

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

650 V, 20 A, 190 mΩ

NTPF190N65S3HF

Description

SUPERFET III MOSFET is onsemi’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.

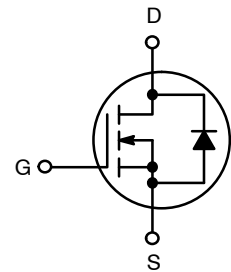
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 152\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 34\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 316\text{ pF}$)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

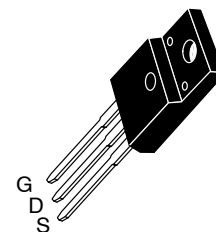
Applications

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

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

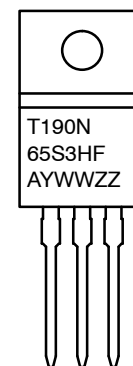


POWER MOSFET



TO-220 FULLPAK
CASE 221D

MARKING DIAGRAM



T190N65S3HF	= Specific Device Code
A	= Assembly Location
YWW	= Date Code (Year & Week)
ZZ	= Assembly Lot

ORDERING INFORMATION

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

NTPF190N65S3HF

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)	20*
		- Continuous (T _C = 100°C)	12.7*
I _{DM}	Drain Current	- Pulsed (Note 1)	50*
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)	0.36	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)	36
		- Derate Above 25°C	0.29
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.

*Drain current limited by maximum junction temperature.

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} ≤ 10 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.	3.5	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max.	62.5	

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Shipping
NTPF190N65S3HF	T190N65S3HF	TO-220 FULLPACK	Tube	N/A	N/A	1000 Units

NTPF190N65S3HF

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

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

OFF CHARACTERISTICS

BV _{DSS}	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
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{ mA}$, Referenced to 25°C		0.65		V/ $^\circ\text{C}$
I _{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$			10	μA
		$V_{DS} = 520\text{ V}, T_C = 125^\circ\text{C}$		65		
I _{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$			± 100	nA

ON CHARACTERISTICS

V _{GS(th)}	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 0.43\text{ mA}$	3.0		5.0	V
R _{DS(on)}	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$		152	190	m Ω
g _{FS}	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 10\text{ A}$		11		S

DYNAMIC CHARACTERISTICS

C _{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		1610		pF
C _{oss}	Output Capacitance			30		pF
C _{oss(eff.)}	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		316		pF
C _{oss(er.)}	Energy Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		59		pF
Q _{g(tot)}	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}, I_D = 10\text{ A}, V_{GS} = 10\text{ V}$ (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	$f = 1\text{ MHz}$		6.8		Ω

SWITCHING CHARACTERISTICS

t _{d(on)}	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 4.7\ \Omega$ (Note 4)		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	$V_{GS} = 0\text{ V}, I_{SD} = 10\text{ A}$			1.3	V
t _{rr}	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_{SD} = 10\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$		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.

