

MOSFET – N-Channel, UniFET™, FRFET®

500 V, 20 A, 260 mΩ

FDP20N50F / FDPF20N50FT

Description

UniFET MOSFET is onsemi's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. The body diode's reverse recovery performance of UniFET FRFET MOSFET has been enhanced by lifetime control. Its t_{rr} is less than 100 ns and the reverse dv/dt immunity is 15 V/ns while normal planar MOSFET's have over 200 ns and 4.5 V/ns respectively. Therefore, it can remove additional component and improve system reliability in certain applications in which the performance of MOSFET's body diode is significant. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

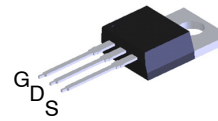
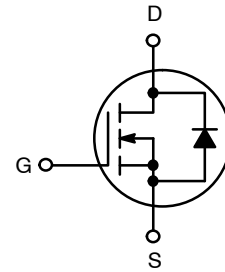
Features

- $R_{DS(on)} = 210 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 10 \text{ A}$
- Low Gate Charge (Typ. 50 nC)
- Low C_{rss} (Typ. 27 pF)
- 100% Avalanche Tested
- Improve dv/dt Capability
- These Devices are Pb-Free and are RoHS Compliant

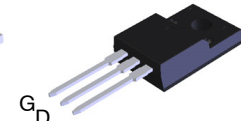
Applications

- LCD/LED TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

V_{DS}	$R_{DS(on)}$ MAX	I_D MAX
500 V	260 mΩ @ 10 V	20 A

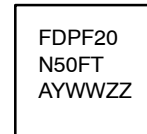
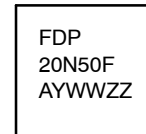


TO-220-3LD
 CASE 340AT



TO-220 Fullpack, 3-Lead
 / TO-220F-3SG
 CASE 221AT

MARKING DIAGRAM



FDP20N50F,
 FDPF20N50FT = Specific Device Code
 A = Assembly Location
 YWW = Date Code (Year & Week)
 ZZ = Assembly Lot

ORDERING INFORMATION

Device	Package	Shipping
FDP20N50F	TO-220	1000 Units / Tube
FDPF20N50FT	TO-220F	1000 Units / Tube

FDP20N50F / FDPF20N50FT

MOSFET MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	FDP20N50F	FDPF20N50FT	Unit
V_{DSS}	Drain to Source Voltage	500		V
V_{GSS}	Gate to Source Voltage	± 30		V
I_D	Drain Current – – Continuous ($T_C = 25^\circ\text{C}$) – Continuous ($T_C = 100^\circ\text{C}$)	20 12.9	20* 12.9*	A
I_{DM}	Drain Current – Pulsed (Note 1)	80	80*	A
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	1110		mJ
I_{AR}	Avalanche Current (Note 1)	20		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	25		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20		V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$) – Derate Above 25°C	250 2.0	38.5 0.3	W 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 Second	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.

*Drain current limited by maximum junction temperature

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. $L = 5\text{ mH}$, $I_{AS} = 20\text{ A}$, $V_{DD} = 50\text{ V}$, $R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 20\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$

THERMAL CHARACTERISTICS

Symbol	Parameter	FDP20N50F	FDPF20N50FT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.5	3.3	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-sink, Typ.	0.5	–	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	62.5	$^\circ\text{C}/\text{W}$

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

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

OFF CHARACTERISTICS

BV_{DSS}	Drain-Source Breakdown Voltage	$I_D = 250\ \mu\text{A}$, $V_{GS} = 0\text{ V}$, $T_J = 25^\circ\text{C}$	500	–	–	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C	–	0.7	–	V/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}$, $V_{GS} = 0\text{ V}$	–	–	10	μA
		$V_{DS} = 400\text{ V}$, $T_C = 125^\circ\text{C}$	–	–	100	
I_{GSS}	Gate-Body Leakage Current	$V_{GS} = \pm 30\text{ V}$, $V_{DS} = 0\text{ V}$	–	–	± 100	nA

