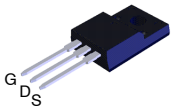
# MOSFET – N-Channel, UniFET™

## 650 V, 15 A, 440 mΩ

# FDPF15N65

| $V_{DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 650 V | 440 mΩ @ 10 V | 15 A |




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

### 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. 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.

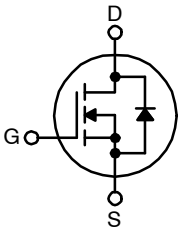
### Features

- $R_{DS(on)}$ = 360 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 7.5 A
- Low Gate Charge (Typ. 48.5 nC)
- Low $C_{rss}$ (Typ. 23.6 pF)
- 100% Avalanche Tested

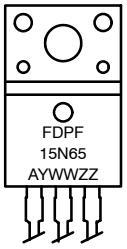
### Applications

- LCD / LED / PDP TV and Monitor
- Uninterruptible Power Supply

### N−CHANNEL MOSFET




### MARKING DIAGRAM




| | |
|---|---|
| FDPF15N65 | = Specific Device Code |
| A | = Assembly Location |
| YWW | = Date Code (Year & Week) |
| ZZ | = Assembly Lot |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

© Semiconductor Components Industries, LLC, 2006

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25°C unless otherwise noted)

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain−Source Voltage | | 650 | V |
| $I_D$ | Drain Current | − Continuous ($T_C$ = 25°C)<br>− Continuous ($T_C$ = 100°C) | 15*<br>9.5* | A<br>A |
| $I_{DM}$ | Drain Current | − Pulsed (Note 1) | 60* | A |
| $V_{GSS}$ | Gate−Source Voltage | | ±30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 637 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 15 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 25.0 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 4.5 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C)<br>− Derate Above 25°C | 38.5<br>0.3 | W<br>W/°C |
| $T_J$, $T_{STG}$ | 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. L = 5.23 mH, $I_{AS}$ = 15 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 15 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction−to−Case, Max. | 3.3 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction−to−Ambient, Max. | 62.5 | °C/W |

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain−Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_J$ = 25°C | 650 | – | – | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | – | 0.65 | – | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = 520 V, $T_C$ = 125°C | –<br>– | –<br>– | 1<br>10 | μA<br>μA |
| $I_{GSSF}$ | Gate−Body Leakage Current, Forward | $V_{GS}$ = 30 V, $V_{DS}$ = 0 V | – | – | 100 | nA |
| $I_{GSSR}$ | Gate−Body Leakage Current, Reverse | $V_{GS}$ = −30 V, $V_{DS}$ = 0V | – | – | −100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 3.0 | – | 5.0 | V |
| $R_{DS(on)}$ | Static Drain−Source On−Resistance | $V_{GS}$ = 10 V, $I_D$ = 7.5 A | – | 0.36 | 0.44 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 7.5 A | – | 19.2 | – | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 2380 | 3095 | pF |
| $C_{oss}$ | Output Capacitance | | – | 295 | 385 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | – | 23.6 | 35.5 | pF |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn−On Delay Time | $V_{DD}$ = 325 V, $I_D$ = 15 A, $V_{GS}$ = 10 V, $R_G$ = 21.7 Ω (Note 4) | – | 65 | 140 | ns |
| $t_r$ | Turn−On Rise Time | | – | 125 | 260 | ns |
| $t_{d(off)}$ | Turn−Off Delay Time | | – | 105 | 220 | ns |
| $t_f$ | Turn−Off Fall Time | | – | 65 | 140 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 520 V, $I_D$ = 15 A, $V_{GS}$ = 10 V (Note 4) | – | 48.5 | 63.0 | nC |
| $Q_{gs}$ | Gate−Source Charge | | – | 14.0 | – | nC |
| $Q_{gd}$ | Gate−Drain Charge | | – | 21.2 | – | nC |
| **DRAIN−SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS** | | | | | | |
| $I_S$ | Maximum Continuous Drain−Source Diode Forward Current | | – | – | 15* | A |
| $I_{SM}$ | Maximum Pulsed Drain−Source Diode Forward Current | | – | – | 60 | A |
| $V_{SD}$ | Drain−Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 15 A | – | – | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 15 A, $dI_F/dt$ = 100 A/μs | – | 496 | – | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 5.69 | – | 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