4. Essentially independent of operating temperature typical characteristics.

NTPF190N65S3HF

TYPICAL CHARACTERISTICS

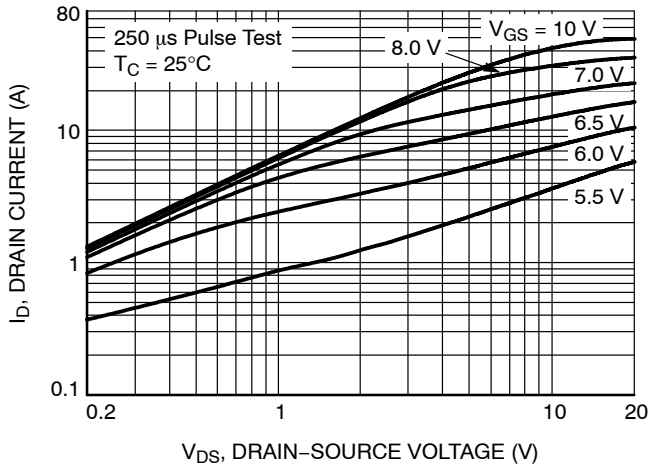


Figure 1. On-Region Characteristics

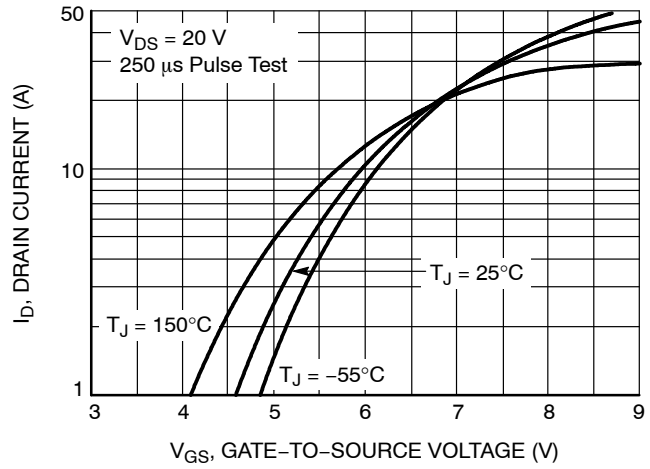


Figure 2. Transfer Characteristics

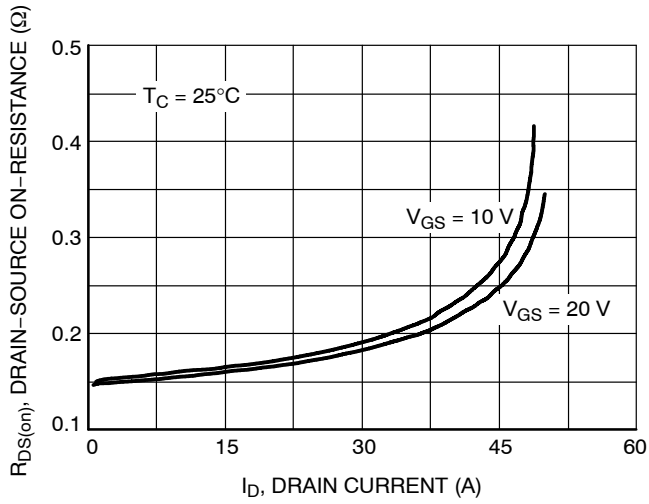