ON CHARACTERISTICS

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\ \mu\text{A}$	3.0	–	5.0	V
$R_{DS(on)}$	Static Drain-Source On Resistance	$V_{GS} = 10\text{ V}$, $I_D = 10\text{ A}$	–	0.22	0.26	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20\text{ V}$, $I_D = 10\text{ A}$	–	25	–	S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$	–	2550	3390	pF
C_{oss}	Output Capacitance		–	350	465	pF
C_{rss}	Reverse Transfer Capacitance		–	27	40	pF
$Q_{g(tot)}$	Total Gate Charge at 10 V	$V_{DS} = 400\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = 10\text{ V}$ (Note 4)	–	50	65	nC
Q_{gs}	Gate to Source Gate Charge		–	14	–	nC
Q_{gd}	Gate to Drain "Miller" Charge		–	20	–	nC

FDP20N50F / FDPF20N50FT

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

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

SWITCHING CHARACTERISTICS

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}$, $I_D = 20\text{ A}$, $R_G = 25\ \Omega$ (Note 4)	–	45	100	ns
t_r	Turn-On Rise Time		–	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		–	100	210	ns
t_f	Turn-Off Fall Time		–	60	130	ns

DRAIN-SOURCE DIODE CHARACTERISTICS

I_S	Maximum Continuous Drain to Source Diode Forward Current		–	–	20	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		–	–	80	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 20\text{ A}$	–	–	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}$, $I_{SD} = 20\text{ A}$ $di_F/dt = 100\text{ A}/\mu\text{s}$	–	154	–	ns
Q_{rr}	Reverse Recovery Charge		–	0.5	–	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.

