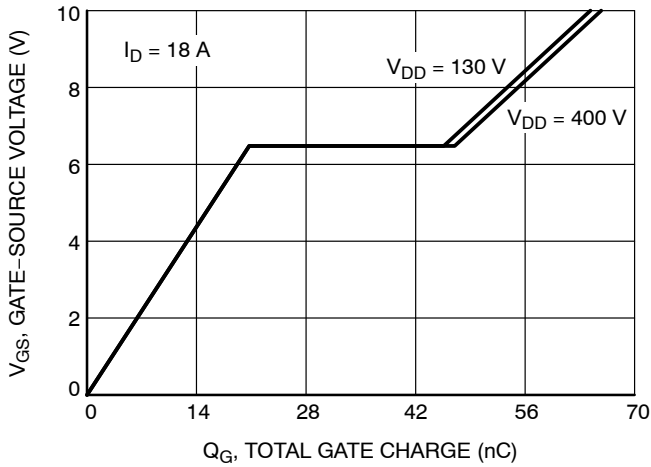


Figure 7. Gate Charge Characteristics

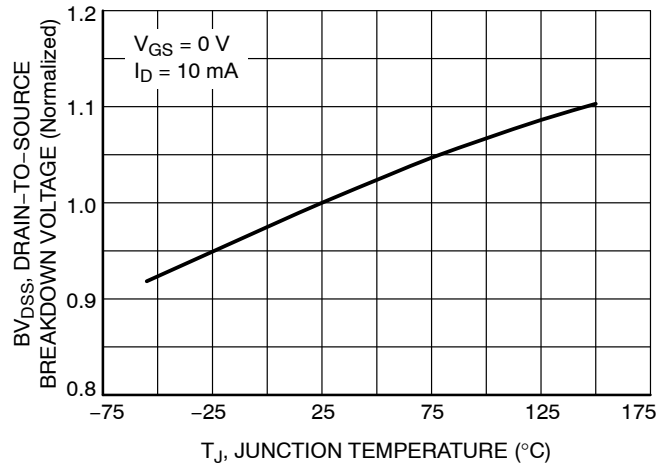


Figure 8. Breakdown Voltage Variation vs. Temperature

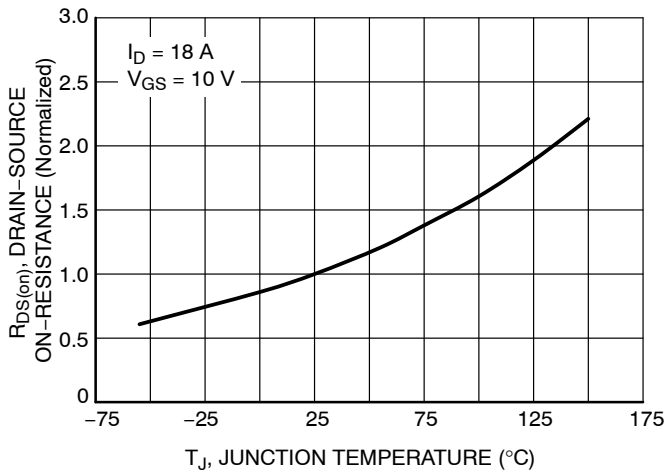


Figure 9. On-Resistance Variation vs. Temperature

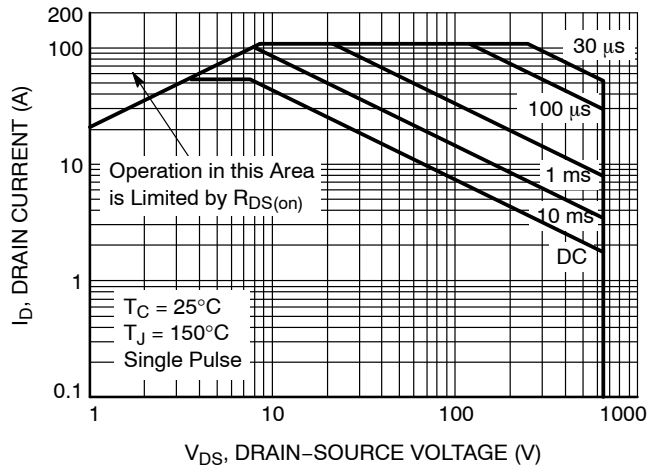


Figure 10. Maximum Safe Operating Area