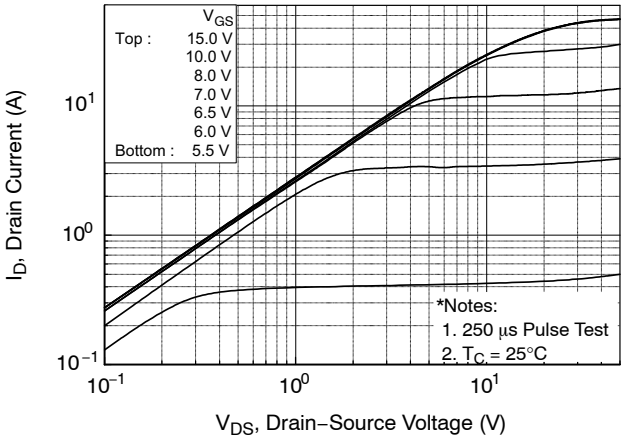



**Figure 1. On−Region Characteristics**

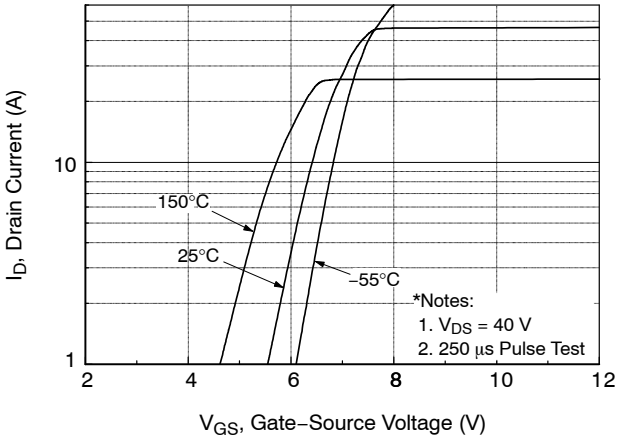



**Figure 2. Transfer Characteristics**

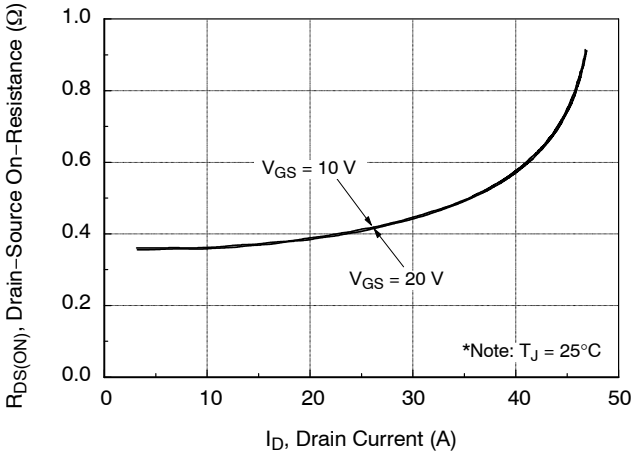



**Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage**

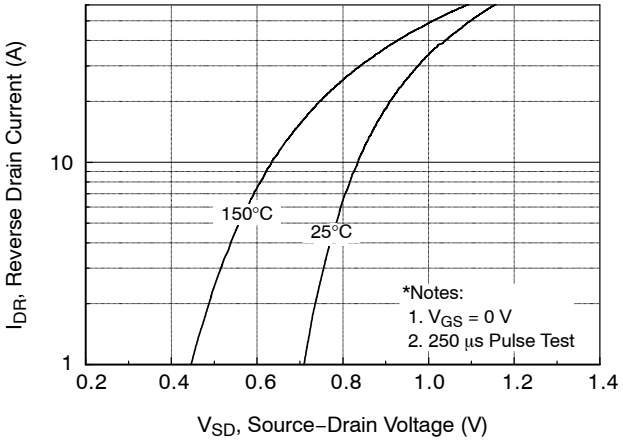



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

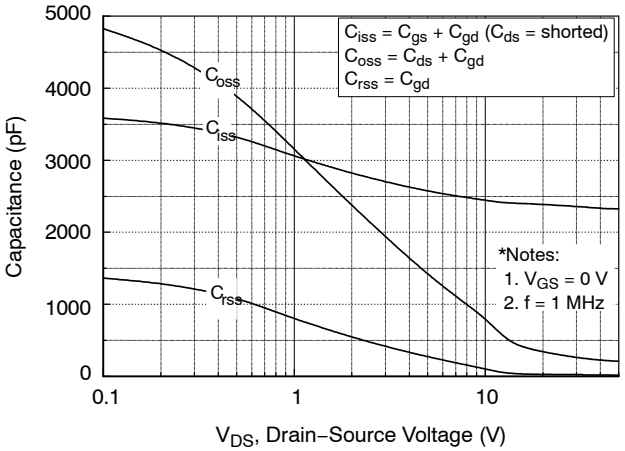