4. Essentially Independent of Operating Temperature Typical Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS

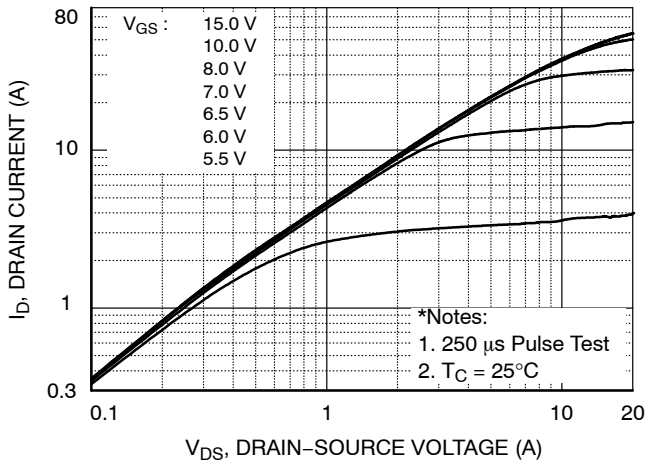


Figure 1. On-Region Characteristics

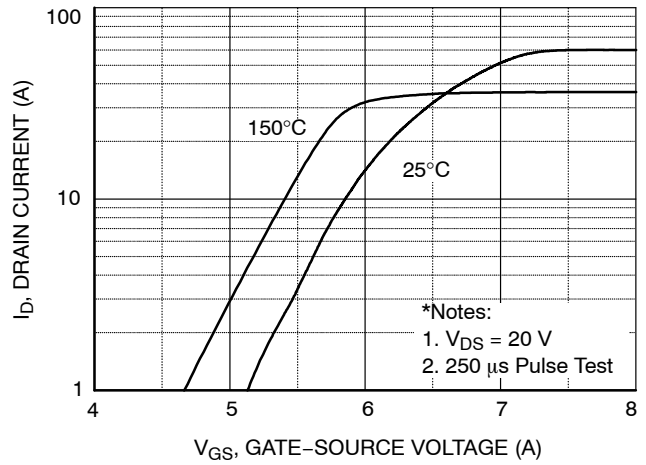


Figure 2. Transfer Characteristics

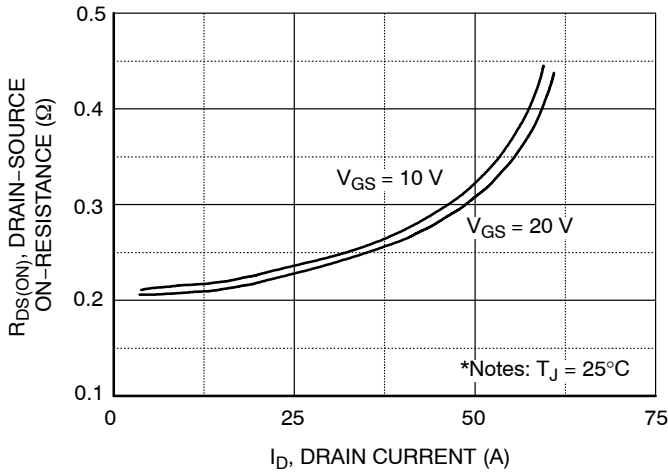


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

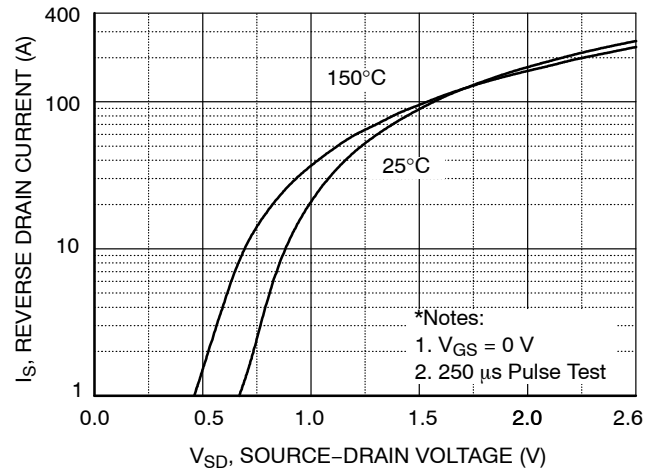


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

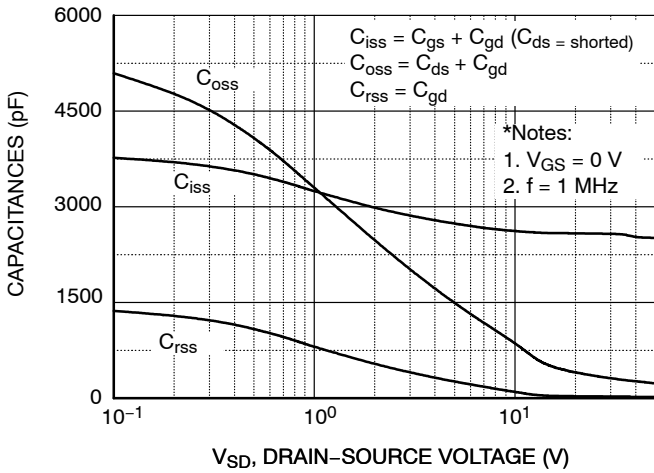


Figure 5. Capacitance Characteristics

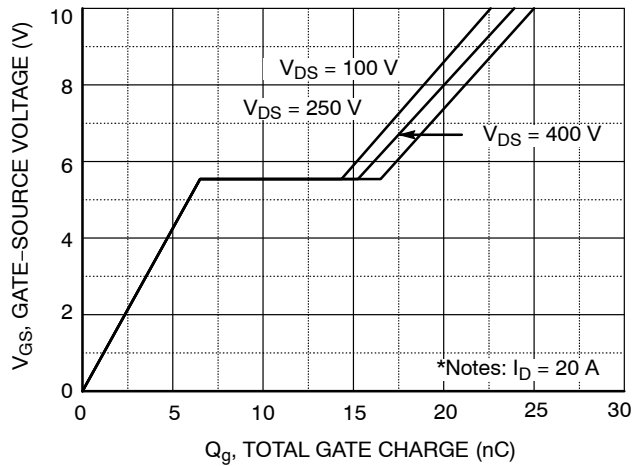


Figure 6. Gate Charge Characteristics

FDP20N50F / FDPF20N50FT

TYPICAL CHARACTERISTICS (continued)