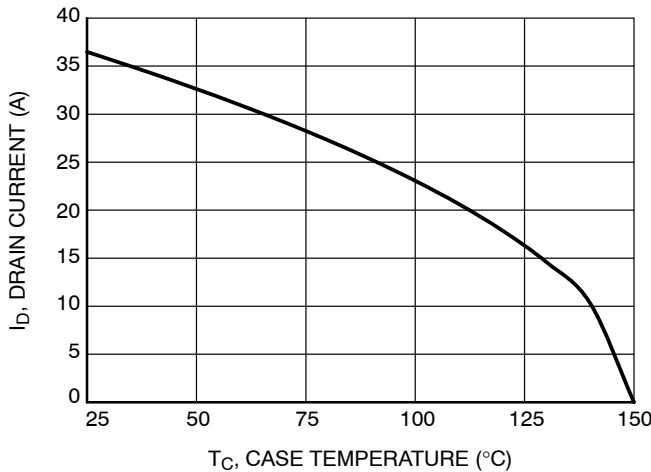


Figure 11. Maximum Drain Current vs. Case Temperature

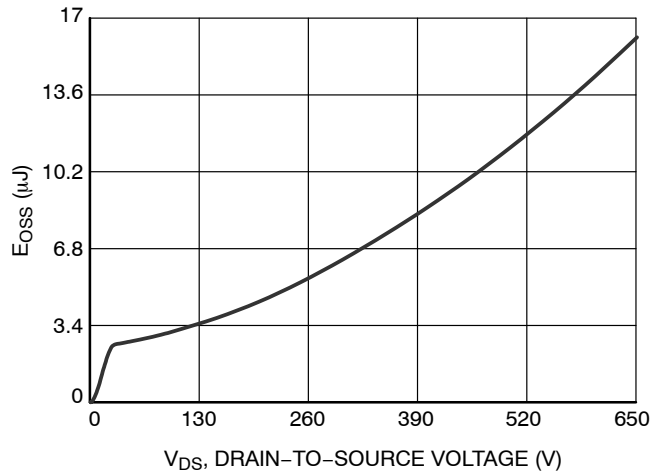


Figure 12. E_{OSS} vs. Drain-to-Source Voltage

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TYPICAL CHARACTERISTICS

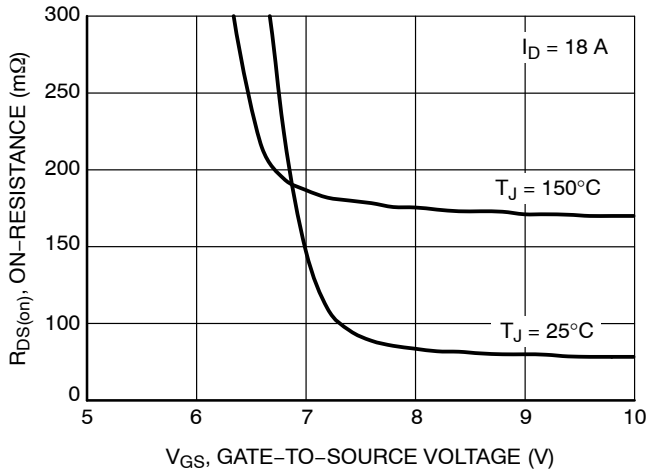


Figure 13. $R_{DS(on)}$ vs. Gate Voltage

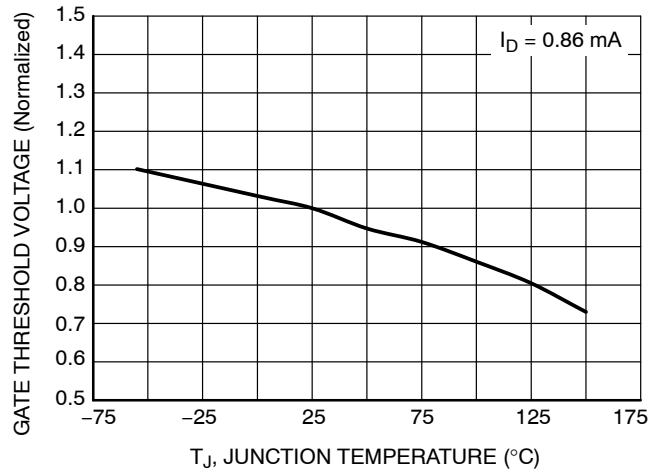