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

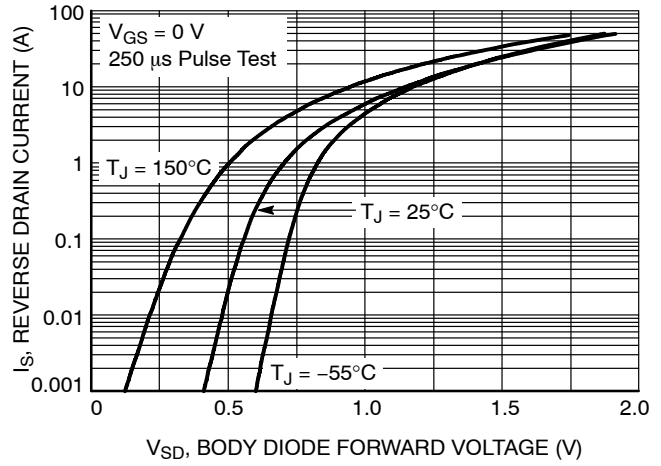


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

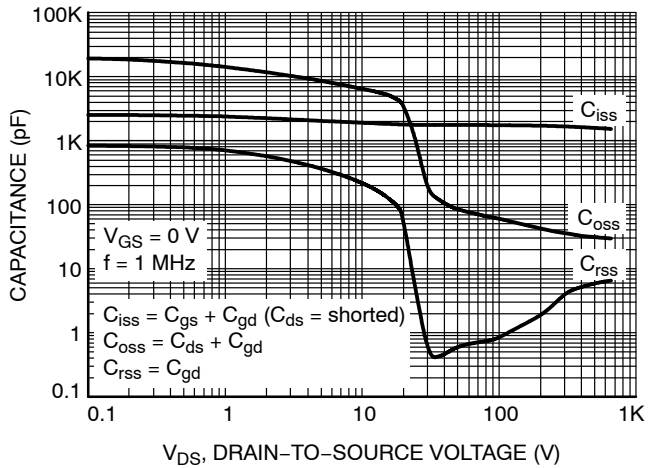


Figure 5. Capacitance Characteristics

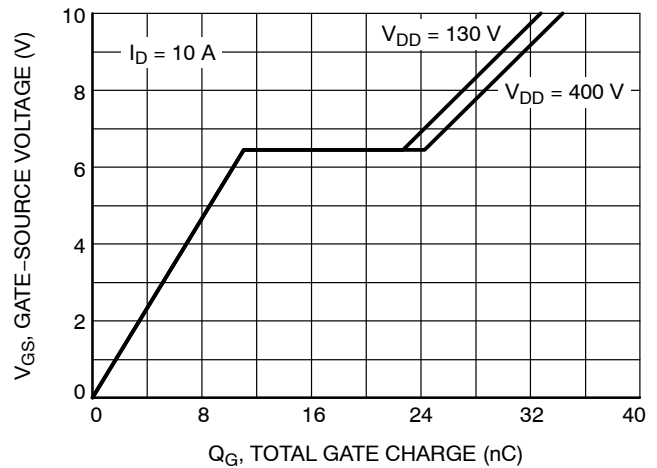


Figure 6. Gate Charge Characteristics

NTPF190N65S3HF

TYPICAL CHARACTERISTICS