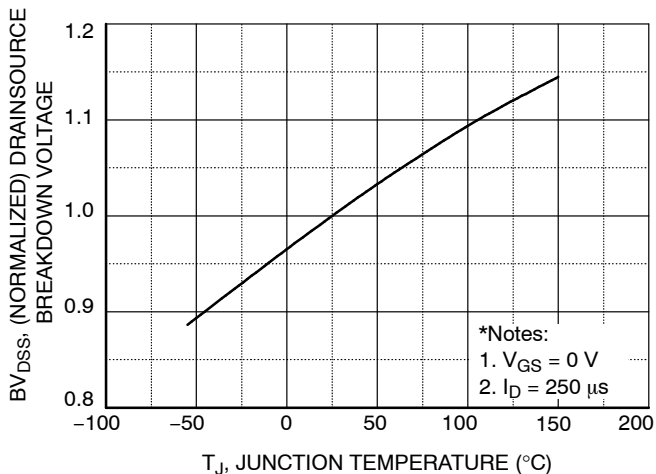


Figure 7. Breakdown Voltage Variation vs. Temperature

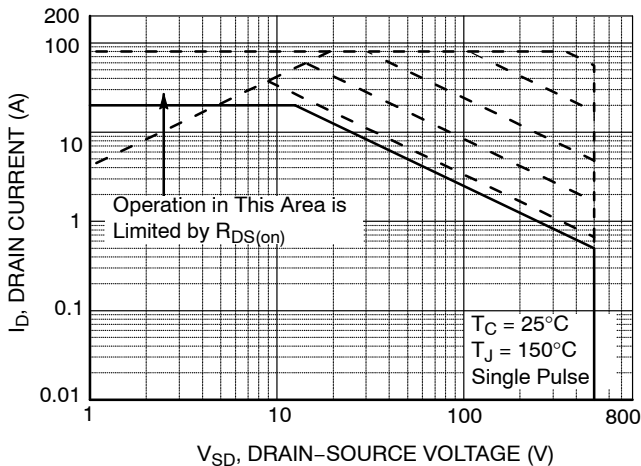


Figure 8. Maximum Safe Operating Area - FDP20N50F

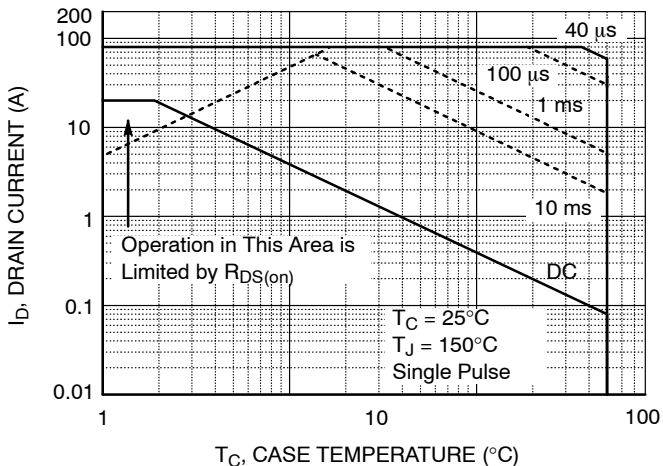


Figure 9. Maximum Safe Operating Area - FDP20N50F

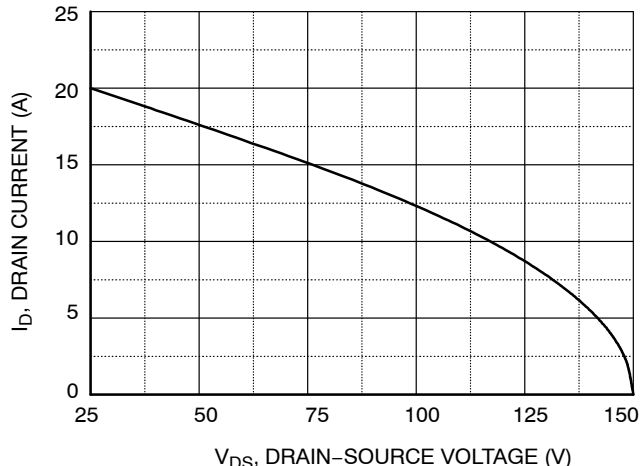


Figure 10. Maximum Drain Current vs. Case Temperature

FDP20N50F / FDPF20N50FT

Typical Performance Characteristics (continued)