Figure 14. Normalized Gate Threshold Voltage vs. Temperature

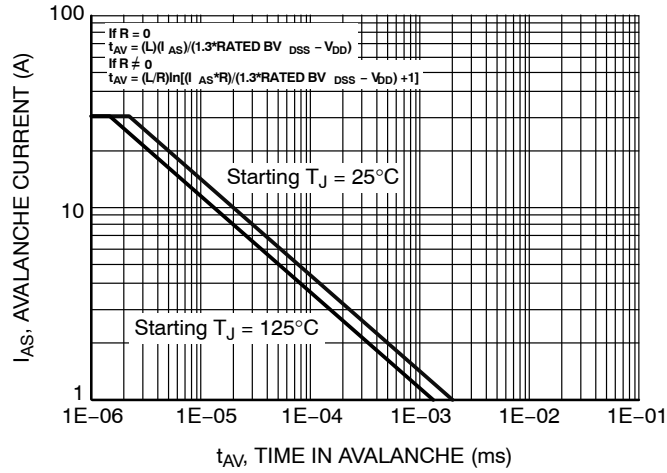


Figure 15. Unclamped Inductive Switching Capability

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TYPICAL CHARACTERISTICS

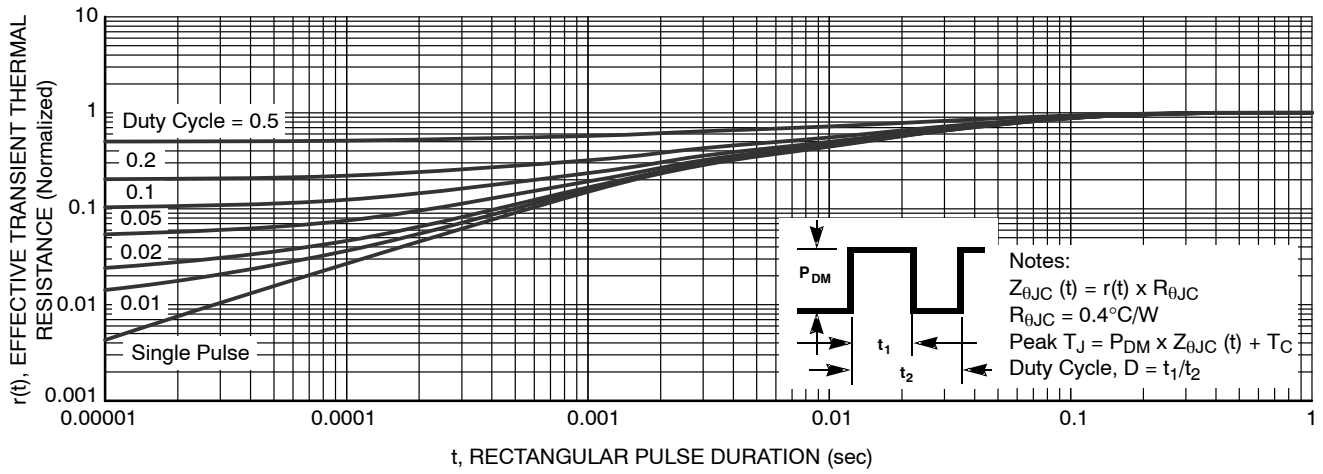


Figure 16. Transient Thermal Response

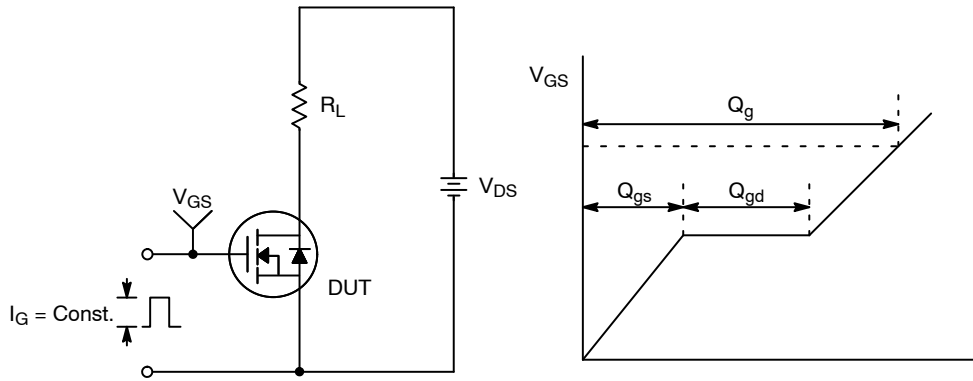


