

# FCB199N65S3

## Power MOSFET, N-Channel, SUPERFET<sup>®</sup> III, Easy Drive, 650 V, 14 A, 199 mΩ

### 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 advance 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 various power system miniaturization and higher efficiency.

### Features

- 700 V @  $T_J = 150^{\circ}\text{C}$
- Typ.  $R_{DS(on)} = 170\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 30\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 277\text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Applications

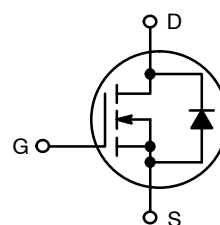
- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar



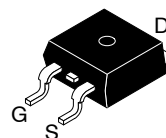
ON Semiconductor<sup>®</sup>

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$V_{DSS}$	$R_{DS(on)}\text{ MAX}$	$I_D\text{ MAX}$
650 V	199 mΩ @ 10 V	14 A

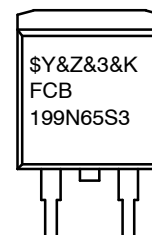


POWER MOSFET



D<sup>2</sup>-PAK  
CASE 418AJ

### MARKING DIAGRAM



\$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Data Code (Year & Week)
&K	= Lot
FCB199N65S3	= Specific Device Code

### ORDERING INFORMATION

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

# FCB199N65S3

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , Unless otherwise specified)

Symbol	Parameter		Value	Unit
$V_{DSS}$	Drain to Source Voltage		650	V
$V_{GSS}$	Gate to Source Voltage	DC	$\pm 30$	V
		AC ( $f > 1\text{ Hz}$ )	$\pm 30$	V
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ\text{C}$ )	14	A
		Continuous ( $T_C = 100^\circ\text{C}$ )	9	
$I_{DM}$	Drain Current	Pulsed (Note 1)	35	A
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)		76	mJ
$I_{AS}$	Avalanche Current (Note 1)		2.5	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)		0.98	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	98	W
		Derate Above $25^\circ\text{C}$	0.79	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range		$-55$ to $+150$	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 s		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.  $I_{AS} = 2.5\text{ A}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .

3.  $I_{SD} \leq 7\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .

## THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.27	$^\circ\text{C}/\text{W}$
	Thermal Resistance, Junction to Ambient, Max. (Note 4)	40	

4. Device on 1 in<sup>2</sup> pad 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 <sup>†</sup>
FCB199N65S3	FCB199N65S3	D <sup>2</sup> -PAK	330 mm	24 mm	800 / Tape & Reel

<sup>†</sup>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.

# FCB199N65S3

## 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 <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C	650	–	–	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C	700	–	–	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, Referenced to 25°C	–	0.6	–	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V	–	–	1	μA
		V <sub>DS</sub> = 520 V, T <sub>C</sub> = 125°C	–	0.89	–	
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V	–	–	±100	nA

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.4 mA	2.5	–	4.5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 7 A	–	170	199	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 7 A	–	10	–	S

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1 MHz	–	1225	–	pF
C <sub>oss</sub>	Output Capacitance		–	30	–	pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	–	277	–	pF
C <sub>oss(er.)</sub>	Energy Related Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	–	43	–	pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10 V	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 7 A, V <sub>GS</sub> = 10 V (Note 5)	–	30	–	nC
Q <sub>gs</sub>	Gate to Source Gate Charge		–	7.4	–	nC
Q <sub>gd</sub>	Gate to Drain “Miller” Charge		–	13	–	nC
ESR	Equivalent Series Resistance	f = 1 MHz	–	7	–	Ω

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 400 V, I <sub>D</sub> = 7 A, V <sub>GS</sub> = 10 V, R <sub>g</sub> = 4.7 Ω (Note 5)	–	19	–	ns
t <sub>r</sub>	Turn-On Rise Time		–	23	–	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		–	52	–	ns
t <sub>f</sub>	Turn-Off Fall Time		–	15	–	ns