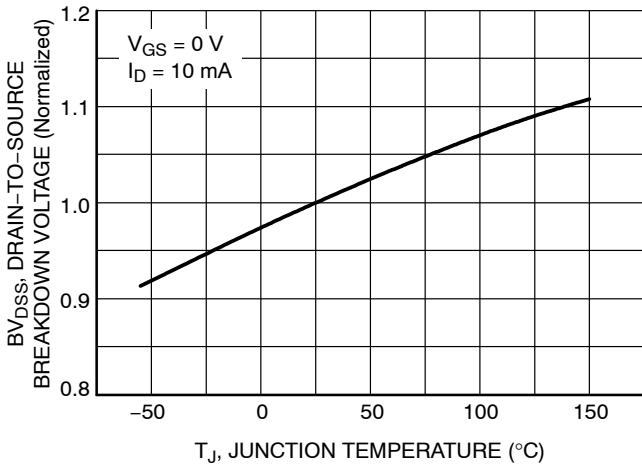


Figure 7. Breakdown Voltage Variation vs. Temperature

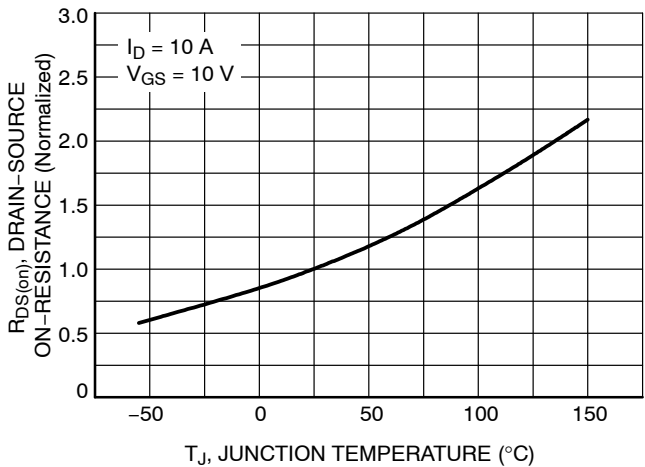


Figure 8. On-Resistance Variation vs. Temperature

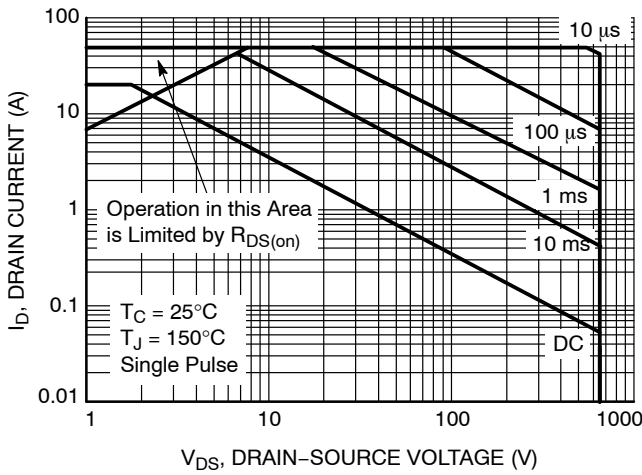


Figure 9. Maximum Safe Operating Area

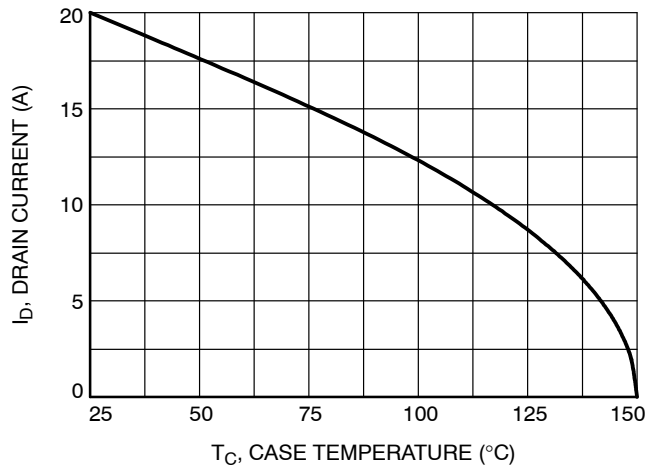