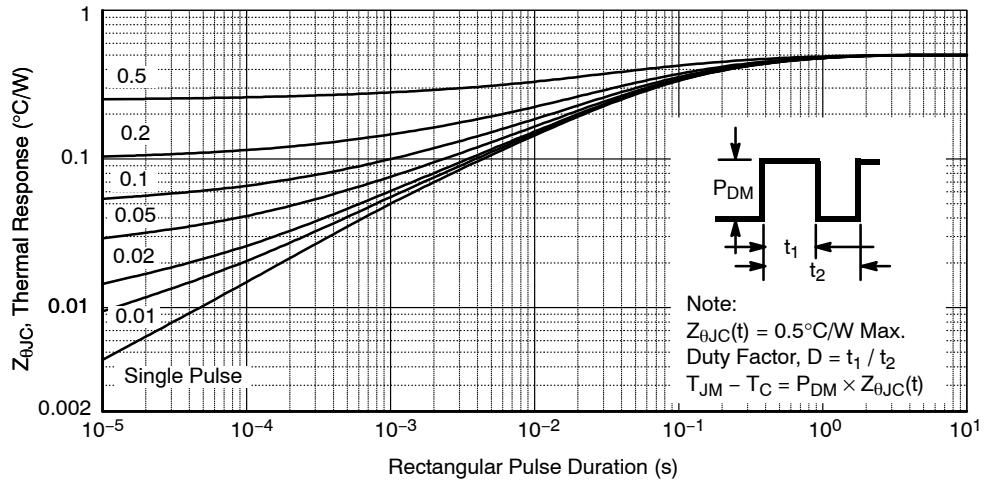


Figure 11. Transient Thermal Response Curve for FDP20N50F

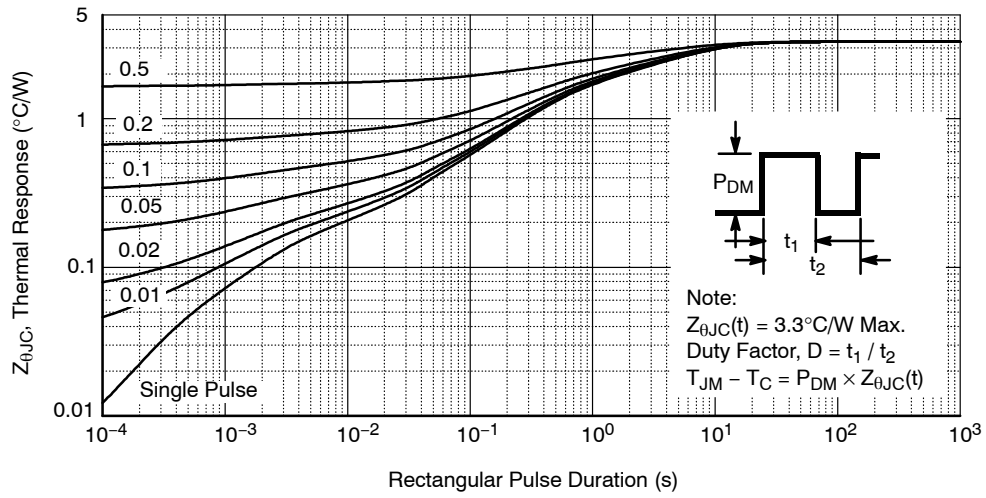


Figure 12. Transient Thermal Response Curve for FDPF20N50FT

FDP20N50F / FDPF20N50FT