### SOURCE-DRAIN DIODE CHARACTERISTICS

I <sub>S</sub>	Maximum Continuous Source to Drain Diode Forward Current		–	–	14	A
I <sub>SM</sub>	Maximum Pulsed Source to Drain Diode Forward Current		–	–	35	A
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 7 A	–	–	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 7 A, dI <sub>F</sub> /dt = 100 A/μs	–	256	–	ns
Q <sub>rr</sub>	Reverse Recovery Charge		–	3.5	–	μC

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 PERFORMANCE CHARACTERISTICS

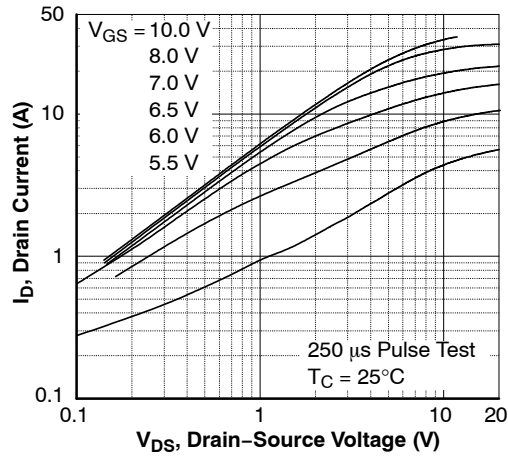


Figure 1. On-Region Characteristics

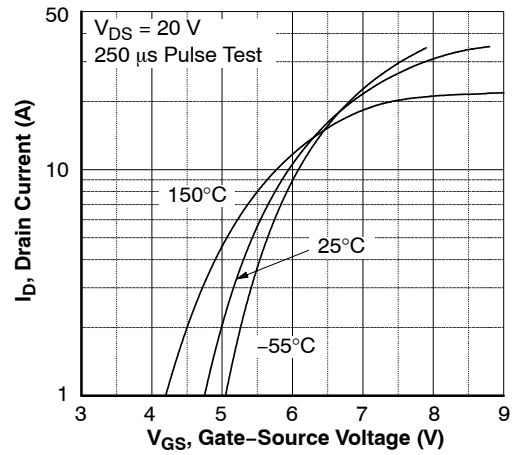


Figure 2. Transfer Characteristics

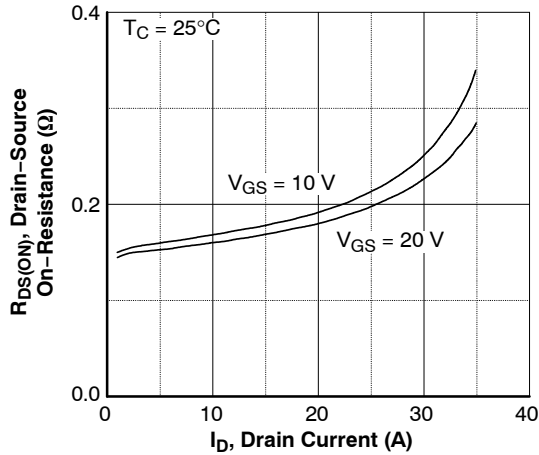


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

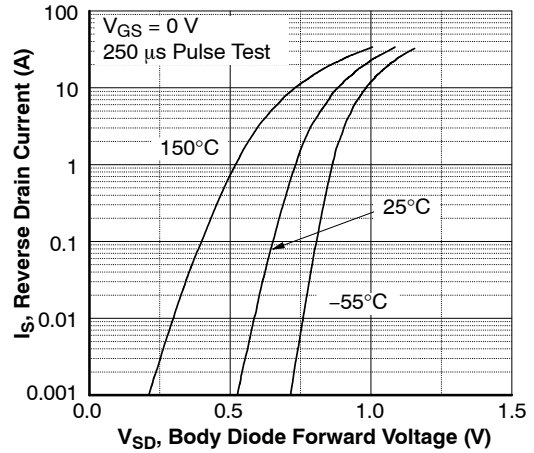


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

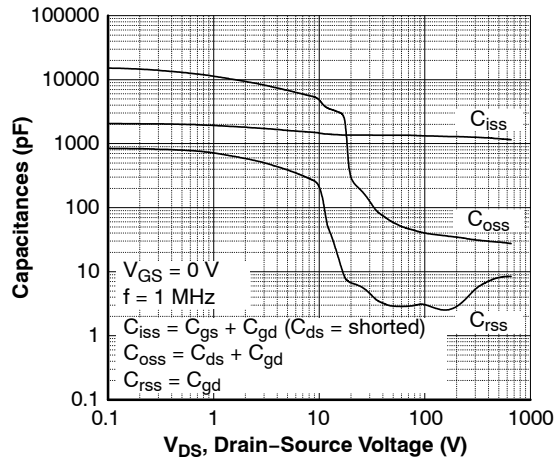


Figure 5. Capacitance Characteristics