Figure 10. Maximum Drain Current vs. Case Temperature

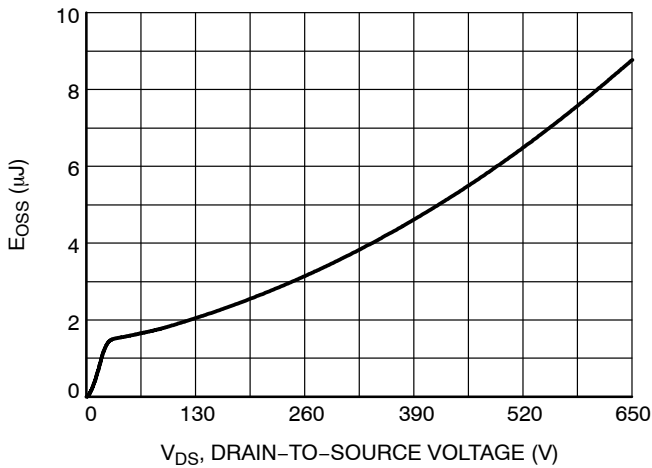


Figure 11. E_{OSS} vs. Drain-to-Source Voltage

NTPF190N65S3HF

TYPICAL CHARACTERISTICS

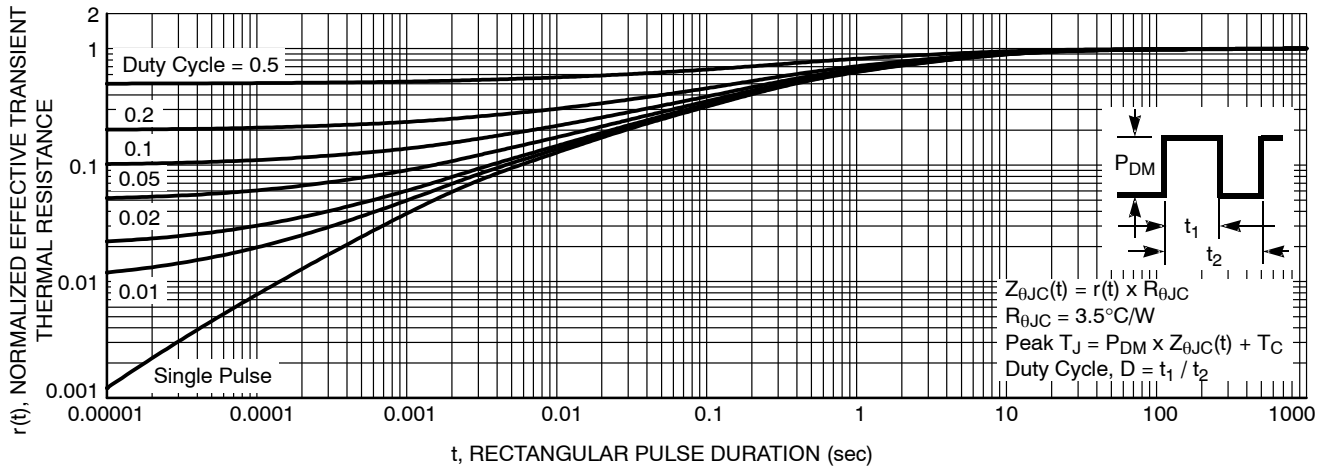


Figure 12. Transient Thermal Response Curve

NTPF190N65S3HF

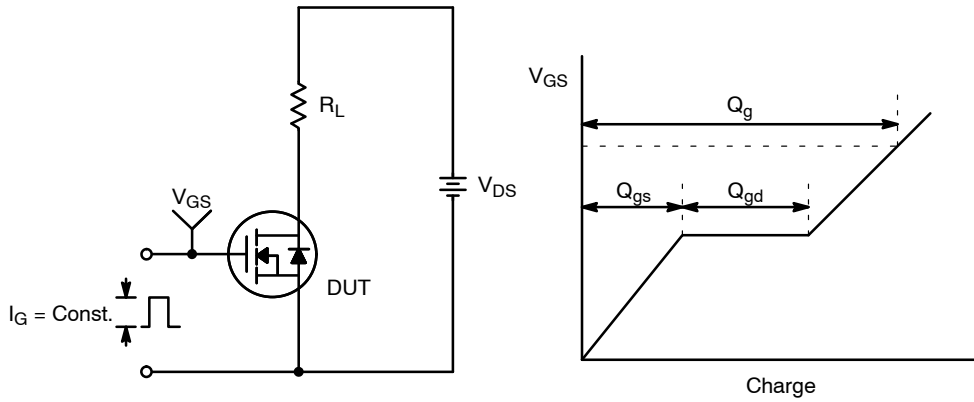