Figure 17. Gate Charge Test Circuit & Waveform

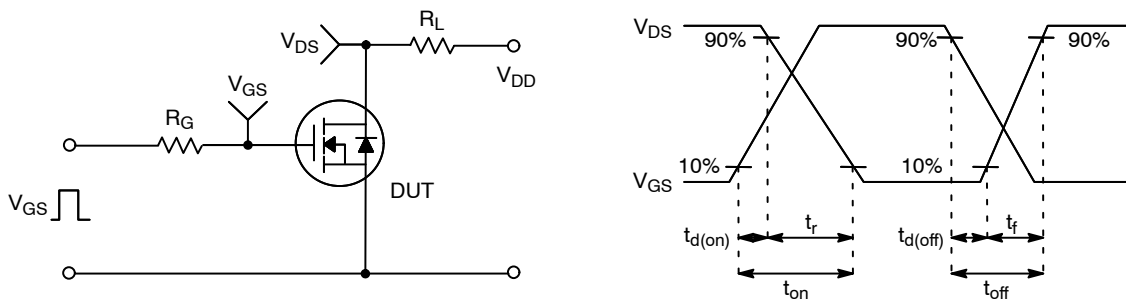


Figure 18. Resistive Switching Test Circuit & Waveforms

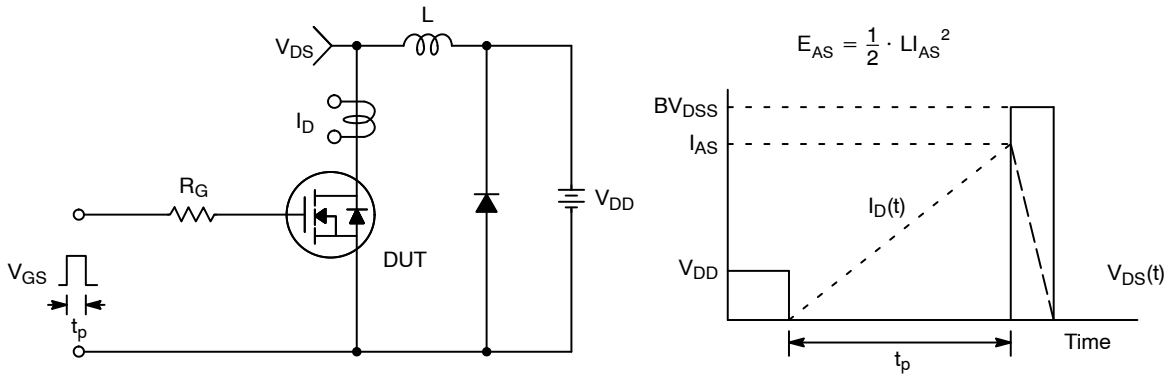


Figure 19. Unclamped Inductive Switching Test Circuit & Waveforms

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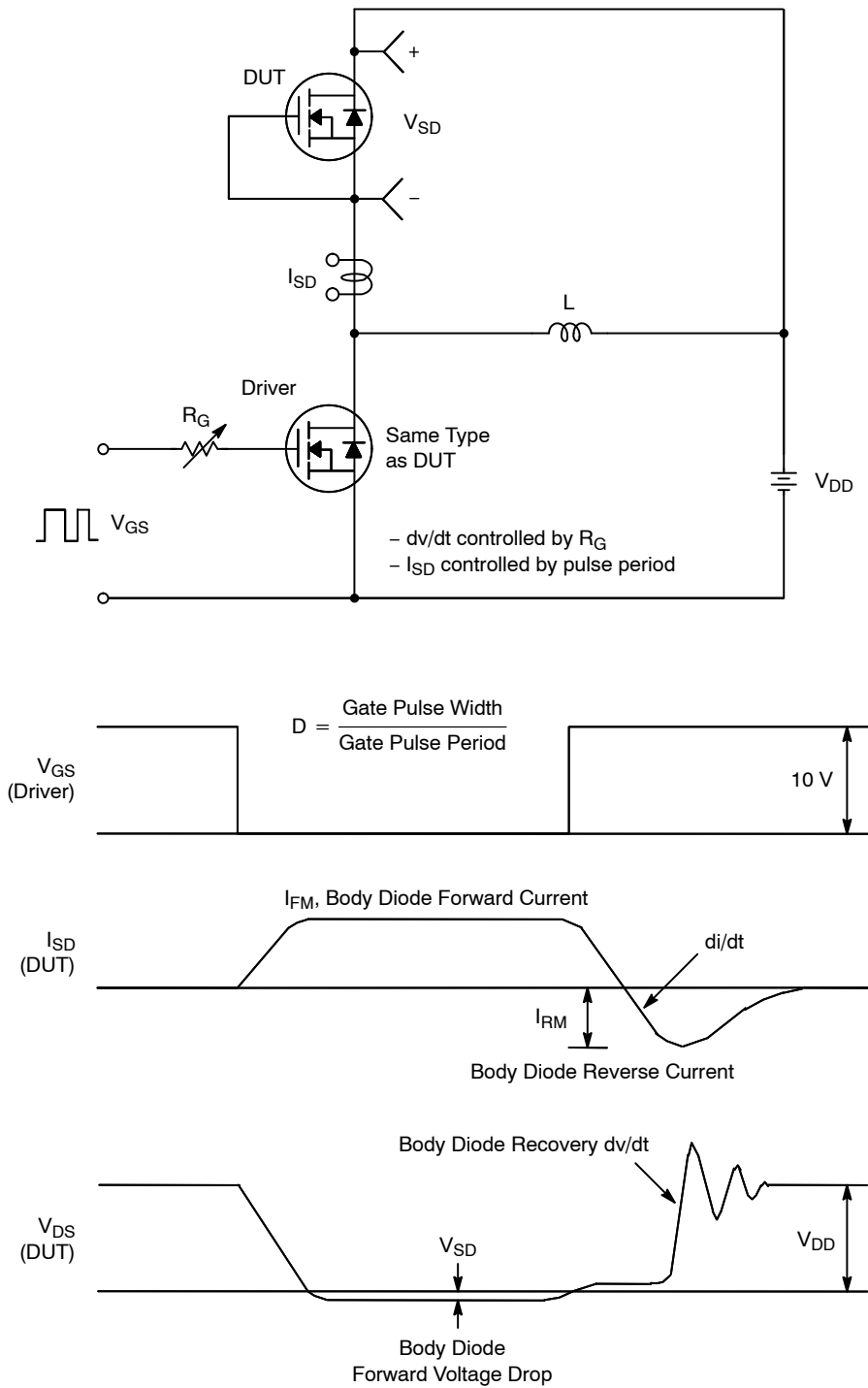
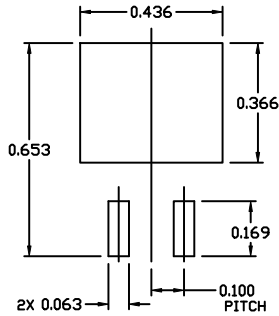


