

# FCP165N65S3

## Power MOSFET, N-Channel, SUPERFET® III, Easy-Drive, 650 V, 19 A, 165 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 advanced technology is tailored to minimize conduction loss, provides superior switching performance, and withstand extreme dv/dt rate. Consequently, SUPERFET III MOSFET Easy-drive series helps manage EMI issues and allows for easier design implementation.

### Features

- 700 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 140 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 39 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(\text{eff.})} = 341 \text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

### Applications

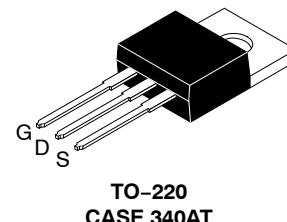
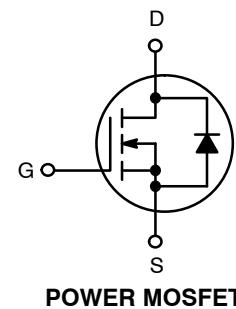
- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Industrial Power Supplies
- Lighting / Charger / Adapter



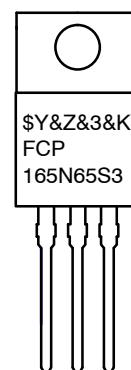
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

$V_{DSS}$	$R_{DS(\text{ON}) \text{ MAX}}$	$I_D \text{ MAX}$
650 V	165 mΩ @ 10 V	19 A



### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Data Code (Year & Week)  
&K = Lot  
FCP165N65S3 = Specific Device Code

### ORDERING INFORMATION

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

# FCP165N65S3

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, Unless otherwise noted)

Symbol	Parameter		FCP165N65S3	Unit
V <sub>DSS</sub>	Drain to Source Voltage		650	V
V <sub>GSS</sub>	Gate to Source Voltage	– DC	±30	V
		– AC (f > 1 Hz)	±30	
I <sub>D</sub>	Drain Current	– Continuous (T <sub>C</sub> = 25°C)	19	A
		– Continuous (T <sub>C</sub> = 100°C)	12.3	
I <sub>DM</sub>	Drain Current	– Pulsed (Note 1)	47.5	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		87	mJ
I <sub>AS</sub>	Avalanche Current (Note 2)		2.7	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)		1.54	mJ
dv/dt	MOSFET dv/dt		100	V/ns
	Peak Diode Recovery dv/dt (Note 3)		20	
P <sub>D</sub>	Power Dissipation	(T <sub>C</sub> = 25°C)	154	W
		– Derate Above 25°C	1.23	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range		–55 to +150	°C
T <sub>L</sub>	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<sub>AS</sub> = 2.7 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 9.5 A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 400 V, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

Symbol	Parameter	FCP165N65S3	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case, Max.	0.81	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient, Max.	62.5	

## PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP165N65S3	FCP165N65S3	TO-220	Tube	N/A	N/A	50 Units

# FCP165N65S3

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
--------	-----------	-----------------	------	------	------	------

## OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}, T_J = 25^\circ\text{C}$	650	–	–	V
		$V_{GS} = 0 \text{ V}, I_D = 1 \text{ mA}, T_J = 150^\circ\text{C}$	700	–	–	V
$\Delta V_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1 \text{ mA}$ , Referenced to $25^\circ\text{C}$	–	0.64	–	$\text{V}/^\circ\text{C}$
Id <sub>SS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 650 \text{ V}, V_{GS} = 0 \text{ V}$	–	–	1	$\mu\text{A}$
		$V_{DS} = 520 \text{ V}, T_C = 125^\circ\text{C}$	–	0.85	–	
I <sub>GSS</sub>	Gate to Body Leakage Current	$V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$	–	–	$\pm 100$	nA

## ON CHARACTERISTICS

$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1.9 \text{ mA}$	2.5	–	4.5	V
$R_{DS(\text{on})}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 9.5 \text{ A}$	–	140	165	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20 \text{ V}, I_D = 9.5 \text{ A}$	–	12	–	S