Figure 13. Gate Charge Test Circuit & Waveform

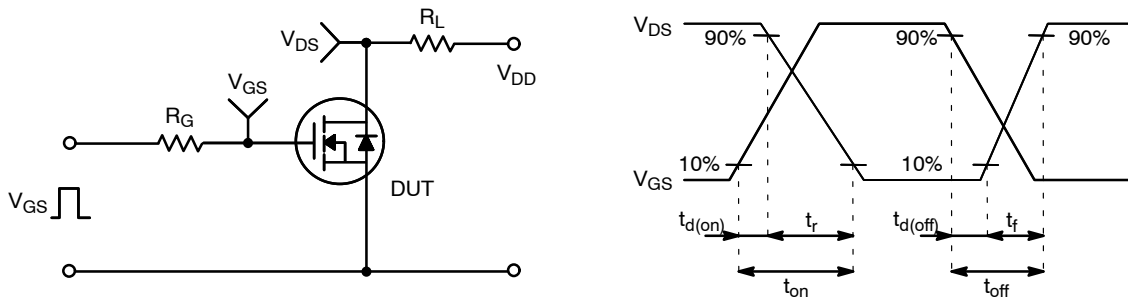


Figure 14. Resistive Switching Test Circuit & Waveforms

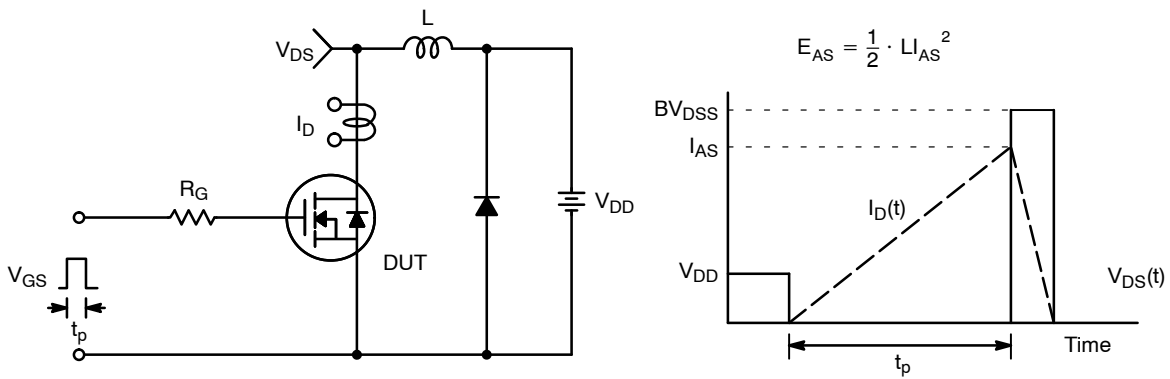


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

NTPF190N65S3HF

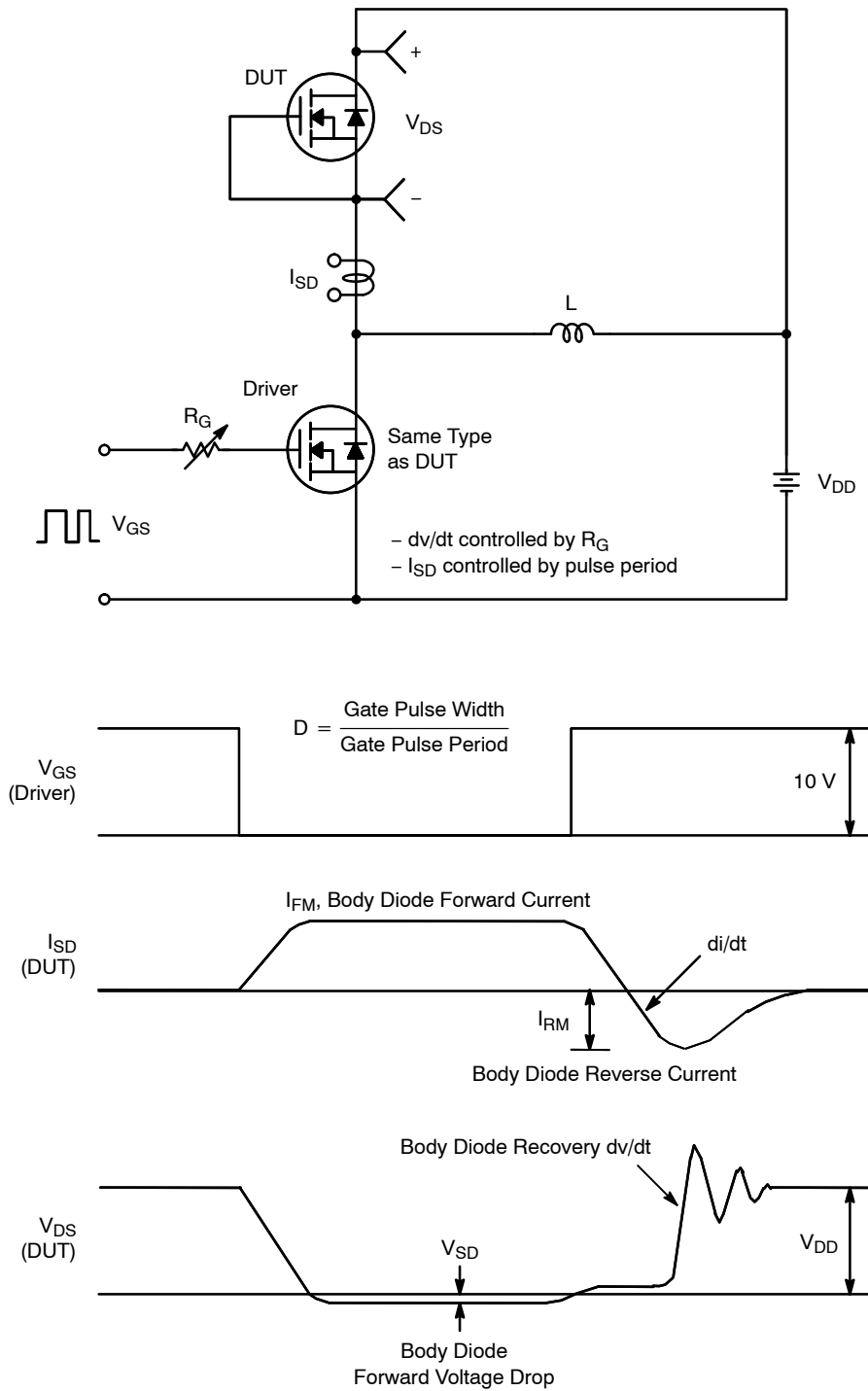
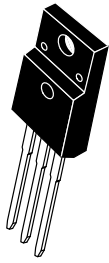