Figure 20. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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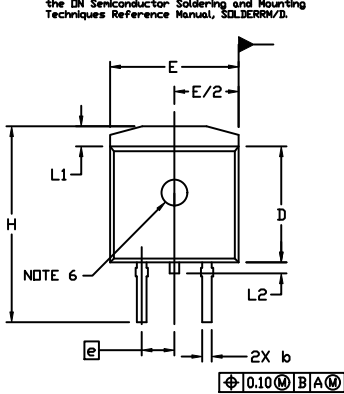
PACKAGE DIMENSIONS

D²PAK-3 (TO-263, 3-LEAD) CASE 418AJ ISSUE E



RECOMMENDED MOUNTING FOOTPRINT

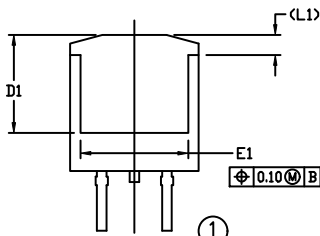
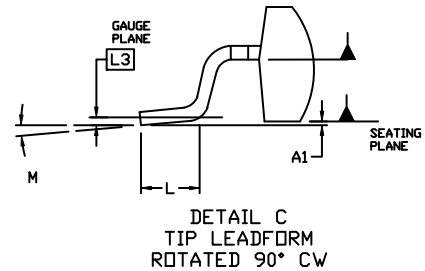
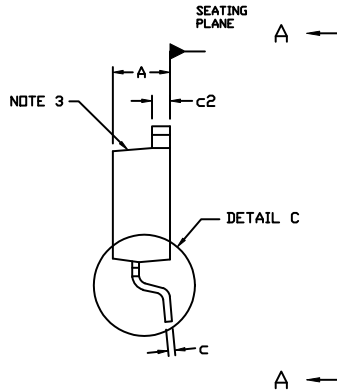
For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.



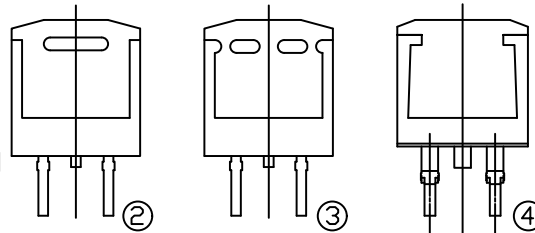
NOTES:

- 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	-8°	8°	-8°	8°



VIEW A-A



VIEW A-A
OPTIONAL CONSTRUCTIONS

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