## DYNAMIC CHARACTERISTICS

$C_{iss}$	Input Capacitance	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	–	1500	–	$\text{pF}$
$C_{oss}$	Output Capacitance		–	35	–	$\text{pF}$
$C_{oss(\text{eff.})}$	Effective Output Capacitance	$V_{DS} = 0 \text{ V to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	–	341	–	$\text{pF}$
$C_{oss(\text{er.})}$	Energy Related Output Capacitance	$V_{DS} = 0 \text{ V to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	–	49	–	$\text{pF}$
$Q_{g(\text{tot})}$	Total Gate Charge at $10 \text{ V}$	$V_{DS} = 400 \text{ V}, I_D = 9.5 \text{ A}, V_{GS} = 10 \text{ V}$ (Note 4)	–	39	–	nC
$Q_{gs}$	Gate to Source Gate Charge		–	11	–	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		–	16	–	nC
ESR	Equivalent Series Resistance		$f = 1 \text{ MHz}$	–	4.6	$\Omega$

## SWITCHING CHARACTERISTICS

$t_{d(\text{on})}$	Turn-On Delay Time	$V_{DD} = 400 \text{ V}, I_D = 9.5 \text{ A}, V_{GS} = 10 \text{ V}, R_g = 4.7 \Omega$ (Note 4)	–	21	–	ns
$t_r$	Turn-On Rise Time		–	22	–	ns
$t_{d(\text{off})}$	Turn-Off Delay Time		–	53	–	ns
$t_f$	Turn-Off Fall Time		–	13	–	ns

## SOURCE-DRAIN DIODE CHARACTERISTICS

$I_S$	Maximum Continuous Source to Drain Diode Forward Current	–	–	19	A	
$I_{SM}$	Maximum Pulsed Source to Drain Diode Forward Current	–	–	47.5	A	
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 9.5 \text{ A}$	–	–	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_{SD} = 9.5 \text{ A}, dI_F/dt = 100 \text{ A}/\mu\text{s}$	–	339	–	ns
$Q_{rr}$	Reverse Recovery Charge		–	5.8	–	$\mu\text{C}$

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 PERFORMANCE CHARACTERISTICS