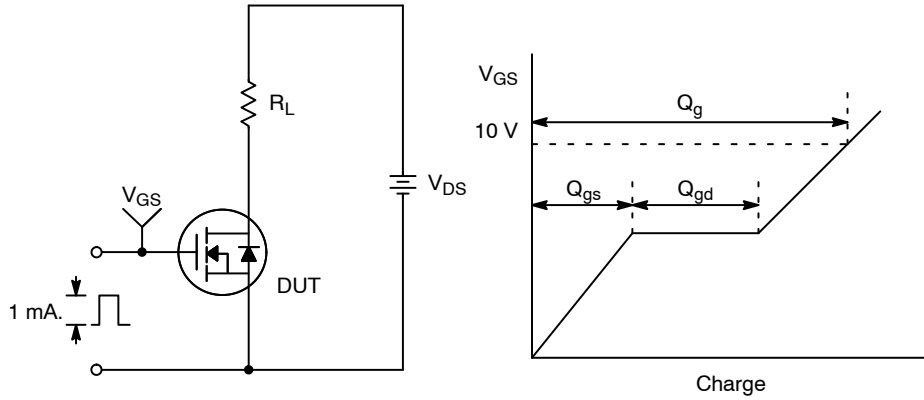


Figure 13. Gate Charge Test Circuit & Waveform

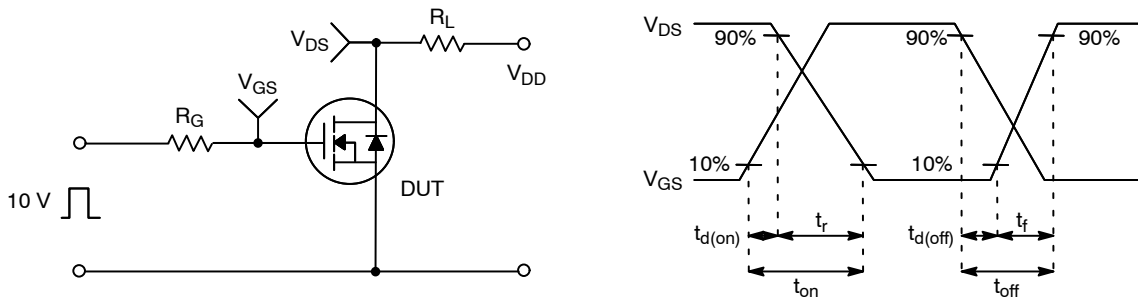


Figure 14. Resistive Switching Test Circuit & Waveforms

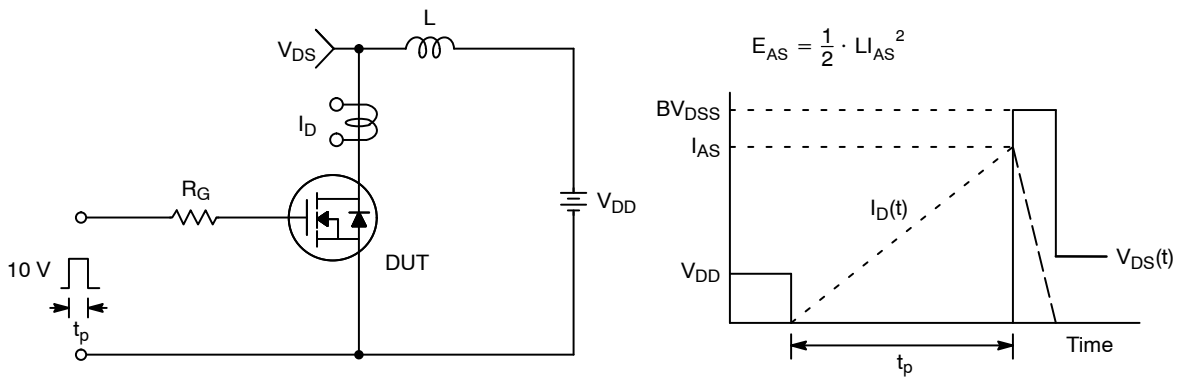