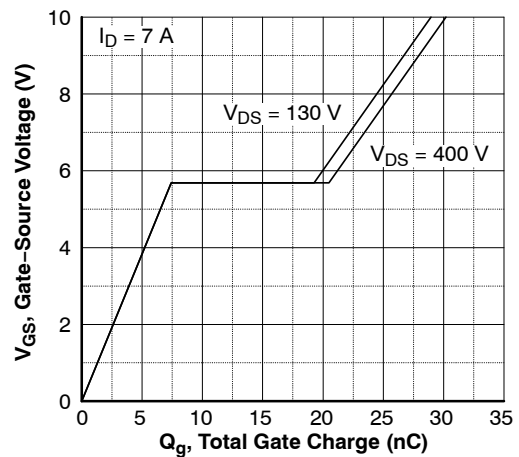


Figure 6. Gate Charge Characteristics

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

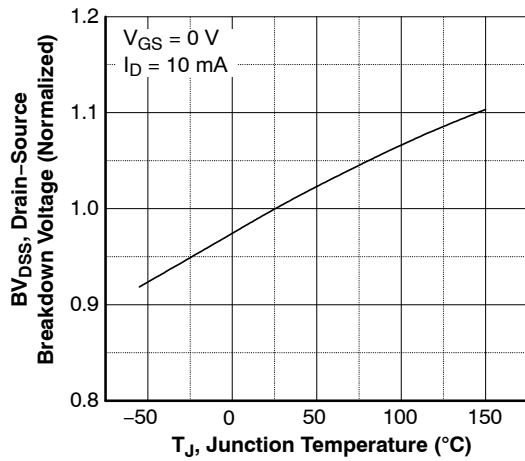


Figure 7. Breakdown Voltage Variation vs. Temperature

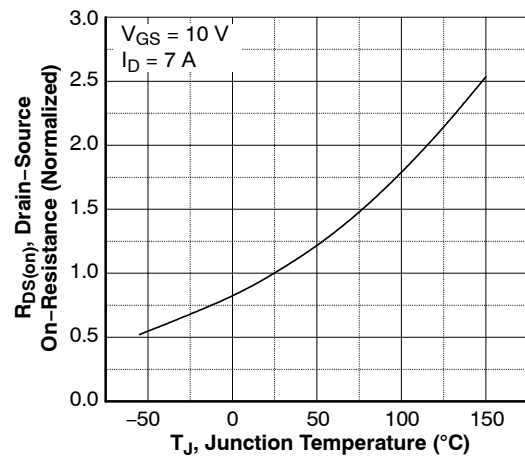


Figure 8. On-Resistance Variation vs. Temperature

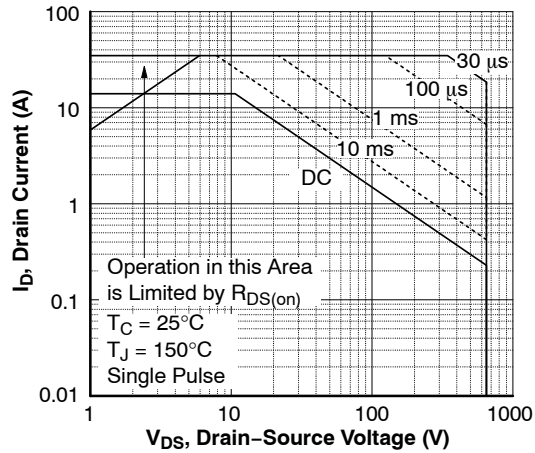


Figure 9. Maximum Safe Operating Area

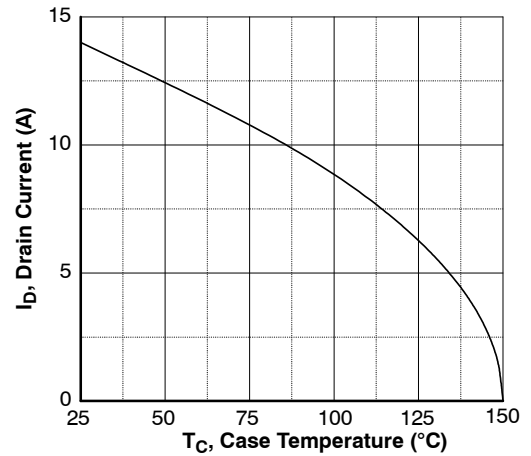
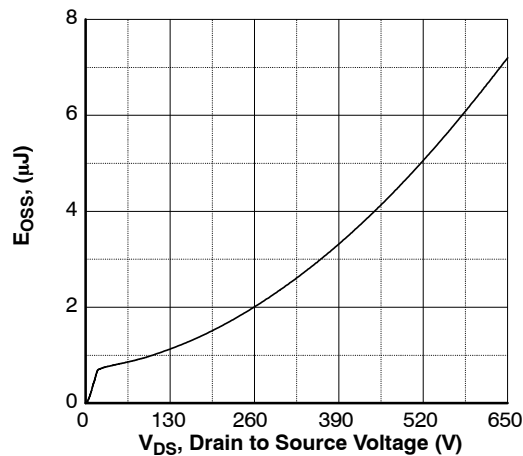