**Figure 5. Capacitance Characteristics**

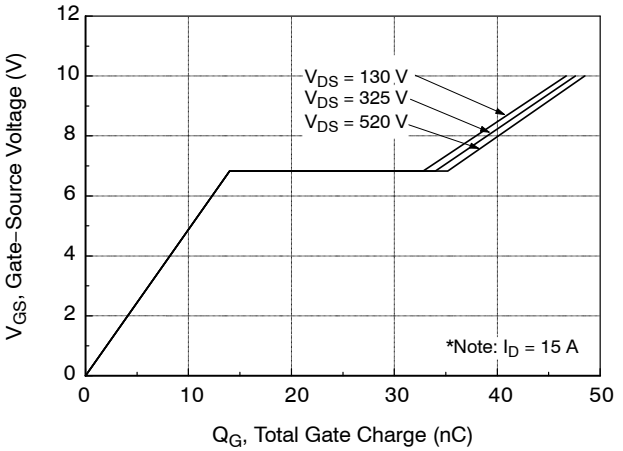



**Figure 6. Gate Charge Characteristics**

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

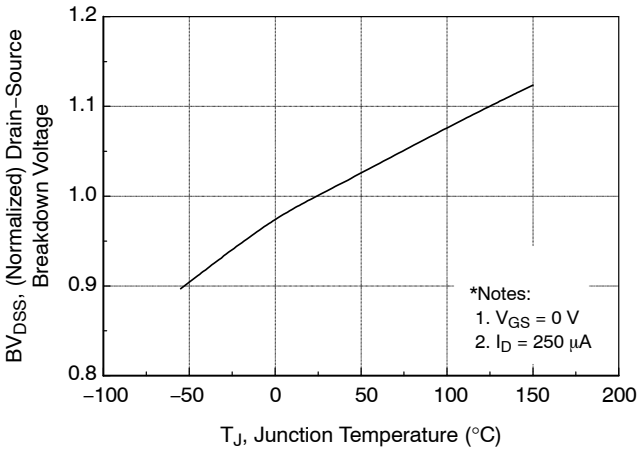



**Figure 7. Breakdown Voltage Variation vs. Temperature**

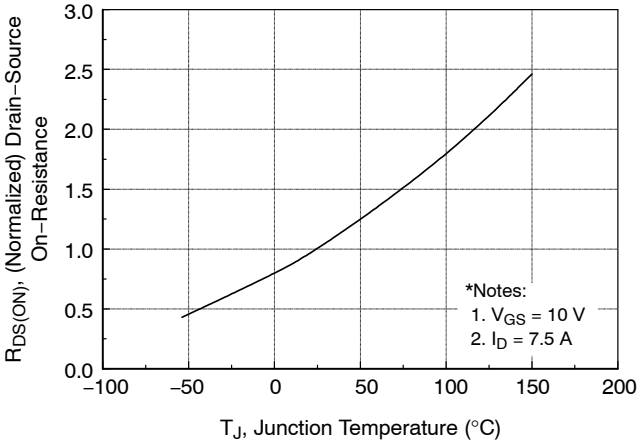



**Figure 8. On−Resistance Variation vs. Temperature**

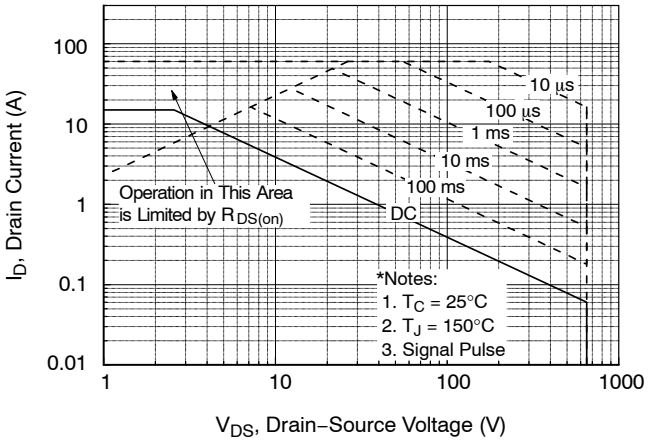



**Figure 9. Safe Operating Area**

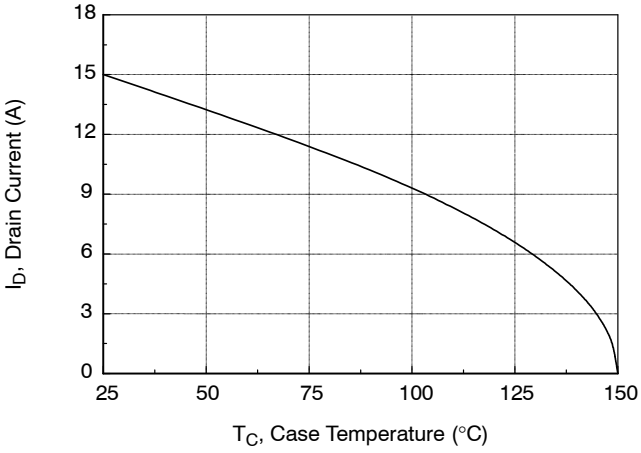