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

SUPERFET and FRFET are registered trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries.

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

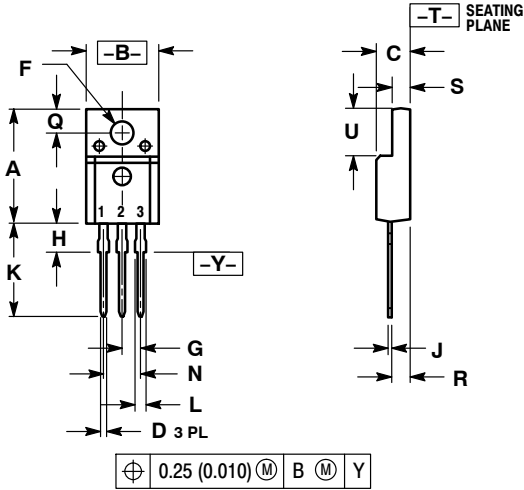
ON Semiconductor®



SCALE 1:1

TO-220 FULLPAK CASE 221D-03 ISSUE K

DATE 27 FEB 2009



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 - CONTROLLING DIMENSION: INCH
 - 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

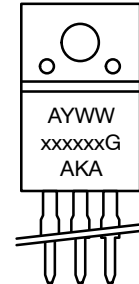
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88

MARKING DIAGRAMS

- | | | |
|--|---|--|
| STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE | STYLE 2:
PIN 1. BASE
2. COLLECTOR
3. EMITTER | STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE |
| STYLE 4:
PIN 1. CATHODE
2. ANODE
3. CATHODE | STYLE 5:
PIN 1. CATHODE
2. ANODE
3. GATE | STYLE 6:
PIN 1. MT 1
2. MT 2
3. GATE |



Bipolar



Rectifier

- | | |
|-------------------------------|---------------------------|
| xxxxxx = Specific Device Code | A = Assembly Location |
| G = Pb-Free Package | Y = Year |
| A = Assembly Location | WW = Work Week |
| Y = Year | xxxxxx = Device Code |
| WW = Work Week | G = Pb-Free Package |
| | AKA = Polarity Designator |

DOCUMENT NUMBER:	98ASB42514B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-220 FULLPAK	PAGE 1 OF 1

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 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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 **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** 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 **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales