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

FDP20N50F / FDPF20N50FT

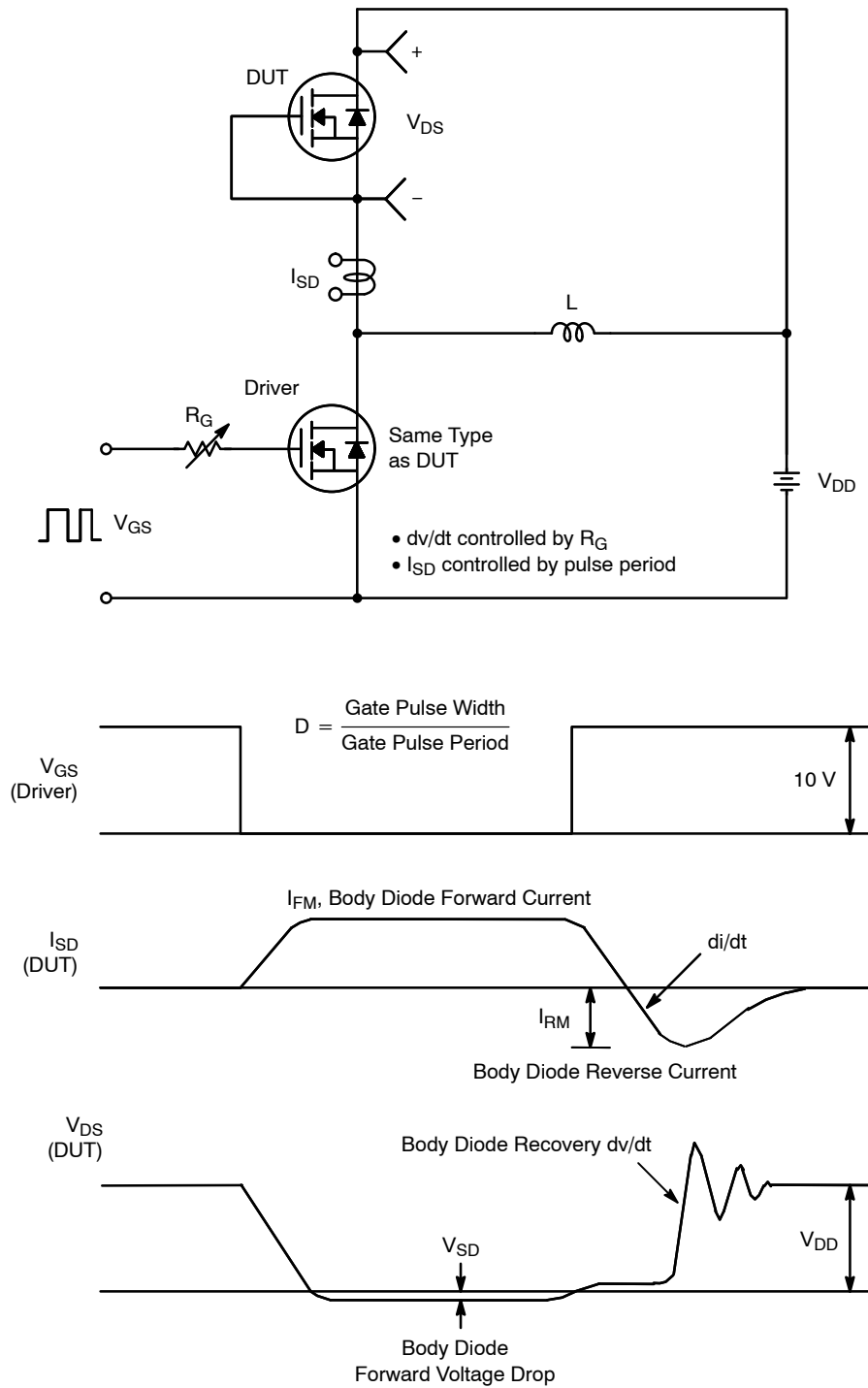


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

UniFET is a trademark of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries.