**Figure 10. Maximum Drain Current vs. Case Temperature**

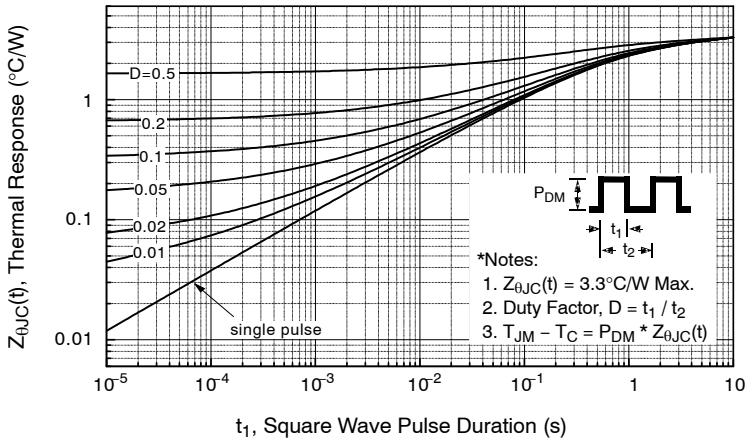



**Figure 11. Transient Thermal Response Curve**

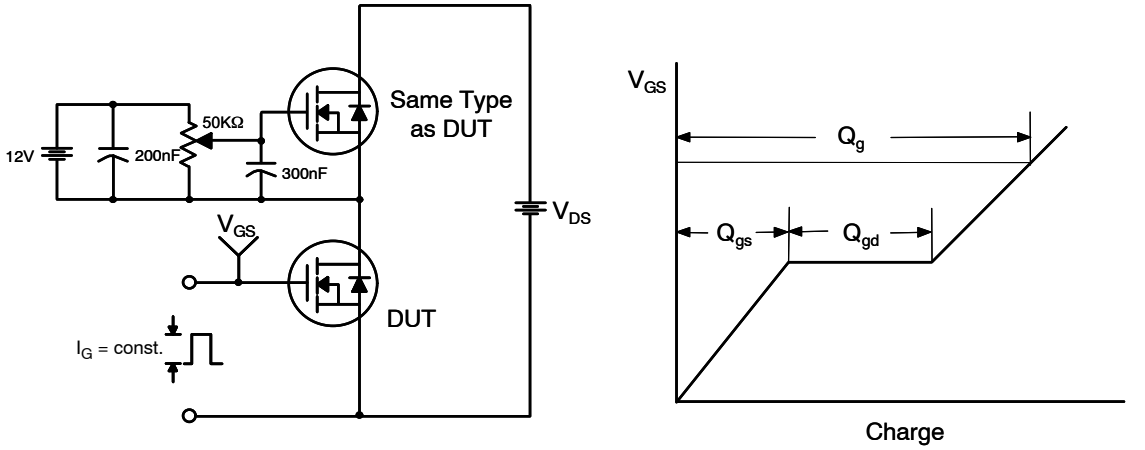



**Figure 12. Gate Charge Test Circuit & Waveform**

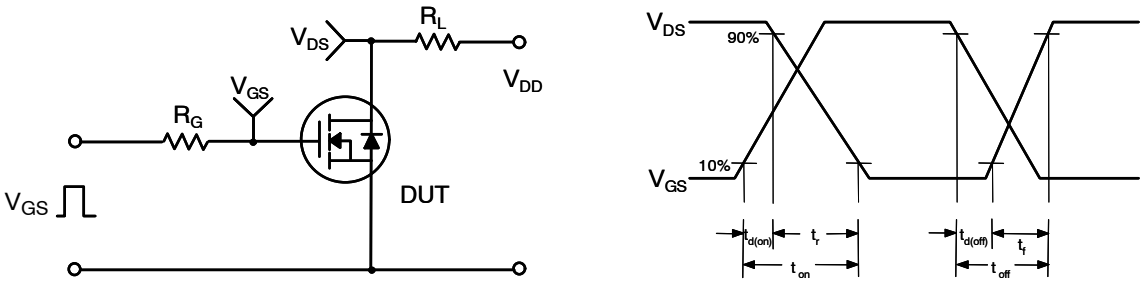



**Figure 13. Resistive Switching Test Circuit & Waveforms**

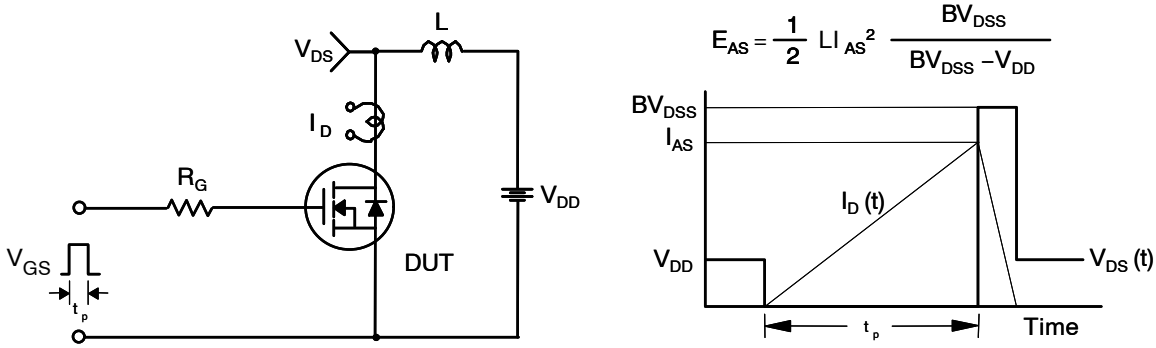



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