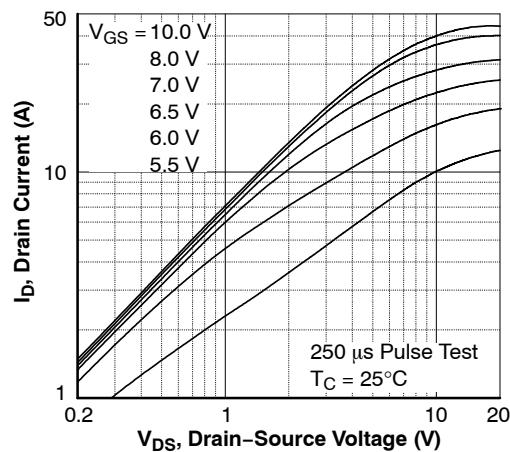


Figure 1. On-Region Characteristics

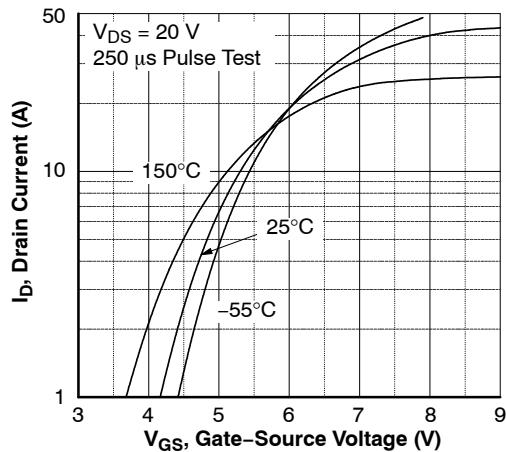


Figure 2. Transfer Characteristics

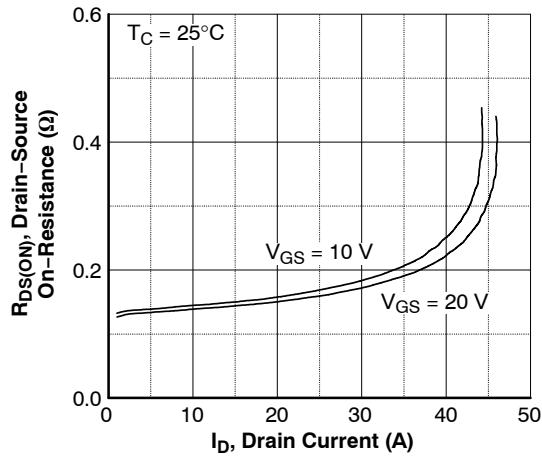


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

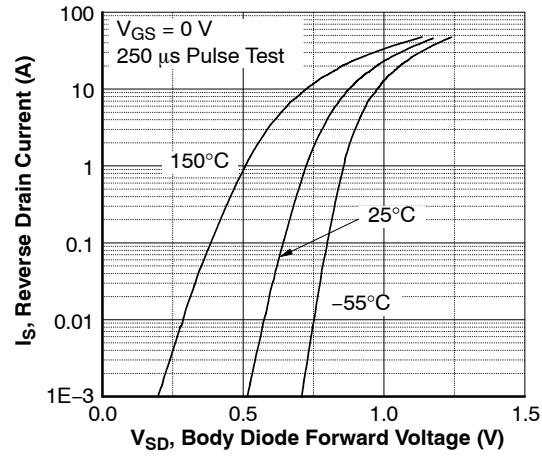


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

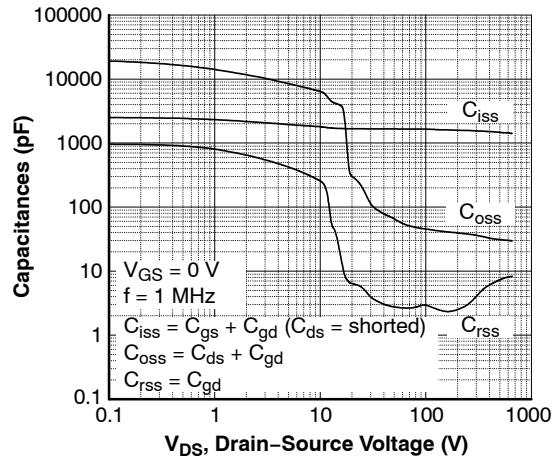


Figure 5. Capacitance Characteristics

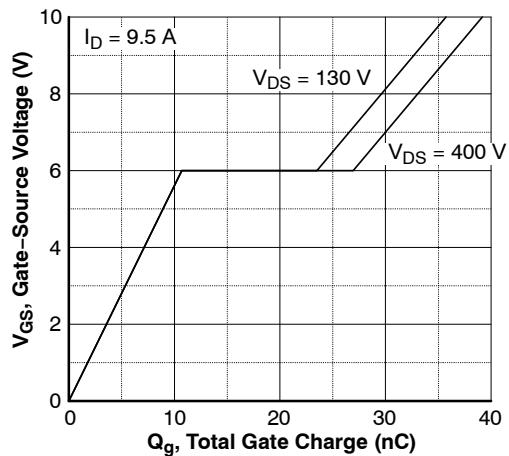


Figure 6. Gate Charge Characteristics

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