Figure 10. Maximum Drain Current vs. Case Temperature

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

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

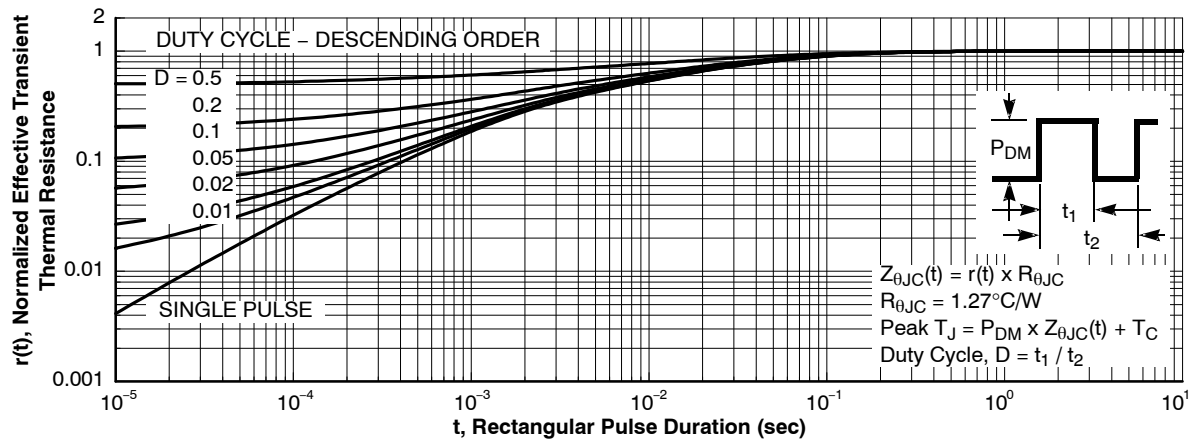


Figure 12. Transient Thermal Response Curve