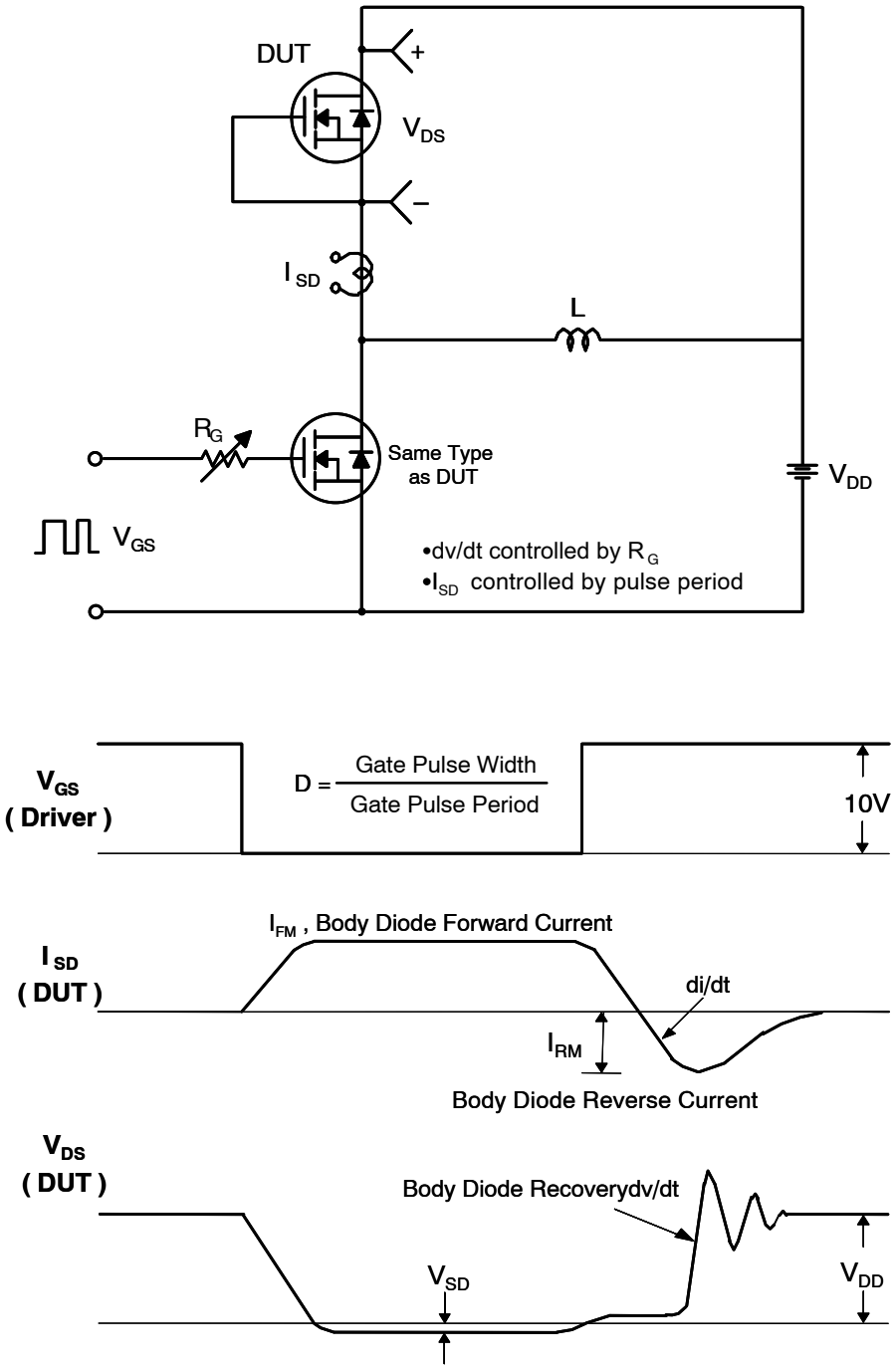



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

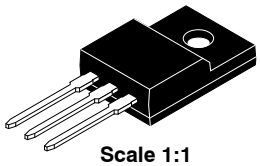
## PACKAGE MARKING AND ORDERING INFORMATION

| Part Number | Top Mark | Package | Shipping |
|---|---|---|---|
| FDPF15N65 | FDPF15N65 | TO−220 Fullpack, 3−Lead / TO−220F−3SG CASE 221AT | 1,000 Units / Tube |

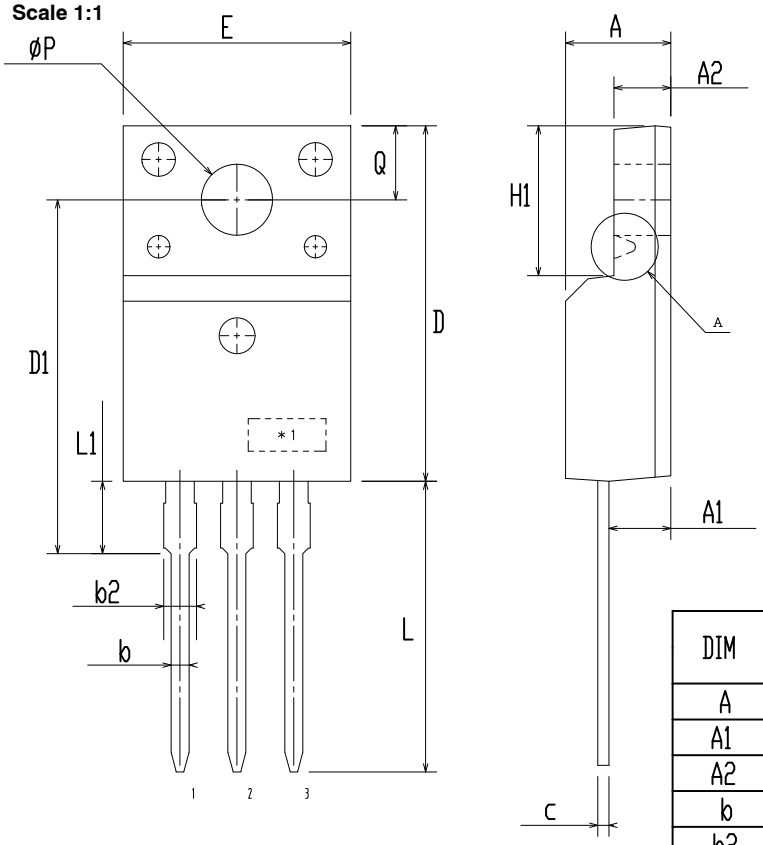
UniFET is trademark of Semiconductor Components Industries, LLC dba “**onsemi**” or its affiliates and/or subsidiaries in the United States and/or other countries.

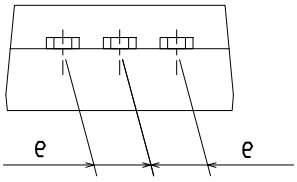
**TO−220 Fullpack, 3−Lead / TO−220F−3SG**
CASE 221AT
ISSUE B

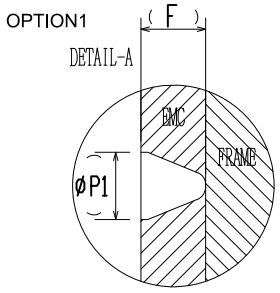
DATE 19 JAN 2021



**Scale 1:1**




| DIM | MILLIMITERS | | |
|---|---|---|---|
| | 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 |
| ø P | 2.98 | 3.18 | 3.38 |
| ø 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 PROTRUCSIONS.
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** |

**onsemi** and onsemi are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the 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. **onsemi** does not convey any license under its patent rights nor the rights of others.

© Semiconductor Components Industries, LLC, 2012

**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