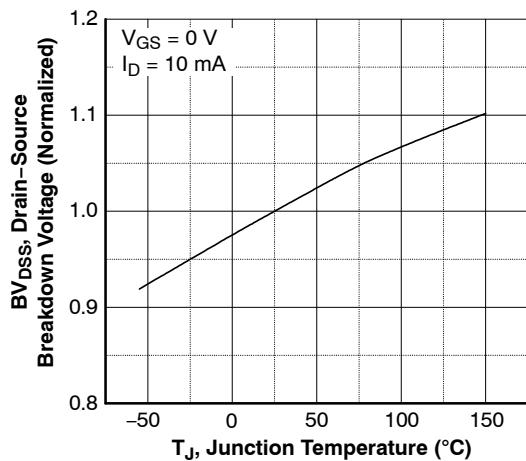


Figure 7. Breakdown Voltage Variation vs. Temperature

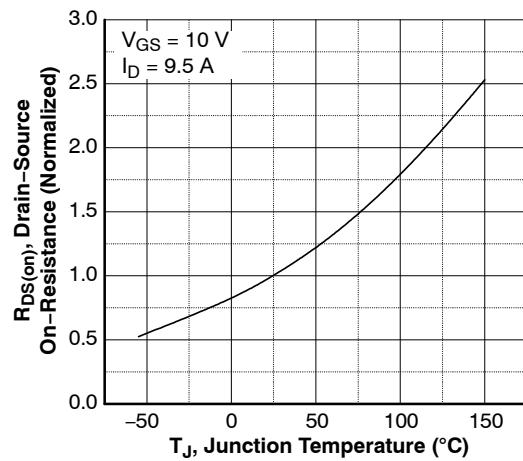


Figure 8. On-Resistance Variation vs. Temperature

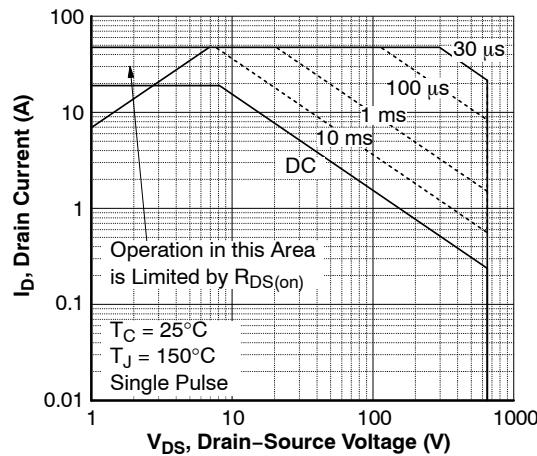


Figure 9. Maximum Safe Operating Area

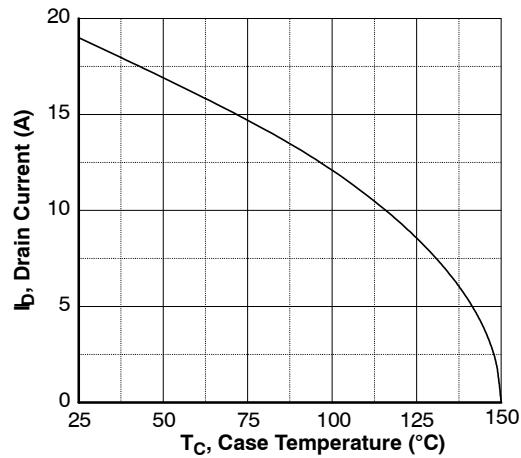


Figure 10. Maximum Drain Current vs. Case Temperature

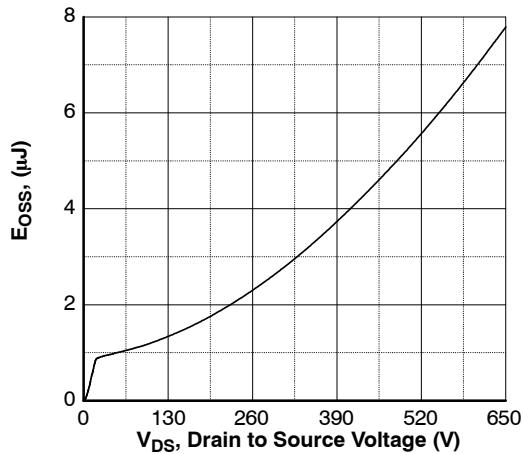


Figure 11. E\_OSS vs. Drain to Source Voltage

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

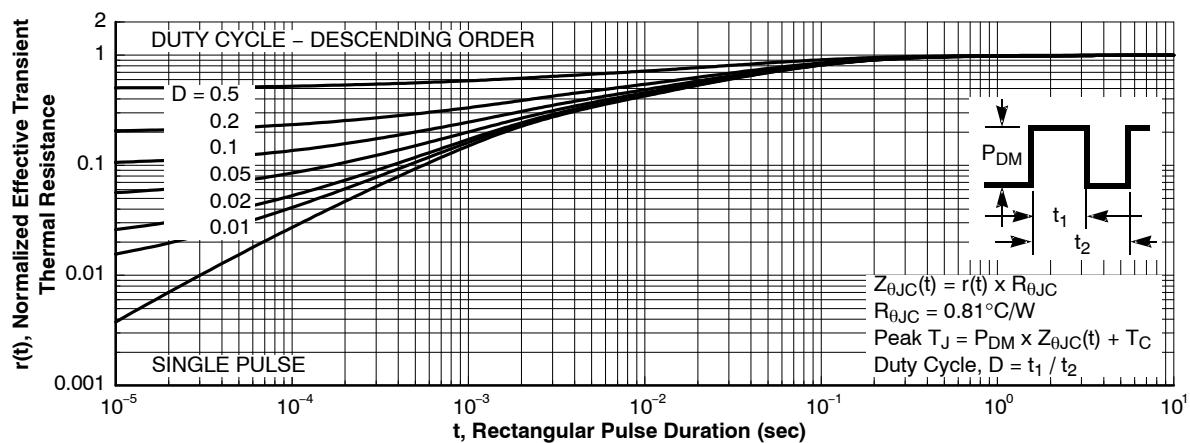


Figure 12. Transient Thermal Response Curve