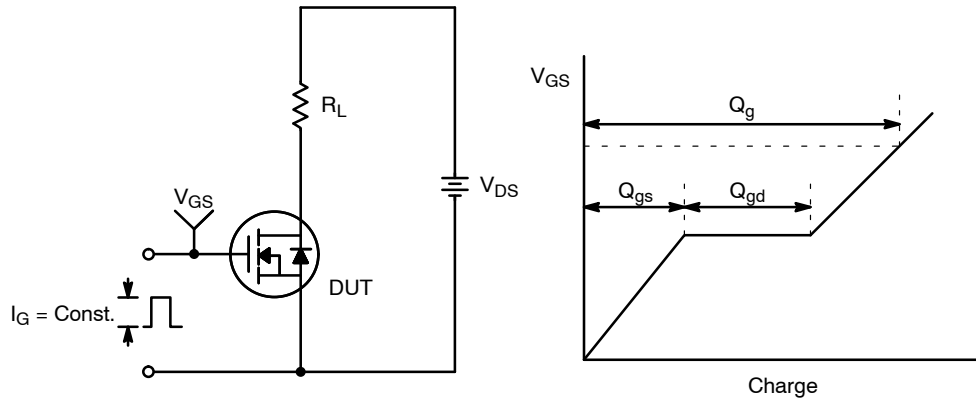


Figure 13. Gate Charge Test Circuit & Waveform

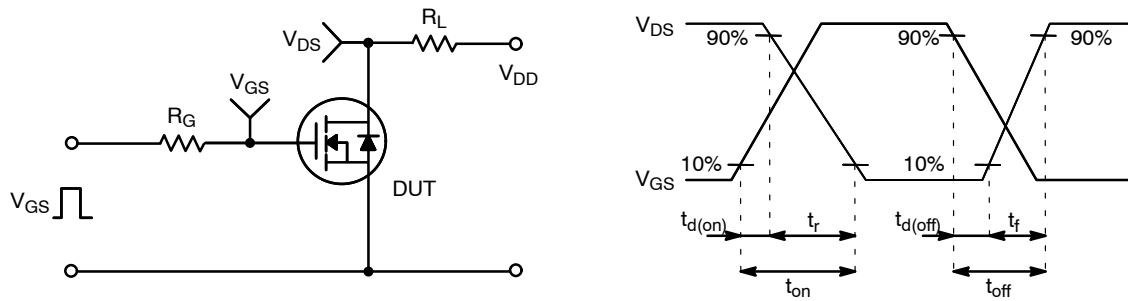


Figure 14. Resistive Switching Test Circuit & Waveforms

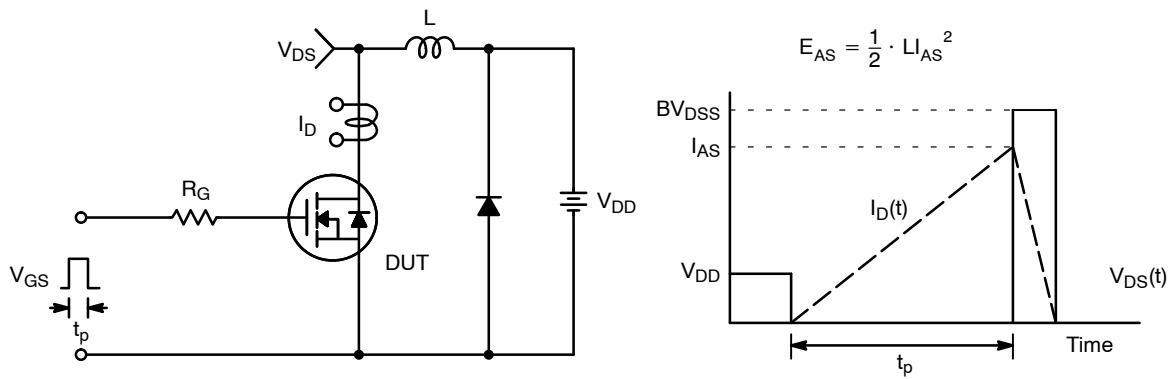
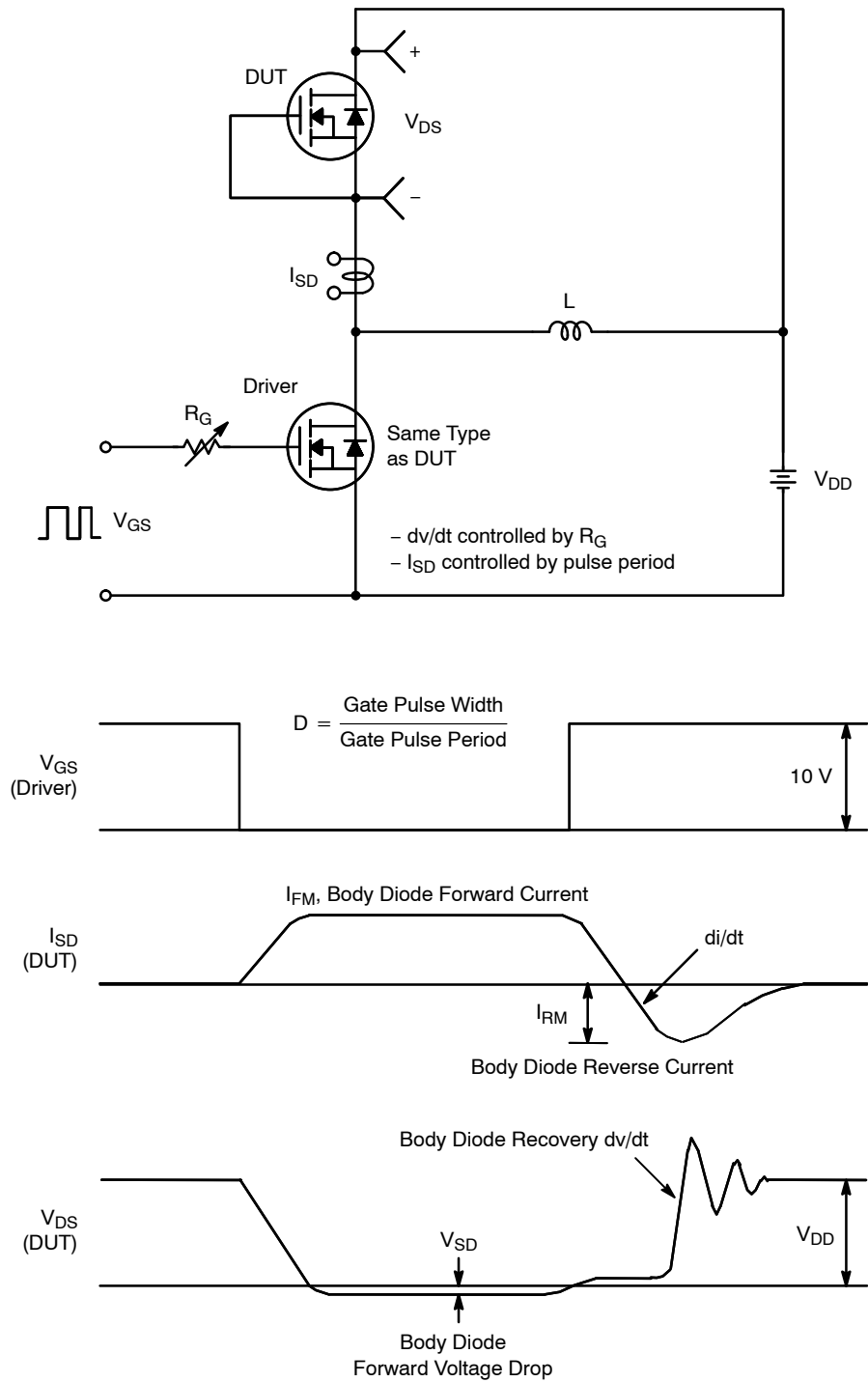