FRFET is a registered trademark 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®

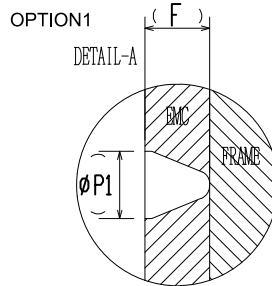
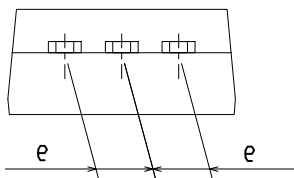
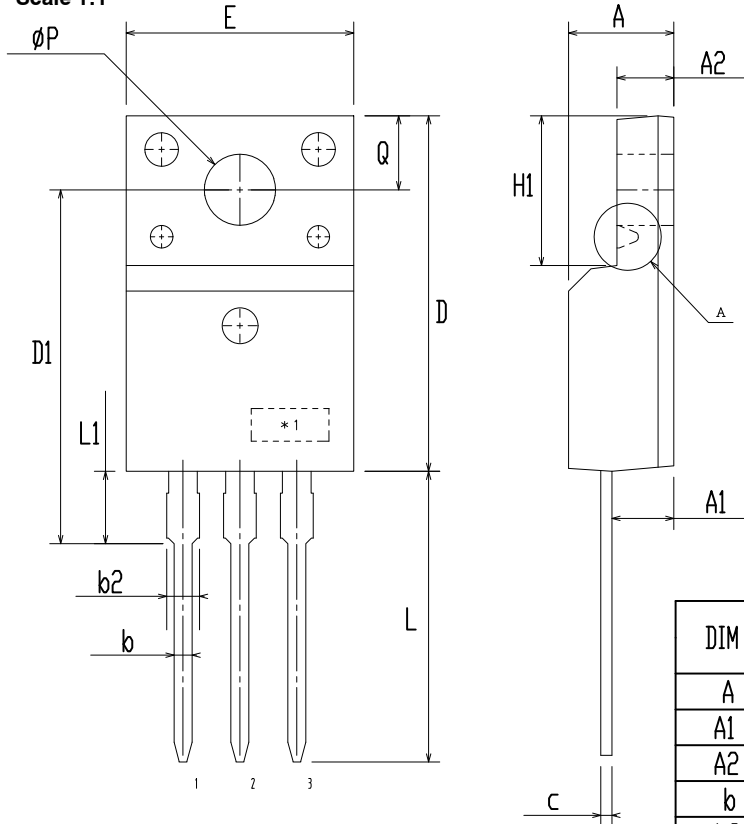


TO-220 Fullpack, 3-Lead / TO-220F-3SG CASE 221AT ISSUE B

DATE 19 JAN 2021



Scale 1:1



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
phi P	2.98	3.18	3.38
phi P1	~	1.00	~
Q	3.20	3.30	3.40

NOTES:

- A. DIMENSION AND TOLERANCE AS ASME Y14.5-2009
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUCTIONS.
- C. OPTION 1 - WITH SUPPORT PIN HOLE
OPTION 2 - NO SUPPORT PIN HOLE

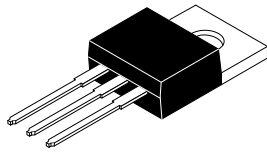
DOCUMENT NUMBER:	98AON67439E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TO-220 FULLPACK, 3-LEAD / TO-220F-3SG	PAGE 1 OF 1

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.

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



Scale 1:1

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.
DESCRIPTION:	TO-220-3LD	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