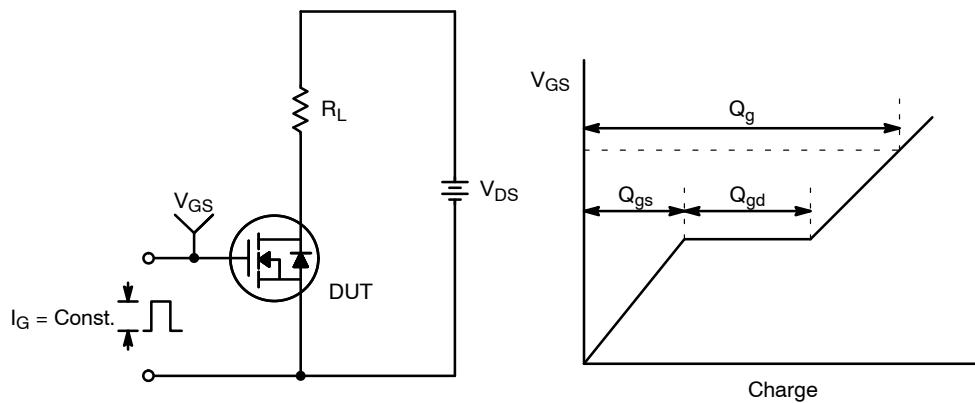


Figure 13. Gate Charge Test Circuit & Waveform

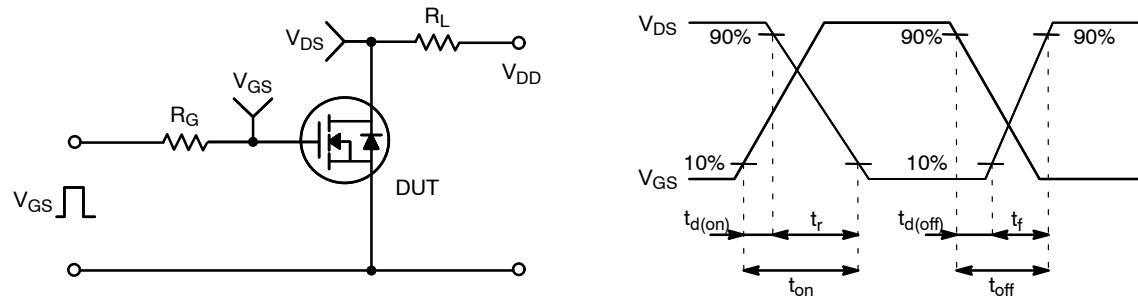


Figure 14. Resistive Switching Test Circuit & Waveforms

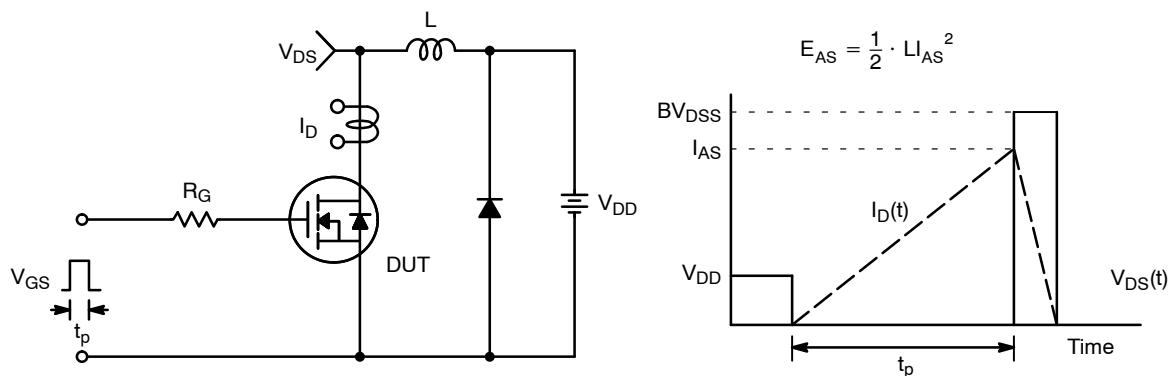


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

# FCP165N65S3

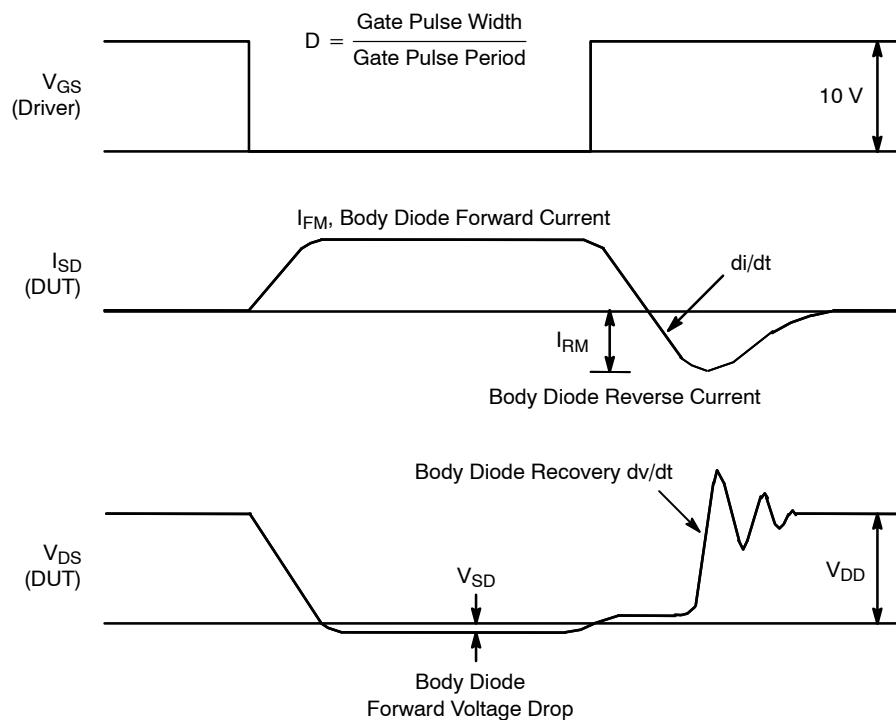
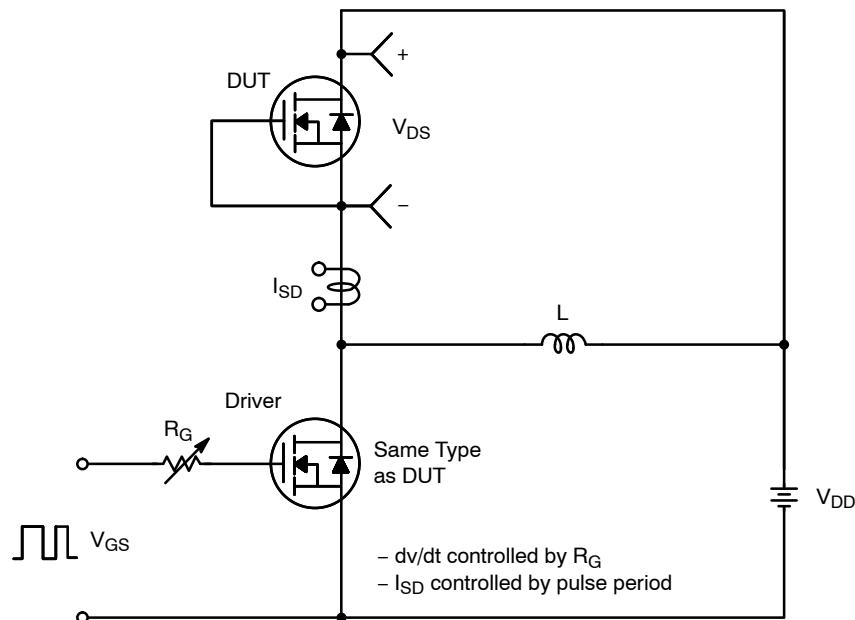
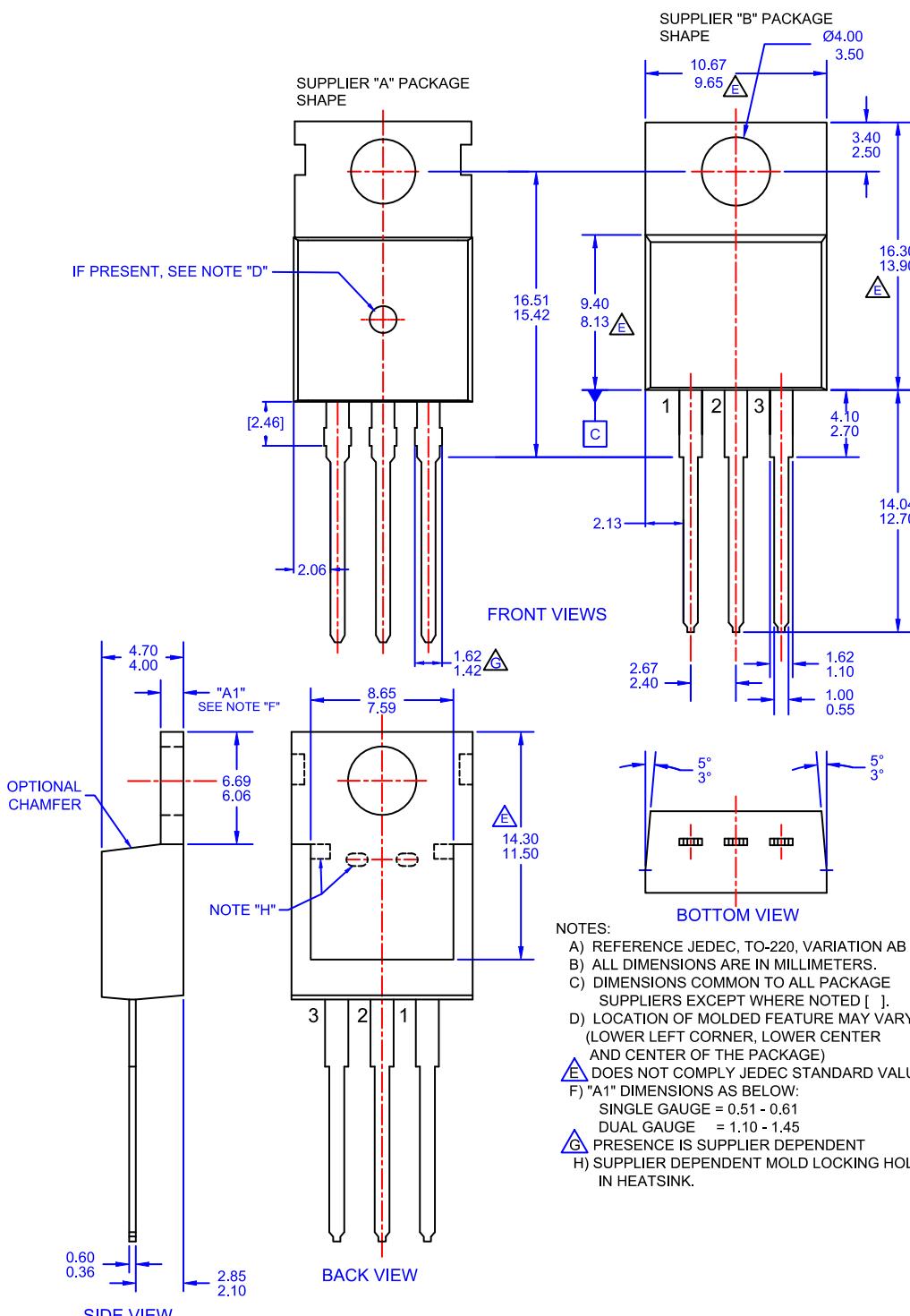


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

SUPERFET is a registered trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

TO-220-3LD  
CASE 340AT  
ISSUE A

DATE 03 OCT 2017



NOTES:

- A) REFERENCE JEDEC, TO-220, VARIATION AB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
- D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
- E) DOES NOT COMPLY JEDEC STANDARD VALUE.
- F) "A1" DIMENSIONS AS BELOW:
  - SINGLE GAUGE = 0.51 - 0.61
  - DUAL GAUGE = 1.10 - 1.45
- G) PRESENCE IS SUPPLIER DEPENDENT
- H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

DOCUMENT NUMBER:	98AON13818G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
STATUS:	ON SEMICONDUCTOR STANDARD	
NEW STANDARD:		
DESCRIPTION:	TO-220-3LD	PAGE 1 OF 2



DOCUMENT NUMBER:  
98AON13818G

PAGE 2 OF 2

**ON Semiconductor** and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada

**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)

**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local  
Sales Representative



# OCEAN CHIPS

## Океан Электроники

### Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибутором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибутором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«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).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А