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

# FCB199N65S3



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



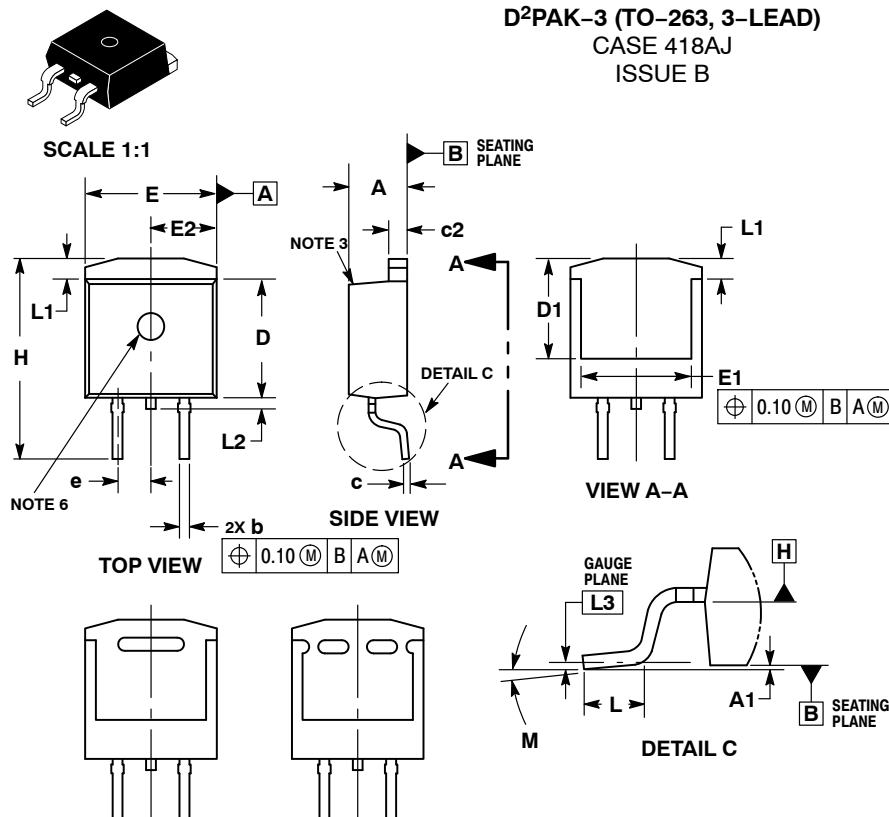
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



## D<sup>2</sup>PAK-3 (TO-263, 3-LEAD) CASE 418AJ ISSUE B

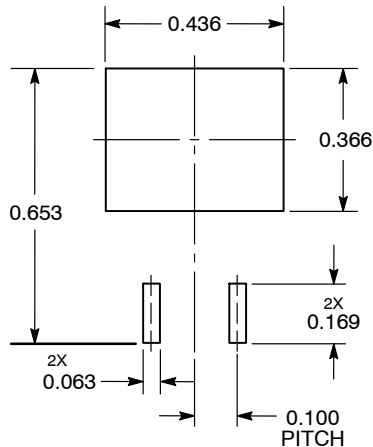
DATE 08 OCT 2013



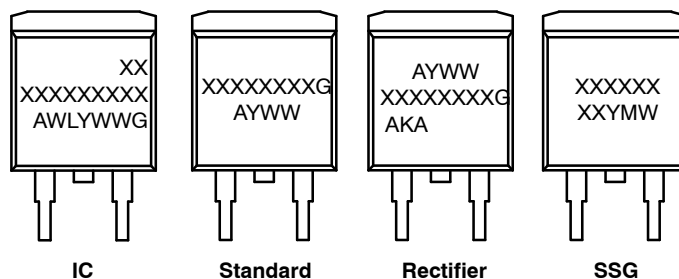
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.160	0.190	4.06	4.83
A1	0.000	0.010	0.00	0.25
b	0.020	0.039	0.51	0.99
c	0.012	0.029	0.30	0.74
c2	0.045	0.065	1.14	1.65
D	0.330	0.380	8.38	9.65
D1	0.260	---	6.60	---
E	0.380	0.420	9.65	10.67
E1	0.245	---	6.22	---
e	0.100 BSC		2.54 BSC	
H	0.575	0.625	14.60	15.88
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°	

**VIEW A-A**  
OPTIONAL CONSTRUCTIONS

### RECOMMENDED SOLDERING FOOTPRINT\*



### GENERIC 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

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

\*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.

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

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«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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